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Module of Silicon Photomultipliers as a single photon detector of Cherenkov photons

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We have studied the possibility to use silicon photomultipliers as a single photon detector in a proximity focusing RICH with aerogel radiator; such a counter is considered for the Belle-2 detector. Their main advantage over conventional photomultiplier tubes is their operation in high magnetic fields. Their disadvantage is the relatively high dark noise count rate ($\sim \text{MHz/mm}^2$) which can be overcome by using a narrow time window in the data acquisition. A module, consisting of 64 (8x8) Hamamatsu MPPC S10362-11-100P silicon photomultipliers, has been constructed and tested with Cherenkov photons emitted in an aerogel radiator by 120 GeV/c pions from the CERN T4-H6 beam. To increase the signal to noise ratio, i.e. to increase the effective surface on which light is detected, the light concentrators have been employed. In the beam test setup with 1 cm thick aerogel of $n=1.03$ we obtained 1.6 photons per ring. The light yield increased by a factor of 2.3 to 3.6 photons per ring when the light concentrators were used. With the final focusing radiator of thickness of 4 cm and $n \sim 1.05$ and with the improved light guide production we expect to detect about 30 photons per ring.

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plenary

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