ATLAS experiment at the LHC Run 3

- ATLAS: a multi-purpose detector at the LHC to search for unknown new physics and measure the Standard Model physics at TeV scale
- For Run 3 (2021-24) detector upgrade is ongoing
- Successfully operated during Run 2 (94% data-taking efficiency)
- Maximum instantaneous luminosity in Run 3 is almost the same as Run 2 (~2×10^{34} cm^{-2} s^{-1})

Level-1 muon trigger upgrade at the endcap (1<|\eta|<2.4)

Early-Run 2 system
- Muon candidates are reconstructed by the coincidence of 3 stations at Thin-Gap Chamber (TGC) Big Wheel (BW) (each station provides 2D position information)
- Sector-logic (SL) board roughly calculates \( p_T \) in 6 levels and it is passed to central trigger processor (CTP) via muon-CTP interface (MUCTPI)

New system for Run 3
- Muon candidates are reconstructed by hits at TGC BW and NEW inner detectors

Performance of new endcap muon trigger

Signal efficiency

- \( p_T > 20 \text{ GeV} \) trigger relative efficiency w.r.t. Run 2 algorithm
- High efficiency (~97%) w.r.t. Run 2, 3% loss coming from NSW segment finding efficiency
- Different criteria to require NSW coincidence are tested

Charge measurement

- \( p_T \) measurement, \( p_T \) resolution is ~30% at \( p_T = 4 \text{ GeV} \) and ~15% at \( p_T = 20 \text{ GeV} \)
- Charge information can provide:
  - Selectivities of opposite sign muons in L1Topo
  - Better inner coincidence map

Summary

- Upgrade of ATLAS endcap muon trigger system for the LHC Run 3
- New inner coincidence with upgraded sector-logic board improves the coverage and the \( p_T \) resolution;
- Great fake muon reduction expected
- Additional information can be sent to central trigger processor and level-1 topological trigger
- \( p_T \) is measured in 15 levels (1GeV step); plateau efficiency is ~97% w.r.t. Run 2
- Muon charge is measured in ~98% accuracy
- The expected rate meets the requirement

ATLAS Level-1 Endcap Muon Trigger from Run-2 to Run-3

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- Very tight event selection during data taking must be applied
  - 40MHz → recording rate 1kHz
- Object-based pipeline trigger
  - High-\( p_T \) muons, electrons, jets, missing \( E_t \), ...
- Level-1: roughly selects events with high-\( p_T \) objects reconstructed by custom-made hardware with a short latency (~2.5\( \mu s \))
- High-level trigger: Software-based; more sophisticated selection

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https://twiki.cern.ch/twiki/bin/view/AtlasPublic/L1MuonTriggerPublicResults