

The Supra-Omega Resonance Theory: A Closed Structural Architecture

Introducing SORT Version 6: An architecturally complete, pre-empirically
validated framework for cross-domain analysis.



ARCHITECTURAL CLOSURE
PRECEDES EMPIRICAL
CONFRONTATION BY DESIGN.

A Pattern of Structurally Diverse Anomalies Challenges a Purely Dynamical View

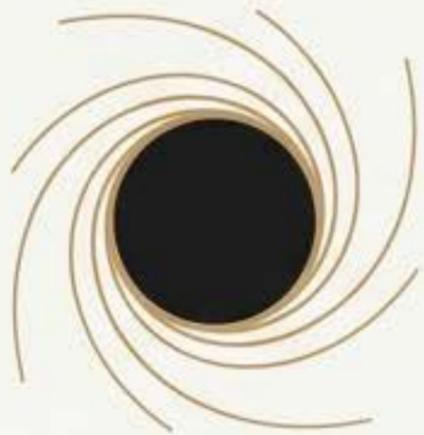
We observe a growing set of tensions that resist isolated dynamical solutions. These are not just measurement errors, but structural inconsistencies across different scales and observational probes.



The Hubble Tension: Persistent discrepancy in the inferred Hubble constant between early- and late-Universe probes.



Early Galaxy Formation: Unexpectedly early appearance of massive galaxies observed by JWST, challenging formation timelines.



Overmassive Black Hole Seeds: Evidence for supermassive black hole seeds at high redshift that appear too large, too early.



Large-Scale CMB Anomalies: Statistically significant low- ℓ anomalies and alignment features in the CMB.

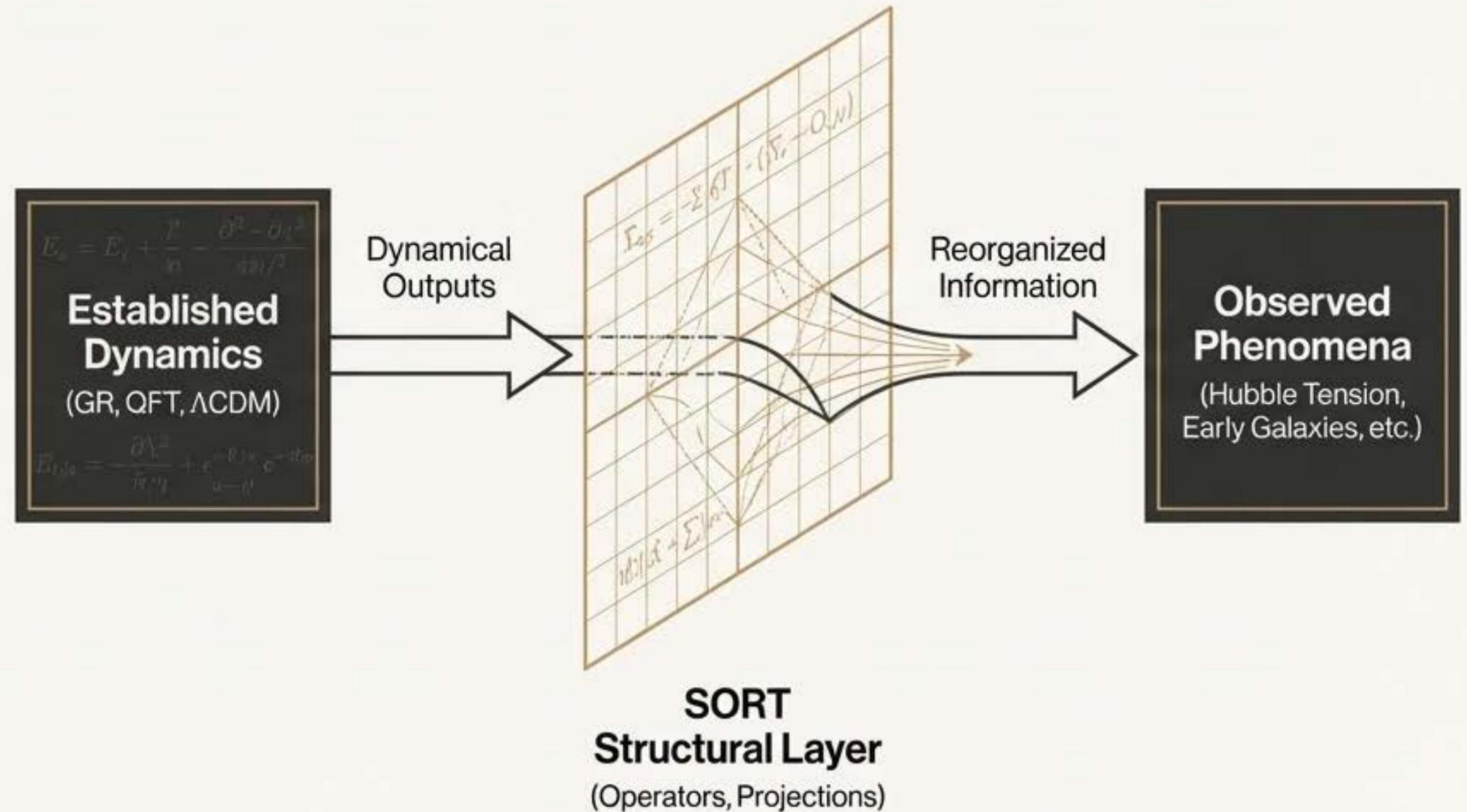
These anomalies motivate the exploration of a framework that operates at the level of structural consistency, not just additional dynamics.

