Verification Deck v2 (Ratio OS)

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Abstract. I present a minimal *Ratio OS*: a fixed registry of exact rational inputs p/q at a reference scale plus a single experimental ruler (M_W). By arithmetic alone, this registry reproduces a set of benchmark observables (masses, widths, atomic levels) to the displayed digits. Version 2 (**v2**) fixes a sign-convention slip in the $[U(1)_Y]^3$ anomaly line and adds the missing muon entry m_μ/v so that the Koide check is fully auditable. We also state the rationalization provenance rule used to obtain new entries from measurement.

Ratio OS (definition): A minimal operating set consisting of (i) a *registry* of exact fractions p/q for dimensionless inputs and (ii) a single dimensionful ruler (M_W). All predictions are computed by arithmetic on these ratios; no floating parameters are refit in downstream checks.

Provenance rule (for any new p/q): bounded continued fraction with denominator cap $D_{\max=500{,}000}$; we record the approximation error to the reference value.

Seed Registry (v2)

Ruler: $M_W = 80.379\,000\,\mathrm{GeV}$. The dimensionless registry entries are exact rationals:

Quantity	Fraction p/q	Decimal
M_W/v	17807/54547	0.32645242
M_Z/v	18749/50625	0.37035062
M_H/v	22034/43315	0.50869214
m_τ/v	2561/354878	0.007216565
m_μ/v (new)	169/393827	0.000429122
m_e/v	43/20719113	0.000002075
$\sin^2\theta_W$	7852/33959	0.23122000
α_{em}	2639/361638	0.007297353

Muon provenance: using $m_\mu^{\mathrm{ref}} = 0.105\,658\,\mathrm{GeV}$ and v (from the registry+rule), bounded-CF with $D_{\max=500{,}000}$ yields $m_\mu/v = 169/393827$. This predicts $m_\mu = 0.105\,658\,\mathrm{GeV}$ (absolute error $\approx$ $0.000\,000\,\mathrm{keV}$, relative $\approx 0.004\,\mathrm{ppm}$).

A. Higgs VEV and Mass Snapshots

From M_W/v and the ruler M_W, the VEV is

$$v = \frac{M_W}{M_W/v} = 246.219\,650\,\mathrm{GeV}. \tag{1}$$

Mass predictions by pure ratio multiplication:

$$M_Z = (M_Z/v)\,v = 91.187\,600\,\mathrm{GeV}, \tag{2}$$
$$M_H = (M_H/v)\,v = 125.250\,000\,\mathrm{GeV}, \tag{3}$$
$$m_\tau = (m_\tau/v)\,v = 1.776\,860\,\mathrm{GeV}, \tag{4}$$
$$m_e = (m_e/v)\,v = 0.000\,511\,\mathrm{GeV}. \tag{5}$$

B. $H \to \tau^+\tau^-$ (Width and BR)

With $\beta = \sqrt{1 - 4m_\tau^2/M_H^2}$ we obtain $\beta = 0.999597405$. The tree-level width

$$\Gamma_{\tau\tau} = \frac{M_H}{8\pi}\left(\frac{m_\tau}{v}\right)^2 \beta^3 = 0.000\,259\,\mathrm{GeV} = 0.259\,223\,\mathrm{MeV}. \tag{6}$$

Using $\Gamma_{\mathrm{tot}} = 4.070\,000\,\mathrm{MeV}$ (as in v1), the branching ratio is

$$\mathrm{BR}(H \to \tau\tau) \ = \ \frac{\Gamma_{\tau\tau}}{\Gamma_{\mathrm{tot}}} \ = \ 6.369\%. \tag{7}$$

C. Custodial Snapshot

Tree-level identity: $\rho \equiv M_W^2/(M_Z^2 \cos^2\theta_W) = 1$ can be written as

$$\left(\frac{M_W}{M_Z}\right)^2 \stackrel{?}{=} 1 - \sin^2\theta_W. \tag{8}$$

Numbers from the registry give $LHS = 0.77698678$, $RHS = 0.76878000$, hence $\Delta \equiv LHS - RHS = 0.008207$ (scheme/radiative effects expected).

D. Hydrogen Ground State

Using α_{em} and m_e from the registry, the nonrelativistic ground state is

$$E_1 = -\frac{\alpha_{\mathrm{em}}^2}{2}\, m_e = 0.000\,000\,\mathrm{GeV} \ = \ -13.605\,700\,\mathrm{eV}. \tag{9}$$

E. Koide Relation (now auditable)

With (m_e, m_μ, m_τ) determined by the registry and the muon provenance rule above,

$$Q_\ell \equiv \frac{m_e + m_\mu + m_\tau}{\left(\sqrt{m_e} + \sqrt{m_\mu} + \sqrt{m_\tau}\right)^2} \ = \ 0.666660512\,, \qquad Q_\ell - \frac{2}{3} = -0.000006155. \tag{10}$$

F. Gauge-Anomaly Sanity (corrected)

In anomaly sums we count *left-chiral Weyl fields*. Right-chiral fields are included as left-chiral conjugates with *flipped hypercharge* $Y \to -Y$. For one generation of the SM:

$$[U(1)_Y]^3: \quad 3\cdot 2\left(\tfrac{1}{6}\right)^3 \ + \ 3\left(-\tfrac{2}{3}\right)^3 \ + \ 3\left(+\tfrac{1}{3}\right)^3 \ + \ 2\left(-\tfrac{1}{2}\right)^3 \ + \ (+1)^3 \ = \ 0. \tag{11}$$

$$SU(2)^2U(1): \quad 3\cdot 2\left(\tfrac{1}{6}\right) \ + \ 2\left(-\tfrac{1}{2}\right) \ = \ 0. \qquad SU(3)^2U(1): \quad 2\cdot\left(\tfrac{1}{6}\right) \ + \ \left(-\tfrac{2}{3}\right) \ + \ \left(+\tfrac{1}{3}\right) \ = \ 0. \tag{12}$$

v1 erratum: the displayed $[U(1)_Y]^3$ line omitted the $Y \to -Y$ flip for RH fields, yielding a nonzero sum. The corrected convention restores exact cancellation.

G. What changed from v1 (and why)

- **Muon added**: v1 lacked m_μ/v, making Koide unverifiable from the registry alone. v2 adds m_μ/v using the declared bounded-CF rule ($D_{\max=500{,}000}$) and records the approximation error.
- **Anomaly line fixed**: v1's $[U(1)_Y]^3$ display kept RH hypercharges unflipped. In v2 we state the left-chiral convention explicitly and flip Y for RH fields, giving the standard cancellation.
- **Clarified "Ratio OS"**: v2 defines the term up front and emphasizes the provenance rule for any new p/q.

Reproducibility: All numbers in this deck are recomputable from the registry table, the ruler M_W, and the stated formulas, using standard arithmetic.