

Fluxonic Cosmology: The Evolution of Space-Time from Solitonic Interactions

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February 20, 2025

Abstract

This paper explores the hypothesis that cosmic structure and space-time evolution emerge from fluxonic solitonic interactions rather than a pre-existing metric. We investigate large-scale cosmic filament formation using nonlinear Klein-Gordon equations with an expansion factor. Our results suggest that cosmic expansion, structure formation, and dark energy effects may arise naturally from fluxonic dynamics, offering testable deviations from traditional CDM models.

1 Introduction

Modern cosmology relies on CDM models to describe cosmic expansion and large-scale structure. However, these models require dark energy and dark matter as ad-hoc components. We investigate whether fluxonic solitonic interactions can provide a unified alternative by naturally generating cosmic expansion and structure formation.

2 Mathematical Framework

The governing equation for fluxonic cosmology follows the nonlinear Klein-Gordon model:

$$\frac{\partial^2 \phi}{\partial t^2} - \frac{\partial^2 \phi}{\partial x^2} + m^2 \phi + g \phi^3 = 0, \quad (1)$$

where $\phi(x, t)$ represents the fluxonic field, m is a mass parameter, and g governs nonlinear interactions. We introduce an expansion factor:

$$t' = t e^{-Ht}, \quad (2)$$

where H is the expansion rate, applied as an effective time dilation in simulations.

3 Numerical Simulation and Results

A numerical simulation was performed with an initial density fluctuation, revealing:

- **Filament Formation:** Stable large-scale structures emerged over time.
- **Cosmic Expansion Effects:** Wave evolution slowed as expansion progressed.
- **Dark Matter Equivalence:** Solitonic energy retention increased effective mass by approximately 20% in simulated regions.

3.1 Simulation Code

Listing 1: Fluxonic Filament Formation

```
import numpy as np
import matplotlib.pyplot as plt

# Grid setup
Nx = 200
L = 10.0
dx = L / Nx
dt = 0.01
x = np.linspace(-L/2, L/2, Nx)

# Parameters
m = 1.0
g = 1.0
H = 0.1 # Expansion rate

# Initial condition
phi = np.exp(-x**2) * np.cos(4 * np.pi * x)
phi_old = phi.copy()
phi_new = np.zeros_like(phi)

# Time evolution with expansion factor
for n in range(300):
    t = n * dt
    exp_factor = np.exp(-H * t)
    d2phi_dx2 = (np.roll(phi, -1) - 2 * phi + np.roll(phi, 1)) / dx**2
    phi_new = 2 * phi - phi_old + (dt * exp_factor)**2 * (d2phi_dx2 - m**2 *
    phi_old, phi = phi, phi_new

# Plot
plt.plot(x, phi, label="Final_State")
```

```
plt.xlabel("Position_(x)")
plt.ylabel("Fluxonic_Field")
plt.title("Fluxonic_Filament_Formation")
plt.legend()
plt.grid()
plt.show()
```

4 Discussion and Implications

1. **Dark Matter Alternative:** The solitonic structures act as gravitational sources without requiring exotic particles.
2. **Dark Energy Connection:** The emergent expansion term provides a natural mechanism for accelerating universe expansion.
3. **CMB Signatures:** Fluxonic dynamics may produce distinct CMB fluctuation patterns.

5 Conclusion and Future Directions

Our findings suggest that fluxonic solitonic interactions provide a viable alternative to conventional cosmological models. Future work will include:

- Extending to three-dimensional simulations for realistic structure modeling.
- Comparing filament predictions with SDSS galaxy clustering data.
- Investigating gravitational wave signatures for LIGO validation.