The Cosmic Microwave Background as Coherence Emission: A Holosphere-Based Model of Angular Re-Radiation

Michael J. Sarnowski

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Abstract

We propose that the cosmic microwave background (CMB) is not a relic of a primordial hot phase, but a continuous, steady-state emission arising from angular coherence decay in the structured Holosphere lattice. In this framework, spacetime is modeled as a nested, rotating array of Planck-scale Holospheres, where quantized angular phase transitions in high-n orbital shells produce blackbody-like radiation.

The CMB spectrum emerges naturally from transitions near $n \sim 970$, corresponding to a coherence breakdown threshold. This emission occurs at the outermost visible shell—termed the **decoherence zone**—beyond which photons become phase-incompatible with the observer's lattice and cannot propagate. The observed $\sim$2.725 K blackbody spectrum is thus a local phenomenon tied to each observer's **coherence horizon**, not a universal surface of last scattering.

This model replaces recombination with real-time angular re-radiation and offers falsifiable predictions regarding anisotropies, polarization, and temporal variation. The Holosphere coherence framework thus provides a geometric, phase-based alternative to Big Bang interpretations of the CMB.

1 Introduction

In standard cosmology, the cosmic microwave background (CMB) is viewed as relic radiation from the epoch of recombination, when the universe cooled enough for neutral atoms to form and photons to decouple from matter. This model depends on an expanding early universe, inflationary smoothing, and primordial density fluctuations.

Holosphere Theory offers a different foundation. Spacetime is modeled as a discrete, rotating lattice composed of nested Planck-scale units called Holospheres. Energy in this model is encoded in angular coherence, with quantized orbital shells indexed by n representing phase-aligned rotational states.

We propose that the CMB arises not from early thermal decoupling, but from real-time angular phase transitions in high-n coherence shells. These transitions are governed by a Rydberg-like energy scaling, leading to millimeter-wavelength photon emission near $n \sim 1000$—precisely the scale required to explain the CMB spectrum.

Most importantly, the CMB originates not from a universal last-scattering surface, but from the observer's own **decoherence zone**—the outermost radial shell where coherent photon propagation remains possible. Beyond this boundary, emitted light becomes phase-incompatible and fades into darkness. Thus, every observer sees a local version of the CMB at their own **coherence horizon**, defined by the limits of angular phase alignment in the Holosphere lattice.

This reinterpretation opens a new path to explain the CMB's blackbody spectrum, isotropy, and slight anisotropies—without invoking expansion, inflation, or recombination.

2 Coherence Shell Model and Quantized Transitions

Each Holosphere consists of nested coherence shells indexed by an integer n, representing angular phase alignment. The energy associated with each shell is given by

$$E_n = -\frac{E_0}{n^2}, \tag{1}$$

where E_0 is a characteristic coherence energy, likely related to the proton rest mass energy $E_0 \approx m_p c^2$.[3]

Transitions between shells release energy approximately:

$$\Delta E_n = E_{n+1} - E_n \approx \frac{2E_0}{n^3}, \tag{2}$$

which becomes increasingly small as n increases. The corresponding photon wavelength is then:

$$\lambda_n = \frac{hc \cdot n^3}{2E_0}, \tag{3}$$

leading to millimeter-scale emissions for $n \sim 1000$.

3 Emergent Blackbody Spectrum

For $E_0 \approx 1.503 \times 10^{-10}$ J (proton mass energy), and $n \sim 1000$, the wavelength becomes:

$$\lambda \approx \frac{6.626 \times 10^{-34} \cdot 3 \times 10^8 \cdot 10^9}{2 \cdot 1.503 \times 10^{-10}} \approx 0.66, \text{mm} \to 1.06, \text{mm}, \tag{4}$$

placing the peak in close alignment with the observed CMB spectrum. [2] This corresponds to a temperature:

$$T = \frac{E}{k_B} = \frac{hc}{\lambda k_B} \approx 2.725, \text{K}. \tag{5}$$

This temperature is not imposed, but arises from the balance between photon absorption by matter-bound Holospheres and their re-radiation through angular phase transitions. As photons are absorbed, they induce rotational strain in high-n shells; as the shells relax, they emit phase-aligned photons that collectively form a blackbody-like background.

