

The ATLAS trigger in 2017 and 2018 –developments and performance

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The ATLAS Trigger system has been operating successfully during LHC Run-2, between 2015 and 2017. Its excellent performance has been vital for the ATLAS physics program, selecting interesting collision events for a 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 with the large number of simultaneous proton-proton interactions (pile-up). At the Level-1 trigger these improvements resulted in more pile-up-robust selection efficiencies and event rates, as well as in a reduction of fake candidate particles. A new hardware system, designed to analyse event-topologies, supports a more refined event selection at Level-1. Exemplary are the application of angular and invariant mass cuts in low momentum di-lepton and di-jet triggers, keeping the Level-1 rate of such selections, which are essential for many physics analyses, at an affordable level. A hardware-based, high-rate track reconstruction, currently being commissioned, enables the high-level software trigger to make use of tracking information at its full input rate. Such full-scan tracking has an important role in reducing the pile-up dependence of triggers based on isolated single leptons and those selecting on total transverse energy. Together with an upgrade of the high-level trigger selections to deploy more offline-like reconstruction techniques, these changes dramatically improve the performance of the trigger selection to nearly that of the offline reconstruction.

At the beginning of 2017 more than 1000 different ATLAS trigger selections had been carefully compiled into a “trigger menu”, covering all aspects of the ATLAS physics program and allowing for the expected rise in LHC luminosity. An unexpected change in the LHC conditions in the middle of 2017 toward an environment with much higher pile-up resulted in a much-increased CPU usage of the software trigger and reduced performance, requiring adaptation of the selection software and the general trigger menu design.

This presentation gives a comprehensive review of the ATLAS trigger system in 2017, covering briefly the changes compared to 2016, operational aspects, and encountered constraints. The trigger menu strategy for 2018, the last year of Run-2 will be shown. Focus will be put on the new event-topology-based selections at the Level-1 trigger, and on the trigger performance at high pile-up seen in 2017. The improvement measures taken for 2018 will be discussed and substantiated with first 2018 trigger performance plots.

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