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# Common Origin of Asymmetric Self-interacting Dark Matter and Dirac Leptogenesis

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Assuming dark matter to be asymmetric as well as self-interacting and neutrinos to be Dirac fermions, we propose a framework to address the observed baryon imbalance of the universe. We add three right-handed neutrinos $\nu_{R_i}$, $i = 1, 2, 3$, one singlet fermion $\chi$, a doublet fermion $\psi$, and heavy scalar doublets $\eta_i$, $i = 1, 2$ to the Standard Model. Both $\chi$ and $\psi$ are fermions with non-zero charge under an extended $U(1)_{B-L} \times U(1)_D$ symmetry. Additionally, a $\mathcal{Z}_2$ symmetry is imposed, where the singlets $\chi$, $\nu_R$, and $\eta$ are negative and the doublet $\psi$ is positive. Given the assumption that neutrinos are Dirac particles, $B - L$ turns into an exact symmetry of the universe. The CP-violating out-of-equilibrium decay of heavy scalar $\eta$ generates an equal and opposite $B - L$ asymmetry among the left-handed ($\nu_L$) and right-handed ($\nu_R$) neutrinos. The $\nu_L - \nu_R$ equilibration process does not take place until below the Electroweak phase transition scale because of tiny Yukawa couplings. During this time, Sphaleron processes, which are active at temperatures higher than 100 GeV, transform a portion of the $B - L$ asymmetry stored in left-handed neutrinos into baryon asymmetry. MeV scale gauge boson $Z'$ of $U(1)_D$ sector mediates both annihilation of symmetric dark matter component and self-interaction among dark matter particles. Moreover, $Z'$ mixes with the Standard Model Z-boson and facilitates dark matter direct detection.

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