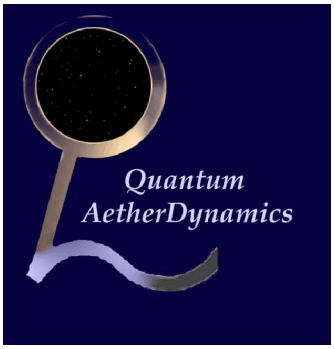

Quantum AetherDynamics Institute (QADI)

First-Principles Derivation of the Isotropic Closure Factor: Aether-Unit Geometry, Closure Topology, and $\Gamma_{\text{iso}} = 8\pi/3$ in QMU

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Abstract

Previous work established that cosmological expansion in the Aether Physics Model follows

$$H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}},$$

where the exponent $4/5$ arises from the closure-measure ratio $8/5$ and the factor $8\pi/3$ appears as the isotropic closure normalization. The present work derives this isotropic factor directly from Aether-unit geometry and closure topology.

The derivation begins from the spherical orientation space of an Aether unit, whose full angular closure measure is 4π. This measure is normalized over three independent volumetric axes, giving the volumetric closure coefficient $4\pi/3$. Closure transport is then shown to be intrinsically bidirectional: every outward formation channel has a corresponding return channel required by chronovibrational closure. This doubles the volumetric coefficient, yielding

$$\Gamma_{\text{iso}} = 2\left(\frac{4\pi}{3}\right) = \frac{8\pi}{3}.$$

Thus Γ_{iso} is not an empirical fitting factor and not an imported Friedmann coefficient. It is the geometric density parameter of isotropic Aether expansion, arising from the topology of bidirectional closure flux across the Aether-unit boundary. This completes the internal QMU derivation of the cosmological scaling relation.

Keywords: Aether Physics Model, Quantum Measurement Units, isotropic closure factor, Aether unit, closure topology, loxodromic transport, cosmology

1 Introduction

Previous QMU cosmology papers derived the expansion relation

$$H = F_q \alpha_a^{4/5} \sqrt{\Gamma_{\text{iso}}},$$

with

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}.$$

The closure-measure exponent was shown to arise from the ratio

$$D_{\text{cl}} = \frac{8}{5},$$

where eight orientation-resolved loxodromic transport channels are distributed across five volumetric–chronovibrational closure constraints Thomson [2026a].

A later density-gradient formulation showed that the same scaling follows from a density-weighted closure operator in Aether-density gradients Thomson [2026b]. In that framework, Γ_{iso} enters as the isotropic volumetric normalization factor:

$$H^2 = {F_q}^2 \alpha_a^{8/5} \Gamma_{\text{iso}}.$$

The present work isolates and derives this factor from first principles. The goal is to show that

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}$$

is not an external cosmological assumption, but an intrinsic consequence of Aether-unit geometry and closure topology.

This derivation completes the QMU cosmological scaling program by providing a first-principles origin for the isotropic closure factor, so that all terms in the expansion relation

$$H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}}$$

are derived internally within the Aether Physics Model.

2 Aether-Unit Orientation Space

An Aether unit is treated as a volumetric closure domain. Its boundary supports all possible orientations of closure-front propagation. The complete isotropic orientation measure of a spherical boundary is

$$\int_{S^2} d\Omega = 4\pi \tag{1}$$

This is the standard solid-angle measure of the unit sphere Arfken et al. [2013], Frankel [2011].

This is the total angular measure available to closure transport through the Aether-unit boundary.

In QMU, however, isotropic expansion is not a one-directional surface process. It is a volumetric closure response distributed over the three independent spatial directions of the Aether unit. Therefore the angular measure must be normalized per volumetric axis:

$$\Gamma_{\text{vol}} = \frac{4\pi}{3}. \tag{2}$$

This factor is the one-sided volumetric closure coefficient. It represents the isotropic angular closure measure per independent spatial direction.

3 Closure Flux Through the Aether Boundary

Let $d\Phi_{\text{cl}}$ denote an infinitesimal closure flux through the Aether-unit boundary. For isotropic closure propagation,

$$d\Phi_{\text{cl}} \propto d\Omega.$$

The total one-sided closure flux is therefore proportional to

$$\Phi_{\text{cl}}^{(+)} \propto \int_{S^2} d\Omega = 4\pi.$$

When distributed over the three volumetric degrees of freedom, the normalized one-sided flux becomes

$$\overline{\Phi}_{\text{cl}}^{(+)} \propto \frac{4\pi}{3}.$$

This is the geometric origin of the $4\pi/3$ factor. It is not introduced from mass density or gravitational coupling; it is the normalized angular measure of isotropic closure transport through a volumetric Aether unit.

