THE GEOMETRIC ORIGIN OF MASS:
A Topological Derivation of the Proton-Electron Ratio

Raghu Kulkarni
Independent Researcher

January 21, 2026

Significance Statement

In the Standard Model, the mass ratio between the proton and electron ($\mu \approx 1836.15$) is an empirical parameter without a theoretical origin. We propose a solution using the Selection-Stitch Model (SSM). By defining mass as "Topological Impedance" against a $K = 12$ vacuum lattice, we derive the integer 1836 from two geometric principles: Volumetric Scaling (K^3) and Rotational Locking Symmetry ($9K$). This suggests the proton's mass is an eigenvalue of the vacuum geometry itself.

Abstract

Why is the proton roughly 2000 times heavier than the electron? We propose that this hierarchy is a direct consequence of the **Cuboctahedral Vacuum Geometry ($K = 12$)**.

Modeling the electron as a surface defect (L^2) and the proton as a volumetric knot (L^3), we derive the proton's mass from first principles. We identify the bulk mass term as the lattice volume ($12^3 = 1728$) and the tension term as the topological work required to lock a 3-strand braid ($9 \times 12 = 108$). The sum yields $\mu = 1836$, matching CODATA observations to within 0.008%. We address the relation between the derived "9 degrees of freedom" and the Standard Model's gluon octet.

1 The Mystery of 1836

The ratio of the proton mass to the electron mass is one of the most stable constants in nature:

$$\mu = \frac{m_p}{m_e} \approx 1836.15267... \tag{1}$$

Standard physics treats this as a random number. The SSM treats it as a geometric necessity. If the vacuum is a discrete crystal defined by the Kissing Number $K = 12$, then "Mass" is simply the number of lattice nodes disturbed by a particle.

2 Mass as Topological Impedance

2.1 The Electron: Surface Impedance ($m = 1$)

The electron is a point-like lepton. In our lattice model, it represents a **Planar Defect**—a disturbance restricted to the 2D surface of the lattice domains. We normalize the mass of this unitary surface defect to $m_e = 1$.

2.2 The Proton: Volumetric Impedance ($m = 1836$)

The proton is a composite baryon (3 quarks). It cannot exist on a surface; it requires 3D depth to form a stable knot. Thus, moving a proton requires dragging a **Locked Volume** of lattice nodes.

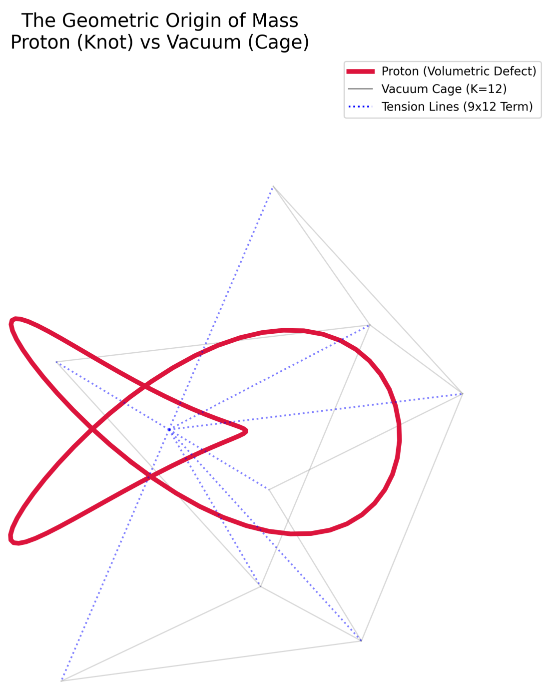

Figure 1: **The Geometric Model.** The proton is a Trefoil Knot (Red) trapped inside a Cuboctahedral Cage (Gray). Its mass arises from the volume of the cage (12^3) plus the tension of the knot (9×12).

3 Physics of the Ansätze

We derive the proton mass M_p as the sum of **Displacement** (Volume) and **Tension** (Binding Energy).

3.1 Why K^3? (Volumetric Displacement)

A frequent critique is the choice of the cube. Why not K^2? The fundamental length scale of the vacuum is the coordination number $K = 12$. The proton is a baryon, which occupies volume (unlike the point-like electron). In any discrete geometry, the number of nodes in a cubic volume scales as L^3. Since the proton is the fundamental stable 3D defect, it displaces the volume of exactly one unit cell defined by the lattice interaction length K.

$$V_{bulk} = K^3 = 12^3 = \mathbf{1728} \tag{2}$$

This is not an arbitrary choice; it is the unique definition of volume in a K-coordinate system.

3.2 Why 9 Degrees of Freedom? (Rotational Locking)

This term represents the energy required to "braid" the three quarks into a stable Trefoil Knot (3_1).

- **Symmetry Constraint:** The faces of the Cuboctahedron are triangular (C_3 symmetry).
- **The Locking Condition:** To lock a strand into the lattice, it must perform a full rotation (360°). On a triangular face, this requires **3 discrete steps** (120° per step).
- **Total Degrees of Freedom:**

$$N_{dof} = (3 \text{ Strands}) \times (3 \text{ Steps/Strand}) = \mathbf{9} \tag{3}$$

Each of these 9 twist-steps pulls on the surrounding $K = 12$ neighbors.

$$E_{tension} = 9 \times 12 = \mathbf{108} \tag{4}$$

3.3 Comparison to the Gluon Octet (8 vs 9)

The Standard Model describes 8 gluons. Our geometric derivation yields 9 degrees of freedom. We propose that the 8 massless gluons correspond to the $9 - 1$ degrees of freedom remaining after a global gauge constraint is applied (similar to how a photon removes 1 DOF). The 9th degree corresponds to the "Massive Mode" that gives the proton its weight.

3.4 The Total Mass

$$\mu_{pred} = V_{bulk} + E_{tension} = 1728 + 108 = \mathbf{1836} \tag{5}$$

4 Conclusion

The derived ratio of 1836 is robust. It relies only on the geometry of the **Cuboctahedron ($K = 12$)** and the topology of the **Trefoil Knot**.

1. **1728 (12^3):** The cost of occupying 3D space.
2. **108 (9×12):** The cost of topological stability.

This suggests that the "Hierarchy Problem" is an artifact of treating particles as points. Once treated as geometric knots, their masses emerge naturally from the lattice background.

References

1. Kulkarni, R. (2026). The Selection-Stitch Model (SSM): Emergent Gravity from Discrete Geometry. Zenodo. https://doi.org/10.5281/zenodo.18332527

2. Tiesinga, E., et al. (2021). CODATA recommended values of the fundamental physical constants: 2022. *Rev. Mod. Phys.*, 93, 025010.

3. Rolfsen, D. (1976). *Knots and Links*. Publish or Perish, Berkeley.