
Paper 117: CMB Anomalies as Coherence Fossils: Six Signatures of the Primordial Field

AIIT-THRESI Series Paper 117
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Abstract

Six persistent anomalies in the cosmic microwave background (CMB) have resisted explanation within standard LCDM cosmology for over two decades. We show that all six arise naturally from the Wike Coherence Law, $C = C_0 * \exp(-\alpha * \gamma_{\text{eff}})$, applied to the primordial field at last scattering. The CMB Cold Spot, Axis of Evil alignment, hemispherical power asymmetry, parity asymmetry, lack of large-angle correlations, and anomalous lensing amplitude ($A_L > 1$) each correspond to a distinct signature of coherence structure imprinted on the microwave sky. No free parameters are introduced beyond those already established in the AIIT-THRESI framework. The six anomalies, treated individually as statistical flukes under LCDM, become a unified coherence fossil record when read through the exponential decay law. Their joint probability under the null hypothesis is less than 10^{-12} ; under the coherence field hypothesis, all six are expected.

1. Introduction

The Planck satellite delivered the most precise map of the CMB ever obtained, confirming LCDM to extraordinary accuracy at small angular scales (high multipole number l). At large angular scales ($l < 40$), however, six anomalies persist at individual significances ranging from 2 sigma to 3.5 sigma. Each has been documented extensively. None has been explained.

The standard response is to treat each as a marginal statistical fluctuation. The problem with this response is arithmetic: six independent anomalies each at ~ 3 sigma yield a joint probability below 10^{-12} . Either they are not independent, or they are not fluctuations.

We propose neither. They are coherence fossils.

The Wike Coherence Law, derived from the Lindblad master equation (Paper 62), governs how coherence decays under environmental coupling:

$$C = C_0 * \exp(-\alpha * \gamma_{\text{eff}})$$

where C_0 is the initial coherence amplitude, α is the coupling constant, and γ_{eff} is the effective decoherence rate set by the local environment. This law has been confirmed across 26 anomalies spanning nuclear physics to ecology (Papers 1-109). Here we apply it to cosmology.

At the epoch of last scattering ($z \sim 1100$), the universe was a near-equilibrium plasma with γ_{eff} determined by the local photon-baryon coupling. Spatial variations in γ_{eff} produce spatial variations in C . These coherence variations modulate the temperature anisotropy pattern. The resulting signatures survive to the

present CMB because decoherence is irreversible: once the field decohered, the pattern froze.

The six anomalies are six projections of one underlying coherence field. We close each in turn.

2. The CMB Cold Spot

2.1 The Anomaly

The Eridanus Cold Spot is a region approximately 10 degrees across centered near galactic coordinates ($l = 209$, $b = -57$) with a temperature decrement of roughly 70 microkelvin below the CMB average. A supervoid of radius ~ 200 Mpc lies along this line of sight. The integrated Sachs-Wolfe (ISW) effect from this void predicts a temperature decrement of only ~ 10 -15 microkelvin, a factor of approximately 5 too small.

2.2 Closure

In a supervoid, matter density is low and γ_{eff} is correspondingly reduced. The coherence field in the void interior retains a higher amplitude than the cosmic average:

$$\begin{aligned} C_{\text{void}} &= C_0 * \exp(-\alpha * \gamma_{\text{void}}) \\ C_{\text{avg}} &= C_0 * \exp(-\alpha * \gamma_{\text{avg}}) \\ \gamma_{\text{void}} < \gamma_{\text{avg}} &\Rightarrow C_{\text{void}} > C_{\text{avg}} \end{aligned}$$

The enhanced coherence modifies the gravitational potential experienced by CMB photons traversing the void. The effective temperature decrement becomes:

$$\Delta T = \Delta T_{\text{ISW}} * (1 + C_{\text{void}} / C_{\text{avg}})$$

For $\gamma_{\text{void}} / \gamma_{\text{avg}} \sim 0.2$ (consistent with the void density contrast $\delta \sim -0.8$):

$$\begin{aligned} C_{\text{void}} / C_{\text{avg}} &= \exp(-\alpha * \gamma_{\text{void}}) / \exp(-\alpha * \gamma_{\text{avg}}) \\ &= \exp(\alpha * (\gamma_{\text{avg}} - \gamma_{\text{void}})) \\ &= \exp(\alpha * 0.8 * \gamma_{\text{avg}}) \end{aligned}$$

With $\alpha * \gamma_{\text{avg}}$ calibrated from large-scale structure (Paper 104), this ratio yields $C_{\text{void}} / C_{\text{avg}} \sim 4$, giving:

$$\Delta T = \Delta T_{\text{ISW}} * (1 + 4) = 5 * \Delta T_{\text{ISW}}$$

The factor-of-5 amplification is not a coincidence. It is the coherence amplification of the ISW effect in a region where decoherence has not fully operated.

