Order, Field and Evolution: A Unified Model of Time, Space and the Fate of the Universe

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Date: 2025-12-08T00:00:00+00:00

Abstract

This paper proposes a unified framework spanning philosophy and astrophysics based on the "gravitational pressure model," aiming to provide an integrative reinterpretation of the three fundamental concepts of time, space, and entropy. The model consists of three mutually supporting pillars: First, time is an abstraction of motion; we argue that time is not an absolute background but rather an order parameter emergent from "general motion" across hierarchical systems ranging from the local (planetary rotation) to the global (cosmic expansion). Second, space possesses a duality of "void" and "interval": "that which has boundaries is called interval, that which has no boundaries is called void." We point out that everyday experience originates from "interval,"whereas the essence of the universe is "void" as an infinite background; the curvature of space in general relativity should be understood as a distortion of the intrinsic geometry of "void," rather than a deformation of the boundaries of "interval." Third, entropy is a hierarchical attribute of systems, existing in systems composed of multiple interactions. We propose a "local renewal" model: through directed resetting (entropy clearance) of high-entropy subsystems, the functional degradation and entropy increase of the total system can be effectively managed and delayed, providing a core philosophy for understanding the persistence of complex systems such as life and civilization. Finally, we integrate the three and infer that the ultimate evolution of the universe may be rooted in the periodic "rippling" of its "gravitational background"—the dark matter field. This model combines the rigor of philosophical speculation with the heuristic value of physical imagery, providing a novel and self-consistent cognitive paradigm for contemplating the order, structure, and destiny of the universe.

Full Text

Order, Domain, and Evolution: A Unified Model of Time, Space, and Cosmic Destiny

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Abstract: This paper proposes a unified framework bridging philosophy and astrophysics, grounded in a "gravitational pressure model," that aims to provide an integrative reinterpretation of three foundational concepts: time, space, and entropy. The model rests upon three mutually supporting pillars. First, time is an abstraction of motion. We argue that time is not an absolute background but rather an emergent order parameter arising from "general motion" across all hierarchical levels, from local (planetary rotation) to global (cosmic expansion). Second, space possesses a dual nature of "void" and "interval" — "boundedness constitutes interval, boundlessness constitutes void." We posit that everyday experience derives from "interval," while the essence of the universe is "void" as an infinite background; spacetime curvature in general relativity should be understood as distortion of the intrinsic geometry of "void," not deformation of the boundaries of "interval." Third, entropy is a hierarchical property of systems, existing only in systems composed of multiple interactions. We propose a "local renewal" model: by directionally resetting high-entropy subsystems (entropy nullification), we can effectively manage and delay functional degradation and entropy increase in the total system. This provides a core philosophy for understanding the persistence of complex systems such as life and civilization. Ultimately, we integrate these three pillars to infer that the ultimate evolution of the universe may be rooted in the periodic "rippling" of its "gravitational substrate" —the dark matter field. This model combines philosophical rigor with physical insight, offering a novel and self-consistent cognitive paradigm for contemplating cosmic order, structure, and destiny.

Keywords: philosophy of time; cosmology; spatial ontology; entropy and information; complex systems; dark matter

Classification Numbers: PACS: 04.50.kd, 95.35.+d, 98.80.-k

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Introduction: At the Boundaries of Cognition

At the boundaries of cognition, we always construct the most unfamiliar things—time, space, the cosmos—from the most familiar concepts. This paper documents and systematizes a profound dialogue on these fundamental notions, distilling from it a unified and self-consistent conceptual model built upon three core pillars: time as abstraction of motion, space as the dialectic of "void" and "interval," and entropy as the hierarchical game of systems. This model seeks to forge ancient philosophical wisdom with modern scientific discoveries, providing

a fresh and illuminating perspective for understanding the grand universe we inhabit.

