Early ATLAS Results

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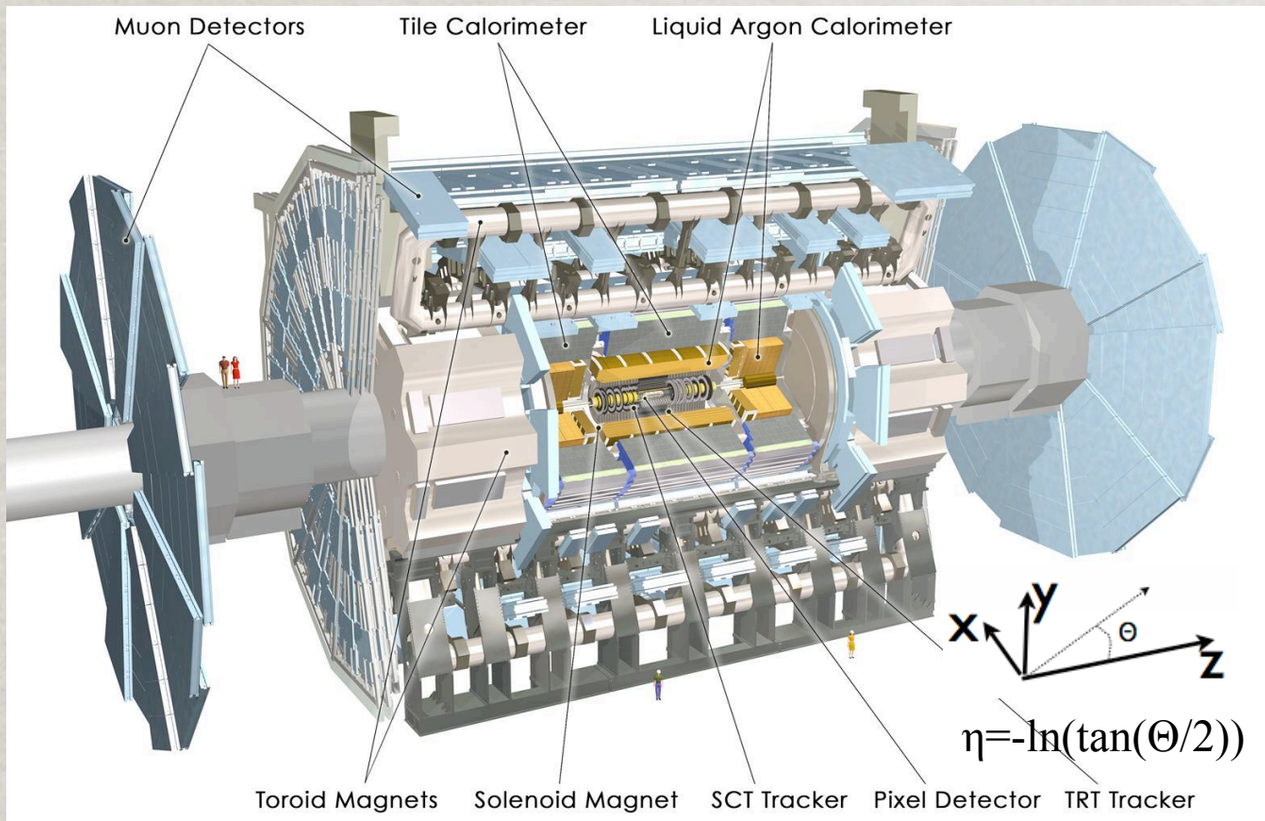
For the ATLAS Collaboration

OUTLINE

- ATLAS Status
- Luminosity Delivered
- Trigger Commissioning
- Performance Measurements
- First high P_T measurements
- For more info look to pLHC talks and https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/

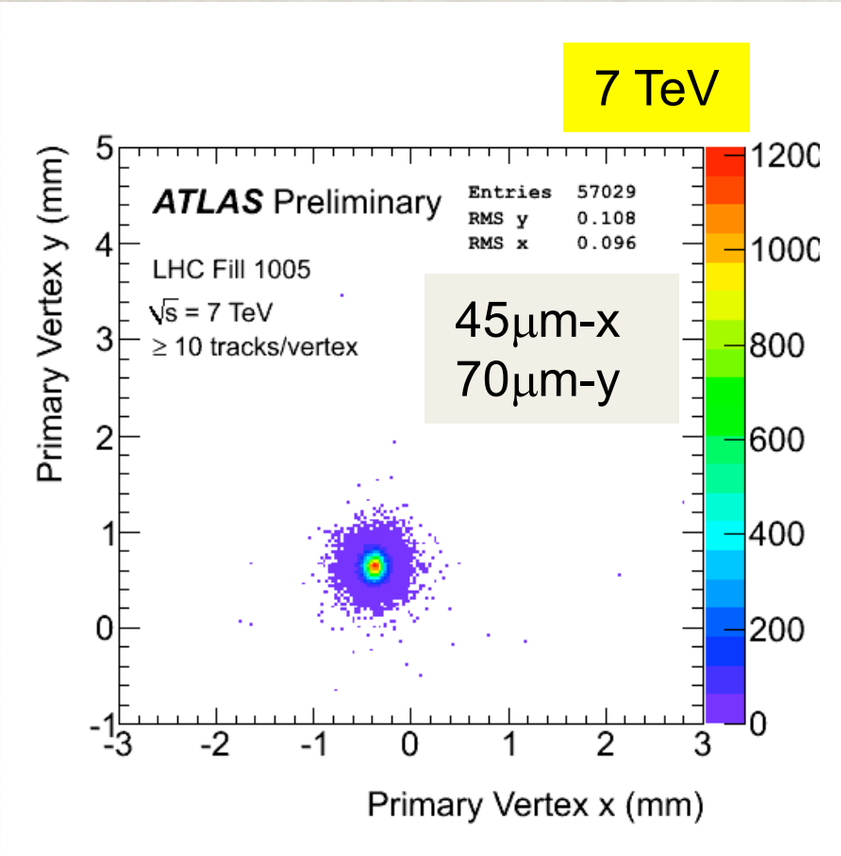
ATLAS STATUS

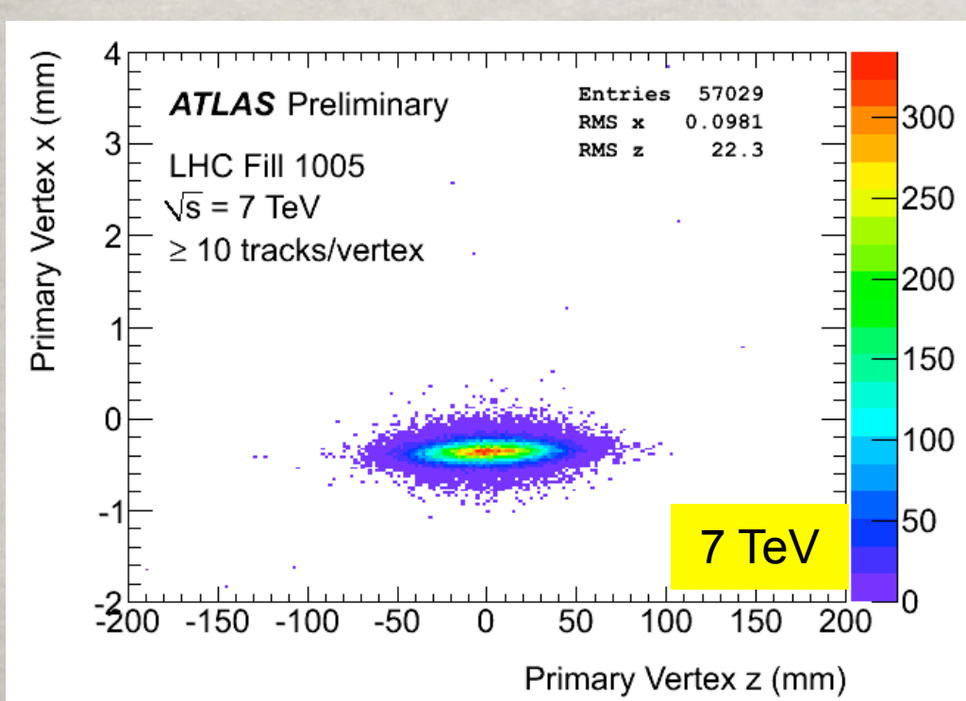


7000 Tons
25 m height
46 m length
0.1 billion channels

Detector	Channels	% Operational
Pixel	80 M	97.5%
SCT	6.3 M	99.3%
TRT	350 K	98%
Lar EM CAL	170 K	98.5%
Tile Cal	9800	97.3%
HEC	5600	99.9%
Forward LAr	3500	100%
Calo Trigger	7160	99.8%
muon RPC Trigger	370K	99.7%
muon TGC Trigger	320K	100%
MDT	350 K	99.7%
CSC	31 K	98.5%
RPC	370 K	97.3%
TGC	320 K	98.8%

