Contribution ID: **1** Type: **Oral**

Deep Learning-Based C14 Pile-Up Identification in the JUNO Experiment

Thursday 14 March 2024 14:50 (20 minutes)

Measuring neutrino mass ordering (NMO) poses a fundamental challenge in neutrino physics. To address this, the Jiangmen Underground Neutrino Observatory (JUNO) experiment is scheduled to commence data collection in late 2024, with the ambitious goal of determining the NMO at a 3-sigma confidence level within a span of 6 years. A key factor in achieving this is ensuring a high-quality energy resolution of positrons. However, the presence of residual C14 isotopes in the liquid scintillator introduces pile-up effects that can impact the positron energy resolution. Mitigating these pile-up effects requires the identification of pile-up events, which presents a significant challenge. The signal from C14 is considerably smaller compared to the positron signal, making its identification difficult. Additionally, the close event time and vertex between a positron and a C14 further compound the identification challenge.

This contribution focuses on the application of deep learning models for the identification of C14 pile-up events. It encompasses a range of models, including convolutional-based models and advanced transformer models. Through performance evaluation, the study showcases the robust capabilities of deep learning models in accurately and effectively identifying pile-up events.

Significance

Considering that pile-up event identification is a common issue across various experiments, the methods proposed in this contribution hold the potential for wider adoption and utilization.

References

Experiment context, if any

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Session Classification: Track 2: Data Analysis - Algorithms and Tools

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