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Finalization and performance evaluation of a novel PET detector for an in-beam small animal PET scanner

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Introduction

We have designed a unique spherical in-beam PET scanner for a novel small animal proton irradiator under development in our group (Fig. 1 (a)). This in-beam PET scanner will image positron emitters generated by the proton beam. In this study, we finalized the configuration of the PET detector and evaluated its performance.

Materials & Methods

Fig. 1 (b) shows the in-beam PET detector composed of a pixelated 3-layer LYSO scintillator block and an 8×8 MPPC array (Hamamatsu photonics K.K, S14161-3050HS-08). The scintillator pixel size is 0.9 mm×0.9 mm×6.67 mm. The array size of the 1st, 2nd and 3rd layers are 23×20, 23×23 and 24×24, respectively. A charge division circuit (CDC) is used to reduce 64 signals to 4 signals. Those signals are transferred to an amplifier circuit board and converted from single-ended to differential readout, connected to a R5560 (CAEN) digitizer module. An Anger calculation is used to identify the interaction position [1]. We configured one pair of the PET detector setup and used a Na-22 point source to reconstruct the corresponding image using a maximum likelihood estimation algorithm.

Results

The point source image was symmetric along x and y directions (Fig. 2 (a)). The Full-Width-at-Half-Maximum of a line profile was 0.85 mm (Fig.2 (b)).

Summary

We finalized and evaluated the in-beam PET detector for our novel small animal in-beam PET scanner. We expect that sub-millimeter spatial resolution will be achievable for the entire system.

Figure 1 **Figure 2**

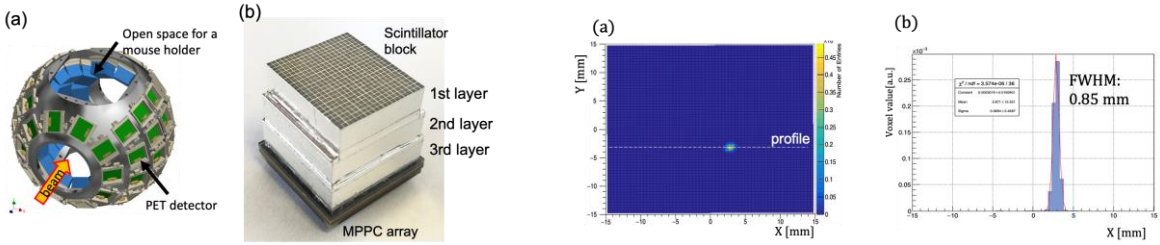

Fig.1: (a) Design of the novel small animal in-beam PET scanner and (b) a staggered 3-layer PET detector module. Fig.2: (a) Reconstructed image of the point source and (b) line profile of the image.

References

[1]T. Tsuda et al.: *IEEE TNS* **53**, 35-39, 2006.

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