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Enhancing Fission Product Yield Predictions by Tuning GEF Code with GEFTuner

The General Description of Fission Observables (GEF) code is widely used for predicting various fission observables, including fission product mass distributions. Accurate fission product yield (FPY) predictions are crucial for applications in reactor physics, nuclear security, and spent fuel management. Traditional models, such as the 5-Gaussian model, rely on a limited parameter set and may not fully capture the complexities of the fission process. In contrast, the GEF code is a semi-empirical model that incorporates both theoretical and empirical insights, allowing it to predict fission observables with significantly higher accuracy.
The GEF code includes approximately 100 parameters, which have traditionally been optimized using an "eye-fit" approach based on expert intuition. However, this manual method lacks efficiency and automation. To address this challenge, we developed GEFTuner, an automated optimization tool designed to refine GEF parameters systematically. Instead of using the standalone GEF version, we utilized the GEF subroutine version (GEFSUB), which isolates the fission process up to the scission point, excluding prompt neutron and gamma emissions. This approach allows for a clearer examination of the fundamental fission process.
Our study focused on optimizing 35 key parameters essential for describing fission channels. The optimization process employed gradient search and a combination of gradient search with grid search. Experimental data for the thermal neutron-induced fission of U-233, U-235, and Pu-239 were used as benchmarks. The results demonstrated that both optimization methods significantly improved the predictive performance of the GEF code.

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