WZ production cross section at 13 TeV in multileptonic decay channel

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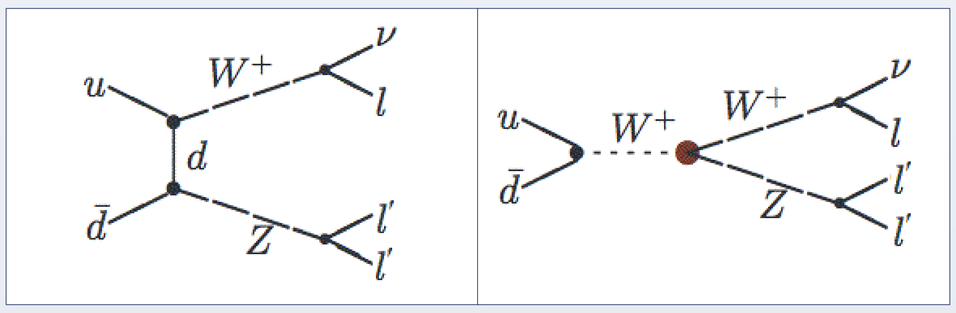
INTRODUCTION

First measurement of the **WZ** production cross section at $\sqrt{s}$ **= 13 TeV** using a dataset corresponding to an integrated luminosity of **2.3 fb^{-1}**.

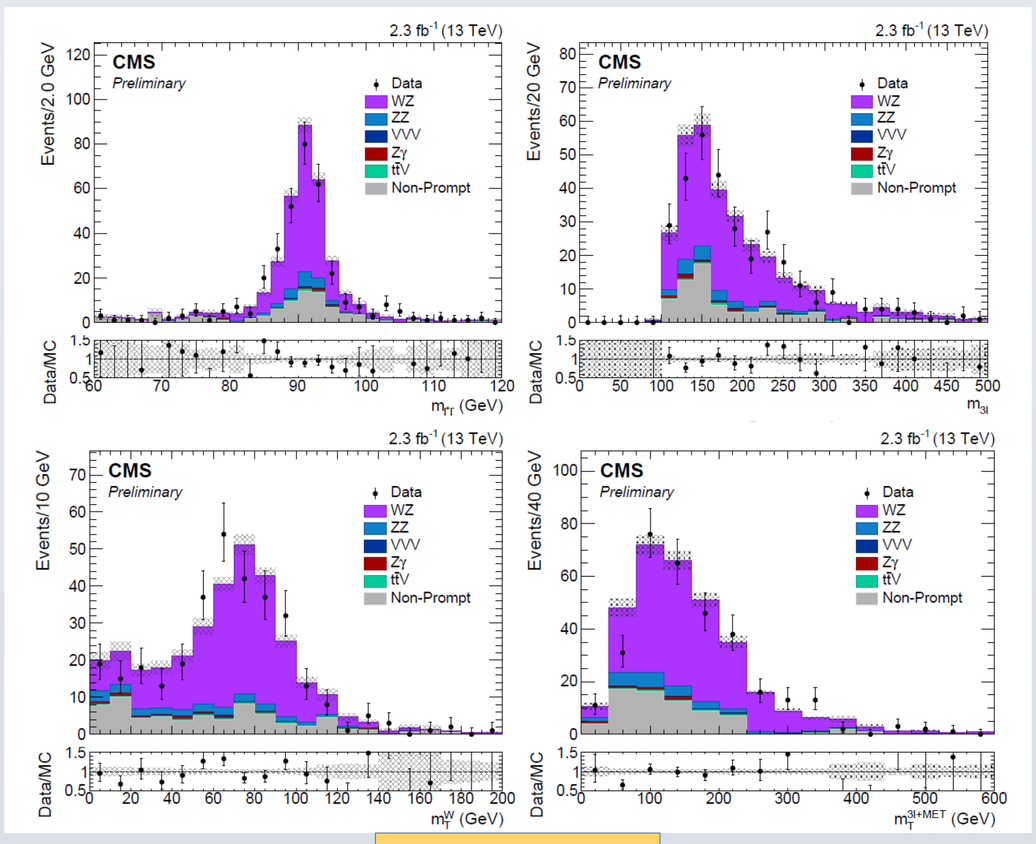
The measurement is performed in the **leptonic decay** modes WZ→ $\ell\nu\ell'\ell'$, where ℓ, ℓ' = e, μ.

