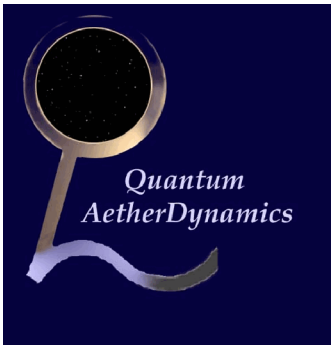

Quantum AetherDynamics Institute (QADI)

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Quantum Measurement Units (QMU)

A System Based on Quantum Constants and Distributed Charge Geometry

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1 Introduction

The QMU dimensional framework and its foundational APM assumptions are developed in companion QADI studies [1; 2; 3; 4; 5; 6].

This monograph introduces the Quantum Measurement Units, explains their role in the Aether Physics Model, and provides a navigable reference to existing QADI research. It also identifies open questions in particle physics, materials, electrodynamics, quantum-space geometry, and cosmology. The aim is to help researchers recognize tractable opportunities for discovery; the directed bibliography and research-frontiers guide are in Sections 32.6 and 33. Detailed new derivations and experimental results are reserved for stand-alone papers; the present reference emphasizes definitions, connections, source provenance, and questions that could motivate future work.

1.1 Brief Overview of the Aether Physics Model

The Aether Physics Model (APM) is a comprehensive theory that seeks to unify quantum mechanics and classical physics by proposing a new understanding of the fundamental nature of the Universe. The APM postulates that space is filled with a dynamic and discrete medium called the Aether, which is composed of quantum units known as Aether units. These quantum units serve as the building blocks of space, matter, and its behavior, and their interactions give rise to the observed physical phenomena in the Universe.

At the core of the APM is the concept of the Gforce, a universal reciprocal force that emerges from the Singularity and is responsible for the manifestation of the fundamental forces, including gravity, electrostatic force, and the magnetic force. The weak interaction is a ratio of the electrostatic and magnetic forces. The Gforce produces the Aether units, causing them to develop spin and temporal vibration, which in turn creates the observed properties of matter and its behavior.

The APM also elaborates on the concept of ”dimensions” as a means to describe the physical structure and spatial characteristics of reality. In the APM, dimensions are not limited to the familiar three spatial dimensions and one time dimension, but also include additional dimensions such as charge and mass. This expanded view of dimensions allows for a more comprehensive description of the Universe and its underlying mechanics.

One of the key features of the APM is its ability to provide a unified description of quantum mechanics and classical physics. By proposing that the quantum realm is a result of the interactions between the Gforce and magnetic charge, the APM bridges the gap between the seemingly incompatible theories of Quantum Mechanics and General Relativity. This unification has the potential to resolve long-standing puzzles in physics, such as the nature of dark matter and dark energy, and to provide a more complete understanding of the Universe.

The APM also introduces a new set of fundamental constants, such as the Aether unit constant and the Gforce constant, which are derived from the known physical constants of Newton’s gravity and Coulomb’s electrostatics. These constants play a crucial role in the APM’s mathematical framework and provide a foundation for the development of the Quantum Measurement Units (QMU) system, which is essential for describing and quantifying the interactions and phenomena within the APM.

In summary, the Aether Physics Model is a bold and innovative theory that proposes a new understanding of the fundamental nature of the Universe. By introducing the concepts of the Aether, the

Gforce, and expanded dimensions, the APM seeks to unify quantum mechanics and classical physics and to provide a comprehensive description of physical reality. The development of the Quantum Measurement Units system is a crucial step in the APM's quest to advance our understanding of the Universe and to unlock new possibilities in physics and related fields.

1.2 Observed Manifestations and the Physical Identification of the Aether

The APM identifies the Aether as the physical substrate expressed in measurable interactions rather than as an entirely unobserved substance added to otherwise empty space. In the APM interpretation, observed magnetic and electrostatic fields, gravitational interactions, and the measurable separation and propagation of signals between physical objects are manifestations of Aether structure and dynamics. Field strength, forces, transit times, interference, and spatial intervals are experimentally accessible observables. The fact that such observables are already measured should not be confused with a claim that an instrument has separately resolved a particular Aether unit or its intrinsic dimensional geometry. APM uses the term *Aether manifestation* for the former interpretation and reserves *discriminating structural measurement* for tests of the latter, more specific model claims [6; 7; 8].

This distinction applies to spatial metrology. Interferometry, ranging, and transit-time measurements determine operational relations between objects and signals. APM attributes those relations to the geometry of quantum space. Their precision is relevant experimental input, but the measured interval alone cannot uniquely identify its proposed five-dimensional carrier or establish a particular constitutive law. Likewise, standard magnetic, electrostatic, and gravitational measurements establish physical interactions; distinguishing QMU's distributed-charge geometry and Aether response from other models requires a predicted relation among observables that can be measured without selecting its parameters from the same result.

Positive charge carriers (holes) in p-type semiconductors offer a further measured example of electronic response: in conventional band terminology, a hole is an unoccupied electron state in an otherwise populated valence band and behaves as a mobile, positively charged quasiparticle. APM may seek an Aether-geometry account of these measurements, but a semiconductor hole is not by definition an unoccupied Aether-unit polarity sector. Identifying the two would require a specific quantitative mapping that predicts such quantities as carrier mobility, Hall response, and recombination behavior under controlled changes in material conditions.

Cosmic microwave background (CMB) polarization rotation supplies an especially useful discriminating observable. A QADI prediction assigns an isotropic rotation $\beta_{\mathrm{APM}} = (16\pi^2)^{-1}\,\mathrm{rad} \simeq 0.362830^\circ$ [9]. A joint analysis of ACT and Planck maps reported $\beta = 0.277^\circ \pm 0.057^\circ$, excluding zero at 4.8σ under its adopted instrumental priors; a dust-robustness analysis reported 3.5σ, and the authors explicitly cautioned that unresolved systematics remain [10]. The nominal predicted-minus-measured difference is about 1.51 quoted statistical standard deviations. Thus the observations can be quantitatively compared with the APM prediction, while the significance of the cosmological rotation and its proposed microscopic origin remain separate questions.

Throughout this reference, observational claims, model identifications, algebraic identities, and predictions of distinctive residuals are kept conceptually separate. The APM assertion that magnetic, electrostatic, gravitational, and spatial phenomena are manifestations of the Aether is stated explicitly; establishing the detailed Aether-unit geometry demands additional discriminating constraints rather than a denial of the measured phenomena themselves.

1.3 Importance of a Consistent and Comprehensive Unit System

In the pursuit of understanding the fundamental nature of the Universe, a consistent and comprehensive unit system is of utmost importance. The development of such a system is crucial for several reasons:

1. Clarity and consistency in describing physical phenomena: A well-defined unit system ensures that physical quantities are expressed in a clear and consistent manner. This clarity helps to avoid confusion and ambiguity when discussing and analyzing various physical phenomena. By using a comprehensive set of units, researchers can accurately describe and compare different aspects of the Universe, from the smallest quantum processes to the largest cosmic structures.

2. Facilitating the unification of theories: A consistent unit system plays a vital role in the unification of different branches of physics. By expressing physical quantities in a standardized way, it becomes easier to identify the relationships and connections between seemingly disparate phenomena. This unification is essential for the development of a comprehensive theory of the Universe, such as the Aether Physics Model, which seeks to bridge the gap between quantum mechanics and classical physics.

3. Enabling precise measurements and predictions: A comprehensive unit system allows for precise measurements of physical quantities, which is essential for the advancement of physics and related fields. By using well-defined units, researchers can make accurate predictions about the behavior and properties of matter under various conditions. This predictive power is crucial for the design and interpretation of experiments, as well as for the development of new technologies based on the principles of physics.

4. Facilitating collaboration and communication: A consistent unit system promotes effective collaboration and communication among researchers from different fields and backgrounds. By using a common language to express physical quantities, scientists can more easily share their findings, compare results, and build upon each other's work. This collaborative approach is essential for the rapid advancement of our understanding of the Universe.

5. Revealing new insights and relationships: A comprehensive unit system can help to reveal new insights and relationships between physical quantities that may not be apparent when using inconsistent or limited sets of units. By organizing units into a coherent framework, researchers can identify patterns and connections that may lead to groundbreaking discoveries and the development of novel theories.

In the context of the Aether Physics Model, the development of the Quantum Measurement Units (QMU) system is a crucial step towards achieving a consistent and comprehensive unit system. The QMU system, based on quantum measurements rather than arbitrary or macro-scale measurements, provides a solid foundation for describing and quantifying the interactions and phenomena within the APM.

By using the QMU system, researchers can more effectively explore the properties of the Aether, the behavior and properties of matter at the quantum level, and the unification of the fundamental forces. This consistent and comprehensive approach to units is essential for the advancement of the Aether Physics Model and for the development of a deeper understanding of the Universe as a whole.

A consistent and comprehensive unit system is of paramount importance for the advancement of

physics and our understanding of the fundamental nature of the Universe. The development of the Quantum Measurement Units system within the Aether Physics Model represents a significant step towards achieving this goal, enabling researchers to explore the frontiers of physics with greater clarity, precision, and insight.

The Quantum Measurement Units (QMU) system is a groundbreaking approach to constructing a consistent and comprehensive set of units for describing the fundamental interactions and phenomena in the Universe. The QMU system is an essential component of the Aether Physics Model (APM), which seeks to unify quantum mechanics and classical physics by proposing a new understanding of the nature of space, matter, and its behavior.

1.4 Quantum Measurements as the Basis For Constructing Units

The Quantum Measurement Units (QMU) system is founded on the principle of using quantum measurements as the basis for constructing units. This approach ensures that the units are directly related to the fundamental properties of matter, its behavior, and the Aether, allowing for a more accurate and precise description of quantum processes and structures.

The QMU system employs quantum measurements that are universal to all subatomic particles and the Aether. These measurements include:

2 Fundamentals of Quantum Measurement Units

Foundational descriptions of the primitive ledger, realizations, and cross-system scales are available in [1; 2; 8; 11; 12].

Exact identities, approximations, and uncertainty

An equality obtained by algebraic substitution of QMU definitions is exact within those definitions, including its numerical coefficients. A historical decimal value written with limited significant figures instead records an approximation and must not be tested as an unlimited-precision identity. Rounding precision is not the same as experimental uncertainty: an empirical comparison requires the measurement uncertainty, any systematic contributions, and correlations where applicable. When a rounded empirical or phenomenological coefficient is used in an algebraic condition, the resulting equation is conditional on that approximation. Dimensional compatibility is necessary for a proposed equality but does not prove numerical or physical equality.

For quantitative comparisons, three different kinds of numerical input must be identified: (i) exact constants or exact model definitions, whose coefficients are not subject to experimental uncertainty; (ii) measured input quantities, which require a stated standard uncertainty and, where relevant, covariance; and (iii) historical rounded estimates, whose last displayed digit reflects presentation precision rather than a known statistical error bar. A value written to three significant figures must not be assigned an uncertainty merely from those digits. When a derived quantity $y = f(x_1, \ldots, x_n)$ is evaluated from measured inputs, first-order standard-uncertainty propagation, when applicable,

is

$$u^2(y) \simeq \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{\partial f}{\partial x_i} \frac{\partial f}{\partial x_j} \operatorname{cov}(x_i, x_j), \tag{1}$$

where $u(y)$ denotes the standard uncertainty of y and the covariance terms must not be discarded without justification. For a monomial $y = C \prod_i x_i^{a_i}$ with nonzero measured inputs, the corresponding relative form is

$$\frac{u^2(y)}{y^2} \simeq \sum_{i,j} a_i a_j \frac{\operatorname{cov}(x_i, x_j)}{x_i x_j}. \tag{2}$$

The coefficient C is treated as exact only if its definition makes it exact; otherwise its uncertainty belongs among the inputs. These propagation formulas describe measurement uncertainty, not the possible error of an unverified physical model or the rounding interval of a historical estimate.

The Quantum Measurement Units (QMU) system constructs physical units from quantum length, frequency, mass, and distributed charge. The following quantities supply the principal dimensional factors.

1. **Quantum length.** The Compton wavelength, λ_C, provides the fundamental length scale. In the QMU construction, this scale applies to the quantum geometry of particles and the Aether. For a particle of mass m, the conventional Compton relation is

   $$\lambda_C = \frac{h}{mc}. \tag{3}$$

   The mass used in a particular QMU construction must therefore be stated; a particle-dependent Compton wavelength should not be confused with a universal numerical constant.
2. **Quantum frequency.** The chronovibration frequency, F_q, is the temporal frequency parameter of the Aether Physics Model (APM). In APM, chronovibration refers to the relationship between forward and backward temporal directions. Its reciprocal defines the chronovibration period, and the fundamental QMU closure gives

   $$\tau_q = \frac{1}{F_q} = \frac{\lambda_C}{c}, \qquad c = F_q \, \lambda_C. \tag{4}$$

   A numerical period of $\tau_q \approx 8.093 \times 10^{-21}\,\mathrm{s}$ is sometimes associated with this construction. It is conditional on the specified numerical values of λ_C and F_q and should not be inferred from the zeptosecond photoionization experiment discussed below.
3. **Quantum mass.** The mass parameter is chosen for the quantum entity being modeled. Examples are the electron mass m_e and proton mass m_p. The maximum Aether mass m_a is a distinct primordial scale in APM and is not identified with either particle mass.
4. **Distributed charge.** QMU distinguishes electrostatic charge from magnetic-charge geometry. The electrostatic quantity is represented by e^2 and the distributed magnetic-charge expression by ${e_\mathrm{emax}}^2$, with the APM charge relation

   $$e^2 = 8\pi\alpha \, {e_\mathrm{emax}}^2. \tag{5}$$

   The ratio $e^2/{e_\mathrm{emax}}^2 = 8\pi\alpha$ is dimensionless under the QMU charge convention, provided both charge expressions use the same distributed-charge dimensions. This equation relates the electrostatic and magnetic-charge expressions; it does not supply an SI conversion factor. Here $e_{e\,\mathrm{max}}$ is a parameter in the distributed-charge expression, *not* a separately existing physical charge component or an independent QMU unit. In the unit ledger, the magnetic-charge quantity is denoted $\mathrm{chrg} = {e_\mathrm{emax}}^2$.

Independent SI benchmarks for the electron-based primitive scales

For a reproducible external comparison, the 2022 CODATA recommended values (NIST SP 961, May 2024) [13] are

$$m_{\mathrm{e}} = 9.1093837139(28) \times 10^{-31}\,\mathrm{kg}, \tag{6}$$

$$\lambda_{C,e} = 2.42631023538(76) \times 10^{-12}\,\mathrm{m}, \tag{7}$$

$$\alpha = 7.2973525643(11) \times 10^{-3}, \tag{8}$$

$$c = 299792458\,\mathrm{m\,s^{-1}} \quad \text{(exact in SI)}, \tag{9}$$

$$h = 6.62607015 \times 10^{-34}\,\mathrm{J\,s} \quad \text{(exact in SI)}. \tag{10}$$

The Compton wavelength above is the *unreduced electron* Compton wavelength $h/(m_e c)$, not the reduced wavelength $h/(2\pi m_e c)$. Thus the conditional electron-based QMU frequency is $F_{q,e} = c/\lambda_{C,e} = m_e c^2/h \simeq 1.23559 \times 10^{20}\,\mathrm{s^{-1}}$, with reciprocal $\tau_{q,e} \simeq 8.09330 \times 10^{-21}\,\mathrm{s}$. These are computed benchmarks from the stated SI inputs, not independent observations of Aether chronovibration. The frequency and period inherit the electron-mass relative standard uncertainty (approximately 3.1×10^{-10}), since c and h are exact SI constants; m_{e} and $\lambda_{C,e}$ are derived from the same adjustment and must not be treated as independent uncertain inputs. The SI value of α is an external comparison datum; the QMU relation $e^2 = 8\pi\alpha {e_{\mathrm{emax}}}^2$ does not independently predict that measured value. The reference is the 2022 CODATA adjustment as published by Mohr and colleagues [13]. The conventional SI constants listed here do not introduce $\hbar$ as a native QMU primitive.

Derived electron-scale closure: numerical and dimensional check

The same external SI inputs allow a numerical check of several QMU ledger relations without assigning independent empirical status to the Aether interpretation. For the electron-based choice $\lambda_C = h/(m_e c)$ and $F_q = c/\lambda_C$, the resulting SI numerical benchmarks are

$$\mathrm{area}_e = \lambda_{C,e}^2 \simeq 5.88698136 \times 10^{-24}\,\mathrm{m^2}, \tag{11}$$

$$\mathrm{rson}_e = F_{q,e}^2 \simeq 1.52668256 \times 10^{40}\,\mathrm{s^{-2}}, \tag{12}$$

$$\mathrm{temp}_e = \lambda_{C,e}^2 F_{q,e}^2 = c^2 = 8.9875517873681764 \times 10^{16}\,\mathrm{m^2\,s^{-2}}, \tag{13}$$

$$E_e = m_e c^2 \simeq 8.18710579 \times 10^{-14}\,\mathrm{J}. \tag{14}$$

The value of c^2 is exact in SI because c is defined exactly; the printed area, resonance and electron energy values are rounded computations. In the product $\lambda_{C,e}^2 F_{q,e}^2$, the dependence on the uncertain electron mass cancels *exactly* when $F_{q,e} = c/\lambda_{C,e}$ is used. Propagating the uncertainties of $\lambda_{C,e}$ and $F_{q,e}$ as independent would therefore produce a spurious nonzero uncertainty in c^2. These SI dimensional labels describe the external numerical realization; they do not replace the native QMU dimensions or assert that the physical Aether has been measured.

As a separate algebraic check of the distributed-charge postulate, the CODATA fine-structure constant gives $8\pi\alpha \simeq 0.183402474$ in the ratio $e^2/{e_{\mathrm{emax}}}^2$. This is a *conditional* dimensionless ratio within the QMU charge convention, not an SI charge conversion and not a prediction of α. No absolute numerical value of ${e_{\mathrm{emax}}}^2$ follows without the corresponding charge-scale convention.

The QMU dimensional construction uses these quantities to connect spatial, temporal, mass, and charge relationships. Its proposed unification of microscopic and macroscopic descriptions remains a theoretical objective; individual predictions require empirical tests.

2.1 Distinction Between Dynamic Units and Substrate Units

Dynamic units describe active processes, interactions, and measurable quantities. Their construction frequently contains a mass factor in the numerator and a distributed magnetic-charge factor in the denominator. For example, the Aether's rotating magnetic-field unit (`rmfd`) represents a dynamical geometric process rather than a material particle. However, the presence or absence of m_{e} alone does not classify a unit: kinematic and geometric quantities can also be dynamic.

Substrate units describe the reciprocal capacity or enabling structure associated with a dynamical quantity. Examples include conductance (`cond`) and capacitance (`capc`). In APM, the quantity `grav`, associated with Newton's gravitational constant G, participates in relating the primordial Aether mass scale m_a to observable quantities. These classifications concern the proposed physical role of a unit, not merely the signs of its dimensional exponents.

2.2 Benefits of Quantum-Based Dimensional Construction

Using a common dimensional ledger can promote consistency across unit definitions, make reciprocal relationships explicit, clarify the role of distributed charge, and support comparisons between QMU and conventional measurement systems. The framework also suggests experimental questions about Aether geometry and electromagnetic interactions. These are proposed benefits of the formalism rather than independent demonstrations of its physical validity.

2.3 Charge Dimensions in Quantum Measurement Units

QMU models charge as distributed over a finite geometric structure rather than as a dimensionless point localization. In its notation, the squared expressions e^2 and ${e_{\mathrm{emax}}}^2$ refer to charge-related distributed quantities. The square should not, by itself, be taken as proof of a particular spatial topology; the geometric interpretation is specified by the APM model.

2.4 Distributed Charge as a Key Concept in QMU

The distributed-charge hypothesis allows geometric structure to enter the definitions of electrical and magnetic quantities. For the electron, the QMU magnetic-charge expression is

$$\mathrm{chrg} = {e_{\mathrm{emax}}}^2, \qquad \mathrm{mcaf} = \frac{1}{{e_{\mathrm{emax}}}^2}. \tag{15}$$

The electrostatic and magnetic expressions are related by Eq. (5). These are QMU model definitions; they should not be conflated with the conventional SI definition of electric charge in coulombs.

2.5 Conversion of Charge Dimensions from SI to QMU

A charge-conversion factor for the electron, `ccfe`, is introduced to bridge conventional SI charge measurements and the QMU distributed-charge convention. Because the two conventions use different charge dimensions, a conversion must specify both the physical quantity and the dimensional convention in which its numerical value is expressed. Symbolically, for a charge-like quantity Q,

$$Q_{\mathrm{QMU}} = \mathrm{ccfe}\, Q_{\mathrm{SI}}, \tag{16}$$

provided `ccfe` is defined with the corresponding dimensions and reference scales. The QADI charge-conversion-factor papers define the electron prescription $\mathrm{ccf_e} = {e_{\mathrm{emax}}}^2/e = e/(8\pi\alpha)$ and present its benchmark applications [14; 15]. Its numerical realization (approximately 8.736×10^{-19} when the SI value of e is substituted) belongs to that stated convention; it does not by itself establish an independently measured SI dimension for the QMU distributed-charge primitive.

For any unit whose dimensional expression contains a power Q^n of the charge-like quantity defined in Eq. (16), its charge contribution transforms by ccfe^n, provided the same charge convention and all other conversion factors are held fixed. For inverse powers $n < 0$, the factor is reciprocal. This rule must be applied to the actual distributed-charge power in the unit ledger; it does not identify an SI coulomb with ${e_{\mathrm{emax}}}^2$ or, without a stated CCF realization, supply a measurement-traceable normalization. The illustrative numerical correspondences are

$$1\,\mathrm{V} \;\longmapsto\; 1.957 \times 10^{-6}\,\mathrm{potn}, \tag{17}$$

$$1\,\mathrm{A} \;\longmapsto\; 0.051\,\mathrm{curr}. \tag{18}$$

These numerical correspondences are *illustrative, not independently established conversion factors*. Their use requires an explicit dimensional definition of `ccfe`; coulombs and squared distributed charge must not be treated as dimensionally interchangeable.

Taken together, the two illustrative numerical assignments also imply a resistance multiplier. If $s_{\mathrm{potn}} = 1.957 \times 10^{-6}\,\mathrm{potn/V}$ and $s_{\mathrm{curr}} = 0.051\,\mathrm{curr/A}$ are used consistently, then

$$s_{\mathrm{resn}} = \frac{s_{\mathrm{potn}}}{s_{\mathrm{curr}}} \approx 3.8 \times 10^{-5}\,\mathrm{resn/\ .} \tag{19}$$

Direct division of the displayed decimal inputs gives $3.8372549\ldots \times 10^{-5}$ before rounding; these extra arithmetic digits are not additional measured precision. The result is reported as 3.8×10^{-5} because the illustrative current factor 0.051 has only two significant figures. This is a *conditional consequence* of the two illustrative assignments, not an independently measured QMU resistance calibration. Any claimed volt, ampere, or ohm correspondence must reproduce all three scales from one stated base-unit convention and charge normalization. Throughout this electron-sector illustration, $\mathrm{ccfe} \equiv \mathrm{ccf_e}$. A bare `ccf` in a species-generic source must be assigned an explicit species index before numerical evaluation; it is not a universal species-independent numerical factor.

2.6 Dimensional Ledger for Cross-System Conversions

A dimensional conversion is determined by the complete dimensional expression of a quantity, not by its unit name. The four QMU reference factors are m_{e}, λ_C, F_q, and the distributed-charge unit ${e_{\mathrm{emax}}}^2$. Write a generic catalog monomial as

$$U = C_U {m_{\mathrm{e}}}^a {\lambda_C}^b {F_q}^c ({e_{\mathrm{emax}}}^2)^d. \tag{20}$$

If s_m, s_λ, s_F, and s_Q are the dimensioned conversion multipliers for these four reference factors between two explicitly defined conventions, the corresponding multiplier for U is

$$s_U = s_m^a s_\lambda^b s_F^c s_Q^d. \tag{21}$$

Here s_Q converts the *entire distributed-charge unit* ${e_{\mathrm{emax}}}^2$, not an independently existing $e_{e\,\mathrm{max}}$ component. In terms of a historical formula written with a power $e_{e\,\mathrm{max}}^{2d}$, its charge factor is s_Q^d.

For $d = -1$ or $d = -2$, this factor is reciprocal. The representation treats ${e_{\mathrm{emax}}}^4 = ({e_{\mathrm{emax}}}^2)^2$ as a derived power, not as an independent primitive.

For example, the QMU definitions give

$$\mathrm{potn} = m_{\mathrm{e}} {\lambda_C}^2 {F_q}^2 / ({e_{\mathrm{emax}}}^2), \tag{22}$$

$$\mathrm{curr} = F_q {e_{\mathrm{emax}}}^2, \tag{23}$$

$$\mathrm{resn} = m_{\mathrm{e}} {\lambda_C}^2 F_q / {e_{\mathrm{emax}}}^4. \tag{24}$$

Consequently their conversion multipliers must satisfy

$$s_{\mathrm{potn}} = s_{\mathrm{curr}} s_{\mathrm{resn}}. \tag{25}$$

This follows algebraically from potn = curr resn and provides a cross-system consistency test. It does not determine any of the multipliers numerically: numerical SI–QMU equivalences require specified base reference scales, charge conventions, and an operational identification of the compared physical quantities.

The exponent d in Eq. (20) counts powers of $\mathrm{chrg} = {e_{\mathrm{emax}}}^2$; one distributed-charge factor has $d = 1$. This is not automatically an SI coulomb-conversion exponent. No independently existing $e_{e\,\mathrm{max}}$ unit is postulated by this conversion ledger.

When the four base conversion scales are empirically determined, their uncertainties must be propagated through the same exponent ledger. For $s_U = \prod_i s_i^{a_i}$ with $\boldsymbol{a} = (a, b, c, d)$, the first-order relative standard uncertainty is

$$\frac{u^2(s_U)}{s_U^2} \simeq \sum_{i,j=1}^{4} a_i a_j \frac{\mathrm{cov}(s_i, s_j)}{s_i s_j}. \tag{26}$$

The covariance terms matter if the conversion scales share measured inputs. For example, the illustrative resistance scale $s_{\mathrm{resn}} = s_{\mathrm{potn}}/s_{\mathrm{curr}}$ would have

$$\frac{u^2(s_{\mathrm{resn}})}{s_{\mathrm{resn}}^2} \simeq \frac{u^2(s_{\mathrm{potn}})}{s_{\mathrm{potn}}^2} + \frac{u^2(s_{\mathrm{curr}})}{s_{\mathrm{curr}}^2} - 2\frac{\mathrm{cov}(s_{\mathrm{potn}}, s_{\mathrm{curr}})}{s_{\mathrm{potn}} s_{\mathrm{curr}}}. \tag{27}$$

No numerical standard uncertainty can be assigned to that illustrative resistance scale because the two illustrative multipliers have not been supplied with measured uncertainties or covariance. The two-significant-figure result above describes the precision of its displayed inputs, not an uncertainty budget.

2.7 Implications of Distributed Charge for Electrical Units

In the QMU dimensional ledger, capacitance and potential are reciprocal constructions:

$$\mathrm{capc} = \frac{1}{\mathrm{potn}}, \qquad \mathrm{capc}\,\mathrm{potn} = 1. \tag{28}$$

This is a relationship between the QMU units as defined by the model; it is not a claim that conventional SI capacitance in farads is numerically the reciprocal of voltage in volts.

The algebraic form of Ohm's law is preserved when the corresponding QMU quantities are consistently defined:

$$\text{potn} = \text{curr} \cdot \text{resn}. \tag{29}$$

Thus the QMU framework seeks a dimensional correspondence between dynamic electrical quantities and their reciprocal substrate capacities. Its physical implications depend on the validity of the distributed-charge model and the explicit SI–QMU bridge.

2.8 Magnetic and Electrostatic Charges

The APM distinguishes electrostatic charge from the distributed magnetic-charge expression. Their roles in the QMU construction are summarized by Eq. (5); further geometric and dynamical details are developed in the following section.

3 Magnetic and Electrostatic Charges

The distributed-charge framework, conversion rules, and electromagnetic force formulation are developed in [16; 14; 15; 17; 18].

The Aether Physics Model distinguishes distributed magnetic charge from electrostatic charge. This proposed distinction differs from the charge description used in conventional electrodynamics and the Standard Model.

3.1 Distinction between magnetic and electrostatic charges in QMU

In the QMU system, subatomic particles are characterized by two distinct types of charge: magnetic charge and electrostatic charge. Magnetic charge, represented by ${e_{\text{emax}}}^2$, is a distributed charge arising from subatomic particles' intrinsic magnetic properties. Electrostatic charge, denoted as e^2, is the traditional concept of electric charge, responsible for the electrostatic interactions between particles.

The distinction between magnetic and electrostatic charges in the QMU system is rooted in the different spatial distributions and geometries of these charges within subatomic particles. Magnetic charge is distributed over a subatomic particle's cardioid or toroid surface, giving rise to its intrinsic magnetic moment and enabling its participation in magnetic interactions. In the APM chronogeometric construction, electrostatic polarity belongs to opposing spherical sectors of the Aether unit; a center-concentrated point charge is not assumed. The projected particle geometry and its field response are distinct descriptions.

The QMU system's recognition of the distinct nature of magnetic and electrostatic charges has significant implications for the understanding of electromagnetic interactions at the quantum level. The separation supplies a proposed geometrical interpretation of electrostatic and magnetic interactions. Whether it improves upon conventional descriptions is an empirical question, not a consequence of the dimensional definitions alone.

3.2 Relationship between magnetic and electrostatic charges

Although magnetic and electrostatic charges are distinct properties of subatomic particles in the QMU system, they are not entirely independent. The fundamental principles of electromagnetism govern the relationship between magnetic and electrostatic charges and are essential for understanding the overall behavior of subatomic particles.

In the QMU system, the relationship between magnetic and electrostatic charges is expressed through the charge ratio, defined as the ratio of the electrostatic charge to the magnetic charge of a subatomic particle. For example, the charge ratio of the electron is given by:

$$e^2 = 8\pi\alpha {e_{\text{emax}}}^2. \tag{30}$$

The defining charge normalization and its species extensions are discussed in [16; 14].

where e^2 is the electrostatic charge expression of the electron, ${e_{\text{emax}}}^2$ is its distributed magnetic-charge expression, and α is the fine-structure constant, a fundamental parameter that characterizes the distortion effect of 1-spin spherical angle electrostatic charge to ½ spin steradian angle magnetic charge.

The numerical coefficient in the electron relation is fixed by the stated QMU charge normalization. In particular, writing $R_e = e^2/{e_{\text{emax}}}^2$ gives

$$R_e = 8\pi\alpha, \qquad \frac{{e_{\text{emax}}}^2}{e^2} = \frac{1}{8\pi\alpha}, \qquad \frac{e^2}{8\pi {e_{\text{emax}}}^2} = \alpha. \tag{31}$$

These are algebraically equivalent forms of the same defining relation, not three independent predictions. A coefficient such as 8π cannot be dropped when converting between the electrostatic and magnetic-charge expressions. The universal mass-to-magnetic-charge ratio below is a separate APM postulate; its dimensional compatibility does not independently establish its empirical validity.

The charge ratio is a constant value that defines the subatomic particle. All electrons have the same electrostatic to magnetic charge ratio, and similar characteristics apply to other subatomic particles. This constant charge ratio is a fundamental property of subatomic particles and is essential for understanding their behavior and interactions.

Another important relationship in the QMU system is the direct proportionality between mass and magnetism (mass per magnetic charge). Although the mass associated with the Aether and subatomic particles may differ, their mass to magnetic charge ratio is always the same. This relationship highlights the intrinsic connection between mass and magnetic charge in the QMU system.

$$\frac{m_{\text{e}}}{{e_{\text{emax}}}^2} = \frac{m_p}{{e_{\text{pmax}}}^2} = \frac{m_n}{{e_{\text{nmax}}}^2} = \frac{m_a}{{e_a}^2}. \tag{32}$$

The universal mass-to-magnetic-charge ratio is treated as a QMU/Aether modeling premise in [16; 4].

It is crucial to note that the mass and magnetic charge of the Aether unit are not material quantities in the same sense as the mass and charge of subatomic particles. Instead, the Aether mass and charge represent the maximum mass and maximum magnetic charge that each Aether unit is

capable of containing. In other words, the Aether mass describes an environmental limit, while the electron or proton mass describes a discrete quantity of what we perceive as physical mass.

3.3 Role of magnetic charge in physical phenomena

The recognition of magnetic charge as a distinct and fundamental property of subatomic particles in the QMU system has far-reaching implications for the understanding of various physical phenomena at the quantum level. Magnetic charge plays a central role in many aspects of quantum physics, from the behavior of individual subatomic particles to the collective properties of matter and the fundamental forces of nature.

One of the most significant roles of magnetic charge in the QMU system is its contribution to the intrinsic magnetic moments of subatomic particles. The magnetic charge distribution on the surface of a subatomic particle gives rise to its intrinsic magnetic moment, which determines its response to external magnetic fields and its participation in magnetic interactions. The QMU interpretation of magnetic moments is a proposed physical model; its quantitative accuracy must be assessed through independently derived predictions and measurements.

In the Aether Physics Model (APM), which describes a functioning Universe, quarks are not considered fundamental building blocks of matter. Instead, quarks are understood to be the result of the destruction of subatomic particles, where the particle breaks into three more or less consistent pieces before permanently disappearing. During this process, the Aether unit is destroyed, and the string of mass returns to its dark matter state. Therefore, quarks are not part of the APM's description of stable matter and do not play a role in the fundamental interactions between subatomic particles.

In the APM, magnetic charge is not responsible for holding quarks together, as quarks are not considered fundamental constituents of matter. Instead, magnetic charge is an inherent property of subatomic particles that arises when a mass string vibrates through the tubular loxodrome path during the process of chronovibration. This magnetic charge contributes to the intrinsic magnetic moments of subatomic particles and their participation in magnetic interactions, but it does not serve as a binding force for quarks.

Moreover, magnetic charge is essential for understanding the behavior of superconductors and other exotic states of matter in the QMU system. In APM, coherent magnetic alignment is proposed as a mechanism relevant to superconductivity. This proposal must reproduce zero resistance, magnetic-flux response (including the Meissner effect), and critical-current behavior to qualify as an experimentally adequate account. These superconductivity applications remain proposed interpretations rather than established consequences of the unit ledger.

Finally, magnetic charge plays a significant role in the QMU system's description of the Aether and its interactions with matter and energy. The Aether's maximum possible magnetic charge distribution is essential for maintaining the stability and coherence of the quantum world and for mediating the propagation of electromagnetic waves and other forms of energy. The recognition of magnetic charge as a fundamental property of the Aether thus provides a new perspective on the nature of space, matter, and the fundamental forces of nature.

Introduction to the QMU grid

The Quantum Measurement Units (QMU) system introduces a comprehensive and organized framework for representing physical quantities and their relationships through the use of a units grid. This grid serves as a powerful tool for visualizing the connections between different aspects of the physical world and for facilitating the development of a unified understanding of the fundamental principles governing the Universe.

3.4 The QMU System Grid: Organizing Dynamic and Substrate Units

The QMU system organizes units into a comprehensive grid encompassing dynamic and substrate expressions of various physical quantities. This grid structure highlights the relationships between different units and their roles in describing active processes, interactions, and the underlying substrate of the Universe (the Aether).

The units grid is divided into several main categories, each representing a fundamental aspect of the physical world. These categories include Magnetic Field Units. This category includes units related to the description of magnetic fields. It contains dynamic units (such as magnetic flux, magnetic potential, and the Aether unit) and substrate units (such as capacitance and conductance). The Aether unit (Au) and the rotating magnetic field unit (rmfd) are interchangeable terms, with Au generally used when describing what the Aether is and rmfd used when explaining what the Aether does.

4 Quantum Measurement Units Grid

The Quantum Measurement Units (QMU) system organizes physical quantities by their dimensional structure and their roles in the Aether Physics Model (APM). Its grid convention and dimensional algebra follow the QADI reference program described in [1; 2; 3].

Fundamental Organization of the Units Grid

The QMU dimensional ledger uses four principal electron-based quantum measurements:

$$\boxed{\left\{m_{\mathrm{e}},\ \lambda_C,\ F_q,\ {e_{\mathrm{emax}}}^2\right\}.} \tag{33}$$

Here m_{e} denotes electron mass, λ_C the electron Compton wavelength, F_q the quantum frequency, and ${e_{\mathrm{emax}}}^2$ the electron distributed magnetic-charge quantity. The symbol ${e_{\mathrm{emax}}}^2$ denotes one complete charge quantity; e_{emax} is a symbolic parameter, not an independently existing QMU unit.

A general monomial representation is

$$\boxed{U = {m_{\mathrm{e}}}^a {\lambda_C}^b {F_q}^c \left({e_{\mathrm{emax}}}^2\right)^d,} \tag{34}$$

where the exponents identify the dimensional structure of the quantity. Numerical constants and species-specific geometric coefficients may be needed in addition to this monomial ledger when constructing a physical law.

Principal Unit Categories

Electric and electromagnetic units. These describe distributed charge, electric and magnetic fields, potentials, fluxes, and their interactions. The grid includes such dynamic quantities as potential and electric field strength and such substrate quantities as permittivity and capacitance.

Inertial and mechanical units. These describe mass, force, energy, momentum, acceleration, and related physical processes and reciprocal capacities.

Length, frequency, and temporal units. These describe spatial and temporal relationships, including length, velocity, frequency, resonance, time, and orbit. APM identifies the Aether as physical space and distinguishes its continuous five-dimensional temporal organization from discrete four-dimensional manifestations. Time is not treated as an independently flowing material substance.

Dynamic and Substrate Expressions

Dynamic QMU expressions describe active processes and interactions, whether material or Aether-related. In many principal families they contain mass in the numerator and distributed magnetic charge in the denominator. Substrate expressions describe complementary capacities or reciprocal quantities, often with distributed charge in the numerator and mass in the denominator. These patterns classify specific families; they are not substitutes for each unit's explicit definition.

For an exact reciprocal pair,

$$\boxed{U_{\text{dyn}}\, U_{\text{sub}} = 1.} \tag{35}$$

Examples from the QMU ledger include

$$\text{potn} \cdot \text{capc} = 1, \tag{36}$$
$$\text{perm} \cdot \text{curl} = 1, \tag{37}$$
$$\text{rmfd} \cdot \text{ptty} = 1. \tag{38}$$

These equations state formal reciprocal relationships in QMU. A comparison with similarly named SI quantities must use the established charge-conversion prescriptions and the specific operational definitions of the quantities being compared.

Material and Aether Expressions of Physical Quantities

The distinction between material and Aether expressions concerns the entity or domain described; it is not synonymous with the distinction between dynamic and substrate expressions.

Material expressions. Material expressions describe observable properties and interactions of particles, atoms, molecules, and larger bodies. They include mass, distributed charge, angular momentum, energy, and other physical quantities associated with material structures.

Aether expressions. Aether expressions describe the proposed quantum substrate of space, including its distributed charge, rotating magnetic-field dynamics, permittivity, permeability, and geometrical responses. APM interprets measured magnetic, electrostatic, and gravitational interactions, as well as spatial and signal-propagation measurements, as manifestations of Aether behavior. Specific Aether-unit structures can be investigated through discriminating measurements.

Material or Aether quantities may each describe active behavior, and each may occur in reciprocal unit families. Thus the two classifications should not be conflated.

New Units and Their Significance

QMU assigns distinct names to dimensional constructions that may be grouped together in conventional descriptions. A principal example is the Aether unit A_u, whose electron-based expression is

$$\boxed{A_u = \frac{m_\mathrm{e} {\lambda_C}^3 {F_q}^2}{{e_\mathrm{emax}}^2}.} \tag{39}$$

The rotating magnetic-field quantity rmfd has the same QMU dimensional expression. The QMU curl quantity is

$$\boxed{\mathrm{curl} = \frac{{e_\mathrm{emax}}^2}{m_\mathrm{e} \lambda_C}.} \tag{40}$$

In QMU, curl names a physical scalar quantity; it is not the spatial vector-calculus operator $\nabla\times$. Their mathematical roles must remain distinct.

Combining the two QMU quantities yields the Ledger One identity:

$$\boxed{A_u \cdot \mathrm{curl} = {\lambda_C}^2 {F_q}^2 = c^2 = \mathrm{temp},} \tag{41}$$

using $c = \lambda_C F_q$. Within the QMU dimensional ledger, A_u is a dimensioned physical quantity, even where its numerical expression reduces to a pure geometrical coefficient in another unit convention.

Additional QMU units name magnetic flux, circulation, charge response, temporal relations, and other physical processes. These names enable researchers to compare distinct dimensional constructions and investigate physical interpretations and constitutive laws in dedicated studies.

Distinguishing Unit Characteristics

Frequency, resonance, time, and orbit are distinct QMU quantities. Their relationship is analogous to the distinction among length, area, and volume: algebraic relationships between units do not

make their dimensions interchangeable.

Resonance

In QMU, resonance is a named physical unit with frequency-squared dimensions:

$$\boxed{\text{rson} = {F_q}^2.} \tag{42}$$

This is not a synonym for a measured frequency at which a driven system responds strongly. A response frequency may be measured in a resonance experiment, but the frequency and the QMU resonance quantity must be identified separately. A named unit involving resonance must be interpreted using its complete ledger formula rather than the verbal expression "resonant frequency."

Example unit name. Quantum Electric Surface Resonance Intensity (`qefr`); its exact dimensional expression is supplied by its catalog definition.

Adaptability

Adaptability characterizes the response of a system to changing external conditions. In a particular QMU unit family, a factor F_q may participate in an adaptability expression, but frequency dimension alone does not prove any specific adaptive response law.

Example unit name. Quantum Electric Field Adaptability (`qefa`); use the complete catalog definition for the unit's dimensions.

Compliance

Compliance characterizes a system's yielding or response to an applied influence. In a particular QMU family, an inverse-frequency factor ${F_q}^{-1}$ may enter a compliance expression. This factor has the dimension of time, but time alone is not a physical definition of compliance.

Example unit name. Quantum Electric Field Compliance (`qefc`); use the complete catalog definition for the unit's dimensions.

Frequency Exponents and Named QMU Quantities

The frequency exponent in the four-primitive ledger gives a precise temporal dimension. These constructions must not be confused merely because they share the same base quantum frequency.

Factor	QMU quantity	Dimension
${F_q}^3$	Frequency cubed	T^{-3}
${F_q}^2$	Resonance	T^{-2}
F_q	Frequency	T^{-1}
${F_q}^0$	No frequency factor	T^0
${F_q}^{-1}$	Time	T
${F_q}^{-2}$	Orbit	T^2

The QMU relationships are

$$\text{rson} = {F_q}^2, \tag{43}$$
$$\text{time} = {F_q}^{-1}, \tag{44}$$
$$\text{orbt} = {F_q}^{-2}. \tag{45}$$

Therefore,

$$\boxed{\text{rson} \cdot \text{orbt} = 1, \qquad \text{orbt} = \text{time}^2.} \tag{46}$$

An orbital period is a time quantity; the QMU orbit unit has time-squared dimensions. Similarly, an observed oscillation frequency is a frequency quantity; QMU resonance has frequency-squared dimensions. The governing equations must preserve these distinctions.

Physical Interpretation of Unit Names

Terms such as resonance, adaptability, and compliance should identify the appropriate QMU quantity or response rather than serve as casual substitutes for frequency, elasticity, or other familiar descriptions. The full unit formula and relevant physical equations determine what a name means. Powers of F_q should not automatically be assigned a physical mechanism without those equations.

Precise unit nomenclature makes the QMU grid useful for discovering relationships that are obscured when quantities with different dimensions are described in the same language.

Quantum Measurement Units

The following QMU family grids organize named units by their dimensional structure and physical roles. Together with the subsequent definitions, reciprocal relationships, cross-family references, and experimental suggestions, they provide a foundation for independent investigation. The present chapter defines and organizes the units; new physical derivations and specific experimental predictions are reserved for dedicated QADI research papers.

5 QMU Unit Family Grids

These tables should be read alongside the original QMU dimensional and metrological references [1; 3; 11].

These grids retain the column and row organization of the QMU reference tables. Dynamic and substrate constructions are shown separately.

Electromagnetic Field and Interaction Units

Dynamic Units

1. Rotating Magnetic Field **2. Aether Unit** **3. Electron Flux** $A_u = \frac{m_e \lambda_C^3 F_q^2}{e_{emax}^2}$ (also rmfd)	**Magnetic Field** $mfld = \frac{m_e \lambda_C^3 F_q}{e_{emax}^2}$	**Magnetic Volume** $mvlm = \frac{m_e \lambda_C^3}{e_{emax}^2}$
1. Electric Potential **2. Electromotive Force** $potn = \frac{m_e \lambda_C^2 F_q^2}{e_{emax}^2}$	**Magnetic Flux** $mflx = \frac{m_e \lambda_C^2 F_q}{e_{emax}^2}$	**Inductance** $indc = \frac{m_e \lambda_C^2}{e_{emax}^2}$
Electric Field Strength $elfs = \frac{m_e \lambda_C F_q^2}{e_{emax}^2}$	**1. Magnetic Rigidity** **2. Magnetic Velocity** $magr = \frac{m_e \lambda_C F_q}{e_{emax}^2}$	**Permeability** $perm = \frac{m_e \lambda_C}{e_{emax}^2}$
1. Diverging Electric Field **2. Surface Tension Charge** **3. Magnetic Resonance** $dvef = \frac{m_e F_q^2}{e_{emax}^2}$ (also stnc or spcd)	**Magnetic Flux Density** $mfxd = \frac{m_e F_q}{e_{emax}^2}$	**1. Magnetism** **2. Mass to Charge Ratio** $mchg = \frac{m_e}{e_{emax}^2}$

Electromagnetic Field and Interaction Units (continued)

Substrate Units

Magnetic Field Exposure $mfde = \frac{e_{emax}^2}{m_e \lambda_C^3}$	**Magnetic Flux Intensity Ratio** $mfir = \frac{e_{emax}^2}{m_e \lambda_C^3 F_q}$	**Permittivity** $ptty = \frac{e_{emax}^2}{m_e \lambda_C^3 F_q^2}$
Aether Fluctuation Potential $aefp = \frac{e_{emax}^2}{m_e \lambda_C^2}$	**Conductance** $cond = \frac{e_{emax}^2}{m_e \lambda_C^2 F_q}$ (also Cd)	**Capacitance** $capc = \frac{e_{emax}^2}{m_e \lambda_C^2 F_q^2}$
Curl $curl = \frac{e_{emax}^2}{m_e \lambda_C}$	**Exposure Diffusion Flux** $exdf = \frac{e_{emax}^2}{m_e \lambda_C F_q}$	**Acceptance** $accp = \frac{e_{emax}^2}{m_e \lambda_C F_q^2}$
Exposure $expr = \frac{e_{emax}^2}{m_e}$	**Conductance Density** $cden = \frac{e_{emax}^2}{m_e F_q}$	**Converging Electric Field** $cvef = \frac{e_{emax}^2}{m_e F_q^2}$

Magnetic Field Resistance and Flow Units

Dynamic Units

Friction $fric = \frac{m_e \lambda_C{}^3 F_q{}^2}{e_{emax}{}^4}$	**Magnetic Flow Impedance** $mgfi = \frac{m_e \lambda_C{}^3 F_q}{e_{emax}{}^4}$	**Flux Flow Equilibrium** $ffeq = \frac{m_e \lambda_C{}^3}{e_{emax}{}^4}$
Kinetic Friction $kfcn = \frac{m_e \lambda_C{}^2 F_q{}^2}{e_{emax}{}^4}$	**Resistance** $resn = \frac{m_e \lambda_C{}^2 F_q}{e_{emax}{}^4}$	**Magnetic Permeance** $magp = \frac{m_e \lambda_C{}^2}{e_{emax}{}^4}$
Magnetic Flux Density Wave $mfdw = \frac{m_e \lambda_C F_q{}^2}{e_{emax}{}^4}$	**Magnetic Diffusion Impedance** $mdif = \frac{m_e \lambda_C F_q}{e_{emax}{}^4}$	**Thermal Magnetic Friction** $thmf = \frac{m_e \lambda_C}{e_{emax}{}^4}$
Aether Resistance Stability Factor $arsf = \frac{m_e F_q{}^2}{e_{emax}{}^4}$	**Potential Charge Concentration Factor** $pccf = \frac{m_e F_q}{e_{emax}{}^4}$	**Magnetic Opposition** $mopp = \frac{m_e}{e_{emax}{}^4}$

Magnetic Field Resistance and Flow Units (continued)

Substrate Units

Electromagnetic Ratio $emro = \frac{e_{emax}{}^4}{m_e \lambda_C{}^3 F_q{}^2}$	**Electromagnetic Interaction Coefficient** $emic = \frac{e_{emax}{}^4}{m_e \lambda_C{}^3 F_q}$	**Current Flow Facilitation Factor** $cfff = \frac{e_{emax}{}^4}{m_e \lambda_C{}^3}$
Magnetic Spatial Compliance $masc = \frac{e_{emax}{}^4}{m_e \lambda_C{}^2 F_q{}^2}$	**Admittance** $admt = \frac{e_{emax}{}^4}{m_e \lambda_C{}^2 F_q}$	**Magnetic Reluctance** $mrlc = \frac{e_{emax}{}^4}{m_e \lambda_C{}^2}$
Magnetic Current Impedance $mcri = \frac{e_{emax}{}^4}{m_e \lambda_C F_q{}^2}$	**Magnetic Field Resistance** $mfdr = \frac{e_{emax}{}^4}{m_e \lambda_C F_q}$	**Magnetic Field Energy** $mfen = \frac{e_{emax}{}^4}{m_e \lambda_C}$
Magnetic Charge per Unit Potential $mcup = \frac{e_{emax}{}^4}{m_e F_q{}^2}$	**Magneto-Spatial Impedance Ratio** $msir = \frac{e_{emax}{}^4}{m_e F_q}$	**Electromagnetic Interaction Density** $emid = \frac{e_{emax}{}^4}{m_e}$

Quantum Electrodynamic Foundational Units

Dynamic Units

Quantum Photomagnetic Density $qpmd = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^3 F_q{}^3}$	**Magnetic Charge per Photon** $mcpp = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^3 F_q{}^2}$	**Magnetic Charge Density per Rotation** $mcdr = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^3 F_q}$	**Magnetic Charge Rotational Density** $mcrd = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^3}$
Quantum Illumination Density $qild = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^2 F_q{}^3}$	**Quantum Electric Charge Flux** $qecf = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^2 F_q{}^2}$	**Charge Surface-Temporal Confinement Coefficient** $cscc = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^2 F_q}$	**Charge Surface Confinement Coefficient** $chcc = \frac{1}{e_{\text{emax}}{}^2 \lambda_C{}^2}$
Quantum Electric Charge Jerk $qecj = \frac{1}{e_{\text{emax}}{}^2 \lambda_C F_q{}^3}$	**Quantum Electric Charge Acceleration** $qeca = \frac{1}{e_{\text{emax}}{}^2 \lambda_C F_q{}^2}$	**Quantum Electric Charge Drift** $qecd = \frac{1}{e_{\text{emax}}{}^2 \lambda_C F_q}$	**Quantum Electric Charge Displacement** $ecdp = \frac{1}{e_{\text{emax}}{}^2 \lambda_C}$
Quantum Electric Charge Intensity $qeci = \frac{1}{e_{\text{emax}}{}^2 F_q{}^3}$	**Quantum Electric Charge Oscillation** $qeco = \frac{1}{e_{\text{emax}}{}^2 F_q{}^2}$	**Quantum Electric Charge Fluctuation** $ecfx = \frac{1}{e_{\text{emax}}{}^2 F_q}$	**Magnetic Charge Affinity** $mcaf = \frac{1}{e_{\text{emax}}{}^2}$

Quantum Electrodynamic Foundational Units (continued)

Substrate Units

Quantum Electric Field Volumetric Resonance $efvr = e_{\text{emax}}{}^2 \lambda_C{}^3 F_q{}^3$	**Quantum Electric Field Volumetric Adaptability** $efva = e_{\text{emax}}{}^2 \lambda_C{}^3 F_q{}^2$	**Quantum Electric Field Volumetric Compliance** $efvc = e_{\text{emax}}{}^2 \lambda_C{}^3 F_q$	**Charge Volume** $chvm = e_{\text{emax}}{}^2 \lambda_C{}^3$
Ball Lightning $ball = e_{\text{emax}}{}^2 \lambda_C{}^2 F_q{}^3$	**Plasma** $plsm = e_{\text{emax}}{}^2 \lambda_C{}^2 F_q{}^2$	**Magnetic Moment** $magm = e_{\text{emax}}{}^2 \lambda_C{}^2 F_q$	**Surface Charge** $sfch = e_{\text{emax}}{}^2 \lambda_C{}^2$
Quantum Electric Field Dynamic Responsivity $efdr = e_{\text{emax}}{}^2 \lambda_C F_q{}^3$	**Accelerating Charge** $acch = e_{\text{emax}}{}^2 \lambda_C F_q{}^2$	**Charge Velocity** $chvl = e_{\text{emax}}{}^2 \lambda_C F_q$	**Charge Length (Charge Displacement)** $chgl = e_{\text{emax}}{}^2 \lambda_C$
Quantum Electric Field Temporal Intensity $efti = e_{\text{emax}}{}^2 F_q{}^3$	**Charge Resonance (Electric Coupling)** $chrs = e_{\text{emax}}{}^2 F_q{}^2$ (also ecup)	**Current** $curr = e_{\text{emax}}{}^2 F_q$	**Charge** $chrg = e_{\text{emax}}{}^2$

Quantum Electrodynamic Distribution Units

Dynamic Units

Quantum Volumetric Charge Inertia $qvci = \frac{\lambda_C{}^3}{e_{\text{emax}}{}^2 F_q{}^3}$	**Quantum Volumetric Charge Reluctance** $qvcr = \frac{\lambda_C{}^3}{e_{\text{emax}}{}^2 F_q{}^2}$	**Quantum Volumetric Charge Persistence** $qvcp = \frac{\lambda_C{}^3}{e_{\text{emax}}{}^2 F_q}$	**Specific Charge** $spch = \frac{\lambda_C{}^3}{e_{\text{emax}}{}^2}$
Quantum Charge Distribution Resistance $qcdr = \frac{\lambda_C{}^2}{e_{\text{emax}}{}^2 F_q{}^3}$	**Quantum Charge Distribution Periodicity** $qcdp = \frac{\lambda_C{}^2}{e_{\text{emax}}{}^2 F_q{}^2}$	**Quantum Charge Distribution Dynamics** $qcdd = \frac{\lambda_C{}^2}{e_{\text{emax}}{}^2 F_q}$	**1. Charge Distribution 2. Stroke** $chds = \frac{\lambda_C{}^2}{e_{\text{emax}}{}^2}$ (also strk)
Quantum Charge Radius Resistance $qcrr = \frac{\lambda_C}{e_{\text{emax}}{}^2 F_q{}^3}$	**Quantum Charge Radius Periodicity** $qcrp = \frac{\lambda_C}{e_{\text{emax}}{}^2 F_q{}^2}$	**Quantum Charge Radius Dynamics** $qcrd = \frac{\lambda_C}{e_{\text{emax}}{}^2 F_q}$	**Charge Radius** $chgr = \frac{\lambda_C}{e_{\text{emax}}{}^2}$

Quantum Electrodynamic Distribution Units (continued)

Substrate Units

Quantum Charge Density Intensity $qcdi = \frac{{e_{\text{emax}}}^2 {F_q}^3}{{\lambda_C}^3}$	**Quantum Charge Density Resonance** $cdrs = \frac{{e_{\text{emax}}}^2 {F_q}^2}{{\lambda_C}^3}$	**Quantum Charge Density Oscillation** $cdos = \frac{{e_{\text{emax}}}^2 F_q}{{\lambda_C}^3}$	**Charge Density** $chgd = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3}$
Quantum Electric Surface Intensity $qesi = \frac{{e_{\text{emax}}}^2 {F_q}^3}{{\lambda_C}^2}$	**Quantum Electric Surface Resonance Intensity** $qefr = \frac{{e_{\text{emax}}}^2 {F_q}^2}{{\lambda_C}^2}$	**Current Density** $cdns = \frac{{e_{\text{emax}}}^2 F_q}{{\lambda_C}^2}$	**Electric Flux Density** $efxd = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2}$
Quantum Electric Gradient Intensity $qegi = \frac{{e_{\text{emax}}}^2 {F_q}^3}{\lambda_C}$	**Quantum Electric Gradient Resonance** $qegr = \frac{{e_{\text{emax}}}^2 {F_q}^2}{\lambda_C}$	**Magnetic Field Intensity** $mfdi = \frac{{e_{\text{emax}}}^2 F_q}{\lambda_C}$	**Electric Charge Gradient** $elcg = \frac{{e_{\text{emax}}}^2}{\lambda_C}$

Electromagnetic Behavioral Units

Dynamic Units

Trivariate Magnetic Oscillation $trmo = \frac{{\lambda_C}^3 {F_q}^3}{{e_{\text{emax}}}^2}$	**Varying Electric Field** $vefd = \frac{{\lambda_C}^3 {F_q}^2}{{e_{\text{emax}}}^2}$	**Electric Field** $efld = \frac{{\lambda_C}^3 F_q}{{e_{\text{emax}}}^2}$	**Specific Charge** $spch = \frac{{\lambda_C}^3}{{e_{\text{emax}}}^2}$
Dynamic Electric Field Intensity $defi = \frac{{\lambda_C}^2 {F_q}^3}{{e_{\text{emax}}}^2}$	**Charge Temperature** $chgt = \frac{{\lambda_C}^2 {F_q}^2}{{e_{\text{emax}}}^2}$	**Charge Sweep** $chgs = \frac{{\lambda_C}^2 F_q}{{e_{\text{emax}}}^2}$	**1. Charge Distribution** **2. Stroke** $chds = \frac{{\lambda_C}^2}{{e_{\text{emax}}}^2}$ (also strk)
Dynamic Electric Field Flux $deff = \frac{\lambda_C {F_q}^3}{{e_{\text{emax}}}^2}$	**Acceleration per Charge** $chga = \frac{\lambda_C {F_q}^2}{{e_{\text{emax}}}^2}$	**Velocity per Charge** $chgv = \frac{\lambda_C F_q}{{e_{\text{emax}}}^2}$	**Charge Radius** $chgr = \frac{\lambda_C}{{e_{\text{emax}}}^2}$
Dynamic Electric Field Oscillation $defo = \frac{{F_q}^3}{{e_{\text{emax}}}^2}$	**Resonance per Charge** $crsn = \frac{{F_q}^2}{{e_{\text{emax}}}^2}$	**1. Magnetic Current** **2. Charge Frequency** $mcur = \frac{F_q}{{e_{\text{emax}}}^2}$ (also chgf)	**Magnetic Charge Affinity** $mcaf = \frac{1}{{e_{\text{emax}}}^2}$

Electromagnetic Behavioral Units (continued)

Substrate Units

Quantum Electric Volumetric Susceptibility $qefs = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3 {F_q}^3}$	**Quantum Electric Field Receptivity** $qerc = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3 {F_q}^2}$	**Quantum Electric Field Compliance** $qefc = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3 F_q}$	**Charge Density** $chgd = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3}$
Quantum Electric Field Intensity $qefi = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2 {F_q}^3}$	**Quantum Electric Surface Resonance Capacity** $efrs = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2 {F_q}^2}$	**Magnetic Charge Density Frequency** $mcdf = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2 F_q}$	**Electric Flux Density** $efxd = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2}$
Quantum Electric Field Plasticity $qefp = \frac{{e_{\text{emax}}}^2}{\lambda_C {F_q}^3}$	**Quantum Electric Field Elasticity** $qefe = \frac{{e_{\text{emax}}}^2}{\lambda_C {F_q}^2}$	**Quantum Electric Field Conductance** $efcd = \frac{{e_{\text{emax}}}^2}{\lambda_C F_q}$	**Electric Charge Gradient** $elcg = \frac{{e_{\text{emax}}}^2}{\lambda_C}$
Quantum Electric Field Permeability $efpm = \frac{{e_{\text{emax}}}^2}{{F_q}^3}$	**Quantum Electric Temporal Susceptibility** $efsu = \frac{{e_{\text{emax}}}^2}{{F_q}^2}$	**Quantum Electric Field Permittivity** $efpt = \frac{{e_{\text{emax}}}^2}{F_q}$	**Charge** $chrg = {e_{\text{emax}}}^2$

Fundamental Inertial and Behavioral Units

Dynamic Units

Light $ligt = m_e {\lambda_C}^3 {F_q}^3$	**Photon** $phtn = m_e {\lambda_C}^3 {F_q}^2$	**Quantum Angular Reach** $qanr = m_e {\lambda_C}^3 F_q$	**Vortex** $vrtx = m_e {\lambda_C}^3$
Power $powr = m_e {\lambda_C}^2 {F_q}^3$	**Energy** $enrg = m_e {\lambda_C}^2 {F_q}^2$	**Angular Momentum** $angm = m_e {\lambda_C}^2 F_q$ (also h)	**Moment of Inertia** $minr = m_e {\lambda_C}^2$
1. Shock Frequency 2. Light Intensity $lint = m_e \lambda_C {F_q}^3$	**Force** $forc = m_e \lambda_C {F_q}^2$	**Momentum** $momt = m_e \lambda_C F_q$	**Torque** $torq = m_e \lambda_C$
Irradiance $irrd = m_e {F_q}^3$	**Surface Tension** $sten = m_e {F_q}^2$	**Intensity** $ints = m_e F_q$	**Mass** $mass = m_e$

Fundamental Inertial and Behavioral Units (continued)

Substrate Units

Optical Compliance $ocmp = \frac{1}{m_e {\lambda_C}^3 {F_q}^3}$	**Innate Particulate Resolvability** $inpr = \frac{1}{m_e {\lambda_C}^3 {F_q}^2}$	**Quantum Volumetric Receptivity** $qvrc = \frac{1}{m_e {\lambda_C}^3 F_q}$	**Quantum Volumetric Inertia** $qvoi = \frac{1}{m_e {\lambda_C}^3}$
Quantum Surface Receptivity $qsrc = \frac{1}{m_e {\lambda_C}^2 {F_q}^3}$	**Quantum Surface Inertia** $qusi = \frac{1}{m_e {\lambda_C}^2 {F_q}^2}$	**Quantum Angular Receptivity Gauge** $qarg = \frac{1}{m_e {\lambda_C}^2 F_q}$	**Quantum Area Inertia** $qari = \frac{1}{m_e {\lambda_C}^2}$
Quantum Inverse Light Intensity $qili = \frac{1}{m_e \lambda_C {F_q}^3}$	**Spatial Tensility** $sptn = \frac{1}{m_e \lambda_C {F_q}^2}$	**Quantum Mobility** $qmob = \frac{1}{m_e \lambda_C F_q}$	**Quantum Flexibility** $qflx = \frac{1}{m_e \lambda_C}$
Quantum Opacity $qopq = \frac{1}{m_e {F_q}^3}$	**Quantum Spreadability** $qspr = \frac{1}{m_e {F_q}^2}$	**Displacement Field** $dfld = \frac{1}{m_e F_q}$	**Quantum Existential Limit** $qexl = \frac{1}{m_e}$

Density and Distributional Behavioral Units

Dynamic Units

Quantum Mass Frequency Activity $qmfa = \frac{m_e {F_q}^3}{{\lambda_C}^3}$	**Quantum Mass Resonance Occupation** $qmro = \frac{m_e {F_q}^2}{{\lambda_C}^3}$	**Quantum Mass Frequency Oscillation** $qmfo = \frac{m_e F_q}{{\lambda_C}^3}$	**Mass Density** $masd = \frac{m_e}{{\lambda_C}^3}$
Quantum Surface Activity $qsac = \frac{m_e {F_q}^3}{{\lambda_C}^2}$	**Force Density** $fdns = \frac{m_e {F_q}^2}{{\lambda_C}^2}$	**Momentum Density** $momd = \frac{m_e F_q}{{\lambda_C}^2}$	**Surface Density** $sfcd = \frac{m_e}{{\lambda_C}^2}$
Pressure Diffusion Rate $pdrt = \frac{m_e {F_q}^3}{\lambda_C}$	**Pressure** $pres = \frac{m_e {F_q}^2}{\lambda_C}$	**Viscosity** $visc = \frac{m_e F_q}{\lambda_C}$	**1. Rebound** **2. Length Density** $ldns = \frac{m_e}{\lambda_C}$ (also rbnd)

Density and Distributional Behavioral Units (continued)

Substrate Units

Quantum Volume Fluctuation Impedance $qvfi = \frac{{\lambda_C}^3}{m_e {F_q}^3}$	**Quantum Volume Temporal Compliance** $qvtc = \frac{{\lambda_C}^3}{m_e {F_q}^2}$	**Quantum Volume Dynamic Flux** $qvdf = \frac{{\lambda_C}^3}{m_e F_q}$	**Specific Volume** $spcv = \frac{{\lambda_C}^3}{m_e}$
Quantum Surface Frequency Response $qsfr = \frac{{\lambda_C}^2}{m_e {F_q}^3}$	**Quantum Area Resonance Compliance** $qarc = \frac{{\lambda_C}^2}{m_e {F_q}^2}$	**Quantum Surface Dynamic Compliance** $qsdc = \frac{{\lambda_C}^2}{m_e F_q}$	**Specific Area** $spar = \frac{{\lambda_C}^2}{m_e}$
Quantum Linear Oscillation Density $qlod = \frac{\lambda_C}{m_e {F_q}^3}$	**Quantum Linear Dynamic Compliance** $qldc = \frac{\lambda_C}{m_e {F_q}^2}$	**Quantum Linear Temporal Compliance** $qltc = \frac{\lambda_C}{m_e F_q}$	**Specific Length** $spln = \frac{\lambda_C}{m_e}$

Coupling and Interactional Behavioral Units

Dynamic Units

Quantum Density Intensity Resistance $qdir = \frac{m_e}{{\lambda_C}^3 {F_q}^3}$	**Mass-Resonance Coupling Ratio** $mrcr = \frac{m_e}{{\lambda_C}^3 {F_q}^2}$	**Mass Frequency Distribution Ratio** $mfrd = \frac{m_e}{{\lambda_C}^3 F_q}$
Surface Charge Intensity Ratio $scir = \frac{m_e}{{\lambda_C}^2 {F_q}^3}$	**Surface Charge Orbital Coefficient** $scoc = \frac{m_e}{{\lambda_C}^2 {F_q}^2}$	**Surface Charge Temporal Factor** $sctf = \frac{m_e}{{\lambda_C}^2 F_q}$
Length Density Quantum Ratio $ldqr = \frac{m_e}{\lambda_C {F_q}^3}$	**Length Density Orbital Coefficient** $ldoc = \frac{m_e}{\lambda_C {F_q}^2}$	**Length Density Temporal Factor** $ldtf = \frac{m_e}{\lambda_C F_q}$
Quantum Mass Intensity Resistance $qmir = \frac{m_e}{{F_q}^3}$	**Quantum Mass Orbital Period** $qmop = \frac{m_e}{{F_q}^2}$	**Quantum Mass Temporal Coefficient** $qmtc = \frac{m_e}{F_q}$

Coupling and Interactional Behavioral Units (continued)

Substrate Units

Quantum Volume Oscillation Density $qvod = \frac{{\lambda_C}^3 {F_q}^3}{m_e}$	**Quantum Aether Gravitational Mobility** $qagm = \frac{{\lambda_C}^3 {F_q}^2}{m_e}$	**Quantum Aether Volumetric Flux Mobility** $qavm = \frac{{\lambda_C}^3 F_q}{m_e}$
Quantum Aether Surface Oscillation Mobility $qasm = \frac{{\lambda_C}^2 {F_q}^3}{m_e}$	**Quantum Aether Thermal Mobility** $qatm = \frac{{\lambda_C}^2 {F_q}^2}{m_e}$	**Quantum Aether Angular Mobility** $qaam = \frac{{\lambda_C}^2 F_q}{m_e}$
Quantum Aether Dynamic Intensity $qadi = \frac{\lambda_C {F_q}^3}{m_e}$	**Quantum Aether Dynamic Mobility** $qadm = \frac{\lambda_C {F_q}^2}{m_e}$	**Quantum Aether Mobility** $qamo = \frac{\lambda_C F_q}{m_e}$
Specific Quantum Intensity Factor $sqif = \frac{{F_q}^3}{m_e}$	**Specific Quantum Resonance** $sqre = \frac{{F_q}^2}{m_e}$	**Specific Quantum Frequency** $sqfr = \frac{F_q}{m_e}$

Oscillation and Spatial Dynamics Units

Dynamic Units

Quantum Volume Oscillation $qvos = {\lambda_C}^3 {F_q}^3$	**1. Double Toroid** **2. Volume-Resonance** $dtrd = {\lambda_C}^3 {F_q}^2$	**Flow** $flow = {\lambda_C}^3 F_q$	**Volume** $volm = {\lambda_C}^3$
Quantum Surface Oscillation $qsfo = {\lambda_C}^2 {F_q}^3$	**1. Radiation Dose** **2. Temperature** $temp = {\lambda_C}^2 {F_q}^2$ (also rdtn)	**1. Sweep** **2. Angular Velocity** $swep = {\lambda_C}^2 F_q$	**Area** $area = {\lambda_C}^2$
Quantum Dynamic Frequency $qdyf = \lambda_C {F_q}^3$	**Acceleration** $accl = \lambda_C {F_q}^2$	**Velocity** $velc = \lambda_C F_q$	**Length** $leng = \lambda_C$
Quantum Intensity Factor $qinf = {F_q}^3$	**Resonance** $rson = {F_q}^2$	**Frequency** $freq = F_q$	

Oscillation and Spatial Dynamics Units (continued)

Substrate Units

Quantum Volume Oscillation Resistance $qvor = \frac{1}{{\lambda_C}^3 {F_q}^3}$	**Inverse Volume Resonance** $invr = \frac{1}{{\lambda_C}^3 {F_q}^2}$	**Volumetric Field Density** $vfdn = \frac{1}{{\lambda_C}^3 F_q}$	**Field Intensity** $fint = \frac{1}{{\lambda_C}^3}$
Quantum Surface Frequency Impedance $qsfi = \frac{1}{{\lambda_C}^2 {F_q}^3}$	**Quantum Surface Intensity** $qsin = \frac{1}{{\lambda_C}^2 {F_q}^2}$	**Surface Flux Resistance** $sfrs = \frac{1}{{\lambda_C}^2 F_q}$	**Bending Radius** $bndr = \frac{1}{{\lambda_C}^2}$
Quantum Dynamic Frequency Resistance $qdfr = \frac{1}{\lambda_C {F_q}^3}$	**Momentum Resistance Coefficient** $morc = \frac{1}{\lambda_C {F_q}^2}$	**Quantum Inertial Density** $quid = \frac{1}{\lambda_C F_q}$	**Wave Number** $wavn = \frac{1}{\lambda_C}$
Quantum Intensity Resistance $qire = \frac{1}{{F_q}^3}$	**Orbit** $orbt = \frac{1}{{F_q}^2}$	**Time** $time = \frac{1}{F_q}$	

Spatio-Temporal Dynamics Units

Dynamic Units

Orbital Volume Evolution $ovev = \frac{{\lambda_C}^3}{{F_q}^3}$	**Volumetric Orbital Coherence** $voco = \frac{{\lambda_C}^3}{{F_q}^2}$	**Volume-Time** $vlmt = \frac{{\lambda_C}^3}{F_q}$
Temporal Area Flux $tafx = \frac{{\lambda_C}^2}{{F_q}^3}$	**Area-Time Flux** $atfx = \frac{{\lambda_C}^2}{{F_q}^2}$	**Active Area** $acta = \frac{{\lambda_C}^2}{F_q}$
Helical Path Length $hepl = \frac{\lambda_C}{{F_q}^3}$	**Quantum Trajectory Length** $qtrl = \frac{\lambda_C}{{F_q}^2}$	**Dynamic Length** $dynl = \frac{\lambda_C}{F_q}$

Spatio-Temporal Dynamics Units (continued)

Substrate Units

Volumetric Quantum Oscillation $voqo = \frac{{F_q}^3}{{\lambda_C}^3}$	**Volumetric Resonance** $vlmr = \frac{{F_q}^2}{{\lambda_C}^3}$	**Volumetric Wave Frequency per Volume** $vlmw = \frac{F_q}{{\lambda_C}^3}$
Transverse Quantum Oscillation Density $tqod = \frac{{F_q}^3}{{\lambda_C}^2}$	**Transverse Resonance** $tvsr = \frac{{F_q}^2}{{\lambda_C}^2}$	**Transverse Wave Frequency per Area** $tvsw = \frac{F_q}{{\lambda_C}^2}$
Scalar Quantum Oscillation Density $sqod = \frac{{F_q}^3}{\lambda_C}$	**Scalar Resonance** $sclr = \frac{{F_q}^2}{\lambda_C}$	**Scalar Wave Vorticity** $sclw = \frac{F_q}{\lambda_C}$

6 QMU unit constructions: catalog 1

For the source dimensional convention and conversion reference tables, see [2; 15; 11].

Entries follow the established QMU website grid order: family, dynamic/substrate grouping, then table row order. Units appearing in multiple grids are defined at their first occurrence.

Electromagnetic Field and Interaction

Dynamic units

Rotating Magnetic Field `rmfd`

QMU primitive representation: $\mathrm{rmfd} = \dfrac{m_\mathrm{e}\,{\lambda_C}^3\,{F_q}^2}{{e_\mathrm{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{rmfd}\,\mathrm{ptty} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression.

$$\text{rmfd} = A_u = \frac{m_\text{e}{\lambda_C}^3 {F_q}^2}{{e_\text{emax}}^2} = \frac{m_a {\lambda_C}^3 {F_q}^2}{{e_a}^2}. \tag{47}$$

The equality of the electron- and Aether-scale expressions assumes the universal mass-to-distributed-charge ratio $m_\text{e}/{e_\text{emax}}^2 = m_a/{e_a}^2$; it does not follow from dimensional matching alone. The rotating magnetic field represents the dynamic Aether-unit quantity in the Aether Physics Model. The Aether unit is a non-material chronogeometric structure, distinct from the material particle occupying an allowed loxodromic path. In the QMU terminology, *Aether unit* names the structure and *rotating magnetic field* names its dynamical role.

Dimensional relationships.

$$\text{rmfd} = \text{mvlm} \cdot \text{rson}, \qquad \text{mvlm} = \frac{m_\text{e}{\lambda_C}^3}{{e_\text{emax}}^2}, \qquad \text{rson} = {F_q}^2, \tag{48}$$

$$\text{rmfd} = \text{mfld} \cdot \text{freq}, \qquad \text{mfld} = \frac{m_\text{e}{\lambda_C}^3 F_q}{{e_\text{emax}}^2}, \qquad \text{freq} = F_q. \tag{49}$$

Using $\text{volm} = {\lambda_C}^3$ and $\text{mchg} = m_\text{e}/{e_\text{emax}}^2$, the same construction gives

$$\text{rmfd} = \text{volm} \cdot \text{rson} \cdot \text{mchg}. \tag{50}$$

Ledger closure.

$$\boxed{A_u \cdot \text{curl} = \text{rmfd} \cdot \text{curl} = \text{temp} = {\lambda_C}^2 {F_q}^2 = c^2}, \qquad \text{curl} = \frac{{e_\text{emax}}^2}{m_\text{e}\lambda_C}. \tag{51}$$

The QMU quantity curl denotes a scalar rotational or torsional construction, not the vector differential operator $\nabla\times$. The product is an identity of the stated dimensional definitions, not an independent experimental verification of the proposed Aether geometry.

Geometric interpretation and scope. The APM associates the Aether unit with five-dimensional loxodromic closure and complementary electrostatic polarity sectors. The dimensionless orientation measure $\Omega_A = 16\pi^2$ must be distinguished from the dimensioned Aether-unit quantity. Writing the geometric orientation factor as $\Omega_A = 16\pi^2$, a dimensionally explicit normalization can be defined by $k_C := A_u/\Omega_A$, so that $A_u = \Omega_A k_C$. Because Ω_A is dimensionless, $[k_C] = [A_u] = [m_\text{e}{\lambda_C}^3 {F_q}^2/{e_\text{emax}}^2]$. This is a normalization identity, not an independent derivation of the Aether-unit magnitude from geometry. The occupied scan area is $A_\text{scan} = {\lambda_C}^2$; the existence of multiple available orientation states does not imply simultaneous material occupation of every path. Quantitative loading laws and observable holonomy remain research questions.

Magnetic Field `mfld`

QMU primitive representation: $\text{mfld} = \dfrac{m_\text{e}\,{\lambda_C}^3\,F_q}{{e_\text{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{mfld}\,\text{mfir} = 1$ (as a formal reciprocal of the stated QMU dimensions).

It represents the flow of magnetism in the Aether. The Maxwellian "magnetic fields" (magnetic flux density, magnetic field intensity, magnetic flux, etc.) are not truly the magnetic field but are rather various aspects of it. The magnetic field is the whole volumetric flow of magnetism in the Aether, where the "flow" manifests in different modes (area times velocity, volume times frequency, length times angular momentum).

Dimensional Expression: $mfld = \frac{m_e \cdot {\lambda_C}^3 \cdot F_q}{{e_{emax}}^2}$

Equations:

$mfld = flow \cdot mchg$: Magnetic field equals $flow$ times $mchg$.

The QMU drag construction is resistance multiplied by length, drag = resn · leng. It has the same primitive dimensions as Magnetic Flow Impedance (mgfi). Consequently,

$$\text{mfld} = \text{chrg} \cdot \text{drag}.$$

$mfld = mfxd \cdot volm$: Magnetic field equals magnetic flux density times volume.

$mfld = curr \cdot ffeq$: Flux flow equilibrium ($ffeq$) is not a unit discussed in Standard Model physics, but it is important in electrodynamics. Flux flow equilibrium describes a static condition of electrons in a conductor that transfers current to the magnetic field. The more current applied to a conductor, the greater the magnetic field it produces.

Magnetic Volume `mvlm`

QMU primitive representation: $\text{mvlm} = \frac{m_e \, {\lambda_C}^3}{{e_{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: mvlm mfde = 1 (as a formal reciprocal of the stated QMU dimensions).

Quantifies the volume occupied by a magnetic field. Magnetic volume may be a direct unit for the phenomenon recognized as phonons.

Dimensional Expression: $mvlm = \frac{m_e \cdot {\lambda_C}^3}{{e_{emax}}^2}$

Equations:

$mvlm = volm \cdot mchg$ Magnetic volume equals volume times magnetic charge.

$mvlm = \frac{mfld}{freq}$ Magnetic volume is the magnetic field per frequency.

$A_u = mvlm \cdot rson$: A space quantum is a resonating magnetic volume (phonon).

Potential `potn`

Family grid Dependency index

QMU primitive representation:

$$\text{potn} = \frac{m_\text{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\text{emax}}^2}.$$

Catalog reciprocal:

$$\text{potn}\,\text{capc} = 1.$$

This is an exact reciprocal identity in the QMU dimensional ledger. It should not be confused with the separate SI definition of capacitance as charge per potential difference.

Physical definition and ledger identities. Within APM, electric potential is energy per distributed magnetic charge. The QMU potential unit admits the following equivalent expressions:

$$\begin{aligned}\text{potn} &= \frac{\text{enrg}}{\text{chrg}},\\ &= \text{temp}\cdot\text{mchg},\\ &= \text{curr}\cdot\text{resn},\\ &= \text{indc}\cdot\text{rson},\\ &= \text{mflx}\cdot\text{freq},\\ &= \text{perm}\cdot\text{accl},\\ &= \frac{1}{\text{capc}}.\end{aligned}$$

Here, $\text{rson} = {F_q}^2$ denotes the QMU resonance unit, not a frequency. These identities specify the QMU dimensional relationships among potential, charge, energy, and field quantities.

Established electron-sector QMU–SI bridge. The species-anchored charge conversion factor and its application rules are derived in [14; 15]. For the electron sector,

$$\text{ccf}_e = \frac{{e_\text{emax}}^2}{e} = \frac{e}{8\pi\alpha}.$$

The charge-denominator conversion of potential is

$$\begin{aligned}\text{potn}\,\text{ccf}_e &= \left(\frac{m_\text{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\text{emax}}^2}\right)\left(\frac{{e_\text{emax}}^2}{e}\right)\\ &= \frac{m_\text{e}\,c^2}{e},\end{aligned}$$

where $c = \lambda_C F_q$. Thus the established QMU conversion benchmark is

$$\boxed{\text{potn}\,\text{ccf}_e = \frac{m_\text{e}c^2}{e} \simeq 510\,998.95\,\text{V} = 510.99895\,\text{kV}.}$$

Equivalently, when expressed using the electron conversion factor,

$$\text{potn} = \frac{510.99895\,\text{kV}}{\text{ccf}_e}.$$

The electron rest energy is approximately 510.999 keV; dividing that energy by the elementary charge yields the corresponding potential difference of approximately 510.999 kV. The latter is a voltage, not an energy. This electron rest-energy-per-charge identity is the GRSEP benchmark established in the cited QADI metrology papers.

Scope of the result. The conversion formula is an algebraic identity of the QMU–SI translation ledger with a specified electron-sector charge normalization. Applying it to a particular apparatus requires its electrical boundary conditions and measurement conventions. A microscopic APM explanation of potential and its role in quantum electrical standards belongs in the corresponding specialized research publications.

Magnetic Flux `mflx`

Family grid Dependency index

QMU primitive representation:

$$\mathrm{mflx} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,F_q}{{e_\mathrm{emax}}^2}.$$

Catalog reciprocal:

$$\mathrm{mflx}\,\mathrm{cond} = 1.$$

This is an exact reciprocal identity of the QMU dimensional ledger.

Sweep and magnetism. Magnetic flux is the product of sweep and the universal mass-to-magnetic-charge ratio:

$$\mathrm{mflx} = \mathrm{swep} \cdot \mathrm{mchg}.$$

This relationship identifies magnetic flux as the sweep of magnetism within the QMU framework.

QMU–SI magnetic-flux translation. The electron charge conversion factor is

$$\mathrm{ccf}_e = \frac{{e_\mathrm{emax}}^2}{e}.$$

As developed in the QADI Charge Conversion Factor and QMU–SI Translation papers [14; 15], the QMU magnetic-flux unit maps to conventional magnetic flux by

$$\mathrm{mflx}\,\mathrm{ccf}_e = \frac{m_\mathrm{e}\,{\lambda_C}^2\,F_q}{e}.$$

Using the QMU identities

$$c = \lambda_C F_q, \qquad h = m_\mathrm{e}\,c\,\lambda_C,$$

this becomes

$$\boxed{\mathrm{mflx}\,\mathrm{ccf}_e = \frac{h}{e} = 2\phi_0},$$

where $\phi_0 = h/(2e)$ is the conventional superconducting flux quantum. Equivalently,

$$\boxed{\frac{\phi_0}{\mathrm{ccf}_e} = \frac{\mathrm{mflx}}{2}}.$$

These are alternative forms of the same QMU–SI conversion identity, not separate empirical adjustments. Within APM, the factor of one-half is interpreted through the proposed magnetic half-spin geometry. The algebraic conversion does not, by itself, establish that microscopic interpretation; the relevant geometry is addressed in the companion APM research.

Resistance and impedance. QMU assigns distinct dimensional expressions to magnetic flux, resistance, and impedance-related quantities. Their appearance in circuit equations must respect those dimensions and the applicable charge-conversion and constitutive relationships. In particular, magnetic flux and resistance should not be added directly as unlike quantities. The QMU–SI translation and Charge Conversion Factor papers provide the appropriate starting point for comparing the QMU description with conventional impedance equations [14; 15].

Inductance `indc`

QMU primitive representation: $\mathrm{indc} = \dfrac{m_\mathrm{e}\,{\lambda_C}^2}{{e_\mathrm{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{indc}\,\mathrm{aefp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$indc = \frac{m_\mathrm{e}{\lambda_C}^2}{{e_\mathrm{emax}}^2}$$

In the QMU catalog this quantity is assigned the inductance role. Numerical equivalence to SI henries requires the separately specified dimensional conversion; equality of names does not establish equality of unit magnitudes.

$\frac{indc}{leng} = 2perm$: The reciprocal of the curl gives the number of turns of the coil in units of twice the permeability ($perm$).

$indc = 2Nperm \cdot leng$: The inductance of a coil in QMU is the turns of $2perm$ times the length in $leng$ units.

The cause of the $2perm$ and $\frac{curl}{2}$ terms is due to the effect of the Aether interacting with physical matter of which neutrons compose half. Neutrons are electrons folded over on top of protons, which pinch two Aether units into the space of one neutron. This principle underlies the diffraction of light around massive bodies and the precession of the perigee of orbits around massive bodies.

Electric Field Strength `elfs`

QMU primitive representation: $\mathrm{elfs} = \dfrac{m_\mathrm{e}\,\lambda_C\,{F_q}^2}{{e_\mathrm{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{elfs}\,\mathrm{accp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Equal to potential per length and reciprocal of capacitance times length.

Dimensional Expression: $elfs = \frac{m_\mathrm{e} \cdot \lambda_C \cdot {F_q}^2}{{e_\mathrm{emax}}^2}$

Equations:

$elfs = \frac{potn}{leng}$: The electric field strength is the potential gradient measuring a specific potential at a specific distance.

$elfs = \frac{1}{capc \cdot leng}$: The electric field strength of a capacitor is reciprocal to the capacity of the plates and the thickness of the dielectric.

$elfs = \frac{forc}{chrg}$: The electric field is traditionally explained as force per charge.

$elfs = \frac{efld \cdot momt}{volm}$: Electric field strength relates to the electric field when the electric field has momentum per volume of effectiveness.

$elfs \cdot efld = resn \cdot temp$: When the electric field strength is applied to other electric fields, we get an insulation unit, which is equal to resistance times temperature.

Magnetic Rigidity `magr`

QMU primitive representation: $\mathrm{magr} = \dfrac{m_\mathrm{e}\,\lambda_C\,F_q}{{e_\mathrm{emax}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{magr}\,\mathrm{exdf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Material's resistance to deformation by a magnetic field. Measuring magnetic rigidity helps characterize materials for applications like MRI machines, particle accelerators, and fusion reactors where strong magnetic fields are present.

$magr = mfld \cdot bndr$: Related to magnetic field (mfld) and bending radius (bndr). It depends on how easily a magnetic field can penetrate a material's permeability. Lower permeability means higher magnetic rigidity. Materials like iron have high permeability and low magnetic rigidity. External fields pass through easily. Materials like bismuth have low permeability and high magnetic rigidity. External fields are resisted. Diamagnetic materials oppose and exclude external fields, giving very high magnetic rigidity. Rigidity also depends on molecular structure. More rigid atomic bonds increase resistance to magnetic deformation forces.

$magr = mfxd \cdot leng$: Magnetic rigidity is measured in units of magnetic flux density (magnetic field strength), like tesla-meters. A higher rigidity means a stronger field is required to cause the same deformation. It relates closely to magnetic susceptibility - how easily a material magnetizes. Higher rigidity gives lower susceptibility.

Permeability `perm`

QMU primitive representation:

$$\mathrm{perm} = \frac{m_\mathrm{e}\,\lambda_C}{{e_\mathrm{emax}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{perm}\,\mathrm{curl} = 1.$$

Physical interpretation. Permeability describes the ability of the Aether to accommodate and interact with distributed magnetic charge. Within the Aether Physics Model (APM), it character-

izes the geometrical response of Aether structure to magnetic excitation.

Unlike a purely phenomenological material coefficient, QMU Permeability is expressed directly through mass, length, and distributed magnetic charge:

$$\boxed{\text{perm} = \text{mchg} \cdot \text{leng} = \frac{1}{\text{curl}}.} \tag{52}$$

The first relationship connects permeability to the universal mass-to-magnetic-charge ratio. The second identifies permeability as the reciprocal of Aether curl, establishing its relationship to intrinsic winding geometry.

Permeability may be understood as the ability of Aether structure to engage passing magnetic charge. This interaction influences how magnetic excitation is accommodated and transmitted through a physical system.

Intrinsic winding and curl. In APM, curl represents an intrinsic geometrical property of the Aether rather than merely the number of turns in a manufactured solenoid.

Because

$$\text{perm} = \frac{1}{\text{curl}},$$

the winding geometry associated with Aether curl is already represented in permeability.

This intrinsic winding must be distinguished from additional turns introduced by an external electrical coil. The latter are properties of the apparatus and can modify its measured magnetic response without changing the fundamental QMU definition.

The corresponding canonical inductance relationship is

$$\boxed{\text{indc} = \text{perm} \cdot \text{leng}.} \tag{53}$$

This is a QMU unit relationship, not a complete constitutive equation for every physical inductor.

Neutron pinching and effective permeability. In APM, the neutron's electron–proton structure is associated with a pinching of the surrounding Aether geometry. This geometrical interaction introduces the complementary physical factors

$$\boxed{2\,\text{perm} \qquad \text{and} \qquad \frac{\text{curl}}{2}.} \tag{54}$$

These factors appear in the APM treatment of the Circular Deflection Angle and related matter–Aether interactions. They account for the geometrical modification attributed to neutron pinching rather than a change in the canonical QMU units.

Accordingly, the exact unit identity

$$\text{perm} \cdot \text{curl} = 1$$

remains unchanged, while the effective physical interaction may be represented through doubled permeability and halved curl where the neutron-pinching geometry applies.

This distinction is essential when applying QMU relationships to empirical measurements. A geometrical factor required by a physical interaction should not be mistaken for an additional factor in the unit definition.

Additional QMU relationships. Permeability also satisfies the dimensional relationships

$$\boxed{\text{perm} = \frac{\text{mflx}}{\text{velc}} = \text{drag} \cdot \text{mcdf}.} \tag{55}$$

The magnetic-flux relationship expresses permeability as magnetic flux per unit penetrating velocity, connecting magnetic response with motion through Aether geometry.

The drag relationship connects permeability with the corresponding mechanical interaction and magnetic-charge deflection quantity (see mcdf).

Together, these identities show how QMU permeability connects magnetic geometry, charge distribution, motion, and mechanical response without requiring the quantities to be independently defined in SI terms.

Relationship to magnetic permeance. QMU Magnetic Permeance is related to Permeability through

$$\boxed{\text{magp} = \frac{\text{perm} \cdot \text{area}}{\text{leng} \cdot \text{chrg}}.} \tag{56}$$

This expression provides a geometrical permeability–area–length relationship while preserving the distributed-charge dimension distinguishing Magnetic Permeance from Inductance.

The intrinsic winding contribution is already contained in perm. Any additional winding or neutron-pinching factor must therefore be associated with the physical configuration being analyzed rather than inserted into the primitive unit identity.

QMU–SI correspondence. Conventional SI permeability relates magnetic flux density to magnetic-field intensity through the material's constitutive response. For a uniform, linear magnetic path, it appears in the familiar permeance expression

$$\mathcal{P}_{\text{SI}} = \frac{\mu A}{\ell}.$$

The native QMU formulation describes permeability through distributed magnetic charge, mass, length, and intrinsic curl.

A quantitative comparison requires translating the complete SI relationships through the established QMU Charge Conversion Factor rules, including their applicable exceptions.

The comparison must also distinguish intrinsic Aether winding from external coil turns and account for neutron-pinching factors when required by the modeled interaction.

The conversion framework is developed in [14; 15].

Research significance. Permeability occupies an important position in the QMU dimensional ledger because it connects mass-to-charge ratio, magnetic flux, velocity, curl, drag, inductance, and magnetic permeance.

Its reciprocal relationship with curl provides a direct mathematical connection between magnetic response and intrinsic Aether geometry.

The APM neutron-pinching interpretation further distinguishes the fundamental unit relationship from the effective geometry encountered in physical measurements.

A systematic QMU–SI reduction could determine whether conventional permeability and magnetic circuit expressions simplify when represented through distributed charge and intrinsic Aether winding.

Further investigations may also examine whether the neutron-pinching geometry contributes to other measured magnetic properties, including magnetic moment, independently of or alongside the half-spin interpretation.

These investigations preserve the established QMU definitions while extending their physical applications and empirical tests.

Diverging Electric Field `dvef`

QMU primitive representation: $\mathrm{dvef} = \dfrac{m_{\mathrm{e}}\, {F_q}^2}{{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{dvef}\,\mathrm{cvef} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The diverging electric field has a unit of its own but in classical electromagnetism diverging electric field is strictly a mathematical operator. It equals the electric field strength per length and represents the electric field spreading out from a point source.

The equation $dvef = mchg \cdot rson$ suggests that the divergence of an electric field is proportional to the product of magnetism and resonance. In other words, the spreading out of an electric field is influenced by the inherent magnetic nature of matter (mchg) and the oscillatory behavior or repetition of a process (rson).

This relationship implies that the divergence of an electric field is not only determined by the electric charge distribution but also by the magnetic properties of matter and the resonant frequencies involved. It highlights the interconnectedness of electric and magnetic phenomena at the quantum level.

From a physical perspective, this relationship could manifest in situations where the presence of

magnetic materials or oscillating magnetic fields influences the behavior and distribution of electric fields. The resonant frequencies associated with these magnetic phenomena can contribute to the divergence or spreading out of the electric field.

It's important to note that this relationship is specific to the QMU system and may not have a direct analogue in classical electromagnetism. The QMU system provides a unique perspective on the fundamental relationships between electric and magnetic phenomena at the quantum scale.

The uniqueness of a quantum dvef:

It represents the smallest quantized "piece" of an electric field emanating from a point. This makes it very different from the continuous field concept in classical physics. A quantum of dvef would discretely alter permittivity in the aether in a localized region.

Magnetic Flux Density `mfxd`

QMU primitive representation:

$$\mathrm{mfxd} = \frac{m_\mathrm{e}\, F_q}{{e_\mathrm{emax}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mfxd}\,\mathrm{cden} = 1.$$

Physical interpretation. Magnetic flux density describes the distribution of magnetic flux relative to spatial extent. In the Aether Physics Model (APM), magnetic phenomena arise from the distributed magnetic-charge structure and dynamics of physical particles and the Aether.

The QMU magnetic flux density unit is constructed from mass, quantum frequency, and distributed magnetic charge. Its primitive representation is

$$\mathrm{mfxd} = \frac{m_\mathrm{e}\, F_q}{{e_\mathrm{emax}}^2}.$$

This expression shows that magnetic flux density contains a temporal frequency factor and the universal mass-to-magnetic-charge ratio.

Using the QMU magnetism unit,

$$\mathrm{mchg} = \frac{m_\mathrm{e}}{{e_\mathrm{emax}}^2},$$

we obtain

$$\boxed{\mathrm{mfxd} = \mathrm{mchg} \cdot F_q}.$$

Thus, magnetic flux density may also be expressed as magnetism multiplied by frequency.

Relationship to magnetic field and volume. The QMU magnetic field unit is

$$\mathrm{mfld} = \frac{m_\mathrm{e}\,{\lambda_C}^3\,F_q}{{e_\mathrm{emax}}^2}.$$

Since the QMU volume unit is

$$\mathrm{volm} = {\lambda_C}^3,$$

magnetic flux density is related to magnetic field through

$$\boxed{\mathrm{mfxd} = \frac{\mathrm{mfld}}{\mathrm{volm}}.}$$

In this relationship, magnetic flux density represents magnetic field per unit volume.

The distinction is important: QMU magnetic field and magnetic flux density are related quantities, but they do not possess identical dimensions.

Relationship to magnetic flux and area. The magnetic flux unit is defined as

$$\mathrm{mflx} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,F_q}{{e_\mathrm{emax}}^2}.$$

Dividing magnetic flux by the QMU area unit,

$$\mathrm{area} = {\lambda_C}^2,$$

gives

$$\boxed{\mathrm{mfxd} = \frac{\mathrm{mflx}}{\mathrm{area}}.}$$

The two expressions are dimensionally equivalent:

$$\boxed{\frac{\mathrm{mfld}}{\mathrm{volm}} = \frac{\mathrm{mflx}}{\mathrm{area}} = \mathrm{mfxd}.}$$

This equivalence demonstrates that magnetic flux density can be obtained either from magnetic field distributed through volume or from magnetic flux distributed across area.

It also follows that

$$\mathrm{mfld} = \mathrm{mfxd} \cdot \mathrm{volm}$$

and

$$\mathrm{mflx} = \mathrm{mfxd} \cdot \mathrm{area}.$$

These are exact identities of the QMU dimensional ledger.

Reciprocal relationship. The catalog reciprocal of magnetic flux density is conductance density:

$$\mathrm{cden} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\, F_q}.$$

Consequently,

$$\boxed{\mathrm{mfxd} \cdot \mathrm{cden} = 1.}$$

This reciprocal relationship connects magnetic flux density with the corresponding substrate quantity in the QMU dimensional grid.

The reciprocal identity is algebraically exact within QMU. Its physical application depends on the equations describing the particular system being investigated.

Measurement and research significance. Magnetic flux density is an important quantity for relating the magnetic properties of matter to the geometry and dynamics of the Aether.

Its QMU expression provides a common dimensional basis for investigating magnetic fields, magnetic flux, distributed charge, and the behavior of magnetic materials.

In conventional electromagnetic measurements, magnetic flux density is expressed in teslas. A quantitative comparison with QMU requires the appropriate QMU–SI charge-conversion rule and consistent definitions of the measured magnetic quantities.

The QADI Charge Conversion Factor and QMU–SI Translation papers provide the established conversion framework [14; 15].

An important research opportunity is to determine whether the QMU relationships among magnetic field, magnetic flux, spatial distribution, and distributed magnetic charge lead to experimentally distinguishable predictions.

Such investigations can use calibrated magnetic field measurements, magnetic materials, and controlled geometries to examine the proposed Aether response.

The QMU dimensional relationships establish the mathematical organization of these quantities. Their application to particular physical systems provides opportunities for further theoretical and experimental research.

Magnetism `mchg`

QMU primitive representation:

$$\text{mchg} = \frac{m_\text{e}}{{e_\text{emax}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{mchg}\,\text{expr} = 1.$$

Physical interpretation. Magnetism, denoted mchg, is the universal mass-to-magnetic-charge ratio in the Aether Physics Model (APM). It expresses the relationship between the mass of a subatomic particle and its intrinsic distributed magnetic charge.

Unlike conventional descriptions that associate magnetism primarily with magnetic fields, magnetic moments, and the motion or spin of electric charge, APM identifies distributed magnetic charge as an inherent physical property of the particle structure.

The magnetism unit quantifies the relationship between mass and distributed magnetic charge rather than the strength of a magnetic field or the magnetic moment of a particular particle.

Its defining expression is

$$\boxed{\text{mchg} = \frac{m_\text{e}}{{e_\text{emax}}^2}} \tag{57}$$

where m_e is the electron mass and ${e_\text{emax}}^2$ is the electron's distributed magnetic charge.

The expression ${e_\text{emax}}^2$ represents the complete distributed-charge quantity. The parameter e_{emax} is not a separately existing physical charge component.

Universal magnetism constant. A foundational postulate of APM is that the ratio of mass to distributed magnetic charge is invariant for stable subatomic particles.

For the electron, proton, neutron, and Aether unit,

$$\boxed{\text{mchg} = \frac{m_e}{{e_\text{emax}}^2} = \frac{m_p}{{e_\text{pmax}}^2} = \frac{m_n}{{e_\text{nmax}}^2} = \frac{m_a}{e_a^2}} \tag{58}$$

The subscripts identify the corresponding particle or Aether scale.

The mass of each particle may differ, but the ratio between its mass and distributed magnetic charge remains constant.

Consequently, the distributed magnetic charge associated with a particle of mass m_i is

$$\boxed{{e_{i\,\text{max}}}^2 = \frac{m_i}{\text{mchg}}} \tag{59}$$

It follows that

$$\frac{{e_{i\,\max}}^2}{{e_{j\,\max}}^2} = \frac{m_i}{m_j}. \tag{60}$$

Thus, particle mass and distributed magnetic charge are directly proportional within the APM construction.

The universality of mchg does not imply that different particles possess identical magnetic fields or magnetic moments.

Those observables also depend on particle geometry, charge distribution, temporal dynamics, and the geometrical relationships governing their interactions.

Relationship to the Unified Charge Equation. The Unified Charge Equation provides a fundamental relationship between electrostatic charge and distributed magnetic charge:

$$\boxed{e^2 = 8\pi\alpha\, {e_{\mathrm{emax}}}^2} \tag{61}$$

In APM, e^2 represents the electrostatic force carrier, ${e_{\mathrm{emax}}}^2$ represents the electron's distributed magnetic force carrier, and $8\pi\alpha$ expresses the corresponding weak interaction ratio.