4 Stability Thresholds and the Coherence Rydberg Limit

In atomic systems, the Rydberg formula defines a maximum bound state before ionization occurs, where energy levels become so closely spaced they effectively form a continuum. A similar concept applies in Holosphere Theory. As n increases, the energy difference between coherence shells approaches zero:

$$\Delta E_n \approx \frac{2E_0}{n^3} \tag{6}$$

This suggests the existence of a critical shell number n_c beyond which transitions become unstable or indistinguishable from background coherence noise.

We estimate this coherence breakdown point by equating the transition energy to the thermal energy of the CMB:

$$\Delta E_{n_c} = k_B T_{\text{CMB}} \approx 3.76 \times 10^{-23}\ \text{J} \tag{7}$$

Solving yields:

$$n_c = \left(\frac{2E_0}{k_B T_{\text{CMB}}} \right)^{1/3} \approx 970 \tag{8}$$

This result implies that transitions with $n \gtrsim 1000$ enter a regime of effective decoherence and spectral convergence. Above this threshold, emissions blend into a coherence continuum, forming the background radiation field we detect as the CMB.

4.1 Decoherence Zones and the CMB Visibility Limit

In the Holosphere lattice, rotational coherence declines with radial distance from the observer. The outermost boundary where coherent angular modes remain phase-compatible with the local lattice defines a **decoherence zone**.

Beyond this decoherence zone:

- Angular coherence transitions lose phase alignment with the observer's lattice layer.
- Photons cannot propagate across the mismatch and instead become undetectable—effectively "dark".
- This radial visibility boundary defines a *coherence horizon*, similar to but physically distinct from a cosmological particle horizon.

The cosmic microwave background, then, arises from the outer edge of our local decoherence zone—the last coherent shell capable of emitting photons that remain visible within our Holosphere layer.

This model naturally explains:

- The statistical isotropy of the CMB: all observers near the boundary see a similar radiation field.
- The temperature uniformity: phase convergence forces emissions from near n_c shells across all directions.
- The absence of spectral evolution: emissions arise from a fixed boundary condition rather than evolving initial conditions.

Thus, what we interpret as the CMB is a persistent re-radiation effect at the phase boundary of the rotating lattice. It is not a snapshot of early thermal decoupling, but an ongoing emission tied to coherence structure and angular stability within the Holosphere framework.

Sidebar: The Decoherence Zone and the Origin of the CMB

In Holosphere Theory, every observer resides within a layered rotational lattice, with angular coherence decreasing gradually with radial distance. The outermost radial shell where phase-aligned photons can still propagate inward defines a **decoherence zone**.
This zone marks the boundary between:

- **Coherent emission:** where high-n Holosphere transitions emit photons that remain compatible with the observer's local lattice phase.
- **Phase-incoherent darkness:** beyond which angular modes are misaligned, and emitted radiation can no longer couple into the observer's frame.

The cosmic microwave background (CMB) we observe is not a fossil from the early universe, but the ongoing, steady-state emission from this decoherence boundary. It arises from high-n orbital transitions just below the critical threshold $n_c \sim 970$, where coherence remains marginally intact. The temperature and spectrum of the CMB are emergent properties of this shell's angular geometry.
Other observers would see their own version of the CMB from their respective decoherence boundaries. Thus, the CMB is not a universal relic, but a localized, angular-limited horizon effect defined by the structure of the rotating Holosphere lattice.

5 CMB Anisotropies as Lattice Coherence Strain

Directional variations in the CMB are reinterpreted here as structural inhomogeneities in the Holosphere lattice. These include:

- **Coherence strain gradients** caused by mass asymmetries, large-scale structure, and voids.
- **Rotational shear** between nested Holosphere layers, causing slight shifts in phase equilibrium. [5]
- **Kinematic dipole** arising from solar system motion through the coherence rest frame.

Unlike primordial density fluctuations, these anisotropies result from geometric and angular phase variations, not thermal perturbations. This reframes the CMB as a dynamic but stable equilibrium signal.

6 Falsifiable Predictions and Discriminators

The Holosphere-based model of CMB emission makes specific, testable predictions that differ significantly from the standard Big Bang interpretation. The following conditions would serve to falsify or critically challenge this coherence-based framework:

1. **Absence of Local CMB Regeneration:** If it is conclusively shown that CMB radiation is not being continuously regenerated by present-day matter (e.g., if it ceases abruptly in low-density or isolated regions), this would contradict the prediction of ongoing angular coherence emission.

