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Performance Measurements of a Depth-Encoding TraPET Detector Module

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The new method to correct a parallax error and the loss of coincidence counts caused by the gap between modules was developed for a small animal PET. We proposed the TraPET scanner composed of 6 dual-layer phoswich detector modules. Each detector module consists of a 5.0 mm-thick trapezoidal-shaped monolithic LSO with a front face of 44.0 x 44.0 mm2 and a back face of 50.0 x 50.0 mm2 and a 25 x 25 array of GSO crystals with a size of 2.0 x 2.0 x 10.0 mm3. The layer of interaction is distinguished by the pulse shape discrimination method. One detector module was built and its performance was evaluated in terms of spatial resolution, sensitivity and the accuracy of the layer identification. The dual-layer crystals were optically coupled to a Hamamatsu H8500 position-sensitive PMT and a resistive charge divider was used to multiplex 64-channel anode outputs into 4-channel position signals. The 4 signals were being sampled continuously by 14-bit ADC at a sampling rate of 105 MHz and the pulse shape discrimination algorithm was achieved through FPGA programming. The detector module was irradiated with a Na-22 point source from the side of the crystals to obtain flood images of each layer and two layers were clearly identified, thus verifying the DOI capability. In this paper, TraPET detector proved to be a reliable design for correcting the parallax error and improving the sensitivity simultaneously in the small animal PET.

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