Contribution ID: **36** Type: **not specified**

The JUNO Experiment

The Jiangmen Underground Neutrino Observatory (JUNO) is new-generation 20-kton multipurpose underground Liquid Scintillator detector designed to address fundamental questions in neutrino and astroparticle physics. Its primary scientific goal is to determine the neutrino mass hierarchy (MH) with a significance of 3-4 σ within approximately six years of data collection. JUNO's exceptional energy resolution (<3% at 1 MeV) and the large fiducial volume will enable precise measurements of three neutrino oscillation parameters: sin2θ12, Δm212, and |Δm231|, with an accuracy better than 1%. These measurements will play a pivotal role in testing the unitarity of the PMNS matrix and predicting neutrinoless double-beta decays.
JUNO will detect antineutrinos from nearby nuclear power plants, providing a robust dataset for MH determination and oscillation parameter measurements. Beyond reactor antineutrinos, JUNO is designed to observe a wide range of neutrino sources, including geoneutrinos, atmospheric neutrinos, solar neutrinos, supernova burst neutrinos and diffuse supernova neutrino backgrounds. A core-collapse supernova at 10 kpc would yield approximately 5000 inverse beta-decay events, 2000 neutrino–proton elastic scattering events and 300 neutrino–electron elastic scattering events in JUNO. These observations will enhance our understanding of supernova mechanisms, collective neutrino oscillations and cosmic star-formation rate. Additionally, JUNO will detect geoneutrinos from uranium and thorium decays at a rate of approximately 400 events per year, significantly improving the statistics.
The experiment will also explore Beyond-Standard-Model physics, including searches for proton decay via the p ⟶ K+ν decay channel, dark-matter annihilation neutrinos, Lorentz invariance violation and non-standard neutrino interactions. JUNO's design allows for future upgrades, such as loading the scintillator with Xe or Te, to enable neutrinoless double-beta decay searches.
JUNO's detector construction began in 2014 and is currently in the commissioning phase, with liquid scintillator filling underway. The experiment is on track to commence data collection by summer 2025.

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