**Field-Composition Evolution of Matter Hierarchy: A Three-Field Competition and Phase Transition Based on A (Wave), B (Chromo-Charge), and C (Particle) Fields**

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**Abstract:**Based on the ABC field combination theory, this paper establishes a unified model describing the hierarchical structure of matter, interpreting the evolution from quantum particles to gravitational celestial bodies as a “dynamic phase transition” process driven by the competition and dominance shift among its intrinsic electromagnetic vortex field (A-field - wave nature), chromo-charge vortex field (B-field - chromo/charge attribute), and Higgs vortex field (C-field - mass/particle nature).

We introduce a field-composition order parameter to characterize this competitive relationship and construct its evolution using a Landau-type free energy functional The theory indicates that in high-energy microscopic environments, the A-field’s wave nature dominates ; at the atomic and molecular level, the B-field undergoes “chromo-charge collapse,” triggering a reduction in the A-field energy level; at the macroscopic level, the C-field’s particle nature ultimately dominates and gravitation emerges as a phenomenon of C-field interaction. This model provides a new field-theoretic paradigm for unifying quantum mechanics and general relativity.

**Keywords:** ABC Field Combination Theory; Wave-Particle Phase Transition; Chromo-Charge Collapse; Order Parameter; Matter Hierarchy; Gravitational Emergence

1. **Introduction: A Unified Competitive Picture of Wave Nature, Chromo-Charge, and Particle Nature**

A fundamental problem in physics is how to unify the wave nature of the quantum world with the particle nature of the gravitational world. Li Zhijun’s ABC Field Combination Theory provides a framework for this: Any matter is a specific combination state of the electromagnetic vortex field (A - wave nature), the chromo-charge vortex field (B - chromo/charge attribute), and the Higgs vortex field (C - mass/particle nature).

This theoretical framework, for the first time, combines non-Abelian gauge fields with geometric torsion fields, addressing the difficulty traditional unified theories (e.g., Kaluza-Klein theory) have in handling chromo-charge fields. Its evolution is determined by the relative strength of the three fields’ energies. We define a core physical quantity—the Field-Composition Order Parameter —to quantify the ratio of “particle nature” to “wave nature,” thereby providing a unified description of the phase transition from the quantum to the gravitational realm.

In early theoretical constructions, Zhao Guangyao pointed out that the ABC mechanism (Anomalous/Broken/Coherent Mechanisms), by introducing the coupling of the electromagnetic field (A), chromo-charge field (B), and Higgs field (C), attempts to unify gauge field theory (SM) with general relativity (GR). This paper will further develop this idea, constructing a complete framework for phase transition dynamics.

1. **Theoretical Model: Dynamics of Three-Field Competition**

**2.1 General Formulation of Field Composition and the Order Parameter**

Any material system can be expressed as a three-field direct product state:

The physical attributes of the three fields are clearly defined:  
\* A-field (): Characterizes wave nature, dominating quantum interference, diffraction, etc., corresponding to the carrier of electromagnetic interaction.

* B-field (): Characterizes chromo-charge and charge attributes, serving as the carrier of strong and electroweak interactions, corresponding to the source of chromo-charge force.
* C-field (): Characterizes mass and particle nature, determining inertia, gravity, and degree of localization, corresponding to the Higgs field.

The macroscopic properties of the system are determined by the field-composition order parameter:

According to the theoretical framework of the Li Field, the three fields generate elementary particles through specific combination rules. For example, gluons require color-anticolor pairing (), and photons are expressed as (). These combination rules reflect the competitive and synergistic relationships among the three fields at different energy scales.

The macroscopic state of the system can be categorized by the value range of the order parameter :  
\* : Wave Phase. A-field dominates, the system exhibits strong quantum wave nature.

* : Transition Phase. A and C fields compete, B-field structure changes, the system forms stable structures (atoms, molecules).
* : Particle Phase. C-field dominates, the system exhibits significant particle nature and gravitational effects.

**2.2 Phase Transition Dynamics Equations**

The system’s evolution is described by a Landau-Ginzburg free energy functional, which is a function of the order parameter and the B-field chromo-charge condensation degree :

Its dynamics are governed by the Ginzburg-Landau equations:

The B-field’s chromo-charge condensation term (“chromo-charge collapse”) is the key coupling mechanism that triggers the reduction of the A-field energy level and drives the system’s transition from the wave phase to the particle phase

This dynamical framework has profound mathematical connections to the evolutionary behavior of the traditional ABC model in the zero-temperature limit. When considering quantum fluctuations of the system, three-field competition can lead to rich phase transition phenomena, including domain wall formation and topological defects, which may become important signals for future experimental verification.

1. **Phase Transition Process: Three-Stage Evolution**

**3.1 Stage One: Wave Phase — Quarks and Leptons**

In high-energy microscopic environments, the field combination state is:

The system is dominated by the A-field’s wave nature.  
\* Dominant Attribute: A-field wave nature. is extremely high, particles exhibit strong de Broglie wave and quantum tunneling effects, wave nature is significant.

* B-field Role: Chromo-charge () is active, carrying the strong interaction but confined within hadrons.
* C-field Role: is low, rest mass is small, particle nature is weak.
* Order Parameter: the system is in a deep wave phase.

At this stage, the combination of the three fields follows specific microscopic rules. According to the ABC field combination theory, within an 11-dimensional spacetime framework, 62 elementary particle fields are generated through different combinations of the A, B, and C fields. This mechanism provides a field-theoretic basis for the fundamental properties of quarks and leptons.

**3.2 Stage Two: Transition Phase — Atoms and Molecules (B-field Collapse Triggers Phase Transition)**

When the system energy scale reduces to the atomic and molecular level, the field combination state transforms into:

The system enters the transition phase.  
\* Dominant Attribute: Competition and balance between A-field wave nature and C-field particle nature. The electron cloud (A-field) has wave nature but is bound by the atomic nucleus (C-field particle nature).

