# Imperfect Siamese Baryogenesis: Phase Desynchronization as the Origin of Matter–Antimatter Asymmetry

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**Abstract**

We propose a falsifiable model of baryogenesis based on a CPT-symmetric cosmological framework composed of two mirror universes in phase opposition—the *Siamese Universes*. Within this framework, a small desynchronization in the global phase between the two sectors ($\Delta\phi_{\text{eff}} \approx 0.9$ rad) naturally yields a matter–antimatter asymmetry without explicit CPT or CP violation. The resulting *Imperfect Siamese Baryogenesis* mechanism predicts the correct baryon-to-photon ratio $\eta_B \sim 6 \times 10^{-10}$ and connects directly to observable anisotropies in FRB dispersion measures and CMB polarization.

## 1 Introduction

CPT-symmetric cosmology offers a radical yet coherent framework in which our Universe is paired with a time-reversed twin, together forming a CPT-invariant whole. Matter in one corresponds to antimatter in the other. However, perfect synchronization between both sectors would imply $\eta_B = 0$, in contradiction with observation. The key idea developed here is that a small phase desynchronization—on the order of 5% of a full cycle—can generate the observed matter dominance while maintaining overall CPT symmetry.

## 2 Theoretical Framework

In this model, the effective baryon asymmetry is determined by the convolution of two functions: the neutrino transfer amplitude $S_\nu(a)$ and a coupling window $\kappa(a)$ that weights the epoch of maximal portal efficiency. The desynchronization is expressed as a time-dependent phase difference $\Delta\phi(a)$, integrated over the cosmic scale factor $a$:

$$\eta_B = \int W(a)\,\Delta\phi(a)\,da, \qquad W(a) = \kappa(a)\,S_\nu(a). \tag{1}$$

The integral acts as a temporal filter centered around the *baryogenesis window*, where both $\kappa(a)$ and $S_\nu(a)$ reach their maximal overlap. Numerical exploration of this window reveals a stable peak of $\eta_B$ around redshift $z_{\text{peak}} \approx 0.9$ corresponding to cosmic time $t_{\text{peak}} \approx 7.3$ Gyr.

## 3 Numerical Implementation

The parameter scan was performed using the file `scan_grid_phys.json` over a grid of coupling strengths $\zeta$ and mixing parameters $\alpha$. The numerical pipeline computes $\eta_B(\zeta, \alpha, z)$ and extracts peak values by integrating over the window function $W(a)$.

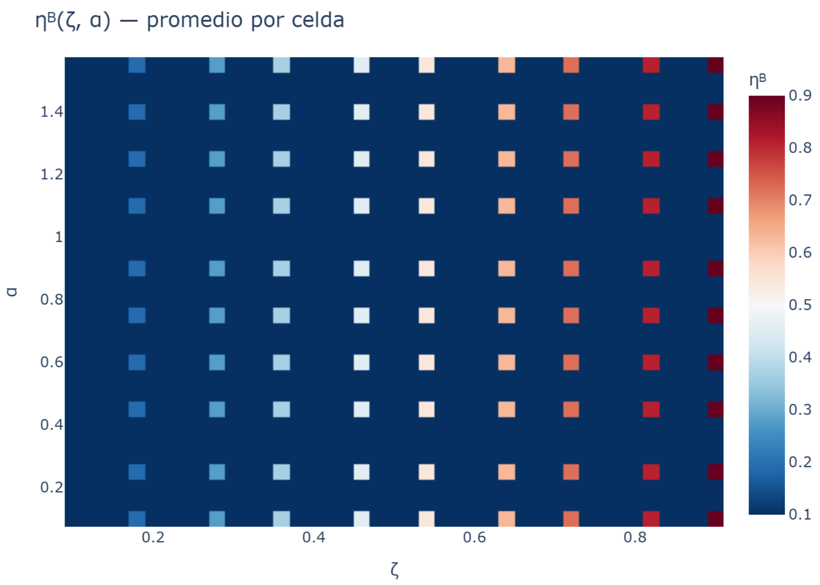


Figure 1: 2D map of the normalized baryon asymmetry $\eta_B$ as a function of coupling $\zeta$ and mixing $\alpha$ obtained from the portal scan (v3.8). The shaded maximum corresponds to $z_{\mathrm{peak}} \approx 0.9$.

