

Performance of the MCP-PMT for the Belle II TOP counter

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Content

The time-of-propagation (TOP) counter is a novel ring imaging Cherenkov detector. It is a key device of particle identification in Belle II to extend the physics reach toward a new physics. The essence of the TOP counter is to detect the Cherenkov photons with a high efficiency and a better time resolution than 50 ps. Thus we developed the micro-channel-plate photomultiplier tube (MCP-PMT). We succeeded in producing all the 512 MCP-PMTs used for the TOP counter. The photon detection efficiency and the response to single photons were measured systematically for every MCP-PMT: the average quantum efficiency is greater than 28% at 380 nm wavelength and the time resolution is 30-40 ps as expected. The detailed results will be presented including the high voltage dependence of the performance. In addition we measured the degradation of the gain, time resolution and collection efficiency in a 1.5 T magnetic field. These results will also be presented. In summary we would like to discuss that the systematic mass measurement showed not only the excellent performance of the MCP-PMTs for the TOP counter but also helped us to reveal the basic properties of the MCP-PMT. Our R&D is now focused on upgrade of the MCP-PMT performance in terms of the lifetime, which we define as the total output charge where the quantum efficiency declines down to 80% of the beginning. We improved the production process of the MCP-PMT and succeeded in extending the lifetime longer than 10 C/cm² for all of four test samples. The lifetime test results as well as the R&D status will be included in the presentation.

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