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Commissioning of the ATLAS Muon Trigger System with early data

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Summary. — An overview of the early results on commissioning and performance of the ATLAS Muon Trigger System is shown. The ATLAS Muon Trigger has been designed to cope with the high interaction rate expected at the LHC. The presented performance studies have been obtained using both cosmic-ray and 900 GeV collision data.

PACS 29.85.Ca – Data acquisition and sorting.

1. – ATLAS Muon Trigger

The ATLAS [1, 2] Trigger System [3] has been designed on three levels in order to reduce the high rate of collision events expected at the LHC. The goal is to have a selection that gives the highest efficiency on the physics events studied and an elevated rejection on background events. In this section we present the three levels of the muon trigger.

1˙1. *Muon Level-One trigger*. – The Level-One (L1) muon trigger is hardware based. Its aim is to select muons giving a first estimate of their parameters. This is done using the trigger chambers: RPC (*Resistive Plate Chambers*) in the central region of the detector, $|\eta| < 1.05$, and TGC (*Thin Gap Chambers*) in the forward region, $1.05 < |\eta| < 2.7$.

1˙2. *Muon Level-Two trigger*. – The Level-Two (L2) trigger uses software algorithms to reconstruct the muon parameters and apply a selection in ~ 20 ms of time:

– μFast uses both the trigger chambers and the precision chambers to perform a more accurate measurement of the muon p_T using the sagitta method, η and ϕ in the spectrometer.

– μComb combines μFast measurement with the corresponding Inner Detector track, improving the resolution on the muon parameters reconstruction.

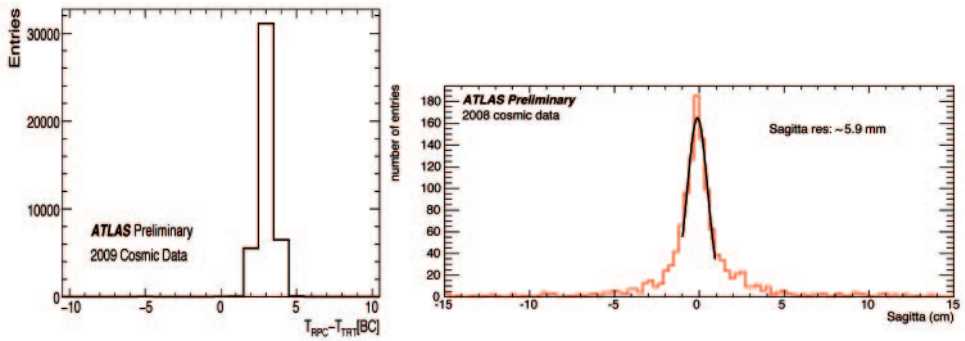

Fig. 1. – Left: calibration of RPC Timing is performed with cosmic muons using the Inner Detector TRT timing as a reference, here the difference between the two is given in units of Bunch Crossing (BC). Right: μFast sagitta reconstruction with cosmic data.

– μIso requires the muon to be isolated using the Inner Detector and Calorimeters information.

– μTile identifies muons by their energy deposit in the Tile Hadronic Calorimeter.

1˙3. *Muon event filter trigger*. – Having about 2 seconds of time to reconstruct the event and apply a selection, the event filter is able to use the offline muon reconstruction algorithms. In analogy to the L2 algorithms, here too the muon is first reconstructed in the muon spectrometer, then combined with an Inner Detector track.

2. – Commissioning of the muon trigger with early data

In this section we present some results on the commissioning of the muon trigger system. Those results have been obtained using either the cosmic-ray data collected in 2009 or the LHC collision data collected in November-December 2009 at $\sqrt{s} = 900\,\text{GeV}$.

The commissioning of the L1 muon trigger has been focused on two main aspects: the roads and the timing alignment. A muon coming from the interaction point leaves hits on the RPC (TGC) stations. The hits are spatially correlated, this correlation is exploited to select real muons looking for the hits in a "coincidence window": the *road*. As for the timing alignment, the trigger devices and the readout devices have to be synchronized, and this has to be done also with respect to the other ATLAS sub-detectors in order to perform a coherent measurement on data (fig. 1 on the left).

Also the validation of the L2 and EF algorithms has been performed using both cosmic and collision data. In fig. 1, on the right, the sagitta measurement performed by μFast with cosmic data is shown.

REFERENCES

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[3] ATLAS Collaboration, *Performance of the ATLAS Muon Trigger Slice with Simulated Data*, *ATL-COM-PHYS-2008-067*, CERN (2008).