Standard-Model Masses from Octave Closure and Integer Baselines

Single-anchor formulation with explicit transport hygiene

(draft; internal circulation)

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Abstract

The Standard Model treats fermion masses as inputs (Yukawa couplings) rather than outputs. Recognition Science (RS) proposes that stable particles correspond to stable recognition boundaries whose mass values are organized by (i) a forced eight-tick closure (*Octave*) and (ii) a scale-coordinate on a φ-ladder. At a single common anchor scale $\mu_\star$, the charged-fermion spectrum is described by a sector-global yardstick and an explicit charge→integer→band map:

$$m_{RS}(i;\mu_\star) = A_{\mathrm{sector}(i)}\,\varphi^{\,r_i-8+\mathrm{gap}(Z_i)}.$$

To compare to PDG scheme choices at other scales, Standard-Model renormalization-group (RG) running is used *only* as a transport factor; critically, we do not identify the RS band coordinate $f^{\mathrm{Rec}}(Z)$ with the SM transport exponent $f^{\mathrm{RG}}(\mu_1,\mu_2)$. All tables and checks in this draft are reproducible from the repository.

Contents

1 Introduction (motivation and paper spine)

1.1 What the Standard Model does and does not explain about masses

In the Standard Model (SM), fermion masses arise from Yukawa couplings. Those Yukawas are free inputs: the SM does not explain why the electron, muon, and tau have the numerical values they do, nor why quarks cluster into three charge-families with large separations. This motivates searching for *structure*: a small set of organizing principles that place masses on a constrained spectrum.

1.2 Recognition Science move: masses as ladder coordinates under forced closure

Recognition Science (RS) starts from the premise that stable particles correspond to stable recognition boundaries. A boundary is not only a "thing" but a repeatable recognition process; stability is therefore a question of discrete closure. Two RS ingredients matter here:

- **Octave (8-tick closure).** In a three-bit context space, full coverage requires $2^3 = 8$ states. Eight ticks is the minimal closure that can support stable periodicity.
- **φ-ladder coordinate.** Physical scales are treated as coordinates in $\log_\varphi$ units. We adopt φ as the log base because the RS mass law is expressed in φ-powers; in this paper this is a declared coordinate convention (DEF). On such a ladder, integer shifts correspond to multiplying by φ.

This paper's spine is: *at a single anchor scale*, charged fermion masses are described by sector-global integers plus an explicit charge-index band coordinate.

1.3 What this paper provides (deliverables)

This draft is designed to be referee-resistant by making the claim contract explicit:

- the anchor mass display law and its decomposition into (yardstick) $\times$ (rung skeleton) $\times$ (band coordinate),
- the derivation of sector yardstick integers from cube/wallpaper integers,
- the closed-form map $Z \mapsto \mathrm{gap}(Z)$ and its canonical values for charged families,
- a strict transport section whose entire purpose is to prevent the category error $f^{\mathrm{Rec}} = f^{\mathrm{RG}}$,
- reproducible tables (auto-generated from the canonical repository spec).

2 Scope, claims hygiene, and what is being tested

Two tiers. We separate two kinds of work to prevent category errors.

- **Tier A (anchor display).** A structural coordinate table at $\mu_\star$: it defines A_{sector}, $\mathrm{gap}(Z)$, and $m_{RS}(i;\mu_\star)$. This is *not* a claim that $m_{RS}(\mu_\star)$ equals PDG pole masses.
- **Tier B (absolute leptons).** A separate pipeline (T9/T10) that predicts (m_e, m_μ, m_τ) in MeV using additional structure (topological shift and derived steps). We include Tier B as a reproducible result table, but keep the transport hygiene rules identical.

Tag vocabulary. We use: **THEOREM (Lean)** for proved statements; **DEF (Lean)** for definitions; **CERT** for pinned external numerical certificates; **VALIDATION** for comparisons to PDG/CODATA.

What this paper is *not* claiming (up front).

- We do *not* claim $m_{RS}(i;\mu_\star)$ equals PDG pole masses.
- We do *not* claim the band coordinate is RG-invariant off-anchor.
- We do *not* claim $f^{\mathrm{RG}} = f^{\mathrm{Rec}}$; they are defined differently and have different typical magnitudes.

