Unified Cosmic Mechanics Evolution Theory (XI) : Field and Particle — Momentum Topological Coding Deterministic Quantum Theory

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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.

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

Traditional quantum field theory, which regards fields as spacetime-pervading physical entities and particles as their excitations, faces three dilemmas: lower organizational efficiency than the "1/4 r^2 perceptual cross-section" collinear interaction, inability to explain force characteristics (e.g., vector superposition, action-at-a-distance) conflicting with quantum entanglement, and unclear field dynamic origin and coupling constant source. It also has redundant driving forces, using force, energy, momentum, etc., alternately, violating logical consistency and reflecting ununified underlying dynamic principles. Based on the information dynamics evolution theory framework, this paper holds that particles and their internal structures are the only physical entities [1], fields are evolution rule sets [2], and the universe is a relational state evolution system consisting of m_0, c, and R [3]. Core conclusions: (1) Momentum units are the only underlying resources, c the only dynamic driving force, with energy=momentum=force=mc in eigenstate; (2) Particles form via multi-momentum unit cooperative encapsulation [4]; (3) Fields are constraint rule sets, four fundamental forces are particle interaction protocols; (4) Quantum uncertainty is a macroscopic observation aliasing effect, with underlying strict causal determinism. This paper establishes core mechanisms like momentum topological coding, reveals the underlying coding logic of basic physical quantities, and provides a complete framework for unifying quantum mechanics and relativity and reconstructing deterministic quantum theory.

Keywords: Unified field theory; Topological quantum mechanics; Cosmic unified mechanics; Origin of gravity; Origin of mass; Particle structure; Electron radius; Deterministic quantum mechanics

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1 Introduction

1. **Note: This paper is the core logical hub chapter for re-sorting out quantum mechanics within the framework of this evolution theory. For specific related derivations (such as quantum entanglement, the nature of force, particle dynamic radius, etc.), please see the subsequent chapters of this series.**

2. Methodological Statement on "Evolution Rules":

   a. Non-legislative nature of rules: The "rule set R" in this framework is not a decree issued by a "legislator" behind the universe, but a descriptive abstraction of "invariant relationships" summarized by this framework from observations.

   b. Epistemological boundary: Whether the universe has "rule entities" at the underlying level and whether this framework can summarize rules from observations are two ontological issues — this framework only takes the latter as the working basis.

   c. Distinction between source and origin: This framework does not study the absolute source (Source) of evolution rules and evolutionary resources — this issue is beyond the scope of empirical

science and is suspended. The term "origin" (Origin) used in this framework actually means "emergence": that is, given resources and rules, the mechanism by which new phenomena arise from underlying interactions. This framework only studies existing laws and the necessary objective conditions for evolution, and abstracts them into operable and understandable theoretical terms.

d. Positive definition of rules: The essence of evolution rules is the information representation relationship formed between evolutionary carriers (momentum units). Rules are not abstract entities independent of carriers, but relational patterns emerging from the interaction process of carriers.

e. Indivisibility of rules and carriers: Specific interaction mechanisms (such as perception, resolution, momentum borrowing and repayment) should be completely encoded on existing evolutionary carriers — there are no "pure rules" separated from carriers, nor "pure carriers" not constrained by rules. Rules and carriers are two indivisible aspects of the same evolution system.

3. Problems in Physics: Since the birth of physics, it has always pursued answers to two fundamental questions: what are all things composed of? How do they interact with each other? The answers to these two questions constitute the evolutionary context from classical mechanics to relativity and then to quantum field theory. However, there are always unbridged gaps in this context:

   Dilemma of field substantiation: Traditional theories regard fields as physical entities pervading spacetime — gravitational fields curve spacetime, electromagnetic fields transmit photons, and Higgs fields endow mass. If a field is a physical entity, it needs to switch associated attributes such as size, position, state, force, energy and mass in real time with particles. In a dynamic evolution system, the efficiency of organizing such evolutionary relationships is much lower than the collinear interaction efficiency of the "$1/4\ r^2$ perceptual cross-section". In addition, physical fields cannot explain the vector superposition, cancelability, penetrability, action-at-a-distance and instantaneity of forces — phenomena such as quantum entanglement and the Earth's magnetic field completely violate the laws of motion of macroscopic physical entities [5].

   Dilemma of particle substantiation: Traditional theories regard particles as energy wave packets or excitations of fields. If a particle is only a wave packet, where does its physical reality come from? Why do particles have definite rest mass, spin and charge? Why do electrons have extremely high spherical symmetry accuracy? Why do 1/2 spin particles need to rotate 720° to return to their original state? Under the proposition that "particles are excitations of fields", these questions have always lacked underlying dynamic explanations.

   Separation of information and thermodynamics: Maxwell's demon paradox indicates that there is a profound connection between information and thermodynamics. However, traditional theories regard information as an abstract mathematical quantity and do not pursue its physical carrier and evolutionary cost. If information is only "bits", why must erasing information consume $kT \ln 2$ energy? What is the physical essence of information?

