Inclusive Muon Production in 900 GeV p-p Collisions with ATLAS Detector

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Summary. — The observation of the inclusive muon production in p-p collisions at a center of mass energy of 900 GeV with the ATLAS detector at LHC is presented. Data used for these studies were collected using a minimum-bias trigger in the December run. The method to select muons coming from collisions is illustrated together with a first comparison of the distributions of these muons with the expected ones from the minimun-bias Monte Carlo samples.

In December 2009 ATLAS observed the first LHC proton-proton collisions at 900 GeV center of mass energy. More than half a million collision candidate events have been collected with the full detector on using a minimum-bias trigger and a dedicated event selection to reject the main background events. This sample has been used to study the first muons from collisions and a first comparison of the distributions of these muons with the expected ones from the minimun-bias Monte Carlo samples has been performed.

In order to apply a minimum bias trigger to select collision candidate events two subdetectors are used: Beam Pickup Timing Devices (BPTX), electrostatic beam pickups located at $\pm$175m from interaction point, and the Minimum Bias Trigger Scintillators (MBTS), asking for at least one hit out of the 32 scintillators covering $2.09 < |\eta| < 3.84$ located at $\pm$ 3.56m in z from the interaction point.

A further selection is then applied offline to the triggered events: at least one MBTS hit on each ATLAS side in time coincidence is required to reduce the contamination from beam halo and beam gas events . Moreover at least 3 good tracks in the Inner Detector (more than 6 silicon hits each one) and at least one track with a momentum grater than 4 GeV/c are required to reject events triggered by cosmic muons, which appear as two tracks in the Inner Detector and nothing more.

The ATLAS detector is capable to reconstruct muons in three different configurations: using only the muon spectrometer, thought to have the best performance at high luminosity, when the Inner Tracker has a very high occupancy (*standalone muons*); combining tracking information from both muon spectrometer and the inner tracker to provide the best quality muons (*combined muons*); combining an inner detector track with calorimeter measurements or with the hits in the first muon spectrometer station, to optimize the reconstruction of low-pT muons that do not reach all three muon spectrometer stations (*tagged muons*).

For the first comparison with the Monte Carlo expectations, fig.1, only muons with $|\eta| < 2.5$ and p > 4 GeV/c have been used. This is because muons coming from minimum bias events are concentrated in the forward region, with very low transverse momentum so a minimum quality criteria selection is applied to guarantee the best reconstruction performances. Only a non-diffractive minimum bias Monte Carlo sample has been used for comparison, being the single-diffractive and double-diffractive contributions negligible (less than 1% correction). Monte Carlo expectations are rescaled to the data luminosity using the weight $w = N_{MC}/(L_{data}\epsilon_{trigger}\sigma_{MC})$. The chosen normalization is the data integrated luminosity after the MBTS trigger selection, being N_{MC} the number of MC processed events, L_{data} the data luminosity, $\epsilon_{trigger}$ the trigger efficiency and σ_{MC} the MC sample cross-section. From the first comparisons Monte Carlo describes well the kinematical distributions of the muons and also the detector response.

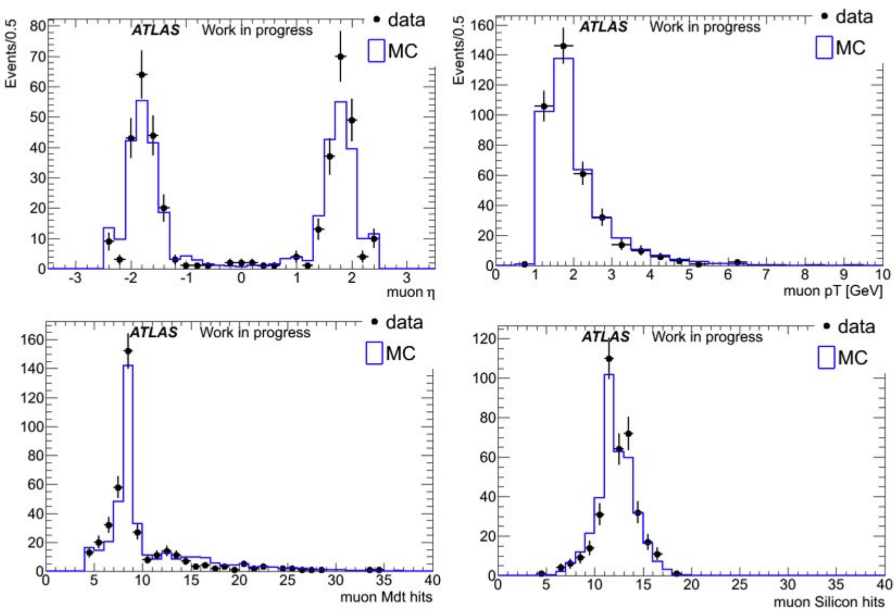

Fig. 1. – *Comparison of 900 GeV data (black dots) and non-diffrattive minimum bias Monte Carlo samples (blue line). Some relevant muon distributions:* p_T*,* η*, number os MDT (Muon Spectrometer) and Silicon (Inner Detector) hits associated to the track. Normalization as described in the text.*