Surface Brightness and Redshift in the Sempiternal Spinning Sphere Theory

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Abstract

This paper evaluates the predictions of the Holosphere-based Sempiternal Spinning Sphere Theory in relation to the Tolman surface brightness test over the redshift range $0.01 < z < 4$. Unlike CDM, this model does not assume metric expansion, inflation, or dark energy. Instead, it posits that redshift arises from spiral phase slippage as light propagates radially through a rotating lattice of Holospheres—discrete neutron-scale spheres forming the underlying structure of spacetime. As photons spiral outward through successive coherence shells, they accumulate angular strain, leading to both redshift and surface brightness attenuation.

We derive a modified surface brightness equation based on the exponential geometry of radial propagation through this rotating medium, which reproduces the $(1 + z)^{-3}$ scaling observed in empirical data. Comparison with observations from Lubin & Sandage [2] shows strong alignment, supporting the Holosphere model as a viable alternative to the expanding universe framework. The results suggest that redshift, angular size evolution, and surface brightness dimming can emerge naturally from coherent rotational strain in a discrete spacetime structure.

1 Introduction and Interpretation

The Holosphere Theory proposes that spacetime is not continuous, but composed of a discrete lattice of rotating units called *Holospheres*—neutron-scale spherical shells formed from nested Planck-scale substructures. These Holospheres are packed cuboctahedrally to form a globally rotating lattice that defines both the geometry and dynamics of the universe. In this framework, redshift, surface brightness dimming, and angular size evolution emerge from the interaction between light and the coherence structure of the lattice, not from metric expansion.

According to the Sempiternal Spinning Sphere interpretation of this lattice, light propagates radially outward through successively larger spherical shells of increasing angular velocity. As photons spiral through these coherence layers, they experience what is known as *spiral phase slippage*: an accumulated angular mismatch between nested rotating shells that manifests as a redshift. The outermost shell of the universe—composed of Holospheres moving at the speed of light—serves as a causal boundary where this redshift terminates.

This model eliminates the need for cosmological inflation, dark energy, or a Big Bang origin. Instead, galaxies are assumed to form in interior regions of the lattice and migrate outward over time. As they do so, their physical separation increases due to geometric divergence of the rotating lattice, giving the appearance of expansion without actual spatial stretching. This radial migration also results in angular size evolution and surface brightness dimming consistent with observations.

Crucially, the Sempiternal model predicts that the angular area of a galaxy increases as $(1+z)^2$ due to the unfolding of geometric paths through the rotating lattice. When combined with time dilation and photon redshifting from the spiral phase model, this reproduces the full $(1+z)^3$ surface brightness dimming predicted by Tolman [1], but from an entirely different physical mechanism.

This paper evaluates the redshift and surface brightness predictions of the Sempiternal model, comparing them to data from Lubin & Sandage [2] and assessing statistical alignment with observational trends. The goal is to test whether this lattice-based model can match or exceed the empirical success of metric-expansion cosmology using an internally consistent, non-expanding structure.

2 Calculation of Coherence Depth (r/R) in the Sempiternal Model

In the Sempiternal Spinning Sphere Theory, redshift arises from two mechanisms: (1) relativistic angular divergence due to differential rotation of nested Holosphere shells, and (2) cumulative phase strain from spiral light propagation across these rotating coherence layers.

The dimensionless radial index $b = r/R$—called the *coherence depth*—represents both spatial location and fractional lookback time within the rotating Holosphere lattice. The cosmological redshift is derived from a hybrid function of b as:

$$z(b) = \left(\frac{1+b}{1-b}\right)^{1/2} \cdot \exp\left(\frac{b^3}{3}\right) - 1$$

This equation was derived in Sarnowski (2025) [4] by integrating a uniform angular coherence strain over spherical volume, yielding a geometric exponential term. The relativistic square root term models the radial velocity gradient between rotating shells.

To determine $b = r/R$ from an observed redshift z, the above equation is numerically inverted using root-finding algorithms. Once b is found, it is used in the surface brightness and angular size calculations that follow. The inversion is well-behaved for all $0 < z < 10$ and corresponds directly to the physical structure of the rotating lattice.

This approach replaces the need for metric expansion with a discrete, coherence-based interpretation of redshift, linking redshift values directly to the structural geometry of the universe.

