A MDT Based First-Level Muon Trigger for ATLAS at HL-LHC

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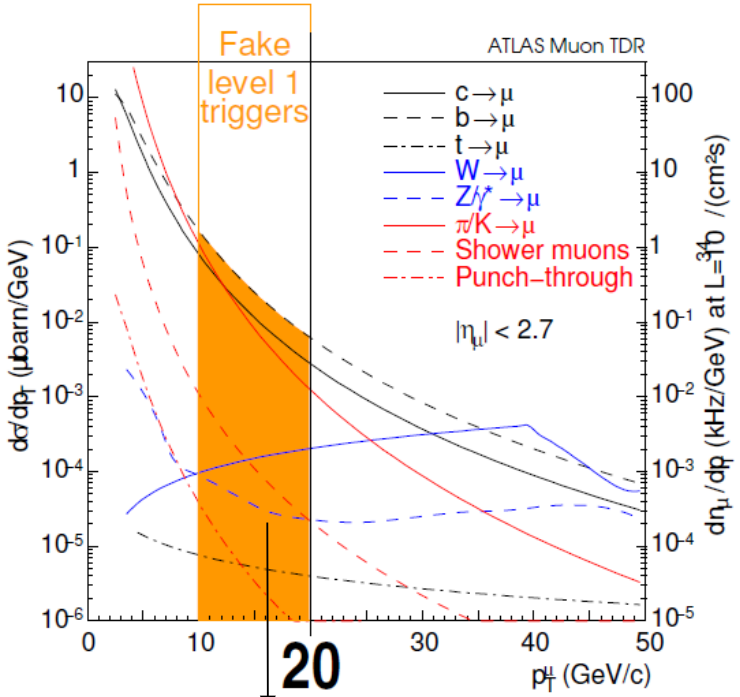
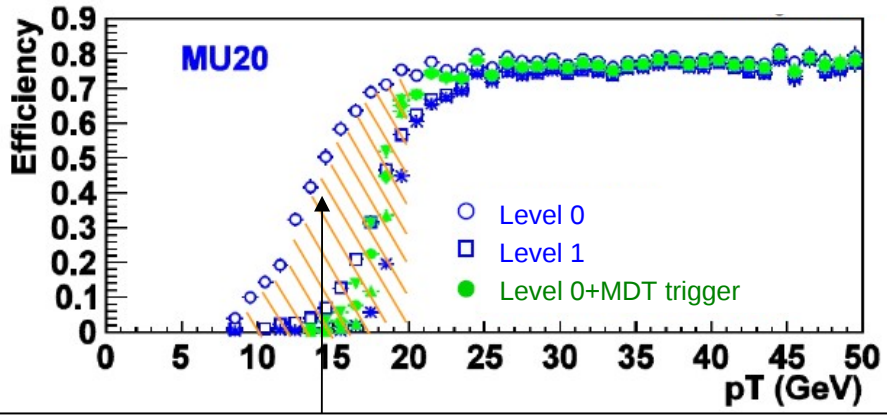
A new multi-level trigger system will be implemented in the ATLAS experiment at HL-LHC:
The first level (Level-0) with 6 μs latency and 500 kHz max. rate will include a new highly selective muon trigger based on the MDT precision muon chambers

