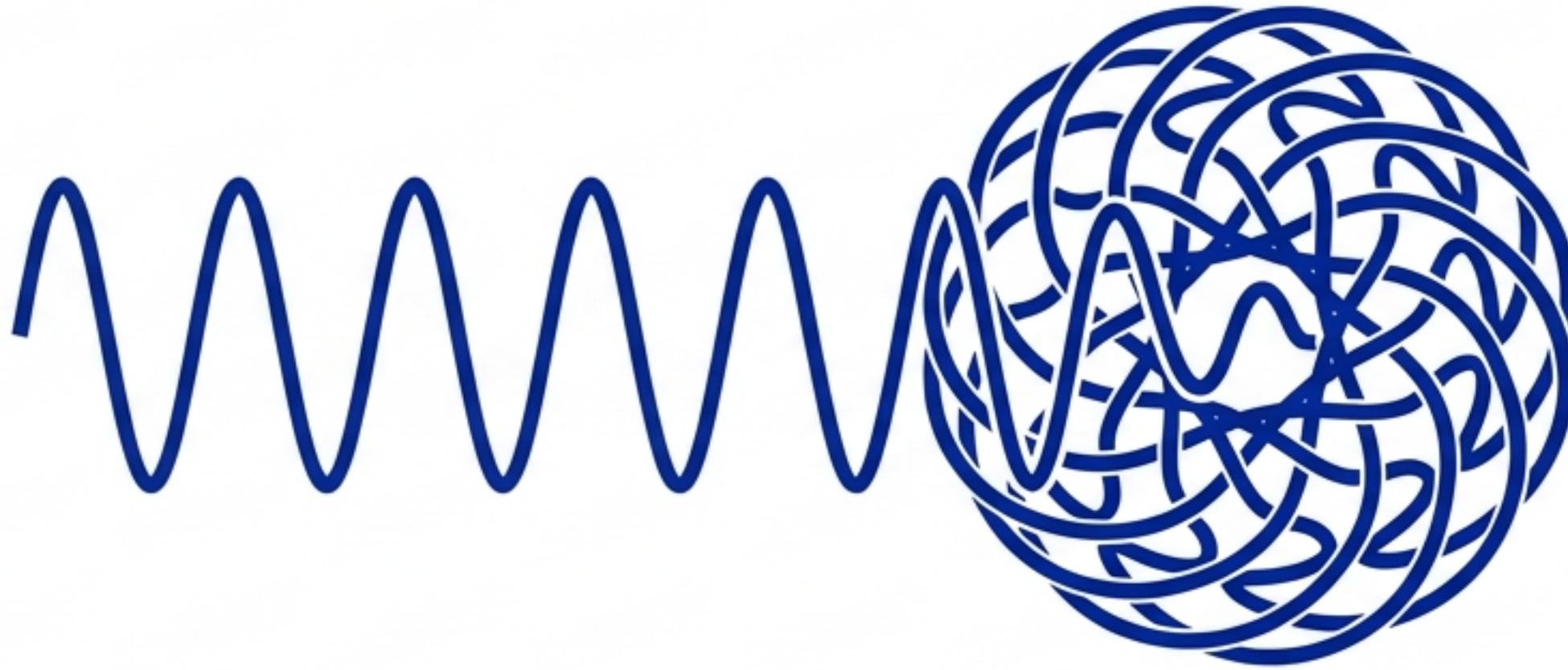


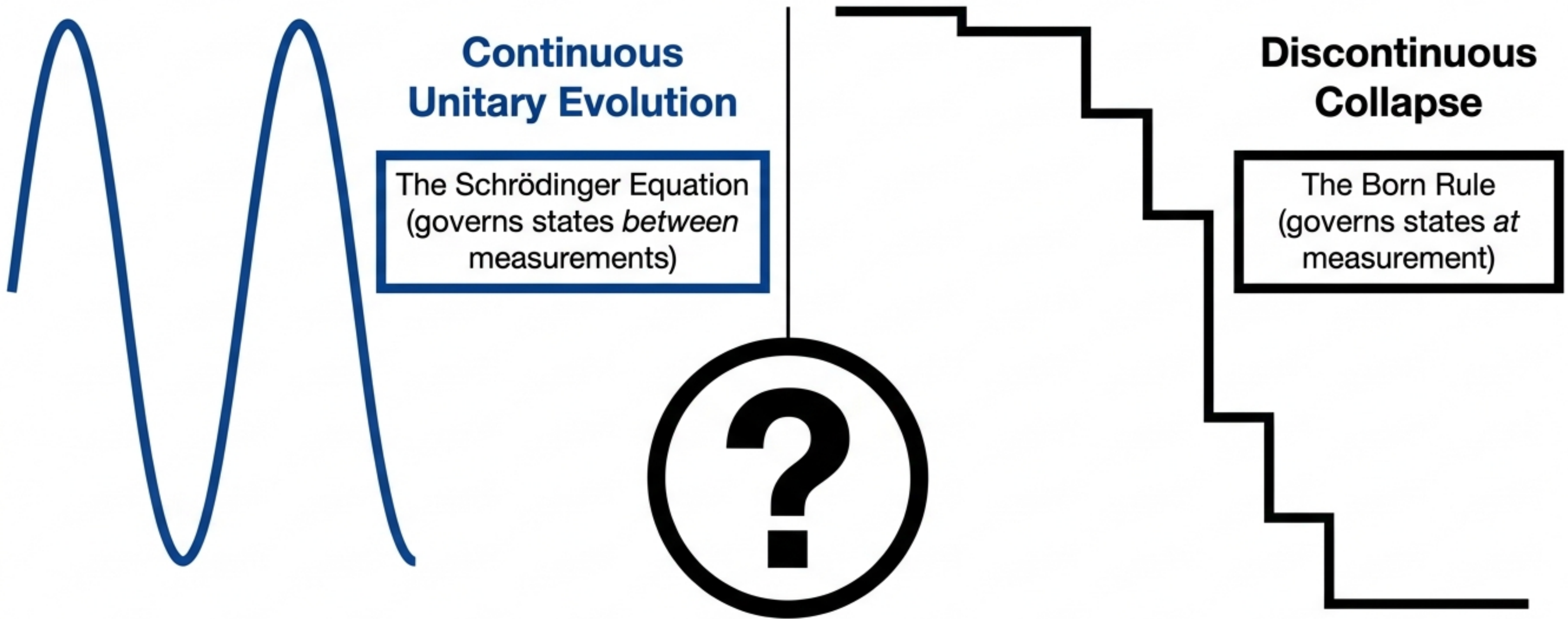
A Physical Explanation of Wave Function Collapse (Paper P70)

Vijay Shankar Sharma | DOI: 10.5281/zenodo.21303296 | PACS: 03.65.Ta, 03.65.Yz



Abstract: Wave function collapse is not an observer-triggered discontinuity, but the irreversible physical coupling of a propagating continuous disturbance to a persistent substrate condensation.

