Origin Axiom — Phase 3 (Exploratory Add-on): Flavor Phase Integration

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Abstract

Phase 3 integrates an empirically fitted phase parameter θ (from CKM+PMNS within a declared ansatz) into the Phase 2 vacuum residue mechanism, and documents the resulting correlation under strict under-claiming.

1 Scope and Non-Claims

Phase 3 is an exploratory add-on phase. We do not claim a solution to the cosmological constant problem, nor a first-principles derivation of θ. We report a reproducible fit for θ within a declared ansatz class and a reproducible injection of θ into an already-established vacuum residue mechanism.

2 Fit Pipeline: CKM+PMNS $\rightarrow \theta$

We define an explicit ansatz mapping θ to target observables and perform a grid-based χ^2 scan. We report best-fit θ, an uncertainty interval, and diagnostics.

2.1 Discrete offset sweep and baseline choice

To avoid hidden parameter fitting, the Phase 3 baseline fixes all offset choices a priori and fits only θ. We nevertheless test a small discrete set of candidate fixed offsets for the PMNS phase mapping, $b_{\mathrm{PMNS}} \in \{0,\ \pi,\ -\pi/2,\ +\pi/2\}$, holding the rest of the ansatz fixed. For each hypothesis we run the same grid scan over θ and compare the minimum χ^2 values. The resulting model-selection evidence is reported in Appendix 1. We adopt as the Phase 3 baseline the discrete hypothesis with the lowest χ^2 (under the frozen CKM/PMNS targets), which selects $b_{\mathrm{PMNS}} = \pi$ for the current exploratory add-on.

3 Injection Pipeline: $\theta \rightarrow$ Phase 2 residue diagnostic

Given the best-fit θ from the Phase 3 fit pipeline, we feed θ into the Phase 2-style injection mechanism as an exploratory diagnostic step. This add-on is strictly under-claimed: the purpose is to document a reproducible, traceable correlation between the fitted flavor-phase parameter and the injection-style residue diagnostic.

3.1 Provenance lock for the injection figure

The injection stage consumes the fitted summary artifact (`theta_fit_summary.csv`) and emits the figure `fig2_delta_rho_vac_vs_theta.pdf`. Alongside the PDF we generate a strict provenance record `fig2_delta_rho_vac_vs_theta.meta.json` that binds the plot to: (i) the exact git commit hash, (ii) SHA-256 hashes of the fit summary and `targets.yaml`, and (iii) the locked baseline model choice (including the fixed b_{PMNS} value). This ensures the injection plot cannot drift away from the declared Phase 3 baseline hypothesis or the frozen targets.

4 Falsifiability and Stress Tests

Phase 3 is an exploratory add-on that binds a single fitted parameter θ (from frozen CKM/PMNS phase targets under a declared ansatz) to a Phase 2-style injection diagnostic. The core falsifiability questions for this add-on are therefore about (i) target stability, (ii) ansatz dependence, and (iii) reproducibility invariants.

4.1 Target-freeze sensitivity

The CKM and PMNS phase targets are frozen snapshots. A materially different future global fit (or a different ordering assumption for δ_{CP}) could shift the best-fit θ and/or the preferred discrete offset choice. This does not falsify Phase 2, but it would falsify the Phase 3 *numerical* baseline as stated here if the discrete sweep no longer prefers $b_{\mathrm{PMNS}} = \pi$ under the updated freeze.

4.2 Discrete hypothesis robustness

We adopt the Phase 3 baseline hypothesis by minimizing χ^2 over a small discrete set $b_{\mathrm{PMNS}} \in \{0, \pi, -\pi/2, +\pi/2\}$, without fitting b_{PMNS}. A falsifying outcome for the current baseline would be that modest, pre-declared changes in the discrete candidate set (e.g., adding $\pm\pi/4$) produce no stable preference or produce a qualitatively different preference without a clear physical rationale.

4.3 Ansatz dependence

The mapping $\theta \mapsto (\delta_{\mathrm{CKM}}, \delta_{\mathrm{CP}})$ is an explicit modeling choice. If alternative, equally simple one-parameter mappings (e.g., non-affine monotone maps, or fixed sign flips) fit comparably well or better, then the baseline mapping used here is not uniquely motivated. This would not falsify the existence of a correlation, but it would weaken any interpretation that relies on a specific functional form.

4.4 Reproducibility invariants

All Phase 3 outputs are required to be reproducible by the gate scripts and the paper bundle manifests. A hard falsification of the Phase 3 computational claim is failure to reproduce the committed bundle artifacts (tables/figures/manifests) from a clean checkout under the declared environment and commands.

5 Limitations

Phase 3 is intentionally conservative and under-claimed. The following limitations are explicit:

- **Exploratory add-on:** Phase 3 does not claim to derive CKM/PMNS phases from first principles; it fits a single parameter θ under a declared ansatz.
- **Frozen targets:** Numerical outcomes depend on the chosen frozen snapshot for CKM δ (PDG) and PMNS δ_{CP} (NuFIT, ordering assumption).
- **Discrete offset choice:** The baseline $b_{\mathrm{PMNS}} = \pi$ is selected by a discrete sweep, not by fitting an additional parameter. This is a method-

Table 1: Discrete fixed-offset sweep for b_{PMNS} with a single fitted parameter θ. Lower χ^2 is better; $\Delta\chi^2$ is relative to the best row.

b_{PMNS} (deg)	θ^* (deg)	χ^2	$\Delta\chi^2$	$\theta^{\mathrm{lo}}_{68\%}$ (rad)	$\theta^{\mathrm{hi}}_{68\%}$ (rad)
180	65.682	0.675474	0.000000	1.120292	1.172128
90	65.790	1.881895	1.206421	1.122491	1.174013
-90	65.556	9.093410	8.417936	1.118407	1.169929
0	65.916	12.712767	12.037293	1.124690	1.176212

ological choice to avoid parameter proliferation, but it also means the model class is only partially explored.

- **Injection diagnostic scope:** The injection-stage curve is treated as a reproducible diagnostic artifact. Interpretation as a physical prediction requires the Phase 2 mechanism definitions and assumptions, and remains outside Phase 3 claims.

- **Circular statistics:** Phase observables are periodic, and χ^2 summaries can hide multimodal or wrap-around structure. We therefore treat χ^2 comparisons as model-selection aids rather than strong statistical evidence.

A Claims Table (Phase 3)

See `phase3/CLAIMS_TABLE.md` for the live evidence map.

B Reproducibility

See `phase3/REPRODUCIBILITY.md`.

References