Consistent Multigroup Theory Enabling Accurate Course-Group Simulation of Gen IV Reactors

PI: Farzad Rahnema – Georgia Institute of Technology

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Collaborators: Dingkang Zhang – Georgia Institute of Technology; Abderrafi M. Ougouag – Idaho National Laboratory; Alireza Haghighat – University of Florida

ABSTRACT

The objective of this proposal is the development of a consistent multi-group theory that accurately accounts for the energy-angle coupling associated with collapsed-group cross sections. This will allow for coarse-group transport and diffusion theory calculations that exhibit continuous energy accuracy and implicitly treat cross-section resonances. This is of particular importance when considering the highly heterogeneous and optically thin reactor designs within the Next Generation Nuclear Plant (NGNP) framework. In such reactors, ignoring the influence of anisotropy in the angular flux on the collapsed cross section, especially at the interface between core and reflector near which control rods are located, results in inaccurate estimates of the rod worth, a serious safety concern. The scope of this project will include the development and verification of a new multi-group theory enabling high-fidelity transport and diffusion calculations in coarse groups, as well as a methodology for the implementation of this method in existing codes. This will allow for a higher accuracy solution of reactor problems while using fewer groups and will reduce the computational expense. The proposed research represents a fundamental advancement in the understanding and improvement of multi-group theory for reactor analysis.