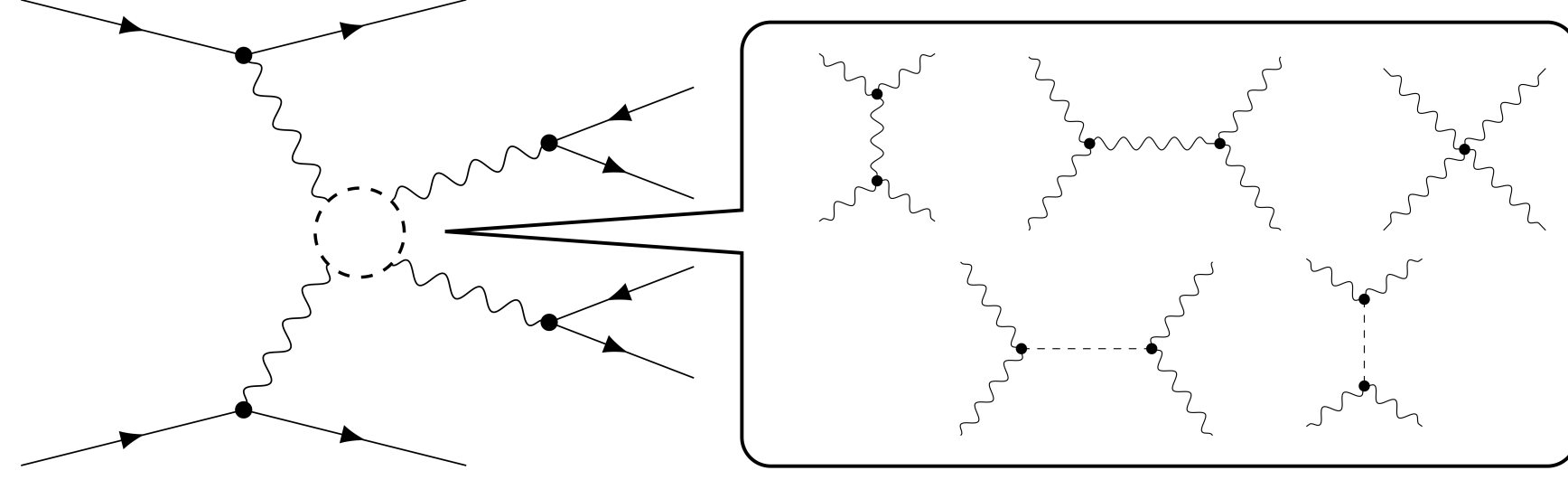


Motivation and Goals

Vector Boson Scattering can be examined experimentally in both $WW \rightarrow WW$ and $WZ \rightarrow WZ$ events. The ultimate goal of this project is to observe Vector Boson Scattering in WZ events with a focus on data with a center-of-mass energy of 13/14 TeV. As the mentioned project is in its infancy the studies shown here focus on work done beforehand in the $WW \rightarrow WW$ channel defined below.



