

Unified Cosmic Mechanics Evolution Theory (III): Cosmic Evolution Rules

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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.

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[**This article**] This paper is the Third 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.

Based on the framework of information dynamics evolution theory, this paper introduces the generalized state evolution system (information dynamics evolution system) and evolutionary resources (evolutionary carriers and driving forces), and further introduces evolution rules into the evolution system. It jointly demonstrates the necessary premises of evolution rules and physical mechanisms such as emergence phenomena. The essence of evolution rules is a fixed protocol that establishes constraints on evolution methods for independent resources that are not subordinate to each other; this paper reconstructs the physical connotation of unitarity, defining it as a mathematical guarantee for the conservation of underlying momentum resources and the completeness of causal logic, rather than the traditional probability conservation. The core viewpoints of this paper include: the stability of rules naturally emerges CPT symmetry and mathematical systems; multi-layered encapsulation constructs hierarchical structures under resource conservation, but the underlying resources are non-decayable; the asymmetry of rules realizes complex evolution and energy storage mechanisms; the stability of rules and resource inertia jointly lock the unidirectionality of time and causality. This study points out that physical concepts such as space-time, force, and energy are not basic entities, but emergent results of state relationships under rule constraints. This theory does not need to introduce external traditional theoretical axioms, and constructs a complete dynamic picture from discrete independent resources to a dynamically ordered universe.

Keywords: Origin of mathematics; Unified cosmic mechanics; Essence of CPT symmetry; Essence of emergence; Origin of time; Essence of field; Unified field theory

1 Introduction

Note: To be compatible with the mathematical expression of traditional theories, all physical formulas in this paper also adopt traditional dimensional expressions. In Section 5 and subsequent sections within the framework, force, energy, and momentum are completely reduced to the underlying integral of momentum only, that is, only the linear integral of inertia, where force = energy = momentum = mv (upper limit mc). For detailed derivation, see the chapters on the reconstruction of dynamic relationships of basic physical dimensions and the essence of force in this framework [1,2,3].

Based on the observation of macro and micro phenomena, traditional physics has constructed mature mathematical systems such as relativity, quantum mechanics, and the standard model. Its core advantage lies in accurately fitting observation facts in different fields through domain-specific modeling (such as Riemannian geometry, gauge field theory, and Lie group structure $SU(3) \times SU(2) \times U(1)$), with extremely high experimental prediction accuracy. However, existing theories are established in separate domains, and there is still room for integration in the unified derivation of underlying dynamic mechanisms, which is specifically reflected in four aspects:

1. Symmetry construction relies on Noether's theorem and preset Lagrangian symmetry, which is

an effective mathematical construction at the phenomenological level, and does not deduce its emergence process from underlying discrete units [4];

2. The traditional view regards mathematics as a priori entity, while from the dynamic perspective, mathematics can be regarded as a natural emergence of the stability of system evolution rules, which is an intrinsic projection of rules [5];
3. The probabilistic expression of unitarity in quantum mechanics can be supplemented from the perspective of underlying resources as the topological invariance of momentum resource counting and the bijectivity of causal logic completeness;
4. The fields and Lie group structures in the standard model are essentially mathematical descriptions of evolution rules, and reducing them to evolution protocols helps unify various interactions.

Based on this, on the basis of the framework of evolutionary resources (quantized momentum units and energy) established in "Unified Cosmic Mechanics Evolution Theory (II) — Evolutionary Resources" [6], this paper introduces evolution rules as a core element, systematically demonstrates the ontological definition, hierarchical system and emergence mechanism of evolution rules, reconstructs the physical connotation of unitarity, clarifies the emergent nature of physical concepts such as symmetry, mathematical systems, and space-time, makes up for the limitations of traditional theories in the unified derivation of underlying dynamics, constructs a complete dynamic picture from discrete independent resources to a dynamically ordered universe, and provides a new research perspective and logical support for the unification of physical theories.

Ontological Boundary of the Theory: Clarifying the Research Scope and Motivation

The core motivation for setting the research boundary in this paper is based on the core insight of Gödel's incompleteness theorem: any self-consistent physical formal system cannot prove the ultimate Source of its basic axioms (i.e., evolution rules) within the system. Such problems are undecidable propositions within the system, and there is no need to pursue them. The core deficiency of the traditional big bang theory is that it attempts to trace the ultimate source of system rules within the cosmic physical system, but implicitly presupposes the pre-existence of rules and evolutionary resources, thus falling into an infinite regression logical trap and violating the internal constraints of the formal system.

Based on this, this paper clarifies the research scope, abandons the ineffective tracing of "where the rules themselves come from", and focuses on two points: first, the necessity of the existence of evolution rules, the emergent phenomena of rule stability, and the physical encoding and physical replication of rules [7].

2 Ontological Definition of Evolution Rules and Introduction of Binary Resources

2.1 Premise Introduction: Binary Structure of Evolutionary Resources

Based on the research conclusions of the previous paper ("Unified Cosmic Mechanics Evolution Theory (II) — Evolutionary Resources") [6], evolutionary resources \mathcal{M} consist of two parts: evolutionary carriers and evolutionary driving forces. The two have separate functions and collaboratively support cosmic evolution. Their core attributes and mathematical representations are as follows:

Evolutionary Carrier: As the core subject of state representation, it is essentially a quantized momentum unit \vec{p}_i ($i = 1, 2, \dots, N$, where N is the total number of cosmic momentum units and is conserved). It is responsible for carrying evolutionary state information, which is equivalent to encoding core attributes such as evolution amplitude, direction vector \vec{e} , and evolution frequency. It satisfies the non-overlapping constraint

$$\forall i \neq j, \text{supp}(\vec{p}_i) \cap \text{supp}(\vec{p}_j) = \emptyset$$

(where supp denotes the support set), corresponding to the non-spatiotemporal overlapping and impenetrability of momentum units.

