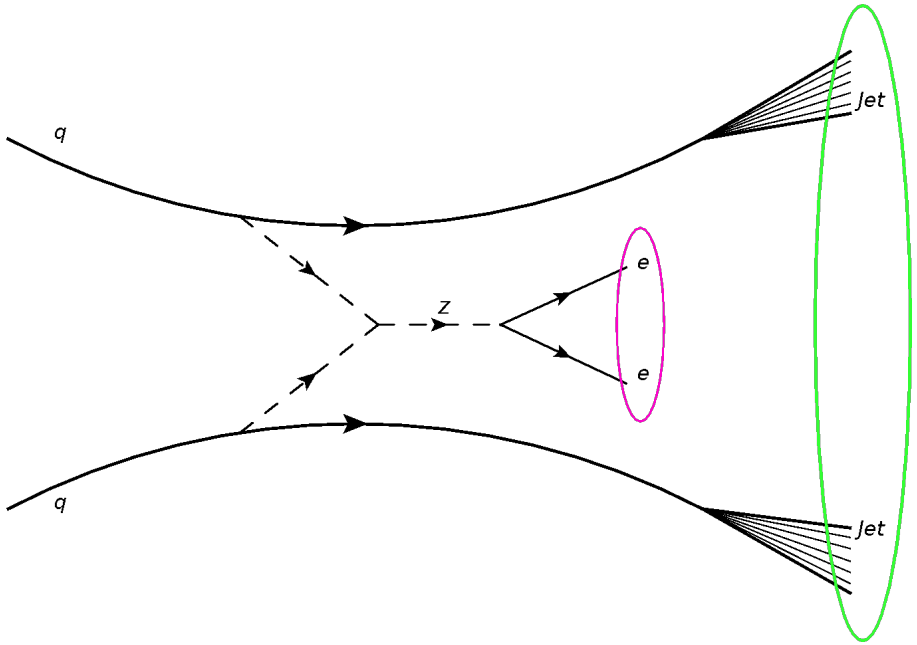
PHYSICS AT THE TERA SCALE
Helmholtz Alliance

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN



Z+jets Background studies for VBF in 8 TeV Data

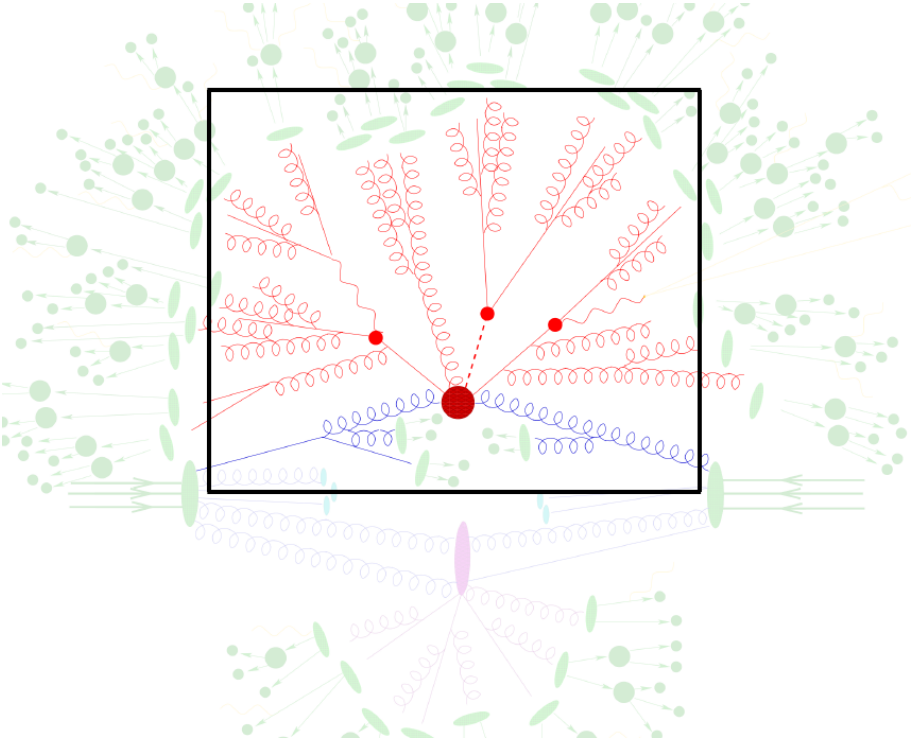
CJV Session, 05.12.12

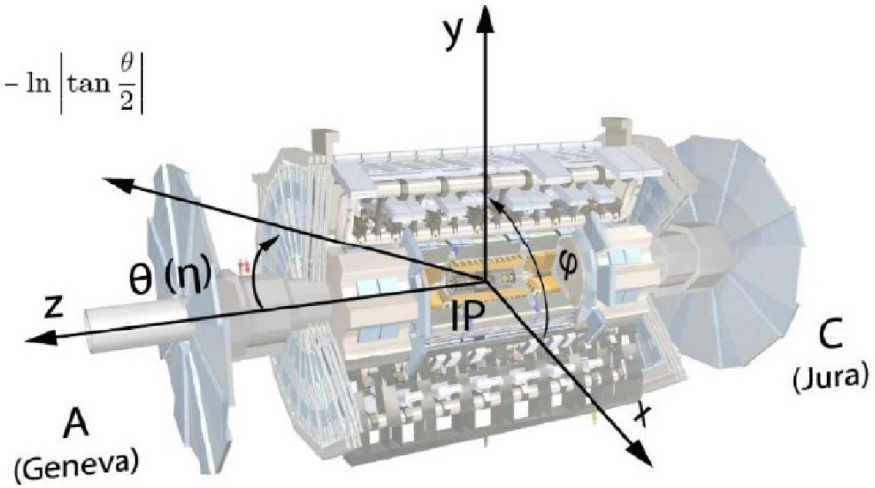
Eric Drechsler

Supervisor: Arnulf Quadt, Ulla Blumenschein
II. Institute of Physics
Georg-August-University Göttingen

Samples

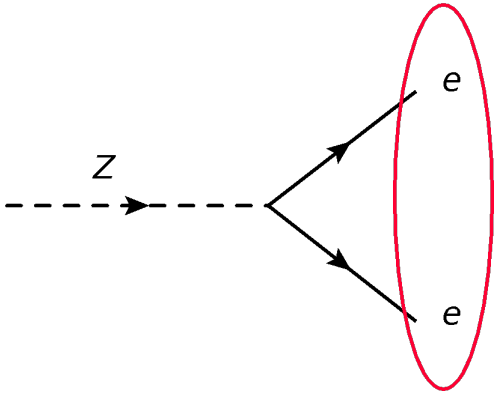
- Alpgen Zee - globally scaled by 1.06
  - Herwig (Tune: AUET2-CTEQ6L1)
  - Pythia (Tune: Perugia2011C)
- MC@NLO+Jimmy Ttbar (CT10)
- Herwig DiBoson WW/ZZ/WZ
  (Tune: AUET2-CTEQ6L1)
- 12.3 fb^{-1} data (period B-E)