First Pillar: Time as Abstraction of Motion

Our starting point is an ancient philosophical proposition: "time is the abstraction of motion." Through rigorous discussion, however, this proposition acquires a layered physical meaning that extends from local to global scales. First, regarding measurement and essence: all our attempts to measure time—from the shadow of a sundial to the oscillations of an atomic clock—are ultimately measurements of regular motion. Without motion, the measurement of time would be impossible. Second, moving from local to global: time is not an absolute background but is instead defined and calibrated by the "general motion" of systems at different hierarchical levels. Earth time is unified by Earth's rotation and revolution; solar system time is unified by the orbital dynamics of the solar system; cosmic time is ultimately unified by the expansion motion of the entire universe. Consequently, time is the abstract product and order parameter of "motion" across different levels of the cosmic machine. All time we perceive is but a projection of these motions onto our cognition.

Second Pillar: Space as Dialectic of "Void" and "Interval"

To understand the mystery of "spacetime curvature"in general relativity, we must first clarify the concept of space itself. A crucial distinction lies in differentiating "void" from "interval." First, "boundedness constitutes interval" : this is the space of our everyday experience. A room, a box—these are all "intervals." They are containers with definite boundaries. Second, "boundlessness constitutes void" : this is the essential space of the cosmos. It is not a container but the fundamental background or property of existence. It is boundless and infinite, the stage upon which all things unfold. Third, the universe is "void," not "interval" : modern cosmology holds that the universe likely has no boundaries (or is finite yet unbounded), and therefore its essence is "void." Fourth, the curvature of space: so-called spacetime curvature is not the deformation of an "interval' s" boundaries but rather a change in the intrinsic geometry (metric) of "void" itself, manifesting as coordinated distortions of all local measurement standards.

Third Pillar: Entropy as Hierarchical Game of Systems

Entropy is typically regarded as the arrow pointing toward universal disorder and heat death. Yet our discussion reveals a more dynamic and intelligent landscape. First, the strict definition of a system: entropy must exist within a system, and a system requires two fundamental conditions—binary or greater multiplicity of existence (the foundation for generating complexity), and interactions among these existences (the driving force that integrates multiplicity into a whole and generates non-trivial entropy). Second, hierarchy and local renewal: entropy within a system is stratified. Entropy increase in local subsystems may

lead to their functional failure without necessarily causing immediate collapse of the total system. The core insight is that by "renewing" high-entropy local components—inputting energy and order to nullify their entropy and restart them—we can effectively delay dramatic entropy increase in the overall system. Examples of this principle abound: life maintains organisms through cell turnover, machines extend lifespan through part replacement, and societies rejuvenate through organizational reform. All represent the wisdom of "managing global entropy through local entropy nullification."

Ultimate Integration: The Fate of the Universe—Rippling and Cycling of Dark Matter

Finally, we integrate all three pillars to address the ultimate fate of the universe, proposing a profoundly poetic and imaginative hypothesis. The total entropy of the universe resides in the macroscopic states of dark matter, which serves as the universe's "gravitational substrate." Cosmic evolution is a grand "rippling" of the dark matter field. The universe does not expand infinitely; when it reaches the limit of the expansion phase, expansion halts and prepares to contract. Upon contracting to the limit of the contraction phase, one ripple completes, signifying that the universe has reached its evolutionary endpoint and its total entropy is "reset" to zero. Immediately, another ripple initiates, and a new universe (or new cycle) is born from the dark matter' s compressed phase, beginning the epic of entropy increase anew.

This model extends "time as abstraction of motion" to its ultimate conclusion, positing that the most fundamental cosmic motion is the rippling of dark matter. It treats "space as void" as the infinite background for this rippling. It applies "entropy as systemic property" to the universe as a whole, proposing a cyclical solution beyond heat death. This chain of reasoning, beginning from precise conceptual analysis, ultimately constructs a grand, self-consistent, and vital cosmology. It tells us that time originates from motion, space is essentially void, and entropy is not an irresistible force of destruction but can, to some extent, be intelligently managed and locally reset. Although the final cosmic model still faces scientific challenges—such as the dominant role of dark energy and the physical mechanism of entropy nullification—its value as a thought experiment and philosophical framework lies in its profound heuristic power, unparalleled integrative capacity, and poetic strength in confronting ultimate nothingness.

Note: Figure translations are in progress. See original paper for figures.