Neutron emission asymmetries from linearly polarized $\gamma$ rays on $^{nat}Cd$, $^{nat}Sn$, and $^{181}Ta$

W. CLARKE SMITH, GERALD FELDMAN, George Washington University, HI$\gamma$S COLLABORATION — Azimuthal asymmetries in neutron yields produced by bombarding targets with linearly polarized photons via $(\gamma,n)$, $(\gamma,2n)$, and $(\gamma,f)$ reactions are being investigated as a possible means of identifying various nuclear isotopes. The High Intensity $\gamma$-ray Source (HI$\gamma$S) at Duke University provides nearly monochromatic, circularly or linearly polarized $\gamma$ rays with high intensity by Compton backscattering free-electron-laser photons from stored electrons. Linearly polarized $\gamma$ rays produced by HI$\gamma$S were incident on $^{nat}Cd$, $^{nat}Sn$, and $^{181}Ta$ targets at six energies $E_\gamma$ between 11.0 and 15.5 MeV and emitted neutrons were detected both parallel and perpendicular to the plane of polarization by an array of 18 liquid-scintillator detectors at angles in the range $\theta = 55^\circ - 142^\circ$. Detected neutrons were distinguished from Compton scattered photons by pulse-shape-discrimination and timing cuts, and their energies ($E_n$) were determined using time-of-flight information over a 0.5 m flight path. The characteristic plots of $R_n$, the ratio of neutron counts parallel to neutron counts perpendicular to the plane of the incident $\gamma$-ray polarization, against $E_n$ were constructed for each value of $E_\gamma$ and $\theta$ and then compared to those for other targets studied at HI$\gamma$S, including fissile nuclei $^{235}U$ and $^{238}U$.

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