The relationship contains no explicit mass term. Mass enters through the universal magnetism constant.

Substituting

$${e_{\mathrm{emax}}}^2 = \frac{m_e}{\mathrm{mchg}}$$

into the Unified Charge Equation gives

$$e^2 = 8\pi\alpha \frac{m_e}{\mathrm{mchg}}. \tag{62}$$

Therefore,

$$\boxed{\mathrm{mchg} = \frac{8\pi\alpha m_e}{e^2}} \tag{63}$$

This demonstrates that the magnetism constant can be expressed through the electron mass, electrostatic charge, and fine-structure constant within the APM charge relationships.

For a particle species i, define its corresponding charge ratio by

$$e^2 = 8\pi\alpha_i {e_{i\,\max}}^2. \tag{64}$$

Combining this definition with the universal magnetism constant yields

$$\boxed{m_i \alpha_i = \frac{\text{mchg}\, e^2}{8\pi}} \tag{65}$$

and hence

$$\boxed{\frac{\alpha_i}{\alpha} = \frac{m_e}{m_i}.} \tag{66}$$

The electrostatic force carrier remains constant, while the distributed magnetic charge and corresponding species charge ratio change with particle mass.

In this way, the Unified Charge Equation and the universal magnetism constant connect the electrostatic, magnetic, and mass sectors of the APM framework.

The APM interpretation of the weak interaction through this charge ratio is distinct from the conventional electroweak coupling formalism. Quantitative correspondence with measured weak-interaction processes is a subject for dedicated research.

Relationship to QMU magnetic quantities. The magnetism constant participates directly in several important QMU identities.

Magnetic flux density is

$$\boxed{\text{mfxd} = \text{mchg} \cdot F_q.} \tag{67}$$

Magnetic flux is

$$\boxed{\text{mflx} = \text{mchg} \cdot {\lambda_C}^2 F_q.} \tag{68}$$

Likewise, electric potential can be expressed as

$$\boxed{\text{potn} = \text{temp} \cdot \text{mchg}.} \tag{69}$$

Since

$$\text{temp} = {\lambda_C}^2 {F_q}^2 = c^2,$$

the potential identity becomes

$$\text{potn} = c^2 \cdot \text{mchg}. \tag{70}$$

These identities show how one universal mass-to-magnetic-charge ratio participates in quantities describing magnetic flux, magnetic flux density, and electric potential.

The quantities have different physical dimensions and functions even though they share the same magnetism constant.

Reciprocal relationship. The QMU reciprocal of magnetism is exposure:

$$\text{expr} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}}. \tag{71}$$

Consequently,

$$\boxed{\text{mchg} \cdot \text{expr} = 1.} \tag{72}$$

Magnetism expresses mass per distributed magnetic charge, while exposure expresses the reciprocal distributed magnetic charge per mass.

This is an exact reciprocal relationship in the QMU dimensional ledger.

Mass, magnetic charge, and geometry. The universal magnetism constant establishes the proportional relationship between particle mass and distributed magnetic charge.

It does not independently determine the geometrical structure of a particle.

In APM, particle species are distinguished by their charge distributions, spatial and temporal geometry, and interactions within the Aether.

Thus, two particles can share the same universal mass-to-magnetic-charge ratio while possessing different masses, magnetic moments, angular momenta, and interaction characteristics.

This distinction is particularly important when interpreting electron, proton, and neutron magnetic measurements.

Their differing magnetic moments need not imply different fundamental magnetism constants; the moments describe the behavior of their particular geometrical structures.

Metrological significance. The magnetism constant provides a common dimensional basis for comparing the mass and distributed magnetic charge assigned to different particle species.

Its universal form is a foundational APM relationship. Its empirical significance depends on independently evaluating the particle-specific relationships implied by the model.

The QMU–SI translation and charge-conversion rules are developed in the companion QADI metrology publications [14; 15].

Those conversion rules are necessary when comparing native QMU charge quantities with electrical measurements expressed in SI units.

Research significance. The magnetism constant suggests several opportunities for further investigation.

One is to determine whether particle-specific magnetic moments can be derived from distributed-charge geometry while maintaining the universal mass-to-magnetic-charge ratio.

Another is to investigate the relationships between mass, magnetic charge, electrostatic charge, and the weak interaction through independent experimental observables.

The universal magnetism constant also provides a conceptual connection between matter and the Aether scale through

$$\text{mchg} = \frac{m_a}{e_a^2}.$$

Within APM, this relationship connects the primordial Aether mass scale to the same mass-to-magnetic-charge structure used for stable subatomic particles.

These investigations provide opportunities for testing the physical implications of the APM charge and mass relationships without requiring the QMU unit catalog to contain every associated derivation.

Substrate units

Magnetic Field Exposure `mfde`

QMU primitive representation: $\text{mfde} = \dfrac{{e_{\text{emax}}}^2}{m_\text{e}\,{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{mfde}\,\text{mvlm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Quantifies the exposure to magnetic field effects within a volume.

$mfde = \frac{vlmw}{mfxd}$: Related to magnetic flux density (mfxd) and volumetric wave (vlmw). Volumetric wave (vlmw) represents frequency per volume. Magnetic flux density (mfxd) quantifies magnetic flux per area. So, mfde is magnetic field effects per volume normalized by flux density. It indicates how concentrated or intense the field effects are in a region. mfde provides insight into field exposure levels and concentration distribution. It is helpful in evaluating magnetic field bioeffects and health impacts. In summary, the mfde unit in QMU represents magnetic field exposure - the intensity and concentration of magnetic field effects within a quantum volume, normalized by the flux density.

Magnetic Flux Intensity Ratio `mfir`

QMU primitive representation: $\text{mfir} = \dfrac{{e_{\text{emax}}}^2}{m_\text{e}\,{\lambda_C}^3\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\text{mfir}\,\text{mfld} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents the ratio of magnetic field intensity to energy density.

$mfir = \frac{mfdi}{enrg}$: Magnetic field intensity (mfdi) quantifies the work a magnetic field can do. Energy density relates to the concentration and strength of energy in a region. So, mfir describes how intensely concentrated or dense a magnetic field is relative to the available energy. It measures the strength or flux of magnetism normalized by the energy. A higher mfir means the magnetic field

has a greater intensity for a given amount of energy. mfir is useful for characterizing and comparing the concentration of different magnetic field configurations. In summary, the mfir unit in QMU represents the magnetic flux intensity ratio - a quantized measure of magnetic field strength relative to energy density. It provides insight into field intensity and concentration effects.

Permittivity `ptty`

QMU primitive representation:

$$\text{ptty} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^3\,{F_q}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{ptty}\,\text{rmfd} = 1.$$

Physical interpretation. Permittivity is a property of the Aether substrate in the Aether Physics Model (APM). Whereas a measurement of an electric field describes an observable interaction, QMU permittivity describes a structural capacity of the Aether associated with distributed charge and its geometrical response. This distinction is especially important when interpreting the ability of space to accommodate charged particles and to participate in electrostatic interactions.

The QMU permittivity unit is not defined merely by analogy with an ordinary capacitor. It is constructed from the Aether's magnetic-charge capacity, mass scale, spatial volume, and resonance:

$$\boxed{\text{ptty} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^3\,{F_q}^2}} \tag{73}$$

The factor ${\lambda_C}^3$ expresses the spatial volume associated with the reference Aether geometry, while ${F_q}^2$ is the QMU resonance unit. Resonance is a frequency-squared quantity, not an oscillation frequency. Together they form the volume–resonance structure of the denominator. The mass-to-distributed-charge ratio supplies the remaining physical dimension.

Using the canonical QMU quantities

$$\text{volm} = {\lambda_C}^3, \qquad \text{rson} = {F_q}^2, \qquad \text{mchg} = \frac{m_{\text{e}}}{{e_{\text{emax}}}^2},$$

permittivity can be written as

$$\boxed{\text{ptty} = \frac{1}{\text{mchg}\,\text{volm}\,\text{rson}}} \tag{74}$$

This is an identity of the QMU dimensional ledger. It makes explicit that permittivity expresses the reciprocal of magnetism acting through a volume–resonance structure. It does not, by itself, constitute a constitutive law for a particular dielectric material.

Reciprocity with the Aether unit. The rotating magnetic field unit is

$$\text{rmfd} = \frac{m_\text{e}\,{\lambda_C}^3\,{F_q}^2}{{e_\text{emax}}^2}.$$

Within the canonical QMU ledger, this is also the primitive dimensional expression for the Aether unit A_u. Consequently,

$$\boxed{\text{ptty} = \frac{1}{\text{rmfd}} = \frac{1}{A_u}} \tag{75}$$

The reciprocal identity is significant because it places permittivity on the substrate side of the same dimensional relationship that defines the rotating magnetic-field structure of the Aether. The Aether unit represents the active geometrical construction; its reciprocal expresses a complementary substrate capacity. Neither quantity should be replaced by a dimensionless number merely because its numerical value can be expressed through a chosen system of units.

Relation to bending radius and field strength. The QMU grid also identifies the relationship

$$\boxed{\text{ptty} = \frac{\text{bndr}}{\text{elfs}}} \tag{76}$$

This expresses permittivity as a ratio of the named QMU bending-radius and electric-field-strength quantities. It associates the substrate's geometrical response with the field-strength measure. The physical meaning of this relationship should be read with the respective definitions of bndr and elfs; it does not imply that permittivity is itself a length or an electric field.

Aether capacity and particle occupation. In the APM geometrical interpretation, the Aether unit has an intrinsic volume–resonance structure associated with its double-cardioid manifestation. The model identifies polarity-specific regions in which matter and distributed charge may participate in different forms of occupation and interaction. Permittivity characterizes a capacity of this substrate rather than the amount of charge actually present at a particular location.

A cavity's capacity to accommodate magnetic charge must be distinguished from its instantaneous occupation by a particle. The former belongs to the Aether's structure; the latter depends on particle species, charge distribution, geometry, and the conditions of interaction. Thus the existence of a nonzero Aether permittivity does not imply that every possible occupation state is populated.

This interpretation also separates intrinsic Aether permittivity from an effective dielectric response of matter. A measured material permittivity can depend on polarization, composition, excitation, and frequency; those dependencies require a material-response equation in addition to the native QMU substrate unit.

Comparison with SI permittivity. Permittivity is one of the explicitly identified exceptions to the ordinary QMU charge-conversion-factor prescription. **No electron charge conversion factor** ccf_e **is applied to** ptty**.** The QMU permittivity and SI vacuum permittivity have different numerical representations because the unit systems and geometrical normalizations are not identical. The absence of a CCF multiplier does not require their reported numerical values to be equal.

The QADI reference convention records the comparison

$$\boxed{\text{ptty} \longleftrightarrow \frac{\varepsilon_0}{4\pi}} \tag{77}$$

Here the arrow denotes the stated QMU–SI reference correspondence, not an instruction to multiply permittivity by ccf_e. The 4π factor is a geometrical normalization associated with the chosen field and charge conventions. Numerical comparison must specify the reference units and the meaning of the reported constants; native QMU and SI dimensional expressions should not be equated without that context.

The charge-conversion exceptions and the applicable translation conventions are discussed in the QADI Charge Conversion Factor and QMU–SI Translation papers [14; 15]. These papers should be consulted rather than applying a generic CCF rule to an explicitly exempt quantity.

Research significance. The QMU permittivity definition connects a measurable electrical response to the proposed spatial and temporal structure of the Aether. It also provides a defined starting point for investigating whether the Aether's volume–resonance geometry produces distinctive relationships among electric-field strength, charge occupation, dielectric response, and propagation.

The dimensional identities above are fixed by the QMU ledger. Any new physical response law or discriminating prediction must be developed and evaluated separately, with explicit boundary conditions and measurable observables. This permits the unit catalog to identify research opportunities without substituting an untested mechanism for an established dimensional definition.

Aether Fluctuation Potential `aefp`

QMU primitive representation: $\text{aefp} = \dfrac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{aefp}\,\text{indc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents the inherent capacity of the quantum Aether to produce virtual excitations and fluctuations.

$aefp = \frac{rson}{potn}$: Significantly, aefp is the inverse of inductance (indc). While inductance involves the manipulation of the Aether by physical matter, aefp reflects the latent fluctuation potential of the Aether itself, unprompted by matter. The aefp unit encapsulates the inherent ability of the quantum aether to induce resonant frequencies, accelerations, and other phenomena without external stimulation. It represents the underlying quantum jitter, fluctuations, and stochastic incitation arising intrinsically from the Aether. Through relationships like $aefp = \frac{rson}{potn}$, the unit reveals the Aether's capacity to produce excitations probabilistically based on its permeability and permittivity - analogous to the way virtual particles spontaneously arise from the quantum vacuum. Specific contexts where aefp may manifest include particle decays, symmetry breaking, mass acquisition, and the Lamb shift. The unit likely relates to the cosmologic constant and issues of vacuum energy density. By quantifying the Aether's latent potential for excitation without cause, the Aether Fluctuation Potential unit provides deeper insight into the quantum virtual processes that the Aether can spontaneously produce independent of matter, energy, or information.

Conductance `cond`

QMU primitive representation:

$$\text{cond} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^2\,F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{cond}\,\text{mflx} = 1.$$

Physical interpretation. In QMU, conductance relates distributed magnetic charge to angular momentum. Since the QMU angular momentum unit is

$$\text{angm} = m_{\text{e}}\,{\lambda_C}^2\,F_q = h,$$

the defining relationship becomes

$$\boxed{\text{chrg} = \text{cond}\cdot\text{angm}}, \qquad \boxed{\text{cond} = \frac{{e_{\text{emax}}}^2}{h}}.$$

Conductance is therefore distributed magnetic charge per unit of angular momentum. In the QMU catalog its reciprocal is magnetic flux, not resistance:

$$\boxed{\text{cond} = \frac{1}{\text{mflx}}}.$$

The additional identity

$$\text{cond} = \frac{\text{sclw}}{\text{elfs}}$$

relates conductance to scalar wave and electric field strength.

Biological mechanics. Conductance is at the interface between material processes and the Aether. BioAetherdynamics proposes conductance as a foundational unit for biological electrical activity, with capacitance and frequency participating in cellular charge transport.

Three QMU identities summarize the proposed relationships:

$$\text{cond}\cdot\text{enrg} = \text{curr}, \tag{78}$$

$$\text{capc}\cdot\text{freq} = \text{cond}, \tag{79}$$

$$\text{ligt}\cdot\text{cond} = \text{accl}\cdot\text{chrg}. \tag{80}$$

The first connects conductance and energy to current; the second connects capacitance and frequency to conductance; and the third relates light and conductance to accelerating charge. These identities are dimensionally exact in the QMU ledger. Their application to cell membranes, ion transport, metabolism, or light-responsive tissues requires specific response equations and experimental measurements.

BioAetherdynamics also proposes that conductance links material experience with awareness. This is an APM interpretation distinct from established electrophysiological measurements and remains an opportunity for testable research.

Metrology and research. QMU and SI conductance employ different charge conventions. Conductance belongs to the special conversion cases treated in the QADI Charge Conversion Factor and QMU–SI Translation papers [14; 15]. A useful experimental direction is to compare membrane conductance, capacitance, and current under controlled stimuli with independently derived QMU response predictions.

Capacitance `capc`

QMU primitive representation: $\mathrm{capc} = \dfrac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,{\lambda_C}^2\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{capc}\,\mathrm{potn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Physical interpretation:

Represents the fundamental ability of space to store and contain charge

Quantifies the inherent capacity of the Aether to accommodate electric charge

Describes a substrate property of space itself rather than an active field phenomenon

$capc = \frac{chrg}{enrg}$: Capacitance represents charge stored as energy

$capc = \frac{1}{potn}$: Capacitance is reciprocal to potential in QMU

$capc = \frac{1}{indc \cdot rson}$: The reciprocal of inductance times resonance gives the internal capacity of the inductor

$capc = \frac{chrg}{pres \cdot volm}$: Capacitance equals charge divided by the product of pressure and volume

The last relationship, $capc = \frac{chrg}{pres \cdot volm}$, is particularly significant as it reveals capacitance as a fundamental property of space itself. This equation shows that capacitance represents how much charge can be contained within a given volume under a certain pressure. In other words, it quantifies the Aether's intrinsic ability to store charge.

This perspective differs fundamentally from the conventional view of capacitance as simply a property of capacitors or dielectric materials. In the QMU system, capacitance emerges as a basic characteristic of space - the ability of the Aether to contain and store charge. This explains why even a vacuum has a non-zero capacitance.

Some key implications of this understanding include:

Capacitance is primarily a property of space (the Aether) rather than of matter

The amount of charge that can be stored depends on both the volume of space and the pressure within it

Dielectric materials work by modifying the local properties of the Aether, rather than by providing capacitance directly

This interpretation aligns with experimental observations while providing a clearer physical picture of what capacitance actually represents at the most fundamental level. It helps explain phenomena like vacuum capacitance and provides a foundation for understanding how dielectric materials

enhance capacitive effects through their interaction with the Aether substrate.

In practical applications, this understanding of capacitance as a spatial property could lead to new approaches for designing capacitive devices and systems. Rather than focusing solely on dielectric materials, engineers might explore ways to optimize the spatial configuration and pressure distribution to achieve desired capacitive effects.

The reciprocal relationship between capacitance and potential ($capc = \frac{1}{potn}$) takes on new meaning in this context - it suggests that the ability of space to store charge is inversely related to the electrical stress (potential) placed upon it. This provides insight into the fundamental limits of charge storage and the behavior of capacitive systems under varying conditions.

Curl `curl`

QMU primitive representation:

$$\mathrm{curl} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,\lambda_C}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{curl}\,\mathrm{perm} = 1.$$

Physical interpretation. Curl describes the intrinsic rotational and torsional geometry of the Aether. Within the Aether Physics Model (APM), it represents the geometrical circulation associated with distributed magnetic charge and the fundamental structure of space.

The QMU expression relates distributed magnetic charge to mass and length:

$$\boxed{\mathrm{curl} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,\lambda_C} = \frac{1}{\mathrm{perm}}.} \tag{81}$$

Curl is the reciprocal of Permeability (perm). This relationship connects the intrinsic winding geometry of the Aether with its capacity to accommodate magnetic excitation.

Unlike the conventional differential curl operator acting on a vector field, the QMU unit curl is a physical dimensional quantity. Its definition must be distinguished from any particular spatial curl calculation.

Fundamental Aether closure. Curl participates in the fundamental Aether closure relationship

$$\boxed{A_u\,\mathrm{curl} = {\lambda_C}^2 {F_q}^2 = c^2 = \mathrm{temp}.} \tag{82}$$

This relationship, known as Ledger One, connects the unified Aether unit area, intrinsic curl, and the velocity-squared quantity temp.

The Aether unit area has physical dimensions in QMU; its geometrical closure coefficient is numerically associated with $16\pi^2$.

This equation establishes an intrinsic relationship between Aether geometry and the propagation scale of light.

Circular Deflection Angle. Curl also appears in the APM formulation of the Einstein Circular Deflection Angle. The conventional expression for the limiting weak-field deflection at radius r is

$$\theta = \frac{4GM}{c^2 r}. \tag{83}$$

For the Sun, using the solar radius as the impact parameter, this gives approximately

$$\theta_\odot = 8.493 \times 10^{-6} \quad \text{radians.}$$

The original QMU formulation expresses the corresponding circular-deflection relationship as

$$\boxed{G\frac{2M}{r} = \theta\,\frac{\text{curl}}{2}\,A_u.} \tag{84}$$

Using Ledger One,

$$A_u\,\text{curl} = c^2,$$

the QMU expression reduces algebraically to

$$G\frac{2M}{r} = \theta\,\frac{c^2}{2},$$

and therefore

$$\boxed{\theta = \frac{4GM}{c^2 r}.} \tag{85}$$

The numerical angular measure is expressed in radians. In the APM dimensional interpretation, the angular normalization is associated with half the Aether curl:

$$\boxed{1\,\text{rad} \longleftrightarrow \frac{\text{curl}}{2}.} \tag{86}$$

This correspondence distinguishes the physical angular normalization from the dimensionless numerical value conventionally assigned to an angle in SI.

The half-curl factor provides the geometrical element used by APM to express circular deflection through the Aether unit area.

Neutron pinching and effective curl. The APM neutron-pinching description attributes a geometrical modification of Aether structure to the bound electron–proton configuration of a neutron.

In this interpretation, the interaction between matter and Aether introduces the complementary physical factors

$$\boxed{\frac{\text{curl}}{2} \qquad \text{and} \qquad 2\,\text{perm.}} \tag{87}$$

These quantities retain the reciprocal relationship

$$\left(\frac{\text{curl}}{2}\right)(2\,\text{perm}) = 1.$$

The factor of one-half is thus associated with the effective curl participating in the modeled interaction, while the corresponding permeability response is doubled.

The APM associates these geometrical factors with the Circular Deflection Angle and related matter–Aether effects.

They do not redefine the canonical QMU units:

$$\text{curl}\,\text{perm} = 1.$$

Rather, they distinguish the underlying unit relationships from the effective geometry governing a physical interaction.

Relationships within the QMU ledger. Curl connects numerous electromagnetic, mechanical, and geometrical quantities. The dimensional identities include

$$\text{mfld} \cdot \text{curl} = \text{swep}, \tag{88}$$
$$\text{mvlm} \cdot \text{curl} = \text{area}, \tag{89}$$
$$\text{potn} \cdot \text{curl} = \text{accl}, \tag{90}$$
$$\text{mflx} \cdot \text{curl} = \text{velc}, \tag{91}$$
$$\text{indc} \cdot \text{curl} = \text{leng}, \tag{92}$$
$$\text{elfs} \cdot \text{curl} = \text{rson}, \tag{93}$$
$$\text{magr} \cdot \text{curl} = \text{freq}, \tag{94}$$
$$\text{perm} \cdot \text{curl} = 1, \tag{95}$$
$$\text{ints} \cdot \text{curl} = \text{mfdi}, \tag{96}$$
$$\text{forc} \cdot \text{curl} = \text{chrs}, \tag{97}$$
$$\text{momt} \cdot \text{curl} = \text{curr}. \tag{98}$$

These relationships show that curl is a central dimensional connector between the rotational geometry of the Aether and its electromagnetic and mechanical expressions.

For example,

$$\text{mflx} \cdot \text{curl} = \text{velc}$$

relates magnetic flux to velocity through the intrinsic curl dimension, while

$$\text{indc} \cdot \text{curl} = \text{leng}$$

connects inductance with spatial extent.

Similarly,

$$\text{potn} \cdot \text{curl} = \text{accl}$$

relates electrical potential to acceleration, and

$$\text{momt} \cdot \text{curl} = \text{curr}$$

connects momentum with electric current.

The resonance identity

$$\text{elfs} \cdot \text{curl} = \text{rson}$$

uses the QMU resonance quantity, $\text{rson} = {F_q}^2$, rather than a conventional resonant frequency.

These are exact relationships within the QMU dimensional ledger. Their application to measured physical systems additionally depends on the relevant interaction geometry and constitutive relationships.

QMU–SI correspondence. Conventional electromagnetic theory uses curl as a differential operator describing local field circulation. QMU additionally assigns curl an intrinsic physical dimension associated with distributed magnetic charge.

This difference is particularly important when interpreting magnetic permeability, inductance, and angular deflection.

The Circular Deflection Angle demonstrates how the APM uses its dimensional curl quantity to represent an angular normalization conventionally reported in radians.

Quantitative comparisons must distinguish this APM angular interpretation from ordinary SI angle conventions and must preserve the relevant geometric factors.

Where electrical or magnetic quantities are translated between SI and QMU, the established Charge Conversion Factor rules and their exceptions also apply.

The conversion framework is developed in [14; 15].

Research significance. Curl is a foundational QMU quantity linking intrinsic Aether geometry, permeability, magnetic flux, inductance, electromagnetic response, and circular deflection.

Its participation in Ledger One establishes the connection between the unified Aether area and the velocity-squared quantity temp.

Its appearance as half-curl in the Circular Deflection Angle provides a further physical interpretation of Aether geometry within the APM neutron-pinching framework.

An important research direction is to investigate whether the same geometrical mechanism contributes to magnetic-moment measurements, including factors previously attributed to magnetic half-spin.

Comparing the neutron-pinching and half-spin mechanisms may help distinguish intrinsic particle geometry from matter–Aether interaction effects.

The QMU unit identities remain invariant, while their physical applications must retain the geometrical factors appropriate to the phenomena under investigation.

Exposure Diffusion Flux `exdf`

QMU primitive representation: $\mathrm{exdf} = \dfrac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,\lambda_C\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{exdf}\,\mathrm{magr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$exdf = \frac{magm}{phtn} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}F_q}$$

Represents the diffusion and transmission of magnetism and charge as magnetic moment through the Aether via photons.

$exdf = \frac{magm}{phtn}$: Exposure Diffusion Flux relates the exposure of the electron's intrinsic magnetism and charge to its diffusion through the quantum Aether at the velocity scale. The unit encapsulates the innate conductivity and permeability of the Aether medium to electron magnetism. While the exposure ($expr$) unit quantifies the basic interaction of exposure to magnetism, exdf describes the flux movement of exposure through the Aether. It represents the diffusion flux velocity of inherent electron properties. Physically, Exposure Diffusion Flux manifests as the natural dispersion of electron magnetism through the quantum vacuum. This diffusion gives rise to electromagnetic propagation effects. Exdf elegantly links the electron's intrinsic properties to the transmission effects enabled by the quantum Aether substrate.

Acceptance `accp`

QMU primitive representation: $\mathrm{accp} = \dfrac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,\lambda_C\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{accp}\,\mathrm{elfs} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents the inherent attractive force between matter and Aether.

Dimensional expression

$$accp = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\lambda_C {F_q}^2}$$

Equations:

Acceptance is the inverse of the $elfs$ (electric field strength) unit. Where $elfs$ represents repulsive forces, Acceptance signifies the complementary attraction and incorporation between matter and Aether. A potential experiment where the acceptance (*accp*) unit could provide insights or be involved is the measurement of the Casimir effect between surfaces - *accp* relates to the attractive force between matter and aether. The Casimir effect depends on quantum vacuum fluctuations.

$$accp = \frac{chrg}{forc}$$

Other tests for *accp*:

Tests of short-range gravity-like forces - *accp* quantifies an inherent attractive force, so it could manifest anomalies like the hypothesized fifth force at small scales. Observing particle entanglement - *accp* describes innate coherence, which could help explain entanglement between particles with shared history. Investigating the Lamb shift of spectral lines - *accp* relates to how charge interacts with the Aether, relevant to quantum corrections to orbitals. Quantifying van der Waals and London dispersion forces - These weak intermolecular forces arise due to correlated charge fluctuations, which *accp* could model. Measuring differences in vacuum permittivity - Since *accp* relates to field effects, it could quantify variances in the permittivity of space itself. Probing Aether drag effects - *accp* may modulate phenomena like frame dragging, since it represents Aether-matter coupling. Testing gravitational anomalies and moduli - *accp* could emerge in unexplained gravity-like phenomena sensitive to the Aether. Astronomical observations of dark matter - Dark matter effects could modulate Aether acceptance effects. The Acceptance unit provides unique insight into the cohesion and interrelationship between matter and the quantum Aether at the most fundamental scale. It represents the latent attraction and openness that balances repulsion effects like electric field strength.

Exposure `expr`

QMU primitive representation: $\mathrm{expr} = \dfrac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{expr}\,\mathrm{mchg} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Quantifies the amount of magnetic charge interacting with mass.

Dimensional Expression: $expr = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}}$

$expr = \frac{1}{mchg}$: Whereas mchg represents the mass-to-magnetic charge ratio of magnetism, the reciprocal of magnetic charge-to-mass ratio quantifies the effect of magnetism on physical matter.

Conductance Density `cden`

QMU primitive representation:

$$\mathrm{cden} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{cden}\,\mathrm{mfxd} = 1.$$

Physical interpretation. Conductance density is a QMU substrate quantity expressing distributed magnetic charge relative to mass and frequency. It belongs to the reciprocal family of magnetic flux density and describes a different aspect of the relationship between magnetic charge and its temporal dynamics.

Its dimensional definition is

$$\boxed{\mathrm{cden} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,F_q} = \frac{\mathrm{expr}}{\mathrm{freq}} = \frac{1}{\mathrm{mfxd}}} \tag{99}$$

where exposure is the reciprocal of the universal magnetism constant:

$$\mathrm{expr} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}}.$$

Since frequency has the dimensions of inverse time, conductance density can also be understood as exposure multiplied by time:

$$\boxed{\mathrm{cden} = \mathrm{expr} \cdot \mathrm{time}.}$$

This relationship emphasizes the temporal dimension of the quantity. Conductance density is not simply conductance distributed over a geometrical area or volume.

Relationship to conductance. The QMU conductance unit is

$$\mathrm{cond} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}.$$

Consequently,

$$\boxed{\mathrm{cden} = \mathrm{cond} \cdot {\lambda_C}^2.}$$

Thus, conductance density is related to conductance through the QMU area unit. The name does not imply the conventional operation of dividing conductance by area; its physical meaning follows from the QMU dimensional construction.

Reciprocal magnetic relationship. Magnetic flux density is defined by

$$\mathrm{mfxd} = \frac{m_{\mathrm{e}}\,F_q}{{e_{\mathrm{emax}}}^2} = \mathrm{mchg} \cdot \mathrm{freq}.$$

Therefore,

$$\boxed{\mathrm{cden} \cdot \mathrm{mfxd} = 1.}$$

This reciprocal pairing relates the magnetic mass-to-charge response to the corresponding substrate quantity. It is an exact dimensional identity within the QMU system.

Distinction from current density. Conductance density must not be confused with current density, which is defined in QMU as

$$\mathrm{cdns} = \mathrm{efxd} \cdot \mathrm{freq} = \frac{{e_{\mathrm{emax}}}^2\,F_q}{{\lambda_C}^2}.$$

Current density contains frequency in the numerator and area in the denominator. Conductance density contains inverse frequency and no spatial dimension.

They therefore describe distinct quantities and cannot be substituted for one another.

Research significance. The reciprocal relationship between conductance density and magnetic flux density offers a potential framework for investigating how distributed magnetic charge participates in material and biological electrical responses.

In biological systems, conductance and charge transport are measurable through membrane currents, voltage responses, and frequency-dependent electrical measurements.

A QMU application would require a constitutive equation relating conductance density to those observables. Establishing that connection is a research opportunity rather than a consequence of dimensional reciprocity alone.

Converging Electric Field `cvef`

QMU primitive representation: $\mathrm{cvef} = \dfrac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{cvef}\,\mathrm{dvef} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents the tendency of the quantum Aether to draw energy, fields, and matter toward a central point.

Dimensional Expression: $cvef = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}} \cdot {F_q}^2}$

Equations:

$cvef = \frac{volm}{A_u}$: This structure gives cvef the proper dimensions to represent the inverse effect of the spreading, diverging electric field unit ($dvef$). While dvef relates to electric fields emanating from a point source outward in all directions, cvef signifies the complementary process of convergence and cohesion back toward a center. Physically, cvef may manifest as the innate force drawing volumetric quanta of fields toward their source, a type of binding or confinement potential limiting outward divergence, and a contraction and coherence related to particle-antiparticle annihilation. The Converging Electric Field unit provides unique insight into the innate focusing, collecting behaviors of the quantum Aether that balance its divergence tendencies. $cvef$ represents the Aether's inherent receptiveness and return.

Magnetic Field Resistance and Flow

Dynamic units

Friction `fric`

QMU primitive representation:

$$\mathrm{fric} = \frac{m_{\mathrm{e}}\,{\lambda_C}^3\,{F_q}^2}{{e_{\mathrm{emax}}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{fric}\,\mathrm{emro} = 1.$$

Physical interpretation. Friction describes opposition to relative motion between interacting physical structures. In conventional mechanics, friction is commonly associated with contacting surfaces, deformation, adhesion, and the dissipation of mechanical energy.

The Aether Physics Model (APM) provides an additional dimensional perspective by relating friction to magnetic charge, electrical potential, resistance, and the dynamics of physical matter.

The QMU friction unit is defined as

$$\boxed{\text{fric} = \frac{m_{\text{e}}\,{\lambda_C}^3\,{F_q}^2}{{e_{\text{emax}}}^4}} \tag{100}$$

Its denominator contains the square of the distributed magnetic-charge unit. This distinguishes friction from QMU quantities involving only one factor of distributed magnetic charge.

The following relationships demonstrate how friction connects with other QMU unit families.

Resistance and velocity.

$$\boxed{\text{fric} = \text{resn} \cdot \text{velc}} \tag{101}$$

Friction is the product of QMU resistance and velocity. This relationship connects opposition to motion with the rate of spatial displacement.

It provides a dimensional bridge between resistance and motion, although the actual frictional response of a physical system depends on its material properties and interaction laws.

Potential and charge gradient.

$$\boxed{\text{fric} = \frac{\text{potn}}{\text{elcg}}} \tag{102}$$

This expression relates friction to electric potential divided by the QMU electric charge gradient.

It suggests a possible connection between mechanical opposition and the spatial organization of distributed charge.

The identity does not require friction to arise exclusively from electrostatic interactions; rather, it identifies compatible dimensional relationships within the QMU framework.

Inductance and charge acceleration.

$$\boxed{\text{fric} = \text{indc} \cdot \text{chga}} \tag{103}$$

This relationship expresses friction through inductance and acceleration per charge.

Within APM, it provides a basis for investigating whether accelerated distributed-charge structures contribute to resistance during material motion.

Determining the magnitude of such a contribution requires a specific physical interaction model.

Magnetic flux and charge velocity.

$$\boxed{\text{fric} = \text{mflx} \cdot \text{chgv}} \tag{104}$$

Friction can also be represented as magnetic flux multiplied by velocity per charge.

This connects the spatial and temporal behavior of magnetic flux with the motion of distributed charge.

The relationship may be useful when examining magnetically influenced contact forces, electromechanical motion, and material interfaces.

Magnetic field and magnetic current.

$$\boxed{\text{fric} = \text{mfld} \cdot \text{mcur}} \tag{105}$$

This identity expresses friction as the product of the QMU magnetic field and magnetic current.

It provides another dimensional route connecting mechanical opposition with magnetic dynamics.

In the APM interpretation, magnetic interactions may contribute to the behavior of moving physical structures. Whether this relationship predicts a measurable frictional effect depends on the geometry and constitutive properties of the system.

Reciprocal relationship. The catalog reciprocal of friction is the electromagnetic ratio, denoted emro:

$$\text{emro} = \frac{{e_{\text{emax}}}^4}{m_{\text{e}} \, {\lambda_C}^3 \, {F_q}^2}.$$

Consequently,

$$\boxed{\text{fric} \cdot \text{emro} = 1.} \tag{106}$$

This is an exact reciprocal identity within the QMU dimensional ledger.

Research significance. The QMU friction relationships provide several ways to investigate mechanical opposition through electrical and magnetic measurements.

Possible applications include material interfaces, magnetic bearings, electromechanical systems, and controlled measurements of friction under varying electromagnetic conditions.

A useful experiment would compare changes in measured friction with independently controlled magnetic or electrical conditions, separating ordinary thermal, mechanical, and material effects from any additional APM prediction.

The QMU identities establish the dimensional connections. Deriving a quantitative friction law and testing its predictions are opportunities for separate research.

Magnetic Flow Impedance `mgfi`

QMU primitive representation:

$$\mathrm{mgfi} = \frac{m_\mathrm{e}\,{\lambda_C}^3\,F_q}{{e_\mathrm{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mgfi}\,\mathrm{emic} = 1.$$

Physical interpretation. Magnetic Flow Impedance describes the opposition encountered by changing magnetic flux within the quantum Aether. In the Aether Physics Model (APM), the Aether is an active physical substrate whose structure participates in the propagation and interaction of magnetic fields.

The QMU unit is defined by

$$\boxed{\mathrm{mgfi} = \frac{m_\mathrm{e}\,{\lambda_C}^3\,F_q}{{e_\mathrm{emax}}^4}} \tag{107}$$

Its dimensional construction includes mass, cubic length, frequency, and two factors of distributed magnetic charge.

This distinguishes Magnetic Flow Impedance from ordinary resistance and from the magnetic field unit itself.

Relationship to magnetic field. One of the defining QMU relationships is

$$\boxed{\mathrm{mgfi} \cdot \mathrm{chrg} = \mathrm{mfld}.} \tag{108}$$

The equation identifies magnetic field as the product of Magnetic Flow Impedance and distributed magnetic charge.

In the APM interpretation, this relationship describes how the presence and movement of magnetic charge interact with the Aether's opposition to magnetic flow.

A useful analogy is friction between contacting surfaces. Ordinary friction describes opposition associated with relative motion, whereas Magnetic Flow Impedance concerns the response of the Aether through which magnetic charge and flux interact.

The analogy does not require the Aether to behave as an ordinary dissipative material. Whether a particular magnetic interaction transfers, stores, or dissipates energy depends on the physical system and its governing equations.

Relationship to friction and frequency. The QMU friction unit is

$$\text{fric} = \frac{m_\text{e}\,{\lambda_C}^3\,{F_q}^2}{{e_\text{emax}}^4}.$$

Comparing the two definitions gives

$$\boxed{\text{fric} = \text{mgfi} \cdot \text{freq}.} \tag{109}$$

Thus Magnetic Flow Impedance differs from QMU friction by one frequency dimension.

This distinction is important. The two units are related, but they describe different dimensional aspects of magnetic interaction.

Relationship to magnetic flux and resistance. The same unit can be expressed through magnetic flux, charge radius, resistance, and length:

$$\text{mgfi} = \frac{\text{mflx} \cdot \text{leng}}{\text{chrg}}, \tag{110}$$

$$\text{mgfi} = \text{resn} \cdot \text{leng}. \tag{111}$$

These expressions follow from the corresponding QMU primitive definitions.

The magnetic-flux relationship shows that Magnetic Flow Impedance equals magnetic flux multiplied by length and divided by distributed magnetic charge.

The resistance-length relationship connects the unit with the spatial extent of magnetic opposition.

Neither relationship by itself establishes that impedance increases with propagation distance. Such behavior would require a physical transport equation specifying the conditions of the interaction.

Reciprocal relationship. The catalog reciprocal of Magnetic Flow Impedance is the Electromagnetic Interaction Coefficient, denoted emic:

$$\text{emic} = \frac{{e_\text{emax}}^4}{m_\text{e}\,{\lambda_C}^3\,F_q}.$$

Consequently,

$$\boxed{\text{mgfi} \cdot \text{emic} = 1.} \tag{112}$$

This reciprocal pairing expresses an exact relationship within the QMU dimensional ledger.

Research significance. Magnetic Flow Impedance provides a dimensional basis for investigating the response of the Aether to magnetic flux and distributed-charge dynamics.

Potential applications include magnetic materials, electromagnetic wave propagation, resonant circuits, magnetic transport, and particle interactions.

The central research question is whether the APM interpretation yields a quantitative relationship between magnetic flux, charge distribution, and propagation response that can be measured independently.

The QMU identities establish the dimensional connections. Specific predictions concerning magnetic drag, energy dissipation, permeability, or particle scattering require corresponding physical models and experimental tests.

Flux Flow Equilibrium `ffeq`

QMU primitive representation:

$$\mathrm{ffeq} = \frac{m_\mathrm{e}\,{\lambda_C}^3}{{e_\mathrm{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ffeq}\,\mathrm{cfff} = 1.$$

Physical interpretation. Flux Flow Equilibrium describes the balance between electrical charge transport and the associated magnetic response of a physical system.

In the Aether Physics Model (APM), moving distributed charge interacts with the magnetic structure of the Aether. These interactions can produce opposing responses that influence the stability and behavior of electromagnetic systems.

The QMU unit is defined by

$$\boxed{\mathrm{ffeq} = \frac{m_\mathrm{e}\,{\lambda_C}^3}{{e_\mathrm{emax}}^4}} \tag{113}$$

Its dimensional structure combines mass and volume with two factors of distributed magnetic charge. Unlike friction and magnetic flow impedance, Flux Flow Equilibrium contains no explicit frequency factor.

This distinction identifies it as a separate quantity within the QMU dimensional ledger.

Relationship to magnetic flow impedance. Magnetic Flow Impedance is defined by

$$\mathrm{mgfi} = \frac{m_\mathrm{e}\,{\lambda_C}^3\,F_q}{{e_\mathrm{emax}}^4}.$$

Consequently,

$$\boxed{\text{mgfi} = \text{ffeq} \cdot \text{freq.}} \tag{114}$$

Likewise, QMU friction is

$$\text{fric} = \frac{m_\text{e}\,{\lambda_C}^3\,{F_q}^2}{{e_\text{emax}}^4},$$

giving

$$\boxed{\text{fric} = \text{ffeq} \cdot \text{rson.}} \tag{115}$$

These relationships distinguish three related quantities according to their frequency dimensions:

$$\text{ffeq} \propto F_q^0, \tag{116}$$
$$\text{mgfi} \propto F_q, \tag{117}$$
$$\text{fric} \propto F_q^2. \tag{118}$$

Here, resonance is the QMU frequency-squared quantity, not an ordinary oscillation frequency.

The three units provide distinct dimensional descriptions of equilibrium, magnetic flow impedance, and friction.

Relationship to eddy current. The QMU ledger includes the identity

$$\boxed{\text{eddy} = \text{forc} \cdot \text{ffeq.}} \tag{119}$$

This relationship connects the eddy-current quantity with force and Flux Flow Equilibrium.

Within APM, it offers a way to investigate the relationship between applied forces, distributed-charge motion, and induced magnetic responses.

In conventional electrodynamics, eddy currents arise when changing magnetic flux induces circulating electric currents in a conducting medium. These currents can produce magnetic fields that oppose the change responsible for their generation.

The QMU identity provides a dimensional connection to such phenomena. Predicting the magnitude and direction of an induced current requires the appropriate physical response equations.

Reciprocal relationship. The catalog reciprocal of Flux Flow Equilibrium is the Current Flow Facilitation Factor, denoted cfff:

$$\text{cfff} = \frac{{e_\text{emax}}^4}{m_\text{e}\,{\lambda_C}^3}.$$

Therefore,

$$\boxed{\text{ffeq} \cdot \text{cfff} = 1.} \tag{120}$$

Within the QMU grid, this reciprocal pair connects the dimensional representation of flux-flow equilibrium with its corresponding facilitation quantity.

The reciprocal relationship is exact within the QMU dimensional system.

Research significance. Flux Flow Equilibrium provides a dimensional framework for examining electromagnetic balance in conductors, coils, magnetic materials, and other systems involving changing magnetic fields.

Potential applications include eddy-current behavior, electromagnetic damping, inductive coupling, and the stabilization of magnetic flux distributions.

A useful research objective is to establish whether the APM interpretation predicts a measurable relationship among applied force, induced current, magnetic response, and material geometry.

The QMU identities identify the dimensional connections. The physical equilibrium conditions and quantitative response laws remain subjects for dedicated theoretical and experimental investigation.

Kinetic Friction `kfcn`

QMU primitive representation:

$$\text{kfcn} = \frac{m_\text{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\text{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{kfcn}\,\text{masc} = 1.$$

Physical interpretation. Kinetic Friction describes the opposition to relative motion expressed per unit length within the QMU dimensional framework.

In the Aether Physics Model (APM), friction is interpreted through interactions among matter, distributed magnetic charge, and the Aether structure. Kinetic Friction identifies the length-normalized aspect of these interactions.

Its primitive expression is

$$\boxed{\text{kfcn} = \frac{m_\text{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\text{emax}}^4}} \tag{121}$$

The denominator contains two factors of the distributed magnetic-charge unit, while the numerator contains mass, squared length, and resonance.

Here, resonance is the QMU quantity $\text{rson} = {F_q}^2$, not an ordinary oscillation frequency.

Relationship to friction and length. The QMU Friction unit is

$$\mathrm{fric} = \frac{m_\mathrm{e}\,{\lambda_C}^3\,{F_q}^2}{{e_\mathrm{emax}}^4}.$$

Dividing by the QMU length unit gives

$$\boxed{\mathrm{kfcn} = \frac{\mathrm{fric}}{\mathrm{leng}}.} \tag{122}$$

Equivalently,

$$\mathrm{fric} = \mathrm{kfcn} \cdot \mathrm{leng}.$$

This relationship distinguishes the two units by one dimension of length.

Friction represents the corresponding QMU quantity with a cubic-length factor, whereas Kinetic Friction contains a squared-length factor.

The distinction is similar to that between a quantity and its value per unit length.

However, the identity does not establish that mechanical friction necessarily accumulates as distance increases.

Whether a physical system exhibits distance-dependent friction, wear, or energy dissipation must be determined from its interaction laws and measurements.

Relationship to resistance. QMU Resistance is defined by

$$\mathrm{resn} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,F_q}{{e_\mathrm{emax}}^4}.$$

Therefore,

$$\boxed{\mathrm{kfcn} = \mathrm{resn} \cdot \mathrm{freq}.} \tag{123}$$

Kinetic Friction differs from resistance by one frequency dimension.

This provides another exact dimensional relationship connecting mechanical opposition with electromagnetic quantities in the QMU system.

Relationship to potential and charge. The QMU electric potential and charge quantities are

$$\mathrm{potn} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\mathrm{emax}}^2}, \qquad \mathrm{chrg} = {e_\mathrm{emax}}^2.$$

Consequently,

$$\boxed{\mathrm{kfcn} = \frac{\mathrm{potn}}{\mathrm{chrg}}.} \tag{124}$$

This relationship expresses Kinetic Friction as potential per distributed magnetic charge.

Within APM, it provides a dimensional connection between mechanical opposition and the charge-dependent structure of electrical potential.

The physical mechanism associated with this relationship requires an appropriate constitutive equation.

Reciprocal relationship. The catalog reciprocal of Kinetic Friction is Magnetic Spatial Compliance, denoted masc:

$$\mathrm{masc} = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,{\lambda_C}^2\,{F_q}^2}.$$

Thus,

$$\boxed{\mathrm{kfcn} \cdot \mathrm{masc} = 1.} \tag{125}$$

This reciprocal relationship connects Kinetic Friction with the corresponding substrate response quantity.

Research significance. Kinetic Friction offers a QMU dimensional basis for investigating the relationship between mechanical motion, resistance, electrical potential, and distributed magnetic charge.

Potential applications include sliding interfaces, electromechanical contacts, magnetic bearings, and materials subjected to controlled motion and electromagnetic fields.

An experimental investigation could compare measured frictional forces, sliding velocity, contact geometry, and magnetic conditions to determine whether an APM-specific response law predicts an independently measurable effect.

The dimensional relationships establish the QMU unit's mathematical structure. Determining the corresponding physical mechanisms and quantitative predictions remains an opportunity for further research.

Resistance `resn`

QMU primitive representation:

$$\mathrm{resn} = \frac{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}{{e_{\mathrm{emax}}}^4}.$$

Catalog reciprocal:

$$\mathrm{resn}\,\mathrm{admt} = 1.$$

Physical interpretation. Resistance describes opposition to the movement of electric charge through a physical system. In conventional electrodynamics, resistance relates an applied potential difference to the resulting electric current.

Within the Aether Physics Model (APM), resistance is expressed through the mass, spatial geometry, quantum frequency, and distributed magnetic charge associated with physical interactions.

The QMU resistance unit is defined by

$$\boxed{\mathrm{resn} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,F_q}{{e_\mathrm{emax}}^4}} \tag{126}$$

The denominator contains two factors of distributed magnetic charge. This distinguishes resistance from the QMU potential and magnetic flux units, which contain one such factor.

Relationship to potential and current. The QMU potential and current units are

$$\mathrm{potn} = \frac{m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^2}{{e_\mathrm{emax}}^2}, \qquad \mathrm{curr} = {e_\mathrm{emax}}^2\,F_q.$$

Their ratio gives

$$\boxed{\mathrm{resn} = \frac{\mathrm{potn}}{\mathrm{curr}}.} \tag{127}$$

Equivalently,

$$\mathrm{potn} = \mathrm{curr} \cdot \mathrm{resn}. \tag{128}$$

This is the QMU dimensional counterpart of the familiar relationship among potential, current, and resistance.

For a specific material or circuit, the measured current depends on its physical response characteristics, temperature, geometry, and operating conditions.

The dimensional identity establishes the relationship among the quantities; the material's constitutive law determines its actual electrical behavior.

Relationship to magnetic current and inductance. QMU also provides the identity

$$\boxed{\mathrm{resn} = \mathrm{mcur} \cdot \mathrm{indc}.} \tag{129}$$

Magnetic current is represented by

$$\mathrm{mcur} = \frac{F_q}{{e_{\mathrm{emax}}}^2},$$

and inductance by

$$\mathrm{indc} = \frac{m_{\mathrm{e}}\,{\lambda_C}^2}{{e_{\mathrm{emax}}}^2}.$$

Their product reproduces the QMU resistance dimension exactly.

This relationship connects resistance to magnetic-current and inductive quantities within the distributed-charge framework.

It does not mean that all measured electrical resistance arises exclusively from inductance. Rather, it identifies a common dimensional structure that may be used when constructing physical models of electromagnetic interactions.

Resistance and impedance. The Aether Physics Model distinguishes electrical resistance from magnetic reactance according to their native QMU dimensions.

Resistance is defined by

$$\mathrm{resn} = \frac{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}{{e_{\mathrm{emax}}}^4} = \frac{\mathrm{potn}}{\mathrm{curr}}.$$

Magnetic flux is defined separately:

$$\mathrm{mflx} = \frac{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}{{e_{\mathrm{emax}}}^2}.$$

Their relationship is

$$\boxed{\mathrm{mflx} = \mathrm{resn} \cdot \mathrm{chrg}.}$$

In QMU, resistance describes the dissipative component of an electrical response, while magnetic flux represents its reactive, stored-field component.

The two quantities differ by one distributed magnetic-charge dimension and therefore cannot be added directly as native QMU quantities.

The QMU impedance ledger represents these components as an ordered pair:

$$\boxed{\mathcal{Z} = (R, \Phi),}$$

where

$$R \in \mathrm{resn}, \qquad \Phi \in \mathrm{mflx}.$$

For comparison with conventional circuit analysis, the magnetic-flux component may be projected onto the resistance dimension:

$$X = \frac{\Phi}{\text{chrg}}.$$

This permits conventional impedance magnitude and phase to be recovered while preserving the separate QMU identities of resistance and magnetic flux.

The full dimensional formulation and purely real circuit-analysis methods are developed in the companion QADI impedance and electrodynamics papers.

The present unit entry records the foundational relationships without repeating their detailed derivations.

The QMU impedance formulation and its purely real circuit-analysis methods are developed in the companion QADI papers [19; 20].

Relationship to conductance. The QMU conductance unit is

$$\text{cond} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^2\,F_q}.$$

Resistance and conductance are not direct reciprocals in the native QMU dimensional system.

Multiplying them gives

$$\boxed{\text{resn} \cdot \text{cond} = \frac{1}{\text{chrg}}.} \tag{130}$$

Thus,

$$\boxed{\text{resn} = \frac{1}{\text{cond} \cdot \text{chrg}}.} \tag{131}$$

This distinction is important when translating between QMU distributed-charge quantities and conventional circuit measurements.

QMU conductance belongs to the special conversion cases developed in the Charge Conversion Factor literature.

Reciprocal relationship. The catalog reciprocal of resistance is admittance, denoted admt:

$$\text{admt} = \frac{{e_{\text{emax}}}^4}{m_{\text{e}}\,{\lambda_C}^2\,F_q}.$$

Therefore,

$$\boxed{\mathrm{resn} \cdot \mathrm{admt} = 1.} \tag{132}$$

The reciprocal relationship is exact within the QMU dimensional ledger.

The distinction between QMU admittance, conductance, and their SI counterparts must be maintained when applying charge-conversion rules.

Metrological significance. QMU resistance employs distributed magnetic charge rather than the conventional SI charge dimension.

The QMU–SI Charge Conversion Factor and translation rules provide the established framework for comparing QMU electrical quantities with measurements expressed in ohms, volts, and amperes [14; 15].

These conversions must be applied consistently before comparing numerical results from the two measurement systems.

Research significance. Resistance provides a connection between charge transport, electric potential, magnetic current, and inductive response in the QMU system.

The dimensional relationships suggest opportunities to investigate the electromagnetic behavior of conductors, resonant circuits, superconducting materials, and biological electrical systems.

A particularly useful research objective is to determine whether a QMU response model predicts a measurable relationship among resistance, inductance, phase, and frequency beyond conventional circuit descriptions.

The dimensional ledger supplies the relationships among the units. The corresponding physical response equations and experimental predictions remain subjects for focused research.

Magnetic Permeance `magp`

QMU primitive representation:

$$\mathrm{magp} = \frac{m_\mathrm{e}\,{\lambda_C}^2}{{e_\mathrm{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{magp}\,\mathrm{mrlc} = 1.$$

Physical interpretation. Magnetic Permeance describes the capacity of a physical system to establish magnetic flux in response to magnetic excitation. It expresses the receptiveness of a magnetic path to flux formation and is the reciprocal of Magnetic Reluctance.

Within the Aether Physics Model (APM), Magnetic Permeance is expressed through mass, squared length, and distributed magnetic charge. The QMU dimensional ledger establishes

$$\boxed{\text{magp} = \frac{\text{mflx}}{\text{curr}} = \frac{1}{\text{mrlc}} = \frac{\text{indc}}{\text{chrg}}.} \tag{133}$$

These relationships distinguish the dimensional identity of Magnetic Permeance from the physical processes governing magnetic flux formation.

Permeability and intrinsic winding. QMU provides a geometrical expression for Magnetic Permeance analogous to the conventional permeability–area–length relationship:

$$\boxed{\text{magp} = \frac{\text{perm} \cdot \text{area}}{\text{leng} \cdot \text{chrg}}.} \tag{134}$$

The corresponding permeability relationship is

$$\text{perm} = \frac{m_{\text{e}}\, \lambda_C}{{e_{\text{emax}}}^2} = \frac{1}{\text{curl}}.$$

In APM, permeability incorporates the intrinsic winding geometry of the Aether through its reciprocal relationship with curl. This geometrical winding is fundamental to the Aether structure and differs from the number of external turns in a manufactured coil.

Consequently, the intrinsic winding contribution is already represented by perm and should not be introduced a second time as an independent multiplier in the canonical Magnetic Permeance identity.

Neutron pinching and magnetic response. The canonical QMU relationship

$$\text{perm} = \frac{1}{\text{curl}}$$

must be distinguished from the effective geometrical factors that arise during physical interactions between matter and Aether.

In the APM neutron-pinching description, the electron–proton structure of the neutron compresses the associated Aether geometry. This interaction gives rise to the complementary factors

$$\boxed{2\,\text{perm} \qquad \text{and} \qquad \frac{\text{curl}}{2}.} \tag{135}$$

These factors are used in the APM treatment of circular deflection and related matter–Aether interactions. They represent physical geometrical effects rather than redefinitions of the QMU units.

For magnetic circuits, the effective response must therefore be distinguished from the canonical Magnetic Permeance dimension. Where the neutron-pinching geometry applies, the effective permeability contribution may involve the doubled-permeability factor, while the corresponding curl contribution is halved.

The applicability of these factors depends on the physical interaction being modeled; they are not universal multipliers to be inserted into every QMU identity.

QMU–SI correspondence. Conventional SI magnetic permeance is commonly expressed as

$$\mathcal{P}_{\mathrm{SI}} = \frac{\Phi}{NI} = \frac{\mu A}{\ell}, \tag{136}$$

where N is the number of external coil turns and NI is the magnetomotive force.

The native QMU dimensional expression is

$$\boxed{\mathrm{magp} = \frac{\mathrm{perm} \cdot \mathrm{area}}{\mathrm{leng} \cdot \mathrm{chrg}}.} \tag{137}$$

In comparing these expressions, the intrinsic Aether winding represented by perm must be distinguished from the external winding geometry of an electrical apparatus.

The correspondence must also account for the APM neutron-pinching factors wherever the physical interaction requires them.

A systematic reduction of the complete SI magnetic-circuit equations through the QMU Charge Conversion Factor is needed to determine whether their apparent differences result from charge conventions, winding geometry, or physical interaction factors.

The conversion methodology and applicable exceptions are developed in [14; 15].

Research significance. Magnetic Permeance provides a direct relationship among magnetic flux, current, permeability, reluctance, and distributed magnetic charge.

The QMU formulation offers an opportunity to simplify magnetic-circuit calculations while retaining the physical distinction between intrinsic Aether geometry and the geometry of external apparatus.

Particularly useful investigations include the relationship between neutron pinching, effective permeability, magnetic response, and the circular-deflection geometry.

A further question is whether comparable geometrical factors influence the magnetic moment (magm), for which APM has previously associated a half-factor with magnetic half-spin. Determining whether that factor arises from intrinsic spin geometry, neutron pinching, or distinct mechanisms requires a separate derivation.

The fundamental QMU identities remain unchanged. Their application to physical systems requires the appropriate geometric and constitutive relationships, which can be tested against empirical measurements.

Magnetic Flux Density Wave `mfdw`

QMU primitive representation:

$$\mathrm{mfdw} = \frac{m_\mathrm{e}\,\lambda_C\,{F_q}^2}{{e_\mathrm{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mfdw}\,\mathrm{mcri} = 1.$$

Physical interpretation. Magnetic Flux Density Wave describes the dynamic relationship between magnetic flux density and the motion of distributed magnetic charge within the Aether Physics Model (APM).

Where Magnetic Flux Density (mfxd) characterizes the spatial concentration of magnetic flux, Magnetic Flux Density Wave (mfdw) incorporates the additional contribution of magnetic charge velocity (chgv).

The QMU dimensional ledger establishes

$$\boxed{\mathrm{mfdw} = \mathrm{mfxd}\cdot\mathrm{chgv} = \frac{\mathrm{elfs}}{\mathrm{chrg}}.} \tag{138}$$

The first relationship connects magnetic flux density with the motion of magnetic charge. The second expresses the same dimensional quantity as electric field strength divided by distributed magnetic charge.

Together, these identities connect magnetic transport, electric field response, and distributed-charge dynamics within a common QMU framework.

Magnetic charge motion and wave behavior. Within APM, magnetic charge is inherently distributed rather than concentrated at dimensionless points. Its motion through Aether geometry can produce changes in the local magnetic flux distribution.

When this motion varies spatially or temporally, the resulting disturbances may exhibit wave-like behavior, including oscillation, phase relationships, and transport of electromagnetic energy.

The relationship

$$\mathrm{mfdw} = \mathrm{mfxd}\cdot\mathrm{chgv}$$

shows how magnetic charge velocity enters the QMU description of this dynamic response.

However, the velocity associated with moving magnetic charge need not equal the propagation velocity of the resulting wave. Wave propagation depends on the physical geometry, coupling, and dynamical response of the Aether system.

Likewise, acceleration or periodic motion may produce oscillatory disturbances, but the QMU dimensional identity alone does not determine their frequency, amplitude, or wavelength.

Relationship to electric field strength. The complementary identity

$$\boxed{\text{elfs} = \text{mfdw} \cdot \text{chrg}} \tag{139}$$

connects the dynamic magnetic-flux-density quantity to electric field strength through distributed magnetic charge.

This relationship provides a direct QMU connection between the electric and magnetic aspects of electromagnetic behavior.

It expresses their dimensional correspondence without introducing an additional independent charge parameter.

The physical relationship between field strength, charge motion, and wave amplitude must be evaluated through the corresponding APM interaction geometry and dynamical equations.

Research significance. Magnetic Flux Density Wave provides a useful QMU quantity for investigating dynamic magnetic charge distributions, electromagnetic wave formation, and coupled electric and magnetic responses.

Potential applications include studies of electromagnetic radiation, magnetic plasma oscillations, field disturbances in conductive media, and time-dependent magnetic systems.

Its two equivalent dimensional expressions offer complementary approaches to analyzing the same physical response: one through magnetic flux density and charge velocity, and the other through electric field strength and distributed magnetic charge.

A particularly useful research direction is to determine the conditions under which changes in magnetic charge motion produce propagating disturbances, and how their velocity, amplitude, frequency, and energy transport follow from APM geometry.

Such investigations can extend the QMU dimensional relationships into predictive wave equations and measurable electromagnetic phenomena.

Magnetic Diffusion Impedance `mdif`

QMU primitive representation:

$$\text{mdif} = \frac{m_{\text{e}}\,\lambda_C\,F_q}{{e_{\text{emax}}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{mdif}\,\text{mfdr} = 1.$$

Physical interpretation. Magnetic Diffusion Impedance describes the opposition associated with the redistribution of magnetic flux through the Aether. Within the Aether Physics Model (APM), this quantity connects distributed magnetic charge, magnetic flux density, and electrical response through a common QMU dimension.

The QMU ledger provides

$$\boxed{\text{mdif} = \text{mfxd} \cdot \text{chgr} = \frac{\text{resn}}{\text{leng}} = \frac{\text{elfs}}{\text{curr}}.} \tag{140}$$

These relationships express complementary aspects of Magnetic Diffusion Impedance.

The magnetic expression relates flux density to the spatial extent of distributed magnetic charge. The resistance relationship identifies the corresponding resistance per unit length, while the electric-field relationship connects the same dimension to electric field strength per unit current.

Magnetic charge geometry. The relationship

$$\text{mdif} = \text{mfxd} \cdot \text{chgr} \tag{141}$$

connects the local concentration of magnetic flux with the magnetic charge radius.

In APM, magnetic charge is distributed across physical geometry rather than concentrated at dimensionless points. Its spatial distribution therefore participates in determining how magnetic interactions extend through the surrounding Aether.

Magnetic Diffusion Impedance provides a dimensional connection between this charge geometry and the associated magnetic flux density.

The actual redistribution of magnetic flux depends on the physical configuration and its dynamical response.

Resistance and electric field. The equivalent relationship

$$\boxed{\text{mdif} = \frac{\text{resn}}{\text{leng}}} \tag{142}$$

identifies Magnetic Diffusion Impedance with the QMU dimension of resistance per unit length.

This relationship is particularly useful when examining distributed electrical and magnetic systems in which resistance varies along a conducting or interacting path.

Similarly,

$$\boxed{\text{mdif} = \frac{\text{elfs}}{\text{curr}}} \tag{143}$$

connects electric field strength to current.

Together, these expressions provide a bridge between the magnetic geometry of distributed charge and the electrical response of a physical system.

They do not, by themselves, establish a specific friction law or require magnetic diffusion impedance to increase with distance. Such behavior depends on the material properties, field configuration, and applicable physical equations.

QMU–SI correspondence. Conventional electromagnetic theory describes magnetic diffusion through the interaction of electrical conductivity, magnetic permeability, and time-dependent fields.

QMU provides an alternative dimensional organization based on distributed magnetic charge and its associated magnetic and electrical quantities.

A quantitative comparison requires translating the complete SI diffusion and impedance relationships through the established QMU Charge Conversion Factor rules, including their applicable exceptions.

The conversion framework is developed in [14; 15].

This comparison can establish whether the native QMU relationships simplify the description of magnetic diffusion while preserving measured electromagnetic behavior.

Research significance. Magnetic Diffusion Impedance connects the geometry of distributed magnetic charge with magnetic flux density, resistance, electric field strength, and current.

Its dimensional relationships offer a framework for examining magnetic diffusion in conductors, magnetic materials, electromagnetic devices, and other systems with spatially varying fields.

A useful research direction is to determine how these QMU relationships contribute to predictive equations for magnetic diffusion, field penetration, and energy dissipation.

Such investigations may reveal simpler relationships between charge geometry and electromagnetic transport while distinguishing the intrinsic Aether response from the properties of particular materials.

The canonical QMU identities provide the dimensional foundation; their physical application requires the corresponding interaction geometry and dynamical laws.

Thermal Magnetic Friction `thmf`

QMU primitive representation:

$$\mathrm{thmf} = \frac{m_\mathrm{e}\,\lambda_C}{{e_\mathrm{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{thmf}\,\mathrm{mfen} = 1.$$

Physical interpretation. Thermal Magnetic Friction describes the relationship between frictional response and the QMU temperature quantity within the Aether Physics Model (APM).

The QMU dimensional ledger establishes

$$\boxed{\text{thmf} = \frac{\text{fric}}{\text{temp}}.} \tag{144}$$

Since QMU temperature is defined by

$$\text{temp} = {\lambda_C}^2 {F_q}^2 = c^2,$$

and friction is expressed as

$$\text{fric} = \frac{m_\text{e}\, {\lambda_C}^3 {F_q}^2}{{e_\text{emax}}^4},$$

their ratio reduces directly to

$$\boxed{\text{thmf} = \frac{m_\text{e}\, \lambda_C}{{e_\text{emax}}^4}.} \tag{145}$$

This establishes Thermal Magnetic Friction as a distinct QMU quantity connecting friction, temperature, mass, length, and distributed magnetic charge.

Thermal and magnetic interactions. Within APM, magnetic charge is distributed through physical geometry, and its motion participates in electromagnetic interactions.

Thermal conditions can influence magnetic behavior by altering the motion, organization, and interactions of matter and its associated electromagnetic fields.

Thermal Magnetic Friction provides a dimensional relationship for investigating how such conditions affect magnetic transport and frictional response.

The identity

$$\text{fric} = \text{thmf} \cdot \text{temp}$$

shows how friction and temperature are connected within the QMU ledger.

However, the QMU temperature quantity should be distinguished from a measured temperature gradient. The dimensional identity does not itself specify the direction of heat transport, the magnitude of magnetic drag, or a particular dissipation mechanism.

These depend on the physical geometry and dynamics of the system being studied.

Relationship to magnetic response. Thermal Magnetic Friction offers a connection between the friction unit and the temperature dimension that can be used when analyzing temperature-dependent magnetic behavior.

Potential applications include the response of magnetic materials to heating, thermally influenced charge transport, magnetic-field relaxation, and interactions between electromagnetic motion and thermal energy transfer.

The APM description can be developed by examining how magnetic field (mfld), magnetic moment (magm), permeability (perm), and distributed magnetic charge (chrg) participate in the corresponding physical process.

The influence of these quantities must be established through their relevant QMU relationships and interaction geometry, rather than by assuming that every thermal change necessarily produces dissipative drag.

QMU–SI correspondence. Conventional descriptions of magnetothermal behavior employ temperature-dependent material properties, transport coefficients, and electromagnetic constitutive equations.

QMU provides a native dimensional relationship between friction and the velocity-squared temperature quantity.

Comparing the two approaches requires translating the relevant SI expressions through the established QMU Charge Conversion Factor rules, including their applicable exceptions.

The conversion framework is presented in [14; 15].

Such comparisons can determine whether the QMU formulation simplifies the description of thermal and magnetic interactions while retaining agreement with empirical measurements.

Research significance. Thermal Magnetic Friction provides a dimensional bridge between the QMU friction and temperature quantities.

Its primitive expression contains mass, length, and two factors of distributed magnetic charge, connecting mechanical response with the charge geometry underlying APM electromagnetism.

A useful research direction is to determine whether the APM geometry provides a direct calculation of temperature-dependent magnetic resistance, relaxation, or dissipation.

Further investigation may establish relationships between thermal response, magnetic permeability, magnetic moment, and charge motion that can be compared with conventional magnetothermal models.

The canonical QMU identity provides the dimensional foundation, while specific frictional and thermal effects arise from the physical interactions being modeled.

Aether Resistance Stability Factor `arsf`

QMU primitive representation: $\mathrm{arsf} = \dfrac{m_\mathrm{e}\,{F_q}^2}{{e_\mathrm{emax}}^4}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{arsf}\,\mathrm{mcup} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents the stability and balance of frictional resistance and flux flow within the Aether medium, in conjunction with its volumetric resonance.

Dimensional expression

$$arsf = \frac{m_\mathrm{e}{F_q}^2}{{e_\mathrm{emax}}^4}$$

$arsf = resn \cdot tvsw$: Relates the Aether Resistance Stability Factor to resistance ($resn$) and transverse wave ($tvsw$). Suggests that arsf quantifies the impact of resistance on the propagation and attenuation of transverse waves in the Aether.

$arsf = \frac{fric}{volm}$: Relates the Aether Resistance Stability Factor to friction ($fric$) and volume ($volm$). Indicates that arsf represents the concentration or density of frictional forces within a given volume of the Aether.

$arsf = ffeq \cdot vlmr$: Relates the Aether Resistance Stability Factor to flux flow equilibrium ($ffeq$) and volumetric resonance ($vlmr$). Implies that arsf quantifies the stability or balance of flux flow relative to the resonant behavior of the Aether medium.

Explanation: The Aether Resistance Stability Factor ($arsf$) is a fundamental unit in the Aether Physics Model that encapsulates the stability and balance of frictional resistance and flux flow within the Aether medium, considering its volumetric resonance. It provides a comprehensive measure of the interplay between these phenomena in the context of the Aether.

The identity $arsf = resn \cdot tvsw$ highlights the relationship between the Aether Resistance Stability Factor and the product of resistance and transverse-wave response. It suggests that arsf quantifies the impact of resistance on the propagation and attenuation of transverse waves in the Aether. A higher value of arsf indicates a stronger influence of resistance on wave behavior, while a lower value suggests a weaker effect.

The equation $arsf = \frac{fric}{volm}$ relates the Aether Resistance Stability Factor to the ratio of frictional force to volume. It implies that arsf represents the concentration or density of frictional forces within a given volume of the Aether. A higher value of arsf indicates a stronger frictional resistance per unit volume, while a lower value suggests a weaker frictional effect relative to the volume.

The identity $arsf = ffeq \cdot vlmr$ connects the Aether Resistance Stability Factor to the product of flux flow equilibrium and volumetric resonance. It signifies that arsf quantifies the stability or balance of flux flow relative to the resonant behavior of the Aether medium. A higher value of arsf suggests a more stable or balanced flux flow relative to the volumetric resonance, while a lower value indicates a less stable or more disrupted flux flow equilibrium.

The Aether Resistance Stability Factor ($arsf$) provides valuable insights into the fundamental properties and behavior of the Aether medium. It captures the complex interplay between frictional

resistance, flux flow, and volumetric resonance, offering a holistic perspective on the stability and balance of these phenomena within the Aether.

By incorporating the concepts of resistance, stability, and the Aether medium, the Aether Resistance Stability Factor ($arsf$) serves as a powerful tool for understanding and quantifying the intricate dynamics of the Aether. It enables researchers to analyze and predict the behavior of the Aether under various conditions, considering the effects of resistance, flux flow, and resonance.

The Aether Resistance Stability Factor ($arsf$) has important implications for the study of energy transfer, wave propagation, and the overall stability of the Aether medium. It provides a foundation for further exploration and understanding of the fundamental properties and interactions within the Aether, as described by the Aether Physics Model.

Potential Charge Concentration Factor `pccf`

QMU primitive representation: $\mathrm{pccf} = \dfrac{m_\mathrm{e}\, F_q}{{e_\mathrm{emax}}^4}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{pccf}\,\mathrm{msir} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Represents a factor that relates the potential to the concentration or intensity of electric charge within a given spatial and temporal scale.

$pccf = potn \cdot cscc$: Relates the Potential Charge Concentration Factor to the potential ($potn$) and the Charge Surface-Temporal Confinement Coefficient ($cscc$). Suggests that $pccf$ is proportional to both the potential and the charge confinement in surface and time.

Explanation: The Potential Charge Concentration Factor ($pccf$) is a unit in the Aether Physics Model that quantifies the relationship between the potential and the concentration or intensity of electric charge within a given surface and temporal scale. It combines the concepts of potential and charge confinement to provide a comprehensive understanding of their interplay. A higher value of pccf suggests a stronger relationship between the potential and the charge concentration in both surface and time. It implies that the potential is more strongly influenced by the confinement or localization of charge within a specific surface extent and at a higher frequency. Conversely, a lower value of $pccf$ indicates a weaker relationship, suggesting that the potential is less sensitive to the charge concentration in space and time.

The Potential Charge Concentration Factor ($pccf$) provides a valuable tool for understanding the interplay between potential and charge concentration in the Aether Physics Model, considering both surface and temporal aspects. It helps to analyze how the distribution and localization of charge impact the potential and vice versa, taking into account the frequency at which charge fluctuations occur.

By incorporating Charge Surface-Temporal Confinement Coefficient ($cscc$) and its relation to the Potential Charge Concentration Factor ($pccf$), researchers can gain a more comprehensive understanding of the surface-temporal distribution, confinement, and concentration of electric charge, as well as its relationship to potential in the context of the Aether Physics Model.

Magnetic Opposition `mopp`

QMU primitive representation:

$$\text{mopp} = \frac{m_\text{e}}{{e_\text{emax}}^4}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{mopp}\,\text{emid} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\text{mopp} = \frac{\text{mass}}{\text{chrg}^2} = \frac{\text{mchg}}{\text{chrg}} = \frac{1}{\text{emid}}.} \tag{146}$$

These identities distinguish Magnetic Opposition from Magnetism (mchg), the universal mass-to-magnetic-charge ratio. Magnetic Opposition contains an additional inverse distributed-charge factor.

Physical interpretation. Magnetic Opposition describes a QMU dimensional quantity associated with the interaction and mutual response of distributed magnetic-charge structures.

Within the Aether Physics Model (APM), magnetic charge is distributed through physical geometry rather than concentrated at dimensionless points. Interactions between charged structures therefore depend on their relative orientation, charge distribution, and geometrical configuration.

The relationship

$$\text{mopp} = \frac{\text{mchg}}{\text{chrg}}$$

expresses Magnetic Opposition as the universal mass-to-charge ratio normalized by an additional charge dimension.

This provides a reference for examining how magnetic structures interact and oppose changes in their relative configurations.

Magnetic Opposition is distinct from electrical resistance (resn). Its unit definition does not inherently imply energy dissipation or a resistive current-flow mechanism.

Research significance. Magnetic Opposition provides a dimensional framework for investigating the balance of magnetic interactions in particle structures, magnetic materials, and coupled distributed-charge systems.

Within APM, it may be particularly useful for examining magnetic alignment, repulsion, binding, and the stability of interacting particle geometries.

A useful research direction is to determine whether mopp contributes directly to calculations of magnetic binding and equilibrium, including electron pairing and other configurations involving overlapping Aether structures.

Its reciprocal, Electromagnetic Inertia Density (emid), provides the complementary QMU dimension.

The canonical identities establish the dimensional relationships, while the magnitude and direction of physical opposition follow from the corresponding magnetic interaction geometry.

Substrate units

Electromagnetic Ratio `emro`

QMU primitive representation: $\mathrm{emro} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,{\lambda_C}^3\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{emro}\,\mathrm{fric} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$emro = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot {\lambda_C}^3 \cdot {F_q}^2}$$

Electromagnetic Ratio is a unit that represents the ratio of the electric charge gradient to potential, or the ratio of the magnetic charge density frequency to magnetic rigidity. It quantifies the relationship between these pairs of quantities and provides insights into the fundamental behavior of electromagnetic phenomena at the quantum level.

The Electromagnetic Ratio is defined by two equations:

where *elcg* is the electric charge gradient, *potn* is the potential, *mcdf* is the magnetic charge density frequency, and *magr* is the magnetic rigidity.

The first equation, $emro = \frac{elcg}{potn}$, suggests that the Electromagnetic Ratio measures how the electric charge gradient varies with respect to potential. A higher *emro* value indicates a steeper electric charge gradient relative to the potential, which could affect the system's distribution and flow of electric charge.

The second equation, $emro = \frac{mcdf}{magr}$, implies that the Electromagnetic Ratio is a measure of how the magnetic charge density frequency varies with respect to magnetic rigidity. A higher *emro* value indicates a higher frequency of magnetic charge density oscillations relative to the magnetic rigidity of the system. This could have implications for the behavior of magnetic fields and their interactions with matter.

The concept of the Electromagnetic Ratio highlights the importance of considering the relationships between different electromagnetic quantities in the QMU system. By understanding how the electric charge gradient, potential, magnetic charge density frequency, and magnetic rigidity are

interconnected, researchers can gain deeper insights into the fundamental nature of electromagnetic phenomena and their manifestations at the quantum scale.

In practical terms, the Electromagnetic Ratio may be useful in analyzing and designing electromagnetic systems, such as those involving electric and magnetic fields, charge distributions, and potential differences. By considering the electromagnetic ratios, engineers and scientists can optimize the performance and efficiency of these systems, taking into account the intricate balance between the relevant electromagnetic quantities.

The Electromagnetic Ratio (*emro*) is a fundamental unit in the QMU system that encapsulates the relationships between key electromagnetic quantities. It provides a new lens through which to understand and manipulate the behavior of electric and magnetic phenomena at the quantum level. It represents a valuable tool for exploring the intricate interplay between electric and magnetic aspects of the quantum world.

Electromagnetic Interaction Coefficient `emic`

QMU primitive representation: $\text{emic} = \dfrac{{e_{\text{emax}}}^4}{m_{\text{e}}\,{\lambda_C}^3\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\text{emic}\,\text{mgfi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$emic = \frac{{e_{\text{emax}}}^4}{m_{\text{e}} \cdot {\lambda_C}^3 \cdot F_q}$$

Electromagnetic Interaction Coefficient is a unit that captures the interplay between various electromagnetic quantities and their spatial variations. It represents a measure of how these quantities interact and influence each other in a given system.

The Electromagnetic Interaction Coefficient is defined by the following equations:

1. $emic = curl \cdot mcdf$
2. $emic = \frac{chrg}{mfld}$
3. $emic = ptty \cdot curr$
4. $emic = cond \cdot elcg$

where *curl* is the curl operator, *mcdf* is the magnetic charge density frequency, *chrg* is the charge, $mfld$ is the magnetic field, *ptty* is the permittivity, *curr* is the current, *cond* is the conductance, and *elcg* is the electric charge gradient.

The first equation, $emic = curl \cdot mcdf$, suggests that the Electromagnetic Interaction Coefficient is related to the rotational aspect of the magnetic charge density frequency. The curl operator quantifies the rotational tendency of a vector field, so this equation implies that *emic* captures the rotational behavior of the magnetic charge density frequency.

The second equation, $emic = \frac{chrg}{mfld}$, indicates that the Electromagnetic Interaction Coefficient is equal to the ratio of charge to magnetic field. This relationship suggests that emic quantifies the

amount of charge per unit magnetic field, which could have implications for the interaction between electric charges and magnetic fields.

The third equation, $emic = ptty \cdot curr$, shows that the Electromagnetic Interaction Coefficient is equal to the product of permittivity and current. Permittivity is a measure of a material's ability to store electric energy, while current represents the flow of electric charge. This equation implies that emic is related to the capacity of a system to store electric energy and support electric current flow.

The fourth equation, $emic = cond \cdot elcg$, indicates that the Electromagnetic Interaction Coefficient is equal to the product of conductance and electric charge gradient. Conductance is a measure of a material's ability to conduct electric current, while the electric charge gradient represents the spatial variation of electric charge. This equation suggests that *emic* is related to the ease with which electric charge can flow through a system in response to an electric charge gradient.

The Electromagnetic Interaction Coefficient provides a unified perspective on the interplay between these electromagnetic quantities and their roles in governing the behavior of electromagnetic phenomena at the quantum level. It suggests that the QMU system may have the ability to quantify the behaviors of subatomic particles using simple dimensional equations, without relying on calculus-based formulations.

Understanding the Electromagnetic Interaction Coefficient can aid researchers and engineers in analyzing and designing systems that involve complex electromagnetic interactions, such as those found in advanced electronic devices, communication systems, and energy storage technologies. By considering the relationships captured by *emic*, researchers can gain insights into the fundamental principles that underlie the behavior of these systems and develop innovative solutions to optimize their performance.

The emergence of the Electromagnetic Interaction Coefficient in the QMU system highlights the potential for describing complex electromagnetic phenomena using straightforward dimensional equations. It represents a step towards developing a comprehensive framework for understanding the behavior of subatomic particles and electromagnetic interactions at the quantum level, which may lead to new insights, principles, and technologies that could revolutionize our understanding and manipulation of the quantum world.

Current Flow Facilitation Factor `cfff`

QMU primitive representation: $\mathrm{cfff} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{cfff}\,\mathrm{ffeq} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$cfff = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot {\lambda_C}^3}$$

Current Flow Facilitation Factor is a unit that represents the ease or propensity of electric current flow in relation to electromagnetic fields and material properties. It quantifies the ability of a system

to support or facilitate the movement of electric charges in response to various electromagnetic influences.

The following equations define the Current Flow Facilitation Factor:

$$cfff = \frac{1}{ffeq} = \frac{curr}{mfld}$$

where $ffeq$ is the flux flow equilibrium, $curr$ is the electric current, $mfld$ is the magnetic field, $chrs$ is the charge resonance, $ptty$ is the permittivity, $efxd$ is the electric flux density, $perm$ is the permeability, and $mfir$ is the magnetic flux intensity ratio.

The first equation, $cfff = \frac{1}{ffeq}$, suggests that the Current Flow Facilitation Factor is inversely proportional to the flux flow equilibrium. Flux flow equilibrium is a measure of the balance between the driving forces and the resistive forces acting on the flow of electric current. A higher value of $cfff$ indicates a lower flux flow equilibrium, meaning that the system is more conducive to the flow of electric current.

The second equation, $cfff = \frac{curr}{mfld}$, indicates that the Current Flow Facilitation Factor is equal to the ratio of electric current to magnetic field. This relationship suggests that $cfff$ quantifies the amount of electric current that can flow per unit magnetic field. A higher value of $cfff$ implies that the system can support a larger electric current for a given magnetic field.

The product $chrs \cdot ptty$ is the product of charge resonance and permittivity. Charge resonance represents the oscillatory behavior of electric charges, while permittivity is a measure of a material's ability to store electric energy. This equation suggests that $cfff$ is related to the ability of a system to support charge oscillations in relation to its capacity to store electric energy.

The fourth equation, $cfff = \frac{efxd}{perm}$, indicates that the Current Flow Facilitation Factor is equal to the ratio of electric flux density to permeability. Electric flux density represents the concentration of electric field lines, while permeability is a measure of a material's ability to support magnetic fields. This relationship suggests that $cfff$ is related to the ability of a system to support electric flux in relation to its magnetic permeability.

The fifth equation, $cfff = curr \cdot mfir$, shows that the Current Flow Facilitation Factor is equal to the product of the electric current and magnetic flux intensity ratio. This equation implies that $cfff$ is related to the combined effect of electric current and the ratio of magnetic flux intensity to electric field intensity.

The Current Flow Facilitation Factor provides a comprehensive measure of the ease or propensity of electric current flow in a system, considering factors such as flux flow equilibrium, magnetic field, charge resonance, permittivity, electric flux density, and permeability. It offers insights into the fundamental principles governing the behavior of electric current in complex electromagnetic environments.

Understanding the Current Flow Facilitation Factor can aid researchers and engineers in analyzing and designing systems that involve the flow of electric current in the presence of electromagnetic fields and specific material properties. By considering the relationships captured by $cfff$, they can develop optimized solutions for various applications, such as electrical conductors, magnetic materials, and energy storage devices.

The identification of the Current Flow Facilitation Factor in the QMU system demonstrates the

power and potential of this framework in uncovering new relationships and concepts that can deepen our understanding of the fundamental principles governing the behavior of electromagnetic phenomena at the quantum scale. As we continue to explore and define the units in the QMU system, we may uncover additional insights and relationships that can further advance our knowledge and capabilities in this field.

Magnetic Spatial Compliance `masc`

QMU primitive representation: $\text{masc} = \dfrac{{e_{\text{emax}}}^4}{m_{\text{e}}\,{\lambda_C}^2\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{masc}\,\text{kfcn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$masc = \frac{{e_{\text{emax}}}^4}{m_{\text{e}} \cdot {\lambda_C}^2 \cdot {F_q}^2}$$

Magnetic Spatial Compliance is a unit that represents the relationship between the spatial distribution of magnetic fields and the associated electric fields, charges, and potentials. It quantifies the degree to which magnetic fields comply with or adapt to the spatial variations of electric fields, charge gradients, and potential differences in a system.

The following four QMU relationships have matching primitive dimensions:

$$masc = \frac{curl}{chga}$$
$$masc = \frac{elcg}{elfs}$$
$$masc = \frac{chrg}{potn}$$
$$masc = efxd \cdot cvef$$

where $curl$ is the curl operator, $chga$ is the acceleration per charge, $elcg$ is the electric charge gradient, $elfs$ is the electric field strength, $chrg$ is the magnetic charge, $potn$ is the potential, $efxd$ is the electric flux density, and $cvef$ is the converging electric field.

The first equation, $masc = \frac{curl}{chga}$, suggests that the Magnetic Spatial Compliance is equal to the ratio of the curl of a magnetic field to the acceleration per charge. The curl operator represents the rotational tendency of a vector field, while the charge acceleration relates to the acceleration experienced by a unit of charge. This relationship implies that masc quantifies the degree to which the rotational aspects of magnetic fields comply with the acceleration of charges in a system.

The second equation, $masc = \frac{elcg}{elfs}$, indicates that the Magnetic Spatial Compliance is equal to the ratio of the electric charge gradient to the electric field strength. The electric charge gradient represents the spatial variation of electric charge density, while the electric field strength relates to the intensity of the electric field. This equation suggests that masc is related to the ability of magnetic fields to adapt to the spatial variations of electric charge and field strength.

The third equation, $masc = \frac{chrg}{potn}$, shows that the Magnetic Spatial Compliance is equal to the ratio of charge to potential. This relationship suggests that masc quantifies the amount of charge that can be accommodated per unit potential difference in a system. It implies that magnetic fields can adjust their spatial distribution to comply with the charge-potential relationship.

The fourth expression is $efxd \cdot cvef$. Its physical interpretation proposes that the Magnetic Spatial Compliance relates to electric flux density and the converging electric field. The electric flux density represents the concentration of electric field lines, while the converging electric field relates to the tendency of electric fields to converge towards a central point. This equation suggests that masc is related to the ability of magnetic fields to comply with the spatial convergence of electric fields.

The Magnetic Spatial Compliance provides a comprehensive measure of the relationship between the spatial distribution of magnetic fields and the associated electric fields, charges, and potentials in a system. It offers insights into the fundamental principles governing the behavior of magnetic fields in the presence of spatially varying electric phenomena.

Understanding the Magnetic Spatial Compliance can aid researchers and engineers in analyzing and designing systems that involve the interaction of magnetic fields with spatially distributed electric fields, charges, and potentials. By considering the relationships captured by masc, they can develop optimized solutions for various applications, such as electromagnetic compatibility, magnetic field shaping, and electro-magnetic coupling.

The identification of the Magnetic Spatial Compliance in the QMU system highlights the power and potential of this framework in uncovering new relationships and concepts that can deepen our understanding of the fundamental principles governing the behavior of magnetic and electric phenomena at the quantum scale.

Admittance `admt`

QMU primitive representation: $\mathrm{admt} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{admt}\,\mathrm{resn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$admt = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot {\lambda_C}^2 \cdot F_q}$$

The *admt* unit is "magnetic admittance." It has the dimensional structure:

$$admt = \frac{chrg}{mflx}$$

Where chrg is magnetic charge and mflx is magnetic flux. It represents the ease with which magnetic flux can change in a system analogous to electrical admittance in circuit analysis but specifically pertains to magnetic charge and flux. admt is the inverse of magnetic impedance. A higher admt indicates magnetic flux changes more readily and depends on the magnetic properties of the material/system.

Magnetically ”soft” materials have higher admittance. admt provides insight into the magnetic conductivity. It is used in magnetic circuit analysis and design to calculate loss, energy transfer, induction, etc. by balancing driving impedance and load admittance.

Magnetic Reluctance `mrlc`

QMU primitive representation:

$$\mathrm{mrlc} = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,{\lambda_C}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mrlc}\,\mathrm{magp} = 1.$$

Physical interpretation. Magnetic Reluctance describes the opposition to establishing magnetic flux within a physical magnetic path. It is the reciprocal of Magnetic Permeance and provides the QMU measure of resistance to magnetic flux formation.

Within the Aether Physics Model (APM), Magnetic Reluctance is expressed through distributed magnetic charge, mass, and squared length.

The QMU dimensional ledger establishes

$$\boxed{\mathrm{mrlc} = \frac{\mathrm{curr}}{\mathrm{mflx}} = \frac{1}{\mathrm{magp}} = \frac{\mathrm{chrg}}{\mathrm{indc}}.} \tag{147}$$

These identities connect magnetic reluctance with current, magnetic flux, permeance, inductance, and distributed magnetic charge.

Greater reluctance corresponds to lower permeance for the same magnetic path. Conversely, lower reluctance indicates a greater capacity to establish magnetic flux under comparable excitation.

Relationship to permeability and geometry. The QMU dimensional relationship between Magnetic Reluctance and Permeability is

$$\boxed{\mathrm{mrlc} = \frac{\mathrm{leng}\cdot\mathrm{chrg}}{\mathrm{perm}\cdot\mathrm{area}}.} \tag{148}$$

This is the reciprocal of the corresponding Magnetic Permeance expression.

In APM, permeability incorporates the intrinsic winding geometry of the Aether through its reciprocal relationship with curl:

$$\mathrm{perm} = \frac{1}{\mathrm{curl}}.$$

Consequently, Magnetic Reluctance can also be expressed as

$$\boxed{\text{mrlc} = \frac{\text{leng} \cdot \text{chrg} \cdot \text{curl}}{\text{area}}.} \tag{149}$$

These relationships connect reluctance directly with intrinsic Aether geometry.

They also show why reluctance depends on the geometrical configuration of a magnetic path. Increasing its length or reducing its cross-sectional area generally increases reluctance when the other relevant properties remain unchanged.

Neutron pinching and magnetic response. The fundamental relationship

$$\text{perm} \cdot \text{curl} = 1$$

must be distinguished from the effective geometrical factors that arise in physical matter–Aether interactions.

Within the APM neutron-pinching model, the interaction introduces complementary factors

$$2\,\text{perm} \qquad \text{and} \qquad \frac{\text{curl}}{2}.$$

These factors appear in the APM treatment of the Circular Deflection Angle and related geometrical interactions.

Where the same neutron-pinching geometry governs magnetic response, the doubled effective permeability corresponds to a reduced effective reluctance for an otherwise unchanged magnetic path.

This physical modification does not redefine the canonical Magnetic Reluctance unit or its reciprocal relationship with Magnetic Permeance.

QMU–SI correspondence. In conventional SI magnetic-circuit analysis, reluctance is expressed as

$$\mathcal{R}_{\text{SI}} = \frac{\mathcal{F}}{\Phi} = \frac{NI}{\Phi} = \frac{\ell}{\mu A}, \tag{150}$$

where magnetomotive force is the product of current I and the number of coil turns N.

The native QMU dimensional expression is

$$\boxed{\text{mrlc} = \frac{\text{curr}}{\text{mflx}} = \frac{\text{leng} \cdot \text{chrg}}{\text{perm} \cdot \text{area}}.} \tag{151}$$

The intrinsic Aether winding represented by QMU permeability must be distinguished from the external winding count of a physical coil.

Determining the full SI–QMU correspondence requires applying the established Charge Conversion Factor rules, accounting for their exceptions, and identifying the geometrical factors associated with the physical magnetic circuit.

The relevant conversion framework is developed in [14; 15].

Research significance. Magnetic Reluctance connects magnetic flux, current, permeability, curl, magnetic permeance, inductance, and distributed magnetic charge.

Its geometrical formulation provides a useful foundation for analyzing transformers, inductors, magnetic cores, air gaps, and other magnetic circuits.

A systematic comparison of SI and QMU magnetic-circuit equations may reveal simplifications arising from the QMU description of intrinsic Aether winding and distributed magnetic charge.

Further research may examine how neutron-pinching geometry modifies effective reluctance and permeability, and whether these effects produce measurable differences in magnetic response.

The canonical QMU relationships establish the dimensional structure, while the physical behavior of a particular magnetic system depends on its geometry and interactions.

Magnetic Current Impedance `mcri`

QMU primitive representation: $\mathrm{mcri} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,\lambda_C\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mcri}\,\mathrm{mfdw} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mcri = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot \lambda_C \cdot {F_q}^2}$$

Magnetic Current Impedance ($mcri$) is dimensionally equivalent to the reciprocal of magnetic permeance ($magp$). The equation for magnetic permeance is given as:

$$magp = \frac{mflx}{curr}$$

Where $mflx$ is magnetic flux and $curr$ is magnetic current. Given that $mcri$ is dimensionally the reciprocal of magnetic permeance, we can express it as:

$$mcri = \frac{curr}{mflx} = \frac{1}{magp}$$

This equation suggests that $mcri$ represents the opposition or difficulty of establishing magnetic flux per unit of magnetic current. In other words, it quantifies the resistance to the flow of magnetic current, which is the flow of magnetic charge. The relationship between $mcri$ and magnetic permeance ($magp$) can be expressed as:

This reciprocal relationship indicates that a higher *mcri* value corresponds to lower magnetic permeance, meaning that it is more difficult to establish magnetic flux in the system. Conversely, a lower *mcri* value corresponds to higher magnetic permeance, indicating that magnetic flux can be more easily established. The dimensional structure of *mcri*, as inferred from the table of Opposing Magnetic Units, is:

This dimensional structure can be interpreted as the ratio of magnetic charge raised to the fourth power to the product of electron mass, Compton wavelength, and quantum frequency squared. This interpretation suggests that *mcri* is a measure of the opposition or resistance to the flow of magnetic current, which is influenced by the magnetic charge, the fundamental properties of the electron, and the quantum frequency of the system.

Magnetic Field Resistance `mfdr`

QMU primitive representation: $\mathrm{mfdr} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\,\lambda_C\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mfdr}\,\mathrm{mdif} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mfdr = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot \lambda_C \cdot F_q}$$

The unit $mfdr$ represents the magnetic field resistance per unit charge. The equations provided:

$$mfdr = \frac{1}{chgr\,mfxd} = \frac{curr}{elfs}$$

provide insight into the nature of this unit.

In the first equation *chgr* (charge radius) represents the spatial extent of the magnetic charge. $mfxd$ (magnetic flux density) is the quantity of magnetic flux per unit area. The product of *chgr* and $mfxd$ signifies the total magnetic flux associated with a magnetic charge. The reciprocal of this product, $mfdr$, then represents the resistance encountered by the magnetic field per unit charge. A higher $mfdr$ value indicates greater resistance to the magnetic field, while a lower value suggests less resistance.

The second equation *curr* (magnetic current) is the flow rate of magnetic charge. $elfs$ (electric field strength) is the force exerted on a unit of magnetic charge by an electric field. The ratio of *curr* to $elfs$ represents the magnetic current per unit of electric field strength. This can be interpreted as the resistance encountered by the magnetic current due to the electric field.

Based on these equations, $mfdr$ quantifies the resistance or opposition experienced by the magnetic field or magnetic current due to various factors, such as the spatial extent of the magnetic charge and the influence of electric fields. It can be seen as a measure of the difficulty of establishing or maintaining a magnetic field or current in a given system.

The dimensional structure of $mfdr$, as inferred from the table of Opposing Magnetic Units, is: $\frac{{e_{\text{emax}}}^4}{m_{\text{e}} \cdot \lambda_C \cdot F_q}$

This dimensional structure can be interpreted as the ratio of magnetic charge raised to the fourth power to the product of electron mass, Compton wavelength, and quantum frequency. This interpretation is consistent with the concept of $mfdr$ as a measure of magnetic field resistance, as it shows the dependence of this resistance on the magnetic charge, the fundamental properties of the electron, and the quantum frequency of the system.

In conclusion, $mfdr$, or magnetic field resistance, is a unit in the $mfdr$ system that quantifies the resistance encountered by magnetic fields or currents due to various factors. It is a valuable concept for understanding the behavior of magnetic phenomena in the presence of electric fields and other influences. Further research and analysis within the framework of the Aether Physics Model are needed to fully explore the implications of $mfdr$ and its potential applications in various fields of science and technology.

Magnetic Field Energy `mfen`

QMU primitive representation: $\text{mfen} = \dfrac{{e_{\text{emax}}}^4}{m_{\text{e}}\,\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\text{mfen}\,\text{thmf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mfen = \frac{{e_{\text{emax}}}^4}{m_{\text{e}} \cdot \lambda_C}$$

$mfen$, as represented in the provided equations, signifies magnetic field energy. The equations:

$$mfen = mfdi \cdot cden = cond \cdot chvl$$

provide insight into the nature of this unit.

In the first equation $mfdi$ (magnetic field intensity) quantifies the work done by a magnetic field on a unit magnetic charge. *cden* (conductance density) is the conductance per unit area, representing the ability of a material to conduct magnetic current. The product of $mfdi$ and *cden* signifies the energy density of the magnetic field, which is the energy stored in the magnetic field per unit volume. This interpretation suggests that $mfen$ quantifies the energy associated with the magnetic field due to the flow of magnetic current.

The second equation *cond* (conductance) is a measure of a material's ability to conduct magnetic current. *chvl* (charge velocity) is the speed at which magnetic charges flow. The product of *cond* and *chvl* represents the flow of magnetic current, which is analogous to the flow of electric current. This can be interpreted as the magnetic power, which is the rate at which magnetic energy is transferred.

Based on these equations, $mfen$ quantifies the energy associated with the magnetic field due to the flow of magnetic current. It can be seen as a measure of the magnetic energy density or magnetic

power in a given system.

The dimensional structure of mfen, as inferred from the table of Opposing Magnetic Units, is: $\frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot \lambda_C}$

This dimensional structure can be interpreted as the ratio of magnetic charge raised to the fourth power to the product of electron mass and Compton wavelength. This interpretation is consistent with the concept of $mfen$ as a measure of magnetic energy, as it shows the dependence of this energy on the magnetic charge and the fundamental properties of the electron.

Magnetic Charge per Unit Potential `mcup`

QMU primitive representation: $\mathrm{mcup} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \, {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mcup}\,\mathrm{arsf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mcup = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot {F_q}^2}$$

mcup, as represented in the provided equations, signifies magnetic charge per unit potential. The equations:

$$mcup = \frac{sfch}{potn} = \frac{magm \cdot chrg}{powr}$$

provide insight into the nature of this unit.

In the first equation $sfch$ (surface charge) is the charge per unit area. *potn* (potential) is the potential energy per unit charge. The ratio of $sfch$ to *potn* represents the amount of charge per unit of potential energy. This can be interpreted as the charge that can be stored on a surface for a given potential.

The second equation *magm* (magnetic moment) is a measure of an object's tendency to align with a magnetic field. *chrg* (charge) is the electric charge. *powr* (power) is the rate of energy transfer. The product of *magm* and *chrg* represents the energy associated with the magnetic moment of a charge. Dividing this by *powr* gives the charge per unit of power, which can be interpreted as the charge required to generate a certain amount of power in a magnetic system.

Based on these equations, *mcup* quantifies the amount of magnetic charge per unit of potential energy or power. It can be seen as a measure of the charge capacity or charge efficiency of a magnetic system. The dimensional structure of *mcup*, as inferred from the table of Opposing Magnetic Units, is: $\frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot {F_q}^2}$

This dimensional structure can be interpreted as the ratio of magnetic charge raised to the fourth power to the product of electron mass and quantum frequency squared. This interpretation is consistent with the concept of *mcup* as a measure of magnetic charge per unit potential, as it shows the dependence of this charge on the magnetic charge and the fundamental properties of the electron and the Aether.

Magneto-Spatial Impedance Ratio `msir`

QMU primitive representation: $\mathrm{msir} = \dfrac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}}\, F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{msir}\,\mathrm{pccf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$msir = \frac{{e_{\mathrm{emax}}}^4}{m_{\mathrm{e}} \cdot F_q}$$

The *msir* unit represents a fundamental ratio that connects spatial, resistive, magnetic, and electric properties. It quantifies the interplay between the extent of a surface or cross-section, the resistance of the system, the magnetic moment generated, and the surface charge distribution relative to the magnetic flux.

The Magneto-Spatial Impedance Ratio (*msir*) unit has the following relationships:

$$msir = \frac{area}{resn} = \frac{magm}{potn} = \frac{sfch}{mflx}$$

Here's an analysis of what the *msir* unit means based on these relationships:

$msir = \frac{area}{resn}$: This relationship suggests that *msir* quantifies the amount of spatial area per unit of resistance. It indicates how much surface or cross-sectional area is associated with a single unit of resistance. A higher *msir* value would imply a larger spatial extent corresponding to each unit of resistance.

$msir = \frac{magm}{potn}$: This ratio relates the magnetic moment to the potential. It suggests that *msir* represents the amount of magnetic moment generated per unit of potential difference. A larger *msir* value indicates a stronger magnetic response or alignment for a given potential.

$msir = \frac{sfch}{mflx}$: This relationship compares the surface charge to the magnetic flux. In the QMU system, magnetic flux is reciprocal to conductance due to the difference in charge dimensions. This relationship implies that *msir* quantifies the amount of charge distributed over a surface per unit of magnetic flux passing through that surface. A higher *msir* value would indicate a greater surface charge density relative to the magnetic flux.