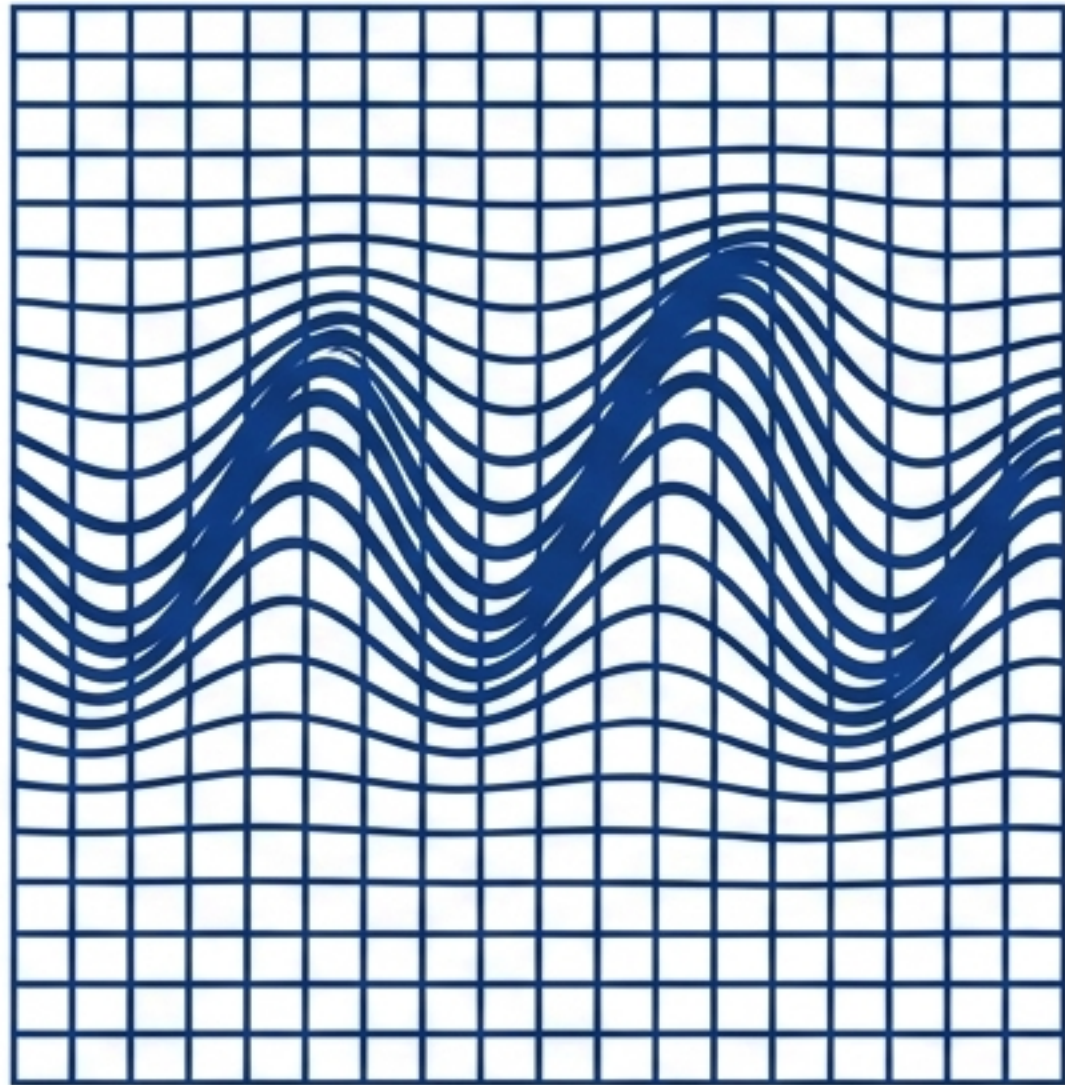
The Core Incompatibility of Standard Quantum Dynamics



The Paradox: Standard QM provide no physical trigger to bridge deterministic evolution and stochastic collapse. It postulates a mathematical discontinuity. © NotebookLM

