

## Section 6. From Indeterminacy to Entropic Stability

With entropic thresholds established, the quantum–classical transition can now be examined at the phenomenological level: how indeterminate behavior gives way to stable and predictable dynamics. Within CUWF, this transition does not require a special collapse postulate, measurement intervention, or modification of quantum laws. Instead, it follows from the increasing dominance of structural stability over pathway competition.

This section therefore focuses on what the transition looks like once stabilization begins to operate. It explains how interference fades as stability increases, why superposition becomes progressively unsupported without the need for ad hoc collapse mechanisms, and how predictable classical behavior emerges as a consequence of stabilized collapse dynamics.

### 6.1 How Interference Fades as Stability Dominates

Quantum interference arises when multiple collapse pathways remain simultaneously viable and sufficiently coherent. As earlier sections have shown, this condition is characteristic of low-stability regimes in which collapse configurations continue to explore configuration space without long-term consolidation.

Let  $\{C_i\}$  denote competing collapse pathways contributing to a configuration. Interference persists when pathway weights remain broadly comparable:

$$|C_1| \approx |C_2| \approx \dots \approx |C_n|$$

As entropic constraints intensify and stability deepens, collapse dynamics begin to favor a restricted subset of pathways. This produces an asymmetry in pathway reinforcement:

$$|C_{\text{dom}}| \gg |C_{j \neq \text{dom}}|$$

Interference then fades not because coherence is destroyed by an external act, but because non-dominant pathways lose structural support. Their contributions decay as repeated collapse events reinforce the same stabilized configuration basin.

Importantly, this suppression is continuous rather than abrupt. The visibility of interference decreases progressively as stability comes to dominate. This helps explain why interference effects may persist in mesoscopic systems and then gradually disappear as stabilization becomes deeper and more robust.

## 6.2 Suppression of Quantum Superposition Without Collapse Postulates

Standard interpretations often invoke wavefunction collapse as a primitive postulate to explain why superpositions are not observed classically. CUWF removes the need for such a postulate by reinterpreting superposition as a regime-dependent feature rather than as a permanent ontological condition.

In CUWF, superposition reflects the coexistence of multiple unstable collapse configurations:

$$\Psi \equiv \sum_i C_i \quad (\text{unstabilized regime})$$

As entropic thresholds are crossed, collapse dynamics selectively reinforce some configurations while suppressing others. The process does not require a discontinuous collapse rule. Rather, it reshapes the effective configuration landscape:

$$\sum_i C_i \rightarrow C_{\text{stable}}$$

The apparent disappearance of superposition is therefore a consequence of stabilization rather than an additional dynamical law. Superposition becomes structurally unsupported once configuration space can no longer sustain multiple competing pathways at comparable weight.

This explains why no observer-triggered collapse is required and why classical outcomes can emerge autonomously once stability conditions are satisfied.

### 6.3 Emergence of Predictable Behavior

Predictability is often conflated with determinism, but the two are not identical in CUWF. Predictable behavior emerges when collapse configurations become sufficiently persistent that future configurations can be inferred from present ones with bounded uncertainty.

Let  $C(t)$  represent a stabilized collapse configuration. Predictability corresponds to bounded deviation under evolution:

$$|C(t + \Delta t) - C(t)| \leq \epsilon$$

for sufficiently small  $\epsilon$  across repeated collapse cycles.

This condition does not require exact invariance. It requires only that deviations remain confined within a stable configuration basin. Once such basins form, trajectories, records, and macroscopic structures become reproducible in practice.

Predictability is therefore an emergent property of stabilized dynamics rather than a primitive axiom. Classical laws describe these stabilized patterns; they do not replace the deeper collapse process from which the patterns arise.

### 6.4 Classical Determinism as Stabilized Collapse Dynamics

Classical determinism is traditionally interpreted as evidence that the underlying laws of reality are themselves fundamentally deterministic. CUWF offers a different interpretation. Determinism is treated as an effective description arising from deep structural stability.

In stabilized regimes, successive collapse configurations satisfy:

$$C_{n+1} \approx F(C_n)$$

where  $F$  represents an effective evolution map constrained by entropic stabilization.

Because deviations are suppressed rather than amplified, the system behaves as though it were governed by deterministic equations. This appearance of determinism persists so long as entropic constraints remain saturated and collapse configurations remain confined to a stable basin.

Classical determinism therefore reflects the robustness of stabilized collapse dynamics rather than the disappearance of all underlying indeterminacy. Quantum indeterminacy has not been abolished; it has become structurally irrelevant within the stabilized regime.

### 6.5 Summary: Stability as the Bridge Between Quantum and Classical Behavior

The transition from quantum indeterminacy to classical predictability is governed by the growing dominance of structural stability over pathway competition. Interference fades as non-dominant pathways lose support, superposition becomes progressively unsupported without the need for collapse postulates, and predictable behavior emerges through configuration persistence.

Classical determinism is thus revealed not as a fundamental principle, but as an emergent consequence of stabilized collapse dynamics. The quantum–classical transition is continuous, structural, and autonomous, requiring neither special measurement rules nor observer intervention.

With this bridge established, the paper can now examine how scale, complexity, and environmental coupling modulate stabilization and shape the observable classical world.