4 Chronovibrational Bidirectionality

Aether closure is not completed by an outward formation channel alone. Every closure-front propagation requires a complementary return channel. In the loxodromic Aether-unit geometry, this bidirectionality appears as paired transport:

$$\text{formation channel} \quad \leftrightarrow \quad \text{return channel}.$$

Equivalently, each closure path carries two chronovibrational orientations:

$$+\tau \qquad \text{and} \qquad -\tau.$$

This is the same paired structure that appears in the closure operator spectrum, where opposite loxodromic orientations cancel the odd transport term and leave the real paired spectrum Thomson [2026a]:

$$\lambda_n^{\text{pair}} = \frac{1}{2}(\lambda_{n,+} + \lambda_{n,-}).$$

Thus bidirectionality is not an optional symmetry. It is required for physical closure. A one-sided closure flux gives only the formation component; full Aether closure requires both formation and return.

Therefore the full isotropic closure factor is

$$\Gamma_{\text{iso}} = 2\Gamma_{\text{vol}}.$$

Substituting

$$\Gamma_{\text{vol}} = \frac{4\pi}{3}$$

gives

$$\Gamma_{\text{iso}} = 2\left(\frac{4\pi}{3}\right) = \frac{8\pi}{3} \tag{3}$$

5 Topological Interpretation

The factor $8\pi/3$ has two independent geometric components:

$$8\pi \quad \text{and} \quad 3.$$

The denominator 3 arises from volumetric normalization over the three independent spatial closure axes:

$$x, \quad y, \quad z.$$

The numerator 8π arises from the total angular measure 4π doubled by chronovibrational bidirectionality:

$$8\pi = 2(4\pi).$$

Therefore,

$$\Gamma_{\text{iso}} = \frac{\text{bidirectional angular closure measure}}{\text{volumetric closure axes}} = \frac{2(4\pi)}{3} = \frac{8\pi}{3}.$$

Equation (1) defines the total angular closure measure, Equation (2) gives the volumetric normalization, and Equation (3) provides the final isotropic closure factor.

This expresses Γ_{iso} as a topological closure density. It counts how isotropic angular closure flux is distributed across volumetric degrees of freedom when both formation and return channels are included. The use of solid-angle measure and orientation-space normalization follows the standard geometric treatment of isotropic angular integration Arfken et al. [2013], Frankel [2011].

6 Relation to Loxodromic Closure Geometry

The loxodromic Aether-unit structure supplies the directed transport channels through which closure flux propagates. Previous work established that the orientation-resolved loxodromic transport count is

$$N_{\text{arc}} = 8,$$

distributed over

$$N_{\text{con}} = 5$$

independent volumetric–chronovibrational constraints, giving

$$D_{\text{cl}} = \frac{8}{5}$$

Thomson [2026a].

That ratio determines the measure exponent:

$$\Omega_{\text{cl}} = \alpha_a^{8/5}.$$

The isotropic factor derived here plays a different role. It does not determine the closure-measure exponent. Instead, it normalizes the isotropic projection of the closure imbalance into volumetric expansion:

$$H^2 = {F_q}^2 \Omega_{\text{cl}} \Gamma_{\text{iso}}.$$

Thus the two geometric factors are complementary:

$$D_{\text{cl}} = \frac{8}{5}$$

controls the closure-density suppression, while

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}$$

controls the isotropic volumetric projection.

Together they give

$$H^2 = {F_q}^2 \alpha_a^{8/5} \frac{8\pi}{3}.$$

7 Comparison with Friedmann-Type Scaling

In conventional cosmological notation, homogeneous expansion is commonly written in a form containing the coefficient

$$\frac{8\pi}{3},$$

as in the Friedmann equation for isotropic expansion Weinberg [2008], Peacock [1999].

In the present QMU derivation, the same coefficient appears, but its source is different. It is not introduced through an assumed mass-density source term. Instead,

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}$$

is the geometric density parameter of isotropic Aether closure.

The QMU expansion law is therefore

$$H^2 = {F_q}^2 \alpha_a^{8/5} \Gamma_{\text{iso}},$$

or

$$H^2 = {F_q}^2 \alpha_a^{8/5} \frac{8\pi}{3}.$$

This has the structural form of a density-driven expansion law, but the source term is the dimensionless closure-density

$$\Omega_{\text{cl}} = \alpha_a^{8/5},$$

rather than an externally imposed mass-energy density.

Thus the correspondence with Friedmann-type scaling is geometric, not imposed. The same coefficient appears because isotropic expansion requires angular closure over a spherical orientation space, normalized over three volumetric directions and doubled by bidirectional closure.

