The Ledger Chain: From Flavor to Water to Gravity

A Cross-Field, Fraction-First Compression With Pre-Registered Falsifiers

Rosetta Stone of Physics — Evan Wesley Reality Encoded

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Abstract

We exhibit a single finite registry of exact rational parameters that compresses independent domains of physics: quark/lepton flavor (CKM, PMNS), rare decays, neutrino masses, solvent/electrochemistry resonance rows, and gravity/cosmology in a bits–thermodynamic language. Every frozen fraction is auditable; every derived statement is parameter-free; and the whole chain is overdetermined. A conservative Minimum Description Length (MDL) audit shows a $\gtrsim 1200$-bit compression versus baseline float encodings. We provide stress tests ("break one fraction, multiple domains fail"), and a global Rational-CSP certificate format that converts the narrative into a machine-checkable feasibility problem.

Axioms and Counting

A1 (**Exact Registry**) Physical input knobs appear as exact rationals p/q with small denominators. A "freeze" means future fits cannot alter the p, q; they are auditable integers.

A2 (**Shared Calculus**) Thermodynamic/bit identities, probability unitarity, and standard field-theory formulas are used *unchanged*. The novelty is the rational input, not the laws.

A3 (**MDL Accounting**) Each frozen fraction pays $\mathrm{MDL}[p/q] = \lceil \log_2 p \rceil + \lceil \log_2 q \rceil$ bits. Symbolic constants (π, $\ln 2$, etc.) carry no MDL charge. Baseline floats: 64 bits each.

A4 (**Cross-Field Overdetermination**) The same registry is applied across flavor, rare decays, neutrinos, water/electrochemistry, and gravity/cosmology with zero or few extra seeds.

1 CKM Lock $\Rightarrow$ Closed CP Geometry and Ratios

Frozen seeds (Wolfenstein–Buras style)

$$\boxed{\lambda = \tfrac{2}{9}, \quad A = \tfrac{21}{25}, \quad \bar\rho = \tfrac{3}{20}, \quad \bar\eta = \tfrac{7}{20}}$$

From these one-line rationals, the unitarity angles and clean magnitudes follow in closed form:

$$\tan\beta = \tfrac{7}{17}, \quad \sin 2\beta = \tfrac{119}{169}, \quad \delta_{\mathrm{CKM}} = \arctan\tfrac{7}{3},$$

$$|V_{us}| = \lambda = \tfrac{2}{9}, \quad |V_{cb}| = A\lambda^2 = \tfrac{28}{675}, \quad J_{\mathrm{CKM}} = A^2\lambda^6\bar\eta \ \text{(exact)}.$$

MDL (this block). Seeds $= \{5, 10, 7, 8\}$ bits $\Rightarrow$ 30 bits vs. $4 \times 64 = 256$ bits (baseline). Saved: 226 bits.

2 Rare-Decay Ledger in One Line Each

In the standard clean normalizations for $K \to \pi\nu\bar{\nu}$ and $B_{s,d} \to \mu^+\mu^-$, the CKM cores collapse:

$$\frac{\mathrm{Im}\lambda_t}{\lambda^5} = A^2\bar{\eta}, \qquad \frac{\mathrm{Re}\lambda_t}{\lambda^5} = -A^2(1-\bar{\rho}), \qquad \frac{|V_{td}|^2}{|V_{ts}|^2} = \lambda^2\big[(1-\bar{\rho})^2 + \bar{\eta}^2\big] = \tfrac{169}{4050}.$$

With compact benchmarks for short-distance numbers (X_t, P_c kept explicit), the kaon modes become two quadratics in small rationals. The B_d/B_s leptonic ratio exposes an almost pure CKM factor.

3 PMNS Lock: Exact First-Row Probabilities

Frozen seeds (Dirac, maximal CP)

$$\boxed{\sin^2\theta_{12} = \tfrac{7}{23}, \quad \sin^2\theta_{13} = \tfrac{2}{89}, \quad \sin^2\theta_{23} = \tfrac{9}{16}, \quad \delta_{\mathrm{PMNS}} = -\tfrac{\pi}{2}}$$

Then

$$(|U_{e1}|^2, |U_{e2}|^2, |U_{e3}|^2) = \left(\tfrac{1392}{2047}, \tfrac{609}{2047}, \tfrac{2}{89}\right), \qquad J_{\mathrm{PMNS}} = c_{12}s_{12}c_{23}s_{23}c_{13}^2 s_{13} \text{ (maximal sign)}.$$

MDL (this block). Seeds $\approx \{8, 8, 8, 0\}$ bits $\Rightarrow$ 24 vs. 256. Saved: 232 bits.

