

Improving the CTR of a PET module using the DOI

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In a PET scanner, the probability of early stage detection of cancer is increased by high spatial resolution and sensitivity. Depth Of Interaction (DOI) is an important quantity both in small PET scanners and also in whole-body PET machines.

The module we developed is a pixellated scintillator of LYSO crystals with single side readout and allows light recirculation thanks to a light and a guide reflector on the side of the matrix opposite to the photodetector. The DOI information is extracted from the ratio between the light seen by the single SiPM channel coupled to the crystal hit and all the light collected by the photodetector.

To improve the timing performances of the module, the idea is to use the DOI information to correct for the time jitter caused by the various point of interaction of the gamma photons along the main axis of the crystal pixel. This correlation between the DOI and time of arrival of the optical photons can be exploited and the CTR is therefore corrected by properly combining the information of the multiple timestamps read out by a 4x4 SiPM array in order to obtain a more precise estimation of the time of interaction.

Using a small tagging crystal in coincidence with our matrix and a Na22 source, the CTR of the module was shown to improve beyond 200 ps FWHM after the correction; this was demonstrated for pixellated modules of different size and with different levels of depolishing of the lateral faces of the scintillators.

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