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Measurement of muon neutrino disappearance with the completed IceCube detector

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We present preliminary results on neutrino oscillations with the first year of data of the completed IceCube detector. IceCube is a cubic kilometer ice Cherenkov high-energy neutrino detector. DeepCore, a region of denser instrumentation in the lower center of IceCube, permits the detection of atmospheric neutrinos with energies as low as 10 GeV.

The disappearance pattern of muon neutrinos was measured by analyzing the shape of their 2-dimensional energy-zenith angle distribution. The study benefits from the development of tools to recover the direction of the muon and total visible energy of the neutrino, allowing reliable reconstruction of events at the detector's threshold. The main background is atmospheric muons, which are removed using the IceCube strings of detectors that surround the DeepCore sub-array as a veto. A sample of high-quality neutrino events that start within DeepCore is selected, with the aim of diminishing the impact of uncertainties in the ice properties and other detection effects. In 343 days of data, we find 1487 neutrino events. This corresponds to a deficit of about 800 events compared to the non-oscillation expectation. In the two flavor approximation, the resulting oscillation parameters are $\sin^2(2\theta_{23}) = 1 (> 0.93)$ and $|\Delta m^2_{32}| = 2.4 \pm 0.4 \cdot 10 - 3$ eV^2. Future steps and projections are also discussed.

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