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The new photodetectors for the LHCb RICH upgrade and their FE design

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The RICH detectors of the LHCb experiment provide particle identification, especially for hadrons, in high energy proton-proton collisions at the LHC at CERN over a wide momentum range (2 to 100 GeV/c). The Cherenkov light is collected on 2D photon detector planes sensitive to single photons. In order to make the detector capable to operate at 40 MHz event readout speed, matching the bunch crossing rate of the accelerator, a substantial upgrade is planned for deployment in 2019. The current hybrid photon detectors (HPD) will be replaced with Multi-Anode photomultiplier tubes (customisations of the Hamamatsu R11265 and the H12699 MaPMTs). These 8×8 pixel devices meet the experimental requirements thanks to their small pixel size (~3×3 mmˆ2 for the R11265 model), high gain (10ˆ6 electrons per photon), negligible dark counts rate (~ 50 Hz/cmˆ2) and moderate cross-talk. The measured performance of several tubes are shown, together with their long-term stability. A new 8-channel front-end chip, named CLARO8, has been specifically designed in 0.35 μm CMOS AMS technology for the MaPMT readout. The CLARO8 chip operates in binary mode and combines low power consumption (~ 1 mW/Ch), remarkable speed (baseline restored in ≤ 25 ns) and radiation hardness. A 12-bit digital register permits the optimisation of the dynamic range and the trigger level for each channel and provides tools for the on-site calibration. The design choices and the characterization of the electronics are presented.

Registered

Yes

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