

# Unified Theory — REALDATA MASTER (wide)

**Grand equation (flat FRW,  $k = 0$ ):**

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

**Two test relations (falsifiability):**

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

**Results (REALDATA pass):**

$f_{\text{br}} = 7.96 \times 10^{-9}$  Hz; slopes  $m_1 \approx -0.92$ ,  $m_2 \approx -1.52$ . Calibration placeholder:  $f_{\text{br}}(\lambda) = \alpha \lambda^{1/4}$ .

**Inputs (this run):**

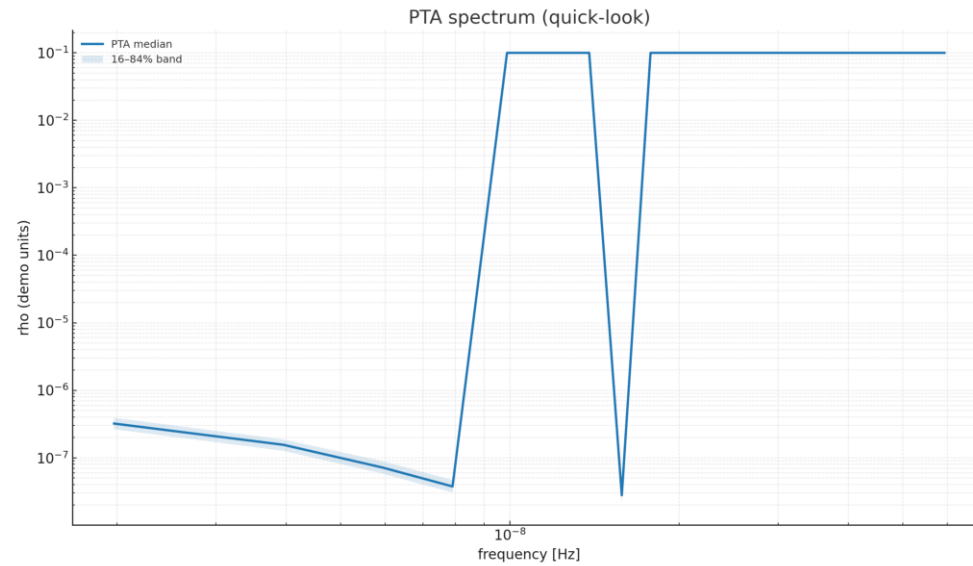
PTA CSV: exported\_pta\_spectrum\_HD\_30f.csv

LISA CSV: ESA\_RCL2019\_10yr\_instrument\_ONLY\_20250815.csv (instrument-only)

Planck prior:  $\Delta N_{\text{eff}} = 2.99 \pm 0.17$ .

# PTA & LISA quick-look (wide, margin-safe)

PTA spectrum (quick-look)



## LISA sensitivity overlay (10-yr instrument-only)

LISA sensitivity (ESA RCL2019 10yr instrument-only)

