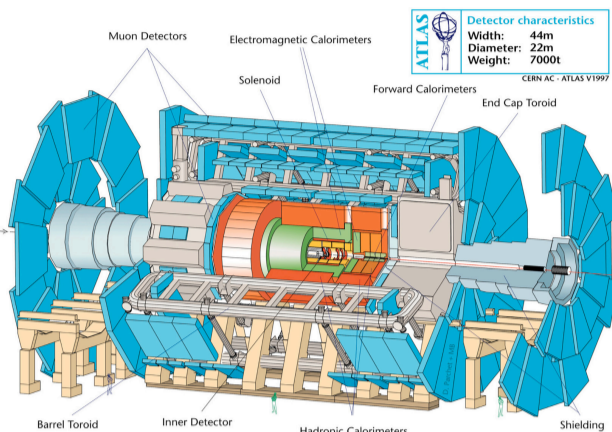


## Jet Physics with ATLAS

Jet production, governed by QCD, is the most dominant process of the LHC proton-proton collisions. Hence, studying jets is an important first step of the LHC program. Before we can expect to understand other fundamental physics, a good understanding of jets is required. Furthermore, with LHC's unprecedented center-of-mass collision energy of 7 TeV, and ATLAS's wide pseudo-rapidity coverage, we are probing QCD in a new kinematic regime. Impressive agreement is observed between data and theory.

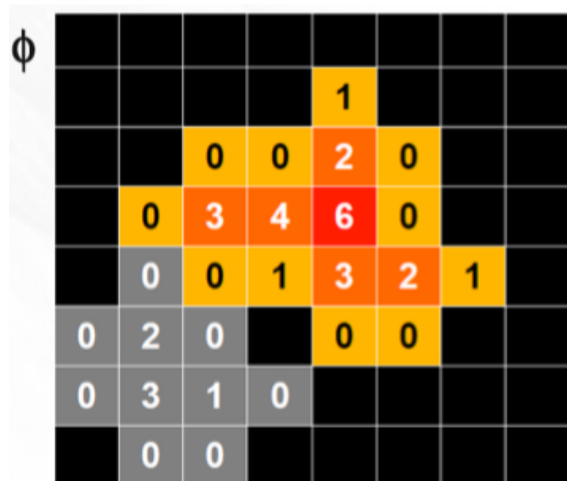
### The ATLAS Detector



- ATLAS (A Toroidal LHC Apparatus) is a general purpose detector of the LHC
- Excellent calorimetry spanning  $|\eta| < 4.9$  in pseudo-rapidity
- Design specification for the jet energy resolution is given by  $\sigma/E = 0.5/\sqrt{E} \oplus 0.03$

### Jet Reconstruction

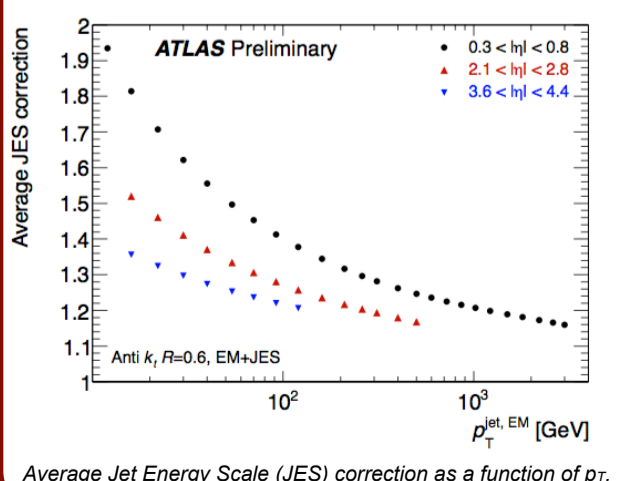
- Jets are reconstructed using the Anti- $k_T$  jet algorithm. Default jet sizes are  $R=0.4$  &  $0.6$
- The input objects are 3-D topological clusters, built from calorimeter cells, following a '4-2-0' noise-suppression technique:
  1. Start with a seed cell, which has the highest energy deposit amongst its neighbours and  $|E| > 4\sigma_{\text{noise}}$
  2. Include neighbouring cells with  $|E| > 2\sigma_{\text{noise}}$
  3. Include last layer of cells with  $|E| > 0\sigma_{\text{noise}}$



Not a cluster!

