Phase 0 Appendices (Non-normative)

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Non-normative. This document contains supporting templates and examples for Phase 0. Binding governance rules are defined only in the Phase 0 constitution paper.

Contents

A Notation and glossary

This appendix defines notation and terms used throughout Phase 0 and inherited by subsequent phases. Where later phases introduce specialized variants, they must either reuse these symbols consistently or explicitly declare deviations.

A.1 Core symbols

- $\theta \in [0, 2\pi)$: universal phase-like control parameter (defined modulo 2π).
- $\theta^{\star}$: a *fiducial representative* value of θ used for benchmark runs or illustrative plots; not a derived constant unless corridor collapse is demonstrated.
- $\Theta \subset [0, 2\pi)$: an admissible set (corridor) of θ values; may be a union of intervals or a discrete set.
- Θ_0: initial prior corridor.
- Θ_i: corridor after applying filters from phases $1, \ldots, i-1$.
- $\mathcal{T}_i(\theta)$: Phase-i test suite (explicit pass/fail criteria) evaluated at θ.
- A: a phase-specified global complex amplitude used to define "cancellation" and the OA floor.
- A_{raw}: the amplitude produced by the unconstrained (constraint-off) evolution.
- A_{con}: the amplitude after enforcement of the OA floor.
- $\varepsilon > 0$: the strictly positive floor in the Origin Axiom constraint.
- R: a phase-specified scalar residual diagnostic associated with non-cancellation / remainder.
- R_{raw}: residual from the unconstrained run.
- R_{con}: residual from the constrained run.
- ΔR: difference between constrained and unconstrained residual (definition must be stated; additive or multiplicative).

A.2 Key terms (glossary)

Cancellation. The approach of the chosen global amplitude toward zero magnitude, $|A| \to 0$, within a specified model/phase definition.

Non-cancellation (Origin Axiom). The postulate that $|A|$ is bounded below by a strictly positive floor ε (Eq. the non-cancellation identity).

Implementation. A concrete algorithm or rule that enforces the postulate within a chosen model, including how corrections are applied and how minimality is defined.

Minimal intervention (MI). An implementation hypothesis stating that when enforcement is required, the smallest correction (according to a declared norm or cost) is applied to satisfy $|A| \geq \varepsilon$.

Non-binding regime. A run/regime in which the raw evolution never violates the floor: $|A_{\text{raw}}(t)| > \varepsilon$ for all times/steps. In this regime the constraint should be non-invasive.

Binding regime. A run/regime in which the raw evolution would violate the floor at least once: $\exists t$ such that $|A_{\text{raw}}(t)| < \varepsilon$. In this regime enforcement must activate, and constrained and unconstrained runs may differ.

Binding certificate. A logged artifact demonstrating that enforcement occurred (e.g. a boolean flag plus a quantitative measure of hits) and that the constrained trajectory differs from the constraint-off ablation in a diagnostically relevant way.

Ablation. A controlled comparison where a single factor is changed (here: constraint OFF vs ON), holding all other settings fixed (seed, configuration, numerics). Required for causal attribution.

Test suite. A set of explicit criteria used to define admissibility of θ values in a phase, including binding evidence (when required), stability, robustness, and transfer viability.

Admissible set / corridor. The subset of θ values that pass a phase's test suite; represented as a union of intervals on $[0, 2\pi)$ or as a discrete set of points.

Corridor method. The protocol that advances the program by intersecting admissible sets across phases:

$$\Theta_{i+1} = \{\theta \in \Theta_i : \mathcal{T}_i(\theta) \text{ passes}\}.$$

Ledger. A deterministic mechanism that ingests per-phase `theta_filter` artifacts and produces a versioned corridor history and dashboard, enabling audit-grade tracking of corridor narrowing over time.

Phase locking. A phase is "locked" only when its claims are explicitly stated, tied to regenerable artifacts, supported by required ablations and binding certificates, and accompanied by full provenance and ledger-compatible corridor outputs (Sec. the Phase 0 main text).

B Phase θ-filter artifact schema (ledger interface)

This appendix defines the minimal machine-readable interface by which each phase reports its admissible θ set to the Phase 0 ledger. The goal is to make corridor evolution deterministic and auditable.

B.1 Design goals

The `theta_filter` artifact must:

- be sufficient to reconstruct the phase's admissible set Θ_{i+1};
- record the phase's declared test suite and the pass/fail outcome for each evaluated θ;
- contain provenance linking each evaluated θ (or interval) to reproducible run identifiers;
- be stable under minor refactors (schema versioned; backwards compatible when possible).

