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The ATLAS trigger evolution and performance during Run 1

During the data-taking period from 2009 until 2012, the ATLAS trigger has been used very successfully to collect proton-proton data at LHC center-of-mass energies between 900 GeV and 8 TeV. The three-level trigger system reduces the event rate from the design bunch-crossing rate of 40 MHz to an average recording rate of about 300 Hz. Using custom electronics with input from the calorimeter and muon detectors, the first level rejects most background collisions in less than 2.5μs. Two subsequent levels of software-based triggers achieve further rejection. The trigger system is designed to select events by identifying muons, electrons, photons, taus, jets, and B-hadron candidates, as well as using global event signatures, such as missing transverse energy.

We give an overview of the strategy and performance of the different trigger selections based mainly on the experience during the 2011 and 2012 LHC proton-proton runs, when the trigger menu had to be adapted quickly in response to the continuous increase of luminosity and pileup. Examples of trigger efficiencies and resolution with respect to offline-reconstructed signals are presented. These results illustrate that we have achieved a very good level of understanding of both the detector and trigger performance and successfully selected streamed data samples suitable for analysis. Furthermore, we describe how the trigger selections and overall trigger menu have evolved and have been further optimized (by, e.g., adding topological triggers, using forward jets for Vector Boson Fusion signal topologies, using isolation or using multi-variate techniques) to cope with the increase of center-of-mass energy and pileup conditions during Run 1.

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