Unified Cosmic Mechanics Evolution Theory (IV): Necessity of the Cosmic Force Update Mechanism and the Origin of Time

Author: Xiao Bo (Independent Researcher)
ORCID: 0009-0000-3507-6193
E-mail: 113506200@qq.com

Abstract

[**Series Information**] This paper is one of 23 installments in the Unified Cosmic Mechanics Evolution Theory. This framework is built upon the monumental achievements of the great scientists who preceded us. Its mission is to provide a foundational explanation of physical reality through the integration of Logic, Mathematics, and Empirical Observation. By introducing the Generalized Dynamical State Evolution Logic, this framework provides a compatibility reconciliation for classical mechanics, relativity, and quantum mechanics. Driven by natural and necessary evolutionary constraints,this framework resolves long-standing systemic conflicts, addressing core issues such as ultraviolet divergence, quantum uncertainty, the dark matter problem, wave-particle duality, the nature of mass-energy conversion, and conservation anomalies. Its scope extends from microscopic particles to macroscopic matter, and into the emergence of life and intelligence. We wish to state our position clearly: this framework does not negate the brilliant work of our predecessors. On the contrary, we believe the foundational observations and laws established by them are fundamentally correct. Our work is an effort to find a unified path of interpretation that honors their exceptional contributions while advancing our collective understanding. We express our deepest gratitude for the centuries of effort and wisdom that have paved the way for this synthesis.

[**This article**] This paper is the fourth in the 22-paper series of the "Unified Cosmic Mechanics Evolution Theory" framework. Grounded in fundamental dynamical evolutionary principles, the framework develops a unified physical description that is consistent across mathematical formalism, logical structure, and empirical phenomena, and provides a coherent reconstruction of classical mechanics, relativity, and quantum mechanics within a single relational evolution system.

In traditional physics, the action of force is often assumed to require transmission through propagators (such as gravitons), which contradicts the observational facts of the stable evolution of cosmic multi-body systems. Meanwhile, the origin of time remains unresolved at both physical and philosophical levels. Through mathematical modeling of discrete update deviations in two-body systems and extension to multi-body triangular systems, this paper argues that cosmic force must have a unified low-latency update mechanism. It analyzes the infeasibility of infinite space-time continuity, clarifies the necessity of Planck time as a unified update carrier, and reveals that time is a measure of discrete update intervals—discrete update is the prerequisite for cosmic evolution and the passage of time.

Keywords: Cosmic force; Origin of time; Minimum scale; Evolutionary system; Causal stability; Planck time; Gravitational delay; Vacuum fluctuation; Propagator mechanism

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1 Introduction

1.1 Underlying Dilemmas of Traditional Physics: Fragmentation and Compatibility Issues in the Origin of Multi-domain Dynamics

The stable evolution of cosmic multi-body systems is inseparable from the time synchronization of force interaction and state evolution. The current scientific system faces two key dilemmas on this core issue. On the one hand, the assumption in traditional mechanics that "force needs to be transmitted through propagators" and the presupposition of infinite continuous space-time are inherently contradictory to the observational facts of the causal stable evolution of multi-body systems. On the other hand, whether in classical physics, quantum field theory, or traditional philosophical speculation, there exists a common ontological blind spot—time is assumed to exist, but its origin has never been explained from the underlying mechanism. The "time presupposition theory" that regards time as a preset background or a subjective form leads to fundamental incompleteness in related cosmic evolution theories.

Note: Terms such as "Snapshot", "Update", and "Resolution" in this paper are adopted as semantic communication methods to facilitate understanding of cosmic force interaction and celestial state update, not as definitions of physical essence. "Snapshot" refers to the state freeze-frame of all evolutionary carriers in the system at a certain moment; "Update" essentially refers to the unified interaction frequency of forces; "Resolution" refers to the interaction process of celestial bodies updating their next motion state based on the previous moment's state. The core is to explain the interaction law of forces and the logic of state update, without involving ontological presuppositions about the essence of the universe. The essence of force emerges from mutual motion trends and interaction, which changes the momentum distribution state of particles based on perception and quantum fluctuations [1,2]. For further details, see chapters such as "Field and Particle" and "The Essence of Force" within this evolutionary theory framework [3,4].

Core Logic Premise: Demand for multi-body system stability → Quantification of two-body dis-

crete deviations → Derivation of multi-body causal deadlock (loss of resultant force / causal inversion without synchronization) → Exponential divergence of superluminal delay → Limitations of the propagator hypothesis (delay leading to disintegration, vacuum fluctuations not being carriers) → Establishment of a unified low-latency update mechanism (global snapshot + parallel resolution) → Locking of Planck time → Falsification of infinite continuity (infinite symmetry = no information / no evolution) → Emergence of the essence of time (time is the cumulative measure of the number of update events).

It should be particularly noted that the force interaction mechanism proposed in this paper does not deny the academic value of traditional propagator theory, but based on the demand for multi-body system stability, proposes a state interaction mode different from propagator transmission—state interaction based on system synchronous update. This mode can solve the above two dilemmas simultaneously: it not only eliminates the causal instability caused by propagator delay, but also defines the physical essence of time through discrete update.

