arXiv Title / Abstract / Supplemental Material (ASCII-safe)

Title: A testable brane-world unification: rho^2 cosmology, dark radiation, and a GW spectral break

Abstract: We present a minimal higher-dimensional (brane-world) framework that yields a modified 4D Friedmann equation H^2 = (8piG/3) rho (1 + rho/2lambda) + Lambda4/3 + C/a^4 (flat FRW). A single physical scale—the brane tension lambda—controls two independent observables: a broken-power-law stochastic gravitational-wave background with break frequency f_br ∝ lambda^(1/4), and an early-universe radiation excess parameterized by Delta N_eff via C. Using the public NANOGrav 15-year KDE free-spectrum (HD, 30 frequencies) and a loose Planck-2018 prior on Delta N_eff, we demonstrate a data-anchored fit and provide a small reproducibility pack (CSV + script). The claim is falsifiable: one value of lambda must simultaneously place the GW break and satisfy CMB/BBN bounds. We outline an explicit RS-type toy embedding of the Standard Model on the brane and show the GR/PPN limit for rho << lambda.

SM Description: Supplemental Material: (i) exported_pta_spectrum_HD_30f.csv (NANOGrav KDE-derived percentiles), (ii) reproduce_posteriors.py (fits broken power law; outputs best-fit JSON and plots), (iii) best_fit_REALDATA.json, and (iv) README_REPRO.txt with a 60-second rerun command.