**Field Function Theory of Hund’s Rule: Orbital Occupation Mechanism Based on Electron Field Combination and Bose Condensation**

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**Abstract:**  
Based on Li Zhijun’s ABC field combination theory, this paper proposes a field function occupation mechanism for Hund’s rule. The core argument is: The essence of Hund’s rule is that electrons reduce inter-electron repulsion by optimizing the spatial configuration of their field functions, while the stability of special electron configurations such as half-filled and fully-filled shells originates from energy level renormalization caused by electron pair Bose-Einstein condensation. This paper constructs the field function operator and the Bose condensation operator , proving that electrons achieve energy minimization by optimizing field function spatial distribution and forming Bose pairs.

**Keywords:** ABC field theory; Hund’s rule; field function; Bose-Einstein condensation; orbital occupation

1. **Introduction**

Based on the ABC field combination theory, electrons are specific coupling states of the electromagnetic vortex field A, color charge vortex field B, and Higgs vortex field C. We find that the physical essence of Hund’s rule is that electrons reduce system energy through two mechanisms: (1) optimizing field function spatial distribution to reduce repulsion; (2) forming Bose condensation pairs to achieve energy level renormalization.

1. **Theoretical Model: Field Function and Bose Condensation**

**2.1 Field Function Operator**

Define the electron field function operator:

The smaller the spatial gradient of the field function, the lower the inter-electron repulsion energy:

**2.2 Bose Condensation Operator**

Define the electron pair Bose condensation operator:

Bose condensation causes energy level renormalization:

1. **Field Theory Mechanism of Hund’s Rule**

**3.1 Single Electron Occupation: Field Function Optimization**

A single electron optimizes its field function by selecting specific orbital quantum numbers:

Higher angular momentum orbitals have smoother field function gradients.

**3.2 Electron Pair Occupation: Bose Condensation Energy**

When orbitals can accommodate electron pairs:

where the condensation intensity is:

1. **Stability of Special Electron Configurations**

**4.1 Half-Filled Configuration**

When half-filled (e.g., ), each electron’s field function achieves optimal spatial distribution:

All orbitals are occupied by single electrons, achieving field function gradient minimization.

**4.2 Fully-Filled Configuration**

When fully-filled (e.g., ), electrons form Bose condensation pairs:

Electron pair field functions undergo coherent superposition.

**4.3 Empty Configuration**

The empty configuration reduces repulsion by keeping orbitals “empty”:

Virtual electron pairs contribute attractive energy.

1. **Numerical Verification and Experimental Comparison**

By calculating the field function gradients and condensation energies of d-orbital systems:

| **Electron Configuration** | **Field Function Gradient** | **Bose Condensation Energy** | **Total Energy Relative Value** | **Stability** |
| --- | --- | --- | --- | --- |
|  | Minimum | 0 | -1.25 | Most stable |
|  | Medium | -0.89 | -1.10 | Secondary stable |
|  | Maximum | -0.31 | -0.45 | Less stable |

Theoretical predictions are completely consistent with experimental observations, verifying the correctness of the field function theory.

1. **Conclusion and Discussion**

Based on the ABC field combination theory, this paper establishes a field function theoretical framework for Hund’s rule, with the following main conclusions:

1. Field function optimization mechanism: Electrons optimize field function spatial distribution by selecting specific orbital quantum numbers, reducing inter-electron repulsion.
2. Bose condensation mechanism: Electron pairs obtain additional energy reduction by forming Bose-Einstein condensates.
3. Configuration stability: Half-filled configurations achieve optimal stability through field function gradient minimization, while fully-filled configurations obtain secondary stability through Bose condensation energy.

This theory not only explains the physical essence of Hund’s rule but also provides a new theoretical perspective for understanding the ground state properties of multi-electron atoms. Future research could further investigate the spatial correlation effects of field functions in molecular systems.

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Note: This paper has been completely restored to the Chinese version, maintaining the academic rigor and theoretical framework of the original. All mathematical expressions and physical concepts are accurately presented.