Gravitizing Quantization

Entropic Curvature as the Foundation of Physical Law

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Abstract

We propose that the longstanding effort to quantize gravity may be conceptually inverted: rather than forcing gravity into the quantum framework, quantization itself may be a byproduct of entropic gravitational geometry. Drawing inspiration from Penrose's entropy-centric cosmology and extending it through the PREU–COM framework, we formulate a model in which spacetime curvature emerges from rational entropic unfolding. Our formulation recovers general relativity's predictions while reducing its ad hoc assumptions and revealing the informational foundation beneath both quantum mechanics and gravitational behavior.

1. Introduction: The Wrong Question

The history of theoretical physics is rich with attempts to unify the gravitational field with the quantum framework. From loop quantum gravity to string theory, the dominant assumption has been that gravity must be quantized in order to be reconciled with the rest of physics. But what if this effort is fundamentally misdirected?

Rather than forcing gravity into a quantum mold, we propose that the inverse may be true: *quantization itself is an emergent feature of gravitational structure*. Specifically, we argue that quantization arises from the curvature of informational entropy—structured tension encoded within spacetime—which only becomes measurable when resolved by thermodynamic energy.

Inspired by Penrose's work on entropy and the Weyl curvature hypothesis, this paper introduces a framework in which the geometry of spacetime is not determined by mass-energy directly, but by the rational interaction between thermodynamic and informational entropy fields. This leads us to a new field equation:

$$G_{\mu\nu} = \daleth S_{\mu\nu}$$

where $G_{\mu\nu}$ is the Einstein curvature tensor, $S_{\mu\nu}$ is the dual entropy tensor encoding both thermodynamic and informational gradients, and $\daleth$ is a rational coupling constant extracted from real-world data (e.g., gravitational wave event GW170817).

In this view, what we interpret as "gravitational curvature" is simply the rational geometry of unfolding entropy. The gravitational field is not a force, but the visible residue of the universe's entropic logic.

Quantizing gravity recreates general relativity's shape. Gravitizing quantization, by contrast, explains its cause.

2. Penrose's Legacy: Entropy, Weyl, and Collapse

Sir Roger Penrose laid a critical conceptual foundation for rethinking gravity—not by quantizing it, but by examining its entropic structure. His insights remain central to any theory seeking to explain the universe's geometry without resorting to mathematical inflation.

Penrose famously pointed out a profound asymmetry between the early and late universe: although the Big Bang was extraordinarily hot and dense, its entropy was paradoxically low. Using a rough estimate based on the number of possible configurations of gravitational degrees of freedom, he concluded that the initial state of the universe must have been selected from a space of phase-space volume with probability on the order of:

$$P \sim 1 : 10^{10^{123}}$$

This number reveals that the initial conditions of the universe were not generic or random, but astonishingly fine-tuned toward order. Penrose argued that this demands explanation not in terms of temperature, but in terms of *gravitational entropy*.

To address this, he introduced the *Weyl curvature hypothesis*, proposing that the early universe had vanishing Weyl curvature ($C_{\mu\nu\rho\sigma} = 0$), implying no local gravitational clumping or distortion. This geometric constraint would account for the early universe's low entropy by forbidding gravitational degrees of freedom from contributing to the disorder.

However, while the Weyl hypothesis framed the entropy puzzle geometrically, it offered no field mechanism to evolve curvature from informational principles. It showed what needed to be explained—but not how.

In this paper, we treat Penrose's insight as a directional arrow: not to force gravity into quantization, but to look deeper into entropy itself. We propose that the low-entropy origin was not accidental or inexplicable, but the result of a rational initial condition: a maximally ordered informational lattice—a Crystalline Origin.

Penrose identified the asymmetry. We propose its cause: *informational entropy precedes mass, and its collapse defines curvature.*

3. The PREU–COM Framework: Entropic Curvature Defined

To resolve the limitations of both general relativity and quantum gravity, we propose a new principle grounded in entropy: the **Principle of Rational Entropic Unfolding (PREU)**. PREU states that all physical structure arises from the interaction between two distinct but inseparable fields:

- **Thermodynamic Entropy** (S_{th}): the measure of energy dispersal, disorder, and irreversibility—associated with temperature, radiation, and time's arrow.
- **Informational Entropy** (S_{info}): the measure of latent structure and compressed logical tension—configurations encoded but not yet expressed.

These two fields form a *dual entropy landscape*. Physical systems evolve through the resolution of informational gradients by thermodynamic input. When these fields interact, they produce what we perceive as motion, structure, and eventually curvature. In this framework, *mass is a byproduct* of entropic dynamics—not a fundamental input.