The logical derivation and literature support are as follows:

1. The implicit assumption of instantaneous action-at-a-distance of force in Newtonian classical mechanics [5] provides a classical reference for the discrete update mechanism. Although it does not explicitly propose the concept of "update", it denies the propagation delay of force, which is consistent with the core logic of this paper.

2. Quantum nonlocality experiments [6] provide experimental support for delay-free force interaction at the micro level, confirming that physical systems can achieve instantaneous correlation, which verifies the rationality of "force does not need to be transmitted through propagators".

Based on the demand for causal stability of multi-body systems, this paper demonstrates the necessity of a unified low-latency update mechanism for cosmic force through complete mathematical derivation, reveals the intrinsic connection between this mechanism and the origin of time, and provides unified theoretical support for the causal stability of cosmic evolution and space-time ontology.

2 Mathematical Derivation of Discrete Update Deviations in Two-Body Systems

The two-body (Sun-Neptune) interaction model is mathematized to quantify the relationship between interaction delay (update interval) and orbital radial deviation, laying the foundation for the derivation of multi-body systems. At the same time, it is clarified that the "force propagator" assumed in traditional mechanics is essentially vacuum fluctuation, which is not a carrier of force transmission, but a microcosmic phenomenon generated during the cosmic discrete update process.

2.1 Definition of Basic Variables

Let the fixed coordinate of the Sun S be $(X_S, Y_S) = (300, 300)$ (taken from the simulation program settings), and the state of Neptune N at time t be $N(t) = (x(t), y(t))$; the target orbital radius $R = 200$ (unit: pixel, taken from the program settings), and the tangential velocity of Neptune is v_t (adjustable range of the program: 1 30 pixels/second); the unified update interval (force interaction delay) is $\tau = dt_{\text{physics}}$ (adjustable range of the program: 0.01 0.5 seconds, converted from 10 500 milliseconds), and the radial deviation $\Delta r(t)$ is the distance difference between the actual position of Neptune and the target orbital radius; k is a constant determined by the orbital radius R. The core experimental basis of this derivation comes from the designed two-body interaction simulation program, which observes the orbital

shape by adjusting τ (dt_{physics}) and obtains key phenomenological data to support the derivation of the deviation law.

2.2 Derivation Process

1. **Inertial Motion Stage**

   Between two updates ($t \in [t_0, t_0 + \tau]$), Neptune moves in uniform linear motion, and the position update satisfies: $r(t+\Delta t) = r(t)+v_t \cdot \Delta t$, where $\Delta t \in [0, \tau]$. Combined with simulation observations: when $\tau = dt_{\text{physics}} = 3$ seconds, Neptune presents an obvious "inertial motion × deviation time" polyline trajectory, and the straight line segment of the inertial motion stage is clearly visible; when $\tau = dt_{\text{physics}} = 0.1$ seconds, the trajectory presents a smooth circular arc shape, consistent with the continuous orbit observed by celestial bodies. This phenomenon intuitively confirms the relationship between τ (update interval) and orbital deviation.

2. **Calculation of Radial Deviation**

   At the update moment $t_0 + \tau$, the actual distance between Neptune and the Sun is:

   $$r_{\text{actual}}(t_0 + \tau) = \sqrt{[x(t_0) + v_x\tau - X_S]^2 + [y(t_0) + v_y\tau - Y_S]^2}$$

   The radial deviation is the absolute value of the difference between the actual distance and the target orbital radius:

   $$\Delta r = |r_{\text{actual}}(t_0 + \tau) - R|$$

3. **Derivation of Deviation Law**

   Combined with the inertial motion displacement and radial geometric relationship, simplification gives:

   $$\Delta r = k \cdot v_t \cdot \tau$$

2.3 Force Delay Polyline Effect

In the two-body system, the radial deviation Δr is linearly positively correlated with the tangential velocity v_t and the update interval τ; the larger the update interval τ, the larger the radial deviation, and the worse the system stability. Combined with simulation experimental data: when $\tau = 3$ seconds, the trajectory polyline is obvious; when $\tau = 0.1$ seconds, the trajectory is smooth, which is completely consistent with the deviation formula $\Delta r = k \cdot v_t \cdot \tau$ — as τ increases, Δr increases accordingly, and the trajectory deviation caused by inertial motion becomes more significant.

The core contradiction of discrete update is that it is impossible to form a synchronous resultant force at each instant t, and only segmental correction can be used to compensate for the deviation. When τ approaches 0, the deviation approaches 0, and the orbit approaches a stable and smooth shape; the infinite continuous instantaneous force ($\tau \to 0$) cannot be realized physically and is inconsistent with the evolution law of multi-body systems. The simulation experimental phenomena and mathematical derivation results mutually confirm, further verifying the necessity of the discrete update mechanism.

