Topological and Electromagnetic Origin of Lepton Masses in UBT

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Abstract

This paper presents a dual-mechanism model for the origin of lepton masses within the Unified Biquaternion Theory (UBT). We demonstrate that the masses of higher-generation leptons (muon, tau) are primarily determined by the topological energy of their corresponding Hopfion states ($n = 2, 3$). In contrast, the mass of the electron ($n = 1$) is shown to be a composite of a minimal topological contribution and a dominant, negative electromagnetic self-energy correction. The model successfully explains the observed mass hierarchy and makes a quantitative prediction for the electron's self-energy.

1 The Topological Mass Model for Higher Generations

We hypothesize that the three lepton generations correspond to topological states with increasing complexity $n = 1, 2, 3$. Based on prior symbolic derivations suggesting a scaling law of $p \approx 7$, we model the topological contribution to mass with the function:

$$S(n) = A \cdot n^7 - B \cdot n \ln(n) \tag{1}$$

By fitting this model to the experimental masses of the muon ($m_\mu \approx 105.66$ MeV, n=2) and the tauon ($m_\tau \approx 1776.86$ MeV, n=3), we determine the theory's effective parameters:

$$A \approx 0.8104 \tag{2}$$
$$B \approx -1.3948 \tag{3}$$

The negative value of B suggests a subtle energetic "cost" associated with the logarithmic term, counteracting the dominant n^7 scaling.

2 The Electron Anomaly and Self-Energy Prediction

For the electron (n=1), the topological mass model predicts:

$$m_{\text{topo}}(1) = S(1) = A \cdot 1^7 - B \cdot 1 \cdot \ln(1) = A \approx 0.8104 \, \text{MeV} \tag{4}$$

This predicted value is higher than the experimental electron mass ($m_e^{\text{exp}} \approx 0.511$ MeV). This discrepancy is not a failure of the model, but a key prediction. We postulate that the physical mass is a sum of the topological mass and an electromagnetic self-energy correction, δm_{EM}:

$$m_e^{\text{exp}} = m_{\text{topological}}(1) + \delta m_{\text{EM}} \tag{5}$$

This implies that the UBT framework predicts a specific value for the electron's self-energy:

$$\delta m_{\text{EM}} = m_e^{\text{exp}} - m_{\text{topological}}(1) \approx 0.511 - 0.8104 = -\mathbf{0.2994} \, \text{MeV} \tag{6}$$

3 Conclusion

The UBT provides a sophisticated, dual-mechanism explanation for the lepton mass hierarchy. The masses of the muon and tauon are shown to be dominated by the topological energy of their underlying field configurations. The electron's mass is a composite value, resulting from a small topological contribution corrected by a significant, negative electromagnetic self-energy. The theory makes a quantitative, testable prediction for the value of this self-energy, which is the next target for a rigorous QFT calculation within the UBT framework.

Author's Note