Anomalous coupling extraction using WZ channel in ATLAS

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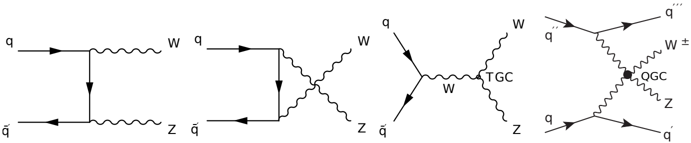
The WZ production

WZ production in the standard model:



include non SM interactions like the aGC:

→ provides direct test of SM predictions

indirect searches of aGC:

→ modified cross sections and kinematic distribution

→ I'm focusing on the aTGC with the idea of extend this studies to aQGC

Signature and selection

Use fully leptonic decay mode ($\ell\ell\ell\nu$)

$\rightarrow$ clean signal, low background but small branching ratio (1.6%)

Dataset 2015-2016: $L = 36.0\ fb^{-1}$, $\sqrt{s} = 13\ TeV$

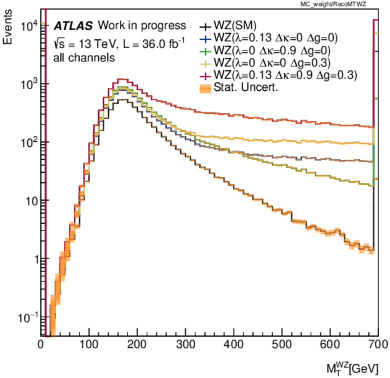
- Signal:
  SM: DSID: 361553-70; gen: Mc@Nlo+Herwig
  aTGC: DSID: 361571-88; gen: Mc@Nlo+Herwig
- Background:
  misid. leptons: data driven
  ZZ: gen: Sherpa 2.2.2
  tt+V: gen: Madgraph/Mc@Nlo+Pythia6/8
  other: gen: Sherpa 2.2.2

The effective lagrangian

The effective lagrangian $\mathcal{L}_{eff}$ used to describe the effect of non SM processes on aTGCs (used for indirect searches):

$$\frac{\mathcal{L}_{WWZ}}{ig_{WWZ}} = g_1^Z \left(W_{\mu\nu}^\dagger W^\mu Z^\nu - W_{\mu\nu} W^{\dagger\mu} Z^\nu\right) + \kappa^Z W_\mu^\dagger W_\nu Z^{\mu\nu} + \frac{\lambda^Z}{m_W^2} W_{\rho\mu}^\dagger W_\nu^\mu Z^{\nu\rho}$$

- in the SM: $\lambda^Z = 0$, $\kappa^Z = g_1^Z = 1$
  - $\rightarrow$ look for deviations λ, $\Delta\kappa$ and Δg from 0
- by implying the aTGC to the SM:
  - $\rightarrow$ increase diboson production
  - $\rightarrow$ modify the kinematics distribution



The MC@NLO reweighting

Approximation of ths number of signal events N_s^i that are expected including the aTGC:

$$N_s^i(\lambda, \Delta\kappa, \Delta g) = W_0^i + \left(\Delta\kappa^Z\right)^2 W_1^i + \left(\lambda^Z\right)^2 W_3^i + 2\Delta g_1^Z W_4^i + 2\Delta\kappa^Z W_5^i + 2\lambda^Z W_6^i + 2\Delta g_1^Z \kappa^Z W_7^i + 2\Delta g_1^Z \lambda^Z W_8^i + 2\Delta\kappa^Z \lambda^Z W_9^i$$

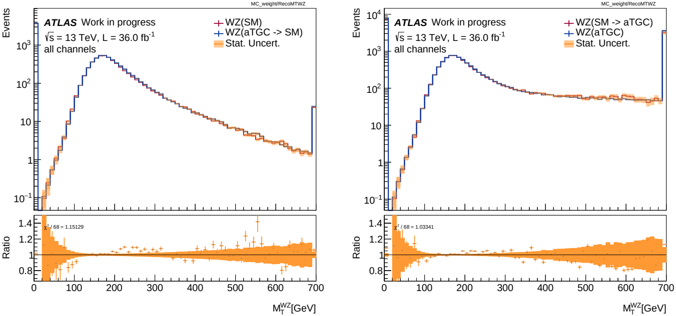
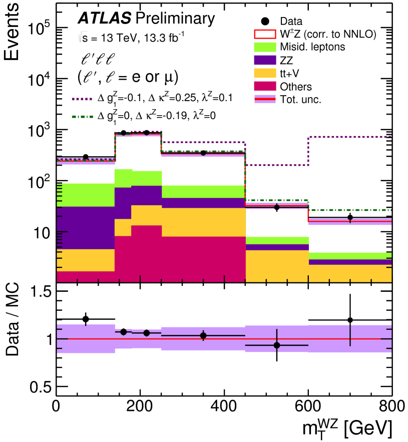


Figure: aTGC point: $\lambda^Z = 0.13\ \Delta\kappa^Z = 0\ \Delta g_1^Z = 0$

- the most sensitive distribution to aTGC
- used to extract limits using $13.3 fb^{-1}$
- 6 M_T^{WZ} $[GeV]$ bins with partition:
  $[0-140]$, $[140-180]$, $[180-250]$, $[250-450]$, $[450-600]$, $[600-\infty]$
- the aTGC weights, the background estimation and the systematic uncertainties were calculated in those bins



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Statistic tool

We have a statistic framework in Dresden

- it's based on RootFit
- currently used by ssWW to extract cross sections
- need to be expanded to do limit settings

  $\rightarrow$ this is what I'm going to do

Limit setting

to set limit, use a likelyhood function defined by rootfit:

$$-\ln L(\alpha, \{x_k\}) = \sum_{i=1}^{6} -\ln\left(\frac{e^{-N_s^i(\alpha,\{x_k\})+N_b^i(\{x_k\})} \times \left(N_s^i(\alpha,\{x_k\})\right) + \left(N_b^i(\alpha,\{x_k\})\right)^{N_{obs}^i}}{N_{obs}^i!} \right) + \sum_{k=1}^{n} \frac{x_k^2}{2}$$

- N_b^i expected background events
- N_{obs}^i observed number of events
- N_s^i are functions of the aTGC parameters $\alpha = \lambda^Z$, $\Delta\kappa^Z$ or Δg_1^Z
- $\sum_{k=1}^{n} \frac{x_k^2}{2}$ sum over all Gaussian constrained systematics

$\rightarrow$ get different N_s^i by reweighting the aTGC point ($\lambda^Z = 0.13$, $\Delta\kappa^Z = \Delta g_1^Z = 0$) for limit setting

Summary and next steps

what is done:

- simulation is working fine
- weights are extracted and tested

what I'm doing:

- preparing workspace for fitting

what I have to do:

- extract $1D$, $2D$ and try as well $3D$ limits and compare with published results
- take aQGC simulation from Stefanie Todt and ssWW published data for aQGC limit extraction

Thank you for your attention!

Appendix

total information of the background:

ZZ:

- DSID: 361603-04; gen :Powheg+Pythia8
- DSID: 361073; gen: Sherpa

tt+V:

- DSID: 410218-20,410155; gen: Mc@Nlo+Pythia8
- DSID: 410049; gen: Madgraph+Pythia6

others:

- DSID: 364500-14; gen: Sherpa 2.2.2
- DSID: 361620-27; gen: Sherpa