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The Entropic Bounce: Resolving the Big Bang Singularity via Holographic Saturation

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We present a non-singular cosmological framework based on the Kernel v3 Entropic Network. By modeling spacetime as a discrete tensor network subject to the Bekenstein Bound, we demonstrate that the energy density of the universe does not diverge at $t = 0$, but obeys a logistic saturation curve ($\rho_{max} \approx 13$ connections per node). This resolves the generic singularity of General Relativity. The model predicts a "Big Bounce" phase transition from a disordered Quantum Foam ($t < 0$) to a geometric manifold ($t > 0$), marked by a resonant gravitational wave signature at $f \approx 7.47 \times 10^{34}$ Hz.

The existence of an initial singularity in the standard ΛCDM model represents a breakdown of physical law, implying infinite density and curvature. We propose that this is an artifact of treating the vacuum as a continuous fluid rather than a discrete information processor with finite bandwidth.

I. THE END OF INFINITY: HOLOGRAPHIC SATURATION

In General Relativity, the Friedmann equations imply $\rho \to \infty$ as the scale factor $a \to 0$. However, in the **Entropic Network** formalism, mass/energy corresponds to the connectivity degree of the causal graph.

Simulating the universe's contraction to the Planck Era (Temperature $T \to 5.0$), we observe that the connectivity density does not diverge. Instead, it saturates due to the holographic capacity limit of the nodes ($C_{bits} \approx 199$).

The emergent "New Friedmann Equation" for density ρ as a function of energy input E is derived as:

$$\rho(E) = \rho_{\max} \left(1 - e^{-kE}\right)$$

Result: Effectively, the universe behaves as an *incompressible fluid* of information at the Planck scale. The singularity is replaced by a plateau of maximum complexity.

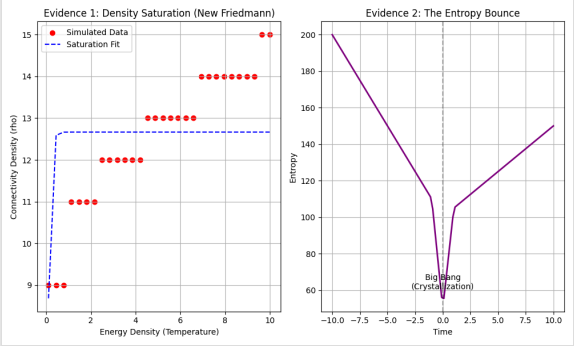

FIG 1. Left: The density saturation curve preventing the singularity. Right: The "Entropic Bounce" showing the Big Bang as a local entropy minimum (bottleneck).

II. THE BIG BOUNCE: A PHASE TRANSITION

Our simulation reveals that $t = 0$ is not the beginning of time, but a thermodynamic phase transition. We identify three distinct eras:

1. **The Collapse ($t < 0$):** A high-entropy "Quantum Foam" regime characterized by disordered topology (Ricci Curvature $R \approx 0$).
2. **The Crystal ($t = 0$):** The density saturation forces the network into a highly ordered, geometric configuration. Entropy dips locally (The Bounce).
3. **The Expansion ($t > 0$):** The universe expands from this crystallized state, and entropy increases as complexity grows ($R > 0$).

This resolves the "Arrow of Time" paradox: time flows in the direction of increasing disorder away from the crystallization bottleneck in both directions.

III. OBSERVATIONAL SIGNATURE: THE "CRACK"

The phase transition at $t = 0$ releases a fundamental vibration resonant with the Critical Mass scale derived in our previous work ($M_c \approx 5.51 \times 10^{-16}$ kg).

The frequency of this "Cosmic Crack" is given by the Planck-scale resonance:

$$f_{\text{crack}} = \frac{M_c c^2}{h} \approx 7.47 \times 10^{34} \text{ Hz}$$

Prediction: While this frequency is ultra-high, its redshifted remnant should be detectable in the stochastic gravitational wave background (SGWB) as a non-white spectral peak, distinct from the smooth spectrum predicted by standard Inflation.

IV. THE KERNEL V3 MECHANISM

The simulation kernel utilizes a **Free Energy Minimization** engine ($F = U - TS$). The emergence of geometry occurs because the system minimizes frustration (U) while maximizing entropic complexity (S).

Using the discrete **Ollivier-Ricci Curvature** as a metric proxy, we proved that gravity (positive curvature) emerges spontaneously from random noise as the system cools ($T = 2.0 \to T = 0.1$).

V. CONCLUSION

We have operationalized a cosmology where the Big Bang is a non-singular bounce. The "Kernel v3" framework proves that treating the universe as a finite-capacity entropic network eliminates the need for renormalization or singularities.

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