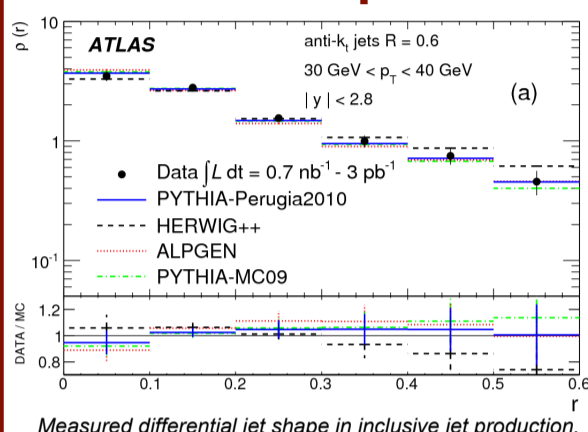
### Jet Calibration

1. Based on the number of additional p-p interactions, excess energy due to pile-up is corrected for (subtracted) at the electromagnetic energy scale
2. Each cluster is made to point to the primary vertex of the event, not the detector center
3. Jet energy and direction are corrected for instrumental effects such as non-compensation and material in front of calorimeter



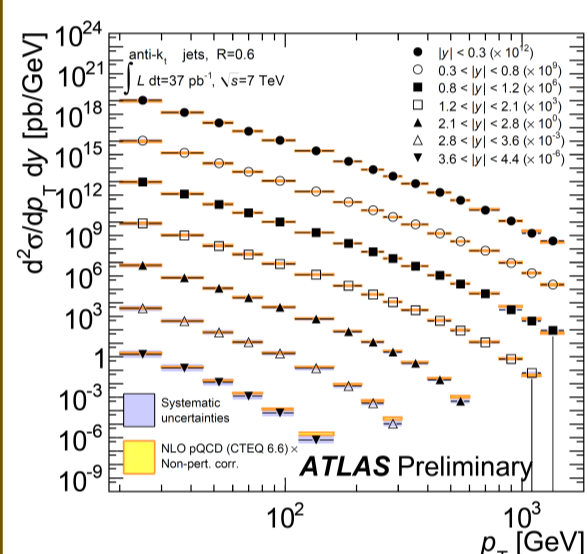
Average Jet Energy Scale (JES) correction as a function of  $p_T$ .

### Jet Shapes

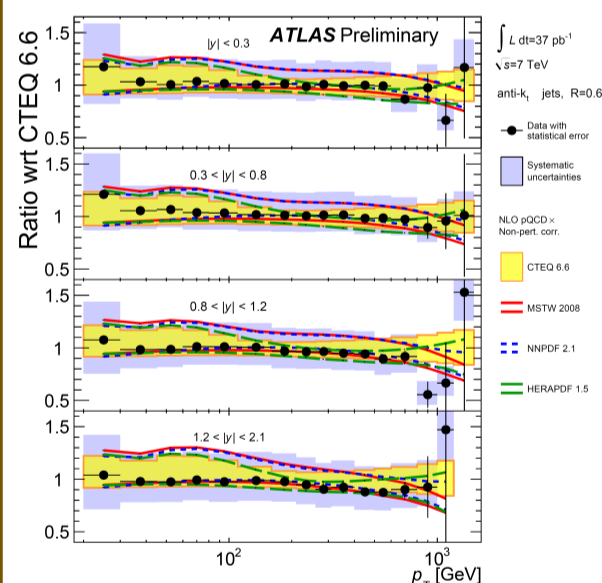


Measured differential jet shape in inclusive jet production.

