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Study of a Detector System for High-Energy Astrophysical Objects Using a Combination of Plastic Scintillator and MPPC

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We are studying a hard X-ray detector using a combination of a plastic scintillator and a multi-pixel photon counters (MPPC). Usually photomultiplier tubes (PMTs) have been adopted to read scintillators because of its high-gain and large photoelectric surface, and studies of PMT and scintillator systems are well advanced. However there exist limitations for PMTs. For example they have relatively large size, require high-voltage to operate and cannot be used in a strong magnetic field. On the other hand, MPPCs do not have such limitations but instead have high quantum efficiency and compact size. Therefore we are developing detectors with a combination of MPPC and plastic scintillator, primarily aiming to be used for the polarization measurements from high-energy astrophysical objects. With high quantum efficiency and fast response of MPPCs, we expect that we can achieve energy threshold level lower than or similar to that of PMTs with a rather compact system. We tested MPPC (S12573-100C)+plastic scintillator (EJ204) system in our laboratory, and succeeded in reading out 5.9 keV X-ray photons from 55Fe by operating the detector at low temperature (-10 ℃), and reading the signal with short shaping time (50 ns). We also confirmed that the light yield of our MPPC+scintillator system is comparable to the one we obtained with a conventional PMT to read scintillator signal. This indicates that it is important to reduce the noise of MPPC in order to achieve the energy threshold of 2-3 keV level. Therefore we plan to test a new MPPC such as S13360 series which has improved performance in terms of the cross talk and after-pulse. In this contribution we will report the test results and discuss future prospects.

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