

## Development and Evaluation of PET-Compton imager based on Ce:Gd<sub>3</sub>Ga<sub>2.7</sub>Al<sub>2.3</sub>O<sub>12</sub> and CeBr<sub>3</sub> scintillators with SiPM arrays

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PET (Positron Emission Tomography) is currently an important tool in molecular imaging and medical diagnosis. Compton imager is a promising tool for future molecular imaging with multi-nuclides based on Compton scattering. Previously we have developed GAGG based Compton imager for environmental application [1][2] and GAGG based PET system[3]. Here we have developed PET-Compton hybrid imager based on two-layer structure using thin scatters and thick absorbers for multi-nuclide imaging. For achieving the good spatial resolution of Compton imager, the energy resolution of scintillators is one of the most important. CeBr<sub>3</sub> is a promising scintillator because of its high light yield over 70000 photon/MeV, excellent energy resolution ~ 3% with no background radiation and fast decay time.

In this study, we present the development of PET-Compton hybrid detector which consists of 8 by 8 MPPC (Multi Pixel Photon Counter / SiPM) array individually coupled with 2.5 x 2.5 x 9mm<sup>3</sup> Ce:Gd<sub>3</sub>Ga<sub>2.7</sub>Al<sub>2.3</sub>O<sub>12</sub> scintillators (absorbers) and MPPC array individually coupled with 2.5 x 2.5 x 1.5mm<sup>3</sup> CeBr<sub>3</sub> scintillators (scatters). The pixel size of MPPC is 3mm by 3mm and operated at the voltage of 55V. CeBr<sub>3</sub> scintillators are grown, packaged and mounted on the MPPC array. The signals from MPPC-scintillators are individually amplified and converted with dynamic time over threshold (dTOT) circuit to record the energy and timing information. In the experiment the image of <sup>111</sup>In and <sup>18</sup>F-FDG, which are used as SPECT and PET tracers, was acquired using the developed detector for Compton imaging and PET imaging.

[1] Jiang, Jianyong, et al. "A prototype of aerial radiation monitoring system using an unmanned helicopter mounting a GAGG scintillator Compton camera." *Journal of Nuclear Science and Technology* 53.7 (2016): 1067-1075.

[2] Kamada, Kei, et al. "2inch diameter single crystal growth and scintillation properties of Ce: Gd<sub>3</sub> Al<sub>2</sub> Ga<sub>3</sub> O<sub>12</sub>." *Journal of Crystal Growth* 352.1 (2012): 88-90.

[3] Yoshino, M., et al. "Development and performance evaluation of Time-over-Threshold based digital PET (TODPET2) scanner using SiPM/Ce: GAGG-arrays for non-invasive measurement of blood RI concentrations." *Journal of Instrumentation* 12.02 (2017): C02028.

### Has accepted

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