A high resolution PET detector for preclinical imaging application

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Abstract

The precision of positron emission tomography (PET) as a quantitative imaging modality in the study of metabolic abnormalities and disease progression in preclinical imaging application depends on specific features in PET detectors such as efficient, accurate, and fast detection capability of gamma rays emitted from the region of interest (ROI) inside the object under investigation. In this study, we are developing a PET detector that matches these features as follows: for high efficiency, high energy resolution, and high light yield, a 10x10 array of LYSO scintillator with crystal dimension 1x1x12 mm^3 is used to absorb and detect the annihilation gammas. For high scintillation photo-detection efficiency (PDE), high gain, and high packing fraction, an 8x8 array of 1x1mm^2 Silicon Photomultipliers (SiPM) are used for detecting the scintillation light. For high compactness, economic-effectiveness, and flexibility, a customized FPGA-based readout electronics is used for signal processing and data acquisition.

The preliminary data showed that an energy resolution of 11.8% at 511 keV photopeak of ^{22}Na is achieved. For crystal identification, all the 100 crystals of LYSO array are resolved and identified. This modular design is being developed to serve in a dedicated high resolution imaging application such as imaging the joints of human finger or small animal preclinical imaging.

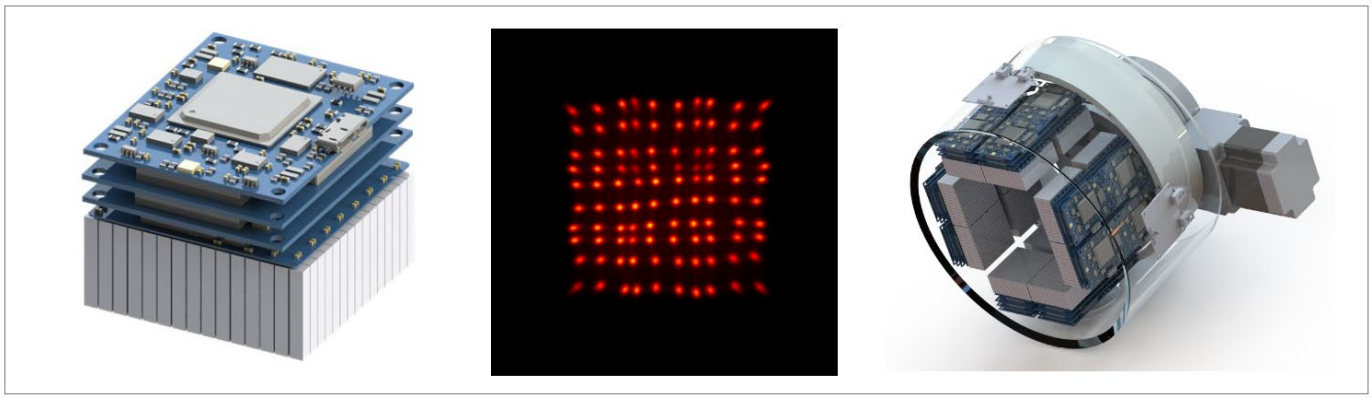

Figure 1. Left: Modular PET detector that is currently being designed. Middle: Flood histogram map or the output image of the scintillation array used in PET detector. Right: CAD design of the Proposed high resolution scanner that can be used for preclinical imaging application.