Primary modes of production:



BACKGROUND ESTIMATION

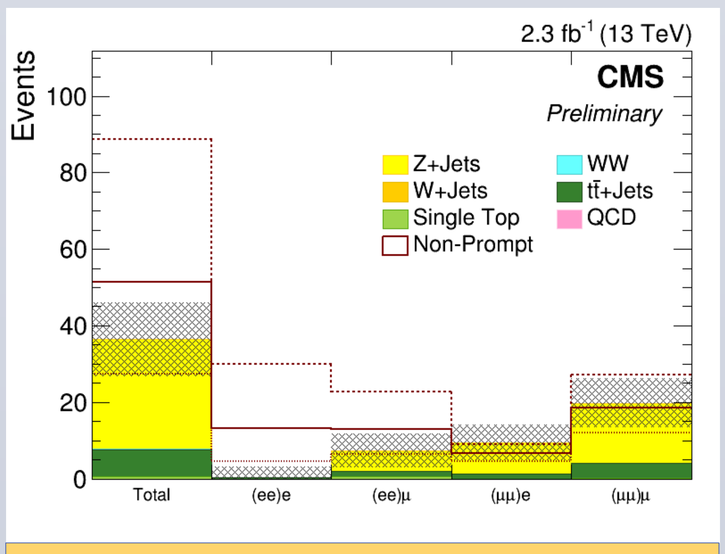
Main background sources are ZZ production and processes with non-prompt leptons (mainly tt̄ and Z + jets).



Control plots

Background sources with prompt leptons are obtained directly from Monte Carlo, while non-prompt backgrounds are estimated using data-driven techniques.

***Tight-to-loose* method:** the probability of lepton misidentification is measured in regions enriched with non-prompt background sources, then propagated to the signal region using the probability of a loosely identified lepton passing our tight requirements.



Closure test of data-driven estimated non-prompt background vs. MC simulation of same processes

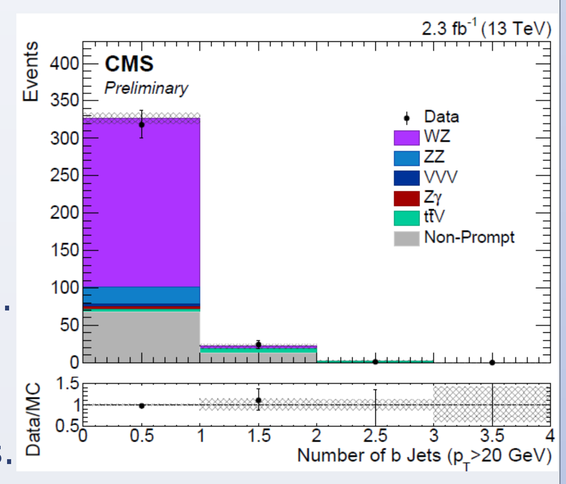
SELECTION

Fiducial region (selected at generator level):

- $p_{\mathrm{T}}^{\ell \mathrm{Z}1}$ > 20 GeV, $p_{T}^{\ell \mathrm{Z}2}$ > 10 GeV.
- $p_{\mathrm{T}}^{\ell \mathrm{W}}$ > 20 GeV.
- All leptons $|\eta|$ < 2.5.
- 60 < m_{Z} < 120 GeV.

Final event selection:

- Exactly 3 isolated leptons.
- 76 < m_{Z} < 106 GeV.
- $m_{\ell\ell}$ > 4 GeV (all $\ell\ell$ combinations).
- $E_{\mathrm{T}}^{\mathrm{miss}}$ > 30 GeV.
- $m_{3\ell}$ > 100 GeV.
- Veto on events with b-tagged jets.