Evolutionary Driver: That is, energy E , as the core driving force for state changes, is mathematically defined as

$$E = \int_{t_1}^{t_2} \left| \frac{d\vec{P}}{dt} \right| dt$$

(where $\vec{P} = \sum \vec{p}_i$ is the total momentum, and $\vec{F} = \frac{d\vec{P}}{dt}$ is the force). It only records the magnitude of the driving force, does not carry the state of causal continuity, and needs to rely on the evolutionary carrier to realize state evolution driving.

Core Attribute: The evolutionary resource units are essentially not subordinate to each other and have no intrinsic correlation. The emergence of their state differences and the establishment of interaction relationships must rely on external constraints (i.e., evolution rules). This is the fundamental premise for the existence of evolution rules, which is also consistent with the core logic that "quantization is the basis for evolvability" — discrete and independent momentum units need rule constraints to get rid of chaos and form an ordered evolution system [8].

2.2 Essence of Rules and Generalized Unitarity

Evolution rules \mathcal{R} are intrinsic laws governing the state transition of evolutionary resources.

We can understand it as a rigid causal constraint mechanism, which naturally constructs ordered state correlations among independent resources that are not subordinate to each other, and condenses chaotic discrete units into an ordered evolution system; in mathematical form, this mechanism is highly isomorphic to the transformation relationship in group theory

$$\hat{\mathcal{R}} : \mathcal{M} \rightarrow \mathcal{S}$$

(where \mathcal{S} is the set of system states), which strictly constrains the state representation method, interaction logic and hierarchical construction rules of resources.

Mathematical Expression:

$$\mathcal{R} : (\text{Carrier}_{\text{Initial State}}, \text{Driver}_{\text{Cost}}) \Rightarrow \text{Carrier}_{\text{Final State}}$$

That is, the evolution rules constrain the evolutionary trajectory that the evolutionary carrier must follow after paying a certain driving force cost, thereby realizing the continuous transmission of causal relationships and the natural replacement of states. This process structurally satisfies the unitary symmetry

$$\hat{\mathcal{R}}^\dagger \hat{\mathcal{R}} = \hat{I}$$

(where \hat{I} is the identity operator), so as to ensure the completeness of the causal chain and the conservation of total resources [4].

Physical Reconstruction of Generalized Unitarity:

In this theory, the unitarity of the evolution rule $\hat{\mathcal{R}}$ ($\hat{\mathcal{R}}^\dagger \hat{\mathcal{R}} = \hat{I}$) no longer represents "probability conservation" in traditional quantum mechanics, but has two more essential physical meanings:

Topological Invariance of Resource Counting: It ensures that the total number of underlying cosmic momentum units N remains strictly constant before and after evolution. That is, the rules only change the arrangement and combination mode (encapsulated state) and direction encoding of momentum units, and never create or destroy the units themselves. Mathematically, it is reflected in that the dimension of the basis of the Hilbert space remains unchanged before and after evolution:

$$\dim(\mathcal{H}_{\text{in}}) = \dim(\mathcal{H}_{\text{out}}) = N$$

Complete Bijectivity of Causal Logic: It ensures that evolution is a deterministic one-to-one mapping. Each output state has one and only one corresponding input history (logically traceable). This does not mean that the physical process can be reversed spontaneously (because the energy cost E_{cost} locks the arrow of time), but refers to the logical rigor of the rule protocol itself — no information is "lost" at the rule level, only the state is "overwritten" at the resource level.

In short, unitarity is a mathematical declaration of "momentum is neither created nor destroyed" and "the causal chain is unbroken".

2.3 Three-Layer Rule Nesting System (Exemplary Protocol Framework)

Note: This section only defines the functional categories and core logic of the rules. The specific physical implementation mechanisms (such as the force refresh mechanism, particle geometric structure, charge quantization mechanism, etc.) are detailed in the subsequent chapter "Fields and Particles" [9]. The three-layer rule nesting forms a complete evolution constraint system, and the rules of each layer act synergistically to realize the emergence from discrete resources to complex systems, as follows:

1. **Perceptual Encoding Rules (\hat{R}_1):** Define the basic state representation method of the evolutionary carrier, including core protocols such as evolution amplitude c , direction encoding \vec{e} , and quantization representation. Its essence is to standardize the encoding of state information of momentum units, which is equivalent to providing a unified basic coupling mechanism for the interaction of different resource units, ensuring that state information is identifiable and transmissible. It corresponds to the input specification of the event function $f : N \rightarrow \mathbb{R}$ in Discrete Continuous Integration (DCI) (see "Unified Cosmic Mechanics Evolution Theory (II) — Evolutionary Resources" [6] for the detailed definition of DCI).
2. **Multi-Layer Encapsulation Rules (\hat{R}_2):** Define the combination logic and hierarchical construction protocol of evolutionary resources. Under the constraint of total resource (carrier + driver) conservation, discrete momentum units are allowed to be combined in multiple layers to form stable

hierarchical structures (such as particles, atoms, molecules, etc.). Its core function is to establish the conservation boundary and decay rules of resource combination, provide constraints for the stable existence of macro structures, and is an important basis for the subsequent emergence of CPT symmetry [10].

3. **Interactive Evolution Rules (\hat{R}_3):** Define the core protocol for dynamic interactions between evolutionary carriers, constrain the causal order of state updates, the payment method of driving force costs, and the state change rules during the interaction process. Its core function is to realize dynamic interaction between resource units, emerge macro forces and space-time effects, and is the key rule for locking the unidirectionality of time and causality, corresponding to the system evolution equation

$$\psi(t + \Delta t) = \hat{\mathcal{R}}(\psi(t), \vec{p}_i)$$

(where Δt is the Planck time t_P) [11].

2.4 Rule Encoding Mechanism and Topological Replication: Origin of Identity

In the three-layer rule system defined above, the core question is: how does the abstract evolution rule R act on each discrete momentum unit, and ensure the absolute consistency of similar structures in the universe (such as all electrons, all protons)? This theory proposes that rules are embedded in the resource combination structure through “topological encoding” and continuously reconstructed during evolution through “self-replication mechanism” to realize the identity and stability of physical entities.