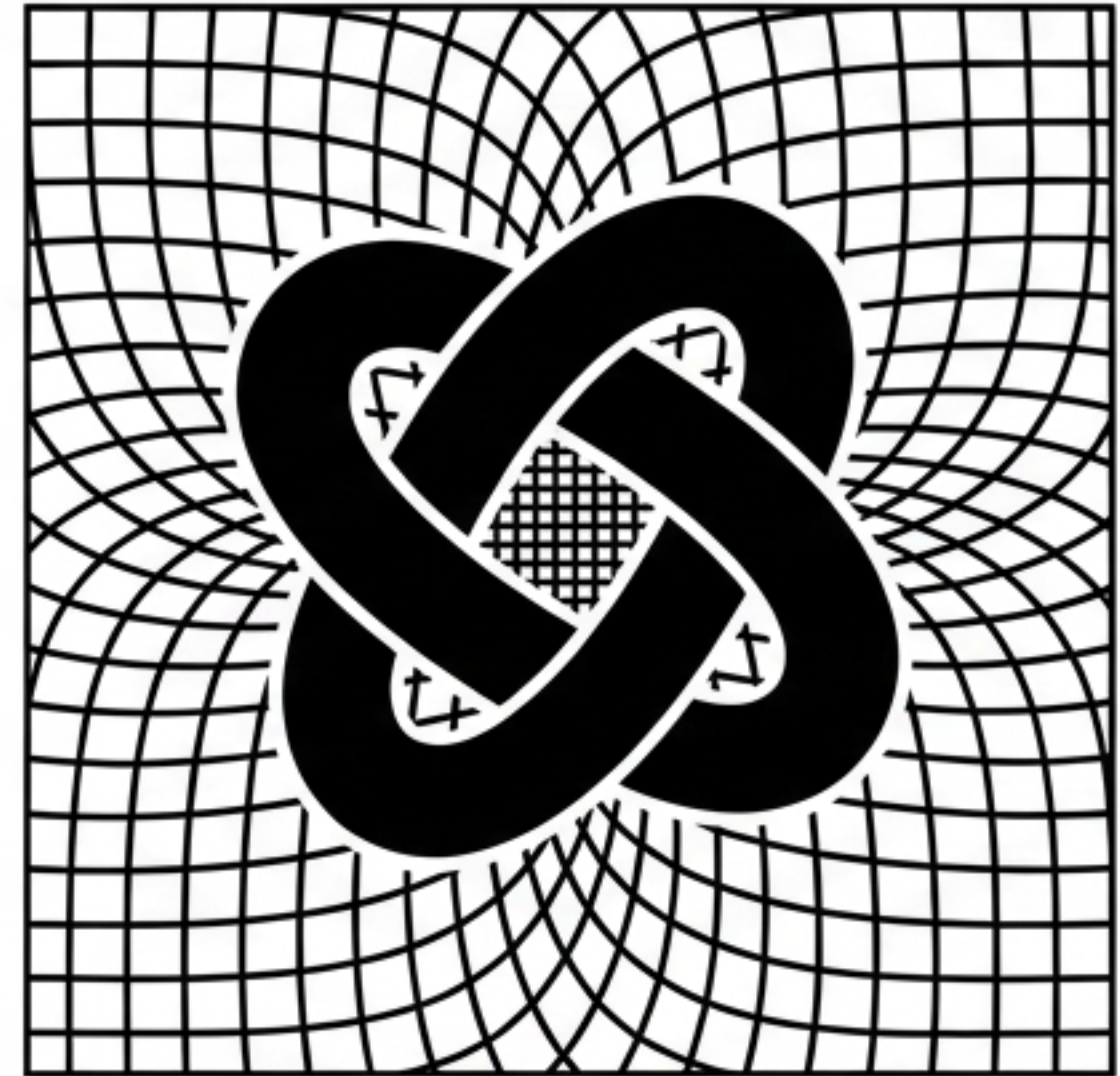
The Substrate Ontology Matrix: Two Classes of Physical States

To solve the measurement problem, we must define the wave function physically. The Sparticle field ($\rho_s = 5.9 \times 10^{-27} \text{ kg/m}^3$) supports two distinct topological states.



Propagating Disturbances

The pre-measurement quantum state. Physically real, spatially distributed, and capable of interference.



Embedded Condensations

Macroscopic matter and detectors. Stable, persistent, and topologically connected to the surrounding substrate.

Grounding the Quantum Scale in Condensation Geometry

Not an arbitrary postulate, but the measurable action of one condensation-scale circulation.