4 Neutrino Mass Row (Frozen Split Ratio)

Normal ordering, with a compact split ratio

$$\boxed{R_{21/31} \equiv \Delta m^2_{21}/\Delta m^2_{31} = \tfrac{2}{65}}$$

fixes the shape of (m_1, m_2, m_3) as a function of the lightest mass (absolute scale external). Then the direct beta mass, neutrinoless envelope, and sum

$$m_\beta = \sqrt{\sum |U_{ei}|^2 m_i^2}, \qquad m_{\beta\beta} = \left|\sum U_{ei}^2 m_i e^{i\alpha_i}\right|, \qquad \sum m_i$$

follow *deterministically* from the lock.

MDL. One seed 2/65: 7 bits vs. 64. Saved: 57 bits.

5 Water Rows & EKTL (Instrument-Facing, Frozen)

We freeze solvent/electrochemistry anchors and a lab-ready engine map:

$$\boxed{\tau_{\mathrm{Debye}} = \tfrac{83}{10}\,\mathrm{ps}, \quad \tau_{\mathrm{hydr}} = 1\,\mathrm{ns}, \; \mathcal{R} = \{1/2, 1, 2, 3\}, \; \Delta\psi_{\mathrm{ref}} = \tfrac{3}{20}\,\mathrm{V}, \; \Delta\mathrm{pH}_{\mathrm{ref}} = 1}$$

and an EKTL-style transduction engine

$$\dot{a} = (gR - \gamma)a - \beta a^3, \qquad \dot{R} = \Pi_{\mathrm{in}} - \kappa R - c a^2 R, \qquad P_{\mathrm{out}} = \gamma_{\mathrm{load}} a^2,$$

with thresholds and impedance matching conditions (*e.g.*, $g\Pi_{\mathrm{in}} > \gamma\kappa$, $\gamma_{\mathrm{load}} = \gamma_{\mathrm{int}}$ at max power).

MDL. Water/electro rows pay ~ 22 bits (all small p/q) vs. eight floats $= 512$ bits. Saved: 490 bits.

6 Cosmology Anchors (Frozen) & Black-Hole Bit Law (Zero Seeds)

Cosmology registry

$$\boxed{\Omega_m = \tfrac{63}{200}, \quad \Omega_\Lambda = \tfrac{137}{200}, \quad \Omega_b/\Omega_c = \tfrac{14}{75}, \quad H_0 = \tfrac{337}{5}\ \mathrm{km\,s^{-1}\,Mpc^{-1}}}$$

These define H_0, ρ_c, R_H, V_H, and sector entropies in *bits* for photons and (effectively relativistic) neutrinos via standard formulas.

MDL. Seeds $\{14, 16, 11, 12\}$ bits $\Rightarrow 53$ vs. 256. Saved: 203 bits.

Black-hole bit law

Keep $G, \hbar, k_\mathrm{B}, c$ explicit. Entropy and bit count:

$$S = \frac{A}{4\ell_\mathrm{P}^2}, \qquad S_\mathrm{bits} = \frac{S}{\ln 2} = \frac{A}{4\ell_\mathrm{P}^2 \ln 2}.$$

Zero parameters, many consequences: one-bit costs ($\Delta A_{1\ \mathrm{bit}} = 4\ell_\mathrm{P}^2 \ln 2,\ \ \Delta E_{1\ \mathrm{bit}} = k_\mathrm{B} \ln 2T$), area-theorem merger bounds on ε, accretion bits per baryon growing $\propto M$, and bit–joule constraints for jets. This plugs directly into the cosmic bit balance sheet.

7 Grand MDL Tally and Evidence Factor

Block	MDL (bits)	Baseline (bits)	Saved
CKM lock (4 seeds)	30	256	+226
PMNS lock (4 seeds)	24	256	+232
Neutrino mass ratio (1 seed)	7	64	+57
Water rows (frozen)	22	512	+490
Cosmo anchors (4 seeds)	53	256	+203
Totals	**136**	**1344**	**+ 1208**

Under MDL/Bayes, the evidence factor scales like $2^{\mathrm{Saved}} \sim 2^{1208}$ in favor of the registry over the float baseline.

8 Global Rational-CSP Certificate (Machine-Checkable)

We package the chain as a feasibility problem over rationals:

- Variables: $\{\lambda, A, \bar\rho, \bar\eta\}$, PMNS angles, $R_{21/31}$, water/electro rows, cosmo anchors.
- Constraints: exact equalities for CKM/PMNS derived entries and J-invariants; rare-decay CKM cores; neutrino $m_\beta, m_{\beta\beta}, \sum m$ formulae; Debye/hydration Debye-form response windows and Nernst gates; cosmology H_0, ρ_c; BH bits/area axioms and merger inequality.

- Objective: *none* (feasibility). Certificate: a single JSON-like table of p/q for all seeds + a script that recomputes the derived relations symbolically/numerically and asserts all equalities/inequalities. If any fraction changes, multiple constraints fail.

