JCAP Letter — Title & Abstract

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.

JCAP Letter — Equations & Setup

SMS: G_{mu nu}+Lambda4 g_{mu nu} = (8piG) T_{mu nu} + (kappa5^4) Pi_{mu nu} - E_{mu nu}.

FRW (flat): H^2 = (8piG/3) rho (1 + rho/2lambda) + Lambda4/3 + C/a^4.

Early-time scale factor: a(t) ~ t^(1/4) (rho^2 era).

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JCAP Letter — Predictions & Falsifiability

GW break: f_br ∝ lambda^(1/4); dark radiation: C maps to Delta N_eff.

One lambda must fit both PTA→LISA context and CMB/BBN bounds.

JCAP Letter — Data-Anchored Two-Pager Summary

NANOGrav 15yr KDE (HD, 30f) + Planck-2018 Delta N_eff prior.

Broken-power-law fit; best-fit table in SM; LISA appendix for sensitivity context.

JCAP Letter — Discussion & Outlook

RS toy embedding (anomaly checklist, Yukawas via localization, radion stabilization).

PPN/GR consistency for rho << lambda; next steps: full likelihood and compactification.