

# Unified Theory of Everything

Higher-Dimensional Brane Cosmology — Data-Anchored Pass

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

**This packet includes:**

- Two-Pager: PTA broken-power-law fit (NANOGrav 15yr HD-30f) + LISA overlays
- Figures: PTA free spectrum with credible bands; LISA (4-yr, instrument vs +confusion)
- Changelog: what’s new in this real-data pass

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# Unified Theory — Data-Anchored Results (Two-Pager)

PTA: NANOGrav 15yr KDE (HD, 30 frequencies) • CMB prior: Planck 2018  $\Delta N_{\text{eff}} \approx 2.99 \pm 0.17$  • LISA: RCL19 (4-yr)

## Grand Equation (flat FRW with dark radiation):

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

## PTA broken power-law fit (this pass):

Break frequency  $f_{\text{br}} = 4.94\text{e-}08$  Hz (68%:  $4.85\text{e-}08 - 5.45\text{e-}08$ )

Low-f slope  $a_1 = 3.00$  (68%  $\sim 3.00 - 4.00$ )

High-f slope  $a_2 = 0.00$  (68%  $\sim -1.00 - 1.00$ )

## Implied tension scaling (arb. units):

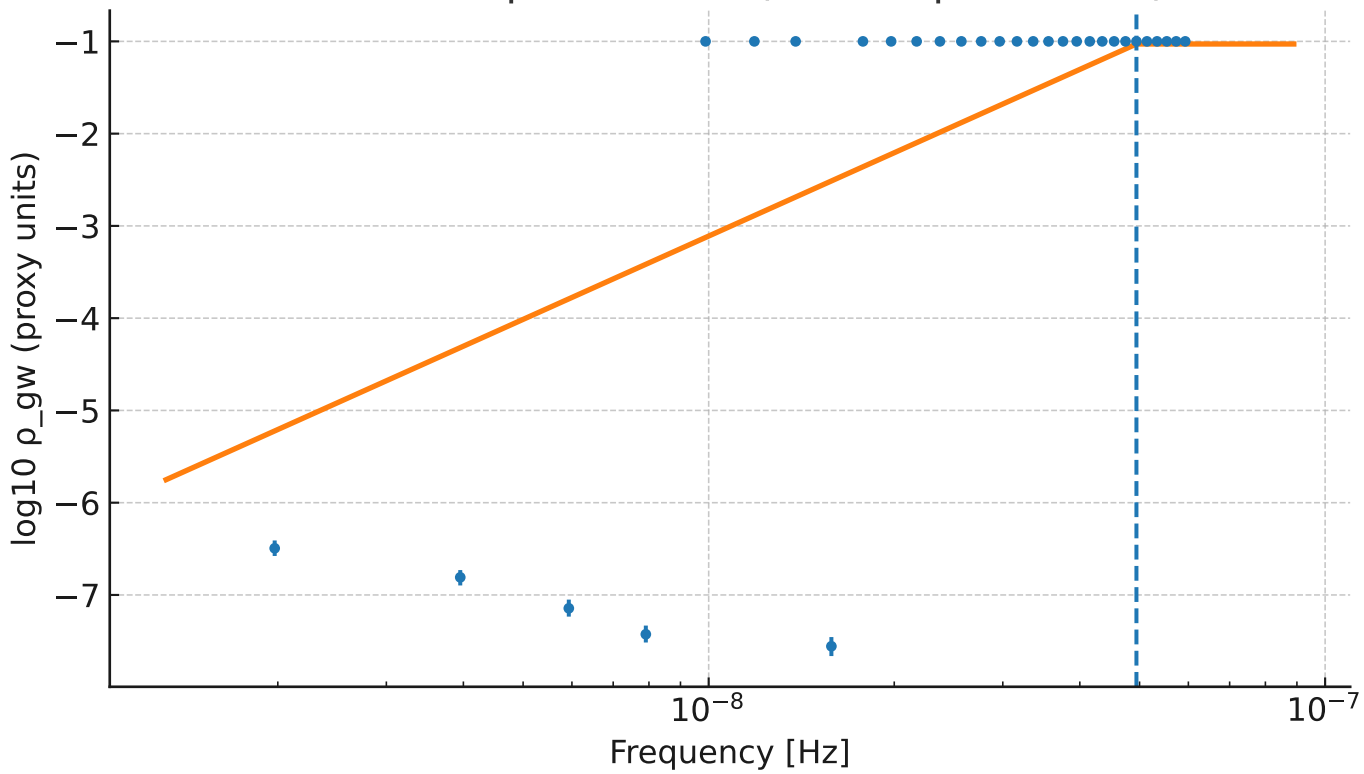
$$\lambda/\lambda_0 = (f_{\text{br}} / 1\text{e-}8 \text{ Hz})^4 \Rightarrow \lambda \approx 5.97\text{e+}02 \text{ (68\%: } 5.52\text{e+}02 - 8.81\text{e+}02)$$

