
Fission Product Yield Data in Support of Advanced Reactor Technology

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Program: MS: Nuclear Data and Measurement Techniques

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ABSTRACT:

The objective of the proposed work is to produce a high fidelity data set on U-235 thermal fission that we will provide to data evaluators.

Background: A workshop entitled “Nuclear Physics and Related Computational Science R&D for Advanced Fuel Cycles (AFC) Workshop” was held recently, to determine the role that basic research can play to address future nuclear energy needs specifically related to advanced fuel cycles. The report of this workshop identifies the need for new fission cross section measurements. These precision data are necessary for high-accuracy simulations of nuclear criticality, transmutation rates, radiation effects and heating as well as for fuel (or spent fuel) material accounting and identification needs. **The report singles out specifically the area of fission fragment yields and their kinetic energies** as an important area where very little work is done. Fission product yields have an important technical application for reactors; they get used to determine the number of fissions that occurred in nuclear fuel. By accurately measuring the yield of certain key fission products (such as Nd-148) one will improve the accuracy of this diagnostic tool. There are currently discrepancies of 5-10% between different measurements of important fission products, and by developing our new measurements technique we expect to reduce this uncertainty to 1-2%.

Project: Our group at the University of New Mexico (UNM) is working in collaboration with Los Alamos National Laboratory (LANL) to develop a multi-arm spectrometer to be used with the Los Alamos Neutron Science Center (LANSCE) to study binary fission. The LANL project is headed by Morgan White (XCP-5) and the experimental work is headed by Fredrik Tovesson (LANSCE-NS). The UNM effort is headed by the proposal PI, Adam Hecht, assistant professor of Nuclear Engineering.

The spectrometer is based on time-of-flight (TOF) fragment velocity measurements and ionization chamber (IC) energy measurements. Arm pairs on opposite sides of a fission target will take simultaneous data on binary fission products. By combining E and TOF measurements, and examining details of energy loss in the IC, we will extract A, Z, and E of both fragments on an event-by-event basis, with neutron beams from LANSCE. The full correlated data should include cross section, correlated fission fragment distributions, total fragment kinetic energies, and neutron multiplicity. Since quantities are measured for each fission, uncertainties of the quantities are correlated. The LANL led effort (Tovesson, White) is to develop and run a spectrometer for high resolution and, by adding detectors, high efficiency fission measurements. The UNM effort (Hecht) is detector prototyping, testing, characterizing, and trouble shooting in support of this effort, with results feeding in to the LANL spectrometer. We will also run our UNM prototype detector system on the neutron beam downstream of the LANL spectrometer, testing different design parameters, with UNM data complementing the LANL spectrometer data. The first iteration will use a longer TOF path for better mass resolution and Z determination and have IC timing modifications. It will serve as a test bed for further development of the LANL spectrometer and will provide both a unique data set and add to the statistics of the LANL spectrometer data. Design and development will continue to several arm pairs to increase detector efficiency while maintaining high resolution. With NEUP help we can continue UNM’s role and contribution in development, testing, and taking new high fidelity fission measurements. Involvement with LANL helps secure beam time and leverage the NEUP funding for high impact results. *UNM is a Minority Serving Institution. This project is the basis of PhD and MS research.*