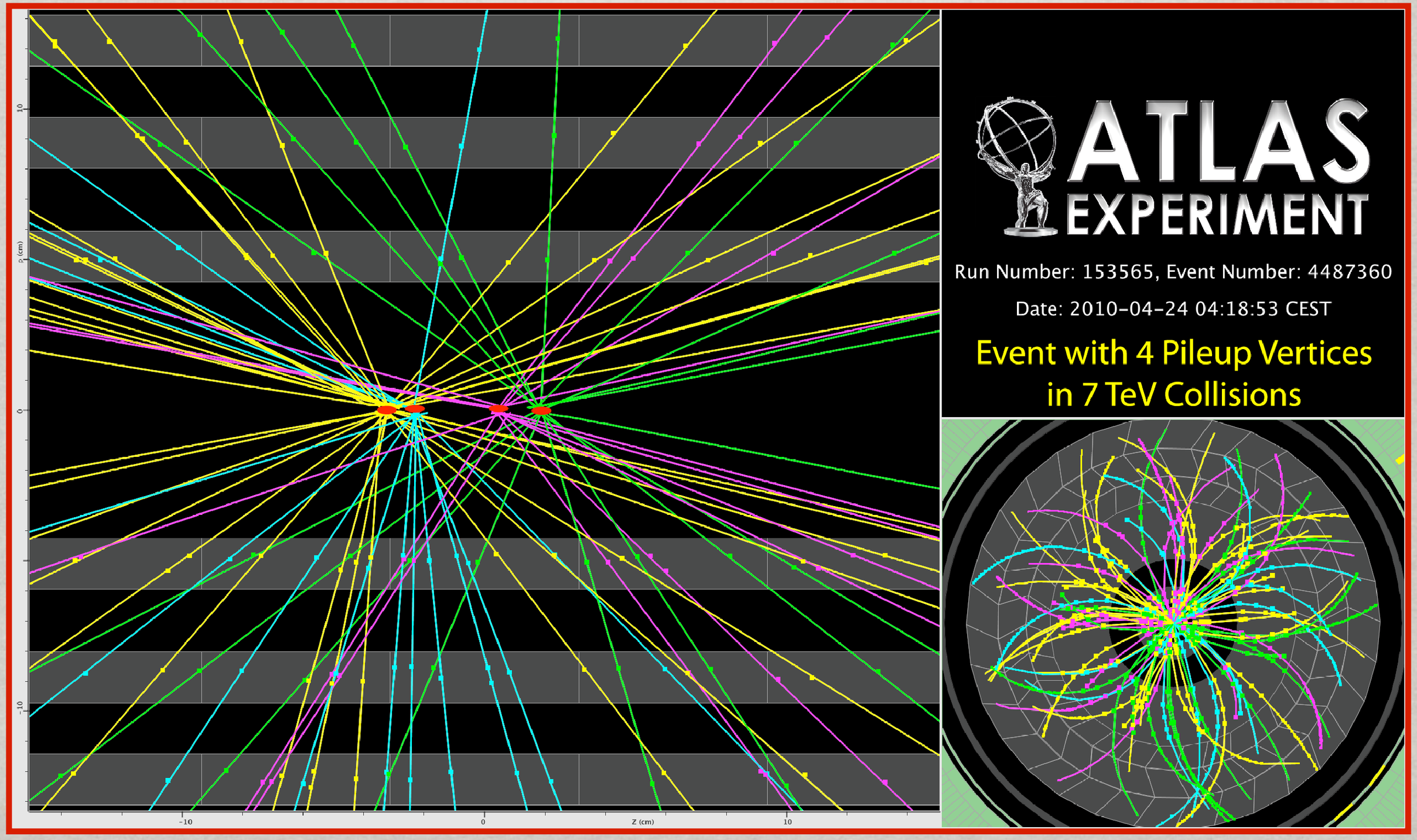
Beam Conditions





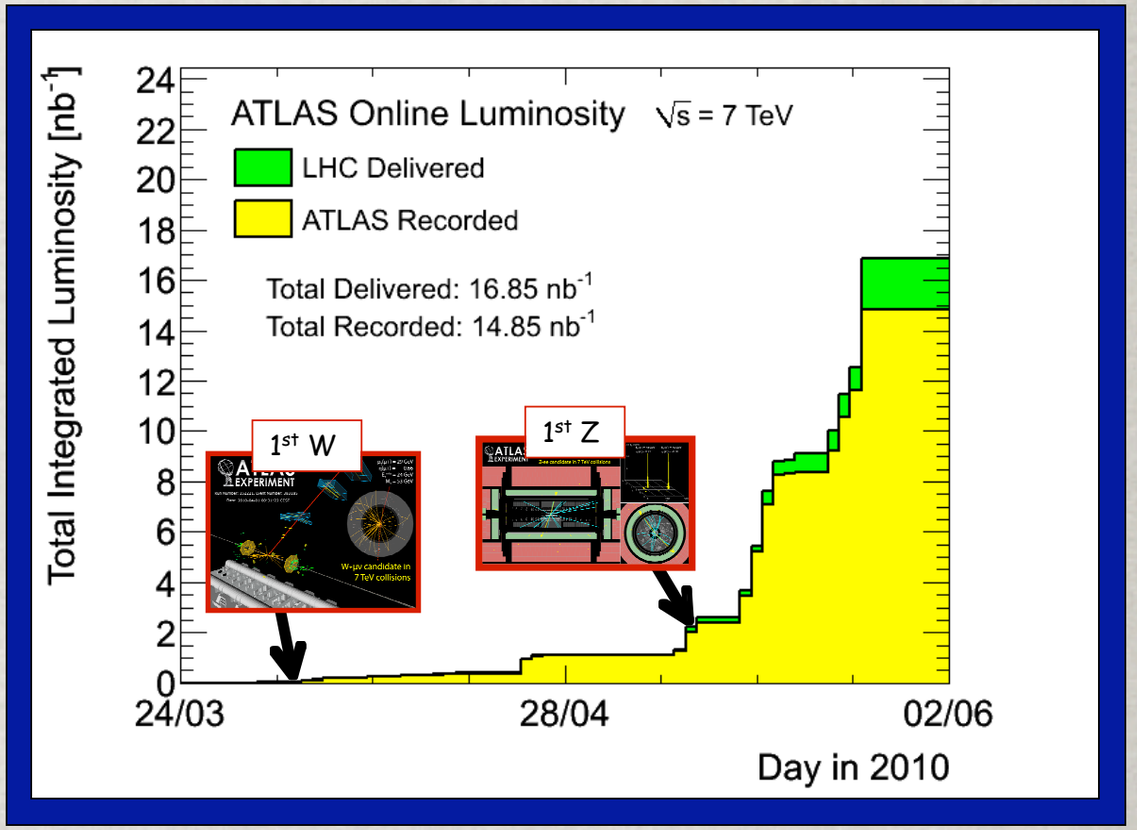
- very stable beam conditions within fill
- some pileup events already!

Multi-vertex event



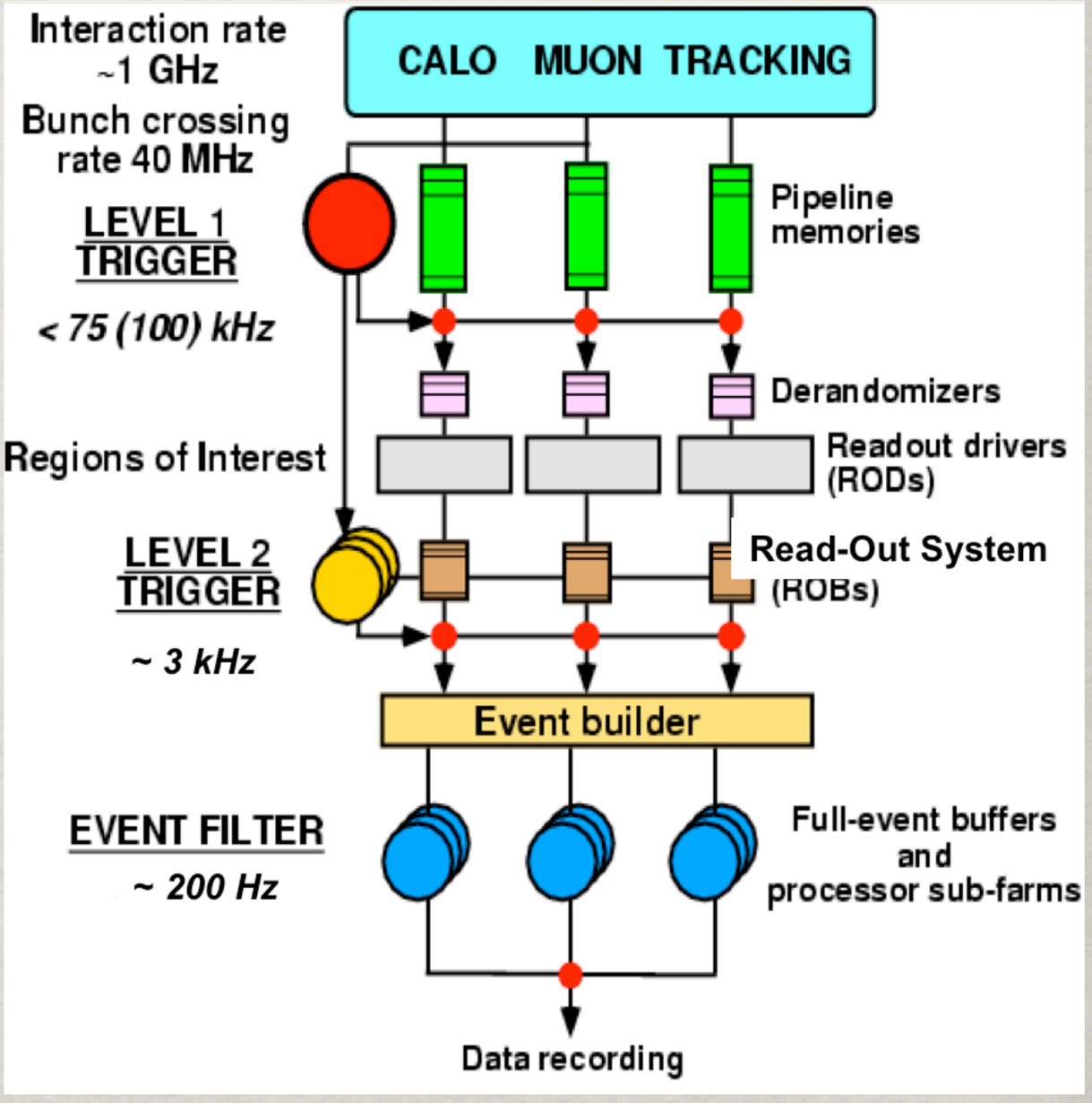
Luminosity

- Will reach 10^{31} by end of year? 10^{32} by end of run
- hope for 100 pb^{-1} by end of year? 1 fb^{-1} by end of the run
- closing in on 100 nb^{-1} soon

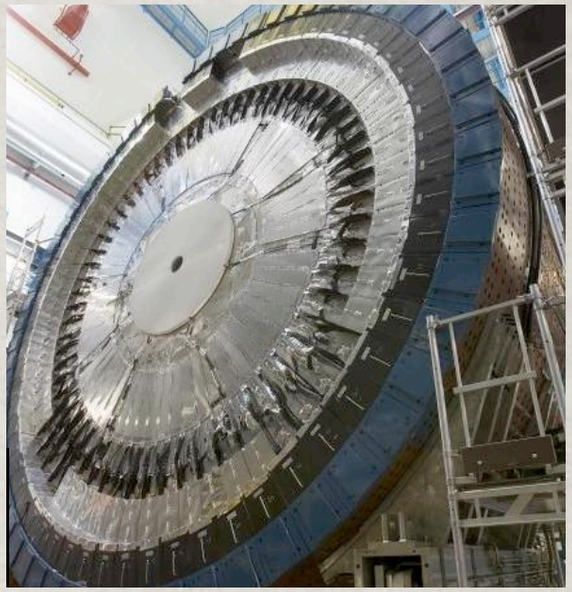


Triggers

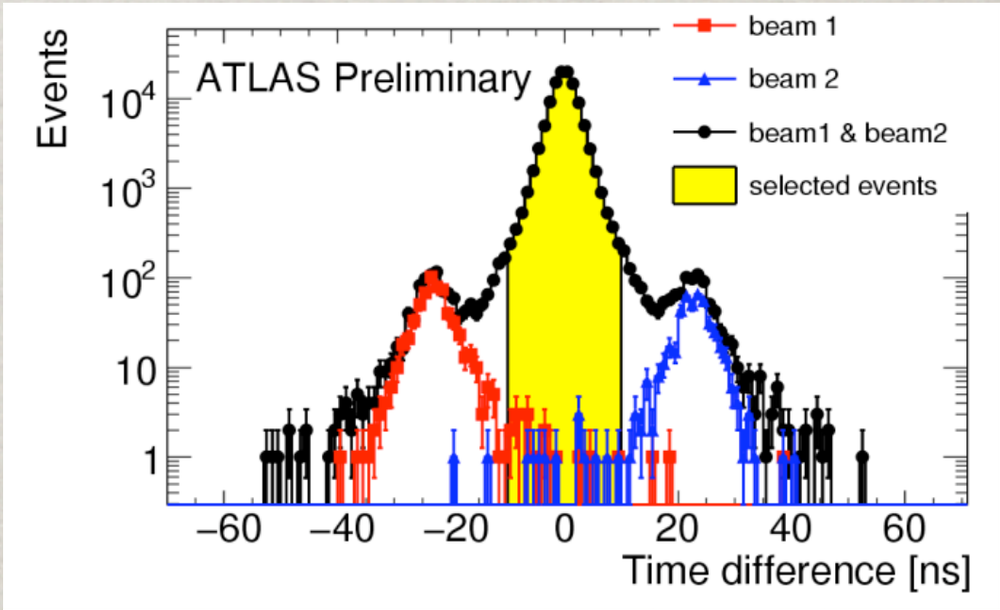
- At startup ran with only LVL1
- HLT in pass through for most chains
- Commission triggers with data



Minbias Trigger



- 16 x 2 counters
- used for dn/dη paper
- efficiencies from high rate random trigger



Trigger Menu

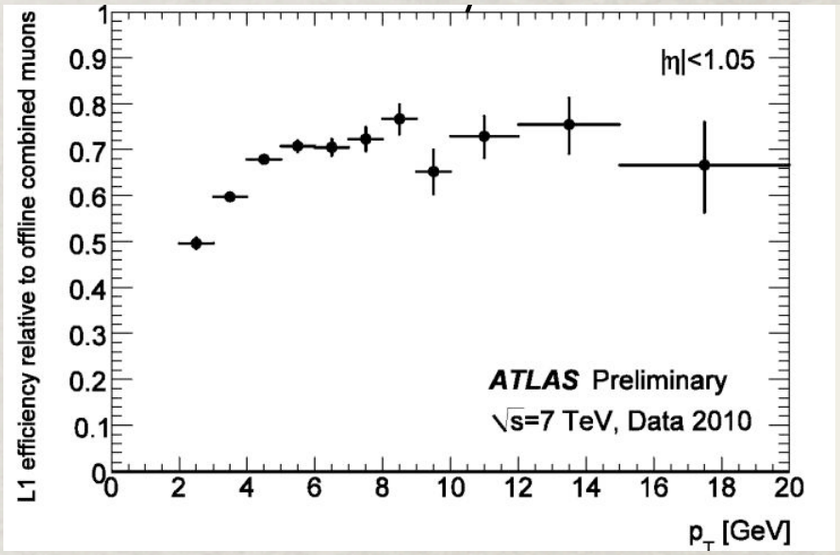
- At the moment relying mostly on L1
- minbias and lowest threshold em trigger rejecting events at HLT

