Topological Selection Rules in Geometric Resonance

A Unified Criterion for Particle Stability

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Abstract

A major critique of geometric mass models is the apparent randomness of the integer modes selected by nature. Why is the Muon ($n = 29$) stable while $n = 30$ is not? This paper introduces the **Unified Pliatsikas Selection Rule**. We demonstrate that stability criteria are not uniform but depend on the topological class of the particle. We define three distinct stability regimes: **Twist Geometry** (Leptons) requiring Primality, **Braid Geometry** (Quarks) requiring Composite factors for Color Charge, and **Cavity Geometry** (Bosons) anchoring to Golden Ratio nodes to minimize destructive interference.

1 Introduction: The Divisibility Filter

In Geometric Resonance Theory ($m \propto n^2$), not all integer modes create stable particles. Most integers represent unstable resonances that decay immediately. Stability is determined by the topology's ability to resist harmonic decomposition.

We propose that the "Selection Rules" for n are governed by the specific interaction requirements (Spin and Color) of the particle family.

2 Type I: Twist Geometry (Leptons)

Constraint: Spin 1/2, No Color Charge ($SU(2) \times U(1)$).
Selection Rule: *Must be Prime or Recursive Prime Fractal.*

Leptons are single, continuous topological knots. Because they do not split into color charges, their geometric mode must be indivisible to remain stable.

- **Electron ($n = 2$):** The First Prime. The fundamental "twist."
- **Muon ($n = 29$):** A **Lucas Prime** (L_7).
- **Tau ($n = 118$):** The **Recursive Fractal**. While 118 is not prime, it represents a fractal embedding of the Muon geometry into the Electron geometry:

$$n_\tau = 2 \times (2 \cdot n_\mu + 1) = 2 \times (59) = 118 \tag{1}$$

This explains the Tau's localized stability and its specific decay channel into Muons and Electrons.

3 Type II: Braid Geometry (Quarks)

Constraint: Spin 1/2, Color Charge ($SU(3)$).
Selection Rule: *Must be Composite (Divisible by 2 or 3).*

Quarks are never found in isolation; they exist only bound in groups of 2 (Mesons) or 3 (Baryons). A Prime Number loop cannot be topologically "braided" into three distinct strands without breaking. Therefore, quarks **must** occupy composite modes to allow for Color Charge splitting.

- **Up Quark ($n = 4$):** 2×2. Allows symmetric 2-point connections.
- **Down Quark ($n = 6$):** 2×3. Allows 2-point and 3-point braiding.
- **Strange Quark ($n = 27$):** 3^3. A perfect triplet braid structure.

Prediction: A quark will never be found at a Prime Number mode ($n = 5, 7, 11$), as these geometries are "Color Blind" and behave as Leptons or Dark Matter.

4 Type III: Cavity Geometry (Bosons)

Constraint: Integer Spin, Force Carriers.
Selection Rule: *Must anchor to Golden Ratio (ϕ) Nodes.*

Gauge bosons must couple to all other particles. To minimize destructive interference across the spectrum, they stabilize at nodes defined by the Fibonacci (F_n) and Lucas (L_n) sequences, which approximate the Golden Ratio ($\phi \approx 1.618$).

- **Z Boson ($n = 845$):** Nearest Lucas Node: $L_{15} = 843$.

$$\text{Deviation} = \frac{|845 - 843|}{843} \approx 0.2\% \tag{2}$$

- **Higgs Boson ($n = 990$):** Nearest Fibonacci Node: $F_{16} = 987$.

$$\text{Deviation} = \frac{|990 - 987|}{987} \approx 0.3\% \tag{3}$$

The slight positive deviation in both cases suggests a systematic "Vacuum Impedance Shift" inherent to the high-energy electroweak vacuum.

5 Summary of Stability Criteria

6 Conclusion

The apparent randomness of nature's selected integers is resolved by applying topological constraints. Leptons require primality for knot integrity, Quarks require composite factors for braid integrity, and Bosons require Golden Ratio nodes for resonant stability.

Particle Type	Interaction	Topological Rule	Evidence
Leptons	Electroweak Only	**Prime / Fractal**	$n = 2, 29$ (Primes)
Quarks	Strong Force ($SU(3)$)	**Composite Factors**	$n = 4, 6, 27$ (Factors)
Bosons	Force Carriers	**Golden Ratio Nodes**	$n \approx F_{16}, L_{15}$
Mesons	Unstable Matter	**High Composites**	$n = 32$ ($\approx$ Pion)

Table 1: The Unified Pliatsikas Selection Rules.