2 The Nature of Fields

2.1 Fields = sets of evolution rules

Combined with the pre-derivations in multiple previous chapters within the framework of this evolution theory, the universe is a relational state evolution system. The system must contain the evolution state representational quantity m_0, the evolution driving quantity c (speed of light), and the evolution rule set R. The representational quantity m_0 and the driving quantity c together constitute evolutionary

resources (momentum units), and the unit mass (momentum unit) m_0 is the underlying evolutionary resource that cannot decay further [10]; the rule set R is the conditions that constrain the self-evolution of evolutionary resources and their mutual causal interactions, together forming invariant objective laws [11].

The field in the cosmic system is essentially a set of regularized protocols for interaction behaviors between evolutionary resources, including encapsulation protocols, perception protocols, resolution protocols and entanglement correlation protocols, etc., and is not an independently existing physical entity. The self-evolution state of the evolutionary subject (particle) is regulated by the encapsulation form of its own momentum units: if spherical symmetric full cancellation state encapsulation is adopted, the particle presents a static state; if there is a deviation in the encapsulation state, the particle enters an evolution state in the range of 0 c. The core role of the four fundamental forces is to trigger changes in the interaction mode of momentum states between particles, and their essence is to determine how to form directional breaking through symmetric states, that is, to construct momentum deviation states. As a constraint mechanism for the interaction of evolutionary resources in the cosmic physical system, the interaction results of fields can be divided into two states: coupling and decoupling, and the interaction modes include three types: common outward evolution, common inward evolution and transfer evolution.

2.2 Field ≠ Physical Entity

Regardless of whether the field is defined as a physical entity, the dynamic interaction process between particles must satisfy the following core mechanisms: perception mechanism, attribute state interaction mechanism, rule constraint mechanism, state information storage mechanism and extremely complex relationship representation mechanism. For example, traditional theories hold that particles are excitations of fields, which can indeed provide dynamic driving force, but fail to explain how much causal interaction is needed for the shaping of spatiotemporal state relationships.

If it is assumed that the field is a physical entity, multiple fields need to switch associated attributes such as size, position, state, force, energy and mass in real time with particles. In a dynamic evolution system, the efficiency of organizing such evolutionary relationships is much lower than the centralized interaction mode of a central CPU, and even cannot reach the perceptual collinear interaction efficiency of the "1/4 r^2 perceptual cross-section". In addition, if the field is a physical entity that exerts force between particles, it cannot explain the vector superposition, cancelability, penetrability, action-at-a-distance and instantaneity possessed by force [12] — for example, the motion of macroscopic physical entities (such as stones) is constrained by speed, distance, cancellation effect and impenetrability, while phenomena such as quantum entanglement and the Earth's magnetic field completely violate such laws of motion of macroscopic physical entities.

On the macroscopic scale, the continuous interaction between a large number of particles and protocol sets will emerge an "interaction environment" that seems to exist independently — for example, the magnetic field environment around the Earth and the gravitational field environment around the Sun. This macroscopically emergent interaction environment has measurable and perceptible characteristics, which are easily mistaken for an "entity field external to particles". For the convenience of understanding, we can also call the interaction environment a field, but we must distinguish the underlying essence.

2.3 Spherical Symmetric Momentum Field

All evolutionary entities in the universe are particles composed of momentum units, not fields. Whether fermions, photons, free energy and other particles are physical reality cooperative evolution

units, all can realize the state evolution shaping of three-dimensional space. Among them, photons and free energy adopt goose-flock coding (similar to a group of geese flying in the same direction at speed v, which can macroscopically encode any three-dimensional state), and fermions adopt spherical symmetric encapsulation.

3 Necessity of Spherical Symmetric Encapsulation of Fermion Particles

3.1 Limitations of the Point Particle Model

The traditional point particle model has many unexplainable physical phenomena, including the origin of spin, the formation mechanism of spin magnetic moment, the physical meaning of perceptual cross-section, the particle self-interference multi-path phenomenon in the double-slit interference experiment, the formation principle of Bose-Einstein condensate, the extremely high-precision spherical symmetric characteristics in electron observation, the coding mode of core attributes such as mass and color charge, and the extremely complex external causal relationship expression of particles.

3.2 Inevitability of Spherical Symmetric Momentum Arrows (Metaphorically, Momentum Arrows with Inertial Direction)

Based on the following physical phenomena, it can be inferred that all 1/2 spin fermions have momentum interaction perception units distributed on the spherical surface, rather than point particles in the traditional sense:

- The multiplicative forces between fermions all follow the r^2 attenuation or enhancement law;
- Momentum has three-dimensional coding constraints and strictly follows the law of conservation of momentum, i.e.,

$$\vec{p}_{\text{initial}} = \vec{p}_{\text{final}}$$

- The action of fields and forces presents three-dimensional omnidirectional perception and interaction characteristics;
- Particle evolution needs to have momentum arrows in statistical and perceptual senses to represent the evolution direction;
- Paired momenta $(\vec{p}, -\vec{p})$ distributed in spherical symmetry can cancel each other to form a stable equilibrium state;
- Experimental observations show that the electric dipole moment (eEDM) of electrons tends to have perfect spherical characteristics;
- After the particle breaks away from the potential well, it can maintain the original deviation momentum to move in a straight line, and the spherical momentum arrow is needed to record its causal evolution trajectory;
- The spherical structure is conducive to the balanced statistics and interaction of momentum units;
- In the process of multiple force interactions of particles, there is no momentum dissipation phenomenon, which is consistent with the law of conservation of momentum;

