Fluxonic Cosmology: A Unified Framework for Space-Time, Electromagnetism, and Gravity

Tshuutheni Emvula and Independent Frontier Science Collaboration

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Abstract

We consolidate Fluxonic Cosmology, addressing electromagnetic completeness, gravitational mediation, and falsifiability. Building on Dewey B. Larsons Reciprocal System Theory, we integrate a vector potential for EM interactions, a derived fluxonic stress-energy tensor for gravity, and an expansion model eliminating dark energy. Simulations validate soliton-driven field interactions, gravitational distortions, and cosmic structure formation, offering a testable alternative to ΛCDM cosmology.

1 Introduction

Fluxonic Cosmology unifies prior research, responding to critiques of theoretical and computational gaps across over 25 iterations. Rooted in Larsons Reciprocal System Theory, where motion is fundamental and space-time are reciprocal, it refines:

- Electromagnetic theory with vector potentials.
- Gravitational effects via a stress-energy tensor.
- Cosmic expansion without dark energy.
- Simulation-validated field interactions and structure formation.

This presents a falsifiable framework challenging traditional cosmology.

2 Mathematical Formulation

2.1 Electromagnetic Model Refinement

The fluxonic electromagnetic model uses a Lagrangian:

$$\mathcal{L}_{\text{fluxon-EM}} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \frac{1}{2}(\partial_\mu\phi\partial^\mu\phi) - V(\phi) - J^\mu A_\mu, \tag{1}$$

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu, \tag{2}$$

$$V(\phi) = \frac{m^2}{2}\phi^2 + \frac{g}{4}\phi^4, \tag{3}$$

yielding:

$$E = -\nabla\phi - \frac{\partial A}{\partial t}, \tag{4}$$

$$B = \nabla \times A, \tag{5}$$

$$\frac{\partial E}{\partial t} = \nabla \times B - \frac{J}{\epsilon_0}, \tag{6}$$

$$\frac{\partial B}{\partial t} = -\nabla \times E, \tag{7}$$

where:

$$J^\mu = q_\phi(\phi\partial^\mu\phi) - \sigma A^\mu, \tag{8}$$

with q_ϕ and σ as coupling constants. This resolves scalar-only limits and ensures soliton-EM consistency.

2.2 Gravitational Stress-Energy Tensor

Gravitational effects are modeled by:

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = 8\pi G(T_{\mu\nu}^{\text{fluxon}} + T_{\mu\nu}^{\text{EM}}), \tag{9}$$

where:

$$T_{\mu\nu}^{\text{fluxon}} = \rho u_\mu u_\nu + p(g_{\mu\nu} + u_\mu u_\nu), \tag{10}$$

$$\rho = \frac{1}{2}(\dot{\phi}^2 + (\nabla\phi)^2) + V(\phi), \tag{11}$$

$$p = \frac{1}{2}(\dot{\phi}^2 - (\nabla\phi)^2) - V(\phi), \tag{12}$$

$$u_\mu = \frac{\partial_\mu\phi}{\sqrt{\partial^\alpha\phi\partial_\alpha\phi}}, \tag{13}$$

$$T_{\mu\nu}^{\text{EM}} = F_{\mu\alpha}F_\nu{}^\alpha - \frac{1}{4}g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}. \tag{14}$$

This derives ρ and p from ϕ, capturing solitonic gravitational mediation.

2.3 Cosmic Expansion Model

Cosmic expansion is driven by:

$$a(t) = e^{Ht}, \quad H = \sqrt{\frac{8\pi G}{3}(\rho_{\text{fluxon}} + \rho_{\text{EM}})}, \tag{15}$$

where ρ_{fluxon} and ρ_{EM} stem from $\mathcal{L}_{\text{fluxon-EM}}$, eliminating dark energy needs.

3 Computational Validation

Simulations validate:

- Stable EM filaments mediating E and B-fields (Figure 1).
- Metric distortions in high-density fluxonic regions (Figure 2).
- Filamentary cosmic networks (Figure 3).
- Soliton collision coherence (Figure 4).

4 Experimental Falsifiability

Proposed tests include:

- Superfluid analogs using BECs with fluxonic interactions.
- Gravitational wave attenuation in dense fluxonic fields.
- EM field responses to solitonic interactions.

5 Conclusion and Future Work

This framework unifies:

- A complete EM model with vector potentials.
- A derived gravitational tensor.
- An expansion model sans dark energy.
- Simulation-validated phenomena.

Future work:

- Expand gravitational simulations to larger scales.
- Predict CMB signatures.
- Test experimentally.

Fluxonic Cosmology offers a testable alternative to ΛCDM.