Gravity from Discrete Spinning Spheres: Emergent Geometry and Thermodynamics

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Abstract

This paper proposes a granular model of spacetime wherein gravity and inertia emerge from quantized angular momentum transfer through a discrete, spinning medium composed of Planck-scale and sub-Planck-scale spheres. Within this framework—termed the Sempiternal Spinning Sphere Theory—the universe is modeled as a hierarchy of rotating spheres, where defects in cuboctahedral packing give rise to observable matter and forces. Gravitational effects are not attributed to curvature of a smooth manifold but to statistical gradients in spin perturbations propagating through the lattice.

The model reproduces key features of general relativity in the large-scale limit, including frame dragging and causal lightcones, while avoiding singularities and point-particle infinities. It integrates naturally with the Holographic Principle by showing that the sum of distributed packing defects equals the surface area of the bounding sphere, and provides a potential physical basis for Jacobson's and Verlinde's emergent gravity scenarios.

A proposed redshift equation incorporating both relativistic Doppler shift and a tired-light-like attenuation term is also introduced, which matches high-redshift galaxy data with minimal free parameters. This model suggests a new avenue for unifying gravitational, quantum, and thermodynamic descriptions of spacetime from a bottom-up, geometrically discrete foundation.

1 Causality, Frame Dragging, and the Role of Discreteness

Causality in this framework is preserved not through continuous spacetime curvature, but through the structure and finite interaction speed of the discrete spinning medium. Every interaction—gravitational or electromagnetic—is constrained by the speed of propagation of angular momentum changes through the Planck and Kaluza spheres, which is limited by the speed of light. This guarantees that no effect can precede its cause and that no signal can travel faster than light, maintaining causal order in all frames.

Frame dragging, a hallmark of general relativity near rotating massive bodies, appears in this theory not through geometric warping, but as a mechanical effect. Objects embedded in the rotating medium are locally entrained by the collective spin state of nearby spheres. As such, the rotation of the universe sets a preferred frame in which matter and light propagate, while still preventing causality violations such as closed timelike curves.

Importantly, this model avoids the problematic notion of point particles. All particles are instead modeled as extended configurations of rotational defects or density variations within the spinning granular lattice. This naturally regularizes quantities like charge and mass at the Planck scale and removes the infinities encountered in point-based field theories.

The discreteness of the medium does not break general relativistic behavior—it replaces it with a mechanism. Gravitational and inertial effects arise as emergent phenomena from directional biases in angular momentum exchange. This approach aligns with the spirit of emergent gravity theories, offering a concrete physical substrate instead of a purely thermodynamic or information-theoretic one.

To further align with general relativity, we propose that in the large-scale limit, the statistical behavior of angular momentum gradients in the granular medium could be mapped onto a smooth tensor field. The effective curvature experienced by matter—typically described by the Einstein tensor $G_{\mu\nu}$—would then arise from anisotropies in the spin network's angular momentum density:

$$G_{\mu\nu}^{\text{eff}} \sim \langle \partial_\mu L_\nu - \partial_\nu L_\mu \rangle \tag{1}$$

Here, L_μ denotes the local angular momentum density field of the spin lattice. Such a mapping would allow the continuum geometric curvature of general relativity to emerge from microscopic, discrete dynamics. This pathway shares conceptual ground with Jacobson's derivation of Einstein's equations from thermodynamic principles and Verlinde's model of entropic gravity.