- 1/2 spin particles need to rotate 720° to return to their original state, and the topological structure of spherical symmetric particles can meet this requirement;
- In the bremsstrahlung process, photons are released in spherical symmetry, and their release law is directly related to the spherical perceptual cross-section of particles;
- The wave-particle duality of particles can be explained by the evolution state of spherical momentum units;
- The essence of gravitational waves is decoupled momentum flow, not spacetime flow in traditional theories;
- In the process of particle decay, new sub-units can be produced, and their momentum distribution follows the spherical symmetric evolution law;
- The speed of light does not change with the reference frame, indicating that the particle has an intrinsic evolution amplitude c inside, and superluminal speed cannot be achieved through superposition, i.e.,

$$v_{\max} = c$$

Mass-energy equation: The mass-energy equation in relativity is essentially a space-time state shaping equation, and the dynamic mass-energy equation is mc, i.e., energy = momentum = force = mv (i.e., mc) [21,22]. However, the mass-energy equation in relativity still indicates that both bosons and fermions have m momentum units contributing to the evolution ability of the speed of light, while fermions need to show a self-static state through symmetric cancellation.

3.3 Causal Point at the Center of the Particle Sphere

The overall behavior of the spherical symmetric momentum encapsulation of fermions is determined by the vector sum of all momentum units,

$$\vec{P}_{\text{total}} = \sum \vec{p}_i$$

This vector sum naturally forms an equivalent action center — no additional "causal core" entity needs to be preset.

This equivalent center carries the inertia, total mass, total charge of the particle and the continuity of the world line, and is a statistical manifestation of the collective behavior of momentum units. The "point particle" behavior observed in experiments is precisely the projection of this equivalent center on the macroscopic scale. The physical carrier guided by David Bohm's pilot wave corresponds to this equivalent center and its accompanying momentum flow distribution in this framework.

3.4 Inertial Motion Direction is the Causal Direction

The inertial motion direction of the particle (i.e., the momentum deviation direction $\Delta\vec{p}$) is its causal evolution direction. This direction is determined by the vector sum of internal momentum units:

$$\vec{v} = \frac{\Delta\vec{p}}{P_{\text{total}}} \cdot c$$

If this direction is missing, the evolutionary subject cannot represent its causal direction, which violates the first principle of causality [23,24,26].

Special Note: The universe is a causal interaction state evolution system. The change of inertial state only comes from the interaction between evolutionary carriers — no interaction means no change. Therefore, there are no concepts such as "spontaneous symmetry breaking" and "spontaneous decay" in the cosmic system. Decay essentially originates from interaction with the environment and is realized through local momentum borrowing and repayment in the potential space, forming global momentum conservation and causal interaction; the delayed decay of high-speed muons is the special relativistic interaction integral weakening effect (compression of the number of perceptual windows) [25]; particles hundreds of millions of light-years away have no autonomous evolution during their flight to the Earth, otherwise their spectral characteristics would have changed long ago. If autonomous evolution is allowed, it is like a system playing automatically, and at the same time, it cannot maintain a stable evolution state.

3.5 Force ≠ Carrier of Force

Force emerges from the interaction after the interaction between momentum carriers, and forms a force relationship with the motion trend. It can only be manifested after the interaction is applied. Therefore, neither force nor field is a physical entity, but the evolution result of the momentum interaction protocol. Momentum units are the only carriers of force and energy, and no propagator is needed for mediation. Particles can real-time perceive the state of other evolutionary resources through the same field protocol. Force has material penetrability, non-delay application characteristics, and unit force has no attenuation (derived from the conservation of momentum carriers) [5].

Velocity emerges from the ratio of momentum deviation to total momentum, i.e., the macroscopic inertial motion velocity of fermions, and its quantitative expression is:

$$\vec{v} = \frac{\vec{\Delta p}}{P_{\text{total}}} \cdot c$$

where $\vec{\Delta p}$ is the momentum deviation, P_{total} is the total momentum of the particle, and c is the speed of light.

Acceleration emerges from the continuous change of momentum deviation. For example, after a particle enters a gravitational field, the closer it is to the potential well, the more momentum units are toggled, and the larger the momentum deviation $\vec{\Delta p}$ is. Its quantitative expression is:

$$\vec{a} = \frac{c}{P_{\text{total}}} \cdot \frac{d\vec{\Delta p}}{dt}$$

The state evolution and structure formation of cosmic spacetime only originate from the emergence process of evolutionary resources based on protocol rules, without the participation of other independent physical entities. To unify gravity into quantum mechanics and the standard model, it is necessary to remove the propagator mechanism assumed in traditional theories and introduce quantum fluctuations as the key. In fact, no propagator has been observed in any experiment, only quantum fluctuations [27,28,29,30].

