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Cosmic Muon Reconstruction in JUNO using Machine Learning Methods

The Jiangmen Underground Neutrino Observatory (JUNO), located in southern China, is a next-generation neutrino experiment equipped with a 20-kton liquid scintillator detector. JUNO's primary goal is to determine the neutrino mass ordering (NMO) through reactor neutrino oscillation measurements. Construction of JUNO is nearing completion, with water filling finished and liquid scintillator filling started in February 2025.
Cosmic muons are one of the main background sources in JUNO because they produce isotopes that mimic the inverse beta decay (IBD) signal. Those isotopes are tightly correlated with the muons in both time and space and are especially abundant in the muon shower regions. Therefore, precise reconstruction of muon tracks and shower positions is required to veto such backgrounds efficiently. In this poster, we present a comprehensive approach using machine learning for cosmic muon track and shower position reconstruction. Cosmic muon events are first categorized based on their track multiplicity, containment, and shower status. Reconstruction strategies are developed for each category, including both reconstruction of muon tracks and shower positions. Their performance with Monte Carlo (MC) simulations are presented.

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