Search for VV resonance in the semi-leptonic channel with the ATLAS detector at $\sqrt{s} = 13$ TeV

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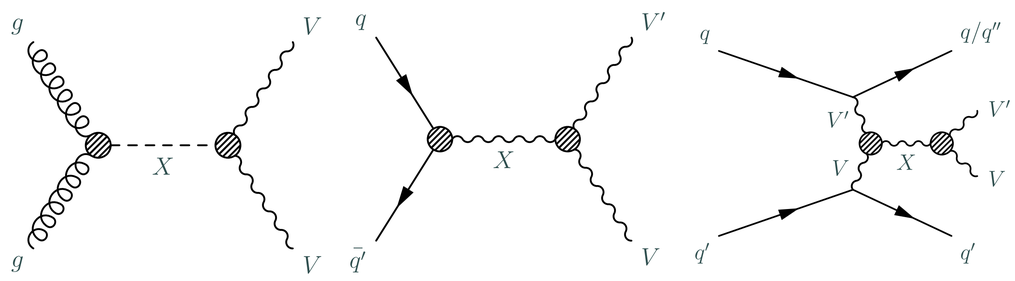
Abstract

There are various Beyond Standard Model (BSM) scenarios that predict the existence of new resonances decaying to a pair of vector bosons W and Z such as extension of the Higgs sector, Heavy vector triplels (HVT) or excited states of Gravitons. This poster describes the search for new resonances decaying to a pair of vector bosons WW and WZ in the semi-leptonic final states, where one weak boson decays leptonically and the other weak boson decays hadronically. The data were collected with the ATLAS detector at the CERN Large Hadron Collider during the 2015 and 2018 periods of pp collisions at a centre of mass energy of $\sqrt{s} = 13$ TeV and correspond to an integrated luminosity of 139 fb^{-1}.

Signal Models

- **Spin 1 HVT** (W', Z') Couplings can be chosen to look like Extended Gauge Sector or Composite Higgs
- **Spin 2 Graviton** from Randal-Sundrum. "Bulk" extension where coupling to light-fermions suppressed
- **Spin 0 Radion** from Randall-Sundrum models. Phenomenology similar to heavy higgs.

Production through ggF, DY and VBF processes are considered depending on the assumed model



Object Selection

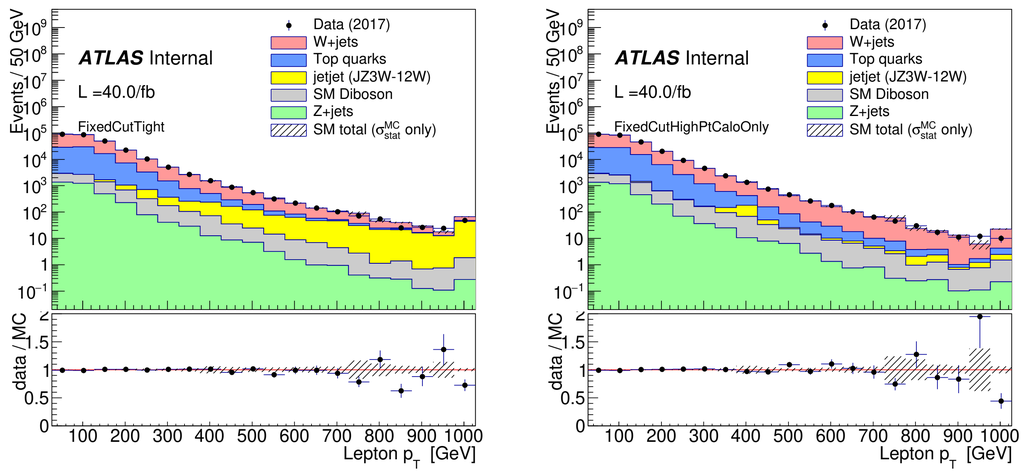
Electrons

$p_T > 30$ GeV, $|\eta| < 2.47$

Muons

$p_T > 30$ GeV, $|\eta| < 2.5$

For both leptons we require a Tight LH discriminant, with a new lepton isolation wp FixedCutTightTrackOnly which improves fake background rejection at high p_T region.



