Central jet veto studies with Z+jets in pp collisions at $\sqrt{s}$=7 TeV with the ATLAS Detector

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PHYSICS AT THE TERA SCALE
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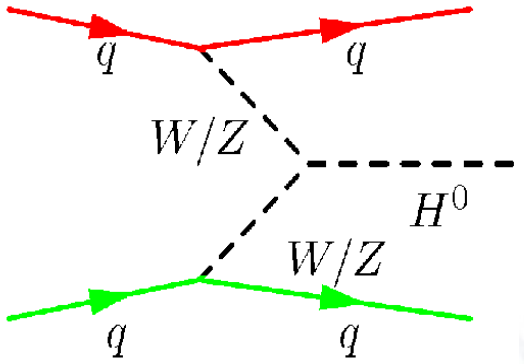
Motivation

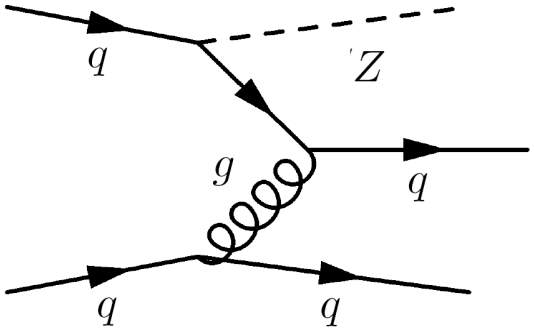
- Search for the Higgs boson in VBFH$\rightarrow\tau^+\tau^-$

VBF H$\rightarrow\tau\tau$:
- 2 hard Jets
  - Very forward
  - Well seperated in η
- Central jets from background

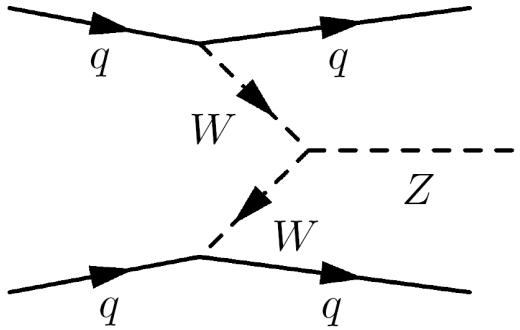


- Expected cross section for VBF H ($\rightarrow\tau\tau\rightarrow$ll+4$\nu$):

  σ x BR=0.012 pb at $\sqrt{s}$=7 TeV for m_H=120 GeV (~ 56,4 events for $\int$Ldt=4.6 fb^{-1})
- Focus on backgrounds (Z+Jets, especially with two electrons in the final state)



Zjj (QCD)



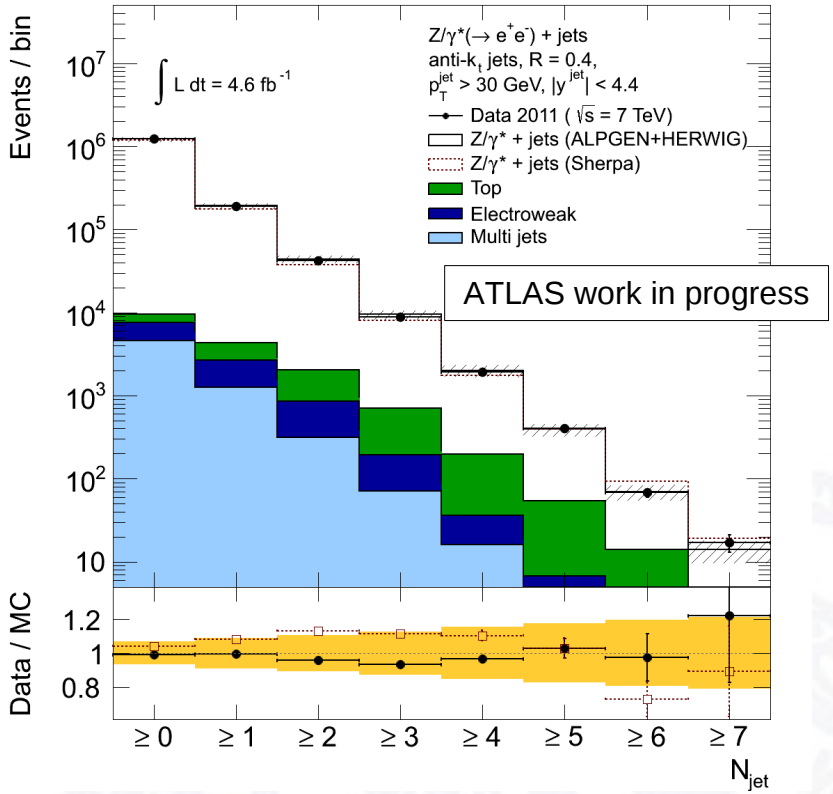
Zjj (EW) (x-sec very small)