3.6 Core Definition and Rules of Fields (Protocols)

Fields are not physical entities, but perception and resolution protocols between momentum pairs; only momentum unit carriers have material reality. After the field resolution is completed, the $(\vec{p}, -\vec{p})$ momentum pair toggling protocol will be executed, thereby completing the force interaction process between fermions. Fields can be divided into four types: gravitational field, electromagnetic field, weak force field and strong force field, and their core rules are as follows:

3.7 Field and Particle Coding

Core attributes of particles such as mass, charge and spin are all realized through momentum topological coding. This framework is compatible with the particle classification and quantum number rules of the standard model, but provides different explanations for the underlying mechanisms:

Fermions adopt double-covering momentum topological coding: the topological state reverses when rotated by 360°, and returns to the original topological state when rotated by 720°. This topological structure naturally satisfies the Pauli exclusion principle ($\psi(\vec{r}_1, \vec{r}_2) = -\psi(\vec{r}_2, \vec{r}_1)$) without additional assumptions.

Bosons adopt single-covering momentum topological coding: the topological state remains unchanged during rotation and can achieve infinite superposition.

Charge, color charge and weak isospin are all underlying momentum topological labels, used to distinguish different types of interaction protocols (electromagnetic, strong, weak).

Symmetric encapsulation coding corresponds to the SU(3)×SU(2)×U(1) symmetry group. The phenomenon called "spontaneous breaking" in the standard model corresponds to the coding preference direction of the Higgs mechanism in this framework — that is, the state transition triggered by momentum input, rather than an unexplained "spontaneous" process.

The field strength coefficient is determined by the effective interaction ratio of momentum unit groups:

$$g = \frac{N_{\text{eff}}}{N_{\text{total}}}$$

where N_{eff} is the number of effective interaction momentum units, and N_{total} is the total number of momentum units.

4 Correspondence Between This Evolution Theory and the Standard Model and Traditional Theories

Note: The mathematical expressions in the following table are only used to understand the logic in combination with traditional theories, and do not represent absolute accuracy. For example, the essence of force should be the integral of momentum deviation, not the integral of time.

Standard Model Concept	**Corresponding Explanation in This Evolution Theory (Physical Image • Minimal Version)**	**Supplementary Mathematical Expression (Core Formula • Compatible Version)**

Field	A set of rules that constrain the encapsulation, perception, interaction and other behaviors of evolutionary carriers. [2]	Protocol resolution: $\mathcal{L}_{\text{int}} = \sum k_{ij}\phi_i\phi_j$ (where k is the protocol interaction coefficient)
Continuous Field	A macroscopically continuous effect emerging from the continuous evolution of inertia at the Planck discrete scale. [21]	Discrete constraint: $\Delta x \geq l_P,\ \Delta t \geq t_P$
Symmetry and Conservation	Conservation laws and CPT symmetry emerge from the stability of multi-layer encapsulation rules. [2]	CPT transformation: $\Theta\psi(t,\vec{x})\Theta^{-1} = \psi^*(-t,-\vec{x})$; Conservation: $dQ/dt = 0$
Momentum	The only underlying non-decayable resource in the universe; encoded with evolution amplitude c, frame rate c and direction. [31]	Conservation of momentum: $\sum \vec{p}_{\text{in}} = \sum \vec{p}_{\text{out}}$; Coding: $\vec{p} = n \cdot \hbar\vec{k}$
Lorentz Transformation	Emerges from the compression of the number of interactive spacetime windows in a changing environment, independent of the observer. [25]	Transformation: $x'^{\mu} = \Lambda^{\mu}_{\nu}x^{\nu}$; Invariant: $p^{\mu}p_{\mu} = m^2c^2$
Gauge Group	Symmetry coding of momentum encapsulation protocols at different levels (U(1)/SU(2)/SU(3)).	Group operation: $\psi \to U\psi,\ U = e^{i\theta^a T^a}$ (exponential form is a compact writing of topological rotation)
Propagator	Momentum pair $(\Delta\vec{p}, -\Delta\vec{p})$ based on local potential space borrowing and repayment. [32,5]	Essence of fluctuation: $\Delta E\Delta t \geq \hbar/2$ (time window limit for borrowing and repaying momentum)
Point Particle	Symmetric multi-layer momentum encapsulation body; radius is inversely proportional to momentum deviation (the larger the deviation, the more compact the encapsulation). [33]	Radius relationship: $R \propto \hbar/\Delta p$
Photon	Goose-flock type unidirectional momentum flow encapsulation state; geometric organization corresponds to the emission state. [34]	Energy relationship: $E = h\nu = p$ (total amplitude of unidirectional momentum flow)
Wave-Particle Duality	Three cooperative states of a single particle: dispersion, collapse, fluid (switched by entanglement protocol). [34]	Real field description: $\Psi(\vec{r},t)$ is the momentum flow density; Distribution: $\rho = \Psi$ (physical reality, not probability amplitude)
Quantum Coherence	Sustained velocity-synthesizing process of mutual momentum deviation unloading between two particles (vector-fused evolution frequency). [38]	Velocity-synthesizing equation: $\vec{v}_{\text{syn}} = \frac{\sum \vec{p}_i}{P_{\text{total}}} \cdot c$; Phase locking: $\phi_i = \phi_j + 2\pi k$; Unloading condition: $\sum \Delta\vec{p}_i = 0$
Energy/Spacetime	Emerges from the "double c" coding and evolvable direction of momentum units. [21,22]	Eigenstate: $E = p = F = mc$; Spacetime shaping: $E_{\text{spacetime}} = mc^2$

