Abstract

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Simulated and Experimental Energy-Multiplicity Correlations in Neutrons from the Spontaneous Fission of Cf-252

One of the main roles of radiation detection in nuclear nonproliferation is to accurately distinguish and characterize special nuclear material (SNM) exploiting the radiation emitted from fissile sources. Current characterization methods employ the analysis of multiplicity, spectra, and angular correlations of emitted neutrons and gamma rays. However, little is known of higher order correlations involving two or more of these emission characteristics. From current theories of nuclear fission, we expect correlations in the spectra of sequentially emitted neutrons from the same fission events. We perform this higher order analysis to quantify neutron energy-multiplicity correlations following the fission of Cf-252 using event-by-event fission data collected by the ChiNu detector array at LANSCE. Fission event generators and transport codes FREYA and MCNPX-PoliMi were used to simulate the detection system, and we compare the magnitude of the simulated correlations with experiment. The effects of angular-multiplicity correlations are also measured by identifying the angles between emitted neutrons in the same event. We present our conclusions and discuss future work, where we will unfold the experimental results and describe the fully correlated neutron emission from spontaneous fission.