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Ultra-low mass primordial black holes in the early universe can explain the PTA signal

Ultra-low mass primordial black holes (PBHs), which evaporate far before Big Bang Nucleosynthesis (BBN), are unconstrained to dominate the energy density of our universe for a short duration. We analyze the stochastic gravitational wave background (SGWB) signals from the domination of ultra-low mass PBHs to explain this recent discovery of SGWB from Pulsar Timing Array collaborations at nanohertz frequencies. This scenario requires a relatively broad peak in the power spectrum of scalar perturbations from inflation with a spectral index in a narrow range of 1.45 to 1.6. The resulting PBH population would have mass around 10^8g, and the initial abundance β_f lies between 10^{-10} and 10^{-9}. We find strong Bayesian evidence that for NANOGrav 15-year data and IPTA data release-2, this explanation is preferred by the data over the generic model where supermassive black hole binaries (SMBHBs) are considered as the source. Though these very light PBHs would decay before BBN, upcoming third-generation terrestrial laser interferometers like the Einstein Telescope (ET) can test the model by observing the GW spectrum produced during the formation of the PBHs. Also, the scalar power spectra associated with our scenario will be within the reach of PIXIE probing CMB spectral distortions.

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