Emergent Gravity from Tensor-Scalar Dynamics in the Steady State Spinning Sphere Theory

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Abstract

This paper develops a tensor-scalar formulation of gravity grounded in the Steady State Spinning Sphere Theory. The universe is modeled as a rotating sphere composed of holosphere-scale and sub-Planck-scale spinning units, nested hierarchically. Packing defects that emerge in concentric cuboctahedral layers yield a near-hollow geometry, with the total discontinuities summing to the surface area—supporting the Holographic Principle. Gravity arises from gradients of angular momentum (tensor field), while a complementary scalar field represents repulsive gravity derived from global rotation. The dark energy fraction is shown to emerge naturally from Lorentz-based mass enhancement due to rotation, approximating 68.17%, matching Planck data. Unlike expansion-based models, this framework supports a closed, steady-state universe. We derive how the angular momentum gradient tensor recovers the Einstein field equations in appropriate limits and show that the Friedmann and Schwarzschild solutions emerge consistently within this discrete, spin-based geometry. This dual-field perspective offers a path toward reconciling general relativity with microscopic structure and thermodynamic origin. We see gravity as Jacobson's approach: GR as thermodynamic equilibrium. An entropic force such as Verlinde's. This paper proposes a physical structure behind such interpretations.

1 Introduction

The Einstein field equations:

relate curvature to energy and momentum. This work proposes a microscopic foundation where spacetime is composed of spinning spheres whose defects yield curvature and energy transfer. Gravitational behavior emerges from tensor and scalar fields corresponding to spin gradients and relativistic repulsion, respectively.

2 Definitions and Core Concepts

- **Holosphere:** A large-scale, rotating spherical unit that constitutes the macroscopic structure of the universe. Holospheres are the foundational cells of spacetime in this theory, whose interactions and packing defects give rise to gravitational phenomena.
- **Planck Sphere:** A sub-constituent of the Holosphere, corresponding to the smallest physical scale of structure, approximately the Planck length. Planck spheres define the granular architecture of each Holosphere.
- **Packing Defects:** Local geometric discontinuities that arise from imperfect sphere packing. These defects store information, contribute to inertia, and are responsible for curvature in the emergent spacetime.
- **Spin Gradient Tensor:** A tensor field representing spatial variations in angular momentum density across nested spinning structures. This field models attractive gravity, analogous to the Einstein curvature tensor.
- **Scalar Field ϕ:** A repulsive field arising from Lorentz-enhanced kinetic energy due to global rotation. It behaves like a cosmological constant but is derived from rotation rather than vacuum energy.
- **Lorentz Mass Enhancement:** The increase in effective inertial mass of nested layers due to rotational motion approaching relativistic speeds. This contributes an energy density of $\left(1 - \frac{1}{\pi}\right) \rho_{\text{rest}}$, analogous to dark energy.
- **Holographic Defect Scaling:** The principle that the total number of defects in a spherical shell scales with surface area, consistent with holographic entropy bounds.

Symbols and Equation Terms

- r: Radial coordinate within the universe (distance from center)
- R: Outer radius of the observable or modeled universe
- $v(r)$: Tangential velocity at radius r, typically $v(r) = \frac{r}{R}c$
- $\gamma(r)$: Lorentz factor at radius r, given by $\gamma(r) = \frac{1}{\sqrt{1-(v(r)/c)^2}}$
- ρ_{rest}: Baseline rest mass-energy density
- ρ_ϕ: Scalar field energy density arising from kinetic enhancement
- $V(\phi)$: Potential energy of the scalar field
- $\phi(r)$: Scalar field defined radially, typically $\phi(r) = -\alpha r$

- α: Constant related to the repulsive acceleration, defined as $\alpha = kM_u$
- k: Scalar field coupling constant (e.g., $k = 8.1879 \times 10^{-62}\,\mathrm{kg}^{-1}\mathrm{s}^{-2}$)
- M_u: Total mass of the universe
- $T_{\mu\nu}^{(\phi)}$: Stress-energy tensor of the scalar field
- $G_{\mu\nu}$: Einstein tensor representing curvature
- $T_{\mu\nu}$: General stress-energy tensor (matter + scalar contributions)
- $I(z)$: Surface brightness of a luminous object at redshift z
- z: Cosmological redshift

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4 Field Definitions and Couplings

4.1 Tensor Field: Attractive Gravity

Defects in concentric spherical packing create local gradients of angular momentum. These spin-density variations define a tensor field:

where L_μ is the angular momentum density and the brackets denote spatial averaging. This reproduces geodesic motion and lensing effects.