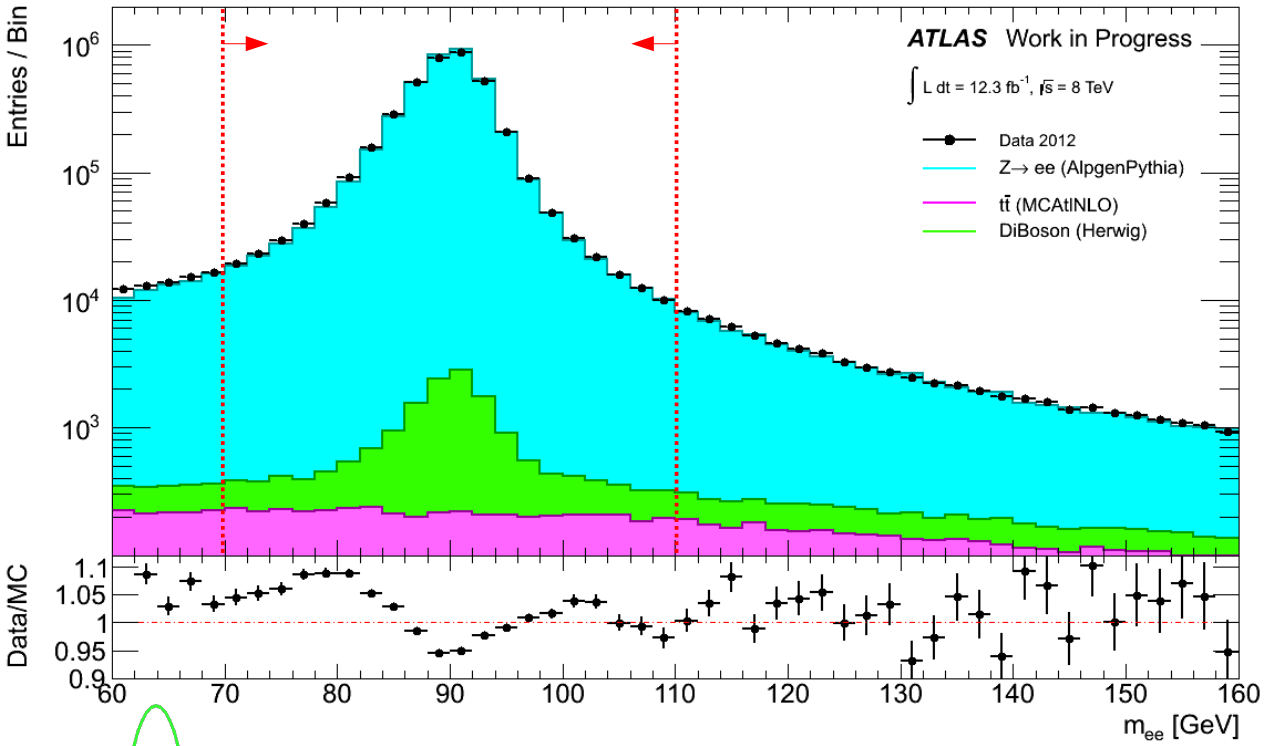
Object Selection/Corrections

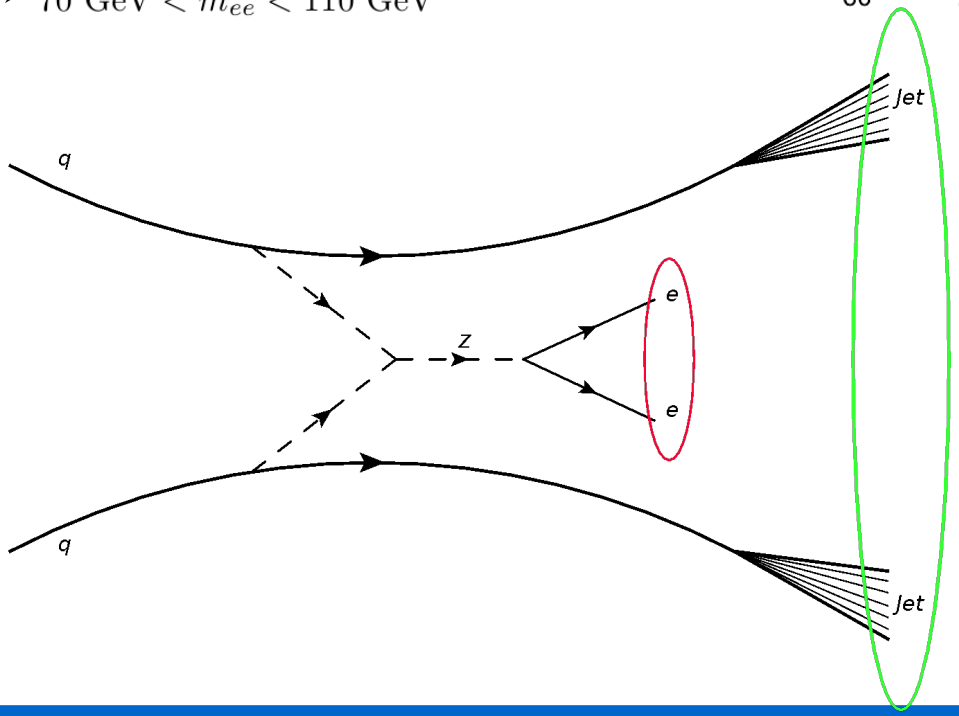
- Jets:
  - `AntiKt4TopoEM`
  - $p_t > 20.\mathrm{GeV}$
  - $|\eta| < 4.5$
- Electrons:
  - `mediumPP` selection
  - $p_t > 20.\mathrm{GeV}$
  - $|\eta| < 2.47$



Zee candidate selection

- Preselection
- pt(e) > 20 GeV
- N(e)==2, Muon/Tau-Veto
- OS charge
- $70\ \text{GeV} < m_{ee} < 110\ \text{GeV}$



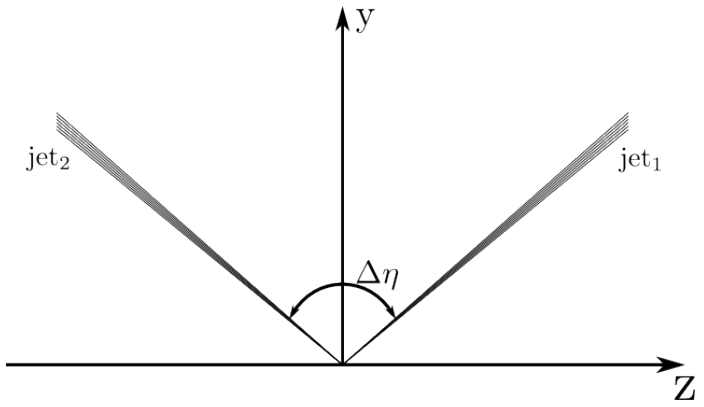


VBF-Zee-Selection

- Zee-Selection
- Leading jet pt > 40 GeV
- Subleading jet pt > 25 GeV
- Pseudorapidity gap ?
- Dijetmass ?

Pseudorapiditygap

$$\Delta\eta = |\eta(j_1) - \eta(j_2)|$$

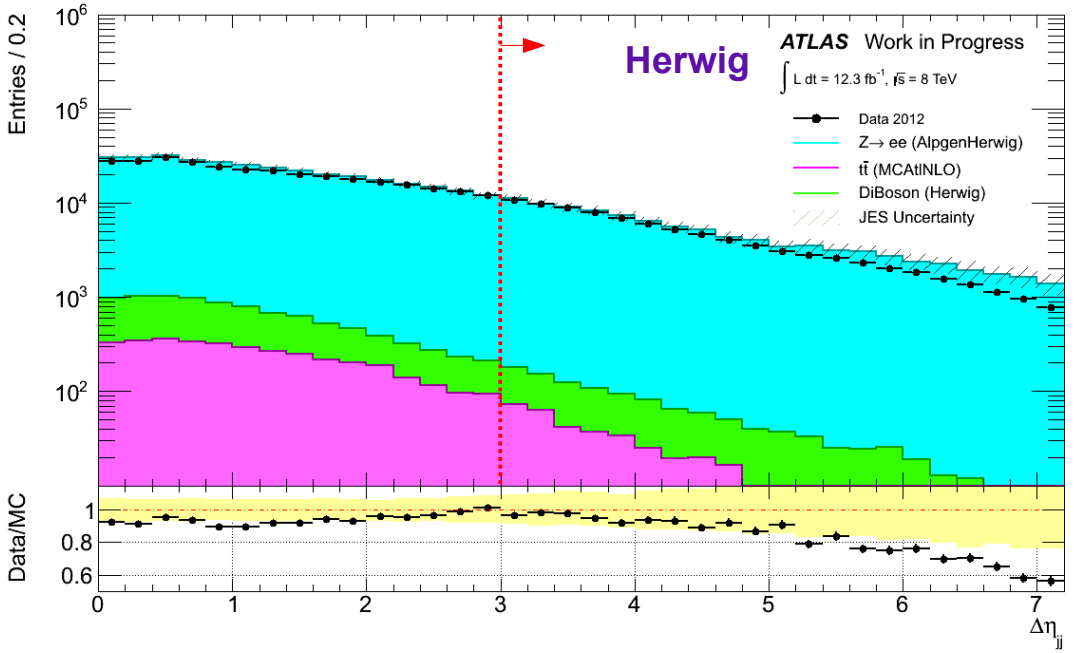


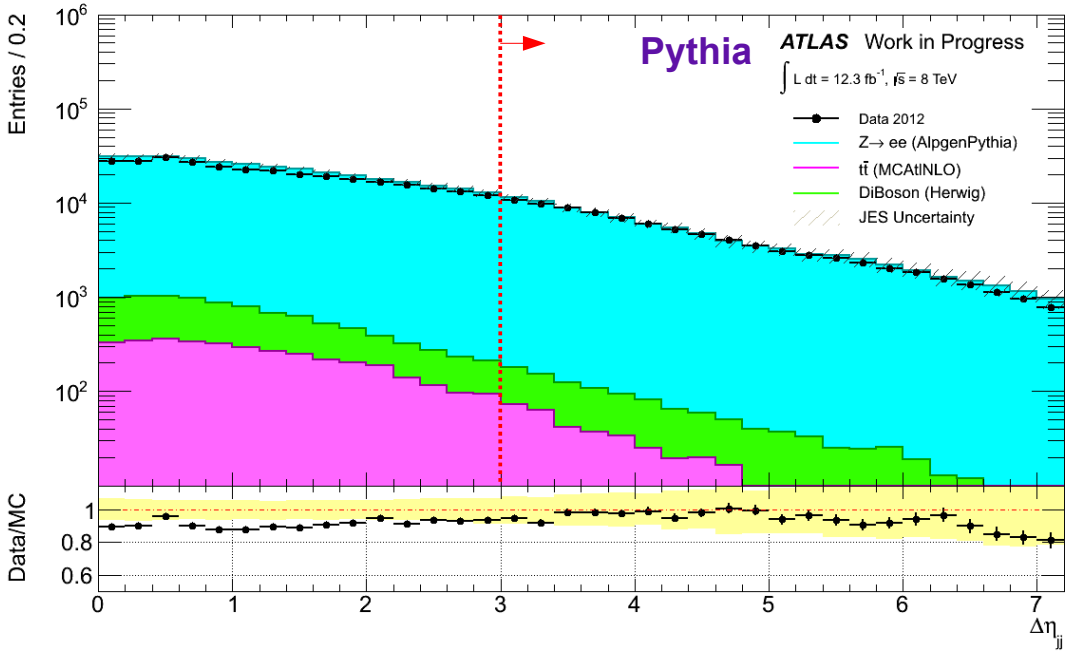
- Zee selection
- pt(leading jet) > 40 GeV
- pt(subleading jet) > 25 GeV

