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Gravitational waves and Baryogenesis from ultralight PBHs

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Hawking radiation (HR) causes ultralight primordial black holes (PBHs) ($10^9 g$) to entirely evaporate and produce all of the particles in a given theory, regardless of their other interactions. Successful baryogenesis via leptogenesis predicts the mass scale of RH neutrinos as well as black holes if right-handed (RH) neutrinos are also created from PBH evaporation. We show that a network of cosmic strings naturally give rise to a strong stochastic gravitational-wave (GW) signal at the sensitivity level of pulsar timing arrays (PTA) and LIGO5, given that the lepton number violation (generation of RH neutrino masses) in the theory is a result of a gauged *U(1)* breaking followed by the formation of PBHs. A break in the GW spectra occurs around MHz frequency due to a short period of black hole dominance in the early universe, for which baryon asymmetry is independent of initial PBH density. As a result, GW detectors with higher frequencies are required to observe the break together with the regular GW signal caused by graviton emission via HR. The NANOGrav PTA's recent discovery of a stochastic common spectrum process (interpreted as GWs) across a large number of pulsars conflicts with PBH baryogenesis for large cosmic string loops ($\simeq 0.1$).

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