**The ABC Field Theory of Particle Wave-Particle Duality: A Complementary Coupling Model of A-Field and C-Field**

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**Abstract:**Based on Li Zhijun’s ABC field combination theory, this paper proposes a new mathematical model describing the complementary relationship between the wave and particle properties of fundamental particles. The core argument is that any fundamental particle is a specific coupling state of the electromagnetic vortex field A, the color charge vortex field B, and the Higgs vortex field C, where the A-field dominates wave properties, the C-field dominates particle properties, and there exists a strict complementary relationship between them. The wave and particle properties are not intrinsic attributes but different manifestations of the A-field and C-field during the coupling process, following a strict mathematical constraint: the product of the A-field energy level and the C-field energy level remains constant, i.e., By constructing the Schrödinger-Higgs coupling equation for the A-C field and introducing the complementary operator this paper rigorously proves the trade-off relationship between wave and particle properties and provides a precise classification of different particles in the A-C phase diagram.

**Keywords:** ABC field theory; wave-particle duality; complementarity principle; A-C coupling; quantum state classification; Schrödinger-Higgs equation

1. **Introduction: A New Perspective on Wave-Particle Duality**

Wave-particle duality is a fundamental yet not fully understood concept in quantum mechanics. The de Broglie relation provides a mathematical connection but does not explain its physical essence. Based on Li Zhijun’s ABC field theory, we propose that wave properties originate from the excitation of the A-field (electromagnetic vortex), particle properties originate from the condensation of the C-field (Higgs vortex), and the two are coupled through the B-field (color charge vortex) to form a stable particle state.

1. **Framework of ABC Field Combination Theory**

Any fundamental particle can be expressed as:

where:  
\* A-field: Describes wave properties, related to electromagnetic interactions.  
\* B-field: Provides color charge attributes, maintaining the stability of field coupling.  
\* C-field: Describes particle properties, coupled with the mass generation mechanism.

1. **Mathematical Model of A-C Field Complementary Coupling**

**3.1 Coupling Equation and Complementary Operator**

The dynamics of the A-field and C-field are described by the Schrödinger-Higgs coupling equation:

where is the complementary operator, satisfying:

**3.2 Mathematical Formulation of the Complementarity Principle**

The A-field energy level and the C-field energy level satisfy the complementary relationship:

where K is a universal constant, independent of particle type.

This leads to the following important conclusions:  
1. When : Wave properties dominate, and the particle exhibits wave packet diffusion.  
2. When : Particle properties dominate, and the particle appears as a localized entity.  
3. When : Wave-particle balance state.

1. **A-C Field Classification of Different Particles**

**4.1 Photon**

\* : Almost no particle properties.  
\* : Pure wave properties.  
\* Manifests as a perfect electromagnetic wave.

**4.2 Electron**

\* : Wave properties dominate.  
\* Long de Broglie wavelength.  
\* Exhibits significant interference and diffraction effects.

**4.3 Higgs Boson**

\* : Particle properties are extremely enhanced.  
\* Appears as a highly localized entity.  
\* Difficult to observe wave characteristics.

**4.4 Neutrino**

\* : Wave properties are extremely enhanced.  
\* Wave function is highly dispersed.  
\* Exhibits extremely strong penetration ability.

1. **Experimental Verification and Theoretical Predictions**

**5.1 Electron Double-Slit Interference**

The interference pattern of electrons can be calculated from the A-field energy level:

where the distribution of is determined by

**5.2 Particle Mass Spectrum**

Particle mass is determined by the C-field energy level:

The larger the mass, the stronger the particle properties and the weaker the wave properties.

1. **Conclusion**

Based on the ABC field combination theory, this paper establishes a rigorous mathematical model of wave-particle duality:  
1. Wave properties originate from A-field excitation, and particle properties originate from C-field condensation.  
2. The A-field energy level and C-field energy level satisfy the complementary relationship   
3. Different particles have clear positions in the A-C phase diagram.  
4. The theory perfectly explains various quantum behaviors, from photons to Higgs bosons.

This theory provides a new mathematical framework and physical imagery for understanding the nature of the quantum world. All mathematical derivations in this theory are based on the fundamental principles of quantum field theory, compatible with existing quantum mechanics frameworks but offering a deeper explanation of the physical mechanisms.

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