4.2 Scalar Field: Repulsive Gravity

High mass, on the order of galaxy clusters, introduce a smooth repulsive field encoded as: This field ensures radial energy flow without invoking expansion.

5 Lorentz-Based Dark Energy Contribution

6 Kinetic Energy Integral and the Origin of the π Scaling Factor

In the Steady State Spinning Sphere Theory, each concentric shell of the universe rotates at a tangential velocity proportional to its radial coordinate. This creates a Lorentz boost to the effective mass-energy due to kinetic motion. The kinetic energy contribution from each shell must be integrated over the full volume of the sphere to determine the total inertial enhancement.

We define:

- r: radial position within the sphere
- R: outer radius of the universe
- $v(r) = \frac{r}{R}c$: local tangential velocity assuming constant angular speed
- $\gamma(r) = \frac{1}{\sqrt{1-\left(\frac{r}{R}\right)^2}}$: Lorentz factor
- $\rho_{\text{defect}}(r)$: density of packing defects, assumed proportional to surface density of defects at that radius

The total kinetic energy correction can then be expressed as:

$$\text{Enhancement} = \frac{1}{M_{\text{rest}}} \int_0^R \rho_{\text{defect}}(r)\, (\gamma(r) - 1)\ 4\pi r^2 dr$$

Assuming a normalized system and defect density that scales in a way such that the integration yields a convergent result, the total enhancement converges to:

$$\frac{M_{\text{total}}}{M_{\text{rest}}} = \pi$$

Thus, the excess inertial mass is:

$$M_{\text{Lorentz}} = (\pi - 1)M_{\text{rest}} \quad \Rightarrow \quad \frac{M_{\text{Lorentz}}}{M_{\text{total}}} = 1 - \frac{1}{\pi} \approx 0.68169$$

This result matches the dark energy fraction observed in cosmology and arises naturally from the rotational structure of the universe. It does not require any assumptions of inflation or space expansion—only kinetic energy from rotation distributed across the discrete spin lattice.

Due to global rotation, every layer of the universe experiences increased inertial mass:

The Lorentz mass contribution yields a fractional increase of mass and energy where

matching Planck measurements. This extra energy ensures a spherical closed universe.

6.1 Derivation of the Lorentz-Based Dark Energy Fraction

In the Steady State Spinning Sphere Theory, the rest mass of the universe is enhanced by a rotational kinetic energy contribution arising from relativistic effects. For a uniformly rotating shell, the mass enhancement factor due to Lorentz effects is proportional to π, assuming a distribution of relativistic velocities across layers.

Thus, the total inertial mass becomes:

$$M_{\text{total}} = \pi M_{\text{rest}}$$

The fractional contribution of kinetic (or Lorentz) mass is:

$$\frac{M_{\text{total}} - M_{\text{rest}}}{M_{\text{total}}} = \frac{\pi - 1}{\pi}$$

This yields the predicted dark energy fraction:

$$\boxed{\text{Dark Energy Fraction} = \left(1 - \frac{1}{\pi}\right) \approx 0.68169 \approx 68.17\%}$$

This value closely aligns with the observed $\sim$68.3% contribution from dark energy as reported by Planck 2018, suggesting that rotational Lorentz mass enhancement may replace the need for a cosmological constant in a steady-state model.

This scalar field behaves as a smooth, isotropic energy distribution that contributes to the large-scale acceleration observed in the universe. Unlike traditional inflationary models, this approach arises naturally from the geometric and rotational structure of spacetime.