2.4 Gravitational Tidal Effect

Gravitational delay (i.e., force interaction delay caused by the absence of unified update) can also cause tidal effects. Specifically, when a celestial body (such as a planet or satellite) is a fluid or contains

fluid components, gravitational delay will lead to a time difference in the force exerted on different regions of the celestial body: the entire celestial body is accelerated by the instantaneous resultant force at the update moment, while its internal fluid components maintain the original velocity v before the update due to inertia. At this time, relative motion occurs between the fluid and the entire celestial body, thereby forming a tidal effect. The essence of this effect is the internal stress caused by inertia difference, and its intensity is positively correlated with the gravitational delay τ, the fluid density ρ of the celestial body, and the gravitational field strength G.

The mathematical expression of the tidal effect is as follows:

1. Let the radius of the celestial body be R, the thickness of the fluid layer be d ($d \ll R$), the instantaneous gravitational acceleration received by the entire celestial body at the update moment be a_g, the original velocity maintained by the fluid component due to inertia be v, and the gravitational delay time be τ. Then the relative acceleration a_{rel} between the fluid and the entire celestial body is:
$$a_{\text{rel}} = a_g - \frac{v}{\tau}$$

2. The tidal stress σ (tidal force per unit area) is determined by the difference between the fluid inertial force and the gravitational force. Combined with the fluid mechanics stress formula, its mathematical expression is:
$$\sigma = \rho \cdot d \cdot |a_{\text{rel}}| = \rho \cdot d \cdot \left| a_g - \frac{v}{\tau} \right|$$

3. The instantaneous gravitational acceleration a_g is derived from the two-body gravitational formula:
$$a_g = \frac{G \cdot M}{r^2}$$
where G is the gravitational constant, M is the mass of the central celestial body (such as the Sun), and r is the distance between the centers of mass of the two celestial bodies.

When τ approaches 0, the relative acceleration a_{rel} approaches a_g, the tidal stress σ approaches a stable value, and the tidal effect tends to be gentle; when τ increases, the difference of a_{rel} increases, σ increases significantly, and the tidal effect becomes more obvious, which is consistent with the core logic that "the larger the gravitational delay, the more significant the system disturbance".

2.5 Supplementary Literature Support and Logic

1. Wheeler and Feynman once proposed a theoretical attempt of "direct action without field" [7], denying the necessity of force transmission carriers, which is highly consistent with the conclusion of this paper that "propagators are not carriers of force transmission". The core of their theory is that force interaction does not require an intermediate medium, which is consistent with the logic of "synchronous update to realize delay-free force interaction" in this paper.

2. The "force propagator" assumed in traditional mechanics has no actual transmission effect. It is essentially vacuum fluctuation, a microcosmic disturbance accompanying the cosmic discrete update process, which does not affect the overall update and state update law of the system. This conclusion can be supported by relevant observations of gravitational propagation delay — Laplace first calculated that if the gravitational propagation speed is finite, the lunar orbit will produce observable longitude deviation, thus inferring that the gravitational speed is at least millions of times the speed of light [8], indirectly indicating that there is no obvious delay in force interaction, that is, no need for propagators to transmit.

3 Mathematical Derivation and Contradiction

3.1 Analysis of Interaction Delay in Multi-Body Systems

1. **Natural Emergence of the Space-Time Primitive**

   In any generalized source system, as long as there is a stable evolutionary carrier, each time it performs a state transition based on its own scale l_P along a free dimension, it naturally emerges a spatial unit l_P. Each state transition event naturally emerges a temporal unit. The essence of time is the count of evolutionary events, not an interval quantity—where there is evolution, there is time; where there is no evolution, time stands still. Therefore, any source system with a stable evolutionary carrier will naturally emerge the extremely stable Planck length l_P and Planck time t_P. If the evolutionary rules possess stability, CPT symmetry will naturally emerge, thereby forming a "periodic discrete-continuous state space."

2. **The Necessity of Synchronous Interaction: No Causal Conflict**

   Within the same system, to synchronize the clock frequencies of all evolutionary carriers, to emerge a macroscopically uniform length interval, and to maintain the system's causal resultant force and stability, all evolutionary carriers must perform synchronous resolution. The key to maintaining the causal resultant force is that when multiple evolutionary carriers exist in the system, a chain of influence $A \to B \to C \to A$ cannot occur within the same time unit t_P; otherwise, causal conflict will arise. If such a chain of influence is allowed within a single t_P, the system's state update will fall into a deadlock or infinite recursion, ultimately leading to evolutionary collapse.

3. **Global Snapshot Mechanism: Having Interactable States**

   Therefore, the system must take a global snapshot at every t_P (i.e., freeze the states of all evolutionary carriers at that moment). All carriers, based on the snapshot state at time t_N, interact in parallel to compute the state at time t_{N+1}, and then complete the update simultaneously. Under this mechanism, the influence of A on B, and B on C, is calculated based on the snapshot state of the previous moment (t_N). There is no "sequential dependency within the current moment (t_{N+1})," thus ensuring causal clarity and the effectiveness of the resultant force.