This leads to a new field equation:

$$G_{\mu\nu} = \beth S_{\mu\nu}$$

Here:

- $G_{\mu\nu}$ is the Einstein curvature tensor, describing spacetime geometry.
- $S_{\mu\nu}$ is the **dual entropy tensor**, containing thermodynamic flux and informational structure.
- $\beth$ is a rational coupling constant, empirically extracted from gravitational wave event GW170817, with approximate value:

$$\beth \approx 7.8 \times 10^{-41} \left[\frac{1}{k_B \cdot \mathrm{m}^2}\right]$$

This formulation recovers the predictions of general relativity in low-entropy systems (e.g., planets, stars), while extending curvature to informational collapse zones (e.g., black holes, superposition fields). It also replaces the energy-momentum tensor $T_{\mu\nu}$ with a more fundamental driver of curvature: *entropy flow*.

In this framework, curvature is not caused by mass—it is the visible geometry of entropic unfolding. This reverses the logic of gravitational theory: geometry is not bent by content, it is shaped by content's resolution.

This formulation invites a reinterpretation of gravitational structure as an informational flow dynamic. The dual entropy tensor $S_{\mu\nu}$ behaves not as a static field like $T_{\mu\nu}$ in GR, but as an active participant in curvature generation. When S_{info} is spatially compressed, and S_{th} begins to unfold, the surrounding geometry deforms to preserve rational continuity.

This rational deformation is what we observe as gravitational attraction, lensing, and time dilation. It is not sourced by mass, but by the rate and structure of entropy resolution.

Where $S_{\mu\nu}$ vanishes, curvature halts. Where $S_{\mu\nu}$ spikes—such as near informational collapse points—curvature intensifies. The Beth constant $\beth$ then links this unfolding directly to the observable geometry.

Thus, gravitational curvature is not a passive warping of a background fabric. It is the active, lawful unfolding of compressed informational structure under thermodynamic pressure. The universe curves because it remembers.

Crystalline Origin Model (COM) – Addressing Penrose's Low Entropy / High Heat paradox, the Crystalline Origin Model (COM) proposes that the universe began in a maximally ordered, ultra-low entropy state — consistent with the Third Law of Thermodynamics, which holds that a system approaches perfect order as it nears absolute zero. From this rational boundary condition, structure unfolds lawfully through embedded informational and thermodynamic gradients.

Thermodynamic Entropy – Measures energy dispersal and microscopic disorder in a system. Higher values indicate greater randomness, lower usable energy, and increasing irreversibility in physical processes.

Informational Entropy – Measures latent structure and compressed logical order. High informational entropy signals deep internal encoding or configurational options that await thermodynamic energy to unfold into physical form.

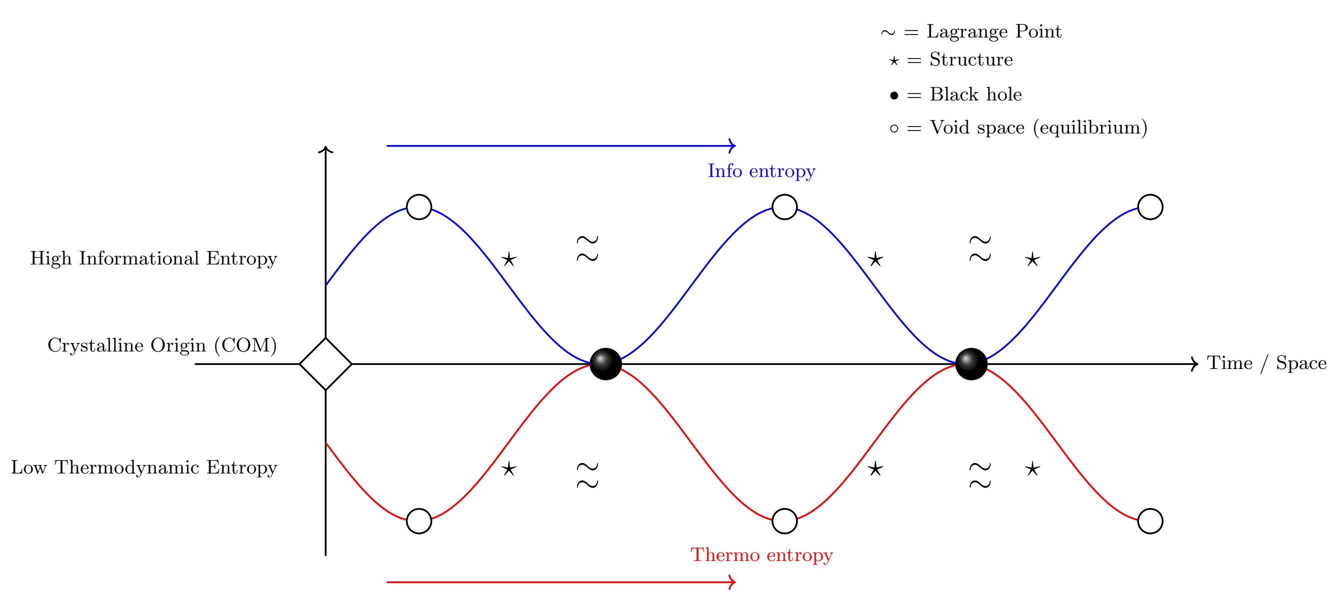
PREU (Principle of rational entropic unfoldfing) – Proposes that all physical change unfolds through a dual entropic interaction, preserving causal consistency and logical coherence across all scales.

