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T^6LYC vs C^6LYC: Comparison of Fast Neutron and γ-Ray Detector Performance for In-Beam Neutron Scattering Measurements

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Neutron and γ-ray dual mode sensitivity is a widely utilized detector capability for nuclear security applications and fundamental nuclear physics measurements, such as neutron scattering and β-delayed neutron emission. In particular, the pulse-shape discrimination (PSD) technique exploitable with $Cs_2{}^6LiYCl_6$:Ce (C^6LYC) scintillators permits simultaneous measurements of neutrons and γ rays from inelastic neutron scattering reactions. C^6LYC also provides a relatively broad dynamic range in neutron energy that usually requires multiple detector types to attain. Recent developments of new elpasolite scintillators has led to $Tl_6{}^6LiYCl_6$:Ce (T^6LYC), a variant of C^6LYC with thallium replacing cesium ions for higher effective $Z(Z_{eff} = 69)$. This work focuses on characterizing the properties of T^6LYC using standard γ-ray calibration sources, an unmoderated ^{252}Cf fission chamber, and in-beam neutron scattering on ^{12}C. Performance comparisons of T^6LYC relative to C^6LYC detectors from the Correlated Gamma-Neutron Array for sCattering (CoGNAC) at Los Alamos National Laboratory will be presented.

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