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Development of a compact scintillator-based high-resolution Compton camera for molecular imaging

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Recently, the Compton camera that can conduct measurements across a wide range of energy (from a few hundred kiloelectronvolts to a few megaelectronvolts) has been studied in the medical imaging field such as nuclear medicine and ion beam therapy. We have earlier developed a small, lightweight scintillator-based handheld Compton camera for environmental surveys. Although the handheld Compton camera showed very high efficiency, its angular resolution of ~8° (FWHM) for a ¹³⁷Cs source was slightly poor for medical imaging. Hence, in this study, we developed a new Compton camera to improve the angular resolution. Both the scatterer and the absorber consist of a Ce-doped Gd₃Al₂Ga₃O₁₂ (Ce:GAGG) scintillator array and multi-pixel photon counter (MPPC) arrays. In the absorber, we applied a 3D position-sensitive scintillator block using a dual-side readout technique. Based on the results of the fundamental imaging test, we confirmed that the new Compton camera showed a significantly improved angular resolution from ~8.9° (FWHM) of the present handheld camera to 5.4° (FWHM) for 662 keV gamma rays. In this study, we also present results of the basic detector performances and that of 3D image reconstruction toward “color” molecular imaging using the new Compton camera.

Primary author: Ms KISIHIMOTO, Aya (Waseda University)

Co-authors: Ms KOIDE, Ayako (Waseda University); Prof. KATAOKA, Jun (Waseda University); Mr SUEOKA, Koki (Waseda University); Mr OHSUKA, Shinji (Hamamatsu Photonics); Mr TAYA, Takanori (Waseda University)

Presenter: Ms KISIHIMOTO, Aya (Waseda University)

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