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Measurement of the High Energy Neutrino-Nucleon Cross Section with IceCube[1] YIQIAN XU, JOANNA KIRYLUK, State Univ of NY- Stony Brook, ICECUBE COLLABORATION — IceCube is a $1\,\mathrm{km}^3$ neutrino detector located at the South Pole. It detects all-sky neutrinos of all flavors. IceCube has measured atmospheric muon and electron neutrino fluxes, and has recently discovered a flux of high energy extraterrestrial diffuse neutrinos. We present a novel analysis method and performance studies to determine the neutrino-nucleon cross section at high energies. It uses atmospheric and extraterrestrial neutrino-induced electromagnetic and hadronic showers (cascades) in the TeV-PeV energy range. In this method, uncertainties associated with the flux are canceled by using the ratio of yields from the Southern and Northern hemispheres in the Sky. At the energies in this study, the yields are sensitive to the deep-inelastic scattering cross-section and nucleon structure in a region of kinematic overlap with HERA and with the LHC. Their actual measurement forms a valuable proof-of-concept towards future measurements in the Extremely-High-Energy regime, which will provide sensitivity to new physics with unique neutrino probes. We have performed and will present an initial sensitivity study for determining the cross section from 5 years of data with the complete IceCube detector, as well as for the proposed IceCube-Gen2 high-energy extension.

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