Jets are reconstructed using anti-k_T algorithm with 2 different Radius parameters:

Small-R jets with R=0.4

$p_T > 30$ GeV

Signal Jet $|\eta| < 2.5$

VBF jet $|\eta| < 4.5$

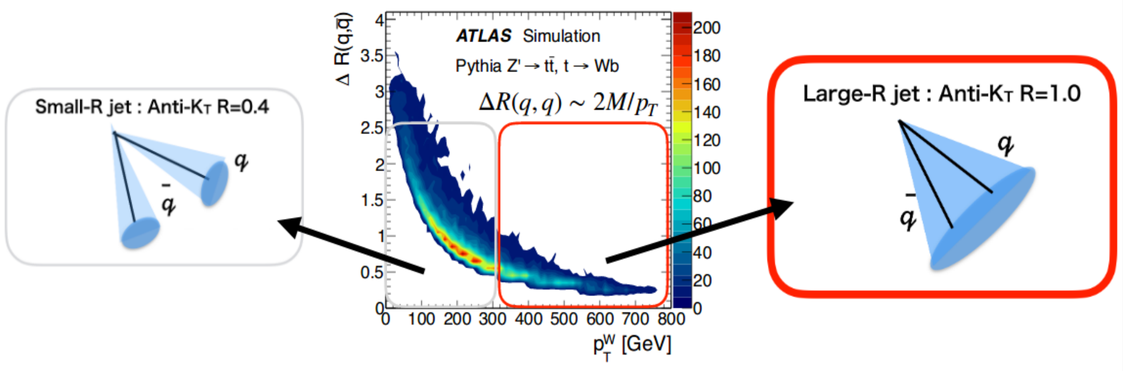
MV2C10 b-tagging algorithm

Large-R jets with R=1.0

$p_T > 200$ GeV

$|\eta| < 2.0$

Jet inputs: Track-CaloCluster



Backgrounds

EWK bkg is estimated using MC

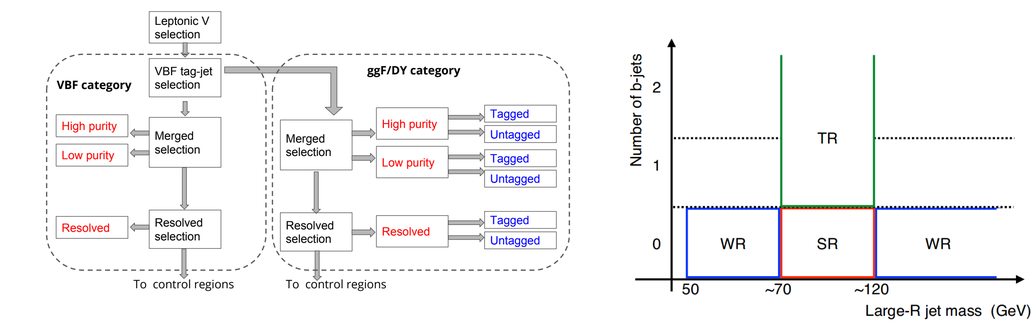
- V+jets and SM diboson are modeled with SHERPA
- $t\bar{t}$ and single-t are simulated with POWHEG

Multijet Bkg is estimated using a data driven template method

- The template shape of the MJ background derived from the MJ-enriched region with inverted lepton ID.
- MJ template is extracted by subtracting from the distribution of the variable under study obtained from the data sample the distributions of the expected contribution for all Standard Model processes in MJCR(VR).
  Two templates are prepared because of the different source of the fake lepton; Electron channel, muon channel with $p_T(W) < 150$ GeV. Muon channel with $p_T(W) > 150$ GeV is not used due to the limited MJ contribution by MET trigger.

