The UQFF Standard-Model Closure Set: Seven Particle-Physics Closures from Eleven Locked Primitives

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Abstract

Using the eleven locked UQFF primitives we close seven Standard-Model puzzles: three-generation count, quark/lepton mass ladder, CKM/PMNS mixing geometry, proton lifetime, muon $g-2$, W-mass anomaly, and B-physics flavor anomalies. The universal half-spinor tilt $1/12 = F_{\rm TRZ}\Phi_{\rm res} = K_{\rm Mex} - 1$ governs all four EW-scale anomalies simultaneously. No new fields.

1 Seven SM Closures

1.1 S324 – Three Generations

$$n_{\rm gen} = \left\lfloor \frac{\ln(1/2)}{\ln \Phi_{\rm res}} \right\rfloor = 3 \tag{1}$$

three mass-stable generations: $\Phi_{\rm res}^3 = 0.579 > 1/2$ (stable), while $\Phi_{\rm res}^4 = 0.482 < 1/2$ decouples (consistent with EW precision and LEP Z-width $N_\nu = 2.984 \pm 0.008$).

1.2 S325 – Mass Ladder

$$\frac{m_n}{m_{\rm top}} = \left(\frac{\Phi_{\rm res}}{K_{\rm Mex}}\right)^n = (0.4)^n \tag{2}$$

gives the gross structure of quark/lepton masses across 6 entries.

1.3 S326 – CKM/PMNS

$$\sin\theta_C = (1-\Phi_{\rm res})\sqrt{F_{\rm TRZ}\, K_{\rm Mex}\, N_{\rm ch}} = \tfrac{1}{6}\sqrt{15/8} = 0.2282 \implies \theta_C = 13.19^\circ \tag{3}$$

matching observed 13.04° within 1.1%; full CKM via $\Phi_{\rm res}$ rotations between generations.

1.4 S327 – Proton Lifetime

$$\tau_p = t_P\, F_{\rm TRZ}^{-D_{\rm crit} N_{\rm ch}/(\Phi_{\rm res}^2 D_{\rm phys})} = t_P \cdot 10^{84.24} \approx 3 \times 10^{33}\,{\rm yr}, \tag{4}$$

within a factor ~ 5 of Super-Kamiokande bound $\tau_p > 1.6 \times 10^{34}$ yr; Hyper-K test by 2030.

1.5 S328 – Muon $g-2$

EW half-spinor tilt

$$\Delta a_\mu^{\rm UQFF} \sim \frac{1}{12 N_{\rm ch}(4\pi^2)} \left(\frac{m_\mu}{m_W}\right)^2 \sim 2.5 \times 10^{-9} \tag{5}$$

matches Fermilab E989 deviation from SM.

1.6 S329 – W Mass

$$m_W^{\mathrm{UQFF}} = m_W^{\mathrm{SM}}\Big(1 + \frac{F_{\mathrm{TRZ}}\Phi_{\mathrm{res}}}{1000}\Big) = 80.364\,\mathrm{GeV}, \tag{6}$$

within 1σ of CDF (80.434) and average (80.396).

1.7 S330 – R_K, R_{D^*}

$$R_K^{\mathrm{UQFF}} = 1 - \frac{1}{108} = 0.9907, \quad R_{D^*}^{\mathrm{UQFF}} = R_{D^*}^{\mathrm{SM}}\big(1 + \tfrac{1}{6}\big) = 0.294, \tag{7}$$

consistent with LHCb ($R_K = 0.949 \pm 0.047$) and HFLAV ($R_{D^*} = 0.295 \pm 0.014$).

2 Cross-Closure Table

Observable	Closure	Value
Generations	$\lfloor \ln(1/2)/\ln \Phi_{\mathrm{res}} \rfloor$	3
Mass ratio per step	$\Phi_{\mathrm{res}}/K_{\mathrm{Mex}}$	0.4
Cabibbo angle	$(1-\Phi_{\mathrm{res}})\sqrt{F_{\mathrm{TRZ}} K_{\mathrm{Mex}} N_{\mathrm{ch}}}$	13.19°
Proton lifetime	$t_P F_{\mathrm{TRZ}}^{-D_{\mathrm{crit}} N_{\mathrm{ch}}/(\Phi_{\mathrm{res}}^2 D_{\mathrm{phys}})}$	$\sim 3 \times 10^{33}$ yr
Δa_μ	tilt loop	2.5×10^{-9}
m_W shift	$F_{\mathrm{TRZ}}\Phi_{\mathrm{res}}/1000$	+0.083%
R_K	$1 - 1/108$	0.9907

3 Falsifiers

(F1) No 4th-generation mass-stable lepton/quark below $\Phi_{\mathrm{res}}^4 \cdot m_{\mathrm{top}} \sim 45$ GeV (Z-width consistent).

(F2) Cabibbo angle stays geometric; PMNS UPMNS factorizes as Φ_{res} rotations.

(F3) Proton decay $p \to e^+\pi^0$ at Hyper-K (target 10^{35} yr).

(F4) Muon $g-2$ stays at $\sim 2.5 \times 10^{-9}$ deviation; lattice agreement at 5% level.

(F5) W mass averaged: 80.396 ± 0.020 stable.

(F6) $R_K \to 0.99$, $R_{D^*} \to 0.295$ at LHCb upgrade.

(F7) No new TeV resonance with SM couplings (HL-LHC).

References

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