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Basic Physics Data: Measurement of Neutron Multiplicity from Induced Fission

PI: Sara Pozzi – University of Michigan

Collaborators: Robert Haight – Los Alamos National Laboratory

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ABSTRACT

Neutron multiplicity counters have been used for several decades, mostly as thermal multiplicity counters based on He-3 detectors. These systems have very good detection efficiency; however, the time resolution suffers from the required moderation of the neutrons. Several new measurement options have recently become available with the advancements in applying organic liquid scintillation detectors to the areas of nuclear nonproliferation and materials control and accountability, and with the developments in fast data-digitization technologies. **Scintillation detectors can provide some energy spectroscopy as well as excellent timing**, thus reducing the number of measured accidentals. Furthermore, shapes of measured pulses can be used to **discriminate between different types of incoming radiation**. For example, neutron pulses can be separated out from gamma-ray pulses. In addition, data-analysis techniques such as neutron **spectrum unfolding** from the measured pulse height distributions (PHDs) can be applied, even in the presence of gamma rays.

This four-year project proposes to build a measurement system based on a relatively large number of scintillation detectors to accurately measure the multiplicity distributions and energy-angle correlations of neutrons emitted from fission events induced in isotopes of interest to Fuel Cycle Research and Development (FCR&D) program. Previous efforts have indicated that the experimental data on which evaluated data are based are deficient even for very important isotopes such as U-235 and Pu-239. These data are crucial for use in simulation codes needed to evaluate the performance of existing systems and to develop new, innovative measurement systems. We propose to use **new, digital technology with arrays of liquid and lithium glass scintillators to complement and improve the accuracy of fission neutron multiplicity data**. These improvements will benefit the national and international user community in both Monte Carlo and deterministic codes.