SORT Provides a Complementary Structural Layer, Not a Replacement for Dynamics

SORT is a projection-based structural framework that operates *in conjunction with established theories* like General Relativity and Λ CDM. It does not modify dynamical equations or postulate new particles.

Instead, it introduces an invariant operator architecture that captures how information and structure are distributed across scales.

Tensions are reinterpreted as manifestations of projection effects within this constrained framework.



The Invariant Mathematical Core of SORT is Built on Three Pillars

INVARIANT CORE

The 22 Resonance Operators $\{\hat{O}_i\}$

A closed, finite set of idempotent operators ($\hat{O}_i^2 = \hat{O}_i$) that form the complete structural basis of the theory.

The Global Projector (\hat{H})

An idempotent projector ($\hat{H}^2 = \hat{H}$) that enforces global consistency and a structural "light-balance" condition across the entire operator set.

The Projection Kernel $\kappa(k)$

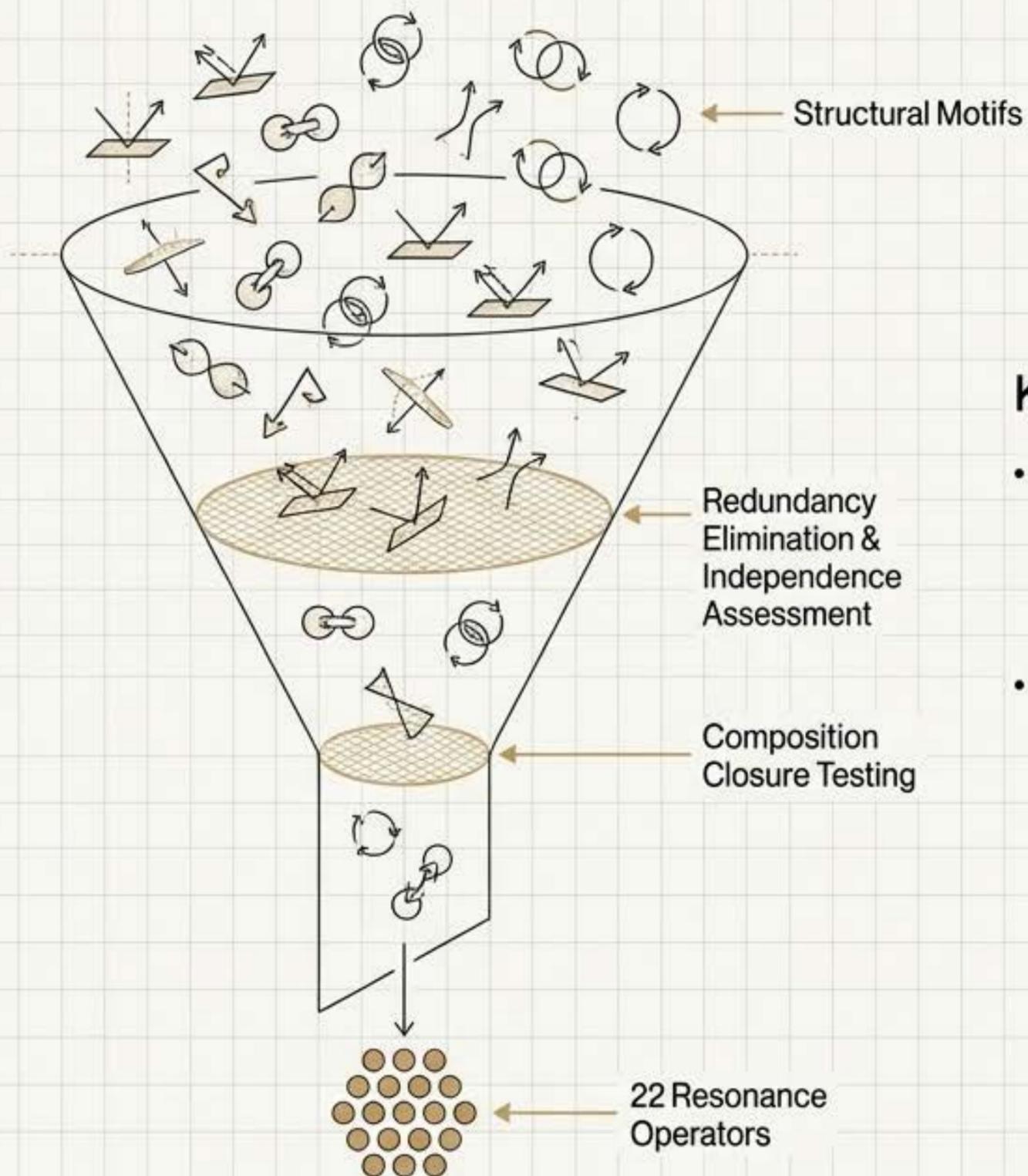
A calibrated, domain-agnostic mechanism that mediates how the invariant structure is projected into specific application domains.

