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Extraction of fissile isotope antineutrino spectra using deep learning

Extensive experimental evidence has confirmed significant discrepancies between the reactor fission isotope antineutrino spectra predicted by the Huber-Mueller model and the data observed in experiments, leading to the phenomenon known as the Reactor Antineutrino Anomaly (RAA). Therefore, accurately measuring the isotope antineutrino spectra is crucial to addressing the RAA issue. Based on the theories and techniques of reactor neutrino physics and deep learning, we have developed a novel statistical analysis technique that utilizes neural network models to extract isotope antineutrino spectra from the observed antineutrino event energy spectra in neutrino detectors. By analyzing and discussing simulated data from a virtual short-baseline reactor neutrino experiment, we found that the spectrum extraction performance of deep learning techniques is superior to traditional chi-squared analysis methods, demonstrating their promising technical potential and prospects. Additionally, the neural network model used in this study is a white-box model, which can be widely accepted by particle physicists and extended to other research topics in physics.

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