

Progress in accounting for the antineutrino spectrum generated by nuclear reactors

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Understanding the magnitude and detailed features of the highly precise IBD antineutrino spectra reported by the Daya Bay, NEOS, and RENO collaborations has been both a challenging and rewarding endeavor. Relative to the Huber–Mueller model, these spectra exhibit an overall ~5% excess in the predicted total yield—commonly referred to as the Reactor Antineutrino Anomaly (RAA)—as well as a deficit in the 4–6 MeV region, often called the “bump.” The origin of the RAA has been linked to a normalization issue in the ^{235}U electron spectrum measurements, while the “bump” is suspected to arise from efficiency effects in the magnetic spectrograph used in those measurements. In addition, the assumption of allowed spectral shapes in the conversion method has been increasingly questioned.

Summation (*ab initio*) calculations, while valuable for tracing antineutrino production, have also faced limitations. These stem primarily from incomplete nuclear database information, particularly for the short-lived fission products that dominate the IBD spectrum. Until recently, decay heat calculations represented the only other application requiring similar data, although the corresponding standards are less precise than the IBD measurements discussed here.

The JUNO collaboration released through arXiv their first results in November 2025. At 53 Km from the reactors, the oscillation pattern induced by θ_{13} - not yet apparent but expected with a larger number of events - as well as the shifting of the spectrum at higher energies due to a non-zero value of θ_{12} , will reinforce even further the need for better nuclear decay data and the electron spectra for the actinide nuclides undergoing fission.

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