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Gravitational Leptogenesis and Primordial Gravitational Waves during PBH-induced Reheating

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We explore the possibility of dynamically producing the observed matter-antimatter asymmetry of the Universe entirely from the evaporation of primordial black holes (PBH), that are formed in an inflaton-dominated background. Considering the inflaton (ϕ) to oscillate in a monomial potential $V(\phi) \propto \phi^n$, we show that it is possible to obtain the desired baryon asymmetry via vanilla leptogenesis from evaporating PBHs of initial mass $lesssim$10 g. The feasible parameter space is heavily dependent on the shape of the inflaton potential during reheating (determined by n), the energy density of PBHs (determined by β), and the nature of the coupling between the inflaton and the Standard Model (SM). We further include in our analysis the minimal gravitational leptogenesis set-up through inflaton scattering via a graviton, that opens up an even larger window for PBH mass, depending on the background equation of state. We finally show that such gravitational leptogenesis scenarios can be tested with upcoming gravitational wave (GW) detectors, courtesy of the blue-tilted primordial GW with inflationary origin, thus paving a way to probe a PBH-induced reheating and leptogenesis era.

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