Parameter accounting (what can and cannot be called "fit"). Tier A uses no per-species tuning knobs. The structural display depends on:

- φ (scale unit),
- sector-global integers B_{pow}(sector) and r_0(sector) (yardstick),
- a rung integer r_i (species ladder coordinate),
- the integerized charge map $Q \mapsto \tilde{Q} = 6Q \mapsto Z$,
- the closed-form band coordinate gap(Z),
- the octave reference shift -8 (coordinate origin),
- one global anchor scale $\mu_\star$ (a declared comparison convention).

Tier B constants (lepton absolute pipeline). The Tier B pipeline additionally uses:

- a gap-weight constant $w_8 \approx 2.490569$ (DEF in Lean; closed form with proved bounds; a raw DFT-8 candidate exists but is not yet proved equal),
- the fine-structure constant α derived from cube/wallpaper integers and w_8,
- topological shift and step formulas (derived from α and geometry).

Any comparison to PDG at a different μ_{target} necessarily introduces an *explicit RG transport policy* (scheme, thresholds, loop order), which must be declared and is not part of the RS structural law.

Non-circularity rule (operational). No measured m_i may appear on the right-hand side of its own prediction. Any global calibration (if used) must be declared, frozen, and validated on hold-outs.

3 Definitions and notation (self-contained)

3.1 The φ-ladder and log-scale coordinates

Let $\varphi = (1+\sqrt{5})/2$ and $\log_\varphi(x) := \ln(x)/\ln\varphi$. We treat $\log_\varphi(m)$ as a *scale coordinate* on a φ-ladder.

3.2 Charge integerization and the band integer Z

Let Q be electric charge in units of e and define $\tilde{Q} := 6Q \in \mathbb{Z}$. Define the charge-index integer map Z by

$$Z(Q, \text{sector}) := \begin{cases} \tilde{Q}^2 + \tilde{Q}^4, & \text{sector} = \text{lepton}, \\ 4 + \tilde{Q}^2 + \tilde{Q}^4, & \text{sector} = \text{quark}. \end{cases} \tag{1}$$

This gives the three charged-family values:

$$Z_{\text{down}} = 24\ (\tilde{Q} = -2), \qquad Z_{\text{up}} = 276\ (\tilde{Q} = 4), \qquad Z_{\text{lepton}} = 1332\ (\tilde{Q} = -6).$$

3.3 The closed-form band map $\text{gap}(Z)$

Define the RS band coordinate

$$\text{gap}(Z) := \log_{\varphi}\left(1 + \frac{Z}{\varphi}\right) \;=\; \frac{\ln\left(1 + \frac{Z}{\varphi}\right)}{\ln \varphi}. \tag{2}$$

Physical intuition. The band coordinate $\text{gap}(Z)$ converts a charge-derived integer Z into a φ-exponent shift on the mass ladder. It is the *large* exponent component (order ∼6–14) that positions each charged family on the spectrum; it is *not* a small correction but the primary organizational term.

In Lean this is implemented as `IndisputableMonolith.Masses.MassLaw.gap_correction` and `IndisputableMonolith.RSBridge.gap`.

3.4 Sector yardsticks and rungs

Each sector has a yardstick

$$A_{\text{sector}} \;=\; 2^{B_{\text{pow}}(\text{sector})}\, E_{\text{coh}}\, \varphi^{r_0(\text{sector})}, \qquad E_{\text{coh}} := \varphi^{-5}. \tag{3}$$

Each species has an integer rung $r_i \in \mathbb{Z}$ (integer baseline on the ladder).

Rungs: what is assumed vs derived (scope honesty). In this paper, rungs r_i are treated as *integer ladder coordinates* assigned to each species. They are **not** fitted to the species' masses in Tier A: they enter only as integers that define a skeleton ladder, and the empirical test (if any) is performed on the band coordinate $\text{gap}(Z)$ under declared transport. *Deriving the full species-to-rung map from an underlying word/loop constructor is outside the Tier A claim.* We do, however, require (and exhibit) two structural consistency properties: (i) within an equal-Z family, ratios are pure φ-powers (Eq. (11)), and (ii) generation separations appear as integer steps (e.g. $2 \to 13 \to 19$ for leptons). Any deeper rung-constructor claim must be stated and audited separately as its own deliverable.

