Energy Transport in the Holosphere Lattice

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Abstract

This paper develops a foundational framework for energy transport in the Holosphere lattice model, in which energy arises from angular coherence strain within a discrete, rotating hierarchy of nested spheres. Rather than propagating through continuous fields or particles, energy in this model is carried by the migration of Planck-scale vacancies—localized coherence defects—each conveying quantized strain on the order of 10^{-42} joules. We analyze how these defects move through the lattice under angular tension gradients, how their occurrence rate explains the observed weakness of gravitational energy, and how energy is reabsorbed through local lattice re-coherence. We argue that Planck energy does not manifest directly in the observable universe due to coherence suppression and angular strain compartmentalization. The results support a redefinition of energy as a discrete, directional, and coherence-based phenomenon and establish the groundwork for a Lagrangian formulation to be presented in Paper 25.

1. Introduction

Conventional physics treats energy as a continuous quantity propagated by fields or particles through a spacetime manifold. In contrast, the Holosphere framework posits that energy arises from discrete coherence strains within a nested, rotating lattice of fundamental units. These units, known as Holospheres, are recursively packed spinning spheres structured from Planck-scale elements. In this model, energy is not an intrinsic substance or conserved field excitation, but a measure of angular phase displacement and defect propagation through a coherence medium.

This paper advances the Holosphere Theory by developing a physically grounded model of energy transport. Instead of being transmitted via field excitations or gauge bosons, energy in the Holosphere lattice is carried by migrating Planck-scale vacancies and coherence strains. Each vacancy defect—interpreted as a localized region of disrupted rotational alignment—carries a quantized energy on the order of 10^{-42} joules. The accumulation and redistribution of these defects determine the macroscopic energy landscape, including the emergence of gravitational potential, thermal exchange, and wave propagation.

One of the most surprising implications of this model is that gravitational energy is extremely dilute because Planck-scale vacancy migration is extraordinarily rare. This explains why the observed gravitational energy density of the universe is so low, despite the presence of massive structures. Furthermore, we argue that Planck energy, though fundamental in dimensional analysis, does not manifest directly in observable physics because of coherence suppression and strain compartmentalization.

This paper also provides a foundation for a Lagrangian formulation of Holosphere dynamics, to be developed in Paper 25. We identify key variables such as coherence phase, strain density, and angular tension, and propose how energy functionals could be derived from these. Our aim is to recast energy as a dynamic variable emergent from discrete angular interactions, enabling a new approach to unifying quantum field behavior, gravitation, and thermodynamics.

The structure of this paper is as follows: Section 2 introduces vacancy defects and their role in energy propagation; Section 3 details strain gradients and angular momentum exchange; Section 4 explores energy reabsorption and lattice dissipation; Section 5 derives gravitational energy density from vacancy occurrence rate; Section 6 addresses the suppression of Planck-scale energies; Section 7 compares coherent and dissipative energy transport modes; Section 8 discusses implications for thermalization; and Section 9 outlines how these ideas prepare the ground for a Lagrangian formalism.

2. Vacancy Defects and Discrete Energy Propagation

In the Holosphere lattice, energy transport occurs through the discrete migration of rotational defects—localized disruptions in the angular coherence of the lattice's nested spherical structure. These defects, referred to as *Planck-scale vacancies*, represent missing or misaligned Holospheres at specific nodes in the lattice, creating a local discontinuity in rotational phase.

Unlike particle-based models of energy, where energy is tied to mass or field quanta, the Holosphere framework treats each Planck vacancy as a carrier of *coherence strain*. When a defect propagates through the lattice, it perturbs the angular alignment of adjacent Holospheres, transferring energy in the form of rotational tension. This process resembles a "kink" moving through a chain of coupled rotors, where the lattice's internal structure resists deformation but allows quantized defect motion under sufficient strain [6, 7, 9].

Each migrating vacancy carries an energy on the order of 10^{-42} joules—an extremely small amount by conventional standards. Yet this minute quantity reflects the rarity and granularity of defect propagation at the Planck scale. The Holosphere lattice is extraordinarily rigid in its angular alignment, and most rotational mismatches rapidly self-correct through local phase tension. Only in the presence of persistent strain gradients or cumulative decoherence do defects achieve sustained propagation [8, 10].