The Magneto-Spatial Impedance Ratio (*msir*) encapsulates the idea that this unit relates magnetic properties (magnetic moment and flux) to spatial properties (area and surface charge) and impedance (resistance and magnetic flux). It highlights the interconnectedness of these phenomena in the context of the IOMU (Inverse Opposing Magnetic Units) category.

The *msir* unit provides insights into how magnetic fields, electric charges, and impedance are intertwined and influence each other in a given system. It may have implications for understanding the behavior of magnetic materials, the distribution of charges in electromagnetic systems, and the relationship between spatial extent and impedance in various physical scenarios.

Further research into the *msir* unit within the Aether Physics Model framework could potentially

lead to new insights and applications in areas such as magnetism, electrodynamics, and the study of impedance in electromagnetic systems.

Electromagnetic Interaction Density `emid`

QMU primitive representation: $\text{emid} = \dfrac{{e_{\text{emax}}}^4}{m_{\text{e}}}$.

Family grid Dependency index

Catalog reciprocal: $\text{emid}\,\text{mopp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Electromagnetic Interaction Density (*emid*) is a fundamental unit in the Quantum Measurement Units (QMU) system that represents the combined effect of electric charge and magnetic charge-mass interaction. It quantifies the density or concentration of electromagnetic interactions in a given system, providing insights into the strength and distribution of electromagnetic fields, energy density, stress, and wave amplitude.

The *emid* unit is derived from the relationship between the exposure (*expr*) and charge (*chrg*) units in the QMU system. Exposure represents the interaction between magnetic charge and mass, quantifying the effect of magnetism on physical matter. Charge, on the other hand, represents the fundamental unit of electric charge, which is the source of electromagnetic interactions. The *emid* unit is expressed as the product of exposure and charge ($expr \cdot chrg$), signifying the combined effect of magnetic charge-mass interaction and electric charge.

In addition to the $expr \cdot chrg$ relationship, the *emid* unit can also be expressed as $\frac{chrg}{mchg}$, where *mchg* represents magnetism or the magnetic charge. This relationship highlights the direct connection between electric charge and magnetic charge, suggesting that the *emid* unit describes the ratio of electric charge to magnetic charge in a system. A higher *emid* value indicates a stronger presence of electric charge relative to magnetic charge, while a lower *emid* value suggests a stronger magnetic charge influence.

Another important relationship is $emid = \frac{magm}{mflx}$, where *magm* represents the magnetic moment and $mflx$ represents the magnetic flux. This relationship implies that the *emid* unit is also related to the ratio of magnetic moment to magnetic flux. It suggests that *emid* quantifies the effectiveness of a given magnetic moment in generating magnetic flux or the amount of magnetic flux produced per unit of magnetic moment. This relationship could provide insights into the efficiency of magnetic systems and the coupling between magnetic moment and magnetic flux.

Furthermore, the *emid* unit is related to the plasma unit (*plsm*) through the relationship $emid = \frac{plsm}{potn}$, where *potn* represents potential. This relationship indicates that the *emid* unit is proportional to the ratio of plasma to potential. Plasma, being a state of matter consisting of a significant number of charged particles, is characterized by its charge density and temperature. The plsm unit captures the essence of plasma by relating charge (*chrg*) and temperature (*temp*) as $plsm = chrg \cdot temp$. The *emid* unit's connection to the *plsm* unit suggests that it could play a role in describing the behavior of plasma in the presence of electromagnetic fields or the generation of plasma through electromagnetic interactions.

The *emid* unit has significant implications for understanding the behavior of electromagnetic fields, the coupling between electric and magnetic phenomena, and the interaction of electromagnetic fields with matter. It could provide valuable insights into various physical scenarios, such as:

Electromagnetic field strength and distribution: *emid* could help quantify the strength and spatial distribution of electromagnetic fields, providing a measure of the intensity of electromagnetic interactions in a given region.

Electromagnetic energy density: The *emid* unit might relate to the energy density of electromagnetic fields, representing the amount of energy stored in a given volume due to the presence of both electric and magnetic charges.

Electromagnetic stress and pressure: *emid* could potentially describe the stress or pressure exerted by electromagnetic fields on matter, taking into account the combined effect of electric charge and magnetic charge-mass interaction.

Electromagnetic wave amplitude: In the context of electromagnetic waves, the *emid* unit might be related to the amplitude of the wave, determining the maximum displacement or intensity of the electric and magnetic field components.

Plasma behavior and generation: The connection between the *emid* unit and the *plsm* unit suggests that *emid* could play a role in describing the behavior of plasma in the presence of electromagnetic fields or the generation of plasma through electromagnetic interactions.

The Electromagnetic Interaction Density (*emid*) unit offers a comprehensive and unified approach to describing the interplay between electric charge, magnetic charge, magnetic moment, magnetic flux, and plasma within the framework of the Quantum Measurement Units system. It provides a valuable tool for analyzing and understanding the fundamental nature of electromagnetic interactions and their effects on matter.

Further research into the *emid* unit and its applications within the Aether Physics Model could lead to new insights and advancements in various fields, such as electromagnetism, plasma physics, and the study of electromagnetic waves and their interactions with matter. As the Aether Physics Model continues to evolve and gain experimental support, the *emid* unit may prove to be a crucial element in unlocking the secrets of the electromagnetic universe and paving the way for groundbreaking discoveries and technological innovations.

Quantum Electrodynamic Foundational

Dynamic units

Quantum Photomagnetic Density `qpmd`

QMU primitive representation: $\text{qpmd} = \dfrac{1}{{\lambda_C}^3 \, {F_q}^3 \, {e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{qpmd} \, \text{efvr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qpmd = \frac{1}{{e_{\text{emax}}}^2 \cdot {\lambda_C}^3 \cdot {F_q}^3}$$

The Quantum Photomagnetic Density (*qpmd*) represents the concentration or distribution of magnetic charge within a given light field, emphasizing the relationship between magnetism and light in a system.

The unit *qpmd* expressed as $\frac{mchg}{ligt}$, represents the relationship between Magnetic Charge ($mchg$) and light ($ligt$). To understand the physical meaning of *qpmd*, let's first recap the key concepts:

1. In the Aether Physics Model (APM), a photon ($phtn$) is defined as the angular momentum of an electron (h - Planck's constant) transferring to the surrounding space at the speed of photons (c). This is expressed as $phtn = h \cdot c$.

2. Light ($ligt$) is the condition of space filled with photons, and it is derived from the product of photons and their frequency ($freq$): $ligt = phtn \cdot freq$.

3. The energy ($enrg$) filling a valence position in an atom is equal to the light divided by the speed of photons ($velc$): $enrg = \frac{ligt}{velc}$, also to the mass of the electron times $velc^2$ (c^2). This energy can also be expressed as $enrg = angm \cdot freq$, where $angm$ is a small portion of the spread-out photon arriving at the frequency of the emitting isotope.

The Quantum Photomagnetic Density (*qpmd*) represents the concentration or distribution of magnetic charge within a given light field. It quantifies the amount of magnetism present in relation to the amount of light in a system.

A higher *qpmd* value indicates a greater magnetic charge per unit light, suggesting that the system has a stronger magnetic presence relative to the light available. Conversely, a lower *qpmd* value implies a weaker magnetic charge per unit light, indicating a reduced magnetic presence relative to the light present.

The *qpmd* unit may provide insights into the behavior of electromagnetic phenomena in the presence of light. It could help explain how the magnetic charge of a system influences the absorption, emission, or interaction of light with matter. For example, materials with a high *qpmd* might exhibit unique optical properties or respond differently to electromagnetic fields in the presence of light.

Furthermore, the *qpmd* unit may shed light on the role of magnetism in the process of photon absorption and emission by atoms. It could potentially offer a new perspective on the mechanisms underlying spectroscopy and the interaction of light with atomic structures.

In the context of the Aether Physics Model (APM), the *qpmd* unit may be particularly relevant in understanding the relationship between magnetism and light in the Aether. As the APM proposes that the Aether is a dynamic and discrete medium composed of quantum units, the *qpmd* unit could help describe how magnetism and light interact within this fundamental structure.

Let's consider the additional relationship: $qpmd = \frac{cscc}{accl}$.

In this equation, *cscc* refers to the Charge Surface-Temporal Confinement Coefficient, which relates time to surface charge ($sfch$). It quantifies the temporal confinement or persistence of charge on a surface. On the other hand, *accl* represents acceleration, which is the rate of change of velocity.

By expressing *qpmd* as $\frac{cscc}{accl}$, we gain further insight into the physical meaning of this unit. It suggests that the Quantum Photomagnetic Density is proportional to the ratio of the Charge Surface-Temporal Confinement Coefficient to acceleration.

This relationship implies that systems with a higher *cscc* (greater temporal confinement of charge

on a surface) and a lower *accl* (slower rate of change of velocity) will have a higher *qpmd*. In other words, when charge is more confined on a surface over time, and the system undergoes slower acceleration, the Quantum Photomagnetic Density increases.

Conversely, systems with a lower *cscc* (less temporal confinement of charge on a surface) and a higher *accl* (faster rate of change of velocity) will have a lower *qpmd*. This means that when charge is less confined on a surface over time, and the system undergoes faster acceleration, the Quantum Photomagnetic Density decreases.

The relationship between *qpmd*, *cscc*, and *accl* may have implications for understanding the behavior of magnetic charge in the presence of light under different conditions of charge confinement and acceleration. It could provide insights into how the temporal persistence of charge on a surface and the rate of change of velocity affect the interaction between magnetism and light.

In the context of the APM, the Quantum Photomagnetic Density (*qpmd*) unit may help elucidate the dynamics of magnetic charge and light within the Aether. It could shed light on how the Aether's quantum units respond to variations in charge confinement and acceleration, and how this influences the overall behavior of electromagnetic phenomena.

As research in the APM progresses, the *qpmd* unit may contribute to a deeper understanding of the complex interplay between magnetism, light, charge confinement, and acceleration at the fundamental level. It could inspire new theoretical models and experimental investigations that explore the implications of this relationship in various physical systems.

Further exploration of the Quantum Photomagnetic Density (*qpmd*) unit and its connection to cscc and accl may lead to breakthroughs in fields such as advanced materials, optoelectronics, and high-energy physics. By unraveling the intricacies of the relationship between magnetism, light, charge confinement, and acceleration, the *qpmd* unit may open up new avenues for technological innovation and scientific discovery.

Magnetic Charge per Photon `mcpp`

QMU primitive representation: $\mathrm{mcpp} = \dfrac{1}{{\lambda_C}^3 \, {F_q}^2 \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mcpp}\,\mathrm{efva} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mcpp = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^3 \cdot {F_q}^2}$$

The *mcpp* unit, which equals $\frac{mchg}{phtn}$, represents the relationship between magnetism (*mchg*) and photons (*phtn*) in the Quantum Measurement Units (QMU) system. Magnetism, denoted by *mchg*, is the magnetic charge, while a photon (*phtn*) is defined as the angular momentum of an electron (h - Planck's constant) transferring to the surrounding space at the speed of photons (c), expressed as $phtn = h \cdot c$.

The Magnetic Charge per Photon (*mcpp*) represents the amount of magnetic charge associated with each photon in a system. It quantifies the relationship between magnetism and the fundamental

quantum of electromagnetic radiation.

A higher *mcpp* value indicates a greater magnetic charge per photon, suggesting that each photon carries a larger amount of magnetism. Conversely, a lower *mcpp* value implies a smaller magnetic charge per photon, indicating that each photon carries a lesser amount of magnetism.

The *mcpp* unit may provide insights into the magnetic properties of photons and how they interact with matter. It could help explain the role of magnetism in the absorption, emission, and propagation of photons in various physical systems.

In the context of the Aether Physics Model (APM), the *mcpp* unit may be particularly relevant in understanding the relationship between magnetism and photons within the Aether. As the APM proposes that photons are excitations of the Aether's quantum units, the *mcpp* unit could shed light on how magnetic charge is associated with these fundamental excitations.

Furthermore, the *mcpp* unit may have implications for the study of quantum electrodynamics (QED) and the nature of electromagnetic interactions at the most fundamental level. It could provide a new perspective on the role of magnetism in the behavior of photons and how this influences the overall dynamics of electromagnetic phenomena.

As research in the APM and QMU system progresses, the Magnetic Charge per Photon (*mcpp*) unit may contribute to a deeper understanding of the relationship between magnetism and photons. It could inspire new theoretical models and experimental investigations that explore the consequences of this relationship in various physical scenarios.

Further exploration of the *mcpp* unit and its implications within the APM framework may lead to advancements in fields such as quantum optics, high-energy physics, and the study of light-matter interactions. By unraveling the intricacies of the relationship between magnetism and photons at the fundamental level, the *mcpp* unit may open up new possibilities for technological innovation and scientific discovery.

Magnetic Charge Distribution per Rotation `mcdr`

QMU primitive representation: $\mathrm{mcdr} = \dfrac{1}{{\lambda_C}^3 \, F_q \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mcdr} \cdot \mathrm{efvc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mcdr = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^3 \cdot F_q}$$

Physical interpretation: The Magnetic Charge Distribution (*mcdr*) unit represents the fundamental distribution pattern of magnetic charge within the quantum structure of space. It quantifies how magnetic charge arranges itself relative to both potential gradients and the geometric structure of Aether units. This relationship is revealed through the equation $mcdr = \frac{pccf}{A_u}$, which shows that magnetic charge distribution is determined by the ratio of potential charge concentration to the quantum unit of space itself.

Key mathematical relationships define mcdr's various aspects: $mcdr = \frac{mchg}{qanr}$ shows how magnetic charge relates to quantum angular reach; $mcdr = mchg \cdot qvrc$ demonstrates its connection to volumetric receptivity; and $mcdr = \frac{ecfx}{volm}$ reveals how charge fluctuations relate to volume. Together, these relationships indicate that magnetic charge distribution follows specific patterns governed by both spatial geometry (through the ${\lambda_C}^3$ term) and temporal dynamics (through the F_q term).

The unit's inverse relationship with ${e_{\text{emax}}}^2$ suggests that the distribution pattern is intrinsically linked to the magnetic charge property itself. This distribution isn't arbitrary but follows precise patterns determined by the geometric structure of space, the present potential gradients, and the fundamental quantum frequency. The *mcdr* unit thus describes a fundamental property of how magnetic charge must distribute itself within the quantum structure of space according to potential gradients, making it essential for understanding charge behavior at the quantum level.

This unit is particularly significant in quantum systems where understanding the spatial distribution of magnetic charge relative to potential gradients is crucial. It provides insights into how magnetic charge arranges itself within the fundamental structure of space and how this arrangement relates to both the geometric properties of Aether units and the potential gradients present in the system.

Magnetic Charge Rotational Density `mcrd`

QMU primitive representation: $\text{mcrd} = \dfrac{1}{{\lambda_C}^3\,{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{mcrd}\,\text{chvm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$mcrd = \frac{1}{{e_{\text{emax}}}^2 \cdot {\lambda_C}^3}$$

Magnetic Charge Rotational Density (*mcrd*) is a fundamental unit in the Aether Physics Model that quantifies the concentration of magnetic charge in relation to rotational and resonant phenomena. It represents the density of magnetic charge as it interacts with dynamic, rotating systems or high-frequency environments.

Physical significance: Magnetic Charge Rotational Density provides insights into how magnetic fields behave in dynamic systems, particularly those involving rotation, resonance, or high-frequency oscillations. It bridges the gap between static magnetic properties and their behavior in more complex, moving systems.

Applications: This unit is crucial for understanding and modeling magnetic phenomena in various contexts, including:

Astrophysical systems with strong rotational components (e.g., pulsars, magnetars)

Quantum-level magnetic resonance phenomena

High-frequency electronic and quantum devices

Vortex-like structures in space and their interaction with magnetic fields

In the Aether Physics Model, *mcrd* serves as a key concept for unifying our understanding of magnetic behavior across different scales and dynamic conditions, from quantum-level interactions to large-scale astrophysical phenomena.

Quantum Illumination Density `qild`

QMU primitive representation: $\text{qild} = \dfrac{1}{{\lambda_C}^2 \, {F_q}^3 \, {e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{qild}\,\text{ball} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qild = \frac{1}{{e_{\text{emax}}}^2 \cdot {\lambda_C}^2 \cdot {F_q}^3}$$

Physical interpretation:

Represents the density of quantum illumination events in space and time

Quantifies the rate of quantum interactions or excitations per unit area and frequency

Describes the intensity of quantum activity in terms of both spatial and temporal dimensions

Significance:

Emerges from the APM's concept of relating quantum events to both space and time

Provides a measure of how "active" or "energetic" a quantum system is in terms of illumination events

Inversely related to magnetic charge, area, and frequency cubed, emphasizing the complex interplay between charge, space, and time in quantum phenomena

Potential applications:

Analyzing the distribution of quantum excitation events in various systems

Characterizing the intensity of light-matter interactions at the quantum level

Studying the relationship between spatial scale, frequency, and quantum activity

Describing the "quantum illumination capacity" of different physical environments or materials

The Quantum Illumination Density (*qild*) unit offers a unique perspective on how quantum excitation or illumination events are distributed in both space and time. By incorporating magnetic charge (${e_{\text{emax}}}^2$), area (${\lambda_C}^2$), and frequency (${F_q}^3$), *qild* allows for a comprehensive quantification of quantum activity.

This unit is particularly useful for describing scenarios where we need to consider the concentration of quantum events or processes in terms of both their spatial distribution and temporal frequency. It could be instrumental in understanding phenomena such as:

Quantum optics and light-matter interactions

Fluorescence and phosphorescence processes at the quantum level

Quantum sensing and detection mechanisms

Energy transfer processes in photosynthetic systems

The inverse relationship with magnetic charge, area, and frequency cubed emphasizes how quantum illumination events are sensitive to changes in charge distribution, spatial scale, and temporal dynamics. This could lead to insights into threshold effects or phase transitions in quantum optical systems.

Note: The *qild* unit in the APM framework provides a tool for exploring the distribution and intensity of quantum illumination phenomena in both space and time. It bridges the gap between charge-based, spatial, and temporal descriptions of quantum behavior. This unit is distinct from others in the APM as it specifically focuses on the density of quantum illumination events, providing a new way to quantify and visualize the "quantum optical activity" of different systems or environments.

This unit could be particularly relevant in discussions of quantum optics, quantum information processing, and in understanding the fundamental nature of light-matter interactions at the quantum scale. It may offer new perspectives on how quantum systems absorb, emit, or interact with light, and how these processes are influenced by the spatial and temporal characteristics of the system. The *qild* unit might also be useful in developing new quantum sensing technologies, optimizing quantum communication protocols, or understanding complex quantum optical phenomena in biological systems.

Quantum Electric Charge Flux `qecf`

QMU primitive representation: $\mathrm{qecf} = \dfrac{1}{{\lambda_C}^2\,{F_q}^2\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qecf}\,\mathrm{plsm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qecf = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^2 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Electric Charge Flux ($qecf$) unit represents the rate of change of electric charge distribution over a quantum surface area. It combines aspects of inverse magnetic charge, inverse quantum area, and inverse squared frequency to describe the dynamic behavior of electric charge in a two-dimensional quantum system.

Characteristics:

As a dynamic unit, it describes active processes involving electric charge movement or redistribution.

The inverse ${e_{\mathrm{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge flux relates to magnetic properties.

The inverse ${\lambda_C}^2$ term implies a surface nature, suggesting this unit describes charge flux over a

two-dimensional quantum area.

The inverse ${F_q}^2$ term indicates a moderate frequency dependence, suggesting the unit's relevance to charge dynamics at quantum timescales.

Potential applications:

Analyzing the flow of electric charge across quantum surfaces or interfaces

Studying charge transfer processes in two-dimensional quantum systems

Characterizing the dynamics of charge redistribution in quantum Hall effect systems

Investigating the interplay between electric charge flux and magnetic phenomena in planar quantum structures

This dynamic unit could be particularly useful in understanding the behavior of electric charge in quantum systems, especially for phenomena occurring on surfaces or in two-dimensional structures. It might provide insights into charge transport in 2D materials, surface plasmon dynamics, or the behavior of charge carriers in quantum wells. The *qecf* unit could help in developing models of how electric charge redistributes and flows in planar quantum systems, potentially leading to new understanding in areas such as nanoelectronics, quantum sensing, and topological quantum computing.

Charge Surface - Temporal Confinement Coefficient `cscc`

QMU primitive representation: $\mathrm{cscc} = \dfrac{1}{{\lambda_C}^2 \, F_q \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{cscc}\,\mathrm{magm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$cscc = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^2 \cdot F_q}$$

The Charge Surface Temporal Confinement Coefficient (*cscc*) is a unit in the Quantum Measurement Units (QMU) system that relates time to surface charge ($sfch$). It quantifies the temporal confinement or persistence of charge on a surface. The equation $cscc = \frac{time}{sfch}$ suggests that *cscc* represents the amount of time associated with a unit of surface charge.

Nature of *cscc*: The *cscc* unit provides insights into the temporal behavior of charge distributed on a surface. It indicates how long a given amount of charge remains confined or localized on a surface before dissipating or redistributing. A higher *cscc* value implies that the charge is more strongly confined and persists for a longer time, while a lower *cscc* value suggests that the charge dissipates or spreads out more quickly.

The *cscc* unit is relevant in understanding the dynamics of charge distribution and the stability of charged surfaces. It takes into account the interplay between the amount of charge present on a surface and the time scale over which the charge remains localized. This temporal aspect of charge confinement is crucial in various electromagnetic phenomena and applications.

How engineers can use *cscc*:

Surface charge analysis: Engineers can use *cscc* to analyze the temporal behavior of charge on surfaces in various devices and systems. By measuring or calculating *cscc*, they can determine how long a specific amount of charge remains confined on a surface before dissipating. This information is valuable in designing and optimizing systems where charge stability and longevity are important factors.

Insulator and dielectric material selection: The *cscc* unit can aid engineers in selecting appropriate insulator or dielectric materials for specific applications. Materials with higher *cscc* values can provide better charge confinement and longer retention times, which may be desirable in applications such as capacitors, electrostatic devices, or charge storage systems.

Charge dissipation and leakage prevention: Understanding the *cscc* of a system can help engineers identify potential issues related to charge dissipation or leakage. By analyzing the *cscc* values of different components or surfaces, engineers can pinpoint areas where charge confinement is weaker and implement measures to improve charge retention, such as using materials with higher *cscc* or optimizing surface geometries.

Electrostatic discharge (ESD) protection: The *cscc* unit can be relevant in designing ESD protection systems. By considering the *cscc* values of different surfaces and materials, engineers can develop strategies to minimize the buildup and sudden discharge of static electricity. This knowledge can help create robust ESD protection measures and ensure the reliability of sensitive electronic components.

Charge transfer and interactions: In systems where charge transfer or interactions between surfaces are crucial, such as in contact electrification or triboelectric devices, understanding the *cscc* of the involved surfaces can provide insights into the efficiency and dynamics of the charge transfer process. Engineers can optimize the design of such systems by considering the temporal confinement of charge on the interacting surfaces.

The Charge Surface Temporal Confinement Coefficient (*cscc*) offers a valuable tool for engineers to analyze and optimize the temporal behavior of charge on surfaces. By incorporating *cscc* into their design considerations, engineers can make informed decisions regarding material selection, charge stability, and system performance in various electromagnetic applications.

Charge Surface Confinement Coefficient `chcc`

QMU primitive representation: $\mathrm{chcc} = \dfrac{1}{{\lambda_C}^2\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{chcc}\,\mathrm{sfch} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$chcc = \frac{1}{{e_{\mathrm{emax}}}^2 {\lambda_C}^2}$$

The Charge Surface Confinement Coefficient (*chcc*) has a multifaceted nature, representing the spatial confinement of magnetic charge on a surface. It can be interpreted in several ways, depending

on the specific relationship being emphasized:

Magnetic Charge Affinity and Area:

The equation $chcc = \frac{mcaf}{area}$ describes the charge surface confinement coefficient as the ratio of magnetic charge affinity ($mcaf$) to area ($area$).

In this context, *chcc* represents the magnetic charge affinity per unit area, indicating the surface's ability to accommodate magnetic charge.

This perspective is valuable for understanding how the surface's magnetic properties influence the spatial confinement of magnetic charge.

Magnetic Current and Sweep:

The equation $chcc = \frac{mcur}{swep}$ relates the charge surface confinement coefficient to magnetic current ($mcur$) and sweep (swep).

It suggests that *chcc* represents the magnetic current per unit sweep, indicating the relationship between the flow of magnetic charge and the angular velocity of the surface.

This perspective is useful for understanding how the dynamic properties of the surface and the magnetic current contribute to the spatial confinement of magnetic charge.

Frequency and Magnetic Moment:

The equation $chcc = \frac{freq}{magm}$ links the charge surface confinement coefficient to frequency ($freq$) and magnetic moment ($magm$).

It suggests that *chcc* is the ratio of frequency to magnetic moment, indicating the contribution of frequency to the spatial confinement of magnetic charge relative to the magnetic moment.

This perspective is valuable for understanding how the oscillatory behavior of the surface and the magnetic moment affect the spatial confinement of magnetic charge.

Magnetic Charge per Photon and Acceleration:

The equation $chcc = mcpp \cdot accl$ links the charge surface confinement coefficient to the magnetic charge per photon ($mcpp$) and acceleration ($accl$).

It suggests that *chcc* is the product of magnetic charge per photon and acceleration, indicating the combined effect of the magnetic charge associated with photons and the acceleration of the surface on the spatial confinement of magnetic charge.

This perspective is valuable for understanding how the interaction between photons and the surface, along with the surface's acceleration, contribute to the spatial confinement of magnetic charge.

Quantum Electric Charge Jerk `qecj`

QMU primitive representation: $\mathrm{qecj} = \dfrac{1}{\lambda_C \, {F_q}^3 \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qecj}\,\mathrm{efdr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qecj = \frac{1}{{e_{\text{emax}}}^2 \cdot \lambda_C \cdot {F_q}^3}$$

Physical interpretation: The Quantum Electric Charge Jerk ($qecj$) unit represents the rate of change of electric charge acceleration along a quantum linear dimension. Its dual relationships $qecj = \frac{ecfx}{accl}$ and $qecj = \frac{qtrl}{magm}$ provide complementary insights into its nature. The first relationship shows how charge fluctuations relate to acceleration, revealing $qecj$ as a measure of the rate of change of charge acceleration in quantum systems. The second relationship demonstrates how quantum trajectory length relates to magnetic moment, indicating $qecj$'s role in connecting spatial paths with magnetic properties.

Key mathematical relationships define $qecj$'s various aspects: The $\frac{ecfx}{accl}$ relationship emphasizes its role in describing rapid changes in charge acceleration, while the $\frac{qtrl}{magm}$ relationship reveals how these changes connect to both the spatial trajectory and magnetic properties of the system. The unit's inverse dependence on ${e_{\text{emax}}}^2$ links it to magnetic charge, while the $\lambda_C \cdot {F_q}^3$ term indicates its strong relationship with both spatial dimension and high-frequency temporal dynamics.

This unit is particularly significant in quantum systems where understanding the relationship between charge dynamics and magnetic properties is crucial. It provides insights into how charge acceleration changes relate to both the spatial paths of quantum systems and their magnetic moments, making it essential for analyzing rapid changes in quantum charge behavior. The strong frequency dependence (${F_q}^3$) suggests qecj is especially relevant to high-frequency quantum phenomena involving rapid changes in charge acceleration.

The unit bridges the dynamic aspects of charge behavior with both geometric and magnetic properties of quantum systems, offering a comprehensive tool for analyzing rapid changes in quantum charge motion. It is particularly valuable for understanding systems where charge acceleration undergoes rapid changes while simultaneously considering the system's spatial trajectory and magnetic characteristics.

Quantum Electric Charge Acceleration `qeca`

QMU primitive representation:

$$\text{qeca} = \frac{1}{\lambda_C \, {F_q}^2 \, {e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{qeca}\,\text{acch} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{qeca} &= \frac{1}{\lambda_C \, {F_q}^2 \, {e_{\text{emax}}}^2} \\ &= \frac{1}{\text{chrg} \cdot \text{accl}} \\ &= \frac{1}{\text{chrg} \cdot \text{leng} \cdot \text{rson}} \\ &= \frac{1}{\text{acch}}.\end{aligned}} \tag{152}$$

These identities follow from the canonical QMU definitions

$$\begin{aligned}\text{chrg} &= {e_{\text{emax}}}^2, \\ \text{leng} &= \lambda_C, \\ \text{rson} &= {F_q}^2, \\ \text{accl} &= \lambda_C \, {F_q}^2, \\ \text{acch} &= \text{chrg} \cdot \text{accl}.\end{aligned}$$

Physical interpretation. Quantum Electric Charge Acceleration (qeca) describes the reciprocal dimensional relationship between distributed charge and acceleration within the Aether Physics Model (APM).

Unlike acceleration alone, qeca includes the inverse distributed-charge dimension. It is therefore the reciprocal of the combined charge-acceleration quantity, rather than an independently defined acceleration.

Within APM, physical charge is distributed through geometrical structure rather than concentrated at a dimensionless point. The qeca unit connects this distributed charge with the spatial and temporal dimensions governing accelerative motion.

The reciprocal relationship

$$\text{qeca} = \frac{1}{\text{acch}}$$

shows that qeca and charge acceleration (acch) are complementary QMU quantities.

For a fixed dimensional normalization, an increase in the charge-acceleration quantity corresponds to a decrease in its reciprocal.

This algebraic relationship does not, by itself, determine how a particular charge distribution accelerates under an applied electromagnetic interaction.

Relationship to quantum geometry. The primitive expression can also be written as

$$\boxed{\text{qeca} = \frac{1}{\text{chrg}} \cdot \frac{1}{\text{leng}} \cdot \frac{1}{\text{rson}}.} \tag{153}$$

This separates the contributions of distributed magnetic charge, length, and resonance.

In QMU,

$$\text{rson} = {F_q}^2$$

is the resonance quantity, which has the dimension of frequency squared. It is not interchangeable with an ordinary resonant frequency.

The relationship illustrates how qeca combines reciprocal charge geometry with reciprocal spatial extent and reciprocal resonance.

Because the temporal structure of the Aether is integral to APM chronogeometry, these relationships offer a useful dimensional framework for investigating charge-dependent accelerative interactions.

Physical applications. Quantum Electric Charge Acceleration provides a dimensional reference for examining charge motion in confined geometries, field-driven acceleration, and time-dependent electromagnetic systems.

Potential applications include quantum transport, charge-carrier dynamics, electromagnetic interactions in one-dimensional structures, and changes in the motion of distributed charge under applied fields.

The qeca identity does not restrict these applications to one-dimensional physical systems. Its single length factor identifies the dimensional structure, while the geometry of an actual interaction may involve multiple spatial and temporal directions.

The magnitude and direction of physical acceleration must be determined from the corresponding APM force and interaction equations.

Research significance. Quantum Electric Charge Acceleration connects distributed magnetic charge, acceleration, length, and resonance within the QMU system.

Its reciprocal relationship with acch provides an alternative dimensional representation of charge-dependent accelerative response.

A useful research direction is to investigate whether the QMU formulation simplifies the calculation of charge acceleration in quantum-scale structures, especially where charge distribution and intrinsic Aether geometry affect electromagnetic motion.

Comparisons with conventional SI descriptions can be developed using the established QMU Charge Conversion Factor framework, including the applicable conversion exceptions.

The relevant methodology is presented in [14; 15].

The canonical QMU relationships provide the dimensional foundation for these investigations, while specific physical predictions follow from the corresponding interaction geometry and dynamical laws.

Quantum Electric Charge Drift `qecd`

QMU primitive representation: $\mathrm{qecd} = \dfrac{1}{\lambda_C \, F_q \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qecd}\,\mathrm{chvl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$qecd = \frac{1}{{e_{\mathrm{emax}}}^2 \lambda_C F_q}$$

Physical interpretation: The Quantum Electric Charge Drift (*qecd*) unit represents the slow, steady movement of electric charge along a quantum linear dimension. It combines aspects of inverse magnetic charge, inverse Compton wavelength, and inverse quantum frequency to describe the gradual drift of electric charge in a one-dimensional quantum system.

Characteristics:

As a dynamic unit, it describes active processes involving steady motion of electric charge.

The inverse ${e_{\mathrm{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge drift relates to magnetic properties.

The inverse λ_C term implies a linear nature, suggesting this unit describes charge drift along a one-dimensional quantum path.

The inverse F_q term indicates a lower frequency dependence compared to *qeca* and *qecj*, suggesting the unit's relevance to slower, more sustained charge motion at quantum timescales.

Potential applications:

Analyzing the steady flow of electric charges in quantum wire-like structures

Studying charge carrier transport in one-dimensional quantum systems under constant fields

Characterizing the long-term dynamics of charge flow in quantum transport phenomena

Investigating the interplay between electric charge drift and magnetic effects in linear quantum structures

This dynamic unit could be particularly useful in understanding the behavior of slowly moving electric charges in quantum systems, especially for phenomena occurring in linear or one-dimensional structures. It might provide insights into steady-state electron flow in nanowires, the behavior of charge carriers in quantum Hall edge states under constant conditions, or the dynamics of charges in molecular wires subject to constant fields. The *qecd* unit could help in developing models of how electric charge moves steadily in linear quantum systems, potentially leading to new understanding in areas such as quantum electronics, nanofluidics of charge, and quantum information transport in linear architectures under steady-state conditions.

Quantum Electric Charge Displacement `ecdp`

QMU primitive representation: $\mathrm{ecdp} = \dfrac{1}{\lambda_C \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{ecdp}\,\mathrm{chgl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$ecdp = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot \lambda_C}$$

Physical interpretation: The Quantum Electric Charge Displacement (*ecdp*) unit represents the spatial shift or displacement of electric charge along a quantum linear dimension. It combines aspects of inverse magnetic charge and inverse Compton wavelength to describe the static displacement of electric charge in a one-dimensional quantum system.

Characteristics:

As a dynamic unit, it describes the result of charge movement rather than the movement itself.

The inverse ${e_{\mathrm{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge displacement relates to magnetic properties.

The inverse λ_C term implies a linear nature, suggesting this unit describes charge displacement along a one-dimensional quantum path.

The absence of an F_q term indicates that this unit is independent of frequency, representing a static or time-independent displacement.

Potential applications:

Analyzing the spatial distribution of electric charges in quantum wire-like structures

Studying charge separation in one-dimensional quantum systems

Characterizing the static charge configuration in quantum devices

Investigating the interplay between electric charge displacement and magnetic effects in linear quantum structures

This dynamic unit could be particularly useful in understanding the spatial arrangement of electric charges in quantum systems, especially for phenomena occurring in linear or one-dimensional structures. It might provide insights into charge separation in quantum dots arranged in a line, the distribution of charges in molecular wires, or the static charge configuration in quantum computing qubits based on charge states. The *ecdp* unit could help in developing models of how electric charge is spatially distributed in linear quantum systems, potentially leading to new understanding in areas such as quantum electronics, static charge configurations in nanodevices, and quantum information storage based on charge positions.

Quantum Electric Charge Intensity `qeci`

QMU primitive representation: $\mathrm{qeci} = \dfrac{1}{{F_q}^3\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qeci}\,\mathrm{efti} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qeci = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot {F_q}^3}$$

Physical interpretation: The Quantum Electric Charge Intensity (*qeci*) unit represents the concentration or intensity of electric charge fluctuations in a quantum system, independent of spatial dimensions. It combines aspects of inverse magnetic charge and inverse cube of quantum frequency to describe the dynamic intensity of electric charge behavior at high frequencies.

Characteristics:

As a dynamic unit, it describes the intensity of charge fluctuations rather than spatial distribution.

The inverse ${e_{\mathrm{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge intensity relates to magnetic properties.

The absence of a λ_C term implies this unit describes charge intensity independent of specific spatial dimensions.

The inverse ${F_q}^3$ term indicates a strong frequency dependence, suggesting the unit's relevance to rapid, high-frequency charge fluctuations.

Potential applications:

Analyzing the intensity of electric charge fluctuations in quantum systems

Studying high-frequency charge dynamics in quantum electrodynamics

Characterizing the strength of charge-related quantum effects in various systems

Investigating the interplay between intense electric charge fluctuations and magnetic phenomena

This dynamic unit could be particularly useful in understanding the behavior of electric charges undergoing rapid fluctuations in quantum systems, especially in contexts where spatial dimensions are less relevant than the intensity and frequency of the fluctuations. It might provide insights into phenomena such as vacuum polarization, the dynamic Casimir effect, or the behavior of virtual particles in intense electromagnetic fields. The *qeci* unit could help in developing models of how electric charge behaves in highly dynamic quantum environments, potentially leading to new understanding in areas such as quantum field theory, high-energy physics, and the study of quantum vacuum fluctuations.

Quantum Electric Charge Oscillation `qeco`

QMU primitive representation: $\text{qeco} = \dfrac{1}{{F_q}^2\,{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{qeco}\,\text{chrs} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qeco = \frac{1}{{e_{\text{emax}}}^2 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Electric Charge Oscillation (*qeco*) unit represents the amplitude or strength of electric charge oscillations in a quantum system, independent of spatial dimensions. It combines aspects of inverse magnetic charge and inverse square of quantum frequency to describe the dynamic oscillatory behavior of electric charge at the quantum scale.

Characteristics:

As a dynamic unit, it describes the oscillatory nature of charge behavior rather than static distribution.

The inverse ${e_{\text{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge oscillations relate to magnetic properties.

The absence of a λ_C term implies this unit describes charge oscillations independent of specific spatial dimensions.

The inverse ${F_q}^2$ term indicates a moderate frequency dependence, suggesting the unit's relevance to resonant or periodic charge behavior.

Potential applications:

Analyzing the strength of electric charge oscillations in quantum systems

Studying resonant charge behavior in quantum electrodynamics

Characterizing the amplitude of charge-related quantum oscillations in various systems

Investigating the interplay between oscillating electric charges and magnetic phenomena

This dynamic unit could be particularly useful in understanding the behavior of electric charges undergoing periodic or resonant oscillations in quantum systems, especially in contexts where spatial dimensions are less relevant than the amplitude and frequency of the oscillations. It might provide insights into phenomena such as plasmon resonances, quantum harmonic oscillators, or the behavior of bound charges in atoms and molecules. The *qeco* unit could help in developing models of how electric charge behaves in oscillatory quantum environments, potentially leading to new understanding in areas such as quantum optics, molecular spectroscopy, and the study of quantum resonant phenomena.

Quantum Electric Charge Fluctuation `ecfx`

QMU primitive representation: $\mathrm{ecfx} = \dfrac{1}{F_q \, {e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{ecfx}\,\mathrm{curr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$ecfx = \frac{1}{{e_{\mathrm{emax}}}^2 \cdot F_q}$$

Physical interpretation: The Quantum Electric Charge Fluctuation ($ecfx$) unit represents the magnitude of electric charge variations or fluctuations in a quantum system over a single quantum time period, independent of spatial dimensions. It combines aspects of inverse magnetic charge and inverse quantum frequency to describe the basic dynamic behavior of electric charge at the quantum scale.

Characteristics:

As a dynamic unit, it describes the fundamental fluctuations of charge behavior rather than static distribution.

The inverse ${e_{\mathrm{emax}}}^2$ term suggests a relationship with the reciprocal of magnetic charge, potentially indicating how electric charge fluctuations relate to magnetic properties.

The absence of a λ_C term implies this unit describes charge fluctuations independent of specific spatial dimensions.

The inverse F_q term indicates a basic frequency dependence, suggesting the unit's relevance to the most fundamental temporal scale of charge behavior.

Potential applications:

Analyzing the basic fluctuations of electric charge in quantum systems

Studying fundamental charge behavior in quantum electrodynamics

Characterizing the intrinsic variability of charge-related quantum phenomena in various systems

Investigating the interplay between fluctuating electric charges and magnetic phenomena at the most basic quantum level

This dynamic unit could be particularly useful in understanding the most fundamental behavior of electric charges undergoing fluctuations in quantum systems, especially in contexts where spatial dimensions are less relevant than the basic temporal variations of charge. It might provide insights into phenomena such as quantum noise in electronic systems, fundamental limits of charge stability, or the intrinsic variability of charge in quantum measurements. The $ecfx$ unit could help in developing models of how electric charge behaves at the most basic quantum timescales, potentially leading to new understanding in areas such as quantum metrology, fundamental limits of quantum electronics, and the study of quantum fluctuations in various physical systems.

Magnetic Charge Affinity `mcaf`

QMU primitive representation:

$$\mathrm{mcaf} = \frac{1}{{e_{\mathrm{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mcaf}\,\mathrm{chrg} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\mathrm{mcaf} = \frac{1}{\mathrm{chrg}} = \frac{\mathrm{mchg}}{\mathrm{mass}}.} \tag{154}$$

These relationships follow from the canonical definitions of distributed magnetic charge and the universal mass-to-charge ratio:

$$\mathrm{chrg} = {e_{\mathrm{emax}}}^2, \qquad \mathrm{mchg} = \frac{m_{\mathrm{e}}}{{e_{\mathrm{emax}}}^2}.$$

Magnetic Charge Affinity therefore provides the reciprocal charge dimension underlying numerous QMU electromagnetic relationships.

Physical interpretation. Magnetic Charge Affinity describes the reciprocal capacity associated with distributed magnetic charge in the Aether Physics Model (APM).

Where chrg expresses the magnitude of distributed magnetic charge, mcaf provides its inverse dimensional representation.

Within APM, charge is distributed through physical geometry rather than concentrated at dimensionless points. Magnetic Charge Affinity consequently provides a useful reference for describing interactions normalized to the participating magnetic charge.

The term *affinity* identifies this reciprocal relationship; it does not independently specify magnetic attraction, repulsion, or binding strength. These physical effects depend on the geometry and orientation of interacting charges.

Unified Charge Equation. The APM Unified Charge Equation relates electrostatic and distributed magnetic charge:

$$\boxed{e^2 = 8\pi\alpha\,{e_{\mathrm{emax}}}^2.} \tag{155}$$

Rearranging gives

$$\boxed{\text{mcaf} = \frac{8\pi\alpha}{e^2}.} \tag{156}$$

This expresses Magnetic Charge Affinity through the electrostatic charge quantity and the APM charge-interaction ratio.

The relationship preserves the distinction between distributed magnetic charge and electrostatic charge rather than treating them as identical physical quantities.

Research significance. Magnetic Charge Affinity provides a fundamental reciprocal charge dimension for analyzing particle geometry, electromagnetic coupling, and interactions involving distributed magnetic charge.

Its connection to the universal mass-to-charge ratio and Unified Charge Equation makes it particularly useful for comparing the magnetic-charge structures of different particle species.

A useful research direction is to examine how charge-normalized QMU relationships simplify calculations of magnetic interactions, binding geometry, and electromagnetic response.

The canonical identities establish the dimensional framework, while physical interaction strengths follow from the corresponding APM geometrical and dynamical relationships.

Substrate units

Quantum Electric Field Volumetric Resonance `efvr`

QMU primitive representation: $\text{efvr} = {\lambda_C}^3 {F_q}^3 {e_{\text{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{efvr}\,\text{qpmd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efvr = {e_{\text{emax}}}^2 \cdot {\lambda_C}^3 \cdot {F_q}^3$$

Physical interpretation: The Quantum Electric Field Volumetric Resonance ($efvr$) unit represents the capacity of the quantum Aether substrate to support and sustain resonant electric field oscillations within a quantum volume. It combines aspects of magnetic charge, quantum volume, and quantum frequency cubed to describe the underlying structure's propensity for maintaining coherent electric field oscillations in three-dimensional space.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its ability to support volumetric electric field resonances.

The ${\lambda_C}^3$ term implies a volumetric nature, suggesting this unit describes the substrate's resonant properties over a three-dimensional quantum space.

The ${F_q}^3$ term indicates a strong frequency dependence, suggesting the substrate's capacity to maintain high-frequency volumetric oscillations.

Potential applications:

Analyzing the quantum vacuum's ability to sustain standing electric field waves in three-dimensional cavities

Studying how the Aether substrate supports electric field resonances in volumetric quantum systems

Characterizing the fundamental resonant modes of electric fields in quantum volumetric structures

Investigating the interplay between electric and magnetic phenomena in three-dimensional quantum resonant systems

This substrate unit could be particularly useful in understanding the fundamental nature of electric field resonances in three-dimensional quantum systems. It might provide insights into cavity quantum electrodynamics, volumetric plasmon resonances, or the behavior of resonant electric fields in quantum dots and other three-dimensional nanostructures. The $efvr$ unit could help in developing models of how the quantum Aether supports and sustains resonant electric field behavior in volumetric systems, potentially leading to new understanding in areas such as quantum optics, three-dimensional quantum computing architectures, and volumetric quantum sensing technologies.

Quantum Electric Field Volumetric Adaptability `efva`

QMU primitive representation: $\mathrm{efva} = {\lambda_C}^3 \, {F_q}^2 \, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{efva} \cdot \mathrm{mcpp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efva = {e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^3 \cdot {F_q}^2$$

Physical interpretation: The Quantum Electric Field Volumetric Adaptability ($efva$) unit represents the capacity of the quantum Aether substrate to adapt to and accommodate changes in electric field configurations within a quantum volume. It combines aspects of magnetic charge, quantum volume, and quantum frequency squared to describe the underlying structure's flexibility in response to electric field variations in three-dimensional space.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\mathrm{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its ability to adapt to volumetric electric field changes.

The ${\lambda_C}^3$ term implies a volumetric nature, suggesting this unit describes the substrate's adaptive properties over a three-dimensional quantum space.

The ${F_q}^2$ term indicates a moderate frequency dependence, suggesting the substrate's capacity to accommodate changes in field configurations at a rate lower than the resonant frequency.

Potential applications:

Analyzing the quantum vacuum's flexibility in adjusting to changing electric field patterns in three-dimensional spaces

Studying how the Aether substrate accommodates electric field reconfigurations in volumetric quantum systems

Characterizing the responsiveness of quantum volumes to electric field perturbations

Investigating the interplay between electric field adaptability and magnetic phenomena in three-dimensional quantum systems

This substrate unit could be particularly useful in understanding how three-dimensional quantum systems respond to and accommodate changes in electric field configurations. It might provide insights into the behavior of quantum fluids, the adaptability of quantum materials to external electric fields, or the response of three-dimensional quantum states to perturbations. The $efva$ unit could help in developing models of how the quantum Aether adapts to changing electric field patterns in volumetric systems, potentially leading to new understanding in areas such as quantum material science, three-dimensional quantum state engineering, and adaptive quantum sensing technologies.

Quantum Electric Field Volumetric Compliance `efvc`

QMU primitive representation: $\mathrm{efvc} = {\lambda_C}^3 \, F_q \, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{efvc}\,\mathrm{mcdr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$efvc = {e_{\mathrm{emax}}}^2 {\lambda_C}^3 F_q$$

Physical interpretation: The Quantum Electric Field Volumetric Compliance ($efvc$) unit represents the capacity of the quantum Aether substrate to yield or deform in response to applied electric fields within a quantum volume. It combines aspects of magnetic charge, quantum volume, and quantum frequency to describe the underlying structure's elasticity or "softness" in response to electric field stress in three-dimensional space.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\mathrm{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its compliance to volumetric electric fields.

The ${\lambda_C}^3$ term implies a volumetric nature, suggesting this unit describes the substrate's compliant properties over a three-dimensional quantum space.

The F_q term indicates a lower frequency dependence compared to $efvr$ and $efva$, suggesting the substrate's capacity to respond to slower, more gradual changes in electric field stress.

Potential applications:

Analyzing the quantum vacuum's "elasticity" in response to electric field stress in three-dimensional spaces

Studying how the Aether substrate deforms under electric field influence in volumetric quantum systems

Characterizing the "softness" or "hardness" of quantum volumes to electric field perturbations

Investigating the interplay between electric field compliance and magnetic phenomena in three-dimensional quantum systems

This substrate unit could be particularly useful in understanding how three-dimensional quantum systems deform or yield in response to applied electric fields. It might provide insights into the behavior of quantum materials under electric stress, the compliance of quantum vacuum to field perturbations, or the response of three-dimensional quantum states to gradual field changes. The $efvc$ unit could help in developing models of how the quantum Aether "gives way" to electric fields in volumetric systems, potentially leading to new understanding in areas such as quantum elasticity, three-dimensional quantum state manipulation, and the fundamental nature of space-time compliance to electromagnetic influences.

Charge Volume `chvm`

QMU primitive representation: $\mathrm{chvm} = {\lambda_C}^3\,{e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{chvm}\,\mathrm{mcrd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Charge Volume ($chvm$) unit has a multifaceted nature, representing the quantum volume associated with magnetic charge. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Magnetic Charge and Volume:

The equation $chvm = chrg \cdot volm$ describes charge volume as the product of magnetic charge ($chrg$) and volume ($volm$).

In this context, charge volume represents the total magnetic charge distributed within a given volume.

This perspective is useful for understanding the volumetric distribution and concentration of magnetic charge in quantum systems.

Magnetic Moment and Dynamic Length:

The equation $chvm = magm \cdot dynl$ relates charge volume to the magnetic moment ($magm$) and dynamic length ($dynl$).

It suggests that charge volume represents the magnetic moment scaled by the dynamic length,

indicating the volumetric extent of magnetic charge associated with the magnetic moment and the system's dynamic length scale.

This perspective is valuable for understanding how charge volume relates to the magnetic moment and the dynamic length scale.

Quantum Intensity Resistance and Electric Field Volumetric Resonance:

The equation $chvm = qire \cdot efvr$ links charge volume to the quantum intensity resistance ($qire$) and electric field volumetric resonance ($efvr$).

It suggests that charge volume is the product of quantum intensity resistance and electric field volumetric resonance, indicating the volumetric extent of magnetic charge associated with the system's resistance to quantum intensity variations and its capacity to support electric field oscillations within a volume.

This perspective is valuable for understanding how charge volume relates to the system's stability against rapid changes and its ability to sustain electric oscillations within a volume.

Current and Volume-Time:

The equation $chvm = curr \cdot vlmt$ links charge volume to the current ($curr$) and volume-time ($vlmt$).

It suggests that charge volume is the product of current and volume-time, indicating the volumetric extent of magnetic charge associated with the flow of magnetic charge and the system's fundamental space-time properties.

This perspective is valuable for understanding how charge volume relates to the flow of magnetic charge and the system's persistence in space-time.

Ball Lightning `ball`

QMU primitive representation:

$$\mathrm{ball} = {\lambda_C}^2 \, {F_q}^3 \, {e_{\mathrm{emax}}}^2.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ball}\,\mathrm{qild} = 1.$$

Primitive relationships.

$$\boxed{\begin{aligned} \mathrm{ball} &= \mathrm{plsm} \cdot \mathrm{freq} \\ &= \mathrm{ligt} \cdot \mathrm{curl} \\ &= \frac{1}{\mathrm{qild}}. \end{aligned}} \tag{157}$$

Physical interpretation and APM model. Ball Lightning represents a QMU dimensional quantity associated with the formation of localized, luminous electromagnetic structures.

The Aether Physics Model (APM) develops this quantity in a spherical-plasmoid formulation based on distributed-charge geometry, magnetic flux, intrinsic Aether curl, and resonance.

In addition to the catalog identities, the published formulation establishes

$$\boxed{\text{ball} = ({e_{\text{emax}}}^2\,\lambda_C)(\text{mflx}\cdot\text{curl}\cdot\text{rson}).} \tag{158}$$

Consequently,

$$\boxed{\frac{\text{ball}}{\text{mflx}\cdot\text{curl}\cdot\text{rson}} = {e_{\text{emax}}}^2\,\lambda_C.} \tag{159}$$

The factor ${e_{\text{emax}}}^2\,\lambda_C$ provides the characteristic spherical-charge scale in the APM interpretation, while magnetic flux, curl, and resonance describe the associated dynamical and geometrical contributions.

Formation and stability. The companion QADI ball-lightning paper develops a minimal Lagrangian for a quasi-spherical plasmoid using magnetic flux, rotational phase, and effective radius as generalized coordinates.

Its construction incorporates magnetic flux storage, rotational stiffness, electromagnetic driving, and spherical confinement geometry.

The resulting equilibrium and small-oscillation analysis identifies conditions for stationary luminous configurations and stable perturbations.

Extensions examine chronovibrational coupling and multiple interacting modes.

These developments provide a physical model beyond the dimensional definition of the ball unit.

Experimental significance. The published APM formulation proposes laboratory tests of plasma onset, spherical-plasmoid formation, magnetic flux, effective curl, and resonance.

Its central objective is to determine whether stable luminous configurations exhibit reproducible relationships among these quantities across different gases, pressures, and experimental geometries.

Thermal and radiative measurements provide additional diagnostics of the resulting plasmoid state.

The dimensional invariant is established algebraically within QMU. Its proposed physical significance must be evaluated through independent measurements of plasmoid formation and stability.

The detailed Lagrangian, stability analysis, and experimental procedures are presented in the companion QADI paper, *Ball Lightning in Quantum Measurement Units (QMU): A Lagrangian Derivation, Universal Invariant, and Laboratory Protocols.*

Plasma `plsm`

QMU primitive representation:

$$\text{plsm} = {\lambda_C}^2 \, {F_q}^2 \, {e_{\text{emax}}}^2.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{plsm}\,\text{qecf} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned} \text{plsm} &= {\lambda_C}^2 {F_q}^2 {e_{\text{emax}}}^2 \\ &= \text{chrg} \cdot \text{temp} \\ &= \text{phtn} \cdot \text{curl} \\ &= \frac{1}{\text{qecf}}. \end{aligned}} \tag{160}$$

These relationships follow from the canonical QMU definitions

$$\text{chrg} = {e_{\text{emax}}}^2, \qquad \text{temp} = {\lambda_C}^2 {F_q}^2 = c^2,$$

together with

$$\text{phtn} = A_u \cdot \text{chrg}$$

and the fundamental Ledger One closure,

$$A_u \text{curl} = \text{temp}.$$

Consequently,

$$\boxed{\text{phtn} \cdot \text{curl} = \text{chrg} \cdot \text{temp}.} \tag{161}$$

This establishes the dimensional connection among the photon quantum, distributed magnetic charge, intrinsic Aether curl, and temperature.

Physical interpretation. Plasma describes a collective state of matter containing mobile charged particles whose electromagnetic interactions influence their motion and organization.

Within the Aether Physics Model (APM), plasma is understood through the interaction of distributed charge with the structured Aether medium.

The QMU identity

$$\text{plsm} = \text{chrg} \cdot \text{temp}$$

connects distributed magnetic charge with the fundamental temperature dimension.

In QMU, temp is a velocity-squared quantity, not simply a numerical reading on an SI temperature scale. Its application to an actual plasma requires the appropriate particle-energy and thermal normalization.

The complementary identity

$$\text{plsm} = \text{phtn} \cdot \text{curl}$$

connects the same dimensional quantity to the photon quantum and the intrinsic rotational geometry of the Aether.

This relationship places electromagnetic excitation and Aether curl directly within the dimensional structure of plasma.

Neither identity alone specifies plasma density, degree of ionization, temperature distribution, or collective stability. These physical properties follow from the relevant plasma interaction equations.

Aether–plasma coupling. The companion QADI research on Aether–Plasma Coupling develops a magnetohydrodynamic (MHD) framework expressed in QMU quantities.

The plasma is represented through mass density (masd), velocity (velc), pressure (pres), magnetic flux density (mfxd), and their spatial and temporal variations.

The Aether contributes through its rotational geometry, particularly the unified Aether area and curl.

An important result is the proposed Aether rotational diffusivity,

$$\boxed{\nu_{\text{Ae}} = \frac{A_u \text{curl}}{F_q} = {\lambda_C}^2 F_q = \text{swep.}} \tag{162}$$

This relationship connects the diffusivity scale directly with Ledger One and the QMU sweep quantity.

In the published MHD formulation, this diffusivity enters both the momentum and magnetic induction equations, representing additional rotational relaxation associated with Aether coupling.

The resulting model predicts wavenumber-dependent damping of Alfven-like, slow, and fast plasma modes.

For an Alfven-like mode, the proposed Aether contribution to the damping rate takes the form

$$\gamma_{\text{Ae}} = \nu_{\text{Ae}} k^2, \tag{163}$$

where k is the mode wavenumber.

This is a physical prediction of the APM plasma model, distinct from the canonical dimensional definition of the plsm unit.

Magnetic flux and plasma transport. Plasma transport also depends on magnetic field geometry, magnetic flux enclosure, particle motion, and the boundaries through which charge and energy are exchanged.

The QADI treatment of Bohm diffusion expresses cross-field transport through the QMU sweep quantity:

$$\boxed{D_{\mathrm{B}} = \frac{\Xi_{\mathrm{B}}}{16}\,\mathrm{swep.}} \tag{164}$$

Here, Ξ_{B} is a dimensionless closure coefficient associated with holonomy and boundary conditions, including sheath interactions and turbulent transport.

This formulation distinguishes intrinsic Aether transport scales from the configuration-dependent behavior of a particular plasma.

The same research connects enclosed magnetic flux with interferometric phase and distinguishes magnetic-charge transport in the plasma interior from electrostatic charge response at sheath boundaries.

These distinctions are essential to calculating measurable plasma transport rather than treating the plsm unit as an independent transport coefficient.

Alfvenic waves and circuit closure. The companion QADI Alfvenic plasma research develops wave propagation, field-aligned currents, double layers, and electrical circuit closure in QMU.

A central distinction is maintained between the magnetic-flux domain and the charge-converted electrical resistance domain.

The natural Alfvenic transmission quantity is expressed through Aether geometry as

$$Z_{\mathrm{APM}} = \sqrt{\frac{A_u}{\mathrm{curl}}} = \mathrm{mflx.} \tag{165}$$

Its charge-converted circuit representation is

$$\boxed{Z_{\Phi I} = \frac{Z_{\mathrm{APM}}}{\mathrm{chrg}} = \mathrm{resn.}} \tag{166}$$

This preserves the dimensional distinction between magnetic flux and electrical resistance while allowing plasma currents and electromagnetic transmission to be analyzed within a common QMU circuit framework.

Thermal and photomagnetic response. Plasma temperature, charge transport, and electromagnetic excitation are interconnected but describe distinct physical properties.

In particular, a plasma's conductivity, ionization state, and energy distribution depend on particle interactions, collisions, field geometry, and external energy sources.

The QADI laser–plasma research further develops photomagnetic activation through the qpmd and qild quantities.

These studies connect photon excitation, distributed magnetic charge, and measured hot-electron response, including comparisons with experimental laser–plasma datasets.

They provide a more detailed quantitative treatment of light-driven plasma activation than the plsm dimensional identity alone.

Research significance. Plasma provides a central application of QMU because its electromagnetic, thermal, and collective behavior involves several fundamental Aether quantities simultaneously.

The relationship

$$\text{plsm} = \text{chrg} \cdot \text{temp} = \text{phtn} \cdot \text{curl}$$

establishes its canonical dimensional foundation.

The companion QADI papers extend this foundation into plasma transport, magnetohydrodynamic wave propagation, rotational diffusivity, boundary closure, and laser-driven activation.

Particularly useful experimental comparisons include plasma-wave damping, resonator quality factors, cross-field diffusion, sheath response, and the behavior of field-aligned currents and double layers.

These measurements offer ways to distinguish proposed Aether coupling from conventional plasma transport and dissipation.

The plsm unit establishes the dimensional relationship, while the published plasma equations provide the corresponding physical models and testable predictions.

For complete derivations, see the QADI papers on Aether–Plasma Coupling, Bohm Transport Closure, Alfvenic Plasma Electrodynamics, and photomagnetic activation in laser–plasma systems.

Magnetic Moment `magm`

QMU primitive representation: $\text{magm} = {\lambda_C}^2 \, F_q \, {e_{\text{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{magm}\,\text{cscc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$magm = {e_{\text{emax}}}^2 \cdot {\lambda_C}^2 \cdot F_q$$

A magnetic moment measures the influence of the Aether's electrostatic charge against the magnetic charge of the subatomic particle.

Historical-value convention. The following 2004 and 2022 magnetic-moment figures are transcribed from the earlier QMU source as historical comparison values. Their date labels identify the source-era attribution, not an independent verification of the measurement release, reference convention, or covariance. Parenthetical digits are retained where present; values without them are not assigned zero uncertainty. Numerical comparisons are conditional until the source release and measurement conventions have been verified.

The original manuscript quotes the 2004 electron magnetic moment as $\mu_e = -928.476362 \times 10^{-26}\,\mathrm{J/T}$. This is a historical comparison value, not a native QMU definition.

The original manuscript quotes the 2022 electron magnetic moment as $\mu_e = -9.284764703(28) \times 10^{-24}\,\mathrm{J/T}$.

For a separately verified SI comparison, the 2022 CODATA adjustment reports:

$$\mu_e = -9.2847646917(29) \times 10^{-24}\,\mathrm{J/T},$$
$$\mu_e/\mu_B = -1.00115965218046(18).$$

The conventional signed electron g-factor is $g_e = 2\mu_e/\mu_B$ when the positive Bohr magneton is used as reference, yielding $g_e = -2.00231930436092(36)$ from the tabulated moment ratio. The difference between the historical quotation and the CODATA moment is $-1.13 \times 10^{-32}\,\mathrm{J/T}$; the original quotation is not treated as an independently sourced determination or subjected to a statistical discrepancy claim. These benchmark values are external SI data, not QMU predictions (NIST, *2022 CODATA adjustment*, constants table).

The quoted historical values use different numerical precision and reference epochs. Their difference alone does not demonstrate a failure of the stated measurement uncertainties: a statistical compatibility test requires the uncertainties, definitions, and correlations of both determinations. The historical values are retained for source fidelity; the following symbolic QMU identities do not depend on selecting either quoted SI value.

The original proposed QMU electron-moment correspondence is

$$\mu_e = g_e {\lambda_C}^2 F_q \frac{e\, {e_{\mathrm{emax}}}^2}{8\pi {e_{\mathrm{emax}}}^2}. \tag{167}$$

Any numerical SI–QMU interpretation requires an explicitly calibrated distributed-charge conversion.

Here g_e denotes the electron g-factor, determined experimentally through precision magnetic-moment measurements; it should not be described as a quantity measured solely from the Lamb shift. In the electron unit of magnetic moment, the magnetic charge cancels out since the electrons are acting on electrons. The charge terms are retained here as part of the original proposed QMU representation; the historical SI moment values quoted below are not independent validations of those QMU charge factors.

The g-factor is an essential value related to the magnetic moment of the subatomic particle, as it corrects for the precession of the subatomic particle.

The original manuscript quotes the 2004 proton magnetic moment as $\mu_p = 1.410606633 \times 10^{-26}\,\mathrm{J/T}$.

For a separately sourced modern SI benchmark, the 2022 CODATA adjustment gives the following values:

$$\begin{aligned}\mu_p &= 1.41060679545(60) \times 10^{-26}\,\mathrm{J/T},\\ \mu_N &= 5.0507837393(16) \times 10^{-27}\,\mathrm{J/T},\\ \mu_p/\mu_N &= 2.79284734463(82),\\ g_p &= 5.5856946893(16).\end{aligned}$$

The conventional proton g-factor is twice the quoted nuclear-magneton ratio. These values are SI reference data, not independently derived QMU predictions (NIST, *2022 CODATA adjustment*, NIST constants table). Parenthesized digits denote standard uncertainties in the final quoted places.

The original manuscript proposes the following QMU correspondence for the historically quoted proton magnetic moment:

$$\mu_p = g_p {\lambda_C}^2 F_q \frac{e \cdot {e_{\mathrm{emax}}}^2}{8\pi \cdot {e_{pmax}}^2} \tag{168}$$

Here the historical proton g-factor is quoted as 5.58569; its source-release precision and uncertainty are not established by this rounded value. ${e_{pmax}}^2$ is the magnetic charge of the proton, ${e_{\mathrm{emax}}}^2$ is the magnetic charge of the electron, and e is the elementary charge in single dimension charge.

Native QMU magnetic-moment construction.

The QMU unit definition is magm $= {e_{\mathrm{emax}}}^2 {\lambda_C}^2 F_q$. Particle-specific moment expressions must be obtained from the distributed electrostatic and magnetic charge geometry and its closure factors. Neither $\hbar$ nor a conventional magneton is a primitive in this construction. A particle-specific geometric factor and charge normalization are required before the unit expression can be interpreted as a predicted electron, proton, or neutron magnetic moment.

External SI comparison conventions (not QMU definitions).

In conventional SI notation the spin magnetic-moment operator of a charged particle is $\boldsymbol{\mu} = g(q/2m)\mathbf{S}$; for a spin-1/2 projection, $S_z = \pm\hbar/2$. The signed moment component therefore depends on the spin projection and charge sign. For nucleons, tabulated proton and neutron g factors use the *nuclear magneton* $\mu_N = e\hbar/(2m_p)$ as a common reference scale, so $\mu_p = (g_p/2)\mu_N$ and $\mu_n = (g_n/2)\mu_N$ with the appropriate signed convention. This use of m_p in the reference unit does not assert that the neutron's intrinsic moment is physically generated by proton magnetic charge. The neutron is electrically neutral, so its g factor here is defined by the nuclear-magneton convention rather than by inserting its net electric charge into the charged-particle formula. These SI equations are provided as a comparison convention; $\hbar$ is not a native QMU fundamental quantity.

Quantitative SI comparison protocol (external bridge).

For comparison with conventional data, define the Bohr and nuclear magnetons as

$$\mu_B = \frac{e\hbar}{2m_e}, \qquad \mu_N = \frac{e\hbar}{2m_p}, \qquad \frac{\mu_B}{\mu_N} = \frac{m_p}{m_e}. \tag{169}$$

The signed SI comparison values may then be expressed without assuming a QMU conversion:

$$\mu_e^{\mathrm{SI}} = -\frac{|g_e|}{2}\mu_B, \qquad \mu_p^{\mathrm{SI}} = \frac{g_p}{2}\mu_N, \qquad \mu_n^{\mathrm{SI}} = \frac{g_n}{2}\mu_N. \tag{170}$$

The signs here refer to moments projected on the corresponding spin direction; conventions must be fixed consistently before comparing signed values. The neutron expression uses the conventional nuclear-magneton normalization, despite the neutron's vanishing net electric charge. Let M_i^{QMU} be the particle-specific moment derived using native QMU quantities and let $K_{\mu,i}$ convert that expression to SI magnetic-moment units. A quantitative comparison requires

$$\mu_i^{\mathrm{pred,SI}} = K_{\mu,i} M_i^{\mathrm{QMU}}, \qquad \Delta_i = \mu_i^{\mathrm{pred,SI}} - \mu_i^{\mathrm{meas,SI}} \quad (i = e, p, n). \tag{171}$$

The conversion factors $K_{\mu,i}$ must be derived from a stated common base-unit convention and particle-specific charge geometry; they must not be independently fitted to each measured moment and then presented as predictions. Where the model claims a universal conversion factor, the same factor must be used for all three particles. The present unit ledger specifies $\mathrm{magm} = {e_{\mathrm{emax}}}^2 {\lambda_C}^2 F_q$, but does not by itself determine the SI numerical values of the $K_{\mu,i}$. Accordingly, numerical residuals Δ_i cannot yet be reported as verified QMU predictions.

A QMU reinterpretation of any of these moments requires an explicitly dimensioned SI–QMU magnetic-moment conversion, consistent particle-specific charge normalizations, and a numerical comparison with measured moments. Without that bridge, an alternative QMU neutron g factor is a proposed normalization or model prediction, not evidence that the tabulated NIST measurement is erroneous.

The original manuscript quotes the 2004 neutron magnetic moment as $\mu_n = -0.96623640 \times 10^{-26}\,\mathrm{J/T}$.

For a separately verified external SI benchmark, the 2022 CODATA adjustment gives

$$\begin{aligned} \mu_n &= -9.6623653(23) \times 10^{-27}\,\mathrm{J/T}, \\ \mu_n/\mu_N &= -1.91304276(45), \\ g_n &= -3.82608552(90). \end{aligned}$$

Here $g_n = 2\mu_n/\mu_N$ is the conventional nuclear-magneton normalization. These NIST values are a modern comparison standard, not native QMU predictions; the last quoted digits and uncertainties differ from the historical -3.82608545 quotation below (NIST, *2022 CODATA adjustment*, NIST constants table). The benchmark is not used to alter the historical proposed neutron geometry or normalization.

The original proposed QMU correspondence using the conventional neutron g factor is

$$\mu_n = g_{n,\mathrm{NIST}} {\lambda_C}^2 F_q \frac{e\, {e_{\mathrm{emax}}}^2}{8\pi {e_{\mathrm{pmax}}}^2}. \tag{172}$$

This is a proposed rewriting, not an equation supplied by NIST.

Here $g_{n,\mathrm{NIST}}$ denotes the historically quoted conventional neutron g-factor -3.82608545, whose nuclear-magneton reference convention must be retained when comparing magnetic moments. ${e_{pmax}}^2$ represents the magnetic charge of the proton, ${e_{\mathrm{emax}}}^2$ represents the magnetic charge of the electron, and e is the elementary charge. The occurrence of the proton-related factor in the proposed QMU expression must not be confused with the conventional nuclear-magneton reference convention; the QMU particle-specific normalization requires a separate derivation.

Dimensional expressibility in QMU does not establish the correctness or incorrectness of a measured magnetic moment. The apparent dependence on proton mass in the conventional neutron g factor

arises from the nuclear-magneton reference scale. Whether a different QMU normalization yields a physically distinct prediction must be demonstrated separately.

The above analysis also shows that all charges, including the elementary charge, should be distributed. Based on the observation that all charges must be distributed for the force laws to work, and for consistency with the Aether Physics Model, we transpose the magnetic moment electrostatic charge dimensions utilizing the charge conversion factors for each subatomic particle. The original distributed-charge electron expression is

$$\mu_e \, ccfe = g_e {\lambda_C}^2 F_q \frac{e^2 {e_{\mathrm{emax}}}^2}{64\pi^2 \alpha \, {e_{\mathrm{emax}}}^2}. \tag{173}$$

The original distributed-charge proton expression is

$$\mu_p \, ccfp = g_p {\lambda_C}^2 F_q \frac{e^2 {e_{\mathrm{emax}}}^2}{64\pi^2 \alpha_p \, e_{p\,\max}^2}. \tag{174}$$

Here α_p denotes the proton-specific charge parameter written as p in the original equation; its definition and normalization must be established independently.

The original neutron expression retaining the proton charge denominator is

$$\mu_n \, ccfn = g_{n,\mathrm{NIST}} {\lambda_C}^2 F_q \frac{e^2 {e_{\mathrm{emax}}}^2}{64\pi^2 \alpha_n \, e_{p\,\max}^2}. \tag{175}$$

Here α_n denotes the neutron-specific parameter written as n in the original equation.

However, it is highly unlikely that nature has given the neutron a magnetic moment due to the proton's magnetic charge. The original alternative neutron normalization substitutes the neutron charge denominator:

$$\mu_n \, ccfn = g_n {\lambda_C}^2 F_q \frac{e^2 {e_{\mathrm{emax}}}^2}{64\pi^2 \alpha_n \, e_{n\,\max}^2}. \tag{176}$$

The substitution is a model proposal and does not establish a correction to the measured magnetic moment.

The value $g_n = -3.831359$ is a proposed QMU-specific neutron normalization; it must not be substituted for the conventionally tabulated nuclear-magneton g factor without a derivation of the conversion and a comparison of the resulting magnetic moment in SI units.

From the expressions of magnetic moment in the Aether Physics Model, it appears that magnetic moment physically manifests by the interaction of the electrostatic and magnetic charges within each subatomic particle. It is further apparent that the electron plays a key role in causing magnetic moment for each subatomic particle, or at least in measuring subatomic particle magnetic moment.

Comparing Magnetic Moments

The original manuscript proposes the following reduced forms, conditional on its charge-normalization assumptions:

$$\mu_e \, ccfe = \frac{g_e \, magm}{8\pi}, \qquad \mu_p \, ccfp = \frac{g_p \, magm}{8\pi}, \qquad \mu_n \, ccfn = 1.001 \frac{g_n \, magm}{8\pi}. \tag{177}$$

The neutron factor 1.001 is retained at its historically stated precision. It is a numerical approximation in the original comparison, not an assertion of an exact coefficient to unlimited decimal places; the unit ledger alone does not derive its numerical value.

Distinction between the neutron coefficient and quoted g factors.

The historical comparison above quotes $g_{n,\mathrm{NIST}} = -3.82608545$ and the proposed QMU-specific normalization quotes $g_n = -3.831359$. The ratio of their magnitudes is

$$\frac{|g_n|}{|g_{n,\mathrm{NIST}}|} = \frac{3.831359}{3.82608545} \simeq 1.001378315, \tag{178}$$

which rounds to 1.001 at four significant figures, the precision of the historical multiplier in Eq. (177). Thus the two displayed numbers are numerically compatible at that rounding precision; their extra displayed digits do not, by themselves, establish a contradiction. Nevertheless, they represent distinct statements: the ratio compares two quoted g-factor normalizations, while the multiplier belongs to a reduced QMU moment expression. Equating the two physically requires common moment definitions and independently specified conversion factors $ccfn$ and $K_{\mu,n}$. No experimental uncertainty can be inferred from the number of decimal places alone. The quoted values do not establish a fractional error in the measured neutron moment.

Charge-normalization conditions for the reduced moments.

The electron distributed-charge expression reduces by the native charge identity

$$e^2 = 8\pi\alpha\, {e_{\mathrm{emax}}}^2, \qquad \frac{e^2}{64\pi^2\alpha} = \frac{{e_{\mathrm{emax}}}^2}{8\pi}, \tag{179}$$

so that $\mu_e\, ccfe = g_e\, magm/(8\pi)$ follows provided the same α and $e_{e\,\max}$ normalization is used throughout. This reduction is algebraic; it does not determine $ccfe$ numerically.

For the proton expression, the analogous reduction to $g_p\, magm/(8\pi)$ holds only if

$$\alpha_p {e_{\mathrm{pmax}}}^2 = \alpha {e_{\mathrm{emax}}}^2. \tag{180}$$

The corresponding neutron expression with the neutron's own magnetic-charge denominator reduces to

$$\mu_n\, ccfn = \frac{g_n\, magm}{8\pi}\, \frac{\alpha {e_{\mathrm{emax}}}^2}{\alpha_n {e_{\mathrm{nmax}}}^2}. \tag{181}$$

Consequently, the historically rounded numerical multiplier 1.001 corresponds to the approximate condition

$$\frac{\alpha {e_{\mathrm{emax}}}^2}{\alpha_n {e_{\mathrm{nmax}}}^2} \simeq 1.001. \tag{182}$$

The universal mass-to-magnetic-charge ratio supplies a further conditional reduction. If the postulated equality

$$\frac{m_{\mathrm{e}}}{{e_{\mathrm{emax}}}^2} = \frac{m_p}{{e_{\mathrm{pmax}}}^2} = \frac{m_n}{{e_{\mathrm{nmax}}}^2} \tag{183}$$

is imposed for the same particle charge definitions, then

$$\frac{{e_{\mathrm{pmax}}}^2}{{e_{\mathrm{emax}}}^2} = \frac{m_p}{m_{\mathrm{e}}}, \qquad \frac{{e_{\mathrm{nmax}}}^2}{{e_{\mathrm{emax}}}^2} = \frac{m_n}{m_{\mathrm{e}}}. \tag{184}$$

Under that assumption, the proton reduced-moment condition is equivalent to

$$\alpha_p = \alpha \frac{m_{\mathrm{e}}}{m_p}, \tag{185}$$

while the proposed rounded neutron multiplier corresponds to

$$\alpha_n \simeq \frac{\alpha}{1.001}\frac{m_\mathrm{e}}{m_n}. \tag{186}$$

These equations express the necessary particle-specific charge parameters in terms of empirical particle masses. They do not derive the parameters independently from particle geometry, nor do they derive the neutron multiplier 1.001. If α_p or α_n has a different independent definition elsewhere in APM, that definition must satisfy these equalities before the corresponding reduced magnetic-moment expression can be asserted. In particular, setting $\alpha_p = \alpha$ would be incompatible with the proton reduction under the universal mass-to-charge postulate unless $m_p = m_\mathrm{e}$.

Independent-geometry criterion for particle-specific charge parameters.

The mass-ratio expressions above are conditional solutions of the magnetic-moment normalization equations. They must not be counted as independent geometrical determinations of α_p or α_n. An independent APM construction would specify each particle's distributed-charge geometry and the rule mapping that geometry to its charge parameter, without using the measured magnetic moment or the target reduced-moment equality to select the parameter. For the proton, that independent construction must be checked against $\alpha_p {e_\mathrm{pmax}}^2 = \alpha {e_\mathrm{emax}}^2$; for the neutron it must be checked against $\alpha {e_\mathrm{emax}}^2/(\alpha_n {e_\mathrm{nmax}}^2) \simeq 1.001$ if the proposed numerical multiplier is retained. These are consistency tests, not geometric proofs. The present reference does not supply a standalone derivation of either particle-specific parameter from a fully specified stationary particle geometry. The electron-ring and near-spherical proton descriptions are structural interpretations; by themselves they do not assign numerical values to α_p or α_n. In addition, the neutron normalization must not be inferred from the proton's nuclear-magneton reference convention.

Potential neutron magnetic-moment discrepancy.

The original QMU reduced-moment expression retains the approximate factor 1.001 in Eq. (177). Accordingly, Eq. (182) records an approximate condition at the stated historical rounding precision, not an experimentally exact equality. The exact symbolic reduction is Eq. (181); no uncertainty interval for the underlying theoretical coefficient is inferred solely from the digits displayed. The factor is a potential discrepancy between the QMU formulation and the conventionally accepted neutron magnetic moment; it is not a correction imposed on neutron geometry to reproduce a measured value. The unit ledger alone neither derives the numerical factor nor establishes an error in the experimental measurement or calibration program. Determining the origin and significance of any discrepancy requires an independent quantitative investigation beyond the scope of this reference to QMU definitions and relationships.

The unreduced expressions containing a single e rather than e^2 have a different charge degree and cannot be equated to these distributed-charge expressions without the stated charge-conversion factors.

The QMU expressions propose a geometrical account of the magnetic moments. Agreement or disagreement with the NIST values must be evaluated after translating all expressions to a common magnetic-moment unit and propagating input uncertainties; no error in the measured neutron moment follows from a change of reference normalization.

The occurrence of the proton mass in a neutron-moment expression must be distinguished from its appearance in the conventional nuclear-magneton reference unit.

A revised neutron magnetic-moment value cannot be inferred from a change of QMU charge normal-

ization alone. A quantitative value requires the particle-specific normalization, a dimensioned SI conversion, and a comparison with the measured neutron moment under the same sign convention.

The proposed QMU magnetic-moment expressions include the geometrical factor 8π and relationships between electrostatic and magnetic charge quantities. Identifying this factor with a weak-interaction coupling requires a separate derivation and observable test; the numerical factor alone does not establish that identification.

Bohr Magneton

The earlier QMU source quotes the Bohr magneton as $\mu_B = 9.2740100783 \times 10^{-24}\,\mathrm{J/T}$. This historical numerical quotation is preserved as such; its original release attribution and uncertainty have not been established. The independently verified 2022 CODATA recommended value is $\mu_B = 9.2740100657(29) \times 10^{-24}\,\mathrm{J/T}$, where the parenthetical digits denote the standard uncertainty in the last printed digits. The historical and CODATA values differ by $1.26 \times 10^{-32}\,\mathrm{J/T}$ (approximately 1.36×10^{-9} in relative terms). That difference does not by itself establish a discrepancy between experiments, because the historical quotation has not been traced to a dated source release. The CODATA value and uncertainty are from NIST, *CODATA Value: Bohr magneton*, 2022 adjustment (`https://physics.nist.gov/cgi-bin/cuu/Value?mub`). The original proposed correspondence is

$$\mu_B \, ccf = \frac{magm}{4\pi}. \tag{187}$$

This is an SI–QMU bridge hypothesis, not a native QMU definition. The displayed decimal for μ_B is an empirical reference value; the $1/(4\pi)$ coefficient belongs to the proposed symbolic correspondence and is not inferred from the number of printed digits in that value. Numerical validation of this correspondence requires a separately established conversion factor ccf and compatible uncertainty treatment.

This is one example of many where empirically derived physical constants are expressed in terms of whole quantum measurement units.

Phonon Magnetic Moment

Phonons are quasiparticles representing quantized vibrational modes in the Aether electrostatic dipole lattice. These oscillating dipoles can create an effective magnetic moment. So, we can relate the phonon magnetic moment to magm.

While phonons have no charge, their resonant oscillations can induce an effective magnetic moment proportional to the electron's intrinsic properties - thereby relating to the Bohr magneton through the magm unit.

Surface Charge `sfch`

QMU primitive representation: $\mathrm{sfch} = {\lambda_C}^2 \, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sfch}\,\mathrm{chcc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sfch = {e_{\mathrm{emax}}}^2 \cdot {\lambda_C}^2$$

The Surface Charge ($sfch$) unit has a multifaceted nature, representing the amount of magnetic charge present on a surface. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Magnetic Charge and Area:

The equation $sfch = chrg \cdot area$ describes surface charge as the product of magnetic charge ($chrg$) and the area over which it is distributed.

In this context, surface charge represents the total amount of magnetic charge present on a given surface.

This perspective is useful for understanding how the magnetic charge is distributed and concentrated on surfaces.

Magnetic Moment and Frequency:

The equation $sfch = \frac{magm}{freq}$ relates surface charge to the magnetic moment ($magm$) and frequency ($freq$).

It suggests that surface charge represents the magnetic moment per unit frequency, indicating the amount of magnetic charge associated with the oscillatory motion of the surface.

This perspective is valuable for understanding how surface charge relates to the magnetic moment and the frequency of oscillation.

Curl and Vortex:

The equation $sfch = curl \cdot vrtx$ links surface charge to the curl ($curl$) and vortex ($vrtx$).

It suggests that surface charge is the product of curl and vortex, indicating the amount of magnetic charge associated with the rotational motion and spatial extent of the surface.

This perspective is valuable for understanding how surface charge relates to the spatial curvature and rotational properties of the surface.

Photon and Acceptance:

The equation $sfch = phtn \cdot accp$ links surface charge to the photon ($phtn$) and acceptance ($accp$).

It suggests that surface charge is the product of photon and acceptance, indicating the amount of magnetic charge associated with the interaction between photons and the surface.

This perspective is valuable for understanding how surface charge relates to the interaction of light with the surface and the surface's ability to accommodate magnetic charge.

Quantum Electric Field Dynamic Responsivity `efdr`

QMU primitive representation: $\mathrm{efdr} = \lambda_C \, {F_q}^3 \, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{efdr} \, \mathrm{qecj} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efdr = {e_{\text{emax}}}^2 \cdot \lambda_C \cdot {F_q}^3$$

Physical interpretation: The Quantum Electric Field Dynamic Responsivity ($efdr$) unit represents the capacity of the quantum Aether substrate to respond to rapidly changing electric fields along a linear quantum dimension. It combines aspects of magnetic charge (${e_{\text{emax}}}^2$) and quantum dynamic frequency ($qdyf = \lambda_C \cdot {F_q}^3$) to describe the underlying structure's ability to accommodate and respond to highly dynamic electric field changes in one-dimensional space.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its dynamic responsivity to electric fields.

The $qdyf$ term implies a high-frequency, dynamic nature, suggesting this unit describes the substrate's properties in response to rapidly changing fields along a one-dimensional quantum path.

The strong frequency dependence (${F_q}^3$) indicates the substrate's capacity to respond to very rapid field changes.

Potential applications:

Analyzing the quantum vacuum's ability to accommodate rapidly changing electric fields in one-dimensional structures

Studying how the Aether substrate responds to high-frequency electric field fluctuations in quantum wires or linear chains

Characterizing the limits of electric field change rates in quantum linear structures

Investigating the interplay between dynamic electric fields and magnetic phenomena in one-dimensional quantum systems

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Charge Acceleration `acch`

QMU primitive representation:

$$\text{acch} = \lambda_C \, {F_q}^2 \, {e_{\text{emax}}}^2.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{acch}\,\text{qeca} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{acch} &= \text{chrg} \cdot \text{accl} \\ &= \text{chgl} \cdot \text{rson} \\ &= \text{chrg} \cdot \text{leng} \cdot \text{freq}^2 \\ &= \frac{\text{chrg} \cdot \text{leng}}{\text{time}^2} \\ &= \frac{1}{\text{qeca}}.\end{aligned}} \tag{188}$$

These relationships follow from

$$\text{chrg} = {e_{\text{emax}}}^2, \qquad \text{accl} = \lambda_C {F_q}^2,$$
$$\text{chgl} = {e_{\text{emax}}}^2 \lambda_C, \qquad \text{rson} = {F_q}^2.$$

Physical interpretation. Charge Acceleration (acch) represents the acceleration dimension weighted by distributed magnetic charge within the Aether Physics Model (APM).

Its defining relationship is

$$\text{acch} = \text{chrg} \cdot \text{accl}.$$

Where Acceleration (accl) expresses length per squared time, acch includes the distributed magnetic-charge dimension associated with Aether and particle geometry.

Equivalently,

$$\text{acch} = \text{chgl} \cdot \text{rson}$$

connects Charge Length (chgl) with Resonance (rson), the QMU frequency-squared quantity.

This provides a dimensional basis for describing second-order temporal interactions involving extended magnetic-charge structures.

Distinction from charge-normalized acceleration. Charge Acceleration (acch) must not be confused with Charge Acceleration per Charge (chga), which is separately defined in the QADI catalog.

The distinction is fundamental: acch is constructed by multiplying acceleration by distributed magnetic charge, whereas chga has its own charge-dependent primitive definition.

The two units are not synonyms and must not be interchanged in QMU equations or dimensional conversions.

Research significance. Charge Acceleration provides a direct connection among distributed magnetic charge, spatial displacement, and second-order temporal structure.

Within APM, it is relevant to investigations of charge circulation, accelerated charge configurations, particle geometry, and electromagnetic interactions involving changing motion.

The relationship

$$\text{acch} = \text{chgl} \cdot \text{rson}$$

is especially useful for expressing charge-weighted acceleration in terms of established QMU quantities.

Its reciprocal, Quantum Electric Charge Acceleration (qeca), provides the complementary dimension.

The canonical identities define the charge-weighted acceleration scale; the actual acceleration of a physical charge distribution follows from its interaction geometry and equations of motion.

Charge Velocity `chvl`

QMU primitive representation: $\text{chvl} = \lambda_C \, F_q \, {e_{\text{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{chvl}\,\text{qecd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$chvl = {e_{\text{emax}}}^2 \cdot \lambda_C \cdot F_q$$

The QMU *chvl* measures the speed at which magnetic charges flow. It is similar to electric current's charge flow velocity, but it pertains specifically to the movement of magnetic charges. This magnetic charge flow velocity is the magnetic equivalent of electric charge velocity.

The *chvl* value depends on the magnetic conductivity of the system. A higher *chvl* value indicates faster magnetic charge flow. It provides valuable information about the rate of changes in magnetic flux. *chvl* is useful for analyzing magnetic circuits and induction.

Charge Length `chgl`

QMU primitive representation: $\text{chgl} = \lambda_C \, {e_{\text{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{chgl}\,\text{ecdp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Dimensional expression

$$chgl = {e_{\text{emax}}}^2 \lambda_C$$

The Charge Length (*chgl*) unit is a multifaceted concept in the Quantum Measurement Units (QMU) system, representing the spatial extent or distribution of magnetic charge along a linear

dimension. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Charge and Wave Number:

The equation $chgl = \frac{chrg}{wavn}$ describes charge length as the ratio of magnetic charge ($chrg$) to wave number ($wavn$).

In this context, charge length represents the amount of magnetic charge per unit wave number, indicating the spatial extent of charge distribution along a wave.

This perspective is useful for understanding how the magnetic charge is distributed in wave-like quantum systems.

Magnetic Moment and Velocity:

The equation $chgl = \frac{magm}{velc}$ relates charge length to the magnetic moment ($magm$) and velocity ($velc$).

It suggests that charge length represents the magnetic moment per unit velocity, indicating the spatial extent of charge distribution associated with a moving magnetic charge.

This perspective is valuable for understanding how charge length relates to the magnetic moment and the speed of a moving charge.

Curl and Moment of Inertia:

The equation $chgl = curl \cdot minr$ links charge length to the curl ($curl$) and moment of inertia ($minr$).

It suggests that charge length is the product of curl and moment of inertia, indicating the spatial extent of charge distribution associated with the rotational motion of a charge.

This perspective is valuable for understanding how charge length relates to the spatial curvature and the rotational inertia of a moving charge.

Quantum Electric Field Temporal Intensity `efti`

QMU primitive representation: efti $= {F_q}^3 \, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: efti qeci $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efti = {e_{\mathrm{emax}}}^2 \cdot {F_q}^3$$

Physical interpretation: The Quantum Electric Field Temporal Intensity ($efti$) unit represents the capacity of the quantum Aether substrate to support and respond to intense, rapidly changing electric fields, independent of spatial dimensions. It combines aspects of magnetic charge and quantum frequency cubed to describe the underlying structure's ability to accommodate highly dynamic electric field fluctuations in the quantum vacuum.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its response to intense temporal electric field variations.

The absence of a λ_C term implies this unit describes the substrate's properties independent of specific spatial dimensions, focusing purely on temporal aspects.

The ${F_q}^3$ term indicates a strong frequency dependence, suggesting the substrate's capacity to support very rapid and intense field fluctuations.

Potential applications:

Analyzing the quantum vacuum's ability to sustain extremely rapid electric field changes

Studying how the Aether substrate responds to high-frequency, high-intensity electric field fluctuations

Characterizing the limits of electric field change rates in the quantum vacuum

Investigating the interplay between intense, rapidly changing electric fields and magnetic phenomena in the quantum substrate

This substrate unit could be particularly useful in understanding the fundamental nature of intense, rapidly changing electric fields in the quantum vacuum, regardless of specific geometric configurations. It might provide insights into phenomena such as vacuum polarization under extreme conditions, the behavior of virtual particles in intense, rapidly fluctuating fields, or the limits of electromagnetic field intensities in quantum electrodynamics. The $efti$ unit could help in developing models of how the quantum Aether responds to and supports extremely dynamic electric field behavior, potentially leading to new understanding in areas such as high-energy physics, ultrafast quantum optics, and the study of quantum vacuum under extreme electromagnetic conditions.

Charge Resonance `chrs`

QMU primitive representation: $\text{chrs} = {F_q}^2\,{e_{\text{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{chrs}\,\text{qeco} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$chrs = {e_{\text{emax}}}^2 \cdot {F_q}^2$$

The Charge Resonance ($chrs$) unit is a versatile tool in the Quantum Measurement Units (QMU) system, representing the rate at which charge oscillates or cycles in a quantum system. This unit can be interpreted in several ways, depending on the specific relationship being emphasized:

1. Charge Oscillation:

The equation $chrs = \frac{chrg}{orbt}$ describes charge resonance as the amount of charge cycling per unit of orbital time.

In this context, charge resonance represents the frequency of charge oscillations, with a higher "$chrs$" value indicating more rapid cycling of charge.

This perspective is useful for understanding the temporal dynamics of charge in quantum systems, particularly those with inherent periodicities or resonant behaviors.

2. Velocity-Length Relationship:

The equation $chrs = \frac{chvl}{dynl}$ relates charge resonance to the charge velocity ($chvl$) and dynamic length ($dynl$).

It suggests that charge resonance represents a dynamic balance between how fast charge moves and the characteristic length scale over which it oscillates.

This perspective is valuable for understanding how charge oscillations adapt to different spatial and temporal scales in quantum systems.

3. Power-Flux Dynamics:

The equation $chrs = \frac{powr}{mflx}$ links charge resonance to the power ($powr$) and magnetic flux (mflx) in a quantum system.

It suggests that charge resonance represents the efficiency of energy transfer or the rate of energy cycling per unit magnetic flux.

This perspective is useful for understanding how charge oscillations contribute to energy dynamics and the behavior of quantum systems in electromagnetic fields.

Overall, the Charge Resonance ($chrs$) unit provides a multifaceted view of charge dynamics in quantum systems, emphasizing its oscillatory nature and its relationship to various physical quantities. Whether interpreted in terms of charge oscillation, velocity-length balance, or power-flux dynamics, "$chrs$" offers insights into the fundamental behavior of charge at the quantum level.

Current `curr`

QMU primitive representation: $\mathrm{curr} = F_q\, {e_{\mathrm{emax}}}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{curr}\,\mathrm{ecfx} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$curr = {e_{\mathrm{emax}}}^2 \cdot F_q$$

The Current ($curr$) unit in the Quantum Measurement Units (QMU) system quantifies the rate of magnetic charge flow in a quantum system. It can be interpreted in several ways, depending on the specific relationship being emphasized:

1. Potential and Resistance:

The equation $curr = \frac{potn}{resn}$ describes the magnetic charge current as the ratio of potential ($potn$) to resistance ($resn$) and is identical to Ohm's Law.

In this context, the current represents the flow of magnetic charge driven by a potential difference

and impeded by resistance.

This perspective is useful for understanding the relationship between potential, magnetic charge flow, and resistance in quantum systems.

2. Magnetic Flux and Permeance:

The equation $curr = \frac{mflx}{magp}$ relates the current to the magnetic flux ($mflx$) and magnetic permeance ($magp$).

It suggests that the current represents the flow of magnetic flux allowed by the system's magnetic permeance.

This perspective is valuable for understanding how charge flow relates to magnetic flux and the system's ability to support magnetic field lines.

3. Curl and Momentum:

The equation $curr = curl \cdot momt$ links magnetic charge current to the curl of the magnetic field and the momentum ($momt$) of the moving charge.

It suggests that the current is a manifestation of the interaction between the spatial curvature of the magnetic field and the momentum of the moving charge.

This perspective is valuable for understanding how the charge flow emerges from the interplay between the magnetic field geometry and the momentum of the charge carriers.

4. Angular Momentum and Inductance:

The equation $curr = \frac{angm}{indc}$ links current to the angular momentum ($angm$) of the moving charge and the inductance ($indc$) of the system.

It suggests that the magnetic charge current represents the flow of angular momentum associated with the moving charge, influenced by the system's inductance.

This perspective is valuable for understanding how the charge flow relates to the angular momentum of the charge carriers and the system's ability to store magnetic energy.

5. Capacitance and Power:

The equation $curr = capc \cdot powr$ links current to the capacitance ($capc$) of the system and the power ($powr$) associated with the charge flow.

It suggests that the current represents the rate at which the system's capacitance can store energy due to the flow of charge.

This perspective is valuable for understanding how the magnetic charge flow interacts with the system's ability to store electromagnetic energy.

6. Conductance and Energy:

The equation $curr = cond \cdot enrg$ links magnetic charge current to the conductance ($cond$) of the system and the energy ($enrg$) associated with the magnetic charge flow.

It suggests that the current represents the flow of magnetic charge enabled by the system's conductance and driven by the available energy.

This perspective is valuable for understanding how the magnetic charge flow emerges from the

interplay between the system's ability to conduct magnetic charge and the available energy such as in biological cellular systems.

Overall, the magnetic Current (*curr*) unit provides a multifaceted view of magnetic charge dynamics in quantum systems, emphasizing its flow properties and relationships to various physical quantities. Whether interpreted in terms of potential and resistance, magnetic flux and permeance, curl and momentum, angular momentum and inductance, capacitance and power, or conductance and energy, "*curr*" offers insights into the fundamental behavior of magnetic charge flow at the quantum level.

Charge `chrg`

QMU primitive representation:

$$\mathrm{chrg} = {e_{\mathrm{emax}}}^2.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{chrg}\,\mathrm{mcaf} = 1.$$

Physical interpretation. Charge is a fundamental physical quantity in the Aether Physics Model (APM). Within Quantum Measurement Units (QMU), charge is inherently distributed through geometrical structure rather than concentrated at an infinitesimal point.

The canonical charge unit is

$$\boxed{\mathrm{chrg} = {e_{\mathrm{emax}}}^2.} \tag{189}$$

Here, ${e_{\mathrm{emax}}}^2$ represents the distributed magnetic-charge quantity associated with the electron reference structure.

The symbol e_{emax} is a mathematical parameter used to express the charge distribution. It is not an independently existing physical charge component or a separate QMU unit.

The physically defined quantity is e^2_{emax}, represented by chrg.

This distinction is fundamental to APM: charge is a property of geometrical structure, and its physical interactions depend on how that charge is distributed within the Aether.

Distributed magnetic charge. APM describes elementary particles through distinct geometrical configurations of distributed charge.

The electron is associated with an extended, predominantly toroidal configuration, whereas the proton is associated with a more nearly spherical charge geometry.

These structures differ in their spatial organization while participating in the same fundamental charge relationships.

The QMU charge unit provides the reference against which the magnetic charge distributions of other particles can be expressed.

Consequently, chrg does not imply that all particles possess the same magnetic charge magnitude. Rather, it establishes the dimensional basis for comparing their distributed magnetic-charge structures.

Universal mass-to-charge relationship. A central APM relationship is the universal mass-to-magnetic-charge ratio:

$$\boxed{\text{mchg} = \frac{m_e}{e_{emax}^2} = \frac{m_p}{e_{pmax}^2} = \frac{m_n}{e_{nmax}^2} = \frac{m_a}{e_a^2}.} \tag{190}$$

The respective charge quantities describe the electron, proton, neutron, and fundamental Aether mass reference.

This relationship expresses the APM principle that distributed magnetic charge scales directly with mass.

For a particle of mass m_i,

$$\boxed{e_{i,max}^2 = \frac{m_i}{\text{mchg}}.} \tag{191}$$

The mass-to-charge ratio remains invariant, while particle geometry determines how the associated charge is distributed and how it participates in physical interactions.

This provides a direct connection between mass, distributed charge, and particle structure.

Magnetic and electrostatic charge. APM distinguishes distributed magnetic charge from the electrostatic charge observed in electrical interactions.

The relationship between these quantities is expressed through the Unified Charge Equation:

$$\boxed{e^2 = 8\pi\alpha_i e_{i,max}^2.} \tag{192}$$

Here, e^2 represents the electrostatic force-carrier quantity, while $e_{i,max}^2$ represents the distributed magnetic-charge quantity of particle species i.

The factor $8\pi\alpha_i$ specifies the corresponding APM electrostatic-to- magnetic charge relationship.

For the electron,

$$e^2 = 8\pi\alpha\, {e_{\text{emax}}}^2. \tag{193}$$

The distinction is important because the QMU charge unit is defined by distributed magnetic charge, not by simply identifying it with the SI coulomb or the elementary electric charge used in conventional notation.

Relationships within the QMU ledger. Distributed charge participates in numerous QMU dimensional relationships, including

$$\text{chrg} = \frac{\text{mass}}{\text{mchg}}, \tag{194}$$

$$\text{chrg} = \text{cond} \cdot \text{angm}, \tag{195}$$

$$\text{mflx} = \text{resn} \cdot \text{chrg}, \tag{196}$$

$$\text{indc} = \text{magp} \cdot \text{chrg}, \tag{197}$$

$$\text{plsm} = \text{chrg} \cdot \text{temp}, \tag{198}$$

$$\text{acch} = \text{chrg} \cdot \text{accl}. \tag{199}$$

These relationships illustrate the central position of charge within the QMU dimensional system.

The first identity connects charge with mass through the universal mass-to-charge ratio.

The relationship with angular momentum connects charge with rotational dynamics, while the magnetic-flux and inductance identities establish its role in electromagnetic circuit quantities.

The plasma and charge-acceleration relationships extend the same charge dimension into thermal and dynamical phenomena.

These are dimensional identities. The physical behavior of a particular system additionally depends on its charge distribution and interaction geometry.

QMU–SI correspondence. Conventional SI electromagnetism expresses electric charge in coulombs and develops electromagnetic quantities through its corresponding unit conventions.

QMU instead uses distributed magnetic charge as its native charge dimension.

A quantitative translation between the systems therefore requires the appropriate Charge Conversion Factor and recognition of the distinct physical charge quantities.

For the electron reference,

$$\text{ccf}_e = \frac{{e_{\text{emax}}}^2}{e}. \tag{200}$$

This conversion framework must be applied according to the dimensional and physical quantities involved, including the established exceptions for particular electromagnetic units.

The detailed conversion rules and benchmark relationships are developed in [14; 15].

The purpose of the translation is not to redefine QMU charge in SI terms, but to express measurable relationships consistently between the two systems.

Research significance. Charge occupies a foundational role in the Aether Physics Model because it connects particle mass, geometry, angular momentum, electromagnetic response, and the structure of the Aether itself.