Data & Monte Carlo

- Data:
  - pp-collisions at 7 TeV from 2011
  - Integrated luminosity of 4.6 fb^{-1}
- Monte Carlo (fully simulated):
  - **QCD Z(→ee)+jets:** Alpgen + Herwig, Sherpa 1.4
  - **QCD:** data driven
  - **Ttbar:** data driven
  - **Single Top:** AcerMC + Pythia
  - **Z(→ττ)+jets:** Alpgen + Herwig
  - **W(→eν)+jets:** Alpgen + Herwig
  - **Diboson:** Herwig + Jimmy
- pQCD predictions:
  - Blackhat (arXiv:hep-ph/1004.1659, arXiv:hep-ph/1108.2229), Z+0,1,2,3,4 jets NL0

Detector level results

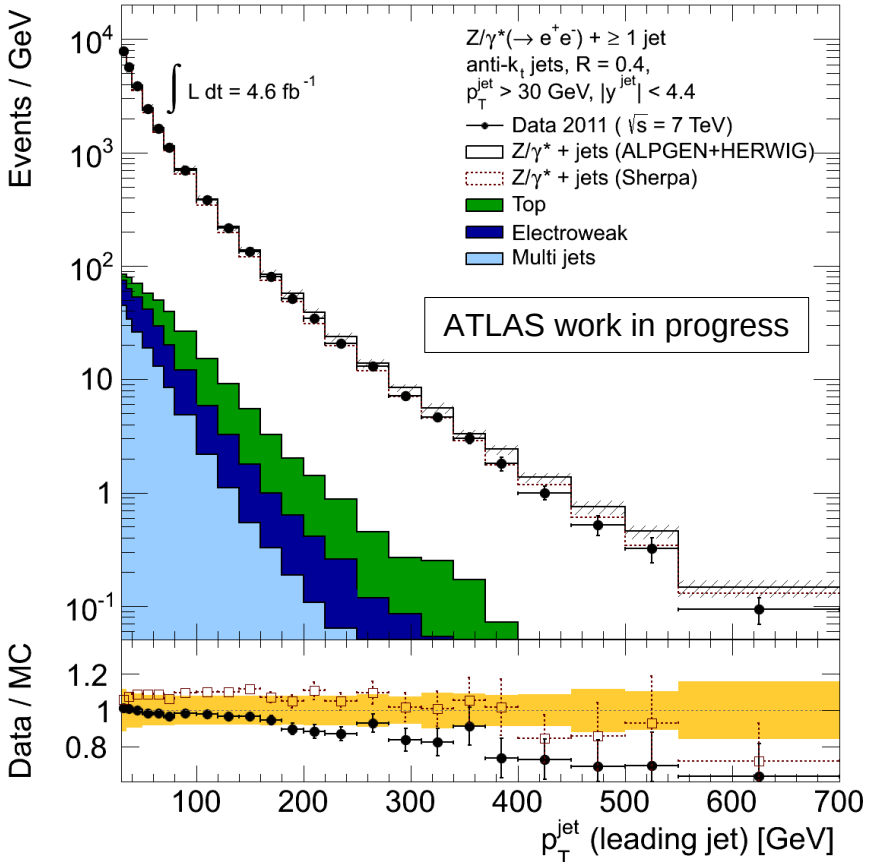
- Z selection: 2 opposite sign leptons, p_T>20GeV, 66<M(ll)<116GeV
- Jet selection:
  - Antikt jets, R=0.4, p_T>30 GeV, |y|<4.4
  - Jet isolation: ΔR(lepton,jet)>0.5
- Signal MC: ALPGEN+HERWIG and Sherpa 1.4
- MC: scaled to integrated luminosity in data
- Main backgrounds:
  - QCD multijet (0.4%-1.5%, electron channel)
  - Ttbar (0.2%-26%, both channels)
  - Diboson (0.2%-1.2%, both channels)
- QCD multijet is estimated from data using template fits
- Ttbar is estimated from data extracting the shape from ttbar dilepton eμ events



