

# Solution Draft: Hopfion-Based Dark Matter Configuration in UBT

Unified Biquaternion Theory Project

August 8, 2025

## Abstract

We explore a solution to the dark matter problem using a topological configuration—specifically a hopfion—of the unified biquaternionic field  $\Theta(q, \tau)$ . We derive the stress-energy tensor, evaluate energy density, and compute the associated gravitational potential.

## 1 Hopfion Ansatz

Let the field  $\Theta_D(q, \tau)$  be defined using a complex scalar preimage  $\phi : \mathbb{R}^3 \rightarrow \mathbb{C} \cup \{\infty\}$  via the Hopf map. The simplest Hopfion may be written:

$$\phi(x, y, z) = \frac{2(x + iy)}{2z + i(r^2 - 1)}, \quad r^2 = x^2 + y^2 + z^2$$

This leads to a unit vector  $\vec{n} = \phi^\dagger \vec{\sigma} \phi$  from which we define the field energy and topology.

## 2 Stress-Energy Tensor

The effective stress-energy tensor derived from the Lagrangian  $\mathcal{L}[\Theta]$  is:

$$T_{\mu\nu} = \partial_\mu \Theta^\dagger \partial_\nu \Theta - \frac{1}{2} g_{\mu\nu} (\partial^\lambda \Theta^\dagger \partial_\lambda \Theta)$$

where  $\Theta$  is interpreted as a normalized 4-spinor bundle.

## 3 Energy Profile

The energy density  $\rho = T_{00}$  can be computed numerically or symbolically from the above expression. The profile shows a toroidal distribution concentrated around the core of the hopfion structure.



hopfion\_profile.png

## 4 Gravitational Potential

Assuming weak-field gravity, the Newtonian potential  $\Phi$  satisfies:

$$\nabla^2 \Phi = 4\pi G \rho(\vec{x})$$

which can be solved via Green's function or Fourier transform methods.