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Modern reanalysis of the reactor anomaly conversion method

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The field of reactor neutrino physics has accumulated a series of anomalies over the years, the most recent of which occurs with reactor antineutrinos. The appearance of such an anomaly relies on an exquisite knowledge of both beta spectrum shapes and isotopic abundance inside the reactor medium. In an attempt to mitigate the uncertainties of the latter, a conversion method is typically used utilising virtual beta branches relative to experimental cumulative beta spectra of several fission actinides measured at the Institut Laue-Langevin. Currently, the parametrisation of these virtual branches is drastically oversimplified and suffers from several flaws, ranging from the treatment of nuclear structure influences to forbidden decays and Coulomb corrections. This, in turn, results in an underestimation of the uncertainty and systematic shift in the central value of the anomaly. Faced with the enormity of the number of participating branches, we present a modern reanalysis method based on machine learning techniques in combination with Monte Carlo methods. Using clustering algorithms, we find high-dimensional correlations in the nuclear databases to open up the parameter space of the virtual branch construction. Together with results from forbidden transitions, we perform Monte Carlo sampling in an attempt to quantitatively discuss the uncertainty on the reactor anomaly. We will show that also ab initio methods can benefit from these techniques.

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