The universal mass-to-charge ratio provides a common quantitative relationship among particle species, while their distinct geometries determine how distributed charge participates in physical interactions.

The Unified Charge Equation connects magnetic-charge distributions with electrostatic phenomena and provides a framework for examining their relative interaction strengths.

Research opportunities include investigating how particle geometry determines observable electromagnetic properties, how distributed charge influences magnetic moments and binding interactions, and whether QMU charge relationships simplify the corresponding SI formulations.

Further work may also examine the role of distributed charge in plasma behavior, electromagnetic radiation, superconducting structures, and the geometrical organization of matter.

The canonical QMU charge definition provides the dimensional foundation for these investigations. The corresponding physical predictions follow from APM geometry, charge distribution, and interaction laws.

(see Quantum Electrodynamic Foundational Units)

7 QMU unit constructions: catalog 2

For the source dimensional convention and conversion reference tables, see [2; 1; 11].

Entries follow the established QMU website grid order: family, dynamic/substrate grouping, then table row order. Units appearing in multiple grids are defined at their first occurrence.

Quantum Electrodynamic Distribution

Dynamic units

Quantum Volumetric Charge Inertia `qvci`

QMU primitive representation:

$$\mathrm{qvci} = \frac{{\lambda_C}^3}{{F_q}^3\,{e_{\mathrm{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{qvci}\,\mathrm{qcdi} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{qvci} &= \frac{{\lambda_C}^3}{{F_q}^3\,{e_{\text{emax}}}^2} \\ &= \frac{\text{volm}}{\text{chrg}\cdot\text{freq}^3} \\ &= \frac{\text{volm}\cdot\text{time}^3}{\text{chrg}} \\ &= \frac{1}{\text{qcdi}}.\end{aligned}} \tag{201}$$

These relationships follow from the canonical QMU definitions

$$\begin{aligned}\text{volm} &= {\lambda_C}^3, \\ \text{chrg} &= {e_{\text{emax}}}^2, \\ \text{freq} &= F_q, \\ \text{time} &= {F_q}^{-1}.\end{aligned}$$

Thus, Quantum Volumetric Charge Inertia combines volume, cubic temporal extent, and reciprocal distributed magnetic charge within a single QMU dimension.

Physical interpretation. Quantum Volumetric Charge Inertia (qvci) provides a dimensional framework for describing the persistence of distributed charge configurations within a quantum volume.

In the Aether Physics Model (APM), charge is inherently distributed through physical geometry rather than concentrated at dimensionless points.

Changes in a volumetric charge distribution therefore involve the reorganization of charge across spatial and temporal dimensions.

The qvci unit combines three spatial dimensions with three temporal factors and an inverse charge dimension.

This structure makes it relevant to investigations of charge redistribution, temporal response, and the maintenance of coherent charge geometry.

The designation *inertia* refers to the proposed resistance of a distributed charge configuration to changes in its state. It should not be confused with ordinary mechanical mass or moment of inertia.

Volume and distributed charge. The relationship

$$\text{qvci} = \frac{\text{volm}\cdot\text{time}^3}{\text{chrg}} \tag{202}$$

expresses Quantum Volumetric Charge Inertia through volume, temporal extent, and distributed charge.

The volume contribution identifies the three-dimensional spatial scale associated with the charge configuration.

The reciprocal charge contribution relates the quantity to the distributed magnetic charge participating in that configuration.

For otherwise identical reference factors, the numerical value of qvci scales directly with volume and inversely with charge.

However, the physical stability of a charge distribution also depends on its geometry, binding interactions, electromagnetic environment, and boundary conditions.

A larger volume does not necessarily imply greater resistance to charge redistribution in every physical system.

Temporal structure and response. The inverse cubic frequency factor is

$$\frac{1}{{F_q}^3} = \text{time}^3.$$

This establishes a third-order temporal dimension within the QMU representation.

The cubic temporal dependence provides a reference for examining charge configurations whose physical response involves multiple coupled temporal processes or higher-order dynamics.

Within APM chronogeometry, the distinction between spatial structure and temporal organization is fundamental to the description of physical charge.

The qvci unit offers a means of exploring how volumetric charge geometry may retain or redistribute its organization during time-dependent electromagnetic interactions.

The primitive frequency F_q defines the QMU reference scale. It should not be identified automatically with the variable frequency of an externally applied electromagnetic field.

Consequently, frequency-dependent stability or relaxation must be calculated from the applicable physical equations, rather than inferred solely from the inverse cubic frequency dimension.

Relationship to charge inertia. The reciprocal QMU quantity is Quantum Charge Density Inertia (qcdi):

$$\boxed{\text{qcdi} = \frac{\text{chrg} \cdot \text{freq}^3}{\text{volm}}.} \tag{203}$$

The reciprocal relationship is therefore

$$\text{qvci} \cdot \text{qcdi} = 1.$$

Where qvci expresses volume and temporal extent per unit distributed charge, qcdi expresses distributed charge per unit volume together with a cubic frequency dimension.

These complementary quantities provide alternative dimensional descriptions for investigating volumetric charge organization and its temporal response.

Their reciprocal relationship is exact within the QMU ledger and does not require the two quantities to represent independent physical mechanisms.

Research significance. Quantum Volumetric Charge Inertia provides a dimensional connection among distributed charge, quantum volume, and third-order temporal structure.

It offers a useful foundation for investigating charge organization in confined geometries, electromagnetic materials, plasma structures, and other systems involving time-dependent charge distributions.

Potential research applications include the response of quantum-scale structures to rapidly varying electromagnetic fields, charge relaxation in confined volumes, and the persistence of coherent distributed-charge configurations.

Within APM, a particularly interesting direction is to investigate whether the three spatial and three temporal factors of qvci can be related to the six-dimensional chronogeometry of the Aether.

Establishing such a connection would require a geometric derivation linking the unit's temporal dimensions to the physical mechanisms governing charge redistribution and stability.

The canonical QMU identities provide the dimensional foundation for these investigations. Quantitative predictions of charge inertia, relaxation, or stability require the corresponding interaction geometry and dynamical laws.

Quantum Volumetric Charge Reluctance `qvcr`

QMU primitive representation: $\mathrm{qvcr} = \dfrac{{\lambda_C}^3}{{F_q}^2\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvcr}\,\mathrm{cdrs} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvcr = \frac{{\lambda_C}^3}{{e_{\mathrm{emax}}}^2 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Volumetric Charge Reluctance (*qvcr*) unit represents the ratio of a quantum system's specific charge to its resonant frequency squared. It describes the resistance of a quantum volume to moderate-frequency changes in its charge state, balancing the spatial distribution of charge against the system's natural oscillatory behavior.

Characteristics:

As a dynamic unit, it relates the system's charge distribution to its resonant response.

The *spch* (Specific Charge) component, $\frac{{\lambda_C}^3}{{e_{\mathrm{emax}}}^2}$, represents the unit volume per charge.

The inverse *rson* (Resonance) component, $\frac{1}{{F_q}^2}$, represents the system's inclination to oscillate at its natural frequency.

Higher *qvcr* values indicate greater reluctance to change charge states at moderate frequencies relative to the system's resonant behavior.

Potential applications:

Analyzing how charge distribution affects a quantum system's response to moderate-frequency electromagnetic fields

Studying the relationship between spatial charge configuration and temporal oscillatory behavior in quantum structures

Characterizing the balance between charge localization and resonant response in quantum materials

Investigating how the interplay of specific charge and resonance influences charge stability in quantum devices

This understanding of *qvcr* as the ratio of specific charge to resonance provides a more nuanced view of charge behavior in quantum systems. It highlights the interplay between the spatial aspect of charge distribution and the temporal aspect of resonant frequency. This perspective could be particularly valuable in fields such as quantum electronics, where understanding the balance between charge localization and dynamic response is crucial for device design and operation. It might also offer new insights into phenomena like charge density waves, where spatial charge patterns interact with system-wide oscillations.

Quantum Volumetric Charge Persistence `qvcp`

QMU primitive representation: $\mathrm{qvcp} = \dfrac{{\lambda_C}^3}{F_q\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvcp}\,\mathrm{cdos} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvcp = \frac{{\lambda_C}^3}{{e_{\mathrm{emax}}}^2 \cdot F_q}$$

Physical interpretation: The Quantum Volumetric Charge Persistence (*qvcp*) unit represents the tendency of a quantum volume to maintain its charge distribution over time. It combines the system's specific charge (spch) with the inverse of its fundamental frequency (freq), describing how the spatial charge distribution relates to the system's basic temporal scale.

Characteristics:

As a dynamic unit, it relates the system's charge distribution to its fundamental temporal behavior.

The *spch* (Specific Charge) component, $\frac{{\lambda_C}^3}{{e_{\mathrm{emax}}}^2}$, represents the unit volume per charge.

The inverse $freq$ (Frequency) component, $\frac{1}{F_q}$, represents the system's basic time scale.

Higher *qvcp* values indicate greater persistence of charge distributions over time.

Potential applications:

Analyzing the stability of charge configurations in quantum systems over their characteristic time scales

Studying how charge distributions evolve in time for various quantum structures

Characterizing the longevity of charge-based quantum states

Investigating the relationship between spatial charge patterns and temporal evolution in quantum materials

This unit provides insight into how charge distributions persist over the fundamental time scales of quantum systems. It could be particularly useful in understanding phenomena such as charge retention in quantum dots, the lifetime of charge-based qubits, or the stability of charge configurations in molecular systems. The *qvcp* unit bridges the gap between static charge distributions and dynamic temporal behavior, offering a tool for analyzing how quantum systems maintain their charge states over time.

Specific Charge `spch`

QMU primitive representation: $\text{spch} = \dfrac{{\lambda_C}^3}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{spch}\,\text{chgd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Specific Charge (*spch*) unit represents the amount of quantum volume associated with a unit of magnetic charge. It describes the spatial distribution of charge within a quantum system, indicating how "spread out" or "concentrated" the charge is in three-dimensional quantum space.

A higher *spch* value indicates a more diffuse charge distribution. This understanding of spch as a volume-to-charge ratio provides a fundamental measure of how charge is distributed in quantum space. It could be particularly useful in understanding phenomena such as electron orbitals in atoms, charge delocalization in molecules, or charge confinement in nanostructures.

The relationships between *spch* and other QMU units offer further insights into its meaning and potential applications:

$spch = \frac{volm}{chrg}$: This equation straightforwardly shows the relationship between quantum volume ($volm$) and magnetic charge ($chrg$), indicating the volume per unit charge.

$spch = qcdr \cdot qdyf$: This relationship suggests that specific charge can also be understood as the product of quantum charge distribution resistance ($qcdr$) and quantum dynamic frequency ($qdyf$).

$spch = potn \cdot qldc$: Specific charge can be expressed as the product of potential ($potn$) and quantum linear dynamic compliance ($qldc$).

$spch = \frac{qldc}{capc}$: It can also be written as the ratio of quantum linear dynamic compliance ($qldc$) to capacitance ($capc$).

Quantum Charge Distribution Resistance `qcdr`

QMU primitive representation:

$$\text{qcdr} = \frac{{\lambda_C}^2}{{F_q}^3\,{e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{qcdr}\,\text{qesi} = 1.$$

Physical interpretation. Quantum Charge Distribution Resistance (qcdr) describes a QMU dimensional quantity associated with the temporal response of distributed charge across a two-dimensional spatial structure.

Its primitive expression can be written as

$$\boxed{\text{qcdr} = \frac{\text{area}\cdot\text{time}^3}{\text{chrg}} = \frac{1}{\text{qesi}}.} \tag{204}$$

Within the Aether Physics Model (APM), charge is inherently distributed through physical geometry. The area factor identifies the two-dimensional spatial extent, while the cubic temporal factor connects the quantity to the time-dependent organization of charge.

The term *resistance* suggests opposition to changes in charge distribution, rather than conventional electrical resistance measured in SI ohms.

Research significance. The qcdr unit provides a dimensional framework for investigating the persistence, redistribution, and time-dependent response of charge across surfaces or other two-dimensional geometries.

Potential applications include charge transport along interfaces, electromagnetic surface structures, and the stability of distributed-charge configurations.

Determining the physical resistance associated with a particular system requires its interaction geometry and dynamical equations. The QMU identity supplies the dimensional foundation for that investigation.

Quantum Charge Distribution Periodicity `qcdp`

QMU primitive representation:

$$\text{qcdp} = \frac{{\lambda_C}^2}{{F_q}^2\,{e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{qcdp}\,\mathrm{qefr} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{qcdp} &= \mathrm{chds}\cdot\mathrm{orbt}\\ &= \frac{\mathrm{chds}}{\mathrm{rson}}\\ &= \frac{\mathrm{area}\cdot\mathrm{time}^2}{\mathrm{chrg}}\\ &= \frac{\mathrm{area}}{\mathrm{chrg}\cdot\mathrm{freq}^2}\\ &= \frac{1}{\mathrm{qefr}}.\end{aligned}} \tag{205}$$

These relationships follow from

$$\mathrm{chds} = \frac{{\lambda_C}^2}{{e_{\mathrm{emax}}}^2}, \qquad \mathrm{orbt} = {F_q}^{-2}, \qquad \mathrm{rson} = {F_q}^2.$$

Physical interpretation. Quantum Charge Distribution Periodicity (qcdp) connects the spatial geometry of distributed magnetic charge with the orbital temporal dimension of the Aether Physics Model (APM).

Charge Distribution (chds) expresses area per unit distributed magnetic charge. Multiplication by QMU Orbit introduces a squared-time factor:

$$\mathrm{qcdp} = \mathrm{chds}\cdot\mathrm{orbt}.$$

In APM, particle charge occupies extended geometrical structures, including circulating surface configurations associated with Aether chronogeometry.

The qcdp unit provides a dimensional reference for relating these spatial charge distributions to cyclic temporal structure.

Its designation as *Periodicity* reflects this geometrical relationship. QMU Orbit is a time-squared quantity, not the duration of an individual orbital revolution.

Consequently, qcdp describes charge-distribution geometry weighted by squared time, rather than a physical oscillation period alone.

Relationship to resonance. The reciprocal relationship between Orbit and Resonance gives

$$\boxed{\mathrm{qcdp}\cdot\mathrm{rson} = \mathrm{chds}.} \tag{206}$$

Thus, the charge-normalized area is recovered by multiplying qcdp by the QMU resonance factor.

The reciprocal unit is

$$\text{qefr} = \frac{\text{chrg} \cdot \text{rson}}{\text{area}}.$$

Together, qcdp and qefr provide complementary descriptions of charge-distribution geometry and squared-frequency scaling.

These identities do not independently determine the frequency or stability of a physical oscillation.

Research significance. Quantum Charge Distribution Periodicity provides a connection among distributed magnetic charge, surface geometry, orbital structure, and resonance.

Within APM, it is particularly relevant to investigations of circulating particle-charge configurations and their temporal organization.

Potential applications include particle orbital geometry, charge-distribution resonance, surface oscillations, and the stability of cyclic charge structures.

A useful research direction is to determine whether qcdp contributes to the closure conditions governing recurring charge configurations, including the projected geometries of circulating Aether structures.

Its reciprocal, qefr, provides the complementary QMU dimension for describing the corresponding resonance-weighted charge distribution.

Quantum Charge Distribution Dynamics `qcdd`

QMU primitive representation: $\text{qcdd} = \dfrac{{\lambda_C}^2}{F_q\,{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: qcdd cdns = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qcdd = \frac{{\lambda_C}^2}{{e_{\text{emax}}}^2 \cdot F_q}$$

Physical interpretation: The Quantum Charge Distribution Dynamics (*qcdd*) unit represents the rate at which a quantum system's charge distribution changes or evolves. It combines the system's charge distribution (chds) with its fundamental frequency (freq), describing how the spatial arrangement of charge interacts with the system's basic temporal behavior.

Characteristics:

As a dynamic unit, it relates the system's charge distribution to its fundamental frequency of change.

The *chds* (Charge Distribution) component, $\frac{{\lambda_C}^2}{{e_{\text{emax}}}^2}$, represents the unit area per charge.

The inverse $freq$ (Frequency) component, F_q, represents the system's fundamental time change.

Higher *qcdd* values indicate more rapid dynamics of charge distribution.

Potential applications:

Analyzing the dynamic behavior of charge distributions in quantum systems

Studying how two-dimensional quantum structures evolve in time

Characterizing the rate of change of charge-based quantum states

Investigating the relationship between spatial charge patterns and their temporal evolution in quantum materials

This unit provides insight into how charge distributions in quantum systems change over time at their fundamental frequency. It could be particularly useful in understanding phenomena such as the dynamic behavior of electrons in two-dimensional materials, the rate of change of charge configurations in quantum dots, or the evolution of charge density waves. The *qcdd* unit bridges the gap between static charge distributions and their dynamic behavior, offering a tool for analyzing how quantum systems evolve their charge states through time.

Charge Distribution `chds`

QMU primitive representation: $\text{chds} = \frac{{\lambda_C}^2}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{chds}\,\text{efxd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Charge Distribution (*chds*) unit, also referred to as Stroke (*strk*), represents the spatial extent of magnetic charge distribution over a quantum area. It describes how magnetic charge is spread out or concentrated in a two-dimensional quantum space.

A higher *chds* value indicates a more diffuse charge distribution, potentially influencing surface conductivity and interactions with external fields. This understanding of chds as an area-to-charge ratio provides a fundamental measure of how charge is distributed in two-dimensional quantum space. It could be particularly useful in understanding phenomena such as electron distribution in 2D materials, charge accumulation at interfaces, or charge delocalization in molecular monolayers.

The relationships between chds and other QMU units offer further insights into its meaning and potential applications:

$chds = \frac{area}{chrg}$: This equation straightforwardly shows the relationship between quantum area ($area$) and magnetic charge ($chrg$), indicating the area per unit charge.

$chds = \frac{freq}{cdns}$: This relationship suggests that charge distribution can also be understood as the ratio of frequency ($freq$) to current density (cdns).

$chds = qvci \cdot sqod$: This equation presents charge distribution as the product of quantum volumetric charge inertia ($qvci$) and scalar quantum oscillation density ($sqod$). This perspective suggests that charge distribution in a 2D quantum system is intrinsically linked to both the inertial properties

of charge within a volume and the density of oscillations along a linear dimension. A higher qvci implies greater resistance to changes in charge state, while a higher sqod indicates a greater intensity of quantum oscillations along a line. The interplay between these volumetric and linear quantum properties determines the spatial distribution of charge in the 2D system.

Quantum Charge Radius Resistance `qcrr`

QMU primitive representation:

$$\text{qcrr} = \frac{\lambda_C}{{F_q}^3 \, {e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{qcrr}\,\text{qegi} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned} \text{qcrr} &= \text{chgr} \cdot \text{time}^3 \\ &= \frac{\text{chgr}}{\text{freq}^3} \\ &= \text{qcrd} \cdot \text{orbt} \\ &= \frac{\text{qcrd}}{\text{rson}} \\ &= \frac{1}{\text{qegi}}. \end{aligned}} \tag{207}$$

These relationships follow from

$$\text{chgr} = \frac{\lambda_C}{{e_{\text{emax}}}^2}, \qquad \text{qcrd} = \frac{\lambda_C}{F_q \, {e_{\text{emax}}}^2}, \qquad \text{rson} = {F_q}^2, \qquad \text{orbt} = {F_q}^{-2}.$$

Physical interpretation. Quantum Charge Radius Resistance (qcrr) connects charge-normalized radial geometry with the third-order temporal dimension of the Aether Physics Model (APM).

Charge Radius (chgr) represents length per unit distributed magnetic charge. The qcrr unit extends this relationship through three QMU temporal factors:

$$\text{qcrr} = \text{chgr} \cdot \text{time}^3.$$

Within APM, charge occupies extended geometrical structures rather than dimensionless points. The qcrr quantity therefore provides a dimensional reference for examining the temporal behavior of radial charge distributions.

Its designation as *Resistance* associates the quantity with the persistence or stability of charge geometry under time-dependent interactions.

The primitive identity does not, by itself, specify a physical resistance, damping coefficient, or restoring force. These properties depend on the corresponding APM interaction equations.

Relationship to charge-radius dynamics. The connection with Quantum Charge Radius Dynamics (qcrd) is

$$\boxed{\text{qcrr} = \text{qcrd} \cdot \text{orbt} = \frac{\text{qcrd}}{\text{rson}}.} \tag{208}$$

The related QMU quantities form a temporal progression:

$$\begin{aligned} \text{chgr} &= \frac{\text{leng}}{\text{chrg}}, \\ \text{qcrd} &= \text{chgr} \cdot \text{time}, \\ \text{qcrr} &= \text{chgr} \cdot \text{time}^3. \end{aligned}$$

Thus, qcrr extends the temporal dimension of qcrd by the QMU Orbit factor.

Its reciprocal provides the complementary dimension:

$$\text{qegi} = \frac{\text{chrg} \cdot \text{freq}^3}{\text{leng}}.$$

This establishes a direct relationship between charge-normalized radial geometry and cubic-frequency scaling.

Research significance. Quantum Charge Radius Resistance provides a dimensional reference for investigating the stability and temporal response of distributed radial charge structures.

Potential applications include particle charge geometry, oscillatory deformation, resonant radial interactions, and the response of extended charge distributions to time-dependent electromagnetic fields.

A useful research direction is to determine whether qcrr enters the governing equations for radial deformation or stability of particle charge structures within APM.

Its reciprocal, qegi, provides the complementary QMU dimension for expressing such relationships.

The canonical identities establish the dimensional framework, while specific resistance and stability properties follow from the physical interaction geometry.

Quantum Charge Radius Periodicity `qcrp`

QMU primitive representation: $\mathrm{qcrp} = \dfrac{\lambda_C}{{F_q}^2\,{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qcrp}\,\mathrm{qegr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qcrp = \frac{\lambda_C}{{e_{\mathrm{emax}}}^2 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Charge Radius Periodicity (*qcrp*) unit represents the characteristic time scale over which a quantum system's charge radius completes a cycle or returns to its initial state. It combines the system's charge radius (*chgr*) with its orbital period (*orbt*), describing how the radial extent of charge distribution relates to its temporal cyclic behavior.

Characteristics:

As a dynamic unit, it relates the system's charge radius to its natural oscillation period.

The *chgr* (Charge Radius) component, $\frac{\lambda_C}{{e_{\mathrm{emax}}}^2}$, represents the characteristic length scale of the charge distribution.

The *orbt* (Orbital Time) component, $\frac{1}{{F_q}^2}$, represents the system's characteristic oscillation period.

Higher *qcrp* values indicate longer periodicities for a given charge radius.

Potential applications:

Analyzing the cyclic behavior of charge radii in quantum systems

Studying how radially symmetric quantum structures evolve over their characteristic time scales

Characterizing the temporal stability of radially distributed charge-based quantum states

Investigating the relationship between charge radius and temporal periodicity in atomic or molecular systems

This unit provides insight into how the radial extent of charge distributions in quantum systems relates to their natural oscillation periods. It could be particularly useful in understanding phenomena such as:

The orbital periods of electrons in different atomic shells

The characteristic oscillation times of radially symmetric charge distributions in quantum dots

The coherence times of radially distributed charge-based qubits

The relationship between spatial extent and temporal evolution in Rydberg atoms

The *qcrp* unit bridges the gap between the radial extent of charge distributions and their temporal evolution, offering a tool for analyzing how quantum systems cycle through their radial charge states over time. This could be valuable in fields such as atomic and molecular physics, quantum optics,

and quantum computing, where understanding the interplay between spatial charge characteristics and temporal behavior is crucial.

Quantum Charge Radius Dynamics `qcrd`

QMU primitive representation:

$$\text{qcrd} = \frac{\lambda_C}{F_q \, {e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{qcrd}\,\text{mfdi} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{qcrd} &= \text{chgr} \cdot \text{time} \\ &= \frac{\text{leng}}{\text{chrg} \cdot \text{freq}} \\ &= \frac{\text{leng}}{\text{curr}} \\ &= \frac{1}{\text{mfdi}}.\end{aligned}} \tag{209}$$

These identities follow from

$$\text{chgr} = \frac{\lambda_C}{{e_{\text{emax}}}^2}, \qquad \text{curr} = {e_{\text{emax}}}^2 F_q, \qquad \text{time} = {F_q}^{-1}.$$

Physical interpretation. Quantum Charge Radius Dynamics (qcrd) connects charge-normalized radial geometry with the fundamental temporal dimension of the Aether Physics Model (APM).

The Charge Radius unit (chgr) expresses length per unit distributed magnetic charge. Multiplication by QMU Time introduces the corresponding temporal factor:

$$\text{qcrd} = \text{chgr} \cdot \text{time}.$$

This relationship provides a dimensional reference for examining the organization of radially distributed charge over the Aether chronovibration period.

Although named *Dynamics*, qcrd does not directly represent radial velocity or the time derivative of a physical charge radius.

Rather, its primitive dimensions combine length, distributed charge, and time.

Relationship to magnetic field intensity. The reciprocal relationship

$$\boxed{\text{qcrd} \cdot \text{mfdi} = 1} \tag{210}$$

connects Quantum Charge Radius Dynamics with Magnetic Field Intensity (mfdi).

Since

$$\text{qcrd} = \frac{\text{leng}}{\text{curr}},$$

the reciprocal takes the form

$$\text{mfdi} = \frac{\text{curr}}{\text{leng}}.$$

This expresses a direct QMU connection between charge-normalized radial extent, electric current, and magnetic field intensity.

In APM, distributed magnetic charge occupies extended particle geometry. The reciprocal pair therefore provides a convenient dimensional relationship for analyzing current-bearing structures and their magnetic interactions.

The actual magnetic-field distribution depends on the geometry and dynamics of the charge configuration.

Research significance. Quantum Charge Radius Dynamics provides a dimensional connection between radial charge geometry, chronovibration, current, and magnetic field intensity.

Potential applications include particle charge circulation, current-bearing geometrical structures, and the magnetic response of distributed-charge systems.

Its reciprocal relationship with mfdi is particularly useful when expressing magnetic field intensity in terms of current and characteristic length.

Further applications may examine how changing particle geometries modify radial charge distributions and their associated magnetic fields.

The canonical identities provide the dimensional foundation for these calculations, while physical radial motion requires the corresponding dynamical equations.

Charge Radius `chgr`

QMU primitive representation: $\text{chgr} = \dfrac{\lambda_C}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{chgr}\,\text{elcg} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Charge Radius ($chgr$) unit has a multifaceted nature, representing the effective radial extent of the magnetic charge distribution. It can be interpreted in several ways, depending on the specific relationship with other QMU units:

Magnetism and Specific Length:

The equation $chgr = mchg \cdot spln$ describes charge radius as the product of magnetism ($mchg$) and specific length ($spln$).

In this context, charge radius represents the magnetic charge's effective spatial extent, influenced by the system's magnetism and the linear distribution of mass.

This perspective is useful for understanding how the magnetic properties of the system and the distribution of mass along a line contribute to the effective size of the magnetic charge.

Curl and Magnetic Permeance:

The equation $chgr = curl \cdot magp$ relates charge radius to the curl ($curl$) and magnetic permeance ($magp$).

It suggests that charge radius can be understood as the product of spatial curvature and magnetic permeance, indicating how the geometry of space and the system's ability to support magnetic flux contribute to the effective size of the magnetic charge.

Magnetic Flux and Momentum:

The equation $chgr = \frac{mflx}{momt}$ links charge radius to magnetic flux ($mflx$) and momentum ($momt$).

It implies that charge radius can be interpreted as the ratio of magnetic flux to momentum, indicating how the magnetic flux relative to the magnetic charge's motion influences its effective size.

Potential and Force:

The equation $chgr = \frac{potn}{forc}$ relates charge radius to potential ($potn$) and force ($forc$).

It suggests that charge radius can be understood as the potential difference per unit force, indicating how the potential relative to the force acting on the magnetic charge influences its effective size.

Substrate units

Quantum Charge Density Intensity `qcdi`

QMU primitive representation: $\mathrm{qcdi} = \dfrac{{F_q}^3 \, {e_{\mathrm{emax}}}^2}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qcdi}\,\mathrm{qvci} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qcdi = \frac{{e_{\text{emax}}}^2 \cdot {F_q}^3}{{\lambda_C}^3}$$

Physical interpretation: The Quantum Charge Density Intensity (*qcdi*) unit represents the intensity of charge density fluctuations within a quantum volume. It combines the system's charge density (*chgd*) with its quantum intensity factor (*qinf*), describing how the volumetric concentration of charge interacts with high-frequency quantum processes.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The *chgd* (Charge Density) component, $\frac{{e_{\text{emax}}}^2}{{\lambda_C}^3}$, represents the charge per unit quantum volume.

The *qinf* (Quantum Intensity Factor) component, ${F_q}^3$, represents the intensity of quantum processes.

Higher *qcdi* values indicate more intense charge density fluctuations at high frequencies.

Potential applications:

Analyzing the intensity of charge density fluctuations in quantum vacuum

Studying how the quantum Aether supports high-frequency charge density variations

Characterizing the substrate's capacity for intense charge density oscillations

Investigating the relationship between charge density and high-frequency quantum processes in various materials

This unit provides insight into how the quantum substrate supports intense, high-frequency charge density fluctuations. It could be particularly useful in understanding phenomena such as:

Vacuum polarization effects in quantum electrodynamics

The behavior of virtual particle-antiparticle pairs in the quantum vacuum

High-frequency charge density waves in quantum materials

The substrate's role in supporting intense electromagnetic fields

The *qcdi* unit bridges the gap between static charge density and dynamic high-frequency quantum processes, offering a tool for analyzing how the quantum Aether accommodates and facilitates intense charge density fluctuations. This could be valuable in fields such as quantum field theory, condensed matter physics, and quantum optics, where understanding the substrate's capacity for supporting high-frequency charge density variations is crucial for describing fundamental quantum phenomena.

Quantum Charge Density Resonance `cdrs`

QMU primitive representation:

$$\text{cdrs} = \frac{{F_q}^2 \, {e_{\text{emax}}}^2}{{\lambda_C}^3}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{cdrs}\,\text{qvcr} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{cdrs} &= \text{chgd} \cdot \text{rson} \\ &= \text{cdos} \cdot \text{freq} \\ &= \frac{\text{chrg} \cdot \text{freq}^2}{\text{volm}} \\ &= \frac{\text{chgd}}{\text{orbt}} \\ &= \frac{1}{\text{qvcr}}.\end{aligned}} \tag{211}$$

These relationships follow from

$$\text{chgd} = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3}, \qquad \text{cdos} = \text{chgd} \cdot F_q, \qquad \text{rson} = {F_q}^2.$$

Physical interpretation. Quantum Charge Density Resonance (cdrs) connects volumetric distributed magnetic charge with the resonance dimension of the Aether Physics Model (APM).

The defining relationship

$$\text{cdrs} = \text{chgd} \cdot \text{rson}$$

combines magnetic charge density with the squared chronovibration frequency of an Aether unit.

In QMU, Resonance (rson) is a frequency-squared quantity. It provides the temporal dimension associated with second-order oscillatory dynamics rather than a separate resonant frequency.

Within APM, distributed magnetic charge occupies extended geometrical structures. The cdrs unit consequently provides a reference scale for examining the resonant behavior of volumetric charge distributions.

The unit establishes the dimensional scale; the physical resonance mode, amplitude, phase, and stability depend on the interacting geometry.

Relationship to charge oscillation. Charge Density (chgd), Quantum Charge Density Oscillation (cdos), and cdrs form a consistent temporal sequence:

$$\boxed{\begin{aligned} \text{chgd} &= \frac{\text{chrg}}{\text{volm}}, \\ \text{cdos} &= \text{chgd} \cdot \text{freq}, \\ \text{cdrs} &= \text{cdos} \cdot \text{freq} = \text{chgd} \cdot \text{rson}. \end{aligned}} \tag{212}$$

Thus, cdos supplies a first-order temporal charge-density scale, while cdrs supplies the corresponding second-order scale.

For a physical charge-density distribution $\rho_{\text{chrg}}(\mathbf{x}, t)$,

$$\left[\frac{\partial^2 \rho_{\text{chrg}}}{\partial t^2}\right] = [\text{cdrs}].$$

The temporal dynamics may therefore be expressed in normalized form as

$$\frac{\partial^2 \rho_{\text{chrg}}}{\partial t^2} = \text{cdrs}\,\mathcal{R},$$

where $\mathcal{R}$ is a dimensionless response determined by the physical charge geometry and interaction equations.

This formulation distinguishes the fundamental QMU resonance scale from the actual acceleration of charge-density variation in a particular system.

Research significance. Quantum Charge Density Resonance provides a dimensional foundation for investigating resonant interactions involving distributed magnetic charge in Aether volumes.

Potential applications include particle charge circulation, collective plasma oscillations, confined electromagnetic modes, and geometrically organized charge-density resonance.

A useful research direction is to derive the resonance conditions of specific APM charge configurations and determine whether they yield measurable frequency relationships, mode structures, or stability criteria.

Its reciprocal, Quantum Volume Charge Resonance (qvcr), supplies the complementary QMU dimension.

The canonical identities establish the dimensional reference for these investigations, while actual resonant behavior follows from the corresponding APM dynamical equations.

Quantum Charge Density Oscillation `cdos`

QMU primitive representation:

$$\text{cdos} = \frac{F_q\, {e_{\text{emax}}}^2}{{\lambda_C}^3}.$$

Catalog reciprocal:

$$\mathrm{cdos}\,\mathrm{qvcp} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{cdos} &= \mathrm{chgd}\cdot\mathrm{freq}\\ &= \frac{\mathrm{chrg}}{\mathrm{volm}\cdot\mathrm{time}}\\ &= \frac{\mathrm{curr}}{\mathrm{volm}}\\ &= \frac{1}{\mathrm{qvcp}}.\end{aligned}} \tag{213}$$

These identities follow from

$$\mathrm{chgd} = \frac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^3}, \qquad \mathrm{curr} = {e_{\mathrm{emax}}}^2 F_q.$$

Thus, cdos represents distributed magnetic charge density scaled by the fundamental QMU chronovibration frequency.

Physical interpretation. Quantum Charge Density Oscillation (cdos) connects the volumetric distribution of magnetic charge with the temporal frequency of the Aether Physics Model (APM).

Within APM, magnetic charge is inherently distributed through physical geometry rather than concentrated at dimensionless points.

The relationship

$$\mathrm{cdos} = \mathrm{chgd}\cdot\mathrm{freq}$$

provides a charge-density rate scale associated with the fundamental chronovibration of an Aether unit.

Equivalently, cdos expresses QMU Current per unit volume. This establishes its connection to temporally organized charge without requiring a particular direction of charge transport.

The unit characterizes the dimensional scale of charge-density oscillation; it does not independently specify an oscillation amplitude, phase, or waveform.

Relationship to charge dynamics. For a physical charge-density distribution $\rho_{\mathrm{chrg}}(\mathbf{x}, t)$, a temporal variation has the dimension

$$\left[\frac{\partial \rho_{\mathrm{chrg}}}{\partial t}\right] = [\mathrm{cdos}].$$

Consequently, cdos provides a natural QMU reference for normalizing temporal changes in distributed charge density.

A particular system may be described by

$$\frac{\partial \rho_{\mathrm{chrg}}}{\partial t} = \mathrm{cdos}\, \mathcal{D},$$

where $\mathcal{D}$ is a dimensionless response function determined by the charge geometry and physical dynamics.

This representation separates the fundamental QMU scale from the actual behavior of an oscillating charge distribution.

Research significance. Quantum Charge Density Oscillation provides a dimensional connection among charge density, chronovibration, and current within Aether geometry.

Potential applications include particle charge circulation, electromagnetic oscillations, charge redistribution, and the temporal response of confined distributed-charge structures.

An important research direction is to determine whether the APM geometry of circulating charge predicts specific oscillation modes, phase relationships, or measurable electromagnetic responses.

The reciprocal Quantum Volume Charge Period (qvcp) provides the complementary QMU dimension.

The canonical identities establish the dimensional reference, while the oscillation spectrum and propagation behavior follow from the corresponding APM interaction equations.

Charge Density `chgd`

QMU primitive representation:

$$\mathrm{chgd} = \frac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^3}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{chgd}\, \mathrm{spch} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\mathrm{chgd} = \frac{\mathrm{chrg}}{\mathrm{volm}} = \frac{1}{\mathrm{spch}}.} \tag{214}$$

This expression relates distributed magnetic charge to the three-dimensional volume of the Aether reference structure.

Physical interpretation. Charge Density (chgd) describes the amount of distributed magnetic charge associated with a unit volume in the Aether Physics Model (APM).

Unlike an idealized point-charge description, APM treats charge as an inherent property of extended geometrical structures. The chgd unit provides the volumetric reference for examining how charge is distributed within particles, materials, and Aether configurations.

A greater charge density indicates more distributed magnetic charge per unit volume, while a lower density indicates a more spatially diffuse distribution.

Charge density does not, by itself, determine the geometry or polarity of a charge configuration. These depend on the physical structure and interaction being modeled.

Research significance. Charge Density provides a foundation for investigating charge distributions in particles, plasmas, conductive materials, and other volumetric electromagnetic structures.

Its reciprocal, Specific Charge (spch), expresses volume per unit distributed charge, providing a complementary description of charge distribution.

Together, these quantities offer a direct dimensional connection between magnetic charge and spatial volume, supporting research into charge transport, particle geometry, and electromagnetic interactions.

For related units and dimensional relationships, see the section on Quantum Electrodynamic Distribution Units.

Quantum Electric Surface Intensity `qesi`

QMU primitive representation:

$$\mathrm{qesi} = \frac{{F_q}^3 \, {e_{\mathrm{emax}}}^2}{{\lambda_C}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{qesi}\,\mathrm{qcdr} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\mathrm{qesi} = \frac{\mathrm{chrg} \cdot \mathrm{freq}^3}{\mathrm{area}} = \frac{1}{\mathrm{qcdr}}.} \tag{215}$$

This relationship combines distributed magnetic charge per unit area with a cubic frequency dimension.

Physical interpretation. Quantum Electric Surface Intensity (qesi) describes the temporal intensity of distributed charge associated with a two-dimensional surface in the Aether Physics Model (APM).

The charge-to-area ratio expresses surface charge density, while the cubic frequency factor introduces third-order temporal dependence into the QMU dimensional structure.

Within APM, charge is inherently distributed through physical geometry. The qesi unit therefore provides a reference for examining how charge organized across a surface participates in rapidly varying electromagnetic interactions.

The cubic frequency factor is part of the canonical QMU dimension and does not, by itself, specify the frequency or amplitude of an applied excitation.

Relationship to charge distribution. The reciprocal quantity, Quantum Charge Distribution Resistance (qcdr), satisfies

$$\boxed{\text{qcdr} = \frac{\text{area} \cdot \text{time}^3}{\text{chrg}}.} \tag{216}$$

Thus, qesi and qcdr provide complementary dimensional descriptions of surface-charge organization and its temporal response.

Their reciprocal relationship connects charge intensity with the corresponding distribution-resistance dimension without equating either quantity directly to conventional SI electrical resistance.

Research significance. Quantum Electric Surface Intensity provides a dimensional framework for investigating time-dependent charge distributions across particle surfaces, material interfaces, and other two-dimensional geometries.

Potential applications include surface electromagnetic waves, charge relaxation, interfacial transport, and the stability of distributed-charge structures.

Within APM, the unit may also be useful for examining the temporal behavior of charge distributed across the geometrical surfaces of elementary particles.

Its canonical relationships establish the dimensional foundation for deriving physical response equations and comparing their predictions with measured electromagnetic behavior.

Quantum Electric Surface Resonance Intensity `qefr`

QMU primitive representation: $\text{qefr} = \dfrac{{F_q}^2 \, {e_{\text{emax}}}^2}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{qefr}\,\text{qcdp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qefr = \frac{{e_{\text{emax}}}^2 \cdot {F_q}^2}{{\lambda_C}^2}$$

Physical interpretation:

Represents the resonant behavior of quantum electric fields across a surface area

Quantifies the intensity of electric field oscillations at resonant frequencies per unit area in the Aether

Describes the combined effect of electric flux density and quantum resonance on a surface

Significance:

Emerges from the APM's concept of relating electric field properties to resonant quantum phenomena on surfaces

Provides a measure of how "resonant" or "coherent" an electric field is at the quantum level on a given surface

Combines aspects of electric flux density and resonance, linking electromagnetic and quantum oscillatory concepts

Potential applications:

Analyzing the resonant behavior of electric fields in quantum environments on surfaces

Characterizing the coherence of quantum electrodynamic effects in two-dimensional systems

Studying the relationship between electric flux density and quantum resonance on interfaces

Describing the "quantum electric field resonance" of various surface phenomena or materials

This unit offers a unique perspective on how electric fields resonate and maintain coherence at quantum scales on surfaces. By combining electric flux density ($efxd$) with resonance ($rson$), $qefr$ allows for the quantification of electric field phenomena that involve both electromagnetic and resonant quantum aspects within the Aether framework.

Current Density `cdns`

QMU primitive representation: $\mathrm{cdns} = \dfrac{F_q \, {e_{\mathrm{emax}}}^2}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{cdns}\,\mathrm{qcdd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Current Density (*cdns*) unit is a multifaceted concept in the Quantum Measurement Units (QMU) system, representing the conductivity of a material or system with respect to magnetic charge flow. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Conductance and Surface Tension:

The equation $cdns = cond \cdot sten$ describes current density as the product of conductance (*cond*) and surface tension (*sten*).

In this context, current density represents the material's ability to conduct magnetic charge across a surface or interface, influenced by the surface's cohesive forces.

This perspective is helpful for understanding the relationship between conductance, surface tension, and charge flow at material boundaries or interfaces.

Electric Flux Density and Frequency:

The equation $cdns = efxd \cdot freq$ relates current density to electric flux density ($efxd$) and frequency ($freq$).

It expresses current density as electric flux density multiplied by frequency.

This relation describes current density, not conductance density; the two have distinct QMU dimensions.

Current and Area:

The equation $cdns = \frac{curr}{area}$ links current density to the magnetic charge current ($curr$) and the area through which it flows.

It suggests that current density represents the flow of current per unit area.

This perspective is valuable for understanding how current density relates to the current flow and the spatial extent of the conducting region.

Electric Flux Density `efxd`

QMU primitive representation: $\mathrm{efxd} = \dfrac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{efxd}\,\mathrm{chds} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Electric Flux Density ($efxd$) unit, as defined in the Aether Physics Model, has a multifaceted nature, representing the flux of magnetic charge through a given area. It can be interpreted in several ways, depending on the specific relationship with other QMU units:

Magnetic Charge and Area:

The equation $efxd = \frac{chrg}{area}$ describes electric flux density as the ratio of magnetic charge ($chrg$) to area ($area$).

In this context, electric flux density represents the amount of magnetic charge per unit area.

This perspective is useful for understanding the distribution of magnetic charge across quantum surfaces.

Velocity and Electric Field:

The equation $efxd = \frac{velc}{efld}$ relates electric flux density to the velocity ($velc$) and the electric field ($efld$).

It suggests that electric flux density can be understood as the ratio of velocity to electric field intensity, indicating the flux of magnetic charge per unit electric field strength.

This perspective is valuable for understanding how electric flux density relates to the speed of magnetic charge movement and the strength of the electric field.

Magnetic Field Intensity and Velocity:

The equation $efxd = \frac{mfdi}{velc}$ links electric flux density to magnetic field intensity ($mfdi$) and velocity ($velc$).

It suggests that electric flux density can be interpreted as the ratio of magnetic field intensity to velocity, indicating the magnetic field strength per unit speed of magnetic charge.

This perspective is valuable for understanding how electric flux density relates to the magnetic field intensity and the speed of magnetic charge movement.

Quantum Electric Gradient Intensity `qegi`

QMU primitive representation: $\mathrm{qegi} = \dfrac{{F_q}^3\,{e_{\mathrm{emax}}}^2}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qegi}\,\mathrm{qcrr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qegi = \frac{{e_{\mathrm{emax}}}^2 \cdot {F_q}^3}{\lambda_C}$$

Physical interpretation:

Represents the intensity of quantum electric charge gradient fluctuations along a linear dimension

Quantifies the rate of high-frequency changes in electric potential gradient in the Aether

Describes the combined effect of electric charge gradient and quantum intensity factor in one-dimensional space

Significance:

Emerges from the APM's concept of relating electric potential gradient to high-frequency quantum phenomena in linear systems

Provides a measure of how "intense" or "active" an electric charge gradient is at the quantum level along a given path

Combines aspects of electric charge gradient and quantum intensity factor, linking electrostatic and quantum frequency concepts

Potential applications:

Analyzing the behavior of electric potential gradients in high-frequency quantum environments in one-dimensional systems

Characterizing the intensity of quantum electrodynamic effects in linear structures like quantum wires or molecular chains

Studying the relationship between electric charge gradient and quantum intensity in nanoscale electronic devices

Describing the ”quantum electric gradient activity” of various linear phenomena or materials

This unit offers a unique perspective on how electric charge gradients behave and fluctuate at high frequencies in quantum linear systems. By combining electric charge gradient (*elcg*) with the quantum intensity factor (*qinf*), *qegi* allows for the quantification of electric field gradient phenomena that involve both electrostatic and high-frequency quantum aspects within the Aether framework. This could be particularly relevant for understanding and optimizing quantum transport processes in one-dimensional nanostructures.

Quantum Electric Gradient Resonance `qegr`

QMU primitive representation: $\mathrm{qegr} = \dfrac{{F_q}^2 \, {e_{\mathrm{emax}}}^2}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qegr}\,\mathrm{qcrp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qegr = \frac{{e_{\mathrm{emax}}}^2 \cdot {F_q}^2}{\lambda_C}$$

Physical interpretation:

Represents the resonant behavior of quantum electric charge gradients along a linear dimension

Quantifies the intensity of electric potential gradient oscillations at resonant frequencies in the Aether

Describes the combined effect of electric charge gradient and quantum resonance in one-dimensional space

Significance:

Emerges from the APM's concept of relating electric potential gradient to resonant quantum phenomena in linear systems

Provides a measure of how ”resonant” or ”coherent” an electric charge gradient is at the quantum level along a given path

Combines aspects of electric charge gradient and resonance, linking electrostatic and quantum oscillatory concepts

Potential applications:

Analyzing the resonant behavior of electric potential gradients in quantum environments in one-dimensional systems

Characterizing the coherence of quantum electrodynamic effects in linear structures like quantum wires or molecular chains

Studying the relationship between electric charge gradient and quantum resonance in nanoscale electronic devices

Describing the ”quantum electric gradient resonance” of various linear phenomena or materials

This unit offers a unique perspective on how electric charge gradients resonate and maintain coherence at quantum scales in linear systems. By combining electric charge gradient ($elcg$) with resonance ($rson$), $qegr$ allows for the quantification of electric field gradient phenomena that involve both electrostatic and resonant quantum aspects within the Aether framework. This could be particularly relevant for understanding and optimizing quantum coherence and resonant transport processes in one-dimensional nanostructures, potentially leading to novel applications in quantum computing and quantum sensing technologies.

Magnetic Field Intensity `mfdi`

QMU primitive representation: $\mathrm{mfdi} = \dfrac{F_q \, {e_{\mathrm{emax}}}^2}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{mfdi}\,\mathrm{qcrd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Magnetic Field Intensity ($mfdi$) unit has a multifaceted nature, representing the strength or intensity of the magnetic field in a quantum system. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Magnetic Moment and Volume:

The equation $mfdi = \frac{magm}{volm}$ describes magnetic field intensity as the ratio of magnetic moment ($magm$) to volume ($volm$). This is dimensionally consistent with the catalog definitions $magm = {e_{\mathrm{emax}}}^2 {\lambda_C}^2 F_q$ and $volm = {\lambda_C}^3$.

In this context, mfdi represents the magnetic moment per unit volume, indicating how much magnetic moment is concentrated within a given space.

This perspective is useful for understanding the distribution and strength of magnetic moments in quantum systems.

Energy and Magnetic Field:

The equation $mfdi = \frac{enrg}{mfld}$ relates mfdi to energy ($enrg$) and magnetic field ($mfld$).

It suggests that mfdi represents the energy per unit magnetic field, indicating the amount of energy associated with a given magnetic field strength.

This perspective is valuable for understanding the relationship between energy and magnetic field intensity.

Curl and Intensity:

The equation $mfdi = curl \cdot ints$ links mfdi to the curl ($curl$) and intensity ($ints$).

It suggests that $mfdi$ is the product of curl and intensity, indicating the magnetic field intensity arising from the spatial curvature and the concentration of a physical quantity.

This perspective is valuable for understanding how spatial curvature and intensity contribute to the magnetic field intensity.

Electric Charge Gradient `elcg`

QMU primitive representation:

$$\text{elcg} = \frac{{e_{\text{emax}}}^2}{\lambda_C}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{elcg}\,\text{chgr} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\text{elcg} = \frac{\text{chrg}}{\text{leng}} = \frac{\text{potn}}{\text{fric}} = \frac{1}{\text{chgr}}.} \tag{217}$$

These relationships connect distributed magnetic charge, length, electric potential, and friction within a common QMU dimension.

Physical interpretation. Electric Charge Gradient (elcg) describes the linear distribution of magnetic charge within the Aether Physics Model (APM).

Because APM treats charge as an extended geometrical quantity, elcg provides a measure of charge distributed along a characteristic length.

The relationship

$$\text{elcg} = \frac{\text{chrg}}{\text{leng}}$$

is analogous to linear charge density, although the QMU charge dimension represents distributed magnetic charge rather than conventional SI electric charge.

A greater elcg value corresponds to more charge per unit length, while a smaller value indicates a more extended distribution for the same charge.

The term *gradient* identifies the QMU catalog quantity. A local spatial gradient, such as a derivative of charge density, requires an explicitly defined charge distribution and coordinate.

Relationship to potential and friction. The complementary identity

$$\boxed{\text{fric} \cdot \text{elcg} = \text{potn}} \tag{218}$$

connects charge distribution with electrical potential and the QMU friction quantity.

This establishes a dimensional link between distributed-charge geometry and electromagnetic response.

The identity does not require physical friction or energy dissipation to occur whenever a charge gradient exists. Those effects depend on the relevant interaction geometry and dynamics.

Research significance. Electric Charge Gradient provides a useful dimensional reference for studying charge distributions along particle structures, conductive paths, interfaces, and other extended geometries.

Within APM, it may help characterize how charge arrangement influences electrical potential, magnetic interactions, and transport.

Its reciprocal, Charge Radius (chgr), provides a complementary geometrical description through length per unit distributed charge.

For related relationships, see the Quantum Electrodynamic Distribution Units section.

Electromagnetic Behavioral

Dynamic units

Trivariate Magnetic Oscillation `trmo`

QMU primitive representation: $\text{trmo} = \dfrac{{\lambda_C}^3 \, {F_q}^3}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{trmo}\,\text{qefs} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Tri-Modal Oscillation (*trmo*) unit has a multifaceted nature, representing the resistance to rapid changes in a quantum system. It can be interpreted in several ways, depending on the specific relationship being emphasized:

Specific Charge and Quantum Intensity Factor:

The equation $trmo = spch \cdot qinf$ describes trmo as the product of specific charge (*spch*) and the quantum intensity factor (*qinf*).

In this context, trmo represents the resistance to electric oscillations arising from the interplay between the spatial distribution of charge and the intensity of high-frequency quantum processes.

This perspective highlights how the spatial configuration of charge and the intensity of quantum fluctuations contribute to the system's stability against rapid electric variations.

Temperature and Charge Velocity:

The equation $trmo = temp \cdot chgv$ relates trmo to the temperature (*temp*) and velocity per charge (*chgv*).

It suggests that trmo represents the resistance to electric oscillations resulting from the combined effects of thermal energy and the speed of charge movement.

This perspective emphasizes the role of both thermal and kinetic factors in determining the system's stability against rapid electric variations.

Electric Field and Resonance:

The equation $trmo = efld \cdot rson$ links trmo to the electric field ($efld$) and resonance ($rson$).

It suggests that trmo represents the resistance to electric oscillations arising from the interaction between the electric field and the resonance of the system.

This perspective highlights the interplay between electric field strength and the system's oscillatory behavior in determining its resistance to rapid electric variations.

Varying Electric Field `vefd`

QMU primitive representation: $\mathrm{vefd} = \dfrac{{\lambda_C}^3 {F_q}^2}{{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{vefd}\,\mathrm{qerc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Varying Electric Field ($vefd$) unit, as presented in the Aether Physics Model, signifies the resistance to fluctuations in electric field strength within a quantum system. It can be understood through various relationships with other QMU units:

Electric Field Strength and Specific Area:

The equation $vefd = elfs \cdot spar$ expresses $vefd$ as the product of electric field strength ($elfs$) and specific area ($spar$).

This implies that vefd quantifies the resistance to electric field strength variations per unit area.

A higher vefd value suggests a greater ability to maintain a stable electric field even with varying charge distributions over an area.

Charge Sweep and Charge Velocity:

The equation $vefd = chgs \cdot velc$ relates vefd to charge sweep ($chgs$) and charge velocity ($velc$).

This indicates that vefd represents the resistance to electric field fluctuations arising from the combined effect of the spatial extent of charge and its velocity.

A system with a higher vefd is less susceptible to electric field variations caused by moving charges.

Magnetic Current and Flow:

The equation $vefd = mcur \cdot flow$ links $vefd$ to magnetic current ($mcur$) and flow ($flow$).

This suggests that vefd quantifies the resistance to electric field changes due to the interaction between magnetic charge flow and the quantum volumetric flow rate.

A higher vefd value indicates greater stability in the electric field despite variations in both magnetic charge flow and quantum volume flow.

Electric Field `efld`

QMU primitive representation: $\text{efld} = \dfrac{{\lambda_C}^3 F_q}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: efld qefc = 1 (as a formal reciprocal of the stated QMU dimensions).

The Electric Field ($efld$) unit, as represented in the Aether Physics Model, embodies the intensity of the electric field within a quantum system. It can be understood through various relationships with other QMU units:

Magnetic Field and Mass:

The equation $efld = \frac{mfld}{mass}$ expresses efld as the ratio of the magnetic field ($mfld$) to mass ($mass$).

This implies that $efld$ quantifies the electric field intensity generated per unit of mass in the presence of a magnetic field.

A higher $efld$ value suggests a stronger electric field is produced for a given mass with a constant magnetic field.

Temperature and Magnetic Field Intensity:

The equation $efld = \frac{temp}{mfdi}$ relates efld to temperature ($temp$) and magnetic field intensity ($mfdi$).

This indicates that efld represents the electric field intensity produced per unit of magnetic field intensity at a given temperature.

A system with a higher efld is more effective at generating an electric field for a given magnetic field intensity and temperature.

Flow and Magnetic Charge:

The equation $efld = \frac{flow}{chrg}$ links efld to quantum flow ($flow$) and magnetic charge ($chrg$).

This suggests that $efld$ quantifies the electric field intensity generated per unit of magnetic charge due to the quantum volumetric flow rate.

A higher $efld$ value indicates a stronger electric field is produced for a given magnetic charge with a constant quantum flow.

Potential and Quantum Linear Temporal Compliance:

The equation $efld = potn \cdot qltc$ links efld to potential ($potn$) and quantum linear temporal compliance ($qltc$).

This suggests that efld quantifies the electric field intensity due to the interaction between potential and the temporal compliance of a linear quantum system.

A higher efld value indicates a stronger electric field is generated for a given potential with constant quantum linear temporal compliance.

Dynamic Electric Field Intensity `defi`

QMU primitive representation: $\text{defi} = \dfrac{{\lambda_C}^2 {F_q}^3}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{defi}\,\text{qefi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$defi = \frac{{\lambda_C}^2 \cdot {F_q}^3}{{e_{\text{emax}}}^2}$$

Physical interpretation: The Dynamic Electric Field Intensity ($defi$) unit represents the intensity or strength of a dynamic electric field at the quantum scale. It combines aspects of area, frequency , and charge to describe how electric fields behave and interact in rapidly changing quantum environments.

Characteristics:

It's classified as a dynamic electric field unit, relevant for time-varying or rapidly fluctuating electric fields.

The presence of ${F_q}^3$ indicates a strong dependence on the quantum frequency, emphasizing its dynamic nature.

The inverse relationship with magnetic charge (${e_{\text{emax}}}^2$) might relate to how the field interacts with or is influenced by magnetic charge.

The ${\lambda_C}^2$ term suggests a dependence on the quantum area of space, indicating the field's behavior over a two-dimensional quantum region.

Potential applications:

Analyzing fast-switching electric fields in quantum devices

Studying the behavior of charged particles in rapidly changing electromagnetic environments

Characterizing dynamic electric field effects in two-dimensional quantum systems

Investigating quantum electrodynamic phenomena in planar structures

This unit could be particularly useful in contexts where the rapid variation of electric fields over quantum areas is important, such as in two-dimensional quantum materials, surface plasmon dynamics, or in understanding certain aspects of quantum field fluctuations in planar geometries.

Charge Temperature `chgt`

QMU primitive representation:

$$\text{chgt} = \frac{{\lambda_C}^2 {F_q}^2}{{e_{\text{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{chgt}\,\text{efrs} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{chgt} &= \frac{\text{temp}}{\text{chrg}} \\ &= \frac{\text{velc}^2}{\text{chrg}} \\ &= \frac{A_u}{\text{torq}} \\ &= \frac{1}{\text{efrs}}.\end{aligned}} \tag{219}$$

These relationships follow from

$$\text{temp} = {\lambda_C}^2 {F_q}^2 = c^2, \qquad \text{chrg} = {e_{\text{emax}}}^2.$$

Thus, Charge Temperature expresses the fundamental QMU temperature quantity per unit distributed magnetic charge.

Physical interpretation. Charge Temperature (chgt) connects the temporal dynamics of Aether geometry with its distributed magnetic-charge structure.

Within the Aether Physics Model (APM), temperature is a velocity-squared quantity associated with chronovibration, rather than simply a measure of macroscopic thermal agitation.

The relationship

$$\text{chgt} = \frac{\text{temp}}{\text{chrg}}$$

expresses this dynamical scale relative to the distributed charge of the electron reference structure.

This quantity is distinct from thermodynamic temperature measured in kelvin.

Relationship to the Aether unit. In APM, a subatomic particle is described through a circulating string of mass, the *ligamen circulatus*, interacting with the geometry of an Aether unit.

The corresponding QMU relationships are

$$\boxed{A_u = \frac{hc}{\text{chrg}} = \text{torq} \cdot \text{chgt}.} \tag{220}$$

Using the canonical construction

$$\text{torq} = m_{\text{e}}\lambda_C,$$

we obtain

$$\text{torq} \cdot \text{chgt} = (m_{\text{e}}\lambda_C)\frac{{\lambda_C}^2 {F_q}^2}{{e_{\text{emax}}}^2} = A_u.$$

In the APM interpretation, torq represents the ligamen circulatus associated with the dark-matter substrate, while chgt provides the complementary charge-temperature factor participating in its manifestation as physical matter.

This relationship connects particle mass structure, distributed charge, and Aether geometry within a single dimensional closure.

Relationship to curl. Ledger One establishes

$$A_u \text{curl} = \text{temp}.$$

Substituting the Charge Temperature relationship gives

$$\boxed{\text{torq} \cdot \text{chgt} \cdot \text{curl} = \text{temp}.} \tag{221}$$

This connects the ligamen circulatus, charge temperature, and intrinsic Aether curl to the fundamental velocity-squared quantity.

Research significance. Charge Temperature provides a direct dimensional connection among distributed magnetic charge, chronovibration, Aether curl, and the ligamen circulatus.

Its role in the Aether unit relationship makes it particularly relevant to investigations of particle formation, mass manifestation, and the interaction between matter and quantum space.

A useful research direction is to develop the dynamical conditions under which the ligamen circulatus occupies a stable Aether geometry and produces the observable properties of a particle.

The QMU identities establish the dimensional relationships, while the physical process of particle formation is described by the corresponding APM geometrical dynamics.

Charge Sweep `chgs`

QMU primitive representation: $\text{chgs} = \dfrac{{\lambda_C}^2 F_q}{{e_{\text{emax}}}^2}.$

Family grid Dependency index

Catalog reciprocal: $\text{chgs}\,\text{mcdf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Charge Sweep ($chgs$) unit has a multifaceted nature, representing the amount of magnetic charge in a quantum system undergoing angular motion or "sweep." It can be interpreted in several ways, depending on the specific relationship being emphasized:

Potential and Displacement Field:

The equation $chgs = potn \cdot dfld$ describes charge sweep as the product of potential ($potn$) and displacement field ($dfld$).

In this context, charge sweep represents the amount of magnetic charge undergoing angular motion due to the potential difference and the displacement field.

This perspective is useful for understanding how potential differences and displacement fields induce magnetic charge movement and contribute to the system's magnetic moment.

Magnetic Flux and Mass:

The equation $chgs = \frac{mflx}{mass}$ relates charge sweep to magnetic flux ($mflx$) and mass ($mass$).

It suggests that charge sweep represents the magnetic flux per unit mass, indicating the amount of magnetic charge involved in angular motion relative to the system's mass.

This perspective is valuable for understanding how magnetic flux and mass influence the magnetic charge's participation in rotational dynamics.

Curl and Magnetic Flow Impedance:

The equation $chgs = curl \cdot mgfi$ links charge sweep to the curl ($curl$) and magnetic flow impedance ($mgfi$).

It suggests that charge sweep is the product of curl and magnetic flow impedance, indicating the amount of magnetic charge involved in angular motion due to the spatial curvature and the system's resistance to magnetic flux flow.

This perspective is valuable for understanding how spatial curvature and magnetic flow impedance affect the magnetic charge's participation in rotational dynamics.

Dynamic Electric Field Flux `deff`

QMU primitive representation: $\mathrm{deff} = \dfrac{\lambda_C \, {F_q}^3}{{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{deff}\,\mathrm{qefp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$deff = \frac{\lambda_C \cdot {F_q}^3}{{e_{\mathrm{emax}}}^2}$$

Physical interpretation: The Dynamic Electric Field Flux ($deff$) unit represents the rate of change of electric field flux through a linear quantum dimension. It combines aspects of length, frequency, and charge to describe how electric field flux varies rapidly in quantum systems.

Characteristics:

It's classified as a dynamic electric field unit, relevant for time-varying or rapidly changing electric field flux.

The presence of ${F_q}^3$ indicates a strong dependence on the quantum frequency, emphasizing its highly dynamic nature.

The inverse relationship with magnetic charge (${e_{\text{emax}}}^2$) suggests an interaction between the changing electric field flux and magnetic charge.

The λ_C term implies a relationship to a linear quantum dimension, possibly representing flux through a one-dimensional quantum path or line.

Potential applications:

Analyzing rapidly changing electric field flux in quantum wire systems

Studying dynamic electromagnetic phenomena in one-dimensional quantum structures

Characterizing fast-switching behavior in quantum devices with linear geometries

Investigating quantum electrodynamic effects in systems with linear confinement

This unit could be particularly useful in contexts where the rapid variation of electric field flux along quantum linear dimensions is important, such as in quantum nanowires, edge states of topological insulators, or in understanding certain aspects of quantum field dynamics in confined linear geometries.

Acceleration per Charge `chga`

QMU primitive representation: $\text{chga} = \dfrac{\lambda_C \, {F_q}^2}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{chga}\,\text{qefe} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Acceleration per Charge (*chga*) unit has a multifaceted nature, representing the acceleration of magnetic charge in a quantum system. It can be interpreted in several ways, depending on the specific relationship with other QMU units:

Friction and Inductance:

The equation $chga = \frac{fric}{indc}$ describes acceleration per charge as the ratio of friction ($fric$) to inductance ($indc$).

In this context, acceleration per charge represents the acceleration of magnetic charge resulting from the frictional force acting against the inductance of the system.

This perspective is useful for understanding how friction and inductance influence the acceleration of magnetic charge.

Potential and Torque:

The equation $chga = \frac{potn}{torq}$ relates acceleration per charge to potential ($potn$) and torque ($torq$).

It suggests that charge acceleration can be understood as the potential difference per unit torque.

A higher charge acceleration value indicates a greater potential difference required to produce the same amount of angular acceleration, represented by torque.

Electric Field Strength and Mass:

The equation $chga = \frac{elfs}{mass}$ links acceleration per charge to electric field strength ($elfs$) and mass ($mass$).

This implies that charge acceleration can be interpreted as the electric field strength per unit mass.

A higher charge acceleration value indicates a greater electric field strength acting on a unit of mass, leading to a larger acceleration of the magnetic charge.

Velocity per Charge `chgv`

QMU primitive representation: $\mathrm{chgv} = \dfrac{\lambda_C \, F_q}{{e_{\mathrm{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{chgv}\,\mathrm{efcd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Physical interpretation:

Represents the velocity or rate of motion of magnetic charge at the quantum scale

Quantifies how fast magnetic charge moves through the Aether structure

Describes the spatial displacement rate of magnetic charge in quantum systems

Significance:

Emerges from the APM's concept of magnetic charge motion in quantum space

Provides a fundamental measure of magnetic charge transport rates

Combines aspects of quantum length, frequency, and magnetic charge in motion phenomena

Relationships to other units:

$chgv = \frac{velc}{chrg}$: Shows velocity per charge as the ratio of quantum velocity to charge, indicating the fundamental relationship between motion and charge quantity

$chgv = \frac{accl}{curr}$: Links charge velocity to the ratio of acceleration and current, revealing how acceleration of charge relates to its flow rate

$chgv = \frac{potn}{momt}$: Connects velocity per charge to the ratio of potential to momentum, demonstrating the relationship between electric potential and mechanical motion

Potential applications:

Analyzing charge transport in quantum conductors and semiconductors

Characterizing electron drift velocities in quantum materials

Studying charge carrier mobility in quantum devices

Investigating quantum Hall effects and related phenomena

Describing quantum particle drift in electromagnetic fields

The Velocity per Charge (*chgv*) unit offers a unique perspective on how magnetic charge moves through quantum systems. This unit is particularly useful for describing scenarios where we need to consider the rate at which magnetic charge moves through space. The fundamental relationships provide insight into three different aspects of charge motion:

The relationship with quantum velocity and charge ($\frac{velc}{chrg}$) shows how charge velocity emerges from the basic motion of quantum entities

The connection to acceleration and current ($\frac{accl}{curr}$) reveals the dynamic nature of charge flow

The relationship between potential and momentum ($\frac{potn}{momt}$) demonstrates how electrical and mechanical properties combine in charge transport

These relationships suggest that velocity per charge is not just a simple motion but rather emerges from the interplay of electromagnetic and mechanical properties in quantum systems. The unit bridges classical concepts like velocity and acceleration with quantum properties of charge and potential, offering a more complete picture of charge transport at the quantum scale.

Note: The *chgv* unit in the APM framework provides a tool for exploring the motion of magnetic charge at the quantum level. It unifies concepts of mechanical motion, electromagnetic properties, and charge transport in quantum systems, offering potential new insights into charge transport mechanisms in quantum physics. This understanding could be particularly valuable in developing more efficient electronic devices and understanding fundamental charge transport processes.

Dynamic Electric Field Oscillation `defo`

QMU primitive representation: $\text{defo} = \dfrac{{F_q}^3}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{defo}\,\text{efpm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$defo = \frac{{F_q}^3}{{e_{\text{emax}}}^2}$$

Physical interpretation: The Dynamic Electric Field Oscillation ($defo$) unit represents the rate of oscillation or fluctuation of an electric field relative to the magnetic charge at the quantum scale. It combines aspects of frequency and charge to describe rapid oscillations in electric fields without explicit spatial dependence.

Characteristics:

It's classified as a dynamic electric field unit, focusing on the temporal aspects of rapidly changing electric fields.

The presence of ${F_q}^3$ indicates a strong dependence on the quantum frequency, emphasizing its highly dynamic and oscillatory nature.

The inverse relationship with magnetic charge (${e_{\text{emax}}}^2$) suggests an interplay between the oscillating electric field and magnetic charge.

The absence of a length term implies this unit describes oscillations independent of spatial dimensions, focusing purely on the temporal dynamics.

Potential applications:

Analyzing high-frequency oscillations in quantum electromagnetic systems

Studying the interaction between rapidly changing electric fields and magnetic charges

Characterizing ultrafast electric field dynamics in quantum optics and electrodynamics

Investigating quantum vacuum fluctuations and their temporal characteristics

This unit could be particularly useful in contexts where the rapid oscillation of electric fields at the quantum level is of interest, independent of spatial considerations. It might find applications in areas such as quantum optics, high-frequency quantum electronics, and studies of fundamental quantum electrodynamic processes. The $defo$ unit could provide insights into the pure temporal dynamics of electric fields in quantum systems, potentially revealing new phenomena or behaviors at extremely high frequencies.

Resonance per Charge `crsn`

QMU primitive representation: $\text{crsn} = \dfrac{{F_q}^2}{{e_{\text{emax}}}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{crsn}\,\text{efsu} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The Resonance per Charge ($crsn$) unit has a multifaceted nature, representing the resonance of magnetic charge in a quantum system. It can be interpreted in several ways, depending on the specific relationship with other QMU units:

Resonance and Magnetic Charge:

The equation $crsn = \frac{rson}{chrg}$ describes resonance per charge as the ratio of resonance ($rson$) to magnetic charge ($chrg$).

In this context, resonance per charge represents the resonance per unit magnetic charge, indicating the system's resonance relative to the amount of magnetic charge present.

This perspective is useful for understanding how resonance and magnetic charge influence the oscillatory behavior of the system.

Curl and Magnetic Flux Density Wave:

The equation $crsn = curl \cdot mfdw$ relates resonance per charge to the curl ($curl$) and magnetic flux density wave (mfdw).

It suggests that resonance per charge can be understood as the product of spatial curvature and magnetic flux density wave, indicating how the geometry of space and the wave-like propagation of magnetic flux density contribute to the resonance of magnetic charge.

Quantum Surface Frequency Oscillation and Magnetic Moment:

The equation $crsn = \frac{qsfo}{magm}$ links resonance per charge to the quantum surface frequency oscillation ($qsfo$) and magnetic moment ($magm$).

It implies that resonance per charge can be interpreted as the ratio of quantum surface frequency oscillation to magnetic moment, indicating how the oscillatory behavior of a surface relative to the magnetic moment influences the resonance of magnetic charge.

Charge Acceleration and Length:

The equation $crsn = \frac{chga}{leng}$ relates resonance per charge to acceleration per charge ($chga$) and length ($leng$).

It suggests that resonance per charge can be understood as the acceleration per charge per unit length, indicating how the acceleration of magnetic charge relative to the spatial extent of the system contributes to the resonance of magnetic charge.

Magnetic Current `mcur`

QMU primitive representation:

$$\mathrm{mcur} = \frac{F_q}{{e_{\mathrm{emax}}}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mcur}\,\mathrm{efpt} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{mcur} &= \frac{\mathrm{freq}}{\mathrm{chrg}} \\ &= \frac{\mathrm{rson}}{\mathrm{curr}} \\ &= \frac{1}{\mathrm{efpt}}.\end{aligned}} \tag{222}$$

These relationships follow from

$$\mathrm{chrg} = {e_{\mathrm{emax}}}^2, \qquad \mathrm{curr} = {e_{\mathrm{emax}}}^2 F_q, \qquad \mathrm{rson} = {F_q}^2.$$

Consequently,

$$\boxed{\mathrm{mcur} \cdot \mathrm{curr} = \mathrm{rson}.} \tag{223}$$

This identity establishes the complementary charge dimensions of Magnetic Current and Electric Current within QMU.

Physical interpretation. Magnetic Current describes a current-like quantity associated with the reciprocal distributed magnetic-charge dimension within the Aether Physics Model (APM).

Unlike Electric Current (curr), which combines distributed charge with frequency, Magnetic Current (mcur) combines frequency with reciprocal distributed charge.

This distinction reflects the different roles of magnetic and electric interactions within the geometrical charge structure of the Aether.

In APM, magnetic charge is inherently distributed through extended particle geometry, including toroidal configurations. The mcur quantity provides a dimensional reference for examining the magnetic response associated with this structure.

Its reciprocal charge dependence should not be confused with the conventional transport of magnetic monopoles or with electric current measured in amperes.

Relationship to resonance. The relationship

$$\boxed{\text{mcur} = \frac{\text{rson}}{\text{curr}}} \tag{224}$$

connects Magnetic Current with Electric Current through the QMU resonance quantity.

Since

$$\text{rson} = {F_q}^2,$$

resonance has the dimension of frequency squared rather than ordinary frequency.

The product of Magnetic Current and Electric Current therefore reproduces the QMU resonance dimension.

This relationship suggests examining how complementary magnetic and electric responses participate in electromagnetic oscillation and resonant interactions.

The dimensional identity itself does not determine oscillation amplitude, phase, or energy transfer. These depend on the corresponding physical geometry and dynamical equations.

Research significance. Magnetic Current provides a complementary dimensional description of electromagnetic response alongside Electric Current.

Its inverse charge dependence and relationship to resonance may be useful for investigating toroidal charge motion, magnetic coupling, and the organization of electromagnetic oscillations.

Within APM, a useful research direction is to determine how mcur participates in the dynamics of distributed magnetic charge and how those relationships correspond to measurable magnetic and electrical phenomena.

The canonical QMU identities establish the dimensional foundation for these investigations, while physical current and transport behavior require the appropriate interaction equations.

Substrate units

Quantum Electric Volumetric Susceptibility `qefs`

QMU primitive representation: $\text{qefs} = \dfrac{{e_{\text{emax}}}^2}{{\lambda_C}^3 \, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{qefs}\,\text{trmo} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qefs = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3 \cdot {F_q}^3}$$

Physical interpretation: The Quantum Electric Field Susceptibility ($qefs$) unit represents the capacity of the quantum Aether substrate to accommodate or respond to electric field changes within a quantum volume. It combines aspects of charge, volume , and frequency to describe the underlying structure's receptivity to electric field fluctuations.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its electric field response.

The ${\lambda_C}^3$ term implies a volumetric nature, suggesting this unit describes the substrate's properties over a three-dimensional quantum space.

The ${F_q}^3$ term indicates a strong frequency dependence, suggesting the substrate's response varies with the rate of field changes.

Potential applications:

Analyzing the quantum vacuum's response to electric field perturbations

Studying how the Aether substrate influences electric field propagation in quantum systems

Characterizing the fundamental limits of electric field strength in quantum volumes

Investigating the interplay between electric and magnetic phenomena in the quantum substrate

This substrate unit could be particularly useful in understanding the fundamental nature of electric fields in quantum systems. It might provide insights into phenomena such as vacuum polarization, the Casimir effect, or the behavior of virtual particles. The $qefs$ unit could help in developing models of how the quantum Aether influences and constrains electric field behavior, potentially leading to new understanding in quantum electrodynamics and related fields.

Quantum Electric Field Receptivity `qerc`

QMU primitive representation: $\mathrm{qerc} = \dfrac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^3\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qerc}\,\mathrm{vefd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qerc = \frac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^3 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Electric Field Receptivity ($qerc$) unit represents the capacity of the quantum Aether substrate to receive or accommodate electric field changes within a quantum volume at a lower frequency scale than $qefs$. It combines aspects of charge, volume, and frequency to describe the underlying structure's receptivity to electric field variations.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\mathrm{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its electric field receptivity.

The ${\lambda_C}^3$ term implies a volumetric nature, suggesting this unit describes the substrate's properties over a three-dimensional quantum space.

The ${F_q}^2$ term indicates a frequency dependence, but less pronounced than in $qefs$, suggesting the substrate's response to slower field changes.

Potential applications:

Analyzing the quantum vacuum's receptivity to lower-frequency electric field fluctuations

Studying how the Aether substrate influences electric field storage or capacitance in quantum systems

Characterizing the fundamental limits of electric field gradients in quantum volumes

Investigating the interplay between electric and magnetic phenomena in the quantum substrate at lower frequencies

This substrate unit could be particularly useful in understanding the fundamental nature of electric fields in quantum systems, especially for phenomena occurring at lower frequencies than those described by $qefs$. It might provide insights into quantum capacitance, the behavior of bound electric fields, or the response of the quantum vacuum to slower electromagnetic perturbations. The $qerc$ unit could help in developing models of how the quantum Aether influences and constrains electric field behavior in various frequency regimes, potentially leading to new understanding in quantum electrodynamics and related fields.

Quantum Electric Field Compliance `qefc`

QMU primitive representation:

$$\text{qefc} = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3 F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{qefc}\,\text{efld} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{qefc} &= \frac{\text{chrg}}{\text{volm}\cdot\text{freq}} \\ &= \text{chgd}\cdot\text{time} \\ &= \frac{1}{\text{efld}}.\end{aligned}} \tag{225}$$

These relationships follow from $\text{chgd} = \text{chrg}/\text{volm}$ and $\text{time} = {F_q}^{-1}$.

Physical interpretation. Quantum Electric Field Compliance (qefc) describes the temporal capacity associated with distributed charge within a quantum volume of the Aether Physics Model (APM).

The charge-density contribution represents magnetic charge distributed through three-dimensional geometry, while the temporal factor connects that distribution to the fundamental Aether chronovibration period.

In APM, the term *compliance* refers to the ability of the Aether substrate to accommodate electric-field interactions through its distributed-charge structure.

Unlike an active field quantity, qefc provides a complementary substrate dimension associated with field response.

The primitive definition does not assign a particular relaxation time or material susceptibility. Such properties depend on the interaction geometry and the dynamics of the physical system.

Relationship to electric fields. The reciprocal quantity is Electric Field Distribution (efld):

$$\boxed{\text{efld} = \frac{\text{volm}}{\text{chrg}\cdot\text{time}}.} \tag{226}$$

Consequently,

$$\text{qefc}\cdot\text{efld} = 1.$$

This reciprocal relationship connects the temporal organization of volumetric charge with its complementary electric-field distribution dimension.

The single inverse-frequency factor also distinguishes qefc from related QMU quantities containing higher frequency powers.

It should not be interpreted as proof that qefc applies only to slowly varying fields. The actual response frequency and relaxation behavior follow from the applicable physical equations.

Research significance. Quantum Electric Field Compliance provides a dimensional reference for investigating electric-field accommodation, charge redistribution, and temporal response within Aether volumes.

Potential applications include dielectric response, charge relaxation, electrostatic field persistence, and electromagnetic behavior in confined geometries.

A useful research direction is to determine how qefc relates to measurable electric-field response and whether the QMU formulation simplifies conventional descriptions of volumetric charge dynamics.

Its reciprocal connection with efld provides a starting point for deriving and comparing the corresponding physical response relationships.

Quantum Electric Field Intensity `qefi`

QMU primitive representation: $\text{qefi} = \dfrac{{e_{\text{emax}}}^2}{{\lambda_C}^2 \, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{qefi}\,\text{defi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qefi = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2 \cdot {F_q}^3}$$

Physical interpretation: The Quantum Electric Field Intensity ($qefi$) unit represents the capacity of the quantum Aether substrate to support resonant electric field oscillations across a quantum surface area. It combines aspects of charge, area, and frequency to describe the underlying structure's propensity for sustaining coherent electric field fluctuations.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its electric field resonance.

The ${\lambda_C}^2$ term implies a surface nature, suggesting this unit describes the substrate's properties over a two-dimensional quantum area.

The ${F_q}^3$ term indicates a strong frequency dependence, suggesting the substrate's capacity for high-frequency intensity behavior.

Potential applications:

Analyzing the quantum vacuum's ability to support standing electric field waves on surfaces

Studying how the Aether substrate influences electric field resonances in two-dimensional quantum systems

Characterizing the fundamental limits of electric field oscillations in quantum surface structures

Investigating the interplay between electric and magnetic phenomena in planar quantum resonant systems

This substrate unit could be particularly useful in understanding the fundamental nature of electric field intensities in quantum systems, especially for phenomena occurring on surfaces or in two-dimensional structures. It might provide insights into surface plasmons, quantum Hall effects, or the behavior of electric fields in 2D materials like graphene. The $qefi$ unit could help in developing models of how the quantum Aether supports and constrains resonant electric field behavior in planar geometries, potentially leading to new understanding in areas such as nanophotonics, quantum optics, and topological quantum systems.

Quantum Electric Surface Resonance Capacity `efrs`

QMU primitive representation: $\text{efrs} = \dfrac{{e_{\text{emax}}}^2}{{\lambda_C}^2 {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: efrs chgt $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efrs = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^2 \cdot {F_q}^2}$$

Physical interpretation: The Quantum Electric Field Resonance ($efrs$) unit represents the capacity of the quantum Aether substrate to support and sustain resonant electric field oscillations across a quantum surface area. It combines aspects of charge, area, and resonance to describe the underlying structure's propensity for maintaining coherent electric field oscillations.

Characteristics:

As a substrate unit, it describes a property of the quantum Aether itself, rather than an active field.

The ${e_{\text{emax}}}^2$ term suggests a relationship with magnetic charge, potentially indicating how the substrate's magnetic properties influence its ability to support electric field resonances.

The ${\lambda_C}^2$ term implies a surface nature, suggesting this unit describes the substrate's resonant properties over a two-dimensional quantum area.

The ${F_q}^2$ term indicates a frequency dependence appropriate for describing resonant behavior, sug-

gesting the substrate's capacity to maintain rhythmic field oscillations.

Potential applications:

Analyzing the quantum vacuum's ability to sustain standing electric field waves on surfaces

Studying how the Aether substrate supports electric field resonances in two-dimensional quantum systems

Characterizing the fundamental resonant modes of electric fields in quantum surface structures

Investigating the interplay between electric and magnetic phenomena in planar quantum resonant systems

This substrate unit could be particularly useful in understanding the fundamental nature of electric field resonances in quantum systems, especially for phenomena occurring on surfaces or in two-dimensional structures. It might provide insights into surface plasmons, quantum Hall effects, or the behavior of resonant electric fields in 2D materials. The $efrs$ unit could help in developing models of how the quantum Aether supports and sustains resonant electric field behavior in planar systems, potentially leading to new understanding in areas such as nanophotonics, quantum optics, and topological quantum systems.

Magnetic Charge Density Frequency `mcdf`

QMU primitive representation:

$$\mathrm{mcdf} = \frac{{e_{\mathrm{emax}}}^2}{{\lambda_C}^2 F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mcdf}\,\mathrm{chgs} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{mcdf} &= \frac{\mathrm{chrg}}{\mathrm{area}\cdot\mathrm{freq}} \\ &= \frac{\mathrm{chrg}\cdot\mathrm{time}}{\mathrm{area}} \\ &= \frac{\mathrm{perm}}{\mathrm{drag}} \\ &= \frac{1}{\mathrm{chgs}}.\end{aligned}} \tag{227}$$

These relationships connect distributed magnetic charge, surface area, temporal structure, permeability, and drag.

Physical interpretation. Magnetic Charge Density Frequency (mcdf) describes the temporal weighting of distributed magnetic charge across a surface within the Aether Physics Model (APM).

The relationship

$$\text{mcdf} = \frac{\text{chrg}}{\text{area}} \cdot \text{time}$$

expresses surface magnetic-charge density multiplied by the QMU chronovibration period.

Within APM, magnetic charge is distributed through extended geometrical structures, including the surfaces of elementary particles and Aether units.

The mcdf quantity therefore provides a dimensional reference for examining how surface charge distribution participates in temporally organized magnetic interactions.

Although the unit is relevant to magnetic field behavior, it is distinct from Magnetic Field Intensity (mfdi). Its definition does not directly measure magnetic field strength.

Relationship to permeability and drag. The QMU relationship

$$\boxed{\text{perm} = \text{drag} \cdot \text{mcdf}} \tag{228}$$

connects Magnetic Charge Density Frequency with permeability and drag.

Using the canonical definitions,

$$\text{drag} = \text{resn} \cdot \text{leng},$$

the relationship becomes

$$\text{perm} = \text{resn} \cdot \text{leng} \cdot \text{mcdf}. \tag{229}$$

Here resn denotes the QMU Resistance unit, not Resonance (rson). The drag construction has the same QMU dimensions as mgfi, and this product reproduces the canonical permeability primitive exactly.

In APM, permeability also incorporates the intrinsic winding geometry of the Aether through

$$\text{perm} = \frac{1}{\text{curl}}.$$

Consequently,

$$\boxed{\text{drag} \cdot \text{mcdf} \cdot \text{curl} = 1.} \tag{230}$$

This identity connects surface magnetic-charge distribution with the reciprocal relationship between Aether permeability and curl.

The physical effects of drag and magnetic interaction depend on the geometry and dynamics of the system.

Research significance. Magnetic Charge Density Frequency provides a dimensional bridge between surface charge distribution, temporal structure, permeability, drag, and Aether curl.

Potential applications include particle surface interactions, magnetic materials, electromagnetic transport, and the response of distributed-charge structures to changing fields.

An important research direction is to determine how mcdf contributes to the physical relationship between magnetic charge distribution and effective permeability, including geometrical modifications associated with matter–Aether interactions.

Its reciprocal, Charge Geometric Susceptibility (chgs), provides the complementary QMU dimension.

The canonical identities establish the dimensional relationships, while measurable magnetic response follows from the corresponding physical interaction equations.

Quantum Electric Field Plasticity `qefp`

QMU primitive representation: $\mathrm{qefp} = \dfrac{{e_{\mathrm{emax}}}^2}{\lambda_C \, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qefp}\,\mathrm{deff} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qefp = \frac{{e_{\mathrm{emax}}}^2}{\lambda_C \cdot {F_q}^3}$$

Physical interpretation: The Quantum Electric Field Plasticity ($qefp$) unit represents the capacity of the quantum Aether substrate to undergo persistent deformations in response to electric field changes along a quantum linear dimension. It combines aspects of charge , length, and frequency to describe the underlying structure's ability to retain electric field-induced changes.

Potential applications:

Analyzing the quantum vacuum's ability to retain electric field-induced changes along linear paths

Studying how the Aether substrate influences electric field memory effects in one-dimensional quantum systems

Characterizing the fundamental limits of electric field persistence in quantum wire-like structures

Investigating the interplay between electric and magnetic phenomena in linear quantum systems with high-frequency perturbations

This substrate unit could be particularly useful in understanding the fundamental nature of electric field plasticity in quantum systems, especially for phenomena occurring in one-dimensional or linear structures. It might provide insights into quantum wire behavior, edge states in topological insulators, or the response of the quantum vacuum to high-frequency electromagnetic perturbations in confined linear geometries. The $qefp$ unit could help in developing models of how the quantum Aether retains and evolves electric field-induced changes in linear systems, potentially leading to

new understanding in areas such as quantum information processing, nanoscale electronics, and one-dimensional quantum field theories.

Quantum Electric Field Elasticity `qefe`

QMU primitive representation: $\text{qefe} = \dfrac{{e_{\text{emax}}}^2}{\lambda_C \, {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{qefe}\,\text{chga} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qefe = \frac{{e_{\text{emax}}}^2}{\lambda_C \cdot {F_q}^2}$$

Physical interpretation: The Quantum Electric Field Elasticity ($qefe$) unit represents the capacity of the quantum Aether substrate to reversibly deform in response to electric field changes along a quantum linear dimension. It combines aspects of charge, length, and frequency to describe the underlying structure's ability to stretch and return to its original state under electric field influences.

Potential applications:

Analyzing the quantum vacuum's ability to elastically respond to electric field changes along linear paths

Studying how the Aether substrate influences reversible electric field deformations in one-dimensional quantum systems

Characterizing the fundamental limits of elastic behavior in quantum wire-like structures under electric field stress

Investigating the interplay between electric and magnetic phenomena in linear quantum systems with elastic responses

This substrate unit could be particularly useful in understanding the fundamental nature of electric field elasticity in quantum systems, especially for phenomena occurring in one-dimensional or linear structures. It might provide insights into the behavior of quantum wires under electric stress, the elastic properties of edge states in topological materials, or the response of the quantum vacuum to reversible electromagnetic perturbations in confined linear geometries. The $qefe$ unit could help in developing models of how the quantum Aether elastically deforms and recovers in response to electric field changes in linear systems, potentially leading to new understanding in areas such as quantum elasticity, nanomechanics, and one-dimensional quantum electrodynamics.

Quantum Electric Field Conductance `efcd`

QMU primitive representation: $\text{efcd} = \dfrac{{e_{\text{emax}}}^2}{\lambda_C \, F_q}$.

Family grid Dependency index

Catalog reciprocal: efcd chgv = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efcd = \frac{{e_{\text{emax}}}^2}{\lambda_C \cdot F_q}$$

Physical interpretation: The Quantum Electric Field Conductance ($efcd$) unit represents the capacity of the quantum Aether substrate to facilitate the flow or transmission of electric fields along a quantum linear dimension. It combines aspects of charge, length, and frequency to describe the underlying structure's ability to conduct or propagate electric field changes.

Potential applications:

Analyzing the quantum vacuum's ability to transmit electric field changes along linear paths

Studying how the Aether substrate influences electric field propagation in one-dimensional quantum systems

Characterizing the fundamental limits of electric field transmission in quantum wire-like structures

Investigating the interplay between electric and magnetic phenomena in linear quantum systems with regards to field propagation

This substrate unit could be particularly useful in understanding the fundamental nature of electric field transmission in quantum systems, especially for phenomena occurring in one-dimensional or linear structures. It might provide insights into quantum wire conductance, electric field propagation along edge states in topological insulators, or the response of the quantum vacuum to electromagnetic signals in confined linear geometries. The $efcd$ unit could help in developing models of how the quantum Aether conducts and propagates electric field changes in linear systems, potentially leading to new understanding in areas such as quantum information transfer, nanoscale electronics, and one-dimensional quantum field theories.

Quantum Electric Field Permeability `efpm`

QMU primitive representation: efpm $= \frac{{e_{\text{emax}}}^2}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: efpm defo = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efpm = \frac{{e_{\text{emax}}}^2}{{F_q}^3}$$

Physical interpretation: The Quantum Electric Field Permeability ($efpm$) unit represents the capacity of the quantum Aether substrate to allow the penetration and propagation of high-frequency electric fields, independent of spatial dimensions. It combines aspects of charge and frequency to describe the underlying structure's receptiveness to rapidly changing electric fields.

Potential applications:

Analyzing the quantum vacuum's intrinsic ability to support high-frequency electric field fluctuations

Studying how the Aether substrate influences the propagation of ultra-fast electric field pulses

Characterizing the fundamental limits of electric field penetration in the quantum substrate

Investigating the interplay between electric and magnetic phenomena in high-frequency quantum electrodynamics

This substrate unit could be particularly useful in understanding the fundamental nature of high-frequency electric field behavior in the quantum vacuum, independent of specific geometric configurations. It might provide insights into phenomena such as vacuum polarization, the dynamic Casimir effect, or the behavior of virtual particles in intense, rapidly changing fields. The $efpm$ unit could help in developing models of how the quantum Aether responds to and supports extremely rapid electric field changes, potentially leading to new understanding in areas such as quantum optics, high-energy physics, and fundamental quantum electrodynamics.

Quantum Electric Temporal Susceptibility `efsu`

QMU primitive representation: $\text{efsu} = \dfrac{{e_{\text{emax}}}^2}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{efsu}\,\text{crsn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$efsu = \frac{{e_{\text{emax}}}^2}{{F_q}^2}$$

Physical interpretation: The Quantum Electric Field Susceptibility ($efsu$) unit represents the capacity of the quantum Aether substrate to respond to and support moderate-frequency electric field changes, independent of spatial dimensions. It combines aspects of charge and frequency to describe the underlying structure's responsiveness to electric field variations.

Potential applications:

Analyzing the quantum vacuum's inherent capacity to support electric field fluctuations

Studying how the Aether substrate influences the propagation of moderate-frequency electric field oscillations

Characterizing the fundamental response of the quantum substrate to electric field perturbations

Investigating the interplay between electric and magnetic phenomena in quantum electrodynamics at moderate frequencies

This substrate unit could be particularly useful in understanding the fundamental nature of electric field behavior in the quantum vacuum at moderate frequencies, independent of specific geometric configurations. It might provide insights into phenomena such as vacuum polarizability, the Lamb shift, or the behavior of virtual electron-positron pairs in moderately changing fields. The $efsu$ unit

could help in developing models of how the quantum Aether responds to and supports electric field changes at scales relevant to atomic and molecular processes, potentially leading to new understanding in areas such as quantum chemistry, condensed matter physics, and quantum electrodynamics in material systems.

Quantum Electric Field Permittivity `efpt`

QMU primitive representation:

$$\text{efpt} = \frac{{e_{\text{emax}}}^2}{F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\text{efpt}\,\text{mcur} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{efpt} &= \frac{\text{chrg}}{\text{freq}} \\ &= \text{chrg} \cdot \text{time} \\ &= \frac{\text{chrg}^2}{\text{curr}} \\ &= \frac{1}{\text{mcur}}.\end{aligned}} \tag{231}$$

These identities follow from the canonical QMU definitions

$$\text{chrg} = {e_{\text{emax}}}^2, \qquad \text{curr} = {e_{\text{emax}}}^2 F_q, \qquad \text{mcur} = \frac{F_q}{{e_{\text{emax}}}^2}.$$

Physical interpretation. Quantum Electric Field Permittivity (efpt) represents a charge-temporal capacity associated with the Aether's response to electric excitation.

Within the Aether Physics Model (APM), distributed magnetic charge is an intrinsic property of physical geometry. The efpt unit combines this charge dimension with the fundamental chronovibration period:

$$\text{efpt} = \text{chrg} \cdot \text{time}.$$

This relationship provides a dimensional reference for examining how distributed charge participates in sustaining or responding to electric-field interactions over a temporal interval.

Unlike a spatial field quantity, efpt contains no explicit length, area, or volume factor. Its primitive expression therefore isolates charge and temporal structure from the additional geometry of a particular electromagnetic system.

The term *permittivity* reflects the proposed capacity of the Aether to accommodate electric excitation. The dimensional identity itself does not specify a material polarization law or a maximum sustainable field strength.

Relationship to magnetic current. The reciprocal relationship

$$\boxed{\text{efpt} \cdot \text{mcur} = 1} \tag{232}$$

connects the temporal charge capacity of efpt with Magnetic Current (mcur).

Where efpt combines distributed charge with time, mcur combines reciprocal distributed charge with frequency.

These complementary quantities provide a direct QMU relationship between charge accommodation and current-like magnetic response.

This relationship is distinct from conventional electric current and does not independently establish a transport or dissipation mechanism.

Distinction from Permittivity. Quantum Electric Field Permittivity (efpt) must be distinguished from the QMU Permittivity unit (ptty):

$$\text{ptty} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}\,{\lambda_C}^3 {F_q}^2}.$$

While ptty includes mass, spatial volume, and resonance dimensions, efpt contains only distributed charge and time.

Consequently, the two quantities represent different dimensional aspects of the Aether's electromagnetic response and are not interchangeable.

Their correspondence with SI electric permittivity requires the complete QMU–SI conversion rules, including the established exceptions for permittivity-related quantities.

Research significance. Quantum Electric Field Permittivity provides a fundamental charge-temporal reference for investigating electric-field response within Aether geometry.

Potential applications include charge relaxation, electromagnetic polarization, field persistence, and the temporal organization of distributed charge.

A useful research direction is to determine how efpt relates to measurable electric-field response and whether its reciprocal connection with mcur simplifies the description of electromagnetic interactions.

The canonical QMU relationships provide the dimensional foundation, while specific material and field behavior follows from the corresponding APM interaction equations.

Fundamental Inertial and Behavioral

Dynamic units

Light `ligt`

QMU primitive representation: $\mathrm{ligt} = m_\mathrm{e}\,{\lambda_C}^3\,{F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{ligt}\,\mathrm{ocmp} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $ligt = m_\mathrm{e} \cdot {\lambda_C}^3 \cdot {F_q}^3$

Physical interpretation:

Represents the flow of angular momentum waves through space

Quantifies light as either transverse waves or scalar waves of angular momentum

Describes light without invoking concepts of mass or charge density

Significance:

Emerges from the APM's concept of light as pure angular momentum waves

Provides a measure of light intensity in terms of angular momentum flow

Can manifest as either transverse waves ($tvsw$) or scalar waves ($sclw$), offering a dual description of light propagation

Potential applications:

Analyzing light propagation in various media and geometries

Characterizing light in terms of its fundamental angular momentum nature

Studying the behavior of light as both transverse and scalar waves

Describing light phenomena without relying on particle-based or charge-based models

The Light ($ligt$) unit offers a unique perspective on the nature of light as flows of angular momentum waves. By defining light in terms of angular momentum ($angm$), transverse volumetric surface waves ($tvsw$) or scalar waves ($sclw$), and flow ($flow$) or sweep ($swep$), it captures the wave essence of light without invoking particle or charge concepts.

This unit is particularly useful for describing scenarios where we need to consider light as pure energy propagation without mass or charge. It could be instrumental in understanding phenomena such as:

Light propagation in various media (transverse waves) and in waveguides (scalar waves)

Interference and diffraction patterns in terms of angular momentum flows

Energy transfer processes in photosynthesis and other light-dependent systems

Quantum optics experiments focusing on the wave nature of light

The dual representation (transverse and scalar) allows for a more comprehensive understanding of

light behavior in different contexts, emphasizing its adaptable wave nature.

Note: The *ligt* unit in the APM framework provides a tool for quantifying and analyzing light purely as waves of angular momentum. This approach offers a fundamental shift from traditional particle-based or electromagnetic field models, aligning with the APM's view of light as a massless, chargeless phenomenon.

This unit could be particularly relevant in reinterpreting classical optics experiments, developing new approaches to quantum optics, and understanding light-matter interactions from a wave-centric perspective. It may offer new insights into phenomena like entanglement, quantum information transfer, and the nature of photon-like behavior without invoking particle concepts.

The *ligt* unit's formulation in the APM could lead to novel approaches in optical technology, communication systems, and our understanding of cosmic light phenomena, all based on the fundamental nature of light as flowing angular momentum waves.

Photon `phtn`

QMU primitive representation: $\text{phtn} = m_\text{e}\,{\lambda_C}^3\,{F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{phtn}\,\text{inpr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$phtn = m_\text{e} \cdot {\lambda_C}^3 \cdot {F_q}^2$$

Physical interpretation:

Represents a radially expanding burst of angular momentum in the Aether

Quantifies the transfer of angular momentum from an electron's orbital transition to the surrounding Aether

Describes a dynamic, expanding phenomenon, not a particle or energy packet

Significance:

Emerges from the APM's concept of light as a condition of space filled with photons

Provides a measure of angular momentum transfer in the Aether without invoking particle concepts

Directly related to Planck's constant (h) and the speed of photons (c), emphasizing the quantum nature of angular momentum transfer

Potential applications:

Analyzing the radial expansion of angular momentum in the Aether

Characterizing the fundamental process of light emission in terms of electron orbital transitions

Studying the relationship between irradiance ($irrd$) and volume-time ($vlmt$) in photon propagation

Describing the inverse square law of irradiance as a natural consequence of photon expansion

The Photon (*phtn*) unit offers a unique perspective on the nature of light emission and propagation as described by the APM. By defining the photon as a radially expanding burst of angular momentum, it represents the dynamic transfer of angular momentum from electron transitions to the Aether, rather than a particle or energy packet.

This unit is particularly useful for describing scenarios where we need to consider the expansion of angular momentum in space and time. It could be instrumental in understanding phenomena such as:

The process of light emission from atomic transitions

The decrease in irradiance over distance due to photon expansion

The filling of space with photons to create the condition of light

The interaction of expanding photons with matter

The equation $phtn = irrd \cdot vlmt$ emphasizes the dynamic nature of the photon, showing how its irradiance decreases as its volume increases over time. This naturally explains the inverse square law without resorting to particle concepts.

Note: The *phtn* unit in the APM framework provides a tool for quantifying and analyzing light emission and propagation as a process of angular momentum transfer and expansion in the Aether. This approach offers a significant departure from particle-based or energy packet models, aligning with the APM's view of light as a condition of space and photons as expanding bursts of angular momentum.

This unit could be particularly relevant in reinterpreting atomic emission processes, developing new models for light propagation, and understanding the fundamental nature of light-matter interactions. It may offer new insights into the nature of the Aether itself, the process of energy transfer in quantum systems, and the relationship between matter and the surrounding space.

The *phtn* unit's formulation in the APM could lead to novel approaches in understanding cosmic light phenomena, developing new optical technologies, and exploring the fundamental nature of quantum processes, all based on the concept of photons as expanding angular momentum in the Aether.

