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Boosted dark matter driven by cosmic rays and diffuse supernova neutrinos

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Direct detection of light dark matter can be significantly enhanced by upscattering of dark matter with energetic particles in the cosmic ambient. This boosted dark matter flux can reach kinetic energies up to tens of MeV, while the typical kinetic energies of GeV mass dark matter particles in the Milky Way halo are of the order of keV. Dark matter boosted by energetic diffuse supernova background neutrinos can be detected only through nuclear or electron scattering in ground-based detectors requiring a nonzero interaction of dark matter with nucleon or electron, in addition to its interaction with neutrino. However, in the presence of dark matter-nucleon (electron) interaction, the scattering of dark matter with cosmic rays is unavoidable. Thus, we consider boosted dark matter resulting from diffuse supernova neutrinos as well as cosmic protons (electrons) considering both energy-dependent and energy-independent scattering cross sections between dark matter and standard model particles. We explore this scenario in dark matter detectors such as XENONnT and neutrino detectors like Super-Kamiokande.

Authors: Prof. GHOSH, Dilip Kumar (Indian Association for the Cultivation of Science); HUITU, Katri (University of Helsinki); HEIKINHEIMO, Matti (University of Helsinki and Helsinki Institute of Physics); JEESUN, Sk; GUPTA, Tushar

Presenter: GUPTA, Tushar

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