The Neutron Scattering Cross Section and Angular Distribution Measurement Program at LANL

K. J. Kelly[1], E. A. Bennett[1], M. Devlin[1], J. M. O'Donnell[1], and M. Paris[1]
[1]*Los Alamos National Laboratory, Los Alamos, NM 87545, USA*

Despite literature measurements going back nearly a century, neutron scattering cross sections and angular distributions are still one of the most significant sources of uncertainty in simulations of nuclear systems. Actinide scattering cross sections are particularly poorly-known because of, *e.g.*, high level densities and presence of fission, but even well-studied nuclei like ^{12}C show signs of nuclear data evaluation issues. A highly-segmented array of dual n-γ-capable CLYC-6 detectors named the Correlated Gamma-Neutron Array for sCattering (CoGNAC) is under development at Los Alamos National Laboratory for measurements of elastic and inelastic scattering cross sections with n, γ, and correlated n-γ angular distribution capabilities, and the potential for extensions to measurements of $(n,2n)$, $(n,3n)$ and other reactions.

Demonstrations of some of the experimental approaches to be utilized with this array will be shown through measurements of neutron scattering from natural carbon, iron, and platinum data collected with a 54-detector EJ-309 liquid scintillator detector array. Results from measurements of the $Q = 4.4398$ MeV ^{12}C$(n,n\gamma)$ reaction will be discussed as well, examples of which are shown in Figs. 1(a)–1(f) with correlation matrices derived from the experimental analysis. Finally, preliminary data from measurements of n-γ emission from aluminum, beryllium, and iron targets collected with a partially-completed CoGNAC array operated in coincidence with this same liquid scintillator array will be shown, and compared with relevant evaluations and literature data.

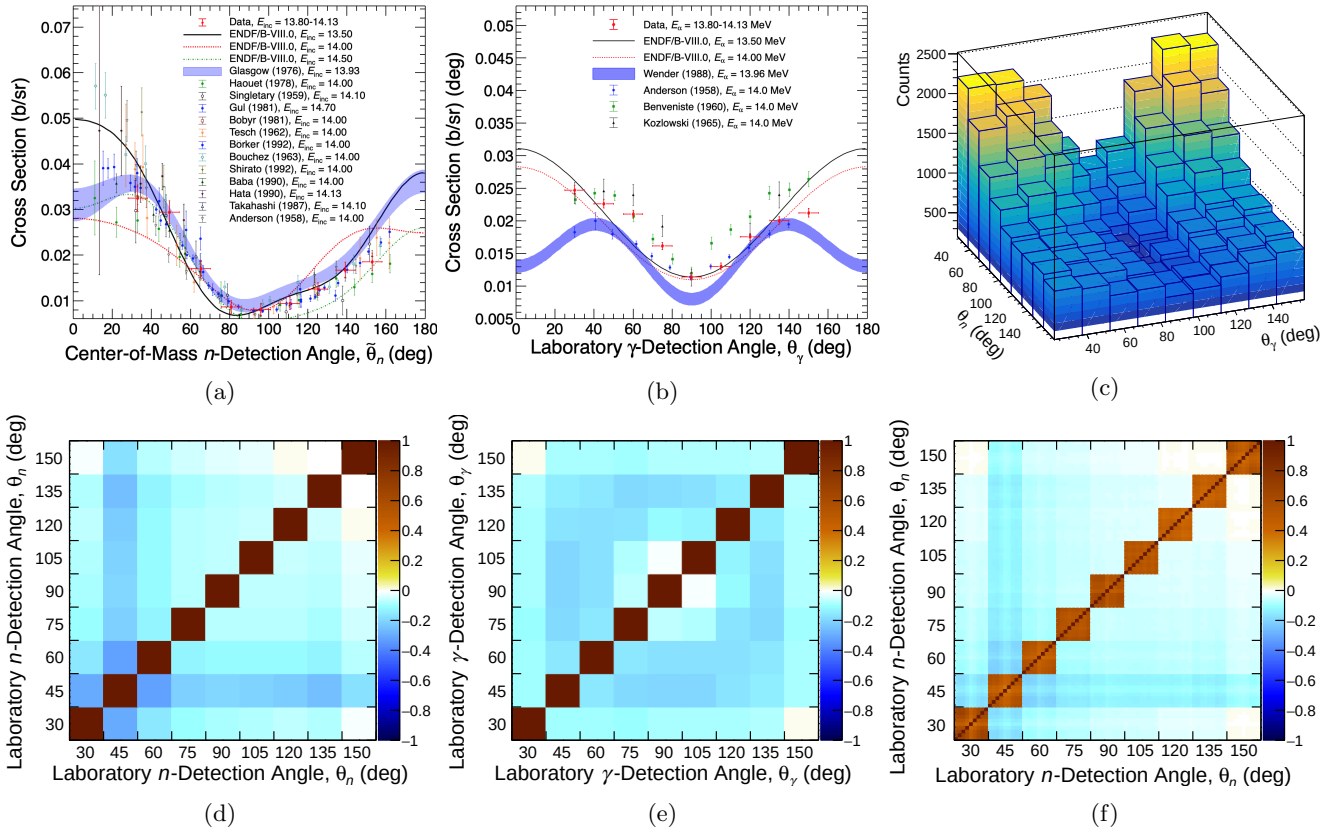

FIG. 1: Experimental results for n, γ, and correlated n-γ angular distributions for measurements of neutron reactions on natural carbon as described in the text are shown in panels (a), (b), and (c), respectively. Panels (a) and (b) correspond to an incident neutron energy of ≈ 14 MeV, while panel (c) corresponds to ≈ 6.25 MeV. Recent ENDF/B-VIII.0 and relevant literature data are shown where applicable. The correlation matrices calculated from the experimental covariance matrices are shown in panels (d), (e), and (f) for the n, γ, and correlated n-γ distributions at $E_n^{inc} \approx 14$ MeV.