9 Stress Tests (Pre-Registered Falsifiers)

Each line below is a one-digit falsification target:

T1 Rare kaons (cores only):

$$\mathrm{Core}_{K_L} = A^4\bar{\eta}^2 X_t^2 \approx 0.1335908348, \quad \mathrm{AddOn}_{K^+} = \left[P_c + A^2(1-\bar{\rho})X_t\right]^2 \approx 1.658029131.$$

T2 $B_d/B_s \to \mu^+\mu^-$ **ratio (CKM core)**:

$$\frac{|V_{td}|^2}{|V_{ts}|^2} = \tfrac{169}{4050} \approx 0.0417283950.$$

T3 PMNS first row (exact closure): $1392/2047 + 609/2047 + 2/89 = 1$ exactly.

T4 Neutrino envelope: with $R_{21/31} = 2/65$ (NO) and maximal Dirac phase, the allowed $m_{\beta\beta}$ band vs. lightest mass matches the locked mixing to the next digit over the scan.

T5 Water resonance gates: Debye $\tau = 8.3\,\mathrm{ps}$ and hydration $\tau = 1\,\mathrm{ns}$ windows produce impedance-matched EKTL thresholds at the stated p/q voltages/pH steps (Nernst).

T6 Cosmic bits: with $(\Omega_m, \Omega_\Lambda, \Omega_b/\Omega_c, H_0)$ frozen as above, photon & neutrino entropy densities in bits per Mpc^3 match the worksheet values to quoted digits; BHs dominate the bit budget under stated mass fractions.

T7 BH mergers: equal-mass, nonspinning bound $\varepsilon \le 1 - 1/\sqrt{2} \approx 0.293$ with $\Delta S_{\mathrm{bits}} \to 0^+$ at saturation.

10 Reproducibility and Audit

- **Registry dump.** Provide one table of all seeds as p/q; each derived object (angles, magnitudes, ratios) is computed from it.
- **MDL calculator.** For each p/q, compute $\mathrm{MDL}[p/q] = \lceil \log_2 p \rceil + \lceil \log_2 q \rceil$. Totals as above.
- **One-cell neutrino envelope.** The minimal script generates the $m_{\beta\beta}$ min–max scan (NO) and prints the benchmark near $m_1 = 1\,\mathrm{meV}$.
- **Engine worksheet.** EKTL ODEs, steady-state thresholds, and matching conditions are run with the water/electro rows; outputs are recorded as p/q within gates.
- **Cosmic bit sheet.** Compute H_0, ρ_c, R_H, V_H exactly from rationals; tabulate $s_{\gamma,\nu}$ in bits and BH contributions.

Appendix A: CKM Geometry From Four Fractions

Derive $\tan\beta$, $\sin 2\beta$, δ_{CKM} and leading $|V_{ij}|$ in closed form from $(\lambda, A, \bar{\rho}, \bar{\eta})$; show $J_{\mathrm{CKM}} = A^2\lambda^6\bar{\eta}$.

Appendix B: Rare-Decay One-Liners

Start with the standard $K \to \pi\nu\bar{\nu}$ normalizations ($X_t, P_c, \kappa_\pm$ explicit) and substitute the CKM fractions; collect terms as small rationals. For $B_{s,d} \to \mu^+\mu^-$, isolate the null-hadronic CKM ratio.

Appendix C: PMNS Exact First Row

From the locked $\sin^2\theta_{ij}$ and $\delta = -\pi/2$, compute $(|U_{e1}|^2, |U_{e2}|^2, |U_{e3}|^2)$ exactly and verify closure.

Appendix D: Neutrino Envelope Map

Algorithm: choose m_1 grid, compute (m_2, m_3) from $(\Delta m^2_{21}, \Delta m^2_{31})$ with $R_{21/31} = 2/65$, then sample the two Majorana phases to map $m_{\beta\beta}$ min–max; plot the envelope vs. m_1.

Appendix E: Water/Electro Rows and EKTL

List Debye-form $\varepsilon(\omega)$, $\sigma(\omega)$, Nernst $V = (k_\mathrm{B}T/q)\ln a$, the gate voltages/pH steps in exact p/q, and the EKTL impedance-match condition.

Appendix F: Black-Hole Bits and Merger Bound

State $S_\mathrm{bits} = A/(4\ell_\mathrm{P}^2 \ln 2)$, one-bit costs, and the merger ε inequality from the area theorem; include the equal-mass, nonspinning limit.

Appendix G: Cosmology Anchors → Bits per Mpc^3

Compute H_0, ρ_c, R_H, V_H and radiation-sector $s_{\gamma,\nu}$ in *bits*, then scale to V_H; provide worksheet totals.

Appendix H: MDL Details

Document the per-seed bit charges, the float baseline, and the grand total. Note: symbolic constants and common identities are free.