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The Future of RICH Detectors through the Light of the LHCb RICHes

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The two RICH detectors of the LHCb experiment have been operational since 2008 and the data provided by them have been crucial for the physics program of LHCb. They have achieved an impressive performance for such complex detectors, one for all, its Cherenkov angle resolution of 0.67 mrad for single photons. The current system is expected to continue to take data until 2019, when a two year shutdown (LS1) is foreseen and LHCb will undergo a significant upgrade.

For this upgrade, a new RICH system configuration is in preparation (called Upg1a). Building on the present detector and strictly leaving intact the volumes already occupied in the experiment, it will feature a new optical system for RICH1, new photodetectors, and front-end and DAQ electronics capable of acquisition rates up to 40 MHz. It is planned to be operational at the start of year 2021.

With the advent of the High Luminosity LHC (HL-LHC) from 2027, there is opportunity for a 50-fold increase in the luminosity at LHCb compared to the present, which would further physics goals. To cope with this challenge, the RICH system needs to be redesigned to improve resolutions and reduce occupancies. In this scenario two new upgrade phases could be foreseen: phase 1b could be introduced in LS3 with a possible further upgrade in LS4, spanning a period between 2025 and 2035.

A proposal focused on the Phase 1b is presented. It shows how to overcome the challenges of the new conditions while still providing excellent particle identification within the constraints of the present LHCb experiment. The design makes use of latest and future technological advances in photodetection, electronics and optical materials. Details will be presented and the expected performance will be reported.

Although applied to specific circumstances, these ideas are used as a paradigm of what we think is achievable in the development and realization of high precision RICH detectors.

Registered

Yes

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