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Neutrino mass ordering sensitivity and Precision measurement of oscillation parameters in JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) is a 20-kiloton liquid scintillator detector located ∼650 m underground in southern China, now in final commissioning phase. Its central detector, equipped with 17612 20-inch LPMTs and 25600 3-inch SPMTs, achieves total 78% photo-coverage for high energy resolution.

JUNO's primary goals are to determine the neutrino mass ordering (NMO) and precisely measure the neutrino oscillation parameters Δm^2_{31}, Δm^2_{21}, and $\sin^2\theta_{12}$. The reactor neutrinos, emitted from two nuclear power plants at ∼53 km baseline corresponding to solar oscillation maximum, are detected via inverse beta decay (IBD) reaction. The neutrino mass ordering manifests as subtle energy-dependent phase shifts in the energy spectrum, which JUNO resolves via its unprecedented energy resolution ($\leq 3\%$ at 1 MeV) and accurate energy scale control (overall non-linearity effects $< 1\%$). This capability enables JUNO to achieve 3σ NMO sensitivity in about 7 years of data-taking. Moreover, the large target mass and great energy resolution enables JUNO to independently measure Δm^2_{31}, Δm^2_{21}, and $\sin^2\theta_{12}$ with sub-percent precision. Such high-precision measurements will play an important role in global analysis of neutrino oscillation, specially, using synergies with accelerator neutrino experiments to boost the NMO sensitivity of JUNO.

This contribution will focus on the latest studies of oscillation physics with reactor neutrinos at JUNO, including the sensitivity of NMO and precise measurement of neutrino parameters.

Neutrino Properties

current status of experimental measurements of oscillation parameters, JUNO

Neutrino Telescopes & Multi-messenger

None

Neutrino Theory & Cosmology

None

Data Science and Detector R&D

None

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