Fractal Causality: Mathematical Skeleton (v2)

This document provides the cleaned mathematical framework for Fractal Causality (FC), focusing solely on the testable equations without philosophical narrative.

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1. Power Spectrum Template

The core testable prediction is a log-periodically modulated power spectrum:

$P(k) = P_{LCDM}(k) * [1 + \varepsilon \cos(\omega \ln(k/k0) + \phi)]$

where:
ε = echo amplitude (strength of modulation)
ω = log-frequency of oscillation
k0 = pivot scale
ϕ = phase

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2. Parameter Priors (for testing)

$\varepsilon \in [-0.1, 0.1]$
$\omega \in [1, 50]$
$\phi \in [0, 2\pi)$
k0 chosen within survey's k-range (e.g., 0.01–0.2 h/Mpc)

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3. Predictions

• Residuals $\Delta P(k) = P_{data}(k) – P_{LCDM}(k)$ should show oscillations matching the template.
• Bispectrum B(k1, k2, k3) should exhibit phase-coherent oscillations with the same ω, ϕ.
• Cross-dataset consistency: true signals must persist across independent surveys.

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4. Extensions

Beyond cosmology, FC suggests that log-periodic echoes may appear in:
• Stochastic gravitational wave background spectra $\Omega_{GW}(f)$.
• Correlated optical clock fluctuations across large baselines.

Conclusion

This skeleton is meant for direct testing: fit the above template to cosmological and physical datasets, compare Bayesian evidence (Z_{FC} vs Z_{null}), and assess support for or against FC.