This core is mathematically frozen in Version 6, forming a stable, load-bearing architecture for all subsequent analysis.

The 22 Resonance Operators Emerged from Structural Convergence, Not Axiomatic Postulation

Origin and Reduction

- **Iterative Analysis:** The operators were identified through analysis of recurring structural motifs (projection, duality, entanglement, self-reference) across theoretical contexts.
- **Rigorous Consolidation:** An initial broad set of candidates was reduced through redundancy elimination, independence assessment, and composition closure tests.
- **Closure Criterion:** The process terminated at 22 operators when the set closed under composition ($[\hat{O}_i, \hat{O}_j] \in \text{span}\{\hat{O}_k\}$), producing no new independent motifs.



Key Properties

- **Idempotency ($\hat{O}_i^2 = \hat{O}_i$):** Ensures structural finiteness and stability; repeated application does not generate new states.
- **Light-Balance Condition:** The set is partitioned into 11 'constructive' and 11 'reductive' operators, with normalized weights summing to zero ($\sum w_i = 0$), ensuring structural neutrality of the core.

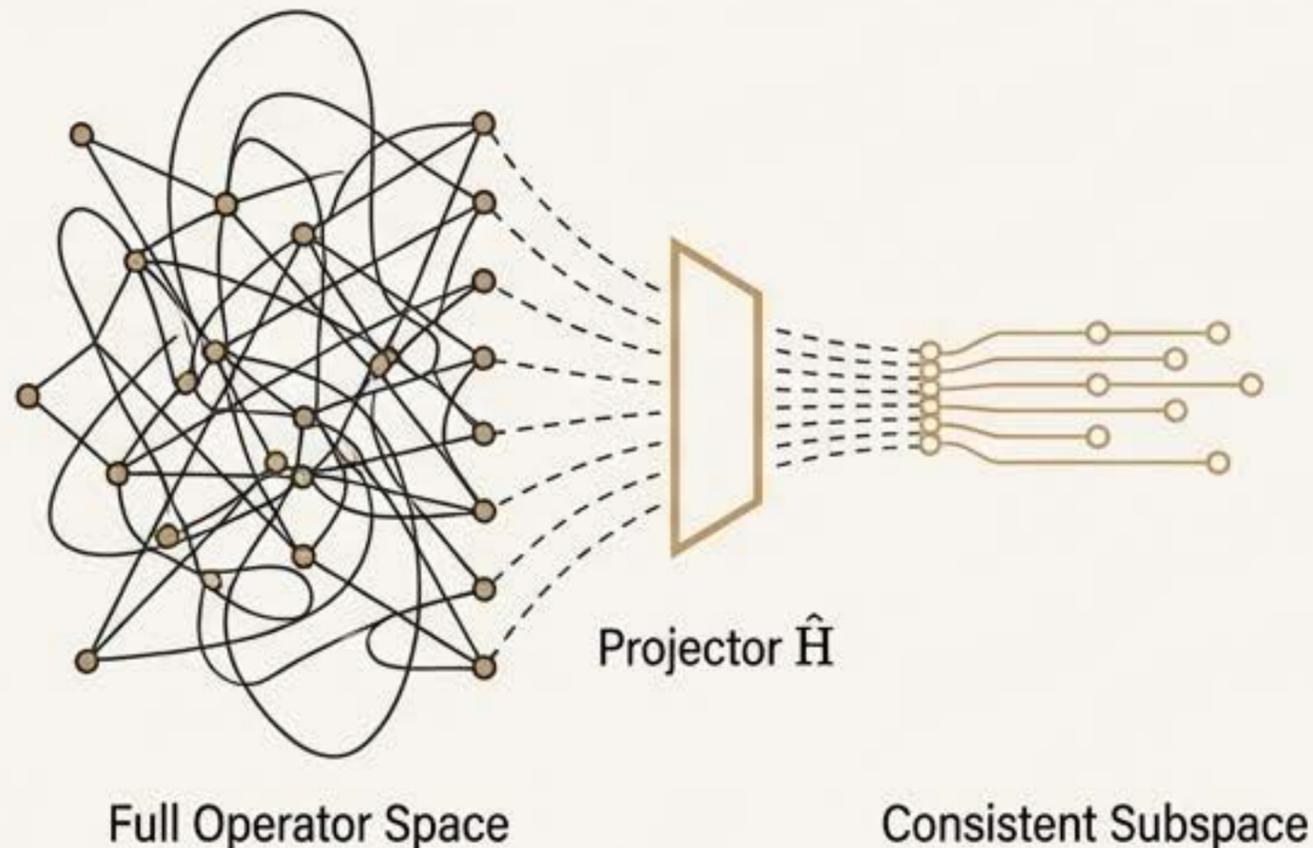
The Projector Enforces Consistency While the Kernel Mediates Projection