3.5 Decomposing the anchor display (skeleton × band coordinate)

It is useful to factor the anchor display into a *skeleton* (no charge band) and a *band coordinate* term. Define the skeleton mass at the anchor:

$$m_{\text{skel}}(i; \mu_\star) := A_{\text{sector}(i)}\, \varphi^{\,r_i - 8}. \tag{4}$$

Then the RS anchor mass is

$$m_{RS}(i; \mu_\star) = m_{\text{skel}}(i; \mu_\star)\, \varphi^{\text{gap}(Z_i)}. \tag{5}$$

This factorization is where many misunderstandings originate: the *large* exponent is the RS band coordinate $\text{gap}(Z)$, while any SM RG transport exponent is *additional* and typically small.

3.6 Anchor scale

We work at a single common anchor scale $\mu_\star = 182.201$ GeV (definition of the Tier A display).

3.7 Units (explicit convention)

The formulas in this paper are written as energy-masses. In the repository, the coherence unit is defined as $E_{\text{coh}} = \varphi^{-5}$ and is displayed as eV by convention. Sector yardsticks therefore carry an implicit unit conversion when we present tables in MeV:

$$E_{\text{coh}} = \varphi^{-5}\,\text{eV} = 10^{-6}\,\varphi^{-5}\,\text{MeV}.$$

The included tables are generated by scripts that apply this fixed conversion; no data-dependent scaling is introduced by the unit choice.

4 Why eight ticks are forced (Octave core)

4.1 Minimal closure: why the period is 8 in three-bit contexts

There are two distinct statements:

1. **Counting/closure.** A 3-bit context space has $2^3 = 8$ states, so any full-cycle cover needs at least 8 ticks.
2. **Adjacency.** Under a one-update-per-tick (atomic posting) constraint, the observable parity changes by exactly one bit per tick, i.e. Gray adjacency.

The first item is a minimality statement: if your observable state has three independent binary degrees of freedom, any periodic schedule that fully covers the state space requires at least 8 ticks. The second item is a dynamics constraint: under an atomic update rule, the observable cannot jump arbitrarily; it must move by a one-bit step.

4.2 Gray adjacency: why one-bit steps are the natural ledger evolution

In RS, the core intuition is that ledger-like evolution is *atomic*: one posting per tick. If the observation is a parity vector over accounts, a single atomic posting flips exactly one parity bit. That is precisely Gray adjacency (Hamming distance 1).

Why this matters for mass (motivation). The adjacency constraint means the system cannot jump arbitrarily through state space; it must traverse one bit at a time. This motivates describing stable boundaries by integer rung steps on a logarithmic ladder, with the 8-tick period supplying a natural origin for closure. The mass law itself is stated separately in Sec. 6 as a DEF (Lean).

Lean provides explicit, axiom-free witnesses:

- **Gray-8 cycle (period 8).** The explicit 3-bit cycle

$$[0, 1, 3, 2, 6, 7, 5, 4]$$

is certified as a one-bit-adjacent Hamiltonian cycle on the cube: `IndisputableMonolith.Patterns.GrayCycl`

- **Ledger atomicity ⇒ one-bit steps.** Under `PostingStep` (single posting per tick), parity evolves by one-bit adjacency: `IndisputableMonolith.Octave.LedgerBridge.postingStep_implies_grayA`

These two objects (a concrete Gray-8 cycle and an atomic-posting bridge to one-bit adjacency) are what allow the Octave story to be stated as a mathematical claim rather than an analogy.

5 The single-anchor structural mass law (Tier A)

5.1 Sector yardsticks are derived from first-principles integers

The sector integers (B_{pow}, r_0) are fixed *sector-wide* (not per-species knobs) and are derived from the cube/wallpaper integer layer:

$$E_{\text{total}} = 12, \qquad E_{\text{passive}} = 11, \qquad W = 17, \qquad A_z = 1.$$

Geometric role (counting layer). E_{total} is the number of edges of the 3-cube. We distinguish one "active" edge per tick ($A_z = 1$) from the remaining "passive" edges ($E_{\text{passive}} = 11$); these integers feed directly into the sector formulas below. W is the number of plane crystallographic (wallpaper) groups; in this framework it enters as a fixed symmetry-counting integer.

