

CAUSAL MECHANICAL COSMOLOGY — PAPER 2 (V2.2)

Subtitle: *Structural Emergence of Cosmological Phenomena from Timeless Causal Mechanics*

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Abstract

This paper extends the causal-mechanical framework established in Paper 1 by applying its timeless structural principles to the emergence of cosmological phenomena. Using the symbolic system built on ω (fundamental causal magnitude), ρ (causal density), and ∇ (structural gradient), the paper demonstrates how large-scale structure, apparent expansion, and energy-like behaviour arise from purely structural relationships. No temporal evolution is required; cosmological features emerge from invariant causal configurations governed by structural constraints. This approach provides a logically consistent alternative to time-dependent cosmology.

I. Introduction: The Architecture of Necessity

Paper 1 established that cosmological structure can be reconstructed without invoking time as a fundamental variable. Paper 2 applies this framework to the phenomena traditionally explained through temporal evolution: expansion, curvature, and clustering. The central claim is that cosmological phenomena emerge from **Structural Necessity**, not temporal dynamics. By treating ω , ρ , and ∇ as structural quantities, we obtain a cosmology free of singularities and independent of temporal assumptions.

II. Foundational Structural Principles (Trilogy Anchors)

The framework relies on the primary primitives established in the preceding work:

- **SEA-TRILOGY-ANCHOR-L1:** Structural variation is expressed through $\nabla\omega$, not temporal change.
- **SEA-TRILOGY-ANCHOR-L2:** Causal density determines structural variation:
$$\nabla\omega \propto \rho$$
- **SEA-TRILOGY-ANCHOR-L3:** Stable configurations satisfy the structural constraint:
$$\nabla \cdot (\rho \nabla \omega) = 0$$

III. Mathematical Framework for Emergent Structure

The symbolic system becomes the mathematical backbone for applied cosmology, defining how geometry and energy emerge from the Sea:

1. **Structural Curvature (K):** Curvature emerges from second-order structural variation:
 $K \propto \nabla \cdot (\nabla \rho)$
2. **Apparent Expansion:** Arises from divergence in causal density, producing expansion-like observational effects without requiring temporal growth: $\nabla \cdot \rho > 0$
3. **Energy-Like Behaviour (E):** Energy is reinterpreted as structural capacity rather than a temporal quantity: $E \equiv \rho \omega$

IV. Emergence of Cosmological Phenomena

1. **Apparent Expansion:** Traditional cosmology interprets redshift as evidence of temporal growth. In this framework, redshift corresponds to structural divergence ($\nabla \cdot \rho$). Expansion is an interpretation of the gradient, not a temporal necessity.
2. **Clustering:** Arises from stability conditions. Regions where $\Delta \omega < 0$ (the Laplacian) attract causal density, producing structure without the need for an "arrow of time."
3. **The Cosmic Web:** The filamentary architecture of the universe emerges from the interplay of gradients in ρ and the structural constraints of the equilibrium condition.

V. Discussion

This paper reframes cosmology as a system of structural necessity. By removing time, the model avoids the contradictions inherent in time-dependent models—such as the requirement for inflationary fields or the "Big Bang" singularity. The symbolic system (ω, ρ, ∇) is expressive enough to capture the full breadth of observed large-scale structure through pure mechanics.

VI. Conclusion

Cosmological structure does not require time as a fundamental variable. Paper 2 demonstrates that the causal-mechanical framework is structurally predictive and capable of reproducing observed phenomena without temporal assumptions. Paper 3 will unify these results into a complete, timeless cosmological model.

Author Declarations

Originality & Affiliation:

The author confirms that this manuscript is an original work developed independently and without institutional affiliation. All concepts, formulations, and interpretations are the result of the author's own research and reasoning.

Conflict of Interest:

The author declares no conflicts of interest, financial or otherwise, that influenced the development or presentation of this work.

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