Direct measurement of radioactive $^{56,59}$Ni(n,p) reactions at Los Alamos Neutron Science Center (LANSCE)

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In nuclear applications including nucleosynthesis network calculations or device-performance simulations, available nuclear physics inputs are limited to the measurements on stable or accessible radioactive nuclei, remaining thousands of reactions to rely on the theoretically predicted reaction rates. Hauser-Feshbach (HF) formalism is widely used to predict these reaction cross sections, however difficulties like renormalizations of calculated neutron-induced reaction cross sections to experimental observables, or shape discrepancies of neutron-induced charged particle reaction cross sections below 10 MeV among different HF codes have been addressed.

At Los Alamos Neutron Science Center (LANSCE), neutrons are produced in the energy range of thermal to several-hundred MeV. Direct, high-precision measurements on neutron-induced reactions allow us to validating HF nuclear input parameters through advanced nuclear reaction modeling for enhancing the fidelity of these theoretical predictions. The recently developed LENZ (Low Energy NZ) instrument is optimized to investigate double-differential cross sections on (n,p) and (n,α) reactions with the focus of low detection thresholds and large solid angle coverage.

I will present the on-going, exploratory effort of measuring the $^{56}$Ni(n,p) reaction cross sections for the neutron energy up to 5 MeV at LANSCE, which is directly to confirm the importance of $\nu p$ process during neutrino-wind driven environments. $^{56}$Ni is a radioactive nucleus with the half life of 6 days, so we have developed the radioactive isotope irradiation and target fabrication techniques at the Isotope Production Facility (IPF) at LANL. I will update the progress on the benchmark measurement of the IPF fabricated, radioactive $^{59}$Ni(n,p) reaction, which was performed in Dec. 2019.

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