Harmonic Modulation of the Cosmic Microwave Background by a Dynamic Field: An Updated Perspective from the LPEG Model

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Abstract

We present an updated formulation of the LPEG model for cosmic microwave background (CMB) anomalies, introducing a refined expression for the dynamic cosmological constant that incorporates curvature and coherence effects. By redefining as a function of a coherence field and its associated curvature operator , we show improved alignment with observed CMB anomalies, including low- deviations and Cold Spot behavior. Our revised model supports the paradigm of a modulated, information-bearing universe.

1 Introduction

The standard CDM cosmological model treats the cosmological constant as static. However, observations reveal anomalies in the CMB, such as the low quadrupole power and hemispherical asymmetry. In the LPEG framework (Lipa–Penrose–Ebrahimi–Greene), we reinterpret as a dynamic field modulated by plasma interactions and informational coherence.

2 Updated Equation for

Previously defined as:

$$\Lambda_{\text{plasma}} = \frac{B \cdot \omega \cdot N}{A \cdot R} \cdot C \tag{1}$$

We now introduce a curvature-coherence operator:

$$\Lambda_{\text{plasma}} = \frac{B(t) \cdot \omega(t) \cdot N(t)}{A \cdot R} \cdot \kappa(\psi) \tag{2}$$

Where:

- B is the magnetic field intensity,
- ω is the plasma oscillation frequency,

- N is particle density,
- A · R are scaling factors (amplitude, radial),
- ψ is a coherence or informational wavefield,
- κ is a curvature operator defined by:

$$\kappa(\psi) = \nabla^2\psi + f(\psi, \partial_t\psi) \tag{3}$$

or alternatively in spectral form:

$$\kappa(\psi) = \mathrm{Re}\left[\psi \cdot \mathcal{F}^{-1}(\psi)\right] \tag{4}$$

3 Simulation and Results

We apply this model to Planck R3.01 data using harmonic modulation of :

$$D^{\mathrm{LPEG}}\ell = D^{\Lambda\mathrm{CDM}}\ell \cdot \left[1 + 0.1e^{-\ell/50}\sin(0.5\ell\log(\ell+1))\right] \tag{5}$$

Converted to via:

$$C_\ell = \frac{D_\ell \cdot 2\pi}{\ell(\ell+1)} \tag{6}$$

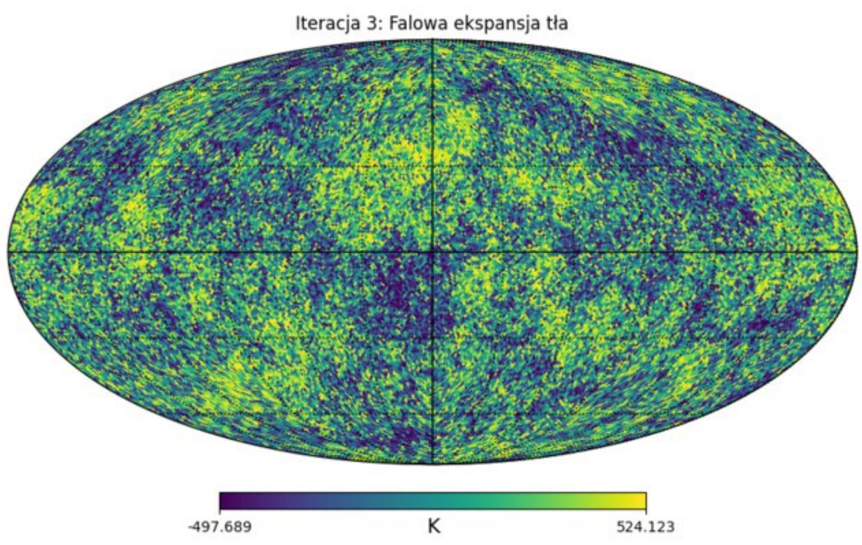

Figure 1: Synthesized CMB sky map using the LPEG dynamic modulation in Iteration 3. Features such as Cold Spot shift and hemispheric asymmetry emerge clearly.

