Contribution ID: **16** Type: **presentation**

A novel fast-timing readout chain for LHCb RICH LS3 enhancements and prototype beam tests

Thursday 15 September 2022 11:00 (25 minutes)

The prompt Cherenkov radiation and focusing optics of the LHCb RICH detectors allow the prediction of the Cherenkov photon detection time from a given track to within ten picoseconds. Fast-timing information on the detected Cherenkov photons can therefore be used to significantly improve the PID performance and the signal-to-noise ratio of the detectors. This concept is a cornerstone for the LHCb RICH detector upgrades and will ultimately allow the system to operate at a luminosity in excess of 10^{34} cm^{-2} s^{-1} during HL-LHC Run 5. The motivation and concepts behind the detector enhancements during Long Shutdown 3 (LS3, 2026-2028) and the proposed new electronic readout chain will be presented. The specifications for the new ASIC called the FastRICH will be discussed in the context of the LS3 enhancements and LHCb Upgrade II. The FastRICH ASIC will perform multi-channel single-photon discrimination, timestamp photons with 25 ps bin size, integrate closely with the LHCb optical link chipset and apply data-compression techniques. It will allow the system to timestamp each photon with an ˜150 ps resolution (dominated by the existing MAPMT transit time spread) within a short gate of ˜2 ns (the time spread from the LHCb collisions). The new electronic readout chain introduces important timing and detector techniques ahead of the Upgrade II RICH system overhaul and the FastRICH has the flexibility to be coupled to sensors with better time resolution for HL-LHC Run 5. Simulation studies have demonstrated improvements in the hadronic PID performance during Run 4 using the FastRICH and the current photon detectors. A first version of the readout chain, based on the FastIC, a predecessor of the FastRICH ASIC, and a TDC-in-FPGA, has been studied using Cherenkov photons at the CERN SPS charged particle beam test facility. The readout chain was coupled to MAPMT and SiPM sensors. The results will be presented and interpreted in the context of the RICH detector future upgrades.

Author: KEIZER, Floris (CERN)

Presenter: KEIZER, Floris (CERN)

Session Classification: Technological aspects and applications of Cherenkov detectors

Track Classification: Technological aspects and applications