**The ABC Field-Composition Wave-Dynamics Interpretation of the - Puzzle and Weak Force Parity Violation**

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**Abstract:**  
Based on Li Zhijun’s ABC field-composition theory, this paper reveals the underlying mechanism of the and particle decay puzzle and, for the first time, strictly proves the parity non-conservation of weak interactions from the first principles of ABC field-composition wave dynamics. The core argument is that and are actually different parity states of the same field-composition particle (the meson), and the difference in their decay paths stems from the intrinsic asymmetry in the coupling of the weak interaction Hamiltonian to different chiral components within the ABC field-composition wave function. This paper constructs the field-composition wave function of the meson, and introduces the chiral projection operator acting on the A-field component. By deriving the decay amplitude matrix element of this particle under the weak force, its expression is found to be where the relative phase and modulus of the vector coupling constant and the axial vector coupling constant are unequal (). This directly leads to the asymmetry in the angular distribution of decay products, thereby violating parity. This model not only solves the historical puzzle but also provides a pre-assumption-free, naturally emergent theoretical explanation for parity non-conservation from the underlying perspective of ABC field-composition.

**Keywords:** ABC field-composition theory; - puzzle; Parity non-conservation; Chiral projection; Decay amplitude; A-field; B-field; C-field

1. **Introduction: Historical Puzzle and Theoretical Breakthrough**

Historically, the and particles had the same mass and lifetime but decayed to final states with different parities:  
\* (even parity)  
\* (odd parity)

Lee and Yang proposed in 1956 the revolutionary idea that parity might not be conserved in weak interactions, which was confirmed by Wu’s cobalt-60 -decay experiment in 1957. Based on the ABC theory, this paper proposes a more fundamental view: and are actually different field-composition configurations of the same particle (the meson), and the parity asymmetry of their decay paths originates from the selective coupling of the weak interaction to the chiral components of the A-field within the ABC field-composition wave function.

1. **Theoretical Framework: The ABC Field-Composition Wave Function of the Meson and Chiral Projection**

**2.1 The ABC Field-Composition State of the Meson**

The meson (composed of a strange anti-quark and an up quark) field-composition state can be expressed as the direct product of the ABC fields of its constituent quarks:

Its total wave function is a parity doublet and can exist in a superposition of different parity states:

where is the parity operator.

**2.2 The Coupling Mechanism of the Weak Force in the ABC Fields**

The weak interaction couples through the charged current, with its Hamiltonian density:

where the weak current is composed of the A-field components (electromagnetic vortex field) of the quarks:

The key here is the axial vector term which changes sign under parity transformation

In the ABC theory, the weak force primarily couples to the A-field. We project it onto its left-handed and right-handed components:

The weak current can thus be decomposed as:

The root of parity non-conservation lies in: Unless the coupling strengths to the left-handed and right-handed A-field components are unequal (), meaning the weak force distinguishes left from right. The B-field and C-field do not directly participate in the weak current, but they indirectly influence the decay process by constraining the state of the quarks.

1. **Solving the - Decay Puzzle: Calculation of the Decay Amplitude**

Consider the decay of the meson to two mesons ( mode) or three mesons ( mode). Its decay amplitude is determined by the weak force matrix element:

**3.1 Parity Selection Rules**

Final state parity:  
\* For : (even parity)  
\* For : Due to the presence of orbital angular momentum, the total parity of the system is usually odd ().

Therefore:  
\*   
\*

**3.2 Matrix Element Calculation and Parity Violation**

The weak force Hamiltonian is a scalar but is composed of vector and axial vector currents. Its parity transformation property is:

Since and the term changes sign.

When calculating the matrix element, needs to be projected onto its parity eigenstates Because mixes parity, the non-zero matrix elements are:

The experimental observation that both decay channels exist simultaneously proves that the initial meson state is a parity-mixed state, and that has off-diagonal elements between parity eigenstates. This is direct evidence of parity non-conservation.

**3.3 Angular Distribution Asymmetry (Mathematical Proof)**

The most direct evidence comes from the angular distribution of decay products. Consider the -decay of a polarized nucleus:

The square of its decay amplitude can be calculated as:

where is the angle between the electron emission direction and the nuclear spin direction.

* If parity is conserved then , and the distribution is symmetric.
* However, the Wu experiment observed a non-zero term, and electrons were more likely to be emitted opposite to the spin direction. This directly proves that and parity is not conserved.

In the ABC theory, this term arises from the interference of the chiral components of the A-field wave function under the weak force:

Because , it leads to front-back asymmetry.

1. **Conclusion**

Based on the ABC field-composition theory, this paper solves the - puzzle and proves weak force parity non-conservation:  
1. - Identity: and are different parity decay channels of the same meson. Their very existence proves that the weak force does not conserve parity.  
2. Mechanistic Root Cause: Parity non-conservation stems from the mixture of vector current and axial vector current in the weak current, leading to different coupling strengths to the left-handed and right-handed components of the A-field wave function ().  
3. Mathematical Proof: By calculating the decay amplitude and angular distribution, it is found to contain odd-function terms (e.g., which is the mathematical fingerprint of parity non-conservation.  
4. Theoretical Innovation: Starting from the chiral projection of the ABC field-composition wave function, this paper provides a pre-assumption-free, naturally emergent theoretical explanation for parity non-conservation, deepening the understanding of the nature of the weak force.

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