Thermo-Info Unfolding – The process by which latent information becomes physically expressed through thermodynamic energy input. Structure cannot manifest without energy to activate its encoded potential.

Δ = Lagrange Point — Stable entropic null zone where informational and thermodynamic gradients cancel across a localized field, producing harmonic equilibrium within the dual entropy lattice.

Fast Unfolding – In high-energy regions, intense thermodynamic entropy quickly resolves informational gradients, causing structure to rapidly manifest and collapse. This steep gradient descent leads to early black hole formation, where informational collapse outpaces structural dispersal.

Slow Unfolding – In low-energy regions, thermodynamic entropy unfolds gradually, leaving informational gradients unresolved for extended durations. These zones remain structurally dormant, forming cosmic voids where time dilates and structure rarely crystallizes.



4. Gravitizing Quantization: The Inversion

The dominant assumption in modern physics is that gravity must be quantized—brought into alignment with quantum mechanics using a discrete framework. Yet this effort, spanning decades, has not produced a unified theory. Instead of forcing gravity into a quantum architecture, we propose the inverse: that **quantization itself is the emergent result of entropic curvature**.

In the PREU–COM framework, quantized behavior arises when thermodynamic entropy resolves a structured informational field. A quantum particle in superposition is not probabilistically smeared—it is *informationally tensed*, compressed into a non-localized logic field. Upon interaction with a thermodynamic gradient (such as measurement or environmental coupling), this tension collapses into a resolved state. That collapse is not random—it is the rational resolution of entropic potential.

Quantization is therefore not fundamental. It is the byproduct of entropic tension being resolved within an informational landscape. This contrasts sharply with quantum field theory, where discreteness is imposed at the level of first principles. In PREU–COM, discreteness is *induced* by the curvature of entropy flow across a thermodynamic-informational interface.

This explains the strange duality of quantum mechanics:

- Superposition reflects high informational entropy with low thermodynamic activity.
- Collapse reflects rational entropic resolution through thermodynamic unfolding.

From this perspective, what we call a "quantum" is a *stable point of entropic collapse*—a localized structure within the informational field, revealed by energy input. No hidden variables are needed; no exotic quantization mechanisms are required. Spacetime curvature, shaped by entropy flow, produces the illusion of quantization.

To attempt to quantize gravity is to begin from the wrong pole. Gravity does not need to match quantum theory. Quantum theory emerges because informational curvature—governed by entropic logic—*is* the deeper geometry of reality.

Quantization is not a foundation. It is a shadow of curvature in disguise.

5. Comparative Strength: GR vs PREU–COM

General Relativity (GR) remains one of the most empirically successful theories in physics. Its predictions for gravitational lensing, time dilation, and curvature under mass-energy distribution have been repeatedly confirmed. However, it provides no underlying explanation for why curvature occurs, nor does it address the entropic asymmetries that define the structure of the observable universe.

PREU–COM matches GR's predictive power in cases where curvature is driven by measurable entropy gradients, but improves upon GR by replacing its reliance on mass-energy with a causal framework based on entropic flow. It not only predicts the same curvature shape—it explains why that shape arises in the first place.