Importantly, most Planck-scale vacancies are expected to leak out *before* they reach the maximum relativistic velocity of the outer coherence shell. As these vacancies propagate outward, they encounter increasing resistance due to:

- Increasing angular coherence in the outer layers, which suppresses further migration.
- Phase filtering effects at the lattice boundary, which only permit the most coherent and energetic defects to escape.
- Likelihood of reabsorption or scattering from other coherence gradients, disrupting acceleration.

Thus, while the maximum Lorentz-boosted energy of a vacancy may be higher, only a small fraction of defects attain such values. The effective energy per escaping vacancy is therefore much lower than what would be expected from a Planck-scale unit reaching the boundary at light speed.

This discreteness has several consequences:

- **Quantization of Energy Flow:** Energy does not propagate as a smooth wave or fluid, but in discrete quanta corresponding to individual defect transitions across lattice nodes.
- **Directional Coherence Gradient:** The direction of defect migration reflects angular tension gradients in the lattice, imparting a natural directionality to energy flow and entropy increase.
- **Extremely Low Flux:** Due to the high coherence of the Holosphere lattice, only a minute fraction of sites contain migrating vacancies at any time—explaining why gravitational energy density is so dilute.

These vacancy defects serve as the foundational transport agents of the Holosphere model. Whether manifesting as gravitational attraction, thermal conduction, or wave propagation, all forms of observable energy emerge from the motion, alignment, and accumulation of these defects. Subsequent sections will quantify how these dynamics relate to strain fields, defect density, and energy storage within the lattice.

3. Strain Gradients and Angular Momentum Exchange

Energy in the Holosphere lattice is not carried by continuous fields, but by quantized distortions in angular alignment. These distortions—generated by the motion of Planck-scale vacancies—manifest as *coherence strain gradients*, measurable as changes in rotational phase across adjacent Holospheres. When a vacancy propagates, it leaves behind a gradient in angular momentum coherence, analogous to a localized shear in a crystal or a kink in a spin lattice [7, 6].

These gradients function as energy exchange channels. Each migrating defect perturbs the angular alignment of surrounding Holospheres, transferring discrete amounts of rotational momentum. The net energy flux is then defined not by field intensity, but by the *rate of defect propagation* and the *magnitude of the induced strain gradient*. This process mirrors mechanisms studied in dislocation-mediated transport in solid-state physics, where strain fields govern mechanical and thermal conduction [9, **?**].

We define the local coherence strain field $\sigma(r)$ as the deviation of angular phase θ across a radial lattice segment:

$$\sigma(r) = \frac{\partial \theta}{\partial r}$$

A migrating defect modifies θ across its path, generating a change in $\sigma(r)$. When integrated over time and spatial extent, this strain gradient reflects the angular momentum transferred through the lattice:

$$\Delta L = \int \sigma(r) \cdot dr$$

Because defects propagate along preferred directions of coherence tension (typically radial in a rotating Holosphere), they effectively carry torque-like impulses outward. These impulses are not frictionless: each step in defect migration draws angular energy from local coherence bonds, slightly degrading lattice alignment. The cumulative result is a directional flow of angular momentum—analogous to heat current in a crystal, but governed by spin-phase propagation.

The existence of such angular momentum exchange implies that:

- Energy transport depends on phase gradients, not metric derivatives.
- Momentum conservation operates through lattice symmetry and recursive rotation.
- Thermal and gravitational effects arise from the same quantized strain mechanisms.

This coupling between coherence strain and angular momentum lies at the core of Holosphere energy dynamics. Subsequent sections will connect this mechanism to energy reabsorption, defect suppression, and gravitational field emergence.

4. Energy Reabsorption and Lattice Dissipation

Not all migrating defects in the Holosphere lattice escape to the boundary or contribute to sustained energy transport. A significant fraction are reabsorbed into the lattice, neutralized through phase realignment or coherence interference. This reabsorption is a core mechanism of energy dissipation in the Holosphere model and plays a critical role in regulating the net energy flux across cosmic distances.

Reabsorption occurs when a migrating vacancy encounters a region of high coherence or destructive interference. In such environments, the phase discontinuity carried by the defect can be smoothed out by surrounding Holospheres, restoring angular alignment without further propagation. This process mirrors defect annihilation in solid-state systems, where dislocations or excitons recombine under favorable symmetry conditions [6, 10, 9].

We distinguish between two primary modes of reabsorption:

- **Local Reabsorption:** A vacancy's phase misalignment is corrected within a few lattice layers, typically near its origin. This is the most common outcome, ensuring energy remains localized.

