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Performance of the MCP-PMTs of the TOP counter in the first beam operation of the Belle II experiment

Thursday, 29 November 2018 15:50 (20 minutes)

We developed a square-shaped micro-channel-plate photomultiplier tube (MCP-PMT) in collaboration with Hamamatsu Photonics K.K., successfully produced more than 630 MCP-PMTs so far, and installed 512 MCP-PMTs into the TOP counter of the Belle II experiment in 2016. The TOP counter is the first-ever detector that is equipped with such a large number of MCP-PMTs. All the MCP-PMTs have a time resolution better than 50 ps for single photon detection and a peak quantum efficiency of 29% on average at a wavelength around 360 nm. Those excellent time resolution and efficiency are essential for the TOP counter to reconstruct the Cherenkov image for particle identification.
Using the laser calibration system which can distribute single photons to all the installed MCP-PMTs in situ, the gains of the MCP-PMTs were tuned to be 5times;10⁵ in 1.5 T of the magnetic field. The efficiency of the readout electronics to discriminate the MCP-PMT pulses at that gain was evaluated to be greater than 90%. With this configuration, the MCP-PMTs were operated in success for the first beam data taking of the Belle II experiment in 2018. The number of detected photons per track from the beam collisions was evaluated, and it was confirmed to be roughly consistent with our expectation.
In this presentation, we will show the performance of the MCP-PMTs measured in detail in our test benches ahead of the installation and the one confirmed in the first beam operation.

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