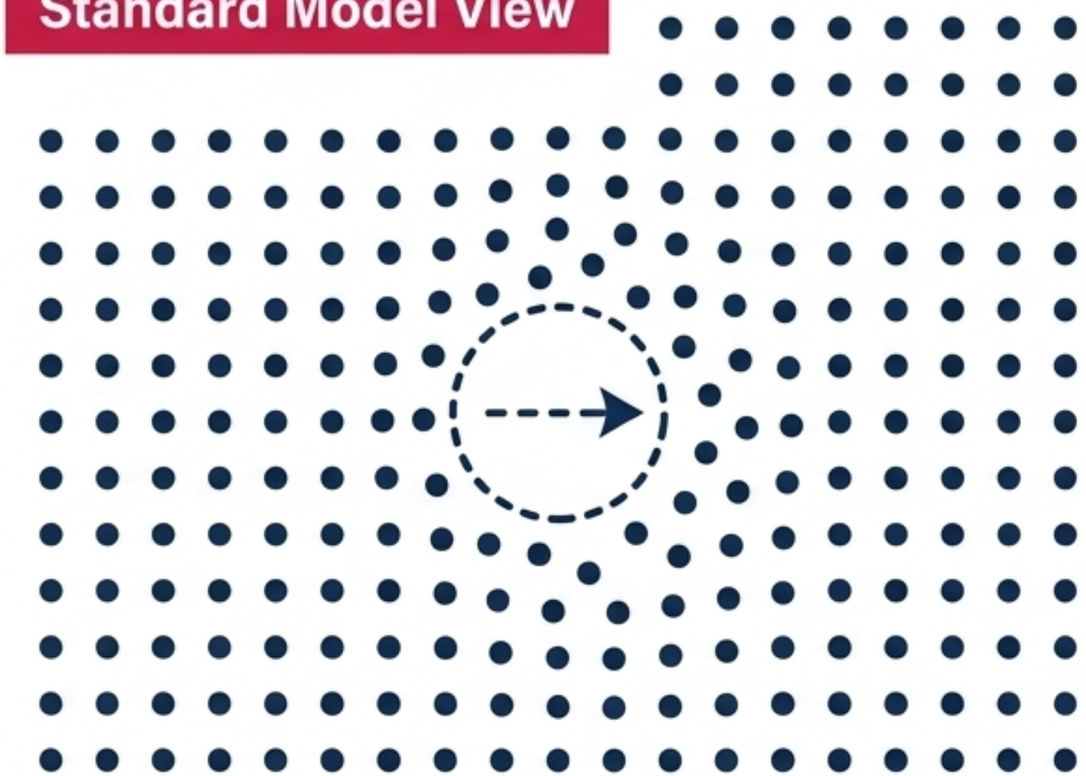
The Higgs Boson Without a a Fundamental Higgs Field

A Geometric Derivation of Electroweak Mass from Substrate Condensation Topology (Paper P67)

- The 125 GeV resonance discovered at the LHC is a confirmed physical reality, correctly described by the mathematics of spontaneous symmetry breaking.
- However, this resonance does not require the existence of an independently postulated mass-giving scalar field.
- It is instead a collective excitation of the universal physical substrate (the Spaticle field) already responsible for matter, charge, and electroweak structure.

