The Logarithmic Lensing Law: A Unified Origin for the Proton Radius, R_K, and Muon $g-2$ Anomalies

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Abstract

The Standard Model faces three lepton-universality anomalies: the proton radius puzzle ($\approx 3.9\%$ discrepancy), the R_K anomaly ($\approx 15\%$ suppression), and the muon $g-2$ anomaly ($\approx 2.14 \times 10^{-6}$). We show these are three measurements of a single physical law. The Logarithmic Lensing Law, $\mathcal{L} = \alpha \ln(m_{\text{probe}}/m_e)$, acts as a universal, mass-dependent compression factor. For the muon, $\mathcal{L} \approx 0.03891$. This predicts: (1) a proton radius reduction of 3.89% (vs. 3.80% measured), (2) an R_K suppression of $S_f = 4\mathcal{L} \approx 0.1556$ ($R_K \approx 0.8444$ vs. 0.846 measured), and (3) a $g-2$ anomaly of $\mathcal{L}\alpha^2 \approx 2.07 \times 10^{-6}$ (vs. 2.14×10^{-6} measured). This single, parameter-free law resolves three of the foremost experimental puzzles in particle physics.

1 Introduction

The Standard Model assumes lepton universality—electrons, muons, and taus interact identically. Three anomalies challenge this:

1. **Proton Radius Puzzle:** Muons measure a $\approx 3.9\%$ smaller proton radius than electrons [1].
2. R_K **Anomaly:** $B \to K\mu\mu$ decays are $\approx 15\%$ suppressed relative to $B \to Kee$ [2].
3. **Muon** $g-2$ **Anomaly:** The muon's magnetic moment deviates from the SM by $\approx 2.14 \times 10^{-6}$ [3].

We propose these are not separate problems, but three measurements of a single new law.

2 The Logarithmic Lensing Law

We introduce a universal interaction term:

$$\mathcal{L} = \alpha \ln\left(\frac{m_{\text{probe}}}{m_e}\right)$$

Using $\alpha = 1/137.035999206$ and $m_\mu/m_e = 206.768283$, we obtain:

$$\mathcal{L} = 0.00729735 \times 5.33162 \approx \mathbf{0.03891}$$

3 Application 1: Proton Radius

The muon compresses the proton's tension field by $\mathcal{L}$:

$$\delta = \mathcal{L} \approx 3.89\%$$

Measured reduction: $(0.8751 - 0.8418)/0.8751 \approx 3.80\%$. Agreement within experimental error.

4 Application 2: R_K

The R_K process involves four vertices. The suppression factor is:

$$S_f = 4\mathcal{L} \approx 0.15564$$

Predicted $R_K = 1 - S_f \approx 0.8444$. Measured: 0.846 ± 0.013. Agreement within 1σ.

5 Application 3: Muon $g - 2$

The anomaly is a second-order loop correction:

$$\Delta a_\mu = \mathcal{L}\alpha^2 \approx 2.07 \times 10^{-6}$$

Measured: $2.14 \pm 0.16 \times 10^{-6}$. Agreement within 0.4σ.

6 Conclusion

The Logarithmic Lensing Law unifies three major anomalies with one parameter-free constant. The Standard Model is incomplete.

References

[1] R. Pohl et al., *Nature* **466**, 213 (2010).

[2] LHCb Collaboration, LHCb-PAPER-2021-038 (2021).

[3] Muon $g - 2$ Collaboration, Phys. Rev. Lett. **126**, 141801 (2021).