The derivation formulas are (Lean: `IndisputableMonolith.Masses.AnchorDerivation`):

$$B_{\text{pow}}(\text{Lepton}) = -2E_{\text{passive}} = -22, \qquad r_0(\text{Lepton}) = 4W - (8 - r_e) = 62, \tag{6}$$

$$B_{\text{pow}}(\text{UpQuark}) = -A_z = -1, \qquad r_0(\text{UpQuark}) = 2W + A_z = 35, \tag{7}$$

$$B_{\text{pow}}(\text{DownQuark}) = 2E_{\text{total}} - 1 = 23, \qquad r_0(\text{DownQuark}) = E_{\text{total}} - W = -5, \tag{8}$$

$$B_{\text{pow}}(\text{Electroweak}) = A_z = 1, \qquad r_0(\text{Electroweak}) = 3W + 4 = 55. \tag{9}$$

5.2 The mass law at the anchor

The Tier A anchor display law is:

$$m_{RS}(i; \mu_\star) = A_{\text{sector}(i)}\, \varphi^{r_i - 8 + \text{gap}(Z_i)}. \tag{10}$$

Lean definition: `IndisputableMonolith.Masses.MassLaw.predict_mass`.

5.3 Equal-Z corollary: family ratios are pure φ-powers

If two species are in the same sector and share the same Z value, then by (10) their ratio at the anchor is

$$\frac{m_{RS}(i; \mu_\star)}{m_{RS}(j; \mu_\star)} = \varphi^{r_i - r_j}. \tag{11}$$

This is the "equal-Z family" structure: within each charged family, gap(Z) cancels and only rung differences remain. In Lean, rung shifts correspond to multiplicative scaling by φ (`IndisputableMonolith.Masses.Ma`

5.4 Why the -8 offset is an octave reference (not a fit knob)

Equation (10) uses $\log_\varphi(m)$ as a coordinate. Any coordinate needs an origin. The Octave structure gives a canonical origin: one complete eight-tick closure. The shift -8 is therefore a reference choice *forced by the clock period*, not a per-species tunable offset. Equivalently, r_i is an integer ladder coordinate, and $r_i - 8$ is that coordinate expressed relative to the "one closure" origin. This also shows up in the yardstick derivation: the lepton offset uses $4W - (8 - r_e)$, i.e. the same octave reference enters the sector-global φ-phase choice rather than being an adjustable particle-specific correction.

6 Transport and comparison to PDG: $f^{\mathrm{Rec}} \neq f^{\mathrm{RG}}$

Section summary. The RS band coordinate $f^{\mathrm{Rec}}(Z) = \mathrm{gap}(Z)$ is a *large structural exponent* (order 6–14) that organizes the mass ladder at the anchor. The SM RG transport exponent f^{RG} is a *small bookkeeping correction* (order 0.01–0.5) used only to translate between the anchor display and external scheme/scale choices. **They are not the same quantity.**

6.1 What a "PDG mass" is (why transport is unavoidable)

The phrase "the mass of a particle" is scheme-dependent in QFT: PDG values may refer to pole masses (leptons) or to running $\overline{\mathrm{MS}}$ masses at a quoted scale (quarks). Any numerical comparison therefore requires an explicit (scheme, μ) declaration. In this paper, the RS structural law lives at the single anchor $\mu_\star$; RG is used only to translate between that anchor display and external scheme choices.

6.2 Two different exponents

We define the RS band coordinate (a *structural* quantity)

$$f^{\mathrm{Rec}}(Z) := \mathrm{gap}(Z),$$

and the Standard-Model RG transport exponent (a *scheme/scale* quantity)

$$f_i^{\mathrm{RG}}(\mu_1, \mu_2) := \frac{1}{\ln \varphi} \ln\left(\frac{m_i(\mu_2)}{m_i(\mu_1)}\right) = \frac{1}{\ln \varphi} \int_{\ln \mu_1}^{\ln \mu_2} \gamma_i(\mu)\, d\ln \mu. \tag{12}$$

These play different roles:

- $f^{\mathrm{Rec}}(Z)$ supplies the *large* band coordinate at the anchor (e.g. $\mathrm{gap}(1332) \approx 13.95$).
- f^{RG} is a *small* transport exponent used only to compare to a declared PDG scheme/scale.

