# Muon Trigger Studies for the ATLAS Detector

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The ATLAS Trigger system consists of three trigger levels. After the first level, about 100.000 out of 40 million events per second have been selected. After the third level trigger, about a hundred events per second remain to be stored for further analysis.

Muon trigger is obtained from a system of resistive plate chambers (RPCs) which are part of the muon spectrometer (see Fig.1). They provide a fast signal with a coarse spatial resolution. From the three layers of muon detectors (MDT), the middle layer is equipped with two, the outer with a single layer RPCs. By using these three layers of RPCs, two with small, one with a larger separation, the curvature of a through-going muon can be determined quickly using look-up tables. This way, the level 1 muon trigger system is able to select muons according to their transverse momentum for six standard thresholds (6, 8, 10, 11, 20, 40 GeV).

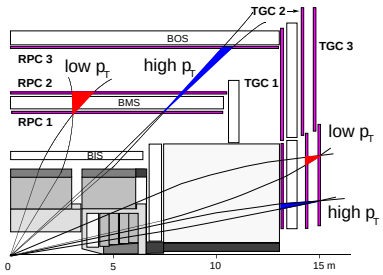


Fig. 1: ATLAS Level-1 muon trigger scheme [1]

By using datasets of physics events from a detailed simulation of the ATLAS detector, estimates on detector behaviour (like trigger efficiencies and turn-on curves) can be studied even before the start of LHC.

As a first step, single muons have been simulated to determine level 1 (single) muon trigger efficiencies. The efficiencies by $p_t$ (see Fig.2) show a typical turn-on curve and reach a plateau of about 80-86% depending on the chosen threshold. Differences between efficiencies occur because of the (geometrical) acceptance of the trigger detectors. The loss in trigger acceptance can be reduced by combining trigger signals from several detector components of the ATLAS detector at higher trigger levels.

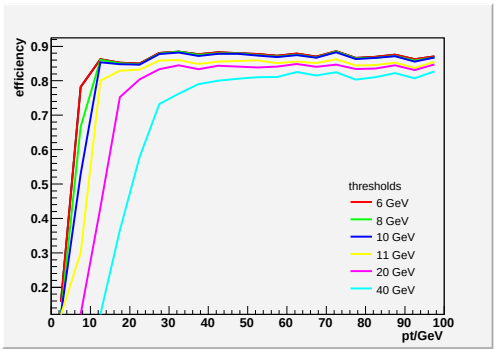


Fig. 2: ATLAS level 1 single muon trigger efficiency by $p_t$

Fig.3 shows efficiency versus pseudorapidity $\eta = -\ln\tan(\theta/2)$, where $\theta$ is the polar angle. The dip in efficiency for the barrel region ($-1 \leq \eta \leq 1$) is due to inefficiencies caused by the feet of the ATLAS detector and by services, like cables and cryo lines to the inner detector components. The drop towards $|\eta| = 2.25$ is due to the end of muon trigger acceptance close to the beam pipe.

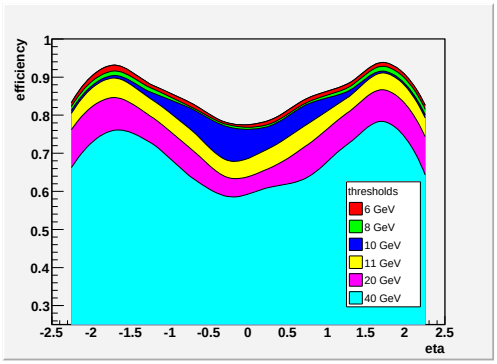


Fig. 3: ATLAS level 1 single muon trigger efficiency by $\eta$

Fig.4 shows the efficiency versus $\eta$ and $\phi$. Inefficiencies can be seen in the central $\eta$ region for $-2 \leq \phi \leq -1$ (ATLAS feet), $\phi = 1.5$ (cables to central detector) and $2.2 \leq \phi \leq \pi$ (cryo lines).

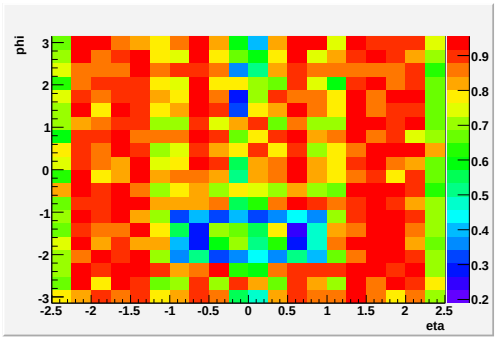


Fig. 4: level 1 single muon efficiency by $\eta$ and $\phi$ (20 GeV threshold)

First results for $Z \rightarrow \mu^+\mu^-$ and leptoquark reactions show similar efficiencies, but can yet only be taken as preliminary due to low statistics. More precise results will be achieved as soon as larger datasets become available. Including other trigger signals from level 1 and higher levels, a trigger definition will be derived to efficiently select $Z \rightarrow \mu^+\mu^-$ and leptoquark events, respectively.

## References

[1] The ATLAS MUON TDR
http://atlasinfo.cern.ch/Atlas/GROUPS/MUON/TDR/Web/TDR.html