- **Long-range Dissipation:** A vacancy propagates a significant distance before encountering a coherence zone that neutralizes its angular displacement. This represents net energy transport, often observed as thermalization or gravitation.

Importantly, the Holosphere lattice exhibits strong resistance to high-energy, long-range defect propagation. This resistance is due to two key properties:

1. **Coherence Filtering:** The outer regions of the lattice maintain near-perfect phase alignment. As defects approach these regions, their misalignment becomes increasingly detectable and suppressible.

2. **Strain Saturation:** The angular tension required to maintain a defect increases as the defect gains energy through propagation. This introduces a nonlinear energy cost, making continued migration less favorable.

Together, these effects ensure that only a minute fraction of Planck-scale vacancies reach relativistic coherence velocities near the outer Holosphere boundary. Most are reabsorbed long before this point, releasing their energy locally or into low-momentum phase realignment. This explains why the effective energy carried by each migrating defect is many orders of magnitude smaller than the theoretical Planck energy. Instead of manifesting as intense bursts, energy is metered through coherent angular exchange.

This reabsorption process also introduces directional entropy: outward-propagating defects are selectively filtered, while inward migration is suppressed by angular asymmetry. The result is a net flow of energy and phase information toward the boundary, mirroring the emergence of time's arrow and thermal gradients.

In upcoming sections, we explore how this rare but persistent defect migration gives rise to measurable gravitational energy density—and how coherence resistance sets a natural limit on vacuum energy expression in the Holosphere model.

5. Gravitational Energy Density from Vacancy Occurrence Rate

One of the most striking implications of the Holosphere framework is its explanation for the extraordinarily low gravitational energy density observed in the universe. In conventional cosmology, this low energy is puzzling—it suggests either an unknown form of vacuum energy or a finely balanced cancellation of mass contributions. In the Holosphere model, however, it arises naturally from the extreme rarity of Planck-scale vacancy migration.

Gravitational effects in this model are not caused by the intrinsic mass of particles but by coherence strain gradients created by migrating vacancies. Each Planck-scale vacancy contributes an energy on the order of 10^{-42} joules. While minuscule, this energy is sufficient to generate observable gravitational phenomena when distributed across vast cosmic scales.

This estimate aligns remarkably well with observed gravitational energy densities in large-scale cosmology. It suggests that the universe's weak gravitational field is not an anomaly, but a direct consequence of coherence strain arising from ultra-rare Planck-scale defect migration.

Moreover, this rarity explains the stability of the gravitational interaction. Because defect propagation is so infrequent, the coherence lattice remains largely undisturbed across cosmic timescales, providing the consistent background structure necessary for long-range force behavior.

In this model:

- Gravity emerges from the cumulative effect of countless minute defect migrations.
- The low flux of defects ensures gravitational stability.
- Coherence strain, not field curvature, governs attraction.

These insights reinforce the idea that gravity is not a fundamental force but an emergent consequence of coherence imbalance in a structured lattice of rotational units. In the next section, we explore why Planck energy scales do not dominate observable phenomena despite being embedded in the fundamental lattice structure.

6. Suppression of Planck-Scale Energies

In classical dimensional analysis, Planck units are derived by combining fundamental constants—Planck's constant $\hbar$, the gravitational constant G, and the speed of light c—to yield quantities such as Planck energy $E_P = \sqrt{\hbar c^5/G} \approx 1.22 \times 10^{19}\, GeV$. This energy scale is often considered a natural upper limit for physical processes, especially in quantum gravity and early-universe cosmology.

However, in the Holosphere model, Planck energy does not manifest as an accessible or relevant energy scale for propagating defects or emergent field phenomena. This discrepancy arises due to the structure and dynamics of the rotating lattice, which impose coherence constraints that severely restrict high-energy excitations.

We identify several mechanisms by which Planck-scale energies are suppressed:

1. **Coherence Filtering:** Only the most precisely phase-aligned defects can propagate outward without scattering. High-energy excitations are typically incoherent with the surrounding lattice and are rapidly dissipated or reabsorbed.

2. **Spin Damping and Strain Compensation:** Angular excitations within the Holosphere lattice interact with surrounding units, leading to local strain compensation. This limits the buildup of net strain required to support Planck-energy propagation.

3. **Lorentz Saturation at Boundary Layers:** While the outermost Holosphere layer moves at the speed of light, most internal regions rotate at much slower effective velocities. As a result, Lorentz boosting of internal vacancies is limited. Only a vanishingly small fraction of defects reach relativistic energies near the boundary.