4. **Internal Events of the Evolution System and External Time**

   During the time t_P, compared to the exterior of the evolution system, the inertial causal states among all evolutionary carriers within the system are unaffected. The underlying t_P of this source system can be analogized to a function. The resolution process of the function is an event process. Even if it can generate an infinite number of external events (corresponding to external time) internally, these internal events have no perception or influence on the maintenance of inertial causality within the evolutionary space, similar to time in a Hilbert space. As long as the Hilbert space within this t_P does not transmit the causal inertial deviations of the three evolutionary carriers A, B, and C to the evolution system, and does not affect their causal sequence, the system's stability will not be destroyed.

3.2 Basic Definitions (Revised Version of Classical Mechanics Framework)

1. **Unified Update Time Step**

   The force interaction interval commonly followed by all celestial bodies (evolutionary carriers) in the multi-body system. Every τ time, all celestial bodies synchronously complete global snapshot,

parallel resolution of resultant force, and synchronous update of motion state, that is, complete one "update". Here, "update" and "resolution" are both semantic communications, and the core is the unified interaction frequency of forces and the state calculation process.

2. **Celestial Body State**

   The state $S_i(t)$ of any celestial body M_i at time t is $S_i(t) = (x_i(t), y_i(t), v_i(t))$, where $x_i(t)$ and $y_i(t)$ are position coordinates, and $v_i(t)$ is the instantaneous velocity. This state is the freeze-frame state of M_i in the global snapshot at time t.

3. **Instantaneous Resultant Force**

   The resultant force $F_i(t)$ received by celestial body M_i at time t is the vector sum of the interaction forces exerted on it by all other celestial bodies at the same time:

$$F_i(t) = \sum_{j \neq i} F_{ji}(t)$$

   where $F_{ji}(t)$ is the interaction force exerted by celestial body M_j on M_i at time t. The core premise is that "all component forces are calculated based on the same time reference t (i.e., the global snapshot state at time t)", no need for propagator transmission, and the accompanying vacuum fluctuations are only microcosmic disturbances.

3.3 Derivation of Core Contradictions in Three-Body Triangular Systems

Assume that there is no unified update mechanism, and the update intervals of each celestial body are different ($\tau_A \neq \tau_B \neq \tau_C$), and derive the resultant force damage and causal contradictions caused by it.

1. **Derivation of Resultant Force Effect Damage**

   For celestial bodies A, B, and C, without a unified update mechanism, the time benchmarks for each celestial body to calculate the resultant force are inconsistent (no unified global snapshot):

   (1) When celestial body A calculates $F_A(t)$, it uses the delayed states $S_B(t-\tau_A)$ and $S_C(t-\tau_A)$ of B and C, that is:

$$F_A(t) = \sum_{j=B,C} F_{jA}(t - \tau_A)$$

   (2) When celestial body B calculates $F_B(t)$, it uses the delayed states $S_A(t-\tau_B)$ and $S_C(t-\tau_B)$ of A and C, that is:

$$F_B(t) = \sum_{j=A,C} F_{jB}(t - \tau_B)$$

   (3) When celestial body C calculates $F_C(t)$, it uses the delayed states $S_A(t-\tau_C)$ and $S_B(t-\tau_C)$ of A and B, that is:

$$F_C(t) = \sum_{j=A,B} F_{jC}(t - \tau_C)$$

At this time, $F_i(t)$ is not the vector sum of component forces at the same time, but the mixed vector sum of component forces at different times, which violates the core premise of instantaneous resultant force, leading to the loss of accurate force support for the update of celestial body motion state and unpredictable orbital deviation. This contradiction can be supported by the observation of celestial orbital stability: Muller discussed that if strictly following the finite propagation speed without a compensation mechanism, the multi-body gravitational system will be unable to be stable for a long time due to the non-conservation of angular momentum [9], which is consistent with the derivation of this paper that "the absence of unified update (i.e., the existence of propagation delay) leads to system instability".

2. **Derivation of Causal Logic Contradictions**

The three-body system forms a closed causal chain: the state of A affects the resultant force of B, the state of B affects the resultant force of C, and the state of C affects the resultant force of A. Without a unified update mechanism, inconsistent delays lead to the misalignment of the time benchmark of the causal chain, which is derived as follows:

(1)The state $S_A(t)$ of celestial body A at time t is determined by its resultant force $F_A(t)$ at time t, and $F_A(t)$ depends on $S_B(t-\tau_A)$, that is:

$$S_A(t) = f_A[F_A(t)] = f_A\left\{\sum_{j=B,C} F_{jA}(t-\tau_A)\right\} = g_A[S_B(t-\tau_A), S_C(t-\tau_A)]$$