B.2 Minimal required fields

Each phase must emit a JSON file named

$$\texttt{phase\_XX\_theta\_filter.json}, \tag{1}$$

where XX is a zero-padded phase number.

The minimal schema is:

```
{
  "schema_version": "1.0",
  "phase": 2,
  "subphase": "optional-string",
  "theta_domain": [0.0, 6.283185307179586],

  "theta_prior": {
    "type": "intervals",
    "intervals": [[2.18, 5.54]]
  },

  "theta_grid": [2.18, 2.20, 2.22, ...],

  "tests": ["binds", "stable", "robust", "transfer_viable"],

  "pass": [true, false, true, ...],

  "fail_reasons": [
    [],
    ["binds=false", "stable=false"],
    []
  ],

  "provenance": {
    "git_commit": "abcdef123456",
    "config_hash": "sha256:...",
    "environment": "pip-freeze-or-env-hash",
    "run_ids": {
      "theta=2.18": "outputs/runs/<run_id>/",
      "theta=2.20": "outputs/runs/<run_id>/"
    }
  }
}
```

B.3 Optional fields (recommended)

The following fields are optional but recommended for diagnostics and ranking:

Scores. A phase may provide one or more score arrays aligned with theta_grid:

```
"score": {
  "intervention_cost": [...],
  "stability_margin": [...],
  "transfer_penalty": [...],
```

```
  "total": [...]
}
```

Scores should be documented in the phase paper and interpreted cautiously. Scores do not replace pass/fail; they rank within the admissible set.

Interval representation. If a phase analytically characterizes admissibility as intervals rather than by grid scan, it may omit `theta_grid` and instead provide:

```
"theta_pass": {
  "type": "intervals",
  "intervals": [[a1, b1], [a2, b2]]
}
```

The ledger will accept either representation. If both are present, `theta_pass` takes precedence.

Binding metrics. When OA impact is claimed, phases should include binding metrics per θ:

```
"binding": {
  "epsilon": 1e-6,
  "hit_fraction": [...],
  "n_hits": [...],
  "min_raw_minus_eps": [...]
}
```

B.4 Ledger interpretation rules

To ensure determinism, the ledger applies the following rules:

1. The admissible set Θ_{i+1} is reconstructed from either:
   - `theta_pass.intervals` (if present), or
   - the subset of `theta_grid` entries where `pass=true`, grouped into contiguous intervals using a declared grid spacing tolerance.
2. Corridors are represented internally as unions of intervals on $[0, 2\pi)$. Any wrap-around interval is represented as two intervals.
3. The new corridor is computed by intersection:

$$\Theta \leftarrow \Theta \cap \Theta_{i+1}.$$

4. If the intersection is empty, the ledger must emit an error state and record which phase artifact caused the empty intersection.

B.5 Schema evolution

Future schema versions must:

- bump `schema_version`,
- preserve required fields or provide an explicit compatibility layer in the ledger,
- document changes in Phase 0 and in the ledger README.

C Toy example: corridor shrinking by intersecting independent thresholds

This appendix provides a minimal illustrative example of the corridor method. The goal is not to model physics, but to show how independent constraints can narrow an initially broad Θ_0 toward a small interval or isolated point(s).

C.1 Setup

Let $\theta \in [0, 2\pi)$ and begin with a broad prior corridor:

$$\Theta_0 = [0, 2\pi). \tag{2}$$

Assume three independent layers (phases) each supplies a pass/fail test based on a threshold condition.

C.2 Layer 1: a smooth preference window

Suppose Phase I admits θ values that satisfy

$$\mathcal{T}_1(\theta): \quad |\sin(\theta - \alpha)| \le c_1, \tag{3}$$

for some α and $0 < c_1 < 1$. This yields an admissible set Θ_1 consisting of two intervals per 2π period centered near $\theta \approx \alpha$ and $\theta \approx \alpha + \pi$.

C.3 Layer 2: a binding "kink" constraint

Suppose Phase II includes a binding condition where enforcement activates only when a diagnostic dips below a floor:

$$R_{\mathrm{raw}}(\theta) < \varepsilon. \tag{4}$$

If, for illustration, $R_{\mathrm{raw}}(\theta)$ crosses ε near a specific phase offset, then the admissible set Θ_2 may be defined as:

$$\mathcal{T}_2(\theta): \quad R_{\mathrm{raw}}(\theta) < \varepsilon \quad \text{and} \quad \Delta R(\theta) > 0, \tag{5}$$

where ΔR measures a detectable OA impact relative to a constraint-off ablation. This constraint can produce sharp boundaries (a "kink") separating binding from non-binding regions and can therefore shrink Θ_1 substantially when intersected.

