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Energy Dependent Fission Product Yields from Neutron- and Photon-induced Fission

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Fission product yields (FPY) are essential ingredients for addressing questions relevant to a range of basic and applied physics. Examples include the cosmic nucleosynthesis processes that created the elements from iron to uranium, decay heat release in nuclear reactors, reactor neutrino studies, radioisotope production, development of advanced reactor and transmutation systems, and many national security applications. While new applications will require accurate energy-dependent FPY data over a broad set of incident neutron energies, the current evaluated FPY data files contain only three energy points: thermal, fast, and 14-MeV incident energies. The goal of this study is to provide high-precision and energy dependent FPY data using monoenergetic neutron beams with energies between 0.5 and 15 MeV.

Absolute cumulative fission product yields have been determined for about 100 fission products representing 40 mass chains during neutron-induced fission of 235U, 238U, and 239Pu. Using rapid belt-driven irradiated target transfer system (RABITTS) [1] and irradiations with varying duration, gamma-ray decay history of fission products between 1 second to a few days have been measured. The number of fissions during the irradiation times was determined via a dual fission ionization chamber loaded with thin electroplated foils with the same actinide material. The obtained new FPY data provides a more complete picture of the FPY landscape - from the initial distribution produced directly by fission, through the complex, time-dependent evolution of the yields from beta-decay and neutron emission [2]. This work also provides a unique capability to bridge short-lived fission product yields [3] to our measured cumulative fission yields [4]. An overview of the recent experimental results obtained by the LLNL-LANL-TUNL collaboration will be presented. The FPY results will be discussed in terms of their energy and target-mass dependency.

[1] S. Finch et al., Nuc. Instrum. Meth A 1025, 166127 (2022).
[2] A. Tonchev et al., EPJ Web of Conference 239, 03001 (2020).
[3] A.P.D. Ramirez et al., Manuscript submitted for publication.
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