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Constraining dark matter capture and annihilation cross sections by searching for neutrino signature from the Earth core

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We study the sensitivity of IceCube/DeepCore detector to dark matter (DM) annihilations in the Earth core. We focus on annihilation modes DM DM−>nu anti-nu, tauˆ+ tauˆ-, b anti-b, and Wˆ+Wˆ-. Both track and cascade events are considered in our analysis.

By fixing the DM annihilation cross section at some nominal values, we study the sensitivity of IceCube/DeepCore detector to DM spin-independent capture cross section for a DM mass range from few tens of GeV to 10 TeV. This sensitivity is compared with the existing IceCube 79 string constraint on the same cross section , which was obtained by searching for DM annihilations in the Sun. We also compare this sensitivity to DM direct detection results, in particular the XENON 100 (2012) limit and the parameter regions by DAMA and CRESST-II experiments.

We also present IceCube/DeepCore sensitivity to DM annihilation cross section as a function of DM mass by fixing DM spin-independent capture cross section at XENON 100 (2012) and XENON 1T limits. This sensitivity is compared with the preferred DM parameter range derived from the combined fitting to PAMELA and AMS02 positron fraction data.

We conclude that the search for DM annihilations in the Earth core provides competitive constraints on DM capture and annihilation cross sections in the case of low-mass DM.

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