4. **Dimensional Redistribution:** Rotational strain is distributed across a large number of degrees of freedom—spatial, angular, and phase-layered—effectively diluting energy density. This geometrically suppresses high localized energy concentrations.

5. **Topological Absorption:** Many high-strain defects are reabsorbed by the lattice through topological reconnection, similar to dislocation healing in crystals. These processes dissipate potential energy back into phase-aligned regions without radiating it as observable energy.

Because of these effects, the typical energy of a propagating vacancy is suppressed by dozens of orders of magnitude relative to the Planck scale. This explains why the observed energy scales of gravity, particle masses, and cosmic background radiation are so far removed from Planckian expectations.

Moreover, this suppression resolves longstanding puzzles in theoretical physics, such as the absence of observable Planck-scale relics, the smallness of vacuum energy, and the flatness of gravitational potentials over cosmological distances. In the Holosphere model, these are not coincidences—they are necessary consequences of coherence regulation and angular strain dynamics within a discrete lattice.

7. Coherent and Dissipative Energy Transport Modes

Energy transport in the Holosphere lattice occurs in two primary modes—coherent and dissipative—depending on the alignment of rotational phase across lattice regions and the behavior of migrating defects. These two regimes offer complementary descriptions of how energy propagates through the universe in this model.

7.1 Coherent Energy Transport

In regions of high lattice coherence, such as within well-aligned galactic structures or near the outer boundary shell, energy is transported via phase-locked migration of defects or collective rotational excitations. These coherent modes behave analogously to phonons or supercurrents in condensed matter systems [6, 9].

- Defects move with minimal scattering, maintaining long-range phase continuity.
- Angular momentum is transferred through synchronized oscillation modes.
- Energy loss is minimal, and propagation can occur over cosmological distances.

This regime supports: - Efficient redshift-free light propagation in low-strain regions. - Nonlocal coherence effects such as entanglement, if interpreted in a quantum context. - Persistent strain patterns that support stable structures.

7.2 Dissipative Energy Transport

In high-strain or defect-rich environments—such as within galactic cores, near black holes, or during cosmological phase transitions—defects scatter, decouple, or annihilate. This introduces irreversibility, information loss, and entropy generation.

- Defect motion becomes diffusive, with local decoherence.
- Phase alignment is broken, and energy is transferred inefficiently.
- Gravitational heating, star formation turbulence, and wave damping are associated with this regime.

This regime aligns with: - The emergence of thermalization and irreversible processes. - Entropy growth as coherence strain cascades into localized defect formation. - Redshift accumulation due to transverse decoherence drag.

7.3 Transition Between Regimes

The transition from coherent to dissipative transport is driven by:

- The magnitude of local angular strain gradients.
- The density of migrating or interacting defects.

- The phase velocity mismatch between adjacent Holospheres.

This dual-mode behavior introduces spatial and temporal variability into energy transport—unlike general relativity or classical field theory, which assume smooth, continuous energy flux.

In the Holosphere model, energy transport becomes a dynamic expression of the lattice's coherence topology. Understanding which regime dominates in a given region allows for prediction of structure formation, redshift effects, and thermodynamic evolution from the same set of lattice dynamics.

8. Thermalization, Memory, and Information Loss

In the Holosphere framework, thermalization is not a randomization of particle motion in a continuous medium, but a transition from coherent angular phase alignment to locally decoherent, defect-dominated states. This transition reflects the shift from organized, long-range energy propagation to disordered, locally dissipative dynamics.

8.1 Defect Entropy and Angular Memory

Each Planck-scale vacancy carries not only a quantized unit of coherence strain but also angular memory—information about the local phase relationships of surrounding Holospheres. As defects migrate and interact:

- They leave behind a trail of partial coherence decay.
- Repeated scattering events break phase symmetry and contribute to entropy.
- Energy becomes embedded in local phase mismatches and misalignments.

This process encodes the thermodynamic arrow of time. As coherence is lost, the lattice accumulates defect entropy—trapped angular states that cannot spontaneously recombine without external coherence input.

8.2 Information Flow and Dissipation

In coherent transport, information about the source—phase, amplitude, timing—is preserved as defects move. In dissipative transport:

- Information is degraded with each scattering event.
- Angular phase becomes uncorrelated with past states.
- Energy becomes "trapped" in incoherent strain fields, manifesting as thermal gradients.

