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Detecting EeV tau neutrinos at PeV energies with IceCube

IceCube has measured an astrophysical flux of neutrinos extending to 10 PeV. However, a guaranteed yet undetected flux of cosmogenic neutrinos remains elusive. The cosmogenic neutrino energy density peaks at ~EeV energies. This has led to the development of novel detection technologies optimized for EeV neutrinos; among them, notably, are radio detectors. However, we show here that a similar number of cosmogenic neutrino events is expected at PeV energies where ice or water Chenrekov technologies are sensitive. This is due to the fact that cosmogenic tau neutrinos are not absorbed when traversing Earth, but rather they cascade down in energy. We show that the rate of upgoing cosmogenic neutrinos is twice those that are earth-skimming, with a unique zenith and spectral distribution. We present a possible search with the currently available ten years of IceCube data, and highlight this method's potential by constraining ANITA's anomalous EeV events.

Mini-abstract

GZK tau neutrinos can be detected above the astrophysical background at PeV energies with IceCube

Primary author: SAFA, Ibrahim (University of Wisconsin - Madison)

Co-authors: PIZZUTO, Alex (University of Wisconsin-Madison); KHEIRANDISH, Ali (University of Wisconsin, Madison); Dr ARGUELLES, Carlos (MIT); Prof. HALZEN, Francis (University of Wisconsin); Mr HUSSAIN, Raamis (University of Wisconsin Madison); Prof. JUSTIN, Vandenbroucke (UW Madison)

Presenter: SAFA, Ibrahim (University of Wisconsin - Madison)

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