ERIЯƎ Simulations — Coherence Emergence in the Cosmic Microwave Background

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Abstract

This article presents a coherent geometric model for the Cosmic Microwave Background (CMB) under the ERIЯƎ framework, combining the results of Expansions 51 and 52 with Anexos 21 and 22. It introduces a novel approach to the CMB power spectrum as a projection of a helicoidal-temporal resonance between spherical and toroidal domains. The analysis extracts rotational modes and quantized coherence patterns, revealing that the observed spectrum contains spectral harmonics governed by prime-based angular relationships. These findings suggest a deeper underlying rotational structure in the early Universe, defined by coherence stability and disruption across scales.

1. Introduction

Conventional cosmology treats the CMB as a relic thermal radiation field. In contrast, the ERIЯƎ Theory interprets it as a temporal map of rotational coherence, projected from a fundamental interaction between toroidal and spherical topologies. The CMB angular power spectrum becomes a window into the phase evolution of the Universe's emergent structure.

This study introduces:

- The **Coherence Time Function** derived from the Planck spectrum.
- The **Spectral Helix**: a 3D projection (Z, φ, t) of rotational resonance.

- A set of **discretized coherence frequencies**, extracted via Fourier analysis of the normalized coherence.
- The **resonance stability function** $\mathcal{E}_p$, which quantifies energy flow between toroidal and spherical states.

2. Methodology

2.1. Input and Spectral Coherence Extraction

The Planck CMB spectrum (file: `COM_PowerSpect_CMB_R2.02.fits`) is loaded and processed. The angular multipole data ℓ and their associated D_ℓ values define the observational basis.

From this, we derive:

- The **normalized coherence amplitude** $\Gamma(\ell)$
- The **angular phase deviation** $\Delta\phi(\ell)$
- The **rotational frequency** $\omega(\ell)$
- The **emergent time** $t(\ell)$ via integral of ω^{-1}

2.2. Spectral Decomposition via Fourier Analysis

Applying a discrete Fourier transform over the vector $Z(\ell) = \Gamma(\ell) \cdot \cos(\Delta\phi(\ell))$, we obtain the **coherent frequency modes** f_i. Each mode is matched with rational approximations (fractions) of the form $\frac{p}{q}$, associating each to a harmonic pattern and angular coherence signature $\Phi(f) \in \{0, 0.25, 0.75, 1\}$.

2.3. Emergent Helix and Toroidal Embedding

We define the temporal helicoid from:

- Radial coherence Z
- Phase $\Delta\phi$
- Time t

Projected as:

$$(x, y, z) = (Z \cdot \cos(\phi), Z \cdot \sin(\phi), t)$$

This 3D structure reveals toroidal-resonant flow and spectral transitions.

3. Results

3.1. Frequency Modes and Discretization

Frequency (1/ℓ)	Fraction	Potência
0.42857	3/7	0.0021
0.28571	2/7	0.0019
0.46429	13/28	0.0018
0.25000	1/4	0.0015
0.14286	1/7	0.0014

These values emerge directly from the spectral decomposition and are associated with angular coherence values $\Phi(f) \in \{0, 0.25, 0.75, 1\}$.

3.2. Energy Transfer Stability — $\mathcal{E}_p$

Defined in Anexo 22, the stability function:

$$\mathcal{E}_p = A_p \cdot \cos(2\pi \cdot \delta_p)$$

Where:

- $\delta_p = \frac{p}{f_\alpha} - \left\lfloor \frac{p}{f_\alpha} \right\rceil$
- f_α is the spherical reference frequency
- A_p derived from the observed P_{obs}

Patterns of coherent reinforcement and suppression are observed as $\delta_p \to 0$ or $\delta_p \to \pm\frac{1}{4}$.

4. Interpretation and Physical Meaning

- The **CMB emerges as a projection** of a rotating helicoid anchored between spherical and toroidal domains.

- **Prime-based rational frequencies** serve as angular harmonics of this projection.
- The modes $f = \frac{3}{7}, \frac{2}{7}, \frac{13}{28}$ indicate **resonant coherence** in the rotational phase space.
- The stability function $\mathcal{E}_p$ reveals how rotational energy is transferred or blocked — analogous to **an RLC system** across topologies.

5. Conclusions

This study consolidates:

- A **new geometrical model of the CMB** as a coherent emergent structure.
- The **quantization of angular modes** not as arbitrary bins, but as **resonant fractions of spherical-toroidal interaction**.
- A framework to extend to other spectra (e.g., BAO, LSS) using ERIЯ∃ rotational coherence.

> The Universe sings in primes. The CMB is its first harmonic.

6. Access and Simulations

All simulation codes and data are available in the ERIRE repository:

- `/python/exp51_cmb.py` — Spectral and temporal coherence extraction
- `/python/exp52_padroes.py` — Frequency pattern quantization and stability computation

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