Simplified Menu

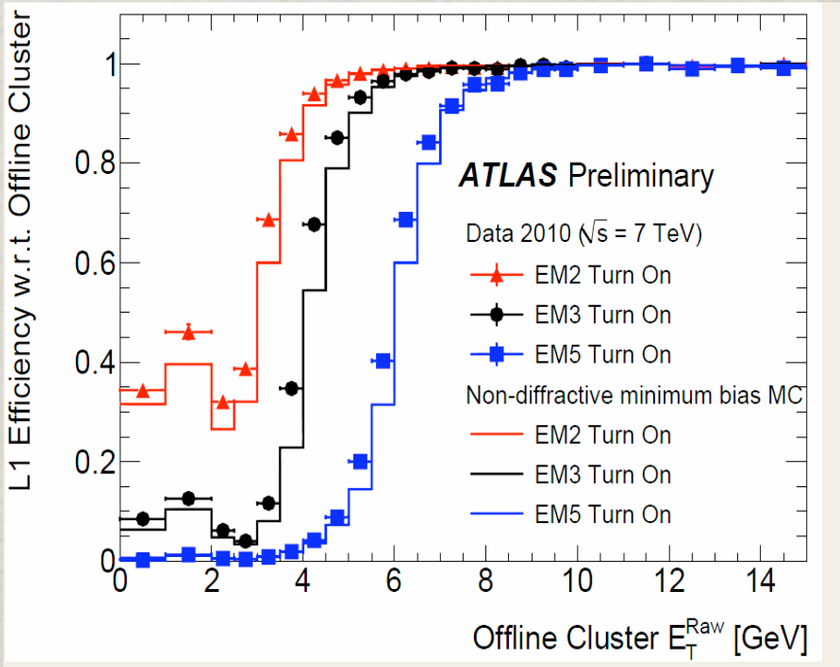
Object	Lowest L1 Threshold	Lowest HLT Threshold
Electron/ Photon	EM2	e3
Tau	Tau 5	tau 12
Muon	Mu 4	mu 4
Met	XE 10	xe 20
Jet	J5	j20

Understanding Triggers

mu4



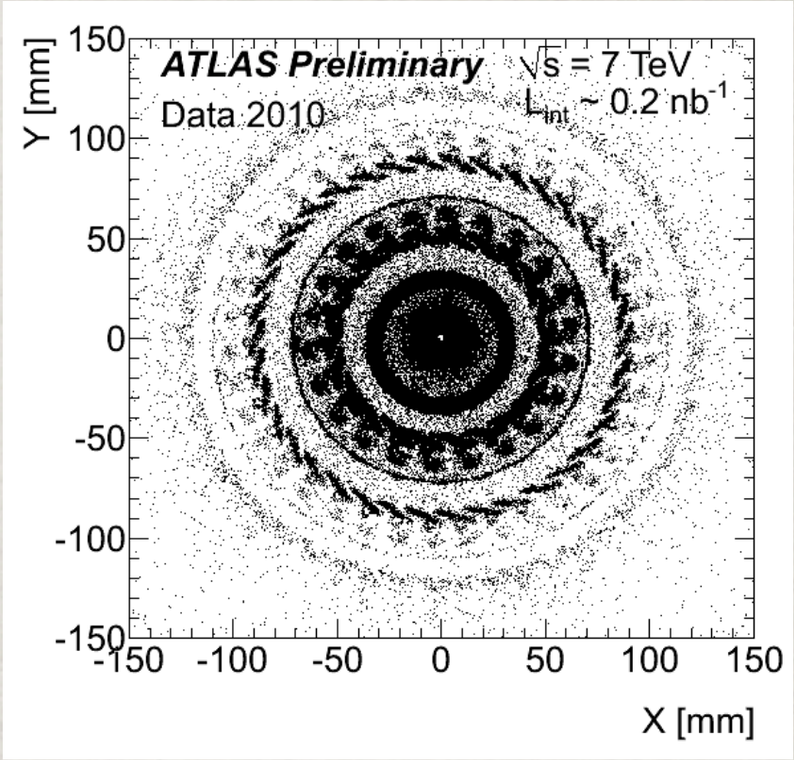
- Turn on curves relative to offline reconstruction
- Most object triggers functioning as expected
- Muon timing being adjusted

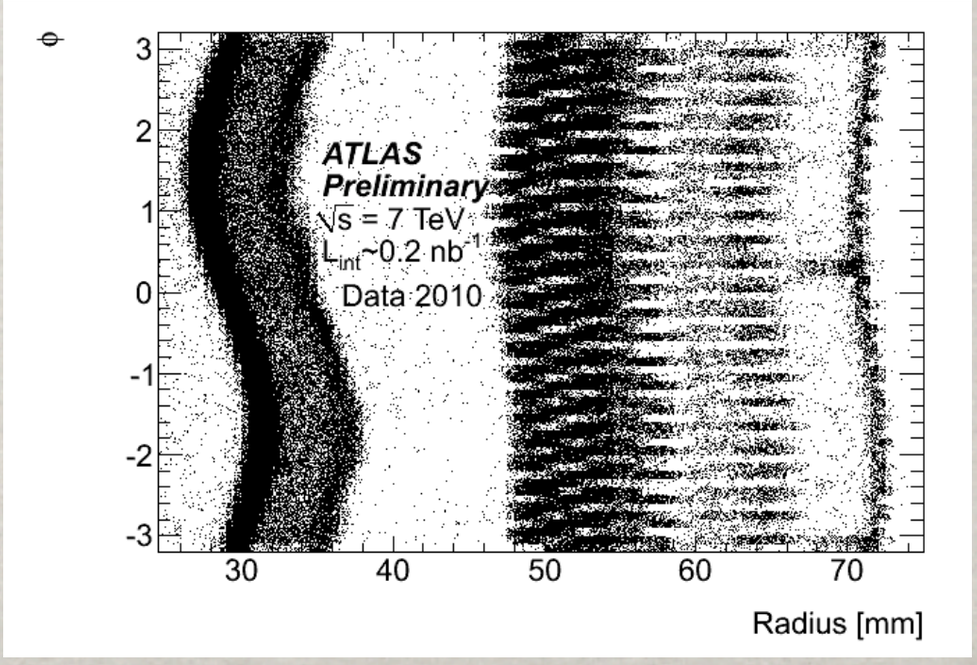


Performance Highlights

Mapping the Detector

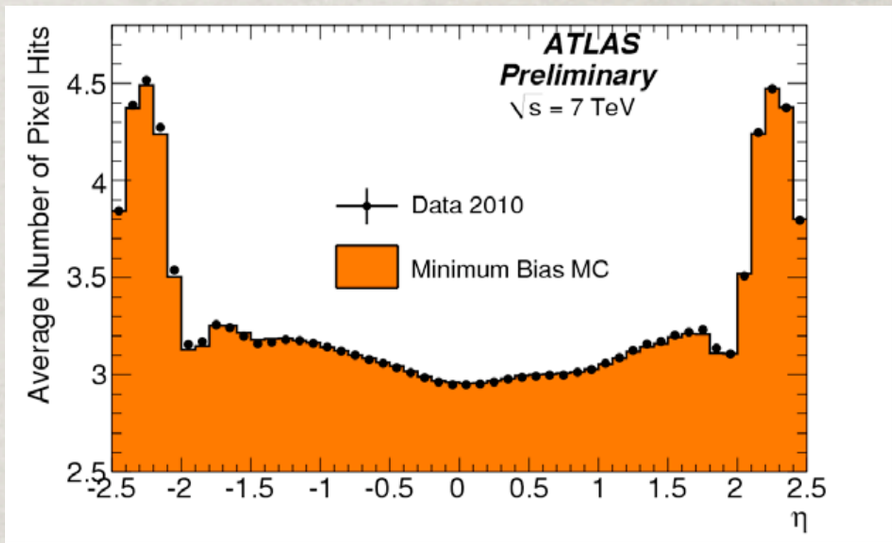
- Traditionally use conversions to map detector
- Here - hadronic interactions with material used look for vertices rejecting Ks, gamma, Lambda
- General good description
- Beam pipe displaced! ~ mm

