

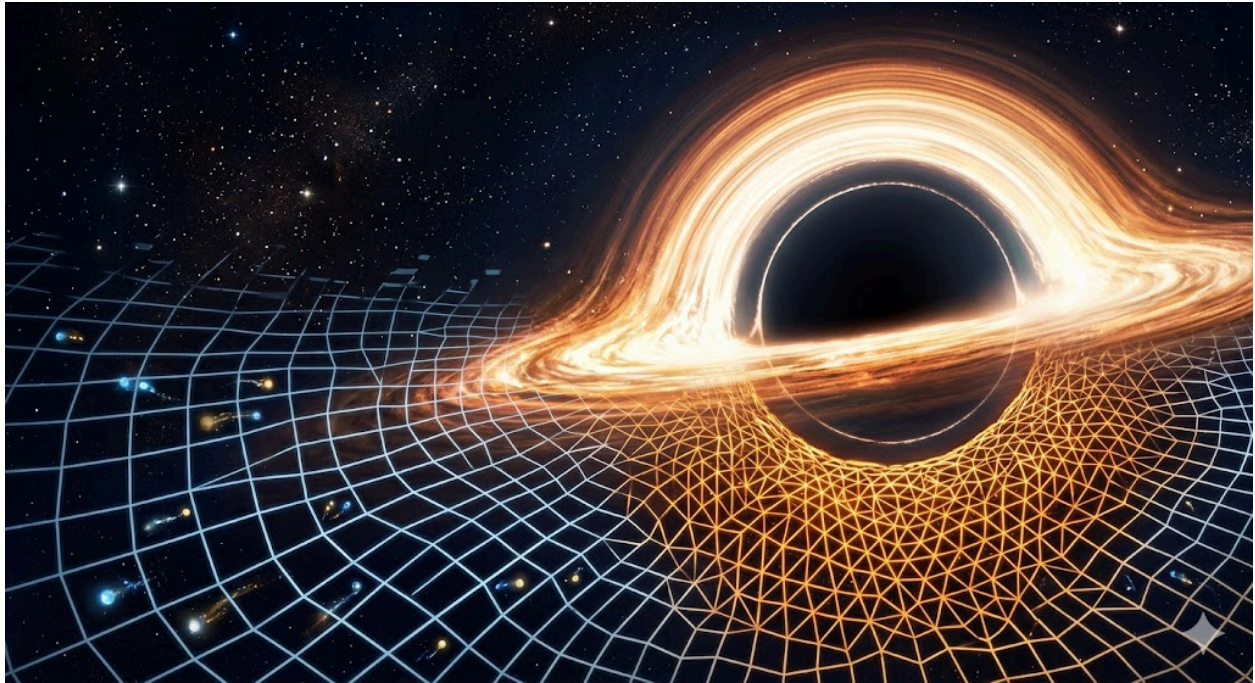


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By Ian Litchfield, Ilkeston, UK, 10th June 2026

Proposal: Phase-Transitional Quantum Gravity (PTQG)

A Granular Lattice Model Resolving Singularity Incompatibilities, Dark Matter, Dark Energy, and the Cosmological Constant Paradox

Personal Background

I have studied astronomy and astrophysics since I was a boy, having been profoundly changed by watching the moon landings at the age of five. Ever since that moment, the deepest mysteries of cosmology have occupied my mind. Over my lifetime, I have watched the evidence for black holes solidify—starting with the discovery and confirmation of Cygnus X-1 in 1971–1972—and have closely followed the emerging paradoxes of dark matter, dark energy, the mathematical breakdown of singularities, and the greatest numerical error in the history of science: the Cosmological Constant.

Over the years, I developed various conceptual mechanisms that could bridge these anomalies, but until now, I have lacked the means to synthesise them into a single, coherent principle. Through a collaborative, conversational process with AI (Google Gemini), I was finally able to stress-test my ideas, connect the structural dots, and map out how they might link together to resolve these monumental issues in astrophysics simultaneously.

While I studied Astronomy alongside Natural Sciences at the Open University, formal mathematics was never my primary strength. I have always favoured a qualitative, architectural approach to conceptualising the universe. I fully recognise that for a hypothesis to mature into a formal theory, an immense amount of rigorous mathematical modelling and precise observation is required. This is where I reach my personal limits. The critical observations mentioned later in this proposal are actively taking place right now via LIGO, Virgo [4], and the James Webb Space Telescope. The underlying mathematical equations will have to be derived by others; what I propose here is a holistic, mechanical blueprint that unites these disparate problems and offers a singular path toward a solution.