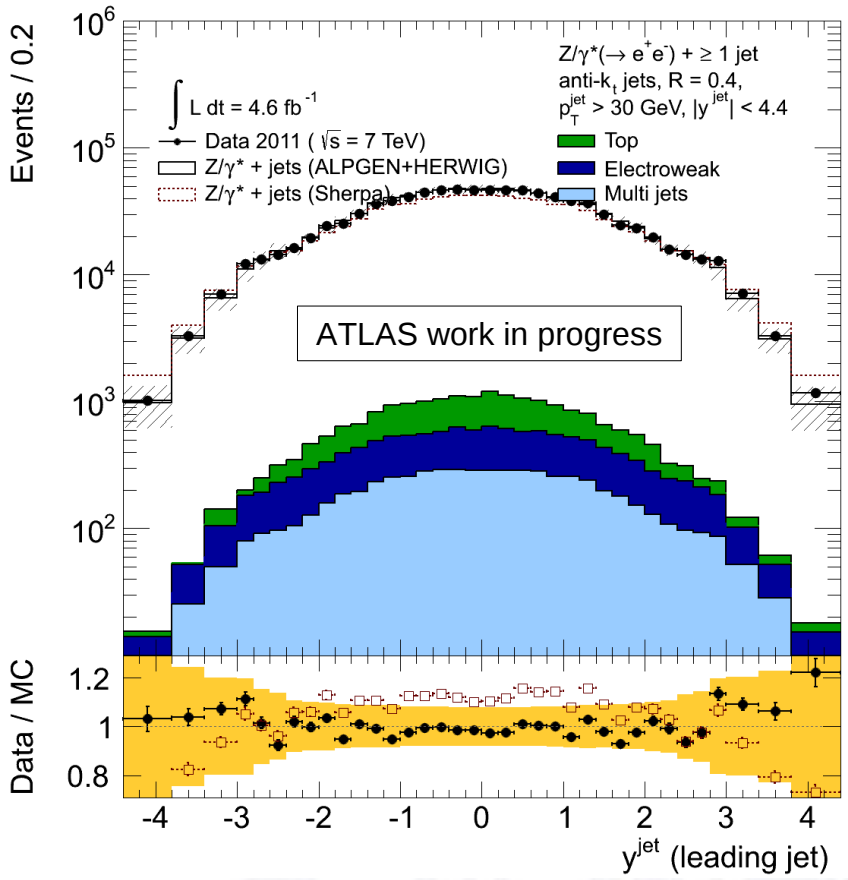
- Systematic uncertainties:
  - Jets: JES (dominat), JER
  - Lepton: ID, reco efficiency, energy scale and resolution
  - Trigger and beamspot
  - Background normalization
  - Luminosity