- large rapidity gaps > 6 – AlpgenHerwig shows discrepancy

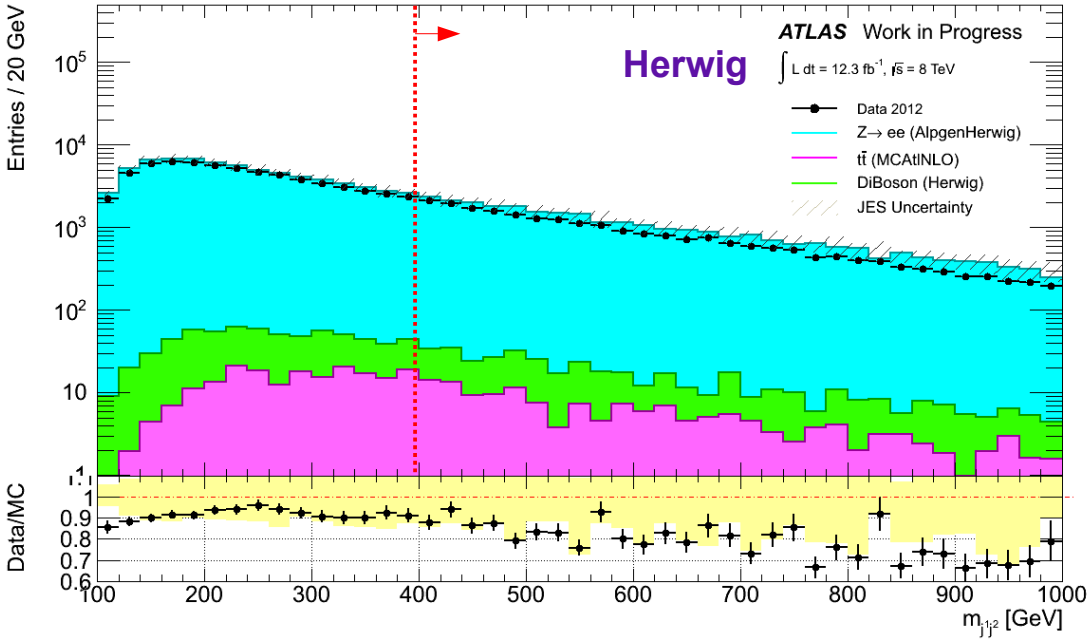
- in AlpgenPythia within systematics

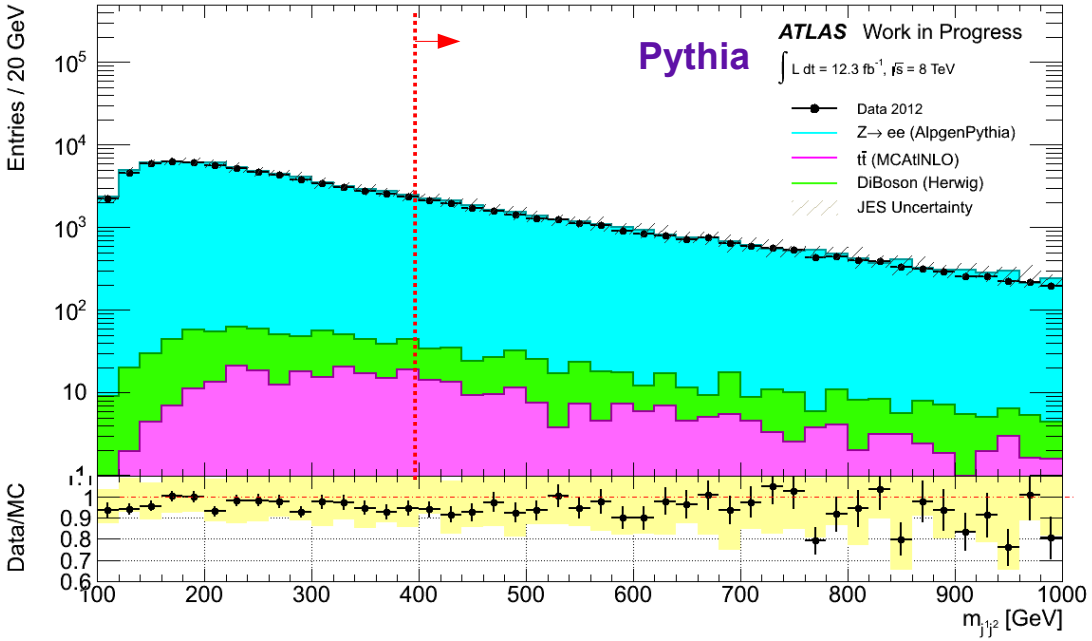
$$\Delta\eta > 3.0$$

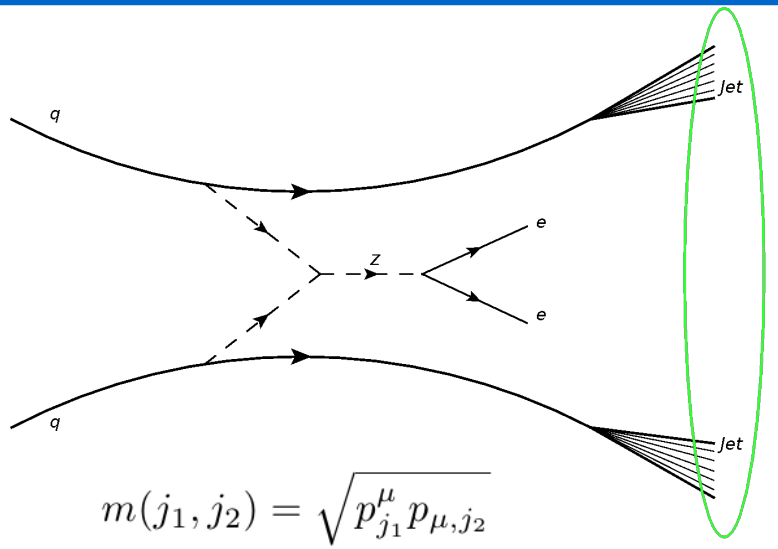




Dijetmass







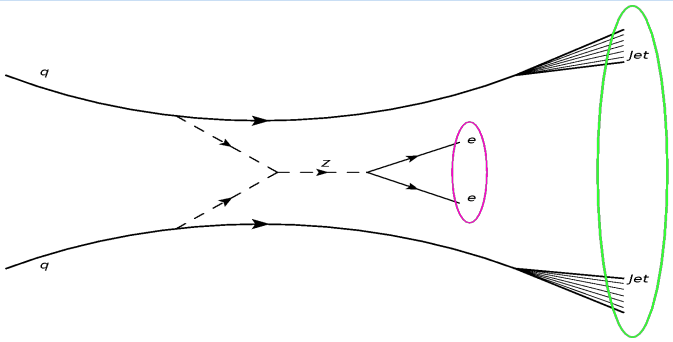
$$m(j_1, j_2) = \sqrt{p^{\mu}_{j_1} p_{\mu, j_2}}$$

- Zee selection
- pt(leading jet) > 40 GeV
- pt(subleading jet) > 25 GeV
- Rapidity Gap $\Delta\eta > 3.0$

- large masses – AlpgenHerwig shows tendency towards higher event numbers

- Deviations in AlpgenPythia covered by systematics

$$m(j_1, j_2) > 400 \text{ GeV}$$

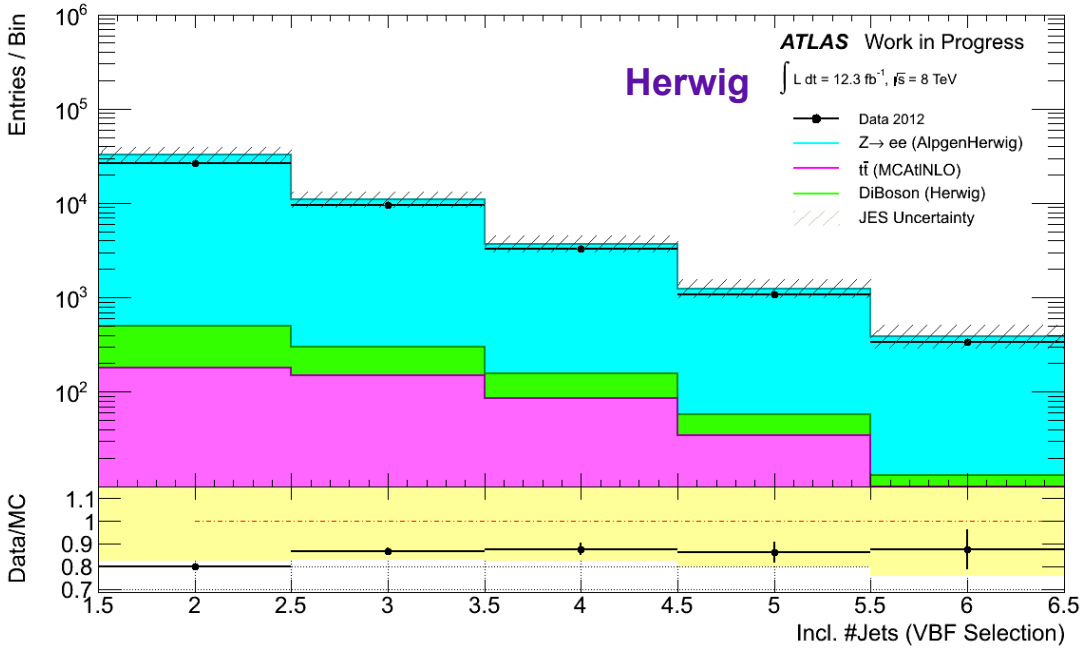


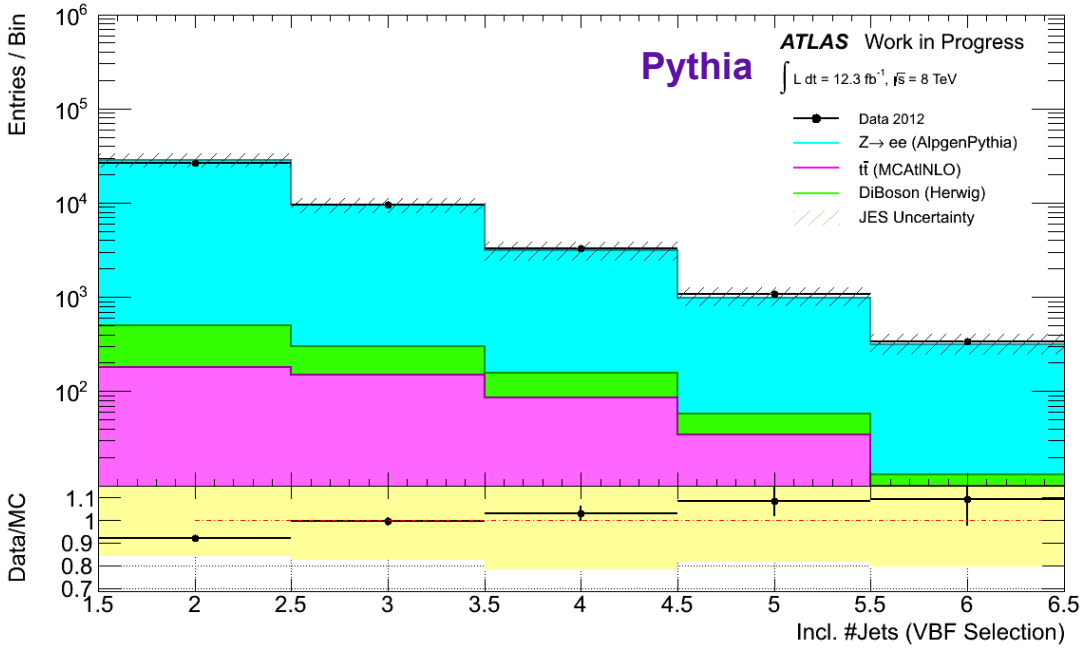
Inclusive Jet Multiplicity

- Zee selection
- pt(leading jet) > 40 GeV
- pt(subleading jet) > 25 GeV
- Rapidity Gap $\Delta\eta > 3.0$
- Dijetmass $m(j_1, j_2) > 400$ GeV

