Ledger v2.4 — By Evan Wesley

Program: *Fraction Physics Ledger*

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Abstract

I show the latest ledger, that uses exact rational locks when applicable, and follows the program's MDL discipline. Where helpful, we provide derived checks, exact identities, and compact audit relations.

Contents

Conventions and Scoring

- All base "locks" are stated as exact rationals p/q (or discrete symbols). Derived quantities propagate those rationals exactly when feasible.
- MDL bit-cost for a fraction p/q is $L(p/q) = \lceil \log_2 p \rceil + \lceil \log_2 q \rceil$.
- Numerical renderings are provided for readability; exact rationals remain primary.

1 Canonical Fine-Structure Seeds (G.1 vs G.2)

We freeze the two v2.3 predictions for the inverse fine-structure constant:

$$\alpha_{\mathrm{G.1}}^{-1} = \frac{11183280301129}{81608342400} = 137.03599377517806316820864 62768\ldots, \tag{1}$$

$$\alpha_{\mathrm{G.2}}^{-1} = \frac{370638943017318088595145540361}{2704683041268417903431761920} = 137.035999177004923218053788 5571\ldots. \tag{2}$$

Reciprocals and differences (for reference):

$$\alpha_{\mathrm{G.1}} = 7.2973528519857709933379801406 3 \times 10^{-3}, \tag{3}$$

$$\alpha_{\mathrm{G.2}} = 7.2973525643311628622161874266 6 \times 10^{-3}, \tag{4}$$

$$\Delta\alpha \equiv \alpha_{\mathrm{G.2}} - \alpha_{\mathrm{G.1}} = -2.8765460813112179 \times 10^{-10}, \tag{5}$$

$$\frac{\Delta\alpha}{\alpha_{\mathrm{G.2}}} = -3.941903664311808 \times 10^{-8}. \tag{6}$$

Technical Note: Propagation Toggles

Muon a_μ (QED, 5 loops). With $x \equiv \alpha/\pi$ and coefficients $C_1 = \frac{1}{2}$, $C_2 = 0.765857420$, $C_3 = 24.05050985$, $C_4 = 130.8782$, $C_5 = 751.0$,

$$a_\mu^{\mathrm{QED}}(\alpha) = \sum_{n=1}^{5} C_n x^n. \tag{7}$$

Evaluated at the two seeds:

$$a_{\mu,\,\mathrm{G.1}}^{\mathrm{QED}} = 1.1658472343359142409254635 8 \times 10^{-3}, \tag{8}$$

$$a_{\mu,\,\mathrm{G.2}}^{\mathrm{QED}} = 1.1658471881922329281718383 0 \times 10^{-3}, \tag{9}$$

$$\Delta a_\mu^{\mathrm{QED}} = -4.6143681312753625 \times 10^{-11}, \quad \frac{\Delta a_\mu^{\mathrm{QED}}}{a_{\mu,\,\mathrm{G.2}}^{\mathrm{QED}}} = -3.9579527900482560 \times 10^{-8}. \tag{10}$$

The linearized response $\frac{\partial a_\mu}{\partial \alpha}|_{\mathrm{G.2}}\, \Delta\alpha$ numerically matches $\Delta a_\mu^{\mathrm{QED}}$ at the shown precision.

Electron Yukawa y_e. Exact lock (v2.3):

$$y_e = \sqrt{2}\,\frac{43}{20\,719\,113} = 2.9350283085015795 \times 10^{-6}. \tag{11}$$

Audit relation $y_e \approx \frac{7}{127}\alpha^2$ gives

$$y_e^{(\alpha,\,\mathrm{G.1})} = 2.9351142560999532 \times 10^{-6}, \qquad \frac{y_e^{(\alpha,\,\mathrm{G.1})} - y_e}{y_e} = +2.92833967307 \times 10^{-5}, \tag{12}$$

$$y_e^{(\alpha,\,\mathrm{G.2})} = 2.9351140247012141 \times 10^{-6}, \qquad \frac{y_e^{(\alpha,\,\mathrm{G.2})} - y_e}{y_e} = +2.92045563534 \times 10^{-5}. \tag{13}$$

2 Neutrino Sector: Leptonic CP Pair (M–LCP–01)

Locks: $\delta_{\mathrm{CP}} = -\pi/2$ (discrete), $J_\ell = -\frac{1}{30}$.
Frozen angles: $\sin^2\theta_{12} = \frac{31}{101}$, $\sin^2\theta_{13} = \frac{1}{45}$, $\sin^2\theta_{23} = \frac{5}{9}$.

$$J_\ell = s_{12}c_{12}s_{23}c_{23}s_{13}c_{13}^2 \sin\delta, \qquad J_\ell^{\mathrm{calc}}\,(\delta = -\pi/2) = -0.033405262\ldots \tag{14}$$

Deviation from $-1/30$: $\Delta J \approx -7.19 \times 10^{-5}$ (relative 2.16×10^{-3}). Bit-cost for $1/30$: $L = 5$.

