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Triggering in ATLAS in Run 2 and Run 3

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The ATLAS experiment at the LHC can record about 1 kHz of physics collisions, out of an LHC design bunch crossing rate of 40 MHz. To achieve a high selection efficiency for rare physics events while reducing the significant background rate, a two-level trigger system is used.

The event selection is based on physics signatures, such as the presence of energetic leptons, photons, jets or missing energy. In addition, the trigger system can exploit algorithms using topological information and multivariate methods to carry out the filtering for the many physics analyses pursued by the ATLAS collaboration. In Run 2, around 1500 individual selection paths, the trigger chains, were used for data taking, each with specified rate and bandwidth assignments.

We will give an overview of the Run-2 trigger menu and its performance, allowing the audience to get a taste of the broad physics program that the trigger is supporting. We present the tools that allow us to predict and optimize the trigger rates and CPU consumption for the anticipated LHC luminosities and outline the system to monitor deviations from the individual trigger target rates, and to quickly react to the changing LHC conditions and data taking scenarios.

As an outlook to the upcoming ATLAS data-taking period in Run 3 from 2022 onwards, we present the design principles and ongoing implementation of the new trigger software within the multithreaded framework AthenaMT together with some outlook to the expected performance improvements.

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