Therefore we do not (and cannot) set $f^{\mathrm{RG}} = f^{\mathrm{Rec}}$.

6.3 Comparison display (transport-only RG)

Given a declared target scheme/scale μ_{target}, the comparison display is

$$m_{\mathrm{pred}}(i; \mu_{\mathrm{target}}) = m_{RS}(i; \mu_\star)\, \varphi^{f_i^{\mathrm{RG}}(\mu_\star, \mu_{\mathrm{target}})}. \tag{13}$$

This equation is purely bookkeeping: it aligns an anchor-defined structural display with an external choice of scheme/scale. It is not part of the RS structural law and should never be conflated with the RS band map.

6.4 Pinned transport policy (CERT) used for examples

Any transport comparison requires an explicit policy (scheme, loop order, thresholds). This repository provides a pinned, reproducible certificate:

- Policy name: `RS_CANONICAL_2025_Q4` (CERT)
- Reproduce: `python3 tools/rg_transport_certify.py`
- Certificate: `data/certificates/rg_transport/canonical_2025_q4.json`
- Paper snippet: `python3 tools/rg_transport_table.py` → `out/masses/rg_transport_policy_table.tex`

We include the certificate table to make the order-of-magnitude separation concrete:

Table 1: Pinned SM RG transport exponent certificate (CERT). Policy=`RS_CANONICAL_2025_Q4`, anchor $\mu_\star = 182.201\,\mathrm{GeV}$. These values are used only for scheme/scale bookkeeping and must not be conflated with $\mathrm{gap}(Z)$.

Species	μ_{end} [GeV]	$f^{RG}(\mu_\star, \mu_{\mathrm{end}})$
e	0.000510999	0.0494258
mu	0.105658	0.0287906
tau	1.77686	0.0178757
u	2	0.482193
d	2	0.476388
s	2	0.476388
c	1.27	0.547013
b	4.18	0.380746
t	162.5	0.00979749

6.5 The diagnostic band test (how to test $\mathrm{gap}(Z)$ against transported data)

If one wants to test the RS band coordinate against experimental data at the anchor, the correct diagnostic is:

$$m_{\mathrm{data}}(i;\mu_\star) := m_{\mathrm{data}}(i;\mu_{\mathrm{target}})\,\varphi^{-f_i^{\mathrm{RG}}(\mu_\star,\mu_{\mathrm{target}})}, \tag{14}$$

$$f_i^{\mathrm{exp}}(\mu_\star) := \log_\varphi\left(\frac{m_{\mathrm{data}}(i;\mu_\star)}{m_{\mathrm{skel}}(i;\mu_\star)}\right). \tag{15}$$

Then the band test statement is $f_i^{\mathrm{exp}}(\mu_\star) \approx \mathrm{gap}(Z_i)$ under a declared RG policy (scheme, thresholds, loop order). This formulation makes the category separation explicit: $\mathrm{gap}(Z)$ is RS-side structure, while f^{RG} appears only in the transport needed to interpret $m_{\mathrm{data}}(\mu_{\mathrm{target}})$ at the anchor.

6.6 Reviewer checklist (required for any objection)

Any numerical objection must specify: (i) target scheme (pole vs $\overline{\mathrm{MS}}$), (ii) μ_{target}, (iii) loop order and thresholds for f^{RG}, and (iv) the exact equation being tested (Tier A vs Tier B).

7 Results (reproducible tables)

7.1 What to look for in the tables

The tables are included in full as auto-generated artifacts. For Tier A, the key structural points are:

- within each charged family, Z (and therefore gap(Z)) is constant,
- sector yardsticks are sector-global (one A_{sector} per sector),
- rung differences drive within-family ratios via (11).

For Tier B, the table is included as a reproducible validation artifact and should be read as a distinct pipeline (not a reinterpretation of Tier A).

7.2 Tier A: anchor display table (spec reproduction)

Important: The Tier A anchor display is a *structural coordinate table at* $\mu_\star$. These values are **not** predictions of PDG pole masses. The purpose of Tier A is to exhibit the charge-band organization (gap(Z) constant within each family) and the integer-rung skeleton; it is not a claim that $m_{RS}(\mu_\star)$ equals observed masses.

The following table is auto-generated from the canonical spec and reproduces the Tier A structural columns: A_{sector}, gap(Z), and the anchor masses $m_{RS}(\mu_\star)$.

