Real time analysis with the upgraded LHCb trigger in Run-III

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The current LHCb trigger system consists of a hardware level, which reduces the LHC bunch-crossing rate of 40 MHz to 1 MHz, a rate at which the entire detector is read out. A second level, implemented in a farm of around 20k parallel processing CPUs, the event rate is reduced to around 12.5 kHz. The LHCb experiment plans a major upgrade of the detector and DAQ system in the LHC long shutdown II (2018-2019). In this upgrade, a purely software based trigger system is being developed and it will have to process the full 30 MHz of bunch crossings with inelastic collisions. LHCb will also receive a factor of 5 increase in the instantaneous luminosity, which further contributes to the challenge of reconstructing and selecting events in real time with the CPU farm. We discuss the plans and progress towards achieving efficient reconstruction and selection with a 30 MHz throughput. Another challenge is to exploit the increased signal rate that results from removing the 1 MHz readout bottleneck, combined with the higher instantaneous luminosity. Many charm hadron signals can be recorded at up to 50 times higher rate. LHCb is implementing a new paradigm in the form of real time data analysis, in which abundant signals are recorded in a reduced event format that can be fed directly to the physics analyses. These data do not need any further offline event reconstruction, which allows a larger fraction of the grid computing resources to be devoted to Monte Carlo productions. We discuss how this real time analysis model is absolutely critical to the LHCb upgrade, and how it will evolve during Run-II.

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DAQ

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