First observation of WZ events in leptonic channels with ATLAS

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1 Introduction

Triple gauge boson couplings (TGC) predicted by the Standard Model, such as the WWZ trilinear coupling present in $W^{\pm}Z$ production, have not yet been determined with the same precision as other parameters of the model. Their precise measurement can probe for possible new physics in the bosonic sector. This poster presented the results of the measurement of $W^{\pm}Z$ production in 205 pb^{-1} of pp collision data at $\sqrt{s} = 7$ TeV collected by the ATLAS experiment in 2011, using fully leptonic decays ($W^{\pm}Z \to \ell\ell\ell\nu$) with electrons and muons, as related in ATLAS Conference Note [1].

2 Selection and Reconstruction

Events are required to have a single electron or muon trigger fired. Candidate muons must be combined (i.e. reconstructed both in the muon spectrometer and in the inner tracker), isolated and have $p_{\mathrm{T}} > 15$ GeV and $|\eta| < 2.4$. Electron candidates must be isolated, have cluster $E_T > 15$ GeV and be within $|\eta| < 1.37$ or $1.52 < |\eta| < 2.47$. The longitudinal impact parameter with respect to the primary vertex must be less than 10 mm. One primary vertex, with at least 3 good tracks associated with it, is required. Events with two leptons of the same flavour and opposite charge with an invariant mass within 10 GeV of the Z mass are selected. Events are then required to have at least 3 reconstructed leptons originating from the same primary vertex. The $E_{\mathrm{T}}^{\mathrm{miss}}$ in the event must be greater than 25 GeV and the transverse mass of the system formed from the third lepton and the $E_{\mathrm{T}}^{\mathrm{miss}}$ must be greater than 20 GeV. For muon- (electron-)triggered events, one of the selected muons (electrons) is required to have $p_{\mathrm{T}} > 20(25)$ GeV to ensure it is well onto the efficiency plateau.

3 Results

We observe 12 $W^{\pm}Z$ candidates in data, with $9.1 \pm 0.2(\mathrm{stat}) \pm 1.3(\mathrm{sys})$ signal and $2.0 \pm 0.3(\mathrm{stat}) \pm 0.7(\mathrm{sys})$ background events expected. The dominant contribution to the systematic uncertainty related to object reconstruction is the pileup condition description for $E_{\mathrm{T}}^{\mathrm{miss}}$, which is approximatively 11%. The signal and background

contributions are mainly modeled with Monte Carlo simulation, validated with data-driven measurements. For the final $W^{\pm}Z$ candidates, the transverse momentum of the leading lepton and of the $W^{\pm}Z$ system are shown in Figure 1.

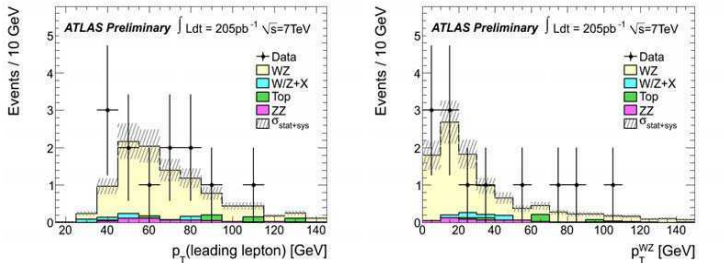

Figure 1: Transverse momentum of the leading lepton (left) and of the $W^{\pm}Z$ system (right). Points represent observed events, while histograms are MC predictions.

Cross-sections are obtained by maximizing the likelihood function (equation 1), where N_s^i, N_b^i and N_{obs}^i are respectively the number of expected signal events, expected background events and observed events. The index i runs over the four decay channels eee, μee, $\mu\mu e$ and $\mu\mu\mu$. Br^i is the branching ratio of each channel, $\mathcal{L}$ is the integrated luminosity and A^i is the signal acceptance.

$$L(\sigma_{WZ\to l\nu l'l'}) = \prod_{i=1}^{4} \frac{e^{-(N_s^i+N_b^i)} \times (N_s^i + N_b^i)^{N_{obs}^i}}{(N_{obs}^i)!}, \quad N_s^i = \sigma_{WZ\to l\nu l'l'} \times Br^i \times \mathcal{L} \times A^i \quad (1)$$

To combine all channels, a common phase space region is used to extract fiducial cross-sections: $p_T^{\mu,e} > 15$ GeV, $|\eta^{\mu,e}| < 2.5$, $p_T^{\nu} > 25$ GeV, $|M_{ll} - M_{\mathrm{Z\ Pole}}| < 10$ GeV and $M_T^W > 20$ GeV. The final results for the combined fiducial (σ_{WZ}^{fid}) and combined total cross (σ_{WZ}^{tot}) section measurements are shown below.

$$\sigma_{WZ}^{fid} = 6.6^{+2.5}_{-2.1}(\mathrm{stat})\ ^{+1.1}_{-1.0}(\mathrm{syst})\ ^{+0.4}_{-0.4}(\mathrm{lumi})\ \mathrm{pb}$$

$$\sigma_{WZ}^{tot} = 18^{+7}_{-6}(\mathrm{stat})\ ^{+3}_{-3}(\mathrm{syst})\ ^{+1}_{-1}(\mathrm{lumi})\ \mathrm{pb}$$

Good agreement with the Standard Model cross-section ($16.9^{+1.2}_{-0.8}$ pb) is observed.

References

[1] The ATLAS Collaboration, *Measurement of the $WZ \to \ell\ell\ell\nu$ Production Cross-Section in Proton-Proton Collisions at $\sqrt{s}$=7 TeV with the ATLAS Detector*, June 2011, ATLAS-CONF-2011-084, http://cdsweb.cern.ch/record/1356191.