### Inclusive Jet Cross Section

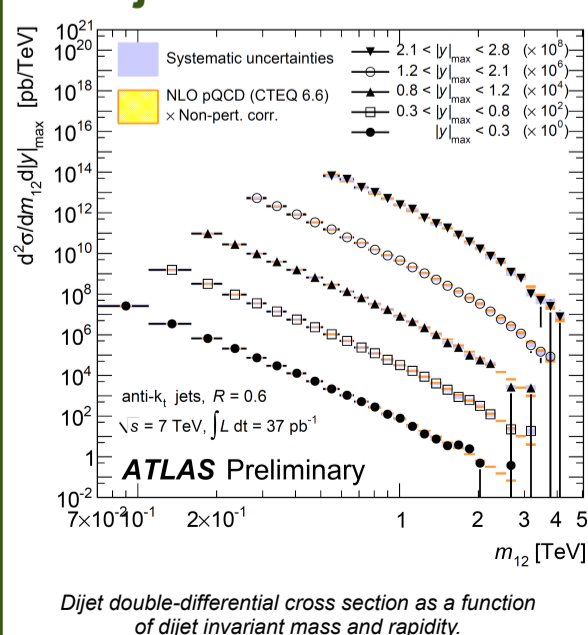


Inclusive jet double-differential cross section as function of jet transverse momentum ( $p_T$ ) and rapidity ( $y$ ).



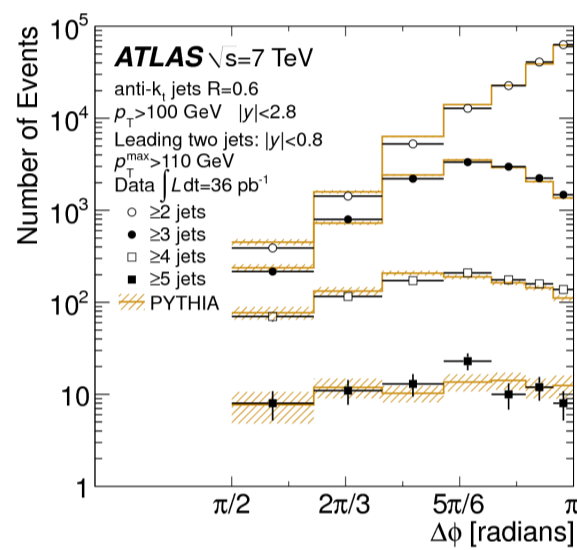
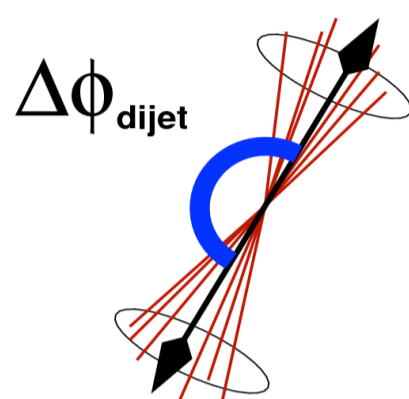
Inclusive jet cross section comparisons to theoretical predictions using different PDF sets. CTEQ 6.6 is chosen as the reference.

