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Singlet-doublet dark matter induced radiative neutrino mass and TeV scale leptogenesis

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The singlet-doublet dark matter model is one of the most studied WIMP scenarios to realize the relic of DM in a large parameter space. In this work, we study the two-step leptogenesis in the singlet-doublet Majorana dark matter model. We extend the Standard Model (SM) by introducing three Majorana singlet fermions (N_i), three doublet fermions (Ψ_i), and a singlet scalar (Φ), all of which are odd under an imposed Z_2 symmetry, while SM particles remain even.
The CP-violating out-of-decay of the heavier singlets ($N_{2,3}$) to the lighter doublets (Ψ_i) generates an asymmetry in the doublets. This asymmetry is then transferred to the lepton asymmetry via decays of Ψ_i to leptons. Prior to the electro-weak (EW) symmetry breaking, this lepton asymmetry is converted to the baryon asymmetry by the EW spharelons. We also show that the imposed Z_2 symmetry prevents neutrino masses at tree level but allows them to be generated at one loop. Additionally, we analyze the dark matter relic, including the annihilation, co-annihilation, and co-scattering processes. We constrain the parameter space with the present direct, indirect, and collider searches.

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