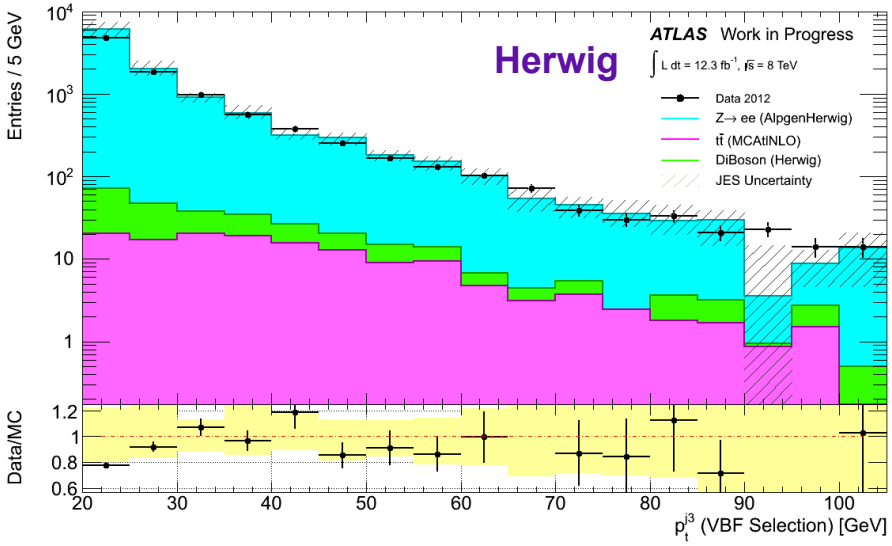
- Fluctuations covered by systematics

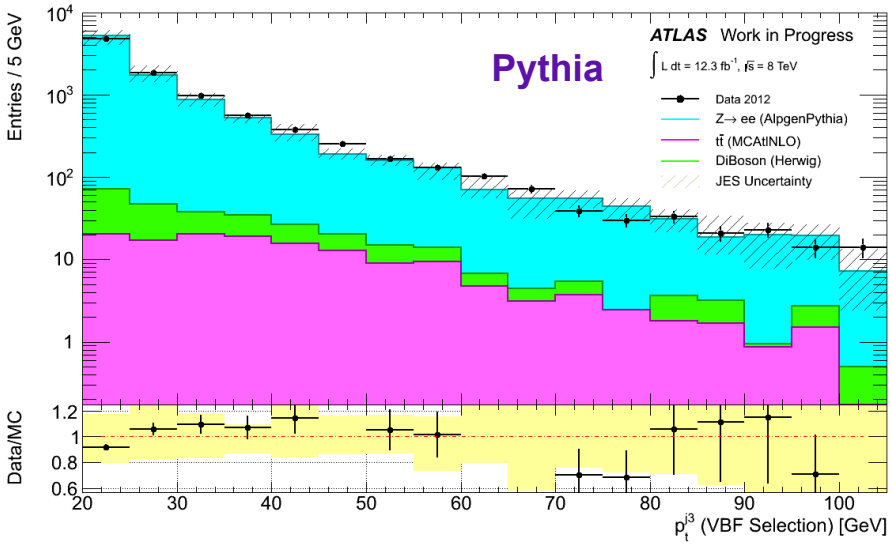
Sample	VBF Events
AlpgenHerwig Zee	30493.9 ± 174.6
AlpgenPythia Zee	26391.7 ± 162.5
Herwig Diboson	317.8 ± 17.8
Ttbar	178.5 ± 13.4
MC Sum (Herwig)	30990.2 ± 176.0
MC Sum (Pythia)	26888.0 ± 163.9
Data	26231 ± 162