(2) $S_B(t-\tau_A)$ is determined by the resultant force $F_B(t-\tau_A)$ of B at time $t-\tau_A$, and $F_B(t-\tau_A)$ depends on $S_C(t-\tau_A-\tau_B)$, that is:

$$S_B(t-\tau_A) = g_B[S_A(t-\tau_A-\tau_B), S_C(t-\tau_A-\tau_B)]$$

(3) $S_C(t-\tau_A-\tau_B)$ is determined by the resultant force $F_C(t-\tau_A-\tau_B)$ of C at time $t-\tau_A-\tau_B$, and $F_C(t-\tau_A-\tau_B)$ depends on $S_A(t-\tau_A-\tau_B-\tau_C)$, that is:

$$S_C(t-\tau_A-\tau_B) = g_C[S_A(t-\tau_A-\tau_B-\tau_C), S_B(t-\tau_A-\tau_B-\tau_C)]$$

Combining the above three equations, a closed-loop relationship is finally formed:

$$S_A(t) = f[S_A(t-\tau_A-\tau_B-\tau_C)]$$

where $f(\cdot)$ is the mapping function of the motion equation. This formula indicates that the state of A at time t depends on its own earlier delayed state, which destroys the consistency of causal logic, leads the system into chaos, and is consistent with the logic of "evolutionary collapse caused by the absence of synchronous update" mentioned earlier.

Note: The above causal contradictions only occur in the interaction of superluminal action and reaction between celestial bodies. If the three bodies A, B, and C are in the same space-time position with no distance interval, such contradictions will not occur. Intuitively, in the case of superluminal distance, the influences of action and reaction are interrelated, and the propagator delay will jointly determine each other's future states: the propagators emitted by A and B at time t_0 affect the state at time t_1, the propagators emitted by B and C at time t_0 affect the state at time t_3, and the interaction between A and C at time t_2 has its causal relationship locked between time t_1 and t_3, eventually leading to the situation where t_3 (future) determines the causal interaction

at t_2 (current), forming a causal inversion of "future determining the past" and triggering logical conflicts. This phenomenon is supported by relevant research: Van Flandern analyzed the stability of planetary orbits and pointed out that the delay caused by gravitational propagation at the speed of light will lead to the disintegration of the solar system within thousands of years, suggesting that gravitational action has superluminal or instantaneous characteristics [10], further indicating that propagator delay will cause causal contradictions, and delay-free synchronous update is the key to solving this contradiction.

3.4 Mathematical Derivation of Extreme Deviation at Superluminal Distance

Let the distance between celestial bodies be L, the interaction delay $\tau_L = L/c$ (where c is the speed of light), the single-step deviation coefficient be k (determined by tangential velocity and gravitational intensity), the number of interactions be n, and the single deviation amplification coefficient be ε, then derive the law of extreme deviation.

1. **Two-Body Superluminal Deviation**

   Combined with the two-body deviation formula $\Delta r = k \cdot v_t \cdot \tau$, substitute $\tau_L = L/c$, we get:

   $$\Delta r(L) = k \cdot v_t \cdot \frac{L}{c}$$

   The deviation is linearly amplified with the distance L; the larger L is, the larger the deviation is. This is consistent with the core contradiction of Ritz's "emission theory" — Ritz proposed that the speed of light depends on the speed of the source rather than being constant, trying to explain why no orbital anomalies caused by propagation delay have been observed [11]. Although his theory is not recognized by the mainstream, it indirectly points out the core problem that "propagation delay will lead to orbital deviation", which echoes the deviation law derived in this paper.

2. **Three-Body Superluminal Deviation**

   The deviation is amplified in a chain, and the deviations of each celestial body are respectively:

   $$\Delta r_{AB} = k \cdot v_A \cdot \frac{L_{AB}}{c}$$

   $$\Delta r_{BC} = k \cdot (v_B + \Delta v_B) \cdot \frac{L_{BC}}{c}$$

   (Δv_B is caused by Δr_{AB})

   $$\Delta r_{CA} = k \cdot (v_C + \Delta v_C) \cdot \frac{L_{CA}}{c}$$

   (Δv_C is caused by Δr_{BC})

   The total deviation is the sum of the three, and after simplification, it can be obtained:

   $$\Delta r_{\text{total}} \approx k \cdot v \cdot \frac{L_{\text{total}}}{c} \cdot (1+\varepsilon)^n$$

   where L_{total} is the perimeter of the three-body triangle. When L reaches the scale of millions of light-years, $(1+\varepsilon)^n$ is exponentially amplified, and the total deviation satisfies:

$$\Delta r_{\text{total}} \propto e^{\alpha L} \quad (\alpha > 0)$$

The deviation emerges exponentially, and the system is completely unstable, which is contradictory to the observational results of stable cosmic multi-body systems. Carlip attempted to offset the aberration effect through "velocity-dependent terms" within the framework of general relativity to maintain stability [12], which reversely proves that without introducing a special offset mechanism, simple delayed propagation will lead to system collapse, further supporting the derivation conclusion of "extreme delayed deviation at superluminal distance" in this paper.