### Dijet Cross Section

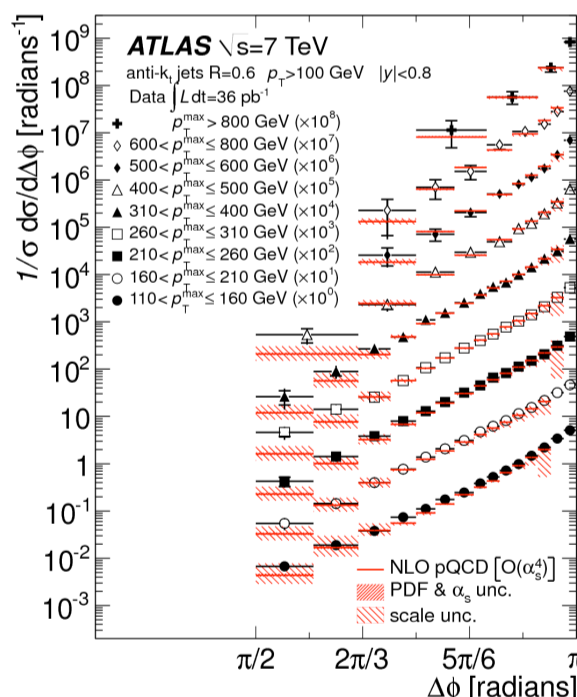


Dijet double-differential cross section as a function of dijet invariant mass and rapidity.

### Dijet Azimuthal Decorrelations

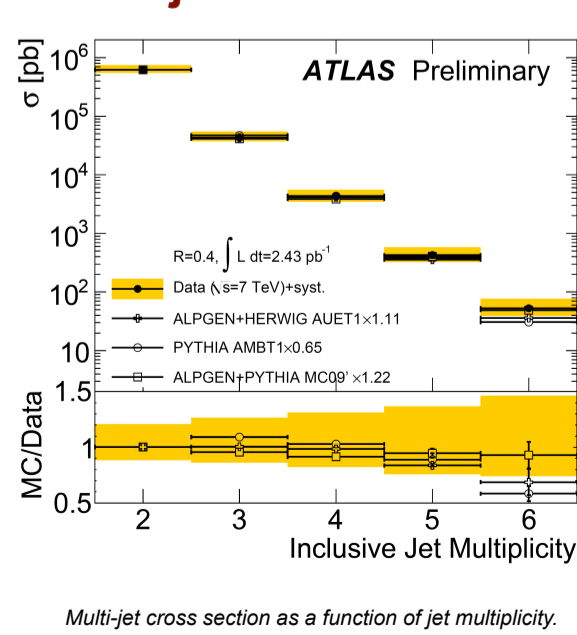


The  $\Delta\phi$  distribution for different numbers of final state jets.



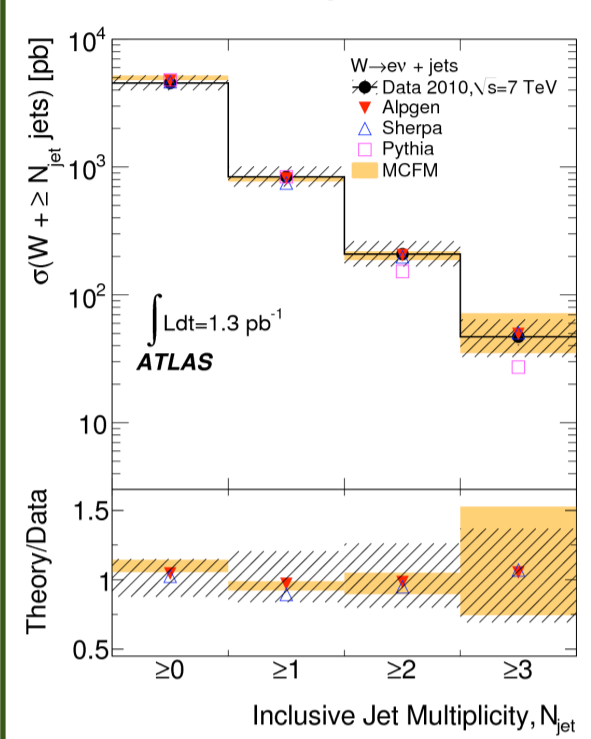
Relative differential cross section as a function of  $\Delta\phi$  binned in nine different  $p_T$  regions.

