Foundations of QMU in Gaussian cgs: Aether Geometry, Ledger Identities, and a Minimal Replacement for Maxwell

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Abstract

In the Quantum Measurement Units (QMU) framework, electric and magnetic charges are ledgered as geometric excitations of a discrete Aether unit with geometry constant ($A_u = (4\pi)^2 = 16\pi^2$) in Gaussian cgs. With $k_C = 1$, charge is purely geometric.[1] We show that a compact set of geometry–first identities closes the QMU ledger: (i) an electro–magnetic channel conversion governed by ($8\pi\alpha$), (ii) a speed invariance ($\mathrm{curl} \cdot \mathrm{mflx} = \lambda_C F_q = c$), and (iii) an Aether magnetic maximum (${e_a}^2 = (\mathrm{volm})^2(\mathrm{rson})^2/(A_u G)$). We decompose ($A_u$) into four toroidal loxodromes, align full–spin (electrostatic) vs. half–spin (magnetic) occupancy (cf. torus windings/knots [13, 14]), and articulate a minimal, geometry–anchored field set that reduces to Maxwell when the magnetic channel is empty (compare dual-symmetric Maxwell with magnetic sources [6, 7, 8]). We then enumerate eight concrete capabilities that this field set enables beyond Maxwell, each with crisp QMU scalings and falsifiable observables (Casimir/Lifshitz background [9, 10, 11, 12]).

1 Ledger and Notation (QMU in cgs)

We adopt the following primitives and names. For accessibility, we list Gaussian–cgs bridges (orientation only). The ledger remains geometry-first (Gaussian references: [1, 2]).

- Base: electron mass (m_e), quantum length (λ_C) (Compton), quantum frequency (F_q), electrostatic charge unit (e^2), magnetic charge unit (${e_\mathrm{emax}}^2 = e^2/(8\pi\alpha)$), and the Aether geometry constant ($A_u = 16\pi^2$).[2]
- Behavioral units: ($\mathrm{volm} = {\lambda_C}^3$) and ($\mathrm{rson} = {F_q}^2$).
- Magnetic curvature/throughput: ($\mathrm{curl} = {e_\mathrm{emax}}^2/(m_\mathrm{e}\lambda_C)$), ($\mathrm{mflx} = m_\mathrm{e}{\lambda_C}^2 F_q/{e_\mathrm{emax}}^2$).
- Aether maxima: maximum Aether magnetic charge (${e_a}^2$) defined in Sec. 4.

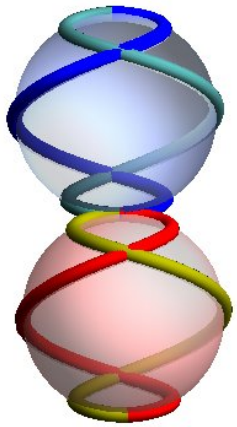
[1] For Gaussian conventions and the 4π normalization, see e.g. Jackson [1].
[2] Historical anchors for λ_C and F_q: Compton [3]; for α, see Sommerfeld and modern adjustments [4, 5].

Table 1: QMU primitives with Gaussian–cgs bridges (orientation only).

Symbol	QMU meaning	cgs bridge
m_e	electron mass	Gaussian mass unit (see [1])
λ_C	Compton (quantum) length	$h/(m_e c)$ [3]
F_q	quantum frequency	$c/\lambda_C = m_e c^2/h$
e^2	electrostatic charge unit	e^2 (Gaussian) [1, 2]
${e_{\text{emax}}}^2$	magnetic charge unit	$e^2/(8\pi\alpha)$ (channel conversion)
A_u	Aether geometry constant	$16\pi^2$ (Gauss surface square)

2 Geometry of Charge and the Four–Loxodrome Decomposition

In Gaussian cgs, Gauss's law $\oint \mathbf{E}\cdot d\mathbf{S} = 4\pi q$ yields a flux square proportional to $(4\pi)^2$ [1]. We



Postulate 1. *that a single Aether cell resolves this geometry into four constant-pitch windings on the torus (loxodromes), each carrying a 2π poloidal by 2π toroidal phase:*

$$A_u = \sum_{\ell=1}^{4} (2\pi)_{tor} \times (2\pi)_{pol} = 4 \times 4\pi^2 = 16\pi^2. \tag{1}$$

This uses constant-pitch winding as in torus-knot/loxodrome geometry (see [13, 14] for standard constructions). Full-spin electrostatic occupancy fills all four sectors; half-spin magnetic occupancy alternates.