3 Electroweak: Low-Q^2 Weak Mixing (M–EW–01)

$$\boxed{\sin^2\theta_W(Q^2 \approx 5 \times 10^{-3}\,\mathrm{GeV}^2) = \frac{117}{490} = 0.2387755102\ldots} \quad (L = 16). \tag{15}$$

Distinct from the M_Z-scale lock 25/108 recorded in the Ledger.

4 Quark Flavor: CKM Skeleton and J_q (M–CKM–01)

$$\lambda = \frac{9}{40} = 0.225, \qquad A = \frac{21}{25} = 0.84, \qquad \bar\rho = \frac{3}{20} = 0.15, \qquad \bar\eta = \frac{7}{20} = 0.35. \tag{16}$$

Leading checks: $|V_{us}| = \lambda$, $|V_{cb}| = A\lambda^2 = \frac{1701}{40000} = 0.042525$, $|V_{ub}|/|V_{cb}| = \lambda\sqrt{\bar\rho^2 + \bar\eta^2} \approx 0.085677$.
J_q (calc) $\approx 3.208 \times 10^{-5}$. Convenience lock (v2.3): $\boxed{J_q = \frac{3}{100000}}$ (bit-cost $L = 19$).

5 Rare-Decay Anchors (M–RARE–01)

$$\mathcal{B}(K^+ \to \pi^+\nu\bar\nu) = \frac{89}{10} \times 10^{-11} = 8.9 \times 10^{-11}, \tag{17}$$

$$\mathcal{B}(K_L \to \pi^0\nu\bar\nu) = \frac{17}{5} \times 10^{-11} = 3.4 \times 10^{-11}, \tag{18}$$

$$\mathcal{B}(B_s \to \mu^+\mu^-) = \frac{183}{50} \times 10^{-10} = 3.66 \times 10^{-9}. \tag{19}$$

Ratio $K_L/K^+ = \frac{34}{89} = 0.3820$. Bit-costs (fractional parts): $L = 11, 8, 14$ respectively.

6 Cosmology Core and Deriveds (M–COSMO–01)

Locks: $\Omega_m = \frac{63}{200}$, $\Omega_\Lambda = \frac{137}{200}$, $h = \frac{31}{46}$. Also $\Omega_b h^2 = \frac{14}{625}$, $\Omega_c h^2 = \frac{3}{25}$, $f_b = \frac{5}{32}$.
Exact identities: flatness $\Omega_m + \Omega_\Lambda = 1$; $H_0 = 100h = \frac{1550}{23}\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$; $q_0 = \frac{1}{2}\Omega_m - \Omega_\Lambda = -\frac{211}{400} = -0.5275$; $\Omega_\Lambda/\Omega_m = \frac{137}{63}$.

Cosmic Age t_0 (M–AGE–01)

In flat ΛCDM,

$$t_0 = \frac{1}{H_0}\,\frac{2}{3\sqrt{\Omega_\Lambda}}\ln\!\left(\frac{1+\sqrt{\Omega_\Lambda}}{\sqrt{\Omega_m}}\right) = \frac{1}{H_0}\,\frac{2}{3\sqrt{1-\Omega_m}}\ \mathrm{asinh}\sqrt{\frac{1-\Omega_m}{\Omega_m}}. \tag{20}$$

With the locks above, $t_0 \approx 13.7980148033\,\mathrm{Gyr}$ and $H_0 t_0 \approx 0.9509854899$.

7 PMNS First Row (M–PMNS–01)

Inputs: $\sin^2\theta_{12} = \frac{31}{101}$, $\sin^2\theta_{13} = \frac{1}{45}$, $\sin^2\theta_{23} = \frac{5}{9}$. Then

$$|U_{e1}|^2 = (1-\tfrac{31}{101})(1-\tfrac{1}{45}) = \tfrac{616}{909} \approx 0.67789, \tag{21}$$
$$|U_{e2}|^2 = (\tfrac{31}{101})(1-\tfrac{1}{45}) = \tfrac{1364}{4545} \approx 0.30033, \tag{22}$$
$$|U_{e3}|^2 = \tfrac{1}{45} \approx 0.02222, \tag{23}$$

with exact unitarity $|U_{e1}|^2 + |U_{e2}|^2 + |U_{e3}|^2 = 1$.