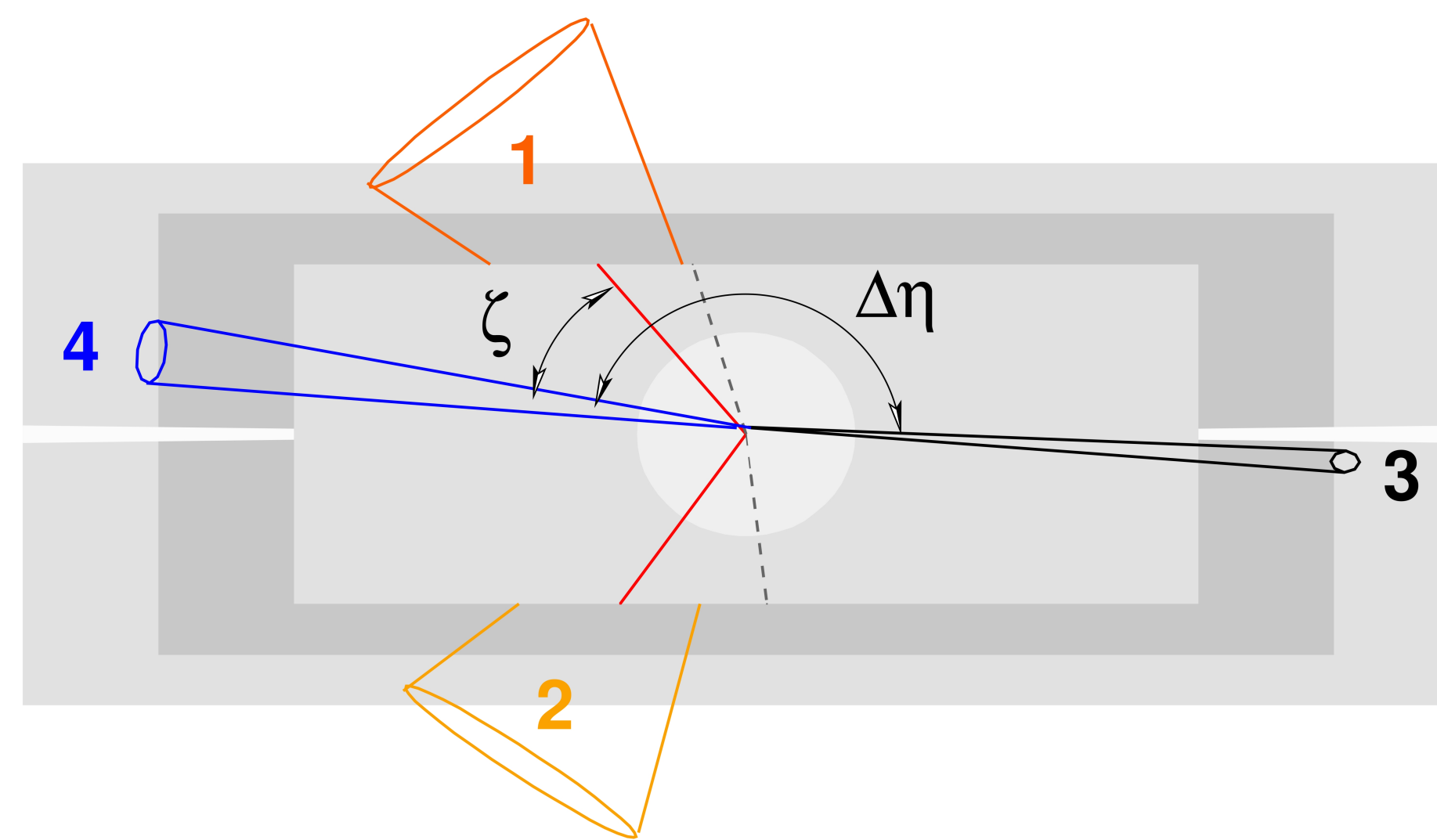
Vector Boson Scattering is a probe for many questions:

- Does the Standard Model quartic gauge coupling exist?
- How large is the purely electroweak contribution to the total cross-section of di-boson events?
- Are the properties of the new scalar Boson found at 126 GeV consistent with the Higgs boson predicted by the Standard Model?
- Is the unitarity violation restored completely by the new-found boson or are there additional effects to be found?
- Are there effects of physics beyond the Standard Model that are manifest as anomalous quartic gauge couplings?

Event Layout

The general $WW \rightarrow WW$ Event Layout is defined by:

- two highly energetic jets (called tagging jets) (3,4)
- large pseudo rapidity gap between jets
- large invariant mass of di-jet system (m_{jj})
- two well isolated leptons with high momentum that lie between the tagging jets (1,2)
- Electroweak contributions show no color flow between tagging jets $\rightarrow$ less jet activity in central region