The Global Projector (\hat{H})

Definition: A spectral sum of the weighted operators:

$$\hat{H} = \sum w_i \hat{O}_i.$$

Function: Enforces global idempotency ($\hat{H}^2 = \hat{H}$), selecting only the globally consistent subspace of the full operator space. It acts as the ultimate arbiter of structural admissibility.

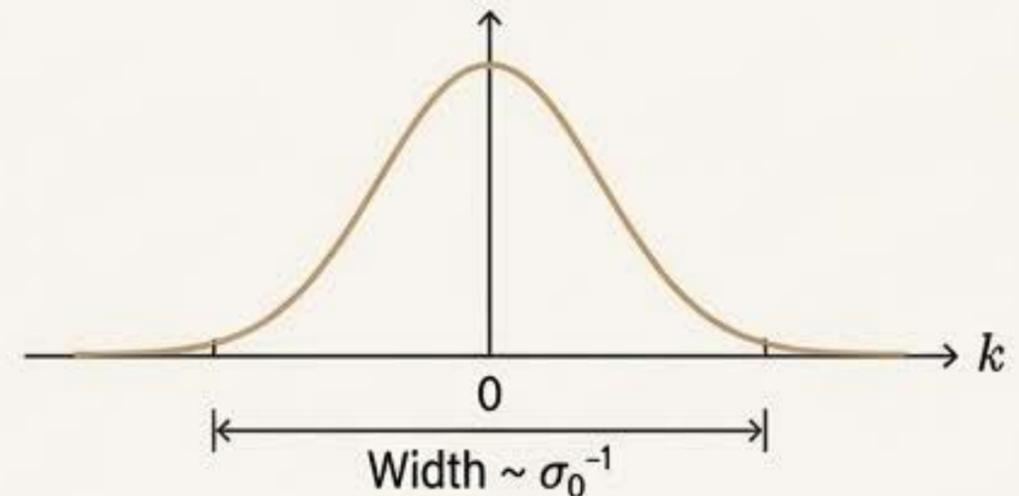


The Projection Kernel $\kappa(k)$

Definition: A Gaussian form that governs non-local coupling and smooth spectral suppression.

$$\kappa(k) = \exp \left[-\frac{(\sigma_0 L_H k)^2}{2} \right]$$

Invariant Calibration: The structural regularization scale, σ_0 , is not a free parameter. It is fixed by internal consistency requirements of the operator-kernel system.



$$\sigma_0 = 0.00190643$$

This value is invariant across all domains.

Pre-Empirical Closure is a Deliberate Methodological Choice for Rigor and Falsifiability

