Ricardo Maldonado’s Unified Theory of Everything

A compact, testable brane-world framework connecting early-universe dynamics to gravitational-wave and radiation observables.

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Executive Summary

We model our 4-D universe as a brane embedded in a higher-D bulk. Projecting the higher-D field equations yields a modified 4-D Friedmann equation with a high-energy term ($\propto \rho^2$) and a dark-radiation term ($\propto a^{-4}$). The framework is falsifiable because a single parameter—the brane tension λ—controls (i) a spectral break in the stochastic gravitational-wave background, and (ii) an effective radiation excess ΔN_{eff} constrained by CMB/BBN.

Grand Equation (flat FRW, k = 0)

$$H^2 = (8\pi G/3) \cdot \rho \cdot (1 + \rho/(2\lambda)) + \Lambda_4/3 + \square/a^4$$

Two test relations:

$$f_{br}(\lambda) \propto \lambda^{(1/4)}$$

$$\square / \rho_{\gamma,0} = (7/8) \cdot (4/11)^{(4/3)} \cdot \Delta N_{eff}$$

Low-energy limit $\rho \ll \lambda \rightarrow$ standard GR.

Predictions & Falsifiability

1) A broken-power-law SGWB with a break frequency f_{br} set by λ (PTA now; LISA next).
2) A correlated dark-radiation contribution mapped to ΔN_{eff} (CMB/BBN).
Falsifiable rule: the same λ must fit both sectors. If not, the model fails.

Data Anchors (public values used)

• PTA anchoring: published NANOGrav/IPTA spectral points (CSV).
• Early radiation prior: Planck-2018 central value ($\Delta N_{eff} \approx 2.99 \pm 0.17$).
• LISA sensitivity: Robson-Cornish-Liu analytic approximation (CSV overlays).
Files are packaged in the Repro Pack to regenerate the figures.

Next Steps for Reviewers

- Swap in full official PTA CSV and run joint likelihood with CMB/BBN priors.
- Report posteriors for λ and ΔN_{eff} with uncertainties and a goodness-of-fit metric.
- Provide an explicit compactification page (RS toy shown in supplement).
- Submit PRD/JCAP Letter + Supplement; share code and CSV (Zenodo DOI).