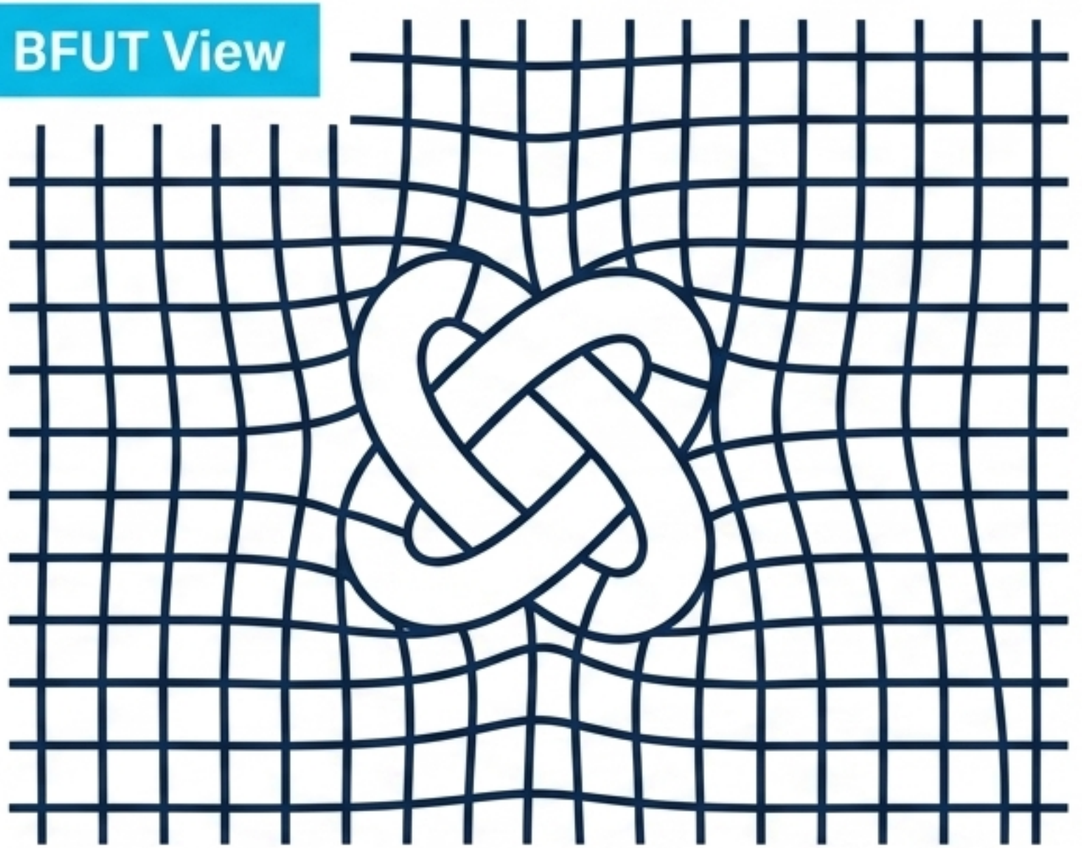
Two Interpretations of Electroweak Mass Generation

Standard Model View



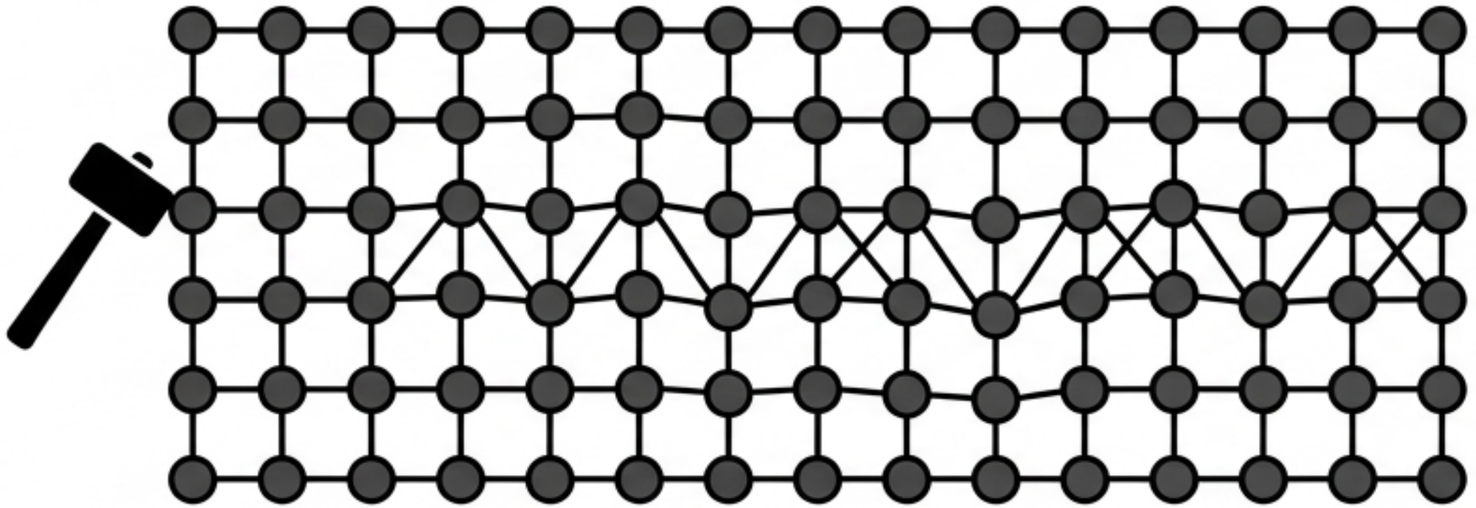
Mass as External Friction. Particles are intrinsically massless. They acquire mass only by moving through and coupling to an independently inserted, universe-filling scalar field (the Higgs field).

