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Inflationary Gravitational waves as test for low scale leptogenesis

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We study thermal and non-thermal resonant leptogenesis in a general setting where a heavy scalar ϕ decays to right-handed neutrinos (RHNs) whose further out-of-equilibrium decay generates the required lepton asymmetry. Domination of the energy budget of the Universe by the ϕ or the RHNs alters the evolution history of the primordial gravitational waves (PGW) of inflationary origin, which re-enter the horizon after inflation, modifying the spectral shape. The decays of ϕ and RHNs release entropy into the early Universe while nearly degenerate RHNs facilitate low and intermediate-scale leptogenesis. We show that depending on the coupling y_R of ϕ to radiation species, RHNs can achieve thermal abundance before decaying, which gives rise to thermal leptogenesis. A characteristic damping of the GW spectrum resulting in knee-like features would provide evidence for low-scale thermal and non-thermal leptogenesis. We explore the parameter space for the lightest right-handed neutrino mass $M_1 \in [10^2, 10^{14}]$ GeV and washout parameter K that depends on the light-heavy neutrino Yukawa couplings λ,

in the weak ($K < 1$) and strong ($K > 1$) washout regimes. The resulting novel features compatible with observed baryon asymmetry are detectable by future experiments like LISA and ET. By estimating signal-to-noise ratio (SNR) for upcoming GW experiments, we investigate the effect of the scalar mass M_ϕ and reheating temperature T_ϕ, which depends on the $\phi - N$ Yukawa couplings y_N.

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