The Phi-Regime of the UNNS Substrate A Generative Foundation Beyond State-Based Quantum Mechanics

UNNS Research Collective

Abstract

We present a formal treatment of the Phi-regime within the UNNS Substrate. The framework separates generability, projection, and stabilization into distinct but equally fundamental regimes. Quantum states are treated as projection-level structures induced from generability, while collapse is reformulated as stability-based selection. This approach resolves measurement, nonlocality, and observer-dependence without hidden variables or observer privileging.

1. Motivation and Scope

Standard quantum mechanics is a state-based theory. Its fundamental object, the wavefunction Ψ (or density operator ρ), is defined on a Hilbert space and evolves according to prescribed dynamical laws. Conceptual problems associated with measurement, collapse, and nonlocal correlations arise only after such states are already assumed to exist.

The UNNS Substrate adopts a different foundational stance:

> States are not fundamental. Generability is.

In UNNS, the term *Substrate* refers to the complete foundational framework incorporating three structural regimes:

- generability (Phi),
- projection (Psi),

- stabilization (tau),

together with the operators relating them.

The purpose of this paper is to formalize the Phi-regime of the UNNS Substrate in a mathematically explicit and canon-consistent manner.

2. Structural Separation of Regimes

Let:

- C denote a configuration substrate (not assumed classical),
- $H(C)$ denote a projection-level state space constructed over C,
- $\Psi \in H(C)$ denote a projection-level state.

Within the UNNS Substrate, Ψ belongs to the projection regime and is not ontologically primitive. Instead, projection-level states are induced from a deeper generative structure.

This motivates the introduction of the Phi-regime.

3. The Phi-Regime as Generability

Definition 3.1 (Phi-Regime). The Phi-regime is the generability regime of the UNNS Substrate. It consists of rules, constraints, or generative structures that determine which projection- level states may arise.

Formally, the Phi-regime supports a generator mapping

$$\mathrm{Gen} : \Phi \to \mathcal{F}(H(C)),$$

where $\mathcal{F}(H(C))$ denotes families of elements of $H(C)$.

For each element $\varphi \in \Phi$,

$$\mathrm{Gen}(\varphi) = \{\Psi_k \mid k \in K\},$$

where the index k ranges over contextual, recursive, or boundary parameters.

Crucially:

- φ is not an element of $H(C)$,
- there is no canonical embedding of Φ into $H(C)$.

The Phi-regime is therefore a law-space of generability, not a state-space.

4. Recursion and Nesting

Generability in the UNNS Substrate is inherently recursive.

Introduce a recursion depth parameter

$$d \in N.$$

For each depth, define a generator

$$\text{Gen}_d : \Phi \to H(C),$$

together with refinement operators

$$R_{d \to d+1} : H(C) \to H(C).$$

These satisfy the coherence condition

$$\text{Gen}_{d+1}(\varphi) \approx R_{d \to d+1}(\text{Gen}_d(\varphi)),$$

up to equivalence or normalization.

Projection-level structures therefore arise as recursive unfoldings of generability within the Phi-regime.

5. Generative Grammar Formulation

An equivalent formulation of the Phi-regime may be given using generative rewriting systems.

Let:

- Σ be a finite or countable alphabet,
- $T(\Sigma)$ be the set of finite rooted trees over Σ,
- $\rho \subset T(\Sigma) \times T(\Sigma)$ be a set of rewrite rules,
- $w : \rho \to C$ be a weight assignment.

The Phi-regime may be represented as the triple

$$\Phi = (\Sigma, \rho, w).$$

A derivation is a sequence

$$t_0 \to t_1 \to \cdots \to t_n$$

allowed by ρ.

Projection. Let

$$P : T(\Sigma) \to H(C)$$

be a projection mapping.

A projection-level structure is then induced by

$$\Psi = \sum_{derivations} \left(\prod_i w(\rho_i) \right) P(t_n).$$

Thus projection-level states encode generative history rather than primitive reality.

6. Nonlocal Correlations

If two projection-level states Ψ_A and Ψ_B arise from derivations sharing a common ancestral structure, their correlation reflects shared generability rather than signal exchange:

$$\mathrm{Corr}(A, B) \sim sharedgenerativeorigin.$$

No local hidden variables are introduced, and no causal signaling is required. Bell inequality violations therefore present no contradiction.

7. Stabilization and Selection

Introduce a stability functional

$$S : H(C) \to R$$

and a threshold value θ.

A projection-level structure is stable if

$$S(\Psi) \geq \theta.$$

Selection replaces collapse:

$$\mathrm{Select}(\varphi) = \{\Psi \in \mathrm{Gen}(\varphi) \mid S(\Psi) \geq \theta\}.$$

Any irreversible physical interaction may enforce this selection. Observers are special cases of stabilizing systems, not ontological prerequisites.

8. Relation to Quantum Mechanics

Quantum mechanics describes dynamics internal to the projection regime. The UNNS Substrate addresses a prior question: why projection-level structures exist at all.

The Schrödinger equation remains valid within its domain of applicability, but it is not foundational.

9. Core Claims

1. The UNNS Substrate incorporates generability, projection, and stabilization.
2. The Phi-regime specifies generability, not states.
3. Projection-level states arise from generative recursion.
4. Nonlocality reflects shared generative structure.
5. Collapse is stability-based selection.

10. Outlook

This framework enables:

- recursive-depth-dependent decoherence models,
- non-Markovian correlation analysis,
- substrate-aware extensions of quantum field theory,
- a clean separation of ontology and measurement.

The Phi-regime is not speculative metaphysics. It is the generative regime of the UNNS Substrate from which projection and stability arise.