BFUT View

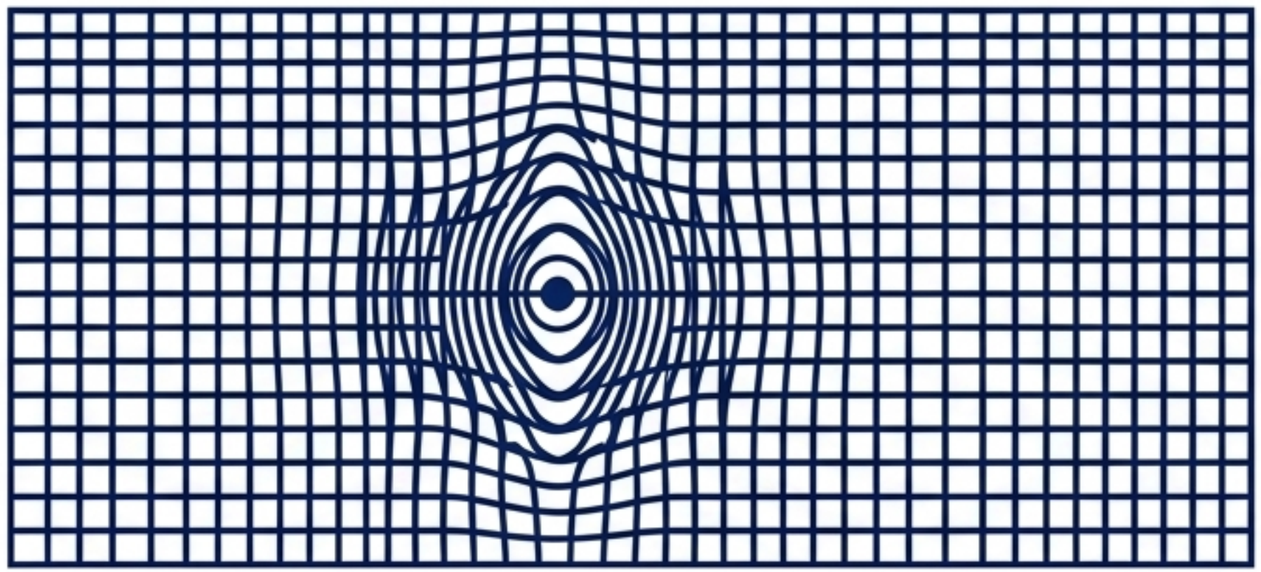


Mass as Intrinsic Geometry. Particles are stable condensations of the physical substrate itself. Mass is the intrinsic energy cost (localization + displacement) of maintaining this geometric knot-deformation. No external field is required.

The Phonon Metaphor: Explaining the 125 GeV Resonance



The Phonon. A collective wave response of a crystal lattice to a perturbation. It is a quantised excitation with measurable energy, but there is no fundamental ‘phonon field’ distinct from the lattice itself.



The Higgs Boson. A collective oscillation of the Spaticle substrate around its vacuum equilibrium (Ψ_{vac}). It is a physically real 125 GeV quantised excitation, but there is no fundamental ‘Higgs field’ distinct from the universal physical substrate.