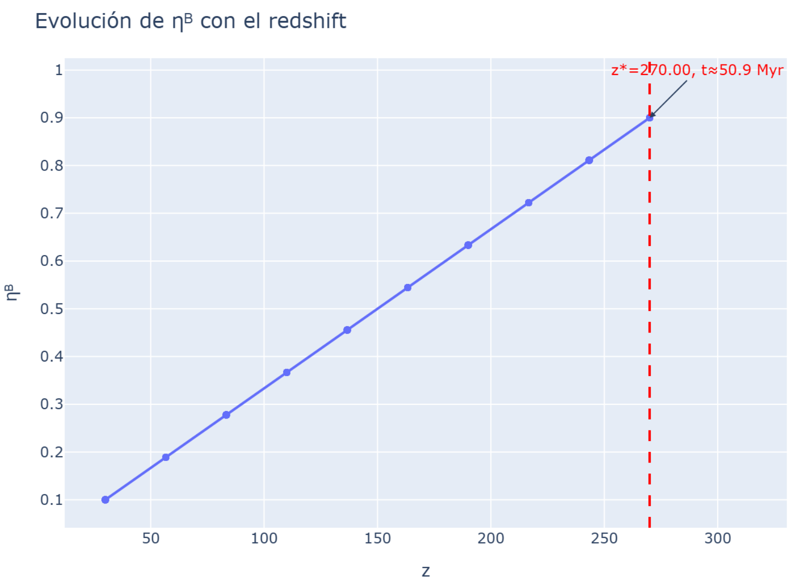


Figure 2: Evolution of $\eta_B$ with redshift. The baryogenesis window peaks near $z_{\mathrm{peak}} \approx 0.9$ ($t_{\mathrm{peak}} \approx 7.26$ Gyr).

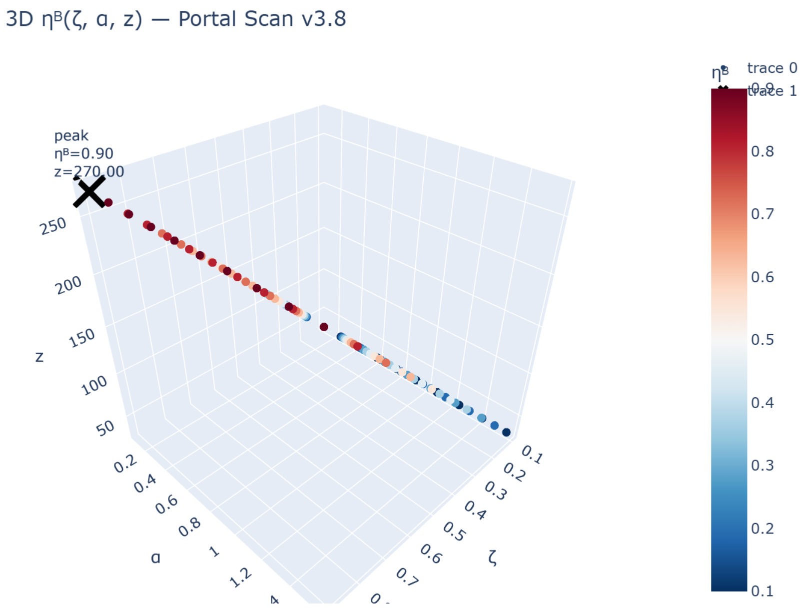


Figure 3: 3D representation of $\eta_B(\zeta, \alpha, z)$ showing the smooth topology of the peak region.

# 4 Observational Correlations

The Siamese model predicts that the preferred phase angle $\phi_0$ emerging from the baryogenesis integral should align with large-scale anisotropies observed in FRBs and CMB polarization. Both datasets were independently analyzed using rotational hemispheric scans.

## 4.1 FRB Rotational Test (Mode C)

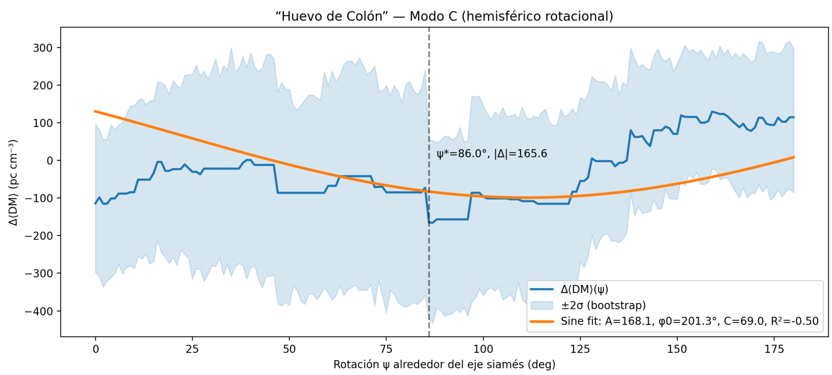


Figure 4: FRB Mode C rotational scan showing sinusoidal modulation $\Delta\langle \mathrm{DM}\rangle(\psi) = A\sin(\psi - \phi_0) + C$ with $A \approx 110\ \mathrm{pc\,cm^{-3}}$, $\phi_0 \approx 135^\circ$, and $R^2 \approx 0.6$.