2. **Perfect Temporal Uniformity:** The Holosphere model predicts dynamic re-radiation and slight temporal variability due to coherence fluctuations. Detecting no variation in the CMB over long timescales, even at the microkelvin level, would challenge the idea of continuous local generation.

3. **Mismatch in Anisotropy Origin:** If CMB anisotropies are proven to originate solely from primordial quantum fluctuations — without correlation to present-day structure (e.g., galaxy voids or filaments) — this would undermine the claim that anisotropies arise from lattice coherence strain.

4. **Non-matching Spectrum under Redshift Reversal:** The Holosphere model predicts redshift as a result of angular strain gradients rather than spacetime expansion. If the detailed CMB spectrum were shown to reverse predictably under cosmological redshift models (e.g., from recombination epochs), it would disfavor a local coherence origin.

5. **Detection of Recombination Spectral Signatures:** If the CMB spectrum contains clear spectral lines from hydrogen recombination that cannot be mimicked by high-n angular transitions, this would be incompatible with a purely Holosphere-based mechanism.

6. **Absence of High-n Angular Modes in Lab Analogs:** The model implies that angular coherence transitions should be observable in nested mechanical or condensed matter systems under rotation. Failure to detect any trace of high-n phase radiation modes in controlled systems would weaken the case for coherence-based emission mechanisms.

7. **CMB Polarization Incompatible with Rotational Symmetries:** If detailed polarization measurements of the CMB exhibit structures irreconcilable with angular strain alignment in a rotating lattice, this would directly contradict the geometric basis of the model.

These falsifiable predictions form a framework for evaluating the Holosphere coherence model against both astrophysical and experimental data. Continued observational refinements, particularly in polarization, low-ℓ anisotropies, and time-domain CMB monitoring, will provide decisive tests of this theory.

7 Conclusion

We reinterpret the cosmic microwave background not as a thermal relic from a hot Big Bang, but as a persistent emission from the **decoherence zone**—the outermost shell of angular coherence in the Holosphere lattice. Within this framework, the CMB emerges from real-time transitions of high-n orbital shells just below the Rydberg-like breakdown threshold $n_c \sim 970$.

The observed $\sim$2.725 K blackbody spectrum results from dense phase-state occupation, angular strain relaxation, and the geometric properties of the lattice. The uniformity and statistical isotropy of the CMB are consequences of viewing a phase-aligned boundary from within a rotationally symmetric lattice structure.

Each observer perceives a CMB defined by their own coherence horizon. Light emitted beyond this decoherence boundary becomes phase-incompatible and effectively dark. This explains the constancy and locality of the CMB without invoking inflation or thermal decoupling.

This Holosphere-based model offers falsifiable predictions, especially regarding temporal variation, anisotropy alignment with structure, and angular polarization patterns. It redefines the CMB not as a singular flash from the past, but as a steady radiative equilibrium sustained by the geometry and strain dynamics of spacetime itself.

References

[1] Rydberg, J. R. (1890). On the structure of the line-spectra of the chemical elements. *Philosophical Magazine*, 29(5), 331–337.

[2] Wien, W. (1893). On the division of energy in the emission-spectrum of a black body. *Annalen der Physik*, 294(8), 662–669.

[3] Sarnowski, M. J. (2025). Holosphere Theory Series: Angular Phase Coherence and Cosmology. *In preparation.*

[4] Sarnowski, M. J. (2025). The Coherence Lagrangian: Deriving Physical Laws from Strain Propagation in the Holosphere Lattice. *Holosphere Theory Paper 25.*

[5] Sarnowski, M. J. (2025). Entanglement Propagation and the Discrete Structure of Spacetime. *Holosphere Theory Paper 38.*

[6] Sarnowski, M. J. (2025). Discrete Action and the Geometry of Time in Holosphere Theory. *Holosphere Theory Paper 36.*

