



Contribution ID : 719

Type : Oral presentation

The LHCb trigger system: performance and outlook

Thursday, 3 July 2014 15:00 (30)

The LHCb experiment is a spectrometer dedicated to the study of heavy flavour at the LHC. The current LHCb trigger system consists of a hardware level, which reduces the LHC inelastic collision rate of 13MHz to 1 MHz, at which the entire detector is read out. In a second level, implemented in a farm of 20k parallel-processing CPUs, the event rate is reduced to about 5 kHz. We review the performance of the LHCb trigger system, focusing on the High Level Trigger, during Run I of the LHC.

The High Level Trigger showcased a number of pioneering concepts, for example : the deployment of an inclusive multivariate B-hadron tagger as the main physics trigger of the experiment, buffering of events to local disks in order to leverage the otherwise idle resources when the LHC does not produce collisions, and simulation-free event-by-event trigger efficiency corrections.

The LHCb experiment plans a major upgrade of the detector and DAQ system in the LHC shutdown of 2018. In this upgrade, a purely software based trigger system is being developed, which will have to process the full 30 MHz of inelastic collisions delivered by the LHC. We demonstrate that the planned architecture will be able to meet this challenge, particularly in the context of running stability and long term reproducibility of the trigger decisions.

This talk will cover the design and performance of the LHCb trigger system in Run I as well as the planned improvements in the upgrade of the LHCb experiment.

Summary

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Session Classification : Computing and Data Handling

Track Classification : Computing and Data Handling