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# Asymmetric Self-interacting Dark matter via Dirac Leptogenesis

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The nature of neutrinos, whether Dirac or Majorana, is hitherto not known. Assuming that the neutrinos are Dirac, which needs $B - L$ to be an exact symmetry, we attempt to explain the observed proportionality between the relic densities of dark matter (DM) and baryonic matter in the present Universe $i.e.$, $\Omega_{\rm DM} \approx 5\,\Omega_{\rm B}$. We extend the Standard Model (SM) by introducing heavy scalar doublets $X_i, i = 1, 2$ and $\eta$, two singlet scalars $\Phi$ and $\Phi'$, a vector-like Dirac fermion $\chi$ representing the DM and three right-handed neutrinos $\nu_{R_i}, i = 1, 2, 3$. Assuming $B - L$ is an exact symmetry of the early Universe, the CP-violating out-of-equilibrium decay of heavy scalar doublets: $X_i, i = 1, 2$ to the SM lepton doublet $L$ and the right-handed neutrino $\nu_R$, generate equal and opposite $B-L$ asymmetry among left ($\nu_L$) and right ($\nu_R$)-handed neutrinos. We ensure that $\nu_L - \nu_R$ equilibration does not occur until below the electroweak (EW) phase transition during which a part of the lepton asymmetry gets converted to dark matter asymmetry through a dimension eight operator, which conserves $B - L$ symmetry and remains in thermal equilibrium above sphaleron decoupling temperature. A part of the remaining $B - L$ asymmetry then gets converted to a net B-asymmetry through EW-sphalerons which are active at a temperature above 100 GeV. To alleviate the small-scale anomalies of $\Lambda$CDM, we assume the DM ($\chi$) to be self-interacting via a light mediator $\Phi$, which not only depletes the symmetric component of the DM, but also paves a way to detect the DM at terrestrial laboratories through $\Phi - H$ mixing, where $H$ is the SM Higgs doublet.

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