3 Channel Conversion and Core Ledger Identities

By definition ${e_{\text{emax}}}^2 = e^2/(8\pi\alpha)$ (fine-structure context [4, 5]). Then

$$\boxed{\frac{e^2}{{e_{\text{emax}}}^2} = 8\pi\alpha, \qquad \frac{A_u {e_{\text{emax}}}^2}{e^2} = \frac{2\pi}{\alpha}.} \tag{2}$$

Identity 1 (Speed Closure)**.** *With (*$\text{curl} = {e_{\text{emax}}}^2/(m_e\lambda_C)$*) and (*$\text{mflx} = m_e {\lambda_C}^2 F_q/{e_{\text{emax}}}^2$*),*

$$\boxed{\text{curl}\cdot\text{mflx} = \lambda_C F_q = c.} \tag{3}$$

Proof (QMU cancellation).

$$\left(\frac{{e_{\text{emax}}}^2}{m_e\lambda_C}\right)\left(\frac{m_e {\lambda_C}^2 F_q}{{e_{\text{emax}}}^2}\right) = \lambda_C F_q = c.$$

Mass and magnetic-charge units cancel (contrast with medium-dependent $v = 1/\sqrt{\epsilon\mu}$ in Maxwell's formulation [1]).

Identity 2 (Flux–Square Invariant)**.** *For any closed surface enclosing charge q,*

$$\boxed{\frac{\left(\oint \mathbf{E}\cdot d\mathbf{S}\right)^2}{q^2} = A_u.} \tag{4}$$

Proof sketch. *Gaussian Gauss's law gives $\oint \mathbf{E}\cdot d\mathbf{S} = 4\pi q$ [1]. Squaring enforces the four-sector budget $(4\pi)^2 = A_u$; the loxodrome decomposition assigns equal constant-pitch shares to each sector.*

4 Maxima and the Gravity Stitch Through the Magnetic Channel

Proposition 1 (Aether magnetic maximum as an extremal cap)**.** *There is a maximal magnetic channel charge compatible with (i) the four-sector budget A_u, (ii) two correlated volumes (two half-spin populations), and (iii) the speed-closure identity. It is*

$$\boxed{{e_a}^2 = \frac{{\lambda_C}^6 {F_q}^4}{A_u G} = \frac{(\mathrm{volm})^2(\mathrm{rson})^2}{A_u G}.} \tag{5}$$

Derivation (QMU-only). *Consider an extremal where the magnetic channel saturates transport while remaining gravitationally bound per Aether cell. The only scalar cap formed from the ledger primitives that (a) is quadratic in correlated volume and resonance, (b) divides by A_u, and (c) inverts G is $({\lambda_C}^3)^2({F_q}^2)^2/(A_u G)$. Attempts to substitute purely electromagnetic invariants over-constrain transport (cf. c-closure above), hence gravity stitches through the magnetic channel. For background on magnetic charges and dual symmetry, see [6, 7, 8].*

Remark 1 (Why ${\lambda_C}^6$ is not "6D")**.** ${\lambda_C}^6 = ({\lambda_C}^3)^2$ *encodes two correlated 3D volumes (two loxodrome populations), not extra spatial dimensions; similarly, ${F_q}^4 = ({F_q}^2)^2$ encodes quadratic resonance closure.*

5 A Minimal Geometry-First Field Set

Postulate 2 (Aether Geometry)**.** *Space partitions into Aether cells with seat map $A_u = 16\pi^2$, resolved as four loxodromes per cell (torus windings [13, 14]).*

Postulate 3 (Two Charges and Currents)**.** *Electrostatic charge density ρ_{e} and magnetic loxodromic charge density ρ_{m} (units e^2 and ${e_{\mathrm{emax}}}^2$), with currents $\mathbf{j}_{\mathrm{e}}, \mathbf{j}_{\mathrm{m}}$.*

Postulate 4 (Flux Normalizations)**.**

$$\boxed{\oint_S \mathbf{E}\cdot d\mathbf{S} = 4\pi q_{\mathrm{e}} \equiv \Phi_E, \qquad \oint_S \mathbf{B}\cdot d\mathbf{S} = 4\pi q_{\mathrm{m}} \equiv \Phi_B.} \tag{6}$$

Postulate 5 (Squared-Flux Occupancy Constraint)**.**

$$\boxed{\int_S\int_S (\mathbf{B}\cdot d\mathbf{S})(\mathbf{B}\cdot d\mathbf{S}') = A_u\, q_{\mathrm{m}}^2(S) \iff \Phi_B^2 = A_u\, q_{\mathrm{m}}^2.} \tag{7}$$