Results - p_T and y

leading jet p_T



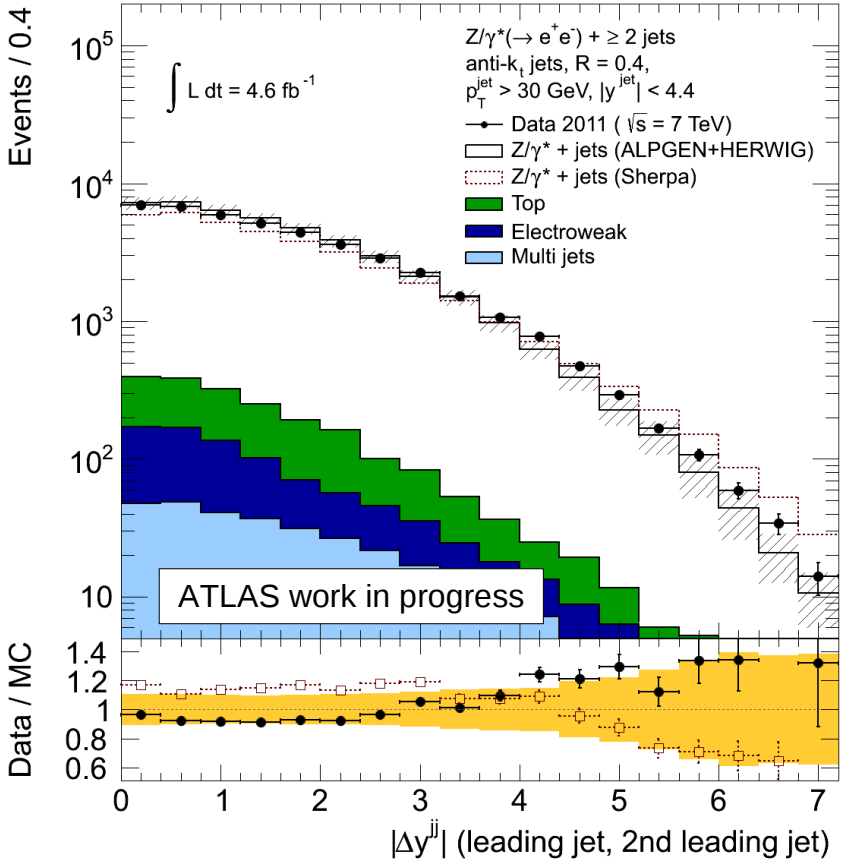
leading jet rapidity



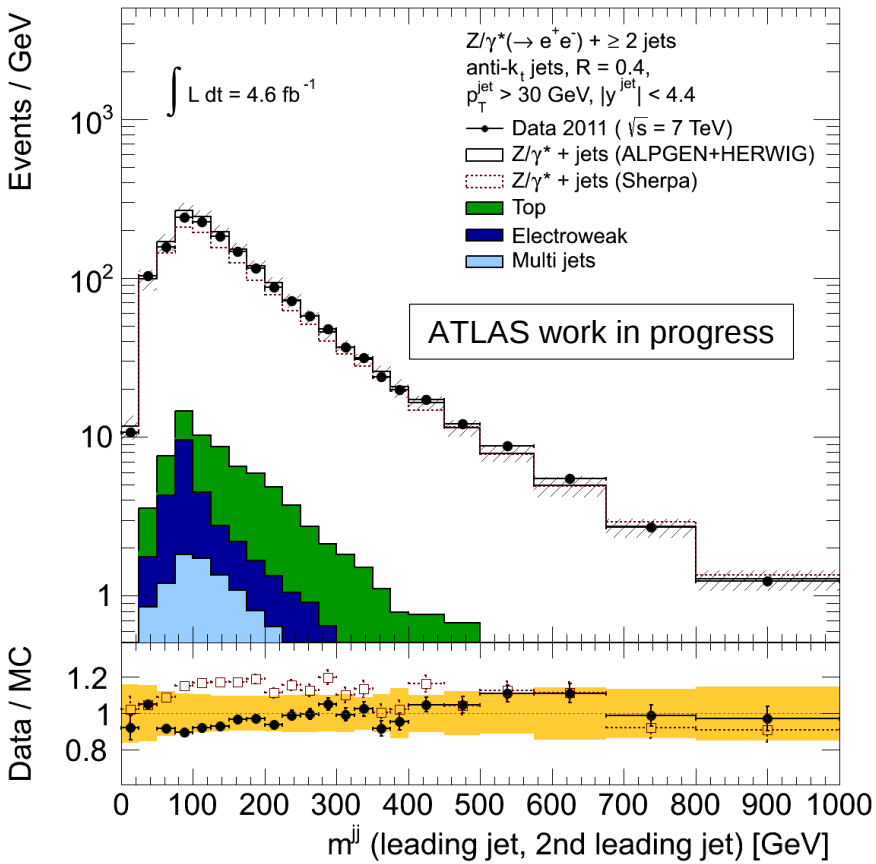
- ME+PS generators show discrepancies for large p_T
- Sherpa overshoots data in forward region

