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Coincidence method to reduce Si-PM (MPPC) dark counts

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Silicon photomultipliers (Si-PM, Multi-pixel photon counter (MPPC)) are a photo detector, which can count photons with multiple avalanche photodiode pixels in Geiger mode. With a high gain (10^6), small size (˜mm), and lower operational voltage (˜50V), they can be used as a readout of scintillation photons of scintillators. However, the rate of dark counts is high (˜1 Mcps) preventing to lower the detection threshold down to a few photons.

Coincidence method by an external trigger is a good technique to reduce the random noise triggers of Si-PMs (MPPCs). Polarimeters in hard X-ray/soft gamma-ray astrophysics is an example, which simultaneously detect a pair of a Compton scattering and photo-absorption signals to measure the azimuthal anisotropy of the scattering angle. Although the energy deposit of the Compton scattering is as low as ˜keV, the photo-absorption signal deposits larger energy, which can be used as the external trigger. In this presentation, we show experimental results of a plastic scintillator (EJ-204 4x4x15 mm3) and MPPC (S13360-3050CS 3x3 mm2) to detect Compton scattering signals of a few keV with 241Am pulser. We also discuss other cases using multiple Si-PMs (MPPCs) (e.g., the readout of a large scintillator by an array for an active shield) especially with respect to the lower energy threshold.

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