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Real-time analysis from the trigger candidates and novel calibration strategy at the LHCb experiment

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The availability of computing resources is a limiting factor in data collection at the LHCb experiment, due to the high production rate of beauty and charm hadrons. For Run 2, LHCb has implemented a novel approach to make optimal use of these resources: The output of the first software trigger stage is buffered to disk and the second stage is executed asynchronously, using 100% of the available trigger farm even between LHC fills. As an integral part of the new strategy, the detector is aligned and calibrated, and the data are fully reconstructed, in real-time, permitting offline-quality signal selections. Without the need to reconstruct offline, it is possible to save only the information needed for analysis directly from the trigger. This concept, called the "LHCb Turbo stream", maximises the signal rate saved to disk. The analysis of the data collected also required appropriate calibration samples to determine the tracking and PID performance. A novel strategy has been introduced in Run 2, where the selection of calibration samples is implemented as a Turbo stream. A further processing of the data is required in order to provide background subtracted samples for the determination of performance, which is achieved through a centralised production that makes highly efficient use of computing resources. These data are also used in the development of new algorithms to evaluate the detector performance in LHC upgrade scenarios. The aim of this talk is twofold. It will cover the major steps of the implementation, and detail the use of the calibration samples to determine the PID performance and tracking efficiency. It will also present how LHCb dynamically adapts the output rate of the first trigger stage to the LHC efficiency, and how the Turbo paradigm was extended in 2017 to dynamically persist any information required for analysis. This can range from only the signal candidate object to the complete event, with user-selectable granularity.

Experimental Collaboration

LHCb

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