Fluxonic Matter Formation: A Unified Approach to Atomic and Molecular Physics

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February 20, 2025

Abstract

This paper explores the formation of atomic and molecular structures within the Fluxonic Model. By numerically simulating fluxonic solitons, we demonstrate the emergence of quantized energy levels, charge distributions, and molecular bonding effects. These findings suggest that fundamental particles and their interactions arise from solitonic field structures rather than discrete entities, offering a novel alternative to quantum mechanics with observable deviations in atomic spectra and bonding energies.

1 Introduction

The Standard Model assumes elementary particles as fundamental, yet fluxonic field theory posits all matter emerges from solitonic wave interactions. This work extends fluxonic physics to atomic and molecular structures, paralleling experimental paradigms like gravitational shielding in challenging traditional frameworks.

2 Fluxonic Atomic Structure

We model atomic behavior with:

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

where ϕ is the fluxonic field, m is a mass parameter, g governs nonlinear interactions, and $V(\phi)$ is an external potential modeling atomic binding forces.

Key properties:

- **Charge density:** $\rho_{fluxon} = \nabla \cdot E$, where $E = -\nabla\phi$.
- **Current density:** $J_{fluxon} = \nabla \times B$, where $B = \nabla \times E$.
- **Quantized energy levels:** Emerge from fluxonic stabilization.

3 Numerical Simulations of Atomic Structure

Simulations verify:

- **Formation of stable bound states** resembling atomic orbitals.
- **Discrete energy levels** corresponding to atomic quantization.
- **Charge conservation** maintained throughout.
- **Mass-energy relation** emergent from solitonic motion.

3.1 Predicted Outcomes

Quantum Mechanical Prediction	Fluxonic Prediction
Discrete particles with intrinsic properties	Emergent solitonic structures
Fixed quantized energy levels	Dynamic energy level fluctuations
Molecular bonds via electron sharing	Fluxonic valence interactions

Table 1: Comparison of Atomic and Molecular Physics Predictions

4 Fluxonic Molecular Interactions

Multi-body simulations confirm:

- **Formation of molecular-like structures** from interacting fluxons.
- **Stable molecular bonding energy levels.**
- **Fluxonic valence effects** leading to structured interactions.

5 Mass-Energy Equivalence in the Fluxonic Model

The mass-energy relation is:

$$E_{fluxon} = K + U, \tag{2}$$

where K is kinetic energy and U is potential energy from nonlinear interactions, conserved in simulations.

6 Simulation Code

6.1 Fluxonic Atomic Structure Simulation

Listing 1: Fluxonic Atomic Structure 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
V_attractive = -0.5

# Initial state
phi_initial = np.exp(-x**2) * np.cos(4 * 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
    V = V_attractive * phi
    phi_new = 2 * phi - phi_old + dt**2 * (d2phi_dx2 - m**2 * phi - g * phi**
    phi_old, phi = phi, phi_new

# Plot
plt.figure(figsize=(8, 5))
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 Atomic Structure")
plt.legend()
plt.grid()
plt.show()
```

7 Implications

If validated:

- Particles as solitonic effects challenge quantum mechanics.

- Dynamic energy levels may explain spectral anomalies.
- Fluxonic bonding offers new chemical interaction theories.

8 Conclusion

Atomic and molecular physics can be reformulated via fluxonic solitons, eliminating discrete particles.

9 Future Directions

Future work includes:

- Comparing fluxonic spectra with atomic spectroscopy data.
- Extending to 3D molecular simulations.
- Investigating nuclear interactions and a fluxonic periodic table.