8 Muon $g-2$ Block (M–MUON–01)

Seed α by default with G.2; G.1 may be used as a toggle. QED through 5 loops:

$$a_\mu^{\mathrm{QED}} = \sum_{n=1}^{5} C_n(\alpha/\pi)^n, \quad C_1 = \tfrac{1}{2},\ C_2 = 0.765857420,\ C_3 = 24.05050985,\ C_4 = 130.8782,\ C_5 = 751.0. \tag{24}$$

Bookkeeping adds: $a_{\mathrm{EW}} = 153.6 \times 10^{-11}$, $a_{\mathrm{HAD}} = 6937 \times 10^{-11}$ (illustrative standard bundles). This module demonstrates that the exact ledger α integrates cleanly into precision machinery.

9 Micro↔Macro Bridge (M–BRIDGE–01)

Record the echo $\lfloor \alpha^{-1} \rfloor = 137$ and the cosmology lock $\Omega_\Lambda = \frac{137}{200}$; note also $\Omega_\Lambda/\Omega_m = \frac{137}{63}$ and flatness. No causal claim; this is a mapping/record module.

10 Electron Yukawa (M–ELECTRON–01)

Exact lock (v2.3): $y_e = \sqrt{2}\,\dfrac{43}{20\,719\,113}$. Compact audit line $y_e \approx \frac{7}{127}\alpha^2$ (using G.2) has relative miss $\sim 2.92 \times 10^{-5}$.

11 Axion Template (M–AXION–01)

$$m_a(f_a) = \frac{57}{10} \times 10^{-6}\,\mathrm{eV} \times \frac{10^{12}\,\mathrm{GeV}}{f_a}. \tag{25}$$

Examples: $f_a = 10^{12}\,\mathrm{GeV} \Rightarrow m_a = 5.7\,\mu\mathrm{eV}$; $f_a = 10^{11}\,\mathrm{GeV} \Rightarrow 57\,\mu\mathrm{eV}$; $f_a = 10^{13}\,\mathrm{GeV} \Rightarrow 0.57\,\mu\mathrm{eV}$.

12 EW Running Ratio (M–RUN–01)

Bridge between the staged EW locks:

$$\mathcal{R}_W \equiv \frac{\sin^2\theta_W(Q^2 \approx 5\times 10^{-3}\,\mathrm{GeV}^2)}{\sin^2\theta_W(M_Z)} = \frac{117/490}{25/108} = \frac{6318}{6125} \approx 1.0315102040816326. \tag{26}$$

Bit-cost: $L = 26$.

Staging Table (Summary)

Module	Observable(s)	Frozen value(s)	Bit-cost	Sector
M–LCP–01	$\delta_{\mathrm{CP}},\ J_\ell$	$-\pi/2,\ -1/30$	5 (for J_ℓ)	Neutr
M–EW–01	$\sin^2\theta_W$ @ low Q^2	117/490	16	Electr
M–CKM–01	$\lambda, A, \bar\rho, \bar\eta;\ J_q$	9/40, 21/25, 3/20, 7/20; 3/100000	$10, 10, 7, 8;\ 19$	Quark
M–RARE–01	$K\to\pi\nu\bar\nu;\ B_s\to\mu\mu$	$89/10\times 10^{-11};\ 17/5\times 10^{-11};\ 183/50\times 10^{-10}$	11; 8; 14	Kaons
M–COSMO–01	$\Omega_m, \Omega_\Lambda, h;\ q_0, H_0$	63/200; 137/200; 31/46; −211/400; 1550/23	14; 16; 11; 17; 16	Cosmo
M–PMNS–01	$\lvert U_{e1}\rvert^2, \lvert U_{e2}\rvert^2, \lvert U_{e3}\rvert^2$	616/909; 1364/4545; 1/45	20; 24; 6	Neutr
M–MUON–01	a_μ(QED)+(EW+HAD)	seeded by α (G.2)	–	QED
M–BRIDGE–01	$\alpha^{-1} \leftrightarrow \Omega_\Lambda$	$\lfloor\alpha^{-1}\rfloor = 137;\ \Omega_\Lambda = 137/200$	16	Cross-
M–ELECTRON–01	y_e	$\sqrt{2}\,43/20{,}719{,}113$ (exact)	–	Lepto
M–AXION–01	$m_a(f_a)$ template	$(57/10)\times 10^{-6}\,\mathrm{eV}\,(10^{12}\,\mathrm{GeV}/f_a)$	10	Axion
M–RUN–01	$\mathcal{R}_W$	6318/6125	26	Electr

Reproducibility Checklist

1. State the seed (G.1 or G.2) before any propagation and quote exact rationals first.
2. Carry exact rationals through algebra; defer decimal rendering to the end.
3. Report deltas $\Delta\alpha$, $\Delta\mathcal{O}$ and relative shifts.
4. Validate with linear response when $\mathcal{O}(\alpha)$ is smooth.
5. Only assign MDL bit-costs when introducing new locks; deriveds inherit costs.