### Multi-jet Cross Section

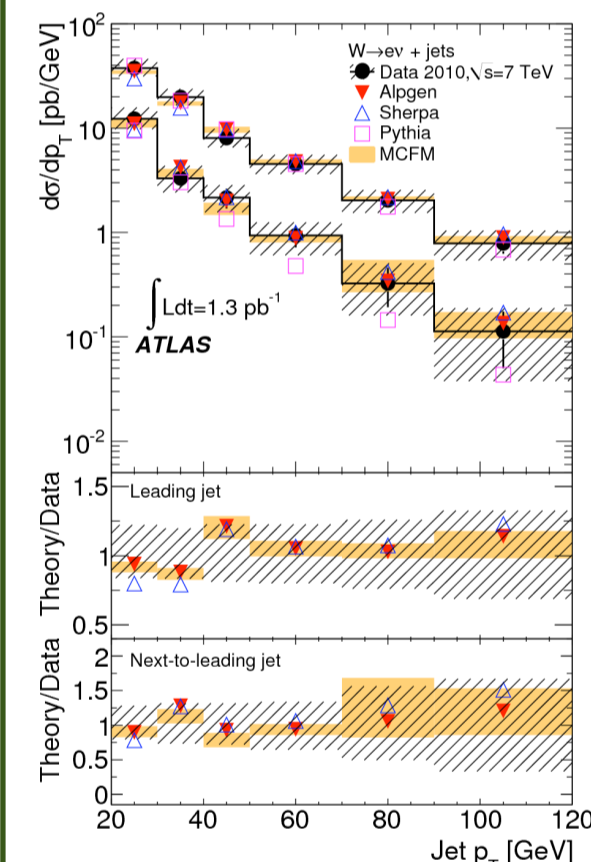


Multi-jet cross section as a function of jet multiplicity.

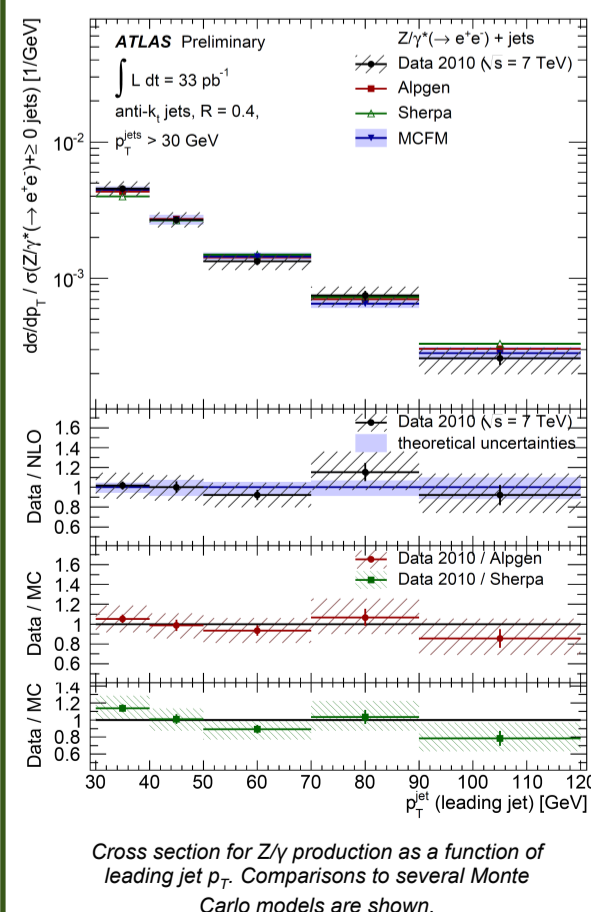
### W/Z+jets



Cross section for W production as a function of jet multiplicity. Jets are required to have  $p_T > 20$  GeV and  $|\eta| < 2.8$ .



Cross sections for W production as a function of  $p_T$  of each of the two leading jets.



Cross section for Z/gamma production as a function of leading jet  $p_T$ . Comparisons to several Monte Carlo models are shown.