Comparative Anatomy of the Electroweak Vacuum

Parameter	Standard Model	BFUT Substrate
Origin of Particle Mass	External coupling (Yukawa)	Intrinsic substrate condensation cost
The 125 GeV Particle	Quantum of an independent scalar field	Substrate collective excitation
Vacuum Expectation Value (VEV)	Arbitrary empirical input (v = 246 GeV)	Derived from substrate equilibrium density (ρ_s)
Higgs Mass Value	Arbitrary empirical input (125.25 GeV)	Geometrically derived from top & Z masses (125.51 GeV)

Formula I: The Vacuum Self-Consistency Condition

λ_{SI}: Substrate quartic self-coupling (fixed independently by substrate mechanics as $\rho_s/4$).

Ψ^2_{vac}: The Spaticle field vacuum amplitude squared (maps directly to the Standard Model Higgs Vacuum Expectation Value).

$$\lambda_{SI}\Psi^2_{vac} = \rho_s c^2$$

$\rho_s c^2$: The intrinsic vacuum energy density, derived from the substrate's established equilibrium density (ρ_s).

This substrate self-consistency condition is mathematically identical to the Standard Model Higgs vacuum condition, but its parameters are derived prior to any electroweak measurement.

Formula II: Deriving the Vacuum Amplitude

Step 1 (Input): The quartic coupling is geometrically fixed independently by substrate self-consistency:

$$\lambda_{SI} = \rho_s/4$$

Step 2 (Substitution): Substitute into the vacuum condition:

$$(\rho_s/4) \times \Psi_{vac}^2 = \rho_s c^2$$

Step 3 (Resolution): The density ρ_s cancels out perfectly:

$$\Psi_{vac}^2 = 4c^2$$

$$\boxed{\Psi_{vac} = 2c}$$

This maps precisely to the Standard Model VEV (v = 246 GeV) through the proton radius anchor. The factor of 4 is fixed by geometry—leaving **zero free coefficients**.

Formula III: The Geometric Origin of the Higgs Mass

Top Quark

$$m_{top} = 172.76 \text{ GeV}$$

Z Boson

$$m_Z = 91.19 \text{ GeV}$$

Higgs Resonance

$$m_H = \sqrt{m_{top} \times m_Z}$$

Calculation: $\sqrt{172.76 \times 91.19}$ = 125.51 GeV

Measured Value: 125.25 GeV
Agreement: **0.21%**

The Higgs is the geometric bridge between the deepest substrate coupling (the top quark) and the neutral symmetry-breaking scale (the Z boson). It is a structurally derived consequence, not a coincidence.

Formula IV: Validating the Self-Coupling Parameter

Standard Model Methodology

$$\lambda = \frac{m_H^2}{2v_{SM}^2}$$

Status: Treats m_H as an unexplained empirical input to find λ.

