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Evaluation of MPPC photon sensors for the PHOS upgrade in ALICE at CERN

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The ALICE experiment aims to reveal a new phase of matter called Quark-Gluon Plasma produced by high-energy heavy-ion collisions at the LHC. PHOS is a high-granularity and high-energy resolution electromagnetic calorimeter composed of more than 10,000 lead-tungstate (PWO) crystals attached with avalanche photodiodes (Hamamatsu S8664-55) to achieve the best energy resolution of σ/E = 3.5% (at 1GeV). One of the important goals is to detect direct photons, especially thermal photons to measure temperature in the QGP phase, that is a unique feature of ALICE in the LHC experiments.

Since the yield of thermal photons is an order of 10-3 compared to others, all the other hits in PHOS have to be removed as precise as possible. A cluster produced by a charged particle can be identified with tracking information, however, clusters made by neutral hadrons cannot be removed. A serious background could be originated by anti-neutrons in low energies, since they create hits of a few GeV in annihilation in the PWO crystals. The TOF technique can be applied to remove these background hits. Unfortunately the present APD readout did not provide good timing resolutions, so we are investigating new photon sensors with a good timing resolution for the PHOS upgrade.

We evaluated basic properties of two types of Multi-Pixel-Photon-Counter (MPPC) with 14,400- and 90,000-pixels. We measured linearity, dynamic range and timing characteristics of these devises using 80ps wide light pulser at 403nm. We constructed a PWO element attached with the MPPC and APD devices to readout cosmic-ray hits. We found the MPPC timing resolution of σ = 500ps, which is much better than APD. In my talk, I present the test results and discuss about possibility of MPPC application to the PHOS upgrade.

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