FRC 100.004 — Quantum Foundations in Fractal Resonance Cognition

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H. Servat

Abstract

We propose a deterministic, resonance–based account of measurement and entanglement. The central idea is that "collapse" corresponds to phase–locking (attractor selection) in a coherence field, so that outcomes appear random macroscopically while the dynamics is lawful. We present a minimal extension of standard open–system dynamics with a small coherence drift, derive qualitative predictions (weak pre–collapse drift; dephasing asymmetry near pointer coupling), and provide reproducible simulations that contrast Fractal Resonance Cognition (FRC) with baseline quantum models. The program is falsifiable: if the predicted pre–collapse signatures are absent in weak–measurement protocols, the resonance hypothesis is ruled out in the tested regime.

1. Introduction

Mainstream interpretations (Copenhagen, Many–Worlds, Bohm, GRW) disagree on the nature of collapse. FRC posits a simpler mechanism: measurement outcomes are the result of a resonance process that phase–locks the system–apparatus state to a pointer attractor. This paper formalizes that idea in the smallest possible way and lists concrete experimental discriminants.

2. Minimal Formalism

Let $\rho(t)$ be the density operator. Write a baseline open–system equation $\dot{\rho} = L[\rho]$ (e.g., Lindblad), and introduce a small coherence drift

$$\dot{\rho} \;=\; L[\rho] \;+\; \alpha\, \nabla_{\rho} \ln C[\rho], \qquad 0 < \alpha \ll 1, \tag{1}$$

with a coherence functional $C[\rho]$ (we use $C[\rho] = \exp[-S(\rho)/k_*]$; S may be von Neumann or a tractable proxy). In the limit $\alpha \to 0$ we recover standard QM. The drift encodes a tendency to ascend the coherence gradient; Appendix A sketches a dissipation inequality inherited from the FRC 566 UCC.

Measurement model (pointer basis). Couple a system observable A to an apparatus pointer via $H_P = g\, A \otimes P$. For $g > 0$, the pointer basis of A becomes a resonant attractor family. The coherence drift weakly biases trajectories toward these attractors; Born weights are recovered as $\alpha \to 0$.

3. Predictions (falsifiable)

(P1) Weak pre–collapse drift. In sequential weak measurements prior to a strong readout, the mean coherence exhibits a small ascent $\Delta S \approx -k_* \Delta \ln C > 0$ before phase–lock.
(P2) Dephasing asymmetry vs pointer coupling. In interferometers with tunable pointer coupling g, FRC predicts a small, systematic deviation in visibility $\mathcal{V}(g)$ relative to standard open–system fits; curves separate near resonant match.

4. Simulations (reproducible)

We provide two minimal simulations (code/100.004/): (i) a weak–measurement toy showing pre–collapse drift and locking time distributions vs α; (ii) an interferometer visibility toy comparing standard vs FRC curves as a function of coupling g. Figures are generated by `make_figures.py` and written to `artifacts/100.004/`.

