W/Z boson production in leptonic final states at the ATLAS experiment

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1 Event selection

The analysis presented here [1] is based on about 35 pb^{-1} of integrated luminosity collected in 2010 by the ATLAS experiment in pp collisions at 7 TeV. Events are selected using a single-lepton trigger requirement with a nominal threshold of transverse momentum $p_{\text{T}} > 13$ GeV for muons and of transverse energy $E_{\text{T}} > 15$ GeV for electrons.

Electrons are required to have pseudorapidity $|\eta| < 2.47$ and $E_{\text{T}} > 20$ GeV; electrons from the transition region between the barrel and endcap calorimeters, $1.37 < |\eta| < 1.52$, are not used. The analysis has been performed including also Z bosons having one electron as described and another (*forward*) electron with $2.5 < |\eta| < 4.9$.

Muons are reconstructed combining an inner detector track with a muon spectrometer track; they are required to have $p_{\text{T}} > 20$ GeV, $|\eta| < 2.4$ and they also must pass an isolation requirement which considerably reduces the QCD background.

W candidates are selected requiring missing transverse energy $E_{\text{T}}^{\text{miss}} > 25$ GeV in addition to an high-pt lepton and transverse mass $m_{\text{T}} > 40$ GeV. Z candidates are selected requiring two high-pt same flavor and opposite sign leptons having the invariant mass within 66 and 116 GeV.

For both channels electroweak backgrounds are estimated from Monte Carlo simulation; QCD background, due to multi–jet production or π/K decays, is estimated from data, extrapolating from control regions: we use isolation$/E_{\text{T}}^{\text{miss}}$ for $W \to \mu\nu$ and isolation$/M_{\mu\mu}$ for $Z \to \mu\mu$, while we fit the M_{ee} distribution relaxing selection cuts for $Z \to ee$ and instead we fit $E_{\text{T}}^{\text{miss}}$ distribution with inverted identification criteria for the electron in case of $W \to e\nu$.

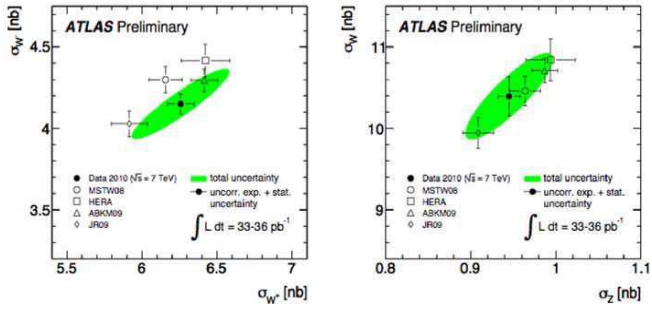

Figure 1: Measured and predicted W^+ vs. W^- (left) and W vs. Z (right) cross sections times leptonic branching ratios; the systematic uncertainties on the luminosity and on the acceptance extrapolation are treated as fully correlated.

2 Results

In total 84103 W^+, 55163 W^- and 11669 Z candidates are selected in the muon channel, while for the electron channel we find 72207 W^+, 49103 W^-, 9721 Z with both electrons in the central region and 4000 Z candidates with a forward electron.

The measured cross sections and their ratio, with their statistical, systematic, luminosity and acceptance extrapolation uncertainties are ($\ell = e, \mu$)

$$\begin{aligned}
\sigma_W^{\text{tot}} \cdot \text{BR}(W \to \ell\nu) &= (10.391 \pm 0.022(\text{sta}) \pm 0.238(\text{sys}) \\
&\quad \pm 0.353(\text{lum}) \pm 0.312(\text{acc}))\,\text{nb}, \\
\sigma_{Z/\gamma^*}^{\text{tot}} \cdot \text{BR}(Z/\gamma^* \to \ell\ell) &= (0.945 \pm 0.006(\text{sta}) \pm 0.011(\text{sys}) \\
&\quad \pm 0.032(\text{lum}) \pm 0.038(\text{acc}))\,\text{nb}, \\
R_{W/Z} &= 10.906 \pm 0.079(\text{sta}) \pm 0.215(\text{sys}) \pm 0.164(\text{acc}),
\end{aligned}$$

where the main systematic uncertainties arise from uncertainties in the luminosity, the $E_{\text{T}}^{\text{miss}}$ resolution and scale and the acceptance. These measurements are in good agreement with NNLO QCD computations using different proton PDF sets as shown in Figure 1.

References

[1] See ATLAS-CONF-2011-041 (http://cdsweb.cern.ch/record/1338570).