PROCEEDINGS OF SCIENCE

WZ production in leptonic decays at CMS

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The study of the associated production of W and Z bosons is performed in proton-proton collisions using data collected by the CMS experiment. WZ production is one of the dominant multiboson production processes at the LHC energies. Thus, a good understanding of this process improves our understanding of the Standard Model. Inclusive cross section measurements and differential cross section measurements for different variables are provided. Constraints on anomalous couplings are also presented.

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1. Introduction

The production process pp → WZ is studied in the trilepton final state at 13 TeV, using the full 2016 data set with a total integrated luminosity of 35.9 fb^{-1} collected with the CMS detector. The poster presentation was based on this publication [1]. WZ associated production provides a unique test of the SM predictions for trilinear gauge couplings: namely the probe of the charged SM WWZ coupling. Deviations from the SM predictions, both in the total and differential cross sections, would indicate hints of new phenomena.

2. Cross Sections

The inclusive cross section is measured, combining four flavour categories (eee, eeμ, e$\mu\mu$, and $\mu\mu\mu$) shown in Fig. 1 (left), to be:

$$\sigma_{\text{tot}}(pp \to WZ) = 48.09^{+1.00}_{-0.96}(\text{stat})^{+0.44}_{-0.37}(\text{theo})^{+2.39}_{-2.17}(\text{syst}) \pm 1.39(\text{lumi})\ \text{pb}, \quad (1)$$

resulting in a total uncertainty of -2.78/+2.98 pb in good agreement with the MATRIX next-to-next-to-leading-order (NNLO) prediction. The result is dominated by systematic uncertainties in mainly the b-tagging and electron efficiency uncertainties. The fiducial cross section and charge asymmetry of the WZ production measurements are also provided. Total cross section can be split

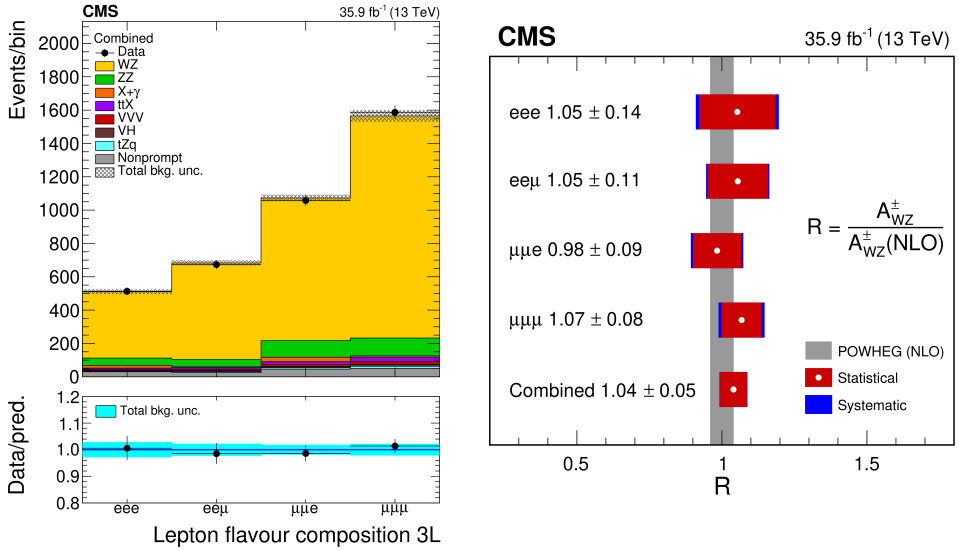

Figure 1: (Left) Distribution of expected and observed event yields in the four flavour categories used for the cross section measurement. (Right) Measured ratio of cross sections for the two charge channels for each of the flavour categories and their combination. Values are normalized to the NLO prediction obtained with POWHEG. Coloured bands for each of the points include both systematic and statistical uncertainties [1].

in W$^+$Z and W$^-$Z and measure the charge asymmetry of WZ production. This measurement, which is limited by the size of the data set, is shown in Fig. 1 (right). A measurement in the fiducial region yields a value of $\sigma_{\text{fid}}(pp \to WZ) = 257.5^{+5.3}_{-5.0}(\text{stat})^{+2.3}_{-2.0}(\text{theo})^{+12.8}_{-11.6}(\text{syst}) \pm 7.4(\text{lumi})$ fb. Fiducial results are extrapolated to the total WZ production cross section for $60 < m_Z^{\text{OSSF}} < 120$ GeV, where m_Z^{OSSF} is the invariant mass of the opposite-sign same-flavor leptons.