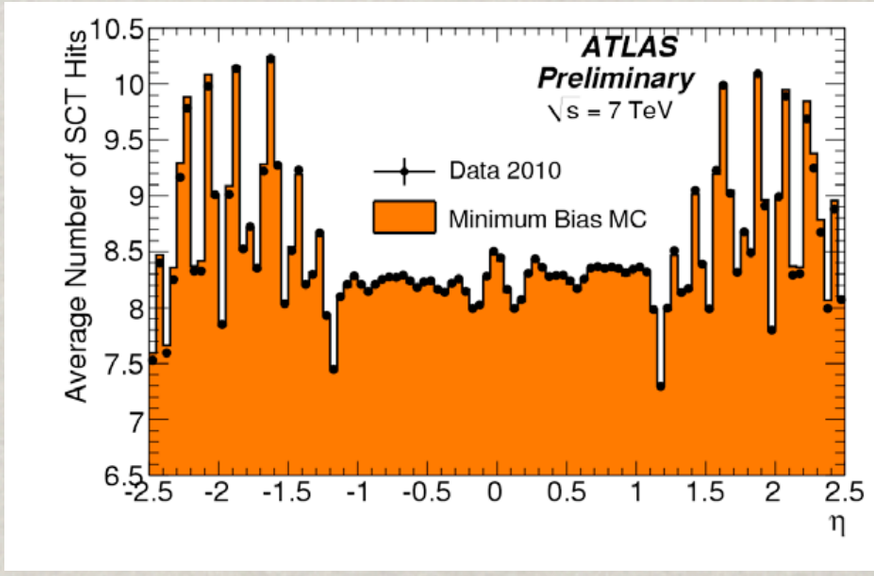




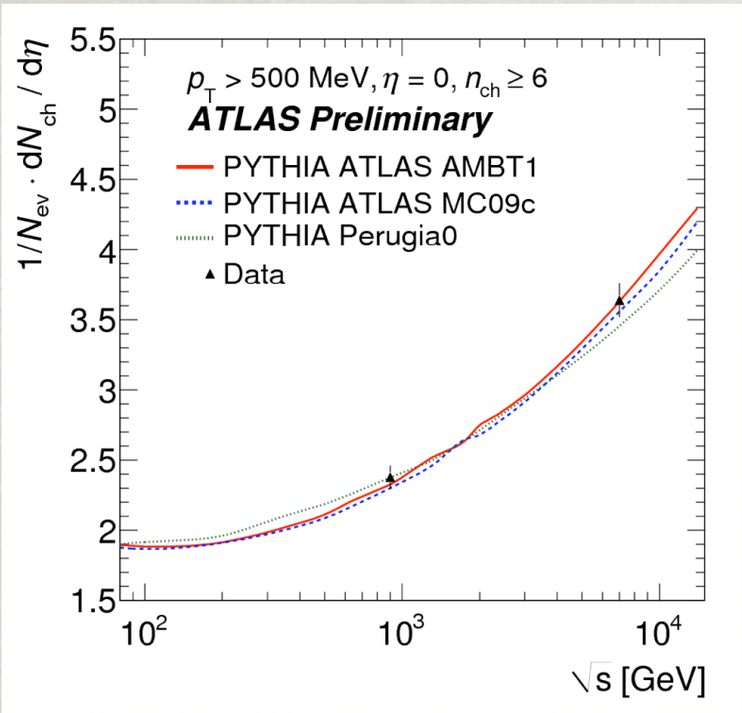
Tracking comparisons

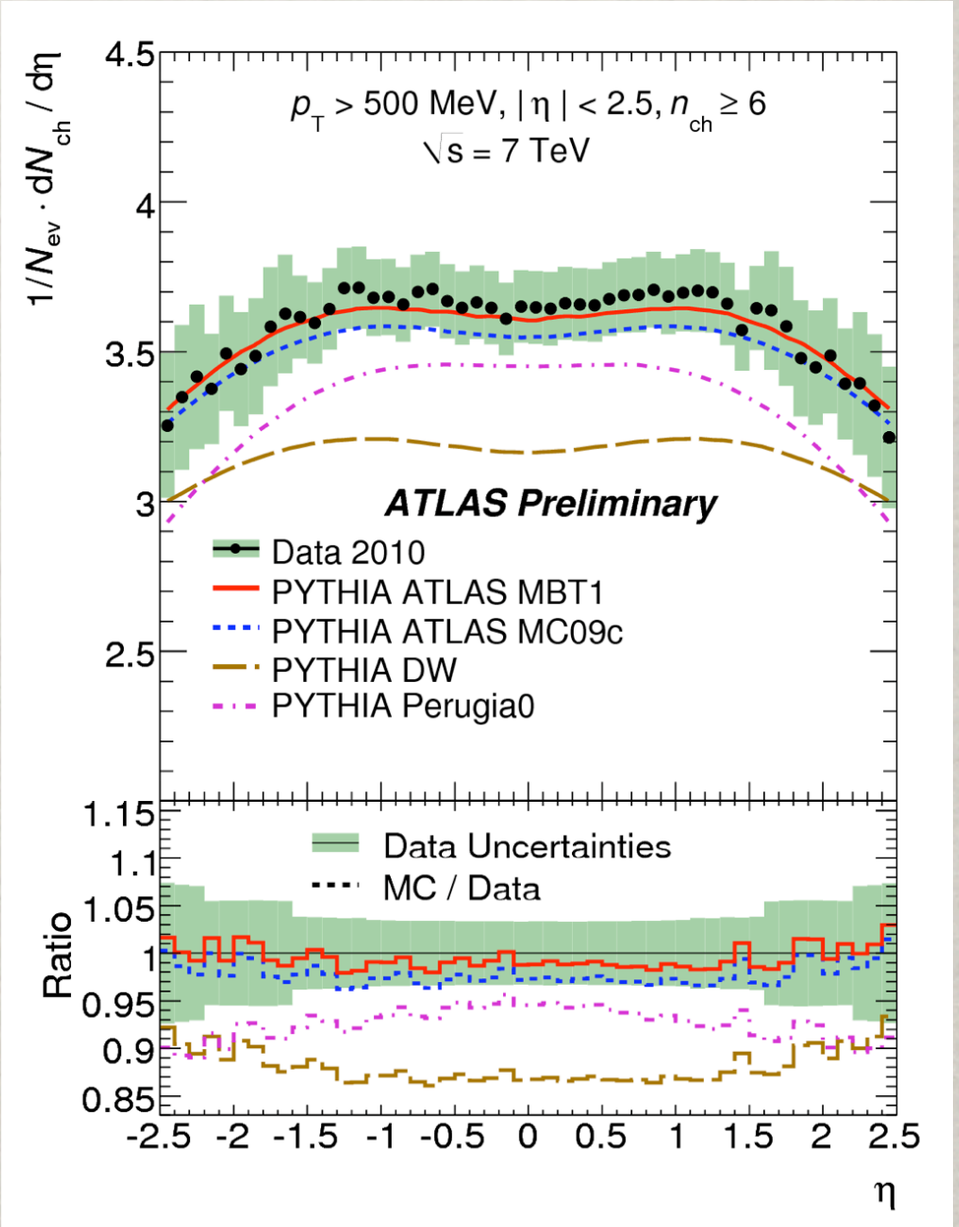
- Excellent description of ID, material, beam spot
- dn/dη paper at 900 GeV accepted
- 7 TeV paper in the works





Charged Particle Multiplicity

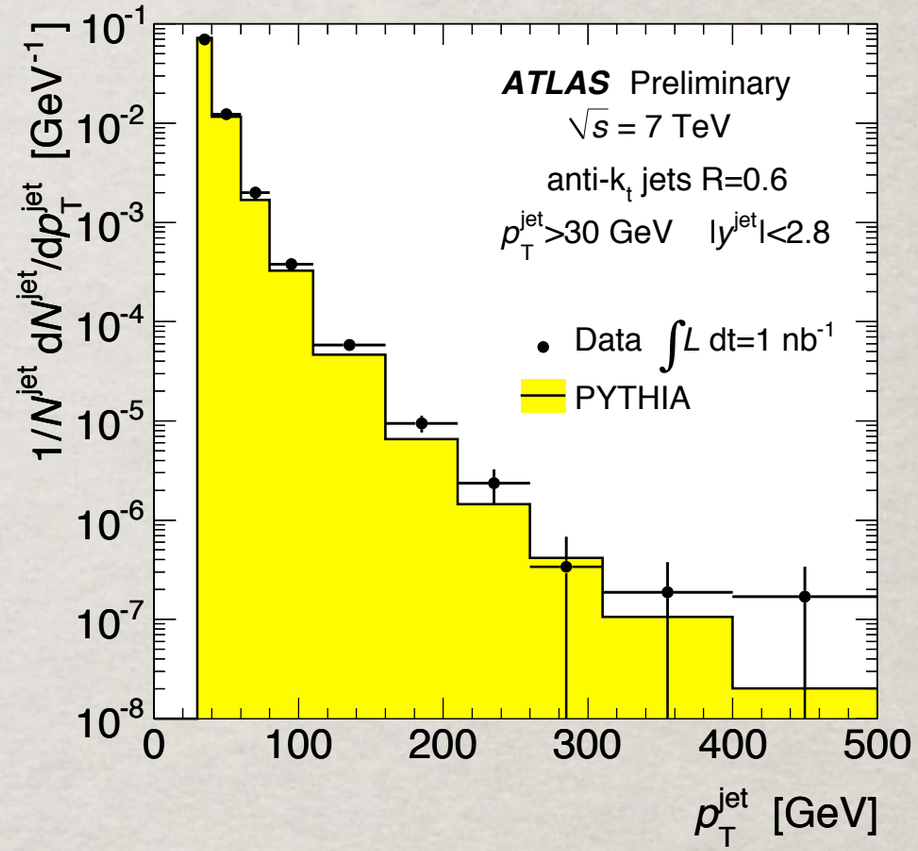


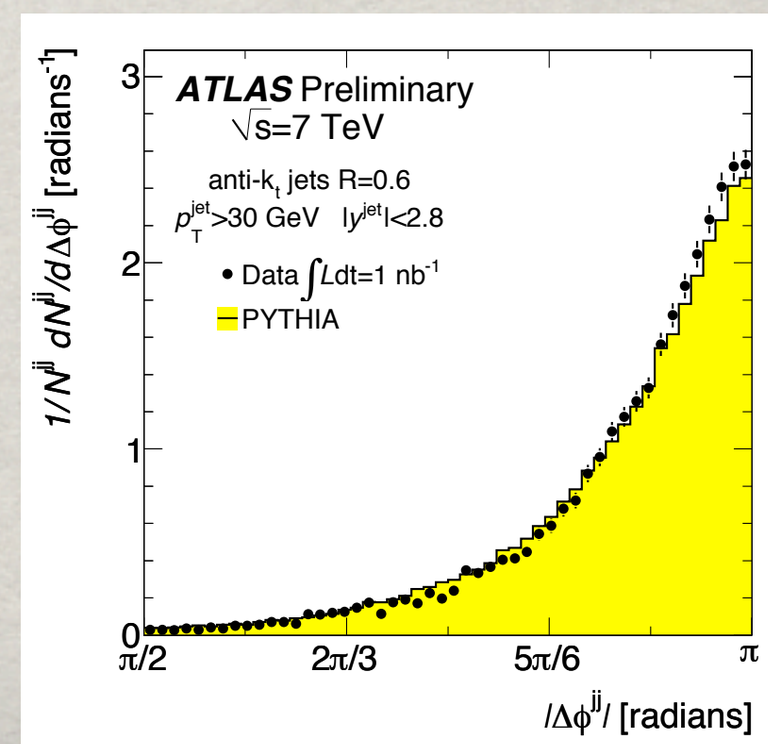


- dn/dη at 7 TeV
- average charge particle multiplicity at 900 GeV and 7 TeV
- good agreement with Pythia tune

Jet Distributions

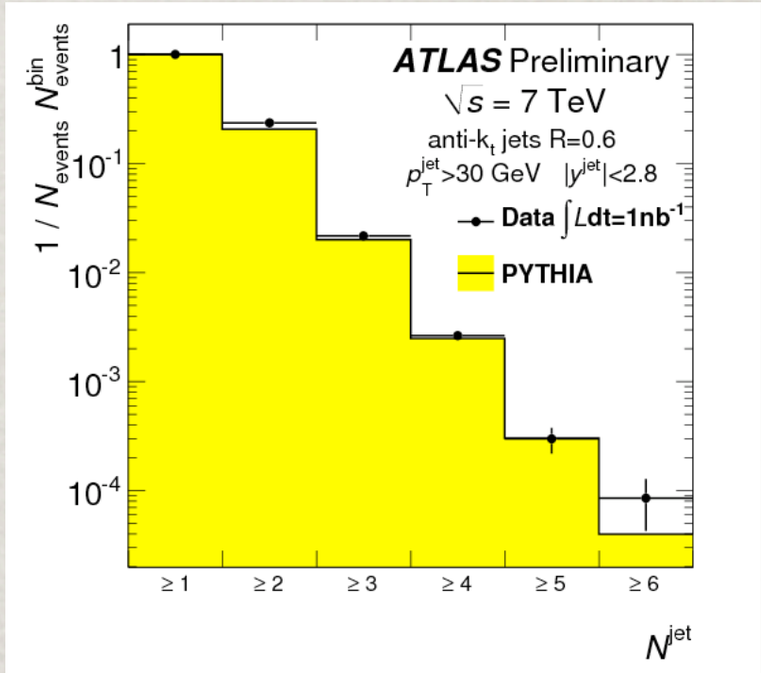
- Jets for $p_T > 20$ GeV
- using antiKt algorithm
- evaluated at EM scale