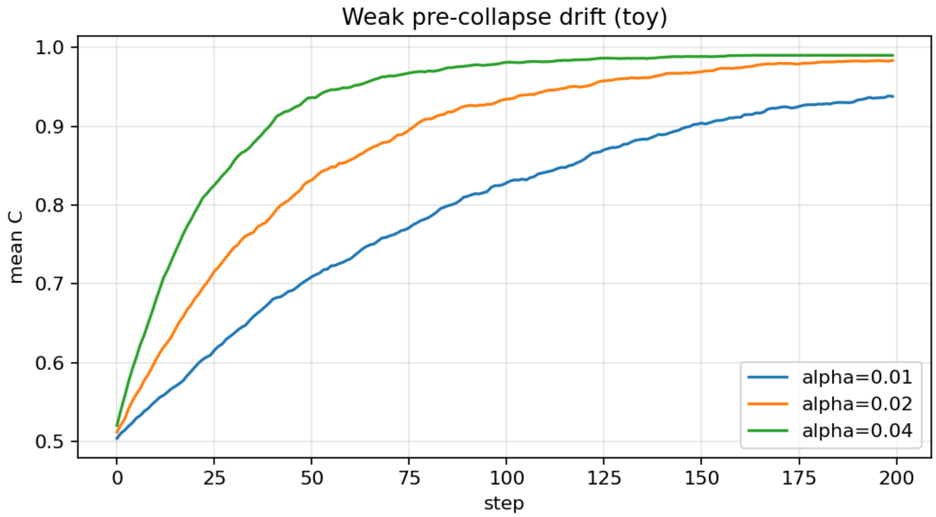

Figure 1. Weak pre–collapse drift and locking times vs α (toy model; seeds fixed).

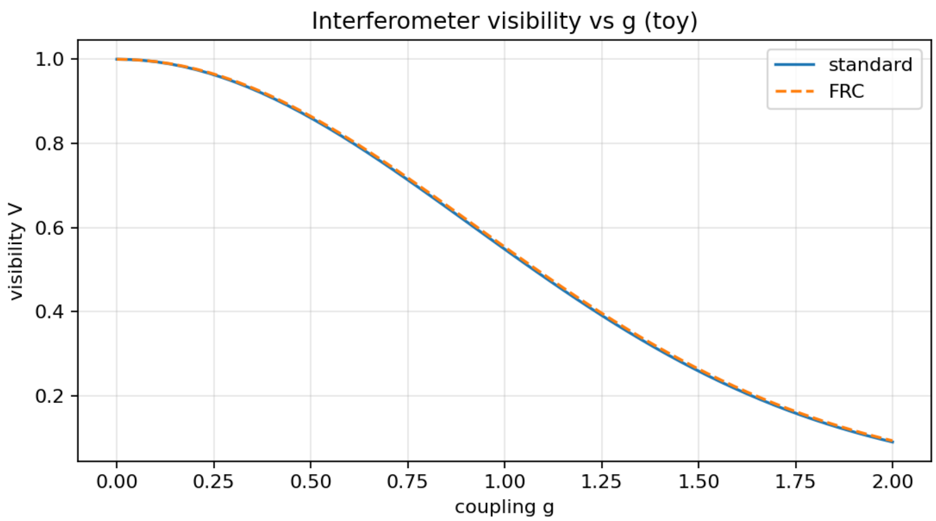

Figure 2. Interferometer visibility $\mathcal{V}(g)$: standard vs FRC toy fits (separation near resonant match).

5. Comparisons and Limits

- **Copenhagen:** collapse postulated; no dynamical mechanism.
- **Many–Worlds:** unitary only; effective collapse by branching; FRC posits real phase–locking with small drift.
- **Bohm:** deterministic trajectories; FRC is deterministic in coherence space rather than position.
- **GRW:** stochastic collapse; FRC uses deterministic drift with noise only through the environment.

Limits: small–α regime; energy accounting; no–signaling constraints; falsifiability via (P1) and (P2).

6. Reproducibility

Code is under `code/100.004/` with a one–command script `make_figures.py`. Figures are regenerated into `artifacts/100.004/`; random seeds are fixed for exact reproduction.

References

- FRC 566.001 — Entropy–Coherence Reciprocity and UCC. DOI: 10.5281/zenodo.17437759.
- FRC 100.003 — Resonant Collapse: Guided Wavefunction Collapse via Resonant Attractors. DOI: 10.5281/zenodo.15079820.
- FRC 100.003.566 — UCC and Dissipation (Scientific Note). DOI: 10.5281/zenodo.17437878.

Appendix A: Dissipation Sketch

Let $C = \exp[-S/k_*]$. In the open–system setting with drift, one obtains a nonnegative production term $\propto \int \|\nabla \ln C\|^2$ under standard boundary conditions, consistent with the UCC dissipation in FRC 566.