Coherence-Based Frame Dragging, Redshift, and Gravitational Quantization in the Holosphere Lattice Model

Michael John Sarnowski

5/16/2025

Abstract

This paper explores how gravitational quantization, frame dragging, and cosmological redshift emerge from angular coherence strain within the Holosphere lattice—a discrete, rotating medium composed of nested Planck-scale spheres. Unlike general relativity, which describes gravity through spacetime curvature, Holosphere Theory models mass, charge, and inertial effects as arising from phase misalignments in a recursive, cuboctahedrally packed lattice. Frame dragging is reinterpreted as mechanical entrainment by rotational coherence gradients, and redshift emerges from Doppler-like spiral slippage and exponential phase drag. The model avoids point particles by describing matter as extended angular defects, regularizing gravitational self-energy and quantizing interaction strengths through discrete shell configurations. We present a summary comparison to general relativity, introduce a spin-gradient redshift approximation, and discuss open challenges including the emergence of an effective metric and correspondence with Einstein's field equations. These results provide a foundation for future derivations of relativistic behavior from lattice-based coherence dynamics.

1 Introduction

Holosphere Theory proposes that all observable physical phenomena—including gravity, inertia, redshift, and frame dragging—emerge from rotational coherence dynamics within a discrete, spinning lattice of nested Holospheres spheres made of Planck scale spheres. These spheres, called Holospheres, form a recursive, cuboctahedrally packed structure that propagates angular momentum and coherence phase through a finite-speed medium. In this model, energy and force interactions arise not from curvature in a continuous manifold, but from angular strain gradients and defect migration across the lattice.

Unlike general relativity, which models gravity as the curvature of spacetime geometry, Holosphere Theory treats gravitational attraction as the result of directional coherence strain around quantized angular defects. Each defect represents a localized misalignment in phase coherence, bounded and stabilized by surrounding layers of rotating Holospheres. These coherence defects replace point particles, enabling finite energy densities and quantized interaction strengths from first principles [9].

This paper focuses on three core applications of the theory:

- Reinterpreting **frame dragging** as a mechanical entrainment effect within the rotating coherence lattice;
- Modeling **gravitational redshift** as cumulative angular phase slippage rather than metric stretching;

- Deriving early forms of **gravitational quantization** from angular momentum distribution across coherent shell layers.

We also contrast these lattice-derived effects with their general relativistic counterparts, propose an approximate redshift formula derived from coherence gradients, and outline key open challenges—such as the emergence of an effective metric and connection to Einstein's equations. The goal is to establish a coherence-based alternative to curved spacetime, grounded in discrete, testable dynamics.

2 Causality, Frame Dragging, and the Role of Discreteness

In Holosphere Theory, causality is preserved not by the global structure of a smooth spacetime manifold, but by the finite propagation speed of coherence strain across a discrete angular lattice. Each Holosphere transmits rotational phase information to its neighbors through coherent orbital alignment, with the maximum speed of propagation capped by the coherence wavefront velocity—identified with the speed of light. This constraint enforces a causal ordering of events, ensuring that no effect can propagate faster than coherence can reorganize across the lattice [5, 6].

Frame dragging, traditionally modeled in general relativity as a twisting of spacetime near a rotating mass, arises here from mechanical entrainment within the Holosphere lattice. Massive, coherently rotating defect structures induce local phase-locking in neighboring Holospheres, causing light and particles to experience frame-preferred propagation directions. This behavior reflects the angular momentum gradient of the surrounding lattice shell layers, creating rotational strain fields that bend trajectories—not through geodesic curvature, but through dynamical coherence alignment [9].

Because the theory forbids idealized point particles, all physical entities are modeled as extended defects in coherence phase. These defects represent localized failures of rotational symmetry, stabilized by surrounding angular momentum flow. As shown in Paper 26, these regions exhibit persistent angular strain and propagate phase gradients outward, generating gravitational and inertial analogs without the need for mass-energy tensors or metric deformation [7, 9].

Importantly, the discrete structure of the Holosphere lattice provides a natural substrate for emergent spacetime behavior. Rather than assuming continuous geometry, the model constructs spacetime-like behavior from the coherent coupling of nested rotational units. Frame dragging, redshift, and inertia are all emergent consequences of how coherence gradients evolve over time within the lattice. This places Holosphere Theory among a broader class of emergent gravity frameworks [3, 4], but with a concrete physical implementation grounded in discrete, testable rotational dynamics.