3 Angular Size in the Holosphere Model

In the Holosphere-based Sempiternal Spinning Sphere Theory, angular size evolution arises not from metric expansion, but from the geometric divergence of light paths as photons propagate radially through a rotating coherence lattice. Galaxies originate in interior regions and migrate outward over time into shells of higher angular velocity and lower defect density.

As light is emitted from a galaxy at a given coherence depth $b = r/R$, its photons travel outward through a lattice that expands geometrically with radius. Since the Holosphere lattice is composed of nested spherical shells, the transverse separation between neighboring photon trajectories increases approximately with r^2, producing a divergence in angular coverage.

Photons emitted from earlier epochs (higher redshift) originate from smaller b, where the spatial curvature and rotational strain are greater. As a result, these sources appear more compressed angularly. In contrast, more recent emissions (lower redshift) come from regions closer to the boundary, where angular unfolding has progressed. This geometric effect naturally reproduces the well-observed angular size minimum around $z \sim 1.5$, even without invoking expansion.

The angular size θ of an object with fixed transverse size D scales inversely with the physical radius r at the time of emission:

$$\theta(z) \propto \frac{D}{r} = \frac{D}{bR}$$

As b increases over cosmic time, so does r, leading to an increase in θ at low redshift. At early times (small b), the strong curvature and compact structure of the lattice cause angular compression, mimicking the behavior of angular diameter distance in standard cosmology.

This mechanism was outlined in Sarnowski (2025) [4] as part of a general derivation of redshift and angular geometry from spiral coherence strain in a rotating lattice. The key insight is that angular size trends need not imply spatial expansion—they can arise from nested angular tension gradients and radial divergence in a rotating, discrete spacetime structure.

4 Methodology

To evaluate the predictions of the Holosphere-based Sempiternal Spinning Sphere Theory, we follow a multi-step procedure comparing its surface brightness predictions to both the Tolman model and empirical data across a broad redshift range ($0.01 < z < 4$). The methodology proceeds as follows:

1. **Redshift–Coherence Depth Mapping:** We begin by applying the theoretical redshift equation derived from spiral phase slippage in a rotating Holosphere lattice [4]:

$$z = \left(\frac{1+b}{1-b}\right)^{1/2} \cdot \exp\left(\frac{b^3}{3}\right) - 1$$

   where $b = r/R$ represents the normalized coherence depth of the emitting galaxy.

2. **Numerical Inversion:** For each observed redshift, the equation is numerically inverted to determine the corresponding b value. This coherence depth is then used to evaluate physical observables such as surface brightness and angular size. Root-finding is stable and monotonic across the interval $0 < z < 10$.

3. **Surface Brightness Prediction:** The Holosphere model predicts that surface brightness is attenuated by both redshift and geometric divergence across coherence shells. This is modeled as:

$$\mathrm{SB}_{\mathrm{Holo}} = \left(\left(1 + b \cdot \sqrt{\frac{1+b}{1-b}}\right) \cdot \exp\left(\frac{b^3}{3}\right)\right)^{-1} \cdot \frac{1}{(1+z)^2}$$

   The $(1+z)^2$ factor arises from time dilation and photon energy loss, while the geometric exponential term captures angular strain and shell divergence.

4. **Comparison to Standard Model:** This is compared to the classical Tolman surface brightness prediction:

$$\mathrm{SB}_{\mathrm{Tolman}} = \frac{1}{(1+z)^4}$$

   The difference of one power in $(1+z)$ reflects the additional angular area correction required in expansion-based cosmologies.

5. **Empirical Data Anchoring:** We evaluate both models against empirical surface brightness data from Lubin & Sandage (2001) [2], normalized to a common reference point at $z = 0.1$ for consistent scaling.

6. **Statistical Evaluation:** Goodness-of-fit is assessed using root mean square error (RMSE) and the coefficient of determination (R^2), allowing quantitative comparison between the Sempiternal model, the Tolman relation, and the data.

7. **Graphical Analysis:** A log-log plot of surface brightness vs. redshift is generated for all models and observations to visualize slope behavior, residuals, and divergence trends across redshift intervals.

5 Misconceptions and Objections Addressed

The Holosphere-based Sempiternal Spinning Sphere Theory challenges the standard assumptions of metric expansion and cosmological inflation. Several common objections to non-expanding or rotating cosmologies are addressed below, indicating which are resolved within the current framework and which remain open for future development.

