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Energy Response Model of the JUNO Central Detector

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The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator detector that started data-taking since late Aug,2025. The primary physics goal is to determine the neutrino mass ordering through a precision measurement of the reactor anti-neutrino energy spectrum. This requires a precise calibration of energy nonlinearity and resolution of positrons in the JUNO detector, which are produced in the reactor anti-neutrino inverse beta decay (IBD) interactions.

This poster presents a model called COMbined model of Energy and Energy Resolution (COMEER), which models detector response of JUNO based on Geant4 step simulations. The model is constrained by data of radioactive gamma sources with various energies deployed at different positions to make precise predictions for the nonlinearity and resolutions of positrons in JUNO.

By correlating energy non-linearity and resolution in Geant4 step-level information with only 3 parameters, COMEER achieves precise prediction simultaneously for non-linearity and resolution of the uniformly distributed IBD positrons, providing a key input to the reactor anti-neutrino oscillation analysis.

Primary author: LIAO, Yilin

Presenter: LIAO, Yilin

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