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From oscillation dip to oscillation valley in atmospheric neutrino experiments

Atmospheric neutrino experiments can show the “oscillation dip” feature in data, due to their sensitivity over a large L/E range. In experiments that can distinguish between neutrinos and antineutrinos, like INO, oscillation dips can be observed in both these channels separately. We present a data-driven approach – that uses the asymmetry in the up and down events, binned in the reconstructed L/E of muons – to demonstrate the dip, thereby confirming the oscillation hypothesis. We further propose, for the first time, the identification of an “oscillation valley” in the $(E_\mu - \cos \theta_\mu)$ plane, feasible for detectors like INO having excellent muon energy and direction resolutions. We illustrate how this two-dimensional valley offers a clear visual representation and test of the L/E dependence, the alignment of the valley quantifying the atmospheric mass-squared difference.

Mini-abstract

Reconstructing oscillation dip and two-dimensional valley using up-down asymmetry of muons at INO

Experiment/Collaboration

India-based Neutrino Observatory (INO)

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