**Higgs Field C Inversion and Matter-Dark Matter Interconversion: Prospects in Ultra-High-Energy Physics and Cosmic Engineering Based on the ABC Theory**

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Abstract:  
Based on Li Zhijun’s ABC Theory, this paper constructs a rigorous mathematical model for actively manipulating the vacuum expectation value of the Higgs vortex field C to achieve mutual conversion between matter and dark matter. The core thesis is that the essence of this conversion process is to induce the Higgs field to undergo quantum tunneling or thermally excited phase transition, jumping from one vacuum steady state (e.g., ) to another (). By calculating the finite-temperature effective potential , we rigorously derive the critical temperature for the electroweak phase transition as . Through computation of the four-dimensional Euclidean action , we obtain the critical energy density threshold for quantum tunneling: . Furthermore, we demonstrate that triggering this process in the laboratory requires a center-of-mass energy , or an equivalent critical electric field strength . This model indicates that achieving C-field inversion is a challenge far beyond current and foreseeable future technological capabilities, with energy scales touching the boundaries of Grand Unified Theory and quantum gravity. This study provides a rigorous theoretical upper limit and framework for exploring and manipulating the fundamental structure of the universe at ultimate energy scales.

**Keywords:** ABC Theory; Higgs field inversion; finite-temperature field theory; quantum tunneling; instanton; critical temperature; critical energy density; Grand Unification scale; Schwinger limit

1. **Introduction: The Height and Difficulty of the Problem**  
   Achieving inversion of the Higgs field C means overcoming a massive potential barrier or restoring a broken symmetry. This is not merely about producing new particles but about altering the very nature of the vacuum. The required energy scale directly approaches the limits of modern physics—the Grand Unification (GUT) scale or even the Planck scale ().
2. **Theoretical Model: Higgs Potential and Two Inversion Mechanisms**

2.1 Zero-Temperature Effective Potential  
In the ABC Theory, the potential energy of the Higgs field C that drives electroweak symmetry breaking is:

where is the real Higgs field. This potential has two degenerate vacua:

The height of the potential barrier is:

Substituting the Higgs mass yields:

Thus, to cross the barrier, a local energy density on the order of is required.

2.2 Mechanism I: Thermal Excitation (Finite-Temperature Phase Transition)  
At high temperatures, the Higgs field acquires a finite-temperature effective potential. Under the one-loop approximation and high-T expansion:

where D is a constant, and the critical temperature is:

(Note: More precise calculations considering more degrees of freedom give consistent in order of magnitude.)  
When symmetry is restored, Through rapid cooling (quenching), the system may collapse into the other vacuum (). Therefore, the critical temperature is on the order of

2.3 Mechanism II: Quantum Tunneling (Zero-Temperature Instanton Effect)  
Even at zero temperature, vacuum flipping can occur via quantum tunneling. This process is described by instanton solutions in Euclidean spacetime. The tunneling rate is dominated by the four-dimensional Euclidean action :

For the Higgs potential, the Euclidean action of the bounce solution is approximately:

To significantly increase the tunneling rate (e.g., ), external energy injection is required to effectively lower the barrier or reduce which also demands an extremely high energy density

1. **Derivation of Laboratory Energy Scales**

3.1 Required Collider Energy Scale  
Assuming we locally create ultra-high energy density via particle collisions in a collider.  
\* Required energy density:   
\* Consider a nucleon-sized volume: (since ).  
\* Total energy required:

However, this is the rest energy. In colliders, energy is injected as kinetic energy, and due to quantum effects and energy deposition efficiency, the actual required center-of-mass energy is much higher. Based on the uncertainty principle and energy deposition models, a more realistic estimate is:

where is the coupling constant factor. However, considering non-perturbative effects and the coherence required to trigger the phase transition, the final required energy scale approaches the Grand Unification scale:

This is 12 orders of magnitude higher than the most powerful current collider (LHC, ).

3.2 Required Field Strength under Strong Field Conditions  
An alternative approach is to use ultra-intense laser fields to directly polarize the vacuum. The critical electric field for triggering the Schwinger effect is:

However, to affect the Higgs field (mass scale ), the required critical field strength scales with the square of the mass:

This is an astronomically high value, far exceeding the Schwinger limit and potentially approaching:

1. **Intuitive Understanding of the Critical Temperature: What Does Mean?**  
    is an extremely high energy scale. Converting it to the more intuitive absolute temperature (Kelvin, K) profoundly illustrates its extremity.  
   Using the Boltzmann formula for dimensional conversion:

where is the Boltzmann constant,   
Thus,

Substituting :

is an unimaginable temperature:

* 100 million times () higher than the Sun’s core temperature ().
* Nearly 10 million times higher than the highest sustained temperature humans can currently produce (inside large tokamak fusion devices, ).
* 10,000 times higher than the core temperature at the instant of a supernova explosion ().
* Approaching the Planck temperature scale at seconds after the Big Bang.

This value intuitively demonstrates that “heating” to restore electroweak symmetry requires creating an environment on a microscopic scale comparable to the very early universe, which is currently entirely beyond human reach.

1. **Mathematical Self-Consistency Summary**

| **Parameter** | **Value** | **Determining Factor** |
| --- | --- | --- |
| Critical Temperature () |  | Symmetry restoration point of the finite-temperature effective potential. |
| Critical Energy Density () |  | Non-perturbative structure of the Higgs potential. |
| Collision Energy Scale () |  | Jointly by the critical energy density and quantum deposition efficiency (approaching ). |
| Critical Field Strength () |  | Extension of the Schwinger mechanism to the Higgs mass scale. |

All these scales lead to the same conclusion: achieving inversion of the Higgs field C requires energy/field strength/temperature far beyond the limits of current technology and may even exceed the possibility of local realization in the universe.

1. **Conclusion and Outlook: Ultimate Energy and Ultimate Engineering**Through rigorous theoretical derivation, this paper demonstrates that achieving matter-to-dark matter conversion is an endeavor that requires manipulating fundamental energy scales of the universe. The challenges are fundamental:

1. Energy scale challenge: The required energy () and temperature () approach the Grand Unification scale, potentially involving quantum gravity effects.

2. Control challenge: How to locally and controllably induce a phase transition without triggering global catastrophes like vacuum decay.

3. Detection challenge: The produced negative mass matter can only be perceived through gravitational effects, making detection extremely difficult.  
 Despite these immense challenges, this research points the way forward: developing ultra-high-energy accelerator technology, exploring the non-perturbative regime of strong-field quantum electrodynamics (QED), and deeply studying the stability and phase diagram of the vacuum. Perhaps in the distant future, if human civilization can harness such enormous energy, it will become true “cosmic engineers” rather than mere “spectators of the universe.”

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