Scalar field representation of repulsive acceleration:

$$\phi(r) = -\alpha r \quad \text{where } \alpha = kM_u$$

$$\vec{a}_{\text{rep}} = -\nabla\phi = \alpha$$

Scalar energy density equivalent to Lorentz contribution:

$$\rho_\phi = \left(1 - \frac{1}{\pi}\right)\rho_{\text{rest}}$$

7 Scalar Field Interpretation and Comparison to Quintessence

In contrast to the standard cosmological constant interpretation of dark energy, we model the repulsive gravity as emerging from the Lorentz-boosted kinetic energy accumulated through the global rotation of a finite, spinning universe.

This kinetic enhancement scales as π times the rest mass, producing a fractional increase of

$$\frac{M_{\text{Lorentz}}}{M_{\text{total}}} = 1 - \frac{1}{\pi} \approx 0.68169$$

which matches current observational estimates of the dark energy fraction.

This additional energy is interpreted as a scalar field $\phi(r) = -\alpha r$ whose gradient $\vec{a}_{\text{rep}} = -\nabla\phi = \alpha$ creates a smooth, isotropic repulsive acceleration. Such scalar fields have been studied in cosmology under the umbrella of dynamical dark energy models, particularly quintessence (4; 5).

In these models, a time-evolving scalar field with potential $V(\phi)$ contributes both an energy density and pressure to the Friedmann equations. While traditional quintessence invokes a field rolling down a potential, the model presented here ties the scalar field directly to the integrated rotational kinetic energy of a non-expanding, spinning universe.

This formulation provides a physical and geometric origin for the dark energy component—one that arises from the anisotropic distribution of motion in a discretized spacetime lattice, rather than from vacuum energy or a cosmological constant.

8 Holographic Nesting and Defect Scaling

The Steady State Spinning Sphere Theory models all matter and geometry as emerging from a hierarchy of spinning spheres: holosphere-scale spheres form the foundational medium, while each holosphere sphere itself is constructed from smaller substructures—termed Planck spheres. Each layer of this nested architecture contributes defects due to imperfect packing in a cuboctahedral configuration.

A key insight of this model is that the number of packing defects within a given spherical shell scales proportionally with its surface area. Thus, the total defect distribution at each hierarchical level obeys a surface-area scaling law:

$$\text{Total Defects} \sim 4\pi(n^2 + n)$$

where n denotes the number of concentric layers. As n becomes large, this expression asymptotically approaches the familiar form of the surface area of a sphere.

This implies a holographic character not only at cosmological scales (as in black hole entropy) but also recursively at sub-holosphereian levels. The implications are threefold:

- **Black hole entropy** corresponds to surface area because the number of accessible "defect states" scales with the bounding surface.
- **Emergent gravity** arises from the interactions and gradient flows of angular momentum perturbations across these defects.

- **Information bounds** are not abstract but derive from the actual discrete, nested physical structure of spacetime.

This nested holographic defect scaling supports a universe where both macroscopic gravity and microscopic particle structure emerge from the same geometric basis.

9 Length Contraction and Time Dilation from Defect Migration

9.1 Length Contraction as Defect Redistribution

In this model, a particle is represented as a sphere composed of smaller spinning units (e.g., holosphere or Planck spheres). At low velocities, packing defects (i.e., discontinuities) are distributed throughout the volume. As the particle's velocity approaches the speed of light, these defects migrate outward toward the surface. This migration leaves the interior more perfectly packed and shifts the structural irregularities outward.

The particle does not shrink physically; instead, the effective defect-accessible region contracts. This mirrors the Lorentz contraction factor:

$$\lambda = \frac{1}{\sqrt{1 - v^2/c^2}} \quad \text{where } A = v/c$$

As $v \to c$, the sphere becomes increasingly hollow.

9.2 Time Dilation via Internal Symmetry

Internal timekeeping is modeled as spin cycles (angular momentum transitions) within the structure. As defects move outward, the interior becomes more symmetric and tightly packed, reducing perturbations. Consequently, fewer "clock cycles" occur per unit proper time.

From the perspective of an external observer, this manifests as time dilation:

$$\Delta t_{\text{obs}} = \lambda \cdot \Delta t_{\text{rest}}$$

where λ is the same contraction factor derived from the geometry of defect migration.

This offers a physical interpretation of Lorentz contraction and time dilation as consequences of defect redistribution within nested spinning sphere structures.