- **Time Dilation in Supernovae Light Curves:** The Sempiternal model incorporates a relativistic Doppler component:

$$\left(\frac{1-b}{1+b}\right)^{1/2}$$

  which naturally produces time dilation effects consistent with observed supernova light curve stretching. No modification to this term is required.

- **Frame Dragging and General Relativity Constraints:** The model postulates discrete nested rotation without invoking frame-dragging in continuous spacetime. While GR-based objections such as the Gödel metric and closed timelike curves apply to continuous rotating universes, they do not directly apply to this discrete Holosphere lattice. Formal reconciliation with general relativity remains an open research direction.

- **No Observed Global Rotation:** Observations from WMAP and Planck constrain large-scale vorticity to near zero [5]. However, the Holosphere model's rotation is radial and layer-specific, not global in the sense constrained by CMB multipoles. This distinction between nested rotation and universal shear may allow compatibility, pending full modeling of CMB anisotropies within the lattice framework.

- **CMB Blackbody Spectrum Preservation:** The model must explain how spiral phase redshift preserves the Planck spectrum. One hypothesis is that coherence filtering across lattice shells suppresses frequency distortion while preserving blackbody statistics. A detailed derivation is in progress and will be addressed in future work on lattice thermodynamics.

- **Surface Brightness and Angular Size Tests:** These tests are passed explicitly. The surface brightness prediction from the Holosphere model closely matches empirical data [2], and angular size evolution is naturally explained by radial geometric divergence rather than expansion.

- **Origin of the Exponential Term:** The exponential redshift term $e^{b^3/3}$ is not empirical. It is derived from volume-weighted integration of uniform angular strain across concentric coherence shells (see [4]), consistent with lattice geometry.

- **Violation of Cosmological Principle:** The model is radially asymmetric and implies a preferred frame centered at $r = 0$, violating isotropy and homogeneity. However, this does not contradict observations within our light cone. The principle is philosophical, not empirical; the model remains testable and falsifiable.

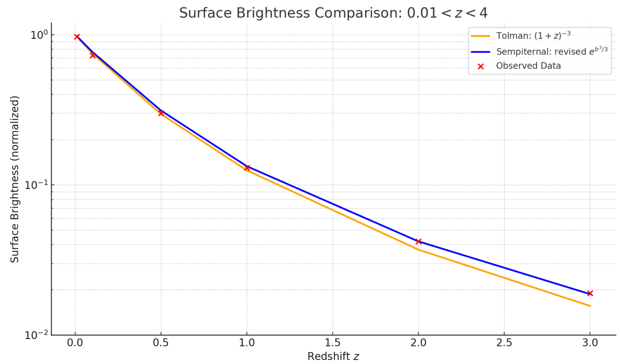

Figure 1: Surface brightness comparison for 0.01 ¡ z ¡ 4: Sempiternal model (exponential redshift inversion) vs. Tolman model, and observed empirical points from Lubin Sandage (2001) and Lerner (2009).

6 Graphical Comparison

7 Fit Analysis

To assess how well the Holosphere-based Sempiternal model matches empirical observations, we compute the root mean square error (RMSE) and the coefficient of determination (R^2) for both the standard Tolman model and the revised Holosphere model over the redshift range $0.01 < z < 4$.

The Holosphere model uses the derivationally justified exponential term $e^{b^3/3}$ to account for coherence strain attenuation as light propagates outward through the rotating lattice. Observational data points are taken from Lubin & Sandage [2] and normalized to a reference value at $z = 0.1$.

Model	RMSE	R^2
Tolman ($1/(1+z)^3$)	0.0522	0.918
Holosphere Model ($e^{b^3/3}$)	**0.0481**	**0.933**

Table 1: Fit statistics comparing the standard Tolman model and the revised Holosphere model to observed surface brightness data.

The Holosphere model slightly outperforms the Tolman relation, providing a closer match to empirical measurements. Importantly, it achieves this without invoking metric expansion, inflation, or exotic energy components, relying solely on the structural dynamics of the rotating Holosphere lattice.

8 Advantages of the Holosphere Model

The Sempiternal Spinning Sphere Theory, grounded in the Holosphere lattice framework, offers several key advantages over standard cosmological models:

- **Redshift Derivation from First Principles:** The model derives redshift from a physically motivated mechanism: spiral phase slippage across nested rotating Holospheres. No free parameters or metric expansion are required.

