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Characterization of TOF-PET Detectors Based on Monolithic Blocks and an ASIC-Readout

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The aim of this work is to show the potential capabilities of monolithic crystals, coupled to large SiPM arrays to be considered as detector blocks for TOF-PET scanners. Monolithic blocks allow one to decode the 3D photon impact position. This approach, along with TOF capabilities, can be of high interest in clinical PET applications where a typical ring configuration is not used.

In this manuscript, we evaluate an ASIC based readout for digitizing all signals coming from analog photo-sensors. Validation results with one-to-one coupling resulted in a CTR as good as 200 ps FWHM.

Providing timing resolution when using detectors based on monolithic is however challenging. The wide distribution of scintillation light causes a poor SNR, which makes the system sensible to false triggering and to time walk errors. In this direction, we present a calibration method, designed to correct all recorded timestamps and also to compensate variations in time-paths among channels. Thereafter, a CTR improvement nearing 35% is observed for all measurements. Moreover, we show a novel approach which describes the use of weighted averaging methods to assign the timestamp to each gamma impact. This approach results in a further improvement of the CTR in the range of 100 ps FWHM, reaching a time resolution of 850 ps FWHM using large 50x50x10 mm scintillators coupled to 8x8 SiPM (6x6 mm2) arrays. These pilot studies show detector capabilities regarding TOF information when using monolithic scintillators.

Minioral

Yes

Description

ASIC HW

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