Quantum Angular Reach `qanr`

QMU primitive representation: $\mathrm{qanr} = m_\mathrm{e}\,{\lambda_C}^3\,F_q$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qanr}\,\mathrm{qvrc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions:

Physical interpretation:

Represents the three-dimensional distribution of angular momentum in quantum systems

Quantifies the "reach" or "influence" of a quantum particle's angular momentum over space

Describes the interaction between a particle's intrinsic angular momentum and the surrounding

Aether

Significance:

Emerges from the APM's concept of quantum angular momentum interacting with the Aether

Provides a measure of how a particle's angular momentum extends and interacts with space

Relates electron mass (m_e), Compton wavelength cubed ($\lambda_C{}^3$), and quantum frequency (F_q)

$qanr = angm \cdot leng$ This shows how the unit represents the spatial extent of angular momentum.

$magm = qanr \cdot curl$ This crucial relationship demonstrates that a particle's magnetic moment ($magm$) results from the interaction between its Quantum Angular Reach ($qanr$) and the $curl$ of the Aether.

Discussion: The Quantum Angular Reach ($qanr$) unit offers a unique perspective on how quantum angular momentum manifests in space. It suggests that the influence of a particle's spin or orbital angular momentum is not confined to a point but extends over a volume of space.

This concept is particularly significant when considering bound electrons in atoms. The $qanr$ could represent the three-dimensional distribution of the electron's angular momentum within the atom, providing a more nuanced view than traditional orbital models.

The relationship $magm = qanr \cdot curl$ is especially profound. It implies that a particle's magnetic moment is not solely an intrinsic property but emerges from the interaction between the particle's extended angular momentum ($qanr$) and the structure of space itself (represented by the Aether's $curl$). This idea aligns with the APM's emphasis on the Aether's role in quantum phenomena.

Furthermore, since the Aether's $curl$ is proportional to the length density of matter, this relationship suggests a connection to General Relativity. It implies that a particle's quantum properties, such as its magnetic moment, could be influenced by the large-scale distribution of matter in its environment. This provides a potential bridge between quantum mechanics and general relativity.

This interpretation of $qanr$ and its role in determining magnetic moment offers several intriguing possibilities:

It suggests that quantum properties we often consider intrinsic might actually be emergent, arising from particle-Aether interactions.

It could explain potential variations in measured values of magnetic moments in different experimental setups or astrophysical environments.

It provides a mechanism for how quantum properties could be influenced by large-scale matter distributions, potentially leading to new predictions about quantum behavior in varying gravitational environments.

The Quantum Angular Reach unit thus represents a crucial concept in the APM, highlighting the dynamic interplay between quantum particles and the structure of space. It offers a more holistic view of quantum phenomena, emphasizing the inseparable nature of particles and their environment.

Vortex `vrtx`

QMU primitive representation: $\mathrm{vrtx} = m_\mathrm{e}\,{\lambda_C}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{vrtx}\,\mathrm{qvoi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $vrtx = m_\mathrm{e} \cdot {\lambda_C}^3 = \frac{1}{qvoi}$

Physical interpretation:

Represents the intrinsic angular momentum or rotational property of a quantum volume

Quantifies the tendency of a quantum volume to form vortex-like structures or exhibit rotational behavior

Describes the product of mass and volume at the quantum scale, indicating a measure of rotational inertia

Significance:

Emerges from the APM's concept of Aether units and their inherent rotational properties

Provides a measure of a quantum volume's capacity for angular momentum or vorticity

Directly related to the inverse of Quantum Volumetric Inertia (qvoi), linking rotational and inertial properties

Potential applications:

Analyzing quantum vortex formation and behavior in superfluids and Bose-Einstein condensates

Characterizing rotational properties of quantum systems, including spin and orbital angular momentum

Studying quantum turbulence and vortex dynamics in quantum fluids

Describing fundamental rotational aspects of particles and fields in quantum mechanics

Relationships to other units:

$$vrtx = \frac{1}{qvoi}$$
$$vrtx = \frac{qanr}{F_q}$$
$$vrtx = \frac{ligt}{{F_q}^3}$$
$$vrtx = \frac{phtn}{rson}$$

These relationships provide important insights:

1. The inverse relationship with *qvoi* suggests that higher vorticity corresponds to lower volumetric inertia.

2. The connection to *qanr* (Quantum Angular Reach) and F_q shows how vorticity relates to angular properties and frequency.

3. The relations to *ligt* and *phtn* demonstrate links between vorticity and electromagnetic phenomena.

Note: The *vrtx* unit in the APM offers a unique perspective on rotational phenomena at the quantum scale. It bridges concepts of mass, volume, and rotation, providing a tool for analyzing vortex-like behavior in quantum systems. This unit emphasizes the APM's view that rotational properties are fundamental to the nature of quantum entities and the Aether itself.

The *vrtx* unit could be especially relevant in contexts such as:

Quantum fluid dynamics, particularly in the study of superfluids and quantum turbulence

Analysis of angular momentum in quantum systems, including spin and orbital components

Investigations into the rotational aspects of fundamental particles

Studies of vortex formation and behavior in quantum field theories

By defining *vrtx* as $m_\mathrm{e} \cdot {\lambda_C}^3$, the APM suggests that quantum vorticity is an intrinsic property related to the mass and spatial extent of quantum entities. This perspective could offer new insights into the nature of rotation and angular momentum at the most fundamental levels of reality, potentially leading to novel understandings of particle properties, field behaviors, and even the structure of space-time itself.

Power `powr`

QMU primitive representation: $\mathrm{powr} = m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{powr}\,\mathrm{qsrc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $powr = m_\mathrm{e} \cdot {\lambda_C}^2 \cdot {F_q}^3$

Physical interpretation:

Represents the rate of energy transfer or transformation at the quantum scale

Quantifies the capacity for energy flow through a quantum surface area per unit time

Describes the product of mass, area, and frequency cubed, indicating a measure of energy flux density

Significance:

Emerges from the APM's concept of energy dynamics in Aether units

Provides a fundamental measure of energy transfer rates in quantum systems

Directly related to the inverse of Quantum Surface Receptivity (*qsrc*), linking power and surface properties

Potential applications:

Analyzing energy transfer processes in quantum systems

Characterizing the intensity of quantum interactions and transformations

Studying radiation and absorption phenomena at the quantum level

Describing fundamental limits on energy flow in quantum devices and processes

Relationships to other units:

$$powr = \frac{1}{qsrc}$$

$$powr = \frac{ligt}{\lambda_C}$$

$$powr = phtn \cdot freq \cdot wavn$$

$$powr = enrg \cdot freq$$

$$powr = forc \cdot velc$$

These relationships provide important insights:

The inverse relationship with $qsrc$ suggests that higher power corresponds to lower surface receptivity.

The relation to $ligt$ and λ_C shows how power is related to light and quantum length scale.

The connection to $phtn$, F_q, and λ_C demonstrates how power relates to photon presence, frequency, and wavelength.

The product of $enrg$ and $freq$ shows the classical definition of power in quantum terms.

The product of $forc$ and $velc$ maintains the connection to classical mechanics.

Note: The $powr$ unit in the APM offers a unique perspective on energy dynamics at the quantum scale. It integrates concepts of light, photons, frequency, and length scale, providing a comprehensive tool for analyzing energy transfer and transformation in quantum systems. This unit emphasizes the APM's view that energy flow is a fundamental aspect of quantum reality, closely tied to the properties of the Aether itself.

The $powr$ unit could be especially relevant in contexts such as:

Quantum optics and photonics, particularly in the study of light-matter interactions

Analysis of energy transfer in quantum devices and quantum information processing

Investigations into quantum thermodynamics and non-equilibrium quantum processes

Studies of radiation emission and absorption in atomic and subatomic systems

By expressing $powr$ in terms of $ligt$, $phtn$, and λ_C, the APM highlights the intimate connection between power, light, and the quantum nature of space. This perspective could offer new insights into the nature of energy flow at the most fundamental levels of reality, potentially leading to novel understandings of quantum efficiency, energy harvesting, and the limits of energy manipulation in quantum systems.

The *powr* unit also demonstrates the APM's ability to bridge classical and quantum concepts, maintaining consistency with classical definitions while providing a deeper, quantum-level understanding of power and energy transfer.

Energy `enrg`

QMU primitive representation: $\mathrm{enrg} = m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{enrg}\,\mathrm{qusi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $enrg = m_\mathrm{e} \cdot {\lambda_C}^2 \cdot {F_q}^2$

Physical interpretation:

Represents the fundamental quantum of action or energy at the quantum scale

Quantifies the capacity for work or the amount of stored work in a quantum system

Describes the product of magnetic field and magnetic field intensity, revealing energy as an interaction between magnetic field properties

Significance:

Emerges from the APM's concept of energy as a fundamental property of Aether units

Provides a basic measure of energy quanta in quantum systems

Directly related to Planck's constant (h) and quantum frequency (F_q), linking energy to the fundamental properties of quantum mechanics

Reveals energy as an interaction between magnetic field properties, offering a new perspective on the nature of energy

Potential applications:

Analyzing energy states and transitions in quantum systems

Characterizing the energy content of quantum particles and fields

Studying energy conservation and transformation in quantum processes

Describing fundamental limits on energy quantization in quantum phenomena

Investigating the relationship between energy and magnetic field properties

Relationships to other units:

$$enrg = h \cdot F_q$$

$$enrg = mfld \cdot mfdi$$

$$enrg = \frac{powr}{freq}$$

$$enrg = mass \cdot temp$$

$$enrg = forc \cdot \lambda_C$$

These relationships provide important insights:

The product of h and F_q shows the direct link to Planck's quantum of action and frequency.

The product of $mfld$ and $mfdi$ reveals energy as an interaction of magnetic field properties.

The relation to $powr$ and $freq$ demonstrates how energy relates to power and time.

The product of $mass$ and $temp$ maintains the connection to classical thermodynamics.

The product of $forc$ and λ_C shows how energy relates to force and quantum length scale.

Note: The $enrg$ unit in the APM offers a fundamental perspective on energy at the quantum scale. The relationship $enrg = mfld \cdot mfdi$ is particularly significant as it presents energy as an interaction between magnetic field and magnetic field intensity. This view potentially offers new insights into the electromagnetic nature of energy at the quantum level.

This definition of $enrg$ emphasizes the APM's unique approach to understanding energy, particularly its relationship to magnetic phenomena. It suggests that at the most fundamental level, energy may be intimately connected to the properties and interactions of magnetic fields within the Aether structure.

The $enrg$ unit could be especially relevant in contexts such as:

Quantum electrodynamics, for exploring the relationship between energy and electromagnetic fields

Magnetism at the quantum scale, particularly in understanding how magnetic properties relate to energy states

Energy storage and transfer mechanisms in quantum systems, especially those involving magnetic phenomena

Investigations into the fundamental nature of energy and its relationship to the structure of space-time

This perspective on energy as a product of magnetic field properties could lead to new approaches in energy research, potentially inspiring novel methods for energy manipulation, storage, and transfer at the quantum level.

Angular Momentum `angm`

QMU primitive representation: $\mathrm{angm} = m_\mathrm{e}\,{\lambda_C}^2\,F_q$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{angm}\,\mathrm{qarg} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $angm = m_\mathrm{e} \cdot {\lambda_C}^2 \cdot F_q = h$

Physical interpretation:

Represents the fundamental quantum of angular momentum at the quantum scale

Quantifies the rotational inertia and rotational velocity of a quantum system

May be compared with magnetic-field and charge-radius constructions, subject to dimensional compatibility

Significance:

Emerges from the APM's concept of intrinsic rotation in Aether units

Provides the basic unit of spin and orbital angular momentum in quantum systems

Exactly equal to Planck's constant (h), highlighting its fundamental role in quantum mechanics

Reveals angular momentum as an interaction between magnetic field and charge distribution

Potential applications:

Analyzing spin states and orbital motion in quantum particles

Characterizing rotational properties of quantum systems

Studying conservation of angular momentum in quantum processes

Describing fundamental limits on rotational quantization in quantum phenomena

Investigating the relationship between angular momentum, magnetic fields, and charge distribution

Relationships to other units:

$$angm = h$$
$$angm = \frac{enrg}{freq}$$
$$angm = \frac{enrg}{freq}$$
$$angm = \frac{powr}{rson}$$
$$angm = mass \cdot velc \cdot leng$$

These relationships provide important insights:

The equality with Planck's constant (h) underscores its fundamental nature in quantum mechanics.

The identity $angm = mfld/chgr$ is consistent with $minr = mfld/(chgr \cdot freq) = angm/freq$.

The relation to $enrg$ and $freq$ shows how angular momentum relates to energy and frequency.

The relation to $powr$ and $rson$ ($F_q{}^2$) demonstrates how angular momentum relates to power and resonance.

The product of $mass$, $velc$, and $leng$ (λ_C) maintains the connection to classical mechanics while incorporating the quantum length scale.

Note: The $angm$ unit in the APM offers a fundamental perspective on rotational motion at the quantum scale. Its definition in the QMU primitives is $m_e {\lambda_C}^2 F_q$; magnetic-field interpretations require a separately consistent construction. This view potentially offers new insights into the electromagnetic nature of angular momentum at the quantum level.

This definition of $angm$ emphasizes the APM's unique approach to understanding angular momentum, particularly its relationship to magnetic and charge phenomena. It suggests that at the

most fundamental level, angular momentum may be intimately connected to the properties and interactions of magnetic fields and charge distributions within the Aether structure.

The *angm* unit could be especially relevant in contexts such as:

Quantum electrodynamics, for exploring the relationship between angular momentum and electromagnetic fields

Spin physics, particularly in understanding how magnetic properties relate to spin states

Orbital angular momentum of light, especially in studying the interaction between light's angular momentum and matter

Investigations into the fundamental nature of rotation and its relationship to the structure of spacetime

This perspective on angular momentum as a product of magnetic field and charge radius properties could lead to new approaches in quantum mechanics and electromagnetism, potentially inspiring novel methods for manipulating and utilizing angular momentum at the quantum level.

Moment of Inertia `minr`

QMU primitive representation: $\mathrm{minr} = m_\mathrm{e}\,{\lambda_C}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{minr}\,\mathrm{qari} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $minr = m_\mathrm{e} \cdot {\lambda_C}^2 = \frac{angm}{freq} = \frac{qanr}{velc} = \frac{mfld}{chgr \cdot freq}$

Physical interpretation:

Represents the resistance to rotational acceleration in a quantum system

Quantifies the distribution of mass with respect to the axis of rotation at the quantum scale

Describes the ratio of angular momentum to frequency, quantum angular reach to velocity, or magnetic field to the product of charge radius and frequency

Significance:

Emerges from the APM's concept of rotational properties in Aether units

Provides a fundamental measure of rotational inertia in quantum systems

Links the concepts of angular momentum, frequency, quantum angular reach, velocity, magnetic field, and charge distribution in rotational quantum phenomena

Potential applications:

Analyzing rotational dynamics of quantum particles and systems

Characterizing the resistance to changes in angular velocity in quantum rotators

Studying the relationship between linear and rotational motion at the quantum scale

Describing fundamental limits on rotational behavior in quantum phenomena

Investigating the interplay between magnetic fields, charge distribution, and rotational properties

Relationships to other units:

$$minr = \frac{angm}{freq}$$
$$minr = \frac{qanr}{velc}$$
$$minr = \frac{mfld}{chgr \cdot freq}$$
$$minr = \frac{enrg}{rson}$$
$$minr = mass \cdot area$$

These relationships provide important insights:

The ratio of $angm$ to $freq$ shows how moment of inertia relates to angular momentum and frequency.

The ratio of $qanr$ to $velc$ demonstrates the connection between quantum angular reach and linear velocity.

The ratio of $mfld$ to $(chgr \cdot freq)$ reveals the relationship between magnetic field, charge radius, and frequency in determining rotational inertia.

The relation to $enrg$ and $rson$ $({F_q}^2)$ shows how moment of inertia relates to energy and resonance.

The product of $mass$ and $area$ $({\lambda_C}^2)$ maintains the classical concept of moment of inertia while incorporating the quantum length scale.

Note: The $minr$ unit in the APM offers a fundamental perspective on rotational inertia at the quantum scale. It bridges classical mechanics concepts with quantum phenomena, providing a tool for analyzing rotational behavior in quantum systems.

This definition of $minr$ highlights several key aspects of the APM's approach to quantum rotational dynamics:

Multifaceted nature of rotational inertia: The APM presents multiple equivalent expressions for $minr$, emphasizing its connections to various quantum phenomena.

Unification of concepts: By relating minr to various other units (angular momentum, frequency, quantum angular reach, velocity, magnetic field, charge radius), the APM demonstrates the interconnectedness of different physical phenomena.

The $minr$ unit could be especially relevant in contexts such as:

Quantum rotors, for analyzing the behavior of rotating quantum systems

Molecular spectroscopy, in understanding rotational energy levels

Quantum gyroscopes and related technologies

Investigations into the quantum nature of rotating black holes or other astrophysical objects

Studies of the relationship between magnetic fields and rotational properties in quantum systems

This perspective on moment of inertia offers a unified view of rotational inertia that bridges classical and quantum concepts, potentially leading to new insights into the nature of rotation, angular momentum, and the structure of space-time itself at the quantum level.

Light Intensity `lint`

QMU primitive representation: $\mathrm{lint} = m_\mathrm{e}\,\lambda_C\,{F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{lint}\,\mathrm{qili} = 1$ (as a formal reciprocal of the stated QMU dimensions).

The unit relationships are $lint = m_\mathrm{e} \cdot \lambda_C \cdot {F_q}^3 = \frac{powr}{leng} = \frac{phtn \cdot freq}{area} = mfxd \cdot acch$. These are equalities at the stated QMU reference normalization.

Physical interpretation:

Represents the intensity or concentration of light energy in a quantum system

Quantifies the energy flux density of electromagnetic radiation at the quantum scale

Describes a product of magnetic flux density and accelerating charge in the QMU ledger; this dimensional relationship does not by itself establish a physical emission mechanism

Significance:

Emerges from the APM's concept of light as a fundamental aspect of Aether units

Provides a measure of the strength or brightness of light at the quantum level

Links the concepts of magnetic flux density and charge acceleration in electromagnetic phenomena

Potential applications:

Analyzing the intensity of light in quantum optical systems

Characterizing the energy density of electromagnetic fields

Studying light-matter interactions at the quantum scale

Describing fundamental limits on light concentration and energy transfer in photonic processes

Investigating the relationship between magnetic fields and charge dynamics in light phenomena

Relationships to other units:

$$lint = mfxd \cdot acch$$

$$lint = \frac{powr}{leng}$$

$$lint = \frac{phtn \cdot freq}{area}$$

$$lint = \frac{enrg \cdot freq}{leng}$$

$$lint = forc \cdot freq$$

These relationships provide important insights:

The product of $mfxd$ and $acch$ reveals light intensity as an interaction of magnetic flux density and charge acceleration.

The ratio of $powr$ to $leng$ shows how light intensity relates to power and quantum length scale.

The product of $phtn$ and $freq$ divided by $area$ reveals the connection between photon presence, frequency, and area.

The relation to $enrg$, $freq$, and $leng$ demonstrates how intensity is related to energy density and frequency.

The product of $forc$ and $freq$ links light intensity to force and frequency.

Note: The $lint$ unit in the APM offers a fundamental perspective on light intensity at the quantum scale. Its definition as $mfxd \cdot acch$ is particularly significant as it presents light intensity as an interaction between magnetic flux density and charge acceleration. This view potentially offers new insights into the electromagnetic nature of light at the quantum level.

This refined definition of lint highlights several key aspects of the APM's approach to quantum optics:

Electromagnetic nature of light: The APM emphasizes the intimate connection between magnetic fields and charge dynamics in the generation of light intensity.

Quantization of light intensity: The APM views light intensity as a fundamental property of quantum systems, quantized in units related to magnetic and charge properties.

Unification of concepts: By relating lint to various other units (power, photons, energy, force, magnetic flux density, charge acceleration), the APM demonstrates the interconnectedness of different physical phenomena.

The $lint$ unit could be especially relevant in contexts such as:

Quantum electrodynamics, for exploring the relationship between magnetic fields, charge dynamics, and light intensity

Photonics and laser physics, in understanding the fundamental mechanisms of light generation and propagation

Studies of light-matter interactions at the quantum level

Investigations into the quantum nature of electromagnetic radiation in various physical systems

This perspective on light intensity as a product of magnetic flux density and charge acceleration properties could lead to new approaches in quantum optics and electromagnetism, potentially inspiring novel methods for manipulating and utilizing light at the quantum level.

Force `forc`

QMU primitive representation: $\mathrm{forc} = m_\mathrm{e}\,\lambda_C\,{F_q}^2$.

Family grid Dependency index

Catalog reciprocal: forc sptn = 1 (as a formal reciprocal of the stated QMU dimensions).

Definitions: $forc = m_{\mathrm{e}} \cdot \lambda_C \cdot {F_q}^2 = \frac{enrg}{leng} = \frac{magr}{curr}$

Physical interpretation:

Represents the fundamental quantum of force at the quantum scale

Quantifies the rate of change of momentum or the ability to cause acceleration in a quantum system

Describes the product of magnetic rigidity and current, revealing force as an interaction between magnetic properties of matter and moving charges

Significance:

Emerges from the APM's concept of interactions between Aether units and matter

Provides a basic measure of interaction strength in quantum systems

Links the concepts of magnetic rigidity and electric current in quantum phenomena

Potential applications:

Analyzing fundamental interactions between particles in quantum systems

Characterizing the strength of quantum forces, especially those involving magnetic interactions

Studying the relationship between magnetic properties of materials and force generation

Describing limits on force magnitudes in quantum phenomena involving current flow

Relationships to other units:

$$forc = magr \cdot curr$$
$$forc = \frac{enrg}{leng}$$
$$forc = \frac{powr}{velc}$$
$$forc = mass \cdot accl$$
$$forc = \frac{lint}{freq}$$

These relationships provide important insights:

The product of *magr* and *curr* reveals force as an interaction of magnetic rigidity and electric current.

The ratio of *enrg* to *leng* shows how force relates to energy density at the quantum scale.

The ratio of *powr* to *velc* demonstrates the connection between force, power, and velocity.

The product of *mass* and *accl* maintains the classical definition of force while incorporating quantum units.

The ratio of *lint* to *freq* links force to light intensity and frequency.

Note: The *forc* unit in the APM offers a fundamental perspective on interactions at the quantum scale. Its definition as $magr \cdot curr$ is particularly significant as it presents force as an interaction

between magnetic rigidity and electric current. This view potentially offers new insights into the nature of forces at the quantum level, especially those involving magnetic materials and current flow.

This definition of $forc$ highlights several key aspects of the APM's approach to quantum interactions:

Magnetic nature of force: The APM emphasizes the connection between magnetic rigidity of materials and moving charges in the generation of force.

Quantization of force: The APM views force as a fundamental property of quantum systems, quantized in units related to the electron mass, Compton wavelength, and quantum frequency.

Unification of concepts: By relating $forc$ to various other units (magnetic rigidity, current, energy, length, power, velocity, mass, acceleration, light intensity), the APM demonstrates the interconnectedness of different physical phenomena.

The $forc$ unit could be especially relevant in contexts such as:

Quantum electrodynamics, for exploring the fundamental nature of electromagnetic interactions

Magnetism at the quantum scale, particularly in understanding how magnetic properties relate to force generation

Spintronics and quantum computing, where magnetic properties and current flow are crucial

Investigations into the behavior of charged particles in magnetic fields

This perspective on force as a product of magnetic rigidity and current could lead to new approaches in understanding quantum interactions, potentially inspiring novel methods for manipulating and utilizing forces at the quantum level, particularly in systems involving magnetic materials and electric currents.

Momentum `momt`

QMU primitive representation: $\mathrm{momt} = m_\mathrm{e}\,\lambda_C\,F_q$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{momt}\,\mathrm{qmob} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $momt = m_\mathrm{e} \cdot \lambda_C \cdot F_q = magr \cdot chrg$

Momentum in the APM quantifies the motion of charged particles in magnetic environments, representing the interaction between a system's magnetic properties and its charge distribution.

Relevant contexts:

Quantum mechanics: Describes particle behavior in magnetic fields

Spintronics: Characterizes electron motion in magnetic materials

Magnetohydrodynamics: Analyzes charged fluid motion in electromagnetic fields

Quantum Hall effect: Explains charge transport in strong magnetic fields

Particle accelerators: Predicts charged particle trajectories in magnetic containment systems

This definition emphasizes the APM's unique perspective on momentum as an interplay between magnetic and charge properties, distinguishing it from classical definitions while maintaining consistency with observed quantum phenomena.

Torque `torq`

QMU primitive representation: $\mathrm{torq} = m_\mathrm{e}\,\lambda_C$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{torq}\,\mathrm{qflx} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $torq = m_\mathrm{e} \cdot \lambda_C = \frac{forc}{rson} = \frac{angm}{velc}$

Torque in the APM quantifies the rotational force in quantum systems, representing the tendency to change angular momentum. It links force, length scale, and frequency at the quantum level.

Relevant contexts:

Quantum rotors: Describes rotational dynamics of molecules and nanostructures

Spin systems: Characterizes interactions in magnetic materials and spin-based quantum devices

Molecular motors: Analyzes rotational motion in biological systems at the nanoscale

Quantum gyroscopes: Predicts behavior of rotating quantum systems

Angular momentum coupling: Explains interactions between orbital and spin angular momenta

This definition emphasizes the APM's perspective on torque as a fundamental quantum property, connecting rotational force to the Compton wavelength and quantum frequency. It provides a framework for understanding rotational phenomena at the quantum scale, bridging classical concepts of torque with quantum mechanical principles.

Irradiance `irrd`

QMU primitive representation: $\mathrm{irrd} = m_\mathrm{e}\,{F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{irrd}\,\mathrm{qopq} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $irrd = m_\mathrm{e} \cdot {F_q}^3 = \frac{powr}{area} = \frac{ligt}{volm} = dvef \cdot curr$

Irradiance in the APM quantifies the power of electromagnetic radiation per unit area at the quantum scale. It represents the product of the diverging electric field and current, and also the ratio of light intensity to volume. This dual representation links electromagnetic energy flux to charge flow, field divergence, and the spatial concentration of light.

Relevant contexts:

Quantum optics: Describes the intensity of light at the quantum level and its spatial distribution

Photonics: Characterizes energy transfer and concentration in optical devices and waveguides

Quantum electrodynamics: Analyzes the interaction of radiation with matter and space

Solar cell physics: Explains energy conversion efficiency and light concentration in photovoltaic devices

Radiation detectors: Predicts sensor response to incoming electromagnetic radiation and its spatial properties

This refined definition emphasizes the APM's perspective on irradiance as a fundamental quantum property, connecting electromagnetic power flux to the diverging electric field and current flow, as well as to the spatial concentration of light. The additional relationship $irrd = \frac{ligt}{volm}$ provides insight into how irradiance relates to light intensity and its distribution in space, offering a more comprehensive understanding of electromagnetic energy transfer at the quantum scale.

This dual representation of irradiance (as dvef $\cdot$ curr and ligt / volm) bridges the concepts of field-charge interactions and spatial light distribution, potentially leading to new insights in areas such as nanophotonics, quantum imaging, and light-matter interactions in confined spaces.

Surface Tension `sten`

QMU primitive representation: $\mathrm{sten} = m_\mathrm{e}\, {F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sten}\,\mathrm{qspr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $sten = m_\mathrm{e} \cdot {F_q}^2 = \frac{forc}{leng} = mfxd \cdot curr$

Surface Tension in the APM quantifies the cohesive forces at interfaces at the quantum scale. It represents the force per unit length along a surface or interface, and also the product of magnetic flux density and current. This definition links surface forces to magnetic field properties and charge flow.

Relevant contexts:

Quantum interfaces: Describes cohesive forces at boundaries between quantum systems in the presence of magnetic fields and currents

Nanoelectronics: Characterizes surface effects in current-carrying nanostructures

Quantum Hall systems: Analyzes edge states and surface phenomena in strong magnetic fields

Superconductor interfaces: Explains surface effects in the presence of supercurrents and magnetic fields

Spintronics: Predicts behavior at interfaces where magnetic properties and current flow interact

This refined definition emphasizes the APM's perspective on surface tension as a fundamental quantum property, connecting interface forces to magnetic flux density and electric current. The relationship $sten = mfxd \cdot curr$ is particularly significant, as it reveals surface tension as an interaction between magnetic field properties and charge flow at the quantum scale.

This representation of surface tension bridges the concepts of surface forces, magnetic phenomena,

and electric currents, potentially leading to new insights in areas such as quantum magnetism, current-driven interface phenomena, and magneto-electric effects at surfaces. It could be especially valuable in understanding and manipulating surface properties in quantum systems where both magnetic fields and electric currents play crucial roles, with potential applications in advanced nanoelectronics, quantum computing devices, and novel quantum materials.

Intensity `ints`

QMU primitive representation: $\mathrm{ints} = m_{\mathrm{e}}\, F_q$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{ints}\,\mathrm{dfld} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $ints = m_{\mathrm{e}} \cdot F_q = \frac{forc}{velc} = mfxd \cdot chrg$

Intensity in the APM quantifies the concentration of a physical quantity at the quantum scale. It represents force per unit velocity, and also the product of magnetic flux density and charge. This dual representation links the concept of intensity to force-velocity relationships and the interaction between magnetic fields and charge distributions.

Relevant contexts:

Quantum electrodynamics: Describes the interaction between charged particles and electromagnetic fields

Magnetohydrodynamics at quantum scales: Characterizes the behavior of charged quantum fluids in magnetic fields

Quantum Hall effect: Analyzes the interplay between charge density and magnetic flux in two-dimensional electron systems

Spintronics: Explains the intensity of spin-dependent phenomena in magnetic materials

Quantum sensors: Predicts the sensitivity of devices based on magnetic field-charge interactions

This refined definition emphasizes the APM's perspective on intensity as a fundamental quantum property, connecting it to both force-velocity relationships and the interplay between magnetic fields and charge. The relationships $ints = \frac{forc}{velc}$ and $ints = mfxd \cdot chrg$ are particularly significant, as they reveal intensity as a measure of force concentration in velocity space and as an interaction between magnetic field properties and charge at the quantum scale.

This representation of intensity bridges the concepts of force, velocity, magnetic phenomena, and charge distribution, potentially leading to new insights in areas such as quantum transport phenomena, magnetic charge dynamics, and the behavior of charged particles in magnetic fields. It could be especially valuable in understanding and manipulating intensity distributions in quantum systems where both magnetic fields and charge play crucial roles, with potential applications in advanced quantum devices, novel magnetic materials, and quantum information processing.

Mass `mass`

QMU primitive representation: mass $= m_{\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: mass qexl $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definitions: $mass = m_{\mathrm{e}}$

In the APM, mass is a fundamental property of matter that represents the amount of dark matter string contained within an Aether unit. Mass quantifies the substance of a physical entity, determining its ability to exist, persist, and interact within the Aether structure. It represents the capacity of an Aether unit to capture and contain dark matter strings.

Significance:

Existence Quantification: Mass determines the degree to which an entity manifests in physical reality within the Aether framework.

Inertial Property: Mass provides the basis for inertia, giving objects the tendency to resist changes in their state of motion or rest.

Gravitational Interaction: Mass forms the basis for gravitational effects, though in the APM, gravity is viewed as the result of space's tendency to be filled with mass.

Gforce $= m_a \cdot \lambda_C \cdot {F_q}^2$: where m_a represents the maximum mass an Aether unit can contain

$G = \text{Gforce} \cdot \frac{{\lambda_C}^2}{{m_a}^2}$: relating mass to the gravitational constant

$forc = mass \cdot accl$: the APM's interpretation of Newton's second law

$mass = \frac{1}{qexl}$: relating mass to the Quantum Existential Limit

Conceptual Implications:

Quantized Nature: In the APM, mass is not infinitely divisible but exists in discrete quanta related to the Aether unit structure.

Dark Matter Origin: Mass is viewed as originating from dark matter strings, providing a direct link between observable matter and dark matter.

Aether Interaction: The concept of mass in the APM is intrinsically tied to the Aether structure, suggesting that mass cannot be fully understood without considering its relationship to the quantum fabric of space.

Limit Concept: The existence of m_a (maximum mass per Aether unit) implies a fundamental limit to how much mass can be concentrated in a given region of space.

Potential Applications:

Analyzing the formation and stability of subatomic particles

Investigating the nature of dark matter and its relationship to observable mass

Studying the limits of gravitational collapse and the formation of black holes

Exploring new approaches to unifying quantum mechanics and gravity

Developing models for the origin of mass that don't rely on the Higgs mechanism

In the APM framework, *mass* is not just a property of matter but a fundamental aspect of the Aether-dark matter interaction. It bridges the gap between the unseen (dark matter strings) and the observable (physical matter), playing a crucial role in determining the behavior of entities at all scales, from subatomic particles to celestial bodies. This conception of *mass* offers a unique perspective on the nature of matter, gravity, and the structure of the Universe itself.

Substrate units

Optical Compliance `ocmp`

QMU primitive representation: $\mathrm{ocmp} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^3\,{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{ocmp}\,\mathrm{ligt} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$ocmp = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^3 \cdot {F_q}^3} = \frac{1}{ligt}$$

Physical interpretation:

Represents the receptivity or compliance of a quantum volume to optical phenomena

Quantifies the ease with which light or electromagnetic radiation can propagate through a quantum volume

Describes the inverse of light intensity in a quantum volume

Significance:

Emerges from the APM's concept of Aether units and their interaction with electromagnetic radiation

Provides a measure of how readily a quantum volume can accommodate or transmit light

Directly related to the inverse of light intensity

Potential applications:

Analyzing the optical properties of quantum media

Characterizing the transparency or opacity of quantum volumes to electromagnetic radiation

Studying light propagation and scattering in quantum systems

Describing the threshold for photon-induced phenomena in quantum volumes

Relationships to other units:

$$ocmp = \frac{1}{ligt}$$

These relationships provide important insights:

The connection to *qvrc* shows that optical compliance decreases with frequency squared compared to volumetric receptivity.

The relation to *qvoi* emphasizes the strong dependence on temporal factors (F_q) in determining optical compliance.

The connection to *qsrc* indicates that optical compliance is less sensitive to spatial factors than surface receptivity.

The inverse relationship with *ligt* (light) directly links this unit to the intensity of electromagnetic radiation in a quantum volume.

Note: The *ocmp* unit in the APM offers a unique perspective on the interaction between light and quantum volumes. Its inverse relationship to light intensity makes it particularly useful for analyzing and describing optical phenomena at the quantum scale. This unit bridges concepts of volumetric properties, frequency dependence, and light propagation, providing a comprehensive tool for studying quantum optical phenomena within the Aether Physics Model framework.

The *ocmp* unit could be especially relevant in contexts such as:

Quantum optics and photonics

Studies of light-matter interactions at the quantum level

Analysis of optical properties in novel materials

Investigations into quantum communication and information processing using light

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Innate Particulate Resolvability `inpr`

QMU primitive representation: $\mathrm{inpr} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^3\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{inpr}\,\mathrm{phtn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$inpr = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^3 \cdot {F_q}^2} = \frac{1}{phtn}$$

Physical interpretation:

Represents the inherent ability of a quantum volume to resolve or distinguish individual particles or quanta

Quantifies the inverse of the photon density in a quantum volume

Describes the spatial-temporal resolution capacity of a quantum system

Significance:

Emerges from the APM's concept of Aether units and their ability to discretize or resolve quantum entities

Provides a measure of how finely a quantum volume can differentiate between individual particles or energy quanta

Directly related to the inverse of photon presence in a quantum volume

Potential applications:

Analyzing the resolving power of quantum detection systems

Characterizing the granularity of quantum fields or media

Studying the limits of quantum measurement and observation

Describing the discretization of energy in quantum volumes

Relationships to other units:

$$inpr = \frac{qvrc}{freq}$$

$$inpr = \frac{qvoi}{rson}$$

$$inpr = \frac{qsrc \cdot freq}{leng}$$

$$inpr = ocmp \cdot freq$$

$$inpr = \frac{1}{phtn}$$

These relationships provide important insights:

The connection to *qvrc* shows that innate particulate resolvability decreases with frequency compared to volumetric receptivity.

The relation to *qvoi* emphasizes the dependence on temporal factors ($freq$) in determining resolvability.

The *qsrc* relationship follows by reduction to the same primitive exponent vector as *inpr*.

The relation to *ocmp* suggests that higher resolvability corresponds to lower optical compliance, multiplied by frequency.

The inverse relationship with *phtn* (photon) directly links this unit to the discrete nature of light in a quantum volume.

Note: The *inpr* unit in the APM offers a unique perspective on the fundamental ability of quantum systems to resolve or distinguish individual particles or energy quanta. Its inverse relationship to photon presence makes it particularly useful for analyzing and describing the discreteness and resolvability of quantum phenomena. This unit bridges concepts of quantum measurement, particle-wave duality, and the granularity of quantum fields, providing a comprehensive tool for studying the limits of quantum observation and detection within the Aether Physics Model framework.

Quantum Volumetric Receptivity `qvrc`

QMU primitive representation: $\mathrm{qvrc} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^3\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvrc}\,\mathrm{qanr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvrc = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^3 \cdot F_q}$$

Physical interpretation:

Represents the receptivity of a quantum volume to external influences or perturbations

Quantifies the ease with which a quantum volume can be excited or modified

Describes the inverse of the energy density required to induce changes in a quantum volume

Significance:

Emerges from the APM's concept of Aether units and their susceptibility to external influences

Provides a measure of how readily a quantum volume can be manipulated or excited

Inversely related to the energy required to induce changes in a quantum volume

Potential applications:

Analyzing the susceptibility of quantum systems to external fields or forces

Characterizing the ease of inducing quantum state transitions in volumetric systems

Studying the propagation of perturbations through quantum media

Describing the efficiency of energy transfer processes in quantum volumes

This unit offers a unique perspective on the receptivity of quantum volumes to external influences. By providing a measure inverse to the product of electron mass, cubic Compton wavelength, and quantum frequency, *qvrc* allows for the quantification of phenomena related to the ease of manipulating or exciting quantum volumes within the Aether framework.

Note: The *qvrc* unit in the APM emphasizes the model's ability to describe the susceptibility of quantum volumes to external influences, potentially offering new insights into quantum excitation processes, field interactions, and energy transfer mechanisms at the most fundamental level. This unit is distinct from others in the APM framework as it specifically focuses on the receptivity of quantum volumes, rather than resistance or inertial properties.

Quantum Volumetric Inertia `qvoi`

QMU primitive representation: $\mathrm{qvoi} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvoi}\,\mathrm{vrtx} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvoi = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^3}$$

Physical interpretation:

Represents the inherent resistance of a quantum volume to changes in its state

Quantifies the inertial property of a quantum volume independent of temporal factors

Describes the inverse of the mass density of a quantum volume

Significance:

Emerges from the APM's concept of Aether units and their intrinsic spatial properties

Provides a measure of how resistant a quantum volume is to spatial deformations or perturbations

Inversely related to the mass contained within a quantum volume

Potential applications:

Analyzing the stability of quantum volumetric structures

Characterizing the resistance to spatial distortions in quantum systems

Studying the propagation of spatial perturbations through quantum media

Describing the distribution of mass within quantum volumes

This unit offers a unique perspective on the inertial properties of quantum volumes. By providing a measure inverse to the product of electron mass and cubic Compton wavelength, *qvoi* allows for the quantification of phenomena related to the resistance of quantum volumes to spatial changes within the Aether framework.

Relationship to *qvrc*: $qvoi/F_q = qvrc$

This dimensional identity expresses Quantum Volumetric Receptivity (*qvrc*) as Quantum Volumetric Inertia (*qvoi*) divided by quantum frequency (F_q), equivalently multiplied by QMU Time. The corresponding physical response requires the specified interaction dynamics.

Note: The qvoi unit in the APM emphasizes the model's ability to describe the intrinsic spatial inertia of quantum volumes, potentially offering new insights into the stability of quantum structures, the propagation of spatial disturbances, and the distribution of mass at the most fundamental level. This unit is distinct from others in the APM framework as it specifically focuses on the spatial inertial properties of quantum volumes, independent of temporal factors.

Quantum Surface Receptivity `qsrc`

QMU primitive representation: $\mathrm{qsrc} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: qsrc powr = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsrc = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^2 \cdot {F_q}^3} = \frac{1}{powr}$$

Physical interpretation:

Represents the receptivity of a quantum surface area to external influences or perturbations

Quantifies the inverse of power density on a quantum surface

Describes the ease with which a quantum surface can absorb or respond to energy flux

Significance:

Emerges from the APM's concept of Aether units and their surface properties

Provides a measure of how readily a quantum surface can be manipulated or excited

Directly related to the inverse of power flux on a quantum surface

Potential applications:

Analyzing the energy absorption characteristics of quantum interfaces

Characterizing the response of quantum surfaces to incident power

Studying energy transfer efficiencies in quantum surface phenomena

Describing the threshold for quantum surface excitations

Relationships to other units:

$$qsrc = \frac{1}{powr}$$

These relationships provide important insights:

The connection to *qvrc* shows that surface receptivity increases with Compton wavelength but decreases with frequency squared, compared to volumetric receptivity.

The relation to *qvoi* emphasizes the role of both spatial (*leng*) and temporal (*freq*) factors in determining surface receptivity.

The inverse relationship with *powr* (power) directly links this unit to energy transfer processes on quantum surfaces.

Note: The *qsrc* unit in the APM offers a unique perspective on the energy absorption and response

characteristics of quantum surfaces. Its inverse relationship to power flux makes it particularly useful for analyzing and describing energy transfer processes at the quantum scale. This unit bridges concepts of receptivity, spatial properties, and energy flux, providing a comprehensive tool for studying quantum surface phenomena within the Aether Physics Model framework.

Quantum Surface Inertia `qusi`

QMU primitive representation: $\mathrm{qusi} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^2\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qusi}\,\mathrm{enrg} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qusi = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^2 \cdot {F_q}^2} = ocmp \cdot velc = \frac{1}{minr \cdot rson}$$

Physical interpretation:

Represents the product of optical compliance, quantum length, and frequency for a quantum surface

Quantifies the inverse of the energy associated with a quantum surface's moment of inertia and resonance

Describes how a quantum surface's inertial properties relate to its optical compliance and fundamental space-time characteristics

Significance:

Emerges from the APM's concept of Aether units, integrating optical, spatial, and temporal aspects of quantum surfaces

Provides a measure of a quantum surface's resistance to energetic perturbations, linked to its optical properties

Directly related to the inverse of the product of moment of inertia and resonance, key factors in surface dynamics

Potential applications:

Analyzing the interplay between optical properties and inertial behavior of quantum surfaces

Characterizing how light interaction affects the energy requirements for quantum surface state transitions

Studying the relationship between optical compliance, spatial extent, and temporal frequency in quantum surface phenomena

Describing fundamental limits on energy transfer and transformation at quantum interfaces, considering optical properties

Relationships to other units:

$$qusi = ocmp \cdot velc$$

$$qusi = inpr \cdot leng$$

$$qusi = \frac{1}{minr \cdot rson}$$

$$qusi = \frac{qvoi \cdot leng}{rson}$$

$$qusi = \frac{qvrc \cdot leng}{freq}$$

These relationships provide important insights:

The connection to *ocmp*, *leng*, and $freq$ highlights the integration of optical, spatial, and temporal factors in surface inertia.

The relation to *inpr* and *leng* emphasizes the role of quantum length in surface inertia.

The inverse relationship with $minr \cdot rson$ directly links qusi to rotational and oscillatory energy of quantum surfaces.

The relation to *qvoi* is dimensionally compatible; the displayed *qvrc* product is not.

Note: The *qusi* unit in the APM offers a unique perspective on quantum surface dynamics, emphasizing the interplay between optical properties, energy, rotation, and oscillation at the quantum scale. Its definition as the product of *ocmp*, *leng*, and $freq$ provides a comprehensive view of how optical compliance and fundamental space characteristics contribute to surface inertial properties. Simultaneously, its expression as the inverse of $minr \cdot rson$ maintains the direct link to the energetic aspects of quantum surface behavior.

This refined definition of *qusi* could be particularly relevant in:

Investigating how light interaction affects quantum surface states and their transitions

Analyzing the role of optical properties in energy transfer processes at quantum interfaces

Exploring the fundamental nature of space quantization in surface phenomena, considering optical effects

Studying the limits of quantum surface manipulations in optically active systems

This definition of *qusi* emphasizes the APM's ability to integrate optical, spatial, temporal, and energetic aspects of quantum surface behavior, potentially offering new insights into the nature of quantum interfaces and their interactions with light.

Quantum Angular Receptivity Gauge `qarg`

QMU primitive representation: $\mathrm{qarg} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^2\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qarg}\,\mathrm{angm} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qarg = \frac{1}{m_{\mathrm{e}} \cdot {\lambda_C}^2 \cdot F_q} = \frac{1}{angm} = qvoi \cdot dynl = ocmp \cdot accl$$

Quantum Angular Receptivity Gauge in the APM quantifies the susceptibility of a quantum system to changes in its angular state. It represents the inverse of angular momentum at the quantum scale, linking rotational dynamics to fundamental quantum parameters.

Physical interpretation:

Represents the receptivity of a quantum system to rotational or angular changes

Quantifies the ease with which angular momentum can be induced or modified in a quantum system

Describes the interplay between volumetric inertia, dynamic length, optical properties, and acceleration at the quantum level

Significance:

Emerges from the APM's concept of Aether units and their rotational properties

Provides a measure of how readily a quantum system can undergo changes in its angular state

Links concepts of inertia, length dynamics, optical compliance, and acceleration in a rotational context

Relationships to other units:

$$qarg = \frac{1}{angm} = qvoi \cdot dynl = ocmp \cdot accl$$

Potential applications:

Analyzing the susceptibility of quantum systems to rotational excitations

Characterizing the ease of inducing spin flips or changes in orbital angular momentum

Studying the propagation of rotational perturbations in quantum systems

Describing the efficiency of angular momentum transfer processes at the quantum scale

Investigating the relationship between optical properties and rotational dynamics

Uniqueness of $qarg$:

Angular focus: Unlike $qsrc$, which relates to surface power receptivity, $qarg$ specifically addresses angular or rotational receptivity.

Frequency sensitivity: $qarg$ is inversely proportional to F_q, making it less sensitive to frequency changes compared to $qsrc$ (which is inversely proportional to ${F_q}^3$).

Inertia-dynamics link: The relationship $qarg = qvoi \cdot dynl$ uniquely connects volumetric inertial properties with dynamic length in a rotational context.

Optical-mechanical connection: The equation $qarg = ocmp \cdot accl$ provides a distinctive link between optical compliance and acceleration in rotational phenomena.

Inverse angular momentum: As the inverse of *angm*, *qarg* offers a complementary perspective on rotational dynamics in quantum systems.

Note: The *qarg* unit in the APM offers a unique perspective on the rotational receptivity of quantum systems. It bridges concepts of angular momentum, volumetric inertia, length dynamics, optical properties, and acceleration, providing a multifaceted tool for analyzing rotational phenomena at the quantum scale. This unit is distinct within the APM framework as it specifically focuses on the susceptibility to angular changes, offering potential new insights into spin dynamics, orbital transitions, and rotational energy transfer processes at the most fundamental level of quantum mechanics.

Quantum Area Inertia `qari`

QMU primitive representation: $\mathrm{qari} = \dfrac{1}{m_\mathrm{e}\,{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qari}\,\mathrm{minr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qari = \frac{1}{m_\mathrm{e} \cdot {\lambda_C}^2}$$

Quantum Area Inertia in the APM quantifies the resistance of a quantum surface to changes in its state of motion or deformation. It represents the inverse of the product of electron mass and Compton wavelength squared, linking surface inertial properties to fundamental quantum parameters.

Physical interpretation:

Represents the inertial property of a quantum surface area

Quantifies the resistance of a quantum surface to acceleration or deformation

Significance:

Provides a measure of how resistant a quantum surface is to changes in its state

Relationships to other units:

$qari = \mathrm{qvoi} \cdot \lambda\mathrm{C}$

$qari = 1 \,/\, (\mathrm{minr})$

$qari = \mathrm{qarg} \cdot \mathrm{freq}$

$qari = \mathrm{inpr} \cdot \mathrm{accl}$

Potential applications:

Analyzing the stability of two-dimensional quantum structures

Characterizing the response of quantum interfaces to external perturbations

Quantum Inverse Light Intensity `qili`

QMU primitive representation: $\mathrm{qili} = \dfrac{1}{m_\mathrm{e}\,\lambda_C\,{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qili}\,\mathrm{lint} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qili = \frac{1}{m_\mathrm{e} \cdot \lambda_C \cdot {F_q}^3}$$

Physical interpretation of *qili*:

Represents the inverse of light intensity at the quantum scale

Quantifies the resistance or impedance to light intensity in a quantum system

Describes the spatial-temporal sparsity of light energy in the Aether

Significance:

Emerges from the APM's concept of light intensity in quantum systems

Provides a measure of how "dark" or "light-resistant" a quantum system is

Directly related to the inverse of electron mass, Compton wavelength, and cube of quantum frequency

Potential applications:

Analyzing regions of low light intensity in quantum optics

Characterizing light-absorbing or light-blocking materials at the quantum scale

Studying quantum systems with minimal light-matter interactions

Describing the "darkness" or "opacity" of various quantum environments

This new unit *qili* could be particularly useful in contexts where we need to consider the absence or suppression of light intensity in quantum systems, complementing the lint unit in the QMU system.

Spatial Tensility `sptn`

QMU primitive representation: $\mathrm{sptn} = \dfrac{1}{m_\mathrm{e}\,\lambda_C\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sptn}\,\mathrm{forc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sptn = \frac{1}{m_{\mathrm{e}} \cdot \lambda_C \cdot {F_q}^2} = \frac{1}{forc}$$

Spatial Tensility (*sptn*) represents the fundamental "stretchiness" or compliance of space at the quantum scale. It quantifies the Aether's capacity to yield, expand, or deform in response to applied forces or energy.

Significance:

Reciprocal Force: *sptn* is the inverse of force ($\frac{1}{forc}$) in the Quantum Measurement Units (QMU) system, embodying the concept of a reciprocal force central to the APM.

Aether Property: It describes a fundamental characteristic of the Aether, representing how space itself responds to the Gforce, thus playing a crucial role in the formation and behavior of Aether units.

Quantum-Classical Bridge: *sptn* provides a conceptual and mathematical link between quantum-scale phenomena and larger-scale concepts like the elasticity of space in General Relativity.

Multiscale Applicability: This unit is relevant across multiple scales, from quantum fluctuations to cosmic expansion, potentially offering insights into phenomena like dark energy.

Relationships and Implications:

Gforce Connection: The direct relationship between *sptn* and Gforce suggests that spatial tensility is not merely a derived concept but a fundamental aspect of reality closely tied to the APM's foundational force.

Quantum Phenomena: *sptn* could help explain various quantum effects, including:

Virtual particle creation and annihilation

Quantum fluctuations

Uncertainty principle (as a manifestation of space's inherent "give")

Cosmological Implications: On larger scales, *sptn* might provide insights into:

The mechanism of cosmic expansion

The nature of dark energy

Propagation of gravitational waves

Experimental Predictions: The concept of spatial tensility suggests possible experiments to measure the "stretchiness" of space at quantum scales, potentially leading to new tests of the APM.

Theoretical Unification: *sptn* could serve as a bridging concept between Quantum Mechanics and General Relativity, offering a quantum-scale description of space's ability to curve or stretch.

Material Science Analogy: While describing a property of space itself, *sptn* draws an intuitive parallel to material properties like elasticity, potentially inspiring new ways of conceptualizing and studying the fabric of reality.

Dimensional Analysis:

The dimensions of *sptn* ($\frac{1}{M \cdot L \cdot F^2}$) represent the inverse of force, quantifying displacement or deformation per unit force. In the context of the APM, this is interpreted as the "yield" or "give" of

space itself.

Applications:

- Analyzing regions of extreme spatial deformation (e.g., near black holes)

- Studying the dynamics of Aether unit formation and interaction

- Investigating the quantum roots of gravitational phenomena

- Exploring new models of cosmic inflation and expansion

- Developing quantum gravity theories that incorporate the concept of spatial tensility

By unifying concepts from Quantum Mechanics, cosmology, and the unique perspective of the Aether Physics Model, spatial tensility (*sptn*) offers a powerful tool for understanding the fundamental nature of space, force, and the fabric of reality itself.

Quantum Mobility `qmob`

QMU primitive representation: $\mathrm{qmob} = \dfrac{1}{m_\mathrm{e}\,\lambda_C\,F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmob}\,\mathrm{momt} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmob = \frac{1}{m_\mathrm{e} \cdot \lambda_C \cdot F_q} = \frac{1}{momt}$$

Quantum Mobility (*qmob*) represents the ease with which a quantum system can change its state of motion. It quantifies the system's responsiveness to impulses or its ability to alter its momentum.

Significance:

Inverse Momentum: *qmob* is the reciprocal of momentum in the QMU system, offering a complementary perspective on quantum motion.

Aether Property: It may describe a fundamental characteristic of the Aether, representing how readily quantum states can change within the Aether structure.

Quantum Fluidity: *qmob* could be interpreted as a measure of "quantum fluidity" or the "slipperiness" of quantum states.

Potential Applications:

Analyzing quantum state transitions and their likelihood

Characterizing the "fluidity" of quantum systems or quantum information

Studying quantum transport phenomena

Investigating the ease of quantum tunneling in various systems

Exploring the concept of quantum friction or resistance to state changes

Conceptual Implications: *qmob* offers a way to quantify how "mobile" or "fluid" quantum states are within the Aether framework. High *qmob* values would indicate systems where quantum states can change easily, while low *qmob* values might suggest more "rigid" or stable quantum configurations.

This unit could provide new insights into quantum behavior, particularly in areas where the ease of state changes is crucial, such as quantum computing, quantum phase transitions, or quantum transport in materials.

Quantum Flexibility `qflx`

QMU primitive representation: $\mathrm{qflx} = \dfrac{1}{m_{\mathrm{e}}\,\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qflx}\,\mathrm{torq} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qflx = \frac{1}{m_{\mathrm{e}} \cdot \lambda_C}$$

Quantum Flexibility ($qflx$) represents the ease with which a quantum system can undergo rotational or torsional changes. It quantifies the system's responsiveness to twisting forces or its ability to alter its angular configuration at the quantum scale.

Significance:

Inverse Torque: $qflx$ is the reciprocal of torque in the QMU system, offering a complementary perspective on quantum rotational dynamics.

Aether Property: It may describe a fundamental characteristic of the Aether, representing how readily quantum rotational states can change within the Aether structure.

Quantum Rotational Compliance: $qflx$ could be interpreted as a measure of "quantum rotational compliance" or the "twistability" of quantum states.

Potential Applications:

Analyzing quantum rotational state transitions and their likelihood

Characterizing the rotational "flexibility" of quantum systems or molecular structures

Studying quantum angular momentum transfer phenomena

Investigating the ease of quantum spin flips in various systems

Exploring the concept of quantum rotational resistance or compliance

Conceptual Implications: $qflx$ offers a way to quantify how "flexible" or "twistable" quantum states are within the Aether framework in terms of their rotational properties. High $qflx$ values would indicate systems where quantum rotational states can change easily, while low $qflx$ values might suggest more rotationally "rigid" or stable quantum configurations.

This unit could provide new insights into quantum behavior, particularly in areas where the ease of rotational state changes is crucial, such as molecular dynamics, spin-based quantum computing,

or the study of angular momentum in quantum systems. It might also offer a new perspective on phenomena like the quantum Hall effect or topological phases of matter, where rotational properties play a significant role.

In the context of the Aether Physics Model, $qflx$ might help describe how the Aether itself responds to rotational influences, potentially offering new ways to understand the transmission of angular momentum through space or the behavior of spin in quantum fields.

Quantum Opacity `qopq`

QMU primitive representation: $\mathrm{qopq} = \dfrac{1}{m_\mathrm{e}\, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qopq}\,\mathrm{irrd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qopq = \frac{1}{m_\mathrm{e} \cdot {F_q}^3}$$

Quantum Opacity (*qopq*) represents the resistance of a quantum system to the flow or absorption of electromagnetic energy. It quantifies the system's tendency to block or attenuate radiation at the quantum scale.

Significance:

Inverse Irradiance: *qopq* is the reciprocal of irradiance in the QMU system, offering a complementary perspective on quantum electromagnetic interactions.

Aether Property: It may describe a fundamental characteristic of the Aether, representing how the quantum vacuum can impede the propagation of electromagnetic energy.

Quantum Electromagnetic Resistance: *qopq* could be interpreted as a measure of "quantum electromagnetic resistance" or the "impenetrability" of quantum states to radiation.

Potential Applications:

Analyzing the absorption and transmission of electromagnetic radiation in quantum systems

Characterizing the "opacity" of quantum materials or structures to various frequencies of radiation

Studying quantum electrodynamics phenomena, particularly in systems with high resistance to electromagnetic interactions

Investigating quantum shielding or cloaking mechanisms

Exploring the concept of quantum electromagnetic impermeability in various contexts

Conceptual Implications: *qopq* offers a way to quantify how "opaque" or "resistant" quantum states are to electromagnetic radiation within the Aether framework. High *qopq* values would indicate systems that strongly resist or block the flow of electromagnetic energy, while low *qopq* values might suggest more "transparent" or electromagnetically permeable quantum configurations.

This unit could provide new insights into quantum behavior, particularly in areas where the interaction between matter and electromagnetic fields is crucial. It might offer new perspectives on phenomena such as:

Quantum optics and photonics

Light-matter interactions at the quantum scale

The behavior of photons in highly opaque quantum media

The limits of electromagnetic energy propagation in quantum systems

Potential quantum mechanisms for electromagnetic cloaking or invisibility

In the context of the Aether Physics Model, *qopq* might help describe how the Aether itself modulates the propagation of electromagnetic energy, potentially offering new ways to understand the nature of light and its interaction with the quantum vacuum. It could also provide insights into the fundamental limits of energy transfer in quantum systems and the nature of electromagnetic interactions at the most fundamental level.

Quantum Spreadability `qspr`

QMU primitive representation: $\mathrm{qspr} = \dfrac{1}{m_{\mathrm{e}}\, {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qspr}\,\mathrm{sten} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qspr = \frac{1}{m_{\mathrm{e}} \cdot {F_q}^2}$$

Quantum Spreadability (*qspr*) represents the tendency of a quantum system to expand or spread across a surface or interface. It quantifies the system's propensity to minimize its surface energy and maximize its area of influence at the quantum scale.

Significance:

Inverse Surface Tension: qspr is the reciprocal of surface tension in the QMU system, offering a complementary perspective on quantum surface dynamics.

Aether Property: It may describe a fundamental characteristic of the Aether, representing how quantum phenomena tend to distribute or spread within the Aether structure.

Quantum Surface Dynamics: *qspr* could be interpreted as a measure of "quantum surface fluidity" or the "spreadability" of quantum states across interfaces.

Potential Applications:

Analyzing quantum wetting phenomena and interface dynamics

Characterizing the behavior of quantum fluids and their tendency to spread

Studying quantum surface states and their propagation

Investigating quantum droplet formation and coalescence

Exploring quantum effects in thin films and 2D materials

Conceptual Implications: *qspr* offers a way to quantify how ”spreadable” or ”fluid-like” quantum states are at interfaces within the Aether framework. High *qspr* values would indicate systems that readily spread or distribute across surfaces, while low *qspr* values might suggest more ”contained” or surface-stable quantum configurations.

This unit could provide new insights into quantum behavior, particularly in areas where surface and interface phenomena are crucial. It might offer new perspectives on:

Quantum capillary effects

The behavior of quantum liquids and superfluids

Quantum surface diffusion processes

The formation and stability of quantum thin films

Topological surface states in quantum materials

In the context of the Aether Physics Model, *qspr* might help describe how quantum phenomena distribute themselves within the fabric of space, potentially offering new ways to understand the nature of quantum delocalization, entanglement spread, and the spatial distribution of quantum fields. It could also provide insights into the fundamental nature of interfaces in quantum systems and how the Aether mediates surface interactions at the most fundamental level.

This concept of Quantum Spreadability (*qspr*) could be particularly relevant in developing new models for quantum surface phenomena, understanding the behavior of exotic quantum materials, and exploring the limits of quantum confinement in low-dimensional systems.

Displacement Field `dfld`

QMU primitive representation: $\mathrm{dfld} = \dfrac{1}{m_{\mathrm{e}}\, F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{dfld}\,\mathrm{ints} = 1$ (as a formal reciprocal of the stated QMU dimensions).

In the Aether Physics Model (APM) and Quantum Measurement Units (QMU) system, the displacement field (*dfld*) is defined as:

Definition

$$dfld = \frac{1}{m_{\mathrm{e}} \cdot F_q}$$

Physical Interpretation: The displacement field (*dfld*) represents the response of the Aether to an applied electric field at the quantum scale. It quantifies the shift or displacement of charge within the Aether units when subjected to an electric influence.

Significance:

Aether Response: $dfld$ describes how the quantum Aether structure deforms or responds to electric fields, providing insight into the ”elasticity” of space itself.

Quantum Polarization: It represents the quantum-scale polarization of the Aether, indicating how easily charge can be displaced within the fabric of space.

Electric Field-Aether Interaction: $dfld$ serves as a bridge between classical electromagnetism and the quantum nature of space in the APM.

$efld = \frac{dfld}{ptty}$: where $efld$ is the electric field and $ptty$ is permittivity

Conceptual Implications:

Quantum Nature of Electric Fields: $dfld$ suggests that electric fields are not just abstract vectors but actual displacements in the quantum structure of space.

Aether Elasticity: The unit provides a measure of how ”stretchable” or ”deformable” the Aether is in response to electric influences.

Quantum Vacuum Polarization: dfld could be related to the concept of vacuum polarization in quantum electrodynamics, giving it a more concrete physical interpretation in terms of Aether displacement.

Potential Applications:

Analyzing the behavior of electric fields in quantum systems

Studying the interaction between matter and the quantum vacuum

Investigating the nature of dielectric materials at the quantum scale

Exploring new models of quantum electrodynamics based on Aether displacement

Developing theories that bridge classical electromagnetism and quantum mechanics

In the APM Framework: The dfld unit is particularly significant in the APM as it directly relates to the model's conception of space as a structured, dynamic entity (the Aether). It provides a quantitative measure of how this structure responds to electromagnetic influences, potentially offering new insights into the nature of charge, electric fields, and the fundamental structure of space itself.

By quantifying the displacement of the Aether in response to electric fields, dfld could play a crucial role in developing a more comprehensive understanding of electromagnetic phenomena, potentially leading to new predictions or interpretations of quantum electrodynamic effects.

Quantum Existential Limit `qexl`

QMU primitive representation: $\mathrm{qexl} = \dfrac{1}{m_{\mathrm{e}}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qexl}\,\mathrm{mass} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qexl = \frac{1}{m_{\mathrm{e}}}$$

Quantum Existential Limit ($qexl$) represents the inverse of mass at the quantum scale. It quantifies the limit or boundary of a quantum entity's ability to exist or persist in the Aether structure, relating directly to the entity's response to forces and accelerations.

Significance:

Existence Threshold: $qexl$ describes the threshold beyond which a quantum entity may not maintain its distinct existence or properties.

Aether Capacity: It represents the Aether's capacity to support the existence of mass, indicating a fundamental limit in the APM framework.

Force-Acceleration Relationship: $qexl$ plays a crucial role in relating force to acceleration at the quantum level.

In the context of G: $G = volm{\cdot}rson{\cdot}3.587{\times}10^{45}qexl$, where the coefficient $3.587{\times}10^{45}$ is a historical numerical factor whose source, units, and precision have not been independently established. In this catalog $qexl = 1/m_{\mathrm{e}}$; it is not $1/m_a$, the inverse of the primordial maximum Aether mass.

$qexl \cdot Gforce = 3.587 \times 10^{45} accl$: This is a historical proposed scaling, not an exact QMU unit identity unless the factor, the mass reference, and the Gforce-to-acceleration mapping are independently specified. Here Gforce denotes geometrical force.

$forc = \frac{accl}{qexl}$: This crucial equation demonstrates how $qexl$ mediates the relationship between force and acceleration, essentially defining inertia at the quantum scale.

Conceptual Implications:

Limit of Existence: High $qexl$ values would indicate systems close to the threshold of losing their distinct existence or properties, while low $qexl$ values suggest more stable, persistent entities.

Inertial Nature: $qexl$ quantifies the inverse of an entity's ability to resist changes to its state, directly relating to its response to forces and accelerations.

Quantum-Classical Bridge: This concept could provide insights into how quantum entities transition to classical behavior as their mass increases (and $qexl$ decreases).

Force Mediation: The equation forc = accl / $qexl$ suggests that qexl acts as a mediator between applied forces and resulting accelerations, potentially offering a new perspective on the nature of inertia and Newton's second law at the quantum level.

Potential Applications:

Analyzing the stability and responsiveness of quantum systems to applied forces

Investigating the limits of matter creation and annihilation in high-energy physics

Studying quantum-to-classical transitions in terms of force and acceleration responses

Exploring new formulations of quantum mechanics that incorporate this fundamental limit

Developing models of quantum gravity that consider the role of qexl in mediating between force and acceleration

This refined definition of *qexl* as a Quantum Existential Limit emphasizes its role in defining the boundaries of existence for quantum entities and its crucial function in mediating between forces and accelerations at the quantum level. It provides a unique perspective on the nature of mass, inertia, and the fundamental behavior of matter within the Aether Physics Model framework.

8 QMU unit constructions: catalog 3

For the source dimensional convention and conversion reference tables, see [2; 1; 11].

Entries follow the established QMU website grid order: family, dynamic/substrate grouping, then table row order. Units appearing in multiple grids are defined at their first occurrence.

Density and Distributional Behavioral

Dynamic units

Quantum Mass Frequency Activity `qmfa`

QMU primitive representation: $\mathrm{qmfa} = \dfrac{m_\mathrm{e}\, {F_q}^3}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmfa}\,\mathrm{qvfi} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmfa = \frac{m_\mathrm{e} \cdot {F_q}^3}{{\lambda_C}^3} = masd \cdot qinf$$

Quantum Mass Frequency Activity ($qmfa$) represents the product of mass density and quantum frequency cubed. It quantifies the intensity of quantum oscillations or activity associated with a given mass density in the Aether structure.

Significance:

Mass-Frequency Coupling: qmfa describes how mass density interacts with high-frequency quantum phenomena in the Aether.

Quantum Dynamism: It provides a measure of the ”vibrancy” or ”activity level” of mass within the quantum fabric of space.

Aether Excitation: $qmfa$ could represent the degree of excitation or perturbation in the Aether due to the presence of mass and its associated quantum frequency interactions.

Conceptual Implications: $qmfa$ offers a way to quantify the dynamic nature of mass in the quantum realm. High $qmfa$ values would indicate systems where mass is not only concentrated but also highly active in terms of quantum frequency interactions. Low $qmfa$ values might suggest more quiescent mass distributions with less quantum frequency activity.

Potential Applications:

Analyzing the behavior of matter in high-energy quantum systems

Characterizing the intensity of quantum fluctuations in various mass distributions

Studying the relationship between mass, energy, and frequency in quantum field theories

Investigating quantum phenomena that involve both mass concentration and high-frequency interactions

Exploring new models of particle behavior in extreme conditions (e.g., early universe, black hole horizons)

In the APM Framework: The $qmfa$ unit could provide insights into how mass (as dark matter strings) interacts with high-frequency quantum phenomena within the Aether units. It might offer new perspectives on:

The nature of particle-wave duality

The behavior of matter in intense electromagnetic fields

The dynamics of virtual particle creation and annihilation

The fundamental nature of quantum energy states and transitions

The relationship between mass, frequency, and the structure of the Aether itself

This Quantum Mass Frequency Activity ($qmfa$) unit could be particularly relevant in developing new models for high-energy physics, understanding the behavior of matter in extreme astrophysical environments, and exploring the deep connections between mass, energy, and quantum frequencies in the fabric of reality as described by the Aether Physics Model.

Quantum Mass Resonance Occupation `qmro`

QMU primitive representation: $\mathrm{qmro} = \dfrac{m_\mathrm{e}\,{F_q}^2}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmro}\,\mathrm{qvtc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmro = \frac{m_\mathrm{e} \cdot {F_q}^2}{{\lambda_C}^3} = masd \cdot rson$$

Quantum Mass Resonance Occupation ($qmro$) represents the product of mass density and quantum resonance. It quantifies the degree to which mass occupies and interacts with resonant quantum states within the Aether structure.

Significance:

Mass-Resonance Coupling: $qmro$ describes how mass density interacts with resonant quantum phenomena in the Aether.

Quantum State Occupation: It provides a measure of how mass ”fills” or ”occupies” resonant quantum states in a given volume of space.

Aether Resonant Excitation: *qmro* could represent the degree of resonant excitation in the Aether due to the presence of mass and its associated quantum frequency interactions.

Conceptual Implications: *qmro* offers a way to quantify the resonant nature of mass in the quantum realm. High *qmro* values would indicate systems where mass is not only concentrated but also highly engaged in resonant quantum states. Low *qmro* values might suggest mass distributions with less quantum resonance activity.

Potential Applications:

Analyzing the behavior of matter in quantum resonant systems

Characterizing the intensity of standing waves in various mass distributions

Studying the relationship between mass and resonant frequencies in quantum mechanics

Investigating quantum phenomena that involve both mass concentration and resonance effects

Exploring new models of particle behavior in cavity quantum electrodynamics

In the APM Framework: The *qmro* unit could provide insights into how mass (as dark matter strings) interacts with resonant phenomena within the Aether units. It might offer new perspectives on:

The nature of quantum harmonic oscillators

The behavior of matter in resonant cavities

The dynamics of coherent quantum states

The fundamental nature of quantum energy levels and transitions

The relationship between mass, resonance, and the structure of the Aether itself

This Quantum Mass Resonance Ooscillatation (*qmro*) unit could be particularly relevant in developing new models for quantum optics, understanding the behavior of matter in resonant quantum systems, and exploring the deep connections between mass, energy, and quantum resonances in the fabric of reality as described by the Aether Physics Model.

Quantum Mass Frequency Oscillation `qmfo`

QMU primitive representation: $\mathrm{qmfo} = \dfrac{m_\mathrm{e}\, F_q}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmfo}\,\mathrm{qvdf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmfo = \frac{m_\mathrm{e} \cdot F_q}{{\lambda_C}^3} = masd \cdot freq$$

Quantum Mass Frequency Oscillation ($qmfo$) represents the product of mass density and quantum frequency. It quantifies the degree to which mass interacts with or occupies frequency states within the Aether structure.

Significance:

Mass-Frequency Interaction: $qmfo$ describes how mass density couples with fundamental frequency in the Aether.

Quantum Oscillation Density: It provides a measure of the density of quantum oscillations associated with mass in a given volume of space.

Aether Frequency Excitation: $qmfo$ could represent the degree of frequency-based excitation in the Aether due to the presence of mass.

Conceptual Implications: $qmfo$ offers a way to quantify the frequency-related behavior of mass in the quantum realm. High $qmfo$ values would indicate systems where mass is not only concentrated but also highly engaged in frequency-based quantum states. Low $qmfo$ values might suggest mass distributions with less frequency-related quantum activity.

Potential Applications:

Analyzing the behavior of matter in frequency-dependent quantum systems

Characterizing the intensity of oscillations in various mass distributions

Studying the relationship between mass and fundamental frequencies in quantum mechanics

Investigating quantum phenomena that involve both mass concentration and frequency effects

Exploring new models of particle behavior in quantum field theories

In the APM Framework: The $qmfo$ unit could provide insights into how mass (as dark matter strings) interacts with fundamental frequency phenomena within the Aether units. It might offer new perspectives on:

The nature of matter waves and de Broglie wavelengths

The behavior of matter in periodic potentials

The dynamics of quantum oscillators

The fundamental nature of particle spin and angular momentum

The relationship between mass, frequency, and the structure of the Aether itself

This Quantum Mass Frequency Oscillation ($qmfo$) unit could be particularly relevant in developing new models for quantum mechanics, understanding the behavior of matter in periodic quantum systems, and exploring the deep connections between mass, energy, and fundamental frequencies in the fabric of reality as described by the Aether Physics Model. It may also provide insights into phenomena such as the Compton effect, where the interaction between photons and electrons is frequency-dependent.

Mass Density `masd`

QMU primitive representation: $\mathrm{masd} = \dfrac{m_\mathrm{e}}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{masd}\,\mathrm{spcv} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$masd = \frac{m_\mathrm{e}}{{\lambda_C}^3}$$

Mass Density (*masd*) represents the concentration of mass within a quantum volume of space. It quantifies how much dark matter string is contained within a given Aether unit volume.

Significance:

Quantum Concentration: *masd* describes the density of mass at the most fundamental level, providing insight into how tightly dark matter strings are packed within the Aether structure.

Aether Capacity Utilization: It indicates how close a region of space is to its maximum mass capacity, as defined by the APM.

Gravitational Potential: In the APM, *masd* could be directly related to the gravitational potential of a region, as gravity is viewed as space's tendency to be filled with mass.

$masd = \frac{mass}{volm}$: where *volm* is the quantum volume (${\lambda_C}^3$)

Conceptual Implications:

Quantized Density: *masd* suggests that mass density, like mass itself, is quantized at the most fundamental level.

Aether Structure: The unit provides insight into how mass distributes itself within the Aether framework, potentially relating to the structure and properties of space itself.

Limit Concept: There may be a maximum value for *masd*, corresponding to the maximum amount of dark matter string that can be contained within an Aether unit.

Quantum-Classical Bridge: *masd* could provide a link between quantum-scale mass distributions and classical concepts of density.

Potential Applications:

Analyzing the internal structure of subatomic particles

Investigating the limits of gravitational collapse and the formation of black holes

Studying the distribution of dark matter in the universe

Exploring new models of quantum gravity that incorporate mass density at the Aether unit level

Developing theories about the origin and evolution of cosmic structures based on fundamental mass density distributions

In the APM Framework: The *masd* unit is particularly significant as it directly relates to the

model's conception of mass as dark matter strings contained within Aether units. It provides a quantitative measure of how "full" a region of quantum space is, potentially offering new insights into phenomena ranging from particle physics to cosmology.

By quantifying the density of mass at the quantum scale, *masd* could play a crucial role in developing a more comprehensive understanding of gravitation, the structure of particles, and the large-scale distribution of matter in the universe. It might also provide a new perspective on the nature of vacuum energy and the cosmological constant, as it relates directly to the concentration of mass (and potentially energy) in what we typically consider "empty" space.

Quantum Surface Activity `qsac`

QMU primitive representation: $\mathrm{qsac} = \dfrac{m_\mathrm{e}\, {F_q}^3}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qsac}\,\mathrm{qsfr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsac = \frac{m_\mathrm{e} \cdot {F_q}^3}{{\lambda_C}^2} = sfcd \cdot qinf$$

Physical interpretation:

Represents the intensity of quantum activity on a surface area

Quantifies the rate of change or oscillation of mass distribution on a quantum surface

Describes the dynamic nature of mass concentration on Aether unit surfaces over time

Significance:

Emerges from the combination of surface mass density and quantum intensity factor in the APM

Provides a measure of how "active" or "energetic" a quantum surface is in terms of mass dynamics

Combines aspects of spatial mass distribution and temporal frequency in surface phenomena

Potential applications:

Analyzing the dynamic behavior of quantum surfaces in various systems

Characterizing the energy flux across quantum interfaces

Studying the relationship between mass distribution and frequency in surface quantum phenomena

Describing the intensity of quantum fluctuations on material surfaces

Relationships to other units:

These relationships provide important insights:

The direct relation to $sfcd$ and $qinf$ shows how surface activity combines mass distribution and frequency.

The connection to *pres* and *sclw* links surface activity to pressure as a scalar wave.

The relation to *lint* and *volm* demonstrates that quantum surface activity can be understood as light intensity per unit volume, suggesting a connection between surface phenomena and volumetric light interactions.

Note: The *qsac* unit in the APM offers a unique perspective on the dynamic nature of quantum surfaces, incorporating mass distribution, temporal aspects, and light intensity. This unit bridges concepts of surface density, quantum dynamics, and electromagnetic phenomena, providing a comprehensive tool for studying active surface phenomena within the Aether Physics Model framework.

The *qsac* unit could be especially relevant in contexts such as:

Surface catalysis and chemical reactivity at the quantum scale

Dynamic behavior of two-dimensional quantum materials

Energy transfer processes at quantum interfaces

Quantum surface fluctuations and their role in various physical phenomena

Light-matter interactions at surfaces and interfaces

This unit emphasizes the APM's ability to describe complex, dynamic quantum behaviors at surfaces, potentially offering new insights into surface-specific quantum effects and their role in various physical and chemical processes at the quantum scale. The relationship to light intensity per volume suggests that *qsac* could be particularly useful in understanding phenomena where electromagnetic interactions play a crucial role in surface dynamics.

Force Density `fdns`

QMU primitive representation: $\text{fdns} = \dfrac{m_\text{e} {F_q}^2}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{fdns}\,\text{qarc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$fdns = \frac{m_\text{e} \cdot {F_q}^2}{{\lambda_C}^2}$$

Physical interpretation:

Represents the concentration of force within a quantum volume

Quantifies the intensity of force fields in three-dimensional space at the quantum scale

Describes the spatial distribution of force within Aether units

Significance:

Emerges from the APM's concept of force distribution within quantum volumes

Provides a measure of how intensely force is packed into a given quantum space

Combines aspects of mass, frequency, and spatial dimensions in force phenomena

Potential applications:

Analyzing the distribution of forces in quantum systems

Characterizing the strength of quantum force fields in various contexts

Studying the relationship between force, mass, and spatial scales in quantum mechanics

Describing the intensity of interactions in quantum field theories

Relationships to other units:

These relationships provide important insights:

The relation to *forc* and *volm* directly shows how force density is a measure of force per unit volume.

The connection to *pres* and *wavn* links force density to pressure and the wave number, suggesting a relationship between force density and wavelength in quantum systems.

The relation to *masd* and *accl* demonstrates how force density emerges from mass density and acceleration.

Note: The *fdns* unit in the APM offers a unique perspective on the spatial distribution of forces at the quantum scale. This unit bridges concepts of force, volume, and quantum dynamics, providing a comprehensive tool for studying force phenomena within the Aether Physics Model framework.

The *fdns* unit could be especially relevant in contexts such as:

Quantum field theories and the spatial distribution of field strengths

Studies of quantum gravity and the concentration of gravitational effects at small scales

Analysis of strong and weak nuclear forces within atomic nuclei

Investigations into quantum pressure and stress in condensed matter systems

This unit emphasizes the APM's ability to describe the spatial aspects of force at the quantum level, potentially offering new insights into the nature of interactions and their distribution in space. It may provide a new way to visualize and quantify how forces manifest and propagate through the quantum structure of space, leading to a deeper understanding of fundamental interactions in physics.

Momentum Density `momd`

QMU primitive representation: $\mathrm{momd} = \dfrac{m_\mathrm{e}\, F_q}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{momd}\,\mathrm{qsdc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$momd = \frac{m_{\mathrm{e}} \cdot F_q}{{\lambda_C}^2} = \frac{momt}{volm}$$

Physical interpretation:

Represents the concentration of linear momentum within a quantum volume

Quantifies the intensity of translational motion in three-dimensional space at the quantum scale

Describes the spatial distribution of momentum within Aether units

Significance:

Emerges from the APM's concept of momentum distribution within quantum volumes

Provides a measure of how densely packed linear motion is in a given quantum space

Combines aspects of mass, frequency, and spatial dimensions in momentum phenomena

Potential applications:

Analyzing the distribution of particle momentum in quantum systems

Characterizing the intensity of quantum flows and currents

Studying the relationship between momentum, mass, and spatial scales in quantum mechanics

Describing the density of particle flux in quantum field theories

Relationships to other units:

These relationships provide important insights:

The relation to *momt* and *volm* directly shows how momentum density is a measure of momentum per unit volume.

The connection to *masd* and *velc* links momentum density to mass density and velocity, reflecting its nature as a measure of mass flow.

The relation to *pres* and *velc* reveals a connection between momentum density and pressure, suggesting a link between particle motion and force per unit area in quantum systems.

Note: The *momd* unit in the APM offers a unique perspective on the spatial distribution of linear momentum at the quantum scale. This unit bridges concepts of motion, volume, and quantum dynamics, providing a comprehensive tool for studying translational phenomena within the Aether Physics Model framework.

The *momd* unit could be especially relevant in contexts such as:

Quantum fluid dynamics and superfluidity

Studies of electron transport in materials

Analysis of matter waves and de Broglie wavelengths

Investigations into quantum pressure and its relation to particle motion

Exploration of quantum states with defined momentum distributions

This unit emphasizes the APM's ability to describe the spatial aspects of linear momentum at

the quantum level, potentially offering new insights into the nature of particle motion and its distribution in space. It may provide a new way to visualize and quantify how momentum manifests and propagates through the quantum structure of space, leading to a deeper understanding of fundamental translational phenomena in physics and their relation to quantum pressure.

Surface Density `sfcd`

QMU primitive representation: $\mathrm{sfcd} = \dfrac{m_\mathrm{e}}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sfcd}\,\mathrm{spar} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sfcd = \frac{m_\mathrm{e}}{{\lambda_C}^2}$$

Represents the concentration of mass over a quantum surface area within an Aether unit and quantifies how much dark matter string is distributed along the tubular loxodrome path during one quantum frequency cycle in the forward time direction. The $sfcd$ unit describes the two-dimensional mass distribution at the quantum scale, where the area is defined by the circular string of mass moving along the tubular loxodrome path.

Significance:

Emerges from the APM's concept of mass distribution on quantum surfaces within Aether units

Provides a measure of how densely mass is packed along the tubular loxodrome path

Directly related to the electron mass and inversely related to the square of the Compton wavelength, reflecting the fundamental relationship between mass and quantum length scales in the Aether unit structure

Conceptual Implications:

Quantized Surface Density: Confirms that mass distribution on surfaces within Aether units is quantized at the most fundamental level.

Aether Unit Structure: Provides insight into the specific geometry of mass distribution within Aether units, emphasizing the role of the tubular loxodrome path.

Frequency-Dependent Distribution: The mass distribution is tied to the quantum frequency cycle in the forward time direction, suggesting a dynamic aspect to surface density at the quantum level.

Constant Area Product: The product of circumference and tubular length being constant (${\lambda_C}^2$) implies a fundamental relationship between linear and circular aspects of the Aether unit structure.

Potential Applications:

Analyzing the internal structure and dynamics of subatomic particles within Aether units

Investigating mass distribution in quantum systems with cyclical or helical geometries

Studying the relationship between quantum frequency and mass distribution in Aether units

Exploring new models of quantum gravity that incorporate this specific geometry of mass distribution

Developing theories about particle interactions based on their mass distribution along tubular loxodrome paths

Macro-scale Manifestations: While the $sfcd$ unit is defined at the quantum level within Aether units, it can have manifestations and implications at larger scales:

Composite Particles: The surface density of more complex particles could be understood as combinations or arrangements of these fundamental $sfcd$ units.

Material Properties: Bulk material properties related to surface phenomena might be traced back to these fundamental $sfcd$ distributions.

Quantum Field Theories: The $sfcd$ concept could inform new approaches to quantum field theories, considering fields as collections of these fundamental surface density units.

Cosmological Models: Large-scale cosmic structures might be modeled as aggregations of these fundamental $sfcd$ units, potentially offering new insights into dark matter distribution and cosmic web formation.

In the APM Framework: The $sfcd$ unit, with this refined understanding, becomes a crucial link between the geometry of Aether units, the behavior of subatomic particles, and the distribution of mass at quantum scales. It provides a quantitative measure of how mass is structured within the most fundamental units of space, potentially offering new insights into phenomena ranging from particle physics to cosmology.

Pressure Diffusion Rate `pdrt`

QMU primitive representation: $\mathrm{pdrt} = \dfrac{m_\mathrm{e}\, {F_q}^3}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{pdrt}\,\mathrm{qlod} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$pdrt = \frac{m_\mathrm{e} \cdot {F_q}^3}{\lambda_C} = ldns \cdot qinf = pres \cdot freq = visc \cdot rson$$

Physical interpretation:

Represents the rate at which pressure or stress diffuses through a medium at the quantum scale

Quantifies the speed of pressure propagation or stress relaxation in a quantum system

Describes the dynamic behavior of pressure waves or stress fields in the Aether

Significance:

Emerges from the APM's concept of pressure dynamics and stress propagation in quantum media

Provides a measure of how quickly pressure or stress information spreads through a quantum system

Combines aspects of length density, quantum intensity, pressure, and viscosity in a single unit

Potential applications:

Analyzing the propagation of pressure waves in quantum fluids

Characterizing the stress relaxation times in quantum materials

Studying the relationship between pressure, viscosity, and frequency in quantum systems

Describing the dynamics of stress fields in the quantum vacuum

Relationships to other units:

These relationships provide important insights:

The relation to $ldns$ and $qinf$ links pressure diffusion to spatial density and quantum intensity, suggesting how pressure propagates through the quantum structure of space.

The connection to $pres$ and $freq$ shows how pressure diffusion rate scales with pressure and quantum frequency, indicating the dynamic nature of pressure in quantum systems.

The relation to $visc$ and $rson$ reveals how viscosity and quantum frequency interact to determine pressure diffusion, potentially describing the resistance to pressure flow in quantum media.

Note: The $pdrt$ unit in the APM offers a unique perspective on the dynamics of pressure and stress at the quantum scale. This unit bridges concepts of spatial density, quantum intensity, pressure, and viscosity, providing a comprehensive tool for studying the propagation of stress and pressure within the Aether Physics Model framework.

The $pdrt$ unit could be especially relevant in contexts such as:

Quantum hydrodynamics and the behavior of quantum fluids

Studies of phonon propagation in quantum materials

Analysis of stress wave propagation in quantum structures

Investigations into the dynamic properties of the quantum vacuum

Exploration of quantum viscoelasticity and its relation to pressure dynamics

This unit emphasizes the APM's ability to describe the dynamic aspects of pressure and stress at the quantum level, potentially offering new insights into the nature of force propagation through the quantum structure of space. It may provide a new way to visualize and quantify how pressure and stress manifest and evolve in quantum systems, leading to a deeper understanding of fundamental force-carrying phenomena in physics.

The $pdrt$ unit could also have implications for understanding the mechanism of force transmission in quantum field theories, potentially shedding light on the nature of virtual particle exchange and the propagation of interactions through the quantum vacuum.

Pressure `pres`

QMU primitive representation: $\text{pres} = \dfrac{m_\text{e} {F_q}^2}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\text{pres}\,\text{qldc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$pres = \frac{m_\text{e} \cdot {F_q}^2}{\lambda_C}$$

Physical interpretation:

Represents force per unit area at the quantum scale

Quantifies the intensity of force distribution over a surface within the Aether structure

Describes the energy density in a quantum volume

Significance:

Emerges from the APM's concept of force distribution in quantum space

Provides a fundamental measure of stress in the Aether fabric

Combines aspects of mass, frequency, and spatial dimensions in force phenomena

Potential applications:

Analyzing quantum vacuum energy density

Characterizing stress in quantum materials and structures

Studying the relationship between energy, force, and spatial scales in quantum mechanics

Describing quantum fluctuations and their effects on spacetime

Relationships to other units:

pres = forc / area

pres = enrg / volm

pres = momd · velc

pres = ldns · rson

These relationships provide important insights:

The relation to forc and area maintains the classical definition of pressure at the quantum scale.

The connection to enrg and volm links pressure to energy density, reflecting its nature as a measure of energy concentration.

The relation to momd and velc shows how pressure arises from the flow of momentum, connecting it to quantum dynamics.

The connection to ldns and rson reveals how pressure relates to length density and resonant frequency in the Aether structure.

Note: The pres unit in the APM, as defined by me · Fq^2 / λC, offers a unique perspective on force distribution and energy concentration at the quantum scale. This unit bridges concepts of force, energy, space, and quantum dynamics, providing a comprehensive tool for studying stress and energy phenomena within the Aether Physics Model framework.

This definition of pres, combined with its relationships to other units, emphasizes the APM's ability to describe the spatial aspects of force and energy at the quantum level. It potentially offers new insights into the nature of vacuum energy, quantum stress, and the fundamental structure of space. The unit may provide a new way to visualize and quantify how force and energy manifest in the quantum structure of space, leading to a deeper understanding of fundamental phenomena in physics, from particle interactions to cosmic expansion.

The pres unit could be especially relevant in contexts such as:

Quantum field theory and vacuum energy calculations

Studies of quantum fluids and their thermodynamic properties

Analysis of stress-strain relationships in quantum materials

Investigations into spacetime curvature and its relation to energy density

Exploration of quantum phase transitions driven by pressure

Viscosity `visc`

QMU primitive representation: $\mathrm{visc} = \dfrac{m_{\mathrm{e}}\, F_q}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{visc}\,\mathrm{qltc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$visc = \frac{m_{\mathrm{e}} \cdot F_q}{\lambda_C}$$

Physical interpretation:

Represents the resistance to flow or deformation at the quantum scale

Quantifies the internal friction within a quantum fluid or material

Describes the rate of momentum transfer between adjacent layers of Aether units

Significance:

Emerges from the APM's concept of interactions between Aether units during relative motion

Provides a fundamental measure of resistance to shear stress in the quantum Aether

Combines aspects of mass, frequency, and spatial dimensions in fluid dynamics phenomena

Potential applications:

Analyzing quantum fluid behavior and superfluidity

Characterizing viscous properties of exotic quantum materials

Studying energy dissipation mechanisms in quantum systems

Describing quantum turbulence and vortex dynamics

Relationships to other units:

$$visc = pres \cdot time$$
$$visc = \frac{forc \cdot time}{area}$$
$$visc = momd \cdot leng$$
$$visc = \frac{enrg \cdot time}{volm}$$

These relationships provide important insights:

The relation to *pres* and *time* shows how viscosity emerges over time as pressure is applied, linking it to quantum relaxation processes.

The connection to $forc$, *time*, and *area* demonstrates viscosity's role in resisting deformation, scaling with force and time but inversely with area.

The relation to *momd* and *leng* reveals viscosity as a product of momentum density and length, connecting it to the spatial extent of momentum transfer in quantum systems.

The link to *enrg*, *time*, and *volm* shows viscosity's role in energy dissipation per unit volume over time, relevant to quantum thermodynamics.

Note: The *visc* unit in the APM, defined as $\frac{m_e \cdot F_q}{\lambda_C}$, offers a unique perspective on fluid dynamics and resistance to motion at the quantum scale. This unit bridges concepts of force, energy, momentum, and spatial-temporal dynamics, providing a comprehensive tool for studying flow phenomena within the Aether Physics Model framework.

This definition of *visc*, combined with its relationships to other units, emphasizes the APM's ability to describe the dynamic aspects of quantum fluids and materials. It potentially offers new insights into quantum coherence, dissipation mechanisms, and the fundamental nature of flow at the smallest scales. The unit may provide a new way to quantify and visualize how resistance to motion manifests in the quantum structure of space, leading to a deeper understanding of phenomena from superfluidity to quantum turbulence.

The *visc* unit could be especially relevant in contexts such as:

Quantum hydrodynamics and superfluid behavior

Studies of quantum vortices and their dynamics

Analysis of energy dissipation in quantum circuits and devices

Investigations into quantum transport phenomena in condensed matter systems

Exploration of quantum analogs to classical fluid dynamics concepts

Length Density `ldns`

QMU primitive representation:

$$\mathrm{ldns} = \frac{m_\mathrm{e}}{\lambda_C}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ldns}\,\mathrm{spln} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\mathrm{ldns} = \frac{\mathrm{mass}}{\mathrm{leng}} = \frac{1}{\mathrm{spln}}.} \tag{233}$$

Length Density expresses mass per unit length. The canonical QMU reference uses electron mass and the Compton wavelength, while the same dimension applies to larger physical systems using their corresponding mass and length.

Physical interpretation. Within the Aether Physics Model (APM), Length Density describes the concentration of matter relative to a characteristic spatial extent.

Unlike volume density, which distributes mass through three dimensions, Length Density expresses the mass associated with a single length dimension.

This distinction is particularly important in the APM treatment of geometrical force and the curvature of photon trajectories.

The source-dependent quantity

$$\mathrm{ldns}_M(r) = \frac{M}{r}$$

relates the mass M of a physical source to the radial distance r at which its geometrical influence is evaluated.

Circular Deflection Angle. Length Density occupies a central position in the APM Circular Deflection Angle equation.

For a spherical source, the weak-field light-deflection relationship is

$$\boxed{\theta = \frac{4G}{c^2}\frac{M}{r}.} \tag{234}$$

Here, r represents the light ray's impact parameter and M is the enclosed source mass under the applicable spherical approximation.

Expressed through source Length Density,

$$\boxed{\theta = \frac{4G}{c^2}\,\mathrm{ldns}_M(r).} \tag{235}$$

The APM formulation uses the fundamental Aether closure

$$A_u\mathrm{curl} = c^2$$

to express the same relationship as

$$\boxed{2G\,\mathrm{ldns}_M(r) = \theta\,\frac{\mathrm{curl}}{2}\,A_u.} \tag{236}$$

Thus, twice the source Length Density, multiplied by G, corresponds to the angular deflection expressed through half the Aether curl and unified area.

The factor of one-half is associated in APM with the neutron-pinching geometry of matter–Aether interactions.

This is a physical geometrical factor, not a modification of the canonical Length Density or Curl units.

The equation reproduces the conventional weak-field circular deflection result while expressing its propagation scale through the QMU Aether closure.

Research significance. Length Density provides a direct connection between material structure and the APM description of photon-path curvature.

Its applications extend from neutron structure and compact astronomical objects to stellar systems, galactic matter distributions, and filamentary structures.

The relationship between source Length Density and Aether curl offers a useful foundation for investigating gravitational lensing, orbital dynamics, and the geometrical response of space to matter.

For nonspherical or spatially varying sources, the relevant mass distribution and interaction geometry must be included rather than replacing the system with a single mass-to-radius ratio.

The detailed matter–Aether equations, half-curl interpretation, and associated observational applications are developed in the companion QADI gravitational and circular-deflection papers.

Substrate units

Quantum Volume Fluctuation Impedance `qvfi`

QMU primitive representation: $\mathrm{qvfi} = \dfrac{{\lambda_C}^3}{m_\mathrm{e}\,{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvfi}\,\mathrm{qmfa} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvfi = \frac{{\lambda_C}^3}{m_\mathrm{e} \cdot {F_q}^3} = volm \cdot qopq$$

Physical interpretation:

Represents the impedance to high-frequency electromagnetic fluctuations within a quantum volume

Quantifies the resistance of a defined space to rapid changes in electromagnetic energy density

Describes the combined effect of spatial extent and quantum opacity on a volume's stability against electromagnetic perturbations

Significance:

Emerges from the interaction between volumetric properties (${\lambda_C}^3$) and inverse mass-frequency ($\frac{1}{m_\mathrm{e} \cdot {F_q}^3}$) in the APM

Provides a measure of a quantum volume's resilience to rapid, high-frequency electromagnetic changes

Links concepts of Compton wavelength, mass, frequency, volume, and quantum opacity in a unified framework

Potential applications:

Developing advanced electromagnetic shielding technologies

Designing quantum information protection systems to reduce decoherence

Creating novel materials with controlled electromagnetic absorption properties

Advancing stealth technologies by manipulating the detectability of objects

Enhancing energy harvesting techniques through precise control of energy absorption

Furthering fundamental research into quantum vacuum fluctuations and cosmological phenomena

Relationships to other units:

These relationships provide important insights:

The relation to *spcv* and *qinf* shows how *qvfi* emerges from the interplay of specific volume and quantum intensity factor.

The inverse relation to *masd* and *qvos* links *qvfi* to mass density and quantum volume oscillations, emphasizing its role in stabilizing quantum volumes against rapid fluctuations.

The product of $volm$ and $qopq$ reveals how $qvfi$ combines volumetric properties with quantum opacity, highlighting its role in modulating volume-electromagnetic interactions at the quantum scale.

Note: The $qvfi$ unit in the APM offers a unique perspective on the interaction between space and electromagnetic phenomena at the quantum level. It provides a tool for analyzing and potentially controlling how volumes of space respond to high-frequency electromagnetic fluctuations. This unit is particularly significant as it unifies concepts from quantum optics, quantum field theory, and condensed matter physics, offering new ways to understand and manipulate the quantum properties of space.

The $qvfi$ unit could be particularly relevant in:

Engineering applications for electromagnetic shielding and quantum information protection

Developing new materials with precisely controlled electromagnetic properties

Advancing our understanding of quantum vacuum fluctuations and their implications for cosmology

Exploring the fundamental nature of space-energy interactions at the quantum scale

Investigating potential links between quantum opacity and phenomena like dark energy or the cosmological constant

By manipulating $qvfi$, engineers and physicists might be able to create volumes of space with tailored responses to electromagnetic radiation, opening up new possibilities in fields ranging from quantum computing to astrophysics.

Quantum Volume Temporal Compliance `qvtc`

QMU primitive representation: $\mathrm{qvtc} = \dfrac{{\lambda_C}^3}{m_\mathrm{e}\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvtc}\,\mathrm{qmro} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvtc = \frac{{\lambda_C}^3}{m_\mathrm{e} \cdot {F_q}^2} = volm \cdot qspr$$

Physical interpretation:

Represents the susceptibility of a quantum volume to temporal fluctuations

Quantifies the combined effect of spatial extent and quantum spreadability on a volume's temporal adaptability

Describes the spatiotemporal elasticity of a quantum system in response to frequency variations

Significance:

Emerges from the relationship between spatial volume (${\lambda_C}^3$) and inverse mass-resonance ($\frac{1}{m_\mathrm{e} \cdot {F_q}^2}$) in the APM

Provides a measure of a quantum volume's responsiveness to temporal dynamics, linked to its size and propensity for spatial spreading

Unifies concepts of Compton wavelength, mass, frequency, volume, and quantum spreadability in a cohesive spatiotemporal framework

Potential applications:

Analyzing space compression effects in quantum systems of varying sizes

Characterizing the temporal behavior of quantum fields in relation to their spatial spreading tendencies

Studying the relationship between space, resonance, and quantum spreadability in quantum space density theories

Investigating how quantum systems of different volumes respond to rapid changes in external frequencies

Exploring quantum information propagation in both space and chronovibration

Relationships to other units:

These relationships provide important insights:

The relation to $qvfi$ and $freq$ shows how $qvtc$ emerges as a temporal extension of quantum volume fluctuation impedance.

The connection to $volm$, $mass$, and $rson$ links $qvtc$ to volumetric properties and resonant behavior in quantum systems.

The ratio of $spcv$ to $rson$ reveals $qvtc$'s role in describing the balance between specific volume and resonance in quantum dynamics.

The product of $volm$ and $qspr$ emphasizes how temporal compliance is influenced by both the spatial extent and the quantum spreadability of a system.

Note: The $qvtc$ unit in the APM offers a unique perspective on the spatiotemporal behavior of quantum volumes. It provides a tool for analyzing how spatial volumes at the quantum scale respond to and accommodate temporal fluctuations, while also considering their propensity for spatial spreading. This unit is distinct within the APM framework as it specifically focuses on the interplay between spatial extent, temporal dynamics, and quantum spreadability, potentially offering new insights into the nature of spacetime at the quantum level.

The $qvtc$ unit could be particularly relevant in:

Studying the quantum foundations of general relativity and space compression/stretching across different spatial scales

Exploring quantum coherence and decoherence processes in systems with varying volumes and spreadability

Investigating the behavior of quantum fields in dynamically changing environments, considering both their size and spreading tendencies

Developing models for quantum clock synchronization across spatial distances, accounting for volume-dependent effects

Analyzing the spatiotemporal aspects of quantum entanglement in extended systems

Examining how quantum information propagates through space and chronovibration in relation to system size and spreadability

By exploring *qvtc* and its relationships to volume, quantum spreadability, specific volume, and resonance, researchers might gain new perspectives on the fundamental relationships between space, chronovibration, and quantum behavior. This could potentially lead to advancements in our understanding of quantum space density gradients, the nature of space-resonance itself, and the mechanisms underlying quantum information propagation in both spatial and temporal domains.

Quantum Volume Dynamic Flux `qvdf`

QMU primitive representation: $\mathrm{qvdf} = \dfrac{{\lambda_C}^3}{m_\mathrm{e}\, F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvdf}\,\mathrm{qmfo} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvdf = \frac{{\lambda_C}^3}{m_\mathrm{e} \cdot F_q}$$

Physical interpretation:

Represents the dynamic flux capacity of a quantum volume

Quantifies the ability of a quantum volume to accommodate or transmit dynamic changes

Describes the interplay between spatial extent and mass-frequency in quantum systems

Significance:

Emerges from the relationship between spatial volume (${\lambda_C}^3$) and reciprocal mass-frequency ($\frac{1}{m_\mathrm{e} \cdot F_q}$) in the APM

Provides a measure of a quantum volume's responsiveness to dynamic changes

Links concepts of Compton wavelength, mass, and frequency in a volumetric flux framework

Potential applications:

Analyzing the propagation of dynamic changes through quantum volumes

Characterizing the flux capacity of quantum fields in varying spatial volumes

Studying the relationship between space and dynamic processes in quantum systems

Investigating quantum systems' response to gradual changes in external influences

Relationships to other units:

These relationships provide important insights:

The relation to *qvtc* and $freq$ shows how *qvdf* emerges as a dynamic extension of quantum volume

temporal compliance.