1. **Rules as Encoding and Source of Identity:** Embedded protocols of geometric topology and instantiation of rules. The constraint of evolution rules R on resources is a geometric topological encoding; discrete momentum units $\langle p \rangle_i$ combined by R_2 generate Topological Configuration Code (TCC). For a particle type (e.g., electron), the encoding Code_e defines internal phase, winding number and symmetry group, with $\text{Particle_type Topology}(\{\langle p \rangle_i\}) = \text{Code_type}$. Rules are compiled into particle geometry, and identical particles originate from the instantiation and replication of the same rule codes.
2. **Topological Protection and Anti-Interference:** The stability of rule encoding relies on topological protection. Local disturbances cannot alter the overall topological properties (e.g., winding number), and encoding rewriting only occurs when energy exceeds the topological barrier. The evolution rule \hat{R}_3 enables self-repair of the encoding under dynamic equilibrium, driving the system back to the stable topological state after minor resource deviation.
3. **Mathematical Representation:** Abstract rule operator \hat{R} takes the particle state $|\Psi\rangle$ as the eigenstate in a topological sector, satisfying $\hat{R}|\Psi_{\text{code}}\rangle = \lambda_{\text{code}}|\Psi_{\text{code}}\rangle$ where λ_{code} corresponds to physical eigenvalues (mass, charge). Particle generation is the basis vector expansion in the same topological sector of Hilbert space, and rule replication follows $\hat{R}_{\text{copy}} : (\text{Structure}_A \otimes, \text{Resource}_{\text{new}}) \rightarrow \text{Structure}_B$ with $\text{Code}(\text{Structure}_B) = \text{Code}(\text{Structure}_A)$.

$$|\Psi_{\text{total}}\rangle = \bigoplus_{k=1}^M |\Psi_{\text{code}}^{(k)}\rangle$$

Where $|\Psi_{\text{code}}^{(k)}\rangle$ represents the k-th instance, sharing the same operator structure \hat{R} and eigenvalue λ_{code} , which is observed as identical particles.

3 Rule Stability and Natural Emergence of Symmetry and Mathematics (Corresponding to Core Views 2, 3, 7: CPT Emergence, Mathematical Emergence, Stability Guarantee)

3.1 Intrinsic Meaning of Rule Stability

The stability of evolution rules is an absolute premise for the ordered evolution of the universe. Its core intrinsic meaning is: the rules themselves do not change with the change of time, space or resource state, which is mathematically expressed as

$$\frac{\partial \mathcal{R}}{\partial t} = 0$$

As the absolute benchmark of the evolution system, the stability of rules ensures the consistency of evolution logic — any same input state (carrier + driver), at any time and any spatial position, after being mapped by the same rule, will inevitably output the same state result. This is the core guarantee for the repeatability and predictability of causal relationships, and also conforms to the core attribute of momentum units that "they are neither created nor destroyed, nor can they independently change their evolution state".

From the physical essence, the stability of rules originates from the quantization characteristics and non-decay characteristics of evolutionary resources — the standardized quantization of underlying momentum units (constrained by Planck scale) determines the consistency of rule constraints, which does not need external axiom support and is an intrinsic evolution demand of the system [12].

3.2 Natural Emergence of CPT Symmetry (Corresponding to Views 2, 7)

CPT symmetry (combined symmetry of charge conjugation C, parity transformation P, and time reversal T) is not an axiom introduced externally, but an inevitable result of the consistency of rule stability on all independent evolutionary resources. Its emergence mechanism is highly related to the constraint logic of rules [13]:

Rule stability requires that for any evolutionary resource unit, its evolutionary behavior remains unchanged in the constraint logic of evolution rules under the combined operation of charge conjugation, parity transformation, and time reversal — that is, the constraints of rules on all resource units are universal, and do not change with the change of their charge attributes, spatial orientation, and time direction. This universality directly leads to the natural emergence of CPT symmetry, which is a direct physical manifestation of rule stability [14].

Example Verification: The absolute equality of the electric charges of protons and electrons ($|q_p| = |q_e|$) is a direct manifestation of the symmetry of the multi-layer encapsulation rule (\hat{R}_2) — \hat{R}_2 has symmetry in the encapsulation constraints of protons and electrons, ensuring the consistency of their charge quantization, thereby ensuring the stability of atomic structures and providing support for the orderliness of cosmic evolution (see Chapter "Fields and Particles" [9] for the specific charge quantization mechanism).

3.3 Emergence of Mathematical Systems (Corresponding to View 3)

Mathematical laws are not independently existing Platonic entities, but projections of stable evolution rules at the information level. Their emergence mechanism originates from the stability and constraint logic of rules, and the essence of mathematics is composed of three parts, which are indispensable [5]:

- 1. Standard Quantized Variable Input (Corresponding to Evolutionary Carriers in Physics):** As quantized momentum units, evolutionary carriers provide standardized basic input for mathematical emergence. Their quantization characteristics (discreteness, non-overlapping) determine the basic attributes of mathematical variables, which is the premise that mathematics can accurately describe evolutionary states — without standardized quantized input, mathematics will lose clear mapping objects and cannot form an ordered system of laws [15].

Mathematical Representation: Let the set of evolutionary carriers be $\mathcal{M} = \{\vec{p}_1, \vec{p}_2, \dots, \vec{p}_N\}$. Its quantization characteristics define the physical basis of the natural number set \mathbb{N} :

$$n = \text{Card}(\mathcal{S}_{\text{subset}}), n \in \mathbb{N}$$

where n represents the cardinality (count) of any subset $\mathcal{S}_{\text{subset}} \subseteq \mathcal{M}$, establishing the discrete origin of arithmetic and number theory; the non-overlapping of carriers

$$\vec{p}_i \cap \vec{p}_j = \emptyset$$

corresponds to the mutual exclusion axiom in set theory.

- 2. Stable Rules (Evolution Rules):** Stable evolution rules provide fixed constraint logic for mathematics. The consistency and invariance of rules determine the repeatability and predictability of mathematical laws. Different types of rules correspond to different branches of mathematics, forming a complete mathematical system [16].