3 Sphere Packing and Defect Formation in the Holosphere Lattice

The structural foundation of Holosphere Theory is a recursively nested lattice composed of spinning units packed in a cuboctahedral geometry. This geometry is chosen for its ability to support angular coherence, isotropic symmetry, and maximal contact among neighboring Holospheres. Each Holosphere is a shell composed of smaller, rotating Planck-scale units, with coherence phase alignment maintained across layers. The structure propagates angular momentum through these nested shells via tightly coupled rotational dynamics [8, 9].

Packing constraints in this lattice naturally give rise to discrete, quantized defect formations. Defects occur when phase alignment between Holospheres is disrupted—either through angular mismatch, symmetry-breaking orbital offsets, or local coherence loss. These defects act as the fundamental carriers of physical properties such as mass, charge, and spin. Rather than point particles, these entities are modeled as extended angular phase discontinuities bounded by coherent orbitals. Each stable defect corresponds to a particular shell configuration—such as 2-sphere, 6-sphere, or 42-sphere arrangements—giving rise to electron, muon, and tau particle identities [9].

Gravitational behavior arises from the strain induced by these defects. A coherence defect introduces an angular momentum gradient in its surrounding lattice, pulling nearby Holospheres into a new alignment configuration. This results in a localized strain field which behaves analogously to gravitational attraction: rather than curving spacetime, it alters the rotational coherence landscape and redirects phase propagation paths. In the continuum limit, such angular strain gradients may approximate classical gravitational curvature [7, **?**].

Holospheres are hollow not in material content, but in coherence function. Their structure is optimized to transmit rotational phase through layered orbital coupling, allowing angular momentum to traverse without internal scattering or dissipation. This hollow coherence mechanism replaces continuous field propagation with a discrete, recursive routing of phase information.

As a result, both classical gravitational behavior and quantum quantization can be traced to the geometry of packing and defect alignment. The emergence of mass, charge, and redshift can all be understood as outcomes of angular strain accumulation and coherence-locking failure across nested Holosphere layers.

4 Implications and Extensions

Holosphere Theory offers a unified physical substrate through which mass, charge, gravity, and redshift emerge as manifestations of angular coherence strain in a discrete, rotating lattice. By modeling matter and fields as extended coherence defects in a recursive cuboctahedral structure, the theory introduces new physical insights and predictive mechanisms across multiple domains.

- **Quantization of Gravity and Charge:** Gravitational and electromagnetic interactions are derived from the geometry of coherence strain and orbital phase symmetry. Charge emerges from handedness in 6-Holosphere orbital shells, while gravity results from persistent angular strain gradients caused by packed defects. Both phenomena are inherently discrete and originate from the lattice structure itself [9, 10].

- **Angular Momentum and Neutrino Behavior:** Neutrino-like entities may correspond to ultra-low strain coherence defects with minimal mass and weak orbital coupling. Their role may be to facilitate phase rebalancing over long lattice distances, acting as regulators of angular momentum transfer and coherence damping in early and late cosmological epochs.

- **Universal Structure and Size Estimates:** Given a maximum coherence propagation velocity (speed of light) and the recursive nature of the lattice, the Holosphere model imposes a natural scale limit on the observable universe. Coherence exhaustion and strain saturation beyond the outermost Holosphere layer set the boundary for effective cosmological reach, matching observational estimates of the universe's radius [10, 6].

- **Generational Structure of Particles:** Distinct angular configurations such as the 2-, 6-, and 42-sphere orbital shells correspond to fermion generations: electrons, muons, and tauons. These configurations define the orbital strain distribution and mass quantization patterns. A hypothesized 780-sphere configuration may represent a fourth, unstable generation (Paper 15), with angular strain instability accounting for non-observation.

- **Redshift Without Expansion:** Redshift is modeled not through metric expansion but through spiral phase slippage and exponential coherence drag across the rotating Holosphere lattice. Light propagating through decreasing coherence zones accumulates Doppler-like redshift along with an exponential attenuation term. This model reproduces the observed cosmological redshift curve without invoking dark energy or comoving distances [11].

These implications illustrate how gravitational, quantum, and cosmological effects can all arise from a common structural foundation: the discrete propagation of angular coherence through a rotational lattice. Rather than treating mass and energy as fundamental inputs, Holosphere Theory derives them as emergent quantities from defect geometry, orbital shell locking, and phase coherence strain.

5 Model Summary Comparison

The table below contrasts key features of general relativity with their Holosphere Theory counterparts. While both models recover similar observable effects (e.g., gravitational attraction, redshift, causality), the underlying mechanisms differ substantially. General relativity treats mass as a source of spacetime curvature, while Holosphere Theory derives force behavior from coherence strain in a discrete lattice of rotating Holospheres.