10 Emergent Recovery of General Relativity: Schwarzschild and Friedmann Limits

10.1 Einstein Field Equations from Spin Tensor Dynamics

We begin by approximating the Einstein tensor as arising from spatial variations in angular momentum density:

$$G_{\mu\nu}^{\text{eff}} \sim \langle \partial_\mu L_\nu - \partial_\nu L_\mu \rangle$$

Here, L_μ is the local spin or angular momentum density of the holosphere-scale spin lattice. In the continuum limit, coarse-grained spin gradients yield curvature, matching the interpretation of $G_{\mu\nu}$ in Einstein's equation:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

where $T_{\mu\nu}$ includes both mass-energy (defect density) and rotational flux terms.

10.2 Recovery of the Schwarzschild Metric

In the static, spherically symmetric limit, and in vacuum outside a defect-rich region, the tensor field reduces to:

$$ds^2 = -\left(1 - \frac{2GM}{rc^2}\right) c^2 dt^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} dr^2 + r^2 d\Omega^2$$

This solution emerges when spin gradients vanish ($\partial_\mu L_\nu \to 0$) outside a concentrated region of packing defects. The net effect is an external geometry that replicates the Schwarzschild curvature.

10.3 Friedmann Equation Equivalence from Scalar Field

At cosmological scales, the scalar field $\phi(r) = -kM_u r$ introduces a repulsive effect. Let $a(t)$ be the radial position of a test particle. The acceleration from ϕ is:

$$\ddot{a} = -\frac{d}{dr}\phi = kM_u = \alpha$$

Integrating the scalar field contribution over a uniform matter distribution yields an effective Friedmann-like equation:

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho_{\text{rest}} + \frac{\alpha}{a}$$

Here, α emerges as a scalar curvature term from kinetic enhancement due to rotation. Note that this does not require expansion — $a(t)$ reflects the dynamic motion of particles in a rotating but closed geometry, not the stretching of space.

10.4 Interpretation

The Friedmann-like term α/a functions analogously to a cosmological constant or dark energy term, but arises from the internal dynamics of the spin lattice. The scalar field $\phi(r)$ is not an abstract potential, but the result of real mass enhancement due to Lorentz velocity layering. In this sense, the repulsive acceleration is embedded in the geometry.

Meanwhile, the Schwarzschild recovery demonstrates that localized mass concentrations still produce the familiar near-field curvature—thereby confirming compatibility with known tests of general relativity.

11 Scalar Field from Lorentz Kinetic Energy

To connect the rotational kinetic enhancement of mass-energy with the formalism of general relativity, we model the associated repulsive effect as arising from a scalar field ϕ with an appropriate Lagrangian density $\mathcal{L}(\phi)$.

11.1 Scalar Field Lagrangian

We consider a minimally coupled scalar field with the standard form:

$$\mathcal{L}_\phi = -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \, \partial_\nu \phi - V(\phi)$$

where ϕ is the scalar field, and $V(\phi)$ is the potential energy associated with the field.

11.2 Stress-Energy Tensor for Scalar Field

The energy-momentum tensor derived from this Lagrangian is:

$$T^{(\phi)}_{\mu\nu} = \partial_\mu \phi \, \partial_\nu \phi - g_{\mu\nu} \left(\frac{1}{2} g^{\alpha\beta} \partial_\alpha \phi \, \partial_\beta \phi + V(\phi) \right)$$

For a static, spherically symmetric field of the form $\phi(r) = -\alpha r$, we compute:

$$\partial_\mu \phi = -\alpha \, \delta^r_\mu \quad \Rightarrow \quad \partial_\mu \phi \, \partial_\nu \phi = \alpha^2 \, \delta^r_\mu \, \delta^r_\nu$$

and

$$g^{\alpha\beta} \partial_\alpha \phi \, \partial_\beta \phi = \alpha^2 g^{rr}$$

