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The upgraded trigger system and di-τ trigger strategies of the ATLAS detector at the HL-LHC

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When LHC enters the High Luminosity (HL-LHC) phase, the instantaneous luminosity will increase from the current 2 x 10ˆ34 cm-2 s-1 (Run II) to a maximum expected value of 7.5 x 10ˆ34 cm-2 s-1, equivalent to 200 interactions per bunch crossing, and the estimated integrated luminosity will reach 3000 fb-1.
New strategies are needed in order to make triggers more selective and to keep pT thresholds for leptons close to the current ones.
The current trigger system is based on a Level-1 hardware trigger plus a High Level Trigger (HLT) implemented in software, two scenarios are being considered for the HL-LHC phase.
The first one is a single Level-0 which will do a preliminary selection of data to reduce the rate to 1 MHz with a latency of 6 μs followed by a High Level Trigger. This corresponds to a 200 kHz target for a di-τ trigger.
The second scenario would reduce the event rate to 2-4 MHz at Level-0, then a Level-1 trigger will further reduce it to 600-800 kHz, followed again by a High Level Trigger.
The new trigger system will rely on better spatial resolution of the LAr calorimeter of ATLAS, whose granularity will be 4 times improved at Level-0 and 16 times at Level-1. This will improve the turn-on curves and the matching between tracks and clusters, it will make transverse energy measurements of reconstructed objects more accurate and it will allow the use of more sophisticated jet algorithms.
Physics motivations for the trigger upgrade at HL-LHC together with an overview of the new trigger system will be given.
The current status of the di-τ trigger at the future HL-LHC Level-0 will then be shown. This study has been performed through simulations of the hadronic decay of the Higgs boson into two taus at a center of mass energy of 14 TeV under a pile-up conditions corresponding to 200 interactions per bunch crossing.
In particular, results on the performance (in terms of turn-on curves and rejection power of the algorithm) will be shown along with the challenges related to the development of this trigger in such a very high pile-up environment.

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