8 Insertion into the QMU Cosmological Scaling Law

The closure-density scaling is

$$\Omega_{\text{cl}} = \alpha_a^{8/5}.$$

The isotropic projection factor is

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}.$$

Therefore,

$$H = F_q \sqrt{\Omega_{\text{cl}} \Gamma_{\text{iso}}}.$$

Substituting gives

$$H = F_q \sqrt{\alpha_a^{8/5} \frac{8\pi}{3}}.$$

Hence

$$\boxed{H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}}}.$$

This completes the internal chain:

$$\text{Aether-unit topology} \;\rightarrow\; \Gamma_{\text{iso}} = \frac{8\pi}{3} \;\rightarrow\; H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}}.$$

The QMU closure-density scaling relation used here follows from the preceding closure-eigenmode and density-gradient derivations Thomson [2026a,b].

9 Physical Interpretation

The isotropic closure factor is the volumetric projection coefficient for closure imbalance. It measures how residual closure flux spreads through the orientation space of an Aether unit and becomes observable as isotropic expansion.

The factor

$$4\pi$$

comes from total angular coverage of the Aether-unit boundary.

The factor

$$\frac{1}{3}$$

comes from distribution across the three volumetric closure axes.

The factor

$$2$$

comes from the bidirectional nature of chronovibrational closure.

Thus

$$\Gamma_{\text{iso}} = 2 \cdot \frac{4\pi}{3} = \frac{8\pi}{3}.$$

This interpretation makes Γ_{iso} a geometric closure-density parameter. It is neither empirical nor arbitrary; it is fixed by the topology of isotropic closure transport.

10 Completion of the QMU Cosmological Scaling Program

The preceding papers established the components of the QMU cosmological scaling relation. The Aether fine-structure parameter α_a was derived from QMU charge structure Thomson [2026d,c], the closure-measure exponent was derived from double-loxodromic transport geometry Thomson [2026a], and the density-gradient closure operator showed how the lowest non-cancelled closure eigenmode produces cosmological expansion Thomson [2026b].

The present work completes this sequence by deriving the isotropic closure factor

$$\Gamma_{\text{iso}} = \frac{8\pi}{3}$$

directly from Aether-unit geometry and closure topology.

Thus the complete QMU expansion relation is

$$H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}}.$$

All factors in this expression now have internal QMU origins:

$$F_q = \frac{c}{\lambda_C}, \qquad \alpha_a = \frac{e^2}{8\pi {e_a}^2}, \qquad \frac{4}{5} = \frac{1}{2}\left(\frac{8}{5}\right), \qquad \Gamma_{\text{iso}} = \frac{8\pi}{3}.$$

The resulting numerical value,

$$H \approx 2.5131 \times 10^{-18}\ \text{s}^{-1} \approx 77.55\ \text{km}\,\text{s}^{-1}\,\text{Mpc}^{-1},$$

is therefore not treated as a fitted cosmological parameter, but as the QMU projection of closure-density imbalance into isotropic volumetric expansion.

11 Conclusion

A first-principles derivation of the isotropic closure factor has been presented, completing the QMU derivation of the cosmological expansion scaling relation from Aether-unit geometry and closure topology. Starting from the angular orientation space of an Aether unit,

$$\int_{S^2} d\Omega = 4\pi,$$

the closure flux was normalized over the three independent volumetric axes, giving

$$\Gamma_{\text{vol}} = \frac{4\pi}{3}.$$

Chronovibrational closure requires bidirectional transport, doubling this one-sided volumetric factor:

$$\Gamma_{\text{iso}} = 2\Gamma_{\text{vol}} = 2\left(\frac{4\pi}{3}\right) = \frac{8\pi}{3}.$$

Therefore the isotropic factor in the QMU cosmological expansion law is fully determined by Aether-unit geometry and closure topology:

$$\boxed{\Gamma_{\text{iso}} = \frac{8\pi}{3}.}$$

Substitution into the closure-density expansion law gives

$$\boxed{H = F_q \alpha_a^{4/5} \sqrt{\frac{8\pi}{3}}.}$$

This completes the geometric derivation of the isotropic normalization factor and strengthens the QMU cosmological chain by removing the last external-looking coefficient from the expansion relation. The QMU cosmological scaling relation is therefore fully determined by closure geometry, closure topology, and QMU charge structure, with no external normalization factors required.

Acknowledgments

The Quantum AetherDynamics Institute (QADI) is a private 501(c)(3) research institute developing the Aether Physics Model (APM) and Quantum Measurement Units (QMU) Thomson III [2025]. Publications and data are archived with DOIs in the AetherPhysics Zenodo community: zenodo.org/communities/aetherphysics.

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