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Test of the HAPD light sensors for the Belle II Aerogel RICH

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The Aerogel Ring-Imaging Cherenkov detector (ARICH) is being installed in the endcap region of Belle II spectrometer to identify particles from B meson decays by detecting the Cherenkov ring image from an aerogel radiator. To detect the single photons, a high-sensitive photon detector which has wide effective area ($\sim 70 \text{ mm} \times 70 \text{ mm}$), a Hybrid Avalanche Photo Detector (HAPD), has been developed in a collaboration with Hamamatsu K.K. The HAPD consists of a hybrid structure of a vacuum tube and an avalanche photodiode (APD). It can be operated in the high magnetic field of the spectrometer (1.5 T) and withstands the radiation levels expected in the Belle II experiment. There are two steps of electric pulse amplification: acceleration by electric field in the vacuum tube part and electron avalanche in the APD part resulting in a total gain of about 10^5 . In the ARICH we use 420 HAPDs in total. Before installing them, we performed quality assessment studies such as measurements of dark current, noise level, signal-to-noise ratio and a 2-dimensional scan with laser illumination. We also measured quantum efficiency of the photocathode. During the HAPD performance tests in the magnetic field, we observed very large signal pulses which cause long dead time for readout electronics in some samples. We have carried out a number of studies to understand this effect, and have found a way to mitigate it and suppress the degradation of ARICH performance. In this presentation, we will show a summary of the HAPD performance and quality assessment measurements including validation in the magnetic field for all of the HAPDs manufactured for the ARICH in the Belle II.

Registered

Yes

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