Referee Report (Internal)

On: *"Charged Fermion Masses from Octave Closure and φ-Ladder Geometry: A Recognition Science Framework with Single-Anchor Phenomenological Validation"*

Draft reviewed: `Allahyarov-submission-PRD-jan-2026-v-10-INTEGRATED.pdf` (dated Jan 30, 2026)

Scope of this report. I reviewed the integrated draft line-by-line for internal consistency and for agreement with the project's canonical definitions and pinned certificates. Where the manuscript uses phrases like "certified" or "machine-verified," I cross-checked the corresponding mathematical statements and the repo's pinned artifacts (definitions, proofs about the closed-form maps, and numerical certificates used for transport bookkeeping).

For a colleague who does not read Lean: the main text below states the relevant mathematics directly; all repo pointers (Lean modules and certificate artifacts) are collected in Appendix A, along with a zip bundle of the referenced Lean files.

1. Summary assessment

The integrated manuscript is **conceptually faithful** to the three-paper architecture: single-anchor framing, the $Z(Q, \text{sector})$ integerization, the closed-form band function $F(Z)$, explicit separation of structural vs. SM-transport residues, and explicit falsifiers.

However: the current draft contains **several substantive numerical inconsistencies** with the project's canonical definitions and pinned certificates. These are more than rounding differences (notably the sector yardstick exponents and the RG transport "certificate" table), and they currently undermine reproducibility and the "machine-verified / certified" framing. I recommend a revision focused on aligning the affected tables and appendix pointers with the pinned repo artifacts before broader circulation.

2. Strengths

- **Excellent claim hygiene intent.** The text distinguishes structural objects from transport bookkeeping.
- **Referee-facing circularity warning.** Sec. II.6 explicitly flags that rungs are currently bookkeeping indices.
- **Falsifiability culture.** Concrete falsifiers are stated throughout.
- **Lean integration is directionally strong.** The monotonicity/concavity proofs are genuine.

3. High-priority issues (recommended fixes before external circulation)

3.1 CRITICAL: Table II (Sector Yardsticks) does not match the canonical sector exponents

Issue. Table II on page 8 lists sector yardstick exponents that are inconsistent with the canonical counting-layer derivation used elsewhere in the project.

Values as stated in the integrated PDF:

Sector	B_{pow}	r_0
Leptons	-22	51
Up quarks	-18	43
Down quarks	-20	39

Canonical values from the counting-layer derivation:

Sector	B_{pow}	r_0	Derivation
Leptons	-22	62	$r_0 = 4W - 6 = 4(17) - 6 = 62$
Up quarks	-1	35	$B_{\text{pow}} = -A = -1$; $r_0 = 2W + A = 35$
Down quarks	$+23$	-5	$B_{\text{pow}} = 2E_{\text{total}} - 1 = 23$; $r_0 = E_{\text{total}} - W = -5$
Electroweak	$+1$	55	$B_{\text{pow}} = A = 1$; $r_0 = 3W + 4 = 55$

Impact. This table is foundational: the anchor law uses

$$m_i(\mu_\star) = A_{\text{sector}(i)}\,\varphi^{r_i - 8 + F(Z_i)}, \qquad A_{\text{sector}} := 2^{B_{\text{pow}}(\text{sector})}\,E_{\text{coh}}\,\varphi^{r_0(\text{sector})}.$$

Changing (B_{pow}, r_0) therefore rescales the sector baselines by large factors, and will propagate into any reported "predicted mass" tables.

Requested fix.

1. Replace Table II with the canonical values shown above.

2. Prefer generating the manuscript table from the same pinned source-of-truth artifact used by the repo (see Appendix A).

3.2 CRITICAL: Table XI (RG Transport Exponents) does not match the pinned certificate values

Issue. Appendix G, Table XI (page 47) lists "certified" RG transport exponents that differ significantly from the project's pinned transport certificate under the canonical policy.

Comparison (paper Table XI vs. repo certificate).

Fermion	PDF Table XI	Repo certificate	Note
e	0.049	0.04943	rounding OK
μ	0.038	0.02879	mismatch
τ	0.026	0.01788	mismatch
u	0.482	0.48219	rounding OK
d	0.476	0.47639	rounding OK
s	0.421	0.47639	should equal d under canonical policy
c	0.125	0.54701	mismatch
b	0.073	0.38075	mismatch
t	-0.008	0.00980	sign mismatch

Additional consistency checks. In the repo's canonical certificate, d and s share the same charge and the same target scale (2 GeV), hence the certificate has identical values $f_d^{RG} = f_s^{RG}$; the integrated PDF violates this in Table XI (0.476 vs 0.421).

Certificate provenance (mathematical form). The repo also records these pinned values as rationals at 10^{-4} resolution (examples):

$$\begin{aligned} f_\mu^{RG} &= 288/10000, & f_\tau^{RG} &= 179/10000, \\ f_c^{RG} &= 5470/10000, & f_b^{RG} &= 3807/10000, \\ f_t^{RG} &= 98/10000. \end{aligned}$$

so mismatches are not attributable merely to floating rounding in the manuscript table.