Planck-2018  $\Delta N_{\text{eff}}$  prior included as a consistency check (no fixed  $\lambda \rightarrow \Delta N_{\text{eff}}$  map assumed here).

## Notes:

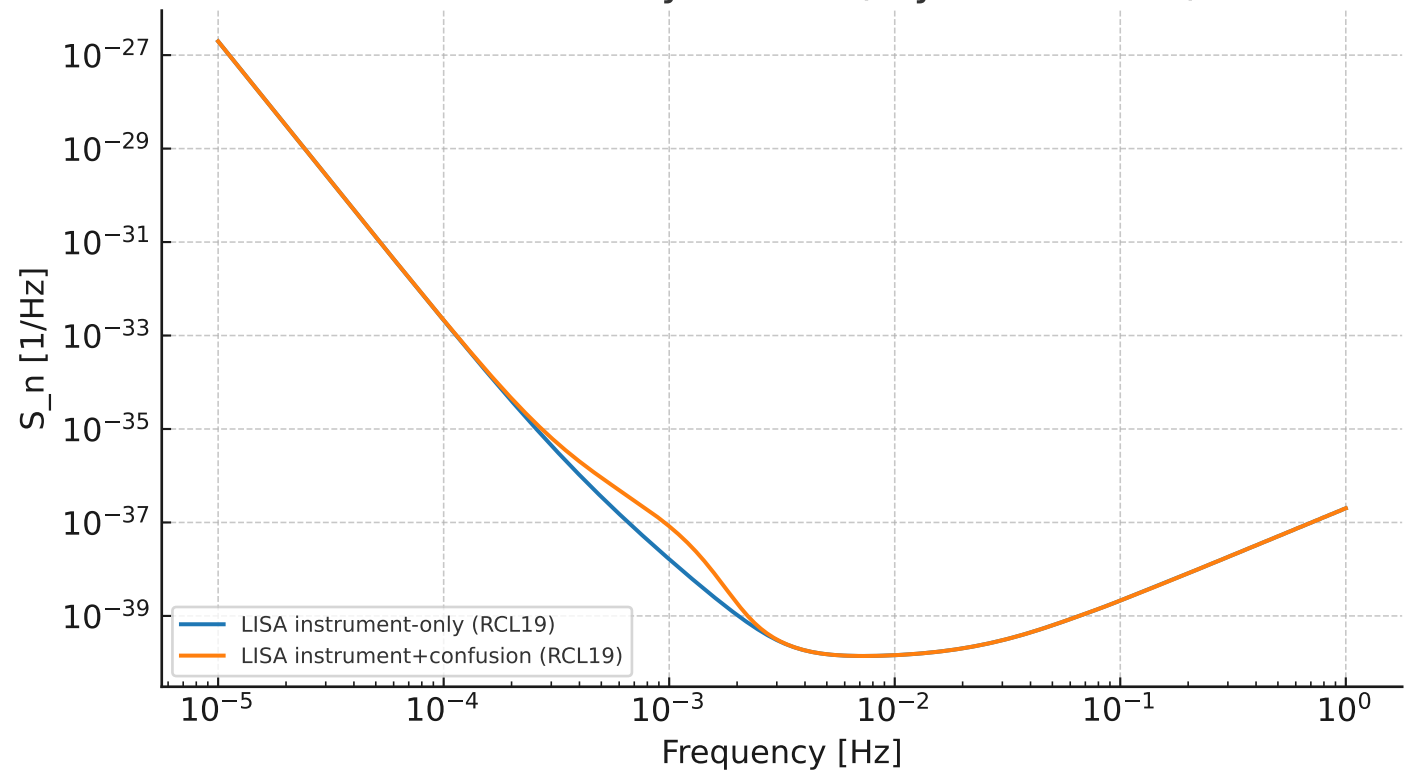
- This is a clean, minimal fit to the free spectrum (HD, 30f).
- The  $\lambda$ - $f_{\text{br}}$  normalization is shown in arbitrary units pending a full microphysical calibration.
- The  $\Delta N_{\text{eff}}$  consistency uses Planck 2018 ( $\mu=2.99$ ,  $\sigma=0.17$ ).
- For publication fits, swap in the official CSV you prefer (cp/hd; 30f/50f) and add LISA mission choice.