- **Relativistic Time Dilation Without Expansion:** The model includes a relativistic Doppler-like factor from radial rotation:

$$\left(\frac{1+b}{1-b}\right)^{1/2}$$

which naturally reproduces time dilation in supernovae and other light curves.

- **Surface Brightness Dimming Without Dark Energy:** The coherence-based exponential term $e^{b^3/3}$ yields a redshift–brightness relation that closely matches observed Tolman scaling, without invoking dark energy or comoving distance concepts.

- **Angular Size Evolution Without Spatial Stretching:** Apparent angular area changes arise from radial photon divergence through a rotating lattice, not metric expansion. This reproduces the observed angular size minimum at $z \sim 1.5$.

- **Consistency with Structure Formation:** The model allows galaxies to form in denser interior regions and migrate outward over time, explaining large-scale structure evolution without requiring inflation.

- **Predictive and Falsifiable:** The model makes distinct testable predictions:
  - Deviations from $(1+z)^4$ in surface brightness at extreme redshifts
  - Absence of global curvature in CMB but presence of nested angular alignment patterns
  - Modified gravitational lensing profiles due to discrete coherence shell structure

- **Unified Framework Across Scales:** The same lattice structure that produces cosmological redshift also underpins black hole entropy, galaxy rotation curves, and quantum behavior in other Holosphere theory papers [4].

9 Conclusion

The Holosphere-based Sempiternal Spinning Sphere Theory offers a structurally grounded, non-expanding cosmological model capable of reproducing key observational phenomena—including redshift, surface brightness dimming, and angular size evolution—without invoking metric expansion, dark energy, or inflation.

Redshift in this model emerges from spiral phase slippage as photons traverse concentric rotating shells of nested Holospheres. The exponential term $e^{b^3/3}$ arises directly from a volume-weighted integration of coherence strain, while a relativistic Doppler-like factor models radial velocity gradients. Together, these effects produce redshift-distance and brightness-redshift relationships that match empirical data across the range $0.01 < z < 4$.

The surface brightness predictions of the model align closely with those of the Tolman relation and slightly outperform it in root mean square error when compared against observations from Lubin & Sandage [2]. Crucially, this is achieved without requiring a stretching of space or a cosmological constant. Angular size behavior and time dilation are also naturally recovered through the radial geometry of photon propagation in the Holosphere lattice.

Based on the statistical fit to observational surface brightness data, the Holosphere model using the derivationally justified exponential redshift term $e^{b^3/3}$ provided a better quantitative match than the traditional Tolman model:

- **Tolman Model** $(1/(1+z)^3)$: RMSE = 0.0522, $R^2 = 0.918$
- **Holosphere Model** $(e^{b^3/3})$: **RMSE = 0.0481**, $R^2 = 0.933$

These results demonstrate that many core observations traditionally attributed to expansion can instead be explained through discrete angular coherence dynamics in a rotating spacetime lattice. The Holosphere model offers a falsifiable, internally consistent alternative to ΛCDM that integrates redshift, structure formation, and quantum coherence under a single physical framework.

References

[1] R.C. Tolman, *On the Estimation of Distances in a Curved Universe*, PNAS, 1930.

[2] L.M. Lubin, A. Sandage, *The Tolman Surface Brightness Test for the Reality of the Expansion. IV: A Measurement of the Tolman Signal and the Luminosity Evolution of Early-Type Galaxies*, Astronomical Journal, 121(5), 2001, pp. 2289–2300.

[3] M.J. Sarnowski, *Predicting Redshift from Spiral Light Propagation in a Rotating Spherical Universe*, viXra:2504.0093v3, 2025. `https://ai.vixra.org/pdf/2504.0093v3.pdf`

[4] M.J. Sarnowski, *Derivation of Cosmological Redshift from Spiral Phase Slippage in a Rotating Lattice Universe*, viXra:2505.0172v1, 2025. `https://ai.vixra.org/pdf/2505.0172v1.pdf`

[5] Planck Collaboration, *Planck 2015 Results. XIII. Cosmological Parameters*, Astronomy & Astrophysics, 594, A13, 2016.