Mathematical Representation: The evolution rule \mathcal{R} is instantiated as a linear operator \hat{U} on the Hilbert space. The stability of the rule ($\frac{\partial \mathcal{R}}{\partial t} = 0$) corresponds to the time independence and unitarity of the operator:

$$|\psi_{t+1}\rangle = \hat{U}|\psi_t\rangle, \hat{U}^\dagger \hat{U} = \hat{I}$$

This deterministic one-to-one mapping (Bijection) ensures the repeatability of logic, and the non-commutativity of rules

$$[\hat{R}_i, \hat{R}_j] \neq 0$$

directly emerges the non-Abelian group theory structure (such as $SU(N)$ group), which constitutes the mathematical basis of symmetry analysis [14].

- 3. Execution Cost (Driver-Energy):** The driving force (energy) required for the execution of evolution rules introduces "processivity" and "measurability" into mathematics, driving the evolutionary carrier to complete state evolution according to the rules, and then emerging measurable mathematical quantities such as energy and time, enabling mathematics to quantitatively describe the cost and results of the evolution process [17].

Mathematical Representation: The accumulation of driving force E introduces a continuity approximation. When the number of evolution steps $N \rightarrow \infty$ and the single-step cost $\epsilon \rightarrow 0$, the discrete sum is converted into a continuous integral, emerging the calculus structure:

$$\text{Total Cost } E = \lim_{N \rightarrow \infty} \sum_{i=1}^N \epsilon_i \longrightarrow \int_{t_0}^t L(\tau) d\tau$$

Among them, the discrete event count N is smoothly converted into the time variable t ($t \approx N \cdot \tau_P$) under the macro limit, making it possible to describe the rate of change $\frac{d}{dt}$. Without this cost mechanism, the system would stay at the level of discrete logic algebra, and analysis cannot emerge.

Specifically, in a standard quantized state evolution system, the quantization characteristics of evolutionary carriers can emerge the information variables of natural numbers (the counting of discrete momentum units corresponds to the basic logic of natural numbers); stable evolution rules can emerge the evolvability, repeatability, and stability of mathematics (the invariance of rules ensures that the same input corresponds to the same output, i.e., the repeatability of mathematical laws); the execution cost that drives the evolutionary carrier to perform state evolution according to the rules emerges two core measurable quantities: energy and time, providing a basis for mathematics to quantitatively describe the evolution process.

It can be further verified by examples: as a simple rule-constrained system, the chessboard system only has "chessboard grids (similar to carriers)" and "chess rules (similar to evolution rules)", but lacks the "execution cost (driving force)" required for evolution, and the chessboard grids themselves do not have the attribute of quantized evolutionary carriers (no potential for independent evolution). Therefore, it cannot emerge the mathematical laws of the existing physical world — it can neither form calculus to describe the evolution process nor emerge measurable quantities such as energy and time, but only form simple counting and logical relationships. This further confirms the core logic that the emergence of mathematics requires the coordination of "quantized input, stable rules, and execution cost".

Specific Corresponding Relationships: The quantization constraints of rules (such as the Planck scale constraint of momentum units) correspond to arithmetic and number theory; the constraints of rules on the direction and amplitude of carriers (such as the orthogonality of vector \vec{e}) correspond to geometry and vector analysis; the symmetry operations of rules (such as CPT combined transformation) correspond to group theory; the dynamic evolution process of rules (such as state update) corresponds to calculus (Discrete Continuous Integration DCI is its form adapted to the cosmic physical essence) [18].

4 Multi-Layer Encapsulation, Resource Conservation and Underlying Non-Decay (Corresponding to Core View 4: Multi-Layer Encapsulation and Underlying Non-Decay)

4.1 Hierarchical Construction Under the Premise of Resource Conservation

The multi-layer encapsulation function of evolution rules must be realized under the constraint of total evolutionary resource conservation — the total cosmic evolutionary resources (total evolutionary carriers + total evolutionary driving forces) remain constant. The multi-layer encapsulation rule (\hat{R}_2) constructs a hierarchical structure from the bottom to the macro through the combination and encoding of discrete momentum units, forming the evolution chain of "momentum units \rightarrow particles \rightarrow atoms \rightarrow molecules \rightarrow macro objects" [10].

Mathematical Constraint: Let the total cosmic momentum be

$$\vec{P}_{\text{total}} = \sum_{i=1}^N \vec{p}_i$$

(where N is a constant value), and the total energy be

$$E_{\text{total}} = \int_0^{+\infty} \left| \frac{d\vec{P}_{\text{total}}}{dt} \right| dt$$

Then, during multi-layer encapsulation, the momentum and energy of any hierarchical structure satisfy the conservation relationship, i.e.,

$$\begin{aligned} \sum \vec{p}_{\text{component}} &= \vec{p}_{\text{whole}} \\ \sum E_{\text{component}} &= E_{\text{whole}} \end{aligned}$$

which is the core condition for the stable existence of hierarchical structures [4].

Multi-layer encapsulation is essentially a process of projecting the discrete free state space $\mathcal{H}_{\text{free}}$ into the bound state subspace $\mathcal{H}_{\text{bound}}$. Define the encapsulation projection operator \hat{P}_{bound} , then the composite particle state is expressed as:

$$|\Psi_{\text{particle}}\rangle = \hat{P}_{\text{bound}} \left(\bigotimes_{i=1}^n |\vec{p}_i\rangle \right)$$

This projection operation forces the momentum units to satisfy specific geometric symmetries (such as spherical symmetry, chirality), thereby emerging a stable entity of "particle". The non-decayability of underlying resources stems from the fact that there is no non-zero subspace of lower dimension in this projection space [19].

Physical Meaning: The essence of hierarchical construction is the reconstruction of resource state relationships by rules. Through the constraints of \hat{R}_2 , discrete and uncorrelated momentum units are organized into aggregates with stable structures, realizing the transformation from chaos to order, laying the foundation for the emergence of complex systems (such as life and galaxies), which is consistent with the emergent philosophy of "more is different" [10].

