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Real-time physics: novel concepts for trigger, calibration & alignment, and data processing with LHCb

The LHCb detector consists of subsystems designed to perform high efficiency tracking (>95%) with an excellent momentum resolution (0.5% for p<20 GeV). Two Ring Imaging Cherenkov detectors provide precise particle identification. In Run II of the LHC, a new scheme for the LHCb software trigger allows splitting the triggering of the event in two stages, giving room to perform the alignment and calibration in real time. In the novel detector alignment and calibration strategy for Run II, data collected at the start of the fill are processed in a few minutes and used to update the alignment, while the calibration constants are evaluated for each run. This allows identical constants to be used in the online and offline reconstruction. The larger timing budget, available in the trigger, results in the convergence of the online and offline reconstruction. The same performance of the track reconstruction and PID are achieved online and offline. This offers the opportunity to optimise the event selection in the trigger with stronger constraints and including the hadronic PID. It additionally increases selection efficiencies and purity and reduces systematic uncertainties. In turn this gives the possibility to finalise physics analyses directly from data objects produced by the online reconstruction. The novel real-time alignment and calibration strategy at LHCb is discussed from both the operational and physics performance points of view. The overall performances of the LHCb detector on the first data of Run II are presented.

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