Project Leviathan: The Temporal Density Hypothesis

Solving the Horizon Problem via Variable Causal Processing Rates

A. Hewitt
Principal Investigator

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Abstract

Standard cosmology (ΛCDM) assumes a linear flow of time ($dt = d\tau$) back to the Big Bang, requiring an ad-hoc "Inflation" field to solve the Horizon and Flatness problems. Project Leviathan proposes an alternative information-theoretic mechanism: the **Temporal Density Hypothesis**. We posit that the rate of causal processing (Effective Time, τ) scales inversely with the complexity of the Universe's Phase Space, following a power law $\tau \propto t^{-\alpha}$. As $t \to 0$, the effective causal time approaches infinity, allowing the early Universe to structurally mature, homogenize, and select observer-compatible histories without requiring superluminal expansion. This project aims to falsify this hypothesis by auditing "impossible" early structures—massive high-z galaxies and super-horizon filaments—which serve as artifacts of this accelerated cosmic pre-history.

1 Theoretical Framework: The Efficiency Curve

We propose that the coordinate time t (measured by atomic clocks) differs from the structural time τ (the accumulation of causal events). The relationship is governed by the *Temporal Density* $\eta(t)$:

$$d\tau = \eta(t)dt \quad \text{where} \quad \eta(t) \approx \left(\frac{t_0}{t}\right)^{\alpha} \tag{1}$$

Here, t_0 is the current age of the Universe and $\alpha > 0$ is the *Agenda Exponent*. If $\alpha = 0$, we recover Standard ΛCDM ($d\tau = dt$).

1.1 The Singularity Asymptote

The critical implication of this hypothesis arises as we approach the initial singularity ($t \to 0$). The total *Effective Causal Time* τ_{total} experienced by the Universe since the Big Bang is the integral of the temporal density:

$$\tau(t) = \int_t^{t_{now}} \eta(t')dt' \propto \int_t^{t_{now}} (t')^{-\alpha}dt' \tag{2}$$

For any exponent $\alpha \geq 1$, this integral diverges:

$$\lim_{t \to 0} \tau(t) = \infty \tag{3}$$

Physical Implication: This implies that the "first second" of the Universe contained an infinite duration of causal processing.

- **Horizon Solution:** Regions of space that appear causally disconnected in linear coordinate time were in fact able to communicate and thermalize over an infinite structural history before expansion took over.
- **Information Selection:** This infinite pre-history allows the Universe to exhaustively search its phase space for a stable, observer-compatible configuration, replacing the random quantum fluctuations of Inflation with a deterministic selection process.

2 Research Aims

2.1 Aim 1: The Chronometry Audit (Deriving α)

Objective: Empirically derive the exponent α by comparing the "Structural Age" of high-redshift objects against their allowed "Coordinate Age."
Methodology:

- Ingest JWST spectral data (CEERS/JADES) for galaxies at $z > 10$.
- Extract *Stellar Population Ages* (T_{struct}) using spectral energy distribution (SED) fitting.
- Compare T_{struct} vs. ΛCDM Age (T_{coord}).
- **The Curve Fit:** We fit the anomaly to the power law model $T_{struct} \approx T_{coord}^{(1-\alpha)}$ to find the best-fit α.

2.2 Aim 2: The Mega-Structure Audit (Horizon Violations)

Objective: Audit the existence of structures exceeding the Homogeneity Scale (> 370 Mpc).
Methodology:

- Audit Quasar and GRB catalogs (SDSS, BOSS) for connected structures > 1.2 Gly (e.g., Hercules-Corona Borealis Great Wall).
- Such structures require a formation time $T_{form} \gg T_{coord}$. The discrepancy provides a secondary independent constraint on α.

2.3 Aim 3: The Void Audit (The Cold Spot)

Objective: Test if the Eridanus Supervoid represents a region where "vacuum clearing" occurred at an accelerated rate.
Methodology:

- Cross-correlate Planck CMB maps with galaxy density maps.
- Determine if the void's depth and size ($R > 200$ Mpc) are statistically impossible ($> 5\sigma$) in a standard Dark Energy growth model.

3 Implications

If $\alpha > 0$ is confirmed:

1. **Inflation is Obsolete:** The smoothness of the CMB is explained by infinite causal contact in the "pre-history" near $t = 0$.
2. **JWST Anomalies Resolved:** Massive early galaxies are not impossible; they are simply older than their redshift suggests.

3. **Teleology:** The Universe's initial conditions were not random, but the result of an exhaustive search for stable histories.