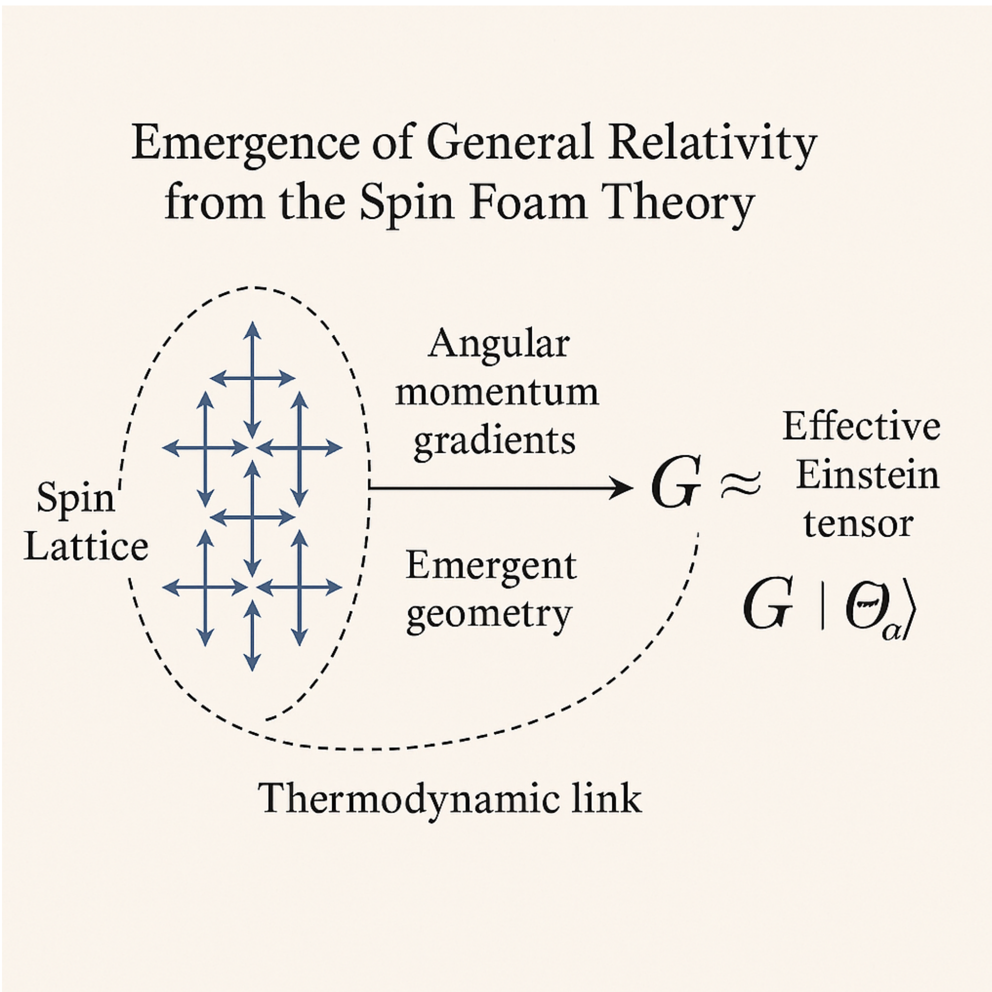
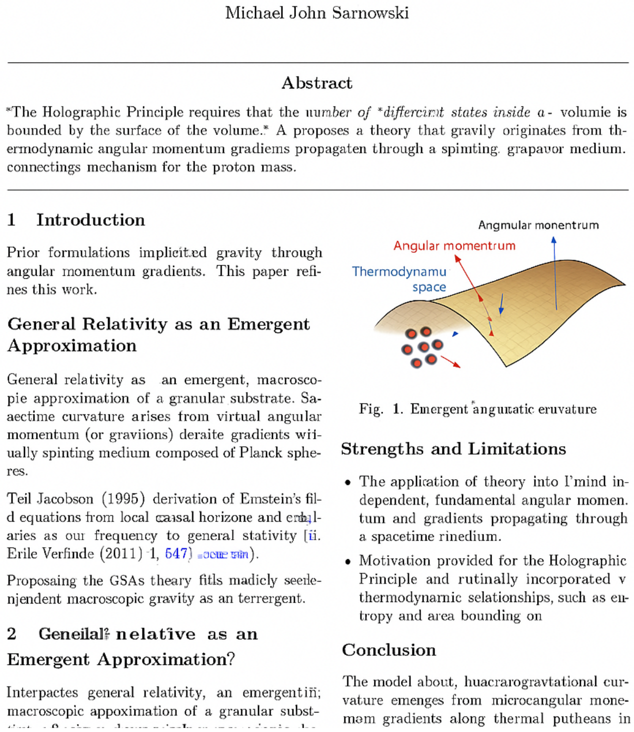


Figure 1: Emergent gravity from angular momentum gradients.