Inclusive muon cross section



ATLAS level-0 20 GeV muon trigger efficiency



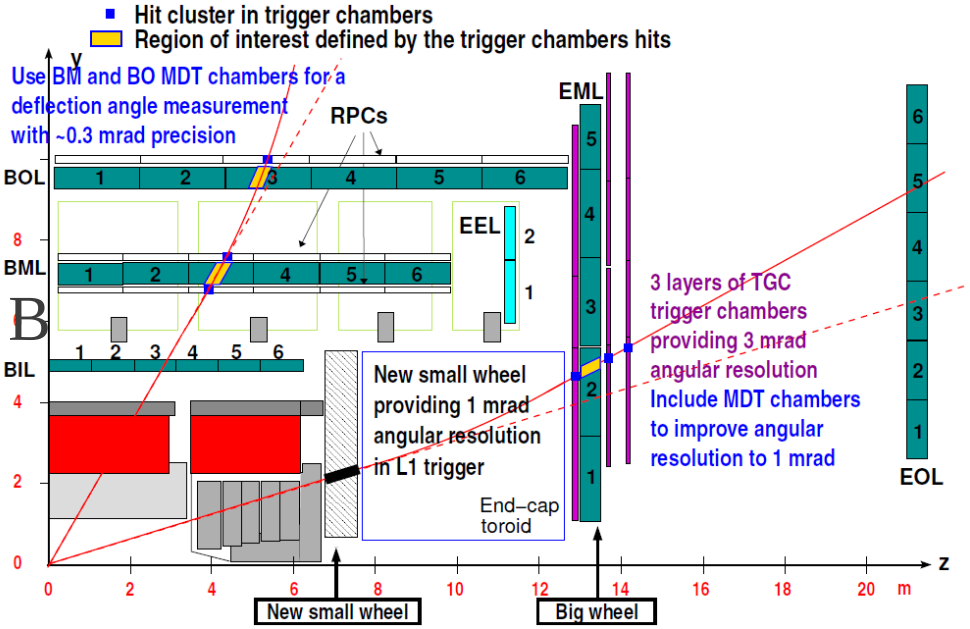
Large sub-threshold efficiency due to relatively low momentum resolution of the present ATLAS first-level muon trigger caused by the limited spatial resolution of the trigger chambers

Muon trigger rate dominated by low pT (sub-threshold) muons

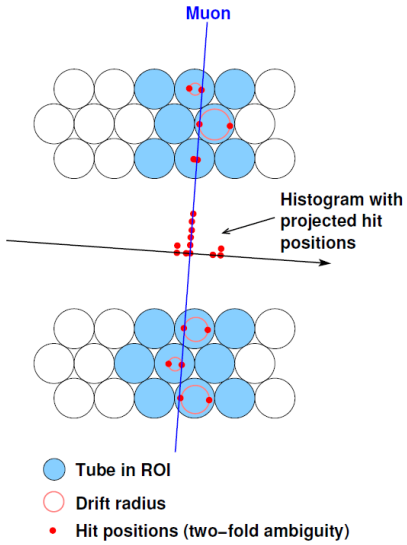
Sharpening of the first-level muon trigger p_T threshold is mandatory for HL-LHC for keeping the muon trigger rate at an acceptable level.

This is achieved by using the MDT precision muon tracking chambers for high-resolution muon momentum mesurement at the first trigger level.

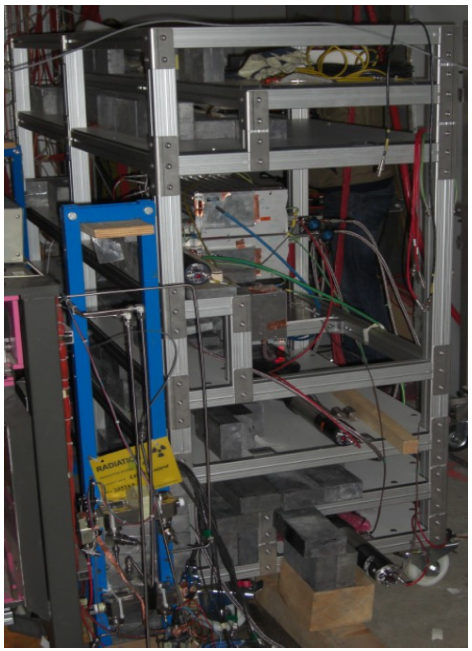
MDT Based Muon Trigger Concept and First Implementation



- Use of the MDT hits in the regions of interest defined by the trigger chambers to improve the muon momentum resolution.
- Fast MDT track reconstruction achieved by a histogram based algorithm seeded by the trigger chamber track.



Demonstrator set-up in the Gamma Irradiation Facility at CERN



Result of the demonstrator test

- Fast track reconstruction algorithm has efficiency close to 99% with a fake rate at 0.1% level.
- Fast track reconstruction performed on a Cortex-M4F ARM processor needs less than 2000 clock cycles, corresponding to a processing time of 11 µs for 200 MHz clock frequency.