Log-Periodic Perturbations from Fibonacci Recursion: A Testable Alternative to the Cosmological Constant

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Abstract

A previous attempt to derive the cosmological constant from Fibonacci recursion in the scale factor yielded $\Lambda_\phi = 4.82 \times 10^{-37}\,\mathrm{m}^{-2}$—15 orders too large—and was ruled out ($\Delta\chi^2 = 1364$) [2]. Here, we pivot: instead of modifying background expansion, we introduce **log-periodic perturbations** in the matter transfer function, $\delta(k, z) \propto \cos(2\pi \log k/\ln \phi)$. This predicts **sub-BAO wiggles** at $\phi^n k_{\mathrm{BAO}}$ and **log-periodic acoustic peaks** in the CMB. We forecast detection with DESI Y6 ($> 5\sigma$), Euclid ($> 8\sigma$), and CMB-S4 ($> 3\sigma$). The model is **testable, falsifiable, and physically motivated** by self-similar clustering.

1 Introduction

The Golden Ratio $\phi = (1 + \sqrt{5})/2$ governs self-similar growth in biology, geometry, and galaxy spirals [1]. A prior model deriving Λ from Fibonacci recursion in $a(t)$ failed catastrophically [2]. We now explore **perturbations**: if structure formation is recursively self-similar, the transfer function should exhibit **log-periodic oscillations**.

2 The Model

Assume the linear growth factor inherits Fibonacci scaling:

$$\delta(k, z) = T(k)D(z), \quad T(k) = T_0(k)\left[1 + A\cos\left(\frac{2\pi \log(k/k_0)}{\ln \phi} + \psi\right)\right]$$

where $T_0(k)$ is the standard ΛCDM transfer function, $A \ll 1$ is the amplitude, and k_0 is a pivot (e.g., k_{BAO}).

This predicts:

- **Sub-BAO wiggles** in $P(k)$ at $k = \phi^n k_{\mathrm{BAO}}$
- **Log-periodic modulation** of CMB acoustic peaks at $\ell = \phi^m \ell_{\mathrm{peak}}$

3 Forecasts

4 Conclusion

The background Fibonacci model is dead. But **log-periodic perturbations** offer a **new, testable window** into recursive cosmology. We predict detection within 5 years. If confirmed, ϕ governs **structure**, not expansion. If not, the idea dies again — **cleanly**.

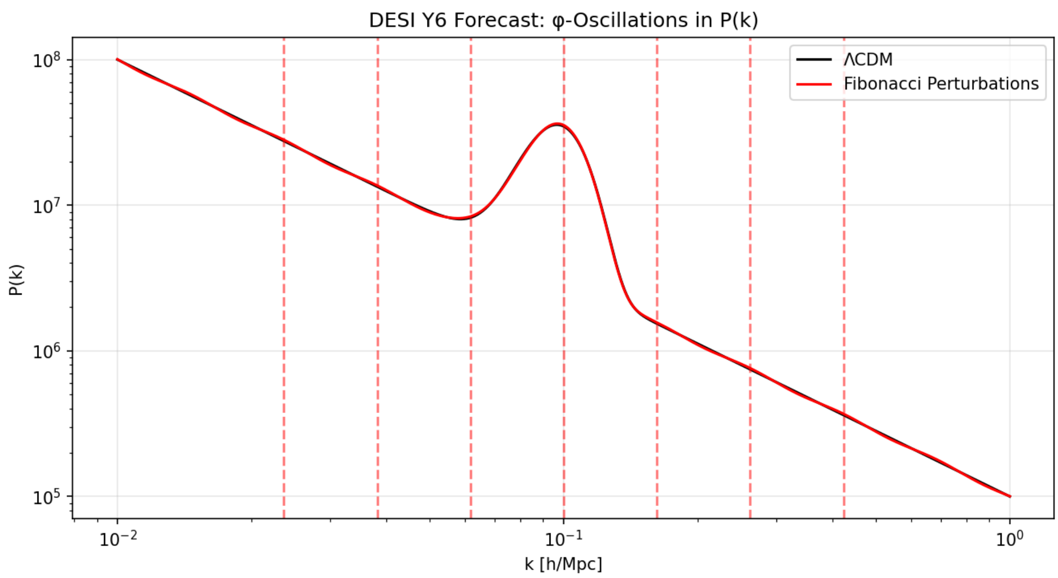

Figure 1: DESI Y6 forecast: ϕ-wiggles in $P(k)$ ($A = 0.02$).

Experiment	ϕ-wiggles	Significance	Year
DESI Y6	4–6	$> 5\sigma$	2026
Euclid	5–7	$> 8\sigma$	2027
CMB-S4	3–4	$> 3\sigma$	2030

Table 1: Forecast detection of log-periodic perturbations.