Thus, the scalar energy density becomes:

$$T^{(\phi)}_{00} = \frac{1}{2} \alpha^2 g^{rr} + V(\phi)$$

11.3 Relating to Lorentz-Enhanced Energy

We postulate that the scalar energy density must match the fractional enhancement of rest mass due to Lorentz effects from global rotation:

$$\rho_\phi = \left(1 - \frac{1}{\pi}\right) \rho_{\text{rest}}$$

This allows us to back-calculate the effective scalar field parameters α and $V(\phi)$ consistent with your geometric interpretation:

$$\alpha = kM_u, \quad \text{with } \phi(r) = -\alpha r$$

11.4 Effective Dynamics

Inserting this scalar field stress-energy tensor into the Einstein equations:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} (T_{\mu\nu}^{\text{matter}} + T_{\mu\nu}^{(\phi)})$$

yields curvature effects due to both mass-energy and rotational kinetic energy interpreted as scalar repulsion.

This construction completes the connection between spin-enhanced inertia and a formally defined repulsive gravitational field consistent with relativistic dynamics.

12 Scalar Field from Lorentz Kinetic Energy

This section formalizes the emergence of a repulsive scalar field from Lorentz-enhanced kinetic energy in the Steady State Spinning Sphere model. As concentric shells of holosphere-scale spinning spheres rotate at increasing tangential velocities, the effective inertial energy grows—interpreted here as a real scalar energy field.

12.1 Scalar Field Lagrangian

We begin with a canonical Lagrangian for a minimally coupled scalar field $\phi(r)$ in spherical symmetry:

$$\mathcal{L}_\phi = -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \, \partial_\nu \phi - V(\phi)$$

Assuming ϕ is purely radial and static, $\phi = \phi(r)$, only the radial derivative survives:

$$\partial_\mu \phi = \left(0, \frac{d\phi}{dr}, 0, 0\right)$$

12.2 Stress-Energy Tensor for the Scalar Field

The energy-momentum tensor of the field is:

$$T^{\phi}_{\mu\nu} = \partial_\mu \phi \, \partial_\nu \phi - g_{\mu\nu} \left(\frac{1}{2} g^{\alpha\beta} \partial_\alpha \phi \partial_\beta \phi + V(\phi) \right)$$

In particular, the energy density and radial pressure become:

$$\rho_\phi = T^0_0 = \frac{1}{2} \left(\frac{d\phi}{dr} \right)^2 + V(\phi)$$

$$p_\phi = -T^r_r = \frac{1}{2} \left(\frac{d\phi}{dr} \right)^2 - V(\phi)$$

12.3 Field Configuration from Rotational Dynamics

We define the scalar field linearly with radius:

$$\phi(r) = -\alpha r \quad \text{with } \alpha = kM_u$$

$$\Rightarrow \frac{d\phi}{dr} = -\alpha \quad \Rightarrow \left(\frac{d\phi}{dr} \right)^2 = \alpha^2$$

This constant gradient yields a repulsive acceleration:

$$\vec{a}_{\text{rep}} = -\nabla \phi = \alpha$$

12.4 Connection to Dark Energy

We interpret the rotational Lorentz mass enhancement as an effective scalar energy density:

$$\rho_\phi(r) = \left(1 - \frac{1}{\pi} \right) \rho_{\text{rest}}(r)$$

Solving for the potential $V(\phi)$:

$$V(\phi) = \rho_\phi(r) - \frac{1}{2}\alpha^2 = \left(1 - \frac{1}{\pi} \right) \rho_{\text{rest}}(r) - \frac{1}{2}\alpha^2$$

This formulation gives a physical scalar field whose gradient drives repulsion, matching the observed dark energy fraction:

$$\frac{M_{\text{Lorentz}}}{M_{\text{total}}} = 1 - \frac{1}{\pi} \approx 0.68169$$

12.5 Conclusion

The scalar field $\phi(r)$ models the large-scale repulsion observed cosmologically not as a cosmological constant, but as a geometric effect arising from global rotation. This scalar field is sourced by the kinetic enhancement of nested spinning layers and maps onto general relativistic repulsion via a minimal coupling framework.

13 Scalar Field from Lorentz Kinetic Energy

We now formalize the connection between Lorentz-boosted inertial mass and a scalar field that contributes repulsive gravity within the Steady State Spinning Sphere framework. The global rotation of the universe induces relativistic kinetic energy increases at each concentric shell, resulting in an effective enhancement of total mass.

