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The LHCb RICH Upgrade II: the challenge of particle identification at High-Lumi LHC

The High-Luminosity LHC (HL-LHC) will present unprecedented opportunities for precision flavour physics, along with new challenges for detector performance in extreme conditions. As part of the LHCb Upgrade II program, the Ring Imaging Cherenkov (RICH) detectors are undergoing a comprehensive redesign to meet the demands of increased luminosity, higher track multiplicities, and tighter timing constraints with occupancies approaching those of general-purpose detectors in the forward region.

This contribution outlines the conceptual design and ongoing R&D efforts for the RICH Upgrade II system. The upgraded detectors will feature ultra-fast photon sensors with improved spatial granularity and picosecond-level time resolution, enhanced optics to mitigate occupancy effects, and fully integrated front-end electronics capable of precision time stamping, enabling 4D particle identification reconstruction to disentangle high-density event topologies.

We will present the current status of sensor and optics development, simulation studies guiding design choices, and initial results from testbeam campaigns, demonstrating how these unprecedented technological advances are essential to realizing LHCb's physics ambitions in the HL-LHC era.

Secondary track

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