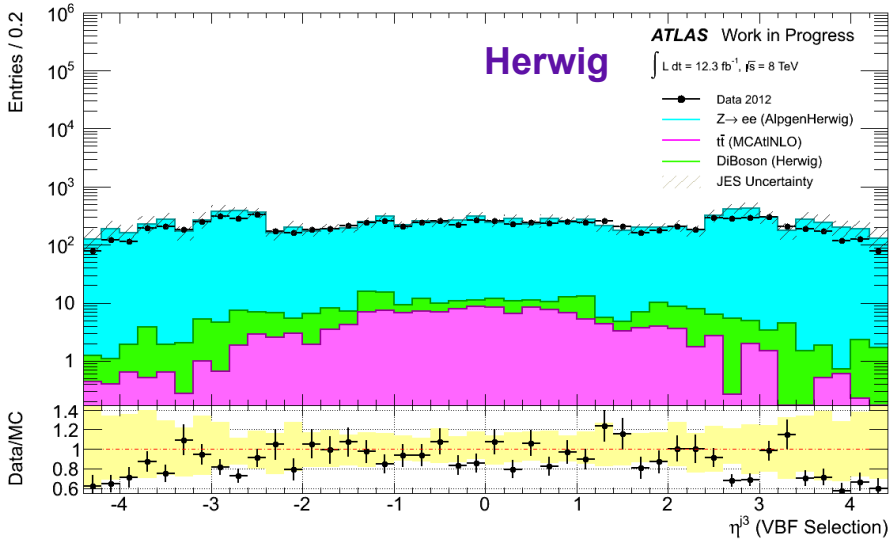


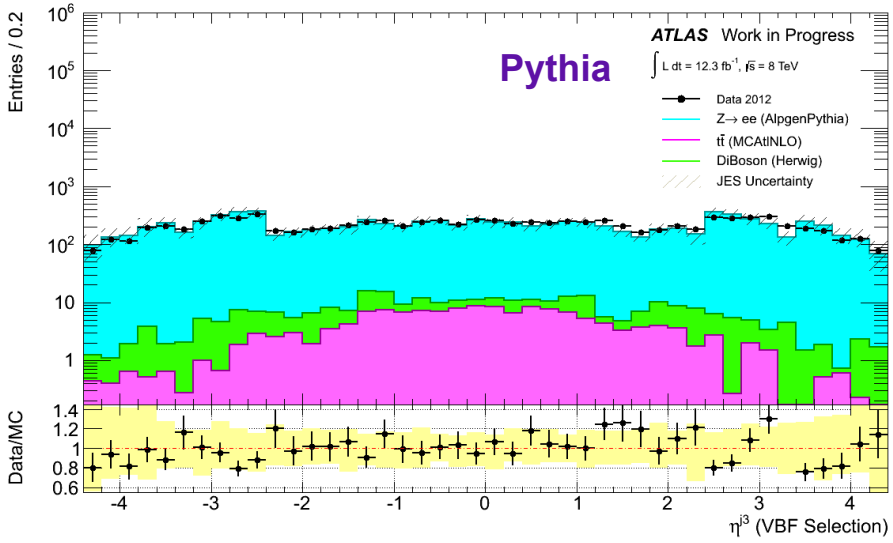
Third Jet pt





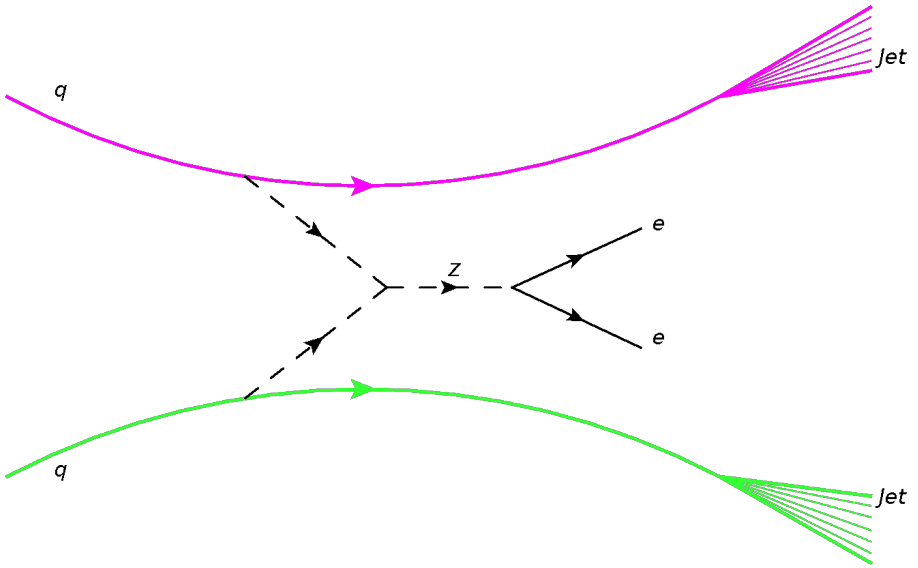
Third Jet eta



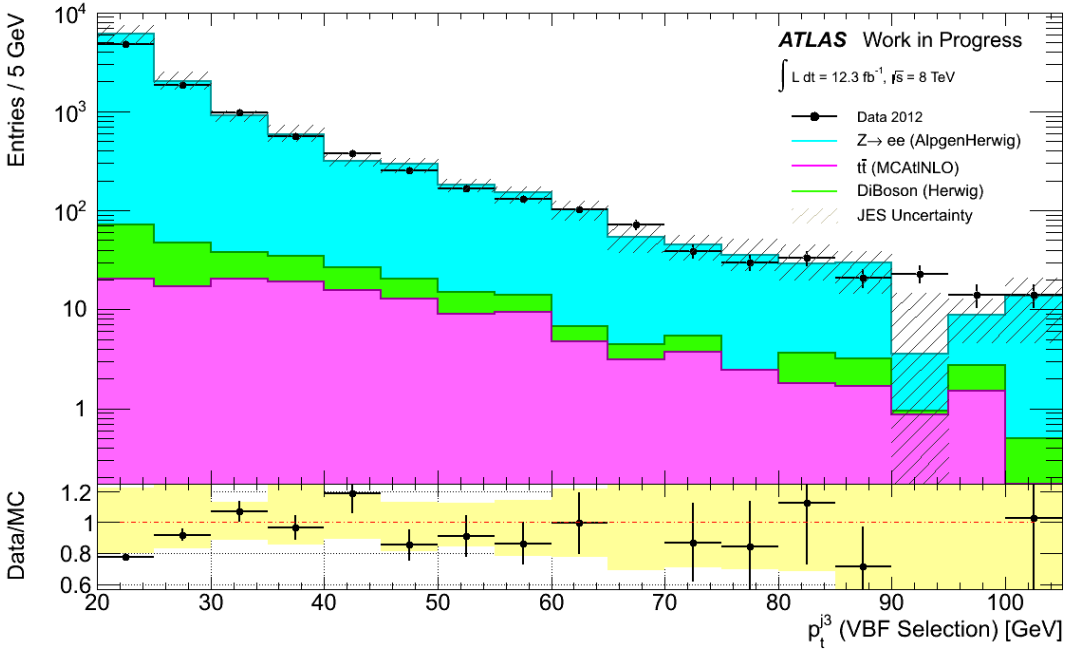


- agreement within JES uncertainty

Jet Veto Efficiency



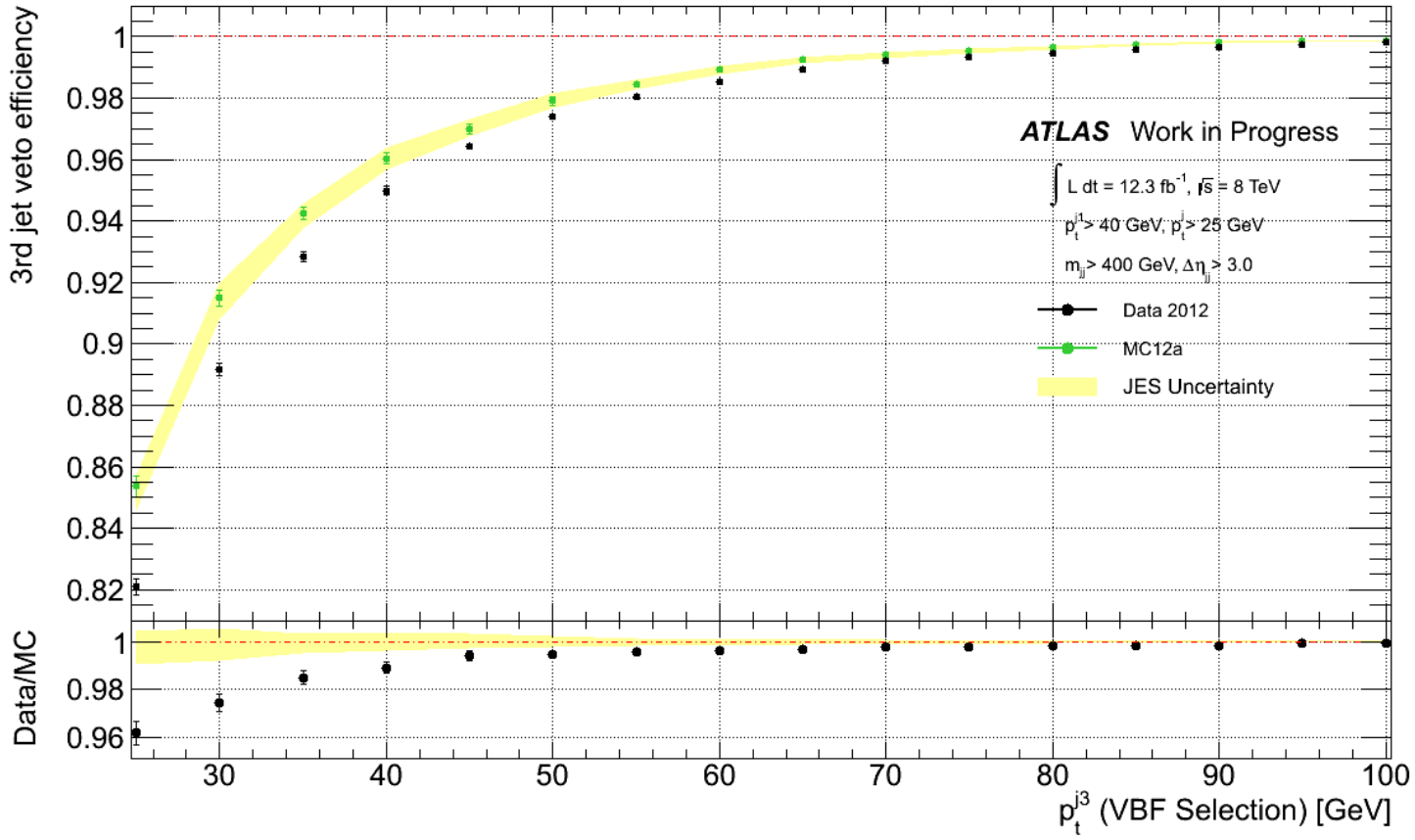
- VBF signal events – no colour flow
- QCD radiation supressed
- BG events additional jets → introduce Jet veto



- Performance of veto: efficiency

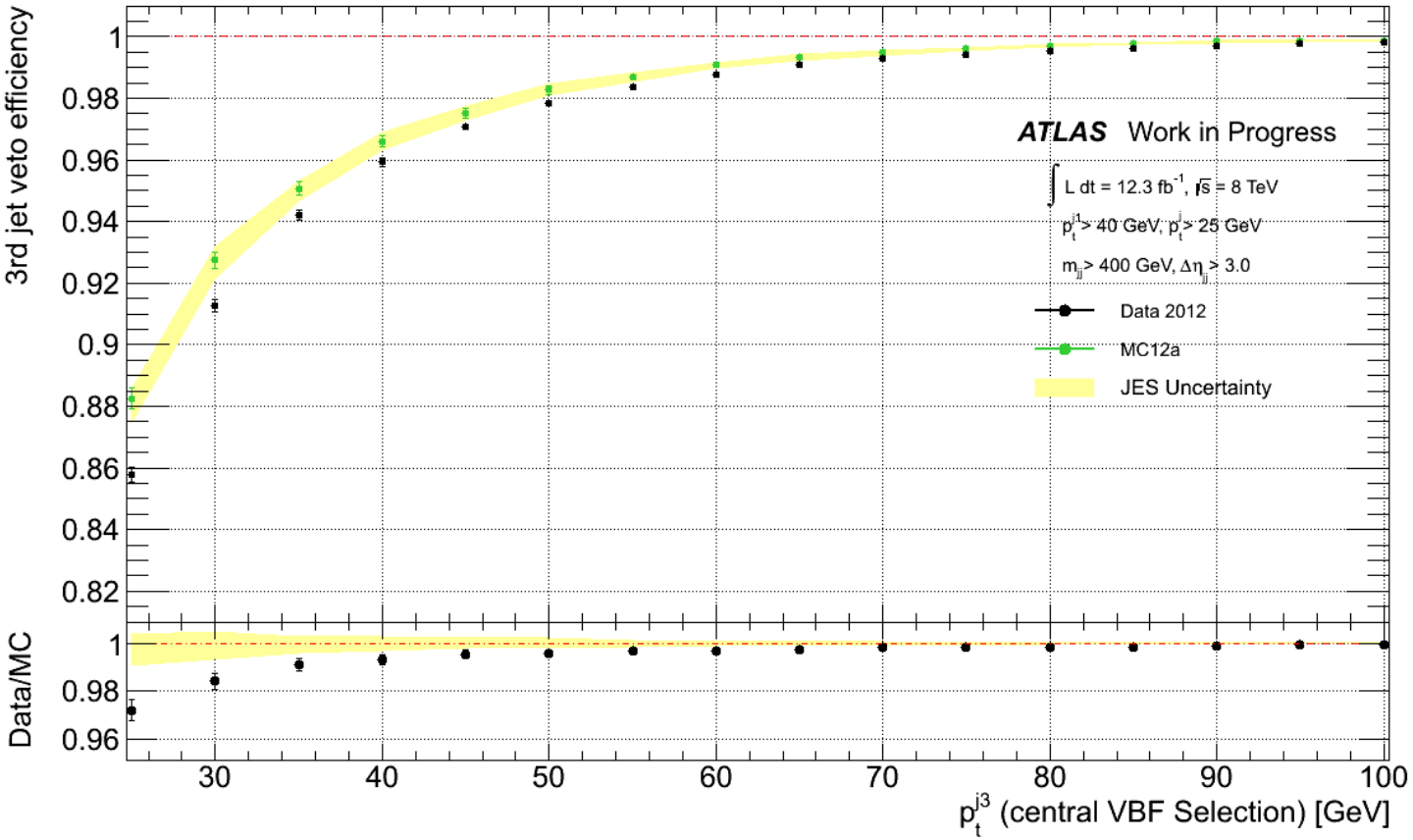
$$\varepsilon_x = 1 - \frac{\text{Number of events with } p_t(j3) > x \text{ GeV}}{\text{Number of VBF events}}$$

Jet Veto Efficiency



- No big difference between AlpgenPythia and AlpgenHerwig (BackUp, 3rd jet pt plots)
- Alpgen efficiency predicition for low pt veto thresholds ~ 4% too high