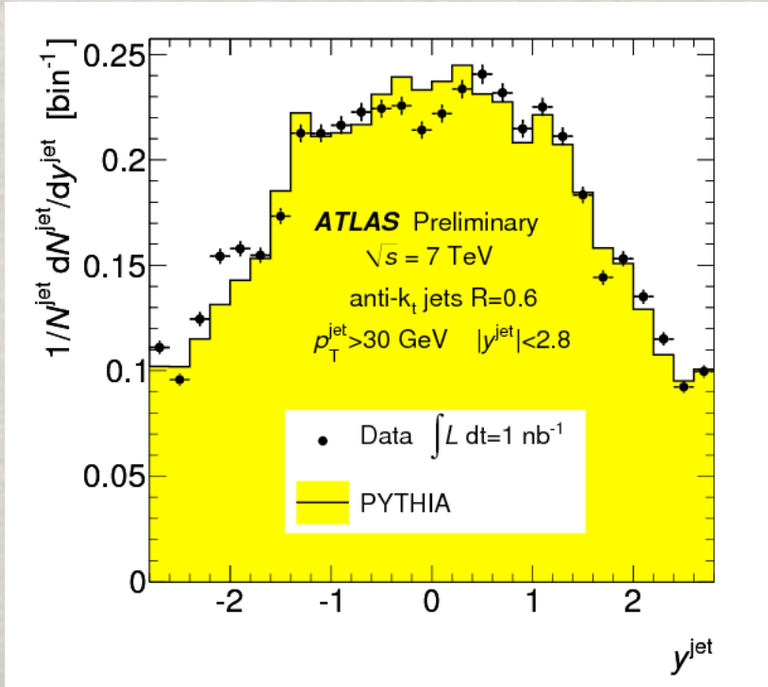




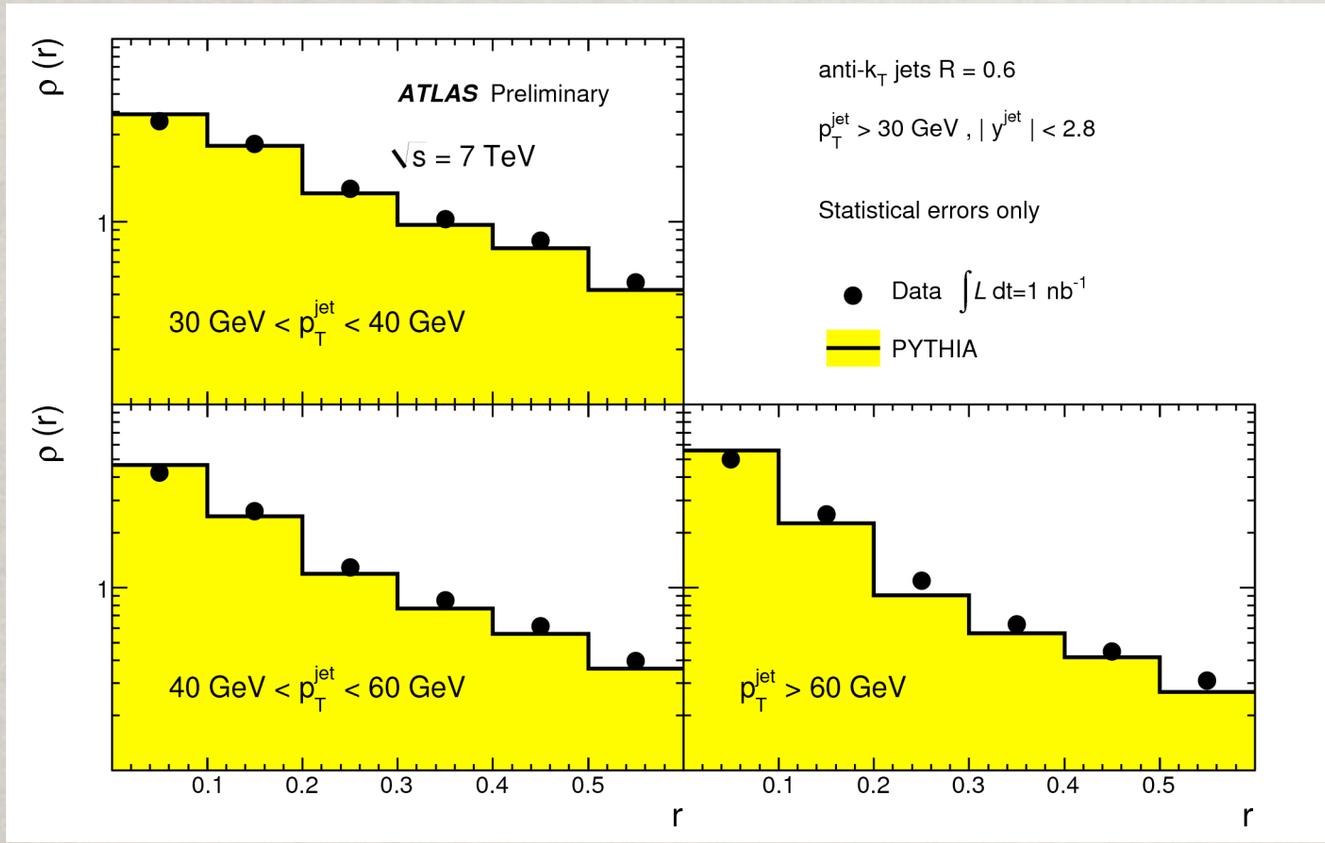
Jets II

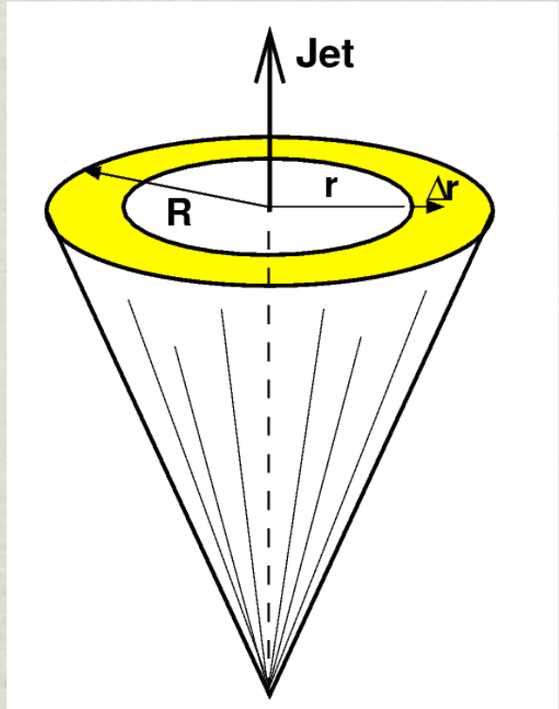
- Multiplicity in good agreement with Pythia
- Rapidity distribution reasonably well reproduced - small deviations under investigation





Jet Shapes



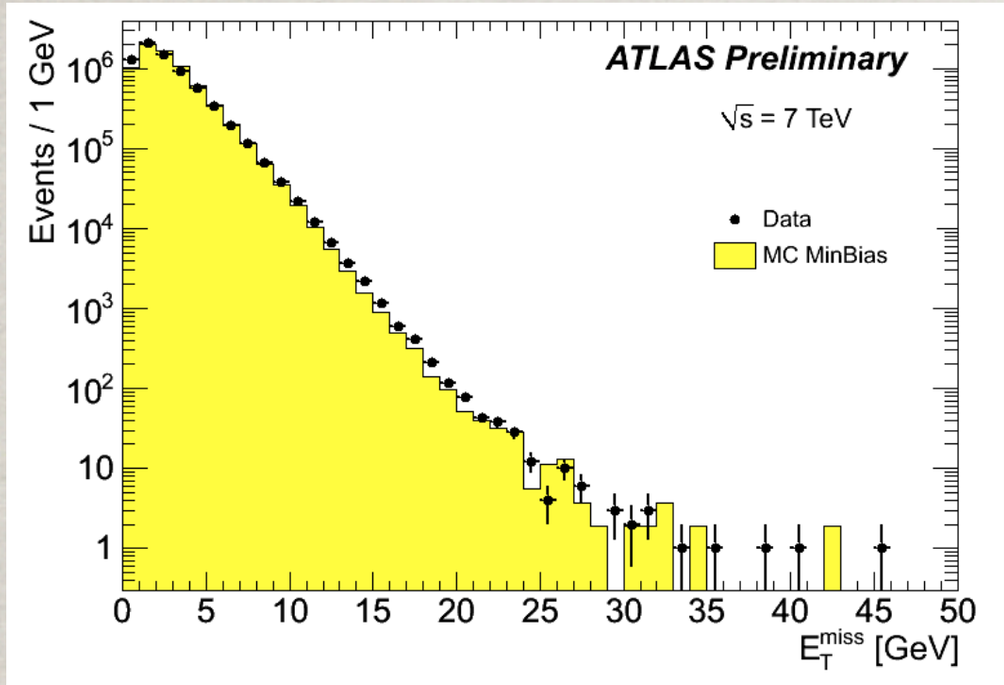


$$\rho(r) = \frac{1}{\Delta r}\frac{1}{N^{jet}}\sum_{\text{jets}}\frac{p_T(r-\Delta r/2, r+\Delta r/2)}{p_T(0,R)},\ 0 \le r \le R$$

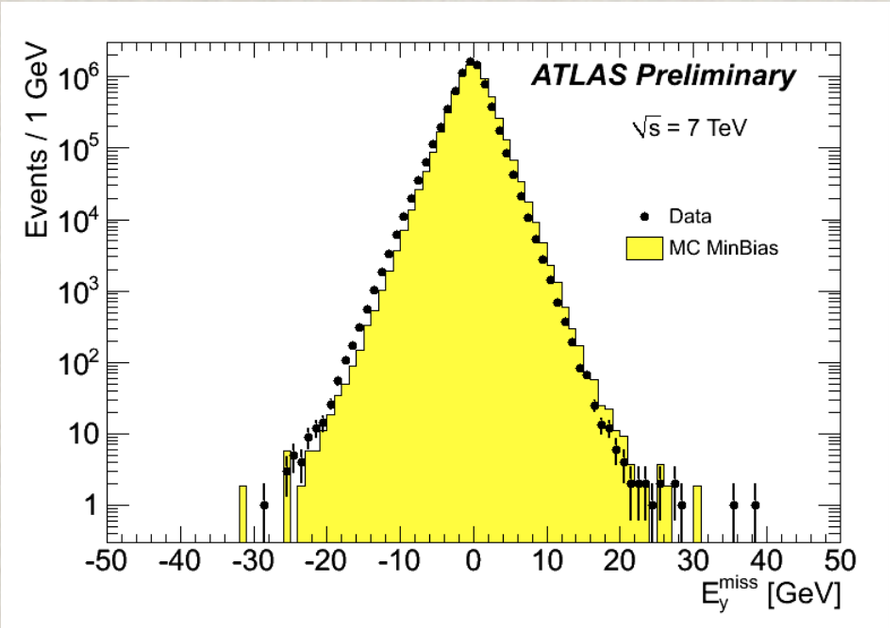
$$R = 0.6 \text{ and } \Delta r = 0.1$$

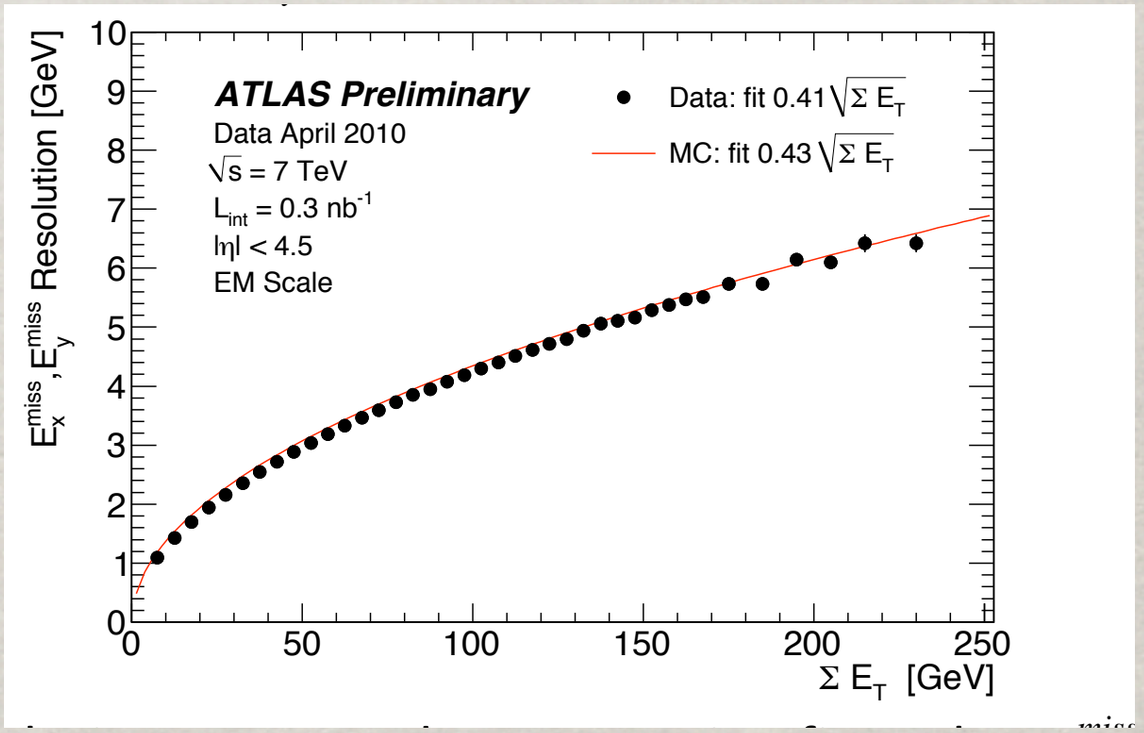
- good agreement of particle/energy flow within jets
- slightly narrower jets in pythia

Missing ET



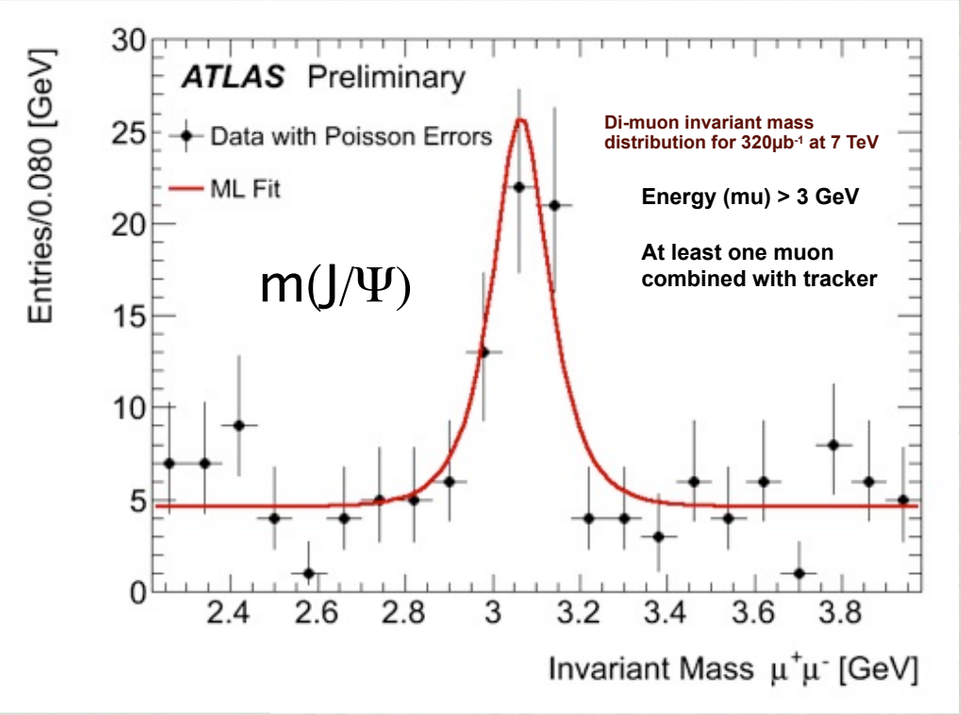
- Excellent agreement with min bias data
- Evaluated at EM scale

