**A Four-Force Unification Model Based on Dark Matter Repulsion-Induced Gravity and ABC Vortex Fields**  
Li Zhijun, Zhao Guangyao  
**Abstract**  
This paper proposes a unification model of universal gravitation and fundamental forces based on the dark matter medium hypothesis. By introducing ABC vortex fields (electromagnetic field A, color charge field B, Higgs field C) coupled with the dark matter scalar field Φ, gravity is interpreted as the macroscopic manifestation of dark matter repulsion effects. The model constructs a unified framework for the higher-dimensional gauge field , whose symmetry breaking decomposes into electromagnetic, weak, strong, and gravitational forces. Through derivation of the Lagrangian density, it is demonstrated that the dark matter repulsion potential reduces to Newtonian gravity in the macroscopic limit. The model predicts observable effects including sub-millimeter gravitational corrections, unified bosons, and dark matter companions. It is compatible with the low-energy limits of general relativity and the Standard Model, offering new perspectives for quantum gravity and dark matter essence.  
**Keywords:** Dark matter repulsion; ABC vortex fields; Unified field theory; Symmetry breaking; Gravity induction mechanism  
 1. Introduction  
Modern physics faces two core challenges: the unification of gravity with quantum mechanics and the nature of dark matter/dark energy. Traditional string theory is constrained by high-dimensional complexity and experimental verification difficulties. Based on the *ABC Mechanism in the Universe* framework (electromagnetic vortex field A, color vortex field B, Higgs vortex field C), combined with the dark matter medium hypothesis, this paper constructs a self-consistent four-force unification model. Key innovations include:  
- **Gravity Origin**: Repulsion between dark matter particle soup (C-field) and matter (C+ field) induces macroscopic gravity.  
- **Unified Field Decomposition**: The higher-dimensional gauge field generates four forces via ABC vortex coupling.  
- **Mathematical Self-Consistency**: Axion-like coupling terms dynamically correlate dark matter and unified fields.  
 2. Theoretical Framework  
 2.1 Basic Assumptions  
1. **Dark Matter Field (Φ)**: A scalar field permeating the universe, repulsively coupled to matter fermion fields with coupling constant .  
2. **ABC Vortex Fields**:  
- Electromagnetic field A (spin-1, peaks A+, troughs A-);  
- Color charge field B (spin-1, three-color components B+, anti-color B-);  
- Higgs field C (spin-1, peaks C+ correspond to matter, troughs C- to dark matter).  
3. **Unified Field ()**: Higher-dimensional gauge field satisfying , where is the graviton tensor field.  
 2.2 Lagrangian Density  
The total Lagrangian comprises three components:

**(1) Dark Matter Field Dynamics**

where is the dark matter field mass and is the self-coupling constant.  
**(2) Unified Field Gauge Term**

Covariant derivative , field strength tensor .  
**(3) Coupling Term (Key Innovation)**

- First term: Dark matter-matter repulsion coupling (: coupling constant);  
- Second term: Axion-like coupling ( is the dual tensor, : Planck mass).  
3. Gravity Induction and Four-Force Unification Mechanism  
 3.1 Gravity Origin: Dark Matter Repulsion Effect  
Repulsion between the dark matter field Φ (C-vortex) and matter field ψ (C+ vortex) generates density gradients, producing an equivalent negative pressure:

In the macroscopic limit (), this reduces to Newtonian gravitational potential:

**Physical Picture**: Repulsive squeezing of C- dark matter particle soup on C+ matter manifests as spacetime curvature (Fig. 1).  
 3.2 Symmetry Breaking and Four-Force Generation  
When the Φ field acquires a vacuum expectation value , the unified field spontaneously breaks via ABC vortex coupling:

- **Electromagnetic Force**: Dominated by A vortex field, ;  
- **Strong Force**: Generated by B vortex field, ;  
- **Weak Force**: Driven by C vortex field, mass terms originate from C-field breaking;  
- **Gravity**: Described by , with dynamical equation:

where is the matter energy-momentum tensor, and is the dark matter correction term.  
4. Mathematical Self-Consistency Verification  
 4.1 Energy Conservation and Quantum Corrections  
- **Noether’s Theorem**: Total energy-momentum tensor of the coupled system is conserved.  
- **Ward-Takahashi Identity**: One-loop corrections satisfy:

Proving axion-like coupling preserves gauge invariance.  
 4.2 Low-Energy Limit Compatibility  
At energies :  
- Gravitational equations reduce to Einstein field equations;  
- ABC vortex coupling terms , restoring the Standard Model.  
 5. Experimental Predictions and Verification  
 5.1 New Particle Predictions  
- **Unified Bosons**: Mass , detectable by high-energy colliders (e.g., upgraded LHC);  
- **Dark Matter Companion (χ)**: Coupled to Φ field, mass , verifiable via indirect detection (e.g., gamma-ray excess).  
 5.2 Gravitational Correction Effects  
- **Sub-millimeter Scale**: Deviation from Newton’s inverse-square law:

Testable via Casimir effect experiments (current precision ).  
 5.3 Cosmological Observations  
- **Dark Matter Repulsion & Galaxy Rotation Curves**: C-field repulsion modifies dark matter halo distribution, explaining why stars at galaxy edges do not decelerate.  
- **Gravitational Wave Frequency Shift**: Coupling between and Φ in strong gravitational fields induces gravitational wave phase shifts, detectable by LIGO/Virgo.  
 6. Discussion and Open Problems  
 6.1 Model Advantages  
1. **Unification**: Achieves four-force unification via ABC vortex-dark matter field coupling.  
2. **Gravity Essence**: Reduces gravity to dark matter-matter repulsion, circumventing quantum gravity divergence issues.  
3. **Experimental Testability**: Predicts sub-millimeter gravity corrections and new particle signals.  
 6.2 Unresolved Issues  
1. **Higher-Order Divergences**: Require supersymmetry or extra dimensions (e.g., 26D compactification) to suppress loop divergences.  
2. **Dark Matter Statistical Behavior**: Quantum statistical properties of C-particle soup need further modeling.  
3. **Inflation Compatibility**: Correlation between Φ field potential and inflation potential must be established.  
 7. Conclusion  
This paper constructs a four-force unification model based on dark matter repulsion-induced gravity. Through coupling between ABC vortex fields and the higher-dimensional gauge field , it reveals gravity as the macroscopic manifestation of dark matter-matter repulsion. The model is mathematically self-consistent, compatible with low-energy limits of existing theories, and predicts observable new physics effects. Future work will focus on supersymmetric extensions, quantum statistical modeling of dark matter, and integration with inflationary cosmology, providing new pathways toward a final unified theory.  
**References**  
1. Li, Z. *The ABC Mechanism in the Universe*. Shanxi Department of Agriculture and Rural Affairs, 2023.  
2. Weinberg, S. *The Quantum Theory of Fields*. Cambridge University Press, 1995.  
3. Carroll, S. M. *Spacetime and Geometry*. Addison-Wesley, 2004.  
4. Adelman-McCarty, J. et al. Axion-Mediated Dark Matter and Gravity. *Phys. Rev. D* **105**, 2022.  
5. LIGO Scientific Collaboration. GW170817: Implications for the Stochastic Gravitational-Wave Background. *ApJL*, 2018.  
**Appendices**  
- **A**: Correspondence between ABC vortex fields and unified field   
- **B**: Derivation of Newtonian limit for dark matter repulsion potential  
- **C**: Proof of gauge invariance for axion-like coupling terms