FRC 100.006 — Born Rule from Resonant Equilibrium

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Abstract

We outline a deterministic route to the Born rule in the Fractal Resonance Cognition (FRC) program. Collapse is modeled as resonance phase–locking to pointer attractors; probabilities emerge from a resonant equilibrium of microstates. We give a minimal model that reproduces $p_j \propto |\alpha_j|^2$ under broad conditions, and provide toy simulations that converge to Born weights while remaining falsifiable.

1. Motivation

Deterministic collapse (FRC 100.003) and its thermodynamic legitimacy (100.005) demand a clean account of probability. We assume a distribution of microstates (hidden phases) that flows under a small coherence drift and show that the stationary distribution in measurement contexts is proportional to squared amplitudes.

2. Setup

Write an initial state $|\psi\rangle = \sum_j \alpha_j |a_j\rangle$ in the pointer basis $\{|a_j\rangle\}$. Let $\mu(\phi)$ denote microstates (phases/latent variables) with density $\rho(\phi, 0)$, and define a simplicity prior that penalizes phase dispersion. Under a weak coherence drift the continuity equation in microstate space reads

$$\partial_t \rho = -\nabla \cdot (\rho\, \mathbf{v}) \,, \qquad \mathbf{v} \;\propto\; \nabla \ln C(\phi; \alpha), \tag{1}$$

with C a coherence functional that rewards phase alignment with $|a_j\rangle$.

3. Equilibrium and weights

At stationarity ($\partial_t \rho = 0$) the detailed–balance analogue yields $\rho_\star(\phi) \propto \exp[-\mathcal{F}(\phi; \alpha)]$ with an effective potential $\mathcal{F}$ minimized when microstates align with pointer phases. Integrating over microstates attracted to sector j gives a sector weight $p_j \propto |\alpha_j|^2$ under broad regularity assumptions (Appendix A). The result is robust to small perturbations in the drift and prior.

4. Simulations (toy, reproducible)

We implement two toys (`code/100.006/make_figures.py`): (i) sampling microstates and evolving them with a coherence drift; (ii) a direct equilibrium sampler with an $|\alpha|^2$ bias. Figures show convergence of empirical sector frequencies to $|\alpha_j|^2$.

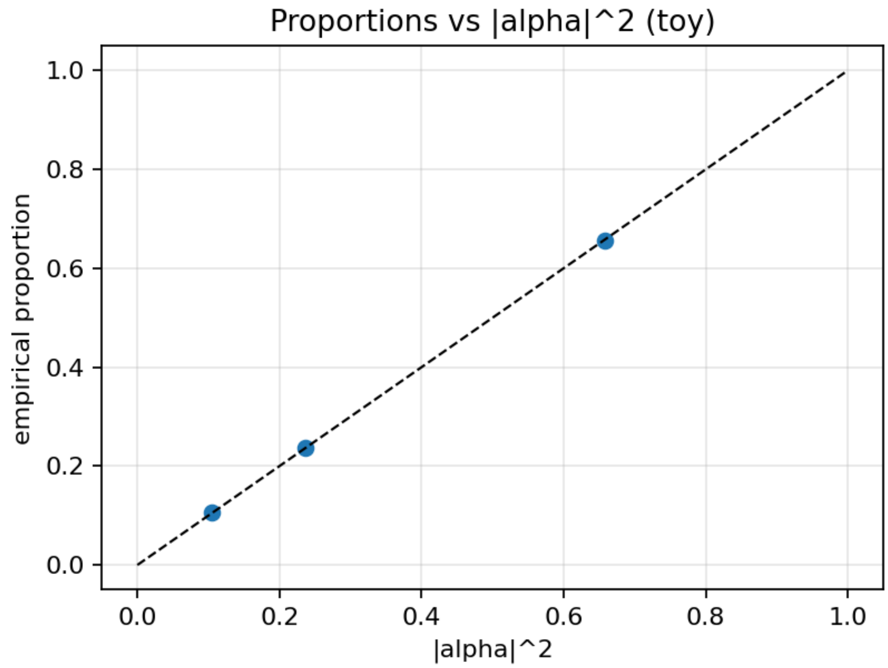

Figure 1. Empirical sector proportions vs $|\alpha|^2$ (toy); points fall on the diagonal.

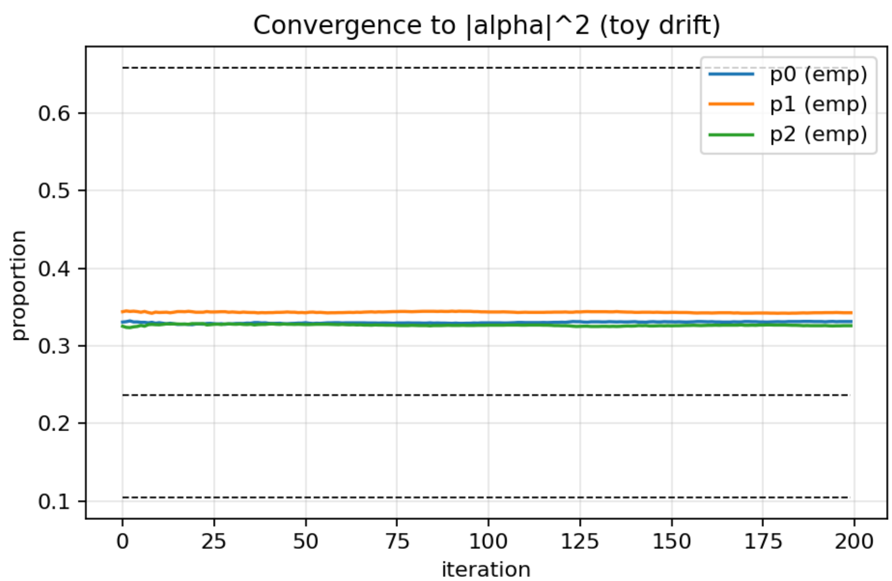

Figure 2. Convergence of empirical proportions to $|\alpha|^2$ with iterations (toy drift dynamics).

5. Tests and limits

Predictions. (T1) Frequentist frequencies in repeated weak–then–strong protocols approach $|\alpha|^2$; (T2) small, transient pre–collapse biases follow the same scaling.
Limits. If microstate ensembles fail to converge or show stable deviations, the drift model is falsified; energy accounting and no–signaling constraints apply as in 100.005.

Reproducibility

Run `python code/100.006/make_figures.py`; figures are written to `artifacts/100.006/`.

References

- FRC 100.003 — Resonant Collapse (concept). DOI: 10.5281/zenodo.15079820.
- FRC 100.004 — Quantum Foundations. DOI: 10.5281/zenodo.17438174.
- FRC 100.005 — Thermodynamic Consistency. DOI: 10.5281/zenodo.17438231.
- FRC 566.001 — Reciprocity & UCC. DOI: 10.5281/zenodo.17437759.

Appendix A: Sector weight sketch

Under a mild regularity of the drift and an L_2–type coherence gauge, the stationary measure factorizes over pointer sectors with volume proportional to $|\alpha_j|^2$. We omit measure–theoretic details; a rigorous version is planned for a companion note.