The table below compares key features of general relativity and Holosphere Theory, emphasizing the different underlying mechanisms despite producing similar observable effects.

Feature	**General Relativity (GR)**	**Holosphere Theory**
Origin of Gravity	Spacetime curvature due to energy-momentum	Angular coherence strain from nested rotational gradients
Redshift Mechanism	Metric expansion and gravitational time dilation	Spiral phase slippage + exponential coherence drag through rotating lattice
Causality Enforcement	Light cones and Lorentz invariance in curved manifolds	Finite coherence propagation speed across the discrete lattice
Particle Model	Point particles in smooth fields	Extended angular coherence defects with orbital quantization
Frame Dragging	Spacetime rotation near massive bodies	Mechanical entrainment from local rotational coherence gradients
Quantization Source	Semi-classical quantization layered on geometry	Discrete orbital packing and strain-locking from lattice symmetry

Table 1: Comparison of General Relativity and Holosphere Theory mechanisms.

6 Preliminary Gravitational Predictions

Within Holosphere Theory, gravitational effects arise from persistent angular strain gradients generated by coherence defects. These strain fields modify how light propagates across the lattice by altering the local phase alignment of Holospheres, redirecting wavefronts and modulating frequency without invoking metric curvature. Here, we propose an approximate redshift relation derived from the rotational dynamics of the coherence medium:

$$\Delta z \sim \frac{1}{N}\left(\frac{\omega R}{c}\right)^2 \tag{1}$$

where ω is the local angular velocity of the Holosphere lattice, R is the radial distance from the defect cluster, c is the maximum coherence propagation speed (light speed), and N is a normalization factor reflecting the number of nested coherent layers contributing to angular strain.

This equation models redshift as an outcome of **spiral coherence drag**—a Doppler-like phase attenuation resulting from light being guided through a lattice rotating transversely to its path. Unlike gravitational redshift in general relativity, which results from potential well depth, the Holosphere model attributes frequency shifts to entrainment and phase slippage within the rotating coherence structure.

Gravitational lensing is likewise understood as a coherence-guided effect: light bends not due to geodesic deformation, but due to angular phase gradients around dense defect structures. The strain tensor σ_{ij} governs how coherence vectors rotate around defect centers, producing effective curvature in the angular trajectory of photons.

While this redshift formulation does not reproduce the exact Schwarzschild deflection angle $\Delta\theta = \frac{4GM}{c^2R}$, it reflects a physically distinct mechanism—namely, the discrete entrainment of photon coherence by angular strain gradients. In the continuum limit, these gradients may approximate the same macroscopic deflection behavior, but their origin is lattice-based and inherently quantized.

Further refinement of this equation may involve:

- Incorporating exponential phase drag terms.
- Modeling N as a function of radial coherence shell thickness and local curvature strain.
- Comparing the angular strain profile with gravitational lensing measurements.

These initial predictions support a testable distinction between Holosphere-based coherence redshift and general relativistic curvature effects.

7 Limitations and Future Directions

While Holosphere Theory offers a novel coherence-based substrate for gravitational and quantum phenomena, several limitations remain. These open challenges define the roadmap for future papers in the series and for ongoing theoretical refinement:

- **Emergent Metric Tensor:** Holosphere Theory does not currently define a metric tensor $g_{\mu\nu}$. Instead, it models geometry through the coherence field $\phi(x,t)$ and angular strain tensor σ_{ij}. A key goal is to recover an effective metric from the phase coherence structure—possibly by coarse-graining over angular momentum density fields or through symmetry constraints on σ_{ij}. This may allow formal recovery of geodesic-like paths from discrete coherence dynamics.

- **Derivation of the Einstein Tensor:** While angular strain gradients successfully reproduce gravitational effects at large scales, a statistical or variational derivation of the Einstein tensor $G_{\mu\nu}$ remains open. We seek to derive an analog from lattice-based conservation laws or Noether-like symmetries in the coherence field $\phi(x,t)$, as outlined in Paper 27 and anticipated in the Lagrangian formulation of Paper 25.

- **Experimental Confirmation of Lattice Structure:** The underlying lattice of Planck-scale Holospheres has not been directly observed. However, indirect evidence may appear in cosmological anisotropy, redshift residuals, coherence-scale time dilation anomalies, or quantized gravitational lensing. Future surveys—particularly of gravitational wave dispersion or ultra-faint redshift patterns—may reveal coherence loss signatures consistent with the model.

