NUCLEAR SEMINAR SERIES

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4:00 pm - Rm 123 NSH

Fast-neutron spectroscopy at FRIB: does simulation predict neutron scattering in plastic scintillator well at FRIB energies? A critical test of simulation using direct single-neutron scattering observations.

Detection of fast neutrons using plastic scintillator has long served as a valuable tool in the study of neutron-unbound nuclear states. Monte Carlo simulation has been critical for interpretation of experimental observables from neutron-scintillator interactions (consisting of elastic and inelastic neutron scattering from C and H nuclei). This is especially important for experiments observing multiple-neutron decays, such as in the study of states above the 2n threshold, owing to the difficulty of distinguishing single and multiple neutron interactions in the detector volume. In order to test the accuracy of our GEANT4 predictions we transported 16 detectors from MoNA (the Modular Neutron Array at NSCL/MSU), each consisting of a 200x10x10 cm3 bar of BC408 organic plastic scintillator with a PMT fixed to each end, to Los Alamos National Lab. The detectors were arranged in two different stacking geometries in the 90-m station on LANSCE/WNR flight path 4FP15L and exposed to a tightly-collimated beam of spallation neutrons ranging in energy from 0.5 to 800 MeV. Monte Carlo simulation predictions for several key scattering observables (using both the GEANT4 physics and the MENATE_R packages) were compared with observations for 20-200 MeV neutrons. Simulation predictions were fairly good over the entire energy range for events involving a single neutron scatter, but much less accurate in predicting key variables for a neutron scattering at least two times in the detector array volume, especially for higher energy neutrons accessible at the upcoming FRIB facility.

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