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FIMP Dark Matter from Leptogenesis in Fast Expanding Universe

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Within the framework of canonical type-I seesaw, a feebly interacting massive particle (FIMP) χ is introduced as a dark matter candidate. The leptogenesis mechanism and dark matter relic density share a common origin via decays of Majorana neutrinos N. Provided an additional species φ whose energy density red-shifts as $\rho_\varphi \propto a^{-(4+n)}$, the Hubble expansion rate is larger than the standard scenario, i.e., the Universe expands faster. The consequences of such a fast expanding Universe on leptogenesis as well as FIMP dark matter are investigated in detail. We demonstrate a significant impact on the final baryon asymmetry and dark matter abundance due to the existence of φ for the strong washout scenario. While for the weak washout scenario, the effects of FEU are relatively small. We introduce scale factors F_L and F_χ to describe the corresponding effects of FEU. A semi-analytical approach to derive the efficiency factors η_L and η_χ in FEU is also discussed. The viable parameter space for success thermal leptogenesis and correct FIMP DM relic density is obtained for standard cosmology and FEU. Our results show that it is possible to distinguish different cosmology scenarios for strong washout cases.

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