Results - $|y^{jj}|$ and m^{jj}

rapidity gap



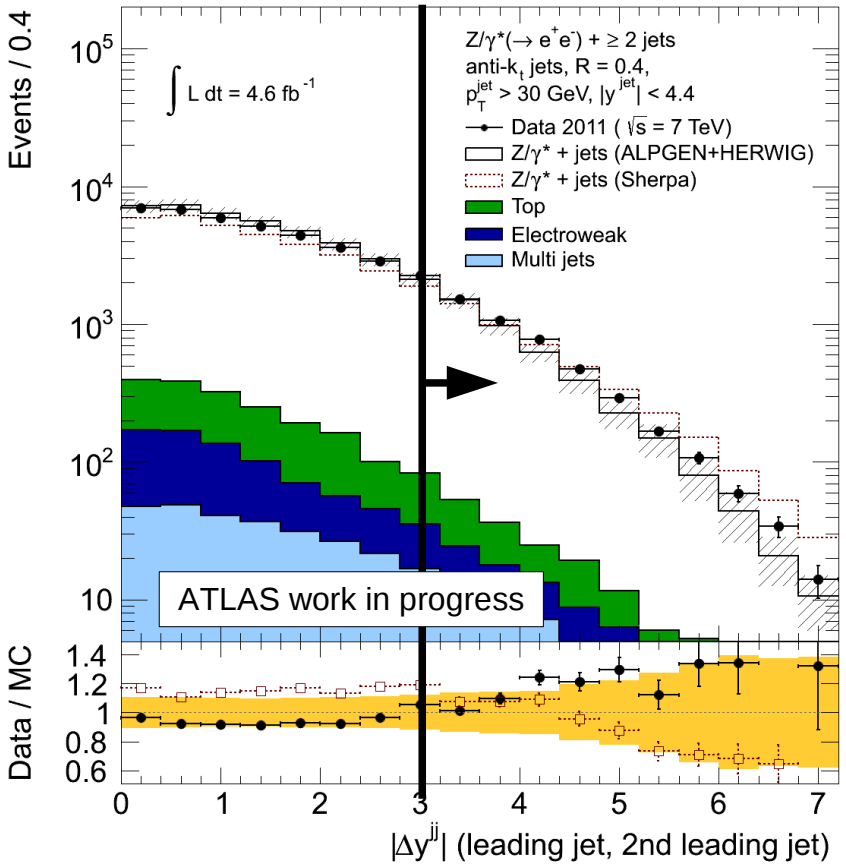
dijetmass



- Very important for VBF Higgs searches and other searches
- Difference in rapidity distributions are reflected in dijet distributions

