The Dawn of Cosmic Engineering: A Field-Recombination Theory for Actively Coupling Dark Energy and Dark Matter

Authors: Zhijun Li, Guangyao Zhao

Abstract:  
Based on Professor Zhijun Li’s ABC theory, this paper proposes a revolutionary concept for actively manipulating the fundamental field structure of the universe to address the problems of dark matter and dark energy. The core argument is: since both matter and dark matter are “field composites” resulting from specific couplings between cosmic energons and the primordial cosmic vortex fields (A, B, C), it may be possible, in principle, to guide or even catalyze dark energy and dark matter to form new couplings with the primordial vortex fields by recreating extreme physical conditions in the laboratory similar to those in the very early universe. This could transform them into detectable and utilizable ordinary matter or new field composites. We construct an effective Lagrangian to describe this “field recombination” process, introduce an artificially induced coupling operator and derive the required energy density threshold and coherent field strength for achieving this process. Furthermore, we explore potential pathways to approach these conditions using next-generation high-energy particle colliders, high-intensity laser fields, and quantum simulators. This research pushes fundamental physics from an era of discovery into an era of creation, providing a theoretical foundation for ultimately harnessing the dark components of the universe.

Keywords: ABC theory; Cosmic engineering; Field recombination; Artificial coupling; Dark energy conversion; Dark matter detection; Extreme physical conditions

1. Introduction: A Paradigm Shift from Discovery to Creation

Modern physics is dedicated to discovering the laws that govern the universe. But can we go further and use these laws to alter the fundamental state of the cosmos? Professor Li’s ABC theory offers a unique perspective: viewing the fundamental constituents of the universe as field composites. This hints at a possibility: changing the essence of matter by altering its “coupling”Method (mode of coupling). This paper aims to systematically explore the theoretical basis, implementation conditions, and potential implications of this “cosmic engineering” concept.

1. Theoretical Framework: The Mechanism of Field Recombination

2.1 Physical Picture of “Field Recombination”

In the ABC theory, the stable existence of a proton relies on the specific coupling pattern between its quark field and the electromagnetic field the color charge field and the Higgs field This pattern was “frozen” during the very early universe under specific physical conditions (high temperature, high energy scale).

Similarly, the stability and undetectability of dark matter originate from its decoupled state from the primordial fields or its coupling solely with the field. Dark energy may correspond to the unexcited ground state energy of the primordial fields.

Therefore, the essence of “field recombination” is to artificially create an extreme environment that reopens the “coupling channel” between the dark components and the primordial fields, thereby breaking the old, stable field combinations and forming new composites that interact with our world.

2.2 Effective Field Theory Description

We introduce an artificially induced coupling operator which acts as a “catalyst.” This operator has a zero vacuum expectation value under normal conditions, but can acquire a non-zero expectation value under the drive of extreme external fields.

The complete effective Lagrangian becomes:

where is the coupling constant. When is sufficiently large, this term will significantly mix the dark and primordial fields, causing the eigenstates to change. This could potentially endow dark matter particles with slight electromagnetic or strong couplings.

1. Extreme Conditions for Realizing Field Recombination

3.1 Energy Scale: Reaching the Grand Unification (GUT) Scale

The coupling patterns of fields in the universe were determined at extremely high energy scales. For example, the electroweak symmetry breaking scale is and the grand unification scale is

To significantly alter these coupling relationships, it likely requires energy densities near or reaching these scales. This means we need to create in the laboratory:

This is an unimaginable energy density, far exceeding any current technology (LHC collision energy

3.2 Coherent Field Strength: Creating Macroscopic Quantum States

High-energy collisions alone are insufficient. We need highly coherent strong fields to produce a significant Possible pathways include:

* Ultra-strong laser fields: Using next-generation ultra-high intensity lasers (e.g., Exawatt lasers) to generate extremely strong, coherent electromagnetic fields which may be sufficient to polarize the vacuum and indirectly affect the coupling of other fields.
* High-density matter states: Creating high-temperature, high-density quark-gluon plasma through inertial confinement fusion or heavy-ion collisions. In this environment, chiral symmetry may be partially restored, temporarily altering the coupling strength between quarks and the Higgs field.

1. Proposed Experimental Pathways

4.1 Pathway I: The Collider Revolution

Construct next-generation ultra-high-energy colliders (e.g., 100 TeV or even 1000 TeV proton-proton colliders) with a center-of-mass energy an order of magnitude higher than the LHC. At this energy, a large number of non-Standard Model particles or new interactions may be produced. These new processes could act as effective providing an indirect coupling bridge between dark matter and ordinary matter.

4.2 Pathway II: Strong-Field Science

Vigorously develop ultra-strong laser technology and ultra-high magnetic field technology. The goal is to produce field strengths 接近 the Schwinger limit At this field strength, the vacuum becomes unstable and spontaneously produces electron-positron pairs. This extreme vacuum polarization effect may briefly alter the boundary conditions of other fields, providing a window for detecting or even exciting dark matter fields.

4.3 Pathway III: Quantum Simulation

Construct quantum models simulating the ABC theory in highly controllable quantum systems (e.g., ultra-cold atomic gases, ion traps). By precisely controlling the simulation parameters, we can “re-enact” the physics of the very early universe on a tabletop scale, studying the dynamic processes of field coupling. This can provide theoretical guidance and inspiration for realizing field recombination in the real universe.

1. Profound Implications and Ethical Considerations

If successful, this would usher in the era of cosmic engineering:

1. Energy revolution: If dark energy can be guided to couple and release its energy, nearly limitless energy could be obtained.
2. Materials revolution: If the coupling of the color charge field B can be manipulated, new types of strong-interaction matter could be created.
3. Cosmic destiny: It might be possible to halt or even reverse the accelerated expansion of the universe.
4. Ethics and risks: Such operations carry unpredictable and enormous risks, potentially accidentally altering the vacuum structure and causing local or even global instability of the universe (vacuum decay). They must be conducted within an extremely strict ethical and safety framework.
5. Conclusion

The concept proposed in this paper pushes physics to the boundary between the era of discovery and the era of creation. Although achieving active “field recombination” faces immense technical challenges (energy scale, coherent control) and unknown theoretical risks, it does not completely violate physical laws.

The core idea is: we are no longer merely observers of the universe, but seek to become active participants by understanding its deepest operational mechanisms. This path, though long and arduous, represents the most grand challenge that human intelligence and curiosity can aspire to. This study provides a preliminary theoretical foundation and potential implementation pathways.

References

[1] Li, Z. J. (2023). The ABC Mechanism in the Universe.  
[2] Ringwald, A. (2021). Fundamental Physics at the Intensity and Cosmic Frontiers. Annual Review of Nuclear and Particle Science.  
[3] Dunne, G. V. (2012). The Schwinger Mechanism and Strong Field Physics. Heisenberg Lectures.  
[4] Ziogas, A. (2023). Vacuum Engineering: Is it Possible? Journal of Cosmology and Astroparticle Physics.  
[5] Future High-Energy Collider Conceptual Design Reports (FCC, CLIC, ILC).

Note: This paper is a conceptual exploration based on Professor Li’s theoretical framework. The physical conditions involved (e.g., the GUT scale) far exceed current technological capabilities, and the related theories (e.g., the ABC theory) are also hypothetical frameworks. This article aims to stimulate thinking and present a future possibility.