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Precision cosmology and the stiff-amplified gravitational-wave background from inflation: implications for the Hubble tension

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The recent NANOGrav finding of a common-spectrum process has invited interpretations as possible evidence of a primordial stochastic gravitational-wave background (SGWB)
stronger than predicted by standard inflation + ΛCDM. Such an SGWB would contribute an extra radiation component to the background Universe which may affect its expansion history. As such, it may help alleviate the current Hubble tension, a novel connection between gravitational waves and cosmology. We demonstrate this by considering a cosmological model, the "standard inflation + stiff amplification" scenario, with two components added to the base-ΛCDM model: a stiff component ($w \equiv p/\rho = 1$) and the primordial SGWB.
Previously, we showed that even for *standard* inflation, the SGWB may be detectable at the high frequencies probed by laser interferometers, if it is amplified by a possible early stiff era after reheating. Models that boost the SGWB enough to cause significant *backreaction*, however, must still preserve the well-measured radiation-matter equality, respecting the demands of precision cosmology. For that, we calculate the fully-coupled evolution of the SGWB and expansion history, sampling parameter space (tensor-to-scalar ratio, reheating temperature and temperature at stiff-to-radiation equality). We then perform a joint analysis of the NANOGrav results and latest upper bounds from *Planck*, big bang nucleosynthesis and Advanced LIGO-Virgo, to constrain the model. The resulting blue-tilted, stiff-amplified SGWB is still too small to explain the NANOGrav results. However, if someday, Advanced LIGO-Virgo detects the SGWB, our model can explain it within standard inflation (*without* requiring an initial spectral tilt). Meanwhile, this model may bring current high-z measurements of the Hubble constant within 3.4σ of the low-z measurements by SH0ES (from 4.4σ) and within 2.6σ of those by H0LiCOW (from 3.1σ), reducing the tension.

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Gravitational waves

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