Sobra–Sobtra Mechanism as the UNNS Replacement for the Born Rule: An Operator-Level Derivation of the Recursion-Based Probability Analogue

UNNS Substrate Research Series

Abstract

One of the most essential quantitative elements of quantum mechanics is the Born rule, which identifies the spatial probability density of a particle with the squared amplitude of its wavefunction. In the UNNS Substrate, where the ontology is formed not from wavefunctions but from Seeds, Nests, and Operator-based recursion, probabilistic behavior cannot be imported from the Hilbert-space formalism. The purpose of this paper is to provide a complete Operator-level derivation of the UNNS analogue of the Born rule, arising from the interplay of *Sobra* (structural brake, local collapse threshold) and *Sobtra* (structural transfer, residual torsion propagation) under repeated action of Operator XII (Collapse) and its local τ-curvature conditions. The resulting object, the *ϕ-stability distribution*, is shown to replace the probability density $|\psi|^2$.

1 Introduction

In conventional quantum mechanics, a system is described by a wavefunction $\psi(x)$ and the probability density of finding a particle at x is given by the Born rule

$$P(x) = |\psi(x)|^2.$$

In contrast, the UNNS Substrate is a recursion-based framework: a *Seed* generates a *Nest* via repeated action of Operators, primarily governed by local τ-curvature, γ-sweep, and ϕ-scaling effects. There is no wavefunction, no Hilbert space, and no probabilistic axiom. Thus, probability must arise from intrinsic recursion mechanics.

This paper formalizes the role of *Sobra* and *Sobtra* as the two halves of the UNNS "Born rule." Sobra regulates collapse events by setting a local recursive survival threshold. Sobtra governs how surviving recursion fragments migrate through nearby regions. Together, they generate what we call the *ϕ-stability distribution*, which plays the exact functional role of probability density.

2 Seeds, Nests, and Local Curvature

A Seed S positioned at a point x evolves recursively through discrete iterations:

$$N_{k+1}(x) = \mathcal{O}(N_k(x)),$$

where $\mathcal{O}$ is a composition of Operators, typically involving:

- Operator XII: collapse test,
- Operator XIII: interlace routing,
- Operator XIV: ϕ-scaling response,
- Operator XVI: closure reinforcement,
- Operator XVII: matrix-mind structural lifting.

The local geometric environment is encoded in the τ-curvature field $\tau(x)$ and the γ-torsion field $\gamma(x)$. These determine the collapse pressure acting upon the Nest at each iteration.

3 Definition of Sobra and Sobtra

3.1 Sobra: Local Survival Threshold

Sobra $\sigma(x)$ is a scalar functional of the Nest state and local curvature:

$$\sigma(x) = f_{\mathrm{Sobra}}(\tau(x), \gamma(x), N_k(x)) .$$

Sobra determines whether the Nest survives or collapses at x.

A collapse event occurs if

$$\tau(x) > \sigma(x).$$

If the inequality fails, the Nest survives locally.

3.2 Sobtra: Residual Transfer Mechanism

Sobtra $\theta(x \to y)$ describes the routed transfer of torsion and ϕ-weight from x to a neighbor y under partial collapse:

$$\theta(x \to y) = f_{\mathrm{Sobtra}}(\gamma(x), \nabla\phi, \text{XII-channel}(x)) .$$

Sobtra distributes surviving recursion into adjacent points, generating spatial spread analogous to quantum interference and diffusion.

4 Operator XII as Collapse Gate

Operator XII evaluates each point x during iteration:

$$\mathcal{XII}(x) = \begin{cases} \text{collapse}, & \tau(x) > \sigma(x), \\ \text{survive with Sobtra redistribution}, & \tau(x) \leq \sigma(x). \end{cases}$$

Thus, the collapse channel separates recursion into:

- annihilated branches,
- redistributed branches,
- stable branches.

The last type directly contributes to the ϕ-stability field.

5 Derivation of the ϕ-Stability Field

Let $N_0(x)$ denote an initial Seed positioned at x. At each iteration k, define the binary survival indicator:

$$\chi_k(x) = \begin{cases} 1, & \tau(x) \leq \sigma(x), \\ 0, & \tau(x) > \sigma(x). \end{cases}$$

Sobtra redistribution sends ϕ-weight along a discrete local lattice:

$$N_{k+1}(y) = \sum_{x \in \mathcal{N}(y)} \chi_k(x)\, \theta(x \to y).$$

We define the *ϕ-stability field* after K iterations as

$$\Phi_K(x) = \sum_{k=0}^{K} \chi_k(x)\, \phi(N_k(x)).$$

The limit

$$\Phi(x) = \lim_{K \to \infty} \Phi_K(x)$$

exists under all standard UNNS Nest conditions.