4.2 Combination and Decay Mechanisms

The multi-layer encapsulation rule (\hat{R}_2) not only constrains the combination logic of resources, but also defines the decay rules of hierarchical structures — high-level structures (such as atoms, molecules) can decay into low-level components (such as atomic nuclei and electrons, protons and neutrons) under specific conditions. This process is essentially the resource re-encoding and relationship reorganization allowed by the rules, which does not violate the law of resource conservation [4].

Mathematical Representation of Decay Process: Let the momentum of the high-level structure be \vec{P}_{high} , and the momenta of the low-level components generated after decay be $\vec{P}_{\text{low}1}, \vec{P}_{\text{low}2}, \dots, \vec{P}_{\text{low}k}$ respectively, then

$$\vec{P}_{\text{high}} = \sum_{i=1}^k \vec{P}_{\text{low}i}$$

is satisfied, and the energy satisfies

$$E_{\text{high}} = \sum_{i=1}^k E_{\text{low}i} + \Delta E$$

(where ΔE is the driving force released during the decay process, i.e., energy).

Core Logic: Decay is the "unpacking" process of hierarchical structures. Its essence is the dynamic adjustment of rule constraints — when the energy accumulation of the high-level structure exceeds the threshold constrained by the rules, the encapsulation constraint of \hat{R}_2 is broken, and the resources return to the low-level discrete state, which may then recombine into new hierarchical structures, realizing the cycle and iteration of evolution.

Note: When the driving force ΔE released by the unpacking of the high-level structure is not absorbed by other units, this part of energy will temporarily return to the "Latent Space" to wait for the call of the next excitation event. This mechanism will be elaborated in detail through the 'propagator' model in the chapter "Fields and Particles" [9].

4.3 Non-Decayability of Underlying Evolutionary Resources

Core Theorem: The most underlying evolutionary resources of the universe (Planck momentum unit $\vec{p}_P = \hbar/\lambda_P \vec{e}$, where λ_P is the Planck length) cannot decay further, and are the absolute basis of cosmic evolution [19].

Derivation Basis: The underlying momentum units are ultimate independent units that are not subordinate to each other. They have no internal substructures and cannot be further decoupled or decomposed through rules — the constraint object of evolution rules is "independent resource units". If the underlying units can decay, it means that they have internal substructures, which contradicts the definition of "underlying units"; at the same time, the non-decayability of underlying units ensures the conservation of the total amount of evolutionary resources, avoiding the collapse of the evolution system caused by the infinite decomposition of resources, and providing underlying support for the stability of rules.

Mathematical Evidence: The size of the Planck momentum unit is $p_P = \hbar/\lambda_P$, where $\lambda_P = \sqrt{\hbar G/c^3}$ (Planck length), \hbar is the reduced Planck constant, G is the gravitational constant, and c is the speed of light. Its physical dimensions and quantization characteristics determine its indivisibility, further confirming the core theorem that underlying resources are non-decayable.

5 Rule Asymmetry: Complex Evolution and Energy Storage Mechanism (Corresponding to Core View 5: Asymmetry Realizes Complex Evolution and Energy Storage)

5.1 Definition of Rule Asymmetry

The asymmetry of evolution rules is mainly defined as the non-commutativity of operations between different rules, which is mathematically expressed as

$$[\hat{R}_i, \hat{R}_j] \neq 0$$

($i \neq j$), that is, different execution orders of rules \hat{R}_i and \hat{R}_j will lead to different evolution results. This non-commutativity is the core embodiment of rule asymmetry [10].

The asymmetry of rules is mathematically characterized by the non-commutativity of operators of rules at different levels:

$$[\hat{R}_{\text{Perception}}, \hat{R}_{\text{Encapsulation}}] = i\hat{K}_{\text{Barrier}} \neq 0$$

Where \hat{K}_{Barrier} is the energy storage operator. This formula shows that performing "perceptual encoding" first and then "multi-layer encapsulation" is essentially different from the reverse operation. This difference (\hat{K}) is exactly the micro-mechanism that locks the driving force into static energy ($E = mc^2$) [17].

Supplementary Note: The asymmetry of rules does not deny the stability of rules, but reflects the difference in constraint logic of different rules on the basis of rule stability — the constraint mode of the rules themselves does not change with time (stability), but the constraint direction and strength of different rules are different (asymmetry). This difference provides the possibility for complex evolution [13].

5.2 Emergence of Energy Storage Mechanism

The core physical meaning of rule asymmetry is to create a "cross-domain transfer" barrier, and then emerge the energy storage mechanism — locking the evolutionary driving force (energy) in a specific carrier configuration (such as mass, potential energy) requires overcoming the asymmetric constraints between different rules. This process of "overcoming constraints" is essentially the process of energy storage, and the amount of energy storage is positively correlated with the strength of asymmetric constraints [17].

Static energy (mass) originates from the non-zero sum encapsulation of internal momentum. Let the vector sum of N momentum units inside the particle be \vec{P}_{ext} (macro momentum), and the modulus of the vector sum of internal relative motion be P_{int} (locked by rule asymmetry). The total energy satisfies the generalized Pythagorean relationship:

$$E_{\text{total}}^2 = (P_{\text{ext}}c)^2 + (P_{\text{int}}c)^2$$

When the particle is at rest macroscopically ($P_{\text{ext}} = 0$), the remaining energy $E_0 = P_{\text{int}}c$ is the static energy mc^2 . Mass m is essentially the total amount of momentum P_{int}/c locked by the rules inside.

Example Verification: Static energy ($E = mc^2$) is the result of asymmetric locking between the free state of the perceptual encoding rule (\hat{R}_1) and the bound state of the multi-layer encapsulation rule (\hat{R}_2). Under the constraint of \hat{R}_1 , momentum units are in a free evolution state, and the driving force can be transmitted freely; under the constraint of \hat{R}_2 , momentum units are encapsulated into stable structures (such as particles), and the driving force is locked in the carrier configuration, forming static energy. (See Chapter "Fields and Particles" [9] for the specific mass encapsulation geometry.)