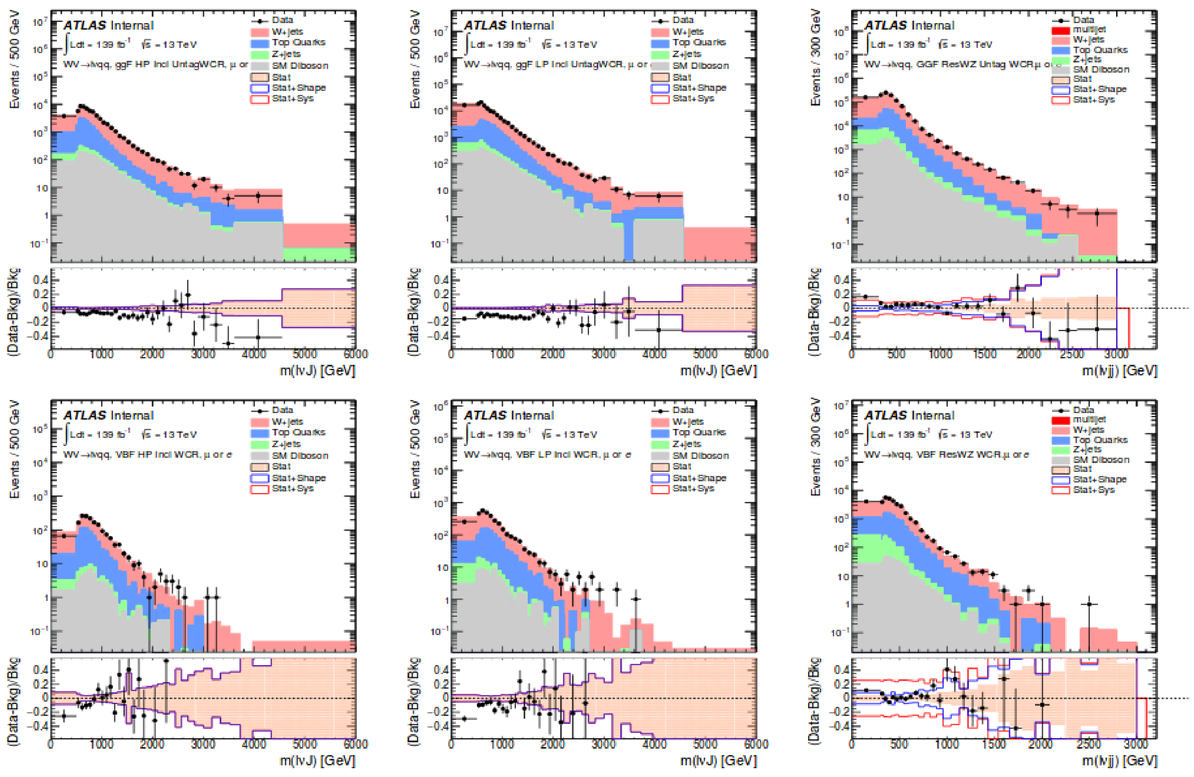
Analysis strategy

We follow the same procedure used in the previous analysis based on 36 fb^{-1} data-set.
At the beginning, events are categorised into 0, 1 and 2 lepton channels by the number of lepton in the final state. For each channel, events are split into VBF and DY/ggF categories. In both VBF and ggF categories "Resolved" and "Merged" analyses are performed targeting on the lower and higher mass regions, respectively. The priority is always given to the merged selection.



In ggF category events are further split according to their b-tags content into tagged sub-category, containing events with two b-tagged jets and untagged sub-category, containing events with less than two b-tagged jets.

- Two CRs dedicated to the W+jets and $t\bar{t}$ events are used to give a constraint to the normalization of the simulated background
  - W+jets CR is defined using mass side-band of the W/Z tagger.
  - $t\bar{t}$ CR is defined by requiring at least one b-tagged jet.



References

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