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Design and detector development for an in-beam small animal PET scanner

Munetaka Nitta[1], Giulio Lovatti[1], Mohhamad Safari[1], Tim Binder[1], Han Gyu Kang[2], Sodai Takyu[2], Georgios Dedes[1], Taiga Yamaya[2], Peter G. Thirolf[1], Katia Parodi[1]

[1] Ludwig-Maximilians-Universität München, Lehrstuhl für Medizinische Physik, Garching bei München, Deutschland

[2] National Institutes for Quantum and Radiological Science and Technology, Japan

Introduction

We have designed an in-beam PET [1] system for the Small animal proton Irradiator for Research in Molecular Image-guided radiation-Oncology (SIRMIO) project. The SIRMIO PET will image positron emitters generated by the proton beam and requires opening space for insertion of additional probes. In this study, we evaluated the performance with simulations. Then, we evaluated a prototype PET detector.

Materials & Methods

We used the MEGAlib software [2] for Monte-Carlo simulations. We assumed 3-layer LYSO blocks composed of pixels with a width of 0.9 mm and a height of 6.7 mm. We designed a spherical shape PET scanner with inner radius of 72 mm by using 56 detectors (Figure 1 left). For the experimental prototype detector evaluation, we prepared a 3-layer LYSO block and SiPM array (3mm × 3mm, 8 × 8 array, KETEK, Figure 1 right). The TOFPET2 ASIC (PETsys Electronics, Portugal) was used as data acquisition system (DAQ). We irradiated 511 keV gamma-rays from a Na-22 source and used an Anger calculation [3].

Results

The simulated detection efficiency was 9.8 % at the center of the PET scanner. Fig. 2 is an experimental flood map obtained by Anger calculation. Each pixel response is clearly separated, meaning that 0.9 mm pixel resolution and 6.7 mm depth resolution was achieved.

Conclusion

We designed a unique in-beam spherical PET scanner. Experimentally, we confirmed feasibility of the prototype detector.

Figure 1

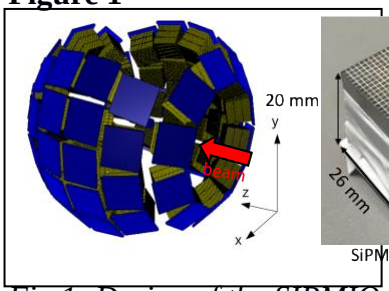

Figure 2

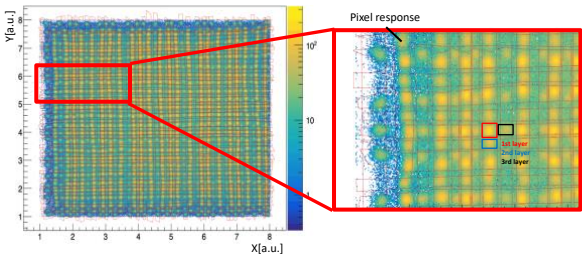

Fig.1: Design of the SIRMIO PET scanner (left) and a prototype detector (right)
Fig.2: Flood map of the prototype detector

Literatur

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