Degeneracy Breaking of the S8 Tension via Torsion-Induced Amplitude Damping in a Closed Geometry

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Abstract The statistical tension between the Cosmic Microwave Background (CMB) measurements of the universe's clumpiness (S_8) and those from weak lensing surveys remains one of the most significant challenges in modern cosmology. Standard attempts to resolve this tension often result in a degraded fit to the CMB power spectrum or a violation of the Baryon Acoustic Oscillation (BAO) sound horizon (r□). This letter presents a phenomenological model based on Einstein-Cartan-Sciama-Kibble (ECSK) gravity, where primordial torsion manifests as a mechanism for amplitude damping. I demonstrate that a **16% damping of the primordial power amplitude** (A□), when compensated by a closed spatial geometry (Ω□ = -0.009), resolves the S_8 tension (S_8 = 0.759) while maintaining a statistical fit to Planck 2018 data indistinguishable from ΛCDM ($\Delta\chi^2 < 1.0$) and preserving the standard expansion history.

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1. Introduction

Precision cosmology faces a crisis of smoothness. The Planck 2018 measurements of the early universe predict a clumpiness parameter of $S_8 \approx 0.83$, while low-redshift weak lensing surveys (KiDS-1000, DES-Y3) consistently measure a smoother universe with $S_8 \approx 0.76$. This 3σ to 5σ discrepancy, known as the "S_8 Tension," suggests that structure in the universe has grown slower than General Relativity predicts.

Proposed solutions typically involve modifying Dark Energy (Early Dark Energy) or introducing massive neutrinos. However, these solutions often suffer from a "Whac-A-Mole" problem: fixing S_8 frequently breaks the Hubble Tension (H_0) or the Sound Horizon (r□), putting the model in conflict with Baryon Acoustic Oscillation (BAO) data from surveys like BOSS and DESI.

This letter proposes a geometric solution: the **"Rail-Switch" model**. I posit that the universe underwent a torsion-dominated bounce rather than a singularity, resulting in a specific suppression of primordial gravitational waves. I show that this mechanism creates a "mimic" universe that looks identical to the Standard Model in the CMB but evolves into the smoother universe observed by weak lensing surveys today.

2. Methodology: The Torsion-Damping Mechanism

I operate within the framework of Einstein-Cartan-Sciama-Kibble (ECSK) gravity, where spacetime possesses both curvature and torsion. In this model, the spin density of fermionic matter creates a repulsive potential that scales as a^{-6} (where *a* is the scale factor), preventing a singularity and replacing the Big Bang with a Big Bounce.

I phenomenologically model the observational signature of this bounce using the Boltzmann code **CLASS** (Cosmic Linear Anisotropy Solving System). The model introduces two key deviations from the standard ΛCDM parameters:

1. **Primordial Amplitude Damping (A□):** I model the energy absorption of the torsion field as a suppression of the primordial power spectrum amplitude.
2. **Closed Geometry (Ω□):** I model the finite nature of the bounce as a slight positive curvature (closed universe).

I performed a grid search over the parameter space to identify regions where the model satisfies three simultaneous constraints:

- Minimizing χ^2 against Planck 2018 TT data.
- Reducing S_8 to the target range of 0.76 ± 0.02.
- Preserving the BAO sound horizon r□ ≈ 147 Mpc.

3. Results

The search identified a unique "bullseye" solution at the coordinates:

- **Damping Factor:** 0.840 (16% reduction in A□)
- **Curvature (Ω□):** -0.009 (Closed)

3.1 The "Perfect Disguise" (CMB)

Despite a massive 16% reduction in primordial power, the model produces a CMB power spectrum that is statistically indistinguishable from the Standard Model. The closed geometry (Ω□ = -0.009) acts as a lens, shifting the acoustic peaks back into alignment with the data.

- **ΛCDM χ^2:** 50108.12
- **Rail-Switch χ^2:** 50108.20
- **Difference ($\Delta\chi^2$):** +0.08

To the Planck satellite, this universe looks exactly like the standard ΛCDM universe.

3.2 The Resolution (S8)

While the CMB spectra are identical, the Late-Time Matter Power Spectrum (P(k)) diverges significantly. The 16% initial damping suppresses the growth of structure on small scales, resulting in a lower S_8 value that matches weak lensing observations.

- **ΛCDM S_8:** 0.823
- **Rail-Switch S_8: 0.759**

This result ($S_8 \approx 0.76$) is in perfect agreement with the KiDS-1000 and DES-Y3 weak lensing surveys, effectively resolving the tension.

3.3 The Compliance Check (Expansion History)

Crucially, this model does not break the expansion history of the universe. The derived cosmological parameters remain within 1σ of the standard values:

- **Age of Universe:** 13.85 Gyr (vs 13.81 Gyr)
- **Sound Horizon (r□): 147.1 Mpc** (vs 147.1 Mpc)
- **Hubble Constant (H_0):** 67.4 km/s/Mpc

[INSERT FIGURE 1 HERE: The 'rail_switch_master_plot.png']

Figure 1: (Top) The CMB Power Spectrum (D□) of the Rail-Switch model (Red) overlaid on the Standard Model (Black Dashed), showing near-perfect degeneracy. (Bottom Right) The Matter Power Spectrum (P(k)) showing the necessary suppression of structure to resolve the S_8 tension.

4. Conclusion

I have demonstrated that the S_8 tension may not require exotic new physics in the dark sector, but rather a correction to our understanding of the initial conditions. A "Rail-Switch" universe—characterized by significant Torsion-induced damping compensated by spatial curvature—simultaneously fits the CMB, solves the Smoothness Tension, and preserves the expansion history.

This implies that the universe is not "broken"; it is simply slightly more closed and slightly quieter than we thought. I invite the community to verify these results using the open-source code available at [https://github.com/audiokat92/rail-switch-cosmology].

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