Independently measured proton mass and charge radius.

$$\hbar = \frac{m_p \cdot c \cdot r_p}{\pi \cdot R_0}$$

Substrate propagation speed.

The dimensionless condensation minimum ($R_0 = 1.27348$), derived mathematically from the free-energy functional.

Takeaway: The scale of quantum mechanics is governed entirely by the physical geometry of matter formation

The Substrate-Level Physical Schrödinger Equation

Standard Formulation (Abstract Postulate)

$$i\hbar \frac{\partial \Psi}{\partial t} = -\frac{\hbar^2}{2m} \nabla^2 \Psi + V\Psi$$

Substitute Geometric $\hbar$



Substitute Geometric $\hbar$



BFUT Geometric Formulation (Substrate Dynamics)

$$i \cdot \left[\frac{m_p \cdot c \cdot r_p}{\pi \cdot R_0} \right] \cdot \frac{\partial \Psi}{\partial t} = - \left[\frac{(m_p \cdot c \cdot r_p)^2}{2\pi^2 \cdot R_0^2 \cdot m} \right] \nabla^2 \Psi + V\Psi$$

By substituting the geometric $\hbar$, the time-evolution and kinetic operators are revealed to be fully governed by condensation geometry, stripping away mathematical abstraction.

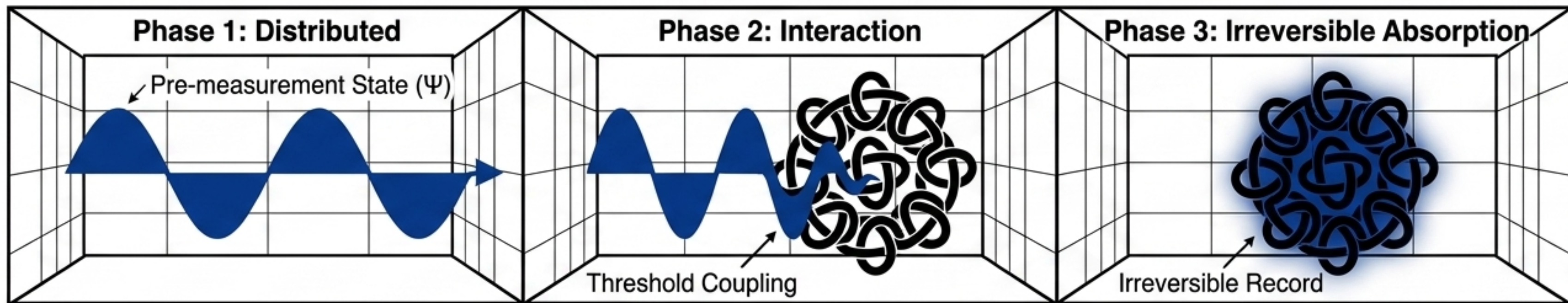
The Universal Carrier Field Equation (F1-cov)

$$g^{\mu\nu}\nabla_{\mu}\nabla_{\nu}(\delta\Psi) - 3\rho_sc^2\delta\Psi = \kappa \nabla^2\Psi_{\text{matter}}$$