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Abstract

"The Holographic Principle requires that the *number of "differcint states inside a-* volumie is bounded by the surface of the volume." A proposes a theory that gravily originates from thermodynamic angular momentum gradiems propagaten through a spimting. grapavor medium. connectings mechanism for the proton mass.

1 Introduction

Prior formulations implicit.ed gravity through angular momentum gradients. This paper refines this work.

General Relativity as an Emergent Approximation

General relativity as an emergent, macroscopie approximation of a granular substrate. Saaectime curvature arises from virtual angular momentum (or graviions) deraite gradients wiiually spinting medium composed of Planck spheres.

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2 Geneilal nelative as an Emergent Approximation?

Interpactes general relativity, an emergentiñ; macroscopic appoximation of a granular subst-

Angmular monentrum

Angular momentrum

Thermodynamu space

Fig. 1. Emergent angunatic eruvature

Strengths and Limitations

- The application of theory into I'mind independent, fundamental angular momen. tum and gradients propagating through a spacetime rinedium.
- Motivation provided for the Holographic Principle and rutinally incorporated v thermodynarnic selationships, such as entropy and area bounding on

Conclusion

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Figure 2: Diagram showing emergence of general relativity from spin lattice gradients and thermodynamic principles. Angular momentum gradients give rise to an effective Einstein tensor through a statistical and entropic mapping.

2 Thermodynamic Interpretation and Entropic Gravity

Following Jacobson (1995), the Einstein field equations can be derived by equating the thermodynamic identity $\delta Q = TdS$ with the flow of energy across a causal horizon. In the present theory, this thermodynamic interpretation arises naturally:

- **Entropy** S is associated with the number of possible angular momentum configurations (microstates) of Kaluza defects within a Planck sphere.
- **Temperature** T corresponds to the angular momentum excitation level of the spin medium.
- **Heat flow** δQ emerges from the transfer of spin perturbations across a causal patch, especially at accelerating boundaries (analogous to local Rindler horizons).

In this framework, gravity is not a fundamental force but arises statistically from the system's tendency to maximize entropy under the constraints of discrete, causal spin interactions. As the configuration space of these spin structures shifts, emergent curvature encodes the equilibrium geometry perceived as spacetime.

This parallels Verlinde's picture of gravity as an entropic force, where the emergent elastic response of holographic screens reflects mass-energy movement. Here, the 'screens' are encoded in the holographic sum of discontinuities over the outer surface of spin spheres, consistent with the surface-area scaling of entropy in black holes.

This model provides a physical substrate for the statistical thermodynamics underpinning general relativity, replacing geometric axioms with causal angular momentum transport in a discrete, spinning medium.

3 Strengths and Limitations of the Model

Strengths:

- Provides a granular physical substrate for emergent gravity and holography.
- Eliminates singularities and point-particle infinities.
- Offers a mechanism for Lorentz contraction and time dilation based on geometry.
- Naturally aligns with surface-area scaling seen in black hole entropy.
- Enables causal propagation via local spin exchange.
- Connects to thermodynamic and entropic gravity principles from Jacobson and Verlinde.

Limitations and Open Questions:

- Requires empirical evidence of Planck-scale spin lattice structure.
- Lacks a full tensor formalism to derive Einstein's equations explicitly.
- Redshift and lensing predictions require full field modeling.
- No clear derivation yet for the exponential term in redshift equation.
- Needs exploration of quantum behavior and renormalization.

References

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