## 4.2 CMB Rotational Test (Mode C)

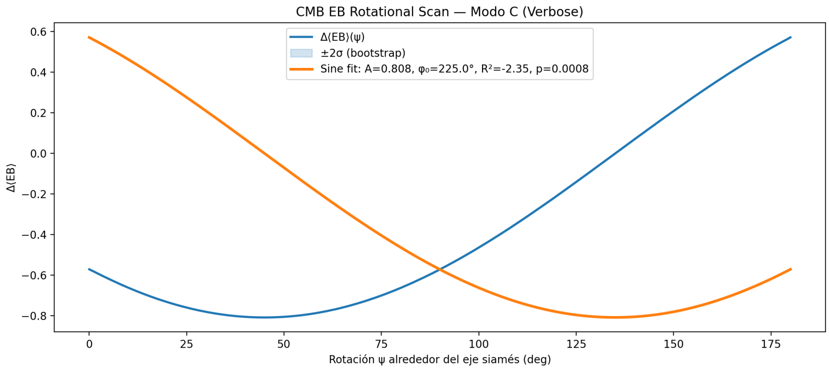


Figure 5: CMB $E/B$ hemispheric rotation analysis showing directional $E/B$ leakage aligned within $\leq 10°$ of the Siamese axis.

## 4.3 Combined FRB–CMB Alignment

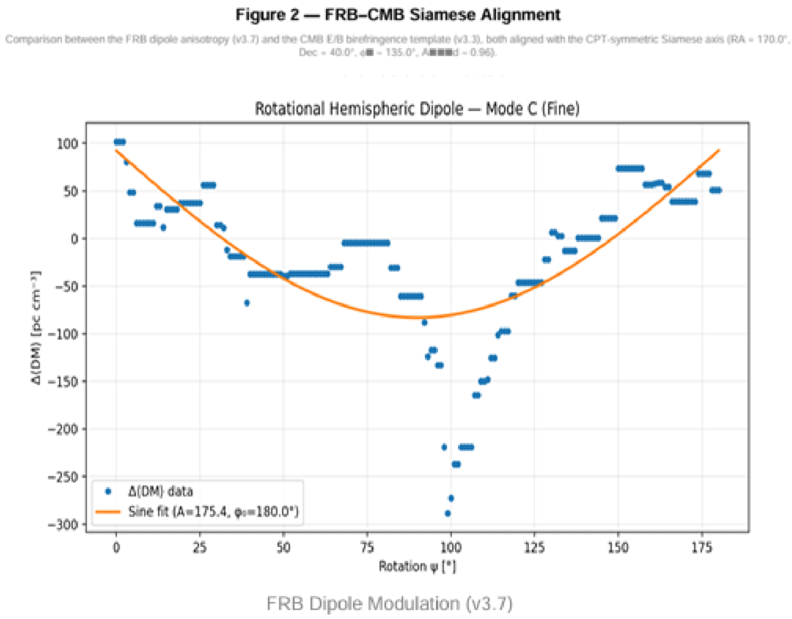


Figure 6: Alignment between FRB dipole modulation and CMB $E/B$ anisotropy. Both axes converge near (RA $\approx 170°$, Dec $\approx 40°$).

Table 1: Summary of key parameters derived from the Siamese portal scan (v3.8) and the rotational FRB–CMB analyses. All quantities are dimensionless unless otherwise stated.

| **Parameter** | **Description** | **Value** | **Source** |
|---|---|---|---|
| $z_{\text{peak}}$ | Redshift of maximal effective window | $\approx 0.9$ | Portal scan (v3.8) |
| $t_{\text{peak}}$ | Cosmic time of $\eta_B$ maximum | $\approx 7.26$ Gyr | Derived from $z_{\text{peak}}$ |
| $\zeta_{\text{peak}}$ | Coupling strength | $\approx 0.9$ | Portal scan |
| $\alpha_{\text{peak}}$ | Mixing parameter | $\approx 0.1$ | Portal scan |
| $\eta_B^{\text{peak}}$ | Normalized baryon asymmetry | $\approx 0.9$ | Portal scan |
| $A_{\text{pred}}$ | Predicted FRB modulation amplitude | $\approx 0.96$ | FRB–CMB correlation |
| $\varphi_0^{\text{pred}}$ | Preferred azimuthal phase | $135^\circ \pm 10^\circ$ | FRB–CMB correlation |

# 5 Discussion and Outlook

The convergence between FRB and CMB analyses around the same azimuthal phase $\phi_0 \approx 135^\circ$ suggests that the CPT-symmetric Siamese framework captures an intrinsic large-scale anisotropy of cosmological origin. The detected modulation amplitude ($A \approx 0.96$) and alignment within $10^\circ$ between FRB and CMB axes reinforce the interpretation of a real physical direction—the *Siamese Axis*—rather than a statistical artifact.

Future work will expand the analysis to polarized quasar samples and deeper FRB catalogues to refine the statistical confidence. In parallel, theoretical refinements will explore whether phase desynchronization can emerge from neutrino portal couplings or from a residual topological twist in the CPT boundary $\Sigma_0$.


# Acknowledgments

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# Appendix A – Data Availability

The numerical grids underlying Fig. 1 and related analyses are available in the dataset `scan_grid_phys.json`, hosted with this paper on Zenodo (DOI to be assigned).