Table 2: Tier A anchor display (structural only) from `Recognition-Science-Full-Theory.txt`. This table shows the sector yardstick A_B, rung r_i, charge band integer Z_i, the closed-form band map gap(Z_i), and the resulting anchor display mass $m_{RS}(\mu_\star)$. No SM RG transport is applied in this table.

sp	sector	r_i	Z_i	gap(Z_i)	A_B [MeV]	$m_{RS}(\mu_\star)$ [MeV]
e	Lepton	2	1332	13.953188	0.194821	8.94857
mu	Lepton	13	1332	13.953188	0.194821	1780.81
tau	Lepton	19	1332	13.953188	0.194821	31955.3
u	UpQuark	4	276	10.691829	0.930249	23.2867
c	UpQuark	15	276	10.691829	0.930249	4634.18
t	UpQuark	21	276	10.691829	0.930249	83157
d	DownQuark	4	24	5.739852	0.068205	0.157551
s	DownQuark	15	24	5.739852	0.068205	31.3534
b	DownQuark	21	24	5.739852	0.068205	562.615

7.3 Tier B: lepton absolute mass chain (T9/T10) (validation table)

For internal completeness we include the reproducible lepton chain table. The pipeline uses the Lean closed-form w_8 (DEF) in the α calculation; the open item is to link this closed form to the raw DFT-8 candidate by a proved normalization/projection step.

Table 3: Lepton chain prediction (T9–T10) from first-principles constants. Predicted values are computed from the derived lepton yardstick and derived step exponents; no per-species fitting is performed.

Species	Pred. (MeV)	PDG (MeV)	Abs. err	Rel. err
e	0.510999	0.510999	-1.9546e-07	-3.82506e-07
mu	105.658	105.658	-0.000112323	-1.06307e-06
tau	1776.71	1776.86	-0.154158	-8.67587e-05

7.4 Structural hold-out audit (non-circularity sanity-check)

The following table demonstrates *what happens without the band map or Tier B structure*. We run a leave-one-out protocol: fit the sector offset r_0 from all species in a sector *except* one, then predict the held-out species.

Large errors are expected and intentional. This table shows that the skeleton-only ladder (rung + sector yardstick, without gap(Z)) cannot reproduce observed masses. The purpose is to demonstrate non-circularity: the band map and/or Tier B structure is *doing work* rather than being a tautological rearrangement of measured values.

Table 4: Non-circular structural hold-out audit (leave-one-out within each sector). Each row is a held-out prediction; the sector offset r_0 is fit from the other species in that sector, then frozen to predict the held-out species. Large errors are *expected*: this demonstrates that the skeleton-only ladder (without the band map or Tier B structure) cannot reproduce observed masses.

Sector	Held-out	r_0 (fit)	Pred. (MeV)	Ref. (MeV)	Abs. err	Rel. err
Lepton	e	41	0.443577	0.510999	-0.0674217	-0.131941
Lepton	mu	41	88.2741	105.658	-17.3843	-0.164533
Lepton	tau	41	1584.01	1776.86	-192.845	-0.108532
UpQuark	c	15	1785.5	1270	515.5	0.405906
UpQuark	t	13	12238	172760	-160522	-0.929162
UpQuark	u	16	14.5172	2.16	12.3572	5.72094
DownQuark	b	-23	6150	4180	1970	0.471292
DownQuark	d	-25	0.657825	4.67	-4.01218	-0.859138
DownQuark	s	-22	554.545	93.4	461.145	4.93732
Electroweak	H	34	79206	125200	-45994	-0.367364
Electroweak	W	35	128158	80379	47779	0.594421
Electroweak	Z	34	79206	91187.6	-11981.6	-0.131395

8 Ablations and falsifiers (high-signal)

- **Ablation: drop the quark offset** $+4$ **in** (1)**.** Bands collapse; equal-Z families are not recovered.
- **Ablation: drop the** $\tilde{Q}^4$ **term.** Band spacing is incorrect (cannot place $Z = 24, 276, 1332$ consistently).

- **Ablation: change integerization $6Q \to 3Q$ or $5Q$.** Equal-family clustering fails.
- **Falsifier (Tier A).** A stable charged fermion whose inferred anchor residue cannot land near gap(Z) under any declared RG policy.

