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Illuminating Very Heavy Dark Matter in the Earth with Tau Neutrinos

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Dark matter continuously accumulates at the Earth's core through DM–nucleon scattering as Earth traverses the Milky Way's dark matter halo. With higher dark matter density in the Earth's core, potential annihilations of these dark matter particles into Standard Model particles, like tau neutrinos and tau leptons, offer an intriguing observational target for indirect dark matter searches. Large-volume neutrino telescopes, with their expansive detection capabilities across wide energy spectra, have opened a new front in identifying dark matter signals originating from Earth's center. Conventional studies have predominantly focused on dark matter masses below a PeV due to Earth's opacity to very-high-energy neutrinos.
In this talk, we reexamine the role of tau regeneration, which enables dark matter annihilation signals from the Earth's center to reach the surface. By focusing on annihilation channels into tau leptons or tau neutrinos, we show that neutrino observatories, like IceCube, can probe much heavier dark matter than previously accessible. Using 7.5 years of IceCube high-energy starting event data, this study sets stringent new upper limits on the spin-independent dark matter–nucleon cross-section, pushing the accessible dark matter mass range from 10^5 GeV to as high as 10^{10} GeV. Our results highlight the potential of current and future neutrino observatories to explore the high-mass regime of Earth-bound dark matter annihilation.

Mini Symposia (Invited Talks Only)

Plenary (Invited talks only)

Authors: Prof. KHEIRANDISH, Ali (University of Nevada, Las Vegas); LIU, Qinrui (Queen's University); DING, Tianyi (University of Nevada, Las Vegas)

Presenter: DING, Tianyi (University of Nevada, Las Vegas)

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