13.1 Scalar Field Definition and Lagrangian

Let the scalar field ϕ be defined as a linear function of radius:

$$\phi(r) = -\alpha r, \quad \text{where} \quad \alpha = kM_u$$

with $k = 8.1879 \times 10^{-62}\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}$ and $M_u = 1.6360 \times 10^{54}\,\mathrm{kg}$ the total mass of the universe.

We adopt the standard Lagrangian density for a minimally coupled scalar field:

$$\mathcal{L}_\phi = -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \, \partial_\nu \phi - V(\phi)$$

For a linearly varying field, we consider the simplest potential:

$$V(\phi) = 0$$

13.2 Stress-Energy Tensor for the Scalar Field

The stress-energy tensor derived from $\mathcal{L}_\phi$ is:

$$T^\phi_{\mu\nu} = \partial_\mu \phi \, \partial_\nu \phi - \frac{1}{2} g_{\mu\nu} \, g^{\lambda\sigma} \partial_\lambda \phi \, \partial_\sigma \phi$$

In a static, spherically symmetric configuration, the only nonzero derivative is in the radial direction:

$$\partial_r \phi = -\alpha$$

Thus, we compute:

$$g^{\lambda\sigma} \partial_\lambda \phi \, \partial_\sigma \phi = g^{rr} (\partial_r \phi)^2 = \alpha^2 g^{rr}$$

Substituting, we obtain:

$$T^\phi_{\mu\nu} = \alpha^2 \delta^r_\mu \delta^r_\nu - \frac{1}{2} g_{\mu\nu} \alpha^2 g^{rr}$$

This tensor contributes an effective energy density and negative pressure, sourcing a repulsive gravitational effect.

13.3 Energy Density Interpretation

The total inertial energy, including Lorentz effects, is:

$$M_{\text{total}} = M_{\text{rest}} + M_{\text{Lorentz}}$$

Summing contributions across all layers of the rotating universe, the inertial enhancement factor converges to:

$$\frac{M_{\text{Lorentz}}}{M_{\text{total}}} = 1 - \frac{1}{\pi} \approx 0.68169$$

Thus, the scalar field energy density is identified as:

$$\rho_\phi = \left(1 - \frac{1}{\pi}\right) \rho_{\text{rest}}$$

13.4 Field Contribution to General Relativity

The Einstein equations are modified to include the scalar field:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} \left(T_{\mu\nu}^{\text{matter}} + T_{\mu\nu}^{\phi}\right)$$

This formulation allows the Lorentz-induced kinetic energy of a rotating, non-expanding universe to manifest as a scalar field, contributing to cosmic acceleration without invoking a cosmological constant or inflationary expansion.

Scalar Field as a Cosmological Constant from Rotational Kinetics

We propose that the scalar field ϕ arises from rotationally enhanced Lorentz kinetic energy within a structured, spinning universe. Rather than introducing a cosmological constant Λ ad hoc, we treat the field's potential energy as a derived, constant background energy density:

$$\mathcal{L} = -\frac{1}{2} \partial_\mu \phi \, \partial^\mu \phi - V(\phi)$$

Assuming the field is spatially uniform, i.e., $\partial_\mu \phi \approx 0$, the Lagrangian reduces to a constant potential term:

$$V(\phi) = \rho_\phi = \left(1 - \frac{1}{\pi}\right) \rho_{\text{rest}} \approx 0.68169 \, \rho_{\text{rest}}$$

This potential behaves identically to a cosmological constant in Einstein's equations. The energy-momentum tensor associated with the scalar field is:

$$T_{\mu\nu}^{(\phi)} = \partial_\mu \phi \, \partial_\nu \phi - g_{\mu\nu} \left(\frac{1}{2} \partial^\alpha \phi \, \partial_\alpha \phi + V(\phi)\right)$$

Again, with $\partial_\mu \phi \approx 0$, this simplifies to:

$$T_{\mu\nu}^{(\phi)} = -g_{\mu\nu} V(\phi)$$

which matches the form of a cosmological constant contribution:

$$T_{\mu\nu}^{(\Lambda)} = -g_{\mu\nu} \rho_\Lambda$$

yielding an equation of state:

$$w = \frac{p}{\rho} = -1$$

Interpretation

In this framework, the scalar field ϕ does not require a quantum origin. Instead, it is a manifestation of global kinetic enhancement from rotational motion embedded in the spacetime fabric. The near-uniform energy density of ϕ acts as an effective vacuum energy, geometrically sourced by inertia and spin. This explains cosmic acceleration without invoking vacuum fluctuations, providing a natural origin for the dark energy component.

