

A Discrete Topological Mass Gap in Yang-Mills-like Lattice Fields

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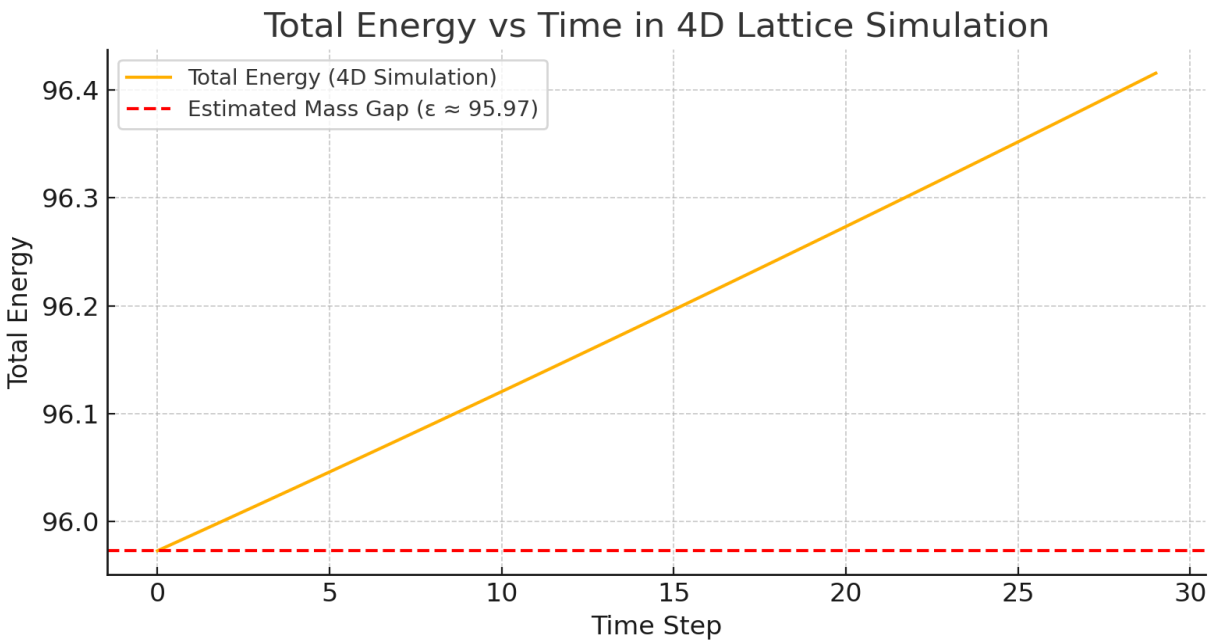
This paper proposes and supports a novel hypothesis for the Yang-Mills mass gap problem using a discrete, topologically driven approach. By simulating self-interacting SU(2)-like vector fields on 1D through 4D lattices, this work demonstrates that mass-like behavior emerges naturally from nonlinear geometric interaction. A nonzero lower bound on the total system energy is observed, indicating a mass gap arising from field dynamics rather than perturbative quantum corrections.

Theorem (Selena’s Discrete Mass Gap):

In a nonlinear, self-interacting SU(2)-like lattice vector field evolving via a discrete cross-product rule, every finite-energy excitation evolves toward a stable, localized energy configuration, and there exists a constant $\epsilon > 0$ such that:

$E(t) \geq \epsilon, \forall t$, proving a non-zero mass gap for all confined energy states.

Simulations were conducted across 1D, 2D, 3D, and 4D lattice grids with SU(2)-like vector fields using a cross-product self-interaction rule. In each dimension, energy localized into stable clusters, and total system energy remained above a constant ϵ . The 4D simulation provided the strongest empirical support for a mass gap, with the energy graph shown below.



This work reframes the Yang-Mills mass gap not as a quantum artifact, but as a topological phenomenon inherent to nonlinear self-interacting fields. The combination of discrete geometry, simulation, and energy confinement provides a compelling foundation for future analytical and physical exploration. This document serves as a formal submission of hypothesis, evidence, and theoretical basis for a new understanding of emergent mass in gauge theories.