Context. *Dual-symmetric Maxwell systems with magnetic sources are classical in the literature [7, 8]; the global squared-flux ledger here is new.*
The time-domain field set is

$$\boldsymbol{\nabla}\cdot\mathbf{E} = 4\pi\rho_{\mathrm{e}}, \qquad \boldsymbol{\nabla}\cdot\mathbf{B} = 4\pi\rho_{\mathrm{m}}, \tag{8}$$

$$\boldsymbol{\nabla}\times\mathbf{B} - \dot{\mathbf{E}} = 4\pi\mathbf{j}_{\mathrm{e}}, \qquad \boldsymbol{\nabla}\times\mathbf{E} + \dot{\mathbf{B}} = -4\pi\mathbf{j}_{\mathrm{m}}, \tag{9}$$

with Postulate 5 acting as a global constraint per enclosing surface. Maxwell is recovered when $\rho_{\mathrm{m}} = \mathbf{j}_{\mathrm{m}} = 0$ and the constraint is inactive.

6 Operational Consequences and Experiments

6.1 Electrostatic Flux–Square Invariant

Spherical Faraday capacitor; QMU coulometry for q_{e}; map $\mathbf{E}$*; test Identity 2 across radii/materials (Gauss/flux background [1, 2]).*

6.2 Speed-Closure Metrology

Independently measure curl *using a rotating magnetic-flux tube (**RMFD**) torsion apparatus (i.e., a driven, asymmetric toroidal/loxo coil that establishes a steady, rotating magnetic-flux tube) and measure* mflx *via calibrated magnetic-flux transfer; then confirm* $\mathrm{curl}\,\mathrm{mflx} = c$ *with a QMU-traceable uncertainty budget.*

6.3 Isotopic Casimir Loxodrome Test

Nominally identical plates differing only by isotopic composition. Suppress electrostatic contributions (grounding/shielding). Predict a residual pressure offset proportional to constituent mass via ${e_{\mathrm{emax}}}^2$*, with angular step plateaus capping near $2\pi/\alpha$ (Casimir/Lifshitz context [9, 10, 11, 12]).*

6.4 Winding-Harmonic Toroidal Cavity

Toroidal/cardioid cavity; sweep boundary angle; record force/pressure steps; match step counts to four sectors and the winding budget $2\pi/\alpha$ (torus windings [13, 14]).

Compact Prediction Scalings (QMU)

$$\begin{aligned}
\textit{(i) Speed closure:}\ & \mathrm{curl}\,\mathrm{mflx} = c,\\
\textit{(ii) Channel conversion:}\ & e^2/{e_{\mathrm{emax}}}^2 = 8\pi\alpha,\\
\textit{(iii) Gravity stitch cap:}\ & {e_a}^2 = \frac{(\mathrm{volm})^2(\mathrm{rson})^2}{A_u G},\\
\textit{(iv) Flux square:}\ & \Big(\oint \mathbf{E}\cdot d\mathbf{S}\Big)^2/q^2 = A_u,\\
\textit{(v) Winding budget:}\ & (A_u\,{e_{\mathrm{emax}}}^2)/e^2 = 2\pi/\alpha.
\end{aligned}$$

7 Capabilities Beyond Maxwell: Eight QMU Powers with Falsifiable Targets

Maxwell corresponds to $\rho_{\mathrm{m}} = \mathbf{j}_{\mathrm{m}} = 0$ with no global squared-flux ledger; the dual-symmetric generalization with magnetic sources is classical [7, 8], but the sector-quantized *constraint and derived invariants are new here.*

1) Real Magnetic-Source Channel with Global Squared-Flux Occupancy

Discrete sector steps in $\oint \mathbf{B}\cdot d\mathbf{S}$ as occupancy rebalances.

2) Flux–Square Quantization (Gauss–Aether Identity)

Spherical Faraday capacitor yields radius/material-independent plateau at $A_u = 16\pi^2$.

3) Constant-Pitch Loxodrome Occupancy (Four Sectors)

Toroidal/cardioid cavity shows discrete force/pressure steps summing to $2\pi/\alpha$ *[13, 14].*

4) Channel-Independent Speed-Closure Product

Independent metrology of curl *and* mflx *multiplies to* c*.*

5) Gravity Stitch via Magnetic Maximum

RMFD torque vs. drive saturates/plateaus as channel approaches ${e_a}^2$ *per active cell.*

6) Isotopic Casimir Loxodrome Shift

Isotope-only plate pairs show a nonzero, mass-proportional residual with step structure (cf. [9, 10, 11, 12]).

7) Fixed Cross-Channel Conversion Ratio

Dual-channel coupler tends to $\Phi_E/\Phi_M \to 8\pi\alpha$ *at fixed winding count.*

8) Nonlinear Mode Selection from the Squared-Flux Ledger

Harmonic generation exhibits sector-parity selection (mod-4 rules).