Jet Veto Efficiency with centrality

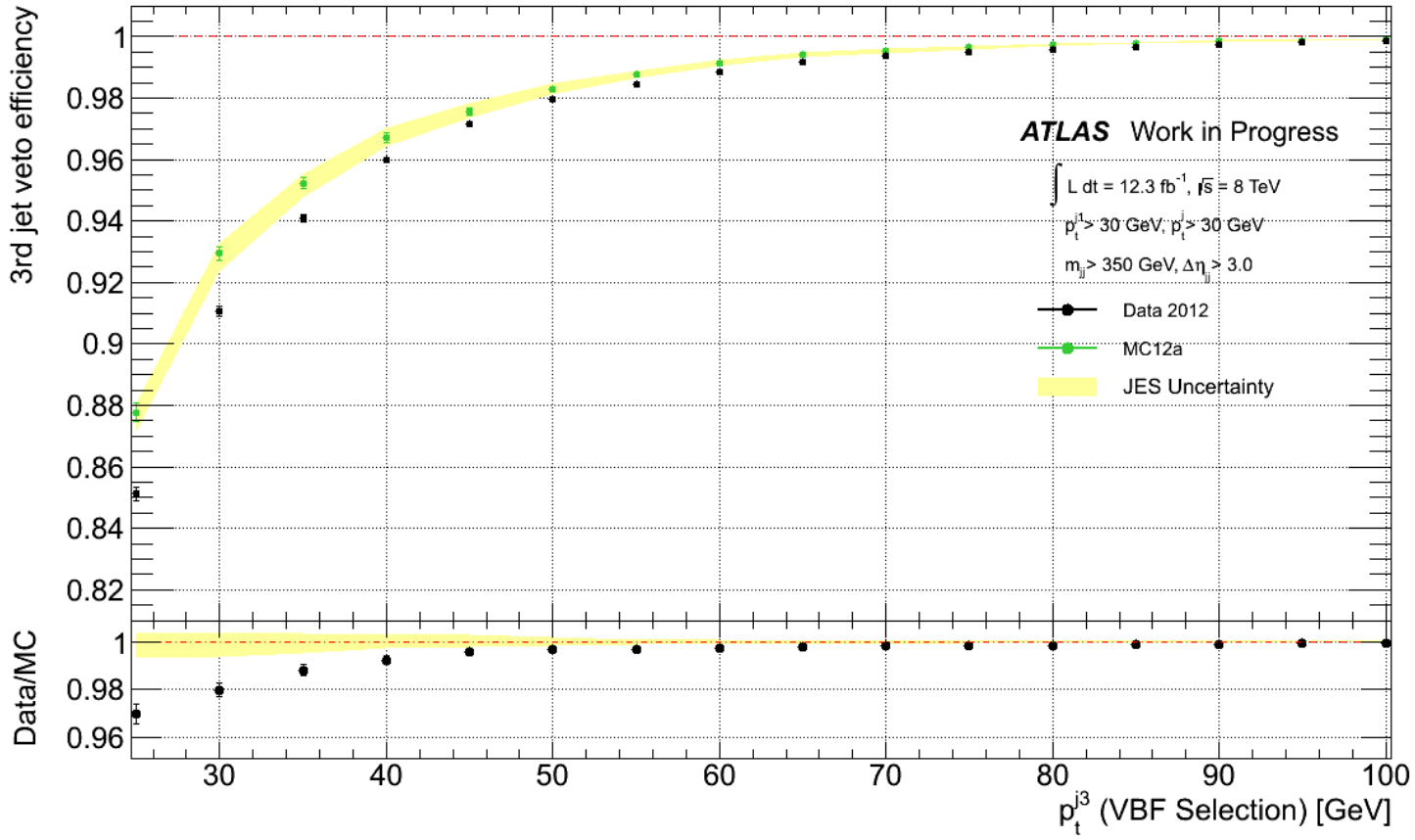


- Additional centrality requirement for 3rd jet:

$$\eta_{1/2} < \eta_3 < \eta_{2/1}$$

- higher efficiency in low pt range
- improvement in prediction of data

Jet Veto Efficiency with 7 TeV selection

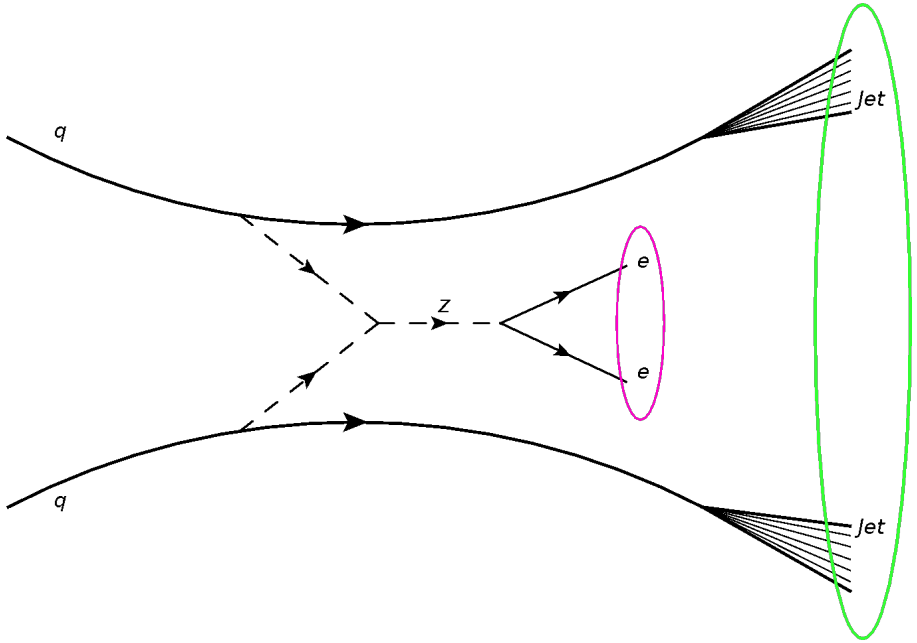


- Selection for 7 TeV (compare Katharinas talk)
  - Zee selection
  - pt(leading jet) > 30 GeV
  - pt(subleading jet) > 30 GeV
  - Rapidity Gap $\Delta\eta > 3.0$
  - Dijetmass $m(j_1, j_2) > 350$ GeV

- similiar to first selection, no big changes

Summary

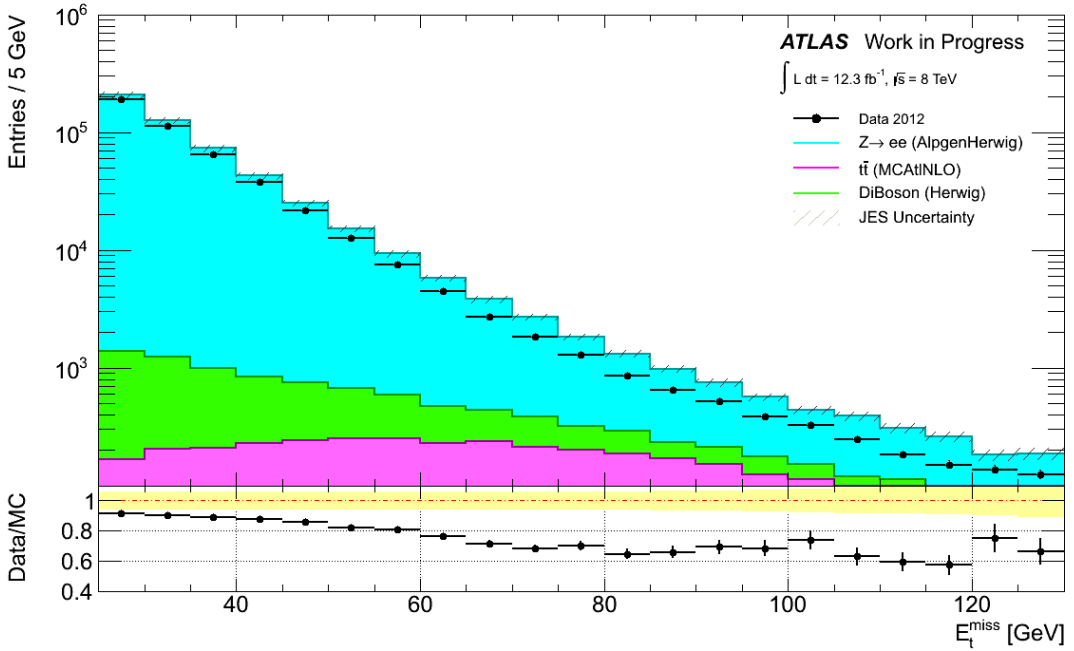
- reconstructed VBF Zee events and compared distributions for different PS generators
- AlpgenHerwig shows discrepancies for VBF relevant variables – namely the rapidity gap
- Performance of AlpgenPythia closer to data, within systematics good agreement
- description of Jet Veto efficiency around 4% off for pt < 35 GeV
- centrality requirement improves efficiency slightly

