Graviton Lattices and the Cosmogenesis of Spacetime:

A Unified Theory of Gravitational Entanglement

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June 29th 2025

Abstract: This paper proposes a unifying cosmological framework wherein the graviton is not merely a quantum of the gravitational field, but the foundational unit of quantum gravitational entanglement. In this model, the universe originated from a single, accreting graviton—a quantum singularity that, upon reaching a critical density, transitioned through a quantum phase shift. This event released mass-energy entangled with newly formed spacetime, giving rise to the observable universe.

This paper hypothesizes that all black holes contain developing gravitons, which act as seeds of future universes, and that spacetime itself is emergent from a lattice of graviton entanglements. Quantum entanglement—across gravity and other forces—may arise from higher-dimensional or imperceptible shared topologies between quantum systems. When gravitational bonds within an over-dense graviton are overcome by compressed strong-force interactions, the graviton "breaks," triggering a localized inflationary expansion.

The framework introduces a duality of observer perspectives: internal observers, entangled within the newly formed spacetime, perceive an origin event; external observers, embedded in the parent spacetime, detect a non-entangled burst (e.g., through gravitational wave-like effects), but remain causally disconnected from the internal expansion. This suggests a multiversal structure rooted in graviton entanglement, where universes emerge within the interiors of black holes.

This paper outlines implications for black hole thermodynamics, quantum information, and potential observational signatures.

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1. Introduction: The quest for a Theory of Everything seeks to unify the fundamental forces of nature and explain the origins of the universe through a coherent framework. This paper offers a novel approach centered around the graviton, not just as a theoretical particle mediating gravity, but as the seed of spacetime itself. I posit that the universe began with a graviton undergoing a critical transformation, resulting in an expansive release of entangled mass-energy that constitutes the fabric of spacetime.

This view challenges traditional conceptions of the Big Bang, black hole singularities, and the separateness of quantum and relativistic regimes. Instead, it offers a bridge: quantum gravitational entanglement, encoded in graviton interactions, is the engine of cosmic evolution.

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2. Gravitons as Accreting Singularities: I redefine the graviton as a quantum-scale singularity capable of accreting mass and spacetime curvature. In this model, any black hole may contain a nascent graviton—a compact region whose gravity intensifies with ongoing accretion. This internal buildup continues until a critical density is reached.

At the point of critical density, gravitational bonds are strained against internal strong-force pressures. This culminates in a phase transition, analogous to quantum tunneling or a vacuum metastability event, triggering a spacetime-generative explosion. The resulting event resembles a Big Bang from the interior frame of the graviton.

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3. The Lattice of Gravitational Entanglement: Spacetime is proposed to emerge from a quantum network of entangled gravitons. Each graviton, through entanglement, is connected to others via shared quantum states. This interconnected structure forms a spacetime lattice.

This model parallels concepts in loop quantum gravity (e.g., spin networks) and holographic theories (e.g., ER=EPR), suggesting that geometric properties of spacetime arise from entanglement configurations. Thus, spacetime is not a static backdrop but a dynamic quantum tapestry.

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4. Phase Transition: From Compression to Expansion: As a graviton compresses under accretion, gravity intensifies until the energy density exceeds the binding capacity of gravitational confinement. At this threshold, the compressed strong nuclear force dominates, disrupting gravitational bonds. This moment represents a quantum bounce.

Mass and energy explode outward, but are quantumly entangled with the new spacetime formed in the process. The expansion is not into a preexisting space, but into a spacetime generated in tandem with the released energy.

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5. Observer Frames and Entanglement Domains: Observers inside the newly created spacetime perceive a coherent expansion and origin event—a "Big Bang."

Observers in the surrounding parent spacetime (e.g., one in which the original black hole exists) detect only an external signature, such as a gravitational ripple. They are not entangled with the internal spacetime and thus cannot perceive or access its contents.

This entanglement asymmetry implies that universes are causally isolated unless entanglement bridges exist. This concept parallels black hole complementarity and aligns with information conservation principles.

Moreover, the perceptual basis of observation itself is governed by entanglement. Observers entangled within the same spacetime domain will perceive their surroundings as classically deterministic, where events resolve into definite outcomes due to shared quantum histories. In contrast, an unentangled observer interacting with a foreign quantum system would perceive it in terms of superpositions and wave-like uncertainty. Thus, classical reality emerges not universally but locally, contingent on the structure of entanglement among observers and systems.

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6. Multiverse Architecture: If every black hole harbors a developing graviton, each could serve as a generative node for a new universe. The multiverse thus forms an evolving network of entangled spacetimes, each internally coherent but externally unobservable except through gravitational remnants.

This view addresses the entropy and time asymmetry paradoxes by enabling entropy resets in each spacetime domain, while preserving information in the broader entanglement structure.

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7. Implications and Testable Predictions: Potential observational implications include:

- Gravitational wave echoes or anomalous bursts from black holes.
- CMB irregularities suggesting entanglement influence.
- Deviations in Hawking radiation spectra indicating internal entanglement processes.

Although speculative, these may guide the design of future observational frameworks, particularly with next-generation gravitational observatories.

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8. Philosophical and Foundational Implications: This model redefines what constitutes a universe. Rather than a singular totality, a universe is an entangled domain of spacetime bound to a graviton origin. Information is preserved across domains through gravitational entanglement, offering a resolution to the black hole information paradox.

It challenges classical notions of causality, locality, and continuity, and offers a framework in which emergence, not absoluteness, defines physical reality.

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9. Conclusion and Future Work: This theory presents a framework where spacetime, gravity, and cosmogenesis are unified through graviton entanglement. It offers potential synthesis with higher-dimensional models (such as Geometric Unity), allowing dynamic graviton processes to be embedded in a continuous topological manifold.

Future work will focus on developing a rigorous mathematical formalism, potentially via tensor networks, spin foam models, or quantum information theory. Simulation of graviton lattices and identification of observational footprints will be essential steps in refining and testing this theory.