5.3 Power Source of Complex Evolution

Argument: If the evolution rules are completely symmetric

$$[\hat{R}_i, \hat{R}_j] = 0$$

then the execution order of any rules will not affect the evolution result, and the system will reach an equilibrium state or completely disintegrate in an instant — the evolution direction of all momentum

units and the transmission mode of driving force are completely consistent, without any state difference, the information entropy tends to zero, and evolution is impossible [10].

The asymmetry of rules breaks this absolute balance, making the evolution states of different resource units different, and the transmission of driving force has barriers, thus forming complex dissipative structures — the stable existence of atoms, the occurrence of chemical reactions, the evolution of life, etc., all rely on the power provided by rule asymmetry. This asymmetry keeps the system in a "non-equilibrium state" all the time, providing an inexhaustible power for the continuous progress of evolution, which is consistent with the core logic of dissipative structure theory [17].

6 Dynamic Locking of Time Arrow and Causal Unidirectionality (Corresponding to Core View 6: Rule Stability and Inertia Emerge Time and Causality)

6.1 Cost Mechanism of Rule Execution

The execution of evolution rules is not without cost. Its core principle is: when the rules drive the evolutionary carrier to change its state, a certain amount of evolutionary driving force (energy) must be consumed, and the cost consumption is always greater than zero, which is mathematically expressed as

$$E_{\text{cost}} > 0$$

This cost mechanism is a necessary condition for rule execution and a guarantee for the orderliness of the evolution system — if rule execution does not require energy consumption, evolution can be repeated infinitely, the system will fall into chaos, and stable causal relationships cannot be formed [17].

Combined with Discrete Continuous Integration (DCI), the cost of rule execution can be expressed as

$$E_{\text{cost}} = \int_{DCI} f(N)dN = \sum_{i=1}^N f(i) \cdot \tau$$

(where $\tau = t_P$ is the Planck time, and $f(N)$ is the energy consumption function of a unit event). Each execution of a rule mapping (corresponding to an evolution event) consumes a fixed energy cost, ensuring the orderliness and traceability of evolution [11].

6.2 Emergence of Causal Unidirectionality

The essence of causal relationship is the mandatory order of "paying evolution cost (cause) → changing carrier state (effect)". This unidirectionality is directly locked by the cost mechanism of rule execution: due to the irreversibility of evolution cost consumption — the consumed energy cannot spontaneously return to its original state, so the causal chain can only be transmitted along the direction of "cause → effect" and cannot be traced back in reverse [17].

Causal unidirectionality is locked by the cost mechanism of rule execution. Define the effective information entropy S_n of the system at step n , the evolution process must satisfy:

$$S_{n+1} \geq S_n + \sigma(E_{\text{cost}})$$

Where $\sigma(E_{\text{cost}}) > 0$ is the minimum entropy increase generated by paying the evolutionary driving force E_{cost} . Since each step of evolution must pay a positive cost, S increases monotonically, thus math-

ematically locking the unidirectional flow of time, making "returning to the past" a thermodynamically impossible event.

Mathematical Representation: Let the set of causal relationships be $C = \{(q, \hat{\mathcal{J}}\mathcal{F}(q)) | q \in Q\}$ (where Q is the set of quantized variables, and $\hat{\mathcal{J}}\mathcal{F}$ is the rule function). Then for any causal pair $(q_1, q_2) \in C$, only $q_2 = \hat{\mathcal{J}}\mathcal{F}(q_1)$ exists, and $q_1 = \hat{\mathcal{J}}\mathcal{F}(q_2)$ does not exist, that is, the causal relationship has strict unidirectionality, which is a direct manifestation of the irreversibility of the rule cost mechanism.

6.3 Double Locking of Time Unidirectionality

Time is not a preset background stage, but an intrinsic state relationship attribute of the evolution system emerging from the combination of rule stability and evolutionary resource inertia. Its unidirectionality is realized through the double locking of the "rule side" and the "resource side", as follows [11]:

Lock 1 (Rule Side): The stability of rules ensures that the evolution logic does not drift. Each execution of rules consumes a fixed energy cost ($E_{\text{cost}} > 0$), and the cost consumption is irreversible, leading to the evolution events can only advance along the direction of "past \rightarrow present \rightarrow future" and cannot be reversed. Combined with the time definition of DCI

$$t = \int_{DCI} 1dN = N \cdot \tau$$

(where N is the count of evolution events), time is essentially the cumulative result of evolution events, and the irreversibility of events directly locks the unidirectionality of time, forming the macro time arrow.

Lock 2 (Resource Side): The inertia of evolutionary resources (momentum units) — in the absence of new driving force, momentum units cannot independently change their inertial state, that is, maintain the current evolution direction, amplitude and frequency (mathematically expressed as

$$\frac{d\vec{p}_i}{dt} = 0$$

), and cannot spontaneously return to the past state. This inertia makes the change of evolution state can only rely on external driving force, further strengthening the unidirectionality of time and causality, and avoiding the reverse tracing of evolution.

Conclusion: The unidirectionality of time and causality is the result of the synergistic effect of rule stability and resource inertia. Both are intrinsic attributes of the evolution system, not independently existing background entities. This conclusion is highly consistent with the core viewpoint of the time emergence theory.

7 Information Continuity: Emergence of State Encoding, Resource Conservation and Local Stability

There is no absolute "information conservation" in the traditional understanding in the cosmic system. Its evolution foundation is only composed of two core characteristics: "causal continuity of state encoding (non-skippable)" and "strict conservation of the total number of encodable resources (momentum units)". These two together support the ordered evolution of the universe, but do not mean the complete preservation of historical information.

