QGMF: A Curvature-Resolved, Shell-Projection Model of the Microwave Sky

Amber Blakley

September 2025

Abstract

This paper presents the Quantum Gravity Model Framework (QGMF), a curvature-resolved model in which the observed microwave and infrared sky is a projection from within the Milky Way's curvature shell. The framework replaces inflationary initial conditions and post-hoc foreground subtraction with an explicit geometric generator: a torsion-modulated shell embedded in a stationary background. The main results are: (i) a forward model for temperature and polarization anisotropies $\{T, E, B\}(\hat{\boldsymbol{n}})$ directly from local curvature, torsion, and line-of-sight projection; (ii) derived peak spacing and parity relations that differ from ΛCDM; (iii) falsifiable tests using infrared morphology, latitude scaling, polarization phase, and parity asymmetry; and (iv) a reinterpretation of the "Local Group" as a shell-resolved formation sequence. The Milky Way is treated as the generator of the coherence seen in full-sky maps, not a contaminant to be removed.

1 Overview

The observed full-sky microwave maps contain a bright band identified with the Galactic plane. Standard pipelines subtract this band as "foreground" to recover a statistically isotropic cosmic microwave background (CMB) attributed to early-universe physics. QGMF inverts this approach: the band is the primary generator. The sky is modeled as a projection from within a thin curvature shell associated with the Milky Way's mass-energy distribution and its environment. Temperature and polarization anisotropies are curvature and torsion echoes of this shell under line-of-sight (LOS) integration.

2 Geometric framework

2.1 Spacetime, shell, and fields

Let $(\mathcal{M}, g_{\mu\nu}, \Gamma^{\lambda}{}_{\mu\nu})$ be a metric-affine spacetime with metric $g_{\mu\nu}$ and general connection Γ. Define torsion

$$T^{\lambda}_{\ \mu\nu} \equiv \Gamma^{\lambda}{}_{\mu\nu} - \Gamma^{\lambda}{}_{\nu\mu}, \tag{1}$$

and curvature

$$R^{\rho}{}_{\sigma\mu\nu} \equiv \partial_{\mu}\Gamma^{\rho}{}_{\nu\sigma} - \partial_{\nu}\Gamma^{\rho}{}_{\mu\sigma} + \Gamma^{\rho}{}_{\mu\lambda}\Gamma^{\lambda}{}_{\nu\sigma} - \Gamma^{\rho}{}_{\nu\lambda}\Gamma^{\lambda}{}_{\mu\sigma}. \tag{2}$$

We model the Milky Way curvature shell as a timelike hypersurface Σ with mean radius R_s and angular thickness σ, embedded in $\mathcal{M}$. Introduce a scalar modulation field $M(x)$ capturing effective emissivity and scattering from dust, gas, and magnetized plasma:

$$M(x) = M_0 \exp\left(-\frac{d_{\perp}(x,\Sigma)^2}{2\sigma^2}\right)\left[1 + \alpha\,\mathcal{K}(x) + \beta\,\mathcal{T}(x)\right], \tag{3}$$

where $d_{\perp}$ is geodesic distance to Σ, $\mathcal{K}(x)$ is a curvature scalar proxy (e.g., $R \equiv R^{\mu}{}_{\mu}$), and $\mathcal{T}(x)$ is a torsion invariant (e.g., $T_{\mu}T^{\mu}$ with $T_{\mu} \equiv T^{\alpha}_{\ \mu\alpha}$). Parameters $(M_0, \alpha, \beta, \sigma, R_s)$ are to be fit or constrained.

2.2 Projection to the sky

Let the observer be at x_0. For each sightline direction $\hat{\boldsymbol{n}}$, define affine parameter λ along the null geodesic $x^\mu(\lambda;\hat{\boldsymbol{n}})$. The observed brightness temperature fluctuation is modeled by a LOS integral:

$$\Delta T(\hat{\boldsymbol{n}}) = \int_0^{\lambda_{\max}} W_T(\lambda,\hat{\boldsymbol{n}})\, M(x(\lambda;\hat{\boldsymbol{n}}))\, \mathrm{d}\lambda, \tag{4}$$

with window W_T encoding instrument bandpass and radiative transfer. Polarization is produced by local anisotropic Thomson-like scattering in magnetized plasma. We write the spin-2 field as

$$(Q \pm iU)(\hat{\boldsymbol{n}}) = \int_0^{\lambda_{\max}} W_P(\lambda,\hat{\boldsymbol{n}})\, \Pi_\pm[x(\lambda;\hat{\boldsymbol{n}});\, \mathcal{E}(x), \mathcal{B}(x)]\, \mathrm{d}\lambda, \tag{5}$$

where $\Pi_\pm$ depends on local electric and magnetic field geometry and on the projected quadrupole of M.