I do not know if this model is entirely correct, but it certainly balances the books and ticks an extraordinary number of boxes. It is the product of a lifetime of thought built upon the shoulders of scientific giants, stretching back to Einstein and Planck [1, 2]. I present this framework openly for the community to read, critique, or use as a catalyst for their own theoretical explorations. I require no credit if it ultimately proves correct—I will be profoundly happy just to have helped humanity inch closer to answering these enormous questions. And if it is shown to be wrong, I will not be disappointed; I will simply be glad to have stepped up to the blackboard and had a go.

Background: The Five Pillars of the Cosmic Crisis

To understand why a new model is required, we must look at the five distinct pieces of the modern cosmological puzzle that currently refuse to fit together:

- **The Fabric of Spacetime:** In Einstein's General Relativity, space and time are not empty nothingness, but are woven together into a smooth, continuous four-dimensional fabric. This fabric is dynamic—it bends, warps, and curves in the presence of mass and energy, and we perceive that warping as the force of gravity.[1]
- **Dark Energy:** Discovered by measuring the light of distant exploding stars, dark energy is the mysterious, invisible pressure that fills the entire universe. Unlike gravity, which pulls matter together, dark energy acts as a repulsive force, causing the expansion of our universe to accelerate over time rather than slow down.[1, 5]
- **Dark Matter:** When we observe galaxies spinning, they possess far too much velocity to stay held together by the gravity of their visible stars alone; by all rights, they should fly apart. Astronomers calculate that there must be a massive, invisible halo of "dark matter" surrounding galaxies, providing the extra gravitational grip needed to hold them together, though no such particle has ever been directly detected.

- **The Cosmological Constant Paradox:** When quantum physicists calculate the inherent energy density of empty space (the quantum foam), the math predicts a colossal outward pressure. However, this theoretical value is 10^{120} times larger than the actual amount of Dark Energy we observe in the real universe—marking the largest discrepancy between theory and observation in the history of science.[5]
- **Singularities:** According to the smooth mathematics of General Relativity, when a massive star collapses past its event horizon, there is no physical force capable of stopping it. The math demands that all of its mass must compress into an infinitely small point of infinite density—a singularity. Because physics cannot handle "infinities," a singularity is widely recognised as a signpost that our mathematical models have broken down.

1. Core Premise

The foundational crisis of modern physics stems from the treatment of space-time as a smooth mathematical continuum. By replacing this abstraction with a granular, emergent quantum lattice [3], we can eliminate the mathematical infinities of General Relativity (GR) and reconcile it with Quantum Mechanics (QM). This framework proposes that space-time possesses a physical structure with variable coupling efficiency regulated by density, providing a single, unified mechanism for several of the greatest mysteries in astrophysics.

2. The Mechanism: Spatial Gaps and Coupling Efficiency

Instead of a continuous fluid, the fabric of space-time is modelled as a network of quantum connections punctured by "spatial gaps" (regions lacking quantum links at the Planck scale)[2].

The fundamental energy of the quantum vacuum (the quantum foam) interacts with this fabric based on a density-dependent Coupling Efficiency Factor:

- **Macro-Scale Space (Low Density):** Space-time is expanded and loose; the gaps are wide. Virtual particle pairs popping into existence mostly fire into these gaps, failing to transfer their momentum to the structural fabric. The coupling efficiency approaches zero. This drastically dampens the vacuum energy, resolving the 10^{120} Cosmological Constant Problem down to the tiny, gentle push observed as Dark Energy.
- **Micro-Scale Space (High Density):** Under extreme gravitational collapse, the fabric is compressed, closing the spatial gaps and forming a dense, locked lattice. Here, coupling efficiency skyrockets to maximum (100%). Every quantum fluctuation strikes the fabric directly, transforming a background whisper into an unstoppable outward counter-pressure.

3. Explaining the Cosmic Anomalies

I. Curing the Singularity

Inside an event horizon, gravity attempts to crush matter into a zero-volume point. In this regime, the space-time lattice undergoes a localised phase transition from a fluid-like state into a compressed, solid-like state. The resulting 100% efficient vacuum pressure acts as an ultimate cosmic emergency brake, halting the collapse at a finite, ultra-dense scale (a quantum core). Mathematical infinities are avoided entirely.