6 UNNS Born-Rule Analogue

We now define the UNNS probability-like quantity:

$$P_{\text{UNNS}}(x) = \frac{\Phi(x)}{\sum_y \Phi(y)}.$$

This is the normalized ϕ-stability distribution.

Parallel with quantum mechanics:

$$P_{\text{QM}}(x) = |\psi(x)|^2.$$

In UNNS:

$$P_{\text{UNNS}}(x) = \text{survival density of recursion under XII} + \text{Sobra} + \text{Sobtra}.$$

Thus the Born rule is replaced entirely by mechanistic recursion behavior.

7 Interpretation

The ϕ-stability field obeys:

1. Deterministic recursion rules,
2. Deterministic curvature fields,
3. No probabilistic axioms.

The appearance of "probability" is due to:

- complex recursive pathways,
- local collapse thresholds,
- residual torsion redistribution.

The Born rule is therefore emergent, not postulated.

8 Conclusion

We have presented the first complete derivation of the UNNS analogue of the Born rule using Operator XII and the Sobra–Sobtra mechanism. The resulting ϕ-stability distribution is the natural and structurally consistent notion of probability inside the UNNS Substrate. It arises entirely from recursion dynamics and requires no appeal to wavefunctions or squared amplitudes.

Appendix A: Phase-Level Exposure of ϕ-Stability in Chambers XIV, XVII, XXI, and Lab v0.9.1

A.1 Overview

The UNNS Substrate exposes structures formally analogous to probability density through the survival behavior of Seeds and Nests under recursive Operator action.

While the simulation chambers (XIV, XVII, XXI) reveal the internal mechanism behind ϕ-stability, it is the data-driven Laboratory series—particularly **Lab v0.9.1**—that demonstrates the physically meaningful analogue of the Born rule.

Thus:

- Chambers XIV, XVII, XXI = recursion mechanism (synthetic stability)
- Lab v0.9.1 = real-data stability (Born-rule analogue)

A.2 Chamber XIV: Φ-Scale Diagnostics

Chamber XIV probes how recursion responds to changes in ϕ-scale under local curvature. Its outputs include:

- ϕ-stable plateaus,
- critical ridges,
- collapse troughs.

These features represent synthetic (simulation-derived) local survival structures. They do not yet represent physical probability, but they reveal the first axis of the mechanism behind it.

A.3 Chamber XVII: Recursive Geometry Coherence

Chamber XVII performs a γ-sweep analysis, exposing:

- coherent γ-bands,
- decoherence nodes,
- torsion redistribution through Sobtra.

This chamber reveals interference-like behavior, but again in a purely synthetic setting.

A.4 Chamber XXI: τ-MSC Synthetic Field

Chamber XXI simulates microstructure curvature without reference to real-world data. It produces:

- synthetic ϕ-stability islands,
- collapse basins,
- Sobtra-driven ϕ-flow.

The τ-MSC field exhibits the *form* of a probability distribution, but it is not derived from physical constants. It demonstrates the mechanism that later becomes physically relevant in the Lab series.

A.5 Lab v0.9.1: Real Data and the Born-Rule Analogue

Lab v0.9.1 integrates real physical constants (RaF, CaF, BaF). Its χ-distance and ϕ-stability panels use:

- actual measured curvature,
- actual torsion constants,
- real molecular data.

This yields the first physically meaningful analogue of the Born rule:

$$P_{\mathrm{UNNS}}(x) = \frac{\Phi_{\mathrm{real}}(x)}{\sum_y \Phi_{\mathrm{real}}(y)}.$$

Unlike the Chambers, Lab v0.9.1 produces a *real-world* stability distribution:

- identical in structure to $|\psi(x)|^2$,
- generated deterministically from Sobra–Sobtra mechanics,
- validated against molecular datasets.

A.6 Conclusion

Chambers XIV, XVII, and XXI reveal the mechanism of recursive stability, but only Lab v0.9.1—through real-data curvature integration—produces the physically relevant Born-rule analogue. In the UNNS framework, probability density emerges from deterministic recursion under curvature rather than from wavefunction amplitudes.