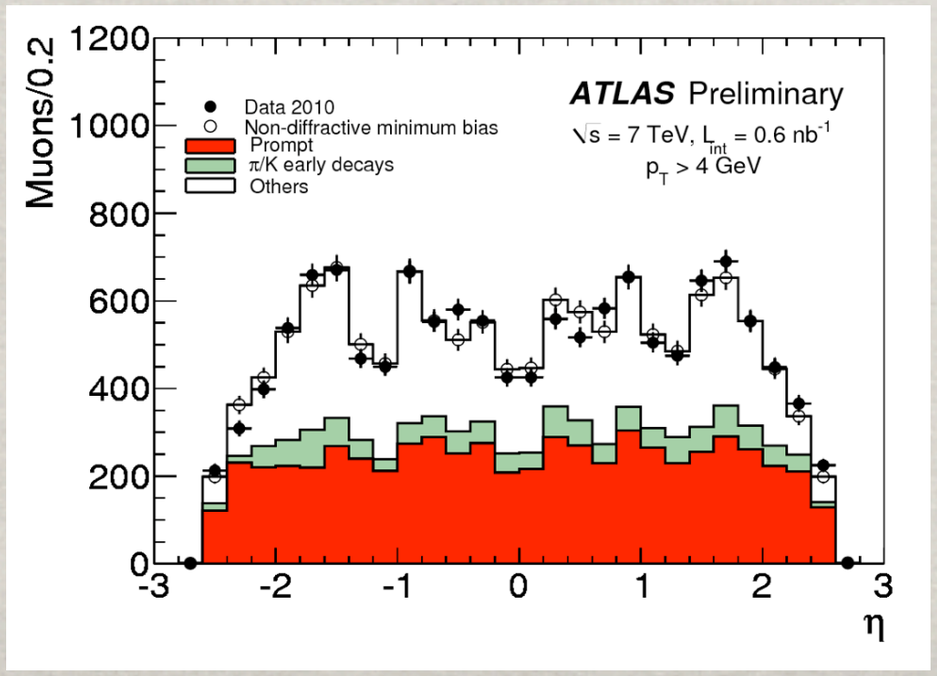


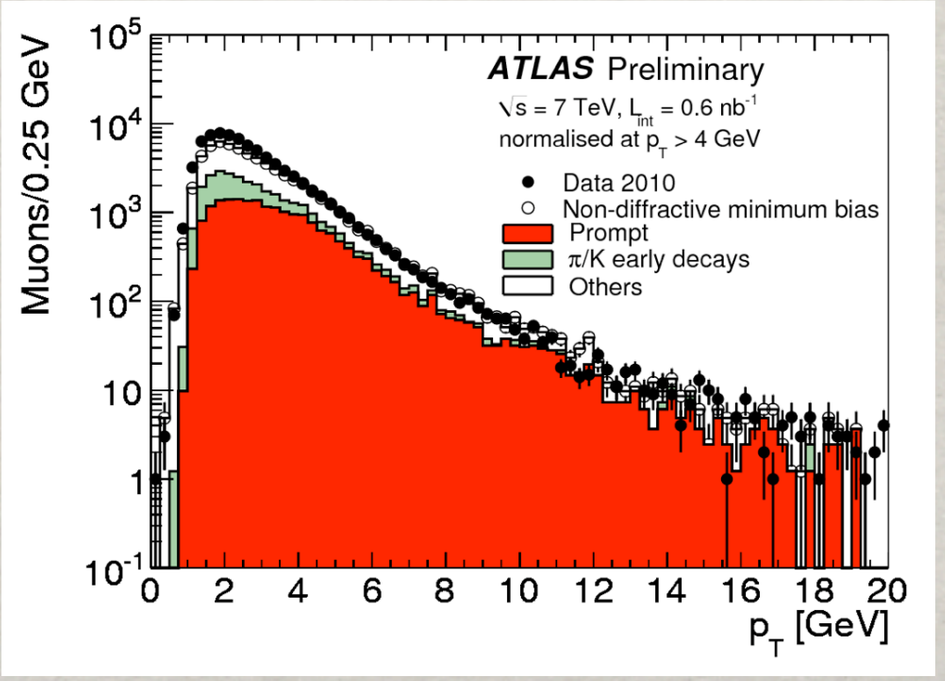


Muon Performance

- $J/\psi \rightarrow \mu\mu$ observed
- good description of inclusive muon spectra

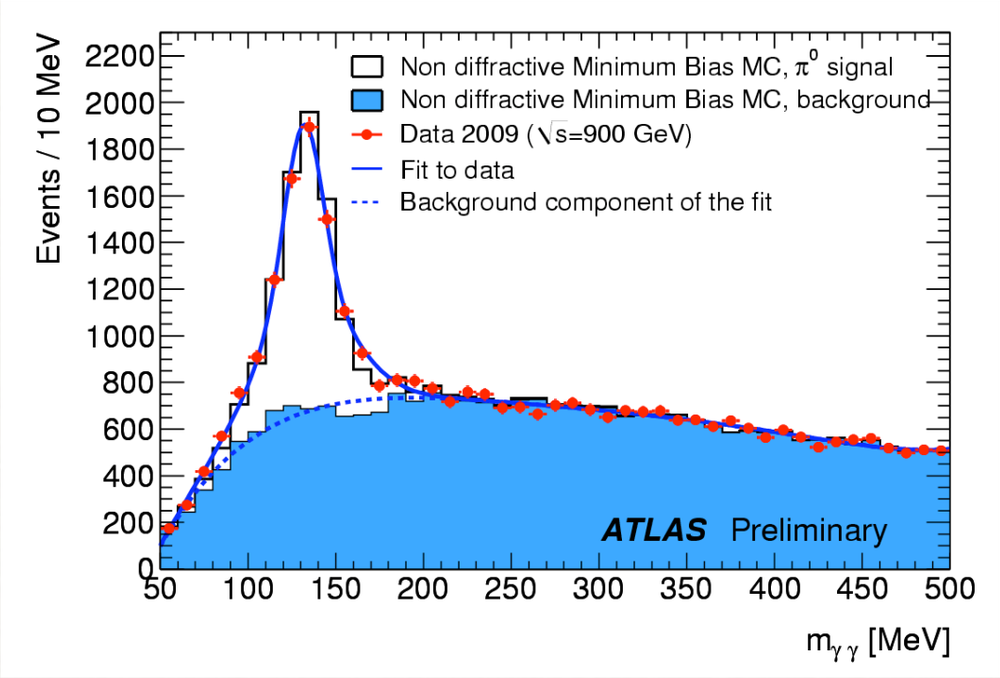


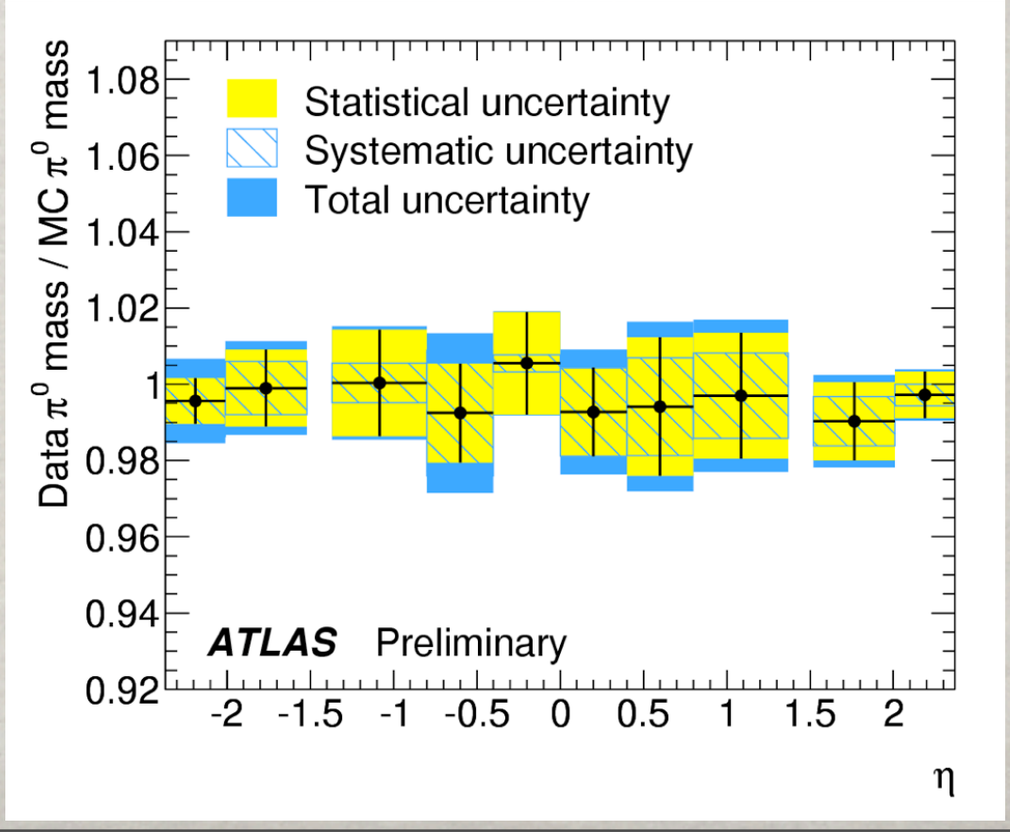




Electron/Photon performance

- Excellent description of data
- On the way to in-situ calibration with SM resonances
- 11 μb^{-1} of data



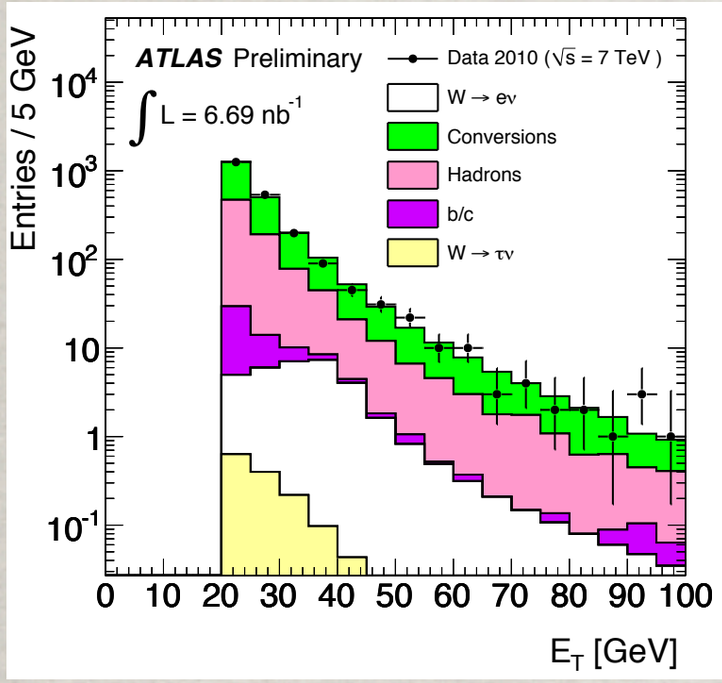


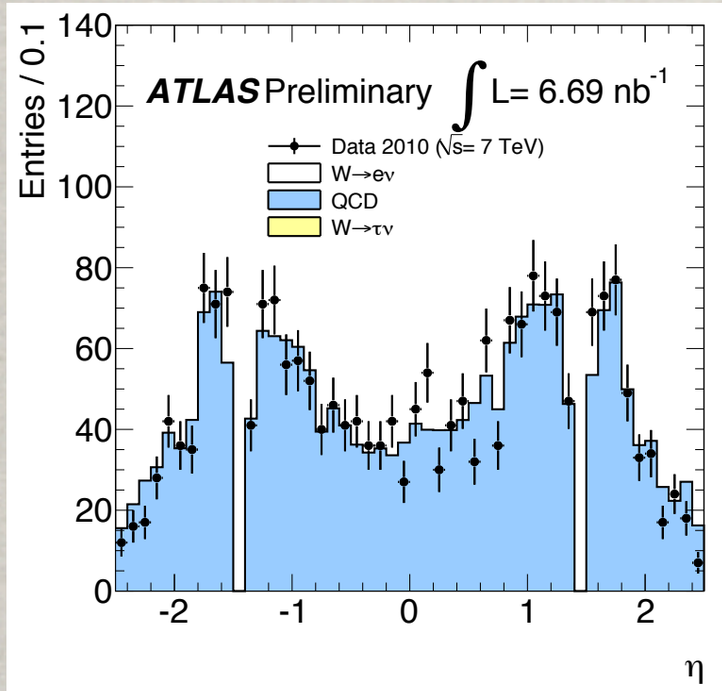
Observation of W and Z candidates

- Preselection
  - Electron/Muon
  - MET
- Background Estimation
- Candidates and Properties

