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Establishing Earth's Matter Effect in Atmospheric Neutrino Oscillations at IceCube DeepCore

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The discovery of non-zero θ13 has opened an exciting opportunity for probing the Earth's matter effect in three-flavor neutrino oscillations. This phenomenon depends upon the energy of neutrinos and the density distribution of electrons they encounter during their propagation. It holds significant relevance for advancing our understanding regarding neutrino mass ordering, complementary and independent information about the internal structure of Earth, and new physics beyond the Standard Model. In this talk, we present how well the DeepCore detector, a densely instrumented sub-array of the IceCube neutrino observatory at the South Pole, can observe these matter effects in atmospheric neutrino oscillations by rejecting vacuum oscillation solutions and aligning with the Preliminary Reference Earth Model (PREM). We further present the improvement in the Asimov sensitivity to reject the vacuum oscillations using the IceCube Upgrade, a new extension of the DeepCore with seven additional strings that will be deployed in the polar season of 2025-26 within DeepCore fiducial volume.

Track type

Neutrino Physics

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