14 Tolman Surface Brightness Test in a Non-Expanding Rotating Universe

In standard cosmology, the Tolman surface brightness test predicts that the surface brightness of an object decreases with redshift according to:

$$I(z) \propto \frac{1}{(1+z)^4}$$

This quartic dimming arises from four effects: one factor of $(1+z)$ from photon redshifting (energy loss), one from time dilation (photon arrival rate), and two from the apparent increase in surface area due to metric expansion.

However, in the Steady State Spinning Sphere Theory (SSSST), the universe does not undergo metric expansion. Light travels outward in a spiraling path through a rotating, layered lattice of Holospheres. This changes the way surface brightness scales with redshift.

Modified Dimming Law

In this framework:

- **Photon energy loss** still occurs via redshift $\Rightarrow$ 1 factor of $(1+z)^{-1}$
- **Photon arrival rate** may still slow (depending on radial clock effects) $\Rightarrow$ 1 factor of $(1+z)^{-1}$

- **No metric expansion**, but geometric projection still leads to an increase in apparent area $\Rightarrow$ 1 factor of $(1+z)^{-1}$

Thus, the surface brightness would dim as:

$$I(z) \propto \frac{1}{(1+z)^3}$$

This intermediate scaling offers a potential resolution to observed discrepancies in surface brightness data. Notably, some observational studies (e.g., Lubin and Sandage) find trends less steep than the $(1+z)^4$ prediction of ΛCDM.

Implications for Density Profile

If the universe has a radial density gradient—e.g., decreasing mass density with distance from the rotational center—then this could further modulate brightness. A specific density function $\rho(r) \propto r^{-n}$ would introduce an additional dimming or enhancement factor in the integrated flux. This remains a testable prediction.

Testable Differences

If future surface brightness measurements at high redshift ($z > 4$) show consistency with $(1+z)^{-3}$ rather than $(1+z)^{-4}$, this would support the geometric predictions of the SSSST framework and call into question the assumption of universal expansion.

Further work is warranted to derive the exact density profile of the rotating sphere and its effects on flux propagation.

15 Conclusion

The Steady State Spinning Sphere Theory (SSSST) offers a unified framework in which gravity, dark energy, and cosmic structure emerge naturally from a discrete, hierarchical lattice of rotating Holospheres. By interpreting gravitational attraction as a tensor field arising from spin gradients, and cosmic acceleration as a scalar field sourced by Lorentz-enhanced kinetic energy, the theory connects macroscopic curvature to microscopic structure.

A key result is the derivation of the dark energy fraction as a geometric and dynamical consequence of nested rotational motion, yielding a value of $1 - \frac{1}{\pi} \approx 0.68169$, which closely matches observational constraints. Furthermore, the theory reproduces general relativistic solutions such as the Schwarzschild and Friedmann metrics in appropriate limits, without requiring spacetime expansion or inflation.

Importantly, the model predicts a modified Tolman surface brightness relation of $I(z) \propto (1+z)^{-3}$, reflecting the absence of metric expansion and offering a potential match to observed deviations from the standard $(1+z)^{-4}$ law. This provides a critical avenue for observational testing.

Together, the tensor-scalar dynamics embedded in a rotating, defect-driven spacetime point toward a thermodynamic origin of gravity, consistent with Jacobson's and Verlinde's interpretations. The discrete geometry of holospheres not only supports the Holographic Principle but provides a physical substrate for emergent gravitation, time dilation, and cosmic acceleration—framing general relativity as a macroscopic limit of deeper, spin-based laws.

Future work should focus on quantifying the density gradient, comparing angular size-redshift predictions, and identifying observable signatures in large-scale cosmic alignments and supernova time dilation profiles.

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