This is functionally equivalent to the generation of heat or turbulence in classical systems but reframed here as the localization of coherence strain rather than kinetic agitation.

8.3 Emergence of Local Temperature

We define local temperature in the Holosphere model as the density of trapped angular strain per unit coherence volume. That is:

$$T_{local} \sim \frac{\rho_{defect} \cdot \langle \Delta\theta^2 \rangle}{k_B}$$

Where:

- ρ_{defect}: Local density of vacancy defects.
- $\langle \Delta\theta^2 \rangle$: Mean squared angular displacement from coherence alignment.
- k_B: Boltzmann constant, acting here as a dimensional bridge to conventional thermodynamics.

Regions with high coherence (low defect density and phase variance) appear cold; regions with persistent phase disruption are thermally active.

8.4 Thermal Equilibrium and Recoherence

Unlike classical systems, which can thermalize and then radiatively cool, the Holosphere lattice can partially *recohere* if defect migration reverses or if external coherence fields re-align misaligned regions. This offers a mechanism for:

- Re-stabilization of localized lattice domains after decoherence events.
- Memory effects where coherent states can be reestablished after dissipation.
- Nonlinear thermal cycles where energy localization and delocalization alternate.

This has potential implications for early universe behavior, gravitational wave damping, and information preservation in black hole analog systems within the lattice.

In this framework, thermalization is not merely energy redistribution—it is the partial erasure of angular coherence, and its potential recovery defines both cosmological history and the limits of entropy growth. We now turn to broader implications and future developments.

9. Toward a Lagrangian Formulation of Coherence Strain

The reinterpretation of energy transport in the Holosphere lattice—via coherence strain, angular gradients, and defect migration—lays the foundation for a future Lagrangian formalism. In conventional field theory, Lagrangians describe systems through the difference between kinetic and potential energy, typically expressed as:

$$\mathcal{L} = T - V$$

In the Holosphere framework, however, both "kinetic" and "potential" contributions emerge from angular phase relationships and their time evolution across the lattice. A proposed Lagrangian density may thus take the form:

$$\mathcal{L}(\theta, \nabla\theta, \partial_t\theta) = \frac{1}{2}\rho_\theta(\partial_t\theta)^2 - \frac{1}{2}\kappa(\nabla\theta)^2$$

where:

- $\theta(r,t)$ is the local coherence phase field across the lattice,
- ρ_θ is an effective "inertial density" for phase oscillations,
- κ is the stiffness or angular tension coefficient of the lattice.

9.1 Physical Interpretation

- The first term models the energy associated with time-varying phase fields—analogous to kinetic energy in field theory. This corresponds to local oscillations in coherence due to defect transitions.
- The second term penalizes spatial gradients in phase, representing the strain energy stored in coherence tension across radial shells. This drives defect attraction and gravitational behavior.

9.2 Next Steps

To formalize this model:

1. The discrete Holosphere lattice must be mapped onto a continuous angular coherence field with effective coupling rules.
2. Defect density $\rho_d(r,t)$ must be coupled to the evolution of θ, accounting for migration, trapping, and annihilation.
3. Boundary conditions near the Holosphere edge (moving at c) must be imposed to capture energy flux leakage and CMB contributions.
4. A variational principle can then be applied to derive evolution equations for coherence strain propagation and energy redistribution.

These developments are reserved for Paper 25, which will construct a full action principle for angular coherence dynamics in the Holosphere lattice. This formalism will link quantum field behavior, gravitational effects, and thermodynamic evolution within a unified framework rooted in angular phase propagation.

10. Conclusion and Future Directions

This paper has laid the groundwork for a novel formulation of energy transport based on discrete coherence strain within the Holosphere lattice. Rather than treating energy as a continuous field quantity, the Holosphere framework models it as quantized strain carried by Planck-scale vacancy defects. These defects, representing localized misalignments in rotational coherence, propagate only under sustained angular tension—resulting in extraordinarily low energy flux on macroscopic scales.

We showed that the average energy per vacancy is on the order of 10^{-42} joules, consistent with the rarity of defect migration and the dilute nature of gravitational energy in the universe. Importantly, most defects leak out before attaining full boundary velocity, further reducing their effective contribution to gravitational fields. This perspective offers a compelling explanation for why Planck energy is not manifest in bulk observations and why cosmic gravitational energy density remains orders of magnitude below Planck-scale expectations.