Results - $|y^{jj}|$ and m^{jj}

rapidity gap



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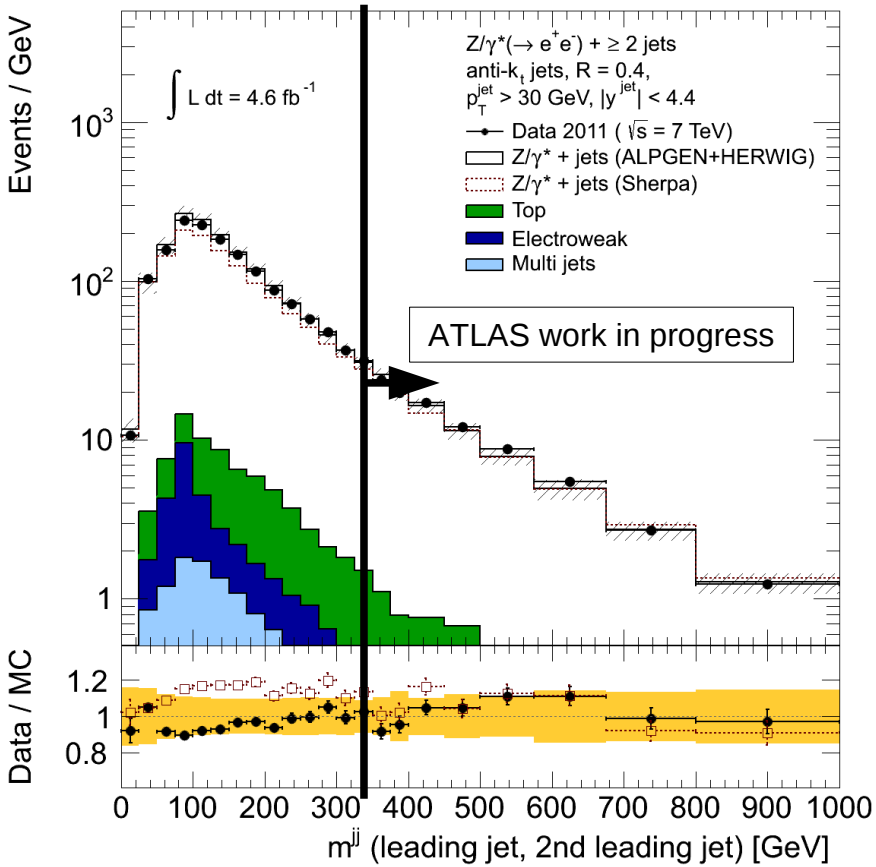