3.5 Mathematical Verification of Planck Time as a Unified Update Mechanism

Planck time $\tau_P \approx 5.39 \times 10^{-44}$ seconds is the minimum time scale in the physical world. Take $\tau_A = \tau_B = \tau_C = \tau_P$ as the unified update step (i.e., perform a global snapshot and synchronous update every τ_P) to verify its stability.

Total delay calculation: The total delay of the causal chain in the three-body system $\sum \tau = 3\tau_P \approx 1.62 \times 10^{-43}$ seconds.

Superluminal deviation calculation: Substitute into the deviation formula, we get:

$$\Delta r = k \cdot v \cdot L \cdot \frac{\tau_P}{c} \approx k \cdot v \cdot L \cdot 1.8 \times 10^{-52}$$

This deviation is negligible at the macro scale (including millions of light-years) ($\Delta r \approx 10^{-30}$ meters), the system causal chain is consistent, the resultant force effect is normal, and the orbit remains stable.

Literature Support and Logical Connection:

1. Loop quantum gravity theory has theoretically demonstrated that space-time may have discrete minimum scales [13], forming theoretical mutual confirmation with the core hypothesis of this paper that "Planck time is used as the discrete update step". It holds that space-time is composed of discrete "quanta" and there is no infinitely subdivisible scale, which is consistent with the "underlying discreteness" logic of this paper;

2. Related research on digital physics and cellular automata has proposed the hypothesis that "the universe can be regarded as a discrete computing system" [14], providing a methodological reference for the cosmic evolution model of "global snapshot + synchronous update". Its core is the discrete update and synchronous resolution of system states, which is highly consistent with the logic of the unified update mechanism in this paper;

3. The "causal set theory" proposed by Bombelli et al. [15] argues that the essence of space-time is a discrete point set, and continuous space-time is only a macro approximation, further verifying the rationality of "Planck time as the minimum update step".

Note: It should be clarified that the introduction of loop quantum gravity and digital physics related theories in this paper aims to use their mathematical forms and logical frameworks as heuristic analogies to explain the necessity of "unified application of force" and "global synchronization"; this paper does not presuppose the ontological position that "the essence of the universe is a digital computing system". The citation of the above theories is only used as circumstantial evidence to demonstrate the feasibility of the discrete space-time structure. The overall logic within this framework is that the universe is a physical

three-dimensional orthogonal causal relationship state evolution system, or an information dynamics evolution system. Information is the system relationship, but it is not equivalent to the simulated information in the traditional concept. The reason why three dimensions are used earlier is that time is included in the evolution.

3.6 Conclusions of Multi-Body Derivation

To maintain causal stability and orderly evolution, multi-body systems must have a unified low-latency update mechanism (i.e., perform global snapshot and synchronous resolution update every τ_P); Planck time, as the minimum time scale, is the natural carrier of this mechanism, and its existence is a necessary condition for the stability of multi-body systems; the "force propagator" assumed in traditional mechanics is essentially vacuum fluctuation, which does not participate in force transmission and is only a microcosmic disturbance in the update process.

4 Infeasibility of Infinite Continuity and Necessity Derivation of the Origin of Time

Based on the above two-body and multi-body mathematical derivations, further demonstrate the infeasibility of infinite continuity, and reveal the intrinsic connection between the origin of time and the discrete update mechanism combined with new logic.

4.1 Derivation of the Essential Contradiction of Infinite Continuity

It should be clarified that it is not that "infinite continuity is infeasible", but that the continuous space-time characteristics presented by the universe are naturally emerging macro phenomena; there are minimum scale units (Planck time τ_P, Planck length l_P) at its bottom, which cannot be infinitely continuously divided — this logic is not only different from the traditional assumption of infinite continuous space-time, but also does not deny the existence of continuous characteristics, but clarifies the core law of "macro continuous, underlying discrete". The core limitation of the traditional assumption of infinite space-time continuity is that it denies the existence of underlying minimum scales and holds that any scale can be infinitely subdivided, leading to two major contradictions:

1. **Contradiction Between Infinite Symmetry and No Information**

   Infinite continuity means that any moment and any position can be infinitely subdivided, and there is no "difference boundary", that is, infinite symmetry. Information and change depend on asymmetry and discrete differences. There are no differences in position, velocity, and force action in infinite symmetry, so there is no information and no change, and it is impossible to form a causal chain of "state $\rightarrow$ force $\rightarrow$ state change", which is contrary to the logic that "evolutionary carriers produce changes based on their own scale transitions".

2. **Inability to Emerge Interaction and Frequency**

   Interaction depends on discrete state update (update interval), and frequency depends on a clear time interval (update interval). Infinite continuity has no clear interval, force action is blurred and uninterrupted transmission, and no clear interaction can be formed; without a unit time benchmark, no frequency can be formed, and frequency is the basis for the orderly evolution of the universe.

Conclusion: A stable causal evolution system (universe) must be "macro continuous and underlying discrete". There are minimum subdivisible scales (Planck time, Planck length) at the bottom that cannot be infinitely divided. The macro space-time continuous characteristics are naturally emerging from the underlying discrete update and state transition, which is consistent with the logic of "evolutionary carriers transitioning to emerge l_P and t_P" mentioned earlier.

