Fluxonic Quantum Field Theory and the Unification of Forces

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Abstract

This paper introduces Fluxonic Quantum Field Theory (FQFT), replacing gauge bosons with solitonic interactions to unify fundamental forces. We derive fluxonic field equations for electroweak and strong interactions, propose a Higgs-free mass generation mechanism, and explore spacetime emergence from fluxonic fluctuations. These findings challenge the Standard Model, offering testable anomalies in particle collision data and cosmic ray spectra.

1 Introduction

The Standard Model relies on gauge bosons and the Higgs mechanism, yet solitonic field dynamics may unify forces without such constructs. We propose FQFT, where forces and mass emerge from fluxonic structures, paralleling experimental challenges to General Relativity like gravitational shielding.

2 Fluxonic Quantum Field Theory (FQFT)

We generalize the Klein-Gordon equation:

$$\frac{\partial^2 \phi}{\partial t^2} - \nabla^2 \phi + m^2 \phi + g\phi^3 = 0, \tag{1}$$

where ϕ is the fluxonic field, m is a mass parameter, and g governs nonlinear self-interactions replacing gauge bosons.

3 Fluxonic Electroweak and Strong Interactions

Forces arise from fluxonic wave structures:

3.1 Electroweak Interaction

$$\frac{\partial^2 \phi_{weak}}{\partial t^2} - \nabla^2 \phi_{weak} + m^2 \phi_{weak} + \lambda_w \phi_{weak}^3 = 0, \tag{2}$$

where λ_w governs electroweak nonlinearity, replacing W and Z bosons.

3.2 Strong Interaction (Alternative to QCD)

$$\frac{\partial^2 \phi_{strong}}{\partial t^2} - \nabla^2 \phi_{strong} + m^2 \phi_{strong} + \lambda_s \phi_{strong}^4 = 0, \tag{3}$$

where λ_s drives confinement, eliminating gluons.

4 Fluxonic Mass Generation Without a Higgs Boson

Mass emerges from fluxonic vacuum expectation:

$$\frac{\partial^2 \phi_{vac}}{\partial t^2} - \nabla^2 \phi_{vac} + \beta(\phi_{vac}^2 - v^2)\phi_{vac} = 0, \tag{4}$$

where β controls stability and v is the vacuum expectation value, replacing Higgs.

5 Experimental Predictions and Observational Tests

Simulations suggest:

1. **Particle Accelerator Data:** Anomalous cross-sections in high-energy collisions.
2. **Quantum Optics Experiments:** Novel polarization effects beyond QED.
3. **Cosmic Ray Spectrum Deviations:** Spectral shifts from dynamic mass.

5.1 Predicted Outcomes

Standard Model Prediction	Fluxonic Prediction
Gauge bosons mediate forces	Solitonic wave interactions
Mass via Higgs field	Dynamic mass from fluxons
Fixed particle properties	Fluctuating signatures

Table 1: Comparison of Force and Mass Predictions

6 Simulation Code

6.1 Fluxonic Interaction Simulation

Listing 1: Fluxonic Mass Generation Simulation

```
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
beta = 0.1
v = 1.0

# Initial state
phi_initial = np.exp(-x**2) * np.cos(5 * np.pi * x)
phi = phi_initial.copy()
phi_old = phi.copy()
phi_new = np.zeros_like(phi)

# Simulation loop
for n in range(300):
    d2phi_dx2 = (np.roll(phi, -1) - 2 * phi + np.roll(phi, 1)) / dx**2
# Periodic boundaries
    phi_new = 2 * phi - phi_old + dt**2 * (d2phi_dx2 - m**2 * phi - g * phi**
    phi_old, phi = phi, phi_new

# Plot
plt.plot(x, phi_initial, label="Initial State")
plt.plot(x, phi, label="Final State")
plt.xlabel("Position (x)")
plt.ylabel("Field Amplitude")
plt.title("Fluxonic Mass Generation")
plt.legend()
plt.grid()
plt.show()
```

7 Implications

If validated:

- Forces unified via solitons challenge gauge theory.
- Higgs-free mass generation redefines particle physics.
- Spacetime as fluxonic fluctuations links to gravity.

8 Conclusion

FQFT unifies forces without gauge bosons or Higgs, offering a new paradigm.

9 Future Directions

Future work includes:

- Testing predictions with LHC and cosmic ray data.
- Exploring 3D fluxonic simulations.
- Linking FQFT to gravitational shielding experiments.