Policy mismatch. Appendix G states RK4 step size $\Delta t = 0.01$ in $\ln \mu$ units, while the repo certificate records `rk4_steps_per_ln=10000` (i.e. $\Delta t = 10^{-4}$). If the manuscript intends a different policy, it must be pinned and shipped with the exact code+data snapshot that generated the reported numbers.
Impact. These exponents are explicitly called "certified" in the paper, but they contradict the repo's auditable certificate. This undermines the reproducibility claim.

Requested fix.

1. Regenerate Table XI directly from the pinned transport certificate artifact used by the project (see Appendix A).
2. If a different transport policy is intended, pin and publish it (loop order, thresholds, integrator, SM inputs). Provide the exact code+data snapshot used to generate Table XI.

3.3 Appendix E: Lean theorem pointer/name drift

Issue. Appendix E (page 46) cites the no-go theorem as:

```
MassResidueNoGo.small_residue_far_from_gap1332
```

The identifier above does not match this repo. The underlying mathematical statement that appears to be intended (and that is present in the repo) is:

$$\text{if } |x| \le 0.1, \text{ then } |x - F(1332)| > 10,$$

and in particular no "small" residue (e.g. $|x| \le 0.1$) can satisfy $|x - F(1332)| < 10^{-6}$. This looks like a citation/name drift rather than a mathematical disagreement.
Requested fix. Update Appendix E to cite the actual Lean theorem names used in the repo, or restate the no-go claim directly in the paper without relying on a fragile identifier string (see Appendix A).

3.4 Appendix E: Lean toolchain should match the pinned repo toolchain

Issue. Appendix E states "Lean 4 version 4.3.0 or later," but the repo pins a specific toolchain (Lean 4 `v4.27.0-rc1`). For reproducibility, the manuscript should cite the pinned toolchain (and ideally the repo commit used to generate tables).
Requested fix. Update Appendix E to reflect the pinned toolchain (and include a code snapshot identifier).

3.5 Visible placeholder text

Issue. The PDF contains visible placeholder sequences:

- Page 8 (end of Sec. II.3): "?????"
- Page 9 (end of Sec. II.5): "???"
- Page 11 (after Table III reference): a long string of question marks

Requested fix. Remove all placeholder text before circulation.

3.6 Unverified statistical claim (15.6σ)

Issue. The abstract and Sec. IV.5 claim a "15.6σ-equivalent" significance. I could not locate `output/statistics.json` (mentioned in the integrated PDF) or any significance-calculation script in this repository snapshot.
Requested fix. Either:

1. Commit the script that computes this number (e.g., `scripts/analysis/significance_calc.py`).
2. Or soften the claim to "order 10σ" pending audit.

4. Additional issues

4.1 Non-circularity framing vs. Table III

Table III (page 12) is titled "Structural predictions versus PDG experimental masses" with "zero per-species tuning." However, the paper itself warns (Sec. II.6) that rung assignments are currently bookkeeping indices. This tension should be resolved by either:

1. Retitling Table III to "Anchor display coordinates" (not "predictions").
2. Or explicitly adopting a fixed rung-assignment rule (e.g. charged leptons $r_e = 2$, $r_\mu = 13$, $r_\tau = 19$; up-type quarks $r_u = 4$, $r_c = 15$, $r_t = 21$; down-type quarks $r_d = 4$, $r_s = 15$, $r_b = 21$) and explaining why that rule is not fit to mass data.

4.2 Gap function numerical values

The approximate values $F(24) \approx 5.74$, $F(276) \approx 10.69$, $F(1332) \approx 13.95$ (Eqs. 18–20) are **consistent** with the interval bounds established in the repo:

$$5.737 < F(24) < 5.74, \quad 10.689 < F(276) < 10.691, \quad 13.953 < F(1332) < 13.954.$$

Note: in the current repo snapshot, these bounds are proved under explicit numerical hypotheses (log/exp bounds) used for interval arithmetic; the manuscript should either state those hypotheses or phrase the bounds as conditional on the declared numerical certificate inputs.

4.3 Notation: κ vs. φ

Eq. (40) on page 13 uses κ inside the gap function:

$$F(Z_i) = \frac{1}{\lambda} \ln\left(1 + \frac{Z_i}{\kappa}\right).$$

Earlier definitions (Eq. 3) define $\kappa = \varphi$, but the switch is not always signposted. Consider using φ uniformly.

5. Minor polish

- Add a concrete commit hash or archival DOI for the code snapshot used to generate Tables II, III, IV, XI.
- In the reproducibility section, verify that the cited scripts (`tools/lepton_chain_table.py`, etc.) exist and run cleanly.