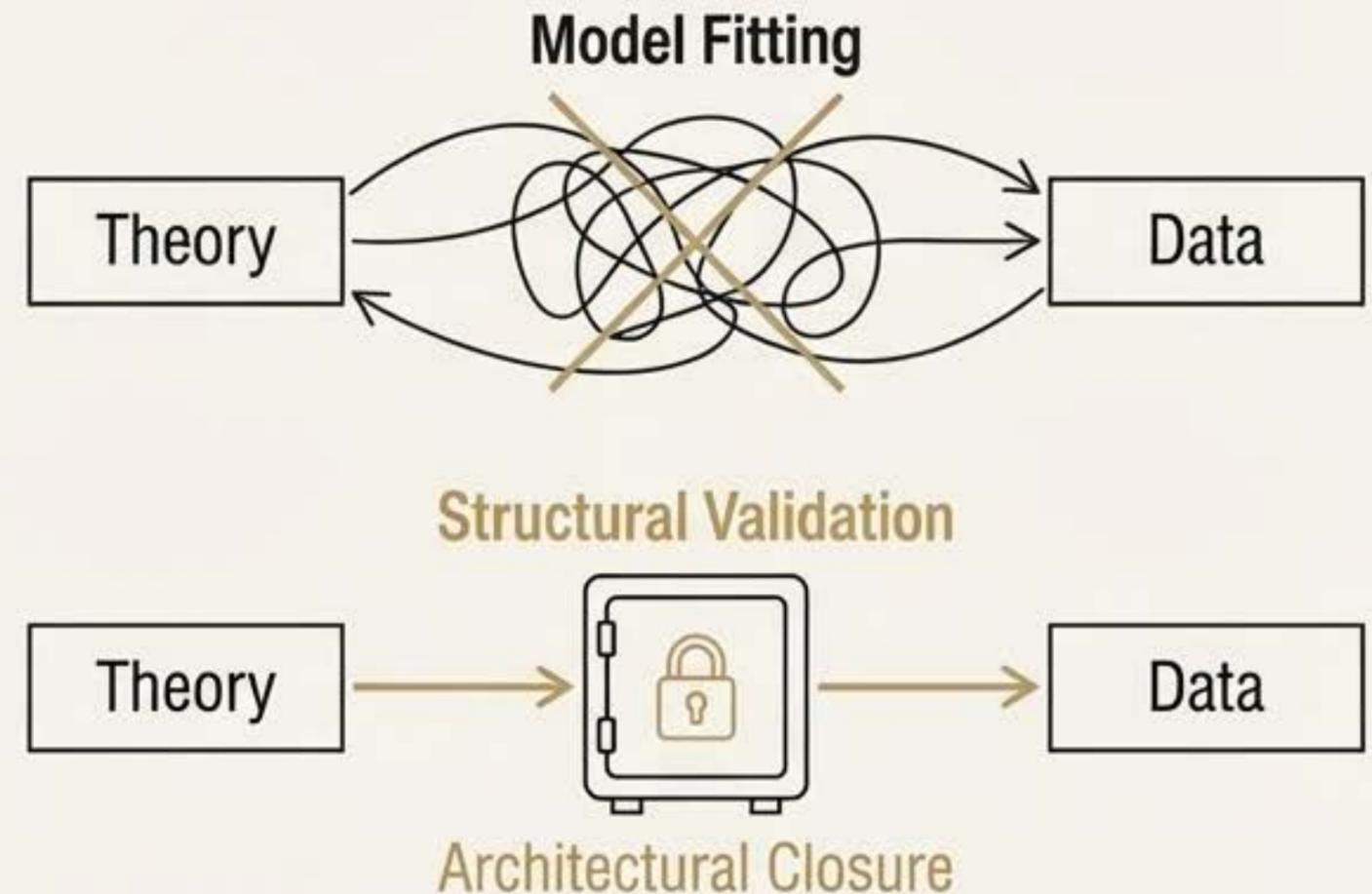
In SORT v6, the mathematical core is intentionally completed, frozen, and internally validated *prior* to any confrontation with observational data.

Rationale

Preserves Falsifiability: It prevents retrospective structural adjustments to fit data, ensuring the architecture itself can be tested.

Ensures Unambiguous Validation: Empirical tests in v7 will target a uniquely specified, non-tunable theoretical object.

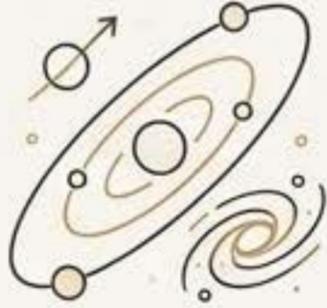
Guarantees Reproducibility: It decouples the core theory's definition from the contingencies of any specific dataset or computational environment.



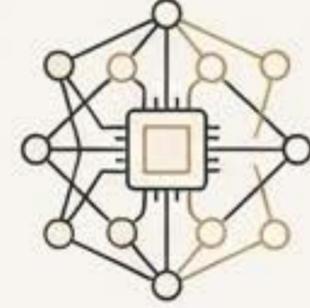
“Empirical confrontation is meaningful only once the underlying structure is fixed. Within SORT, empirical discrepancies cannot be absorbed through parameter proliferation or operator extension.” - *SORT v3 Article*

One Invariant Core, Multiple Domain Realizations

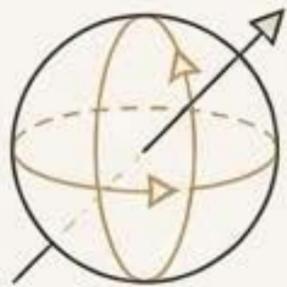
The same immutable mathematical core is instantiated across multiple domains. Each domain provides a semantic interpretation of the core's structure without altering its algebraic identity.



