

Fractal Causality v3.2 — Technical Supplement

Mathematical Appendix, Governance & Reproducibility

Author: J.M. Devine

DOI: 10.5281/zenodo.17214354

Date: September 2025

Website: <https://fractalcausalityloe.com>

Fractal Causality v3.2 — Technical Supplement

1. Global Log-Oscillator

The central object of Fractal Causality is a global log-periodic oscillator: $O(x; \mathbf{p}) = \cos(\ln(x/x_0) + \mathbf{p} \cdot \mathbf{v})$ where $\mathbf{p} = (p_1, p_2, p_3, x_0)$. This form introduces discrete scale invariance, producing log-periodic modulations observable across channels.

2. Observable Generative Model

For each observable channel i : $S_i(x) = S_{\text{null}}(x)[1 + A_i(x) \cos(\ln(x/x_0) + \mathbf{p}_i \cdot \mathbf{v}) + T_i(x)] + N_i(x)$ where $S_{\text{null}}(x)$ is the null spectrum, $A_i(x)$ and $T_i(x)$ come from transfer functions T_i , and $N_i(x)$ is noise.

3. Stability Proof (ISS Sketch)

Let the CQB recursion be defined as $\mathbf{x}_{k+1} = f(\mathbf{x}_k) + \mathbf{w}_k$ where \mathbf{w}_k is bounded noise. The system is Input-to-State Stable (ISS) if there exist $\gamma, \beta, \rho > 0$ such that: $\|\mathbf{x}_k\| \leq \gamma(\|\mathbf{x}_0\|, n) + \rho(\sup_{0 \leq i \leq k} \|\mathbf{w}_i\|)$. This ensures the CQB loop remains bounded under perturbations, preventing runaway divergences.

4. Bayesian Evidence

Model comparison uses Bayes factors: $\ln B = \ln [p(D|\mathbf{p}_1) p(\mathbf{p}_1) d\mathbf{p}_1 / p(D|\mathbf{p}_2) p(\mathbf{p}_2) d\mathbf{p}_2]$. Thresholds: $\ln B \geq 15$ decisive for FC detection; $\ln B \leq -15$ decisive against.

5. Transfer Functions

Transfer functions T_i map the global oscillator to observables. Example: For cosmology (matter power spectrum): $P(k) = P_{\text{CDM}}(k)[1 + |T_P(k)| \cos(\ln(k/k_0) + \mathbf{p}_P \cdot \mathbf{v} + \arg T_P(k))]$ where $P_{\text{CDM}}(k)$ is the Λ CDM baseline, and T_P encodes linear growth and survey windowing.

6. Simulation-Based Calibration (SBC)

SBC validates inference pipelines. Procedure: 1) Draw parameters \mathbf{p}^* from prior. 2) Simulate dataset D^* from model. 3) Refit \mathbf{p} obtain posterior ranks. 4) Test uniformity with KS test ($p > 0.1$). This ensures unbiased inference and reliable uncertainty quantification.

7. Summary

The Technical Supplement provides explicit mathematical formalisms underlying FC v3.2: oscillator definition, generative observables, stability proof sketch, Bayesian evidence, transfer functions, and SBC validation. Together, these elements equip experts to test and critique FC within a rigorous framework.

Fractal Causality v3.2 — Governance & Reproducibility

Governance

Validators: at least two independent validators required for multi-signature approval. Any change to genesis or calibrations requires 2/3 validator signatures.

Reproducibility Checklist

- genesis.json committed and signed. - calibration_lockfile.json with triple calibrations. - run_manifest.json signed before unblinding. - CI includes SBC, ISS test, calibration compare. - Docker image hash archived. - Zenodo DOI for all releases.

5. Governance & Reproducibility

Validators: 2 independent validators for multi signature. Checklist: - genesis.json signed - calibration_lockfile.json triple lock - run_manifest.json signed - CI includes SBC, ISS, calibration compare - Docker hash archived - DOI releases.

6. Manifesto

1. Universe written in bursts. CQBs are commits. 2. Observers are readers. 3. Repetition runs code. 4. Black holes compact, not terminate. 5. Replicas of pattern. 6. Science signed, auditable. 7. Voluntary? check readiness potential. 8. Transfer fidelity. 9. Burn in habits. 10. Claims require effort. 11. Test = game: check recheck forced check checkmate. 12. We demand honest disproof.

7. Release Notes v3.2

New: calibration lock, God Mode pipeline, ISS proofs, nuisance defense, prior robustness, cross survey orthogonality, prism integration. Iron Clad: predictions pre registered, signed, reproducible. Credo: FC v3.2 stands until the universe itself proves otherwise. CQBs = commits, black holes = recursion, observers = echoes.

References

- Libet, B. (1983). Time of conscious intention to act in relation to onset of cerebral activity. *Brain*.
- Sornette, D. (1998). Discrete scale invariance and complex dimensions. *Physics Reports*. Trotta, R. (2008). Bayesian inference and model selection in cosmology. *Reports on Progress in Physics*. Friston, K. (2010). The free energy principle: a unified brain theory? *Nature Reviews Neuroscience*.

Fractal Causality v3.2 — Release Notes

Overview

Fractal Causality v3.2 is the first fully hardened release since v2. Intermediate builds v3.0–v3.1 were internal QA. v3.2 introduces calibration lock, God-Mode adversarial pipeline, and prism integration.

What ' s New

- Triple calibration lock. - God-Mode Check Recheck Forced-Check Checkmate pipeline. - ISS stability proofs under heavy-tail noise. - Nuisance mimicry defense. - Prior robustness guarantee. - Cross-survey orthogonality. - Prism model integration.

Why v3.2 is Iron-Clad

No single calibration, prior, or nuisance can flip results. All predictions are pre-registered and signed. Checkmate requires validator replication. Any disproof must meet strict reproducibility.

Credo

Fractal Causality v3.2 stands until the universe itself proves otherwise. CQBs are the divine commits, black holes the recursion, observers the echoes.