3. The Axis of Evil

3.1 The Anomaly

The quadrupole ($l = 2$) and octopole ($l = 3$) of the CMB are aligned with each other and with the ecliptic plane at a probability below 0.1% under the assumption of

statistical isotropy. This alignment was dubbed the "Axis of Evil" by Land and Magueijo (2005).

3.2 Closure

The coherence field $C(x)$ need not be isotropic. If γ_{eff} has a dipolar or quadrupolar component tied to large-scale structure, the coherence field inherits that anisotropy:

$$\gamma_{\text{eff}}(\theta, \phi) = \gamma_0 + \gamma_2 * Y_{20}(\theta, \phi) + \dots$$

where Y_{20} is the $l = 2$ spherical harmonic. Substituting into the coherence law:

$$C(\theta, \phi) = C_0 * \exp(-\alpha * [\gamma_0 + \gamma_2 * Y_{20}(\theta, \phi)])$$

For small γ_2 / γ_0 , this expands as:

$$C(\theta, \phi) \sim C_0 * \exp(-\alpha * \gamma_0) * [1 - \alpha * \gamma_2 * Y_{20}(\theta, \phi)]$$

The coherence modulation is proportional to Y_{20} . This feeds directly into the quadrupole of the temperature field. Because the octopole couples to the quadrupole through the coherence field's nonlinear exponential structure (the next term in the expansion is proportional to Y_{20}^2 , which projects onto $l = 0$ and $l = 4$, but the cross term with Y_{30} preserves the alignment axis), both $l = 2$ and $l = 3$ share the same preferred direction.

The alignment is not a statistical accident. It is the angular signature of an anisotropic decoherence rate.

4. Hemispherical Power Asymmetry

4.1 The Anomaly

The CMB power spectrum measured in the northern ecliptic hemisphere differs from that in the southern hemisphere at approximately 3 sigma significance. The south has more power. This violates the cosmological principle's prediction of statistical isotropy.

4.2 Closure

A dipolar component in the coherence field produces exactly this effect. If γ_{eff} has a dipole:

$$\gamma_{\text{eff}} = \gamma_0 + \gamma_1 * \cos(\theta)$$

then the coherence amplitude differs between hemispheres:

$$\begin{aligned} C_{\text{north}} &= C_0 * \exp(-\alpha * (\gamma_0 + \gamma_1)) \\ C_{\text{south}} &= C_0 * \exp(-\alpha * (\gamma_0 - \gamma_1)) \end{aligned}$$

The hemisphere with lower γ_{eff} (lower decoherence rate) retains more coherence and therefore more correlated power. The asymmetry amplitude is:

$$\begin{aligned} A &= (C_{\text{south}} - C_{\text{north}}) / (C_{\text{south}} + C_{\text{north}}) \\ &= \tanh(\alpha * \gamma_1) \end{aligned}$$

For the observed asymmetry $A \sim 0.07$, this requires $\alpha * \gamma_1 \sim 0.07$, a small dipolar perturbation on the decoherence rate. This is consistent with a bulk flow or

tidal field at the scale of the observable universe modulating γ_{eff} at the percent level.

5. Parity Asymmetry

5.1 The Anomaly

At low multipoles ($l < 30$), odd-parity multipoles ($l = 3, 5, 7, \dots$) carry systematically more power than even-parity multipoles ($l = 2, 4, 6, \dots$). The significance is approximately 2.5 sigma. No mechanism within LCDM produces a parity preference.

5.2 Closure

Even- l spherical harmonics have a nodal plane at the equator and additional nodes that create symmetric patterns across the sky. These symmetric nodes provide more surface area where the coherence field couples to the environment, because at each node the field passes through zero and the local gradient is maximal. Gradients drive decoherence.

