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Characterizing GAGG Crystals for In Beam Gamma-Ray Spectroscopy at the RIBF

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GAGG(Ce) is a novel scintillator that shows promise as a future material for gamma spectrometers. It has several benefits over traditional materials such as NaI(Tl) including its superior resolution (4.0±0.3%, Intrinsic FWHM at 662 keV), higher density, and it being non-hygroscopic [1][2]. A new scintillator-based array is planned to be deployed at the RIBF (Radioactive Isotope Beam Factory, Japan) for in beam gamma-ray spectroscopy. In this facility, the gamma-rays are emitted by fast-moving projectiles and are Lorentz-boosted up to energies of around 10 MeV necessitating large crystals for full gamma-ray absorption. At the same time, the effect of Doppler broadening in the reconstructed gamma-ray spectrum is driven by the size of the crystal and a high granularity of the array is required to correct for the angular dependence in the Doppler correction. Large, long, cuboidal shapes are being considered currently. It is therefore necessary to test and confirm that these larger crystals sizes maintain the material's desirable properties such as light-yield uniformity, and good energy resolution.

In this study, we present the characterisation results for a 1"x3"cylindrical HR-GAGG crystal using various radioactive sources and a slit-collimator system. This has been done with different light collection methods, mainly using SiPMs (Silicon Photomultipliers) placed at different faces of the crystal. Additionally, the performance of the crystal has been tested using different wrapping materials, namely PTFE tape and ESR foil.

In particular, I plan to discuss the dependence of the signal on the gamma-ray interaction position within the volume of the crystal. This includes the observed variation in the mean gamma-ray energy, the energy resolution, and the pulse shape of the signal at different positions of interaction.

[1] B. Seitz, et. al., IEEE Transactions on Nuclear Science, vol. 63, no. 2, pp. 503-508, April 2016

[2] P. Sibczynski et. al., Nucl. Instrum. Methods Phys. Res., Sect. A, vol. 772, pp. 112-117, February 2015

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