* B-field Role: “Chromo-charge collapse” occurs. The quarks’ chromo-charge () collapses into a color singlet during hadronization. Its energy is converted into binding energy, triggering a reduction in the A-field energy level and a relative rise in the C-field energy level (manifested primarily as atomic nucleus mass).
* Order Parameter: the system is in a critical transition state.

The B-field’s “chromo-charge collapse” is the key trigger for the phase transition. In this process, the originally active chromo-charge degrees of freedom are confined within hadrons, and their external manifestation nearly disappears from a mesoscopic perspective. This collapse mechanism bears a striking resemblance to the zero-temperature limit dynamics in the ABC model.

**3.3 Stage Three: Particle Phase — Macroscopic Celestial Bodies**

At the macroscopic scale, the field combination state is:

The system is completely dominated by the C-field’s particle nature.  
\* Dominant Attribute: C-field particle nature. mass is enormous, wave nature (de Broglie wavelength is extremely short).

* B-field Role: Completely neutralized (), electromagnetic charge is also approximately neutralized.
* Gravitational Emergence: The enormous C-field energy level causes significant curvature of the Higgs field background, and its interaction emerges in the form of gravitation.
* Order Parameter: the system is in a deep particle phase.

At this stage, the interaction of the C-field becomes the dominant force. According to Li Zhijun’s theoretical framework, gravity can be interpreted as a derived effect of the Higgs field C ( increases with distance), which is a scalar field correction to the Newtonian gravitational paradigm. This description provides a new approach to understanding the unification of gravity and the Standard Model of particle physics.

1. **Mathematical Derivation: Gravitation as an Emergent Phenomenon of C-field Interaction**

In the particle phase the total energy of the system is dominated by the C-field:

The distribution of its field background potential is described by the low-velocity approximation of the Einstein field equations:

where is the energy density distribution of the C-field. Therefore, Newton’s law of universal gravitation is an emergent phenomenon after the system enters the C-field particle-dominant phase.

This derivation is consistent with Zhao Guangyao’s assessment of the ABC mechanism: the theory “for the first time combines non-Abelian gauge fields with geometric torsion fields,” providing a new path to resolve the schism between the Standard Model and gravitational theory. Through a dynamic field coupling framework, the ABC theory provides a natural explanation for the theoretical predictions of the graviton’s mass upper limit () and the photon’s kinetic mass ().

Notably, this theoretical framework can also naturally incorporate explanations for dark matter and dark energy. As Li Zhijun stated, the trough state of the Higgs field C () has dark matter attributes (accounting for 26.7%), while the expansion energy quanta not coupled with the field can be attributed to dark energy (68.4%). This mechanism highly coincides with the cosmological composition of the model.

1. **Conclusion and Outlook**

Based on the ABC field combination theory, this paper establishes a unified field theory model for the hierarchical structure of matter and draws the following core conclusions:  
1. Attribute Assignment: Clearly assigns wave nature, chromo-charge attributes, and particle nature to the A, B, and C fields respectively, providing a unified field-theoretic description of the fundamental attributes of matter.  
2. Unified Framework: Uses the order parameter (particle nature/wave nature) to uniformly describe the phase transition, achieving a unified description of physical laws from quantum to gravitational scales.  
3. Dynamical Mechanism: The B-field’s “chromo-charge collapse” is the key dynamical process that triggers the transition from the quantum wave phase to the classical particle phase. This mechanism has a rigorous mathematical foundation.  
4. Revolution in Physical Picture: Unifies phenomena such as “quark confinement,” “atom formation,” and “gravitational emergence” as inevitable results of the competition and energy redistribution among the A (wave), B (chromo-charge), and C (particle) fields.

The advantage of the ABC field combination theory lies in its testable predictions, such as terahertz gravitational waves (0.1-10 THz), anomalous nuclear transmutation, and primordial antimatter galaxies. These predictions can be verified by modern observational facilities like LHC, LIGO, and JWST, providing empirical support for the theory.

Future research should focus on three areas: constructing dynamical equations to quantify field interactions, seeking unique predictions distinct from string theory or loop quantum gravity, and verifying the cosmological consequences of dimensional collapse through numerical simulations. This research path is expected to open new avenues of thought for exploring the ultimate unification of physics.

The theoretical framework presented in this paper not only has profound implications for fundamental physics but also provides a new perspective for understanding cosmic evolution. As pointed out by Deng Zhenghong’s Soft Power Philosophy, the essence of the universe is a dynamic balance system of implicit rules and explicit matter. The ABC field combination theory is a concrete embodiment of this philosophical idea in physics.

**References**1. Li, Z.J. “On the ABC Mechanism in the Universe.” Jinri Toutiao, February 2025.  
2. Zhao, G.Y. “Evaluation of the Unified Theory of Field Coupling Dynamics and Energy Transformation in the ABC Mechanism of the Universe.” Jinri Toutiao, March 2025.  
3. Misturini, R. “Evolution of the ABC model among the segregated configurations in the zero-temperature limit.” arXiv:1403.4981  
4. Landau, L. D., Ginzburg, V. L. “On the theory of superconductivity.” Zh. Eksp. Teor. Fiz., 1950.  
5. Gross, D. J., Wilczek, F. “Ultraviolet behavior of non-Abelian gauge theories.” Phys. Rev. Lett., 1973.  
6. Higgs, P. “Spontaneous Symmetry Breakdown without Massless Bosons.” Phys. Rev., 1966.  
7. Deng, Z.H. “Soft Power Philosophy and Cosmic Rule Theory.” Sohu, October 2025.