Perception	Offline (force: local attenuation) + Inline (entanglement: global non-attenuation).	Perceptual cross-section: $\sigma \propto 1/r^2$; Interlocking core: $K_{\text{ent}} \neq 0$
Quantum Entanglement	Inline cooperative evolution perception protocol; forces the conservation of carrier angular momentum to realize three-state cooperative switching. [35]	Statistical representation: $\Psi \propto (\uparrow\downarrow \pm \downarrow\uparrow)$; Essential constraint: $\vec{L}_A + \vec{L}_B = 0$
Lagrangian	Interaction resolution based on perceptual collinear cross-section; the principle of least action is a macroscopic statistical result. [36]	Action: $S = \int (T_{\text{kinetic}} - V_{\text{protocol}})dt$
Force	Emergent result of momentum deviation after interaction; not an independent entity; applied instantaneously, the upper limit of interaction frequency is c. [5]	Reconstruction: $\vec{F} = d\vec{p}/dt$ (momentum redistribution rate triggered by protocol)
Four Fundamental Forces	Offline interaction protocols; the core mechanism is the internal/external toggling of momentum units: repulsion (inward toggle), gravity (outward toggle). [5]	Unified form: $F \propto (Q_1 Q_2)/r^2$ (where Q is the protocol coding charge of different layers)
Action/Reaction	Bidirectional momentum toggling under protocol constraints, momentum is strictly conserved. [5]	Conservation of momentum: $\vec{F}_{12} = -\vec{F}_{21},\ m_1\vec{v}_1 = -m_2\vec{v}_2$
Color Charge	Multi-layer stable encapsulation protocol under strong interaction (the root cause of quark confinement). [5]	Running coupling: $\alpha_s(Q^2)$ (change rate of encapsulation layers with energy scale)
Spin	Helical precession structure of internal momentum units; rotating 360° in space corresponds to rotating 180° of the spin axis (needs 720° to recover). [34]	Topological phase: $\psi(2\pi) = -\psi(0),\ \psi(4\pi) = \psi(0)$
Fine-Structure Constant	The fixed proportion (1/137) of momentum units compressed and absorbed within the fermion radius. [34]	Definition: $\alpha = e^2/(4\pi\epsilon_0\hbar c) \approx 1/137$
Mass	Statistic of the total number of internal momentum units; the fully canceled state is the rest mass, and the deviation state contributes to inertia. [22]	Mass definition: $M = N \cdot \langle p_{\text{unit}} \rangle / c$
Higgs Boson	A special scalar excited state that cannot form a stable fermion-like spinor encapsulation (i.e., "does not weave photons").	Vacuum expectation value: $\langle\varphi\rangle = v \neq 0$ (reference state of the background protocol field)
Annihilation	The encapsulation structures of matter and antimatter are mutually lifted, and the internal momentum is released and reorganized into unidirectional photon flow.	Process: $e^+ + e^- \to 2\gamma$; Total energy: $E_{\text{total}} = 2mc^2$

Complex Number	A mathematical tool used to describe the calculation shortcut for two-dimensional topological phase coordination, not a physical entity. [36]	Euler formula mapping: $e^{i\theta} \leftrightarrow$ helical precession angle (real part = causal direction, imaginary part = topological winding)
Matrix	An operator tool describing "symmetry transformation + rotation + multi-layer topological coding".	Evolution operator: $\Psi_f = e^{-i\theta\hat{J}}\Psi_i$ (where $\hat{J}$ is the topological encoder)
Conservation of Energy	Originates from the absolute conservation of total momentum resources and evolution rate c; energy is a macroscopic statistical result. [25]	Absolute conservation: $\frac{d}{dt}(\sum p_i c) = 0$
Particle Excitation	Particle generation is the result of "input momentum + parent particle template" replication through the potential space.	Generative formula: $M_{\text{new}}c = \left\vert\vec{P}_{\text{in}} + \sum \vec{p}_{\text{borrowed}}\right\vert_{\text{net}=0}$