7.1 Essence of State Update: Dynamic Erasure and Causal Reconstruction

Specifically, each discrete time step of cosmic evolution ($t_n \rightarrow t_{n+1}$, where Δt is the Planck time t_P) is essentially a coverage and reconstruction of state information, whose core characteristics are reflected in two aspects [11]:

Dynamic Erasure: The encoding of the evolutionary carrier (quantized momentum unit) always corresponds only to the current instantaneous evolution state. When the evolution rules drive the carrier to complete the state update, the old state encoding is physically overwritten by the new state encoding — the specific details of the old state (such as the exact phase distribution of momentum units at the previous moment) will not be continuously stored in the momentum units in the form of "data backup", but will be directly erased.

Causal Continuity: This information erasure does not mean causal breakage. State evolution has strict causal superposition: each new state is the only definite solution of the previous state under the constraint of evolution rules and after paying the corresponding driving force cost (E_{cost}). Therefore, although the old information is "erased" on the carrier, its causal logic is completely inherited. Theoretically, we can trace back and reconstruct the evolution history by reversely applying the evolution rules (if the energy cost allows), but this belongs to the category of logical deduction, not the reading of physically stored information.

Essentially, information is a product of relational states based on evolution rules, and its existence depends on the constraints of rules on the state relationships of evolutionary carriers. In the process of dynamic evolution, information is constantly iterated, erased and reconstructed with state updates — if information is absolutely conserved (i.e., historical states are never erased), the system will fall into logical deadlock due to the accumulation of infinite historical redundancy, and continuous evolution cannot be realized; it is the non-conservation (overwritability) of information that ensures the dynamic flow of evolution and the unidirectionality of time [17].

7.2 Local Emergence of Information Conservation: From Absolute Erasure to Local Metastability

Although the underlying state information is constantly refreshed and erased, in macroscopic observations, the phenomena we observe such as "baryon number conservation", "charge conservation" and "atomic stability" are not absolute conservation laws, but emergent results of "local metastability" constructed by the asymmetry of evolution rules — these phenomena are essentially local dynamically stable states locked by evolution rules, rather than eternal conservation in ontology [19].

1. Physical Mechanism of Local Stability: High Barrier Locking

The illusion of "information conservation" is essentially a high-energy barrier constructed jointly by the multi-layer encapsulation rule (\hat{R}_2) and the interactive evolution rule (\hat{R}_3), which locks specific state encoding modes in low-energy valleys. The physical essence of its core mechanism is:

The asymmetry of the multi-layer encapsulation rule (\hat{R}_2) and the interactive evolution rule (\hat{R}_3) together construct a high-barrier constraint for state encoding — for local systems (such as protons and atoms), the energy cost required to decode their state encoding (such as proton decay, atomic disintegration) and reorganize into new forms (E_{break}) is much higher than the thermal motion energy or interaction energy of the current cosmic environment. This high-barrier constraint makes the state encoding of local systems stable on the macroscopic time scale, thus emerging the illusion

of "information conservation", which is essentially a dynamic stability, not eternity in ontology [17].

Example Evidence: Baryon number conservation and atomic stability are direct manifestations of the high-barrier locking mechanism — the encapsulation constraint of \hat{R}_2 on protons forms a high barrier, making the energy cost required for proton decay far exceed the available driving force in the current cosmic environment. Therefore, protons remain stable on the macroscopic time scale, thereby supporting the stability of atomic structures and providing a guarantee for the long-term existence of local systems (see Chapter "Fields and Particles" [9] for the specific barrier quantization mechanism).

2. Relativity of Conservation and Breaking Conditions

Since "information conservation" is an emergent result of local metastability, it must be relative rather than absolutely unbreakable — this relativity is reflected in: the stable existence of local metastability depends on the energy scale environment and evolution rule constraints of the current universe. When the external energy input exceeds the barrier threshold locked by the rules ($E_{\text{input}} > E_{\text{break}}$), the local metastability is broken, the original state encoding mode disintegrates, and it is manifested as "failure of conservation laws" [13].

Verification Under Extreme Conditions: In the high-temperature environment of the early universe (energy scale far exceeding the current cosmic energy scale) or high-energy particle collision experiments, the driving energy input from the outside exceeds the barrier threshold. At this time, the illusions of "baryon number conservation" and "charge conservation" are broken, protons can decay, charge encoding modes can be reorganized, and the underlying momentum units are re-encoded into new forms — this process fully follows the evolution resource conservation rule, which is only the reconstruction of state encoding, not the generation or annihilation of momentum units.

Essence of Thermodynamic Entropy Increase: The entropy increase in the second law of thermodynamics is essentially a process in which the system crosses the barrier constructed by rules from a highly ordered "local information stable state" (low-entropy metastable state) and slides into a more probable "information rapid iteration state" (high-entropy disordered state). Its core driving force is the irreversible consumption of evolution cost, which is consistent with the logic of dynamic erasure and reconstruction of information [17].

7.3 Conclusion: Eternal Resources, Flowing Information

In summary, the information logic of cosmic evolution can be summarized into three core points, forming a perfect closed loop with the core viewpoints such as resource conservation and causal unidirectionality mentioned earlier:

- 1. Underlying Absolute Conservation:** Only the total number of quantized momentum units (N) is absolutely conserved, which is the material basis of cosmic evolution and the core premise for the dynamic reconstruction of state encoding [4];
- 2. Dynamic Non-Conservation of States:** The specific state encoding (information) is physically erased and rewritten at each evolution moment, which is a necessary condition for time flow and irreversible evolution, and also a core guarantee for the continuous advancement of evolution [11];
- 3. Local Emergent Stability:** Various observed "conservation laws" and "stability" are high-barrier metastable states constructed by evolution rules at specific energy scales. They support the long-term existence of local systems (atoms, molecules, galaxies, etc.), but they are not unbreakable

absolute laws. Their stability depends on the energy scale environment and rule constraints of the current universe [19].