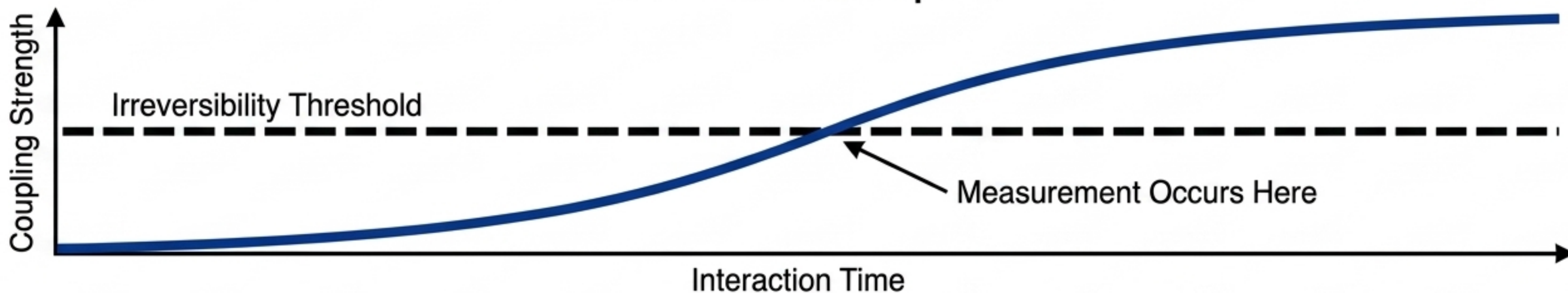
Variable Definitions		Connecting Concept
$\delta\Psi$	The localized, non-relativistic limit of the universal Sparticle carrier perturbation (which we conventionally call the quantum wave function Ψ).	The Schrödinger equation is not an independent law of nature. It emerges mathematically as the non-relativistic, localized limit of this single covariant substrate propagation equation.
ρ_sc^2	The intrinsic vacuum energy density of the substrate (Sparticle field stiffness).	
κ	Source-to-substrate coupling.	

Wave Function Collapse is Threshold Coupling

The Mechanism Schematic

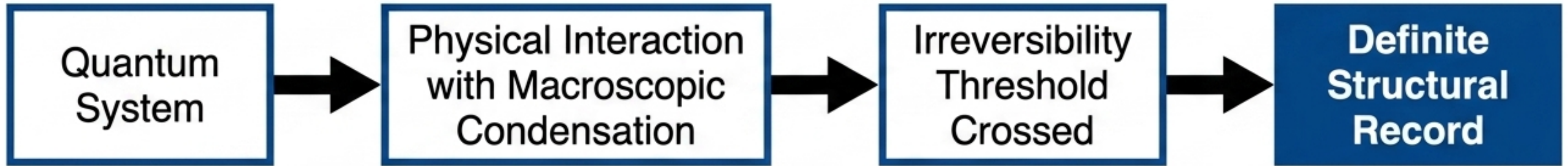


The Threshold Graph

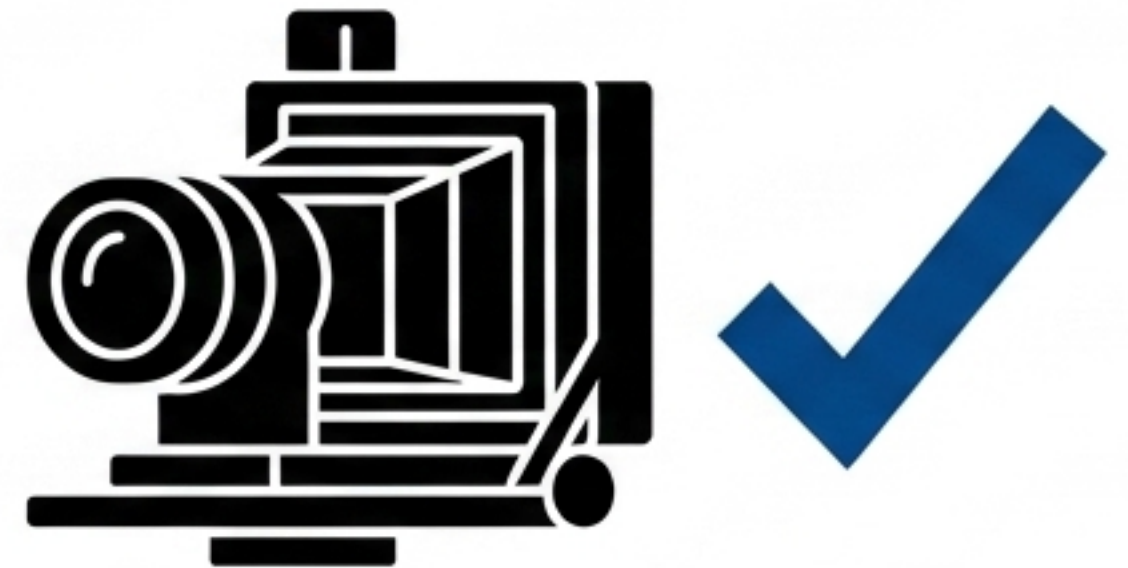


Key Insight: Collapse occurs when a propagating disturbance couples to an embedded condensation with enough organizational stability to make the absorption irreversible.

