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Upgrade of the LHCb RICH detectors and characterisation of the new opto-electronics chain

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The LHCb detector has been upgraded to deal with a five-fold increase in the instantaneous luminosity delivered to the experiment during LHC Run 3 and to readout data at the full bunch crossing rate of 40 MHz. The enhanced LHCb RICH detectors now feature Multianode Photomultiplier Tubes (MaPMTs), covering a total area of approximately 4 square meters, and a brand new frontend electronics to comply with the trigger-less readout architecture. The opto-electronics chain is capable to detect single photons at repetition rates of up to 100 MHz/cm² while maintaining an exceptionally low noise count rate.

The upgrade is comprehensively outlined, including details about the characterisation and studies on the photon detection system. Special attention is given to the key properties of the photomultipliers with the characterisation of an unexpected noise source observed in the MaPMTs, persisting for several microseconds after the primary signal. Strategies to equalise and operate the approximately 200000 channels of the RICH system under optimal conditions are extensively discussed.

The stability and uniformity achieved by optimising the parameters of the opto-electronics chain enable the RICH system to function successfully to provide an excellent charged hadron identification in high occupancy conditions. The employment of MaPMTs opens unprecedented capabilities of evaluating the luminosity with the RICH detectors by estimating the anodic currents and cross calibrate them with the number of Cherenkov hits. The innovative technique to estimate the luminosity online and offline is presented.

Collaboration

Role of Submitter

I am the presenter

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