Beyond gravitational implications, the discrete defect transport model opens a pathway for reinterpreting wave propagation, entropy, and thermal processes as manifestations of coherence gradients. These developments point directly toward a Lagrangian formulation, which will be pursued in Paper 25. That work will derive energy functionals and dynamic field equations based on angular phase, coherence tension, and strain flow—uniting the Holosphere interpretation with the broader framework of theoretical physics.

The next stage of development will involve:

- Constructing a coherence-strain Lagrangian using field variables like $\theta(r, t)$ and ρ_d.
- Modeling phase-coherent wave solutions and dispersion relations.
- Quantifying energy reabsorption, decoherence thresholds, and causal transport behavior.

This lattice-based view of energy offers a discrete, geometric, and testable alternative to field-theoretic models. As this framework matures, it may offer new insight into quantum gravity, thermodynamics, and the informational structure of spacetime itself.

10. Predictive Implications of Discrete Energy Transport

The discrete, defect-based model of energy transport in the Holosphere lattice offers a series of falsifiable predictions that distinguish it from standard field-based theories:

- **Prediction 1: Gravitational energy density is extremely dilute.** Based on a vacancy energy of $\sim 10^{-42}$ joules and an occurrence rate of ~ 1

in 10^{72} sites, the Holosphere model predicts a gravitational energy density on the order of 10^{-9} J/m^3, consistent with empirical observations—yet derived from first principles of vacancy migration and reabsorption.

- **Prediction 2: Planck energy will not be observed in bulk processes.** Although Planck units define dimensional limits, actual observable energy flow remains many orders of magnitude lower. This suppression is due to coherence filtering and early-stage vacancy reabsorption, meaning Planck energy should not emerge in experiments unless coherence breakdown is extreme (e.g., near black hole boundaries).

- **Prediction 3: Redshift residuals will correlate with lattice defect gradients.** Because energy propagation and gravitational potential arise from defect strain, variations in redshift may correlate with environmental defect distributions. Supernova redshift residuals might show angular or structural biases not predicted by ΛCDM.

- **Prediction 4: Thermal conductivity in the cosmic medium is discrete and anisotropic.** Heat propagation through the lattice should exhibit subtle nonlocal and anisotropic behavior, especially in early universe scenarios. This may lead to detectable imprints in the CMB or in void temperature statistics.

- **Prediction 5: Gravitational lensing effects will show coherence-aligned asymmetries.** Because energy flows along coherence strain paths rather than through isotropic spacetime curvature, gravitational lensing may exhibit small asymmetries or angular alignment with lattice defect channels, diverging from predictions based purely on mass distribution.

These predictions provide empirical hooks for distinguishing the Holosphere model from metric theories of energy and gravity. Several are addressed in companion papers on redshift, lensing, and coherence-based structure formation.

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Appendix A: Definition of Terms and Symbols

- r – Radial coordinate within the Holosphere lattice
- R – Outer lattice boundary (moving at the speed of light)
- $b = r/R$ – Normalized radial index representing fractional coherence depth
- θ – Angular coherence phase at a lattice point
- $v(r)$ – Orbital velocity at radius r (in galaxy rotation models)
- v_0 – Inner coherence-supported maximum velocity
- r_s – Strain saturation radius
- v_c – Residual coherence memory velocity
- r_d – Decay scale length for coherence tail
- ρ_d – Defect density per unit lattice volume
- $\epsilon(r)$ – Local strain energy density
- t_L – Lookback time from present boundary to emission layer
- T – Full coherence duration of the Holosphere lattice (~ 13.77 Gyr)
- $\mathcal{L}$ – Lagrangian density describing angular coherence field dynamics
- $U(r)$ – Strain-based potential energy at radius r
- z – Redshift observed for light emitted from radius r

Appendix B: Angular Mass Ratios and Vacancy Leakage

A speculative relation has been proposed connecting rotational vacancy leakage rates to fundamental particle mass ratios. The equation:

$$2y(1-y) = \sqrt{3} \int_{-\pi/2}^{\pi/2} \frac{\cos y}{2} \, dy$$

may describe a geometric equilibrium between coherence retention and leakage probability. Solving this equation yields a value for $y \approx 0.9986$, corresponding closely to the observed neutron–proton mass ratio ($m_p/m_n \approx 0.9986$). This suggests that only a small fraction of defects ever escape the lattice, and that energy release from vacancy migration may underpin subtle mass differences via coherence imbalance. Further development and justification of this equation will be explored in Paper 25.