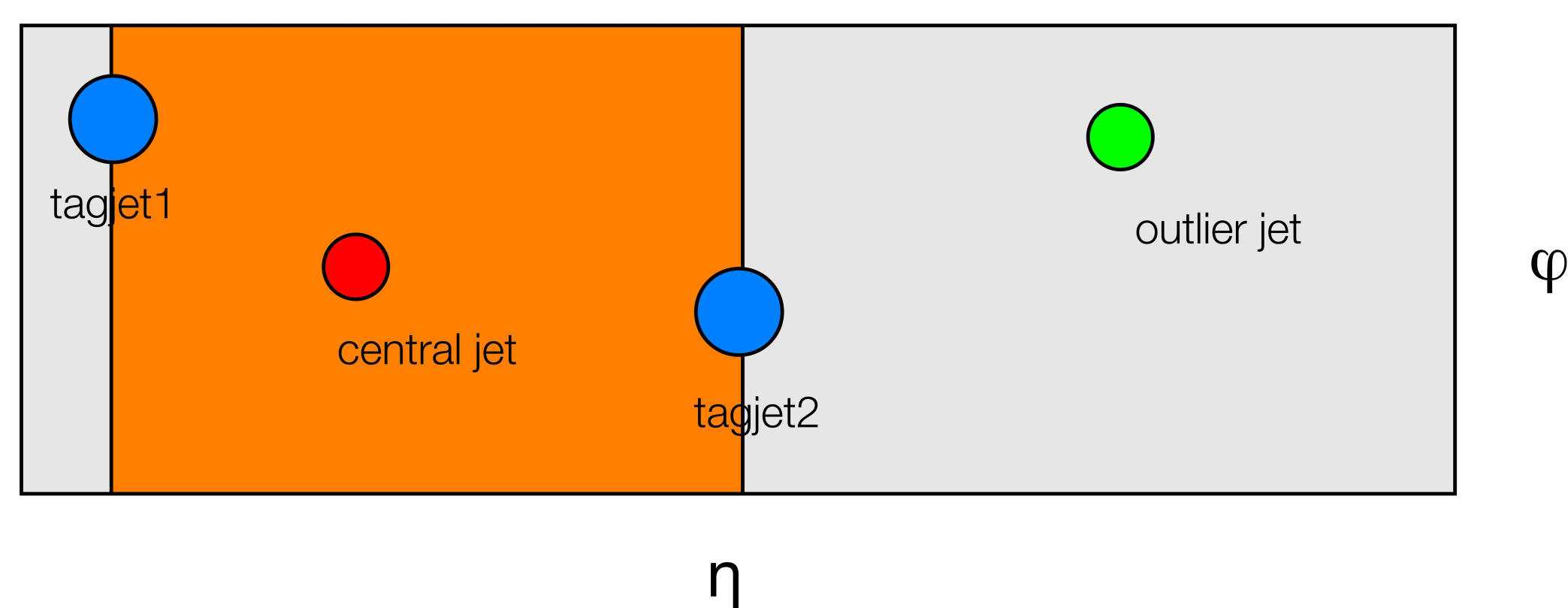


Object Selection:

- Jets:**
 - $p_T > 30$ GeV
 - $|\eta| < 4.5$
 - pileup suppression
 - discarded if near leptons
- Leptons:**
 - tight quality requirements
 - $p_T > 15$ GeV
 - $|\eta| < 2.5$
 - well isolated