Differential cross sections are measured as a function of Z boson p_T, the leading jet p_T, and the invariant mass of the three lepton and missing transverse momentum system M(WZ). The results are compared with predictions from the POWHEG and MadGraph5_aMC@NLO generators interfaced with Pythia v8 as shown in Fig. 2.

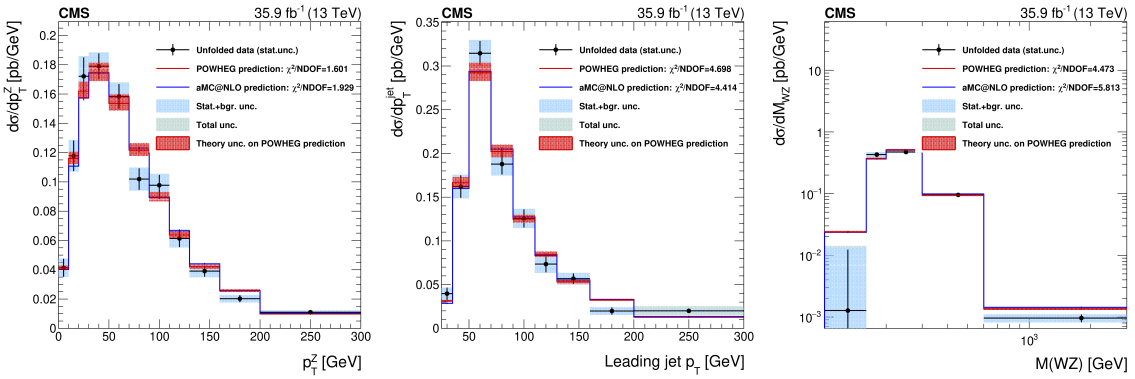

Figure 2: Differential distribution for the Z boson p_T (left), the leading jet p_T (middle) and the mass of the WZ system (right). The data distribution is unfolded at the dressed leptons level and compared with the POWHEG and MadGraph5_aMC@NLO NLO generator predictions. The red band around the POWHEG prediction represents the theory uncertainty in it; the effect on the unfolded data of this uncertainty, through the unfolding matrix, is included in the shaded bands described in the legend [1].

3. Anomalous Couplings

In addition, confidence intervals for anomalous triple gauge boson couplings are derived for each of the possible one-dimensional and two-dimensional (Fig. 3) combinations of the anomalous couplings parameters, via a binned maximum likelihood fit to the M(WZ) variable.

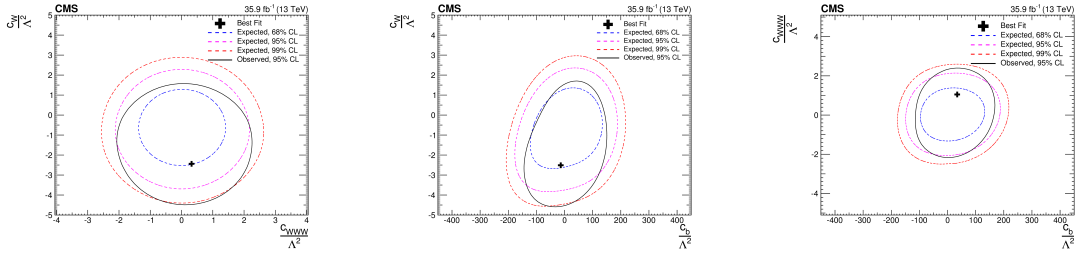

Figure 3: Two-dimensional confidence regions for each of the possible combinations of the considered aTGC parameters. The contours of the expected confidence regions for 68% and 95% confidence level are presented in each case. The parameters considered in each plot are cW-cWWW (left), cW-cb (middle) and cWWW-cb (right) [1].

References

[1] The CMS Collaboration, Measurements of the pp → WZ inclusive and differential production cross sections and constraints on charged anomalous triple gauge couplings at $\sqrt{s}$ = 13 TeV. J. High Energ. Phys. 2019, 122 (2019). https://doi.org/10.1007/JHEP04(2019)122.