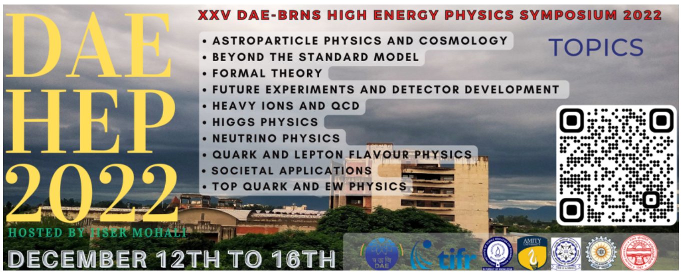

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Light Dirac neutrino portal dark matter with observable ΔN_{eff}

Tuesday 13 December 2022 16:00 (15 minutes)

We propose a Dirac neutrino portal dark matter scenario by minimally extending the particle content of the Standard Model (SM) with three right-handed neutrinos (ν_R), a Dirac fermion dark matter candidate (ψ) and a complex scalar (ϕ), all of which are singlets under the SM gauge group. An additional $\mathbb{Z}_4$ symmetry has been introduced for the stability of dark matter candidate ψ and also ensuring the Dirac nature of light neutrinos at the same time. Both the right-handed neutrinos and the dark matter thermalise with the SM plasma due to a new Yukawa interaction involving ν_R, ψ and ϕ while the latter maintains thermal contact via the Higgs portal interaction. The decoupling of ν_R occurs when ϕ loses its kinetic equilibrium with the SM plasma and thereafter all three $\mathbb{Z}_4$ charged particles form an equilibrium among themselves with a temperature T_{ν_R}. The dark matter candidate ψ finally freezes out within the dark sector and preserves its relic abundance. We have found that in the present scenario, some portion of low mass dark matter ($M_\psi \leq 10$ GeV) is already excluded by the Planck 2018 data for keeping ν_Rs in the thermal bath below a temperature of 600 MeV and thereby producing an excess contribution to $N_{\rm eff}$. The next generation experiments like CMB-S4, SPT-3G etc. will have the required sensitivities to probe the entire model parameter space of this minimal scenario, especially the low mass range of ψ where direct detection experiments are still not capable enough for detection.

Session

Astroparticle Physics and Cosmology

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