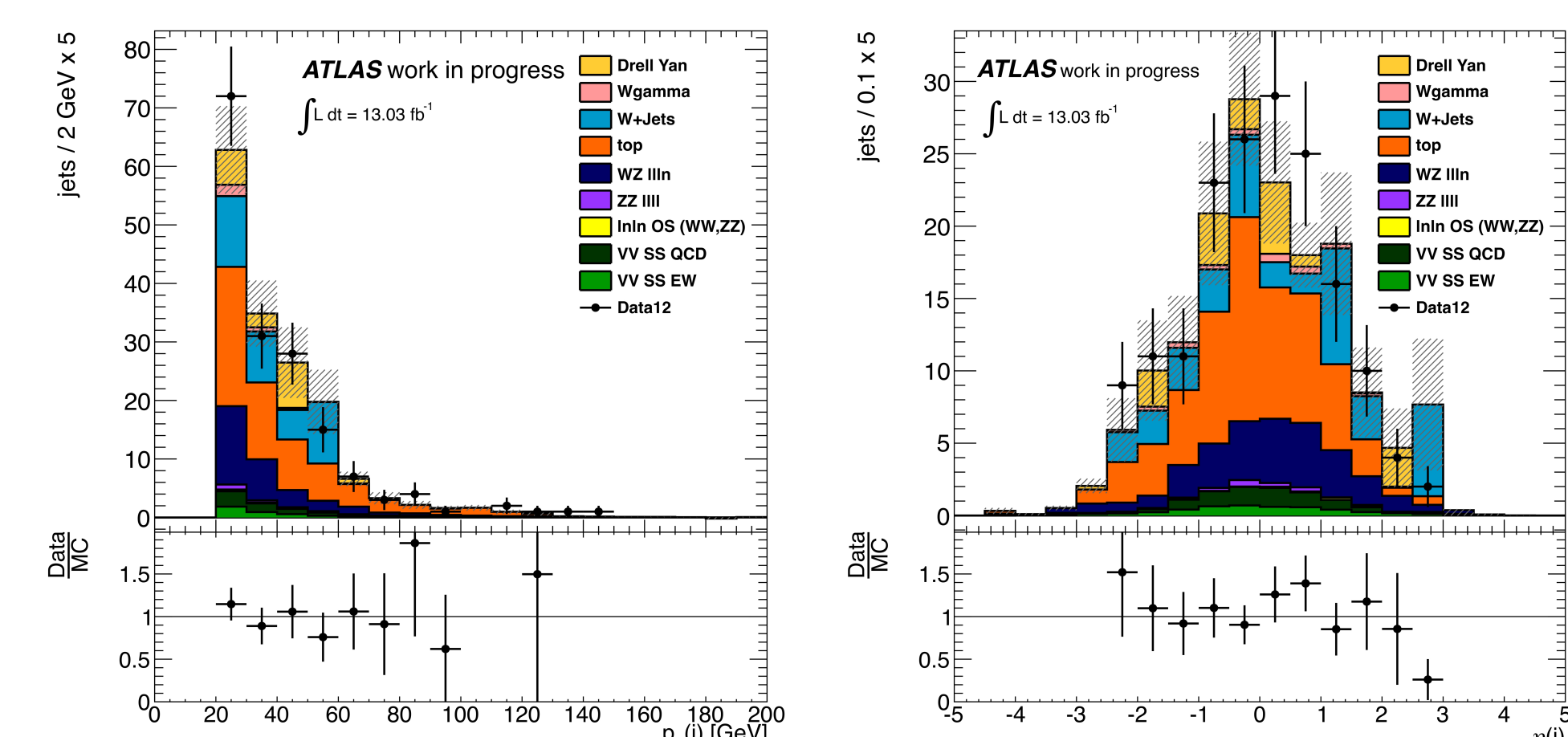
Central Jet Veto

Definition of Central Jet Veto in Vector Boson Scattering



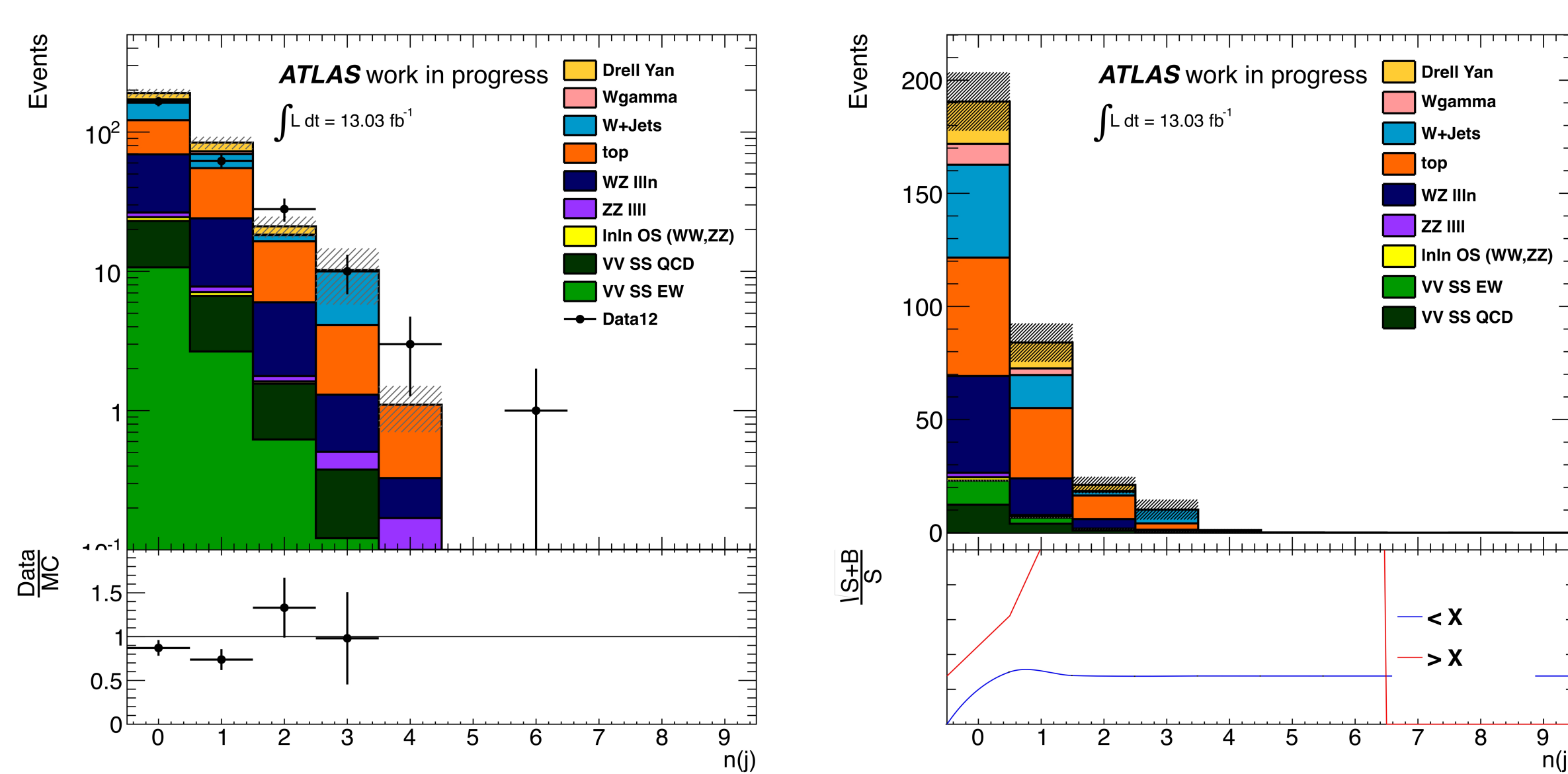
- Central jets have transverse momentum larger than 20 GeV
- Central region is defined by tagging jets $\rightarrow$ dynamically defined region

Modeling of central jets in $WW \rightarrow WW$ same sign channel



- Plots show di-lepton events with $m_{jj} > 150$ GeV constraint
- Modeling seems good within statistical uncertainties.

Results



- Central jet multiplicity (left plots, shown linearly with data and logarithmically with optimization information)
- Data and simulated events agree fairly well
- Central jet veto decreases signal by about 10%
- Evaluation used to figures of merit
 - Discovery significance with the signal being only the electroweak contribution to the WW same sign events
 - Error on the measurement with the signal being both electroweak and QCD contributions to the WW same sign events
- Both figures of merit showed that a CJV would either have no effect or even an detrimental one
- As a consequence CJV veto was not applied in the analysis

References

- [1] "Next-to-leading order QCD predictions for $W+W+jj$ production at the LHC", T. Melia, K. Melnikov, R. Rontsch, G. Zanderighi, <http://arxiv.org/abs/1007.5313>
- [2] "Sensitivity of ATLAS to Alternative Mechanisms of Electroweak Symmetry Breaking in Vector Boson Scattering $qq \rightarrow qqll\nu\nu$ ", J. Schumacher, <http://cds.cern.ch/record/1308395>
- [3] "Jet tagging and central jet veto in VBF Higgs search in 4.4 fb^{-1} data sample", I. Tsukerman, <https://cds.cern.ch/record/1417819>

Talks

- "Aspects of Vector Boson Scattering at ATLAS", 6th Annual Workshop of the Helmholtz Alliance "Physics at the Terascale", Hamburg, Dec 2012

Profit from the GK

- Attendance of Workshops (Statistics, Block Course, Outreach)
- Possibility to go to soft skill courses (e.g. Vermittlerworkshop)
- Additional travel money
- More colleagues at home institute

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