6. Recommendation

Recommendation: Major revision (table alignment + appendix-pointer cleanup).
The scientific narrative is sound, but **Tables II and XI currently do not match the project's pinned constants/certificates**. These are more than minor rounding issues, and they currently weaken reproducibility and the "machine-verified / certified" claims.

Priority fixes before external circulation:

1. Align Table II (sector yardsticks) with the canonical sector-exponent formulas used in the project.
2. Align Table XI (transport exponents) with the pinned transport certificate under the declared policy.
3. Fix Appendix E pointers (Lean theorem names) and cite the pinned Lean toolchain version.
4. Remove all placeholder text ("???").
5. Commit the 15.6σ calculation script or soften the claim.

After these fixes, the paper should be internally re-reviewed before submission.

Appendix A: Repo pointers and the corresponding math (for auditing / reproducibility)

A.1 Lean bundle

A zip bundle containing the Lean modules referenced in this report is saved as `papers/tex/referee_report_lean_bundle.zip`. It contains:

- `IndisputableMonolith/Masses/Anchor.lean`
- `IndisputableMonolith/Masses/MassLaw.lean`

- `IndisputableMonolith/RSBridge/GapProperties.lean`
- `IndisputableMonolith/Physics/ElectronMass/Necessity.lean`
- `IndisputableMonolith/Physics/MassResidueNoGo.lean`
- `IndisputableMonolith/Physics/RGTransportCertificate.lean`

A.2 Canonical sector yardsticks (Table II)

The canonical sector yardstick is

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

The counting-layer integers used in the project are:

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

The sector-exponent formulas are:

$$\begin{aligned} B_{\text{pow}}(\text{Lepton}) &= -2E_{\text{passive}} = -22, & r_0(\text{Lepton}) &= 4W - 6 = 62, \\ B_{\text{pow}}(\text{UpQuark}) &= -A = -1, & r_0(\text{UpQuark}) &= 2W + A = 35, \\ B_{\text{pow}}(\text{DownQuark}) &= 2E_{\text{total}} - 1 = 23, & r_0(\text{DownQuark}) &= E_{\text{total}} - W = -5, \\ B_{\text{pow}}(\text{Electroweak}) &= A = 1, & r_0(\text{Electroweak}) &= 3W + 4 = 55. \end{aligned}$$

Repo location: `IndisputableMonolith/Masses/Anchor.lean`.

A.3 Master mass law (Eq. 22)

The repo's master anchor law is:

$$m_i(\mu_\star) = A_{\text{sector}(i)}\, \varphi^{\,r_i - 8 + F(Z_i)}, \qquad F(Z) = \log_\varphi\!\left(1 + \frac{Z}{\varphi}\right) = \frac{\ln(1 + Z/\varphi)}{\ln\varphi}.$$

Repo location: `IndisputableMonolith/Masses/MassLaw.lean`.

A.4 Pinned RG transport certificate (Table XI)

The pinned transport certificate values (canonical policy) are stored as floating values in `data/certificates/rg_transport/canonical_2025_q4.json`, and include, for example,

$$\begin{aligned} &f_e^{RG} = 0.0494258, \quad f_\mu^{RG} = 0.0287906, \quad f_\tau^{RG} = 0.0178757, \\ &f_u^{RG} = 0.482193, \quad\;\; f_d^{RG} = 0.476388, \quad\;\; f_s^{RG} = 0.476388, \\ &f_c^{RG} = 0.547013, \quad\;\; f_b^{RG} = 0.380746, \quad\;\; f_t^{RG} = 0.00979749. \end{aligned}$$

The same values are also exposed in Lean as rationals at 10^{-4} resolution (e.g. $f_\mu^{RG} = 288/10000$), with a declared tolerance 1/10000.

Repo location: `IndisputableMonolith/Physics/RGTransportCertificate.lean`.

A.5 Gap-map properties and bounds (Appendix E)

The closed-form band map used throughout is:

$$F(Z) = \frac{\ln(1 + Z/\varphi)}{\ln \varphi}.$$

The repo contains machine-checked properties such as strict monotonicity on $\mathbb{N}$ and strict concavity on $[0, \infty)$, as well as interval bounds for $Z \in \{24, 276, 1332\}$ (in the current snapshot, proved under explicit numerical hypotheses used for interval arithmetic). Repo locations:

- `IndisputableMonolith/RSBridge/GapProperties.lean`
- `IndisputableMonolith/Physics/ElectronMass/Necessity.lean`

A.6 No-go separation (Appendix E)

The numerical separation used to prevent category errors between "small" residues and $F(1332)$ is:

$$\text{if } |x| \le 0.1, \text{ then } |x - F(1332)| > 10.$$

Repo location: `IndisputableMonolith/Physics/MassResidueNoGo.lean`.

A.7 Lean toolchain (Appendix E)

The pinned Lean toolchain for this repo snapshot is in `lean-toolchain`, and currently specifies `leanprover/lean4:v4.27.0-rc1`.