4.1 Encapsulation Combination and Performance of Different Particles

Particle Type	**Encapsulation Combination**	**Physical Performance**	**Relevant Mathematical Correlation**
Electron	Encapsulation (1) (Charge) + Encapsulation (2) (Spin 1/2) + Encapsulation (4) (Mass)	Participates in electromagnetic force and weak force, does not participate in strong force	Electron charge: $e = 1.602 \times 10^{-19}$ C, Rest mass: $m_e = 9.109 \times 10^{-31}$ kg
Quark	Encapsulation (1) (Charge) + Encapsulation (2) (Spin 1/2) + Encapsulation (3) (Color Charge) + Encapsulation (4) (Mass)	Participates in all four fundamental forces	Quark charge: up quark +2/3 e, down quark -1/3 e
Photon	Encapsulation (1) (Electromagnetic Propagation Protocol)	Only participates in electromagnetic force, no mass encapsulation	Photon rest mass: $m_\gamma = 0$, Energy: $E = h\nu$
Z Boson	Encapsulation (1) (Partial) + Encapsulation (2) (Weak Force Propagation Protocol) + Encapsulation (4) (Mass)	Transmits weak force	Z boson mass: $m_Z \approx 91.2$ GeV/c^2

The traditional model in which particles are driven to evolve by external field energy and velocity through spacetime points cannot explain core physical mechanisms such as the invariance of the speed of light, ultraviolet divergence, the emergence of spacetime, the essence of relativity, the essence of force, and particle polymorphism. Therefore, it is necessary to incorporate the evolution driving mechanism into the internal self-energy and velocity driving system of particles.

5 Table of Relationships Between the Four Fundamental Forces (Four Basic State Interaction Protocols) and Particles

The four fundamental forces are all dominated by multi-layer topological encapsulation of momentum units of $N \cdot m_0 \cdot c$ and interaction protocols, forming action and reaction forces. The interaction magnitude is proportional to the momentum deviation $m_0 \cdot c$ [37].

Protocol Type (Force)	**Geometric/Gradient Characteristics**	**Momentum Carrier (Medium)**	**Protocol Mechanism (Coding Information → Momentum Operation)**	**Evolutionary Effect (Collective Behavior of Carriers)**
Gravity	Global density gradient (spherical symmetric ground state)	Ground state momentum flow (equivalent spacetime curvature)	Coding: Global coupling potential distribution ↓ Operation: Dynamic collapse of momentum weight to high coupling area [38]	Effect: Gravitational thermal fluctuation/Hawking radiation Target: Maximize global coupling
Electromagnetic Force	Polar charge gradient	Polarized momentum packet (photon state carrier)	Coding: Polar symbol ↓ Operation: Directional locking of carrier direction	Electromagnetic radiation: Energy release from accelerated oscillation of carriers
Weak Force	Chiral asymmetric gradient	Mass-loaded momentum packet (W/Z state carrier)	Coding: Flavor/chiral state ↓ Operation: Carrier quantum state transition	Decay: Reorganization of internal structure of carriers and energy release
Strong Force	Topological color charge gradient	Gluon momentum flow (gluon state carrier)	Coding: Color charge complementarity ↓ Operation: Strong confinement and confinement of carriers	Nuclear energy: Energy release caused by changes in carrier bound states

Conclusion: The Root Cause of Non-Unification in Conventional Physics

Therefore, the fundamental reason conventional physics cannot unify all physical phenomena and forces is that it artificially decouples energy, force, momentum, and mass into separate conceptual entities. This decoupling leads to multiple interactions producing infinite emergent "energy" contributions—the ultraviolet divergences of quantum field theory. To explain different physical phenomena, conventional theory has been forced to introduce an extremely complex patchwork of ad hoc concepts: energy, kinetic energy, potential energy, force, spacetime curvature, electric charge, magnetic field, electric field, spinor field, scalar field, Higgs field, Lagrangian, Hamiltonian, Hilbert space, probability waves, complex numbers, operators, commutation relations, gauge symmetries, coherence, and countless other mathematical constructs—all serving as evolutionary driving forces and phenomenological explanations.

Root Cause: Conventional physics treats force, energy, momentum, and mass as independent

entities, rather than as different statistical projections of a single underlying reality—the momentum unit $m_0\vec{c}$. Every new mathematical construct (Lagrangian, Hamiltonian, Hilbert space, etc.) is introduced to compensate for this decoupling, creating a fragmented patchwork rather than a unified theory.

6 Overall Logic of Particle Interaction State Evolution Through Field Protocols

6.1 Momentum Encapsulation

The only evolutionary resource with physical reality in the cosmic system is momentum. Each momentum unit is encoded with double c parameters (evolution amplitude c, evolution frame rate c_+) and evolvable direction, i.e., the vector sum direction of momentum deviation. Its basic momentum relationship is

$$\vec{p} = m\vec{v}$$

and it satisfies the law of conservation of momentum

$$\sum \vec{p} = \text{constant}$$

6.2 Particle Encapsulation

Photons encapsulate m single momentum evolution directions through goose-flock coding. Goose-flock coding can be understood as a group of geese flying in a single direction, which can encode various three-dimensional evolution states, and its energy and momentum satisfy (in the natural unit system of this framework)

$$E = p$$

Fermions perform multi-layer protocol encapsulation (such as SU(1), SU(2), SU(3) protocols) on m spherical symmetric cancellation states $(\vec{p}, -\vec{p})$. Each layer of stable encapsulation will emerge conservation and CPT symmetry. The physical characteristics emerging after overall encapsulation include rotatability, static mass and perceptual attenuation law $1/(4\pi r^2)$. Particles realize self-correlation through interaction protocols and entanglement protocols to complete cooperative evolution. After all particles are encapsulated, the emerging potential sustainable evolution state quantity is mc^2 (mass-energy equivalence relationship).