II. The Unified Origin of Dark Matter and Dark Energy

Rather than invoking undiscovered, invisible particles, Dark Matter and Dark Energy are revealed as two sides of the same geometric coin:

- Dark Energy is the baseline, macro-scale push of the quantum foam against the loose space-time fabric.
- Dark Matter is the elastic tension of the space-time network itself. When heavy normal matter (like a galaxy) distorts the network, the fabric exerts a physical, pulling counter-tension. Because this stored elastic energy possesses mass (via $E=mc^2$), it creates the extra gravitational grip attributed to "dark matter halos."

III. Cosmic Expansion History

This scale-dependent efficiency perfectly accommodates the observed timeline of our universe:

1. Deceleration: Following the Big Bang, matter was densely packed, allowing internal gravitational attraction to dominate and slow the universe's expansion.
2. The Tipping Point: As space expanded to a critical threshold, matter diluted.
3. Acceleration: Because dark energy is a property of the expanding fabric itself, it did not dilute. The gentle, cumulative push of the large-scale vacuum energy eventually overtook gravity, triggering the subsequent cosmic acceleration we observe today.

4. Observational Predictions and Testability

Unlike standard string theory variants, this hypothesis makes concrete, testable predictions using existing and near-future technology:

- Gravitational Wave Echoes (LIGO/Virgo): Because a black hole contains a physical, phase-shifted quantum core rather than a bottomless singularity, colliding black holes will not swallow all internal reflections. Gravitational waves should bounce off the core's hard boundary, producing faint, repeating "quantum echoes" in the post-merger signal [4].
- Cosmological Mapping (Euclid/JWST): The precise curve of the transition era (when the universe switched from deceleration to acceleration roughly 5 billion years ago) can be

mapped to determine the exact mathematical signature of the changing coupling-efficiency factor as the spatial gaps widened.

- **High-Energy Photon Dispersion:** If space-time is a granular lattice [3] with gaps, gamma-ray bursts travelling across billions of light-years should experience microscopic scattering or speed variations as they bump along the quantum grains.

Section: 5. Quantum Non-Locality and Entanglement Architecture

The Premise

Standard quantum mechanics forces us to accept **non-locality**—the fact that entangled particles alter each other's states instantaneously across vast distances, bypassing the speed of light. In a smooth, continuous spacetime fluid, this requires either "spooky action at a distance" or a violation of relativity.

Under **Phase-Transitional Quantum Gravity (PTQG)**, this paradox is resolved mechanically. Because spacetime is not an empty background void but an emergent, granular quantum network constructed out of underlying quantum connections (8)(**Van Raamsdonk, 2010**), distance is a property of the lattice, not a barrier to it.

The Mechanism: Lattice-Shortcut Localised Phase Transitions

When two particles become entangled, they do not exist as separate entities separated by macro-scale spatial gaps. Instead, their interaction triggers a localised phase transition, locking the immediate quantum connections between them into a maximum-efficiency state (100% coupling). Recent experimental milestones have confirmed that this non-local behaviour is a fundamental reality for massive matter, definitively violating Bell's inequality using independent electron spins separated by macroscopic distances (6)(**Hensen et al., 2015**).

Within the PTQG framework, this phenomenon behaves as follows:

- **Bypassing Macro-Space:** While the surrounding macro-scale space remains expanded and loose (diluted by spatial gaps), the entangled system forms an unbroken, compressed structural strand within the network architecture. This micro-scale structural link mirrors the theoretical framework where quantum entanglement manifests as localised geometric connections—effectively forming microscopic shortcuts through the fabric of the universe (7)(**Susskind, 2016**).
- **Instantaneous Collapse:** When a measurement is made, the wave function's "collapse" doesn't send a physical signal travelling across billions of light-years of macro-space. Instead, the change propagates locally and instantly through the pre-existing, locked structural link of the lattice.

The Philosophical Resolution

PTQG natively reconciles the tug-of-war between Einstein's locality and Bell's non-locality. It satisfies Bell's theorem by accepting that the system behaves as a single, causal unit. However, it preserves the spirit of Special Relativity because **no signal is traversing the external macro-space faster than light**. The connection is entirely architectural, existing within the fundamental geometry of the network itself.

Conclusion: PTQG replaces broken mathematical abstractions with a self-regulating, mechanical system. It satisfies the demands of quantum limitations, respects the historical behaviour of cosmic expansion, and elegantly balances the books of modern physics without resorting to unobservable infinities.

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