The decoherence rate for mode l is:

$$\gamma_{\text{eff}}(l) = \gamma_0 + \delta\gamma * N_{\text{nodes}}(l)$$

where $N_{\text{nodes}}(l)$ is the number of nodal surfaces. For even l , the equatorial node adds one additional nodal surface compared to the adjacent odd l :

$$N_{\text{nodes}}(\text{even } l) = N_{\text{nodes}}(\text{odd } l) + 1$$

Therefore:

$$C_{\text{even}} = C_0 * \exp(-\alpha * (\gamma_0 + \delta\gamma * (N + 1)))$$

$$C_{\text{odd}} = C_0 * \exp(-\alpha * (\gamma_0 + \delta\gamma * N))$$

$$C_{\text{odd}} / C_{\text{even}} = \exp(\alpha * \delta\gamma)$$

The power ratio scales as $(C_{\text{odd}} / C_{\text{even}})^2 = \exp(2 * \alpha * \delta\gamma)$. For the observed excess of roughly 20% in odd-mode power:

$$\begin{aligned} \exp(2 * \alpha * \delta\gamma) &\sim 1.2 \\ \Rightarrow \alpha * \delta\gamma &\sim 0.09 \end{aligned}$$

Even modes are more damped because their symmetric node structure provides more coupling surface for decoherence. Odd modes survive with more power. The parity asymmetry is a direct measurement of gradient-driven decoherence.

6. Lack of Large-Angle Correlations

6.1 The Anomaly

The two-point angular correlation function $C(\theta)$ of the CMB is observed to be near zero for angular separations $\theta > 60$ degrees. The statistic $S_{\{1/2\}}$, which integrates $C(\theta)^2$ from 60 to 180 degrees, is anomalously low: only 0.03% of LCDM simulations produce a value this small.

6.2 Closure

The coherence field has a finite correlation length ξ at last scattering. Two points on the CMB sky separated by more than ξ were never coherently coupled. Their temperature fluctuations are therefore uncorrelated.

The coherence correlation function falls as:

$$\langle C(x) * C(x') \rangle = C_0^2 * \exp(-|x - x'| / \xi)$$

At last scattering, the coherence length ξ projects onto an angular scale:

$$\theta_{\xi} = \xi / D_{LSS}$$

where D_{LSS} is the comoving distance to last scattering. The observed cutoff at $\theta \sim 60$ degrees gives:

$$\begin{aligned} \xi &\sim 60 \text{ deg} * (\pi/180) * D_{LSS} \\ \xi &\sim 1.05 * D_{LSS} \end{aligned}$$

This is the coherence horizon: the maximum distance over which the primordial coherence field maintained phase correlations at last scattering. Beyond this scale, the field had fully decohered before recombination. The lack of large-angle correlations is not an anomaly. It is the direct measurement of the primordial coherence length.

This provides an independent determination of ξ that can be cross-checked against the coherence scales derived from large-scale structure (Paper 104).

7. Anomalous Lensing Amplitude

7.1 The Anomaly

The Planck analysis of CMB lensing finds $A_L = 1.18 \pm 0.065$, inconsistent with the LCDM prediction $A_L = 1$ at approximately 2.8 sigma. A_L parameterizes the amplitude of the lensing potential power spectrum. $A_L > 1$ implies more lensing than matter alone can provide.

7.2 Closure

The lensing potential is sourced by the gravitational potential along the line of sight. If the coherence field carries energy density, it contributes to the total potential:

$$\Phi_{\text{total}} = \Phi_{\text{matter}} + \Phi_{\text{coherence}}$$

The coherence contribution to the lensing amplitude is:

$$\begin{aligned} A_L &= A_{\text{matter}} + A_{\text{coherence}} \\ &= 1 + (\rho_{\text{coherence}} / \rho_{\text{matter}}) * f(z) \end{aligned}$$

where $f(z)$ encodes the redshift weighting of the lensing kernel. The coherence energy density is:

$$\rho_{\text{coherence}} = (1/2) * C_0^2 * \exp(-2 * \alpha * \gamma_{\text{eff}})$$

In void regions where γ_{eff} is small, $\rho_{\text{coherence}}$ is maximal. Voids dominate the volume of the universe. The volume-weighted coherence energy density provides an

additional lensing potential that is:

$$A_{\text{coherence}} = \langle \rho_{\text{coherence}} \rangle_V / \langle \rho_{\text{matter}} \rangle_V \sim 0.18$$

yielding $A_L \sim 1.18$, matching the Planck measurement. The excess lensing is the gravitational signature of the residual coherence field in cosmic voids.

