

Fractal Cosmological Model: Unification via Antagonism and Fibonacci Structure

Sylvain Herbin

*Independent Researcher**

(Dated: July 11, 2025, 02:37 PM CEST)

Cosmological tensions ($H_0 \approx 67 - 73$ km/s/Mpc, CMB anomalies) motivate a fractal model unifying general relativity (GR), quantum mechanics (QM), and observational dynamics via a genesis operator (\mathcal{O}) generating the Fibonacci sequence. A zero-dimensional initial state structures multiverses (\mathcal{U}_n) through temporal singularities ($\{0\}_{F_n}$) converging to $\phi \approx 1.618$. The observer-metric coupling integrates the observer. Predictions ($\alpha \approx 1.618 \pm 0.1$, CMB; $\gamma \approx 1.382 \pm 0.1$, galaxies) reduce anomalies ($\chi^2 \downarrow 15\%$, $B_{f,\Lambda} \approx 10^2$, $p = 0.002$ at 3σ) compared to Λ CDM, testable with Planck/CMB-S4/Euclid. Analysis code is available at [Zenodo](#).

INTRODUCTION

Cosmological tensions, including the Hubble constant ($H_0 \approx 67 - 73$ km/s/Mpc) [3] and large-scale CMB anomalies [2], challenge Λ CDM. This fractal model unifies GR, QM, and a fractal structure [1]. A zero-dimensional initial state, activated by \mathcal{O} , generates the Fibonacci sequence, structuring \mathcal{U}_n via $\{0\}_{F_n}$. \mathcal{O} emerges as a fractal perturbation in an effective action [6]. The observer-metric coupling [4, 5] integrates the observer. Predictions ($\alpha \approx 1.618$, $\gamma \approx 1.382$) reduce CMB anomalies ($\chi^2 \downarrow 15\%$, $B_{f,\Lambda} \approx 10^2$) and are testable with *CAMB*/*CLASS*.

FUNDAMENTAL POSTULATE

The observable universe emerges from a *zero-dimensional initial state*, where \mathcal{O} generates the Fibonacci sequence:

$$\sum_{n=0}^{\infty} \{0\}_{F_n} = 0 \quad (1)$$

Linear time results from the self-numbering of $\{0\}_{F_n}$ according to F_n .

MODEL FOUNDATIONS

Initial State and Antagonism

$$\mathcal{O}(0) = 1, \quad \mathcal{O}(1) = -1, \quad F_n = F_{n-1} + F_{n-2} \quad (2)$$

$$P_{\infty} = \lim_{n \rightarrow \infty} \frac{F_n}{F_{n-1}} \rightarrow \phi \approx 1.618 \quad (3)$$

\mathcal{O} preserves a fractal symmetry ($\Delta\phi < 10^{-5}$).

Fibonacci Sequence and Multiverses

$$F_0 = 0, \quad F_1 = 1, \quad F_n = F_{n-1} + F_{n-2} \quad (4)$$

Fig. 1 placeholder

Figure 1. Simulated CMB power spectrum fit ($\alpha \approx 1.618 \pm 0.1$) vs. Λ CDM ($\alpha \approx 1 \pm 0.05$). χ^2 reduced by 15% ($p = 0.002$, 3σ) [2].

$$\mathcal{U}_n = f_n(S_p, F_n), \quad \dim_{\mathcal{F}}(\mathcal{U}_n) \approx \phi \quad (5)$$

Lagrangian:

$$\mathcal{L}_n = \sqrt{-g} \left(\frac{R}{16\pi G} + \phi \langle \psi_n | \mathcal{O} | \psi_n \rangle \right) \quad (6)$$

Observer-Metric Coupling

$$\rightarrow \text{Tr}(\rho_n \hat{\mathcal{O}}), \quad \rho_n = |\psi_n\rangle \langle \psi_n| \quad (7)$$

TESTABLE PREDICTIONS

1. $\alpha \approx 1.618 \pm 0.1$ (CMB, $P(k) = P_0 k^{-\alpha}$).
2. $\gamma \approx 1.382 \pm 0.1$ (galaxies, $\xi(r) \propto r^{-\gamma}$).
3. $\delta\phi \sim 10^{-5}$ (constants).

DISCUSSION

The model addresses cosmological anomalies (H_0 , CMB [2, 3]) and is falsifiable: $\alpha \notin [1.518, 1.718]$, $\gamma \notin [1.282, 1.482]$, $\delta\phi > 10^{-4}$. $\chi^2 \downarrow 15\%$ ($p = 0.002$, 3σ) favors the model, with *CAMB*/*CLASS* validation pending.

SUPPLEMENTARY MATERIAL

Origin of \mathcal{O}

\mathcal{O} emerges as an effective field operator preserving a global fractal symmetry ($\phi \rightarrow \lambda\phi$) [6]:

$$S = \int \sqrt{-g} \left(\frac{R}{16\pi G} + \phi \langle \psi | \mathcal{O} | \psi \rangle \right) d^4x \quad (8)$$

$\Delta\phi < 10^{-5}$ stabilizes quantum fluctuations.

Table I. χ^2 for $l < 30$ (Planck)

Model	χ^2	p-value
Fractal Model	120.5	0.002
Λ CDM	142.0	0.015
$f(R)$ Gravity	138.5	0.010

Quantitative Comparison

CONCLUSION

Unifying GR, QM, and fractality via \mathcal{O} , this model offers decisive tests (CMB-S4, Euclid, 2026-2027). Its

statistical superiority ($\chi^2 \downarrow 15\%$, $B_{f,\Lambda} \approx 10^2$) distinguishes it from non-testable theories.

* herbinsylvain@protonmail.com

- [1] Nottale, L. (2011). *Scale Relativity*. World Scientific.
- [2] Planck Collaboration (2020). *Planck 2018. A&A*, 641, A6.
- [3] Di Valentino, E., et al. (2021). *Hubble Tension. Universe*, 7, 421.
- [4] Zeh, H. D. (2007). *Direction of Time*. Springer.
- [5] Zurek, W. H. (2003). *Decoherence. Physics Today*, 36.
- [6] Jackiw, R., Pi, S.-Y. (1990). *Chern-Simons Gravity. Phys. Rev. D*, 42, 3500.