The connection to *volm*, *mass*, and $freq$ links *qvdf* to volumetric properties and frequency behavior in quantum systems.

The ratio of *spcv* to $freq$ reveals *qvdf*'s role in describing the balance between specific volume and frequency in quantum dynamics.

The product of $dfld$ and *volm* emphasizes how dynamic flux is influenced by both the diverging electric field and the spatial extent of a system.

Note: The *qvdf* unit in the APM offers a unique perspective on the dynamic behavior of quantum volumes, particularly in relation to electric field divergence and frequency. It provides a tool for analyzing how spatial volumes at the quantum scale respond to and accommodate dynamic changes, while also considering their electromagnetic properties and frequency-dependent behavior. This unit could be particularly useful in bridging concepts from quantum electrodynamics with those of quantum volumetric dynamics.

The *qvdf* unit could be especially relevant in:

Studying the propagation of electromagnetic disturbances through quantum volumes

Exploring the interplay between electric fields, spatial volumes, and frequencies in quantum dynamic processes

Investigating how quantum information flows through systems with varying electric field divergences, volumes, and frequencies

Developing new models for quantum electrodynamics that incorporate volumetric and frequency-dependent effects

Analyzing the role of spatial extent and frequency in determining a system's response to changing electromagnetic conditions

This unit and its relationships to $dfld$, *volm*, *spcv*, and $freq$ could open up new avenues for research in quantum electrodynamics and quantum dynamics, potentially leading to a deeper understanding of how electric fields, spatial volumes, and frequencies interact at the quantum level. It may provide insights into the nature of quantum fluctuations, the behavior of quantum fields in different spatial and frequency regimes, and the fundamental limits of information transfer in quantum systems.

Specific Volume `spcv`

QMU primitive representation: $\mathrm{spcv} = \dfrac{{\lambda_C}^3}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{spcv}\,\mathrm{masd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$spcv = \frac{{\lambda_C}^3}{m_\mathrm{e}}$$

Physical interpretation:

Represents the volume occupied per unit mass at the quantum scale

Quantifies the inverse density of matter within the Aether structure

Describes the spatial extent of mass distribution in quantum systems

Significance:

Emerges from the APM's concept of mass distribution in quantum space

Provides a fundamental measure of matter's spatial occupancy in the Aether fabric

Combines aspects of spatial dimensions and mass in quantum volumetric phenomena

Potential applications:

Analyzing quantum state equations and phase transitions

Characterizing the compressibility of quantum materials and fluids

Studying the relationship between mass and volume in quantum systems

Describing quantum fluctuations in density and their effects on space

Relationships to other units:

These relationships provide important insights:

The relation to volm and mass maintains the classical definition of specific volume at the quantum scale.

The inverse relationship with masd (mass density) highlights spcv's role as a measure of matter's "sparseness" in quantum space.

The relation to enrg, pres, and mass shows how specific volume emerges from the interplay of energy, pressure, and mass in quantum systems.

Note: The *spcv* unit in the APM offers a unique perspective on the spatial distribution of mass at the quantum scale. This unit bridges concepts of space, mass, energy, and pressure, providing a comprehensive tool for studying volumetric phenomena within the Aether Physics Model framework.

This definition of spcv, combined with its relationships to other units, emphasizes the APM's ability to describe the spatial aspects of matter distribution at the quantum level. It potentially offers new insights into quantum phase transitions, compressibility of quantum matter, and the fundamental nature of density fluctuations in space. The unit may provide a new way to visualize and quantify how mass occupies space in the quantum structure of the Aether, leading to a deeper understanding of phenomena from quantum fluids to cosmological density perturbations.

The *spcv* unit could be especially relevant in contexts such as:

Quantum thermodynamics and equations of state

Studies of quantum phase transitions and critical phenomena

Analysis of quantum fluids and their compressibility

Investigations into quantum gravity and space fabric

Exploration of quantum analogs to classical thermodynamic concepts

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Quantum Surface Frequency Response `qsfr`

QMU primitive representation: $\text{qsfr} = \dfrac{{\lambda_C}^2}{m_\text{e}\,{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: qsfr qsac = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsfr = \frac{{\lambda_C}^2}{m_\text{e} \cdot {F_q}^3}$$

Physical interpretation: The Quantum Surface Frequency Response unit represents the ability of a quantum surface to respond to high-frequency oscillations and perturbations. It describes how readily a two-dimensional quantum structure can accommodate and adapt to rapid changes in its state, combining aspects of quantum length, mass, and temporal response.

qsfr = dynl/pres (dynamic length per unit pressure)

Shows how the unit relates the system's adaptable length scale to applied pressure

Reveals connection between spatial adaptability and force distribution

Suggests how quantum surfaces respond to pressure-induced deformations

qsfr = qvtc/velc (quantum volume temporal compliance per unit velocity)

Links volumetric temporal response to motion

Indicates how temporal compliance scales with velocity

Connects volumetric and surface behavior through motion

qsfr = vlmt/forc (volume-time per unit force)

Describes relationship between four-dimensional space-time and applied forces

Shows how space-time structure responds to force at quantum scale

Reveals fundamental connection between force and quantum geometrical properties

Applications:

Analyzing frequency-dependent responses of quantum surfaces

Studying how quantum membranes and interfaces adapt to rapid perturbations

Investigating the relationship between spatial and temporal compliance in 2D quantum systems

Characterizing the dynamic behavior of quantum surfaces under various forces

Understanding how quantum surfaces mediate between spatial and temporal phenomena

Significance:

Bridges concepts of length, pressure, compliance, and force in quantum surface dynamics

Provides insight into how quantum surfaces respond to and propagate high-frequency disturbances

Helps quantify the limits of quantum surface adaptation to rapid changes

Offers a framework for understanding dynamic quantum surface phenomena

This unit is particularly valuable for understanding how quantum surfaces behave as mediators between spatial and temporal phenomena, potentially offering insights into quantum membrane dynamics, surface waves, and interface phenomena at the quantum scale.

Quantum Area Resonance Compliance `qarc`

QMU primitive representation: $\mathrm{qarc} = \dfrac{{\lambda_C}^2}{m_\mathrm{e}\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qarc}\,\mathrm{fdns} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qarc = \frac{{\lambda_C}^2}{m_\mathrm{e} \cdot {F_q}^2}$$

Physical interpretation:

Represents the compliance of a quantum surface area to resonant oscillations

Quantifies the ability of a given mass distributed over an area to respond to resonant frequencies

Describes the interplay between surface area, mass, and resonant behavior in quantum systems

Significance:

Emerges from the relationship between surface area (${\lambda_C}^2$), mass (m_e), and resonance (${F_q}^2$) in the APM

Provides a measure of a quantum surface's responsiveness to resonant phenomena

Links concepts of Compton wavelength, mass, and frequency in a surface-resonance framework

Potential applications:

Analyzing the resonant behavior of two-dimensional quantum systems

Characterizing the frequency response of quantum surfaces and interfaces

Studying surface wave phenomena in quantum materials

Investigating quantum membrane dynamics and their resonant modes

Relationships to other units:

These relationships provide important insights:

The ratio of *spra* to *rson* shows how *qarc* relates specific area to resonant behavior.

The ratio of *qvtc* to *leng* links *qarc* to volume temporal compliance in a surface context.

The product of *area* and *qspr* connects *qarc* to quantum spreadability over surfaces.

The ratio of *leng* to *pres* relates *qarc* to length and pressure, highlighting its role in the spatial distribution of pressure in resonant systems.

Note: The *qarc* unit in the APM offers a unique perspective on the resonant behavior of quantum surfaces. It provides a tool for analyzing how surface areas at the quantum scale respond to and accommodate resonant oscillations, considering their mass, spatial extent, and pressure distribution. This unit could be particularly useful in studying interface phenomena, surface states, and boundary effects in quantum systems, especially under resonant conditions.

The *qarc* unit could be especially relevant in:

Studying surface plasmons and other surface-bound electromagnetic phenomena

Exploring the behavior of two-dimensional materials like graphene under resonant excitations

Investigating quantum Hall effects and other surface-related quantum phenomena

Developing models for quantum surface states and their interaction with resonant fields

Analyzing the role of surfaces in quantum information processing and quantum computing, particularly in resonant operations

Examining the relationship between surface area, mass, resonant frequencies, and pressure distribution in nanomechanical systems

This unit could open up new avenues for research in quantum surface physics, potentially leading to a deeper understanding of how surfaces behave under resonant conditions in quantum systems. It may provide insights into the nature of quantum surface states, the behavior of quantum fields near resonating boundaries, and the fundamental limits of surface-mediated resonant processes in quantum devices. The relationship between length and pressure in this context could be particularly useful in understanding how resonant phenomena are spatially distributed across quantum surfaces.

Quantum Surface Dynamic Compliance `qsdc`

QMU primitive representation: $\mathrm{qsdc} = \dfrac{{\lambda_C}^2}{m_\mathrm{e}\, F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qsdc}\,\mathrm{momd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsdc = \frac{{\lambda_C}^2}{m_\mathrm{e} \cdot F_q}$$

Physical interpretation:

Represents the compliance of a quantum surface area to dynamic changes

Quantifies the ability of a given mass distributed over an area to respond to frequency-dependent

phenomena

Describes the interplay between surface area, mass, and frequency in quantum systems

Significance:

Emerges from the relationship between surface area ($\lambda_C{}^2$), mass (m_e), and frequency (F_q) in the APM

Provides a measure of a quantum surface's responsiveness to dynamic phenomena

Links concepts of Compton wavelength, mass, and frequency in a surface-dynamic framework

Potential applications:

Analyzing the dynamic behavior of two-dimensional quantum systems

Characterizing the frequency response of quantum surfaces and interfaces

Studying surface wave phenomena and propagation in quantum materials

Investigating quantum membrane dynamics and their frequency-dependent properties

Relationships to other units:

These relationships provide important insights:

The product of *qarc* and $freq$ shows how *qsdc* relates to area resonance compliance across frequencies.

The ratio of *qvdf* to *leng* links *qsdc* to volume dynamic flux in a surface context.

The ratio of *spra* to $freq$ connects *qsdc* to specific area and its frequency dependence.

The product of *area* and *dfld* (displacement field) relates *qsdc* to displacement properties of surfaces, highlighting the connection between surface dynamics and displacement phenomena.

Note: The *qsdc* unit in the APM offers a unique perspective on the dynamic behavior of quantum surfaces. It provides a tool for analyzing how surface areas at the quantum scale respond to and accommodate frequency-dependent changes, considering their mass, spatial extent, and displacement field properties. This unit could be particularly useful in studying interface phenomena, surface states, and boundary effects in quantum systems under dynamic conditions.

The *qsdc* unit could be especially relevant in:

Studying surface plasmons and other surface-bound electromagnetic phenomena

Exploring the behavior of two-dimensional materials like graphene under dynamic excitations

Investigating quantum Hall effects and other surface-related quantum phenomena

Developing models for quantum surface states and their interaction with time-varying electric fields

Analyzing the role of surfaces in quantum information processing and quantum computing, particularly in dynamic operations

Examining the relationship between surface area, mass, frequency, and displacement fields in nanomechanical and nanoelectronic systems

This unit could open up new avenues for research in quantum surface physics, potentially leading

to a deeper understanding of how surfaces behave under dynamic conditions in quantum systems. It may provide insights into the nature of quantum surface states, the behavior of quantum fields near dynamically changing boundaries, and the fundamental limits of surface-mediated dynamic processes in quantum devices. The relationship between area and displacement field in this context could be particularly useful in understanding how electromagnetic phenomena interact with and influence dynamic surface processes at the quantum level.

Specific Area `spar`

QMU primitive representation: $\mathrm{spar} = \dfrac{{\lambda_C}^2}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{spar}\,\mathrm{sfcd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$spar = \frac{{\lambda_C}^2}{m_\mathrm{e}}$$

Physical interpretation:

Represents the surface area per unit mass at the quantum scale

Quantifies the spatial extent of a surface relative to its mass

Describes the ”spreadness” of mass over a two-dimensional space

Significance:

Emerges from the relationship between surface area (${\lambda_C}^2$) and mass (m_e) in the APM

Provides a fundamental measure of how mass is distributed over a surface in quantum systems

Links concepts of Compton wavelength and mass in a surface-mass framework

Potential applications:

Analyzing surface-to-mass ratios in quantum systems and nanostructures

Characterizing two-dimensional materials and their properties

Studying adsorption and catalytic processes at the quantum scale

Investigating surface effects in quantum phenomena

Relationships to other units:

These relationships provide important insights:

The direct relation to *area* and *mass* defines the fundamental nature of specific area.

The ratio of *spcv* to *leng* shows how *spar* relates to volumetric properties in a surface context.

The product of $qsfr$ and $qinf$ links *spar* to high-frequency surface phenomena.

The ratio of $freq$ to *momd* connects *spar* to frequency and momentum density, highlighting its

role in dynamic surface processes.

Note: The *spar* unit in the APM offers a unique perspective on the distribution of mass over surfaces at the quantum scale. It provides a tool for analyzing how matter spreads over two-dimensional spaces, which is crucial for understanding the behavior of low-dimensional quantum systems and nanomaterials.

The *spra* unit could be particularly relevant in:

Studying two-dimensional materials like graphene, where the surface-to-mass ratio is critical

Exploring surface states and interface phenomena in quantum systems

Investigating quantum dots and other nanostructures where surface effects dominate

Analyzing adsorption processes and surface catalysis at the quantum level

Developing models for quantum confinement effects in low-dimensional systems

Examining the relationship between frequency and momentum in surface-bound quantum states

This unit could open up new avenues for research in quantum surface science and nanotechnology, potentially leading to a deeper understanding of how mass, surface area, and frequency interact at the quantum level. It may provide insights into the nature of two-dimensional quantum systems, the behavior of particles confined to surfaces, and the fundamental limits of surface-based quantum devices. The relationship between specific area, frequency, and momentum density could be particularly useful in studying dynamic processes on quantum surfaces and in developing new models for surface-based quantum phenomena.

Quantum Linear Oscillation Density `qlod`

QMU primitive representation: $\mathrm{qlod} = \dfrac{\lambda_C}{m_\mathrm{e}\, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qlod}\,\mathrm{pdrt} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qlod = \frac{\lambda_C}{m_\mathrm{e} \cdot {F_q}^3}$$

Physical interpretation:

Represents the density of quantum oscillations along a linear dimension

Quantifies the intensity of high-frequency quantum activity per unit length

Describes the interplay between linear spatial extent, mass, and frequency in quantum systems

Significance:

Emerges from the relationship between Compton wavelength (λ_C), mass (m_e), and frequency (F_q) in the APM

Provides a measure of quantum oscillatory activity along a linear path

Links concepts of Compton wavelength, mass, and high-frequency phenomena in a one-dimensional framework

Potential applications:

Analyzing high-frequency quantum behavior in one-dimensional systems like quantum wires

Characterizing the frequency response of linear quantum structures

Studying wave propagation in quantum waveguides

Investigating quantum effects in molecular chains or linear arrays of atoms

Relationships to other units:

These relationships provide important insights:

The product of *leng* and *qopq* shows how *qlod* relates length to quantum opacity, suggesting a connection between linear extent and resistance to quantum interactions.

The ratio of *qvdf* to *temp* links *qlod* to quantum volume dynamic flux and temperature, indicating a relationship between linear oscillation density and thermal effects in quantum volumes.

The ratio of $qflx$ to *tqod* connects *qlod* to quantum flux and transverse quantum oscillation density, highlighting the interplay between linear and transverse oscillations.

The inverse relationship with *leng* and $qinf$ remains, emphasizing *qlod*'s connection to length density and quantum intensity factor.

Note: The *qlod* unit in the APM offers a unique perspective on high-frequency quantum phenomena in one-dimensional systems. It provides a tool for analyzing how linear quantum structures respond to and propagate high-frequency oscillations, considering their mass, spatial extent, and interactions with other quantum properties like opacity and temperature. This unit could be particularly useful in studying quantum transport, wave propagation, and high-frequency effects in nanowires, molecular chains, and other linear quantum systems, especially in contexts where thermal effects and quantum opacity play significant roles.

Quantum Linear Dynamic Compliance `qldc`

QMU primitive representation: $\mathrm{qldc} = \dfrac{\lambda_C}{m_\mathrm{e} {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qldc}\,\mathrm{pres} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qldc = \frac{\lambda_C}{m_\mathrm{e} \cdot {F_q}^2}$$

Physical interpretation:

Represents the compliance of a quantum linear system to dynamic changes

Quantifies the ability of a given mass distributed along a line to respond to frequency-dependent phenomena

Describes the interplay between linear spatial extent, mass, and frequency in quantum systems

Significance:

Emerges from the relationship between Compton wavelength (λ_C), mass (m_e), and frequency (F_q) in the APM

Provides a measure of a quantum linear system's responsiveness to dynamic phenomena

Links concepts of Compton wavelength, mass, and frequency in a one-dimensional dynamic framework

Potential applications:

Analyzing the dynamic behavior of one-dimensional quantum systems

Characterizing the frequency response of quantum wires or linear molecular chains

Studying wave propagation in quantum waveguides

Investigating quantum effects in linear arrays of atoms under dynamic conditions

Relationships to other units:

These relationships provide important insights:

The product of *qlod* and $freq$ shows how *qldc* relates to quantum linear oscillation density across frequencies, emphasizing its dynamic nature.

The product of *qspr* and *leng* links *qldc* to quantum spreadability and length, highlighting its role in the spatial dynamics of quantum phenomena.

The ratio of *spln* to $rson$ connects *qldc* to specific length and resonance, emphasizing its relevance to oscillatory behavior in linear systems.

The ratio of *leng* to *sten* relates *qldc* to length and surface tension, suggesting a connection to surface effects in linear quantum systems.

Note: The *qldc* unit in the APM offers a unique perspective on the dynamic behavior of quantum linear systems. It provides a tool for analyzing how one-dimensional quantum structures respond to and accommodate frequency-dependent changes, considering their mass, spatial extent, and surface properties. This unit could be particularly useful in studying quantum transport, wave propagation, and surface effects in one-dimensional quantum systems under dynamic conditions. The relationships with qlod, qspr, and sten offer insights into how linear dynamic compliance is connected to oscillation density, quantum spreadability, and surface tension, providing a more comprehensive understanding of dynamic phenomena in linear quantum structures.

Quantum Linear Temporal Compliance `qltc`

QMU primitive representation: $\mathrm{qltc} = \dfrac{\lambda_C}{m_e F_q}$.

Family grid Dependency index

Catalog reciprocal: qltc visc = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qltc = \frac{\lambda_C}{m_\mathrm{e} \cdot F_q}$$

Physical interpretation:

Represents the temporal compliance of a quantum linear system

Quantifies the ability of a given mass distributed along a line to respond to temporal changes

Describes the interplay between linear spatial extent, mass, and time in quantum systems

Significance:

Emerges from the relationship between Compton wavelength (λ_C), mass (m_e), and quantum frequency (F_q) in the APM

Provides a measure of a quantum linear system's responsiveness to temporal phenomena

Links concepts of Compton wavelength, mass, and time in a one-dimensional framework

Potential applications:

Analyzing the temporal behavior of one-dimensional quantum systems

Characterizing the time-dependent response of quantum wires or linear molecular chains

Studying temporal aspects of wave propagation in quantum waveguides

Investigating time-dependent quantum effects in linear arrays of atoms

Relationships to other units:

These relationships provide important insights:

The product of *qldc* and $freq$ shows how *qltc* relates to quantum linear dynamic compliance across frequencies, emphasizing its temporal nature.

The product of *qmob* and *area* links *qltc* to quantum mobility and spatial extent, suggesting a connection between temporal compliance and spatial quantum behavior.

The ratio of *spln* to $freq$ connects *qltc* to specific length and frequency, emphasizing its relevance to time-dependent behavior in linear systems.

The ratio of *spra* to *velc* relates *qltc* to specific area and velocity, indicating a relationship between temporal compliance and the rate of spatial change in quantum systems.

Note: The *qltc* unit in the APM offers a unique perspective on the temporal behavior of quantum linear systems. It provides a tool for analyzing how one-dimensional quantum structures respond to and accommodate temporal changes, considering their mass, spatial extent, and frequency-dependent properties. This unit could be particularly useful in studying time-dependent phenomena in quantum transport, wave propagation, and temporal evolution in one-dimensional quantum systems. The relationships with *qldc*, *qmob*, *spra*, and *velc* offer insights into how linear temporal compliance is connected to dynamic compliance, quantum mobility, specific area, and velocity, providing a more comprehensive understanding of temporal phenomena in linear quantum structures

and their relationship to spatial properties.

Specific Length `spln`

QMU primitive representation: $\text{spln} = \dfrac{\lambda_C}{m_\text{e}}$.

Family grid Dependency index

Catalog reciprocal: $\text{spln}\,\text{ldns} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$spln = \frac{\lambda_C}{m_\text{e}}$$

Physical interpretation:

Represents the linear extent per unit mass at the quantum scale

Quantifies the one-dimensional spatial distribution of mass

Describes the ”stretchness” of mass along a linear dimension

Significance:

Emerges from the relationship between Compton wavelength (λ_C) and mass (m_e) in the APM

Provides a fundamental measure of how mass is distributed along a length in quantum systems

Links concepts of Compton wavelength and mass in a linear-mass framework

Potential applications:

Analyzing length-to-mass ratios in quantum systems and nanostructures

Characterizing one-dimensional quantum systems such as quantum wires or nanotubes

Studying linear mass distributions in quantum phenomena

Investigating quantum effects in highly elongated structures

Relationships to other units:

These relationships provide important insights:

The direct relation to length and mass defines the fundamental nature of specific length.

The ratio of *velc* to *ints* links *spln* to velocity and intensity, suggesting a connection between specific length and energy propagation.

The inverse relationship with *ldns* (length density) highlights *spln*’s role as a measure of mass distribution along a length. May relate to a spherical object’s radius per mass.

The product of *curl* and *chds* (charge distribution or stroke) connects *spln* to electromagnetic properties and charge dynamics in quantum systems.

Note: The *spln* unit in the APM offers a unique perspective on the distribution of mass along a single dimension at the quantum scale. It provides a tool for analyzing how matter spreads along

a line, which is crucial for understanding the behavior of one-dimensional quantum systems and nanostructures.

The *spln* unit could be particularly relevant in:

Studying one-dimensional materials like carbon nanotubes or quantum wires

Exploring linear quantum states and phenomena

Investigating quantum confinement effects in highly elongated nanostructures

Analyzing linear mass distributions in quantum field theories

Developing models for quantum transport in one-dimensional systems

Examining the relationship between velocity, intensity, and mass distribution in linear quantum states

Investigating the interplay between electromagnetic curl, charge distribution, and specific length in quantum systems

This unit could open up new avenues for research in quantum physics and nanotechnology, potentially leading to a deeper understanding of how mass, length, and electromagnetic properties interact at the quantum level. It may provide insights into the nature of one-dimensional quantum systems, the behavior of particles confined to lines, and the fundamental limits of linear quantum devices. The relationships between specific length, velocity, intensity, length density, curl, and charge distribution could be particularly useful in studying dynamic processes in quantum wires and in developing new models for one-dimensional quantum phenomena, especially those involving electromagnetic interactions.

Coupling and Interactional Behavioral

Dynamic units

Quantum Density Intensity Resistance `qdir`

QMU primitive representation: $\mathrm{qdir} = \dfrac{m_\mathrm{e}}{{\lambda_C}^3 {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qdir}\,\mathrm{qvod} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qdir = \frac{m_\mathrm{e}}{{\lambda_C}^3 \cdot {F_q}^3}$$

Physical interpretation:

Represents the resistance of a quantum volume to intense oscillations or changes

Quantifies the combined effect of mass density and quantum intensity resistance

Describes the interplay between mass concentration and resistance to high-frequency quantum processes

Significance:

Emerges from the product of mass density (*masd*) and quantum intensity resistance (*qire*) in the APM

Provides a measure of how resistant a dense quantum system is to intense quantum phenomena

Links concepts of mass distribution and resistance to high-frequency quantum activities

Potential applications:

Analyzing the behavior of dense quantum systems under intense quantum fluctuations

Characterizing the resistance to quantum processes in high-density materials

Studying the relationship between mass concentration and quantum intensity effects

Investigating quantum damping phenomena in condensed matter systems

Relationships to other units:

These relationships provide important insights:

The product of *masd* and *qire* shows how *qdir* combines mass density with quantum intensity resistance, emphasizing the role of both spatial mass distribution and resistance to high-frequency quantum phenomena.

The product of *mass* and *qvor* links *qdir* to the total mass and quantum volume oscillation resistance, highlighting the connection between the system's overall mass and its resistance to volumetric quantum oscillations.

Note: The *qdir* unit in the APM offers a unique perspective on the resistance of dense quantum systems to intense quantum processes. It provides a tool for analyzing how mass concentration affects the system's response to high-frequency quantum phenomena. This unit could be particularly useful in studying condensed matter systems, quantum materials under extreme conditions, and the behavior of dense quantum fluids. The relationships with mass density, quantum intensity resistance, and quantum volume oscillation resistance offer insights into how density intensity resistance is connected to both the spatial distribution of mass and the system's resistance to various forms of quantum oscillations, providing a more comprehensive understanding of the interplay between mass density and quantum intensity in complex quantum systems.

Mass-Resonance Coupling Ratio `mrcr`

QMU primitive representation:

$$\mathrm{mrcr} = \frac{m_\mathrm{e}}{{\lambda_C}^3 {F_q}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mrcr}\,\mathrm{qagm} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{mrcr} &= \frac{\text{masd}}{\text{rson}} \\ &= \text{masd} \cdot \text{orbt} \\ &= \frac{\text{mass} \cdot \text{time}^2}{\text{volm}} \\ &= \frac{1}{\text{qagm}}.\end{aligned}} \tag{237}$$

These relationships follow from the canonical QMU definitions

$$\text{masd} = \frac{m_\text{e}}{{\lambda_C}^3}, \qquad \text{rson} = {F_q}^2, \qquad \text{orbt} = {F_q}^{-2}.$$

Physical interpretation. Mass-Resonance Coupling Ratio (mrcr) connects volumetric mass distribution with the orbital and resonance dimensions of the Aether Physics Model (APM).

Where Mass Density (masd) describes mass per unit volume, mrcr incorporates the squared-time factor of QMU Orbit:

$$\text{mrcr} = \text{masd} \cdot \text{orbt}.$$

The reciprocal representation expresses the same relationship as mass density divided by resonance.

In QMU, Resonance is the frequency-squared quantity, not an ordinary resonant frequency. Likewise, Orbit is a time-squared quantity, rather than the period of a single revolution.

These relationships provide a dimensional framework for examining how distributed matter participates in cyclic and resonant interactions within Aether geometry.

Relationship to distributed charge. APM connects mass and distributed magnetic charge through the universal mass-to-charge ratio:

$$\text{mchg} = \frac{\text{mass}}{\text{chrg}}.$$

Consequently, mrcr can also be expressed as

$$\boxed{\text{mrcr} = \text{mchg} \cdot \frac{\text{chrg} \cdot \text{orbt}}{\text{volm}}.} \tag{238}$$

This expression connects volumetric mass density with distributed magnetic-charge geometry and the QMU orbital dimension.

The term *coupling* identifies the relationship among these dimensions. A specific physical coupling strength depends on the interaction geometry and governing dynamical equations.

Research significance. Mass-Resonance Coupling Ratio provides a dimensional reference for investigating the response of matter distributions to cyclic and resonant interactions.

Potential applications include particle structure, plasma oscillations, condensed matter systems, and the relationship between mass distribution and Aether chronovibration.

A useful research direction is to determine whether mrcr contributes to measurable relationships involving resonant stability, collective motion, or geometrical response in systems with distributed mass and charge.

Its reciprocal, Quantum Aether Geometric Mass (qagm), supplies the complementary QMU dimension.

The canonical identities establish the dimensional foundation, while specific physical predictions follow from the corresponding APM interaction equations.

Mass Frequency Distribution Ratio `mfrd`

QMU primitive representation:

$$\mathrm{mfrd} = \frac{m_\mathrm{e}}{{\lambda_C}^3 F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{mfrd}\,\mathrm{qavm} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{mfrd} &= \frac{\mathrm{masd}}{\mathrm{freq}} \\ &= \mathrm{masd}\cdot\mathrm{time} \\ &= \frac{\mathrm{mass}\cdot\mathrm{time}}{\mathrm{volm}} \\ &= \frac{1}{\mathrm{qavm}}.\end{aligned}} \tag{239}$$

Physical interpretation. Mass Frequency Distribution Ratio (mfrd) combines volumetric mass density with the fundamental QMU chronovibration period. Its inverse-frequency factor weights the reference mass distribution by time; it does not, by itself, describe a material dispersion law or the spectral distribution of matter.

For an application-specific density ρ_m and characteristic frequency f, the quantity ρ_m/f has the same dimensions as mfrd. Its physical value and frequency dependence must be determined for that system.

Research significance. The exact reciprocal relation with Quantum Aether Volumetric Flux Mobility (qavm) connects mass density per frequency to volume-frequency per mass. The pair

provides complementary dimensional descriptions for investigating time-dependent matter distributions, cyclic mass transport, and resonant geometrical response within APM. Specific transport or resonance behavior follows from the applicable interaction equations.

Surface Charge Intensity Ratio `scir`

QMU primitive representation:

$$\mathrm{scir} = \frac{m_\mathrm{e}}{{\lambda_C}^2 {F_q}^3}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{scir}\,\mathrm{qasm} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{scir} &= \frac{\mathrm{mass}\cdot\mathrm{time}^3}{\mathrm{area}} \\ &= \frac{\mathrm{mass}}{\mathrm{area}\cdot\mathrm{freq}^3} \\ &= \mathrm{scoc}\cdot\mathrm{time} \\ &= \mathrm{mchg}\cdot\frac{\mathrm{chrg}\cdot\mathrm{time}^3}{\mathrm{area}} \\ &= \frac{1}{\mathrm{qasm}}.\end{aligned}} \tag{240}$$

These identities connect surface mass distribution, distributed magnetic charge, and third-order temporal structure.

Physical interpretation. Surface Charge Intensity Ratio (scir) describes the QMU relationship between surface mass density and cubic temporal extent within the Aether Physics Model (APM).

Because mass and distributed magnetic charge are related through the universal mass-to-charge ratio,

$$\mathrm{mchg} = \frac{\mathrm{mass}}{\mathrm{chrg}},$$

the unit can also be expressed as

$$\mathrm{scir} = \mathrm{mchg}\frac{\mathrm{chrg}}{\mathrm{area}}\cdot\mathrm{time}^3.$$

This identifies the connection between distributed surface charge and the associated mass geometry.

The three temporal factors extend the surface-charge dimensional structure beyond the Temporal Factor (sctf) and Orbital Coefficient (scoc).

The designation *Intensity Ratio* reflects its position in the QMU dimensional system. The primitive expression does not, by itself, specify energy-transfer intensity, resistance, or a particular oscillation mechanism.

Temporal relationships. The related QMU quantities form a consistent dimensional progression:

$$\begin{aligned} \mathrm{sctf} &= \frac{\mathrm{mass} \cdot \mathrm{time}}{\mathrm{area}}, \\ \mathrm{scoc} &= \mathrm{sctf} \cdot \mathrm{time}, \\ \mathrm{scir} &= \mathrm{scoc} \cdot \mathrm{time}. \end{aligned} \tag{241}$$

This sequence connects the same surface mass distribution with successive temporal dimensions.

Within APM, these relationships provide a framework for investigating the temporal organization of charge distributed across particle surfaces.

Research significance. Surface Charge Intensity Ratio provides a dimensional reference for studying surface-charge organization, temporal response, and electromagnetic interactions in extended geometrical structures.

Potential applications include particle surface dynamics, interfacial electromagnetic response, and cyclic interactions involving distributed charge.

A useful research direction is to determine whether third-order temporal relationships contribute to measurable surface-field behavior or reveal simplifications in QMU descriptions of electromagnetic transport.

Its reciprocal, Quantum Aether Surface Mass (qasm), supplies the complementary QMU dimension.

The canonical identities establish the dimensional foundation, while specific physical behavior follows from the corresponding APM interaction geometry and dynamical equations.

Surface Charge Orbital Coefficient `scoc`

QMU primitive representation:

$$\mathrm{scoc} = \frac{m_\mathrm{e}}{{\lambda_C}^2 \, {F_q}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{scoc}\,\mathrm{qatm} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{scoc} &= \frac{\text{mass}}{\text{area}\cdot\text{rson}}\\ &= \frac{\text{mass}\cdot\text{orbt}}{\text{area}}\\ &= \text{sctf}\cdot\text{time}\\ &= \text{mchg}\cdot\frac{\text{chrg}\cdot\text{orbt}}{\text{area}}\\ &= \frac{1}{\text{qatm}}.\end{aligned}} \tag{242}$$

These identities use the canonical relationships

$$\text{rson} = {F_q}^2, \qquad \text{orbt} = {F_q}^{-2}, \qquad \text{mchg} = \frac{\text{mass}}{\text{chrg}}.$$

Physical interpretation. Surface Charge Orbital Coefficient (scoc) connects the mass associated with a distributed surface charge to the orbital dimension of Aether chronogeometry.

The primitive expression combines surface mass density with the QMU Orbit quantity:

$$\text{scoc} = \frac{\text{mass}}{\text{area}}\cdot\text{orbt}.$$

In QMU, Orbit has the dimension of time squared, while its reciprocal, Resonance (rson), has the dimension of frequency squared. These quantities must be distinguished from an ordinary orbital period or oscillation frequency.

Within the Aether Physics Model (APM), mass and distributed magnetic charge are connected by the universal mass-to-charge ratio. Consequently, scoc provides a dimensional link between surface charge geometry and cyclic temporal structure.

This relationship is relevant to the extended charge surfaces of particles, including their toroidal and near-spherical configurations.

Temporal relationships. Surface Charge Orbital Coefficient extends the temporal structure of Surface Charge Temporal Factor (sctf):

$$\boxed{\text{scoc} = \text{sctf}\cdot\text{time}.} \tag{243}$$

Together, the related QMU quantities form a progression:

$$\begin{aligned}\frac{\text{mass}}{\text{area}} &\quad \text{Surface mass density},\\ \text{sctf} &= \frac{\text{mass}\cdot\text{time}}{\text{area}},\\ \text{scoc} &= \frac{\text{mass}\cdot\text{orbt}}{\text{area}}.\end{aligned}$$

This progression connects spatial charge organization with successive temporal dimensions without assuming that the dimensional factors independently determine orbital motion.

Research significance. Surface Charge Orbital Coefficient provides a dimensional framework for investigating cyclic interactions involving distributed charge on particle surfaces and other extended geometries.

Potential applications include particle orbital structure, magnetic interactions, resonant surface response, and the stability of geometrically organized charge distributions.

A useful research direction is to determine how this coefficient enters the physical equations governing surface-charge circulation and whether it simplifies calculations involving particle geometry and orbital response.

Its reciprocal, Quantum Aether Temporal Mass (qatm), supplies the complementary QMU dimension.

The canonical relationships establish the dimensional foundation, while specific orbital and electromagnetic behavior follows from the corresponding APM interaction geometry.

Surface Charge Temporal Factor `sctf`

QMU primitive representation:

$$\mathrm{sctf} = \frac{m_\mathrm{e}}{{\lambda_C}^2 \, F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{sctf}\,\mathrm{qaam} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned} \mathrm{sctf} &= \frac{\mathrm{mass}\cdot\mathrm{time}}{\mathrm{area}} \\ &= \frac{\mathrm{mass}}{\mathrm{area}\cdot\mathrm{freq}} \\ &= \frac{\mathrm{mchg}\cdot\mathrm{chrg}\cdot\mathrm{time}}{\mathrm{area}} \\ &= \frac{1}{\mathrm{qaam}}. \end{aligned}} \tag{244}$$

These identities connect surface mass distribution, distributed magnetic charge, and the fundamental QMU temporal scale.

Physical interpretation. Surface Charge Temporal Factor (sctf) describes the temporal dimension associated with mass distributed across a surface.

Within the Aether Physics Model (APM), mass and distributed magnetic charge are related through the universal mass-to-charge ratio:

$$\mathrm{mchg} = \frac{\mathrm{mass}}{\mathrm{chrg}}.$$

Consequently,

$$\boxed{\mathrm{sctf} = \mathrm{mchg}\frac{\mathrm{chrg}}{\mathrm{area}} \cdot \mathrm{time}.} \tag{245}$$

This expression connects the temporal organization of surface charge with its associated mass distribution.

In APM, particle charge occupies extended geometrical structures rather than dimensionless points. The sctf unit therefore provides a dimensional reference for examining how charged surfaces participate in time-dependent interactions.

The temporal factor represents the QMU chronovibration period; it does not independently establish charge transport, surface relaxation, or oscillation.

Research significance. Surface Charge Temporal Factor provides a useful connection between surface mass density, distributed magnetic charge, and temporal geometry.

Potential applications include particle surface dynamics, charge redistribution across material interfaces, and the time-dependent response of extended electromagnetic structures.

Within APM, the unit may help investigate how the geometry of distributed surface charge influences temporal response, magnetic interactions, and particle stability.

Its reciprocal, Quantum Aether Area Mass (qaam), supplies the complementary QMU dimension.

The canonical relationships establish the dimensional foundation for these investigations, while physical response depends on the corresponding interaction geometry and dynamics.

Length Density Quantum Ratio `ldqr`

QMU primitive representation:

$$\mathrm{ldqr} = \frac{m_\mathrm{e}}{\lambda_C \, {F_q}^3}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ldqr}\,\mathrm{qadi} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\text{ldqr} &= \frac{\text{ldns}}{\text{freq}^3} \\ &= \text{ldns} \cdot \text{time}^3 \\ &= \text{ldoc} \cdot \text{time} \\ &= \frac{\text{mass} \cdot \text{time}^3}{\text{leng}} \\ &= \frac{1}{\text{qadi}}.\end{aligned}} \tag{246}$$

These relationships extend Length Density through three temporal factors, connecting the spatial distribution of mass with the third-order temporal dimension.

Physical interpretation. Length Density Quantum Ratio (ldqr) describes the QMU dimensional relationship between linear mass density and cubic temporal extent within the Aether Physics Model (APM).

Where Length Density (ldns) represents mass per unit length, ldqr introduces three inverse-frequency factors:

$$\text{ldqr} = \text{ldns} \cdot \text{time}^3.$$

This construction connects the spatial concentration of mass with higher-order temporal behavior associated with Aether chronogeometry.

The designation *Quantum Ratio* identifies its position within the QMU dimensional system. Its inverse cubic frequency dimension does not, by itself, establish resistance to oscillation or a particular high-frequency response.

Those properties depend on the physical geometry and interaction equations.

Temporal relationships. Length Density participates in a progressive sequence of QMU quantities:

$$\begin{aligned}\text{ldns} &= \frac{\text{mass}}{\text{leng}}, \\ \text{ldtf} &= \text{ldns} \cdot \text{time}, \\ \text{ldoc} &= \text{ldns} \cdot \text{time}^2, \\ \text{ldqr} &= \text{ldns} \cdot \text{time}^3.\end{aligned}$$

The sequence illustrates how a single spatial mass distribution can be represented through successive temporal dimensions.

Within APM, this provides a useful framework for investigating the relationship between matter geometry, chronovibration, and higher-order temporal interactions.

Research significance. Length Density Quantum Ratio provides a dimensional foundation for examining linear or filamentary mass structures subject to time-dependent interactions.

Potential applications include quantum transport, cyclic matter configurations, higher-order temporal response, and the interaction of mass distributions with Aether geometry.

A particularly useful research direction is to investigate whether the third-order temporal factor corresponds to measurable relationships involving matter stability, resonance, or geometrical response.

Its reciprocal, Quantum Aether Density Interaction (qadi), supplies the complementary QMU dimension.

The canonical identities establish the dimensional structure, while specific physical predictions require the corresponding APM interaction equations.

Length Density Orbital Coefficient `ldoc`

QMU primitive representation:

$$\mathrm{ldoc} = \frac{m_\mathrm{e}}{\lambda_C \, {F_q}^2}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ldoc}\,\mathrm{qadm} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{ldoc} &= \frac{\mathrm{ldns}}{\mathrm{rson}} \\ &= \mathrm{ldns} \cdot \mathrm{orbt} \\ &= \frac{\mathrm{mass} \cdot \mathrm{time}^2}{\mathrm{leng}} \\ &= \frac{1}{\mathrm{qadm}}.\end{aligned}} \tag{247}$$

These identities follow from

$$\mathrm{ldns} = \frac{m_\mathrm{e}}{\lambda_C}, \qquad \mathrm{rson} = {F_q}^2, \qquad \mathrm{orbt} = {F_q}^{-2}.$$

Physical interpretation. Length Density Orbital Coefficient (ldoc) connects linear mass distribution with the orbital dimension of Aether chronogeometry.

Where Length Density (ldns) expresses mass per unit length, ldoc incorporates an additional squared-time factor through the QMU Orbit quantity:

$$\text{ldoc} = \text{ldns} \cdot \text{orbt}.$$

In QMU, Orbit is a time-squared quantity, not simply the period of a conventional orbital revolution. Its reciprocal, Resonance (rson), has the dimension of frequency squared.

The ldoc unit therefore relates the spatial concentration of mass to the temporal structure associated with orbital and resonant phenomena.

This relationship provides a dimensional foundation for examining how distributed matter participates in cyclic geometrical interactions.

Relationship to geometrical response. Length Density enters the APM Circular Deflection Angle through the source mass-to-radius ratio.

The ldoc unit extends this relationship by the QMU orbital factor, making it relevant to investigations of matter distributions undergoing orbital or cyclic interactions.

For a source mass M and characteristic radius r, the corresponding physical construction may be expressed as

$$\text{ldoc}_M = \frac{M}{r}\,\tau_{\text{orb}}^2,$$

where τ_{orb} denotes the specified orbital time scale.

This construction illustrates how the canonical QMU dimension can be applied to a physical system without identifying the fundamental QMU Orbit unit with an arbitrary orbital period.

Research significance. Length Density Orbital Coefficient provides a connection among linear mass distribution, orbital geometry, and resonance within QMU.

Potential applications include particle orbital structures, filamentary matter configurations, cyclic mass distributions, and the geometrical response of matter under orbital motion.

A useful research direction is to investigate whether the combination of Length Density and Orbit provides simpler relationships for calculating cyclic matter–Aether interactions, particularly where mass distribution and geometrical deflection are coupled.

The canonical identities establish the dimensional structure, while specific physical behavior follows from the applicable orbital geometry and interaction equations.

Length Density Temporal Factor `ldtf`

QMU primitive representation:

$$\text{ldtf} = \frac{m_{\text{e}}}{\lambda_C\, F_q}.$$

Family grid Dependency index

Catalog reciprocal:

$$\mathrm{ldtf}\,\mathrm{qamo} = 1.$$

Primitive relationships. The QMU dimensional ledger establishes

$$\boxed{\begin{aligned}\mathrm{ldtf} &= \frac{\mathrm{ldns}}{\mathrm{freq}} \\ &= \mathrm{ldns} \cdot \mathrm{time} \\ &= \frac{\mathrm{mass} \cdot \mathrm{time}}{\mathrm{leng}} \\ &= \frac{1}{\mathrm{qamo}}.\end{aligned}} \tag{248}$$

These relationships express the temporal scaling of linear mass density through the fundamental QMU chronovibration period.

Physical interpretation. Length Density Temporal Factor (ldtf) connects mass distributed along a characteristic length with temporal extent in the Aether Physics Model (APM).

Where Length Density (ldns) describes mass per unit length, ldtf incorporates an additional time dimension:

$$\mathrm{ldtf} = \mathrm{ldns} \cdot \mathrm{time}.$$

This provides a dimensional reference for examining the persistence and time-dependent organization of linear mass structures.

The temporal factor does not, by itself, imply that the mass distribution is changing. Such evolution depends on the physical interactions governing the system.

Relationship to geometrical response. Length Density plays an important role in the APM Circular Deflection Angle, where a source's mass-to-radius ratio enters the geometrical deflection relationship.

The ldtf unit extends this dimension by one temporal factor, providing a possible reference for investigating time-dependent matter distributions and their associated geometrical response.

For a source of mass M and characteristic radius r, the analogous source-dependent quantity is

$$\mathrm{ldtf}_M(r,t) = \frac{M(t)}{r(t)}\,\tau,$$

where τ is the specified observation or interaction interval.

This expression connects source Length Density with a physical time interval without changing the canonical QMU unit.

Research significance. Length Density Temporal Factor provides a dimensional framework for studying the temporal behavior of filamentary, linear, and radially distributed matter.

Potential applications include evolving particle structures, mass transport, time-dependent astronomical sources, and changes in the geometrical response associated with matter distribution.

Within APM, an especially useful research direction is to examine whether temporal changes in source Length Density produce measurable variations in photon deflection or other geometrical interactions.

The QMU identity establishes the dimensional relationship, while specific predictions require the corresponding matter–Aether interaction equations.

Quantum Mass Intensity Resistance `qmir`

QMU primitive representation: $\mathrm{qmir} = \dfrac{m_\mathrm{e}}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmir}\,\mathrm{sqif} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmir = \frac{m_\mathrm{e}}{{F_q}^3}$$

Physical interpretation:

Represents the product of mass and quantum intensity resistance

Quantifies the resistance of a given mass to high-frequency quantum processes

Describes how a mass interacts with or impedes intense quantum fluctuations in the Aether

Significance:

Emerges from the APM's concept of mass interaction with high-frequency quantum phenomena

Provides a measure of how matter resists or responds to intense quantum activities

Potential applications:

Analyzing the behavior of particles or objects in high-energy quantum environments

Characterizing materials based on their resistance to intense quantum fluctuations

Studying quantum systems where both mass and high-frequency processes play crucial roles

Investigating the relationship between matter and intense quantum field interactions in the Aether

This unit could be particularly relevant in fields such as particle physics, quantum optics, and in studying the behavior of matter in extreme quantum conditions where high-frequency processes dominate.

Quantum Mass Orbital Period `qmop`

QMU primitive representation: $\mathrm{qmop} = \dfrac{m_\mathrm{e}}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmop}\,\mathrm{sqre} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmop = \frac{m_\mathrm{e}}{{F_q}^2}$$

Physical interpretation:

Represents the product of mass and orbital time in quantum systems

Quantifies the relationship between an object's mass and its quantum orbital period

Describes how mass influences or is influenced by cyclic quantum processes in the Aether

Significance:

Emerges from the APM's concept of mass interaction with quantum orbital phenomena

Provides a measure of how matter relates to quantum periodicity and cyclic behavior

Potential applications:

Analyzing the orbital characteristics of particles or objects in quantum systems

Characterizing the relationship between mass and orbital periods in atomic or molecular systems

Studying quantum systems where both mass and cyclic processes are significant

Investigating the connection between matter and quantum resonance phenomena in the Aether

This unit could be particularly relevant in fields such as atomic physics, quantum chemistry, and in studying the behavior of matter in systems with well-defined quantum periodicities. It might offer insights into the relationship between mass and quantum orbital dynamics, potentially informing our understanding of atomic structures, molecular vibrations, and other cyclic quantum phenomena.

Quantum Mass Temporal Coefficient `qmtc`

QMU primitive representation: $\mathrm{qmtc} = \dfrac{m_\mathrm{e}}{F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qmtc}\,\mathrm{sqfr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qmtc = \frac{m_\mathrm{e}}{F_q}$$

Physical interpretation:

Represents the product of mass and time, or the ratio of mass to frequency in quantum systems

Quantifies the relationship between an object's mass and its temporal evolution or frequency response

Describes how mass interacts with or influences temporal processes in the Aether

Significance:

Emerges from the APM's concept of mass interaction with quantum temporal phenomena

Provides a measure of how matter behaves over time or responds to different frequencies in quantum systems

Potential applications:

Analyzing the temporal behavior of massive particles in quantum environments

Characterizing the frequency response of materials or objects in quantum systems

Studying quantum systems where both mass and time-dependent processes are crucial

Investigating the relationship between matter and quantum temporal evolution in the Aether

This unit could be particularly relevant in fields such as quantum dynamics, matter wave physics, and in studying the behavior of massive particles in time-dependent quantum systems. It might offer insights into the connection between mass and quantum temporal phenomena, potentially informing our understanding of particle decay processes, quantum coherence times, and the interaction of matter with time-varying quantum fields.

Substrate units

Quantum Volume Oscillation Density `qvod`

QMU primitive representation: $\mathrm{qvod} = \dfrac{{\lambda_C}^3 {F_q}^3}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qvod}\,\mathrm{qdir} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvod = \frac{{\lambda_C}^3 \cdot {F_q}^3}{m_\mathrm{e}}$$

Physical interpretation:

Represents the density of quantum volume oscillations per unit mass

Quantifies the relationship between gravitational effects, frequency, mass, specific volume, and quantum intensity in systems

Describes the intensity of spatial-temporal fluctuations in the Aether relative to mass and volume

Significance:

Emerges from the APM's concept of quantum oscillations, gravity, mass interactions, and specific volume

Provides a measure of how gravitational effects, frequency, and quantum intensity relate to mass and volume in quantum systems

Potential applications:

Analyzing the interplay between gravity, frequency, mass, volume, and quantum intensity in volumetric phenomena

Characterizing materials or systems based on their quantum oscillation properties relative to mass and specific volume

Studying quantum systems where gravitational effects, frequency, mass, volume, and quantum intensity all play significant roles

Investigating the relationship between spatial-temporal fluctuations, mass distribution, and volumetric properties in the Aether

This unit could be particularly relevant in fields such as quantum gravity, cosmology, and in studying the behavior of matter in highly dynamic quantum environments. It might offer insights into the connection between gravity, quantum oscillations, mass, volume, and quantum intensity, potentially informing our understanding of quantum fluctuations in gravitational fields, mass-energy-volume relationships in quantum systems, and the nature of space-time at quantum scales.

Quantum Aether Gravitational Mobility `qagm`

QMU primitive representation: $\mathrm{qagm} = \dfrac{{\lambda_C}^3 {F_q}^2}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qagm}\,\mathrm{mrcr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qagm = \frac{{\lambda_C}^3 \cdot {F_q}^2}{m_\mathrm{e}}$$

Physical interpretation:

Represents the gravitational mobility or responsiveness of a quantum system in the Aether relative to its mass

Quantifies the capacity of a quantum entity to interact gravitationally within the Aether structure

Represents the tendency of space resonance to be filled with mass

Describes the relationship between specific volume, resonance, and mass in gravitational phenomena

Significance:

Emerges from the APM's concept of gravity as a property of space rather than a force between masses

Provides a measure of how "gravitationally mobile" or "gravitationally responsive" a quantum system is within the Aether framework

Combines aspects of volume, frequency squared, and mass, linking volumetric, resonant, and inertial concepts in the Aether

Potential applications:

Analyzing gravitational effects at the quantum scale

Characterizing the gravitational properties of different regions of space in the Aether

Studying the relationship between specific volume, resonance, and mass in gravitational phenomena

Describing the "quantum Aether gravitational responsiveness" of various particles or materials

Relationships to other units:

$\frac{grav}{3.587 \times 10^{45}} = G = \text{Gforce}\frac{{\lambda_C}^2}{{m_a}^2}$: The relationship with Gforce, λ_C, and m_a is retained as a historical proposed bridge. The numerical coefficient 3.587×10^{45} is not defined here as an exact dimensionless constant; its dimensional normalization and derivation must be established before equating the QMU quantity *grav* numerically with the SI gravitational constant G. Gforce denotes geometrical force.

$grav = spcv \cdot rson$: The product of *spcv* and *rson* relates *grav* to specific volume and resonance, suggesting a connection between gravity and volumetric quantum oscillations.

$grav = \frac{temp}{ldns}$: The ratio of *temp* to *ldns* connects *grav* to temperature and length density, indicating a relationship between gravitational properties, thermal energy, and spatial distribution of mass.

$qagm = qavm \cdot freq$: Connects gravitational mobility to volumetric flux mobility and frequency

Note: The *grav* unit in the APM offers a unique perspective on gravity, viewing it as a property of space rather than a force between masses. This approach aligns with the APM's concept of space density gradients instead of the traditional view of spacetime curvature. The grav unit provides a tool for analyzing gravitational phenomena in terms of space's capacity to accommodate mass, potentially offering new insights into the nature of gravity at quantum scales and its relationship to other quantum properties of space. The relationships with specific volume, resonance, temperature, and length density suggest complex interactions between gravity and other physical properties in the APM framework.

Quantum Aether Volumetric Flux Mobility `qavm`

QMU primitive representation: $\text{qavm} = \dfrac{{\lambda_C}^3 \, F_q}{m_\text{e}}$.

Family grid Dependency index

Catalog reciprocal: $\text{qavm}\,\text{mfrd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qavm = \frac{{\lambda_C}^3 \cdot F_q}{m_\mathrm{e}}$$

Physical interpretation:

Represents the volumetric flux mobility of a quantum system in the Aether relative to its mass

Quantifies the responsiveness of a quantum system to volumetric changes or flow in the Aether per unit mass

Describes the capacity of a quantum entity to engage in or respond to volumetric flux within the Aether structure

Significance:

Emerges from the APM's concept of relating volumetric quantum flow in the Aether to mass

Provides a measure of how "flux-mobile" or "volumetrically responsive" a quantum system is within the Aether framework

Combines aspects of volume (λC^3), frequency (Fq), and mass (me), linking volumetric, temporal, and inertial concepts in the Aether

Potential applications:

Analyzing quantum fluid dynamics and their dependence on mass

Characterizing the volumetric behavior of quantum systems in the Aether

Studying the relationship between mass and quantum volumetric flux

Describing the "quantum Aether volumetric responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems engage in or respond to volumetric flux within the Aether structure, relative to their mass. By expressing flow per unit mass, *qavm* allows for the quantification of volumetric quantum phenomena that involve spatial, temporal, and inertial aspects within the Aether framework.

The *qavm* unit could be particularly relevant in contexts such as:

Quantum turbulence, explaining mass-dependent vortex dynamics in superfluids

Quantum phase transitions, describing volume changes in quantum critical phenomena

Quantum vacuum fluctuations, characterizing the volumetric flux of virtual particles

Quantum cosmology, studying the expansion of space at the quantum scale

This unit bridges concepts from quantum fluid dynamics, volumetric quantum mechanics, and the Aether Physics Model. It could provide a novel way to understand and quantify how mass influences a system's volumetric quantum behavior in the Aether, potentially leading to new predictions or explanations for observed quantum flux phenomena.

The *qavm* unit might offer insights into the fundamental nature of quantum space, its dynamic properties, and how these relate to the mass of systems within the context of the Aether structure. This could be particularly valuable in developing new theories about the nature of space itself, the behavior of quantum fields in expanding or contracting volumes, and the interaction between matter and the quantum vacuum.

Quantum Aether Surface Oscillation Mobility `qasm`

QMU primitive representation: $\mathrm{qasm} = \dfrac{{\lambda_C}^2 {F_q}^3}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qasm}\,\mathrm{scir} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qasm = \frac{{\lambda_C}^2 \cdot {F_q}^3}{m_\mathrm{e}}$$

Physical interpretation:

Represents the surface oscillation mobility of a quantum system in the Aether relative to its mass

Quantifies the responsiveness of a quantum system's surface to high-frequency oscillations in the Aether per unit mass

Describes the capacity of a quantum entity's surface to engage in intense oscillatory behavior within the Aether structure

Significance:

Emerges from the APM's concept of relating surface quantum oscillations in the Aether to mass

Provides a measure of how "surface-oscillation mobile" or "surface-dynamically responsive" a quantum system is within the Aether framework

Combines aspects of area (λC^2), frequency cubed (Fq^3), and mass (me), linking surface, high-frequency oscillation, and inertial concepts in the Aether

Potential applications:

Analyzing surface quantum effects and their dependence on mass

Characterizing the surface dynamics of quantum systems in the Aether

Studying the relationship between mass and surface quantum oscillations

Describing the "quantum Aether surface oscillation responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems' surfaces engage in high-frequency oscillations within the Aether structure, relative to their mass. By expressing Quantum Surface Oscillation ($qfso$) per unit mass, $qasm$ allows for the quantification of surface quantum phenomena that involve spatial, high-frequency temporal, and inertial aspects within the Aether framework.

The $qasm$ unit could be particularly relevant in contexts such as:

Surface plasmonics, explaining mass-dependent surface oscillations in nanoparticles

Quantum surface science, describing surface state dynamics in topological materials

Quantum catalysis, characterizing the activity of catalyst surfaces at the quantum level

Quantum sensing, optimizing surface-based quantum sensors

This unit bridges concepts from surface quantum mechanics, high-frequency dynamics, and the Aether Physics Model. It could provide a novel way to understand and quantify how mass influences a system's surface quantum behavior in the Aether, potentially leading to new predictions or explanations for observed surface quantum phenomena.

The *qasm* unit might offer insights into the fundamental nature of surface quantum states, their oscillatory behavior, and how this relates to the mass of the system within the context of the Aether structure. This could be particularly valuable in developing new quantum technologies that rely on surface effects, such as quantum dot displays, advanced catalysts, or quantum computing architectures based on surface states.

Quantum Aether Thermal Mobility `qatm`

QMU primitive representation: $\mathrm{qatm} = \dfrac{{\lambda_C}^2 {F_q}^2}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qatm}\,\mathrm{scoc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qatm = \frac{{\lambda_C}^2 \cdot {F_q}^2}{m_\mathrm{e}}$$

Physical interpretation:

Represents the thermal mobility or heat capacity of a quantum system in the Aether relative to its mass

Quantifies the thermal responsiveness of a quantum system in the Aether per unit mass

Describes the capacity of a quantum entity to accommodate or transmit thermal energy within the Aether structure

Significance:

Emerges from the APM's concept of relating thermal behavior in the Aether to mass

Provides a measure of how "thermally mobile" or "heat responsive" a quantum system is within the Aether framework

Combines aspects of area (λC^2), frequency squared (Fq^2), and mass (me), linking spatial, thermal, and inertial concepts in the Aether

Potential applications:

Analyzing heat transfer and thermal behavior at the quantum scale

Characterizing the thermal properties of quantum systems in the Aether

Studying the relationship between mass and temperature in quantum thermodynamics

Describing the "quantum Aether thermal responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems respond to and handle thermal

energy within the Aether structure. By expressing temperature (temp) per unit mass, *qatm* allows for the quantification of thermal quantum phenomena that involve spatial, energetic, and inertial aspects within the Aether framework.

The *qatm* unit could be particularly relevant in contexts such as:

Quantum thermodynamics, explaining heat capacity and thermal behavior in terms of Aether thermal mobility

Nanoscale heat transfer, describing thermal conductivity in quantum-confined systems

Quantum phase transitions, characterizing temperature-driven quantum critical phenomena

Quantum sensing, optimizing thermometry at the quantum scale

This unit bridges concepts from quantum mechanics, classical thermodynamics, and the Aether Physics Model. It could provide a novel way to understand and quantify how mass influences a system's thermal behavior in the quantum realm, potentially leading to new predictions or explanations for observed quantum thermal phenomena. The *qatm* unit might offer insights into the fundamental nature of temperature, heat, and thermal energy at the quantum scale within the context of the Aether structure.

Moreover, this unit could be crucial in developing a more comprehensive understanding of the interplay between mass, temperature, and quantum behavior, potentially leading to advancements in fields such as quantum computing (where temperature control is critical) and the study of exotic quantum states of matter.

Quantum Aether Angular Mobility `qaam`

QMU primitive representation: $\mathrm{qaam} = \dfrac{{\lambda_C}^2\, F_q}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qaam}\,\mathrm{sctf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qaam = \frac{{\lambda_C}^2 \cdot F_q}{m_\mathrm{e}}$$

Physical interpretation:

Represents the angular mobility of a quantum system through the Aether relative to its mass

Quantifies the rotational or sweeping responsiveness of a quantum system in the Aether per unit mass

Describes the capacity of a quantum entity to undergo angular changes or rotations within the Aether structure

Significance:

Emerges from the APM's concept of relating angular motion through the Aether to mass

Provides a measure of how ”rotationally mobile” or ”angularly responsive” a quantum system is within the Aether framework

Combines aspects of area, frequency, and mass, linking spatial, temporal, and inertial concepts in the context of angular motion

Potential applications:

Analyzing spin dynamics and angular momentum changes in quantum particles

Characterizing the rotational behavior of quantum systems in the Aether

Studying the relationship between mass and angular velocity in quantum systems

Describing the ”quantum Aether angular responsiveness” of various particles or materials

This unit offers a unique perspective on how quantum systems respond to angular changes or engage in rotational motion within the Aether structure. By expressing sweep (*swep*) per unit mass, *qaam* allows for the quantification of angular quantum mobility phenomena that involve spatial, temporal, and inertial aspects within the Aether framework.

The *qaam* unit could be particularly relevant in contexts such as:

Quantum spin systems, explaining spin dynamics in terms of Aether angular mobility

Particle physics, describing the intrinsic angular momentum properties of particles in the Aether

Quantum optics, characterizing the polarization states of photons and their interactions

Quantum computing, optimizing qubit designs that rely on spin or angular momentum states

This unit bridges concepts from quantum angular momentum, classical rotational dynamics, and the Aether Physics Model. It could provide a novel way to understand and quantify how mass influences a system's ability to undergo angular changes in the quantum realm, potentially leading to new predictions or explanations for observed quantum rotational phenomena. The *qaam* unit might offer insights into the fundamental nature of spin, angular momentum, and rotational behavior at the quantum scale within the context of the Aether structure.

Quantum Aether Dynamic Intensity `qadi`

QMU primitive representation: $\mathrm{qadi} = \dfrac{\lambda_C \, {F_q}^3}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qadi}\,\mathrm{ldqr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qadi = \frac{\lambda_C \cdot {F_q}^3}{m_\mathrm{e}}$$

Physical interpretation:

Represents the resonant mobility of a quantum system through the Aether relative to its mass

Quantifies the responsiveness of a quantum system to resonant Aether interactions per unit mass

Describes the propensity of a quantum entity to engage in resonant oscillations within the Aether structure

Significance:

Emerges from the APM's concept of relating resonant motion through the Aether to mass

Provides a measure of how "resonantly mobile" or "coherently responsive" a quantum system is within the Aether framework

Combines aspects of length, frequency cubed, and mass, linking spatial, high-frequency temporal, and inertial concepts in the Aether

Potential applications:

Analyzing resonant quantum effects and their propagation through materials

Characterizing the coherent quantum behavior of particles in the Aether

Studying the relationship between mass and resonant quantum state evolution in the Aether

Describing the "quantum Aether resonant responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems engage in resonant interactions with and move coherently through the Aether structure. By combining the Quantum Aether Mobility (*qamo*) with resonance (*rson*), *qadi* allows for the quantification of resonant quantum mobility phenomena that involve spatial, high-frequency temporal, and inertial aspects within the Aether framework.

The qarm unit could be particularly relevant in contexts such as:

Quantum coherence phenomena, explaining sustained quantum states in terms of Aether resonant mobility

Particle physics, describing resonant interactions of particles with the Aether

Quantum optics, characterizing the resonant propagation of photons through the Aether

Quantum computing, optimizing qubit designs for sustained coherent oscillations

This unit bridges concepts from quantum mechanics, resonance phenomena, and the Aether Physics Model, potentially offering new insights into the nature of coherent motion and resonant interactions at the quantum scale. It could provide a novel way to understand and quantify how mass influences a system's ability to maintain resonant behavior in the quantum realm, potentially leading to new predictions or explanations for observed quantum coherence phenomena.

Quantum Aether Dynamic Mobility `qadm`

QMU primitive representation: $\mathrm{qadm} = \dfrac{\lambda_C \, {F_q}^2}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qadm}\,\mathrm{ldoc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qadm = \frac{\lambda_C \cdot {F_q}^2}{m_\mathrm{e}}$$

Physical interpretation:

Represents the dynamic mobility of a quantum system through the Aether relative to its mass

Quantifies the responsiveness of a quantum system to frequency changes or accelerations in the Aether per unit mass

Describes the capacity of a quantum entity to undergo rapid changes in its state or motion within the Aether structure

Significance:

Emerges from the APM's concept of relating dynamic motion through the Aether to mass

Provides a measure of how "dynamically mobile" or "acceleratively responsive" a quantum system is within the Aether framework

Combines aspects of length, frequency squared, and mass, linking spatial, temporal dynamics, and inertial concepts in the Aether

Potential applications:

Analyzing rapid quantum state transitions and their propagation through materials

Characterizing the dynamic quantum behavior of particles in the Aether

Studying the relationship between mass and acceleration in quantum systems within the Aether

Describing the "quantum Aether dynamic responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems respond to rapid changes or accelerations within the Aether structure. By combining the Quantum Aether Mobility ($qamo$) with frequency ($freq$), or expressing it as acceleration per mass, $qadm$ allows for the quantification of dynamic quantum mobility phenomena that involve spatial, temporal, and inertial aspects within the Aether framework.

The $qadm$ unit could be particularly relevant in contexts such as:

Quantum state transitions, explaining rapid state changes in terms of Aether dynamic mobility

Particle physics, describing the behavior of particles under high-energy conditions in the Aether

Quantum field theories, characterizing the rapid propagation of field disturbances

Quantum computing, optimizing qubit designs for fast operations and readouts

This unit bridges concepts from quantum mechanics, classical dynamics, and the Aether Physics Model, potentially offering new insights into the nature of rapid motion and acceleration at the quantum scale. It could provide a novel way to understand and quantify how mass influences a system's ability to undergo rapid changes in the quantum realm, potentially leading to new predictions or explanations for observed quantum dynamics phenomena.

Quantum Aether Mobility `qamo`

QMU primitive representation: $\mathrm{qamo} = \dfrac{\lambda_C\, F_q}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qamo}\,\mathrm{ldtf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qamo = \frac{\lambda_C \cdot F_q}{m_\mathrm{e}}$$

Physical interpretation:

Represents the quantum mobility of a system through the Aether relative to its mass

Quantifies the responsiveness of a quantum system to Aether interactions per unit mass

Describes the ease with which a quantum entity can change its state or position in the Aether structure

Significance:

Emerges from the APM's concept of relating motion through the Aether to mass

Provides a measure of how "mobile" or "responsive" a quantum system is within the Aether framework

Potential applications:

Analyzing the propagation of quantum effects through materials

Characterizing the quantum behavior of particles in the Aether

Studying the relationship between mass and quantum state evolution in the Aether

Describing the "quantum Aether responsiveness" of various particles or materials

This unit offers a unique perspective on how quantum systems interact with and move through the Aether structure. By combining the Compton wavelength with quantum frequency and inversely with electron mass, *qamo* allows for the quantification of quantum mobility phenomena that involve spatial, temporal, and inertial aspects within the Aether framework.

The *qamo* unit could be particularly relevant in contexts such as:

Quantum tunneling, potentially explaining tunneling rates in terms of Aether mobility

Particle physics, describing how different particles interact with the Aether

Quantum field theories, characterizing the propagation of field disturbances

Quantum computing, optimizing qubit designs for faster state transitions

This unit bridges concepts from quantum mechanics, relativity, and classical physics, potentially offering new insights into the nature of motion and interaction at the quantum scale within the Aether Physics Model. It could provide a novel way to understand and quantify how mass influences

a system's behavior in the quantum realm, potentially leading to new predictions or explanations for observed quantum phenomena.

In the context of classical and quantum physics, this quantity could be interpreted as:

Specific Impulse: While traditionally measured in units of time, specific impulse in rocketry is conceptually similar to velocity per mass. It represents the change in momentum per unit mass of propellant.

Inverse of Momentum Density: The reciprocal of velocity per mass is mass per velocity, which is a form of momentum density. Thus, velocity per mass could represent how easily a system's momentum density can be changed.

Mobility in Fields: In the presence of a force field, velocity per mass could indicate how responsive an object is to that field. Objects with higher velocity per mass would accelerate more under the same force.

Quantum Mobility: In quantum mechanics, this could relate to how easily quantum states evolve or change in response to perturbations, scaled by the system's mass.

Aether Responsiveness: In the context of the APM, this quantity might represent how readily a given mass interacts with or responds to the Aether. A higher value could indicate a greater degree of coupling between the mass and the Aether structure.

Quantum Information Propagation: It could be a measure of how quickly quantum information spreads through a system relative to its mass.

Inverse Mass-Normalized Resistance: In the APM, this could represent the inverse of a system's resistance to motion through the Aether, normalized by mass.

Specific Quantum Intensity Factor `sqif`

QMU primitive representation: $\mathrm{sqif} = \dfrac{{F_q}^3}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sqif}\,\mathrm{qmir} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sqif = \frac{{F_q}^3}{m_\mathrm{e}}$$

Physical interpretation:

Represents the quantum intensity factor per unit mass

Quantifies the relationship between high-frequency quantum processes and mass in a system

Describes how quantum intensity scales with respect to mass in the Aether

Significance:

Emerges from the APM's concept of relating quantum intensity to mass

Provides a measure of how intense quantum phenomena occur relative to the amount of mass present

Potential applications:

Analyzing the intensity of quantum processes in different mass systems

Characterizing materials or particles based on their quantum intensity-to-mass ratio

Studying quantum systems where the relationship between high-frequency quantum activity and mass is critical

Investigating how intense quantum processes scale with mass in various physical scenarios

This unit could be particularly relevant in fields such as high-energy physics, quantum field theory, and in studying the behavior of matter under extreme quantum conditions. It might offer insights into the relationship between mass and the intensity of quantum fluctuations, potentially informing our understanding of vacuum energy, particle interactions at high energies, and the fundamental nature of matter-energy relationships in intense quantum environments.

Specific Quantum Resonance `sqre`

QMU primitive representation: $\mathrm{sqre} = \dfrac{{F_q}^2}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sqre}\,\mathrm{qmop} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sqre = \frac{{F_q}^2}{m_\mathrm{e}}$$

Physical interpretation:

Represents the quantum resonance per unit mass

Quantifies the relationship between quantum resonant behavior and mass in a system

Describes how quantum resonance scales with respect to mass in the Aether

Significance:

Emerges from the APM's concept of relating quantum resonance to mass

Provides a measure of how quantum resonant phenomena occur relative to the amount of mass present

Potential applications:

Analyzing the resonant behavior of different mass systems at the quantum level

Characterizing materials or particles based on their quantum resonance-to-mass ratio

Studying quantum systems where the relationship between resonant frequency and mass is critical

Investigating how quantum resonant processes scale with mass in various physical scenarios

This unit could be particularly relevant in fields such as quantum optics, condensed matter physics, and in studying the behavior of quantum oscillators. It might offer insights into the relationship between mass and inherent quantum resonances, potentially informing our understanding of atomic and molecular spectra, quantum coherence phenomena, and the fundamental nature of matter-energy interactions in resonant quantum systems.

Specific Quantum Frequency `sqfr`

QMU primitive representation: $\mathrm{sqfr} = \dfrac{F_q}{m_\mathrm{e}}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sqfr}\,\mathrm{qmtc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sqfr = \frac{F_q}{m_\mathrm{e}}$$

Physical interpretation:

Represents the quantum frequency per unit mass

Quantifies the relationship between quantum oscillation rate and mass in a system

Describes how quantum frequency scales with respect to mass in the Aether

Significance:

Emerges from the APM's concept of relating quantum frequency to mass

Provides a measure of how quantum oscillations or processes occur relative to the amount of mass present

Potential applications:

Analyzing the frequency response of different mass systems at the quantum level

Characterizing materials or particles based on their quantum frequency-to-mass ratio

Studying quantum systems where the relationship between oscillation frequency and mass is critical

Investigating how quantum processes scale with mass in various physical scenarios

This unit could be particularly relevant in fields such as particle physics, quantum mechanics, and in studying the behavior of matter waves. It might offer insights into the relationship between mass and inherent quantum oscillations, potentially informing our understanding of particle properties, quantum state transitions, and the fundamental nature of matter-energy relationships in quantum systems.

9 QMU unit constructions: catalog 4

For the source dimensional convention and conversion reference tables, see [2; 1; 11].

Entries follow the established QMU website grid order: family, dynamic/substrate grouping, then table row order. Units appearing in multiple grids are defined at their first occurrence.

Oscillation and Spatial Dynamics

Dynamic units

Quantum Volume Oscillation `qvos`

QMU primitive representation: qvos $= {\lambda_C}^3 \, {F_q}^3$.

Family grid Dependency index

Catalog reciprocal: qvos qvor $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvos = {\lambda_C}^3 \cdot {F_q}^3 = dtrd \cdot freq = volm \cdot qinf$$

The Quantum Volume Oscillation ($qvos$) in the APM quantifies the rate of oscillation or change within a quantum volume. It represents the product of a quantum volume and the cube of frequency, linking spatial and high-frequency temporal aspects of quantum phenomena.

Physical interpretation:

Represents the intensity of oscillation or change within a quantum volume

Quantifies the degree of high-frequency quantum processes occurring in a defined spatial volume

Describes the ”activity” or ”dynamism” of a quantum volume in terms of both its size and its high-frequency oscillation rate

Significance:

Emerges from the combination of spatial (${\lambda_C}^3$) and high-frequency temporal (${F_q}^3$) quantum properties

Provides a measure of how intensely a quantum volume is oscillating or changing

Links concepts of double toroid ($dtrd$), volume ($volm$), frequency ($freq$), and quantum intensity factor ($qinf$)

Relationships to other units:

Potential applications:

Analyzing high-frequency volumetric oscillations in quantum systems

Characterizing the intense activity level of quantum volumes in various contexts

Studying the relationship between spatial extent and high-frequency oscillations in quantum phenomena

Describing the dynamism of quantum fields within defined volumes at high frequencies

Investigating quantum processes that involve both spatial and high-frequency temporal components

Note: The *qvos* unit in the APM offers a unique perspective on quantum volumetric phenomena by combining spatial and high-frequency temporal aspects. It bridges concepts of quantum volume, double toroid, frequency, and quantum intensity factor, providing a tool for analyzing how intensely a quantum volume is oscillating or changing at high frequencies. This unit is distinct within the APM framework as it specifically focuses on the combination of volumetric and high-frequency oscillatory properties, potentially offering new insights into quantum field behaviors, volumetric quantum dynamics, and the interplay between spatial and intense temporal aspects of quantum phenomena.

Double Toroid or Volume Resonance `dtrd`

QMU primitive representation: $\mathrm{dtrd} = {\lambda_C}^3 \, {F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{dtrd}\,\mathrm{invr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$dtrd = {\lambda_C}^3 \cdot {F_q}^2$$

The dtrd unit quantifies volumetric resonance at the quantum scale. It combines a quantum volume (${\lambda_C}^3$) with a two-dimensional frequency known as resonance (${F_q}^2$), representing a three-dimensional oscillating structure within the Aether.

Physical interpretation:

Measures resonant behavior in a quantum volume of space

Quantifies three-dimensional standing waves at quantum scales

Represents the oscillatory nature of Aether units in three spatial dimensions

Potential applications:

Describing quantum vacuum fluctuations

Analyzing three-dimensional electromagnetic wave behavior

Studying resonant modes in quantum cavities

Characterizing volumetric properties of subatomic particles

Flow `flow`

QMU primitive representation: $\text{flow} = {\lambda_C}^3 F_q$.

Family grid Dependency index

Catalog reciprocal: $\text{flow}\,\text{vfdn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$flow = {\lambda_C}^3 \cdot F_q$$

The $flow$ unit quantifies the rate of volume change at the quantum scale. It combines a quantum volume (${\lambda_C}^3$) with a frequency (F_q), representing the flow of space or Aether units per unit time.

Physical interpretation:

Measures the rate of quantum volume displacement

Quantifies the movement of Aether units in three-dimensional space

Represents the dynamic nature of space at quantum scales

Potential applications:

Describing quantum fluid dynamics

Analyzing energy flow in quantum systems

Studying the movement of charge carriers in quantum materials

Characterizing spatial-temporal variations in quantum fields

Volume `volm`

QMU primitive representation: $\text{volm} = {\lambda_C}^3$.

Family grid Dependency index

Catalog reciprocal: $\text{volm}\,\text{fint} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$volm = {\lambda_C}^3$$

The $volm$ unit represents the fundamental quantum volume in the Aether Physics Model. It is defined as the cube of the Compton wavelength, providing a discrete measure of space at the quantum scale.

Physical interpretation:

Represents the smallest discrete unit of volume in quantized space

Quantifies the spatial extent of an Aether unit

Serves as a fundamental building block for describing spatial properties in quantum systems

Potential applications:

Defining the volume of subatomic particles

Analyzing spatial distributions in quantum systems

Characterizing quantum confinement effects

Describing quantum vacuum structure

Quantum Surface Oscillation `qsfo`

QMU primitive representation: qsfo $= {\lambda_C}^2 {F_q}^3$.

Family grid Dependency index

Catalog reciprocal: qsfo qsfi $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsfo = {\lambda_C}^2 \cdot {F_q}^3 = temp \cdot freq$$

The Quantum Surface Frequency Oscillation ($qsfo$) in the APM quantifies the high-frequency oscillation or change on a quantum surface area. It represents the product of temperature and frequency, linking thermal and oscillatory aspects of quantum surface phenomena.

Physical interpretation:

Represents the interplay between thermal energy and frequency on a quantum surface

Quantifies the degree of thermally-driven, high-frequency quantum processes on a surface

Describes the ”thermal-vibrational activity” of a quantum surface

Significance:

Emerges from the combination of thermal (temp) and frequency (freq) quantum properties

Provides a measure of how thermal energy couples with high-frequency oscillations on a quantum surface

Relationships to other units:

Potential applications:

Analyzing the coupling between thermal energy and high-frequency oscillations in quantum systems

Characterizing thermally-driven frequency spectra of quantum surface oscillations

Studying quantum surface phenomena where both temperature and frequency play crucial roles

Investigating the behavior of quantum fields on thermally excited, rapidly oscillating surfaces

Exploring potential applications in quantum thermodynamics and high-frequency thermal processes at the quantum scale

Note: The $qsfo$ unit in the APM offers a unique perspective on quantum surface phenomena by emphasizing the relationship between thermal energy and high-frequency oscillations. This unit bridges concepts of temperature and frequency in quantum surface dynamics, potentially offering new insights into thermally-driven quantum processes and high-frequency phenomena on surfaces. The distinction between qsfo and other units like tafx highlights the APM's ability to capture different aspects of quantum surface behavior, particularly the interplay between thermal and oscillatory properties.

Temperature `temp`

QMU primitive representation: $\text{temp} = {\lambda_C}^2 \, {F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{temp}\,\text{qsin} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$temp = {\lambda_C}^2 \cdot {F_q}^2$$

The *temp* unit represents a quantum-scale measure of temperature in the Aether Physics Model. It combines a quantum area (${\lambda_C}^2$) with a two-dimensional frequency known as resonance (${F_q}^2$), providing a novel perspective on thermal energy at the most fundamental level.

Physical interpretation:

Quantifies the kinetic energy of quantum-scale oscillations

Represents the intensity of Aether unit vibrations

Measures the degree of excitation in quantum systems

Potential applications:

Describing thermal behavior at quantum scales

Analyzing energy distributions in subatomic particles

Characterizing quantum thermodynamic processes

Studying temperature-dependent quantum phenomena

This unit offers a unique approach to temperature, directly linking it to fundamental quantum properties of space and frequency. It aligns with the APM's goal of describing physical phenomena in terms of quantized Aether units, potentially providing new insights into the nature of heat and thermal energy at the quantum level.

Note: The *temp* unit in the APM differs significantly from classical temperature concepts, emphasizing the model's departure from conventional thermodynamics in favor of a more fundamental, quantum-based approach.

Sweep or Angular Velocity `swep`

QMU primitive representation: $\text{swep} = {\lambda_C}^2 \, F_q$.

Family grid Dependency index

Catalog reciprocal: $\text{swep}\,\text{sfrs} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$swep = {\lambda_C}^2 \cdot F_q$$

The *swep* unit represents a quantum-scale sweep or angular velocity measure in the Aether Physics Model. It combines a quantum area (${\lambda_C}^2$) with a frequency (F_q), providing a fundamental description of rotational motion or field sweeping at the quantum level.

Physical interpretation:

Quantifies the rate of angular displacement in quantum systems

Represents the rotational speed of Aether units

Measures the frequency of field oscillations over a quantum area

Potential applications:

Describing spin properties of subatomic particles

Analyzing angular momentum in quantum systems

Characterizing magnetic field rotations at the quantum scale

Studying vortex behavior in quantum fluids

This unit offers a unique approach to angular velocity, directly linking it to fundamental quantum properties of space and frequency. It aligns with the APM's goal of describing physical phenomena in terms of quantized Aether units, potentially providing new insights into rotational and oscillatory behaviors at the quantum level.

Note: The *swep* unit in the APM provides a quantum-mechanical perspective on angular motion, emphasizing the model's focus on discrete, quantized descriptions of physical phenomena.

Area `area`

QMU primitive representation: $\text{area} = {\lambda_C}^2$.

Family grid Dependency index

Catalog reciprocal: $\text{area}\,\text{bndr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$area = {\lambda_C}^2$$

The *area* unit represents the fundamental quantum area in the Aether Physics Model. It is defined as the square of the Compton wavelength, providing a discrete measure of surface at the quantum scale.

Physical interpretation:

Represents the smallest discrete unit of area in quantized space

Quantifies the cross-sectional extent of an Aether unit

Serves as a fundamental building block for describing surface properties in quantum systems

Potential applications:

Defining the surface area of subatomic particles

Analyzing two-dimensional quantum phenomena

Characterizing interfaces in quantum systems

Describing quantum surface effects and interactions

This unit aligns with the APM's concept of a quantized Aether composed of discrete units. Using the Compton wavelength as its basis, *area* provides a natural and consistent way to measure surfaces at quantum scales, potentially offering new insights into the structure of space and the behavior of matter at two-dimensional interfaces at the most fundamental level.

Note: The *area* unit in the APM emphasizes the discrete nature of space at quantum scales, contrasting with the continuous area concepts used in classical physics.

Quantum Dynamic Frequency `qdyf`

QMU primitive representation: $\mathrm{qdyf} = \lambda_C \, {F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qdyf}\,\mathrm{qdfr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qdyf = \lambda_C \cdot F_{q^3} = accl \cdot freq = velc \cdot rson$$

Concise statement: The Quantum Dynamic Frequency ($qdyf$) in the APM quantifies the rate of change in velocity or acceleration at high frequencies in quantum systems. It represents the product of the Compton wavelength and the cube of frequency, linking spatial and high-frequency temporal aspects of quantum motion.

Physical interpretation:

Represents the intensity of change in motion at high frequencies in quantum systems

Quantifies the degree of rapid acceleration or velocity changes in quantum phenomena

Describes the "dynamic activity" of quantum particles or fields in terms of both their motion and high-frequency oscillation rate

Significance:

Emerges from the combination of spatial (λ_C) and high-frequency temporal (F_{q^3}) quantum properties

Provides a measure of how rapidly quantum motion is changing at high frequencies

Links concepts of acceleration, velocity, frequency, and resonance in quantum dynamics

Relationships to other units:

Potential applications:

Analyzing high-frequency changes in quantum particle motion

Characterizing the dynamic behavior of quantum systems undergoing rapid acceleration

Studying the relationship between velocity and resonance in quantum phenomena

Describing the behavior of quantum fields experiencing rapid changes in motion

Investigating quantum processes that involve both motion and high-frequency oscillations

Note: The *qdyf* unit in the APM offers a unique perspective on quantum dynamics by combining aspects of motion and high-frequency oscillations. It provides a tool for analyzing how quantum systems change their motion rapidly and frequently. This unit is distinct within the APM framework as it specifically focuses on the combination of dynamic motion and high-frequency oscillatory properties, potentially offering new insights into quantum particle behavior, field dynamics, and the interplay between motion and frequency in quantum phenomena.

Acceleration `accl`

QMU primitive representation: $\mathrm{accl} = \lambda_C \, {F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{accl}\,\mathrm{morc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$accl = \lambda_C \cdot {F_q}^2$$

The *accl* unit represents a quantum-scale measure of acceleration in the Aether Physics Model. It combines a quantum length (λ_C) with a two-dimensional frequency (${F_q}^2$), providing a fundamental description of change in velocity at the quantum level.

Physical interpretation:

Quantifies the rate of change of velocity for quantum entities

Represents the intensity of force acting on Aether units

Potential applications:

Describing particle behavior in strong force fields

Analyzing quantum oscillator systems

Characterizing gravitational effects at quantum scales

Studying acceleration in quantum tunneling phenomena

This unit offers a unique approach to acceleration, directly linking it to fundamental quantum properties of space and frequency. It aligns with the APM's goal of describing physical phenomena in terms of quantized Aether units, potentially providing new insights into dynamics and force interactions at the quantum level.

Note: The *accl* unit in the APM provides a quantum-mechanical perspective on acceleration, emphasizing the model's focus on discrete, quantized descriptions of physical phenomena. This approach may offer new ways to understand and describe motion at the most fundamental levels of reality.

Quantum Velocity `velc`

QMU primitive representation: $\text{velc} = \lambda_C \, F_q$.

Family grid Dependency index

Catalog reciprocal: $\text{velc} \cdot \text{quid} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$velc = \lambda_C \cdot F_q$$

The *velc* unit represents the fundamental quantum velocity in the Aether Physics Model. It combines the quantum length (λ_C) with the quantum frequency (F_q), resulting in a constant value that corresponds to the speed of photons in vacuum.

Physical interpretation:

Represents the maximum velocity attainable in the universe

Quantifies the propagation speed of electromagnetic waves in vacuum

Describes the fundamental relationship between length and frequency in the quantum Aether

Significance:

Its constancy in all local space is a cornerstone of Special Relativity

Serves as a universal speed limit for information transfer and causality

Emerges naturally from the APM's quantum structure of length and frequency

Potential applications:

Analyzing light propagation in quantum systems

Characterizing the behavior of photons

Studying space compression effects at quantum scales

This unit aligns with the APM's approach of deriving fundamental constants from quantum measurements. By expressing the speed of photons in terms of Compton wavelength and quantum frequency, the APM provides a novel perspective on this crucial constant, potentially offering new

insights into the nature of length, frequency, and the propagation of electromagnetic waves at the most fundamental level.

Compton wavelength `leng`

QMU primitive representation: $\mathrm{leng} = \lambda_C$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{leng}\,\mathrm{wavn} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$leng = \lambda_C$$

The *leng* unit represents the fundamental quantum length in the Aether Physics Model. It is defined as equivalent to the Compton wavelength, providing a discrete measure of distance at the quantum scale.

Physical interpretation:

Represents the smallest discrete unit of length in quantized space

Quantifies the average radius of a single Aether unit

Serves as a fundamental building block for describing spatial properties in quantum systems

Significance:

Emerges naturally from the APM's quantum structure of space

Provides a universal length scale for quantum phenomena

Links particle properties (mass) to spatial dimensions through the Compton wavelength

Potential applications:

Defining the size of subatomic particles

Analyzing spatial distributions in quantum systems

Characterizing quantum confinement effects

Describing quantum vacuum structure

This unit aligns with the APM's concept of a quantized Aether composed of discrete units. By using the Compton wavelength as its fundamental length unit, the APM provides a natural and consistent way to measure distances at quantum scales, potentially offering new insights into the structure of space and the behavior of matter at the most fundamental level.

Note: The leng unit in the APM emphasizes the discrete nature of space at quantum scales, contrasting with the continuous length concepts used in classical physics. This approach may lead to new understandings of spatial relationships and interactions in quantum systems.

Quantum Intensity Factor `qinf`

QMU primitive representation: $\mathrm{qinf} = {F_q}^3$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qinf}\,\mathrm{qire} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition: $qinf = {F_q}^3$, where F_q is the quantum frequency, a fundamental constant in the APM.

Concise statement: The Quantum Intensity Factor ($qinf$) in the APM quantifies the rate or intensity of quantum processes, particularly those involving energy transfer or field interactions at the most fundamental level.

Physical interpretation:

Represents the intensity or rate of quantum phenomena

Quantifies the degree of energy transfer or field interaction in quantum systems

Describes the ”speed” or ”vigor” of quantum processes in three-dimensional space

Significance:

Emerges from the APM’s concept of quantum frequency as a fundamental property of Aether units

Provides a measure of how rapidly or intensely quantum processes occur

Appears in units related to power, light intensity, and energy transfer rates

Relationships to other units:

Present in the definition of power: $powr = m_\mathrm{e} \cdot {\lambda_C}^2 \cdot qinf$

Appears in light intensity: $lint = m_\mathrm{e} \cdot \lambda_C \cdot qinf$

Found in irradiance: $irrd = m_\mathrm{e} \cdot qinf$

Potential applications:

Analyzing the intensity of quantum field interactions

Characterizing the rate of energy transfer in quantum systems

Studying the efficiency of quantum processes in various physical contexts

Describing the ”strength” or ”vigor” of quantum phenomena in three-dimensional space

Investigating the relationship between frequency and energy transfer in quantum electrodynamics

Note: The $qinf$ unit in the APM offers a unique perspective on the intensity of quantum processes. It bridges concepts of frequency, energy transfer, and field interactions, providing a tool for analyzing the vigor of quantum phenomena. This unit is distinct within the APM framework as it specifically focuses on the rate or intensity of quantum processes, offering potential new insights into energy dynamics, field interactions, and the fundamental nature of quantum phenomena.

Resonance `rson`

QMU primitive representation: $\mathrm{rson} = {F_q}^2$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{rson}\,\mathrm{orbt} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$rson = {F_q}^2$$

The *rson* unit represents the fundamental quantum resonance in the Aether Physics Model. It is defined as the square of the quantum frequency, providing a measure of oscillatory behavior at the quantum scale.

Physical interpretation:

Quantifies the intensity of oscillations in quantum systems

Represents the rate of energy exchange between two coupled oscillators

Describes the frequency of standing waves in quantum structures

Significance:

Emerges from the APM's concept of chronovibration in Aether units

Provides a two-dimensional frequency measure, reflecting the APM's view of time as non-linear

Links to the APM's description of subatomic particle behavior and quantum phenomena

Potential applications:

Analyzing quantum oscillator systems

Describing resonant energy transfer in atomic and molecular systems

Characterizing quantum mechanical tunneling

Studying coherence and decoherence in quantum systems

This unit aligns with the APM's approach of using quantum measurements to construct units. By squaring the quantum frequency, *rson* offers a unique perspective on resonance phenomena at the quantum level, potentially providing new insights into the nature of oscillations, energy exchange, and wave behavior in quantum systems.

Note: The *rson* unit in the APM emphasizes the model's view of resonance as a fundamental aspect of quantum reality, possibly offering new ways to understand and describe periodic phenomena at the most fundamental levels of existence.

Quantum frequency `freq`

QMU primitive representation: $\mathrm{freq} = F_q$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{freq}\,\mathrm{time} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$freq = F_q$$

The $freq$ unit represents the fundamental quantum frequency in the Aether Physics Model. It is defined as equivalent to the quantum frequency, providing a discrete measure of temporal oscillation at the quantum scale.

Physical interpretation:

Represents the rate of chronovibration of an Aether unit

Quantifies the fundamental temporal oscillation in quantum systems

Describes the rate of change in quantum states

Significance:

Emerges from the APM's concept of chronovibration

Provides a universal frequency scale for quantum phenomena

Directly related to the speed of photons and Compton wavelength ($c = \lambda_C \cdot F_q$)

Potential applications:

Defining the oscillation rates of subatomic particles

Analyzing energy levels in quantum systems

Characterizing quantum state transitions

Describing quantum field fluctuations

This unit aligns with the APM's concept of a quantized Aether with inherent temporal oscillations. By using the quantum frequency as its fundamental frequency unit, the APM provides a natural and consistent way to measure temporal phenomena at quantum scales, potentially offering new insights into the structure of time and the behavior of matter at the most fundamental level.

Note: The $freq$ unit in the APM emphasizes the discrete nature of temporal oscillations at quantum scales, contrasting with the continuous frequency concepts used in classical physics. This approach may lead to new understandings of temporal relationships and interactions in quantum systems.

Substrate units

Quantum Volume Oscillation Resistance `qvor`

QMU primitive representation: $\text{qvor} = \dfrac{1}{{\lambda_C}^3 \, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{qvor}\,\text{qvos} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qvor = \frac{1}{{\lambda_C}^3 \cdot {F_q}^3} = \frac{1}{qvos}$$

The Quantum Volume Oscillation Resistance (*qvor*) in the APM quantifies the resistance or impedance to high-frequency oscillations or changes within a quantum volume. It represents the inverse of the product of a quantum volume and the cube of frequency, indicating the system's reluctance to undergo rapid volumetric changes.

Physical interpretation:

Represents the resistance to intense oscillation or change within a quantum volume

Quantifies the impedance to high-frequency quantum processes occurring in a defined spatial volume

Describes the "stability" or "inertia" of a quantum volume against rapid, intense changes

Significance:

Emerges from the inverse combination of spatial (${\lambda_C}^3$) and high-frequency temporal (${F_q}^3$) quantum properties

Provides a measure of how resistant a quantum volume is to intense oscillations or changes

Links concepts of volume stability, frequency resistance, and quantum inertia

Relationships to other units:

Potential applications:

Analyzing stability of quantum volumes against high-frequency perturbations

Characterizing the resistance of quantum systems to rapid volumetric changes

Studying the factors that contribute to quantum volume stability in various contexts

Describing the inertial properties of quantum fields within defined volumes at high frequencies

Investigating quantum processes that involve resistance to both spatial and high-frequency temporal changes

Note: The *qvor* unit in the APM offers a unique perspective on quantum volumetric phenomena by representing resistance to combined spatial and high-frequency temporal changes. It provides a tool for analyzing how stable or resistant a quantum volume is to intense, rapid oscillations or changes. This unit is distinct within the APM framework as it specifically focuses on the resistance to combined volumetric and high-frequency oscillatory properties, potentially offering new insights into

quantum field stability, volumetric quantum inertia, and the factors that contribute to resistance against rapid changes in quantum volumes.

Inverse Volume Resonance `invr`

QMU primitive representation: $\mathrm{invr} = \dfrac{1}{{\lambda_C}^3\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{invr}\,\mathrm{dtrd} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$invr = \frac{1}{{\lambda_C}^3 \cdot {F_q}^2}$$

Physical interpretation:

Represents the inverse of volumetric resonance at the quantum scale

Quantifies the resistance or impedance to three-dimensional oscillations in the Aether

Describes the spatial-temporal density of quantum anti-nodes or points of minimum oscillation

Significance:

Emerges from the APM's concept of Aether units and their oscillatory nature

Provides a measure of quantum volume stability or resistance to resonance

Inversely related to the intensity of three-dimensional standing waves in quantum space

Potential applications:

Analyzing quantum systems with suppressed volumetric oscillations

Characterizing regions of space with minimal quantum fluctuations

Studying quantum damping effects in three-dimensional systems

Describing the stability of quantum structures resistant to volumetric resonance

This unit offers a unique perspective on the absence or suppression of volumetric resonance in quantum systems. By providing a measure inverse to the dtrd unit, *invr* allows for the quantification of phenomena related to quantum stability and resistance to three-dimensional oscillations in the Aether.

Note: The *invr* unit in the APM emphasizes the model's ability to describe both resonant and non-resonant quantum volumes, potentially offering new insights into quantum stability, damping, and the structure of space at the most fundamental level.

Volumetric Field Density `vfdn`

QMU primitive representation: $\text{vfdn} = \dfrac{1}{{\lambda_C}^3\, F_q}$.

Family grid Dependency index

Catalog reciprocal: vfdn flow = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$vfdn = \frac{1}{{\lambda_C}^3 \cdot F_q}$$

Physical interpretation:

Represents the density of quantum field effects in a given volume and time

Quantifies the concentration of quantum interactions per unit space-time

Describes the intensity of Aether unit activity in a volumetric and temporal context

Significance:

Emerges from the APM's concept of Aether units and their dynamic nature

Provides a measure of quantum field strength per unit volume and time

Inversely related to the rate of quantum volume displacement

Potential applications:

Analyzing the intensity of quantum fields in confined spaces

Characterizing the strength of interactions in quantum field theories

Studying the concentration of quantum effects in high-energy physics

Describing the density of quantum information in a given space-time volume

This unit offers a unique perspective on the intensity of quantum fields and their effects within a given volume and temporal framework. By providing a measure inverse to the flow unit, $vfdn$ allows for the quantification of phenomena related to quantum field concentrations and interactions in the Aether.

Note: The $vfdn$ unit in the APM emphasizes the model's ability to describe the intensity of quantum fields in space-time, potentially offering new insights into field theories, particle interactions, and the structure of the quantum vacuum at the most fundamental level.

Field Intensity `fint`

QMU primitive representation: $\text{fint} = \dfrac{1}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: fint volm = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$fint = \frac{1}{{\lambda_C}^3}$$

The $fint$ unit represents the quantum field intensity in the Aether Physics Model. It is defined as the reciprocal of the cubic Compton wavelength, providing a measure of field strength per quantum volume.

Physical interpretation:

Quantifies the strength or concentration of a field within a quantum volume

Represents the density of field lines in a quantum space

Describes the intensity of Aether unit interactions

Significance:

Emerges from the APM's concept of quantized fields within the Aether structure

Provides a volumetric measure of field intensity at the quantum scale

Links field strength to the fundamental quantum length (Compton wavelength)

Potential applications:

Analyzing electromagnetic field strengths at quantum scales

Characterizing gravitational field intensity in quantum gravity theories

Studying strong and weak force field distributions in particle physics

Describing quantum vacuum fluctuations and their intensities

This unit aligns with the APM's approach of using quantum measurements to construct units. By defining field intensity in terms of the Compton wavelength, $fint$ offers a unique perspective on field phenomena at the quantum level, potentially providing new insights into the nature of forces and interactions in quantum systems.

Note: The $fint$ unit in the APM emphasizes the model's view of fields as fundamental aspects of the quantized Aether, possibly offering new ways to understand and describe force-carrying phenomena at the most fundamental levels of existence.

Quantum Surface Frequency Impedance `qsfi`

QMU primitive representation: $\text{qsfi} = \frac{1}{{\lambda_C}^2 {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: qsfi qsfo = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsfi = \frac{1}{{\lambda_C}^2 \cdot {F_q}^3}$$

The Quantum Surface Frequency Impedance ($qsfi$) in the APM quantifies the resistance to high-frequency oscillations or changes on a quantum surface area, particularly in relation to thermal effects. It represents the inverse of the product of temperature and frequency, indicating the system's reluctance to undergo rapid, thermally-driven surface changes.

Physical interpretation:

Represents the impedance to intense, thermally-coupled oscillations on a quantum surface

Quantifies the resistance to high-frequency quantum processes occurring on a defined surface area in thermal contexts

Describes the "thermal-vibrational stability" of a quantum surface against rapid, intense changes

Significance:

Emerges from the inverse combination of thermal (temp) and frequency (freq) quantum properties

Provides a measure of how resistant a quantum surface is to thermally-driven, high-frequency oscillations

Links concepts of surface stability, thermal resistance, and frequency impedance in quantum systems

Relationships to other units:

Potential applications:

Analyzing stability of quantum surfaces against thermally-induced high-frequency perturbations

Characterizing the resistance of quantum systems to rapid, thermally-driven surface changes

Studying the factors that contribute to quantum surface stability in various thermal and frequency contexts

Describing the impedance properties of quantum fields on surfaces at high frequencies and temperatures

Investigating quantum processes that involve resistance to both thermal and high-frequency surface changes

Note: The $qsfi$ unit in the APM offers a unique perspective on quantum surface phenomena by representing impedance to combined thermal and high-frequency changes. It provides a tool for analyzing how stable or resistant a quantum surface is to intense, rapid, thermally-driven oscillations or changes. This unit is distinct within the APM framework as it specifically focuses on the resistance to combined thermal and high-frequency oscillatory properties on surfaces, potentially offering new insights into quantum surface stability, thermal-frequency interactions, and the factors that contribute to resistance against rapid, thermally-induced changes in quantum surface phenomena.