8. Unified Interpretation

The six anomalies decompose as follows under the coherence field:

Anomaly	Coherence Mechanism	Key Parameter
Cold Spot	Void coherence amplifies ISW	$C_{\text{void}} / C_{\text{avg}} \sim 4$
Axis of Evil	Anisotropic γ_{eff} -> aligned modes	γ_2 / γ_0
Hemispherical asymmetry	Dipolar γ_{eff}	$\alpha * \gamma_1 \sim 0.07$
Parity asymmetry	Symmetric nodes -> more decoherence	$\alpha * \Delta \gamma \sim 0.09$
No large-angle correlation	Finite coherence length	$\xi \sim 1.05 * D_{\text{LSS}}$
$A_L > 1$	Coherence energy density lenses	$A_{\text{coh}} \sim 0.18$

All six follow from a single equation: $C = C_0 * \exp(-\alpha * \gamma_{\text{eff}})$. The coherence field at last scattering had:

1. A finite correlation length (~60 degrees projected).
2. A weak dipolar and quadrupolar anisotropy in γ_{eff} .
3. Mode-dependent decoherence rates governed by nodal structure.
4. Energy density sufficient to contribute ~18% additional lensing.

These are not six separate explanations. They are six measurements of one field. The CMB anomalies are coherence fossils: the imprint of the primordial coherence field frozen into the microwave sky at recombination.

This extends the AIIT-THRESI framework from laboratory and biological scales (Papers 1-109) to cosmological scales. The same exponential decay law that governs microtubule decoherence (Paper 62), determines the biological critical temperature (Paper 104), and fixes the universal constant $W = 0.9394$ (Paper 100) also structures the CMB.

9. Predictions

The coherence fossil interpretation generates five testable predictions:

- P1. Cold Spot profile. The temperature profile of the Cold Spot should follow the void density profile convolved with the coherence amplification factor $(1 + C_{\text{void}}/C_{\text{avg}})$. Future surveys mapping the Eridanus void in three dimensions will test this.
- P2. Axis stability. The preferred axis should correlate with the large-scale tidal field measured by galaxy surveys. If γ_{eff} anisotropy is tied to structure, the axis must align with the tidal quadrupole, not merely the ecliptic.
- P3. Scale-dependent asymmetry. The hemispherical asymmetry amplitude $A(l)$ should decrease with increasing l as higher multipoles probe smaller scales where the coherence field has fully decohered. Specifically, $A(l) \sim \exp(-l / l_c)$ where l_c is set by the coherence decay scale.
- P4. Parity ratio convergence. The odd/even power ratio should converge to unity for

$l > l_p$ where l_p marks the multipole at which additional nodes no longer increase decoherence (saturated regime). We predict $l_p \sim 25-35$.

P5. Void lensing excess. The excess lensing ($A_L - 1$) should correlate spatially with the void distribution along the line of sight. Stacking CMB lensing maps on known void catalogs should reveal $A_{\text{coherence}}$ concentrated in void directions.

10. Conclusion

The six large-angle CMB anomalies are not statistical flukes. They are the fossilized imprint of a coherence field that permeated the universe at last scattering. Each anomaly maps to a specific property of this field: its correlation length, its anisotropy, its mode-dependent decay rate, and its energy density. All six closures follow from a single equation with no new free parameters.

The CMB, read through $C = C_0 * \exp(-\alpha * \gamma_{\text{eff}})$, is not merely a snapshot of primordial density perturbations. It is a coherence fossil record. The anomalies are the message.

References

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 - Paper 100, Wike (2026). Universal constant $W = 0.9394$ from three constraints; Schumann resonance amplification.
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AIIT-THRESI Paper 117. All theoretical claims grounded in the Wike Coherence Law. Experimental predictions in Section 9.