UNCERTAINTIES

Signal and prompt backgrounds:

- Theoretical uncertainty on normalization: QCD scales and PDF variations.
- For ZZ, used statistical uncertainty from CMS measurement.
- Jet energy scale, b-tagging, trigger and lepton efficiencies…

Non-prompt backgrounds:

- 30%, covering differences between the estimated and measured number of events in tt̄ and Drell-Yan control regions.

Source	Contribution to total σ
Theoretical	1%
Trigger eff.	< 1%
Lepton Id. & Iso.	2-4%
$E_{\mathrm{T}}^{\mathrm{miss}}$ reco.	1-3%
Pileup	1%
ZZ	1%
tt̄V	< 1%
VVV, Zγ	< 1%
Non-prompt bkg.	5-6%
Luminosity	2.7%

RESULTS

Decay channel	$N_{\mathrm{WZ}}^{\mathrm{exp}}$	Background Non-prompt	Background Prompt	Total expected	Observed
eee	$35.88 \pm 0.63^{+1.62}_{-1.57}$	$10.64 \pm 1.73^{+3.26}_{-2.51}$	$6.08 \pm 0.59^{+0.65}_{-0.57}$	$52.61 \pm 1.93^{+3.80}_{-3.13}$	49
eeμ	$50.23 \pm 0.77^{+2.05}_{-2.01}$	$14.84 \pm 3.56^{+3.89}_{-2.99}$	$7.57 \pm 0.47^{+0.86}_{-0.75}$	$72.64 \pm 3.67^{+4.60}_{-3.82}$	78
$\mu\mu$e	$56.02 \pm 0.80^{+2.80}_{-2.73}$	$21.56 \pm 3.21^{+5.02}_{-3.86}$	$8.43 \pm 0.55^{+1.03}_{-0.91}$	$86.02 \pm 3.35^{+6.02}_{-5.02}$	83
$\mu\mu\mu$	$83.96 \pm 0.99^{+3.12}_{-3.05}$	$20.16 \pm 4.91^{+6.20}_{-4.77}$	$11.13 \pm 0.49^{+1.34}_{-1.17}$	$115.25 \pm 5.03^{+7.23}_{-5.96}$	108
Total	$226.10 \pm 1.61^{+8.70}_{-8.51}$	$67.20 \pm 7.08^{+14.62}_{-11.25}$	$33.21 \pm 1.05^{+3.83}_{-3.35}$	$326.52 \pm 7.33^{+17.99}_{-15.12}$	318

Theoretical prediction

- Fiducial:

$\sigma_{\mathrm{fid}}\left(\mathrm{pp}\rightarrow \mathrm{WZ}\rightarrow \ell\nu\ell'\ell'\right) = 274\ ^{+11}_{-10}$ fb

- Inclusive:

$\sigma\ (\mathrm{pp}\rightarrow \mathrm{WZ}) = 42.7\ ^{+1.6}_{-0.8}$ pb

Good agreement between theoretical predictions and experimental measurements

Measurement

- Fiducial:

$\boldsymbol{\sigma_{\mathrm{fid}}\left(\mathrm{pp}\rightarrow \mathrm{WZ}\rightarrow \ell\nu\ell'\ell'\right) = 266 \pm 22\ (\mathrm{stat})\ ^{+21}_{-22}\ (\mathrm{syst}) \pm 9\ (\mathrm{lumi})}$ **fb**

- Inclusive:

$\sigma\ (\mathrm{pp}\rightarrow \mathrm{WZ}) = 41.0 \pm 3.4\ (\mathrm{stat})\ ^{+3.3}_{-3.4}\ (\mathrm{syst}) \pm 0.4\ (\mathrm{theo}) \pm 1.4\ (\mathrm{lumi})$ pb

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