Quantum Surface Intensity `qsin`

QMU primitive representation: $\mathrm{qsin} = \dfrac{1}{{\lambda_C}^2\,{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: qsin temp = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qsin = \frac{1}{{\lambda_C}^2 \cdot {F_q}^2}$$

Physical interpretation:

Represents the inverse of quantum temperature or surface resonance

Quantifies the resistance to two-dimensional oscillations or excitations in the Aether

Describes the spatial-temporal density of quantum effects on a surface

Significance:

Emerges from the APM's concept of Aether units and their surface properties

Provides a measure of quantum surface stability or resistance to excitation

Inversely related to the intensity of two-dimensional oscillations in quantum space

Potential applications:

Analyzing quantum systems with suppressed surface oscillations

Characterizing the stability of quantum interfaces or boundaries

Studying quantum damping effects in two-dimensional systems

Describing the resistance to energy transfer across quantum surfaces

This unit offers a unique perspective on the stability or resistance to excitation of quantum surfaces. By providing a measure inverse to the temp unit, *qsin* allows for the quantification of phenomena related to quantum surface stability and resistance to two-dimensional oscillations in the Aether.

Note: The *qsin* unit in the APM emphasizes the model's ability to describe both excited and stable quantum surfaces, potentially offering new insights into interface phenomena, two-dimensional quantum systems, and energy transfer processes at the most fundamental level.

Surface Flux Resistance `sfrs`

QMU primitive representation: $\mathrm{sfrs} = \dfrac{1}{{\lambda_C}^2\,F_q}$.

Family grid Dependency index

Catalog reciprocal: sfrs swep = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sfrs = \frac{1}{{\lambda_C}^2 \cdot F_q}$$

Physical interpretation:

Represents the resistance to quantum flux across a surface

Quantifies the impedance to angular or rotational motion in quantum systems

Describes the spatial-temporal resistance to field sweeping or circulation

Significance:

Emerges from the APM's concept of Aether units and their rotational properties

Provides a measure of quantum surface stability against rotational or sweeping effects

Inversely related to the rate of angular displacement or field sweeping in quantum space

Potential applications:

Analyzing the resistance to spin flips in quantum systems

Characterizing the stability of magnetic domains at quantum scales

Studying vorticity suppression in quantum fluids

Describing the impedance to circular or rotational field propagation

This unit offers a unique perspective on the resistance to rotational or sweeping phenomena on quantum surfaces. By providing a measure inverse to the swep unit, $sfrs$ allows for the quantification of phenomena related to quantum rotational stability and resistance to angular flux in the Aether.

Note: The $sfrs$ unit in the APM emphasizes the model's ability to describe resistance to rotational and sweeping effects in quantum systems, potentially offering new insights into spin dynamics, magnetic phenomena, and angular momentum transfer at the most fundamental level.

Bending Radius `bndr`

QMU primitive representation: $\text{bndr} = \frac{1}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: bndr area = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$bndr = \frac{1}{{\lambda_C}^2}$$

The *bndr* unit represents the quantum bending radius in the Aether Physics Model. It is defined as the reciprocal of the squared Compton wavelength, providing a measure of curvature at the quantum scale.

Physical interpretation:

Quantifies the degree of spatial curvature in quantum systems

Represents the inverse radius of curvature for quantum-scale phenomena

Describes the bending of space or fields at the fundamental level

Significance:

Emerges from the APM's concept of quantized space curvature

Provides a measure of spatial deformation at quantum scales

Links curvature to the fundamental quantum length (Compton wavelength)

Potential applications:

Analyzing gravitational effects in quantum gravity theories

Characterizing the curvature of electromagnetic fields at quantum scales

Studying the bending of particle trajectories in strong force fields

Describing quantum geometric phases and topological effects

This unit aligns with the APM's approach of using quantum measurements to construct units. By defining bending radius in terms of the Compton wavelength, *bndr* offers a unique perspective on spatial curvature at the quantum level, potentially providing new insights into the nature of space, gravity, and other force fields in quantum systems.

Note: The *bndr* unit in the APM emphasizes the model's view of space curvature as a fundamental aspect of quantum reality, possibly offering new ways to understand and describe gravitational and other force effects at the most fundamental levels of existence. This could be particularly relevant in bridging quantum mechanics and general relativity.

Quantum Dynamic Frequency Resistance `qdfr`

QMU primitive representation: $\mathrm{qdfr} = \dfrac{1}{\lambda_C \, {F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qdfr}\,\mathrm{qdyf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qdfr = \frac{1}{\lambda_C \cdot {F_q}^3}$$

The Quantum Dynamic Frequency Resistance ($qdfr$) in the APM quantifies the resistance to high-frequency changes in velocity or acceleration in quantum systems. It represents the inverse of the product of the Compton wavelength and the cube of frequency, indicating the system's reluctance to undergo rapid changes in motion.

Physical interpretation:

Represents the impedance to intense changes in motion at high frequencies in quantum systems

Quantifies the resistance to rapid acceleration or velocity changes in quantum phenomena

Describes the ”inertial stability” of quantum particles or fields against high-frequency dynamic changes

Significance:

Emerges from the inverse combination of spatial (λ_C) and high-frequency temporal (${F_q}^3$) quantum properties

Provides a measure of how resistant quantum motion is to rapid changes at high frequencies

Links concepts of inertia, frequency resistance, and resonance impedance in quantum dynamics

Relationships to other units:

Potential applications:

Analyzing stability of quantum particle motion against high-frequency perturbations

Characterizing the resistance of quantum systems to rapid changes in acceleration or velocity

Studying the factors that contribute to dynamic stability in various quantum contexts

Describing the inertial properties of quantum fields experiencing rapid changes in motion

Investigating quantum processes that involve resistance to both motion and high-frequency oscillations

Note: The *qdfr* unit in the APM offers a unique perspective on quantum dynamics by representing resistance to combined motion and high-frequency changes. It provides a tool for analyzing how stable or resistant a quantum system is to intense, rapid changes in its dynamic state. This unit is distinct within the APM framework as it specifically focuses on the resistance to combined motion and high-frequency oscillatory properties, potentially offering new insights into quantum particle behavior, field dynamics stability, and the factors that contribute to resistance against rapid changes in quantum motion and oscillation.

Momentum Resistance Coefficient `morc`

QMU primitive representation: $\mathrm{morc} = \dfrac{1}{\lambda_C \, {F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{morc}\,\mathrm{accl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$morc = \frac{1}{\lambda_C \cdot {F_q}^2}$$

Physical interpretation:

Represents the resistance to changes in momentum at the quantum scale

Quantifies the impedance to acceleration in quantum systems

Describes the spatial-temporal resistance to velocity changes in the Aether

Significance:

Emerges from the APM's concept of Aether units and their inertial properties

Provides a measure of quantum inertia or resistance to motion changes

Inversely related to the rate of velocity change in quantum space

Potential applications:

Analyzing the stability of quantum states against external perturbations

Characterizing the resistance to force application in quantum systems

Studying the persistence of motion in quantum particles

Describing the impedance to energy transfer in collision processes

This unit offers a unique perspective on the resistance to acceleration or changes in momentum at the quantum level. By providing a measure inverse to the *accl* unit, *morc* allows for the quantification of phenomena related to quantum inertia and resistance to motion changes in the Aether.

Note: The *morc* unit in the APM emphasizes the model's ability to describe resistance to acceleration and momentum changes in quantum systems, potentially offering new insights into inertial properties, force interactions, and energy transfer processes at the most fundamental level. This unit is distinct from others in the APM framework as it specifically focuses on the resistance to changes in motion, rather than static or rotational properties.

Quantum Inertial Density `quid`

QMU primitive representation: $\text{quid} = \dfrac{1}{\lambda_C\, F_q}$.

Family grid Dependency index

Catalog reciprocal: $\text{quid}\,\text{velc} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$quid = \frac{1}{\lambda_C \cdot F_q} = \frac{1}{velc}$$

Physical interpretation:

Represents the resistance to uniform motion at the quantum scale

Quantifies the impedance to velocity in quantum systems

Describes the spatial-temporal density of inertial effects in the Aether

Significance:

Emerges from the APM's concept of Aether units and their kinematic properties

Provides a measure of quantum resistance to maintaining constant velocity

Inversely related to the speed of propagation in quantum space

Potential applications:

Analyzing the propagation of quantum information through space

Characterizing the resistance to particle or wave motion in quantum fields

Studying the persistence of uniform motion in quantum systems

Describing the impedance to energy propagation in quantum media

This unit offers a unique perspective on the resistance to uniform motion at the quantum level. By providing a measure inverse to the *velc* unit, *quid* allows for the quantification of phenomena related to quantum inertia and resistance to constant velocity in the Aether.

Note: The *quid* unit in the APM emphasizes the model's ability to describe resistance to uniform motion in quantum systems, potentially offering new insights into wave propagation, particle motion, and energy transfer processes at the most fundamental level. This unit is distinct from others in the APM framework as it specifically focuses on the resistance to constant velocity, rather than acceleration or rotational properties.

Wave Number `wavn`

QMU primitive representation: $\text{wavn} = \dfrac{1}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\text{wavn}\,\text{leng} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$wavn = \frac{1}{\lambda_C}$$

The *wavn* unit represents the quantum wave number in the Aether Physics Model. It is defined as the reciprocal of the Compton wavelength, providing a measure of spatial frequency at the quantum scale.

Physical interpretation:

Quantifies the number of waves per unit distance in quantum systems

Represents the spatial frequency of oscillations in the Aether

Describes the reciprocal of wavelength for quantum-scale phenomena

Significance:

Emerges naturally from the APM's quantum structure of space

Provides a fundamental measure of spatial periodicity at quantum scales

Potential applications:

Analyzing wave propagation in quantum systems

Studying quantum interference and diffraction phenomena

Describing quantum states in momentum space

This unit aligns with the APM's concept of a quantized Aether with wave-like properties. By defining wave number in terms of the Compton wavelength, *wavn* offers a unique perspective on spatial periodicity at the quantum level, potentially providing new insights into the wave nature of matter and energy.

Note: The *wavn* unit in the APM emphasizes the wave-like nature of quantum phenomena. This approach may lead to new understandings of quantum behavior and could be particularly useful in describing quantum mechanical systems in terms of their spatial frequency characteristics.

Quantum Intensity Resistance `qire`

QMU primitive representation: $\mathrm{qire} = \dfrac{1}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qire}\,\mathrm{qinf} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qire = \frac{1}{qinf} = \frac{1}{{F_q}^3}$$

Where F_q is the quantum frequency, a fundamental constant in the APM.

The Quantum Intensity Resistance (*qire*) in the APM quantifies the resistance or impedance to rapid quantum processes, particularly those involving energy transfer or field interactions at the most fundamental level.

Physical interpretation:

Represents the resistance to intense or rapid quantum phenomena

Quantifies the impedance to high degrees of energy transfer or field interaction in quantum systems

Describes the "damping" or "slowing" of quantum processes in three-dimensional space

Significance:

Emerges from the APM's concept of quantum frequency as a fundamental property of Aether units

Provides a measure of how much a quantum system resists rapid or intense processes

Appears in the reciprocal of units related to power, light intensity, and energy transfer rates

Relationships to other units:

Present in the reciprocal of power: $qire = \frac{mass \cdot area}{powr}$

Appears in the reciprocal of light intensity: $qire = \frac{mass \cdot leng}{lint}$

Found in the reciprocal of irradiance: $qire = \frac{mass}{irrd}$

Potential applications:

Analyzing the resistance to intense quantum field interactions

Characterizing the impedance to rapid energy transfer in quantum systems

Studying the factors that limit the efficiency of quantum processes

Describing the ”damping” of quantum phenomena in three-dimensional space

Investigating the relationship between frequency and energy transfer resistance in quantum electrodynamics

Note: The *qire* unit in the APM offers a unique perspective on the resistance to intense quantum processes. It bridges concepts of frequency, energy transfer impedance, and field interaction resistance, providing a tool for analyzing the limitations on the vigor of quantum phenomena. This unit is distinct within the APM framework as it focuses explicitly on the resistance to rapid or intense quantum processes, offering potential new insights into energy dynamics constraints, field interaction limitations, and the fundamental nature of quantum phenomena resistance.

Orbit `orbt`

QMU primitive representation: $\mathrm{orbt} = \frac{1}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{orbt}\,\mathrm{rson} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$orbt = \frac{1}{{F_q}^2}$$

The *orbt* unit represents the quantum orbit time in the Aether Physics Model. It is defined as the reciprocal of the squared quantum frequency, providing a measure of orbital period at the quantum scale.

Physical interpretation:

Quantifies the time for a complete orbit or cycle in quantum systems

Represents the period of rotational motion in Aether units

Describes the reciprocal of resonance frequency for quantum-scale phenomena

Significance:

Emerges from the APM's concept of chronovibration in Aether units

Provides a fundamental measure of cyclic time intervals at quantum scales

Relates to the APM's description of subatomic particle behavior and quantum phenomena

Potential applications:

Analyzing orbital periods of electrons in atomic systems

Characterizing cyclic processes in quantum mechanics

Studying quantum oscillations and rotations

Describing periodicity in quantum field theories

This unit aligns with the APM's approach of using quantum measurements to construct units. By defining orbit time in terms of the quantum frequency, *orbt* offers a unique perspective on periodic motion and cyclic phenomena at the quantum level, potentially providing new insights into the nature of time and rotational behavior in quantum systems.

Note: The *orbt* unit in the APM emphasizes the model's view of time as fundamentally cyclic at quantum scales, possibly offering new ways to understand and describe periodic phenomena at the most fundamental levels of existence. This could be particularly relevant in bridging quantum mechanics with classical orbital mechanics and in understanding quantum-scale rotational processes.

Time `time`

QMU primitive representation: $\text{time} = \dfrac{1}{F_q}$.

Family grid Dependency index

Catalog reciprocal: $\text{time}\,\text{freq} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$time = \frac{1}{F_q}$$

The *time* unit is the fundamental interval of the four-dimensional, externally registered quantum-moment sequence in the Aether Physics Model (APM). It is defined as the reciprocal of the quantum frequency. The underlying five-dimensional dynamical temporal structure is treated as continuous; discreteness here refers to the four-dimensional manifestation.

Physical interpretation:

Represents the period of a single chronovibration of an Aether unit

Quantifies the native interval of a completed quantum moment in the APM

Describes the duration of the most basic, indivisible quantum event

Significance:

Emerges directly from the APM's concept of chronovibration

Establishes the reference interval for four-dimensional quantum-moment registration in the APM

Directly related to the speed of light and Compton wavelength ($\lambda_C = c \cdot time$)

APM context: The quantum moment specifies a complete four-dimensional registration cycle. It does not imply that the continuous internal five-dimensional temporal dynamics lack sub-cycle structure. Whether this construction imposes an operational measurement bound remains an ex-

perimental question.

Recent experimental context: In 2020, scientists measured an extremely short time interval of 247 zeptoseconds ($247 \times 10^{-21} seconds$) during the photoionization of a hydrogen molecule. While this demonstrates the incredible precision of modern quantum measurements, the APM suggests that there exists an even smaller, fundamental time unit that may be beyond our current measurement capabilities.

Potential applications:

Defining the ultimate limit for duration of quantum state transitions

Providing a theoretical foundation for understanding the fastest possible quantum processes

Establishing a baseline for analyzing temporal aspects of quantum entanglement

Offering new perspectives on the nature of time in quantum field theories

This unit is central to the APM's concept of a quantized Aether with inherent temporal oscillations. By defining a fundamental four-dimensional registration interval, the APM provides a natural and consistent way to understand temporal phenomena at quantum scales, potentially offering profound insights into the structure of time and the behavior of matter at the most fundamental level.

Note: This distinction between continuous intrinsic temporal dynamics and discrete four-dimensional registration is specific to the APM and remains to be established experimentally.

Spatio-Temporal Dynamics

Dynamic units

Orbital Volume Evolution `ovev`

QMU primitive representation: ovev $= \dfrac{{\lambda_C}^3}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: ovev voqo $= 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$ovev = \frac{{\lambda_C}^3}{{F_q}^3} = volm \cdot orbt \cdot time$$

Physical interpretation:

Represents the evolution of a quantum volume through orbital motion and linear time

Quantifies the interplay between spatial volume, orbital period, and linear temporal progression

Describes the three-dimensional temporal structure of quantum orbital systems

Significance:

Emerges from the APM's concept of Aether units and their complex temporal dynamics

Provides a measure of how quantum volumes evolve through both orbital and linear time

Emphasizes the multidimensional nature of time in quantum orbital systems

Potential applications:

Analyzing the behavior of quantum particles in complex orbital systems

Characterizing the stability and evolution of atomic and molecular orbitals

Studying the interplay between orbital motion and linear time progression in quantum systems

Describing quantum processes that involve both cyclic and linear temporal components

This unit offers a unique perspective on how quantum volumes evolve through both orbital and linear time. By combining the quantum volume (${\lambda_C}^3$) with orbit time ($\frac{1}{{F_q}^2}$) and linear time ($\frac{1}{F_q}$), *ovev* allows for the quantification of phenomena that involve spatial extent, orbital periodicity, and linear temporal progression within the Aether framework.

The inclusion of orbit time (time squared) reflects the cyclic nature of orbital motion, while the additional linear time dimension accounts for the overall temporal evolution of the system. This three-dimensional temporal structure (two dimensions from orbit time and one from linear time) provides a more complete description of temporal dynamics in quantum orbital systems.

Note: The *ovev* unit in the APM emphasizes the model's ability to describe quantum phenomena that involve complex temporal structures, including both orbital and linear time components. This unit is distinct in its recognition of time's multidimensional nature in quantum orbital systems, potentially offering new insights into atomic and molecular behavior, quantum coherence in cyclic systems, and the fundamental nature of time itself in the quantum realm.

Volumetric Orbital Coherence `voco`

QMU primitive representation: $\text{voco} = \dfrac{{\lambda_C}^3}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\text{voco}\,\text{vlmr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$voco = \frac{{\lambda_C}^3}{{F_q}^2}$$

Physical interpretation:

Represents the coherence of a quantum volume over a complete orbital cycle

Quantifies the persistence of spatial configuration through one full orbital period

Describes the volumetric stability of quantum systems in cyclic motion

Significance:

Emerges from the APM's concept of Aether units and their orbital dynamics

Provides a measure of how quantum volumes maintain coherence over one orbital period

Emphasizes the relationship between spatial volume and cyclic temporal behavior

Potential applications:

Analyzing the stability of electron orbitals in atoms

Characterizing the coherence of quantum states in cyclic systems

Studying the volumetric properties of quantum oscillators

Describing the spatial-temporal structure of standing waves in quantum fields

This unit offers a unique perspective on how quantum volumes maintain coherence through a complete orbital cycle. By combining the quantum volume (${\lambda_C}^3$) with orbit time ($\frac{1}{{F_q}^2}$), *voco* allows for the quantification of phenomena that involve spatial extent and cyclic temporal behavior within the Aether framework.

The inclusion of orbit time (*time* squared) reflects the complete cycle of orbital motion, providing insight into how quantum systems maintain their volumetric integrity over one full period of cyclic behavior. This two-dimensional temporal structure (from orbit time) combined with the spatial volume offers a comprehensive description of coherence in quantum orbital systems.

Note: The *voco* unit in the APM emphasizes the model's ability to describe quantum phenomena that involve volumetric coherence over cyclic time periods. This unit is distinct in its focus on the interplay between spatial volume and orbital time, potentially offering new insights into the stability of atomic and molecular orbitals, the behavior of quantum oscillators, and the nature of coherence in cyclic quantum systems. It differs from *ovev* by excluding the linear time dimension, focusing solely on the relationship between volume and orbital periodicity.

Volume-Time `vlmt`

QMU primitive representation: $\mathrm{vlmt} = \dfrac{{\lambda_C}^3}{F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{vlmt}\,\mathrm{vlmw} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$vlmt = \frac{{\lambda_C}^3}{F_q}$$

Physical interpretation:

Represents the product of quantum volume and linear time

Quantifies the persistence or evolution of a quantum volume over a single time unit

Describes the fundamental space-time extent of quantum events

Significance:

Emerges from the APM's concept of Aether units and their basic space-time properties

Provides a measure of the simplest space-time quantum of events or processes

Emphasizes the fundamental connection between spatial volume and linear time in quantum phenomena

Potential applications:

Analyzing the basic space-time structure of quantum interactions

Characterizing the minimal space-time extent of quantum fluctuations

Studying the volumetric evolution of quantum states over short time scales

Describing the fundamental building blocks of more complex quantum processes

This unit offers a perspective on the most basic space-time quantum in the Aether Physics Model. By combining the quantum volume (${\lambda_C}^3$) with a single quantum time unit ($\frac{1}{F_q}$), vlmt allows for the quantification of the simplest possible space-time events or processes within the Aether framework.

The *vlmt* unit represents a more fundamental space-time quantum compared to units that incorporate orbital time. It describes how a quantum volume persists or changes over the most basic time interval, providing insight into the foundational nature of space-time in the quantum realm.

Note: The *vlmt* unit in the APM emphasizes the model's ability to describe the most fundamental space-time quanta of quantum phenomena. This unit is distinct in its simplicity, focusing on the basic relationship between volume and linear time without incorporating more complex temporal structures. It serves as a foundational unit for understanding more complex quantum space-time phenomena and may offer insights into the basic fabric of space-time at the quantum level.

Temporal Area Flux `tafx`

QMU primitive representation: $\text{tafx} = \dfrac{{\lambda_C}^2}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{tafx}\,\text{tqod} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$tafx = \frac{{\lambda_C}^2}{{F_q}^3} = area \cdot orbt \cdot time$$

Physical interpretation:

Represents the flux of a quantum area through orbital and linear time dimensions

Quantifies the temporal evolution of a two-dimensional quantum surface

Describes the interplay between spatial area, orbital cycles, and linear temporal progression

Significance:

Emerges from the APM's concept of Aether units and their complex surface dynamics

Provides a measure of how quantum areas evolve through both orbital and linear time

Emphasizes the multidimensional nature of time in quantum surface phenomena

Potential applications:

Analyzing the behavior of quantum surfaces in cyclic systems

Characterizing the temporal evolution of two-dimensional quantum structures

Studying the interaction between surface phenomena and complex temporal processes

Describing quantum processes that involve both cyclic and linear temporal components in planar systems

This unit offers a unique perspective on how quantum areas evolve through both orbital and linear time. By combining the quantum area (${\lambda_C}^2$) with orbit time ($\frac{1}{{F_q}^2}$) and linear time ($\frac{1}{F_q}$), $tafx$ allows for the quantification of phenomena that involve spatial extent in two dimensions, orbital periodicity, and linear temporal progression within the Aether framework.

The inclusion of orbit time (*time* squared) reflects the cyclic nature of orbital motion, while the additional linear time dimension accounts for the overall temporal evolution of the system. This three-dimensional temporal structure (two dimensions from orbit time and one from linear time) provides a comprehensive description of temporal dynamics in quantum surface systems.

Note: The $tafx$ unit in the APM emphasizes the model's ability to describe quantum phenomena that involve complex temporal structures in two-dimensional spatial systems. This unit is distinct in its recognition of time's multidimensional nature in quantum surface dynamics, potentially offering new insights into phenomena such as quantum Hall effects, surface plasmons, and two-dimensional quantum materials. It differs from previous units by focusing on area rather than volume, while still incorporating the complex temporal structure.

Area-Time Flux `atfx`

QMU primitive representation: $\mathrm{atfx} = \dfrac{{\lambda_C}^2}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{atfx}\,\mathrm{tvsr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$atfx = \frac{{\lambda_C}^2}{{F_q}^2} = area \cdot orbt$$

Physical interpretation:

Represents the flux of a quantum area through a complete orbital cycle

Quantifies the persistence or evolution of a two-dimensional quantum surface over one orbital period

Describes the interplay between spatial area and cyclic temporal behavior

Significance:

Emerges from the APM's concept of Aether units and their surface dynamics in orbital systems

Provides a measure of how quantum areas maintain coherence or evolve over one orbital period

Emphasizes the relationship between two-dimensional space and cyclic time in quantum phenomena

Potential applications:

Analyzing the stability of two-dimensional quantum structures in cyclic systems

Characterizing the coherence of surface states in atomic and molecular orbitals

Studying the behavior of quantum Hall systems and other two-dimensional quantum effects

Describing the spatial-temporal structure of standing waves on quantum surfaces

This unit offers a unique perspective on how quantum areas evolve through a complete orbital cycle. By combining the quantum area (${\lambda_C}^2$) with orbit time ($\frac{1}{{F_q}^2}$), $atfx$ allows for the quantification of phenomena that involve spatial extent in two dimensions and cyclic temporal behavior within the Aether framework.

The inclusion of orbit time (*time* squared) reflects the complete cycle of orbital motion, providing insight into how two-dimensional quantum systems maintain their integrity or evolve over one full period of cyclic behavior.

Note: The $atfx$ unit in the APM emphasizes the model's ability to describe quantum phenomena that involve area coherence over cyclic time periods. This unit is distinct in its focus on the interplay between two-dimensional space and orbital time, potentially offering new insights into surface phenomena in quantum systems, the behavior of electrons in two-dimensional materials, and the nature of coherence in planar cyclic quantum systems. It differs from volume-based units by focusing on area, and from linear time units by incorporating the cyclic nature of orbital time.

Active Area `acta`

QMU primitive representation: $\text{acta} = \dfrac{{\lambda_C}^2}{F_q}$.

Family grid Dependency index

Catalog reciprocal: $\text{acta}\,\text{tvsw} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$acta = \frac{{\lambda_C}^2}{F_q} = area \cdot time$$

Physical interpretation:

Represents the product of quantum area and linear time

Quantifies the active or dynamic two-dimensional space over a single time unit

Describes the fundamental area-time extent of quantum surface phenomena

Significance:

Emerges from the APM's concept of Aether units and their basic surface dynamics

Provides a measure of the simplest area-time quantum of events or processes

Emphasizes the fundamental connection between spatial area and linear time in quantum surface interactions

Potential applications:

Analyzing the basic area-time structure of quantum surface interactions

Characterizing the minimal area-time extent of two-dimensional quantum fluctuations

Studying the evolution of quantum surface states over short time scales

Describing the fundamental building blocks of more complex planar quantum processes

This unit offers a perspective on the most basic area-time quantum in the Aether Physics Model. By combining the quantum area ($\lambda_C{}^2$) with a single quantum time unit ($\frac{1}{F_q}$), *acta* allows for the quantification of the simplest possible area-time events or processes within the Aether framework.

The *acta* unit represents a fundamental area-time quantum. It describes how a quantum area persists or changes over the most basic time interval, providing insight into the foundational nature of surface phenomena in the quantum realm.

Note: The *acta* unit in the APM emphasizes the model's ability to describe the most fundamental area-time quanta of quantum phenomena. This unit is distinct in its focus on two-dimensional space evolving over linear time, without incorporating more complex temporal structures like orbital time. It serves as a foundational unit for understanding quantum surface phenomena and may offer insights into processes in two-dimensional quantum systems, such as graphene or quantum wells. The *acta* unit bridges the concepts of spatial area and temporal evolution in a simple, yet profound way within the APM framework.

Helical Path Length `hepl`

QMU primitive representation: $\mathrm{hepl} = \dfrac{\lambda_C}{{F_q}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{hepl}\,\mathrm{sqod} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$hepl = \frac{\lambda_C}{{F_q}^3}$$

Physical interpretation:

Represents the characteristic length of a helical path traced by a quantum entity in space-time

Quantifies the spatial extent of orbital motion when considering both rotation and translation

Describes the average radius or total path length of quantum systems undergoing periodic motion in a moving reference frame

Significance:

Emerges from the APM's concept of combining orbital motion with linear translation in quantum systems

Provides a measure of how quantum orbital paths extend in space when considering larger-scale motions

Inversely related to the cube of quantum frequency, emphasizing the impact of rapid oscillations on path geometry

Potential applications:

Analyzing the behavior of quantum particles in complex orbital systems, like electrons in atoms moving through space

Characterizing the effective "reach" or influence of quantum systems undergoing both rotation and translation

Studying the coupling between different scales of motion in quantum phenomena, from atomic to galactic

Describing quantum coherence lengths in systems with multiple, nested periodic motions

The Helical Path Length (*hepl*) unit offers a unique perspective on how quantum entities behave when undergoing multiple types of periodic motion simultaneously. By relating the Compton wavelength to the cube of quantum frequency, *hepl* allows for the quantification of phenomena where orbital motion is combined with larger-scale translations.

This unit is particularly useful for describing scenarios where quantum systems experience nested periodicities, similar to the example of a planet orbiting a star as the star moves through a galaxy. It could be instrumental in understanding phenomena such as electron behavior in moving atoms, quantum coherence in complex systems, or even drawing analogies between quantum and astronomical systems.

The inverse cubic relationship with frequency emphasizes how rapid quantum oscillations can significantly affect the overall path geometry, potentially leading to interesting interference or resonance effects at certain scales.

Quantum Trajectory Length `qtrl`

QMU primitive representation: $\mathrm{qtrl} = \dfrac{\lambda_C}{{F_q}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{qtrl}\,\mathrm{sclr} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$qtrl = \frac{\lambda_C}{{F_2}^2}$$

Physical interpretation:

Represents the characteristic length of a trajectory traced by a quantum entity in space-time

Quantifies the spatial extent of motion for a quantum system over a given number of oscillations

Describes the average distance covered by a quantum particle or wave during one period of its fundamental frequency

Significance:

Emerges from the APM's concept of relating spatial displacement to quantum oscillations

Provides a measure of how far a quantum entity "travels" in space during one cycle of its intrinsic frequency

Inversely related to the square of quantum frequency, emphasizing the relationship between oscillation rate and spatial extent

Potential applications:

Analyzing the effective range of quantum particles in various environments

Characterizing the coherence length of quantum waves in different media

Studying the relationship between a particle's de Broglie wavelength and its quantum trajectory

Describing the spatial extent of quantum tunneling phenomena

The Quantum Trajectory Length (*qtrl*) unit offers a unique perspective on how the motion of quantum entities relates to their intrinsic frequency. By relating the Compton wavelength to the square of quantum frequency, *qtrl* allows for the quantification of the spatial extent of quantum motion over a single oscillation period.

It could be instrumental in understanding phenomena such as electron diffraction, neutron scattering, or the propagation of quantum information.

The inverse square relationship with frequency emphasizes how the spatial extent of quantum motion is intimately tied to its oscillation rate. This could lead to interesting insights into the balance between localization and delocalization in quantum systems.

Note: The *qtrl* unit in the APM framework provides a tool for exploring the connection between the temporal and spatial aspects of quantum motion. It bridges the gap between frequency-based descriptions (like energy or momentum) and space-based descriptions (like position or wavelength) of quantum phenomena. This unit is distinct from others in the APM as it specifically focuses on the characteristic length associated with a single cycle of quantum oscillation, providing a new way to visualize and quantify quantum trajectories.

Dynamic Length `dynl`

QMU primitive representation: $\mathrm{dynl} = \dfrac{\lambda_C}{F_q}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{dynl}\,\mathrm{sclw} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$dynl = \frac{\lambda_C}{F_q}$$

Physical interpretation:

Represents a characteristic length scale that evolves with the quantum frequency

Quantifies the spatial extent of quantum processes that are coupled to fundamental oscillations

Describes a dynamic measure of distance in quantum systems that adapts to the system's intrinsic frequency

Significance:

Emerges from the APM's concept of linking spatial dimensions to quantum temporal oscillations

Provides a measure of how quantum length scales adjust in response to changes in frequency

Inversely related to quantum frequency, emphasizing the reciprocal nature of spatial and temporal quantum phenomena

Potential applications:

Analyzing the effective size of quantum systems under various energetic conditions

Characterizing the spatial reach of quantum interactions as a function of frequency

Studying the relationship between wavelength and frequency in quantum contexts

Describing the dynamic nature of quantum mechanical boundaries and barriers

The Dynamic Length (*dynl*) unit offers a unique perspective on how length scales in quantum systems are inherently tied to their fundamental frequencies. By directly relating the Compton wavelength to the quantum frequency, *dynl* allows for the quantification of spatial dimensions that are responsive to the system's intrinsic oscillations.

This unit is particularly useful for describing scenarios where the relevant length scale of a quantum system changes based on its energetic state or environmental interactions. It could be instrumental in understanding phenomena such as the size of atomic orbitals, the effective range of quantum tunneling, or the spatial extent of quantum coherence in various systems.

The inverse relationship with frequency emphasizes how higher frequency oscillations correspond to shorter dynamic lengths, aligning with our understanding of higher energy states being associated with more localized quantum behaviors.

Note: The *dynl* unit in the APM framework provides a tool for exploring the fluid nature of spatial dimensions in quantum contexts. It bridges the gap between static, classical notions of length and the dynamic, frequency-dependent nature of quantum phenomena. This unit is distinct from others in the APM as it directly couples a fundamental length (Compton wavelength) with the system's intrinsic frequency, offering a new way to conceptualize and quantify the adaptive spatial properties of quantum systems.

This unit could be particularly relevant in discussions of quantum confinement, the behavior of particles in potential wells of varying sizes, and in understanding how quantum systems respond spatially to changes in their energetic conditions. It may also provide insights into the nature of space itself at quantum scales, suggesting a dynamic, frequency-dependent structure to the fabric

of space-time in the Aether Physics Model.

Substrate units

Volumetric Quantum Oscillation `voqo`

QMU primitive representation: $\text{voqo} = \frac{{F_q}^3}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: voqo ovev = 1 (as a formal reciprocal of the stated QMU dimensions).

Definition

$$voqo = \frac{{F_q}^3}{{\lambda_C}^3}$$

Physical interpretation:

Represents the density of quantum oscillations within a given volume of space-time

Quantifies the rate of quantum fluctuations per unit volume in the Aether

Describes the intensity of quantum activity in a three-dimensional region of space

Significance:

Emerges from the APM's concept of relating quantum frequency to three-dimensional space

Provides a measure of how "active" or "energetic" a region of quantum space is

Directly related to the cube of quantum frequency and inversely related to the cube of Compton wavelength, emphasizing the relationship between high-frequency oscillations and small spatial scales

Potential applications:

Analyzing the distribution of quantum energy in space

Characterizing the intensity of vacuum fluctuations in different regions

Studying the relationship between spatial scale and quantum activity

Describing the "quantum density" of various physical systems or environments

The Volumetric Quantum Oscillation (*voqo*) unit offers a unique perspective on how quantum activity is distributed in three-dimensional space. By relating the cube of quantum frequency to the cube of Compton wavelength, *voqo* allows for the quantification of quantum phenomena in terms of their spatial and temporal density.

This unit is particularly useful for describing scenarios where we need to consider the concentration of quantum events or processes within a given volume. It could be instrumental in understanding phenomena such as vacuum energy density, the spatial distribution of virtual particle pairs, or the intensity of quantum fields in various contexts.

The cubic relationship with frequency emphasizes how small changes in frequency can lead to large changes in the volumetric quantum activity. This could lead to insights into threshold effects or phase transitions in quantum systems.

Note: The *voqo* unit in the APM framework provides a tool for exploring the distribution and intensity of quantum phenomena in three-dimensional space. It bridges the gap between frequency-based descriptions of quantum behavior and spatial descriptions of classical phenomena. This unit is distinct from others in the APM as it specifically focuses on the volumetric density of quantum oscillations, providing a new way to quantify and visualize the "quantum richness" of different regions of space-time.

This unit could be particularly relevant in discussions of quantum vacuum energy, cosmological theories involving quantum fluctuations, and in understanding the fundamental nature of space itself in the context of the Aether Physics Model.

Volumetric Resonance `vlmr`

QMU primitive representation: $\text{vlmr} = \dfrac{{F_q}^2}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\text{vlmr}\,\text{voco} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$vlmr = \frac{{F_q}^2}{{\lambda_C}^3}$$

Physical interpretation:

Represents the intensity of resonant phenomena within a given volume of space

Quantifies the density of resonant modes or standing waves in a three-dimensional quantum system

Describes the capacity of a volume to sustain coherent oscillations at the quantum level

Significance:

Emerges from the APM's concept of relating resonant behavior to three-dimensional quantum space

Provides a measure of how "resonant" or "coherent" a region of quantum space is

Directly related to the square of quantum frequency and inversely related to the cube of Compton wavelength, emphasizing the relationship between resonance and spatial scale

Potential applications:

Analyzing the distribution of resonant modes in quantum cavities or confined spaces

Characterizing the density of standing waves in various quantum systems

Studying the relationship between spatial scale and the capacity for coherent oscillations

Describing the "resonance capacity" of different physical environments or materials

The Volumetric Resonance (*vlmr*) unit offers a unique perspective on how resonant phenomena are distributed and sustained in three-dimensional quantum space. By relating the square of quantum frequency to the cube of Compton wavelength, *vlmr* allows for the quantification of a volume's capacity to support coherent oscillations or standing waves.

This unit is particularly useful for describing scenarios where we need to consider the concentration of resonant modes within a given volume. It could be instrumental in understanding phenomena such as cavity quantum electrodynamics, phonon distributions in solid-state physics, or the behavior of quantum fluids and superfluids.

The square relationship with frequency, coupled with the inverse cube relationship to length, emphasizes how resonant phenomena are highly sensitive to both the characteristic frequency of the system and its spatial dimensions. This could lead to insights into size-dependent quantum effects, resonance conditions in nanostructures, or the behavior of quantum systems in confined geometries.

Note: The *vlmr* unit in the APM framework provides a tool for exploring the distribution and intensity of resonant phenomena in three-dimensional quantum space. It bridges the gap between frequency-based descriptions of resonance and spatial descriptions of quantum confinement. This unit is distinct from others in the APM as it specifically focuses on the volumetric density of resonant modes, providing a new way to quantify and visualize the "resonance richness" of different regions of space-time.

This unit could be particularly relevant in discussions of quantum optics, condensed matter physics, and in understanding the fundamental nature of coherent oscillations in quantum systems. It may offer new perspectives on how quantum systems store and exchange energy through resonant modes, and how these modes are influenced by the geometry and scale of the system.

Volumetric Wave Frequency `vlmw`

QMU primitive representation: $\mathrm{vlmw} = \dfrac{F_q}{{\lambda_C}^3}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{vlmw}\,\mathrm{vlmt} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$vlmw = \frac{F_q}{{\lambda_C}^3}$$

Physical interpretation:

Represents the frequency of quantum waves or oscillations per unit volume of space

Quantifies the density of wave phenomena in a three-dimensional quantum system

Describes the rate of quantum fluctuations or oscillations occurring within a given volume

Significance:

Emerges from the APM's concept of relating wave frequency to three-dimensional quantum space

Provides a measure of how "wave-active" a region of quantum space is

Directly related to quantum frequency and inversely related to the cube of Compton wavelength, emphasizing the relationship between wave phenomena and spatial scale

Potential applications:

Analyzing the distribution of wave activity in quantum fields

Characterizing the density of quantum fluctuations in vacuum or material media

Studying the relationship between spatial scale and the frequency of quantum waves

Describing the "wave activity" of different physical environments or states of matter

The Volumetric Wave Frequency (*vlmw*) unit offers a unique perspective on how wave phenomena are distributed in three-dimensional quantum space. By relating the quantum frequency to the cube of Compton wavelength, *vlmw* allows for the quantification of wave activity per unit volume.

This unit is particularly useful for describing scenarios where we need to consider the concentration of wave phenomena within a given volume. It could be instrumental in understanding phenomena such as the density of electromagnetic modes in a cavity, the distribution of phonons in a crystal lattice, or the intensity of quantum field fluctuations in different regions of space.

The linear relationship with frequency, coupled with the inverse cube relationship to length, emphasizes how wave phenomena are sensitive to both the characteristic frequency of the system and its spatial dimensions. This could lead to insights into scale-dependent wave effects, the behavior of quantum waves in confined geometries, or the nature of quantum vacuum fluctuations.

Note: The *vlmw* unit in the APM framework provides a tool for exploring the distribution and frequency of wave phenomena in three-dimensional quantum space. It bridges the gap between frequency-based descriptions of waves and spatial descriptions of quantum systems. This unit is distinct from others in the APM as it specifically focuses on the volumetric density of wave frequency, providing a new way to quantify and visualize the "wave activity" of different regions of space-time.

This unit could be particularly relevant in discussions of quantum field theory, condensed matter physics, and in understanding the fundamental nature of wave-particle duality in quantum systems. It may offer new perspectives on how quantum systems propagate information through wave phenomena, and how these waves are influenced by the geometry and scale of the system. The *vlmw* unit might also be useful in analyzing the energy density of quantum fields and the nature of quantum vacuum states.

Transverse Quantum Oscillation Density `tqod`

QMU primitive representation: $\mathrm{tqod} = \dfrac{{F_q}^3}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{tqod}\,\mathrm{tafx} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$tqod = \frac{{F_q}^3}{{\lambda_C}^2}$$

Physical interpretation:

Represents the density of quantum oscillations across a two-dimensional surface or interface

Quantifies the rate of quantum fluctuations per unit area in the Aether

Describes the intensity of quantum activity on a planar cross-section of space-time

Significance:

Emerges from the APM's concept of relating quantum frequency to two-dimensional space

Provides a measure of how "active" or "energetic" a surface or interface is at the quantum level

Directly related to the cube of quantum frequency and inversely related to the square of Compton wavelength, emphasizing the relationship between high-frequency oscillations and small spatial scales in a planar context

Potential applications:

Analyzing the distribution of quantum energy across surfaces or interfaces

Characterizing the intensity of quantum fluctuations at boundaries between different media

Studying the relationship between spatial scale and quantum activity in two-dimensional systems

Describing the "quantum surface density" of various physical systems or environments

The Transverse Quantum Oscillation Density (*tqod*) unit offers a unique perspective on how quantum activity is distributed across two-dimensional spaces or interfaces. By relating the cube of quantum frequency to the square of Compton wavelength, *tqod* allows for the quantification of quantum phenomena in terms of their surface density and temporal intensity.

This unit is particularly useful for describing scenarios where we need to consider the concentration of quantum events or processes on a surface or interface. It could be instrumental in understanding phenomena such as:

Surface states in topological insulators

Quantum Hall effect in two-dimensional electron gases

Interface phenomena in heterostructures and quantum wells

Quantum effects in graphene and other 2D materials

The cubic relationship with frequency emphasizes how small changes in frequency can lead to large changes in the surface quantum activity. This could lead to insights into threshold effects or phase transitions in planar quantum systems.

Note: The *tqod* unit in the APM framework provides a tool for exploring the distribution and intensity of quantum phenomena on two-dimensional surfaces or interfaces. It bridges the gap between frequency-based descriptions of quantum behavior and spatial descriptions of surface phenomena. This unit is distinct from others in the APM as it specifically focuses on the planar density of quantum oscillations, providing a new way to quantify and visualize the "quantum richness" of different surfaces or interfaces in space-time.

This unit could be particularly relevant in discussions of surface physics, interface phenomena in quantum systems, and in understanding the behavior of quasi-two-dimensional quantum systems. It may offer new insights into the nature of quantum confinement in layered structures and the behavior of quantum fields near boundaries or interfaces.

Transverse Surface Resonance `tvsr`

QMU primitive representation: $\mathrm{tvsr} = \dfrac{{F_q}^2}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{tvsr}\,\mathrm{atfx} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$tvsr = \frac{{F_q}^2}{{\lambda_C}^2}$$

Physical interpretation:

Represents the intensity of resonant phenomena across a two-dimensional surface or interface

Quantifies the density of resonant modes or standing waves in a planar quantum system

Describes the capacity of a surface to sustain coherent oscillations at the quantum level

Significance:

Emerges from the APM's concept of relating resonant behavior to two-dimensional quantum space

Provides a measure of how "resonant" or "coherent" a surface or interface is at the quantum level

Directly related to the square of quantum frequency and inversely related to the square of Compton wavelength, emphasizing the balance between resonance and spatial scale in planar systems

Potential applications:

Analyzing the distribution of resonant modes on surfaces or interfaces

Characterizing the density of standing waves in two-dimensional quantum systems

Studying the relationship between spatial scale and the capacity for coherent oscillations on surfaces

Describing the "surface resonance capacity" of different physical interfaces or materials

The Transverse Surface Resonance (*tvsr*) unit offers a unique perspective on how resonant phenomena are distributed and sustained on two-dimensional surfaces or interfaces in quantum systems. By relating the square of quantum frequency to the square of Compton wavelength, *tvsr* allows for the quantification of a surface's capacity to support coherent oscillations or standing waves.

This unit is particularly useful for describing scenarios where we need to consider the concentration of resonant modes on a given surface. It could be instrumental in understanding phenomena such as:

Surface plasmons in metallic nanostructures

Quantum well states in semiconductor heterostructures

Resonant modes in two-dimensional photonic crystals

Surface acoustic waves in quantum systems

The square relationship with both frequency and length emphasizes a direct correspondence between the characteristic frequency of the system and its spatial dimensions. This could lead to insights into size-dependent resonant effects in nanostructures, surface-specific quantum phenomena, or the behavior of quantum systems at interfaces.

Note: The *tvsr* unit in the APM framework provides a tool for exploring the distribution and intensity of resonant phenomena on two-dimensional surfaces in quantum space. It bridges the gap between frequency-based descriptions of resonance and spatial descriptions of surface quantum behavior. This unit is distinct from others in the APM as it specifically focuses on the surface density of resonant modes, providing a new way to quantify and visualize the "resonance richness" of different interfaces or surfaces in space-time.

This unit could be particularly relevant in discussions of surface science, interface physics, and in understanding the fundamental nature of coherent oscillations in planar quantum systems. It may offer new perspectives on how quantum systems store and exchange energy through surface resonant modes, and how these modes are influenced by the geometry and scale of the interface or surface.

Transverse Surface Wave `tvsw`

QMU primitive representation: $\mathrm{tvsw} = \dfrac{F_q}{{\lambda_C}^2}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{tvsw}\,\mathrm{acta} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$tvsw = \frac{F_q}{{\lambda_C}^2}$$

Physical interpretation:

Represents the frequency of quantum waves or oscillations per unit area on a surface or interface

Quantifies the density of wave phenomena in a two-dimensional quantum system

Describes the rate of quantum fluctuations or oscillations occurring across a given surface area

Significance:

Emerges from the APM's concept of relating wave frequency to two-dimensional quantum space

Provides a measure of how "wave-active" a surface or interface is at the quantum level

Directly related to quantum frequency and inversely related to the square of Compton wavelength, emphasizing the relationship between wave phenomena and spatial scale on surfaces

Potential applications:

Analyzing the distribution of wave activity on quantum interfaces or surfaces

Characterizing the density of quantum fluctuations on material boundaries or interfaces

Studying the relationship between surface area and the frequency of quantum waves

Describing the ”surface wave activity” of different physical environments or states of matter

The Transverse Surface Wave (*tvsw*) unit offers a unique perspective on how wave phenomena are distributed across two-dimensional surfaces or interfaces in quantum systems. By relating the quantum frequency to the square of Compton wavelength, *tvsw* allows for the quantification of wave activity per unit surface area.

This unit is particularly useful for describing scenarios where we need to consider the concentration of wave phenomena on a given surface. It could be instrumental in understanding phenomena such as:

Surface states in topological insulators

Evanescent waves at interfaces

Two-dimensional electron gases in semiconductor heterostructures

Surface plasmon polaritons in nanophotonics

The linear relationship with frequency, coupled with the inverse square relationship to length, emphasizes how surface wave phenomena are sensitive to both the characteristic frequency of the system and its spatial dimensions. This could lead to insights into scale-dependent surface wave effects, the behavior of quantum waves at interfaces, or the nature of quantum fluctuations on surfaces.

Note: The *tvsw* unit in the APM framework provides a tool for exploring the distribution and frequency of wave phenomena on two-dimensional surfaces in quantum space. It bridges the gap between frequency-based descriptions of waves and spatial descriptions of surface quantum systems. This unit is distinct from others in the APM as it specifically focuses on the surface density of wave frequency, providing a new way to quantify and visualize the ”wave activity” of different surfaces or interfaces in space-time.

This unit could be particularly relevant in discussions of surface physics, interface phenomena in quantum systems, and in understanding the fundamental nature of wave-particle duality in confined geometries. It may offer new perspectives on how quantum systems propagate information through surface wave phenomena, and how these waves are influenced by the geometry and scale of the interface or surface. The *tvsw* unit might also be useful in analyzing energy transport along surfaces, the behavior of quantum systems in layered structures, and the nature of quantum vacuum states near boundaries.

Scalar Quantum Oscillation Density `sqod`

QMU primitive representation: $\text{sqod} = \dfrac{{F_q}^3}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\text{sqod}\,\text{hepl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sqod = \frac{{F_q}^3}{\lambda_C}$$

Physical interpretation:

Represents the density of quantum oscillations along a linear dimension or path

Quantifies the rate of quantum fluctuations per unit length in the Aether

Describes the intensity of quantum activity along a one-dimensional trajectory or line

Significance:

Emerges from the APM's concept of relating quantum frequency to one-dimensional space

Provides a measure of how "active" or "energetic" a linear path is at the quantum level

Directly related to the cube of quantum frequency and inversely related to the Compton wavelength, emphasizing the relationship between high-frequency oscillations and small spatial scales in a linear context

Potential applications:

Analyzing the distribution of quantum energy along linear structures or paths

Characterizing the intensity of quantum fluctuations in one-dimensional systems

Studying the relationship between spatial scale and quantum activity in linear quantum systems

Describing the "quantum linear density" of various physical systems or environments

The Scalar Quantum Oscillation Density (*sqod*) unit offers a unique perspective on how quantum activity is distributed along one-dimensional paths or structures. By relating the cube of quantum frequency to the Compton wavelength, *sqod* allows for the quantification of quantum phenomena in terms of their linear density and temporal intensity.

This unit is particularly useful for describing scenarios where we need to consider the concentration of quantum events or processes along a line or in one-dimensional systems. It could be instrumental in understanding phenomena such as:

Quantum behavior in nanowires or carbon nanotubes

One-dimensional electron gases in quantum wires

Quantum transport in molecular chains

Propagation of quantum information along linear pathways

The cubic relationship with frequency emphasizes how small changes in frequency can lead to large changes in the linear quantum activity. This could lead to insights into threshold effects or phase transitions in one-dimensional quantum systems.

Note: The *sqod* unit in the APM framework provides a tool for exploring the distribution and intensity of quantum phenomena along one-dimensional paths or structures. It bridges the gap between frequency-based descriptions of quantum behavior and spatial descriptions of linear phenomena. This unit is distinct from others in the APM as it specifically focuses on the linear density

of quantum oscillations, providing a new way to quantify and visualize the "quantum richness" of different linear paths or one-dimensional structures in space-time.

This unit could be particularly relevant in discussions of quantum transport, one-dimensional condensed matter systems, and in understanding the behavior of quantum fields confined to linear geometries. It may offer new insights into the nature of quantum confinement in one-dimensional structures and the behavior of quantum waves propagating along defined paths.

Scalar Resonance `sclr`

QMU primitive representation: $\mathrm{sclr} = \dfrac{{F_q}^2}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sclr}\,\mathrm{qtrl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sclr = \frac{{F_q}^2}{\lambda_C}$$

Physical interpretation:

Represents the intensity of resonant phenomena along a linear dimension or path

Quantifies the density of resonant modes or standing waves in a one-dimensional quantum system

Describes the capacity of a linear structure to sustain coherent oscillations at the quantum level

Significance:

Emerges from the APM's concept of relating resonant behavior to one-dimensional quantum space

Provides a measure of how "resonant" or "coherent" a linear path or structure is at the quantum level

Directly related to the square of quantum frequency and inversely related to the Compton wavelength, emphasizing the balance between resonance and spatial scale in linear systems

Potential applications:

Analyzing the distribution of resonant modes along linear structures

Characterizing the density of standing waves in one-dimensional quantum systems

Studying the relationship between spatial scale and the capacity for coherent oscillations in linear paths

Describing the "linear resonance capacity" of different physical structures or materials

The Scalar Resonance (*sclr*) unit offers a unique perspective on how resonant phenomena are distributed and sustained along one-dimensional paths or structures in quantum systems. By relating the square of quantum frequency to the Compton wavelength, *sclr* allows for the quantification of a linear structure's capacity to support coherent oscillations or standing waves.

This unit is particularly useful for describing scenarios where we need to consider the concentration of resonant modes along a given path. It could be instrumental in understanding phenomena such as:

Resonant modes in quantum wires or carbon nanotubes

Standing waves in one-dimensional optical cavities

Phonon modes in linear atomic chains

Quantum interference effects in linear structures

The square relationship with frequency and inverse relationship with length emphasizes how resonant phenomena in linear systems are sensitive to both the characteristic frequency of the system and its spatial dimension. This could lead to insights into size-dependent resonant effects in nanostructures, quantum confinement in one-dimensional systems, or the behavior of quantum waves in linear potentials.

Note: The *sclr* unit in the APM framework provides a tool for exploring the distribution and intensity of resonant phenomena along one-dimensional paths in quantum space. It bridges the gap between frequency-based descriptions of resonance and spatial descriptions of linear quantum behavior. This unit is distinct from others in the APM as it specifically focuses on the linear density of resonant modes, providing a new way to quantify and visualize the "resonance richness" of different linear structures or paths in space-time.

This unit could be particularly relevant in discussions of quantum optics in waveguides, electron transport in molecular wires, and in understanding the fundamental nature of coherent oscillations in linear quantum systems. It may offer new perspectives on how quantum systems store and exchange energy through linear resonant modes, and how these modes are influenced by the length and characteristics of the one-dimensional structure.

Scalar Wave `sclw`

QMU primitive representation: $\mathrm{sclw} = \dfrac{F_q}{\lambda_C}$.

Family grid Dependency index

Catalog reciprocal: $\mathrm{sclw}\,\mathrm{dynl} = 1$ (as a formal reciprocal of the stated QMU dimensions).

Definition

$$sclw = \frac{F_q}{\lambda_C}$$

Physical interpretation:

Represents the frequency of quantum waves or oscillations per unit length along a linear dimension or path

Quantifies the density of wave phenomena in a one-dimensional quantum system

Describes the rate of quantum fluctuations or oscillations occurring along a given linear path

Significance:

Emerges from the APM's concept of relating wave frequency to one-dimensional quantum space

Provides a measure of how "wave-active" a linear path or structure is at the quantum level

Directly related to quantum frequency and inversely related to the Compton wavelength, emphasizing the fundamental relationship between wave phenomena and spatial scale in linear systems

Potential applications:

Analyzing the distribution of wave activity along quantum wires or linear structures

Characterizing the density of quantum fluctuations in one-dimensional systems

Studying the relationship between length and the frequency of quantum waves in linear geometries

Describing the "linear wave activity" of different physical environments or states of matter

The Scalar Wave (*sclw*) unit offers a unique perspective on how wave phenomena are distributed along one-dimensional paths or structures in quantum systems. By directly relating the quantum frequency to the Compton wavelength, *sclw* allows for the quantification of wave activity per unit length.

This unit is particularly useful for describing scenarios where we need to consider the concentration of wave phenomena along a given path. It could be instrumental in understanding phenomena such as:

Electron wave functions in quantum wires

Propagation of electromagnetic waves in waveguides

Phonon transport in one-dimensional lattices

Quantum information transfer along linear channels

Note: The *sclw* unit in the APM framework provides a tool for exploring the distribution and frequency of wave phenomena along one-dimensional paths in quantum space. It bridges the gap between frequency-based descriptions of waves and spatial descriptions of linear quantum systems. This unit is distinct from others in the APM as it specifically focuses on the linear density of wave frequency, providing a new way to quantify and visualize the "wave activity" of different linear structures or paths in space.

This unit could be particularly relevant in discussions of quantum transport, one-dimensional condensed matter physics, and in understanding the fundamental nature of wave propagation in confined geometries. It may offer new perspectives on how quantum systems propagate information through linear wave phenomena, and how these waves are influenced by the length and characteristics of the one-dimensional structure. The *sclw* unit might also be useful in analyzing energy transport in molecular chains, the behavior of quantum systems in nanowires, and the nature of quantum vacuum states in linear cavities.

Additional catalog entries not present in website tables

Supplemental units

Eddy Current `eddy`

QMU primitive representation: $\text{eddy} = \dfrac{{m_\text{e}}^2 {\lambda_C}^4 {F_q}^2}{{e_\text{emax}}^4}$.

Dependency index

Definition

$$eddy = mflx^2 = \frac{{m_\text{e}}^2 {\lambda_C}^4 {F_q}^2}{{e_\text{emax}}^4}$$

Dimensional relationships.

$$eddy = (swep \cdot mchg)^2 = (mfld/leng)^2 = (mfxd \cdot area)^2.$$

These identities express the stated QMU construction in terms of the magnetic-flux relationships. In particular, $mfld/freq = mvlm$, not $mflx$, so the length-normalized field $mfld/leng$ is required here; they do not assert that the quantity is numerically identical to a conventional SI eddy current. Unlike the other catalog units, the current catalog does not assign a separate named reciprocal to *eddy*.

Physical interpretation:

Represents the intensity of circulating currents induced in a conducting material

Quantifies the strength of magnetic flux interactions within a medium

Describes the energy dissipation due to induced currents in response to changing magnetic fields

Significance:

Emerges from the APM's concept of magnetic flux interactions in conducting materials

Provides a measure of how strongly a material responds to changing magnetic fields

Directly related to the square of magnetic flux, emphasizing the non-linear nature of eddy current effects

Potential applications:

Analyzing energy losses in transformers and electric motors

Characterizing the electromagnetic damping in conductive materials

Studying the shielding effectiveness of materials against electromagnetic interference

Describing the heat generation in induction heating processes

The Eddy Current (*eddy*) unit offers a unique perspective on how magnetic flux interactions manifest as circulating currents within conducting materials. By defining eddy as the square of magnetic flux ($mflx^2$), it captures the intensity of these induced currents and their associated effects.

This unit is particularly useful for describing scenarios where changing magnetic fields induce currents in conducting materials. It could be instrumental in understanding phenomena such as:

Electromagnetic braking in vehicles and machinery

Magnetic levitation and its associated drag forces

Non-destructive testing of materials using eddy current techniques

Skin effect in conductors at high frequencies

The square relationship with magnetic flux emphasizes the non-linear nature of eddy current effects. Small changes in magnetic flux can lead to significant changes in eddy current intensity, which has important implications for energy efficiency and heat generation in electromagnetic systems.

Note: The *eddy* unit in the APM framework provides a tool for quantifying and analyzing the effects of induced currents in conducting materials. It bridges the gap between magnetic field theory and the practical effects observed in electrical engineering and materials science. This unit is distinct from others in the APM as it specifically focuses on the interaction between magnetic fields and conducting materials, providing a new way to quantify and visualize the "eddy current activity" in different systems.

This unit could be particularly relevant in discussions of electromagnetic induction, power loss in electrical systems, and in understanding the behavior of materials in time-varying magnetic fields. It may offer new perspectives on how to optimize electromagnetic devices for efficiency, design better shielding materials, and develop more sensitive non-destructive testing methods.

The eddy unit also has potential implications for advanced technologies such as magnetic resonance imaging (MRI), where eddy currents can affect image quality, and in the development of novel electromagnetic propulsion systems. Understanding and quantifying eddy currents through this unit could lead to improvements in these and other technologies that rely on electromagnetic interactions.

10 Applications of Quantum Measurement Units

Related QADI worked applications in laser-plasma and materials metrology include [21; 22; 23].

The QMU catalog expresses proposed Aether response quantities as primitive monomials. Their dimensional structure permits consistent comparison even before a constitutive law connects them to a measured system. Four examples illustrate this method without duplicating the unit definitions provided in the catalog.

$$\text{qamo} = \frac{\lambda_C F_q}{m_\mathrm{e}}, \qquad \text{sqfr} = \frac{F_q}{m_\mathrm{e}}, \tag{249}$$

$$\text{sqre} = \frac{{F_q}^2}{m_\mathrm{e}}, \qquad \text{sqif} = \frac{{F_q}^3}{m_\mathrm{e}}. \tag{250}$$

The first unit, Quantum Aether Mobility, combines the length and frequency scales with inverse electron mass. The remaining three units, Specific Quantum Frequency, Specific Quantum Resonance, and Specific Quantum Intensity Factor, form a frequency ladder at fixed inverse mass:

$$\text{sqre} = F_q\,\text{sqfr}, \qquad \text{sqif} = F_q\,\text{sqre}. \tag{251}$$

These are exact reference-unit relationships within the stated QMU definitions. Applications to tunneling, material transport, electromagnetic response, and quantum-state evolution require additional equations specifying the physical observable, coupling coefficients, boundary conditions,

and calibration. The unit definitions alone supply no numerical transport rate or experimental prediction.

11 Exploratory relationships among lesser-studied QMU units

Related QADI ledger constructions involving helicity, induction, and core-geometry variants appear in [24; 25; 26].

The following identities are new *algebraic cross-links* obtained by substituting the catalog's four primitive representations. They are not new empirical laws. Their purpose is to expose possible research questions while retaining the distinction between dimensional identity and physical mechanism. Throughout this section, F_q and λ_C denote the QMU frequency and length primitives, and ${e_{\mathrm{emax}}}^2$ denotes the complete distributed-charge primitive; $e_{e\,\max}$ is only a parameter in that expression.

11.1 Temporal ladders: fluctuation, conduction, and response

$$\mathrm{aefp} = F_q\,\mathrm{cond} = {F_q}^2\,\mathrm{capc}, \tag{252}$$

$$\mathrm{exdf} = F_q\,\mathrm{accp}, \tag{253}$$

$$\mathrm{mgfi} = F_q\,\mathrm{ffeq}, \tag{254}$$

$$\mathrm{mfir} = F_q\,\mathrm{ptty}, \tag{255}$$

$$\mathrm{qusi} = F_q\,\mathrm{qsrc}. \tag{256}$$

For example, the three primitive expressions are

$$\mathrm{aefp} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^2},$$

$$\mathrm{cond} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^2 F_q},$$

$$\mathrm{capc} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^2 {F_q}^2}.$$

The displayed equalities therefore follow exactly. These ladders suggest asking whether an operational experiment can separately identify the temporal response associated with each named construction. A factor of F_q alone does *not* prove a dynamical coupling or a causal conversion between them.

11.2 Surface–volume and illumination cross-links

$$\mathrm{cden} = {\lambda_C}^2\,\mathrm{cond}, \tag{257}$$

$$\mathrm{qild}\,\mathrm{ball} = 1, \tag{258}$$

$$\mathrm{qvos}\,\mathrm{qild} = \frac{\lambda_C}{{e_{\mathrm{emax}}}^2}, \tag{259}$$

$$\mathrm{qvos}\,\mathrm{qsrc} = \frac{\lambda_C}{m_{\mathrm{e}}}, \tag{260}$$

$$\mathrm{qild}\,\mathrm{chrs} = \frac{1}{{\lambda_C}^2 F_q}. \tag{261}$$

The reciprocal relation between Quantum Illumination Density (`qild`) and Ball Lightning (`ball`) is a formal catalog reciprocal, *not* evidence that laboratory ball lightning is governed by this expression. More unusually, the products with Quantum Volume Oscillation (`qvos`) eliminate all frequency powers. This cancellation poses a useful modeling question: could an independently specified observable isolate the residual length-to-charge or length-to-mass ratio? A physical prediction would still require a defined observable, coupling mechanism, dimensional SI bridge where applicable, and a falsifiable measurement protocol.

11.3 A two-axis lattice of charge distribution: spatial order and temporal order

The less-explored volumetric, surface, and radial charge families admit a particularly transparent structure. The following table gives *primitive monomials*, not measured material coefficients. Each step to the right multiplies by F_q; each step downward divides by λ_C.

Spatial family	${F_q}^{-3}$	${F_q}^{-2}$	${F_q}^{-1}$	${F_q}^{0}$
Volume $({\lambda_C}^3/{e_{\mathrm{emax}}}^2)$	`qvci`	`qvcr`	`qvcp`	`spch`
Surface $({\lambda_C}^2/{e_{\mathrm{emax}}}^2)$	`qcdr`	`qcdp`	`qcdd`	`chds`
Radius $(\lambda_C/{e_{\mathrm{emax}}}^2)$	`qcrr`	`qcrp`	`qcrd`	`chgr`

For example, these identities hold without a new coefficient:

$$\mathrm{qvcr} = F_q\,\mathrm{qvci}, \qquad \mathrm{qvcp} = F_q\,\mathrm{qvcr}, \qquad \mathrm{spch} = F_q\,\mathrm{qvcp}, \tag{262}$$

$$\mathrm{qvci} = \lambda_C\,\mathrm{qcdr} = {\lambda_C}^2\,\mathrm{qcrr}, \qquad \mathrm{qcdp} = \lambda_C\,\mathrm{qcrp}, \qquad \mathrm{chds} = \lambda_C\,\mathrm{chgr}. \tag{263}$$

The lattice also produces *rectangle identities* whose products are equal despite different factorizations:

$$\mathrm{qvci}\,\mathrm{qcdp} = \mathrm{qvcr}\,\mathrm{qcdr}, \tag{264}$$

$$\mathrm{qvcp}\,\mathrm{chds} = \mathrm{spch}\,\mathrm{qcdd}, \tag{265}$$

$$\mathrm{qcrr}\,\mathrm{chds} = \mathrm{qcrp}\,\mathrm{qcdd}. \tag{266}$$

The first rectangle, for instance, has the same primitive product ${\lambda_C}^5 {F_q}^{-5}/{e_{\mathrm{emax}}}^4$ on either side. These cross-links provide a direct dimensional consistency check. They also invite a more interesting question: does a proposed constitutive model preserve the same two-axis factorization when spatial gradients and temporal response are measured separately? The algebra alone does not require a physical response law.

11.4 From catalog lattice to discriminating experiments

A research program could define an observable Y and two independently varied controls, one spatial and one temporal. After specifying a physical coupling and the necessary SI–QMU bridge, the model could test whether normalized responses collapse when plotted against L/λ_C and f/F_q, or whether cross-terms break the simple factorization. A failure of such collapse would test the *added constitutive hypothesis*, not disprove the primitive exponent identities. Likewise, a verified collapse would not uniquely establish Aether ontology. These distinctions make the lattice a generator of falsifiable hypotheses rather than a claim of existing experimental confirmation.

11.5 How to use the relationships

Given a target quantity $X = U/V$, express both named units as ${m_\mathrm{e}}^a {\lambda_C}^b {F_q}^c ({e_\mathrm{emax}}^2)^d$, subtract the exponent vectors, and search the full QMU catalog for the resulting vector. Exact matches yield algebraic candidates; multiple matches must be distinguished by their definitions and intended physical interpretations. If no named unit matches, retain the primitive monomial rather than inventing a physical equivalence. These identities should be used to design research questions, not to infer measurements, effects, or ontology from dimensional consistency alone.

12 Cross-family identities: magnetic, electrical, and mechanical units

Related Maxwell, circuit, and distributed-charge QMU developments are presented in [27; 28; 29; 30].

12.1 Magnetic flux, field, and inductance

The magnetic-flux, magnetic-field, inductance, and magnetic-flux-density definitions give

$$\mathrm{indc} = \frac{m_\mathrm{e} {\lambda_C}^2}{{e_\mathrm{emax}}^2}, \qquad \mathrm{mflx} = \frac{m_\mathrm{e} {\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2}, \tag{267}$$

$$\mathrm{mfld} = \frac{m_\mathrm{e} {\lambda_C}^3 F_q}{{e_\mathrm{emax}}^2}, \qquad \mathrm{mfxd} = \frac{m_e F_q}{{e_\mathrm{emax}}^2}. \tag{268}$$

Consequently,

$$\boxed{\mathrm{mflx} = F_q \,\mathrm{indc} = {\lambda_C}^2 \,\mathrm{mfxd}}, \tag{269}$$

$$\boxed{\mathrm{mfld} = \lambda_C \,\mathrm{mflx} = {\lambda_C}^3 \,\mathrm{mfxd}}, \tag{270}$$

$$\mathrm{magr} = \frac{\mathrm{mflx}}{\lambda_C}. \tag{271}$$

These relations form a spatial ladder linking flux density, flux, rigidity, and field. The equalities are identities of the primitive definitions; a constitutive interpretation would specify the geometry and boundary conditions of the magnetic configuration.

12.2 Electrical reciprocals and temporal scaling

The QMU definitions of conductance, resistance, and capacitance are

$$\mathrm{cond} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^2 F_q}, \qquad \mathrm{resn} = \frac{m_{\mathrm{e}}{\lambda_C}^2 F_q}{{e_{\mathrm{emax}}}^4}, \qquad \mathrm{capc} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^2 {F_q}^2}. \tag{272}$$

They imply the cross-family identities

$$\boxed{\mathrm{cond}\,\mathrm{mflx} = 1}, \tag{273}$$

$$\boxed{\mathrm{resn}\,\mathrm{cond} = \frac{1}{{e_{\mathrm{emax}}}^2}}, \tag{274}$$

$$\boxed{\mathrm{capc} = \frac{\mathrm{cond}}{F_q} = \frac{1}{F_q\,\mathrm{mflx}}}, \tag{275}$$

$$\boxed{\mathrm{resn}\,\mathrm{mflx} = \frac{\mathrm{mflx}^2}{{e_{\mathrm{emax}}}^2}}. \tag{276}$$

The distinction between reciprocal magnetic flux and reciprocal electrical resistance is explicit in these expressions. A comparison of QMU electrical response with laboratory impedance requires the corresponding charge normalization and measurement protocol.

12.3 Mechanical spatial and temporal ladders

For force, pressure, force density, momentum, and angular momentum,

$$\mathrm{forc} = m_{\mathrm{e}}\lambda_C {F_q}^2, \qquad \mathrm{pres} = \frac{m_e F_q^2}{\lambda_C}, \qquad \mathrm{fdns} = \frac{m_e F_q^2}{{\lambda_C}^2}, \tag{277}$$

$$\mathrm{momt} = m_{\mathrm{e}}\lambda_C F_q, \qquad \mathrm{angm} = m_{\mathrm{e}}{\lambda_C}^2 F_q. \tag{278}$$

The resulting relationships are

$$\boxed{\mathrm{forc} = {\lambda_C}^2\,\mathrm{pres} = {\lambda_C}^3\,\mathrm{fdns}}, \tag{279}$$

$$\boxed{\mathrm{forc} = F_q\,\mathrm{momt}}, \tag{280}$$

$$\boxed{\mathrm{angm} = \lambda_C\,\mathrm{momt}}, \tag{281}$$

$$\boxed{\mathrm{angm} = \frac{\lambda_C}{F_q}\,\mathrm{forc}}. \tag{282}$$

This set connects spatial concentration with temporal rate. A geometric model can assign explicit surfaces and volumes to the pressure and force-density expressions, then compare the resulting forces with a separately specified dynamical law.

12.4 Magnetic–mechanical intersection

The magnetic moment and angular momentum are respectively

$$\mathrm{magm} = {e_{\mathrm{emax}}}^2{\lambda_C}^2 F_q, \qquad \mathrm{angm} = m_{\mathrm{e}}{\lambda_C}^2 F_q. \tag{283}$$

Therefore,

$$\boxed{\frac{\mathrm{magm}}{\mathrm{angm}} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}}}. \tag{284}$$

The same charge-to-mass factor also connects the magnetic moment with the moment of inertia, $\mathrm{minr} = m_{\mathrm{e}}{\lambda_C}^2$:

$$\boxed{\mathrm{magm} = \frac{{e_{\mathrm{emax}}}^2 F_q}{m_{\mathrm{e}}}\,\mathrm{minr}}. \tag{285}$$

The geometrical question is whether a common distributed-charge configuration determines both moments through one closure construction, and which additional dimensionless factors distinguish electron, proton, and neutron cases.

12.5 Rectangle identities across unit families

Products formed along independent spatial and temporal steps admit alternative factorizations:

$$\boxed{\mathrm{mfld}\,\mathrm{indc} = \lambda_C\,\mathrm{mflx}\,\mathrm{indc}}, \tag{286}$$

$$\boxed{\mathrm{forc}\,\mathrm{momt} = F_q\,\mathrm{momt}^2}, \tag{287}$$

$$\boxed{\mathrm{fdns}\,\mathrm{angm} = \mathrm{pres}\,\mathrm{momt}}. \tag{288}$$

In the final identity both products reduce to ${m_{\mathrm{e}}}^2{F_q}^3$. These alternative factorizations provide direct algebraic checks and possible starting points for geometrical constructions involving stress, angular momentum, and force.

13 Reciprocal constitutive scales and higher-order charge dynamics

For alternative dimensional formulations and charge-aware electrical constitutive conventions, see [31; 14; 19; 20].

13.1 Permeability, permittivity, and curl

The primitive representations of permeability, permittivity, and curl are

$$\mathrm{perm} = \frac{m_{\mathrm{e}}\lambda_C}{{e_{\mathrm{emax}}}^2}, \qquad \mathrm{prmt} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}{\lambda_C}^3{F_q}^2}, \qquad \mathrm{curl} = \frac{{e_{\mathrm{emax}}}^2}{m_{\mathrm{e}}\lambda_C}. \tag{289}$$

Here the symbols perm and prmt denote the permeability and permittivity quantities, respectively:

$$\boxed{\mathrm{perm}\,\mathrm{curl} = 1}, \tag{290}$$

$$\boxed{\mathrm{perm}\,\mathrm{prmt} = \frac{1}{{\lambda_C}^2{F_q}^2} = \frac{1}{c^2}}, \tag{291}$$

$$\boxed{\frac{\mathrm{curl}}{\mathrm{prmt}} = {\lambda_C}^2{F_q}^2\,\mathrm{curl}^2}. \tag{292}$$

The second identity defines a propagation-scale invariant of the two reciprocal response quantities. The physical question is which boundary conditions allow this algebraic pairing to describe a measurable field response.

13.2 Eddy current as a quadratic flux quantity

The catalog defines

$$\mathrm{eddy} = \frac{{m_\mathrm{e}}^2 {\lambda_C}^4 {F_q}^2}{{e_\mathrm{emax}}^4}, \qquad \mathrm{mflx} = \frac{m_\mathrm{e} {\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2}, \qquad \mathrm{indc} = \frac{m_\mathrm{e} {\lambda_C}^2}{{e_\mathrm{emax}}^2}. \tag{293}$$

It follows that

$$\boxed{\mathrm{eddy} = \mathrm{mflx}^2 = {F_q}^2\,\mathrm{indc}^2}. \tag{294}$$

The quadratic form invites a geometrical examination of whether the eddy-current quantity represents a two-flux closure or a squared response amplitude. Such an interpretation requires an independent dynamical definition, not only the algebraic equality.

13.3 Magnetic impedance and spatial order

For the magnetic diffusion and flow impedances,

$$\mathrm{mdif} = \frac{m_\mathrm{e} \lambda_C F_q}{{e_\mathrm{emax}}^4}, \qquad \mathrm{mflow} = \frac{m_\mathrm{e} {\lambda_C}^3 F_q}{{e_\mathrm{emax}}^4}, \qquad \mathrm{mcur} = \frac{{e_\mathrm{emax}}^4}{m_\mathrm{e} \lambda_C {F_q}^2}. \tag{295}$$

The primitive definitions imply

$$\boxed{\mathrm{mflow} = {\lambda_C}^2\,\mathrm{mdif}}, \tag{296}$$

$$\boxed{\mathrm{mdif}\,\mathrm{mcur} = {F_q}^{-1}}, \tag{297}$$

$$\boxed{\mathrm{mflow}\,\mathrm{mcur} = {\lambda_C}^2 {F_q}^{-1}}. \tag{298}$$

The spatial step between diffusion and flow impedance is exactly an area factor, whereas their products with magnetic-current impedance isolate temporal and area–temporal scales.

13.4 A four-level charge-density frequency ladder

The charge-density family forms the sequence

$$D_0 = \frac{{e_\mathrm{emax}}^2}{{\lambda_C}^3}, \qquad D_1 = \frac{{e_\mathrm{emax}}^2 F_q}{{\lambda_C}^3}, \tag{299}$$

$$D_2 = \frac{{e_\mathrm{emax}}^2 {F_q}^2}{{\lambda_C}^3}, \qquad D_3 = \frac{{e_\mathrm{emax}}^2 {F_q}^3}{{\lambda_C}^3}. \tag{300}$$

These are the catalog's charge density, quantum charge-density oscillation, resonance, and intensity quantities, respectively. Hence

$$\boxed{D_{n+1} = F_q D_n \quad (n = 0, 1, 2)}, \tag{301}$$

$$\boxed{D_0 D_3 = D_1 D_2}, \tag{302}$$

$$\boxed{\frac{D_3}{D_1} = \frac{D_2}{D_0} = {F_q}^2}. \tag{303}$$

The product identity is independent of the charge normalization. A proposed response model can test whether these four frequency orders represent distinct observables or merely alternative dimensional descriptions of one underlying charge distribution.

14 Chronogeometric response modes and QMU dimensional closure

The APM chronogeometric background and temporal-sector constructions are discussed in [7; 32; 33; 34].

14.1 A five-dimensional cycle and its four-dimensional projection

The Aether chronogeometry distinguishes three spatial directions and two dynamical temporal directions at fixed electrostatic polarity. Let u and v be periodic coordinates on a dynamical closure surface, with $u, v \in [0, 2\pi)$. A scalar response $\Psi(u, v; \mathbf{x})$ on this surface has the Fourier representation

$$\Psi(u, v; \mathbf{x}) = \sum_{j,k \in \mathbb{Z}} \psi_{jk}(\mathbf{x}) e^{i(ju+kv)}. \tag{304}$$

The cycle average is the projection functional

$$\mathcal{P}_0[\Psi](\mathbf{x}) = \frac{1}{(2\pi)^2} \int_0^{2\pi} \int_0^{2\pi} \Psi(u, v; \mathbf{x})\, du\, dv = \psi_{00}(\mathbf{x}). \tag{305}$$

Thus nonzero Fourier modes can exist in the continuous five-dimensional closure without appearing in the cycle-averaged four-dimensional quantity. A measurement sensitive to the cycle phase requires a different projection functional or a coupling that mixes Fourier modes. The tubular-cardioid appearance of a projected Aether unit is a geometrical hypothesis requiring an explicit embedding and projection map; the Fourier representation alone does not derive that shape.

14.2 Electrostatic polarity and paired response channels

The six-dimensional ontology includes two oppositely directed electrostatic sectors. Represent their dynamical response amplitudes by Ψ_- and Ψ_+. Their symmetric and antisymmetric combinations are

$$\Psi_{\text{even}} = \frac{\Psi_+ + \Psi_-}{2}, \qquad \Psi_{\text{odd}} = \frac{\Psi_+ - \Psi_-}{2}. \tag{306}$$

If the two sectors exchange under polarity reversal, the even combination is unchanged while the odd combination reverses sign. An electrostatic observable may couple to the odd channel while a polarity-insensitive geometric observable couples to the even channel. This selection rule follows from the stated exchange symmetry; it does not imply that the two sectors have equal occupation energies. In particular, occupation of the negative-sector cardioid by one electron does not require occupation of the parallel positive-sector cardioid.

A minimal linear response operator illustrates the distinction:

$$\begin{pmatrix} J_+ \\ J_- \end{pmatrix} = \begin{pmatrix} a & b \\ b & a \end{pmatrix} \begin{pmatrix} \Psi_+ \\ \Psi_- \end{pmatrix}, \qquad J_{\text{even}} = (a+b)\Psi_{\text{even}}, \quad J_{\text{odd}} = (a-b)\Psi_{\text{odd}}. \tag{307}$$

Here a and b are unspecified response coefficients. Unequal diagonal coefficients would break this exchange symmetry and require separate eigenmodes. The model therefore supplies a clear condition to be checked, rather than a fixed constitutive law.

14.3 Frequency order versus dynamical derivatives

For the four-level charge-density sequence defined in Section 13, write

$$D_n = \frac{{e_{\text{emax}}}^2}{{\lambda_C}^3} {F_q}^n, \qquad n = 0, 1, 2, 3. \tag{308}$$

Its exact QMU relations include

$$\frac{D_{n+1}}{D_n} = F_q, \qquad D_0 D_3 = D_1 D_2. \tag{309}$$

A time-harmonic physical field $d(t) = d_0 e^{i\omega t}$ instead obeys $d^{(n)} = (i\omega)^n d$. Identifying a catalog frequency-order scale D_n with the magnitude of the nth derivative therefore requires a constitutive normalization and a convention relating ω to F_q. For a cycle frequency F_q, $\omega = 2\pi F_q$; the factors $(2\pi)^n$ cannot be omitted from an operational derivative model. The catalog ladder is an algebraic scale sequence, not automatically a differential field equation.

14.4 Closure invariants and candidate discriminating tests

The fundamental closure identities are

$$c = \lambda_C F_q, \qquad \text{rson} = {F_q}^2, \qquad A_u \,\text{curl} = c^2. \tag{310}$$

Here A_u is the physically dimensioned QMU area; the numerical $16\pi^2$ closure factor is not a replacement for its dimensions. A five-dimensional constitutive theory must specify how the closure geometry sets the coefficients in its field equations and how those coefficients enter the four-dimensional measurement projection.

Three distinguishable questions follow. First, does a cycle-sensitive observable reveal Fourier components absent from $\mathcal{P}_0$? Second, do polarity-even and polarity-odd probes exhibit different response eigenvalues, consistent with $a+b$ and $a-b$? Third, can one derive the frequency-order coefficients from a single cycle-normalized dynamical law rather than fitting each order independently? A null result for any specified probe constrains the corresponding coupling or projection; it does not contradict the dimensional identities themselves.

15 Geometrical projection weights and cycle-sensitive response

Related geometrical models of the Aether, loxodromes, and their projections are developed in [35; 36; 37; 38].

15.1 A tubular closure surface

Consider a tubular surface embedded in three auxiliary coordinates,

$$\mathbf{X}(u,v) = \big((R + r\cos v)\cos u, (R + r\cos v)\sin u, r\sin v\big), \qquad 0 < r < R, \quad u, v \in [0, 2\pi). \tag{311}$$

The induced metric and area element are

$$ds^2 = (R + r\cos v)^2 du^2 + r^2 dv^2, \qquad dA = r(R + r\cos v)\, du\, dv, \tag{312}$$

with total area

$$A_{\text{tube}} = 4\pi^2 Rr. \tag{313}$$

The radii in this construction describe the intrinsic tubular closure surface, not a stable torus observed in four dimensions. The four-dimensional tubular-cardioid appearance requires a separate projection map. Likewise, $A_{\text{tube}} = A_u$ is a possible geometrical identification to be tested, not an identity implied by the numerical closure factor $16\pi^2$.

15.2 Area-weighted cycle projection

A uniform coordinate average differs from the geometrically normalized area average. Define

$$\langle \Psi \rangle_A = \frac{1}{4\pi^2 Rr} \int_0^{2\pi} \int_0^{2\pi} \Psi(u,v)\, r(R + r\cos v)\, dv\, du. \tag{314}$$

For the real Fourier component $\Psi(u,v) = \psi_0 + \psi_1 \cos v$, direct integration gives

$$\boxed{\langle \Psi \rangle_A = \psi_0 + \frac{r}{2R}\psi_1.} \tag{315}$$

Thus a mode invisible to a uniform coordinate average can contribute to an area-weighted observable through the geometry. The coefficient $r/(2R)$ is obtained from the induced area measure and is not a fitted response constant. In contrast, all modes proportional to $\sin v$ and nonzero u harmonics still have zero area average for this symmetric surface.

15.3 A geometric shape parameter and a falsifiable ratio

Write $\eta = r/R$ and consider a response $\Psi = \psi_0 + \psi_1 \cos v$. The dimensionless geometrical mixing weight is

$$\boxed{\kappa_1 = \frac{\eta}{2}, \qquad 0 < \kappa_1 < \frac{1}{2}.} \tag{316}$$

If two probes sample the same response respectively by uniform coordinate weighting and by area weighting, their difference is

$$\Delta\Psi = \langle \Psi \rangle_A - \mathcal{P}_0[\Psi] = \frac{\eta}{2}\psi_1. \tag{317}$$

A measurement of $\Delta\Psi/\psi_1$ would therefore determine $\eta/2$ under these projection assumptions. This is a conditional prediction of the stated geometry and measurement operators; it is not yet an experimental prediction for a specified instrument. For a near-spherical or self-intersecting limiting geometry, the present regular-torus parametrization is inadequate and must be replaced.

15.4 Polarity-sector projection

For two opposing electrostatic sectors, let their response profiles be $\Psi_\pm = \psi_{0\pm} + \psi_{1\pm}\cos v$, with distinct geometrical ratios $\eta_\pm$. Their area averages are

$$\langle \Psi_\pm \rangle_{A,\pm} = \psi_{0\pm} + \frac{\eta_\pm}{2}\psi_{1\pm}. \tag{318}$$

The projected odd response becomes

$$\boxed{J_{\text{odd}} = \frac{\psi_{0+} - \psi_{0-}}{2} + \frac{\eta_+\psi_{1+} - \eta_-\psi_{1-}}{4}.} \tag{319}$$

The formula permits different geometrical weights and different occupation-sensitive responses for the negative and positive cardioids. No equality of site energies or automatic two-electron occupation is assumed.

15.5 Connection to QMU scales

The geometry supplies dimensionless mixing factors while the QMU ledger supplies physical scales. With $c = \lambda_C F_q$ and $A_u\,\mathrm{curl} = c^2$, a response of QMU dimension $[U]$ may be expressed as $U_0\,\langle\Psi\rangle_A$ for a specified reference quantity U_0 of dimension $[U]$. This separation avoids interpreting an area-weighting factor as a new charge, mass, or frequency constant. Determining R, r, U_0, and the physical projection operator from the five-dimensional Aether closure remains necessary before comparison with measurements.

16 Fourier selection and geometric response moments

For background on five-dimensional to four-dimensional projection and compatibility, see [33; 39].

16.1 Selection rule for the tubular area measure

For the regular tubular surface of Section 15, put $\eta = r/R$ with $0 < \eta < 1$. The normalized area measure becomes

$$d\mu_A = \frac{1 + \eta\cos v}{4\pi^2}\,du\,dv, \qquad \int d\mu_A = 1. \tag{320}$$

Write a square-integrable response as a double Fourier series

$$\Psi(u,v) = \sum_{j,k\in\mathbb{Z}} a_{jk} e^{i(ju+kv)}, \qquad a_{-j,-k} = a_{jk}^* \quad \text{for real } \Psi. \tag{321}$$

Orthogonality gives the exact selection rule

$$\boxed{\langle \Psi \rangle_A = a_{00} + \frac{\eta}{2}(a_{0,1} + a_{0,-1}).} \tag{322}$$

The area-weighted mean selects the zero longitudinal harmonic and only $k = 0, \pm 1$ transverse harmonics. Higher transverse harmonics do not enter *linearly* in this particular area average, although they may contribute to nonlinear response moments.

16.2 Response correlations and mode mixing

For two real response fields Ψ and Φ, their area-weighted product is

$$\langle \Psi\Phi \rangle_A = \sum_{j,k} \sum_{p,q} a_{jk} b_{pq} \left[\delta_{j+p,0}\delta_{k+q,0} + \frac{\eta}{2}\delta_{j+p,0}(\delta_{k+q,1} + \delta_{k+q,-1}) \right]. \tag{323}$$

Consequently, a quadratic measurement can combine harmonics whose indices sum to zero or to the first transverse harmonic. This is a geometric selection rule, not an interaction law or a claim that an instrument measures this product.

16.3 Moments of the first transverse harmonic

Set $x = \cos v$. Its first three raw area-weighted moments are

$$\langle x \rangle_A = \frac{\eta}{2}, \qquad \langle x^2 \rangle_A = \frac{1}{2}, \qquad \langle x^3 \rangle_A = \frac{3\eta}{8}. \tag{324}$$

The variance and third central moment therefore satisfy

$$\boxed{\mathrm{Var}_A(x) = \frac{1}{2} - \frac{\eta^2}{4}, \qquad \mu_{3,A}(x) = -\frac{3\eta}{8} + \frac{\eta^3}{4}.} \tag{325}$$

For $\Psi = \psi_0 + \psi_1 x$, where the coefficients are fixed over the surface, the corresponding relations are

$$\langle \Psi \rangle_A = \psi_0 + \frac{\eta}{2}\psi_1, \tag{326}$$

$$\mathrm{Var}_A(\Psi) = \psi_1^2 \left(\frac{1}{2} - \frac{\eta^2}{4} \right), \tag{327}$$

$$\mu_{3,A}(\Psi) = \psi_1^3 \left(-\frac{3\eta}{8} + \frac{\eta^3}{4} \right). \tag{328}$$

These equations provide consistency conditions for a specified response profile and a specified area-weighted measurement. They cannot determine η uniquely from an unknown response amplitude without additional information.

16.4 Two electrostatic sectors

Let the two polarity sectors have independent $\eta_\pm$ and response amplitudes $\psi_{0\pm}, \psi_{1\pm}$. Each sector obeys the selection and moment equations separately. The even and odd projected means are

$$J_{\text{even}} = \frac{\psi_{0+} + \psi_{0-}}{2} + \frac{\eta_+\psi_{1+} + \eta_-\psi_{1-}}{4}, \tag{329}$$

$$J_{\text{odd}} = \frac{\psi_{0+} - \psi_{0-}}{2} + \frac{\eta_+\psi_{1+} - \eta_-\psi_{1-}}{4}. \tag{330}$$

Neither the surface construction nor these identities imposes equal polarity-sector occupation energies. A four-dimensional cardioid projection and the physically appropriate measurement functional must be specified before interpreting these means as observables.

16.5 Geometric scope

The present results follow from the area element of a regular tubular surface with $0 < r < R$. They do not establish the intrinsic five-dimensional Aether metric, the mapping to its four-dimensional manifestation, or a dynamical coupling to electromagnetic apparatus. Those require a separate geometrical and physical derivation. QMU dimensional closure continues to be governed by $c = \lambda_C F_q$ and $A_u \operatorname{curl} = c^2$.

17 Induced five-dimensional closure measures and harmonic selection

Related five-dimensional geometry and closure models are treated in [7; 36; 40].

17.1 Closure surface embedded in five dimensions

Let $X^A(u, v)$, $A = 1, \ldots, 5$, parameterize a closed two-cycle in a five-dimensional ambient geometry with metric $G_{AB}(X)$. The induced metric, area density, and normalized response functional are

$$g_{ab} = G_{AB}(X)\, \partial_a X^A \partial_b X^B, \tag{331}$$

$$J(u, v) = \sqrt{\det g_{ab}}, \qquad \mathcal{A} = \int_0^{2\pi}\int_0^{2\pi} J(u, v)\, du\, dv, \tag{332}$$

$$\mathcal{P}_G[\Psi] = \frac{1}{\mathcal{A}} \int_0^{2\pi}\int_0^{2\pi} \Psi(u, v) J(u, v)\, du\, dv. \tag{333}$$

The construction specifies a two-dimensional closure surface within a five-dimensional space; it does not identify the entire five-dimensional Aether manifold with a two-dimensional torus. A non-Euclidean ambient metric may be substituted once its components are fixed by the Aether chronogeometry.

For a Fourier response $\Psi = \sum_{j,k} a_{jk} e^{i(ju+kv)}$, define

$$W_{jk} = \frac{1}{\mathcal{A}} \int_0^{2\pi}\int_0^{2\pi} J(u, v) e^{i(ju+kv)}\, du\, dv, \qquad W_{00} = 1. \tag{334}$$

The exact projection and its quadratic counterpart are

$$\boxed{\mathcal{P}_G[\Psi] = \sum_{j,k} a_{jk} W_{jk}}, \tag{335}$$

$$\mathcal{P}_G[\Psi\Phi] = \sum_{j,k,p,q} a_{jk} b_{pq} W_{j+p,k+q}. \tag{336}$$

Thus the harmonic selection rules are determined by the Fourier spectrum of the induced measure, not by the dimensionality of the embedding alone.

17.2 An explicit five-coordinate deformation

A calculable family that extends the tubular surface is

$$X(u,v) = \big((R + r\cos v)\cos u,\ (R + r\cos v)\sin u,\ r\sin v,\ a\cos v,\ b\sin v\big), \qquad R > r > 0. \tag{337}$$

With the Euclidean ambient metric, its induced metric is diagonal:

$$g_{uu} = (R + r\cos v)^2, \qquad g_{uv} = 0, \tag{338}$$

$$g_{vv} = r^2 + a^2\sin^2 v + b^2\cos^2 v, \tag{339}$$

$$J(v) = (R + r\cos v)\sqrt{r^2 + a^2\sin^2 v + b^2\cos^2 v}. \tag{340}$$

When $a = b$, the square root is constant and the first-harmonic selection rule of Section 16 remains exact. Unequal amplitudes produce additional Fourier components in the area measure.

17.3 Leading higher-harmonic contributions

Define

$$L^2 = r^2 + \frac{a^2 + b^2}{2}, \qquad \epsilon = \frac{b^2 - a^2}{L^2}, \qquad \eta = \frac{r}{R}. \tag{341}$$

For $|\epsilon| \ll 1$, the induced density is, through first order,

$$J(v) = RL(1 + \eta\cos v)\left(1 + \frac{\epsilon}{2}\cos 2v\right) + O(\epsilon^2). \tag{342}$$

Its normalized measure can be written

$$d\mu_G = \frac{(1 + \eta\cos v)(1 + \frac{\epsilon}{2}\cos 2v)}{4\pi^2}\, du\, dv + O(\epsilon^2). \tag{343}$$

Expanding the numerator shows the allowed harmonics explicitly:

$$1 + \left(\eta + \frac{\eta\epsilon}{4}\right)\cos v + \frac{\epsilon}{2}\cos 2v + \frac{\eta\epsilon}{4}\cos 3v. \tag{344}$$

In particular, for a response $\Psi = \psi_0 + \psi_1\cos v + \psi_2\cos 2v + \psi_3\cos 3v$, the weighted mean is

$$\boxed{\mathcal{P}_G[\Psi] = \psi_0 + \frac{(\eta + \eta\epsilon/4)\,\psi_1 + (\epsilon/2)\psi_2 + (\eta\epsilon/4)\psi_3}{2} + O(\epsilon^2).} \tag{345}$$

The second and third transverse harmonics therefore enter the linear projection when the additional coordinate amplitudes are unequal. Their coefficients vanish as $\epsilon \to 0$, recovering the regular tubular selection rule.

17.4 Polarity sectors and dimensional closure

The positive and negative electrostatic closure sectors may have distinct $X_{\pm}^{A}$, induced densities $J_{\pm}$, and projection coefficients $W_{jk}^{\pm}$. For sector responses $\Psi_{\pm}$, the polarity-even and polarity-odd means are

$$\mathcal{P}_{\text{even}} = \frac{\mathcal{P}_{G,+}[\Psi_+] + \mathcal{P}_{G,-}[\Psi_-]}{2}, \qquad \mathcal{P}_{\text{odd}} = \frac{\mathcal{P}_{G,+}[\Psi_+] - \mathcal{P}_{G,-}[\Psi_-]}{2}. \tag{346}$$

These geometrical identities impose neither equal site energies nor symmetric occupation. The area density has physical area dimension; the normalized Fourier weights $W_{jk}^{\pm}$ are dimensionless. QMU physical scales remain constrained by $c = \lambda_C F_q$ and $A_u \operatorname{curl} = c^2$. Identifying a specific five-dimensional Aether metric, its four-dimensional cardioid projection, and an apparatus response functional is required to turn these closure integrals into quantitative physical predictions.

18 Five-dimensional closure constraints and polarity-sector geometry

The QADI literature on Aether closure and core-equation variants includes [41; 42; 26].

18.1 Closure normalization and geometric degrees of freedom

Let $X^A(u, v)$ describe a compact two-cycle within the five-dimensional chronogeometry, with induced positive area density $J = \sqrt{\det g}$. The geometric area and its dimensionless shape factor are

$$\mathcal{A}_G = \int_0^{2\pi}\int_0^{2\pi} J\, du\, dv, \qquad \mathcal{C}_G = \frac{\mathcal{A}_G}{RL}, \tag{347}$$

where R and L are nonzero reference lengths. The factor $\mathcal{C}_G$ is invariant under common rescaling of all embedding lengths, while $\mathcal{A}_G$ scales quadratically. The QMU closure factor $16\pi^2$ can therefore be compared with a dimensionless geometric integral only after specifying the normalization and the cycle multiplicity. The numerical closure factor alone does not fix R/L or a unique embedding.

For the five-coordinate family in Section 17, put $a = b = s$ and $L = \sqrt{r^2 + s^2}$. The exact area is

$$\mathcal{A}_G = 4\pi^2 RL, \qquad \mathcal{C}_G = 4\pi^2. \tag{348}$$

Thus a $16\pi^2$ normalized closure requires an additional factor of four relative to this single induced two-cycle, or a different geometric construction. A fourfold multiplicity is a mathematical possibility, not a consequence of the embedding.

18.2 Independent shape and response constraints

For the same symmetric family, the normalized area measure is

$$d\mu_G = \frac{1 + \eta\cos v}{4\pi^2}\, du\, dv, \qquad \eta = \frac{r}{R}. \tag{349}$$

Consequently the first-harmonic projection is

$$\mathcal{P}_G[\cos v] = \frac{\eta}{2}, \qquad \mathcal{P}_G[\cos 2v] = 0. \tag{350}$$

The closure area $4\pi^2 RL$ fixes the product RL, whereas the first-harmonic weight fixes r/R. These are independent geometrical constraints. Even their simultaneous specification leaves the additional coordinate amplitude s subject to $L^2 = r^2 + s^2$ and any further physical boundary conditions.

18.3 Polarity-resolved closure

Denote the opposing electrostatic sectors by $\sigma \in \{+, -\}$. Their induced areas and normalized projections are

$$\mathcal{A}_\sigma = \int J_\sigma \, du \, dv, \qquad \mathcal{P}_\sigma[\Psi_\sigma] = \frac{1}{\mathcal{A}_\sigma} \int \Psi_\sigma J_\sigma \, du \, dv. \tag{351}$$

A total-area constraint of the form $\mathcal{A}_+ + \mathcal{A}_- = \mathcal{A}_{\text{total}}$ does not imply $\mathcal{A}_+ = \mathcal{A}_-$, identical projection coefficients, or equal site occupation energies. For any common response quantity the polarity-even and polarity-odd combinations remain

$$\mathcal{P}_{\text{even}} = \frac{\mathcal{P}_+ + \mathcal{P}_-}{2}, \qquad \mathcal{P}_{\text{odd}} = \frac{\mathcal{P}_+ - \mathcal{P}_-}{2}. \tag{352}$$

The separate cardioid occupation conditions require a dynamical energy functional in addition to the induced geometry.

18.4 Dimensional connection to QMU closure

The physical area scale A_u is not identified with the numerical factor $16\pi^2$. The fundamental QMU relationship is

$$A_u \, \text{curl} = {F_q}^2 \, {\lambda_C}^2 = {\lambda_C}^2 {F_q}^2 = c^2. \tag{353}$$

A dimensionally meaningful geometric closure equation must compare areas with areas, for example $\mathcal{A}_G = \chi A_u$ with χ dimensionless. Neither the numerical value of χ nor an identification of $\mathcal{A}_G$ with the physical Aether closure area follows from the illustrative embedding alone. A specified intrinsic metric and the mapping to the four-dimensional tubular-cardioid projection are required to establish that identification.

19 Covering degree, closure multiplicity, and intrinsic response

The closure-topology context is discussed in [41; 43; 7].

19.1 A multiply traversed chronogeometric cycle

Let $X : T^2 \to \mathcal{M}_5$ be a regular immersion of a two-cycle into a five-dimensional manifold with positive induced two-metric $g = X^* G$. The geometrical area counted with parameter multiplicity is

$$\mathcal{A}[X] = \int_{T^2} \sqrt{\det g} \, du \, dv. \tag{354}$$

For integers $p, q \neq 0$, define the covering map $\phi_{p,q}(u, v) = (pu, qv) \pmod{2\pi}$ and the traversed immersion $X_{p,q} = X \circ \phi_{p,q}$. The change-of-variables formula gives

$$\boxed{\mathcal{A}[X_{p,q}] = |pq| \, \mathcal{A}[X].} \tag{355}$$

The factor $|pq|$ counts traversal sheets, not additional area of the embedded image. In particular, the fourfold choice $p = q = 2$ converts a single-cycle normalized integral of $4\pi^2$ into a sheet-counted integral of $16\pi^2$ without changing the underlying geometric image. The identification of this fourfold traversal with the APM closure factor $16\pi^2$ requires an independent physical closure condition.

19.2 Normalized observables are insensitive to uniform covering

For a scalar response f defined on the geometric image, introduce

$$\mathcal{P}_X[f] = \frac{\int_{T^2} (f \circ X)\sqrt{\det g}\, du\, dv}{\mathcal{A}[X]}. \tag{356}$$

Applying the same covering to the response and the measure yields

$$\boxed{\mathcal{P}_{X\circ\phi_{p,q}}[f] = \mathcal{P}_X[f].} \tag{357}$$

Thus the total sheet-counted closure and the normalized response probe different properties. Multiplicity can alter an extensive geometric integral while leaving every image-defined normalized moment unchanged. A response depending on traversal history rather than image position need not satisfy Eq. (357); such a response requires a specified dynamical transport or holonomy law.

