OFFICIAL ABSTRACT and CERTIFICATION

Prediction of Independent Fission Fragment Isomeric Yields using Machine Learning

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In the process of fission, a heavy nucleus breaks into two excited β-unstable fission fragments. These fragments deexcitate through prompt sequential neutron and gamma emissions which result in independent fission yields. Isomers are excited nuclei that can not easily decay through gamma emission. These isomeric fragments are essential for understanding the spin dependence of fission and have implications for nonproliferation and basic science. However, currently available evaluations of isomeric fission fragment yield data have inconsistencies. If relationships within experimental data can be extracted, then there is the possibility of constructing new models and creating a more accurate evaluation of isomeric fission fragment yields. Therefore the following research question is posed: Is there a hidden relationship in the features of independent isomeric fission yields that can be used to create a model? Analyzing the production of independent isomeric fission yields, there are multiple observables which could influence the yields. It is known that the spin and nuclear structure of the fission fragments and the fissioning nucleus dramatically influence fission yields in a way that is poorly understood. Therefore, it is hypothesized that a regression model should be able to extract the correlations to accurately predict the yield ratios. A random forest machine learning model was used on neutron, proton, and gamma induced fission data from EXFOR experimental database to produce more accurate results that outperform currently available evaluations of isomeric fission fragment yield data. An increase in data available will enhance the accuracy and consistency of the model.

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