The Finite Universe Boundary Hypothesis

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Abstract

This hypothesis proposes that the universe is not infinite, but instead bounded by a relativistic limit: the point at which all matter and energy approach the speed of light and dissolve into non-being. This model suggests that the accelerating expansion of the universe is not a march into infinite space but a progression toward a measurable boundary of dissolution, defined not by distance, but by velocity. At the asymptotic threshold where $v \to c$, time, entropy, and mass decay into null-state. This boundary is the finite edge of our universe — an invisible horizon where reality itself ceases.

1 Introduction

Standard cosmology often treats the universe as either infinite or indefinitely expanding, with no end point. While the Big Bang marks the origin of observable time and space, there is no accepted upper boundary — only the assumption that expansion continues eternally, driven by dark energy. This hypothesis challenges that view. It suggests that the universe's acceleration will drive all mass-energy toward a relativistic boundary where existence terminates. This velocity-bound dissolution defines a finite, though expanding, cosmological structure.

2 Core Hypothesis

Let c represent the speed of light, and $v(t)$ represent the expansion velocity of spacetime. As $t \to \infty$, if $v(t) \to c$, then:

$$\tau = t \cdot \sqrt{1 - \frac{v^2}{c^2}} \Rightarrow 0$$

$$S \to 0, \quad m \to 0, \quad E \to 0$$

Thus, there exists a relativistic dissolution shell ∂U, where the universe fades out. Beyond this shell, no structure, time, or entropy can persist. The universe is not infinite — it is enclosed by its own asymptotic phase space boundary.

3 Supporting Scientific Foundations

- **Special Relativity:** At $v = c$, proper time $\tau = 0$. Time halts.
- **General Relativity:** Without mass, spacetime curvature ceases. The outer edge becomes geometrically flat and causally disconnected.
- **Thermodynamics:** Without time, entropy cannot evolve. This defines an entropy null boundary.
- **Cosmology:** Observations of accelerated expansion suggest $v(t)$ is increasing — supporting the premise that the universe may approach a light-speed threshold.

4 Relativistic Boundary Geometry

Define:

$$\partial U = \{x \in R^4 \mid v(x) = c\}$$

This boundary acts as a dissolving shell — an outer phase space where proper time and entropy fall to zero. Inside ∂U, the universe behaves classically. Outside, no causal structure persists.

This model treats the universe as a finite object embedded in a null-state beyond light-speed.

5 Implications

- The universe has an upper bound: not spatial, but relativistic.
- The total volume of reality is measurable by ∂U.
- Expansion does not produce infinite space — it spreads toward a dissolution threshold.
- Light-speed defines the fading perimeter of reality.

6 Integration with Prior Hypotheses

- **Light-Speed Boundary Hypothesis:** Defines the origin of reality as the first rupture through $v = c$ into being.
- **Light-Speed Cycle Hypothesis:** Proposes that once the universe re-reaches this boundary, it dissolves and rebirths.
- **Finite Universe Boundary Hypothesis:** Closes the loop: it asserts that what appears infinite is a bounded system moving toward dissolution.

These models collectively redefine the universe not as a static object or endless process, but as a bounded structure with defined origins, limits, and cycles.

7 Conclusion

The Finite Universe Boundary Hypothesis offers a shift from classical assumptions of infinity. It reframes the universe as a relativistic structure, bounded by dissolution at the light-speed threshold. As expansion continues, we move closer to this terminal phase space. The observable cosmos is not the entirety of existence — it is a slowly fading ripple approaching the edge of being. This boundary is not the end of distance, but the end of existence.

If correct, this hypothesis provides a measurable outer edge to reality and suggests that cosmic destiny is not heat death or eternal inflation — but relativistic vanishing.