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Quality Assurance procedures for the LHCb RICH Upgrade

During the Long Shutdown 2 of the LHC, the LHCb RICH system has undergone an upgrade to implement the LHCb trigger strategy which increased the read-out rate from 1 MHz to 40 MHz.

The new challenging operating conditions of the upgraded experiment impose the replacement of the Hybrid Photon Detectors (HPD) with Multi-Anode Photomultiplier tubes (MaPMT) and the introduction of customised front-end electronics. The optics and mechanics of RICH 1, the upstream detector, are improved as well, and the support and cooling system redesigned accordingly. The new RICH detectors have a modular design to facilitate maintenance and assembly. The fundamental core element is the Elementary Cell, which is composed of 1 or 4 MaPMTs, depending on the type of the MaPMT, and the associated front-end electronics. Four ECs and one or two Digital Boards containing the interfacing FPGAs, are grouped together into a Photon Detector Module. The RICH photon detectors are arranged into independent columns, with a single column made of 6 PDMs stacked together. The modularity of the detector allowed the development of procedures devoted to test and characterise each component in order to assure compliance with the specification and uniformity of the detector. An overview of the protocols and testing facilities which have been designed and put in place to perform the quality assurance programme is presented. The quality control process lasted more than six years and included the testing and characterisation of the new front-end electronics, the MaPMTs, the ECs, and the assembly, commissioning, and installation of the columns in the LHCb cavern.

Keywords—RICH, Quality Assurance, MaPMT

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