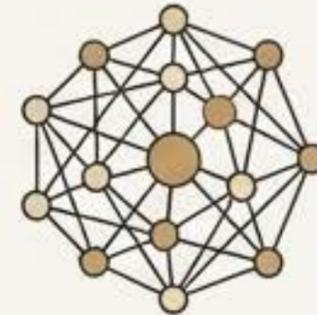
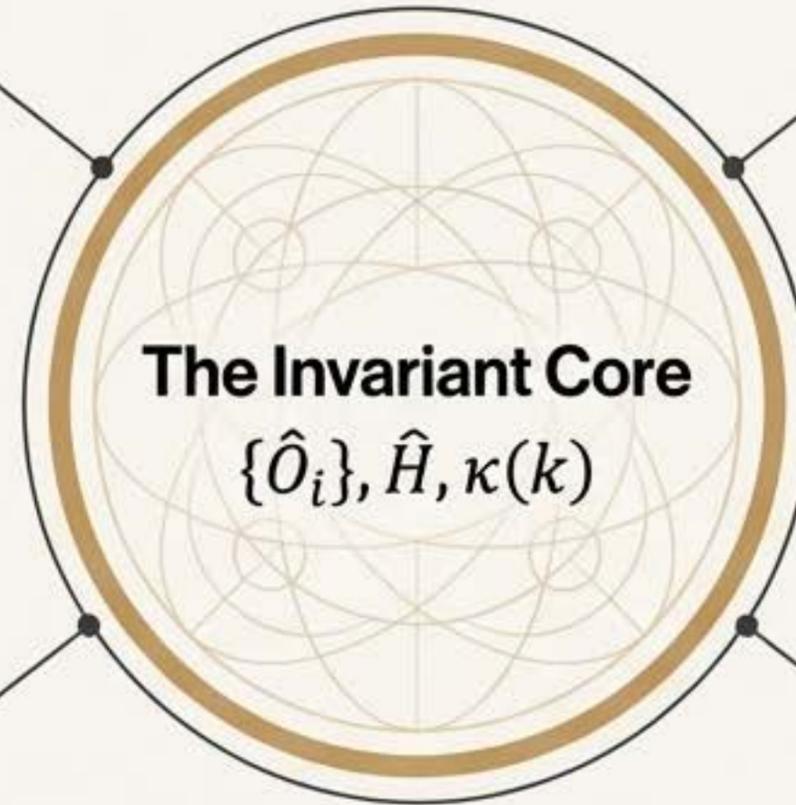
SORT-COSMO (Cosmology)
Organizing persistent anomalies (Hubble drift, early galaxies) as projection-level effects.



SORT-AI (AI Safety)
A structural diagnostic layer for alignment stability, drift, and runtime coherence in advanced AI systems.



SORT-QS (Quantum Systems)
Structural diagnostics for noise, error correction, and hybrid quantum-classical workflows.



SORT-CX (Complex Systems)
Analysis of emergence, network stability, and regime transitions in distributed systems.

Cross-domain consistency is guaranteed. The core algebra is identical across all modules: $\{\hat{O}_i\}_{AI} = \{\hat{O}_i\}_{CX} = \{\hat{O}_i\}_{QS} = \{\hat{O}_i\}_{COSMO}$.

Application Spotlight: SORT-COSMO

Structurally Organizes Cosmological Tensions

SORT-COSMO does not modify gravity. It maps cosmological observables (galaxy densities, expansion rates) to operator diagnostics, interpreting anomalies as projection-density effects.

ID	Title	One-liner
cosmo.01	Early Galaxies	Projection-stabilized structures for early JWST
cosmo.02	Early SMBH Seeds	Kernel-controlled amplification for early SMBH
cosmo.03	Hubble Drift	Scale-dependent H_0 as projection drift
cosmo.04	CMB Anomalies	Large-scale CMB projection features

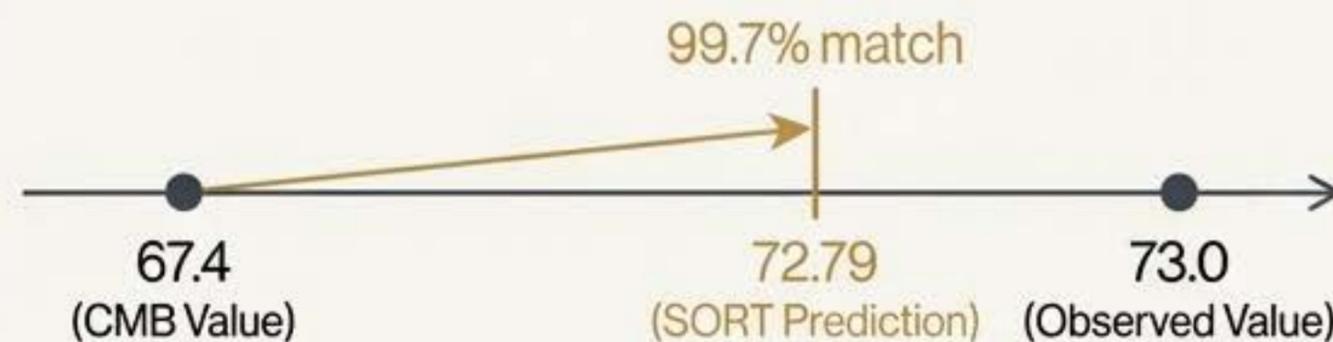
Key Prediction (from MOCK v3 exploratory runs)

