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The development and evaluation of Compton camera (Gri+) for medical imaging applications

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To improve medical treatment, the medical imaging field needs to develop more accurate imaging modalities. Using a Compton camera that has the ability to image a wide energy gamma-ray, has a wide field of view with a good angular resolution and electronically collimated, could help to improve medical treatments. To investigate physiological bodily functions, nuclear medicine imaging uses a low-energy gamma-ray, which is emitted from radiotracers. The distribution of the radiotracer material in the body is commonly imaged using a single-photon emission computed tomography (SPECT) system. However, SPECT systems are inherently limited in terms of their spatial resolution and sensitivity. This is due to SPECT systems being scintillation detection systems equipped with a mechanical collimator. Furthermore, imaging the prompt gamma-ray (up to 10MeV) during proton therapy has emerged as a real-time technique for verifying and monitoring the dose delivered.
The University of Liverpool has developed a Compton camera imaging system (Gri+) consisting of two position-sensitive semiconductor detectors and one coaxial detector; this imaging system is electronically collimated. The double-sided Si(Li) planar strip serves as a scatter detector with 13 orthogonal strips on each side. This detector has a sensitive position resolution of 5x5x8 mm3. Additionally, the HPGe double-sided planar strip serves as an absorber detector. This detector has 12 orthogonal strips on each side with a sensitive position resolution of 5x5x20 mm3. The coaxial HPGe serves as an additional absorber for high energy gamma-rays.
The current study evaluates method used by the Gri+ system and its ability to image a range of gamma-ray energies, commonly used in medical applications. Two point-like sources of 166 keV (139Ce) and 1.8 MeV (88Y) and medical phantom were used to evaluate the system performance and the Gri+ imaging ability. Further analyses are in progress to investigate a higher energy gamma-ray such as 4.4 MeV.

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