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Demonstration of Nuclear Gamma-Ray Polarimetry Based on a Multi-Layer CdTe Compton Camera

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To detect and track structural changes in atomic nuclei, the systematic study of nuclear levels with firm spin-parity assignments is important. While linear polarization measurements have been applied to determine the electromagnetic character of gamma-ray transitions, the applicable range is strongly limited due to the low efficiency of the detection system. The multi-layer Cadmium-Telluride (CdTe) Compton camera can be a state-of-the-art gamma-ray polarimeter for nuclear spectroscopy with the high position sensitivity and the detection efficiency. We demonstrated the capability to operate this detector as a reliable gamma-ray polarimeter by using polarized 847-keV gamma rays produced by the $^{56}\text{Fe}(p, p'\gamma)$ reaction [1]. By combining the experimental data and simulated calculations, the modulation curve for the gamma ray was successfully obtained. A remarkably high polarization sensitivity was achieved, compatible with a reasonable detection efficiency. Based on the obtained results, a possible future gamma-ray polarimetery is discussed in the presentation.

[1] S. Go et al., accepted in Scientific Reports (2023) DOI: 10.1038/s41598-024-52692-2

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