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Performance evaluation of a PET demonstrator for PET-MR imaging based on monolithic LYSO:Ce scintillators

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We are developing a positron emission tomography (PET) insert based on avalanche photodiodes (APDs) arrays and monolithic LYSO:Ce scintillators with the aim of being used for human brain studies inside a clinical 3T MRI equipment. In a previous work [1], we demonstrated the performance of our detectors by implementing an experimental setup consisting of two monolithic blocks working in coincidence, which were read out by the first version of an application specific integrated circuit (ASIC), followed by both external coincidence and digitalization modules. This preliminary demonstrator showed good spatial resolutions at detector level and good imaging qualities, which achieved reconstructed images of Na-22 point sources with spatial resolutions of 2.1 mm FWHM. Nevertheless, we detected image distortions and compressions due to the non-linearities close to the edge of the crystals and the absence of neighbor blocks. In this work we report on the performance evaluation of a larger scale PET demonstrator with higher field of view (FoV), which is based on the new updated ASIC (VATA241) [2] and is formed by two sectors of monolithic detector blocks placed face-to-face. Doing so, we obtain a better evaluation of the imaging capabilities of our BrainPET scanner. Moreover, the new prototype demonstrator has been built for validating the data readout architecture, the coincidence processing implemented in a Virtex 5 field programmable gate array (FPGA), as well as the continuous training method required to determine the points of entrance over the surface of our monolithic detector blocks.

References
[1] I. Sarasola, et al., "PET Demonstrator for a Human Brain Scanner Based on Monolithic Detector Blocks," IEEE Trans. Nucl. Sci., [accepted, under minor revisions]
[2] I. Sarasola, et al., "A novel front-end chip for a human PET scanner based on monolithic detector blocks," 12th International Workshop on Radiation Imaging Detectors IWORID2010, Jan. 2011, JINST 6 C01034 2011.

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