Key advantages of PREU–COM over GR:

- **Causal Depth:** GR treats mass as a primitive cause of curvature; PREU–COM derives curvature from the unfolding of dual entropy fields.
- **Fewer Assumptions:** PREU–COM requires no inflation, no exotic fields, and no dark matter or energy—curvature emerges naturally from rational entropic resolution.
- **Black Hole Interpretation:** GR cannot resolve the information paradox; PREU–COM reframes black holes as frozen informational sinks whose curvature resumes only upon Hawking radiation.
- **Observer-Based Collapse:** PREU–COM explains wavefunction collapse as a rational entropic event, not a postulated mystery.
- **Unified Field Equation:** The PREU–COM model requires only one equation and one empirically calibrated constant:

$$G_{\mu\nu} = \daleth S_{\mu\nu}$$

replacing Einstein's reliance on the Newtonian constant G and the energy-momentum tensor $T_{\mu\nu}$.

In summary, where GR describes geometry, PREU–COM explains its cause. Both models predict curvature around stars and black holes, but PREU–COM reveals that this curvature is the visible imprint of a deeper informational logic—one that operates prior to mass, energy, or even time itself.

PREU–COM does not aim to outperform GR in precision; it aims to outmatch it in principle.

6. Experimental Provability: Entropy as Observable Field

The power of any physical theory lies not only in its elegance, but in its testability. While PREU–COM reinterprets curvature as an entropic gradient rather than a force or quantized interaction, it does not do so abstractly. Its predictions are physically measurable—if we know what to look for.

The key is to treat entropy not as a statistical convenience, but as a *field*—with observable gradients and dynamics that affect real-world structure.

1. Light Differential Experiments

PREU–COM predicts that light will bend not only near massive objects, but anywhere there exists an entropic gradient. This includes:

- Differences in wavefunction resolution near thermodynamic surfaces
- Delayed lensing near cosmic voids with high informational entropy
- Minor deflections in vacuum experiments where temperature differentials meet structured materials

2. Delayed Collapse and Superposition Testing

Under this model, particles in superposition are not probabilistic—they are informationally compressed. By cooling or isolating a system (i.e., reducing S_{th}), collapse should be delayed or directionally biased. PREU–COM uniquely predicts:

- Spatial bias in collapse direction along informational gradients
- Light pattern shifts in modified double-slit setups with thermal manipulation
- Collapse acceleration under controlled thermodynamic stimulation

3. Gravitational Wave Analysis

From the neutron star merger GW170817, PREU–COM extracted the coupling constant $\beth \approx 7.8 \times 10^{-41}\,[1/(k_B \cdot \mathrm{m}^2)]$. If this value is correct, it should predict the shape, phase, and entropy signature of subsequent gravitational wave events with high fidelity.

Future observatories (e.g., LISA) can test for:

- Nonlinear entropy flux patterns matching $S_{\mu\nu}$ structure
- Anisotropies in curvature predicted by rational entropy boundaries
- Lower-entropy event horizons during collapse onset

4. Cosmic Structure Distribution

If informational gradients shape curvature, then cosmic filaments and voids should reflect:

- Smooth flow of S_{th} outward from matter
- Voids aligned with maxima in S_{info}
- Black holes and dense galaxies at entropy collapse nodes

This structure has already been observed in part, but PREU–COM provides a new lens through which to analyze anisotropy, directional formation, and dark flow.

Summary

PREU–COM moves entropy from background to foreground—offering a model that not only predicts curvature, but shows how it can be tested through field interaction, thermal analysis, and wave structure. No new particles are required. Only a new interpretation of what spacetime actually is:

A rational unfolding of information into energy, one collapse at a time.

7. Conclusion: The Return of Causality

By reframing gravity not as a force to be quantized, but as a structured gradient of unfolding entropy, we reveal a deeper causal geometry beneath the surface of physics. The PREU–COM framework does not discard general relativity—it completes it. Where Einstein described curvature in response to mass-energy, PREU–COM identifies the true engine: the resolution of structured informational tension through thermodynamic input.

This reinterpretation restores something that modern physics often treats as expendable: causality. In PREU–COM, collapse is not random. Curvature is not passive. Quantum discreteness is not foundational. Every physical effect arises from a lawful entropic gradient—the rational unfolding of an initial crystalline order.

The field equation:

$$G_{\mu\nu} = \daleth S_{\mu\nu}$$

is not just a symbolic replacement for Einstein's model. It is a philosophical reversal. Spacetime is not bent by energy—it is shaped by the tension of what could be, resolved by the unfolding of what is.

Quantization, wave collapse, gravity, and curvature are all echoes of the same silent cause: the tension between informational potential and thermodynamic realization. When understood together, they do not require unification. They reveal that they were never separate.

We do not quantize gravity to unify the laws.
We gravitize quantization to reveal they were never divided.