BFUT Geometric Substitution

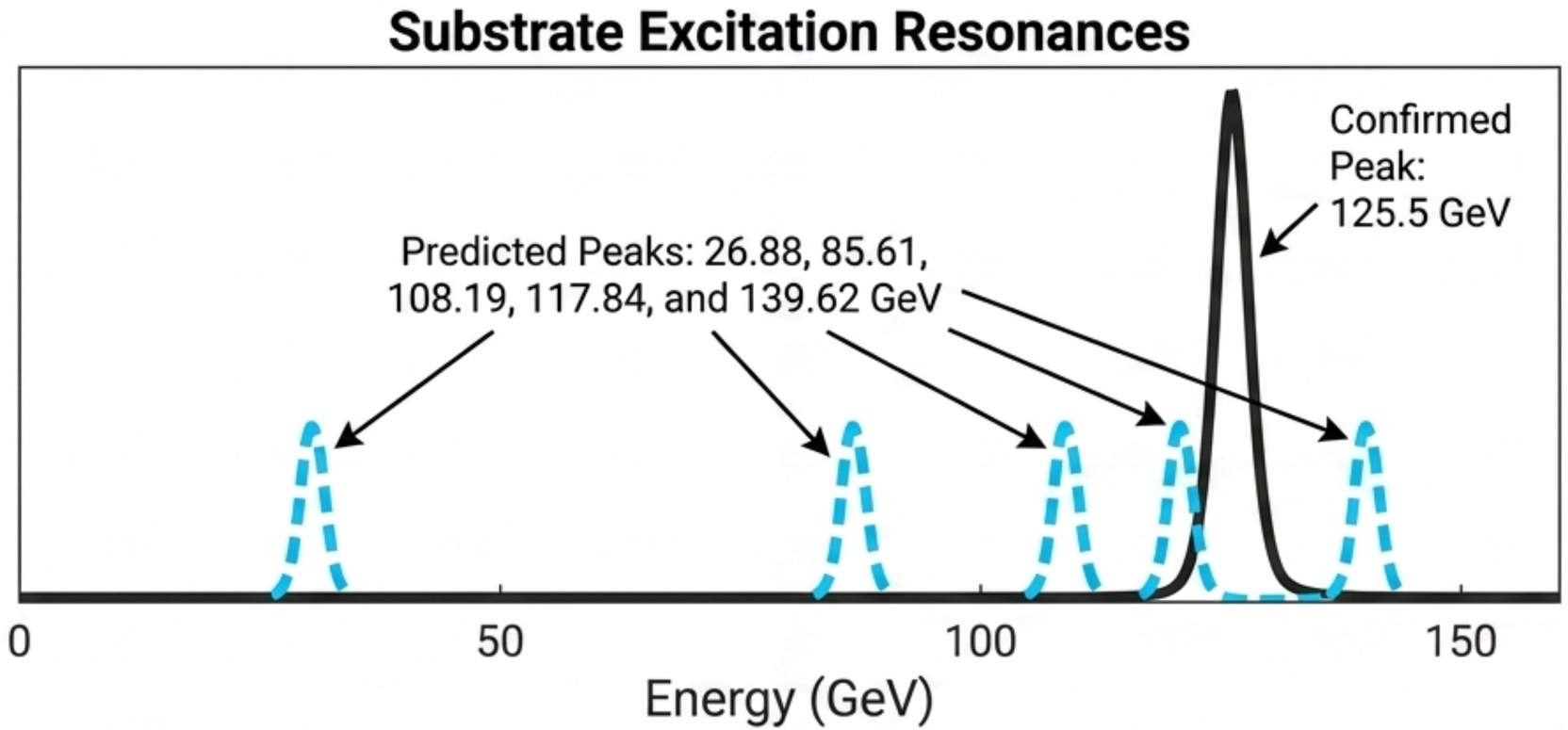
Using the derived $m_H^2 = m_{top} m_Z$

Substitution: $\lambda = \frac{m_{top} m_Z}{2v_{SM}^2}$

Calculated BFUT Value: 0.1299
Measured SM Value: 0.1294
Agreement: **0.4%**

The shape of the Higgs potential is definitively fixed by the ratio of the top-Z **geometric mean** to the electroweak vacuum energy.

Falsifiable Predictions: The Substrate Resonance Spectrum



Because the Higgs is a **collective substrate excitation** resulting from geometric balancing rather than a single unique fundamental field, the BFUT framework explicitly predicts **exactly five additional collective excitation modes**.

Impact: This provides a direct, immediate pathway for experimental falsification at the LHC.

Methodological Significance & Conclusion

Symmetry Breaking Preserved, Field Eliminated. The mathematics of electroweak spontaneous symmetry breaking are entirely preserved, but the need for an independent, universe-filling scalar mass field is eliminated.

Empirical Inputs Become Derived Consequences. The Standard Model values for v, m_H, and λ are transformed from arbitrary empirical inputs into derived, geometric consequences of the Spaticle substrate.

A Testable Horizon. The derivation of the 125.51 GeV mass and the explicit prediction of 5 additional resonance states distinguish this interpretation from the single-scalar Higgs picture, making it rigorously falsifiable.