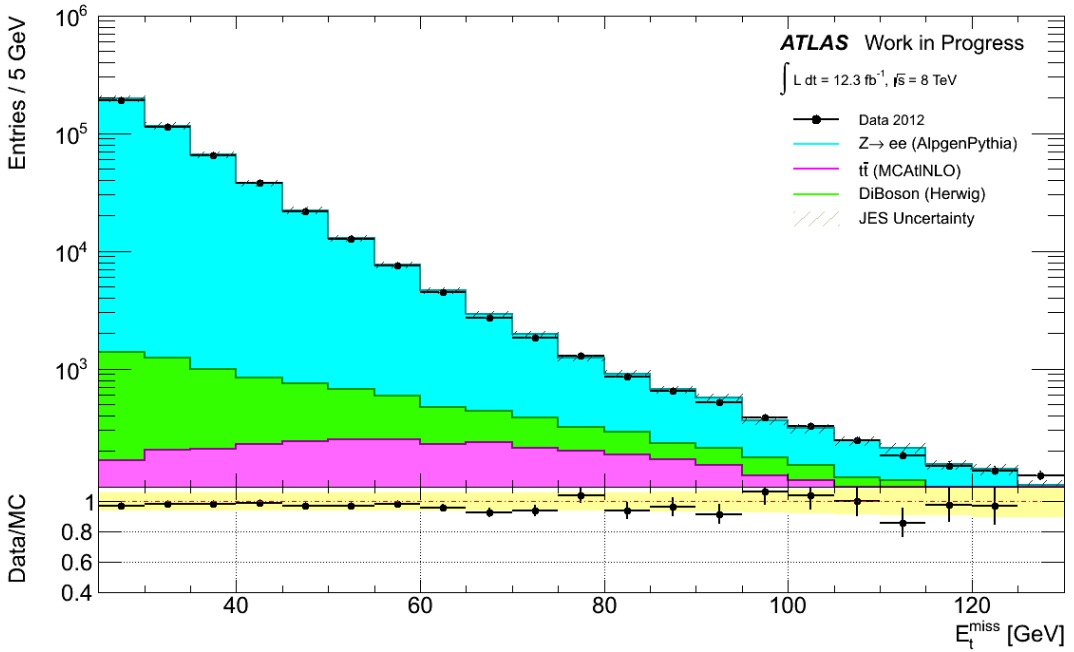


Backup

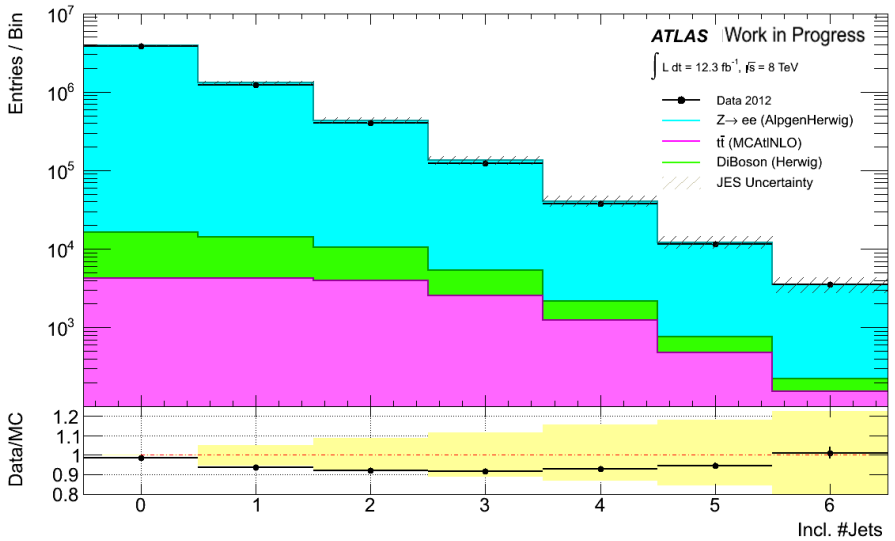
Zee selection – MET_RefFinal_STVF_et

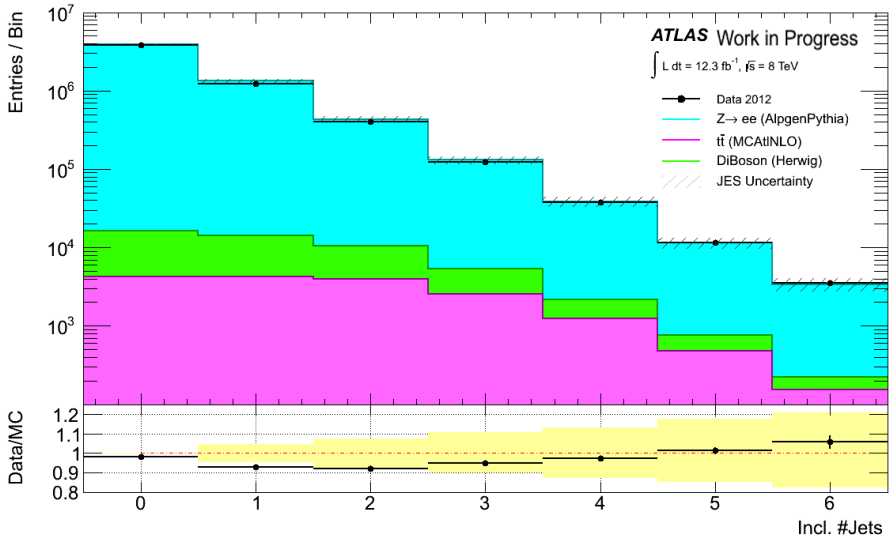
- Impact of Herwig configuration Bug on MET mismodelling
- Histogram shows MET_RefFinal_STVF_et
- Alpgen+Pythia agrees better (high MET)