2.3 E/B decomposition and parity

Define the spin-2 spherical harmonic decomposition of polarization [2]:

$$a^E_{\ell m} \pm i a^B_{\ell m} = -\int (Q \pm iU)(\hat{\boldsymbol{n}})\, {}_{\pm 2}Y^*_{\ell m}(\hat{\boldsymbol{n}})\, \mathrm{d}\Omega. \tag{6}$$

QGMF predicts a controlled B-mode parity asymmetry due to torsion:

$$\mathcal{P}_B \equiv \frac{\sum_{\ell\in\mathcal{L}_{\rm odd}} C^{BB}_\ell - \sum_{\ell\in\mathcal{L}_{\rm even}} C^{BB}_\ell}{\sum_{\ell\le\ell_{\max}} C^{BB}_\ell} \approx \gamma\, \langle\mathcal{T}\rangle_\Sigma, \tag{7}$$

with γ a calculable coefficient under a chosen torsion invariant and $\langle\cdot\rangle_\Sigma$ the shell average.

3 Spectra and peak structure

3.1 Angular scales from shell geometry

Let the shell angular half-thickness be $\Delta\theta \sim \sigma/R_s$. The line-of-sight crossing produces a characteristic harmonic scale

$$\ell_s \approx \frac{\pi}{\Delta\theta}, \qquad \Delta\ell \approx \frac{\pi}{\Delta\theta}, \tag{8}$$

yielding quasi-regular peak spacings in TT, EE, and TE driven by geometry rather than acoustic oscillations. Variations in σ across longitude produce a predictable ℓ-dependent modulation envelope.

3.2 TE phase relation

QGMF predicts a TE cross-spectrum with a geometry-fixed phase:

$$\operatorname{sgn}\big(C^{TE}_\ell\big) \approx \operatorname{sgn}(\partial_\theta M_{\rm eff})\Big|_{\theta\sim\Delta\theta}, \tag{9}$$

where $M_{\rm eff}$ is the LOS-averaged modulation. This yields a stable sign pattern across the first few peaks, sensitive to shell orientation and magnetic field topology.

3.3 BB scaling

Absent primordial gravitational waves, QGMF produces BB via geometry and torsion:

$$C^{BB}_\ell \sim \eta_B^2\, C^{EE}_\ell + \delta_B^2\, \mathcal{S}_\ell[\mathcal{T}], \tag{10}$$

with η_B encoding local Faraday rotation and birefringence, and $\mathcal{S}_\ell[\mathcal{T}]$ the torsion-sourced spectrum. The parity statistic in Eq. (7) distinguishes this from ΛCDM+lensing.

4 Forward model and parameters

4.1 Minimal parameter set

A minimal QGMF parameterization for full-sky fits:

$$\Theta_{\mathrm{QGMF}} = \{R_s,\ \sigma,\ M_0,\ \alpha,\ \beta,\ \phi_{\mathrm{shell}},\ \psi_{\mathrm{B}},\ \eta_B,\ \delta_B\}, \tag{11}$$

where ϕ_{shell} sets shell orientation in Galactic coordinates, ψ_{B} parameterizes large-scale magnetic field orientation, and η_B, δ_B control polarization transfer.

4.2 Map synthesis

Given Θ_{QGMF}, Eqs. (4) and (5) synthesize $\Delta T, Q, U$. Harmonic transforms yield $C_\ell^{TT}, C_\ell^{TE}, C_\ell^{EE}, C_\ell^{BB}$. No foreground subtraction is applied; instead, the generator $M(x)$ is fit jointly to multi-frequency data with instrument bandpasses in W_T, W_P.

5 Comparison with ΛCDM

Aspect	QGMF vs. ΛCDM
Generator	Shell projection $(M,\ \mathcal{K},\ \mathcal{T})$ vs. primordial curvature $\mathcal{R}$
Peaks	Geometric spacing $\Delta\ell \approx \pi/\Delta\theta$ vs. acoustic peaks set by θ_s
Dipole	Kinematic+geometric coupling vs. pure kinematic dipole
Polarization	Torsion+Faraday-sourced B vs. lensing/leakage or tensor modes
Parity	Predictive BB parity asymmetry vs. near-parity with small anomalies
Foregrounds	Modeled as generator vs. subtracted contaminants

In ΛCDM, the primary CMB anisotropies arise from recombination-era physics with power spectra determined by baryon content, cold dark matter, and a cosmological constant [1]. QGMF reproduces qualitative peak patterns through shell geometry without invoking inflation, CDM microphysics, or Λ. Distinct predictions include: (i) latitude-dependent amplitude scaling tied to shell thickness; (ii) TE sign cadence fixed by geometry; (iii) a nonzero BB parity statistic correlated with torsion; and (iv) multi-frequency coherence without foreground subtraction.

