

The Light-Speed Cycle Hypothesis

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Abstract

The Light-Speed Cycle Hypothesis proposes that the universe is not on a path toward eternal expansion or thermal death, but toward a second encounter with the light-speed boundary that originally birthed it. As cosmic acceleration continues, spacetime asymptotically approaches the speed of light. At the boundary $v = c$, time, space, entropy, and causality dissolve. This hypothesis suggests that the universe will ultimately dissolve into non-being — the same null-state from which it emerged — and that this re-entry may catalyse a new Big Bang, establishing a cyclical cosmology governed by light-speed rupture events.

1 Introduction

Contemporary cosmology acknowledges the accelerating expansion of the universe, attributed to a phenomenon termed dark energy. Various models predict different outcomes: heat death, Big Rip, or eternal inflation. However, none reinterpret the expansion as a return trajectory toward the same condition that began the universe. This hypothesis builds on the Light-Speed Boundary Hypothesis, proposing that the universe began when structured energy crossed from the null-state ($v = c$) into being ($v < c$). Now, it continues by positing that the universe is accelerating back toward $v = c$, closing the loop.

2 Core Hypothesis

Existence is bounded between two light-speed transitions:

$$\text{Existence} = \begin{cases} \text{False}, & v \geq c \\ \text{True}, & v < c \end{cases}$$

At $v = c$, proper time $\tau \rightarrow 0$, causality halts, and spacetime dissolves. Just as the universe emerged from this threshold, it may ultimately return to it.

3 Dark Energy as Echo of Rupture

Rather than a force pushing outward, dark energy may be interpreted as the remaining inertia or curvature recoil from the original light-speed rupture. It is not a static cosmological constant but a dynamic echo — the universe accelerating not from within, but being pulled back toward the speed-of-light boundary it once crossed.

4 Mathematical Boundary Conditions

As the universe accelerates:

$$t \rightarrow \infty, \quad v(t) \rightarrow c$$

Then:

- $\tau = t \cdot \sqrt{1 - v^2/c^2} \rightarrow 0$
- $\frac{dS}{dt} \rightarrow 0$ (entropy ceases)
- $\partial U \rightarrow N$ (causality dissolves)

The final condition mirrors the first: spacetime ceases not through collapse, but through vanishing differentiation — a return to the null.

5 The Light-Speed Cycle

This model defines cosmogenesis as a closed loop:

1. Null-State (N): $v = c$, no time, no mass
2. Rupture: Structured energy crosses into being
3. Expansion: Time, entropy, causality evolve
4. Return Trajectory: Acceleration continues $v \rightarrow c$
5. Dissolution: Universe reverts to null
6. New Rupture: Recursive Big Bang

This is a light-speed cycle, not a multiverse or inflation cascade — it is the same universe rhythmically pulsing into and out of existence.

6 Implications

- The universe has a terminal state: $v = c$
- Time and entropy are temporary, bounded phenomena
- The cosmos is not infinite, but cyclically emergent
- There is no need for infinite inflation or eternal fine-tuning

7 Proposed Tests

- Measure asymptotic behaviour of cosmic acceleration
- Explore whether entropy shows logarithmic slowdown
- Reinterpret dark energy as metric recoil
- Model causal disconnection near $v \approx c$

8 Philosophical Considerations

If the universe ends as it began — at $v = c$ — then existence is not linear, but recursive. Being arises not from randomness but from rupture. The arrow of time bends not toward infinity, but toward the same wall it emerged from. There, it resets.

9 Conclusion

The Light-Speed Cycle Hypothesis closes the arc of the Light-Speed Boundary Hypothesis. It reframes the fate of the universe not as decay, but as return — a full cycle from being to non-being and back again. In this model, the universe is a finite, measurable breath through the threshold of light.