8 Discussion: Why the Ledger is Structural

The $k_C = 1$ *normalization makes charge geometric. The Aether constant* $A_u = (4\pi)^2$ *and conversion* $8\pi\alpha$ *close the ledger across bilinear observables. Identities (1) and Prop. 1 show transport speed and gravitational coupling emerge directly from QMU structure, not as added hypotheses. Section 7 exhibits eight concrete capabilities, each supplying a falsifiable handle not present in Maxwell or its standard dual-symmetric extensions [7, 8].*

9 Conclusions

We presented a compact cgs/QMU construction where (i) charge is geometry, (ii) magnetic phenomena resolve as four constant-pitch loxodromic sectors per Aether cell, (iii) electro–magnetic conversion is controlled by $8\pi\alpha$*, (iv) transport speed is a ledger invariant, and (v) gravity stitches solely through the magnetic maximum. We further specified eight new, testable capabilities beyond Maxwell—sector steps, flux–square quantization, winding budgets, speed-closure metrology, magnetic-channel saturation, isotopic Casimir shifts, a fixed conversion ratio, and parity-locked mode selection—each with QMU scalings ready for the lab.*

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Glossary of Symbols (QMU)

Table 2: All symbols used (QMU meanings only; Gaussian–cgs bridges appear earlier for orientation).

Symbol	*Kind*	*Meaning / Role in the ledger*
m_{e}	*base*	*Electron mass (ledger base).*
λ_C	*base*	*Quantum length (Compton length; ledger base).*
F_q	*base*	*Quantum frequency (c/λ_C; ledger base).*
e^2	*base*	*Electrostatic charge unit (e^2 in Gaussian).*
${e_{\mathrm{emax}}}^2$	*base*	*Magnetic charge unit, $e^2/(8\pi\alpha)$.*
A_u	*geom*	*Aether geometry constant $= 16\pi^2$ (four loxodromes).*
α	*const*	*Fine-structure constant (dimensionless).*
G	*const*	*Gravitational constant (enters only via magnetic maximum).*
volm	*unit*	*Quantum volume $= {\lambda_C}^3$.*
rson	*unit*	*Resonance (frequency-squared) $= {F_q}^2$.*
curl	*unit*	*Magnetic curvature/throughput unit $= {e_{\mathrm{emax}}}^2/(m_{\mathrm{e}}\lambda_C)$.*
mflx	*unit*	*Magnetic flux-throughput unit $= m_{\mathrm{e}}{\lambda_C}^2 F_q/{e_{\mathrm{emax}}}^2$.*
${e_a}^2$	*cap*	*Aether magnetic maximum $= \dfrac{(\mathrm{volm})^2(\mathrm{rson})^2}{A_u G} = \dfrac{{\lambda_C}^6 {F_q}^4}{A_u G}$.*
$\mathbf{E}$	*field*	*Electric field.*
$\mathbf{B}$	*field*	*Magnetic field (loxodrome-structured).*
ρ_{e}	*source*	*Electrostatic charge density (units e^2).*
ρ_{m}	*source*	*Magnetic (loxodromic) charge density (units ${e_{\mathrm{emax}}}^2$).*
$\mathbf{j}_{\mathrm{e}}$	*source*	*Electrostatic current density.*
$\mathbf{j}_{\mathrm{m}}$	*source*	*Magnetic (loxodromic) current density.*
q_{e}	*source*	*Enclosed electrostatic charge.*
q_{m}	*source*	*Enclosed magnetic (loxodromic) charge.*
S	*geom*	*Enclosing surface for Gauss-type relations.*
$\Phi_E = \oint_S \mathbf{E}\cdot d\mathbf{S}$	*flux*	*Electric flux through S.*
$\Phi_B = \oint_S \mathbf{B}\cdot d\mathbf{S}$	*flux*	*Magnetic flux through S.*
$c = \lambda_C F_q$	*ident*	*Speed-closure invariant (Identity 1).*
sector	*geom*	*One of the four constant-pitch loxodrome seats per Aether cell.*
toroidal/poloidal phase	*geom*	*Phase advances along torus' major/minor cycles; loxodromes keep a constant pitch (ratio).*
winding budget	*geom*	*Total sector-count governed by $\dfrac{A_u\,{e_{\mathrm{emax}}}^2}{e^2} = \dfrac{2\pi}{\alpha}$.*
RMFD	*device*	*Rotating Magnetic-Flux Tube apparatus for measuring* curl *via torsion and sector occupancy.*

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