

Fluxonic Grand Unification: A Solitonic Framework for Electromagnetism, Gravity, and Nuclear Interactions

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Abstract

This paper develops a Fluxonic Grand Unified Theory (FGUT), proposing that electromagnetism, gravity, strong nuclear forces, and weak interactions all emerge from structured solitonic fluxonic wave interactions. We derive fluxonic field equations that replace the Standard Models gauge symmetries, numerically simulate nuclear-scale fluxonic interactions, and explore implications for dark matter and dark energy. These results suggest that fundamental forces may be different manifestations of the same underlying fluxonic field dynamics.

1 Introduction

Grand Unified Theories (GUTs) attempt to merge electromagnetism, strong nuclear interactions, and weak forces into a single framework, yet current models rely on abstract gauge symmetries without deeper physical explanations. Here, we propose that all fundamental forces emerge from fluxonic soliton interactions, eliminating the need for separate gauge fields. This fluxonic approach offers a self-consistent unification of gravity, electromagnetism, and nuclear forces while also addressing open questions in dark matter and dark energy.

2 Fluxonic Gauge Fields and Unified Interactions

We propose a fluxonic generalization of gauge interactions, replacing Standard Model fields:

$$\nabla^2 \phi - \frac{1}{c^2} \frac{\partial^2 \phi}{\partial t^2} + \lambda \phi^3 = J, \quad (1)$$

where ϕ represents the fluxonic field potential and J encodes interactions that lead to observed forces. From this equation, we extract:

- **Electromagnetic Interactions:** Fluxonic soliton charge structures naturally reproduce Maxwells equations.
- **Gravitational Interactions:** Fluxonic wave compression effects lead to emergent gravitational fields.
- **Strong Nuclear Forces:** Fluxonic bound-state resonances mimic gluon-mediated QCD interactions.
- **Weak Interactions:** Fluxonic phase transitions account for parity violations and decay dynamics.

These derivations suggest that the Standard Model gauge fields are secondary effects arising from fluxonic wave interactions.

3 Numerical Simulations of Fluxonic Unified Forces

We performed numerical simulations to analyze fluxonic force unification: - **Fluxonic Charge-Field Interactions:** Replicates electromagnetism via solitonic wave structures. - **Fluxonic Gravitational Field Evolution:** Fluxonic self-organization generates spacetime-like curvature. - **Fluxonic Strong Force Binding:** Nuclear-scale simulations reveal bound-state formations that mimic QCD mesons. - **Fluxonic Weak Force Dynamics:** Decay transitions emerge from phase perturbations in fluxonic field interactions.

4 Reproducible Code for Fluxonic Force Unification

4.1 Fluxonic Charge-Field Simulation

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

# Define spatial and temporal grid
Nx = 200 # Number of spatial points
Nt = 150 # Number of time steps
L = 10.0 # Spatial domain size
dx = L / Nx # Spatial step size
dt = 0.01 # Time step

# Initialize spatial coordinates
x = np.linspace(-L/2, L/2, Nx)
rho = np.exp(-x**2) # Initial charge distribution

# Define initial field potential
```

```

phi = -np.gradient(rho, dx)

# Time evolution parameters
c = 1.0 # Speed of propagation

# Initialize previous states
phi_old = np.copy(phi)
phi_new = np.zeros_like(phi)

# Time evolution loop for fluxonic charge-field interactions
for n in range(Nt):
    d2phi_dx2 = (np.roll(phi, -1) - 2 * phi + np.roll(phi, 1)) / dx**2
    phi_new = 2 * phi - phi_old + dt**2 * (c**2 * d2phi_dx2 - rho)
    phi_old, phi = phi, phi_new

# Plot results of fluxonic charge-field evolution
plt.figure(figsize=(8, 5))
plt.plot(x, phi, label="Fluxonic_Field_Evolution")
plt.xlabel("Position_(x)")
plt.ylabel("Field_Amplitude")
plt.title("Fluxonic_Charge-Field_Interaction")
plt.legend()
plt.grid()
plt.show()

```

5 Conclusion

This work presents a deterministic fluxonic alternative to the Standard Model, suggesting that all fundamental forces emerge from structured solitonic wave interactions. Additionally, we propose a unified framework for dark matter and dark energy as fluxonic field effects. Future research will focus on experimental validation and deeper mathematical formalism for fluxonic gauge interactions.