

Measurement of $pp \rightarrow Z \rightarrow \mu\mu$ Cross-section at the ATLAS Experiment with the First 10 pb^{-1} at $\sqrt{s} = 14 \text{ TeV}$

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The study of the Z Boson at the ATLAS experiment provides several interesting aspects. The measurements of cross section and transverse momentum spectrum (p_T) of the Z Boson at ATLAS provide additional tests of the standard model and may be sensitive to exotic physics processes. Z-Boson production is also a common background process for many other physics analyses and must be understood very well. In this study first results on the achievable precision of the cross section measurement

$$\sigma(pp \rightarrow Z/\gamma \rightarrow \mu^+ \mu^-) = \frac{N_{\text{Cand}} - N_{\text{Background}}}{\epsilon_{\text{total}} \int L dt} \quad (1)$$

with the first 10 pb^{-1} of LHC data with the ATLAS detector are discussed.

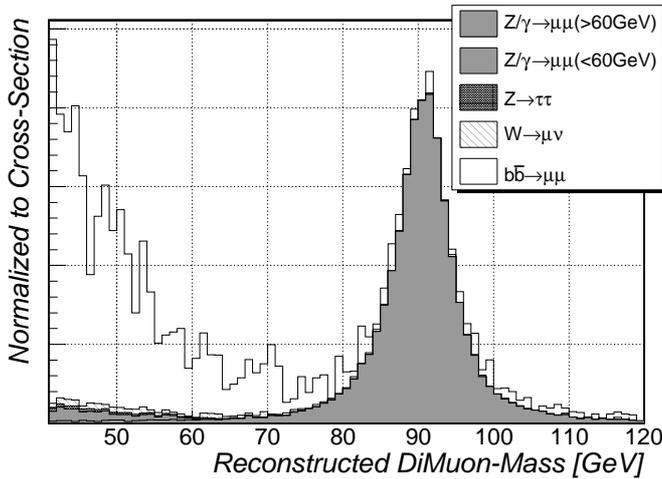


Fig.1: Reconstructed DiMuon Mass for the signal and various background processes

The decay of the Z-Boson into two muons has a very characteristic signature: two high energetic and isolated muons in the final state are produced. For the selection we require at least two reconstructed tracks with opposite charge in the pseudorapidity (η) range between -2.5 and 2.5 in the Muon Spectrometer. These tracks are considered to be muons. The invariant mass of the two muons $M_{\mu\mu}$ must be larger than 60 GeV^1 . The minimal transverse momentum p_T^{min} has to be larger than 15 GeV , while

the maximal transverse momentum p_T^{min} of the two muons must be larger than 25 GeV . Moreover we require the two muons to be isolated to reduce the QCD-background processes. Different methods have been developed to extract the background contribution from data [1].

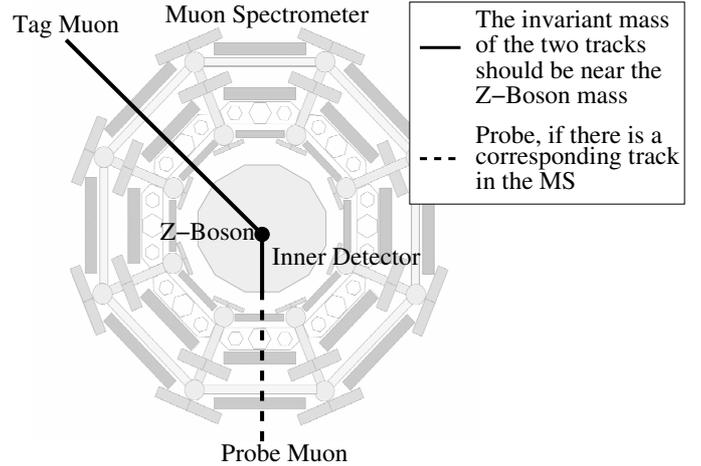


Fig.2: Sketch of the Tag and Probe method

The tag and probe method (see Figure 2) can be used to determine the reconstruction and trigger efficiency of the ATLAS Muon Spectrometer ϵ_{MS} and the efficiency of isolation cuts ϵ_{Iso} . This method uses two tracks which have an invariant mass close to the Z-Boson mass. Hard cuts are applied on one candidate muon (e.g. isolation cuts) which is called *tag muon* and the other muon is used (*probe muon*) to test a specific property.

For an integrated luminosity of 10 pb^{-1} the overall Muon Spectrometer reconstruction efficiency can be determined in this way with a precision of

$$\Delta\epsilon_{MS} \approx \pm 0.21 \text{ (stat)} + 0.29 \text{ (sys)} \quad (2)$$

where 0.21 is the statistical part and 0.29 the systematic part due to the background contribution [2].

References

- [1] M. Schott, Acta Physica Polonica **B38** (2007) 483
- [2] M. Schott *et al.*, Nucl.Instr.Meth. **A572** (2007) 16

¹In the very rare case in which more than 2 reconstructed tracks pass all applied cuts, the muon pair with the invariant mass closer to the Z-Boson mass is considered