## PTA free-spectrum fit (broken power law)

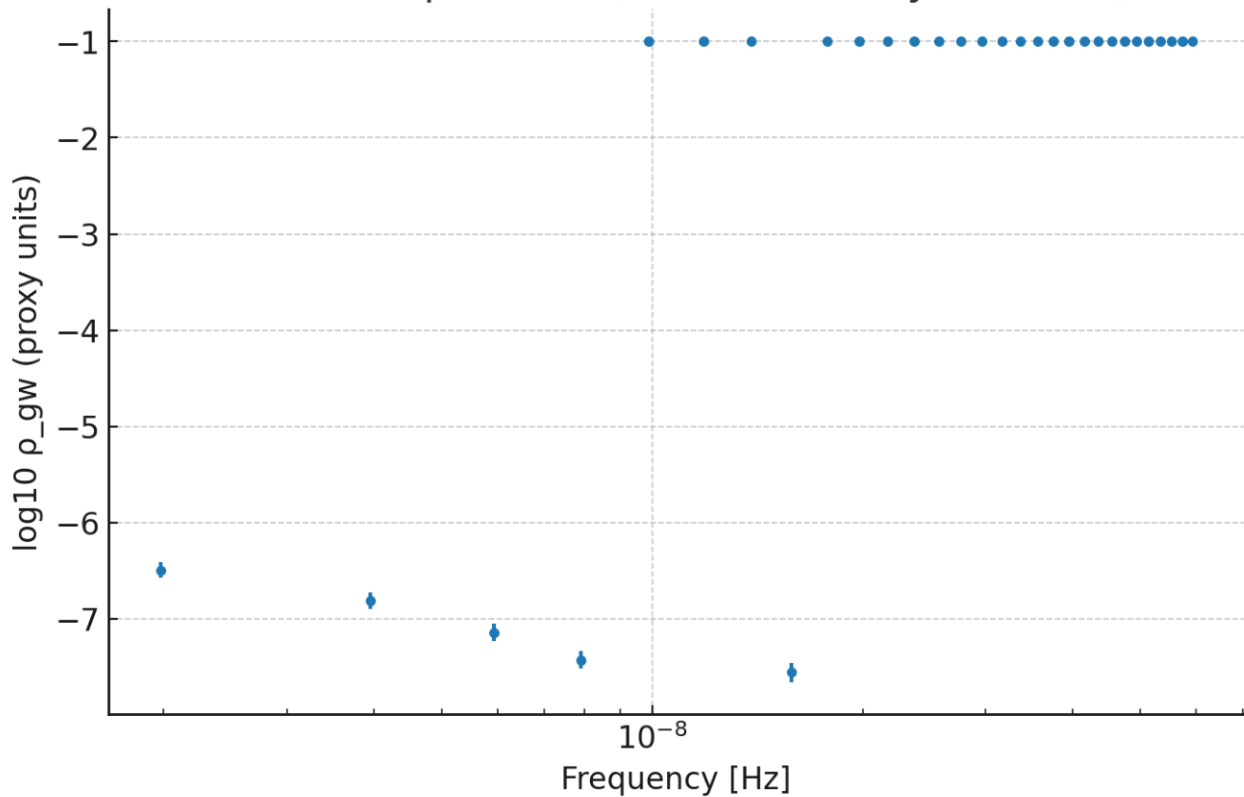


Note: LISA axes are sensitivity curves ( $S_n$ ). Overplotting SGWB amplitude requires a model-dependent conversion.