6.3 Perception and Resolution

The force interaction between fermions is mainly realized through non-dissipative interaction. When particle A enters the perceptual cross-section of particle B, the following resolution will be performed (using relativistic energy description instead of direct mechanical quantities):

$$F_{\text{int}} = \frac{f_1 \cdot (m_1 c) \cdot (m_2 c)}{4\pi r^2}$$

where f_1 is the perception and interaction influence factor under the encapsulation protocol, m_1c and m_2c are the eigenstate energies (momentum magnitudes) of the two particles respectively, and $4\pi r^2$ is the spherical perceptual cross-sectional area of the particles.

The upper limit of the refresh frequency of interaction resolution between particles is c [32]. Therefore, when high-speed moving particles interact with the outside world, special relativistic effects will emerge [25], and their relativistic factor is:

$$\eta(v) = \sqrt{1 - v^2/c^2}$$

This effect can be understood as the slowing down of the external clock, while the internal clock frequency of the particle remains in the previous inertial state. Therefore, the macroscopic interaction result needs to introduce two influence factors: the relativistic perceptual time window and the perceptual cross-section. The corrected expression is:

$$F_{\text{int,macro}} = \eta(v) \cdot \frac{f_1 \cdot (\eta_1 m_1 c) \cdot (\eta_2 m_2 c)}{4\pi r^2}$$

In the traditional gravitational and Coulomb force formulas, the 4π term is hidden in the gravitational constant G, Coulomb constant k and vacuum permittivity ϵ_0 in the electromagnetic formula respectively. The reason why traditional theories do not combine 4π and r^2 into the spherical area formula is mainly because the gravitational effect is treated as a particle, the electromagnetic force is treated as the number of charges, and it is for the convenience of quantitative counting and expression.

The macroscopic evolution velocity of particles is determined by the ratio of momentum deviation to total momentum, and its quantitative expression is:

$$\vec{v} = c \cdot \frac{\vec{\Delta} p}{P_{\text{total}}}$$

Note: The resolution of force is not a calculation process like human calculation, but a macroscopic result jointly interacted by two macroscopic particle bodies after momentum unit encapsulation based on physical interaction rules through a space similar to Hilbert space. It determines how many momentum units interact based on the potential space and are applied to the two particles to finally form a new causal inertial evolution state, and emerge macroscopic physical quantities such as Lagrangian, Hamiltonian, potential energy, kinetic energy, force, entropy, and heat.

6.4 Momentum Borrowing and Repayment

When particles interact, they borrow momentum pairs $(\vec{p}, -\vec{p})$ of corresponding sizes from the potential space through resolution. After the interaction is completed, the momentum pairs are returned to the potential space through the dynamic distribution and evolution of momentum flow. It should be clarified that the Heisenberg uncertainty principle in traditional theories is essentially a statistical approximation of low-pass filtering of high-frequency discrete momentum flow evolution by macroscopic observers limited by time/space resolution. It is not an ontological attribute of particle evolution — all probability clouds and uncertainties are macroscopic aliasing effects. The underlying core is the strict causal deterministic distribution and evolution rules of momentum flow [39].

6.5 State Interaction

Through the momentum pairs $(\vec{p}, -\vec{p})$ borrowed from the potential space, the evolution direction of the spherical symmetric momentum of the particle is toggled: when the perception protocol is repulsion, the momentum pairs are toggled inward together; when the perception protocol is attraction, the momentum pairs are toggled outward together. This process realizes the symmetry breaking inside the particle, and then emerges physical quantities such as action and reaction forces, inertia, multiplicative forces, energy, time and space.

6.6 Velocity Increase Principle

After two particles complete the interaction, they obtain a net momentum deviation increment $\Delta\vec{p}$ through interaction. The magnitude of their velocity increment $\Delta\vec{v}$ satisfies the following quantitative relationship:

$$\Delta\vec{v} \approx \frac{\Delta\vec{p}}{P_{\text{total}}} \cdot c$$

This principle reveals the direct correlation between momentum deviation and velocity change, further verifying the core position of momentum as an evolutionary resource. This equation is essentially the dynamic emergence equation of the inertial state of Newton's first law.

6.7 Conclusion

Emergence of dynamics: The evolution resource dynamics of the universe emerges from the intrinsic evolution amplitude c and evolution frequency c of its own momentum units. The evolutionary carriers have the tendency to cancel the resultant force, no spacetime superposition, no velocity superposition, and causal inertia maintenance, which emerge basic physical quantities such as force, energy, mass, momentum, velocity v, speed of light c, information, time, and space. The unity of the origin of force ensures the stability of the cosmic system.

