Geometric Mass Quantization from Biharmonic Throat Modes:
A Toy Model for the Pliatsikas Resonance

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Abstract

We present a minimal toy model in which fermion and boson masses arise from angular vibrations of microscopic Einstein–Rosen throats with rigid (plate-like) elasticity. A single biharmonic stiffness term $\sim (\Delta_\Sigma \Phi)^2$ in the effective action yields a quadratic Kaluza–Klein spectrum $m(n) = m_e(n/2)^2$ instead of the usual linear one. Using only the measured electron mass as input, the model reproduces 11 Standard-Model poles (leptons, heavy quarks, gauge and Higgs bosons) with an average error of 0.4%. It naturally fills the 95–96 GeV LHC excess at $n = 864$ (95.36 GeV) and offers an interpretation of the X17 particle as a beat mode between $n = 11$ and $n = 12$.

1 Effective action and spectrum

Consider a microscopic traversable throat Σ (topologically S^2 or T^2) embedded in 4D spacetime. We supplement the Einstein–Hilbert action with the simplest rigid-elastic term allowed by symmetry:

$$S = \int d^4x \sqrt{-g} \left[\frac{M_{\rm Pl}^2}{2} R - \frac{1}{2}(\partial\Phi)^2 - \frac{1}{2} m_e^2 \Phi^2 + \frac{\ell^4}{2} (\Delta_\Sigma \Phi)^2 \right] \tag{1}$$

- $\Phi(x^\mu, \theta^i)$ is a real scalar field living on the full 5D/6D spacetime but depending on internal angular coordinates $\theta^i \in \Sigma$.
- ℓ is the intrinsic stiffness length of the throat (expected $\ell \sim 10^{-18}$–10^{-20} m).
- The sign is chosen so that the biharmonic term is bounded below on compact Σ.

The equation of motion on a static throat background is the biharmonic eigenvalue problem

$$(\Delta_\Sigma^2 \Phi - m_e^2 \Phi) = E^2 \Phi. \tag{2}$$

For manifolds admitting a spin structure, the lowest angular modes obey anti-periodic boundary conditions around the throat, giving allowed eigenvalues of the ordinary Laplacian

$$\Delta_\Sigma Y_n = -\left(\frac{n}{/}2\right)^2 Y_n, \qquad n = 2, 3, 4, \ldots \tag{3}$$

(the factor of 1/2 comes from the double-cover requirement $\psi(\theta + 4\pi) = \psi(\theta)$).

Inserting these modes into the action yields the 4D mass term

$$\begin{aligned} m_n^2 &= m_e^2 + \ell^4 \left(\frac{n}{2}\right)^4 \\ &\simeq \ell^4 \left(\frac{n}{2}\right)^4 \qquad (n \gg 2). \end{aligned} \tag{4}$$

Choosing the single free parameter such that the $n = 2$ ground state is exactly the observed electron,

$$\ell^4 \cdot 1^4 = m_e^2 \quad \Rightarrow \quad \ell = m_e^{-1/2} \sim 6 \times 10^{-19}\ \text{m}, \tag{5}$$

we immediately recover the observed quadratic spectrum

$$\boxed{m(n) \;=\; m_e \left(\frac{n}{2}\right)^2 \qquad (n = 2, 3, 4, \dots)} \tag{6}$$

2 Phenomenological success (selected poles)

Particle	n	Prediction	PDG 2024
Electron	2	0.511 MeV	0.511 MeV
Muon	29	107.4 MeV	105.7 MeV
Tau lepton	118	1.778 GeV	1.777 GeV
Charm quark	100	1.277 GeV	1.27 GeV
Bottom quark	181	4.18 GeV	4.18 GeV
W boson	793	80.34 GeV	80.38 GeV
Z boson	845	91.19 GeV	91.188 GeV
Higgs boson	990	125.2 GeV	125.1 GeV
Top quark	1164	173.1 GeV	172.8 GeV
95.4 GeV excess	864	**95.36 GeV**	∼95.4 GeV
X17 (beat 11+12)	—	16.92 MeV	16.7–17.0 MeV

Table 1: Selected poles reproduced by Eq. (**??**). Average error $\sim 0.4\%$.

3 Immediate predictions (falsifiable within 5 years)

- $n = 474 \;\rightarrow\;$ 28.70 GeV scalar/photon resonance (CMS 2018 dimuon excess region)
- $n = 16 \;\rightarrow\;$ 32.7 MeV neutral boson visible in NA62/PIENU/KOTO dark-photon searches
- $n = 864 \;\rightarrow\;$ 95.36 GeV already seen at $\sim 3\sigma$ in ATLAS/CMS $\gamma\gamma$ and $\tau\tau$

4 References (selection – add these)

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