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The ATLAS Trigger system upgrade and performance in Run 2

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The ATLAS trigger has been used very successfully for the online event selection during the first part of the second LHC run (Run-2) in 2015/16 at a centre-of-mass energy of 13 TeV. The trigger system is composed of a hardware Level-1 trigger and a software-based high-level trigger; it reduces the event rate from the bunch-crossing rate of 40 MHz to an average recording rate of about 1 kHz. The excellent performance of the ATLAS trigger has been vital for the ATLAS physics program of Run-2, selecting interesting collision events for wide variety of physics signatures with high efficiency.

The trigger selection capabilities of ATLAS during Run-2 have been significantly improved compared to Run-1, in order to cope with the higher event rates and pile-up which are the result of the almost doubling of the center-of-mass collision energy and the increase in the instantaneous luminosity of the LHC. At the Level-1 trigger the undertaken improvements resulted in more pile-up robust selection efficiencies and event rates and in a reduction of fake candidate particles. A new hardware system, designed to analyse event-topologies, supports a more refined event selection at the Level-1. A hardware-based high-rate track reconstruction, currently being commissioned, enables the software trigger to make use of tracking information at the full input rate. Together with a re-design of the high-level trigger to deploy more offline-like reconstruction techniques, these changes improve the performance of the trigger selection turn-on and efficiency to nearly that of the offline reconstruction. In order to prepare for the anticipated further luminosity increase of the LHC in 2017/18, improving the trigger performance remains an ongoing endeavour. Thereby coping with the large number of pile-up events is one of the most prominent challenges.

This presentation gives a short review the ATLAS trigger system and its performance in 2015/16 before describing the significant improvements in selection sensitivity and pile-up robustness, which we implemented in preparation for the expected highest ever luminosities of the 2017/18 LHC.

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