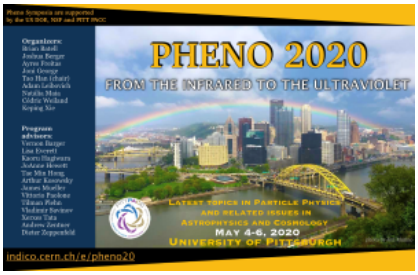

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UV and IR freeze-in production of fermionic dark matter and its possible X-ray signature

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Non-thermal dark matter produced via freeze-in is a well-motivated scenario and it can explain the null results of direct detection experiment because of its feeble interaction with the standard model (SM) particles. In this work, we have considered a minimal extension of SM by adding an SM gauge singlet and $\mathbb{Z}_2$ odd Dirac fermion χ which is the dark matter candidate, a pseudo scalar $\tilde{\phi}$ which also SM gauge singlet but $\mathbb{Z}_2$ even. χ interacts with the SM fields via dimension five operator and because of that, the couplings are suppressed by a heavy mass scale Λ. We have studied the production of the DM candidate via UV, IR and mixed freeze-in in detail and found that for 10^{10} GeV $\leq \Lambda \leq 10^{15}$ GeV, χ is dominantly produced via UV and mixed UV-IR freeze-in when reheat temperature $T_{\rm RH} 10^4$ GeV and the production is dominated by IR and mixed freeze-in below $T_{\rm RH} \simeq 10^4$ GeV. We have studied the cascade annihilation $\chi\bar{\chi} \to \tilde{\phi}\tilde{\phi} \to 4\gamma$ to address the ~ 3.5 keV X-ray line observed from various galaxies taking into account the long lifetime of $\tilde{\phi}$. Finally the allowed parameter space for $\Lambda - g$ plane is obtained by comparing the X-ray flux from the Milky-Way galaxy observed by XMM Newton telescope.

Summary

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