Observer Independence & Environmental Decoherence



Consciousness plays **ZERO** causal role.



Structural stability triggers collapse.

A detector—or any sufficiently persistent macroscopic condensation—reliably triggers collapse through physical coupling alone, whether an observer is present or not.

The Measurement Problem Resolution Matrix

	Copenhagen	Many-Worlds	Objective Collapse (GRW)	BFUT (Paper P70)
Requires Observer/Consciousness?	Yes/ Ambiguous	No	No	✓ No ✓
Introduces New Dynamical Laws?	Yes	No	Yes	✓ No ✓
Maintains a Single Universe?	Yes	No	Yes	✓ Yes ✓
Physical Substrate Mechanism for Collapse?	No	N/A	No	✓ Yes, ✓ Threshold Coupling

The Physical Origin of the Born Rule (Paper P71 Context)

$$P = |\Psi|^2$$

Abstract Probability Amplitude



**Substrate Energy
Density**

$$\propto (\delta\Psi)^2$$

Local Spaticle Disturbance

Probability is not an abstract mathematical weighting. It corresponds directly to the localized physical energy density of the propagating substrate disturbance at the exact point of irreversible coupling.

Addressing the Core Objection: Relocating the Problem?

“

Does specifying an irreversibility threshold merely rename the measurement problem without calculating the exact boundary from first principles?

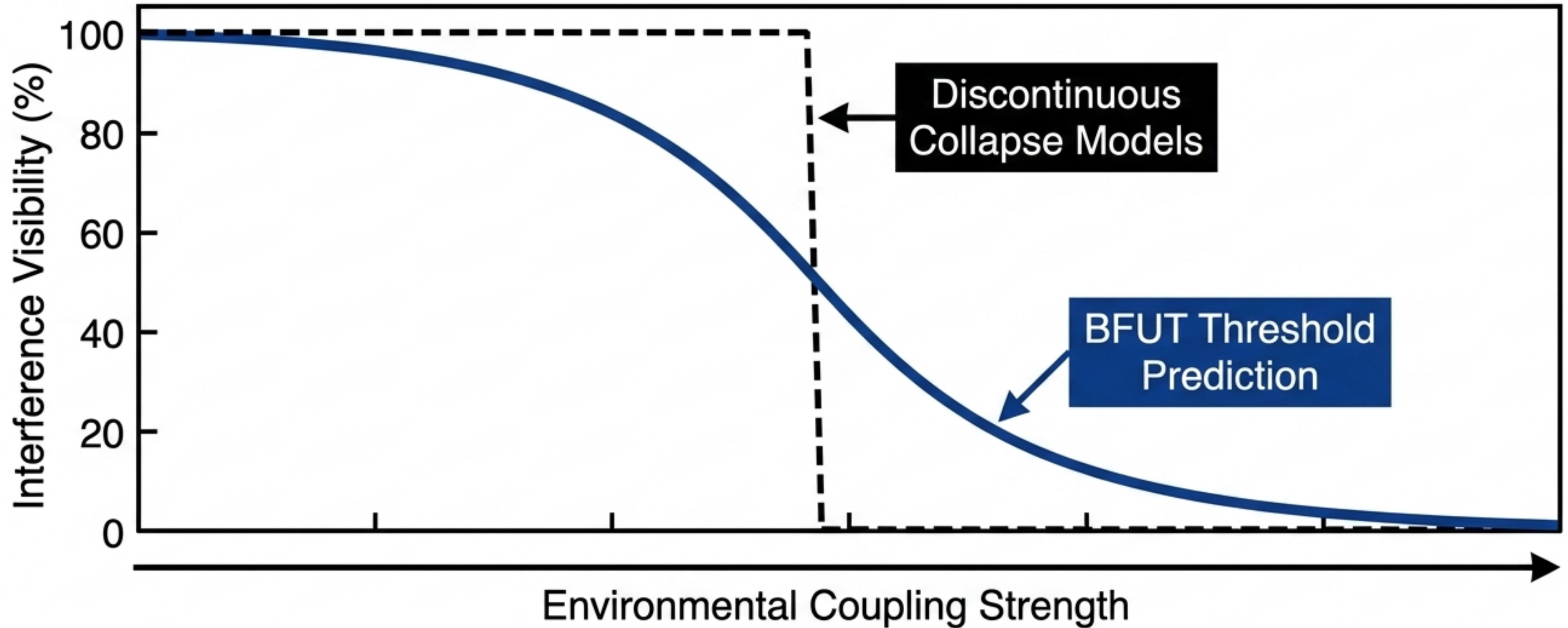
[THE CONCESSION]



