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Using Integral Benchmark Experiments to Improve Differential Nuclear Data Evaluations

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ABSTRACT:

Advanced modeling and simulation (M&S) tools rely on high-fidelity nuclear data evaluations to accurately model interactions between neutrons and matter. Various inconsistencies, approximations, and assumptions limit the accuracy of even high-fidelity nuclear data, thereby introducing computational bias in the predictive power of M&S tools. The overarching goal of this project is to use the results of integral benchmark experiment to inform differential nuclear data evaluations and improve the predictive capability of M&S tools. This goal will be accomplished by developing capabilities to assess the sensitivity of integral benchmark results to evaluated nuclear data parameters, and by using data assimilation tools to directly calibrate the evaluated data parameters and improve the accuracy of M&S tools. Specific aims of this work include:

1. Understanding the impact of uncertainty in evaluated nuclear data parameters on the predictions from high fidelity M&S tools,
2. Identifying the underlying sources of discrepancies between criticality experiment results and those predicted with M&S tools, and
3. Using information about computational biases inferred from nuclear criticality experiments to generate nuclear data evaluations that have been calibrated to maximize the predictive capability of M&S tools.

Success of this work will produce a novel methodology for guiding nuclear data scientists to improve the accuracy of evaluated nuclear cross section and covariance data at multiple stages in the nuclear data pipeline.