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Astrophysical Tau Neutrino Search with the IceCube Neutrino Observatory

Most models predict neutrinos to be produced in astrophysical sources such as Active Galactic Nuclei (AGN) and Gamma Ray Bursts (GRB). Because of the very long baselines from these sources to the Earth a 1:1:1 (electron neutrino:muon neutrino:tau neutrino) flavor ratio is expected at the Earth. The IceCube Neutrino Observatory is a cubic kilometer Cherenkov detector, located deep within the Antarctic ice, built to detect all flavors of neutrinos. Contrary to the case for the two other neutrino flavors, tau neutrino background from atmospheric origin is negligible. The identification of a tau neutrino in IceCube would therefore be strong evidence for the existence of an astrophysical neutrino flux. At sufficiently high energies (above about 1 PeV) the incoming tau neutrino generates in a charged current interaction a tau lepton that can travel far enough before decaying for it to be distinguished from the other flavors. Depending on the track length and decay mode of the tau lepton and the interaction positions, tau neutrinos can lead to several different signatures in the detector. The case where both interactions occur within the detection volume and the tau lepton decays hadronically or to an electron is nicknamed a “Double Bang”. Recent results from the IceCube Collaboration show evidence of the presence of a flux of extraterrestrial neutrinos up to energies where tau neutrino detection via this signature would become feasible. The current status of a search for tau neutrinos via the Double Bang signature in IceCube will be presented.

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