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Solar Atmospheric Neutrinos: A New Neutrino Floor for Dark Matter Searches

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As is well known, dark matter direct detection experiments will ultimately be limited by a "neutrino floor," due to the scattering of nuclei by MeV neutrinos from, e.g., nuclear fusion in the Sun. Here we point out the existence of a new "neutrino floor" that will similarly limit indirect detection with the Sun, due to high-energy neutrinos from cosmic-ray interactions with the solar atmosphere. We have two key findings. First, solar atmospheric neutrinos ⊠1 TeV cause a sensitivity floor for standard WIMP scenarios, for which higher-energy neutrinos are absorbed in the Sun. This floor will be reached once the present sensitivity is improved by just one order of magnitude. Second, for neutrinos ⊠1 TeV, which can be isolated by muon energy loss rate, solar atmospheric neutrinos should soon be detectable in IceCube. Discovery will help probe the complicated effects of solar magnetic fields on cosmic rays. These events will also be backgrounds to WIMP scenarios with long-lived mediators, for which higher-energy neutrinos can escape from the Sun.

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