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Probing the interior of Earth using neutrino oscillations in IceCube-DeepCore

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(REMOTE)

The information about the internal structure of Earth is obtained mainly using seismic studies and gravitational measurements. Neutrinos can be used as an independent probe to explore the interiors of Earth. While passing through Earth, the upward-going atmospheric neutrinos with multi-GeV energies experience matter effects due to the coherent forward scattering with the ambient electrons, which alter the neutrino oscillation patterns. Since the matter effects depend upon the density of electrons, it can be used to shed light on the internal structure of Earth. DeepCore, a densely instrumented sub-array of the IceCube neutrino observatory at the South Pole, detects atmospheric neutrinos over a wide range of baselines with energies as low as about 3 to 5 GeV. We show that this low-energy threshold, access to multiple baselines, high statistics in various oscillation channels, optimized binning scheme in reconstructed energy and zenith, and an efficient particle identification enable DeepCore to observe the presence of Earth's matter effects in three-flavor neutrino oscillations. We further demonstrate that these matter effects in oscillations of atmospheric neutrinos can be used to establish the layered structure inside Earth and measure the mass of Earth and mass of core.

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Classification de Session: Open questions in the study of Earth's mantle and core