C.4 Layer 3: a stability window

Suppose Phase III admits only θ values for which a downstream solver remains stable:

$$\mathcal{T}_3(\theta): \quad \text{solution exists and remains bounded for } t \in [0, T]. \tag{6}$$

In many dynamical systems, stability occurs only in windows, producing disconnected admissible sets.

C.5 Intersection and outcomes

The corridor method advances by intersection:

$$\Theta_{\mathrm{final}} = \Theta_1 \cap \Theta_2 \cap \Theta_3. \tag{7}$$

Depending on the relative placement of windows and thresholds, three typical outcomes occur:

Outcome A: narrow interval. If the three admissible sets overlap in a single small window, the final corridor is a short interval. In this case θ is constrained but not uniquely determined.

Outcome B: discrete candidates. If overlaps occur only at isolated points (e.g. where a binding kink boundary intersects a stability boundary), the final admissible set can become a discrete set. This is common when constraints impose threshold-like behavior or when symmetry is partially broken.

Outcome C: no narrowing. If one or more tests are weakly θ-dependent, the corresponding admissible set is nearly all of $[0, 2\pi)$ and the intersection remains broad. This indicates that the phase is not informative as a filter layer and motivates revisiting its diagnostics or regimes to ensure binding and θ sensitivity.

C.6 Why this matters for the series

The toy example highlights why Phase 0 insists on:

- explicit binding evidence (to ensure OA is actually tested),
- independence of constraints across phases (to avoid redundant filters),
- and ledger-tracked corridor evolution (to make narrowing quantitative).

If later phases succeed, the corridor history will provide transparent evidence for whether a unique $\theta^\star$ is earned, whether multiple discrete candidates remain, or whether θ remains effectively unconstrained by the explored layers.

D Claims checklist (arXiv honesty and auditability)

This appendix is a practical checklist used to prevent overclaiming and to keep the paper series intellectually honest. Each phase must satisfy the relevant items before it can be considered "locked."

D.1 Claim classification

For each statement in the paper, label it as one of:

1. **Definition / postulate** (declared, not derived),
2. **Implementation hypothesis** (algorithmic rule),
3. **Model assumption** (toy environment choices),
4. **Consequence / result** (artifact-backed),
5. **Conjecture / future work** (explicitly non-validated).

If a statement cannot be classified, rewrite it.

D.2 Artifact linkage

For each *result* statement:

- Does the paper cite a figure/table label?
- Does the run manifest identify the exact run ID and config snapshot?
- Is the generating script/path identified?
- Is the git commit hash recorded?

If any answer is "no," the statement is not a result.

D.3 Ablation requirements

For any claim of causal influence of OA enforcement:

- Is there a constraint-off vs constraint-on paired run?
- Are seeds/initial conditions identical?
- Is the only difference the enforcement setting (or ε)?
- Is the effect quantified (difference or ratio)?

If not, the claim must be downgraded to observation or conjecture.

D.4 Binding certificate requirements

For any claim that "the axiom matters":

- Is there at least one binding certificate?
- Is `constraint_applied` explicitly true?
- Is binding intensity recorded (`n_hits`, `hit_fraction`, or equivalent)?
- Is there an overlay diagnostic showing divergence from the ablation baseline?

If not, the claim must be rewritten as "in the explored regime, enforcement did not bind" (non-binding), or removed.

D.5 Invariance and definition dependence

For the chosen A and R:

- Are relevant invariances stated (basis/gauge/coordinate/coarse-graining)?
- If not invariant, is the diagnostic explicitly labeled as a toy quantity?

If not, add the invariance statement or downgrade scope.

D.6 $\theta^\star$ and corridor honesty

- Is $\theta^\star$ labeled as fiducial unless collapse is demonstrated?
- Is the admissible corridor Θ reported for the phase?
- Is the corridor produced by explicit tests and recorded in a ledger-compatible artifact?
- Is any "derived $\theta^\star$" claim supported by corridor-intersection history across independent phases?

If not, remove "derived" language.

D.7 Phase locking gate

Before labeling a phase "locked," confirm:

1. claims are explicit and scoped;
2. artifacts regenerate from a clean checkout at the stated commit;
3. run manifest is complete;
4. ablations and binding certificates exist where required;
5. the phase emits its `theta_filter` JSON and the ledger updates without manual edits.

If any item fails, the phase remains exploratory.