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Neutrino oscillations with atmospheric neutrinos in JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation neutrino experiment in South China that is currently in the final stages of commissioning. Situated beneath 650 meters of rock overburden (∼1800 meters water equivalent), JUNO's central detector features a 20-kiloton liquid scintillator target enclosed within a 35.4-meter-diameter acrylic sphere. It achieves a remarkable 78% photocathode coverage through a hybrid array of 17,612 large (20-inch) and 25,600 small (3-inch) photomultiplier tubes. This extensive coverage is essential to meet the experiment's goal of an unprecedented energy resolution of 3% at 1 MeV.

JUNO's primary objective is to determine the neutrino mass ordering (NMO) using reactor antineutrinos. However, it also has the potential to probe atmospheric neutrino oscillations through matter effects, offering an independent sensitivity to NMO. When combined, these measurements can enhance JUNO's overall sensitivity. Notably, JUNO will be the first experiment to explore GeV-scale atmospheric neutrino oscillations using a large, homogeneous liquid scintillator detector. In contrast to conventional water Cherenkov detectors, JUNO's liquid scintillator requires the development of novel reconstruction techniques to identify neutrino flavors, differentiate between neutrinos and antineutrinos, and reconstruct particle direction and energy in the GeV range.

This talk will be focused on recent advancements toward these goals, including progress in reconstructing the energy and direction of atmospheric neutrinos, identifying neutrino flavor and type, and suppressing background events. Preliminary sensitivity studies will also be discussed.

Neutrino Properties

Prospective measurement of mass ordering and oscillation parameters in JUNO with atmospheric neutrinos

Neutrino Telescopes & Multi-messenger

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Neutrino Theory & Cosmology

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Data Science and Detector R&D

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Author: CERRONE, Vanessa (University of Padova / INFN Padova)

Presenter: CERRONE, Vanessa (University of Padova / INFN Padova)

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