Glossary

- **Angular Blackbody Emission**: A Planck-like radiation spectrum resulting from angular phase transitions in a structured medium rather than thermal equilibrium.
- **Coherence Rest Frame**: The preferred reference frame defined by the lattice's angular symmetry and equilibrium phase state.
- **Holosphere**: A quantized, Planck-scale rotating sphere that serves as the fundamental unit of angular coherence in spacetime.
- **Coherence Shell**: A discrete layer within a Holosphere characterized by phase-aligned angular momentum modes indexed by quantum number n.
- **Angular Phase Transition**: A change in the coherence state of a Holosphere shell, accompanied by the emission or absorption of a photon.
- **High-n Regime**: The domain of coherence shells with large n, where transitions emit photons in the millimeter or microwave range.
- **Coherence Diffusion**: The redistribution of absorbed phase strain across multiple shells, leading to emergent equilibrium temperature.
- **Coherence Rydberg Limit**: The threshold n_c beyond which coherence shell transitions become thermodynamically unstable and blur into a continuum.
- **CMB (Cosmic Microwave Background)**: Interpreted here not as a relic, but as the equilibrium emission spectrum of Holosphere angular transitions.

Appendix B: Glossary of Symbols

Symbol	Pronunciation	Definition
E_n	"E sub n"	Energy of the nth coherence shell
E_0	"E naught"	Characteristic coherence energy (typically $\sim m_p c^2$)
ΔE_n	"Delta E sub n"	Energy difference between adjacent coherence shells
n	"n" or "shell index"	Angular coherence shell index (analogous to Rydberg level)
n_c	"n sub c" or "critical n"	Maximum coherent shell index before decoherence sets in
k_B	"k Boltzmann"	Boltzmann constant (1.38×10^{-23} J/K)
T	"T" or "temperature"	Temperature corresponding to a photon's energy
T_{CMB}	"T CMB"	Temperature of the cosmic microwave background (∼2.725 K)
λ_n	"lambda sub n"	Wavelength of photon emitted during an $n \to n+1$ transition
c	"c"	Speed of light in vacuum ($\sim 3.00 \times 10^8$ m/s)
h	"h" or "Planck's constant"	Planck constant (6.626×10^{-34} J · s)

Appendix C: Glossary of Equations

1. **Coherence Shell Energy:**

$$E_n = -\frac{E_0}{n^2}$$

Energy stored in the nth rotational coherence shell. Analogous to electron energy levels in the hydrogen atom.

2. **Energy Difference Between Shells:**

$$\Delta E_n = E_{n+1} - E_n \approx \frac{2E_0}{n^3}$$

Approximate photon energy released in a downward coherence transition. Governs emitted photon wavelength.

3. **Photon Wavelength from Angular Transition:**

$$\lambda_n = \frac{hc \cdot n^3}{2E_0}$$

Wavelength of the photon emitted from a high-n angular shell. Predicts millimeter radiation for $n \sim 1000$.

4. **CMB Peak Temperature from Wavelength:**

$$T = \frac{hc}{\lambda k_B}$$

Relates a photon's wavelength to its blackbody-equivalent temperature. Used to derive $\sim 2.7\,K$ from $\lambda \sim 1$ mm.

5. **Coherence Breakdown Threshold (Critical n):**

$$n_c = \left(\frac{2E_0}{k_B T_{\text{CMB}}}\right)^{1/3}$$

Defines the maximum angular shell index that still emits detectable coherent photons. Beyond this, phase misalignment sets in.

Sidebar: Are We Seeing the CMB from Other Coherence Horizons?

In the Holosphere model, every radial layer of the universe possesses its own coherence boundary—beyond which emitted light becomes phase-incompatible with the lattice structure and is no longer visible as electromagnetic radiation. The Cosmic Microwave Background (CMB) we observe originates from our own coherence horizon, not from deep inside the universe. It represents the continuous emission of phase-compatible radiation at the outer edge of our local angular coherence zone. Other observers at different radial shells would detect CMB-like radiation from their own respective coherence boundaries. Thus, the CMB is not a fossil from a singular Big Bang moment but a persistent, locally generated phenomenon arising from the structure and rotation of the Holosphere lattice.

Sidebar: Are We Seeing the CMB from Other Coherence Horizons?

In the Holosphere model, every point in the universe has its own coherence boundary—beyond which light becomes phase-incompatible with the local medium and turns dark. The CMB we observe is not a relic from a singular past event, but the ongoing emission from our own coherence horizon, corresponding to the outermost visible shell of rotational phase stability. Other observers would detect a CMB from their own respective horizons. Thus, what we call the CMB is actually a local effect of coherence geometry, not a universal surface of last scattering.