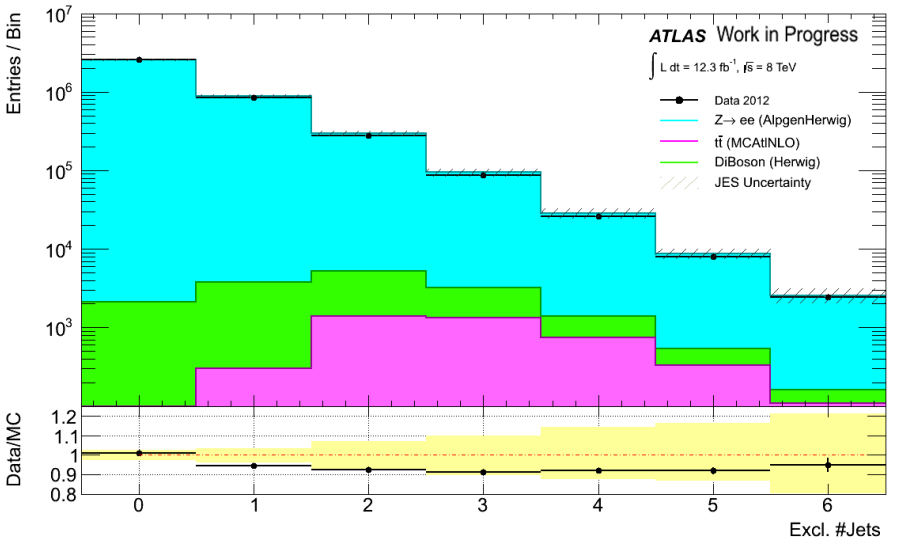


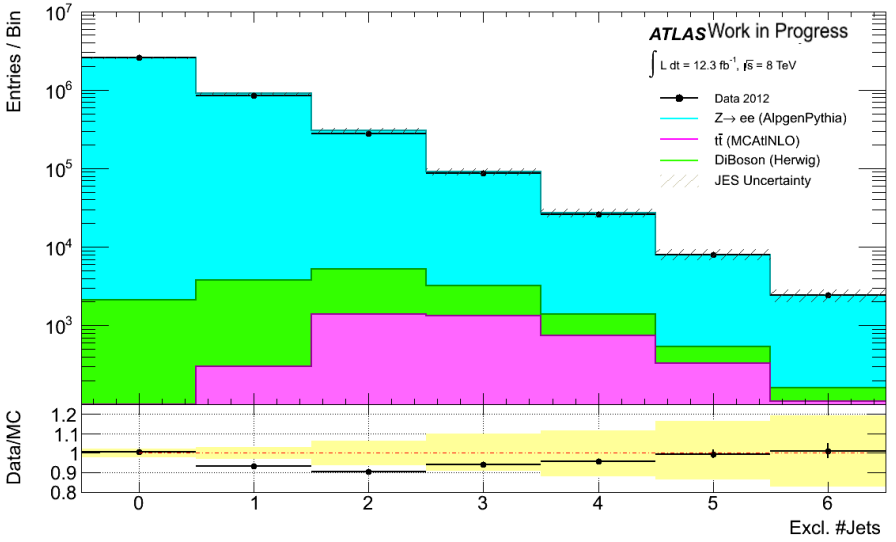
Inclusive Jet Multi Zee Selection



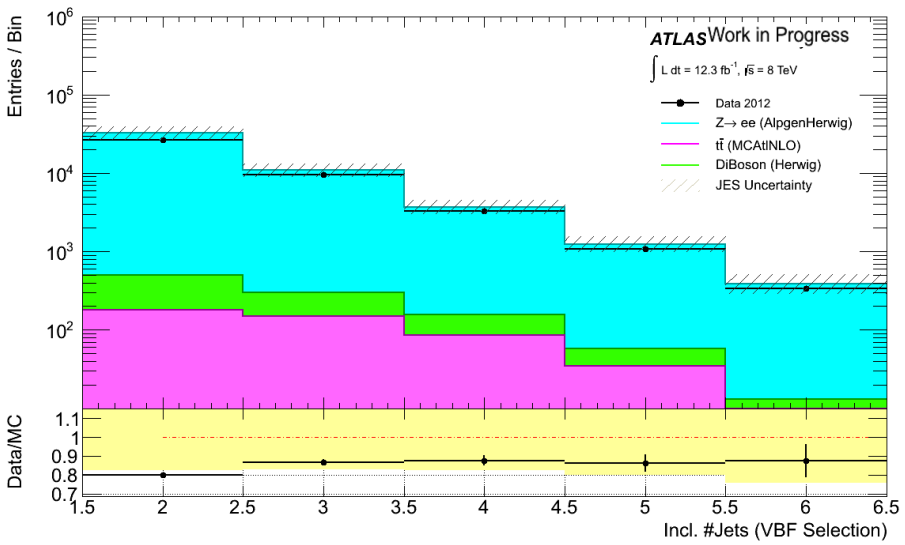


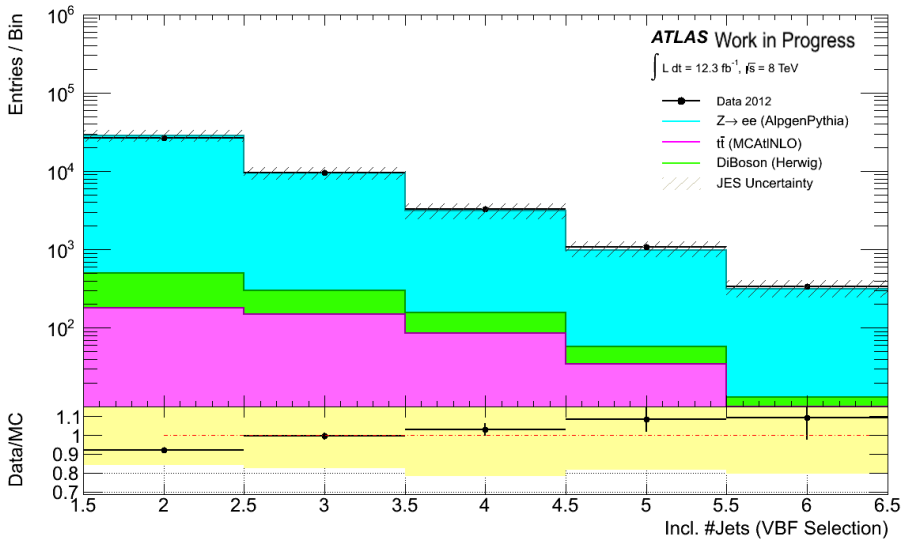
Exclusive Jet Multi Zee Selection



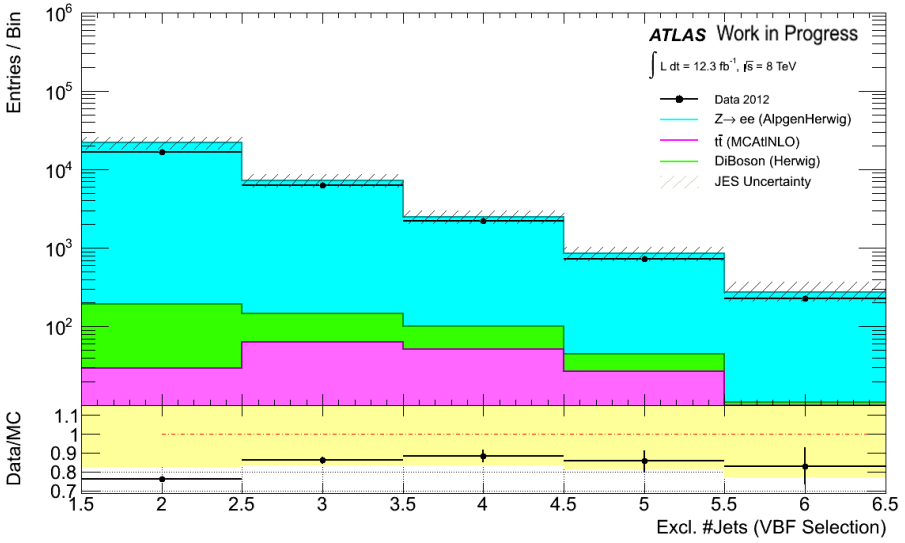


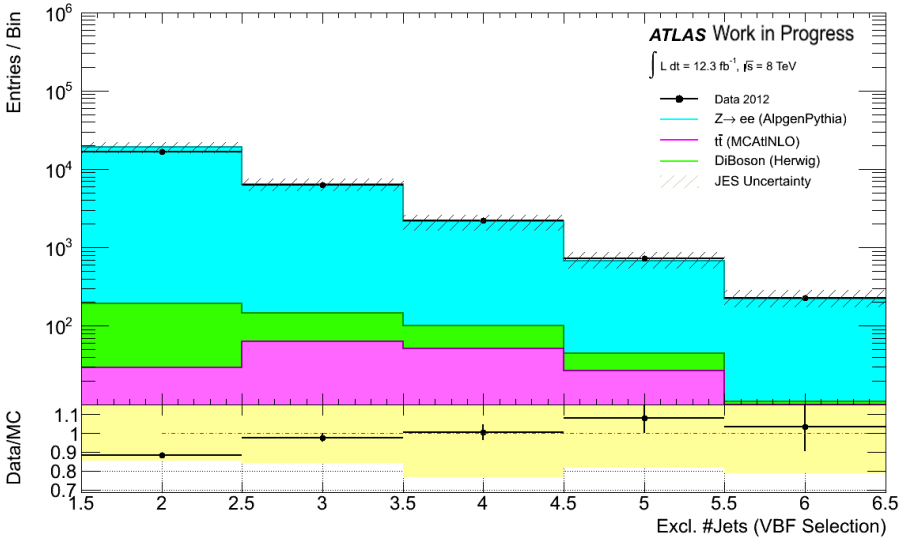
Inclusive Jet Multi VBF Zee Selection



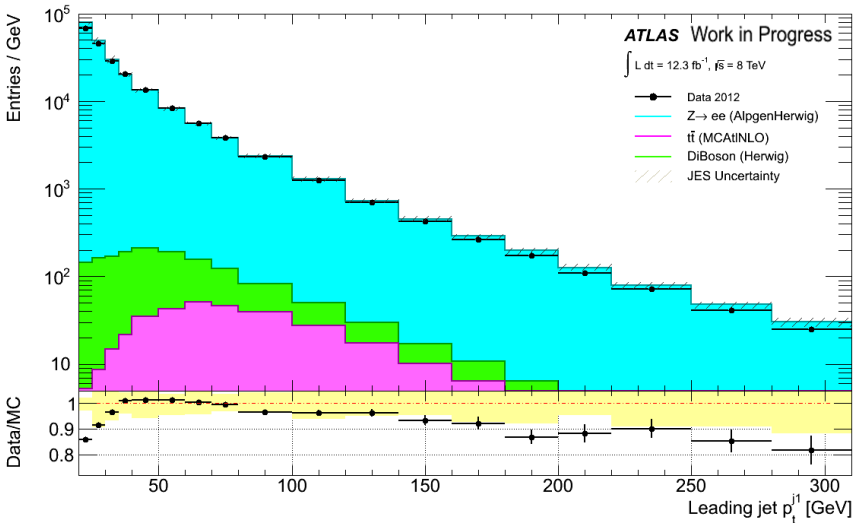


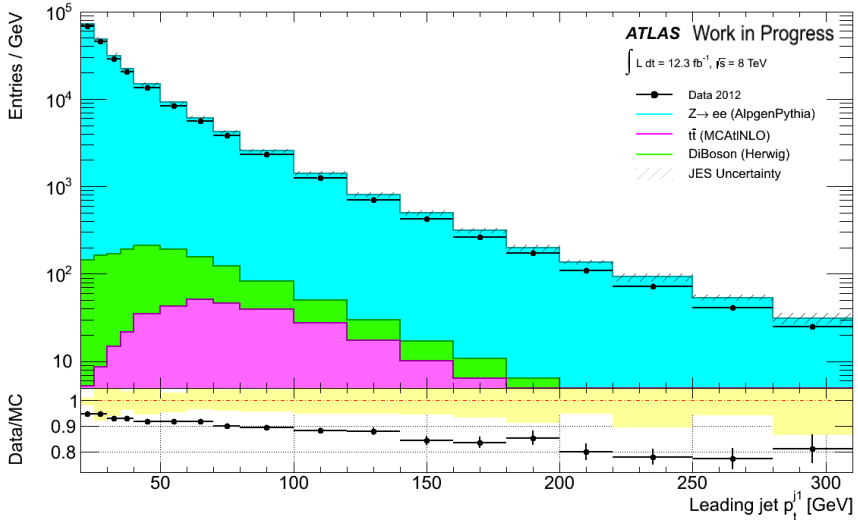
Exclusive Jet Multi VBF Zee Selection





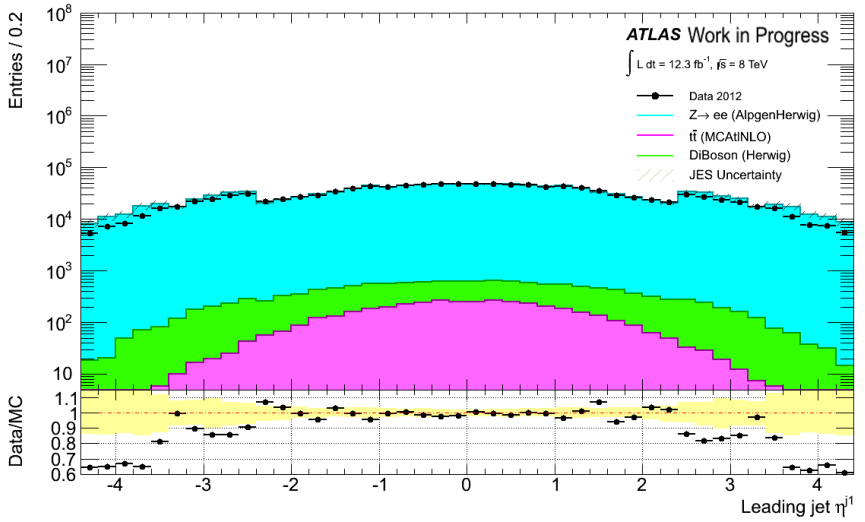
Leading jet pt

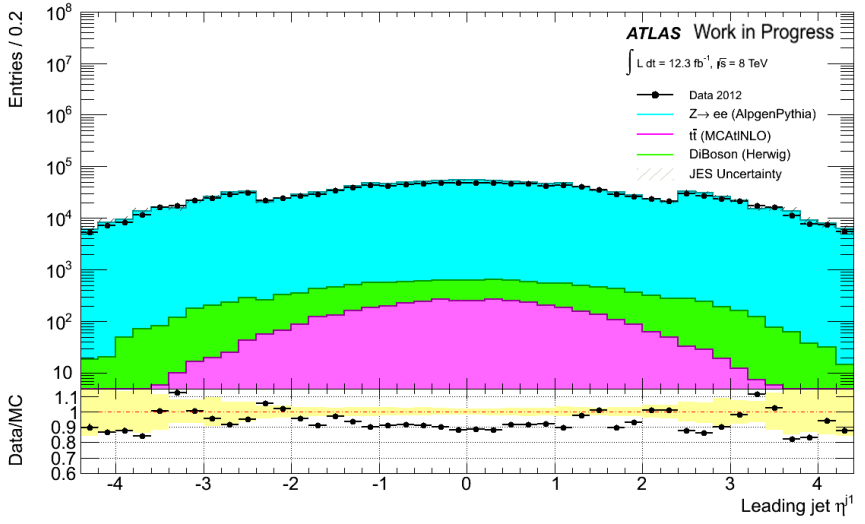




- Tendency of overshooting with AlpgenPythia for pt>50 GeV

Leading jet eta





- Central region undershooted

Jet Veto Efficiency

Only very small difference to Alpgenpythia (BackUp)