SORT predicts a structural Hubble drift of

$$\delta H/H_0 = 0.0800$$

This corresponds to a predicted local Hubble constant of

$$H_{\text{local_pred}} = 72.79 \text{ km/s/Mpc}$$



Application Spotlight: SORT-AI Provides a Structural Diagnostic Layer for AI Safety

Objective

To evaluate system-level stability, drift, and failure regimes without requiring access to model internals (weights, gradients, or training data). This makes it applicable to black-box, proprietary, and API-based systems.

How it Works

AI system components and runtime configurations are mapped to operator chains. Stability is evaluated by checking for deviations under kernel-modulated projection.

Risk Functional

A system-level diagnostic independent of model architecture.

$$R_{AI}(\Delta) = \|\hat{P}_{\kappa}(\hat{J}_{AI}(\Delta)) - \hat{P}_{\kappa}(\hat{J}_{AI}(0))\|_{HR}$$

Application Catalog

ID	Title	One-liner
ai.01	Interconnect Stability	Control Interconnect stability diagnostics
ai.02	Structural Drift Diagnostics	Structural drift detection
ai.03	Safety and Risk Surfaces	Projection-based risk surfaces
ai.05	Data and Retrieval Integrity	Structural retrieval integrity for RAG systems

The MOCK v4 Environment: A Canonical Architecture for Validation and Reproducibility

MOCK v4 is the public-only structural skeleton for SORT v6. It serves exclusively as the architectural and contractual reference.



MOCK v3

(Exploratory Numerical Evidence)

- ◆ Contained exploratory simulations and parameter studies.
- ◆ Provided preliminary numerical evidence (e.g., for Hubble drift).
- ◆ Represents the *numerical exploration phase*.



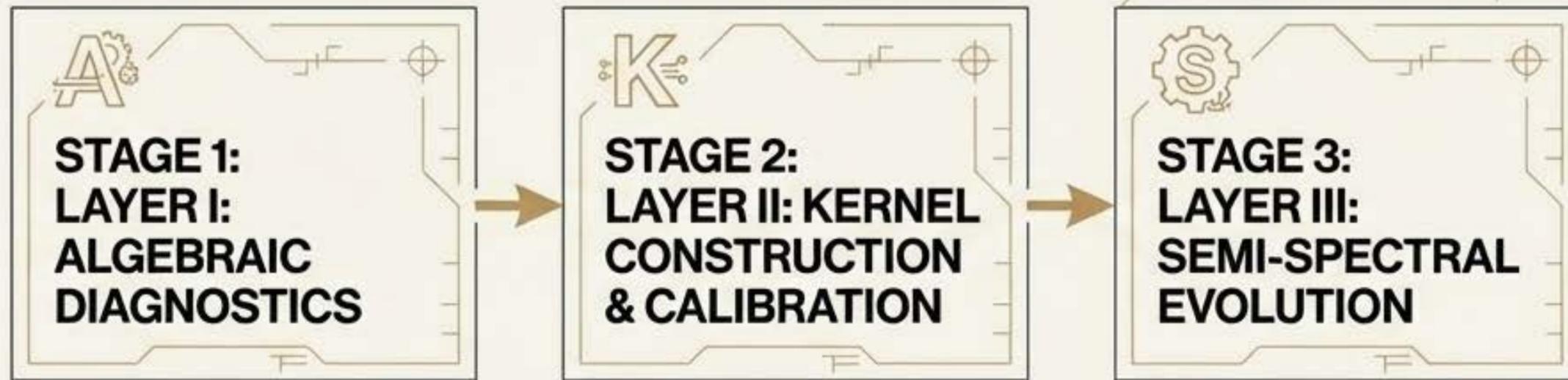
MOCK v4

(Architectural & Contractual Reference)

- ◆ Contains **no numerical simulations**.
- ◆ Provides the formal, public system architecture and API contracts.
- ◆ Represents the *architectural finalization phase*.

MOCK v4 builds on MOCK v3 methodologically, not numerically. It provides the formal structure required to audit prior numerical work and enable future HPC-based reproduction without architectural changes.

Internal Coherence is Verified Through a Rigorous Three-Layer Validation Model



Input: The 22 resonance operators.

Action: Verifies idempotency, commutator closure, Jacobi consistency, and light-balance neutrality of the operator algebra.

Input: Algebraically validated operators.

Action: Validates kernel normalization, parameter stability, and compatibility between the kernel $\kappa(k)$ and the projector \hat{H} .

Input: Validated kernel and projector.