8 Conclusion

Based on the framework of information dynamics evolution theory, this paper systematically introduces evolution rules on the basis of evolutionary resources (momentum units + energy), supplements the core logic of information continuity, and clarifies the ontological boundary of the theory — it does not involve the ultimate source of rules. The "Origin" mentioned in the paper refers to the emergence of various physical phenomena and attributes, constructing a complete derivation chain from "discrete independent resources" to "rule-constrained evolution" and then to "emergence of state relationships". The core logic is as follows:

1. **Premise:** Evolutionary resources consist of non-subordinate quantized momentum units (carriers) and energy (driving force), which require external constraints (evolution rules) to establish state relationships [6,8];
2. **Core:** Evolution rules are fixed protocols that constrain the evolution mode of resources, forming a three-layer nested system of perceptual encoding, multi-layer encapsulation, and interactive evolution, and their execution requires paying energy costs [17];
3. **Mathematical Emergence:** The essence of mathematics consists of three parts: standardized quantized variable input (evolutionary carriers), stable evolution rules, and execution costs (energy), and ordered mathematical laws emerge in the quantized evolution system [5,15];
4. **Information Continuity:** There is no traditional information conservation in the universe, only the non-skippability of state encoding (causal continuity) and the conservation of the total number of momentum units. Information is erased with state updates but can be traced back through rules [11];
5. **Emergence:** The stability of rules emerges CPT symmetry and mathematical systems, multi-layer encapsulation emerges hierarchical structures, the asymmetry of rules emerges energy storage mechanisms, evolution and diversity of emergence, and the stability of rules and resource inertia jointly emerge time and causal unidirectionality [10,13,17];
6. **Essence:** Physical concepts such as space-time, force, and energy are all emergent results of the state relationships of evolutionary resources under rule constraints, not basic entities [12,19].

Therefore, evolutionary resources are the unified origin of dynamics and characteristic quantities; fields are protocols that constrain evolutionary resources, and space-time is an emergent by-product that cannot determine the physical intrinsic state.

References

- [1] Xiao Bo. (2026). Unified Cosmic Mechanics Evolution Theory (V): Reconstruction of Dynamic Relationships of Basic Physical Dimensions [In Press].
- [2] Xiao Bo. (2026). Unified Cosmic Mechanics Evolution Theory (VII): Evolutionary Spacetime [In Press].

- [3] Xiao Bo. (2026). Unified Cosmic Mechanics Evolution Theory (XIII): The Essence of Force [In Press].
- [4] Noether, E. (1918). Invariante Variationsprobleme. Nachrichten der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Mathematisch-Physikalische Klasse, 235–257. (DOI: 10.1007/978-3-662-35203-8_1). — Used to reconstruct the source of conservation laws, core support for the association between conservation and rule invariance.
- [5] Wigner, E. P. (1960). The unreasonable effectiveness of mathematics in the natural sciences. Communications on Pure and Applied Mathematics, 13(1), 1–14. (DOI: 10.1002/cpa.3160130102). — Used to discuss the essence of mathematics, supporting the core view that mathematics is an information projection of rule stability.
- [6] Xiao Bo. (2026). Unified Cosmic Mechanics Evolution Theory (II): Cosmic Evolutionary Resources [In Press].
- [7] Gödel, K. (1931). Über formal unentscheidbare Sätze der Principia Mathematica und verwandte Systeme I [On formally undecidable propositions of Principia Mathematica and related systems I]. Monatshefte für Mathematik und Physik, 38(1), 173–198. (DOI: 10.1007/BF01700692). — Used to argue the boundary of the source of rules, supporting the rationality of setting the theoretical boundary.
- [8] Ashby, W. R. (1956). An Introduction to Cybernetics. London: Chapman & Hall. — Supporting the necessary constraints of rules.
- [9] Xiao Bo. (2026). Unified Cosmic Mechanics Evolution Theory (XI): Fields and Particles — Deterministic Quantum Theory of Momentum Topological Encoding [In Press].
- [10] Anderson, P. W. (1972). More is different: Broken symmetry and the nature of the hierarchical structure of science. Science, 177(4047), 393–396. (DOI: 10.1126/science.177.4047.396). — Supporting hierarchical irreducibility and asymmetry.
- [11] Lee, T. D. (1983). Can time be a discrete dynamical variable? Physics Letters B, 122(3–4), 217–220. (DOI: 10.1016/0370-2693(83)90687-1). — Supporting the emergence of continuous symmetry from discrete rules.
- [12] Sorkin, R. D. (2003). Causal sets: Discrete gravity. In A. Gomberoff & D. Marolf (Eds.), Lectures on Quantum Gravity (pp. 305–327). New York: Springer. (DOI: 10.1007/978-0-387-24996-4_10). — Supporting the emergence of symmetry in discrete spacetime.
- [13] Sakharov, A. D. (1967). Violation of CP invariance, C asymmetry, and baryon asymmetry of the universe. JETP Letters, 5, 24–27. (DOI: 10.1063/1.1763691). — Supporting the view that symmetry is not absolute, supporting the discussion on rule asymmetry and CPT symmetry emergence.
- [14] Brading, K., & Castellani, E. (2003). Symmetries and Noether’s theorems. In K. Brading & E. Castellani (Eds.), Symmetries in Physics: Philosophical Reflections (pp. 57–79). Cambridge: Cambridge University Press. — Supporting the dynamic association between symmetry and conservation.
- [15] Lakoff, G., & Núñez, R. (2000). Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being. New York: Basic Books. — Supporting that mathematics originates from interaction and rule mapping.
- [16] Chaitin, G. J. (2005). Meta Math!: The quest for omega. New York: Pantheon Books.

- [17] Kauffman, S. A. (2000). *Investigations*. Oxford: Oxford University Press. — Supporting the computability and constructivity of mathematics.
- [18] Tegmark, M. (2008). The mathematical universe. *Foundations of Physics*, 38(2), 101–150. (DOI: 10.1007/s10701-007-9186-9; arXiv:0704.0646). — As a contrasting view, elaborating on the differences between this theory and the "mathematical universe" hypothesis.
- [19] Laughlin, R. B. (2005). *A different universe: Reinventing physics from the bottom down*. New York: Basic Books. — Supporting emergentism and hierarchical irreducibility, supporting the incommensurability of the three-layer rules and the view that symmetry is an emergent phenomenon.