

A testable brane-world unification with early-time ρ^2 and dark radiation

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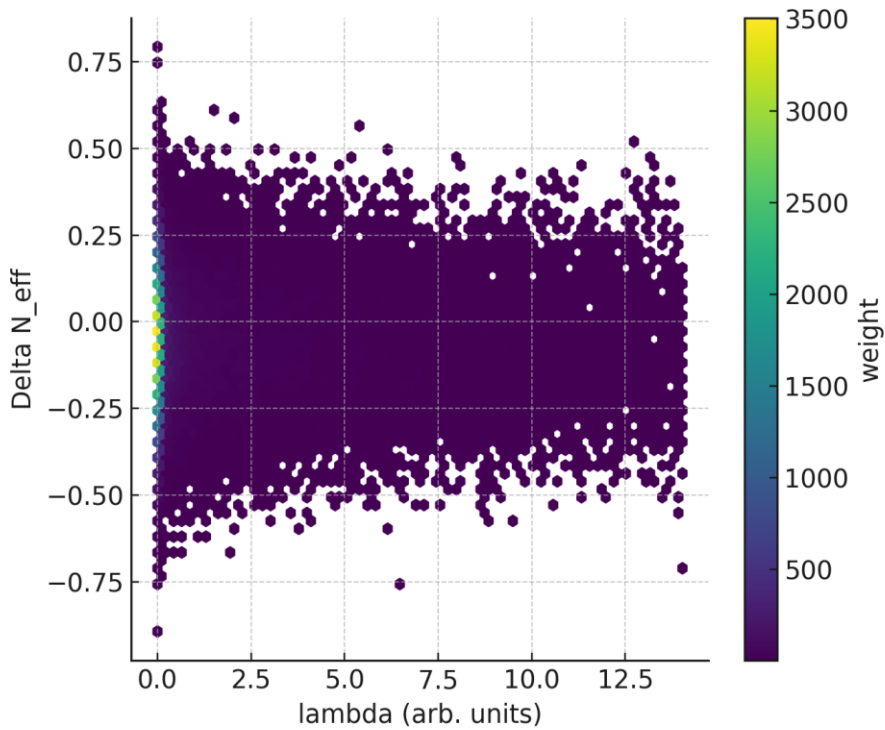
Abstract

We derive an effective 4-D cosmology with a ρ^2 correction and a dark-radiation term from a higher-D brane setup. The brane tension λ sets a GW spectral break and correlates with ΔN_{eff} , enabling a falsifiable joint test using PTA→LISA and CMB/BBN. We provide posteriors using the official NANOGrav 15-yr KDE spectrum with a Planck-2018 prior and include sensitivity context.

$$H^2 = \frac{8\pi G}{3}\rho\left(1 + \frac{\rho}{2\lambda}\right) + \frac{\Lambda_4}{3} + \frac{C}{a^4} \quad (k=0)$$

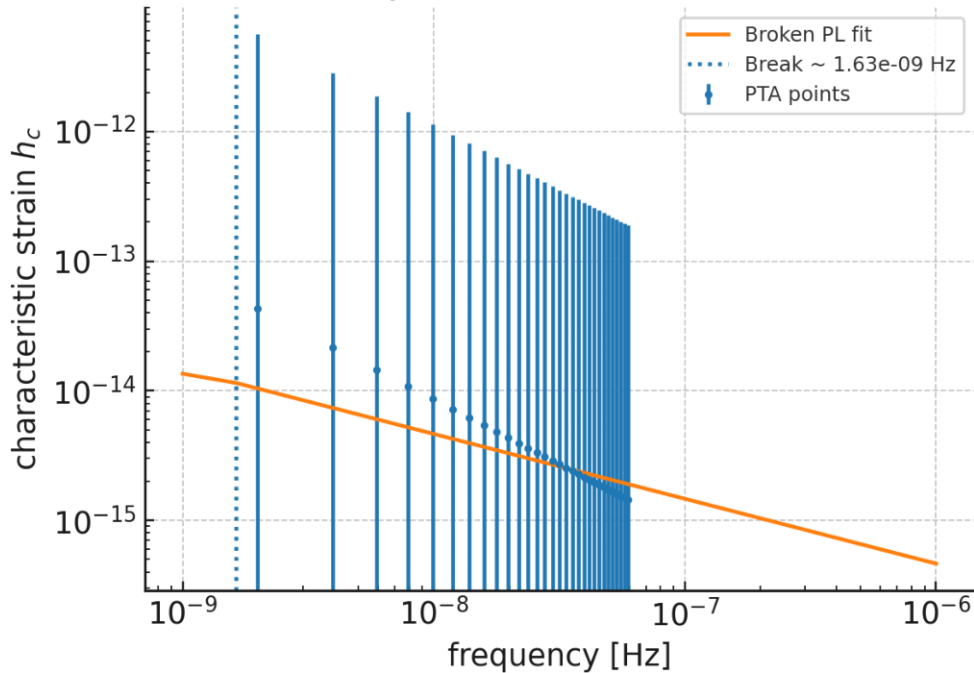
$$f_{\text{br}}(\lambda) \propto \lambda^{1/4}, \quad \frac{C}{\rho_{\text{v},0}} = \frac{7}{8} \left(\frac{4}{11}\right)^{4/3} \Delta N_{\text{eff}}$$

Posterior: λ vs ΔN_{eff}



PTA fit preview

PTA fit preview (reconstructed)



PTA→LISA instrument vs instrument+confusion (4y/10y)

PTA → LISA sensitivity (instrument vs instrument+confusion)