Action: Tests deterministic propagation and convergence of operator sequences to stable normal forms.

MANDATORY VALIDATION TOLERANCES

Test	Tolerance
Idempotency ($\hat{O}_i^2 = \hat{O}_i$)	$\leq 10^{-12}$
Jacobi Residual	$\leq 10^{-14}$
Light-Balance ($\sum c_i = 0$)	$\leq 10^{-14}$
Global Idempotency ($\hat{H}^2 = \hat{H}$)	$\leq 10^{-12}$
Kernel Normalization ($\kappa(0)=1$)	exact

Unambiguous Reproducibility is an Architectural Feature, Not an Afterthought

Every aspect of the SORT v6 framework and MOCK v4 environment is designed to be **fully deterministic and verifiable**, ensuring that all reported structural diagnostics can be independently reproduced.



Fixed Global Seed

All validation runs use a fixed seed to guarantee bitwise reproducibility.

```
seed = 117666
```



Cryptographic Checksums

Every generated artifact is accompanied by a SHA-256 checksum. Any modification results in a mismatch.

```
Reference MOCK v3 Global  
Checksum: F830573...
```

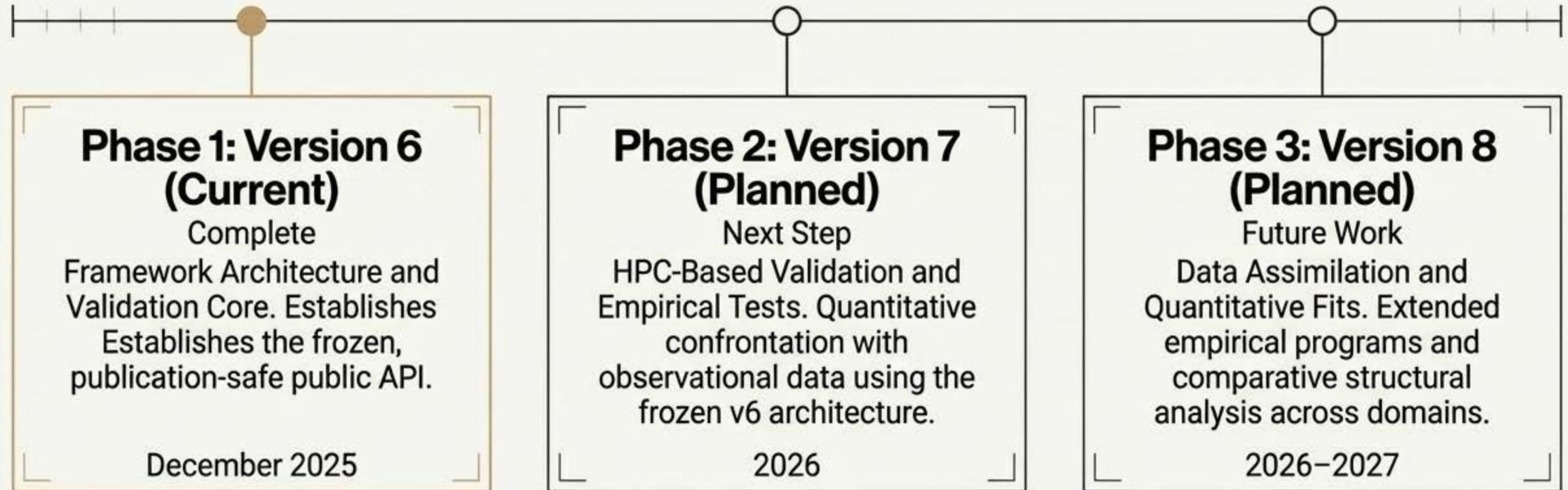


Golden Run Protocol

A canonical procedure for validating any new execution against the archived reference results by requiring exact checksum matches.

These requirements ensure that scientific conclusions are independent of proprietary implementation details and can be traced unambiguously to the validated reference state.

The Development Roadmap is Phased for Increasing Empirical Engagement



The invariant core defined in v6 remains unchanged throughout all phases, preserving the integrity of the validation program.

SORT v6 Delivers a Complete and Testable Architecture for Unified Structural Analysis

A Closed Mathematical Core

A finite 22-operator algebra, a global projector, and a calibrated kernel form an invariant, mathematically frozen core.



A Publication-Safe Architecture

The MOCK v4 environment provides a rigorous, reproducible validation pipeline with a strict separation between the public core and domain applications.



A Foundation for Empirical Testing

By completing the architecture *before* empirical engagement, SORT v6 establishes the necessary conditions for rigorous and unambiguous validation in v7.



The framework is now positioned to test whether projection-based structural constraints can account for phenomena ranging from the Hubble tension to instabilities in AI. It offers a path toward a unified structural description that complements and extends, rather than replaces, established physical theories.