T3 Workshop o n Statistical Nuclear Physics in Astrophysics and Applications
August 14-17 2023, Ohio University, Athens, OH, USA

ABSTRACT

Spin classification of neutron resonances with Machine Learning

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Neutron resonances are sharp fluctuations seen in neutron transmission and capture experiments at low-energy neutron-induced reactions. Properties of neutron resonances are some of the few experimental constraints to nuclear level densities and gamma strength functions (crucial for modeling many nuclear applications). Resonances are characterized by their angular momenta quantum numbers, which are normally assigned through fits often done in an ad hoc and not fully reproducible manner. Comprehensive compilations of evaluated resonances often contain incorrectly assigned spins. To address these, we developed a Machine-Learning method to train an algorithm to identify resonances with incorrect spin assignments. Model training is done on synthetic data constructed to simulate statistical properties of resonances seen in real nuclei, or on ranges of real experimental data known to have reliable assignments. The trained classifier can be applied to resonances sequences from compiled, evaluated, or experimental data. In this work we use 52Cr as a test case to assess the performance of the reclassification, showing how multiple realizations of synthetic data can serve as a validation tool for the machine-learning classifier. We then apply the trained algorithm to make reclassification predictions on a 52Cr evaluated file. We also show results for training the classifier on actual 238U data.

Work supported by the NCSP, funded and managed by the NNSA for the DOE. Work at BNL was sponsored by the Office of NP, Office of Science of the DOE under Contract No. DE-AC02-98CH10886 with BSA, LLC. Supported partly by BNL SURP and the DOE, Office of Science, Office of WDTS under SULI.