6 Falsifiable tests

1. **Latitude scaling law.** Define band-averaged amplitude $A(|b|)$. QGMF predicts

$$A(|b|) \approx A_0 \sec\left(\frac{|b|}{b_0}\right) \exp\left[-\frac{1}{2}\left(\frac{|b|}{b_1}\right)^2\right], \tag{12}$$

   with b_0, b_1 set by σ and shell warps. Stability across frequency after instrument corrections supports the generator model.

2. **Peak shift under $\Delta\sigma$.** Vary σ in fits; test predicted $\Delta\ell \approx \pi/\Delta\theta$ per Eq. (8). A systematic ℓ-shift with σ cannot be mimicked by standard foreground templates.

3. **TE sign cadence.** Measure $\mathrm{sgn}(C_\ell^{TE})$ for the first four extrema. QGMF expects a fixed cadence consistent with Eq. (9); ΛCDM expects the recombination-driven pattern that is insensitive to Galactic geometry.

4. **BB parity statistic.** Compute $\mathcal{P}_B$ in Eq. (7) up to $\ell_{\max} \sim 200$. A significant nonzero value aligned with shell orientation supports torsion sourcing.

5. **Frequency coherence without cleaning.** Jointly fit $M(x)$ across infrared and microwave bands using only instrument bandpasses in W_T, W_P. Residuals below a few percent across bands indicate a common generator.

6. **Sgr A* anchoring.** Localize anisotropy orientation drift around the Galactic center. QGMF predicts alignment drifts that follow shell warps; random orientations would disfavor the model.

7 Local Group as a shell-resolved system

Under QGMF, nearby galaxies (e.g., Andromeda M31, Triangulum M33) are not expected to imprint globally on microwave maps. Their IR and kinematic maps are localized, while the Milky Way shell dominates full-sky projection. A simple formation sequence model positions the Milky Way near a torsion node within Σ, implying late formation relative to systems closer to the shell boundary. This can be tested by comparing dust morphology, polarization phase lags, and kinematics across Local Group members.

8 Data pipeline

1. **Inputs:** Multi-frequency full-sky maps (microwave, sub-mm, IR); instrument bandpasses and beams; Galactic coordinate frames.

2. **Forward modeling:** Evaluate Eqs. (4)–(5) on a HEALPix grid for a trial Θ_{QGMF}.

3. **Harmonics:** Compute C_ℓ with beam/window deconvolution.

4. **Inference:** Fit Θ_{QGMF} by minimizing a joint loss

$$\chi^2 = \sum_\nu \left[\Delta \boldsymbol{m}_\nu^\top \boldsymbol{N}_\nu^{-1} \Delta \boldsymbol{m}_\nu\right] + \sum_{X \in \{TT, TE, EE, BB\}} \sum_\ell \frac{\left(C_{\ell,X}^{\mathrm{obs}} - C_{\ell,X}^{\mathrm{QGMF}}\right)^2}{\sigma_{\ell,X}^2}, \tag{13}$$

   where $\Delta \boldsymbol{m}_\nu$ are map residuals at frequency ν, $\boldsymbol{N}_\nu$ are noise covariances.

5. **Diagnostics:** Evaluate falsifiers in Sec. 6 and parity metric in Eq. (7).

9 Results outline

This paper provides the analytic structure and falsifiers. Empirical fits should report:

1. Best-fit Θ_{QGMF} with uncertainties and parameter correlations.

2. Peak spacing $\Delta\ell$ vs. latitude and frequency.

3. TE sign cadence statistics.

4. BB parity $\mathcal{P}_B$ with null tests.

5. Cross-band residuals and coherence metrics without foreground subtraction.

10 Discussion

QGMF attributes the observed coherence of the microwave sky to local shell geometry rather than primordial fluctuations. The framework is predictive: geometry controls peak positions and phases, torsion controls B-mode parity, and LOS integration produces frequency coherence. The model is falsifiable by parity-null results, absent TE cadence, failure of latitude scaling, or inability to fit multi-band data without subtraction.

11 Conclusion

QGMF provides a minimal, curvature-resolved explanation of full-sky microwave and infrared structure as a shell projection from within the Milky Way. It offers distinct, testable predictions that differ from ΛCDM. Empirical evaluation can resolve which framework better accounts for the sky with fewer assumptions.

Acknowledgments

The author acknowledges the use of AI-assisted audit tools for timestamping, map comparison, and formula verification.

References

[1] Planck Collaboration. Planck 2018 results. I–X. Astronomy & Astrophysics (2020).

[2] M. Zaldarriaga and U. Seljak. All-sky analysis of polarization in the microwave background. Phys. Rev. D 55, 1830 (1997).

[3] W. Hu and M. White. A CMB polarization primer. New Astron. 2, 323 (1997).

[4] M. Kamionkowski, A. Kosowsky, A. Stebbins. Statistics of CMB polarization. Phys. Rev. D 55, 7368 (1997).

[5] W. Hu and S. Dodelson. Cosmic microwave background anisotropies. ARA&A 40, 171 (2002).