P70 honestly concedes that the precise first-principles calculation of the threshold is future work. However, it successfully replaces mathematical discontinuities and magical observer intervention with a specific, physical mechanism: structural absorption.

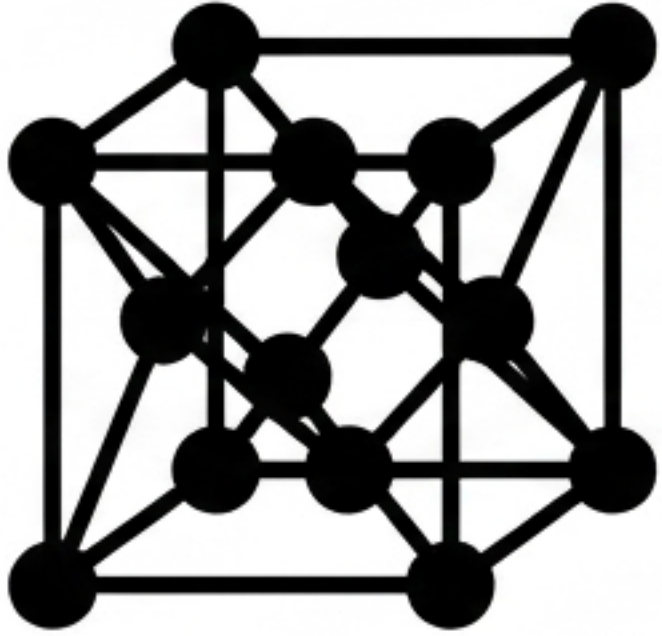
[THE DEFENSE]

Falsifiable Prediction 1: Graded Decoherence



Decoherence must manifest as a continuous suppression of interference visibility as coupling strength increases. An experimentally confirmed binary transition would instantly falsify the threshold-coupling mechanism.

Falsifiable Predictions 2 & 3: Structure and Observers



PREDICTION 2: STRUCTURAL DEPENDENCE

The specific coupling threshold required for irreversible collapse depends purely on the organizational stability of the detector. Different detector architectures will show measurably different effective collapse thresholds under weak measurement protocols.



PREDICTION 3: OBSERVER IRRELEVANCE

No confirmed experimental protocol will ever demonstrate that conscious observation alters collapse timing compared to ordinary physical coupling with a macroscopic apparatus.

Synthesis: Collapse Without Paradox

- 1 One Substrate:** The pre-measurement wave is a real, physically distributed disturbance.
- 2 Zero Discontinuities:** Collapse is ordinary, continuous physical coupling that becomes practically irreversible.
- 3 Zero Observers:** Consciousness plays no physical or causal role in quantum mechanics.

Wave function collapse maintains the mathematics of standard QM while stripping away a century of philosophical paradoxes.