19.3 Holonomy distinguishes traversal from geometry

Let ω be a closed one-form on the cycle and γ_u, γ_v its fundamental loops. Define the dimensionless periods

$$h_u = \frac{1}{2\pi}\oint_{\gamma_u} \omega, \qquad h_v = \frac{1}{2\pi}\oint_{\gamma_v} \omega. \tag{358}$$

Under a covering, the periods along the covered parameter loops obey

$$\boxed{h_u^{(p,q)} = p\, h_u, \qquad h_v^{(p,q)} = q\, h_v.} \tag{359}$$

For a $U(1)$ phase connection these periods are understood modulo the phase periodicity; for a general non-Abelian connection the appropriate objects are path-ordered holonomies, and the simple additive statement need not apply. Consequently, area multiplicity $|pq|$ and directional winding (p, q) contain distinct information. A fourfold area count can arise from $(2, 2)$ or $(4, 1)$, but these have different directional periods whenever the corresponding intrinsic holonomies are nonzero.

19.4 Two electrostatic sectors

For the two opposing Aether electrostatic sectors, write $X_\sigma : T^2 \to \mathcal{M}_5$ and covering integers (p_σ, q_σ), with $\sigma \in \{+, -\}$. The sheet-counted closure is

$$\mathcal{A}_{\text{count}} = \sum_{\sigma\in\{+,-\}} |p_\sigma q_\sigma|\, \mathcal{A}[X_\sigma]. \tag{360}$$

This expression permits distinct sector areas and winding numbers. Neither equal areas nor equal electron occupation energies follow from closure multiplicity. The sector-resolved normalized projections remain individually invariant under their own uniform coverings, while their holonomy periods can change with winding.

19.5 Relation to the physical QMU area

The dimensionless closure factor $16\pi^2$ is distinct from the physical QMU area A_u. A proposed physical identification must state the conversion from an induced geometric area to A_u and preserve

$$A_u \,\mathrm{curl} = {F_q}^2 \, {\lambda_C}^2 = {\lambda_C}^2 {F_q}^2 = c^2. \tag{361}$$

The covering construction supplies a discrete, testable mathematical classification of closure multiplicities; it does not determine the intrinsic five-dimensional metric, the electron/proton stationary geometry, or the physical holonomy connection.

20 Spin-sector holonomy and closure compatibility

Relevant QADI accounts of half-spin realization and topological winding include [32; 34; 44].

20.1 Two independent angular cycles

Let the intrinsic chronogeometric closure admit two oriented fundamental cycles γ_u and γ_v on a parameter torus. A flat $U(1)$ connection $\mathcal{A}$ determines cycle phases

$$H_u = \exp\left(i \oint_{\gamma_u} \mathcal{A} \right), \qquad H_v = \exp\left(i \oint_{\gamma_v} \mathcal{A} \right). \tag{362}$$

A covering with integers (p, q) transforms these phases according to

$$\boxed{H_u^{(p,q)} = H_u^p, \qquad H_v^{(p,q)} = H_v^q.} \tag{363}$$

This relation distinguishes directional winding from the area multiplicity $|pq|$. In particular, coverings with equal multiplicity need not have equal phase responses.

20.2 One-spin and half-spin cycle conditions

The APM distinguishes an electrostatic one-spin sphere and a magnetic half-spin angular sector. A mathematical realization of this distinction requires a specified representation of each angular cycle. If the magnetic cycle is modeled by a spinorial phase, a 2π turn may act as -1 and a 4π turn as $+1$. The corresponding scalar phase condition is

$$H_{\mathrm{m}} = -1, \qquad H_{\mathrm{m}}^2 = +1. \tag{364}$$

For an electrostatic cycle represented by a single-valued scalar phase, $H_{\mathrm{e}} = +1$ after one full turn. These phase assignments are a conditional realization of the one-spin/half-spin distinction, not a derivation of Aether dynamics or a claim that the physical magnetic sector is necessarily a conventional spinor.

20.3 Parity restrictions on covering integers

Suppose the u cycle carries the conditional magnetic phase $H_u = -1$ and the v cycle carries the electrostatic phase $H_v = +1$. Then the lifted cycle is single-valued precisely when

$$(-1)^p = +1, \qquad (+1)^q = +1, \tag{365}$$

so p must be even, whereas the electrostatic condition imposes no restriction on q. Consequently, the least nonzero covering degree consistent with this phase choice is $|pq| = 2$, realized by $(2, 1)$. A fourfold covering is therefore *compatible* with the phase condition but is *not selected* by it. Both $(2, 2)$ and $(4, 1)$ close the magnetic phase, and an independent closure condition is needed to distinguish them.

20.4 Relation to the $16\pi^2$ normalization

For a normalized base-cycle integral $\mathcal{C}_0 = 4\pi^2$, the sheet-counted closure under (p, q) is

$$\mathcal{C}_{p,q} = |pq|\,\mathcal{C}_0. \tag{366}$$

The equality $\mathcal{C}_{p,q} = 16\pi^2$ selects $|pq| = 4$ only after that base normalization and the identification of the physical closure with a sheet-counted integral have been established. A spinorial magnetic phase further requires p even, leaving the candidate absolute winding pairs $(|p|, |q|) = (2, 2)$ and $(4, 1)$. Directional holonomy, electrostatic-sector geometry, or an intrinsic variational principle must provide the additional selection rule.

20.5 Opposing electrostatic sectors

The negative and positive electrostatic Aether sectors can carry separate connections $\mathcal{A}_-$ and $\mathcal{A}_+$, winding pairs (p_-, q_-) and (p_+, q_+), and induced metrics. A single shared closure factor does not require equality of their cycle phases, areas, or electron occupation energies. In particular, the single-electron negative-sector occupation does not require positive-sector electron occupation. A geometric theory of the paired state must separately specify the binding and overlap conditions.

20.6 Dimensional consistency

The topological covering factors and phase holonomies are dimensionless. They cannot by themselves determine the physical QMU area A_u. A complete Aether closure law must preserve the dimensional relation

$$A_u\,\mathrm{curl} = {F_q}^2\,{\lambda_C}^2 = {\lambda_C}^2{F_q}^2 = c^2, \tag{367}$$

while identifying the intrinsic metric, the angular representation, and the physical meaning of the closure normalization.

21 Directional winding spectra and polarity-sensitive closure

For loxodromic and laboratory-orientation context, see [35; 45].

21.1 Pullback of intrinsic modes

Consider two oriented angular coordinates (u, v), each of period 2π, and an intrinsic response $f(u, v)$ with Fourier coefficients f_{jk}:

$$f(u, v) = \sum_{j,k\in\mathbb{Z}} f_{jk}\, e^{i(ju+kv)}. \tag{368}$$

Under the winding map $W_{p,q}(u, v) = (pu, qv)$, with nonzero integers p, q, the pulled-back response is

$$W^*_{p,q} f(u, v) = \sum_{j,k\in\mathbb{Z}} f_{jk} e^{i(jpu+kqv)}. \tag{369}$$

Thus a mode (j, k) on the intrinsic surface appears at parameter wave numbers (jp, kq) on the covering domain. The two winding configurations $(2, 2)$ and $(4, 1)$ therefore have equal sheet-counted area multiplicity but different directional spectral signatures.

21.2 Two closure candidates

For the lowest directional harmonics, the transformation is

covering	$\cos u$	$\cos v$
$(2, 2)$	$\cos(2u)$	$\cos(2v)$
$(4, 1)$	$\cos(4u)$	$\cos v$

(370)

Both candidates satisfy $|pq| = 4$, and both close the conditional magnetic spinorial phase when the u cycle carries $H_u = -1$. Their distinction is not a difference in total covering degree: it is the allocation of winding between the magnetic and electrostatic angular directions. The assignment of these angular coordinates to physical Aether dynamics requires a constitutive specification.

21.3 Area averages and spectral response

For a smooth surface measure $d\mu = w(u, v)\, du\, dv$, define

$$\mathcal{P}_w[f] = \frac{\int_0^{2\pi}\int_0^{2\pi} f(u, v)w(u, v)\, du\, dv}{\int_0^{2\pi}\int_0^{2\pi} w(u, v)\, du\, dv}. \tag{371}$$

If w is uniform, every nonzero Fourier harmonic averages to zero for either winding configuration. Consequently, an unweighted mean cannot distinguish $(2, 2)$ from $(4, 1)$. A nonuniform measure can produce a difference only if its Fourier spectrum overlaps the pulled-back response harmonics. Explicitly, writing $w(u, v) = \sum_{a,b} w_{ab} e^{i(au+bv)}$ yields

$$\boxed{\mathcal{P}_w[W^*_{p,q} f] = \frac{\sum_{j,k} f_{jk} w_{-jp,-kq}}{w_{00}}.} \tag{372}$$

The equation is valid for integrable Fourier expansions with convergent products and $w_{00} > 0$. It specifies the geometrical harmonics required to discriminate between the winding candidates.

21.4 Electrostatic polarity sectors

The negative and positive electrostatic sectors may have distinct induced weights w_- and w_+ and response coefficients $f_{jk}^{(-)}$ and $f_{jk}^{(+)}$. Their respective projections obey Eq. (372) separately. Neither a common fourfold closure factor nor magnetic phase compatibility requires the two sectors to have identical spectra, occupation energies, or electron occupancy. In the single-electron state, negative-sector occupation remains compatible with an unoccupied positive-sector cardioid.

21.5 Physical closure criterion

The $16\pi^2$ factor is a dimensionless angular closure normalization, whereas A_u retains its QMU area dimension. A physical selection between $(2,2)$ and $(4,1)$ must determine the intrinsic metric and the coupling of an observable to the two angular directions. A winding-dependent spectral response becomes testable only when its frequencies, amplitudes, and measurement operator are fixed independently of the data used for comparison.

22 Observable selection, spectral thresholds, and covering invariance

For compatibility and laboratory-boundary context, see [39; 45].

22.1 Band-limited measurement weights

Let $w(u,v) > 0$ be a real measurement density on a parameter fundamental domain, with Fourier coefficients w_{ab}. Suppose its spectral support is restricted to $|a| \le B_u$ and $|b| \le B_v$. For an intrinsic response $f(u,v) = \sum_{j,k} f_{jk} e^{i(ju+kv)}$, Eq. (372) shows that a nonconstant mode (j,k) can contribute to the measured mean only if

$$|pj| \le B_u, \qquad |qk| \le B_v. \tag{373}$$

These are necessary spectral-overlap conditions, not sufficient conditions for a nonzero response: the relevant weight coefficient and intrinsic response coefficient must also be nonzero.

22.2 A minimal discriminating weight

Take a real intrinsic response $f(u,v) = f_0 + A\cos v$ and a positive parameter-domain weight

$$w(u,v) = 1 + \varepsilon \cos v, \qquad |\varepsilon| < 1. \tag{374}$$

For positive winding numbers the normalized projections are

$$\mathcal{P}_w[W_{2,2}^* f] = f_0, \tag{375}$$

$$\mathcal{P}_w[W_{4,1}^* f] = f_0 + \frac{A\varepsilon}{2}. \tag{376}$$

Thus the two fourfold coverings can be distinguished by this specified nonuniform measurement weight if $A\varepsilon \neq 0$. Conversely, with $w = 1 + \varepsilon\cos(2v)$, the $(2,2)$ response is $f_0 + A\varepsilon/2$ and the $(4,1)$

response is f_0. These are exact Fourier-orthogonality results; neither weight is claimed to be the physical Aether measurement density.

22.3 Covering invariance of intrinsic measurements

A crucial distinction arises when the measurement density itself is induced by the intrinsic geometry. Let $d\mu$ be an integrable positive measure on the intrinsic two-torus, and let $W_{p,q}$ be an integer covering of degree $d = |pq|$. For any integrable scalar observable f, integration of the pulled-back top-degree density obeys

$$\int_{\mathbb{T}^2} W_{p,q}^*(f\, d\mu) = d \int_{\mathbb{T}^2} f\, d\mu. \tag{377}$$

Consequently,

$$\boxed{\frac{\int W_{p,q}^*(f\, d\mu)}{\int W_{p,q}^* d\mu} = \frac{\int f\, d\mu}{\int d\mu}.} \tag{378}$$

Here pullback of a density includes the absolute Jacobian, so the statement is valid for orientation-reversing as well as orientation-preserving coverings. This theorem explains why an intrinsic, uniformly sheet-counted area mean cannot identify $(2, 2)$ versus $(4, 1)$: the two choices are different parametrizations with the same normalized intrinsic integral.

22.4 What must break the degeneracy

A discriminating measurement must depend on additional structure that is not merely pulled back from the same intrinsic scalar and measure. Possibilities include a laboratory-fixed directional weight, a specified coupling to a temporal cycle, or a holonomy-sensitive transport operator. Such a coupling must be specified independently of the desired winding result. The parameter-domain example in Eq. (376) uses a fixed w; it is therefore not a contradiction of Eq. (378), in which the measure transforms together with the observable.

22.5 Polarity-resolved observables

For electrostatic sectors $\sigma \in \{-, +\}$, assign separate intrinsic measures $d\mu_\sigma$, responses f_σ, and coupling operators $\mathcal{O}_\sigma$. The invariance theorem holds separately for each sector whenever $\mathcal{O}_\sigma$ reduces to a scalar intrinsic average. Polarity-odd combinations of sector measurements can be informative only if the operators, sector weights, and occupation conditions are specified. A single-electron negative-sector occupation does not require an occupied positive-sector cardioid. The $16\pi^2$ angular closure factor alone fixes none of these couplings, and the QMU area quantity A_u remains dimensioned.

23 Cycle holonomy as a directional measurement operator

Related QADI treatments of holonomy and oriented electromagnetic transport include [33; 18; 45].

23.1 A gauge-invariant observable beyond area averaging

The covering-invariance theorem in Sec. 22 precludes identifying winding numbers through a normalized intrinsic scalar area average alone. A different class of observable arises from parallel transport around an oriented closed cycle. Consider a unitary line-bundle connection on the intrinsic two-torus, written locally as

$$\mathcal{A} = A_u(u, v)\, du + A_v(u, v)\, dv. \tag{379}$$

The notation $A_u(u, v)$ here denotes a connection component, not the QMU unified area A_u. For a closed path γ, define its $U(1)$ holonomy by

$$\mathcal{H}(\gamma) = \exp\left(i \oint_\gamma \mathcal{A} \right). \tag{380}$$

Under a single-valued gauge transformation $\mathcal{A} \mapsto \mathcal{A} + d\chi$, this quantity is invariant. It is a phase observable, not an area measure.

23.2 Flat connections and winding characters

For a flat connection, $d\mathcal{A} = 0$, let θ_u and θ_v be its fundamental-cycle phases, defined modulo 2π. The holonomy of a loop of homology class $(p, q) \in \mathbb{Z}^2$ is

$$\boxed{\mathcal{H}_{p,q} = \exp\big(i(p\theta_u + q\theta_v)\big).} \tag{381}$$

This follows from the additivity of integrals over concatenated cycles and is independent of the path shape within a homology class when the connection is flat. In contrast, if curvature is nonzero, $\mathcal{H}$ may depend on the actual path and the flux enclosed between homologous loops; winding numbers alone are insufficient.

For the two candidate fourfold coverings,

$$\mathcal{H}_{2,2} = \exp\big(i(2\theta_u + 2\theta_v)\big), \tag{382}$$
$$\mathcal{H}_{4,1} = \exp\big(i(4\theta_u + \theta_v)\big). \tag{383}$$

They coincide precisely when

$$\boxed{2\theta_u - \theta_v \in 2\pi\mathbb{Z}.} \tag{384}$$

Thus a nontrivial directional holonomy can break the degeneracy without a parameter-domain measurement weight. Conversely, the special phase relation in Eq. (384) leaves the configurations indistinguishable by this single character. For example, $\theta_u = \theta_v = \pi/2$ gives $\mathcal{H}_{2,2} = 1$ and $\mathcal{H}_{4,1} = i$. These phases are illustrative boundary data, not values derived from the Aether Physics Model.

23.3 One-spin and half-spin conditions do not fix both phases

A spinorial magnetic sign reversal can be represented by $\exp(i\theta_u) = -1$ on a specified primitive cycle, whereas a single-valued electrostatic return may be represented by $\exp(i\theta_v) = 1$. These assignments are conditional: the physical identification of the cycles and their transport laws must first be established. Under these particular assignments, $\theta_u = \pi$ and $\theta_v = 0$ modulo 2π, both

candidate windings have unit holonomy. Hence the qualitative one-spin and half-spin labels, even when encoded as these phase constraints, *do not* select $(2,2)$ over $(4,1)$. A selection requires additional phase information, curvature, or a dynamical action whose stationary configurations differ.

23.4 Two electrostatic sectors and occupation dependence

Write separate connections $\mathcal{A}_-$ and $\mathcal{A}_+$, with independent fundamental-cycle phases $(\theta_{u,-}, \theta_{v,-})$ and $(\theta_{u,+}, \theta_{v,+})$. Their holonomies are

$$\mathcal{H}_{p,q;\sigma} = \exp\big(i(p\theta_{u,\sigma} + q\theta_{v,\sigma})\big), \qquad \sigma \in \{-,+\}. \tag{385}$$

A polarity-even or polarity-odd response may be constructed only after specifying how the measurement couples to these phases. Neither equal sector phases nor equal occupation energies follow from the two-sector geometry. In particular, the unoccupied positive-sector cardioid of a single-electron state must not be treated as a second occupied electron site.

23.5 Physical closure and the required next input

The character in Eq. (381) supplies an explicit *conditional* directional observable, but it does not derive the connection, its phases, or the covering degree from APM dynamics. The numerical factor $16\pi^2$ and the dimensioned QMU area A_u are not interchangeable. A physical selection theorem would require an independently specified chronogeometric connection or transport law, a boundary condition, and a coupling to a measurable response. Until those inputs are supplied, the two fourfold coverings remain mathematically admissible alternatives.

24 Connection constraints from polarity and chronogeometric symmetry

Companion QADI discussions of temporal-charge sectors and field coupling include [32; 46; 18].

24.1 Distinguishing geometric transport from assigned phase

A connection on a two-cycle closure surface is not uniquely specified by the induced metric. Let $\mathcal{A}_\sigma$ be a real $U(1)$ connection one-form on the electrostatic sector $\sigma \in \{-,+\}$. Its curvature is

$$\mathcal{F}_\sigma = d\mathcal{A}_\sigma = \big(\partial_u A_{v,\sigma} - \partial_v A_{u,\sigma}\big)\, du \wedge dv. \tag{386}$$

The metric supplies lengths and areas, but not the connection coefficients: additional transport dynamics or a constitutive relation is necessary. For a flat connection, every gauge-equivalence class on the torus is characterized by two angular periods $(\theta_{u,\sigma}, \theta_{v,\sigma})$ modulo 2π. The periods are not fixed by the area normalization $16\pi^2$.

24.2 Polarity reversal as a constraint, not an identification

Let P exchange the two electrostatic sectors. If a physical polarity reversal reverses the transported charge, an admissible conditional law is

$$P^*\mathcal{A}_+ = -\mathcal{A}_- + d\chi, \qquad P^*\mathcal{F}_+ = -\mathcal{F}_-. \tag{387}$$

The phase of a path γ in the positive sector is then the complex conjugate of the phase of its mapped path in the negative sector, provided χ has a single-valued exponential. This conclusion depends on the charge-reversal transport postulate, not on the mere existence of two oppositely oriented electrostatic spheres. Different sector metrics, occupation energies, and response amplitudes remain admissible.

24.3 A flat-connection degeneracy theorem

Suppose the fundamental-cycle holonomies are constrained to the signs $\exp(i\theta_u) = -1$ and $\exp(i\theta_v) = +1$. Then

$$\mathcal{H}_{p,q} = (-1)^p. \tag{388}$$

For any even p, including both $(p, q) = (2, 2)$ and $(4, 1)$, the holonomy equals $+1$. Thus these sign constraints cannot discriminate the two fourfold coverings. Even if polarity reversal is imposed by Eq. (387), the conjugate of either unit phase is still unity. This is a no-selection result under the stated flat-connection assumptions.

24.4 Curvature and contractible-loop measurements

For a contractible oriented loop $\gamma = \partial S$ lying in a local trivialization, Stokes' theorem yields

$$\mathcal{H}_\sigma(\gamma) = \exp\left(i \int_S \mathcal{F}_\sigma\right). \tag{389}$$

Nonzero curvature can therefore produce a phase distinction not captured by winding parity. Nevertheless, the curvature distribution must be specified independently. In particular, choosing a curvature profile solely to distinguish $(2, 2)$ from $(4, 1)$ would not constitute an APM derivation. A globally defined line bundle over the closed torus obeys

$$\frac{1}{2\pi} \int_{T^2} \mathcal{F}_\sigma = n_\sigma \in \mathbb{Z}, \tag{390}$$

with the sign determined by orientation. Under the conditional polarity-reversal law, compatible orientations imply $n_+ = -n_-$ when the map preserves orientation; an orientation-reversing map changes the corresponding sign relation. This quantization is a mathematical property of $U(1)$ bundles, not an identification of an Aether charge quantum.

24.5 A discriminating calculation requiring physical input

A nontrivial model must specify (i) the five-dimensional dynamical transport rule, (ii) its reduction to each polarity-sector connection, (iii) the map from the intrinsic closure cycle to the four-dimensional tubular-cardioid response, and (iv) an operationally defined phase measurement. Only

then can the relative phase

$$\Delta\Theta_\sigma = \arg\big(\mathcal{H}_{2,2;\sigma}\overline{\mathcal{H}_{4,1;\sigma}}\big) = \theta_{v,\sigma} - 2\theta_{u,\sigma} \pmod{2\pi} \tag{391}$$

be evaluated without assigning illustrative boundary phases. This construction does not assume a second occupied electron in the positive electrostatic sector of a single-electron state.

25 Dimensional Closure and Cross-Family Applications of QMU

Dimensional composition and Aether metrology are treated in [15; 8; 47].

The QMU ledger makes spatial, temporal, inertial, and distributed-charge factors explicit. The following examples use the electron-based reference scales m_e, λ_C, F_q, and ${e_\mathrm{emax}}^2$ to illustrate calculations across several families of units. Every identity in this section follows algebraically from the stated unit definitions. Its physical application requires the relevant geometry, constitutive law, and boundary conditions.

25.1 Primitive-exponent bookkeeping

For a monomial quantity $Q = C{m_\mathrm{e}}^a{\lambda_C}^b{F_q}^c({e_\mathrm{emax}}^2)^d$, define its QMU exponent vector by

$$\boldsymbol{\nu}(Q) = (a, b, c, d), \qquad \boldsymbol{\nu}(Q_1Q_2) = \boldsymbol{\nu}(Q_1) + \boldsymbol{\nu}(Q_2). \tag{392}$$

The fourth component counts powers of the *squared distributed-charge primitive* ${e_\mathrm{emax}}^2$; thus $({e_\mathrm{emax}}^2)^2 = {e_\mathrm{emax}}^4$. A numerical coefficient such as $8\pi\alpha$ does not alter this exponent vector. A unit identity must agree in both primitive exponents and numerical coefficient.

QMU quantity	Primitive representation	(a, b, c, d)
area	${\lambda_C}^2$	$(0, 2, 0, 0)$
rson	${F_q}^2$	$(0, 0, 2, 0)$
temp	${\lambda_C}^2{F_q}^2$	$(0, 2, 2, 0)$
enrg	$m_\mathrm{e}{\lambda_C}^2{F_q}^2$	$(1, 2, 2, 0)$
angm	$m_\mathrm{e}{\lambda_C}^2F_q$	$(1, 2, 1, 0)$
mflx	$m_\mathrm{e}{\lambda_C}^2F_q/{e_\mathrm{emax}}^2$	$(1, 2, 1, -1)$
mfxd	$m_\mathrm{e}F_q/{e_\mathrm{emax}}^2$	$(1, 0, 1, -1)$
cond	${e_\mathrm{emax}}^2/(m_\mathrm{e}{\lambda_C}^2F_q)$	$(-1, -2, -1, 1)$

These vectors describe QMU primitive bookkeeping; conversion to SI requires a separate mapping of the charge primitive.

25.2 Area, resonance, temperature, and energy

The geometric and temporal ledger closes without a charge conversion:

$$\text{area rson} = {\lambda_C}^2 {F_q}^2 = \text{temp} = c^2, \tag{393}$$

$$\text{enrg} = m_\text{e}\,\text{temp} = m_\text{e}{\lambda_C}^2 {F_q}^2, \tag{394}$$

$$\text{forc} = \frac{\text{enrg}}{\lambda_C} = m_\text{e}\lambda_C {F_q}^2, \tag{395}$$

$$\text{pres} = \frac{\text{forc}}{{\lambda_C}^2} = \frac{m_\text{e}{F_q}^2}{\lambda_C}. \tag{396}$$

The Aether closure $A_u\,\text{curl} = {F_q}^2\,{\lambda_C}^2$ is compatible with the same c^2 ledger. Here A_u is a physically dimensioned QMU area quantity; the separate numerical closure factor $16\pi^2$ must not be substituted for A_u without an explicit normalization.

25.3 Frequency ladders and angular momentum

Multiplication by F_q changes a temporal exponent by one:

$$\text{momt} = m_\text{e}\lambda_C F_q, \qquad \text{forc} = F_q\,\text{momt}, \tag{397}$$

$$\text{angm} = \lambda_C\,\text{momt} = m_\text{e}{\lambda_C}^2 F_q, \qquad \text{enrg} = F_q\,\text{angm}. \tag{398}$$

In particular, the last relation gives a direct energy–angular-momentum correspondence in the QMU reference ledger, without introducing the SI-derived reduced Planck constant as a primitive.

25.4 Magnetic flux and electrical response

Using the magnetic and electrical definitions from Section 12,

$$\text{mflx} = {\lambda_C}^2\,\text{mfxd} = F_q\,\text{indc}, \tag{399}$$

$$\text{cond} = \frac{1}{\text{mflx}}, \tag{400}$$

$$\text{capc} = \frac{\text{cond}}{F_q}, \tag{401}$$

$$\text{resn cond} = \frac{1}{{e_\text{emax}}^2}. \tag{402}$$

The reciprocal relation between cond and mflx is a *QMU definition-level identity*, not a claim that laboratory conductance and magnetic flux are numerical reciprocals in SI. The final product retains a charge factor and therefore is not a dimensionless reciprocal relation. This distinction is essential when comparing electrical measurements across unit systems.

25.5 Charge, magnetic moment, and inertial geometry

The distributed-charge normalization is

$$e^2 = 8\pi\alpha\,{e_\text{emax}}^2, \qquad \frac{e^2}{{e_\text{emax}}^2} = 8\pi\alpha. \tag{403}$$

The magnetic moment and angular momentum units then obey

$$\text{magm} = {e_{\text{emax}}}^2 {\lambda_C}^2 F_q, \qquad \text{angm} = m_{\text{e}} {\lambda_C}^2 F_q, \tag{404}$$

$$\frac{\text{magm}}{\text{angm}} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}}, \qquad \text{magm} = \frac{{e_{\text{emax}}}^2}{m_{\text{e}}}\,\text{angm}. \tag{405}$$

This equality relates the reference *units*; measured particle moments can contain additional dimensionless geometric and dynamical coefficients. Neither a measured g-factor nor an absolute SI charge conversion follows from this identity alone.

25.6 A practical consistency test

For any proposed QMU equation, first express both sides as primitive monomials. Next compare their exponent vectors and exact coefficients. Finally identify which factors are definitions, which are measured inputs, and which represent a proposed physical law. For example,

$$\text{fdns}\,\text{angm} = \left(\frac{m_{\text{e}} {F_q}^2}{{\lambda_C}^2}\right)\left(m_{\text{e}} {\lambda_C}^2 F_q\right) = {m_{\text{e}}}^2 {F_q}^3 = \text{pres}\,\text{momt}. \tag{406}$$

Both products have exponent vector $(2, 0, 3, 0)$ and coefficient one. This cross-family check is independent of the SI realization of the primitives. Numerical comparison with experiment is a separate step, requiring uncertainties and an explicit conversion bridge where charge is involved.

26 Numerical Benchmarks Across QMU Unit Families

The QADI conversion-table and SI-translation references for these scales are [11; 15; 3].

A single reference tuple generates the mechanical and temporal QMU benchmarks without changing primitive definitions. For the electron-based SI realization used in Section 2, with input values from CODATA 2022 [13], take

$$m_{\text{e}} = 9.1093837139 \times 10^{-31}\,\text{kg}, \qquad \lambda_C = 2.42631023538 \times 10^{-12}\,\text{m}, \tag{407}$$

$$c = 299792458\,\text{m}\,\text{s}^{-1}, \qquad F_q = c/\lambda_C \simeq 1.23558996549 \times 10^{20}\,\text{s}^{-1}. \tag{408}$$

Here λ_C is the *unreduced* electron Compton wavelength. The SI values provide a numerical realization of the QMU primitives, not a separate derivation of the Aether's physical frequency. Values below are rounded for display; the common input uncertainties and correlations must be retained in precision comparisons.

26.1 Area, temporal resonance, and the temperature ledger

$$\text{area} = {\lambda_C}^2 \simeq 5.88698135831 \times 10^{-24}\,\text{m}^2, \tag{409}$$

$$\text{rson} = {F_q}^2 \simeq 1.52668256282 \times 10^{40}\,\text{s}^{-2}, \tag{410}$$

$$\text{area}\,\text{rson} = {\lambda_C}^2 {F_q}^2 = c^2 = 8.9875517873681764 \times 10^{16}\,\text{m}^2\,\text{s}^{-2} = \text{temp}. \tag{411}$$

The last equality is the QMU temperature-scale definition. It is not an identification with thermodynamic kelvin without an independently specified temperature conversion.

26.2 Momentum, angular momentum, and energy

$$\mathrm{momt} = m_\mathrm{e}\lambda_C F_q = m_\mathrm{e}c \simeq 2.73092453446 \times 10^{-22}\,\mathrm{kg\,m\,s^{-1}}, \tag{412}$$

$$\mathrm{angm} = m_\mathrm{e}{\lambda_C}^2 F_q = m_\mathrm{e}\lambda_C c \simeq 6.62607015 \times 10^{-34}\,\mathrm{J\,s}, \tag{413}$$

$$\mathrm{enrg} = m_\mathrm{e}{\lambda_C}^2 {F_q}^2 = m_\mathrm{e}c^2 \simeq 8.18710578797 \times 10^{-14}\,\mathrm{J}. \tag{414}$$

The computed angular-momentum *unit* equals the SI Planck constant h for the electron Compton definition $\lambda_C = h/(m_\mathrm{e}c)$. This equality is a consequence of the chosen benchmark realization, not a statement that an electron's measured spin is h. In conventional notation electron spin magnitude is $\sqrt{3}\,h/(4\pi)$, while the magnitude of its spin projection is $h/(4\pi)$. The QMU identity $\mathrm{enrg} = F_q\,\mathrm{angm}$ reproduces the numerical benchmark directly.

26.3 Force and pressure from the same primitives

$$\mathrm{forc} = m_\mathrm{e}\lambda_C {F_q}^2 = \frac{m_\mathrm{e}c^2}{\lambda_C} \simeq 3.37430295128 \times 10^{-2}\,\mathrm{N}, \tag{415}$$

$$\mathrm{pres} = \frac{m_\mathrm{e}{F_q}^2}{\lambda_C} = \frac{\mathrm{forc}}{{\lambda_C}^2} \simeq 5.7318050558 \times 10^{21}\,\mathrm{Pa}. \tag{416}$$

These are reference *unit scales*; the numbers do not describe a measured force or pressure acting on an electron.

26.4 Magnetic flux and charge-dependent comparisons

The QMU magnetic-flux unit is

$$\mathrm{mflx} = \frac{m_\mathrm{e}{\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2} = \frac{\mathrm{angm}}{{e_\mathrm{emax}}^2}, \qquad \mathrm{mfxd} = \frac{m_\mathrm{e}F_q}{{e_\mathrm{emax}}^2}, \qquad \mathrm{mflx} = {\lambda_C}^2\,\mathrm{mfxd}. \tag{417}$$

Its SI numerical value cannot be assigned merely by inserting the SI elementary charge for ${e_\mathrm{emax}}^2$: QMU distributed charge requires its explicit SI bridge. The dimensionless normalization can nevertheless be evaluated without that bridge:

$$\frac{e^2}{{e_\mathrm{emax}}^2} = 8\pi\alpha, \qquad \frac{{e_\mathrm{emax}}^4}{({e_\mathrm{emax}}^2)^2} = 1. \tag{418}$$

These equations illustrate the distinction between a numerically testable dimensionless ratio and an absolute charge-dependent conversion.

26.5 Reproducible unit-ledger workflow

For each proposed application, (i) substitute the primitive monomials, (ii) compare exponent vectors and exact coefficients, (iii) insert a consistently correlated benchmark tuple, and (iv) distinguish unit-scale results from measured particle observables. A new physical prediction requires an additional dynamical relation and a defined observable; numerical agreement produced solely by a unit definition is not an independent experimental test.

27 QMU and SI: Equation-Level Comparison and Conversion Boundaries

The relevant QADI conversion conventions are developed in [14; 15; 31; 11].

The comparison below distinguishes three operations: a change of units, a defining identity among QMU reference scales, and a physical law requiring independent evidence. A compact QMU expression is useful for bookkeeping even when it is not a new physical prediction. Let λ_C be the unreduced electron Compton wavelength and $F_q = c/\lambda_C$. The numerical benchmarks of Section 26 use SI values only to realize the same reference scales.

27.1 Mechanical and temporal examples

Quantity or relation	QMU primitive form	Corresponding SI expression or interpretation
Speed scale	$c = \lambda_C F_q$	$c = 299792458\,\mathrm{m\,s^{-1}}$; the equality defines the reference frequency
Area scale	$\mathrm{area} = {\lambda_C}^2$	${\lambda_C}^2$ in $\mathrm{m^2}$
Temporal-square scale	$\mathrm{rson} = {F_q}^2$	${F_q}^2$ in $\mathrm{s^{-2}}$
Temperature ledger	$\mathrm{temp} = {\lambda_C}^2 {F_q}^2 = c^2$	c^2 in $\mathrm{m^2\,s^{-2}}$; not kelvin
Momentum scale	$\mathrm{momt} = m_\mathrm{e}\lambda_C F_q$	$m_\mathrm{e}c$ in $\mathrm{kg\,m\,s^{-1}}$
Angular-momentum scale	$\mathrm{angm} = m_\mathrm{e}{\lambda_C}^2 F_q$	$m_\mathrm{e}\lambda_C c = h$ in J s for the chosen Compton convention
Energy scale	$\mathrm{enrg} = F_q\,\mathrm{angm}$	$m_\mathrm{e}c^2$ in joules
Force scale	$\mathrm{forc} = F_q\,\mathrm{momt}$	$m_\mathrm{e}c^2/\lambda_C$ in newtons
Pressure scale	$\mathrm{pres} = \mathrm{forc}/{\lambda_C}^2$	$m_\mathrm{e}c^2/{\lambda_C}^3$ in pascals

The SI column provides familiar dimensional realizations, not independent observations of a force, pressure, or particle angular momentum. The equality $\mathrm{angm} = h$ is specific to the chosen reference length $\lambda_C = h/(m_\mathrm{e}c)$; the QMU primitive ledger does not take $\hbar$ as a primitive.

27.2 Distributed-charge and magnetic families

The distributed-charge reference ${e_\mathrm{emax}}^2$ must not be silently identified with an SI coulomb squared. The QMU expressions

$$e^2 = 8\pi\alpha\,{e_\mathrm{emax}}^2, \qquad {e_\mathrm{emax}}^4 = ({e_\mathrm{emax}}^2)^2, \tag{419}$$

$$\mathrm{mflx} = \frac{\mathrm{angm}}{{e_\mathrm{emax}}^2}, \qquad \mathrm{mfxd} = \frac{\mathrm{mflx}}{{\lambda_C}^2}, \tag{420}$$

$$\mathrm{cond} = \frac{1}{\mathrm{mflx}}, \qquad \mathrm{magm} = {e_\mathrm{emax}}^2 {\lambda_C}^2 F_q \tag{421}$$

are relations in the QMU catalog. An absolute SI flux, conductance, or magnetic-moment number cannot be inferred from these equations without the charge-conversion mapping and the precise physical quantity to which the mapping applies. In particular, $\mathrm{cond}\,\mathrm{mflx} = 1$ is a reference-unit identity; it is not an SI constitutive law equating the product of measured conductance and measured magnetic flux to a dimensionless one.

27.3 The Aether closure and numerical geometry

The closure ledger reads

$$A_u \,\mathrm{curl} = {F_q}^2 \, {\lambda_C}^2 = c^2 = \mathrm{temp}. \tag{422}$$

The QMU quantity A_u carries its specified physical area dimension; $16\pi^2$ is a numerical closure coefficient, not a substitute for A_u. The ledger expresses a proposed APM closure, whereas $c = \lambda_C F_q$ follows from the chosen reference frequency. Their different logical statuses remain visible even when their algebraic expressions coincide.

27.4 A cross-family worked conversion

The mechanical chain can be checked without new constants:

$$F_q \,\mathrm{angm} = \frac{c}{\lambda_C}\,(m_\mathrm{e}\lambda_C c) = m_\mathrm{e}c^2 = \mathrm{enrg}, \tag{423}$$

$$\frac{\mathrm{enrg}}{\lambda_C} = m_\mathrm{e}\lambda_C {F_q}^2 = \mathrm{forc}, \tag{424}$$

$$\frac{\mathrm{forc}}{{\lambda_C}^2} = \frac{m_\mathrm{e}{F_q}^2}{\lambda_C} = \mathrm{pres}. \tag{425}$$

The same primitive tuple thus generates a consistent energy–force–pressure ladder. No new experimental result is claimed by these algebraic transformations.

27.5 Species-anchored charge conversion

The charge-conversion-factor (CCF) prescription has been developed explicitly in the QADI literature [14; 15]. For a species label X its formal definition is

$$\mathrm{ccf}_X = \frac{e_{X\,\max}^2}{e}, \qquad \mathrm{ccf}_\mathrm{e} = \frac{{e_\mathrm{emax}}^2}{e} = \frac{e}{8\pi\alpha}, \tag{426}$$

where the last equality uses the APM electron charge relation $e^2 = 8\pi\alpha\,{e_\mathrm{emax}}^2$. In the electron sector the corresponding potential and magnetic-flux reference identities read

$$\mathrm{potn}\,\mathrm{ccf}_\mathrm{e} = \frac{m_\mathrm{e}{\lambda_C}^2{F_q}^2}{e} = \frac{m_\mathrm{e}c^2}{e}, \tag{427}$$

$$\mathrm{mflx}\,\mathrm{ccf}_\mathrm{e} = \frac{m_\mathrm{e}{\lambda_C}^2 F_q}{e} = \frac{h}{e}. \tag{428}$$

The CCF applies to singular-charge factors according to the sign of their charge exponent; the source treatment also specifies squared-factor rules for MFR/MFF quantities and five unit-category exceptions: cond, capc, indc, perm, and ptty. These rules describe the proposed QMU–SI translation convention and must be applied to the correct observable and species; they are not permission to identify the dimension of ${e_\mathrm{emax}}^2$ with an SI coulomb squared. The above identities recover familiar SI reference expressions under the stated mapping [14; 15]. Claims of independent empirical calibration require traceable measurements and propagation of uncertainties through that mapping.

27.6 Conversion protocol for external measurements

To compare a measured SI quantity with a QMU result, identify the physical observable and its measurement convention, reduce the QMU expression to the primitive exponent vector, insert a single consistent reference tuple, and apply the published QMU charge-conversion convention where relevant. Preserve numerical coefficients and correlated uncertainties. Finally separate exact definitions, empirically supplied scales, constitutive assumptions, and predictions. This procedure allows compact QMU calculations to be evaluated without confusing a change of representation with a new physical law.

28 Worked SI–QMU Conversion Worksheet

The QADI charge-specific and cross-system conversion prescriptions are described in [14; 15; 11].

A conversion between an SI measurement and its QMU representation has two distinct parts: the numerical magnitude relative to a QMU reference scale and the primitive exponent vector of that scale. The first is dimensionless; the second records the physical dimensions. This worksheet uses the electron-based reference tuple m_e, λ_C, and F_q with $c = \lambda_C F_q$. The numerical illustrations are rounded; calculations requiring metrological precision must retain the full reference values and their uncertainties.

28.1 Reference scales and conversion rule

For a mechanical or temporal QMU reference quantity $Q_0 = {m_\mathrm{e}}^a {\lambda_C}^b {F_q}^d$, define the corresponding SI realization $[Q_0]_\mathrm{SI}$ using consistent SI realizations of the three primitives. For an SI measurement Q_SI of the same physical dimensions, its numerical value in that QMU reference scale is

$$q_\mathrm{QMU} = \frac{Q_\mathrm{SI}}{[Q_0]_\mathrm{SI}}, \qquad Q_\mathrm{SI} = q_\mathrm{QMU}[Q_0]_\mathrm{SI}. \tag{429}$$

The quotient is valid only for matching dimensions and a specified measurement convention. A reference-scale equality does not imply that an observed system has the corresponding physical energy, force, or pressure.

Reference	Primitive expression	Rounded SI realization
Frequency	F_q	$1.23559 \times 10^{20}\,\mathrm{s}^{-1}$
Area	${\lambda_C}^2$	$5.88698 \times 10^{-24}\,\mathrm{m}^2$
Angular momentum	$\mathrm{angm} = m_\mathrm{e}{\lambda_C}^2 F_q$	$6.62607 \times 10^{-34}\,\mathrm{J\,s}$
Energy	$\mathrm{enrg} = m_\mathrm{e}{\lambda_C}^2 {F_q}^2$	$8.18711 \times 10^{-14}\,\mathrm{J}$
Force	$\mathrm{forc} = m_\mathrm{e}\lambda_C {F_q}^2$	$3.37430 \times 10^{-2}\,\mathrm{N}$
Pressure	$\mathrm{pres} = m_\mathrm{e}{F_q}^2/\lambda_C$	$5.73181 \times 10^{21}\,\mathrm{Pa}$

28.2 Energy: one electronvolt to QMU and back

For a measured or specified energy $E = 1\,\mathrm{eV} = 1.602176634 \times 10^{-19}\,\mathrm{J}$, the numerical value relative to the QMU energy reference is

$$q_E = \frac{1.602176634 \times 10^{-19}\,\mathrm{J}}{8.18711 \times 10^{-14}\,\mathrm{J}} \simeq 1.957 \times 10^{-6}, \tag{430}$$

$$E = q_E\, m_\mathrm{e} {\lambda_C}^2 {F_q}^2 \simeq 1.60218 \times 10^{-19}\,\mathrm{J}. \tag{431}$$

The electronvolt-to-joule factor is an SI convention; the QMU exponent vector of the energy reference is $(1, 2, 2, 0)$ in the ordered basis $(m_\mathrm{e}, \lambda_C, F_q, {e_\mathrm{emax}}^2)$.

28.3 Force and pressure: a mechanical conversion chain

For $F = 1\,\mathrm{N}$ and $P = 1\,\mathrm{Pa}$, independently normalized against their respective reference scales,

$$q_F = \frac{1\,\mathrm{N}}{3.37430 \times 10^{-2}\,\mathrm{N}} \simeq 29.636, \tag{432}$$

$$q_P = \frac{1\,\mathrm{Pa}}{5.73181 \times 10^{21}\,\mathrm{Pa}} \simeq 1.74465 \times 10^{-22}. \tag{433}$$

The corresponding QMU exponent vectors are $(1, 1, 2, 0)$ and $(1, -1, 2, 0)$. The inverse conversion multiplies q_F by $m_\mathrm{e} {\lambda_C} {F_q}^2$ and q_P by $m_\mathrm{e} {F_q}^2 / \lambda_C$, respectively. Although $\mathrm{pres} = \mathrm{forc}/{\lambda_C}^2$ as reference scales, a particular measured force and a particular measured pressure are related by $P = F/A$ only when the physical loaded area A is specified.

28.4 Frequency, area, and angular momentum

Three further SI measurements illustrate reference scaling without introducing charge conversion:

$$1\,\mathrm{Hz} \longleftrightarrow \frac{1}{1.23559 \times 10^{20}}\, F_q \simeq 8.0933 \times 10^{-21}\, F_q, \tag{434}$$

$$1\,\mathrm{m}^2 \longleftrightarrow \frac{1}{5.88698 \times 10^{-24}}\, {\lambda_C}^2 \simeq 1.69866 \times 10^{23}\, {\lambda_C}^2, \tag{435}$$

$$1\,\mathrm{J\,s} \longleftrightarrow \frac{1}{6.62607 \times 10^{-34}}\,\mathrm{angm} \simeq 1.50919 \times 10^{33}\,\mathrm{angm}. \tag{436}$$

These quantities have exponent vectors $(0, 0, 1, 0)$, $(0, 2, 0, 0)$, and $(1, 2, 1, 0)$, respectively. In the selected unreduced-Compton convention, the angular-momentum reference equals h numerically; this is a consequence of the reference definitions.

28.5 Distributed charge and the boundary of this worksheet

The reference charge quantity ${e_\mathrm{emax}}^2$ is a QMU distributed-charge unit, not an SI coulomb squared. The relation

$$e^2 = 8\pi\alpha\, {e_\mathrm{emax}}^2, \qquad {e_\mathrm{emax}}^4 = ({e_\mathrm{emax}}^2)^2 \tag{437}$$

can be manipulated within the QMU charge ledger. Species-anchored charge-conversion prescriptions have been published [14; 15]; applying them to measured SI charge, magnetic flux, conductance, or magnetic moment requires the stated charge exponent, exceptions, and an appropriate metrological realization. No charge bridge follows from the mechanical reference scales alone.

28.6 Verification protocol

For every conversion, state the physical observable and convention, record the primitive exponent vector, divide by the matching SI reference scale, and multiply back to check the original measurement. Treat the reference numerical values as rounded unless full precision is supplied. Keep exact defining equalities separate from physical assumptions, measured inputs, and proposed APM predictions.

29 Electrical and Magnetic Dimensional-Consistency Worksheet

The underlying QMU induction, Josephson, charge, and Maxwell ledgers are treated in [25; 48; 17; 27; 28].

The QMU electrical and magnetic families can be checked by expressing each named unit in the common primitive ledger $\left(m_{\mathrm{e}}, \lambda_C, F_q, {e_{\mathrm{emax}}}^2\right)$. The charge coordinate represents a distributed-charge unit; ${e_{\mathrm{emax}}}^2$ is a unit scale and is not an independently existing elementary charge component. The squared charge unit in this ledger is ${e_{\mathrm{emax}}}^4 = ({e_{\mathrm{emax}}}^2)^2$. All results below are algebraic consequences of the stated QMU definitions, not new empirical field laws.

29.1 Exponent-vector rules

Write a reference quantity as $Q = C {m_{\mathrm{e}}}^a {\lambda_C}^b {F_q}^c ({e_{\mathrm{emax}}}^2)^d$, with exponent vector $\boldsymbol{\nu}(Q) = (a, b, c, d)$. Then

$$\boldsymbol{\nu}(Q_1 Q_2) = \boldsymbol{\nu}(Q_1) + \boldsymbol{\nu}(Q_2), \qquad \boldsymbol{\nu}(Q_1/Q_2) = \boldsymbol{\nu}(Q_1) - \boldsymbol{\nu}(Q_2). \tag{438}$$

A proposed equality also requires agreement of its numerical coefficient. In particular, $e^2 = 8\pi\alpha\, {e_{\mathrm{emax}}}^2$ carries a nontrivial dimensionless factor even though its exponent vector agrees with that of ${e_{\mathrm{emax}}}^2$.

29.2 Electrical and magnetic primitive ledger

QMU quantity	Primitive representation	$\boldsymbol{\nu}$
mflx	$m_{\mathrm{e}} {\lambda_C}^2 F_q / {e_{\mathrm{emax}}}^2$	$(1, 2, 1, -1)$
mfxd	$m_{\mathrm{e}} F_q / {e_{\mathrm{emax}}}^2$	$(1, 0, 1, -1)$
indc	$m_{\mathrm{e}} {\lambda_C}^2 / {e_{\mathrm{emax}}}^2$	$(1, 2, 0, -1)$
cond	${e_{\mathrm{emax}}}^2 / (m_{\mathrm{e}} {\lambda_C}^2 F_q)$	$(-1, -2, -1, 1)$
resn	$m_{\mathrm{e}} {\lambda_C}^2 F_q / {e_{\mathrm{emax}}}^4$	$(1, 2, 1, -2)$
capc	${e_{\mathrm{emax}}}^2 / (m_{\mathrm{e}} {\lambda_C}^2 {F_q}^2)$	$(-1, -2, -2, 1)$
perm	$m_{\mathrm{e}} \lambda_C / {e_{\mathrm{emax}}}^2$	$(1, 1, 0, -1)$
prmt	${e_{\mathrm{emax}}}^2 / (m_{\mathrm{e}} {\lambda_C}^3 {F_q}^2)$	$(-1, -3, -2, 1)$
curl	${e_{\mathrm{emax}}}^2 / (m_{\mathrm{e}} \lambda_C)$	$(-1, -1, 0, 1)$
magm	${e_{\mathrm{emax}}}^2 {\lambda_C}^2 F_q$	$(0, 2, 1, 1)$
eddy	$m_{\mathrm{e}}^2 {\lambda_C}^4 {F_q}^2 / {e_{\mathrm{emax}}}^4$	$(2, 4, 2, -2)$

29.3 Worked flux and response closures

The first worksheet reduces each side to the same monomial:

$$\mathrm{mfxd}\,{\lambda_C}^2 = \frac{m_\mathrm{e} F_q}{{e_\mathrm{emax}}^2}{\lambda_C}^2 = \frac{m_\mathrm{e}{\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2} = \mathrm{mflx}, \tag{439}$$

$$\mathrm{indc}\,F_q = \frac{m_\mathrm{e}{\lambda_C}^2}{{e_\mathrm{emax}}^2}F_q = \mathrm{mflx}, \tag{440}$$

$$\mathrm{cond}\,\mathrm{mflx} = \frac{{e_\mathrm{emax}}^2}{m_\mathrm{e}{\lambda_C}^2 F_q}\frac{m_\mathrm{e}{\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2} = 1. \tag{441}$$

The last equality is a reference-unit reciprocal identity. It does not assert that an SI conductance measurement is the reciprocal of an SI magnetic-flux measurement.

29.4 Electrical resistance is not the reciprocal of conductance

The catalog definitions yield

$$\mathrm{resn}\,\mathrm{cond} = \frac{m_\mathrm{e}{\lambda_C}^2 F_q}{{e_\mathrm{emax}}^4}\frac{{e_\mathrm{emax}}^2}{m_\mathrm{e}{\lambda_C}^2 F_q} = \frac{1}{{e_\mathrm{emax}}^2}. \tag{442}$$

Thus $\mathrm{resn} \neq 1/\mathrm{cond}$ in this primitive ledger. Likewise

$$\mathrm{capc} = \frac{\mathrm{cond}}{F_q}, \qquad \mathrm{resn}\,\mathrm{capc} = \frac{1}{{e_\mathrm{emax}}^2 F_q}. \tag{443}$$

These are dimensioned QMU relationships, so an SI circuit interpretation cannot be assigned by analogy alone.

29.5 Permeability, permittivity, and the propagation scale

Direct substitution gives

$$\mathrm{perm}\,\mathrm{curl} = \frac{m_\mathrm{e}\lambda_C}{{e_\mathrm{emax}}^2}\frac{{e_\mathrm{emax}}^2}{m_\mathrm{e}\lambda_C} = 1, \tag{444}$$

$$\mathrm{perm}\,\mathrm{prmt} = \frac{m_\mathrm{e}\lambda_C}{{e_\mathrm{emax}}^2}\frac{{e_\mathrm{emax}}^2}{m_\mathrm{e}{\lambda_C}^3 {F_q}^2} = \frac{1}{{\lambda_C}^2 {F_q}^2} = \frac{1}{c^2}. \tag{445}$$

The second identity is compatible with the mechanical-temporal scale $c = \lambda_C F_q$; whether a physical medium follows this response law requires separately specified dynamics and boundary conditions.

29.6 Quadratic charge order and magnetic moment

Two checks make the charge exponent explicit:

$$\mathrm{mflx}^2 = \frac{{m_\mathrm{e}}^2{\lambda_C}^4{F_q}^2}{{e_\mathrm{emax}}^4} = \mathrm{eddy}, \tag{446}$$

$$\frac{\mathrm{magm}}{\mathrm{angm}} = \frac{{e_\mathrm{emax}}^2{\lambda_C}^2 F_q}{m_\mathrm{e}{\lambda_C}^2 F_q} = \frac{{e_\mathrm{emax}}^2}{m_\mathrm{e}}. \tag{447}$$

The first expression has charge exponent -2 relative to the ${e_{\text{emax}}}^2$ basis, while the second has exponent $+1$. A particle's measured magnetic moment may differ from the reference unit by geometric and dynamical coefficients.

29.7 Boundary between QMU and SI charge measurements

The QADI CCF mapping is explicitly specified in companion papers [14; 15]. Applying that prescription to measured SI quantities requires the charge dimensions, correct species and charge exponent, the stated exception classes, and uncertainties. Mechanical conversions involving m_e, λ_C, and F_q do not determine the electrical bridge. The normalization $e^2 = 8\pi\alpha {e_{\text{emax}}}^2$ supplies an internal charge relation; operational conversion requires the CCF convention. For each electromagnetic calculation, identify the observable, reduce all QMU units to primitive exponents, retain exact coefficients, and apply the convention with appropriate calibration.

30 Cross-Family Dimensional Matrix and Unit Composition

For QMU dimensional axioms and electromagnetic constitutive comparisons, see [1; 29; 14].

The mechanical, temporal, electrical, and magnetic reference scales admit a common primitive representation. For a QMU quantity Q, write

$$Q = C_Q {m_\text{e}}^{a_Q} {\lambda_C}^{b_Q} {F_q}^{c_Q} ({e_{\text{emax}}}^2)^{d_Q}, \qquad \boldsymbol{\nu}(Q) = (a_Q, b_Q, c_Q, d_Q). \tag{448}$$

The numerical coefficient C_Q is retained separately from the exponent vector. In particular, equality of exponent vectors is necessary but not sufficient for equality of physical quantities.

30.1 Cross-family exponent matrix

Family	QMU reference quantity	a	b	c	d
Mechanical	mass $= m_\text{e}$	1	0	0	0
Geometric	leng $= \lambda_C$	0	1	0	0
Temporal	freq $= F_q$	0	0	1	0
Charge	chrg $= {e_{\text{emax}}}^2$	0	0	0	1
Geometric	area $= {\lambda_C}^2$	0	2	0	0
Kinematic	ligt $= \lambda_C F_q$	0	1	1	0
Temporal	rson $= {F_q}^2$	0	0	2	0
Mechanical	momn $= m_\text{e}\lambda_C F_q$	1	1	1	0
Mechanical	angm $= m_\text{e}{\lambda_C}^2 F_q$	1	2	1	0
Mechanical	enrg $= m_\text{e}{\lambda_C}^2 {F_q}^2$	1	2	2	0
Mechanical	forc $= m_\text{e}\lambda_C {F_q}^2$	1	1	2	0
Mechanical	pres $= m_\text{e}{F_q}^2/\lambda_C$	1	-1	2	0
Magnetic	mflx $= m_\text{e}{\lambda_C}^2 F_q/{e_{\text{emax}}}^2$	1	2	1	-1
Magnetic	mfxd $= m_\text{e}F_q/{e_{\text{emax}}}^2$	1	0	1	-1
Electrical	indc $= m_\text{e}{\lambda_C}^2/{e_{\text{emax}}}^2$	1	2	0	-1
Electrical	cond $= {e_{\text{emax}}}^2/(m_\text{e}{\lambda_C}^2 F_q)$	-1	-2	-1	1
Electrical	capc $= {e_{\text{emax}}}^2/(m_\text{e}{\lambda_C}^2 {F_q}^2)$	-1	-2	-2	1
Electrical	resn $= m_\text{e}{\lambda_C}^2 F_q/{e_{\text{emax}}}^4$	1	2	1	-2
Magnetic	magm $= {e_{\text{emax}}}^2{\lambda_C}^2 F_q$	0	2	1	1

Here leng, freq, mass, and momn denote the displayed reference scales rather than asserting additional canonical catalog names. The four primitive columns form an algebraic coordinate system for the quantities shown; they are not a claim that distributed charge consists of independently existing $e_{e\,\max}$ components.

30.2 Composition and nullspace tests

If $Q_1^{n_1} \cdots Q_k^{n_k}$ is dimensionless in the QMU primitive ledger, its exponent sum vanishes:

$$\sum_{j=1}^{k} n_j \boldsymbol{\nu}(Q_j) = \mathbf{0}. \tag{449}$$

For example, direct subtraction of the rows above gives

$$\mathrm{enrg}/(F_q\,\mathrm{angm}) = 1, \tag{450}$$
$$\mathrm{forc}\,\lambda_C/\mathrm{enrg} = 1, \tag{451}$$
$$\mathrm{mflx}/({\lambda_C}^2\,\mathrm{mfxd}) = 1, \tag{452}$$
$$\mathrm{mflx}/(F_q\,\mathrm{indc}) = 1, \tag{453}$$
$$\mathrm{cond}\,\mathrm{mflx} = 1, \tag{454}$$
$$\mathrm{resn}\,\mathrm{cond}\,{e_{\mathrm{emax}}}^2 = 1. \tag{455}$$

These equations concern reference units and their stated normalizations. The same exponent method detects a missing charge factor: resn cond has exponent $(0, 0, 0, -1)$ and therefore cannot equal the dimensionless number one.

30.3 The geometric closure and coefficient ledger

The closure relation $A_u\mathrm{curl} = {\lambda_C}^2 {F_q}^2 = c^2$ combines a physical QMU area with the curl unit. The numerical factor $16\pi^2$ associated with five-dimensional closure is not interchangeable with the dimensioned quantity A_u. Likewise the charge relation

$$e^2 = 8\pi\alpha\,{e_{\mathrm{emax}}}^2 \tag{456}$$

requires retention of its dimensionless coefficient even when the primitive charge exponent agrees. A separate SI realization of distributed charge is needed before a numerical electrical conversion can be claimed.

30.4 Using the matrix for calculation

Given a proposed QMU equation, express each term as a primitive monomial, add or subtract exponent columns as appropriate, and compare the resulting vectors. Only after this dimensional check should exact numerical coefficients, geometric boundary conditions, and empirical calibration be applied. This procedure works uniformly for mechanical and electromagnetic families without imposing SI circuit conventions on the QMU catalog.

31 Catalog-Wide Primitive Dependencies and Reciprocal Structure

The companion QMU dimensional algebra and conversion sources are [1; 3; 11].

Every named entry in the QMU catalog has a primitive monomial representation. The full set of 257 entries can therefore be treated as a finite lattice of exponent vectors. This approach supplies a common navigation and consistency procedure for mechanical, temporal, geometrical, electrical, and magnetic relationships without attributing physical independence to each named unit.

31.1 Charge-normalized exponent coordinates

For any catalog unit Q, let

$$Q = C_Q {m_\mathrm{e}}^a {\lambda_C}^b {F_q}^c ({e_\mathrm{emax}}^2)^d, \qquad \boldsymbol{\nu}(Q) = (a, b, c, d) \in \mathbb{Z}^4. \tag{457}$$

The charge component d is the exponent of the *distributed-charge unit* ${e_\mathrm{emax}}^2$, not the exponent of an independently existing e_emax unit. The published primitive expressions contain only even powers of e_emax, so they admit this representation with integer d. In particular, powers $d = 2$ and $d = -2$ refer to ${e_\mathrm{emax}}^4$ and its reciprocal. The coefficient C_Q is displayed separately because equal exponent vectors need not imply equal normalized physical quantities. Under multiplication, division, and integer powers, the exponent map obeys

$$\boldsymbol{\nu}(PQ) = \boldsymbol{\nu}(P) + \boldsymbol{\nu}(Q), \quad \boldsymbol{\nu}(P/Q) = \boldsymbol{\nu}(P) - \boldsymbol{\nu}(Q), \quad \boldsymbol{\nu}(P^n) = n\boldsymbol{\nu}(P). \tag{458}$$

Four catalog entries provide primitive directions: mass, Compton wavelength, quantum frequency, and charge. Their vectors are $(1, 0, 0, 0)$, $(0, 1, 0, 0)$, $(0, 0, 1, 0)$, and $(0, 0, 0, 1)$, respectively. Thus the exponent matrix has rank four. This is a statement about algebraic coordinates, not a claim that the 257 named quantities are mutually independent or that numerical coefficients can be omitted.

31.2 Catalog-wide distribution and reciprocal closure

Every catalog vector is distinct. Among the 257 named entries, 128 form exact inverse pairs in the primitive ledger (256 entries in 128 pairs). The remaining entry, eddy current, does not have a named reciprocal partner in the catalog. Its vector equals twice the magnetic-flux vector:

$$\boldsymbol{\nu}(\mathrm{eddy}) = 2\boldsymbol{\nu}(\mathrm{mflx}), \qquad \mathrm{eddy} = \mathrm{mflx}^2 \quad \text{at the stated reference normalization.} \tag{459}$$

The formal inverse mflx^{-2} is well-defined, but it is not a separately named catalog unit. A missing catalog name is not a dimensional inconsistency.

Charge exponent d	Entries	Interpretation
-2	13	$({e_\mathrm{emax}}^4)^{-1}$
-1	52	$({e_\mathrm{emax}}^2)^{-1}$
0	128	charge-neutral primitive
1	52	${e_\mathrm{emax}}^2$
2	12	${e_\mathrm{emax}}^4$

Because the reciprocal operation reverses every exponent, entries with $d = \pm 1$ match by charge sector, while most $d = \pm 2$ entries match likewise; the one unpaired eddy-current entry lies in the $d = -2$ sector. The 128 units with $d = 0$ make 64 reciprocal pairs.

31.3 Primitive shifts across named units

Multiplying by one primitive factor moves the exponent vector by a fixed step. Whenever the shifted vector belongs to the catalog, this creates a directed dependency between two named units. The counts below refer to exact exponent matches, not to independent physical coupling laws.

Primitive multiplier	Vector increment	Catalog matches
m_e	$(1, 0, 0, 0)$	102
λ_C	$(0, 1, 0, 0)$	208
F_q	$(0, 0, 1, 0)$	204
${e_\mathrm{emax}}^2$	$(0, 0, 0, 1)$	126

These directed matches constitute a compact dependency graph. For example, the following named-unit chains are present in the catalog:

$$\mathrm{mass} \cdot \mathrm{acceleration} = \mathrm{force}, \qquad \lambda_C \cdot \mathrm{area} = \mathrm{volume}, \tag{460}$$

$$F_q \cdot \mathrm{angm} = \mathrm{enrg}, \qquad F_q \cdot \mathrm{capacitance} = \mathrm{cond}, \tag{461}$$

$$F_q \cdot \mathrm{charge} = \mathrm{current}, \qquad \lambda_C \cdot \mathrm{force} = \mathrm{enrg}. \tag{462}$$

The relationships above express the indicated reference scales. Physical equations involving observed values may also contain geometric coefficients, boundary-dependent factors, or coupling parameters.

31.4 Cross-family closure paths

The same catalog-wide coordinates allow a path to begin in one unit family and end in another without changing primitive definitions:

$$\mathrm{rmfd}\,\mathrm{curl} = \mathrm{temp} = {\lambda_C}^2 {F_q}^2, \tag{463}$$

$$\mathrm{mflx} = F_q\,\mathrm{indc} = {\lambda_C}^2\,\mathrm{mfxd}, \tag{464}$$

$$\mathrm{cond}\,\mathrm{mflx} = 1, \tag{465}$$

$$\mathrm{resn}\,\mathrm{cond}\,{e_\mathrm{emax}}^2 = 1, \tag{466}$$

$${e_\mathrm{emax}}^2\,\mathrm{mflx} = \mathrm{angm}. \tag{467}$$

In these equations, the first line uses the named QMU curl quantity, not the vector differential operator. The geometrical closure $A_u\mathrm{curl} = \mathrm{temp}$ involves a physically dimensioned A_u. The distinct number $16\pi^2$ is not an alternate notation for A_u. Likewise, the charge relation $e^2 = 8\pi\alpha\,{e_\mathrm{emax}}^2$ retains its coefficient and is not a conversion of ${e_\mathrm{emax}}^2$ directly into SI coulombs.

31.5 Complete catalog exponent and inverse index

The following alphabetical index records the complete catalog in the charge-normalized primitive basis. The columns a, b, c, d correspond, respectively, to m_e, λ_C, F_q, and ${e_\mathrm{emax}}^2$. A reciprocal entry

is an index of opposite exponent vector; it does not supply an additional constitutive equation. Names reproduce the catalog nomenclature.

Table 1: Catalog-wide QMU primitive-exponent and reciprocal index

Catalog unit	a	b	c	d	Reciprocal catalog unit
Acceleration	0	1	2	0	Momentum Resistance Coefficient
Acceleration per Charge	0	1	2	-1	Quantum Electric Field Elasticity
Acceptance	-1	-1	-2	1	Electric Field Strength
Active Area	0	2	-1	0	Transverse Surface Wave
Admittance	-1	-2	-1	2	Resistance
Aether Fluctuation Potential	-1	-2	0	1	Inductance
Aether Resistance Stability Factor	1	0	2	-2	Magnetic Charge per Unit Potential
Angular Momentum	1	2	1	0	Quantum Angular Receptivity Gauge
Area	0	2	0	0	Bending Radius
Area-Time Flux	0	2	-2	0	Transverse Surface Resonance
Ball Lightning	0	2	3	1	Quantum Illumination Density
Bending Radius	0	-2	0	0	Area
Capacitance	-1	-2	-2	1	Potential
Charge	0	0	0	1	Magnetic Charge Affinity
Charge Acceleration	0	1	2	1	Quantum Electric Charge Acceleration
Charge Density	0	-3	0	1	Specific Charge
Charge Distribution	0	2	0	-1	Electric Flux Density
Charge Length	0	1	0	1	Quantum Electric Charge Displacement
Charge Radius	0	1	0	-1	Electric Charge Gradient
Charge Resonance	0	0	2	1	Quantum Electric Charge Oscillation
Charge Surface Confinement Coefficient	0	-2	0	-1	Surface Charge
Charge Surface - Temporal Confinement Coefficient	0	-2	-1	-1	Magnetic Moment
Charge Sweep	0	2	1	-1	Magnetic Charge Density Frequency
Charge Temperature	0	2	2	-1	Quantum Electric Surface Resonance Capacity
Charge Velocity	0	1	1	1	Quantum Electric Charge Drift
Charge Volume	0	3	0	1	Magnetic Charge Rotational Density
Compton wavelength	0	1	0	0	Wave Number
Conductance	-1	-2	-1	1	Magnetic Flux
Conductance Density	-1	0	-1	1	Magnetic Flux Density
Converging Electric Field	-1	0	-2	1	Diverging Electric Field
Curl	-1	-1	0	1	Permeability
Current	0	0	1	1	Quantum Electric Charge Fluctuation

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	a	b	c	d	Reciprocal catalog unit
Current Density	0	-2	1	1	Quantum Charge Distribution Dynamics
Current Flow Facilitation Factor	-1	-3	0	2	Flux Flow Equilibrium
Displacement Field	-1	0	-1	0	Intensity
Diverging Electric Field	1	0	2	-1	Converging Electric Field
Double Toroid or Volume Resonance	0	3	2	0	Inverse Volume Resonance
Dynamic Electric Field Flux	0	1	3	-1	Quantum Electric Field Plasticity
Dynamic Electric Field Intensity	0	2	3	-1	Quantum Electric Field Intensity
Dynamic Electric Field Oscillation	0	0	3	-1	Quantum Electric Field Permeability
Dynamic Length	0	1	-1	0	Scalar Wave
Eddy Current	2	4	2	-2	No named reciprocal
Electric Charge Gradient	0	-1	0	1	Charge Radius
Electric Field	0	3	1	-1	Quantum Electric Field Compliance
Electric Field Strength	1	1	2	-1	Acceptance
Electric Flux Density	0	-2	0	1	Charge Distribution
Electromagnetic Interaction Coefficient	-1	-3	-1	2	Magnetic Flow Impedance
Electromagnetic Interaction Density	-1	0	0	2	Magnetic Opposition
Electromagnetic Ratio	-1	-3	-2	2	Friction
Energy	1	2	2	0	Quantum Surface Inertia
Exposure	-1	0	0	1	Magnetism
Exposure Diffusion Flux	-1	-1	-1	1	Magnetic Rigidity
Field Intensity	0	-3	0	0	Volume
Flow	0	3	1	0	Volumetric Field Density
Flux Flow Equilibrium	1	3	0	-2	Current Flow Facilitation Factor
Force	1	1	2	0	Spatial Tensility
Force Density	1	-2	2	0	Quantum Area Resonance Compliance
Friction	1	3	2	-2	Electromagnetic Ratio
Helical Path Length	0	1	-3	0	Scalar Quantum Oscillation Density
Inductance	1	2	0	-1	Aether Fluctuation Potential
Innate Particulate Resolvability	-1	-3	-2	0	Photon
Intensity	1	0	1	0	Displacement Field
Inverse Volume Resonance	0	-3	-2	0	Double Toroid or Volume Resonance
Irradiance	1	0	3	0	Quantum Opacity
Kinetic Friction	1	2	2	-2	Magnetic Spatial Compliance
Length Density	1	-1	0	0	Specific Length
Length Density Orbital Coefficient	1	-1	-2	0	Quantum Aether Dynamic Mobility

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	*a*	*b*	*c*	*d*	Reciprocal catalog unit
Length Density Quantum Ratio	1	-1	-3	0	Quantum Aether Dynamic Intensity
Length Density Temporal Factor	1	-1	-1	0	Quantum Aether Mobility
Light	1	3	3	0	Optical Compliance
Light Intensity	1	1	3	0	Quantum Inverse Light Intensity
Magnetic Charge Affinity	0	0	0	-1	Charge
Magnetic Charge Density Frequency	0	-2	-1	1	Charge Sweep
Magnetic Charge Distribution per Rotation	0	-3	-1	-1	Quantum Electric Field Volumetric Compliance
Magnetic Charge per Photon	0	-3	-2	-1	Quantum Electric Field Volumetric Adaptability
Magnetic Charge per Unit Potential	-1	0	-2	2	Aether Resistance Stability Factor
Magnetic Charge Rotational Density	0	-3	0	-1	Charge Volume
Magnetic Current	0	0	1	-1	Quantum Electric Field Permittivity
Magnetic Current Impedance	-1	-1	-2	2	Magnetic Flux Density Wave
Magnetic Diffusion Impedance	1	1	1	-2	Magnetic Field Resistance
Magnetic Field	1	3	1	-1	Magnetic Flux Intensity Ratio
Magnetic Field Energy	-1	-1	0	2	Thermal Magnetic Friction
Magnetic Field Exposure	-1	-3	0	1	Magnetic Volume
Magnetic Field Intensity	0	-1	1	1	Quantum Charge Radius Dynamics
Magnetic Field Resistance	-1	-1	-1	2	Magnetic Diffusion Impedance
Magnetic Flow Impedance	1	3	1	-2	Electromagnetic Interaction Coefficient
Magnetic Flux	1	2	1	-1	Conductance
Magnetic Flux Density	1	0	1	-1	Conductance Density
Magnetic Flux Density Wave	1	1	2	-2	Magnetic Current Impedance
Magnetic Flux Intensity Ratio	-1	-3	-1	1	Magnetic Field
Magnetic Moment	0	2	1	1	Charge Surface - Temporal Confinement Coefficient
Magnetic Opposition	1	0	0	-2	Electromagnetic Interaction Density
Magnetic Permeance	1	2	0	-2	Magnetic Reluctance
Magnetic Reluctance	-1	-2	0	2	Magnetic Permeance
Magnetic Rigidity	1	1	1	-1	Exposure Diffusion Flux
Magnetic Spatial Compliance	-1	-2	-2	2	Kinetic Friction
Magnetic Volume	1	3	0	-1	Magnetic Field Exposure
Magnetism	1	0	0	-1	Exposure
Magneto-Spatial Impedance Ratio	-1	0	-1	2	Potential Charge Concentration Factor
Mass	1	0	0	0	Quantum Existential Limit
Mass Density	1	-3	0	0	Specific Volume
Mass Frequency Distribution Ratio	1	-3	-1	0	Quantum Aether Volumetric Flux Mobility

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	a	b	c	d	Reciprocal catalog unit
Mass-Resonance Coupling Ratio	1	-3	-2	0	Quantum Aether Gravitational Mobility
Moment of Inertia	1	2	0	0	Quantum Area Inertia
Momentum	1	1	1	0	Quantum Mobility
Momentum Density	1	-2	1	0	Quantum Surface Dynamic Compliance
Momentum Resistance Coefficient	0	-1	-2	0	Acceleration
Optical Compliance	-1	-3	-3	0	Light
Orbit	0	0	-2	0	Resonance
Orbital Volume Evolution	0	3	-3	0	Volumetric Quantum Oscillation
Permeability	1	1	0	-1	Curl
Permittivity	-1	-3	-2	1	Rotating Magnetic Field
Photon	1	3	2	0	Innate Particulate Resolvability
Plasma	0	2	2	1	Quantum Electric Charge Flux
Potential	1	2	2	-1	Capacitance
Potential Charge Concentration Factor	1	0	1	-2	Magneto-Spatial Impedance Ratio
Power	1	2	3	0	Quantum Surface Receptivity
Pressure	1	-1	2	0	Quantum Linear Dynamic Compliance
Pressure Diffusion Rate	1	-1	3	0	Quantum Linear Oscillation Density
Quantum Aether Angular Mobility	-1	2	1	0	Surface Charge Temporal Factor
Quantum Aether Dynamic Intensity	-1	1	3	0	Length Density Quantum Ratio
Quantum Aether Dynamic Mobility	-1	1	2	0	Length Density Orbital Coefficient
Quantum Aether Gravitational Mobility	-1	3	2	0	Mass-Resonance Coupling Ratio
Quantum Aether Mobility	-1	1	1	0	Length Density Temporal Factor
Quantum Aether Surface Oscillation Mobility	-1	2	3	0	Surface Charge Intensity Ratio
Quantum Aether Thermal Mobility	-1	2	2	0	Surface Charge Orbital Coefficient
Quantum Aether Volumetric Flux Mobility	-1	3	1	0	Mass Frequency Distribution Ratio
Quantum Angular Reach	1	3	1	0	Quantum Volumetric Receptivity
Quantum Angular Receptivity Gauge	-1	-2	-1	0	Angular Momentum
Quantum Area Inertia	-1	-2	0	0	Moment of Inertia
Quantum Area Resonance Compliance	-1	2	-2	0	Force Density
Quantum Charge Density Intensity	0	-3	3	1	Quantum Volumetric Charge Inertia
Quantum Charge Density Oscillation	0	-3	1	1	Quantum Volumetric Charge Persistence
Quantum Charge Density Resonance	0	-3	2	1	Quantum Volumetric Charge Reluctance
Quantum Charge Distribution Dynamics	0	2	-1	-1	Current Density
Quantum Charge Distribution Periodicity	0	2	-2	-1	Quantum Electric Surface Resonance Intensity
Quantum Charge Distribution Resistance	0	2	-3	-1	Quantum Electric Surface Intensity

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	a	b	c	d	Reciprocal catalog unit
Quantum Charge Radius Dynamics	0	1	-1	-1	Magnetic Field Intensity
Quantum Charge Radius Periodicity	0	1	-2	-1	Quantum Electric Gradient Resonance
Quantum Charge Radius Resistance	0	1	-3	-1	Quantum Electric Gradient Intensity
Quantum Density Intensity Resistance	1	-3	-3	0	Quantum Volume Oscillation Density
Quantum Dynamic Frequency	0	1	3	0	Quantum Dynamic Frequency Resistance
Quantum Dynamic Frequency Resistance	0	-1	-3	0	Quantum Dynamic Frequency
Quantum Electric Charge Acceleration	0	-1	-2	-1	Charge Acceleration
Quantum Electric Charge Displacement	0	-1	0	-1	Charge Length
Quantum Electric Charge Drift	0	-1	-1	-1	Charge Velocity
Quantum Electric Charge Fluctuation	0	0	-1	-1	Current
Quantum Electric Charge Flux	0	-2	-2	-1	Plasma
Quantum Electric Charge Intensity	0	0	-3	-1	Quantum Electric Field Temporal Intensity
Quantum Electric Charge Jerk	0	-1	-3	-1	Quantum Electric Field Dynamic Responsivity
Quantum Electric Charge Oscillation	0	0	-2	-1	Charge Resonance
Quantum Electric Field Compliance	0	-3	-1	1	Electric Field
Quantum Electric Field Conductance	0	-1	-1	1	Velocity per Charge
Quantum Electric Field Dynamic Responsivity	0	1	3	1	Quantum Electric Charge Jerk
Quantum Electric Field Elasticity	0	-1	-2	1	Acceleration per Charge
Quantum Electric Field Intensity	0	-2	-3	1	Dynamic Electric Field Intensity
Quantum Electric Field Permeability	0	0	-3	1	Dynamic Electric Field Oscillation
Quantum Electric Field Permittivity	0	0	-1	1	Magnetic Current
Quantum Electric Field Plasticity	0	-1	-3	1	Dynamic Electric Field Flux
Quantum Electric Field Receptivity	0	-3	-2	1	Varying Electric Field
Quantum Electric Surface Resonance Intensity	0	-2	2	1	Quantum Charge Distribution Periodicity
Quantum Electric Surface Resonance Capacity	0	-2	-2	1	Charge Temperature
Quantum Electric Volumetric Susceptibility	0	-3	-3	1	Trivariate Magnetic Oscillation
Quantum Electric Temporal Susceptibility	0	0	-2	1	Resonance per Charge
Quantum Electric Field Temporal Intensity	0	0	3	1	Quantum Electric Charge Intensity
Quantum Electric Field Volumetric Adaptability	0	3	2	1	Magnetic Charge per Photon
Quantum Electric Field Volumetric Compliance	0	3	1	1	Magnetic Charge Distribution per Rotation
Quantum Electric Field Volumetric Resonance	0	3	3	1	Quantum Photomagnetic Density
Quantum Electric Gradient Intensity	0	-1	3	1	Quantum Charge Radius Resistance

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	a	b	c	d	Reciprocal catalog unit
Quantum Electric Gradient Resonance	0	-1	2	1	Quantum Charge Radius Periodicity
Quantum Existential Limit	-1	0	0	0	Mass
Quantum Flexibility	-1	-1	0	0	Torque
Quantum frequency	0	0	1	0	Time
Quantum Illumination Density	0	-2	-3	-1	Ball Lightning
Quantum Inertial Density	0	-1	-1	0	Quantum Velocity
Quantum Intensity Factor	0	0	3	0	Quantum Intensity Resistance
Quantum Intensity Resistance	0	0	-3	0	Quantum Intensity Factor
Quantum Inverse Light Intensity	-1	-1	-3	0	Light Intensity
Quantum Linear Dynamic Compliance	-1	1	-2	0	Pressure
Quantum Linear Oscillation Density	-1	1	-3	0	Pressure Diffusion Rate
Quantum Linear Temporal Compliance	-1	1	-1	0	Viscosity
Quantum Mass Frequency Activity	1	-3	3	0	Quantum Volume Fluctuation Impedance
Quantum Mass Frequency Oscillation	1	-3	1	0	Quantum Volume Dynamic Flux
Quantum Mass Intensity Resistance	1	0	-3	0	Specific Quantum Intensity Factor
Quantum Mass Orbital Period	1	0	-2	0	Specific Quantum Resonance
Quantum Mass Resonance Occupation	1	-3	2	0	Quantum Volume Temporal Compliance
Quantum Mass Temporal Coefficient	1	0	-1	0	Specific Quantum Frequency
Quantum Mobility	-1	-1	-1	0	Momentum
Quantum Opacity	-1	0	-3	0	Irradiance
Quantum Photomagnetic Density	0	-3	-3	-1	Quantum Electric Field Volumetric Resonance
Quantum Spreadability	-1	0	-2	0	Surface Tension
Quantum Surface Activity	1	-2	3	0	Quantum Surface Frequency Response
Quantum Surface Dynamic Compliance	-1	2	-1	0	Momentum Density
Quantum Surface Frequency Impedance	0	-2	-3	0	Quantum Surface Oscillation
Quantum Surface Frequency Response	-1	2	-3	0	Quantum Surface Activity
Quantum Surface Inertia	-1	-2	-2	0	Energy
Quantum Surface Intensity	0	-2	-2	0	Temperature
Quantum Surface Oscillation	0	2	3	0	Quantum Surface Frequency Impedance
Quantum Surface Receptivity	-1	-2	-3	0	Power
Quantum Trajectory Length	0	1	-2	0	Scalar Resonance
Quantum Velocity	0	1	1	0	Quantum Inertial Density
Quantum Volume Dynamic Flux	-1	3	-1	0	Quantum Mass Frequency Oscillation
Quantum Volume Fluctuation Impedance	-1	3	-3	0	Quantum Mass Frequency Activity
Quantum Volume Oscillation	0	3	3	0	Quantum Volume Oscillation Resistance

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	*a*	*b*	*c*	*d*	Reciprocal catalog unit
Quantum Volume Oscillation Density	-1	3	3	0	Quantum Density Intensity Resistance
Quantum Volume Oscillation Resistance	0	-3	-3	0	Quantum Volume Oscillation
Quantum Volume Temporal Compliance	-1	3	-2	0	Quantum Mass Resonance Occupation
Quantum Volumetric Charge Inertia	0	3	-3	-1	Quantum Charge Density Intensity
Quantum Volumetric Charge Persistence	0	3	-1	-1	Quantum Charge Density Oscillation
Quantum Volumetric Charge Reluctance	0	3	-2	-1	Quantum Charge Density Resonance
Quantum Volumetric Inertia	-1	-3	0	0	Vortex
Quantum Volumetric Receptivity	-1	-3	-1	0	Quantum Angular Reach
Resistance	1	2	1	-2	Admittance
Resonance	0	0	2	0	Orbit
Resonance per Charge	0	0	2	-1	Quantum Electric Temporal Susceptibility
Rotating Magnetic Field	1	3	2	-1	Permittivity
Scalar Quantum Oscillation Density	0	-1	3	0	Helical Path Length
Scalar Resonance	0	-1	2	0	Quantum Trajectory Length
Scalar Wave	0	-1	1	0	Dynamic Length
Spatial Tensility	-1	-1	-2	0	Force
Specific Area	-1	2	0	0	Surface Density
Specific Charge	0	3	0	-1	Charge Density
Specific Length	-1	1	0	0	Length Density
Specific Quantum Frequency	-1	0	1	0	Quantum Mass Temporal Coefficient
Specific Quantum Intensity Factor	-1	0	3	0	Quantum Mass Intensity Resistance
Specific Quantum Resonance	-1	0	2	0	Quantum Mass Orbital Period
Specific Volume	-1	3	0	0	Mass Density
Surface Charge	0	2	0	1	Charge Surface Confinement Coefficient
Surface Charge Intensity Ratio	1	-2	-3	0	Quantum Aether Surface Oscillation Mobility
Surface Charge Orbital Coefficient	1	-2	-2	0	Quantum Aether Thermal Mobility
Surface Charge Temporal Factor	1	-2	-1	0	Quantum Aether Angular Mobility
Surface Density	1	-2	0	0	Specific Area
Surface Flux Resistance	0	-2	-1	0	Sweep or Angular Velocity
Surface Tension	1	0	2	0	Quantum Spreadability
Sweep or Angular Velocity	0	2	1	0	Surface Flux Resistance
Temperature	0	2	2	0	Quantum Surface Intensity
Temporal Area Flux	0	2	-3	0	Transverse Quantum Oscillation Density
Thermal Magnetic Friction	1	1	0	-2	Magnetic Field Energy
Time	0	0	-1	0	Quantum frequency

Continued on following page

Catalog-wide QMU dependency index (continued)

Catalog unit	a	b	c	d	Reciprocal catalog unit
Torque	1	1	0	0	Quantum Flexibility
Transverse Quantum Oscillation Density	0	-2	3	0	Temporal Area Flux
Transverse Surface Resonance	0	-2	2	0	Area-Time Flux
Transverse Surface Wave	0	-2	1	0	Active Area
Trivariate Magnetic Oscillation	0	3	3	-1	Quantum Electric Volumetric Susceptibility
Varying Electric Field	0	3	2	-1	Quantum Electric Field Receptivity
Velocity per Charge	0	1	1	-1	Quantum Electric Field Conductance
Viscosity	1	-1	1	0	Quantum Linear Temporal Compliance
Volume	0	3	0	0	Field Intensity
Volume-Time	0	3	-1	0	Volumetric Wave Frequency
Volumetric Field Density	0	-3	-1	0	Flow
Volumetric Orbital Coherence	0	3	-2	0	Volumetric Resonance
Volumetric Quantum Oscillation	0	-3	3	0	Orbital Volume Evolution
Volumetric Resonance	0	-3	2	0	Volumetric Orbital Coherence
Volumetric Wave Frequency	0	-3	1	0	Volume-Time
Vortex	1	3	0	0	Quantum Volumetric Inertia
Wave Number	0	-1	0	0	Compton wavelength
Quantum Electric Surface Intensity	0	-2	3	1	Quantum Charge Distribution Resistance

The index can be used in either direction: multiplying unit expressions corresponds to adding their rows, whereas looking up a product or reciprocal corresponds to seeking the resulting exponent vector among the 257 catalog entries. The presence of a matching row identifies a named dimensional construction but does not by itself select a physical process or fix a nontrivial dimensionless coefficient.

32 QADI Research Lineage and Companion Literature

This section identifies source papers supporting the terminology, dimensional conventions, and major application families used throughout this QMU reference. A citation identifies the corresponding QADI research development; it does not by itself establish experimental validation of an APM hypothesis. The unit definitions and their algebraic consequences remain separately specified in the catalog.

32.1 Foundations and reference measurements

The QMU reference system is presented in earlier QADI works on its dimensional axioms, source units, Gaussian-cgs foundations, metrological realization, and reference conversion tables. These

works provide the immediate documentary context for the catalog and its primitive-exponent conventions.

Related QADI publications: [1; 2; 3; 11; 15; 31; 4; 8; 5; 6; 47; 12; 26; 49; 14].

32.2 Distributed charge, fields, and transport

The electromagnetic applications build on QADI papers treating distributed charge and its conversion factor, Maxwell-type ledgers, constitutive systems, induction, Josephson effects, impedance, and the measurement of curl. The charge-conversion studies supply explicit conventions for comparing QMU expressions with singular-charge SI formulae; the existence of a conversion convention is separate from experimental confirmation of a proposed field model.

Related QADI publications: [16; 17; 27; 28; 29; 30; 25; 48; 24; 19; 20; 18; 50; 51; 52; 23; 53; 54].

32.3 Closure geometry and temporal structure

The geometrical applications use a larger QADI programme on Aether closure, loxodromic geometry, chronogeometric projection, polarity and spin sectors, and transport holonomy. Their role here is to supply the modeling context for applications of QMU units. Such theoretical treatments do not replace a measured constitutive law.

Related QADI publications: [7; 32; 33; 41; 42; 35; 34; 36; 37; 38; 43; 40; 46; 55; 39; 44; 56; 45; 57].

32.4 Fields, forces, particles, and mass scales

QADI source papers extend the same measurement language to field dynamics, mass-energy identities, Planck-unit factorization, gravitational-sector modeling, magnetic moments, fine structure, and particle structure. These are companion research directions, not premises required to use the four-coordinate exponent algebra of the catalog.

Related QADI publications: [58; 59; 60; 61; 62; 63; 64; 65; 66; 67; 68; 69; 70; 71; 72; 73; 74].

32.5 Metrological applications and falsification programmes

QADI applications include laboratory instrument proposals, laser-plasma analysis, anisotropy/curl estimators, resonator measurements, astronomical and cosmological examples, and a formal prediction registry. Their inclusion indicates possible ways to operationalize the unit system; the reliability of each experimental claim must be evaluated against the underlying measurement and uncertainty record.

Related QADI publications: [21; 22; 75; 76; 77; 78; 79; 80; 81; 82; 83; 84; 85; 86; 87; 9; 88; 89; 90].

32.6 Directed bibliography for QMU identities and unit families

The following concordance links frequently used QMU definitions, identities, and application classes to the QADI papers in which their detailed derivations, interpretations, or experimental implemen-

tations are developed. It is intended as a navigational supplement to the numbered bibliography: each citation links back to a bibliographic entry containing a DOI. The citation is provenance for the indicated research topic; it does not substitute for the conditions and measurement protocols specified in the source publication.

QMU topic	Research coverage	Sources
Quantum primitive basis and dimension vectors	Base generators, ledger axioms, normal forms, and mechanical QMU reference dimensions	[1; 2]
Reference scales and normalization	CODATA realization, Aether mass/curl metrology, CGS/MKS translation, and Planck-unit factorization	[3; 8; 12]
Distributed charge and fine structure	Relation between electrostatic charge, particle magnetic capacity, the fine-structure normalization, and force laws	[16; 17]
Species-anchored ccf_X	Charge-position rules, dynamic/substrate conversion, squared magnetic-flow-family mapping, and SI anchors	[14; 15]
Charge-exception families	Conductance, capacitance, inductance, permeability, and permittivity; compare their operational electrical meanings	[14; 31; 30]
Resistance, conductance, and impedance	QMU resn, cond, flux/circuit distinctions, and physical impedance partitioning	[19; 20; 30]
Maxwell, fields, and coil operators	mflx, mfxd, perm, electromagnetic closure, and coil geometry	[27; 28; 47]
Induction and Josephson benchmarks	Eddy-current transport, magnetic-flux mapping, and Josephson reference relations	[25; 48]
Ledger One and Aether area	$A_u \,\mathrm{curl} = \lambda_C^2 F_q^2$, A_u/k_C, and geometric closure conservation	[2; 41; 42]
Five-dimensional chronogeometry	Temporal sectors, polarity, projection, and closure conditions in the Aether geometry	[7; 32; 33]
Cardioid and toroidal projection	Particle occupancy, geometric projection, and radius/area ledgers	[35; 36; 37]
Photon and angular-momentum transport	One-spin phtn, holonomy, and paired-support closure	[38; 43]
Gforce and mass-scale relations	Quantum and gravitational scaling, Newtonian limit, Planck normalization, and force-carrier ledgers	[60; 63; 62]
Particle magnetic moments	QMU magnetic moment, neutron magnetic-charge normalization, and electron/muon anomaly applications	[64; 65; 66]
Aether measurements and rmfd	Curl measurement, rotating-field detectors, and STEM–EELS experimental proposals	[8; 76; 54]
Laser and material experiments	Photomagnetic activation, quantum illumination density, and material response measurements	[21; 22; 23]
Predictions and replication protocols	Trumpet resonator, experimental benchmarks, protected predictions, and predeclared falsification procedures	[75; 78; 79]
Astronomical-scale observables	Local expansion, cosmic polarization rotation, and post-Newtonian tests in the QMU ledger	[87; 9; 81]

32.7 Verification register and documentary scope

The full QADI master bibliography is retained with the reproducible source files, while the numbered reference list selectively cites sources actually used here. A citation supports the identifica-

tion and provenance of a stated APM/QMU development; algebraic closure, documentary coverage, measurement realization, and independent experimental verification are distinct evidentiary categories. The accompanying audit ledger in `audits/QADI_REFERENCE_VERIFICATION.csv` records for each cited publication its persistent identifier, manuscript coverage, checked source type, and the remaining verification work. DOI strings obtained solely from the QADI master metadata are not represented as having been checked independently against their Zenodo archival records.

Charge-conversion documentary crosswalk. The electron normalization and species-indexed rule are developed in [14], §§3–4. The same source defines charge-position, MFR/MFF squared-factor, and five no-extra-CCF exception rules. Electron reference expressions for potential and magnetic flux are set out in [15]; the applications should be read alongside the dimensional distinction between SI elementary charge and native QMU distributed-charge dimensions. The conversion-convention question is thus resolved by documentary citation, without treating its defining benchmark equations as independent tests of the proposed Aether physical model.

Source authorities. The 2022 CODATA adjustment is cited through its 2025 publication in *Reviews of Modern Physics* [13]. The DOI-bearing archival record is preferred for bibliographic publication metadata; the current QADI-hosted PDF is a useful source for exact equations, figure versions, and author-visible revision history. Where these differ, the record version and the locally examined PDF should be distinguished. An electronic link resolving to a destination is not a guarantee that the linked PDF has been examined in full.

Conventions and completeness. The selected bibliography is a topical, manuscript-linked subset of QADI's larger master publication catalog. A source title, citation, and DOI provide a retrieval trail; they are not interchangeable with an operational measurement standard or a reproduced experiment. The five CCF exception categories refer to specific QMU definitions, rather than a blanket claim that every similarly named SI quantity has the same physical constitutive meaning. See the explicit charge bridge and SI comparison in Section 27.

33 Research Frontiers: Opportunities for New Discoveries

The purpose of this reference is not only to define units. It is to make the Aether Physics Model (APM) usable as a research programme in which physicists, experimentalists, and instrument designers can identify new questions. QMU provides a common dimensional language; the accompanying QADI publications develop proposed mechanisms, calculations, and measurement approaches. The topics below are *research openings*, not derivations offered or completed by this monograph. Where a definite APM prediction already exists, it is attributed to its source. Other possibilities are questions for future papers, not numerical predictions asserted here. Researchers may investigate these questions without first adopting every APM interpretation.

33.1 Geometry, propagation, and cosmic polarization

Polarization rotation across the Universe. QADI has published the definite isotropic CMB polarization-rotation prediction $\beta_0 = 1/(16\pi^2)$ rad [9]. The immediate observational opportunity

is to compare that fixed prediction with independently calibrated CMB polarization measurements and foreground treatments. A distinct theoretical opportunity is to derive how photon propagation through the proposed Aether loxodromic geometry generates the rotation, and to determine whether the result depends on propagation distance, observing frequency, direction, or emission epoch. Those transport derivations belong in dedicated papers; the present reference supplies their QMU context [38; 43; 7].

Quantum space and propagation geometry. Can the 5D-to-4D projection, chronogeometric closure, or orientation of the Aether fabric produce an independently measurable optical or resonant signature? Comparisons might involve interferometry, cavity perturbation, phase transport, polarization, and controlled changes of apparatus orientation. The discovery opportunity is a measurable relationship not reducible to an arbitrary redefinition of length, time, or phase; its derivation, response kernel, and instrumental null tests would be separate investigations [33; 46; 45].

33.2 Distributed charge and electromagnetic experiments

Charge conversion as a route to new constitutive laws. The Charge Conversion Factor and QMU–SI translation rules are already specified in companion publications [14; 15]. A conversion identity alone predicts no residual. The open physical question is whether distributed-charge geometry yields an experimentally distinct constitutive relationship for voltage, current, flux, impedance, capacitance, or inductance after all reference conventions are held fixed. Carefully calibrated circuits, resonators, and material samples could reveal such relationships, or constrain them [29; 30; 31].

Curl and the rotating Aether response. QMU distinguishes its scalar curl unit from the spatial vector-calculus operator. Can that proposed substrate quantity be operationally extracted from magnetic anisotropy, cavity response, coil geometry, or microscopic spectroscopy, with a consistent value across independent instruments? Existing QADI papers describe curl metrology, rotating-field instruments, and a trumpet resonator; their proposed readouts offer concrete starting points for reproducible tests [8; 76; 54; 75; 23]. A new empirical relation or apparatus-specific prediction should be derived and preregistered separately.

33.3 Particles, condensed matter, and quantum transport

Species-native particle magnetic moments. The measured electron, proton, and neutron magnetic moments are natural benchmarks for distributed-charge particle geometry. A neutron g-factor normalized to neutron mass differs from the conventional proton-mass normalization by the known neutron-to-proton mass ratio; this is a change of convention, not an anomalous measurement. The discovery challenge is instead to calculate species-specific moments and anomalies from charge distribution, spin and topology *without fitting the measured moment being predicted*. QADI magnetic-moment and anomaly papers provide the existing research path [64; 66; 65].

Positive carriers and electron pairing in solids. Semiconductor holes and superconducting charge transport provide controlled laboratories for investigating APM polarity-dependent sites

and magnetic alignment. The distinction between a conventional band-theory hole and a proposed Aether polarity occupation must be maintained until a model predicts a discriminating observable. Useful experimental targets include Hall response, carrier mobility, recombination, flux response, critical current, and reproducible resistance transitions. APM-specific laws of transport or pairing remain subjects for separate papers; QMU circuit and Josephson studies supply starting points [30; 48; 78].

Nonlinear light–matter and phonon dynamics. QMU names dimensional families for photomagnetic activation, illumination density, helicity transport, and material response. Their potential value lies in relating existing optical, laser–plasma, phonon, or magneto-optical measurements across conditions and apparatuses. Researchers can ask whether the same QMU scaling predicts a new response feature or measurable departure from a standard material model. Proposed studies and applications appear in the QADI work on qpmd, qild, phonon helicity, and nonlinear photonic conversion [21; 22; 84; 83].

33.4 Geometrical force, gravitation, and cosmic structure

Local expansion, curvature, and source correlations. APM's Gforce denotes *geometrical force*. QADI papers extend QMU to gravitational response, compact-object metric questions, and matter-formation-induced local expansion. Future studies may test whether the proposed source geometry and delayed response identify distinctive radial, temporal, or directional correlations in astronomical data, rather than merely reproducing known gravitational or expansion measurements. Any such prediction must specify the source model, null comparison, selection effects, and uncertainties in a separate derivation and data analysis [63; 71; 86; 87].

33.5 From an open question to a stand-alone research paper

Each opportunity begins with a physically defined quantity and a question that measurements could settle. A follow-on paper should state its independent APM assumptions, derive the proposed relationship, identify its QMU and SI measurement correspondence, and specify how its observable differs from a conventional baseline or a simple change of units. For experiments, calibration, uncertainty, systematic controls, and a null or rejection criterion should be documented before the decisive data are examined. Existing claims registered by QADI should retain their frozen prediction identifiers; genuinely new equations or decision rules merit new entries rather than retrospective amendments [3; 79].

This is an invitation to further work: a dimensional atlas can organize physical concepts, but new discoveries will come from independent derivations, instrument design, and measurements capable of deciding between explanations. Detailed mathematical developments are intentionally left to their own papers, with the bibliography serving as a path into the wider APM research literature.

34 Conclusion

The experimental registry, metrology programme, and distributed-charge translation framework are documented in [79; 3; 14; 15].

Quantum Measurement Units (QMU) is presented as the dimensional framework of the Aether Physics Model (APM). The catalog organizes 257 named constructions into physical families, distinguishing dynamic expressions from substrate expressions and using the established grid sequence. The principal algebraic relationships include

$$c = \lambda_C F_q, \qquad \text{rson} = {F_q}^2, \qquad A_u \,\text{curl} = {\lambda_C}^2 {F_q}^2 = c^2. \tag{468}$$

These expressions are identities within the stated QMU dimensional definitions. The magnetic, electrostatic, gravitational, and spatial observables that APM interprets as manifestations of the Aether are already experimentally measured, as distinguished in Section 1.2. The identities alone do not, however, uniquely determine the Aether-unit microgeometry or establish every proposed mechanism attached to a catalog entry.

The species-anchored charge-conversion prescription and its QMU–SI benchmark identities have been specified in companion QADI publications [14; 15]. Their correct use requires the physical charge dimension, species label, charge exponent, stated exceptions, and experimental convention to be made explicit. Independent metrological validation of the resulting numerical correspondences remains a distinct experimental task. Other outstanding tasks include independent verification of the catalog equations, operational definitions for new observables, and quantitative comparisons with established measurements.

The present manuscript is therefore a theoretical reference catalog, a guide to the QADI source literature, and an invitation to new research. Section 33 identifies prospective observational and laboratory inquiries while leaving new derivations, detailed apparatus models, and numerical predictions to separate papers. Within APM, measured physical fields and interactions are regarded as observations of Aether manifestations; that identification does not automatically validate each particular structural mechanism. New predictions concerning constitutive response, particle geometry, polarization rotation, or other residuals require separately documented measurements with stated uncertainties. Source definitions, algebraic deductions, observed phenomena, physical interpretations, and experimentally tested model-specific predictions should remain distinguishable throughout the reference.

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