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Light Dirac neutrino portal dark matter with gauged B-L symmetry

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We study a scenario where origin of dark matter is related to the Dirac nature of neutrino, known as the light Dirac neutrino portal dark matter (DNPDM). In such DNPDM set up, light dirac neutrinos take the role of mediating the interactions between dark matter (DM) and standard model (SM) bath. Here, we consider a UV complete model in gauged B-L framework extended by three species of right handed neutrinos (ν_R), two singlet scalars ϕ_1 and ϕ_2 and a Dirac fermion ψ which acts as DM. While the neutrino mass is generated from ν_R, the two scalars ϕ_1 and ϕ_2 with non-zero B-L charge help in realising light Dirac neutrino portal DM and spontaneous B-L symmetry breaking respectively. The beyond SM particles interact among themselves via yukawa coupling depending on which, we have both feebly interacting massive particle (FIMP) and weakly interacting massive particle (WIMP) type DM. We consider both the possibilities and find out the model parameters consistent with DM abundance and effective number of relativistic species, $N_{\rm eff}$. We also study the constraint obtained from structure formation for FIMP type DM. The model not only gives rise to the desired DM phenomenology with observable $\Delta \mathrm{N_{eff}}$, but also leads to new constraints in the gauged $B-L$ parameter space not obtained previously.

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