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Title: Validation of Nuclear Data Sensitivity Calculations by the MCNP PERT Card

Abstract
Predictive codes, like the Monte-Carlo N-Particle (MCNP) transport code, utilize nuclear data to simulate experiments in applications like nuclear nonproliferation and safeguards, criticality safety, and many more. Improving nuclear data causes more precise and accurate calculations, higher-fidelity designs, and reduced procedural/operational costs; in particular, improvements to special nuclear material data may result in more accurate and precise assays and identifications. Therefore, improvements to nuclear data are paramount. Nuclear data is improved through integral benchmark experiments, where a parameter (like multiplication) is estimated from the assembly as well as from predictive simulations. The nuclear data, which is treated as an input of the simulations, is then perturbed until the estimated measurements and simulations agree. An experiment with higher sensitivities would have a larger impact on nuclear data.

The KSEN card of MCNP offers a direct means of estimating the sensitivity of the effective neutron multiplication factor (keff) to the nuclear data. Experiments focused on other parameters can be used to constrain nuclear data in ways that critical experiments alone cannot. There is currently no MCNP tool that can estimate sensitivities of a detector response to nuclear data in a simple method such as KSEN. Subcritical measurements have higher sensitivities to additional nuclear data such as the probability of neutron emission after fission. There is currently no direct means of estimating sensitivities in MCNP outside of the KSEN card; however, results from tallies and utilization of the PERT card can be used to estimate sensitivities. This approach has not been validated. Prior to using the sensitivities estimated with this approach to design high-impact integral benchmark experiments, the results of the approach need to be validated. This work compares the results from the PERT card approach to sensitivities calculated using a brute-force method that uses an external code to manually perturb cross sections.