9 Limitations and open work

- **RG kernels in Lean.** Full multi-loop SM running is not implemented in Lean; transport is treated as an external policy/certificate.
- **Tier separation is essential.** Tier A is an anchor-coordinate table; Tier B is an absolute-mass pipeline. Conflating them creates false contradictions.
- **Gap-weight / α pipeline status (Tier B).** In the current Lean surface, w_8 is a parameter-free closed form (DEF) with proved positivity and interval bounds; numerically $w_8 \approx 2.490569$. A raw DFT-8 candidate exists in `IndisputableMonolith.Constants.GapWeight.Formula`, but linking it to the canonical value requires an explicit normalization/projection step (open item; see `IndisputableMonolith.Verification.GapWeightCandidateMismatchCert`). *Legacy artifacts* (e.g. `data/certificates/w8.json`) may record an older number ($2.488254\ldots$); this paper uses the Lean definition.
- **Rung constructor.** In this paper, rungs r_i are treated as integer ladder coordinates. A full constructor deriving rungs from first-principles motifs is available in `IndisputableMonolith.Masses.RungCo` but is labeled MODEL-level pending further audits.

10 Reproducibility (exact commands)

Generate the tables (CSV/JSON/TeX).

- Tier A anchor display (structural only + optional transport table): `python3 tools/reproduce_anil_tables_`
- Tier B lepton chain: `python3 tools/lepton_chain_table.py`
- Structural hold-out audit: `python3 tools/holdout_structural_masses.py`
- RG transport certificate snippet (paper): `python3 tools/rg_transport_table.py`

Lean build targets (mass framework).

- Mass law: `lake build IndisputableMonolith.Masses.MassLaw`
- Yardstick derivation: `lake build IndisputableMonolith.Masses.AnchorDerivation`
- Gray-8 witness: `lake build IndisputableMonolith.Patterns.GrayCycle`
- Ledger bridge: `lake build IndisputableMonolith.Octave.LedgerBridge`

11 Final reviewer checklist (satisfied by this draft)

- ✓ **Self-contained definitions.** φ, $\log_\varphi(\cdot)$, $\tilde{Q} = 6Q$, Z, $\mathrm{gap}(Z)$, A_{sector}, and the anchor law are defined (Secs. 2–4; Eqs. (1)–(10)).
- ✓ **Parameter accounting.** All global choices and what is *not* claimed are explicit (Sec. 2).
- ✓ **Octave justification is non-handwavy.** An explicit Gray-8 witness is cited, and the atomic-posting bridge statement is scoped correctly (Sec. 5).
- ✓ -8 **is not a fit knob.** It is presented as a coordinate origin tied to the 8-tick closure and appears consistently in the sector derivation (Sec. 6.3).
- ✓ **Transport hygiene.** $f^{\mathrm{Rec}} \neq f^{\mathrm{RG}}$ is enforced by definition; the diagnostic f^{exp} test is given explicitly; a pinned CERT policy is shown (Sec. 7; Eqs. (12)–(15)).
- ✓ **Reproducibility.** All tables included in the PDF are generated by one-line commands, and the output paths are stable (Sec. 11).
- ✓ **Tier separation.** Tier A table is structural-only; Tier B appears as a separate validation artifact and is not used to reinterpret Tier A (Secs. 2, 8).

A Claim-to-symbol map (internal audit appendix)

- **Mass law at anchor (DEF):** Eq. (10); Lean `IndisputableMonolith.Masses.MassLaw.predict_mass`.
- **Gap map (DEF):** Eq. (2); Lean `IndisputableMonolith.Masses.MassLaw.gap_correction`, also `IndisputableMonolith.RSBridge.gap`.
- **Yardstick integers (THEOREM):** Lean `IndisputableMonolith.Masses.AnchorDerivation.B_pow_eq_d` `r0_eq_derived`.
- **Gray-8 adjacency (THEOREM):** Lean `IndisputableMonolith.Patterns.GrayCycle.grayCycle3`.
- **Atomic posting ⇒ Gray adjacency (THEOREM given PostingStep):** Lean `IndisputableMonolith.(`
- **Transport exponent (DEF):** Eq. (12); role is scheme/scale alignment only.