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Scintillation read out with MAPD array for gamma spectrometer

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Abstract.

Nowadays, silicon photomultipliers are widely used as scintillation light readout in many scientific and commercial applications which one of interesting field is gamma spectroscopy. There are various types of SiPMs offered by different vendors. Among these SiPMs, a micropixel avalanche photodiode (MAPD) characterizes its high photon detection efficiency (PDE). It is known that photon detection efficiency of MAPD decreases significantly with increasing pixel density (PD). However, gamma spectrometers require maximum PD/PDE relation. In this study, we present scintillation light detection performance of MAPD with the best PD/PDE, which were developed for gamma spectrometers. Total area of the 16-channel MAPD array was 12×12 mm². The MAPD array was used as a light readout device with CaF₂(Eu), BGO, LYSO, LaBr₃, and YSO(Ce) scintillators. The following measurements were carried out in the experiment: measurements of the breakdown voltage for each channel of the MAPD array, finding the optimal operating voltage, determination of the linearity range of MAPD response for each of the used crystals, and calculation of the energy resolution for 661.6 keV γ -rays from ¹³⁷Cs. Single MAPD with area 3×3 mm² was also studied using the scintillators coupled a light guide and with tapered head. The results of the energy resolution and linearity obtained with the MAPD array coupled to scintillators were compared to those obtained for the same scintillators with single MAPD.

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