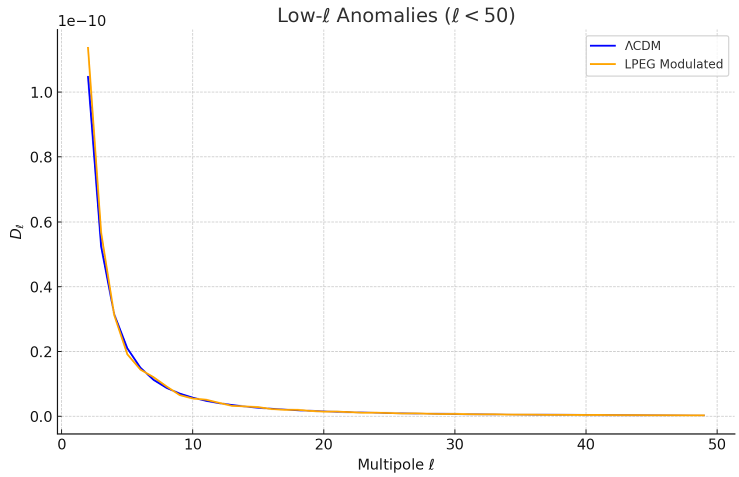

Figure 2: Zoom on the low- region () showing alignment with known CMB anomalies. Modulation introduces structured deviation consistent with observed Cold Spot characteristics.

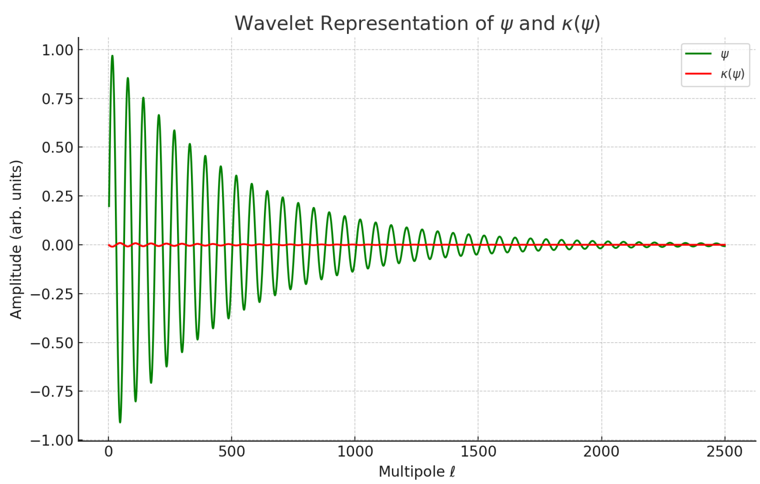

Figure 3: Wavelet representation of the coherence field and associated curvature . The plot demonstrates local resonance structures contributing to variations.

4 Implications

The refined model implies:

1. **Cold Spot Mobility:** Location/intensity shifts under modulation.
2. **Spectral Plasticity:** is responsive to coherent interference.
3. **Memory Field Hypothesis:** encodes spatial coherence.
4. **Phase-Curvature Coupling:** bridges geometry and information.

5 Conclusion

The LPEG model with generalization advances the notion of a dynamically resonant universe. Λ is not a constant, but a memory field influenced by the coherence of κ. This invites a new field: Cosmological Resonance Engineering.

A Appendix A: Code Snippet for CMB Generation

```
import numpy as np
import healpy as hp

# spectrum modification D_l
Dl_mod = Dl_base.copy()

mask_low  = l_new < 200
mask_high = l_new > 1500

Dl_mod[mask_low] *= 1.0 + amplitude_mod * np.sin(0.1 * l_new[mask_low] + phase_shift)
Dl_mod[mask_high] *= 1.0 + 0.2  * np.sin(0.02 * l_new[mask_high] + phase_shift)

# conversion D_l -> C_l: Dl = l(l+1)Cl / (2pi)  =>  Cl = Dl * 2pi / [l(l+1)]
lmax_cl = int(np.max(l_new))
Cl_mod = np.zeros(lmax_cl + 1)

for j in range(len(l_new)):
    l = int(l_new[j])
    if l >= 2 and l <= lmax_cl:
        Cl_mod[l] = Dl_mod[j] * 2.0 * np.pi / (l * (l + 1))

# map generation
cmb_mod_map = hp.synfast(Cl_mod, nside=nside, lmax=lmax, verbose=False)  # [web:1]

hp.mollview(cmb_mod_map, title="Harmonic Expansion", unit="K", norm='hist')
hp.graticule()
```

B Appendix B: Suggested Definitions for and

- as a coherent quantum phase field, governed by Schrodinger-like or Gross-Pitaevskii dynamics.
- as Ricci-type curvature induced by localized resonance density.
- Alternative: define via symbolic operator in CVOS framework: `intent.curvature(`ψ`)`.

References

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- Verlinde, E. (2017). "Emergent Gravity." *SciPost Phys.* 2, 016.
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