- **Refined Redshift Derivation:** The current hybrid redshift equation matches observations using a phenomenological exponential correction term. A more rigorous derivation from first principles—tracing phase slippage, spin entrainment, and coherence decay along the light path—is needed. This may also clarify the connection between redshift and CMB spectral properties in the lattice.

- **Relativistic Lensing and Time Dilation Predictions:** While preliminary results suggest that light deflects along angular coherence gradients, a full derivation of lensing profiles, time dilation curves, and structure formation must be developed from the discrete strain framework. These will provide crucial tests against CDM predictions.

- **Correspondence to Quantum Field Theory:** Although coherence defects encode fermionic and bosonic behavior, a formal mapping between angular orbital states and field operators remains to be constructed. This will require translation between orbital quantization modes in the lattice and standard model field representations.

These challenges do not undermine the theory's conceptual foundation—they point toward the deeper integration of coherence-based physics with gravitational, quantum, and cosmological observations. As the Holosphere framework develops, future papers will expand the Lagrangian formalism, refine redshift models, explore coherence-based field equations, and propose falsifiable predictions grounded in strain-based geometry.

References

[1] S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Space-Time*, Cambridge University Press, 1973.

[2] K. S. Thorne, *Black Holes and Time Warps: Einstein's Outrageous Legacy*, W. W. Norton & Company, 1994.

[3] T. Jacobson, "Thermodynamics of Spacetime: The Einstein Equation of State," *Phys. Rev. Lett.*, 75(7), 1260–1263 (1995). https://doi.org/10.1103/PhysRevLett.75.1260

[4] E. Verlinde, "On the Origin of Gravity and the Laws of Newton," *JHEP*, 2011(4), 29. https://arxiv.org/abs/1001.0785

[5] R. D. Sorkin, "Causal Sets: Discrete Gravity," *Lectures on Quantum Gravity*, 2005. https://arxiv.org/abs/gr-qc/0309009

[6] C. Rovelli, *Quantum Gravity*, Cambridge University Press, 2004.

[7] H. Kleinert, *Gauge Fields in Condensed Matter: Vol. 2 Stresses and Defects*, World Scientific, 2004.

[8] P. M. Chaikin and T. C. Lubensky, *Principles of Condensed Matter Physics*, Cambridge University Press, 1995.

[9] M. J. Sarnowski, "Quantum Mechanics from Vacancy Defects in a Holosphere Lattice," *Holosphere Theory Series*, Paper 1, 2025.

[10] M. J. Sarnowski, "Redshift and Light Propagation in a Spinning Lattice Cosmology," *Holosphere Theory Series*, Paper 2, 2025.

[11] M. J. Sarnowski, "Derivation of Cosmological Redshift from Spiral Phase Slippage," *Holosphere Theory Series*, Paper 11, 2025.

Appendix A: Definitions of Terms and Symbols

- **Holosphere:** A neutron-scale, rotating shell composed of nested Planck spheres, forming the basic coherence unit of the universe.
- $\phi(x,t)$ — **Coherence Field:** A scalar field representing the angular phase alignment at lattice site x and time t. Determines coherence strain, energy flow, and particle behavior.
- σ_{ij} — **Angular Strain Tensor:** A symmetric tensor defined as $\sigma_{ij} = \partial_i\phi \cdot \partial_j\phi$. Measures the local directional tension in angular coherence.
- v_ϕ — **Phase Velocity:** Temporal derivative $\partial_t\phi(x,t)$ representing local phase drift or angular rotation rate at a lattice node.
- L_i — **Angular Momentum Density:** Defined as $L_i = I(x) \cdot \partial_i\phi$, where $I(x)$ is the local moment of inertia. Encodes rotational inertia and coherence momentum.
- **Coherence Defect:** A localized misalignment in angular phase across the Holosphere lattice. Forms the structural basis of particles, mass, and gravitational strain.
- **Spiral Phase Slippage:** A redshift mechanism in which light accumulates frequency shift while spiraling through rotationally misaligned Holospheres.
- **Exponential Coherence Drag:** A cumulative energy loss effect due to coherence attenuation along radial lattice paths—producing exponential correction to redshift.
- **Orbital Shell Configuration:** Discrete sphere groupings (e.g., 2-, 6-, 42-sphere shells) that define quantized particle states and generations through orbital strain patterns.
- **Coherence Frame:** The preferred rest frame defined by global rotational alignment in the Holosphere lattice. Not absolute space, but a maximum-coherence reference.
- **Angular Entrainment:** The rotational alignment of nearby Holospheres to a central coherence defect, producing frame dragging and inertial gradients.