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A multi-purposed reconstruction method based on machine learning for atmospheric neutrino at JUNO

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The Jiangmen Underground Neutrino Observation (JUNO) experiment is designed to measure the neutrino mass order (NMO) using a 20-kton liquid scintillator detector to solve one of the biggest remaining puzzles in neutrino physics. Regarding the sensitivity of JUNO's NMO measurement, besides the precise measurement of reactor neutrinos, the independent measurement of the atmospheric neutrino oscillation has great potential to enhance the sensitivity in the combined analysis. This heavily relies on the event reconstruction performance at high energy (GeV) level, including the angular resolution of the incident neutrino, the energy resolution, as well as the accuracy of the flavor identification etc.
In this contribution, we present a multi-purposed reconstruction algorithm for high energy particles in JUNO based on machine learning method. This includes extracting effective features from tens of thousands of PMT waveforms, as well as the development of two types of machine learning models (spherical GNN and planar CNN/Transformer). Novel techniques, such as improving the model convergence speed and eliminating reconstruction bias by maintaining the rotation-invariance are also discussed. Preliminary results based on JUNO simulation present reconstruction precision at an unprecedented level, showing great application potential for other large liquid scintillator detectors as well.

Significance

This contribution covers the novel reconstruction method based on machine learning and results that are un-reported in other conferences.

References

Experiment context, if any

Jiangmen Underground Neutrino Observation (JUNO)

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