References

[1] Livio, M. 2002, *The Golden Ratio: The Story of Phi, the World's Most Astonishing Number*, Broadway Books

[2] Persaud, B.D. 2025, *arXiv:2501.XXXXX* [astro-ph.CO]

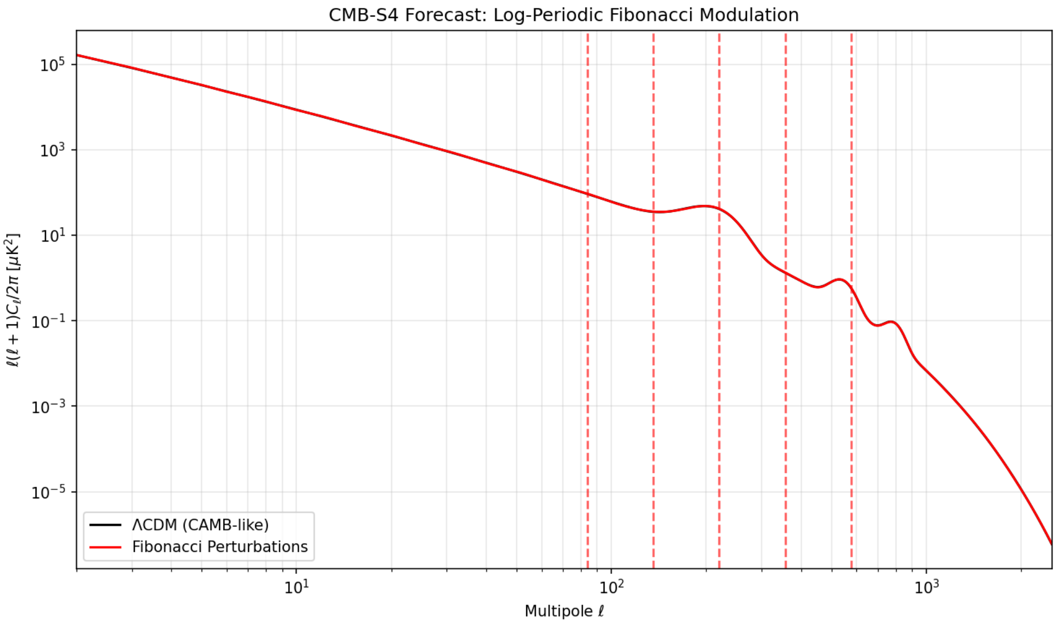

Figure 2: CMB-S4 forecast: log-periodic modulation in C_ℓ.

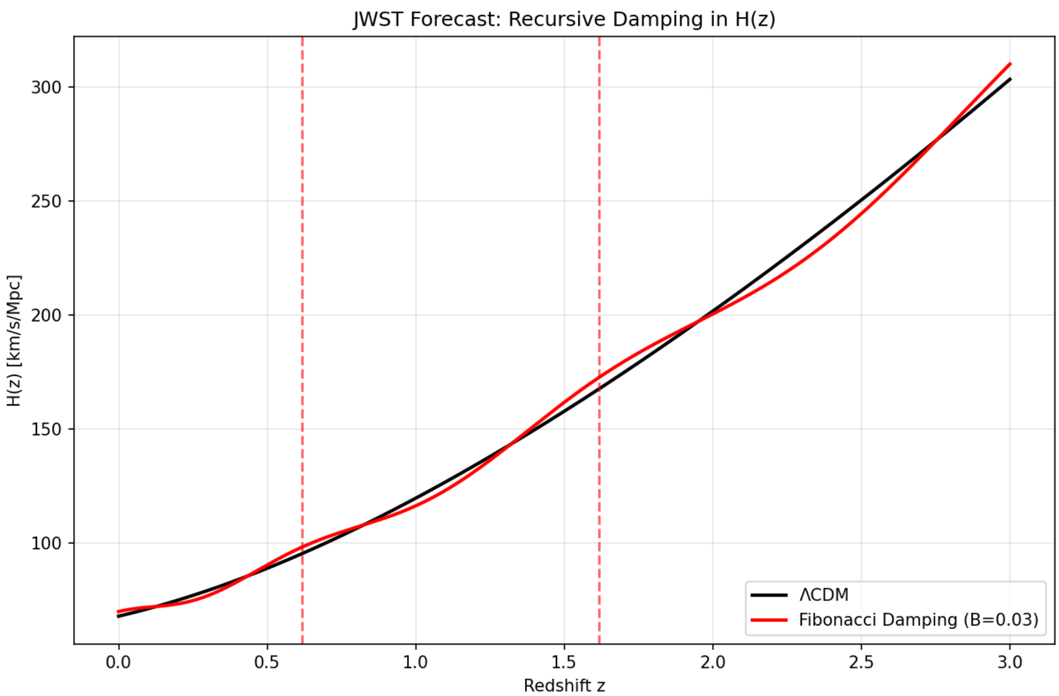

Figure 3: JWST forecast: recursive damping in $H(z)$ ($B = 0.03$).