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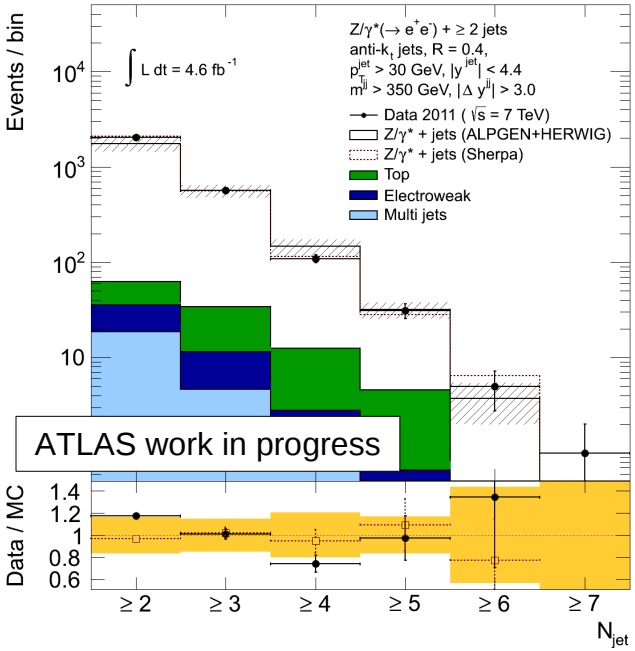
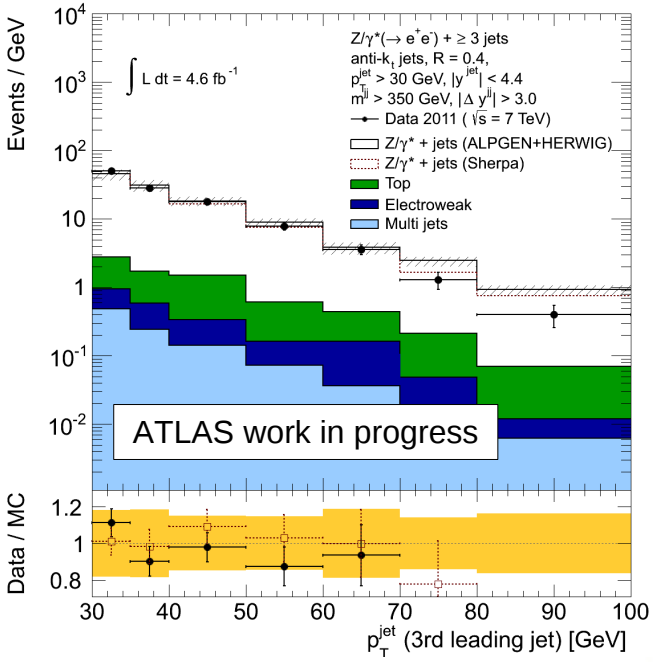
Results – VBF variables