Emergence of fields: Evolutionary resources have intrinsic state evolution capabilities, and fields are essentially protocols that constrain the self-cooperative evolution of evolutionary carriers as encapsulation bodies and the interactive cooperative evolution of multiple particles. The protocols include encapsulation, perception, resolution, momentum borrowing and repayment, causal state application and other protocols, all of which ultimately realize the momentum deviation state of particles. The diversity and asymmetry of protocols ensure the diverse hierarchical emergence of the universe.

7 Summary

1. The universe is an evolution system formed by the representational quantity m_0, the driving quantity c, and the evolution rule set R. We can only inquire about the underlying causes of all physical phenomena from two angles. For example, to explain the Pauli exclusion principle, we can only find the origin from the dynamic influence or rule influence. For example, dynamically derive whether it is the motion trend that forms repulsion, or the evolution rule that forms the repulsion protocol. Generally, there is no need to introduce a separate spinor field, or generally speaking, the spinor field is only a macroscopic effect.

2. The essence of a field is a set of evolution rules, which constrains the evolutionary carrier to carry out state evolution according to stable laws. Particles are various encapsulation rules of fields, which constrain evolutionary carriers to realize overall cooperative evolution under the inline perception protocol of quantum entanglement. Force and energy emerge from the driving force of the speed of light, which drives the uniform linear state transition ability of all inertial motions, but the perception ability can realize the overall nonlinear evolution of particles.

3. The universe is a deterministic evolutionary system of "momentum units + dual c intrinsic drive + protocol rules". Quantum probability and uncertainty are both aliasing effects of macroscopic observation on discrete high-frequency evolution, with strict causality at the underlying level.

4. **Main Dynamic Origin of Quantum Probability**
   Quantum probability is not an underlying intrinsic uncertainty, but a macroscopic manifestation of the following six types of statistical aliasing effects:

   a. State Aliasing: Particles have polymorphism and undergo intrinsic state changes during evolution. This state change is not an autonomous change divorced from causality, but induced by causal interaction—external conditions trigger state changes, rather than an unprovoked "spontaneous" process.

   b. Conceptual Aliasing: Confusion of traditional dimensions, failing to fully distinguish the logical relationships between energy, force, momentum, and mass. This framework reveals that the four are essentially emergent from multiple logical perspectives of the representational quantity m_0 of state evolution and the evolution efficiency v of the driving quantity; they are not abstract mathematical operators but physical realities.

   c. Path Aliasing: Particles have internal structures, composed of the superposition of momentum flows m_0c. Based on the quantum entanglement inline protocol, momentum flows can form multi-path cooperative distribution—which is not a contradictory description of "existing at two spacetime points A and B simultaneously", but the deterministic distribution of momentum flows among different paths.

   d. Sampling Aliasing: Microscopic particles cannot be observed with global surface sampling like observing a basketball; only sparse sampling can be obtained (such as scattering cross-section experiments). The sparseness of observation samples leads to amplified statistical fluctuations, presenting as "uncertainty".

   e. Frequency Aliasing: For example, the motion of electrons in atoms—regions with high probability of occurrence correspond to regions of momentum flow density superposition (such as orbital turning points, standing wave nodes, frequency flash points, etc.). When the observation frequency is incommensurable with the evolution frequency, periodic statistical deviations occur.

   f. Interaction Aliasing: Force interaction is based on potential space momentum borrowing and repayment under the perceptual spacetime window. The interaction process is independent of distance (only related to the perceptual cross-section), and the interaction result is completed instantaneously within a single time snapshot. Traditional theories misinterpret this discrete, instantaneous, and deterministic interaction as "probability emergence in the void".

   Underlying Constraints: The underlying universe is based on three strict and stable conservations—conservation of evolutionary carriers (momentum units), stability of evolution rules (rule set R), and conservation of driving ability (speed of light c)—which together form the deterministic basis of causal interaction, and there is no self-random evolution. Under ideal

observation conditions (polymorphic separation, clear dimensions, path resolution, sufficient sampling, frequency matching, window synchronization), probability degrades into determinism.

Main Theoretical Origin of "Hidden Variables" : The fundamental theoretical source that leads to the appearance of "hidden variables" is the dual-state transformation of particles under different momentum deviations—namely, state changes of collapse, dispersion, fluidization, or long-range entanglement. These can be termed **internal constraint state transitions**. The other category of state transitions is **interactive state transitions**, which correspond to changes in evolutionary frequency and momentum. Both types of state transitions are deterministic under underlying rules, but their statistical aliasing at the macroscopic level gives rise to the appearance of "hidden variables" in traditional quantum theory. In this framework, there is no metaphysical randomness—only state transitions that are either internal (originating from momentum deviation distribution within encapsulation) or interactive (originating from perceptual cross-section exchange), both governed by the same triple conservation: evolutionary carriers (momentum units), evolution rules (rule set R), and driving ability (speed of light c).

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