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The LHCb Trigger in Run-II

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The LHCb trigger system consists of a hardware level, which reduces the event rate of 30 MHz of inelastic collisions to 1 MHz, at which the detector is read out. In the subsequent High Level Trigger, based on a farm of PCs, the event rate is reduced to a level that can be stored and processed offline. For Run-II, the system has been upgraded such that the output of the first stage of the HLT is buffered to the disks on the farm nodes, with a total capacity of 5 PB, while detector alignment and calibration tasks are performed in real time. This, together with improvements to the reconstruction algorithms and an increase in the performance of the PC farm, allows LHCb to be the first high energy collider experiment to perform full offline quality event reconstruction within the trigger. A result of this is that LHCb can now perform real time physics analysis based on the trigger level information which is written to storage in a more compact event format and processed through the “Turbo” stream. The output rate of the trigger can thus be increased from 5 kHz in Run-I, up to 12.5 kHz in Run-II. We discuss the performance of the system with reference to the first physics measurements with the 2015 data, which are based on the Turbo stream. We also discuss the impact of this real-time analysis scheme on the physics programme of the LHCb upgrade, relying entirely on the HLT that will perform an offline-like reconstruction on the full 40 MHz LHC bunch crossing rate in real-time.

Primary authors: FITZPATRICK, Conor (Ecole Polytechnique Federale de Lausanne (CH)); VESTERINEN, Mika Anton (Ruprecht-Karls-Universitaet Heidelberg (DE)); STAHL, Sascha (CERN)

Co-author: MATEV, Rosen (CERN)

Presenter: MATEV, Rosen (CERN)

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