

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

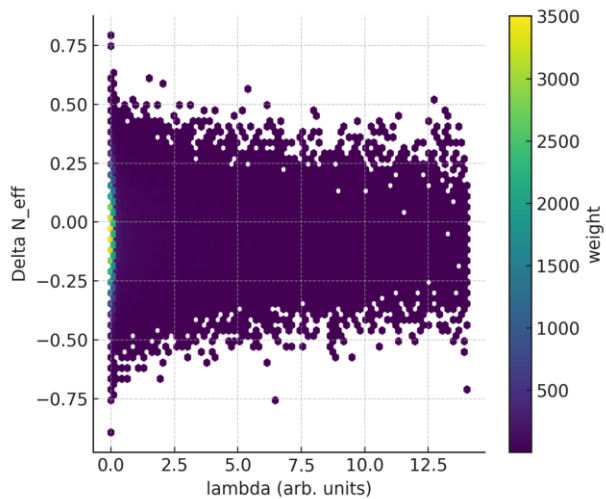
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Abstract

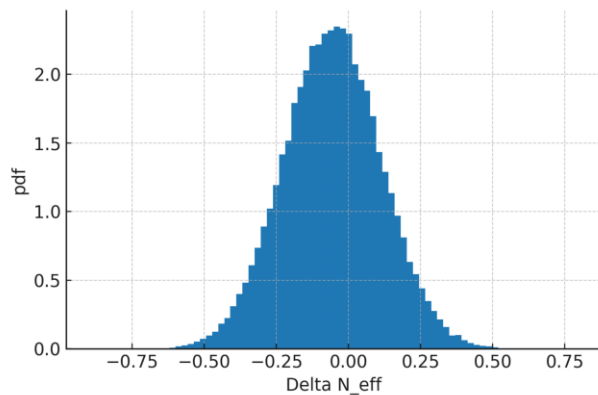
We obtain an effective 4-D cosmology with a ρ^2 correction and a dark-radiation term from a higher-D brane setup. The brane tension λ sets a GW spectral break ($f_{\text{br}} \propto \lambda^{1/4}$) and correlates with ΔN_{eff} , enabling a falsifiable joint test using PTA→LISA and CMB/BBN. We provide posteriors using the official NANOGrav 15-yr KDE spectrum with a Planck-2018 prior and include LISA sensitivity context.

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

Posterior: λ vs ΔN_{eff}

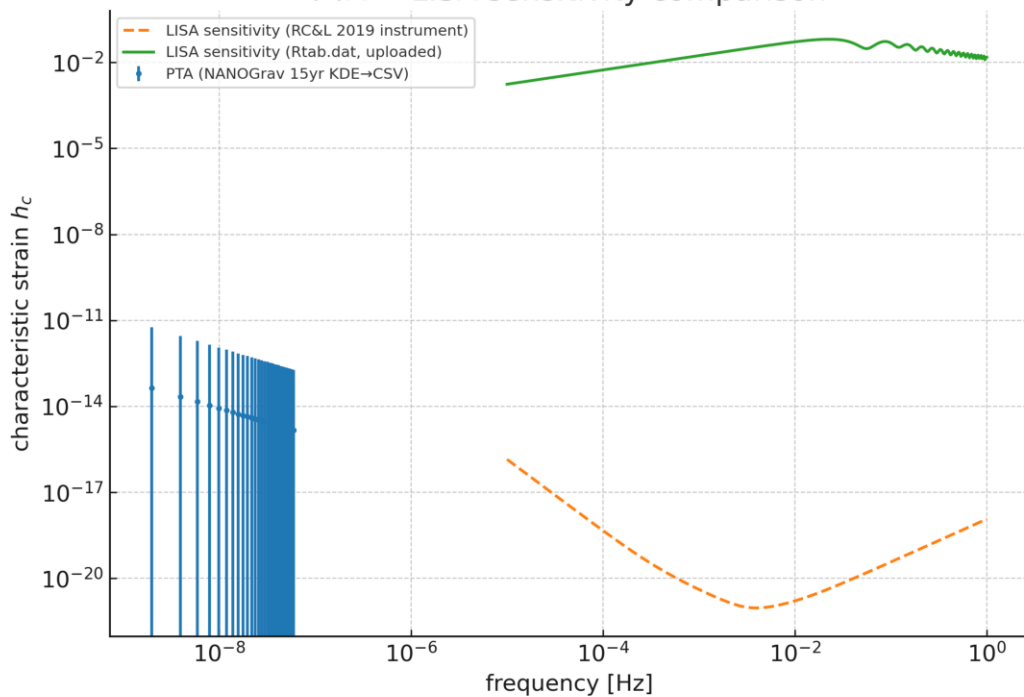


1D: ΔN_{eff}



PTA \rightarrow LISA (Rtab vs instrument)

PTA \rightarrow LISA sensitivity comparison



References (selected)

Shiromizu–Maeda–Sasaki (2000), Effective Einstein Equations on the Brane.

Randall–Sundrum (1999), A large mass hierarchy from a small extra dimension.

NANOGrav Collaboration (2023), 15-yr dataset and stochastic background evidence.

Planck Collaboration (2018), Planck 2018 results (N_eff with BAO).

Robson–Cornish–Liu (2019), LISA sensitivity curves.