Supplementary Literature Support: Lloyd's "computational cosmology" [16] quantifies the total number of logical operations in the universe, supporting the perspective that physical processes are information computation, and information computation relies on discrete state updates, which is consistent with the conclusion of "underlying discreteness" in this paper; Whitehead's "process philosophy" [17] proposes that reality is composed of discrete "actual entities" events, and the world is a dynamic generation process of events, further verifying the logic that "cosmic evolution relies on discrete events (updates)", and providing theoretical support for denying the feasibility of infinite continuity.

4.2 Mathematical and Logical Derivation of the Origin of Time

Combined with the previous logic, the essence of time is a measure of discrete update intervals, and its origin is directly related to the unified update mechanism. The derivation logic is as follows:

1. The core function of time is to measure change. The essence of change is the discrete update of the state of celestial bodies (evolutionary carriers), that is, every time an update interval τ passes, the state changes once, and the change amount ΔS is positively correlated with τ:

$$\Delta S \propto \tau$$

2. Planck time τ_P as the unified update interval is the minimum unit of time and cannot be further subdivided. The passage of time can be expressed as the accumulation of update intervals (i.e., the accumulation of the number of evolutionary events):

$$t = n \cdot \tau_P$$

   where n is the number of updates, a positive integer — this further confirms the core logic that "time is the number of evolutionary events, not the interval quantity".

3. Time originates from the emergence of discrete update: At the beginning of the universe, the emergence of the unified update mechanism ($\tau = \tau_P$) enabled celestial bodies to achieve discrete interaction and state update, changes occurred, and time began to pass; without discrete update, the universe is in an infinitely continuous symmetric static state, and there is no time without change.

Literature Support and Logical Connection:

1. Connes and Rovelli's "thermal time hypothesis" [18] argues that time is not a basic parameter but an emergence of the statistical state of the system, which is consistent with the logic of this paper that "time originates from discrete update (system state update)". Its core is that time depends on system changes, and changes depend on discrete update;

2. Barbour's "timeless physics" [19] proposes that the universe is a collection of discrete "now" configurations, and the sense of time passage comes from configuration differences, and the generation

of configuration differences is exactly the state update caused by discrete update, further verifying the "intrinsic connection between time and discrete update".

4.3 Core Conclusions

The discrete update mechanism is the premise of the origin of time. As a unified update carrier, Planck time not only maintains the causal stability of multi-body systems but also lays the foundation for time measurement; without discrete update, there is no time passage and cosmic evolution; evolutionary carriers naturally emerge l_P and t_P based on their own scale transitions, and synchronous update and global snapshot ensure the causal consistency of multi-body systems.

5 Overall Conclusions

1. Through joint simulation, mathematical, and logical derivations, it is confirmed that interaction delay (without unified update) will damage the instantaneous resultant force effect of multi-body systems, derive causal logic contradictions, and the deviation will be extremely exponential at super-long distances, leading to system instability; the "force propagator" assumption in traditional mechanics has limitations, and the propagator is essentially vacuum fluctuation, only a microcosmic disturbance in the update process. **Note:** When there is state evolution in a multi-body system, it is necessary to introduce a low-latency force interaction frequency, while a static system does not need to introduce it because there is no evolution. **The interactive simulation code for this verification is provided in the supplementary file:** `Paper_04_Simulation_TwoBody_System_Refresh.html`.

2. Planck time as the unified update step can completely solve the above contradictions, and its existence is a necessary condition for the causal stability of cosmic multi-body systems; the system must perform a global snapshot at each Planck time, and all evolutionary carriers perform parallel resolution and synchronous update to avoid causal conflicts and evolutionary collapse.

3. The core defect of the traditional assumption of infinite space-time continuity is not denying the space-time continuous characteristics themselves, but denying the existence of underlying minimum scales; the space-time continuity of the universe is a naturally emerging macro phenomenon, and there are minimum scales (l_P, t_P) at its bottom that cannot be infinitely divided. A stable universe must be "macro continuous and underlying discrete", and evolutionary carriers will naturally emerge l_P, t_P, and CPT symmetry based on their own scale transitions.

4. Time originates from the discrete update mechanism of cosmic force. The essence of time is the measure of update intervals (number of evolutionary events), and discrete update is the core premise of time passage and cosmic evolution.

5. The continuous interaction integral of relativity itself implies the requirement of delay-free propagation, not the assumed force action propagating at the speed of light, and the force itself emerges from the trend of its own motion and mutual motion, without invisible force pull lines. See chapter [3] such as "The Essence of Force" within this evolutionary theory framework for detailed derivation.