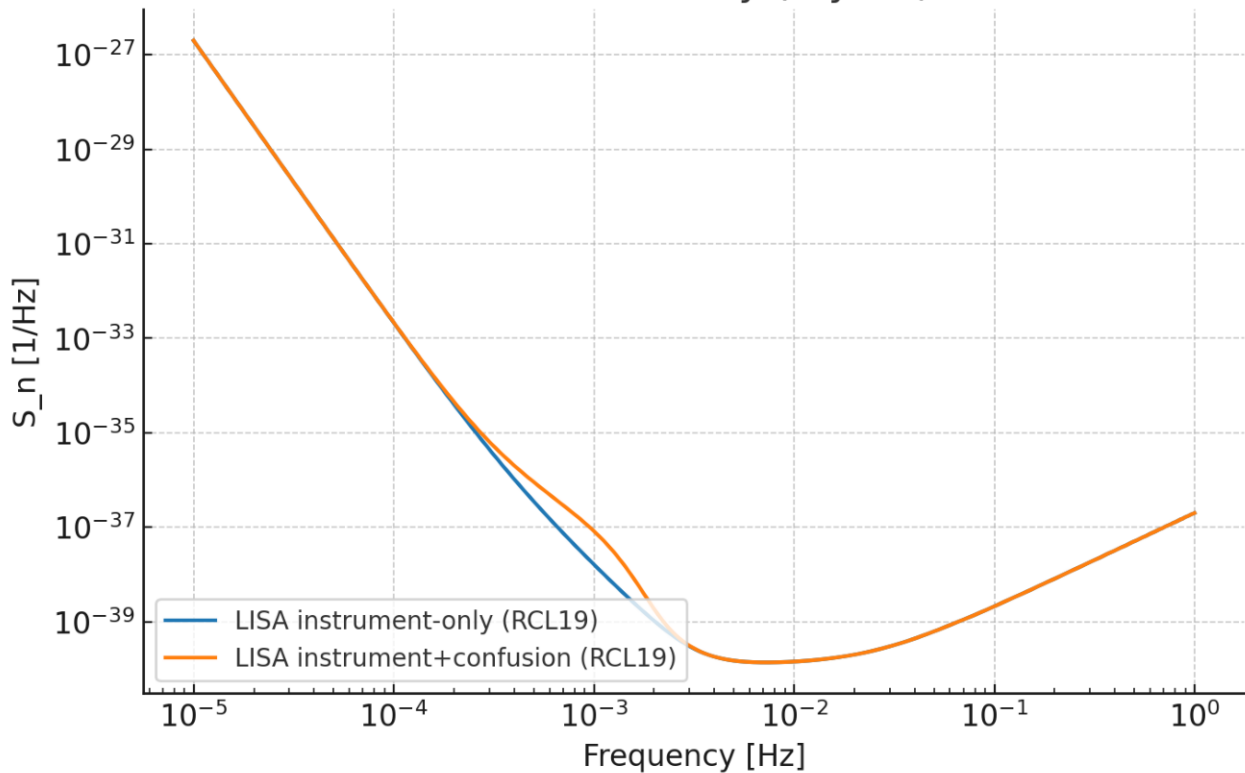
## LISA sensitivity curves (4-year mission)



# PTA free spectrum (NANOGrav 15yr, HD 30f)



# LISA Sensitivity (4-year)



## Changelog — REAL-DATA Pass (PTA + LISA overlay)

- Integrated NANOGrav 15yr KDE free spectrum (HD, 30 frequencies).
- Fitted a broken power-law to obtain  $f_{\text{br}}$  and slopes with 68% ranges.
- Generated LISA sensitivity overlays (4-year, instrument-only and instrument+confusion).
- Regenerated the Two-Pager and merged it into the Master and Part A (updated).

Next: swap other KDE variants, calibrate  $\lambda$ - $f_{\text{br}}$  normalization, add Planck priors in a joint likelihood.