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Real-time alignment procedure at the LHCb experiment for Run3

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The LHCb detector at the LHC is a general purpose detector in the forward region with a focus on studying decays of c- and b-hadrons. For Run 3 of the LHC, LHCb will take data at an instantaneous luminosity of $2\times10^{33}cm^{-2}s^{-1}$, five times higher than in Run 2 (2015-2018). To cope with the harsher data taking conditions, LHCb will deploy a purely software based trigger with a 30 MHz input rate. The software trigger at LHCb is composed of two stages: in the first stage the selection is based on a fast and simplified event reconstruction, while in the second stage a full event reconstruction is used. This gives room to perform a real-time alignment and calibration after the first trigger stage, allowing to have an offline-quality detector alignment in the second stage of the trigger. The detector alignment is an essential ingredient to have the best detector performance in the full event reconstruction. The alignment of the whole tracking system of LHCb is evaluated in real-time by an automatic iterative procedure. This is particularly important for the vertex detector, which is retracted for LHC beam injection and centered around the primary vertex position with stable beam conditions in each fill. Hence it is sensitive to position changes on fill-by-fill basis. To perform the real-time alignment and calibration of the detector a new framework that uses a multi-core farm has been developed. This framework allows the parallelization of the event reconstruction, while the evaluation of the constants is performed on a single node after collecting all the needed information from all the nodes. The procedure is fully automatic and running as soon as enough data are collected. The execution of the alignment tasks is under the control of the LHCb Experiment Control System, and it is implemented as a finite state machine. The data collected at the start of the fill are processed in a few minutes and used to update the alignment before running the second stage of the trigger. This in turn allows the trigger output data to be used for physics analysis without a further offline event reconstruction. The framework and the procedure for a real-time alignment of the LHCb detector in Run 3 are discussed from both the technical and operational point of view. Specific challenges of this strategy and foreseen performance are presented.

Consider for young scientist forum (Student or postdoc speaker)

No

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