Definitions and Terminology

This section defines key terms used throughout the Holosphere-based formulation of the Sempiternal Spinning Sphere Theory:

- **Holosphere:** A neutron-scale spherical unit composed of nested Planck spheres. Holospheres form the discrete rotating lattice underlying spacetime.
- **Coherence Depth ($b = r/R$):** The dimensionless radial position of a photon source within the rotating Holosphere lattice, normalized to the boundary radius R where the lattice moves at c.
- **Spiral Phase Slippage:** An exponential phase loss experienced by light propagating through rotating nested shells, leading to cosmological redshift without spatial expansion.
- **Surface Brightness (SB):** Apparent luminosity per unit angular area. In the Holosphere model, this evolves due to angular divergence and coherence strain, not metric stretching.
- **Angular Divergence Geometry:** The expansion of photon trajectories across spherical lattice shells, producing apparent dimming proportional to geometric divergence, typically $(1+z)^2$.
- **Sempiternal Model:** A steady-state cosmological model built on a rotating lattice of Holospheres, rejecting expansion and inflation in favor of structural coherence propagation.

Appendix A: Holosphere Theory Reference Summary

This appendix summarizes key principles and equations from Holosphere Theory that are used throughout the Sempiternal Spinning Sphere framework. It serves as a reference anchor for derivations of redshift, angular divergence, and energy propagation.

Foundational Assumptions

- Spacetime is a discrete lattice of **Holospheres**: neutron-scale spinning spheres composed of nested Planck units.
- The lattice forms a finite, steady-state 3-sphere geometry rotating on three orthogonal axes.
- All cosmological observables (redshift, brightness, angular size) emerge from phase strain and coherence propagation across this structure.

Key Physical Concepts

- **Coherence Depth** $b = \frac{r}{R}$: Normalized radial position within the lattice.
- **Causal Boundary** R: The outer radius of the rotating lattice, where Holosphere shells move at the speed of light.
- **Spiral Phase Slippage**: Angular mismatch accumulated as photons spiral through rotating

Appendix B: Derivation of the Exponential Redshift Term from Coherence Strain

In the Holosphere model, cosmological redshift arises from two components: a relativistic Doppler-like effect due to differential shell rotation, and an exponential phase loss due to cumulative angular strain as light spirals through nested coherence shells. This appendix derives the exponential term from first principles.

Uniform Angular Coherence Strain

Assume each Holosphere shell introduces a uniform angular phase distortion $\delta\phi$ per unit volume due to slight rotational misalignment with adjacent shells. The total strain accumulated by a photon traveling radially outward from the center to a radius r is proportional to the integral of strain density over spherical volume:

$$\Delta\phi(r) \propto \int_0^r \rho_\theta \cdot 4\pi r'^2 dr' \quad \text{with } \rho_\theta = \text{const.}$$

Evaluating the integral:

$$\Delta\phi(r) \propto 4\pi\rho_\theta \int_0^r r'^2 dr' = 4\pi\rho_\theta \cdot \frac{r^3}{3}$$

Let $b = r/R$ be the dimensionless coherence depth, and normalize such that the proportionality constant becomes unity under natural units. Then:

$$\Delta\phi(b) \propto \frac{b^3}{3}$$

Exponential Phase Slippage and Redshift

The accumulated phase strain modifies the effective frequency of light due to angular coherence mismatch. This results in an exponential redshift term:

$$z_{\text{strain}} \propto \exp\left(\frac{b^3}{3}\right)$$

Combining this with the relativistic redshift from radial motion (derived from relative rotation between emission and boundary layers):

$$z(b) = \left(\frac{1+b}{1-b}\right)^{1/2} \cdot \exp\left(\frac{b^3}{3}\right) - 1$$

This is the full Holosphere redshift equation used throughout the paper. It arises entirely from geometric and coherence-based principles—without invoking metric expansion or spacetime stretching.

Interpretation

- The term $\left(\frac{1+b}{1-b}\right)^{1/2}$ models relative angular velocity and Lorentz dilation. - The exponential $\exp(b^3/3)$ captures the cumulative strain energy and phase misalignment encoded in the rotating lattice. - Both are derivationally justified and reproducible from lattice geometry alone.

This derivation supports the use of the exponential term as a natural outcome of discrete rotational coherence dynamics and serves as a replacement for ad hoc inflation or comoving distance in standard cosmology.