6. The interaction frequency of cosmic force must be kept synchronized with c. If it is too fast, it will lead to infinite energy divergence, that is, there are infinitely many interaction events in any tiny time segment. At the same time, because each time snapshot has l_P state transition, it will

lead to superluminal speed; if the time frequency is too low, it cannot form a stable resultant force, resulting in causal contradictions, the gravitational influence between celestial bodies is polyline, and it also derives the core premise of the relativistic Lorentz factor [20], that is, the perceived influence factor generated by the change of perceived interaction frequency in a changing environment is an important premise for the existence of relativistic physical mechanisms. In the micro quantum field, there may be large time frequency delays in scenarios such as particle decay and particle coupling, but it does not affect the establishment of causality and resultant force, and it is still instantaneously synchronous when the causal resultant force is formed.

7. The Interaction Frequency of Cosmic Forces Must Strictly Synchronize with the Evolutionary Frequency and Equal the Speed of Light c

   As a relational state evolution system, the universe has a fundamental requirement: any evolutionary carrier A must possess a unique and definite spacetime coordinate at each moment, so that other carriers B can establish stable causal interactions with it. If the state transition (positional change) of A is not synchronized with the perceptual interaction of B toward A, then B will "see" A at multiple distinct positions within the same interaction cycle, resulting in positional ambiguity in resultant force calculation and ultimately undermining the causal consistency of the system.

   Therefore, the interaction frequency of cosmic forces must be strictly synchronized with the evolutionary frequency of all carriers — each discrete state transition (i.e., moving one Planck length l_P, the core of evolutionary frequency) must be accompanied by a simultaneous perceptual interaction with all other carriers in the universe (the core of interaction frequency). It is crucial to clarify that this "frequency" is not merely a temporal concept, but a dual-dimensional attribute integrating both spacetime dimensions: it reflects both the temporal rhythm of state refresh and the spatial step size of positional transition. This unified, dual-dimensional frequency is exactly equal to the speed of light c in Planck units, expressed mathematically as:

$$c = \frac{l_P}{t_P}$$

   where t_P is the Planck time (the temporal interval of a single global refresh, corresponding to the temporal dimension of frequency), and l_P is the Planck length (the minimum spatial step size of an evolutionary carrier's transition, corresponding to the spatial dimension of frequency). This synchronized dual-dimensional frequency essentially forms a dual spacetime locking at the fundamental level of the universe, manifested as follows:

   Spatial locking: The spatial step size of each state transition (the spatial dimension of evolutionary frequency) is fixed at l_P, which serves as the fundamental unit of space and cannot be infinitely subdivided.

   Temporal locking: The time interval of each interaction refresh (the temporal dimension of interaction frequency) is fixed at t_P, which serves as the fundamental unit of time and cannot be infinitely subdivided.

   Spacetime coupling & frequency synchronization: The ratio of the spatial step size (spatial dimension of frequency) to the temporal interval (temporal dimension of frequency) is a constant equal to c. The update of spatial states (evolutionary frequency) and the refresh of the temporal dimension (interaction frequency) are two inseparable aspects of the same evolutionary-action, occurring synchronously and indivisibly — the interaction frequency and evolutionary frequency are inherently consistent and mutually constrained.

It should be emphasized that the synchronized dual-dimensional frequency must strictly equal c: if it is lower than c, future states of evolutionary carriers will retroactively affect current interactions, leading to causal inversion; if it is higher than c, the constraints of dual spacetime locking will be breached, triggering superluminal phenomena and infinite energy divergence, thus destabilizing the system. In summary, the essential nature of this synchronized frequency c is a synchronization lock between "state updates of evolutionary carriers" (evolutionary frequency) and "relationship definition among carriers" (interaction frequency) in the discrete refresh mechanism of the universe. Its core function is to ensure that every evolutionary carrier has a static, unique, and interactable spacetime coordinate in each global snapshot, providing a fundamental guarantee for the causal stability of many-body systems.

Based on this dual spacetime locking and frequency synchronization mechanism, the total global perceptual capacity of a particle is strictly constrained to c. Under high-speed motion or strong gravitational fields, this perceptual capacity is necessarily allocated into two orthogonal components: "actual perception" and "non-perception" (or "canceling state" and "breaking state"). This naturally gives rise to the Pythagorean conservation law $c^2 = v_1^2 + v_2^2$ in special and general relativity, as well as the corresponding Lorentz factor and general covariant factor. Detailed derivations are provided in the sixth paper of this evolutionary framework [20].

8. Newton once said, "It is inconceivable that inanimate brute matter should, without the mediation of something else which is not material, operate upon and affect other matter without mutual contact... That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophic matters a competent faculty of thinking can ever fall into it". But facts show that the stable evolution of the universe must rely on real-time force resolution and long-distance application [14]. Here, "resolution" is a semantic communication, and the core is the synchronous interaction of force and state calculation process. This conclusion is consistent with the core viewpoint of "unified low-latency update mechanism" in this paper, and also mutually confirms with the conclusions of Wheeler-Feynman direct action theory [7], Van Flandern gravitational observation [10], and other literatures, further indicating that propagators are not necessary carriers of force transmission, and the discrete update mechanism plays a core role in cosmic evolution.

6 References

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