Luminosity nb^{-1}	electron	muon
W	6.7	6.4
Z	6.7	7.9

Electron

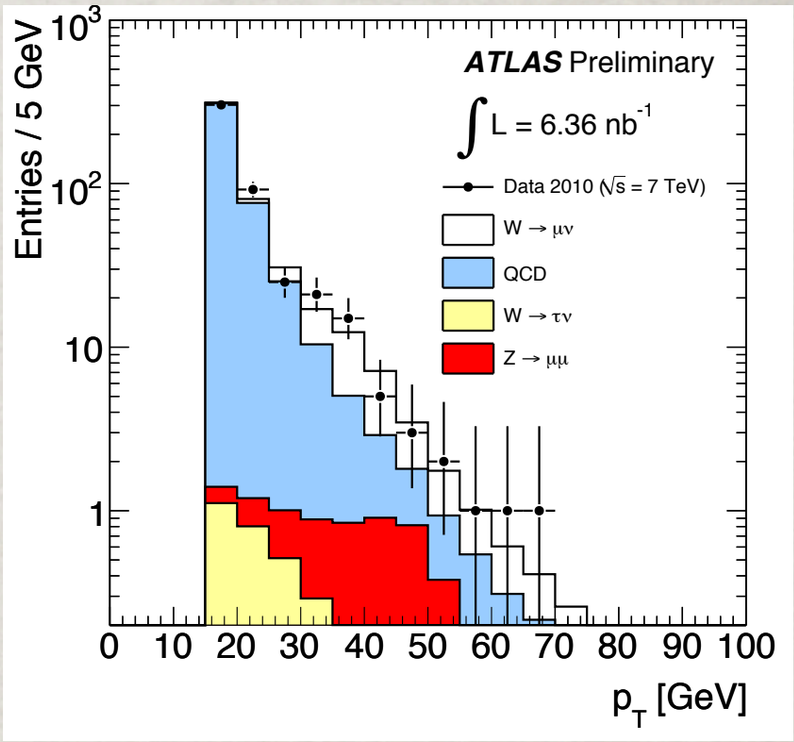


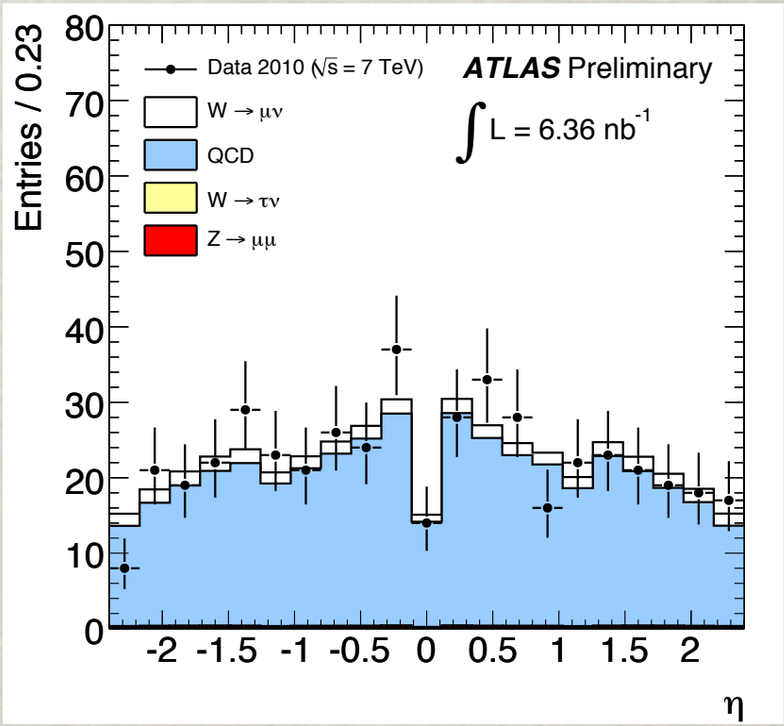


- Loose EM Cluster with $E_T > 20$ GeV
- $|\eta| < 2.47$
- $1.37 < |\eta| < 1.52$
- Background normalized to data (factor of ~2.2)
- Preselection dominated by multijet production

Muon Preselection

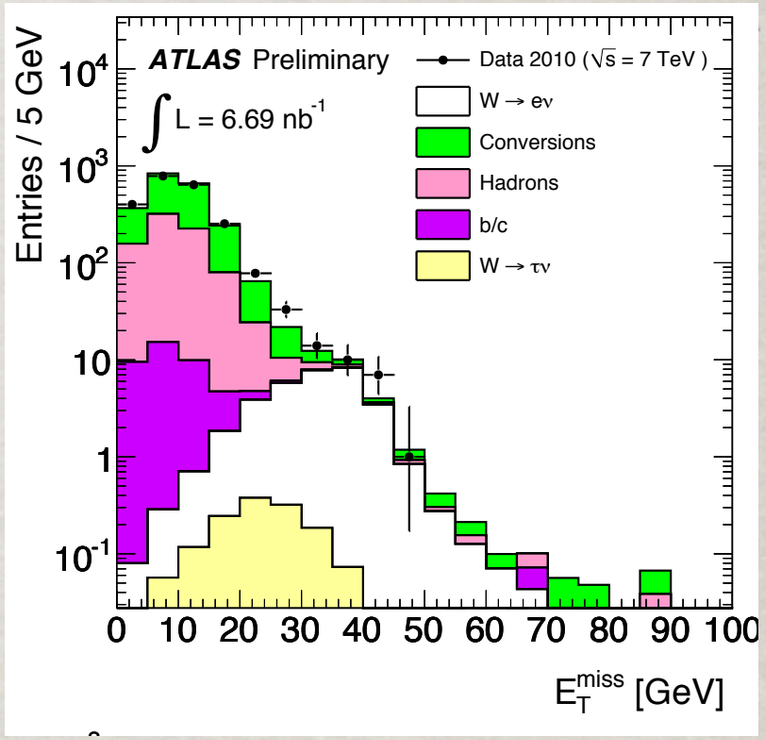
- Combined muon
  - $P_T > 20$ GeV
  - P_T (MS)> 10 GeV
  - $|Z_0 - Z_{PV}| < 1$ cm
- Background MC normalized to data (factor of 1.9)

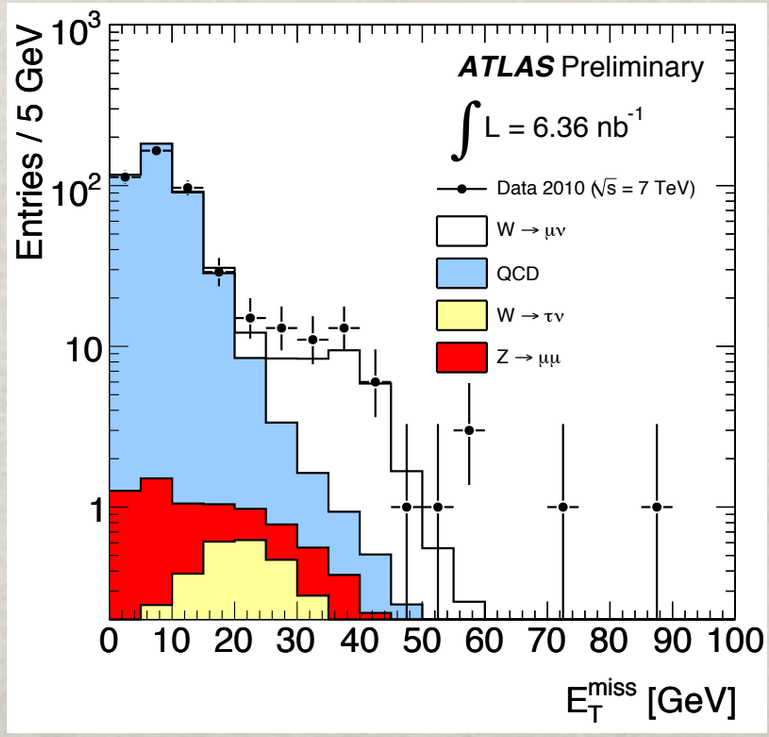




Missing Energy

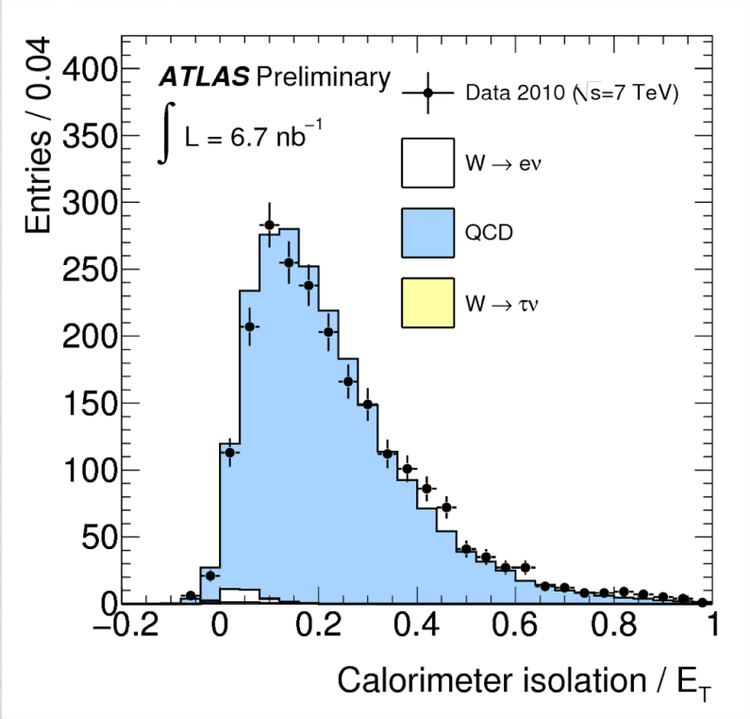
- Based on topological clusters
- Evaluated at the electromagnetic energy scale
- Important in the muon case is the correction from the muon!



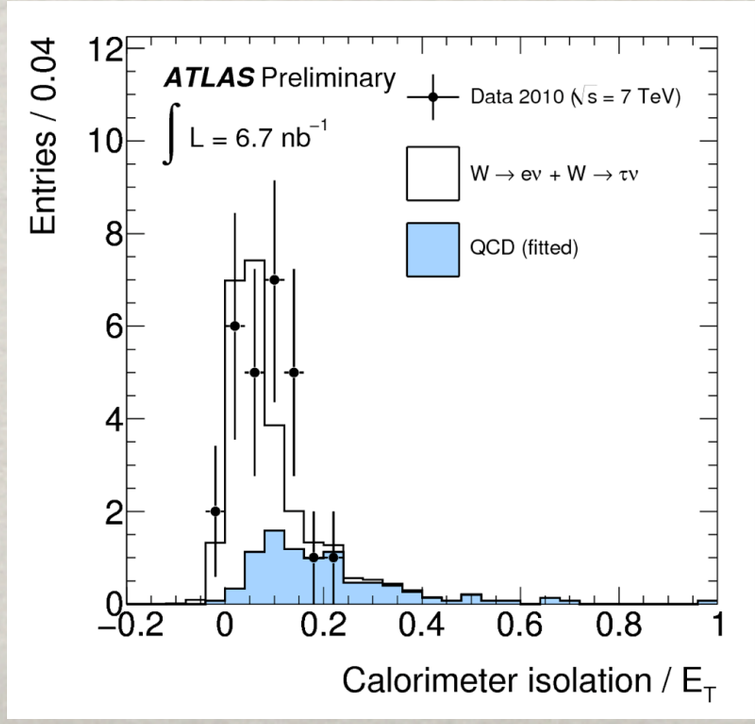


Background Estimation electrons

- Isolation in cone of ΔR =0.3 from MC templates for signal and background



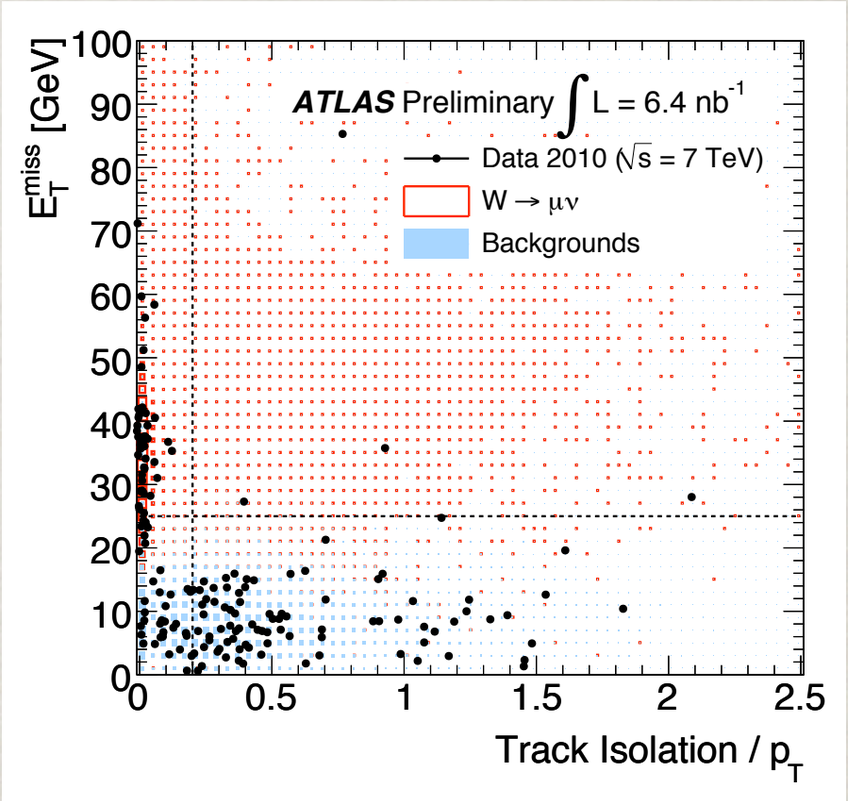
- Fit in both background and signal dominated region for fraction of dijets/W