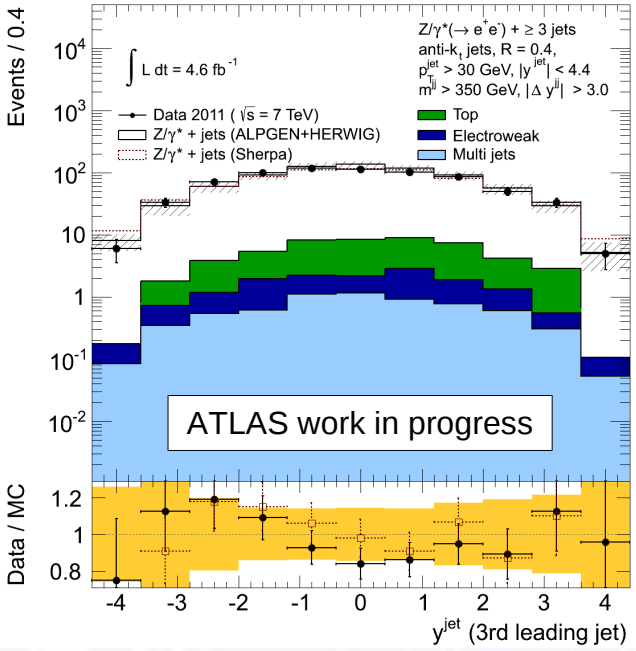
exclusive jet multiplicity



3rd jet p_T

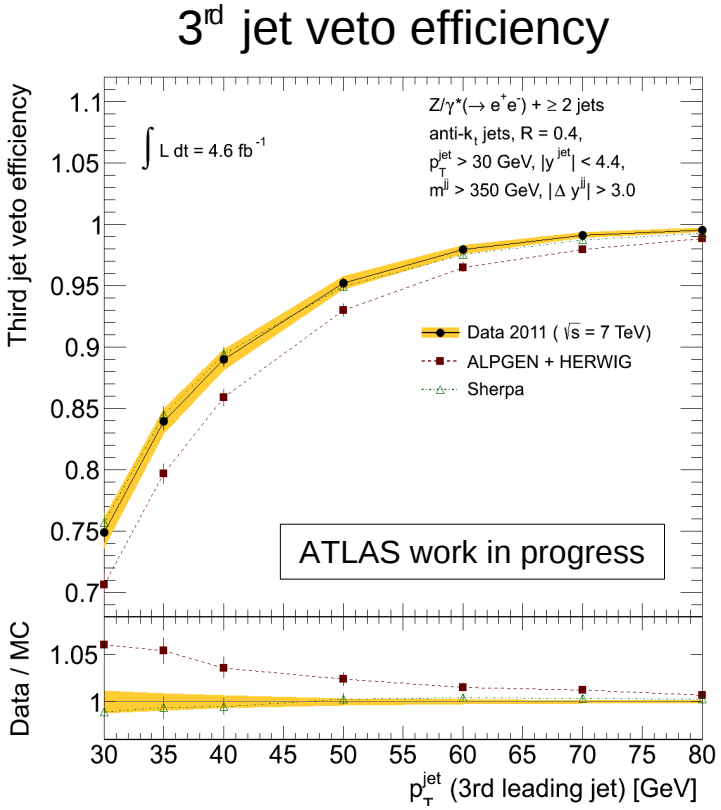


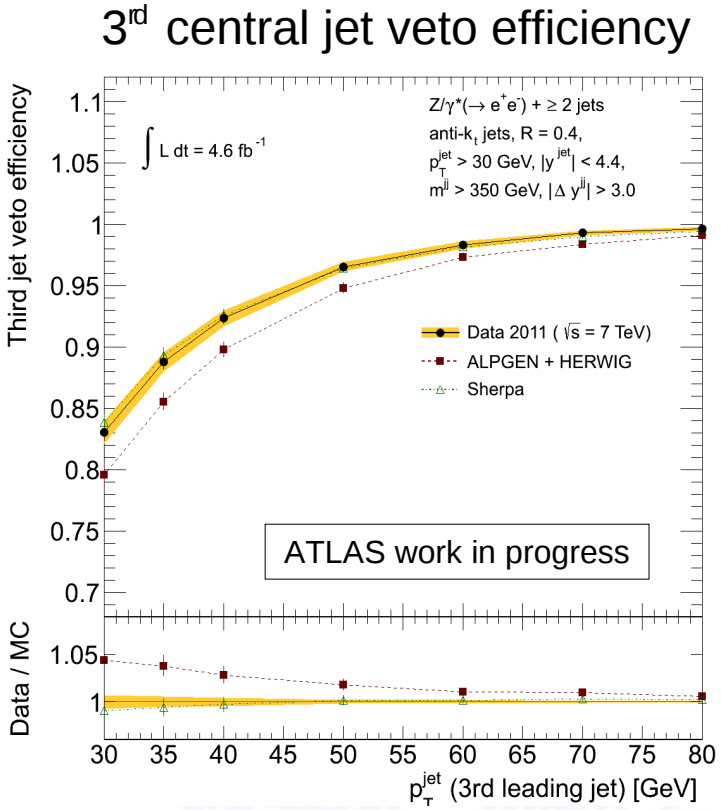
3rd jet rapidity



- Jet multiplicity and 3rd jet kinematics after VBF cuts (m_{jj} > 350 GeV, Δy > 3.0)
- In general, good agreement between predictions and data

Results – VBF, 3rd jet veto efficiency





- Survival efficiency of 3rd jet after VBF cuts
  - For all jets
  - For central jets
- Sherpa/data: good agreement
- ALPGEN predicts too small efficiency

Summary

- Inclusive and differential Z + jets cross section have been measured with respect to VBF Higgs key quantities with full 2011 dataset
- Discrepancies between ME+PS generators and data have been found for some phase space regions
  - Large jet p_T: ME+PS generators overshoot data
  - Jet rapidity: Sherpa overshoots data in forward region, translates into dijet quantities
  - 3rd jet veto efficiency: ALPGEN predicts too low efficiencies
- Outlook:
  - 3rd jet veto efficiency and signal/√background can be used for cut optimization