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Investigating the collinear splitting effects of boosted dark matter at neutrino detectors

We study the probing prospects of cosmic ray boosted dark matter (DM) in the framework of simplified electron-philic dark photon model. Focusing on the dark matter and dark photon masses around keV ~ MeV scale, we consider the bounds obtained from the XENON1T and Super-K experiments. The electron bound state effects are treated carefully in calculating the XENON1T constraint. As for the detection at neutrino detector where the energy threshold is relatively higher, the large logarithmic effects induced by the scale hierarchy between the masses and momentum transfer are considered by introducing the DM parton distribution function (PDF). The logarithmic effects will reduce the electron recoil rate for DM scattering in neutrino detectors. Moreover, we find the DUNE and JUNO experiments provide high sensitivities for probing the dark photon component in the DM PDF through the dark Compton process. We also check the Bullet Cluster constraint on the DM self-scattering cross section.

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