$N_{QCD} = 2.0 \pm 1.2(\text{stat}) \pm 0.4(\text{syst})$

Background estimation Muons

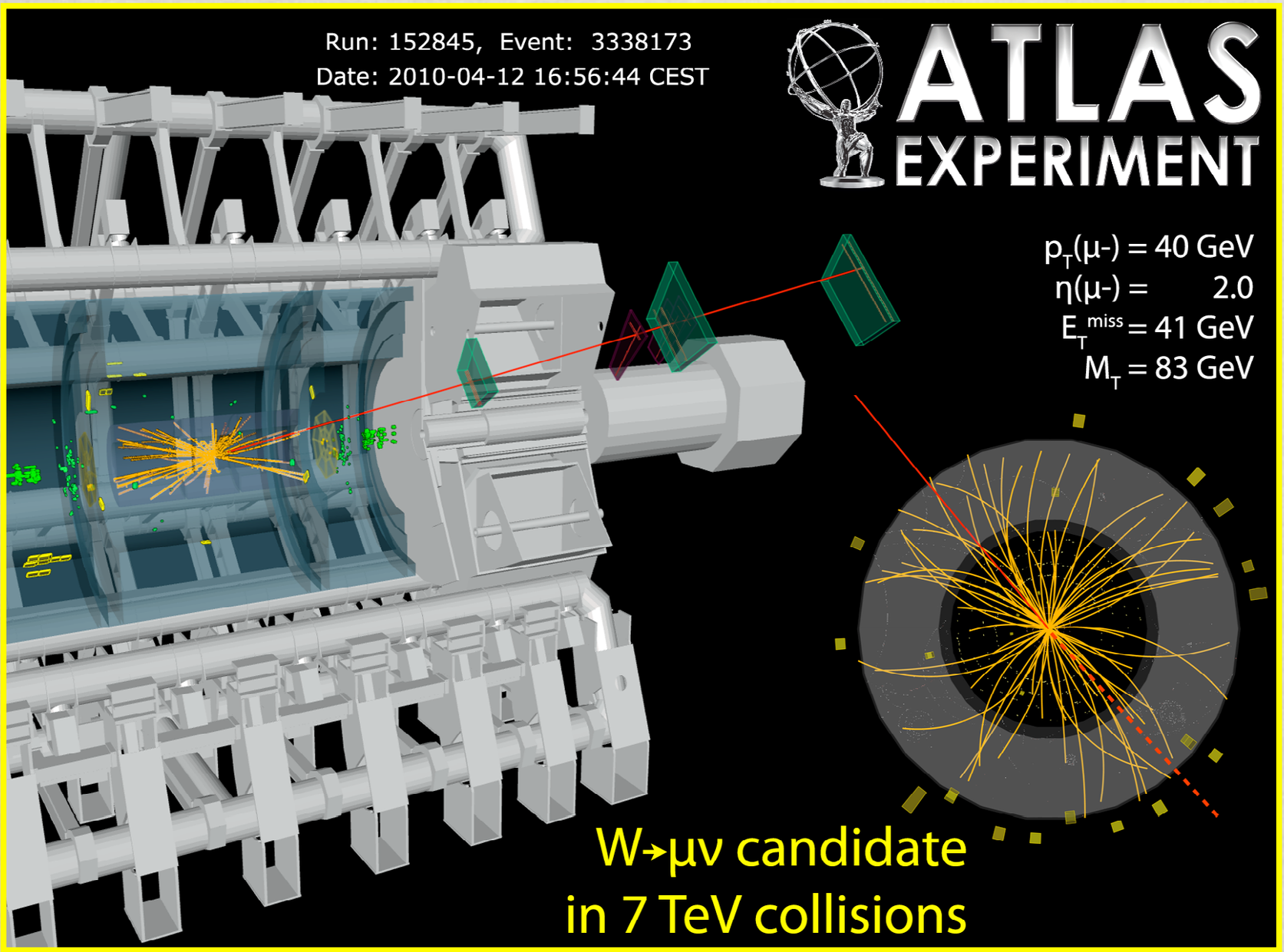
- ABCD method (assuming uncorrelated variables)
- Systematic from residual correlation and MC/Data differences



Background Estimation

$1.0 \pm 0.5(\text{stat}) \pm 0.7(\text{syst})$

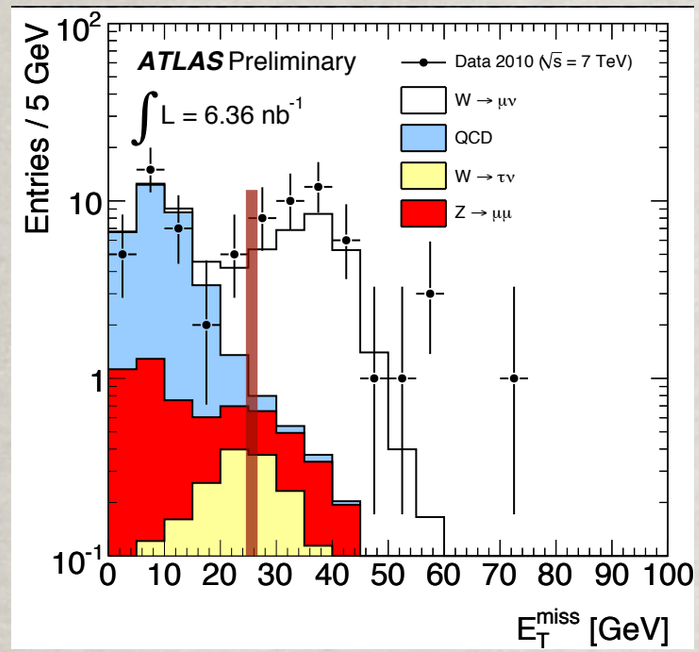
W→μν Event



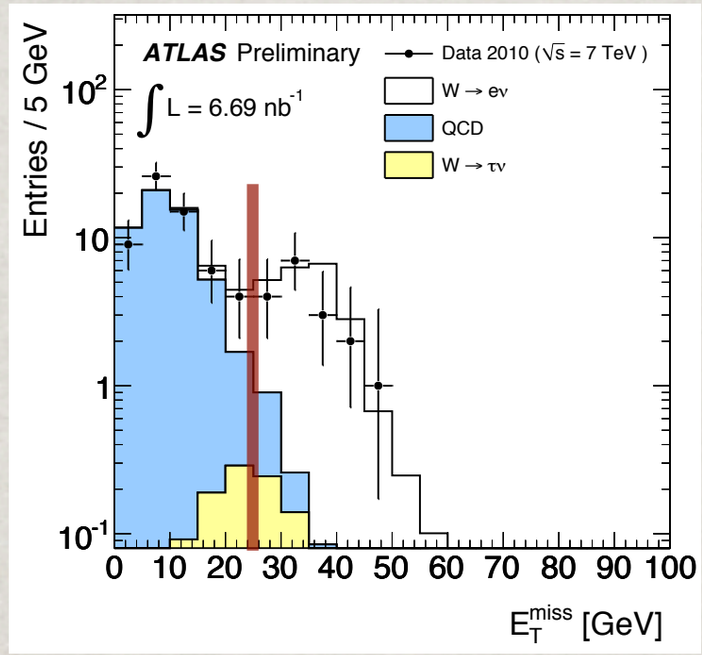
Muon: 3 Pixel hits, 8 SCT hits, 17 TRT hits, 14 MDT hits, Z~0.1 mm from vertex, ID-MS matching within 1 GeV, E_T^{miss} (calorimeter only) ~ 3 GeV

Tight Selection

Muons

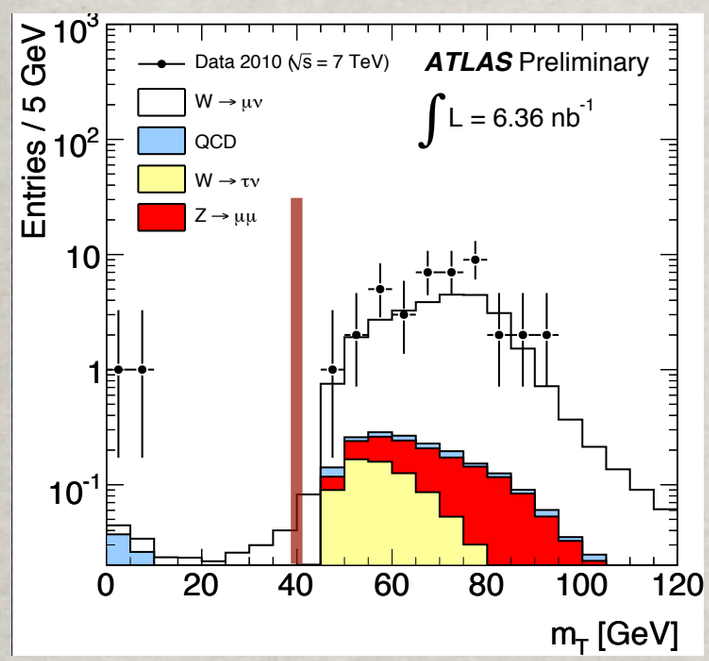


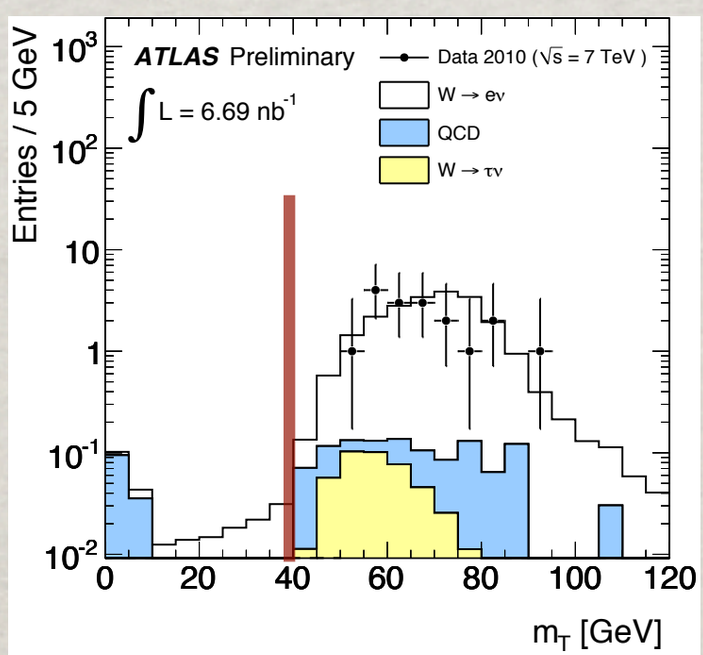
Electrons



Missing E_T > 20 GeV
Transverse Mass > 40 GeV
Tighter electron selection
Isolated Muon

Observe
17 Electron Events
40 Muon Events

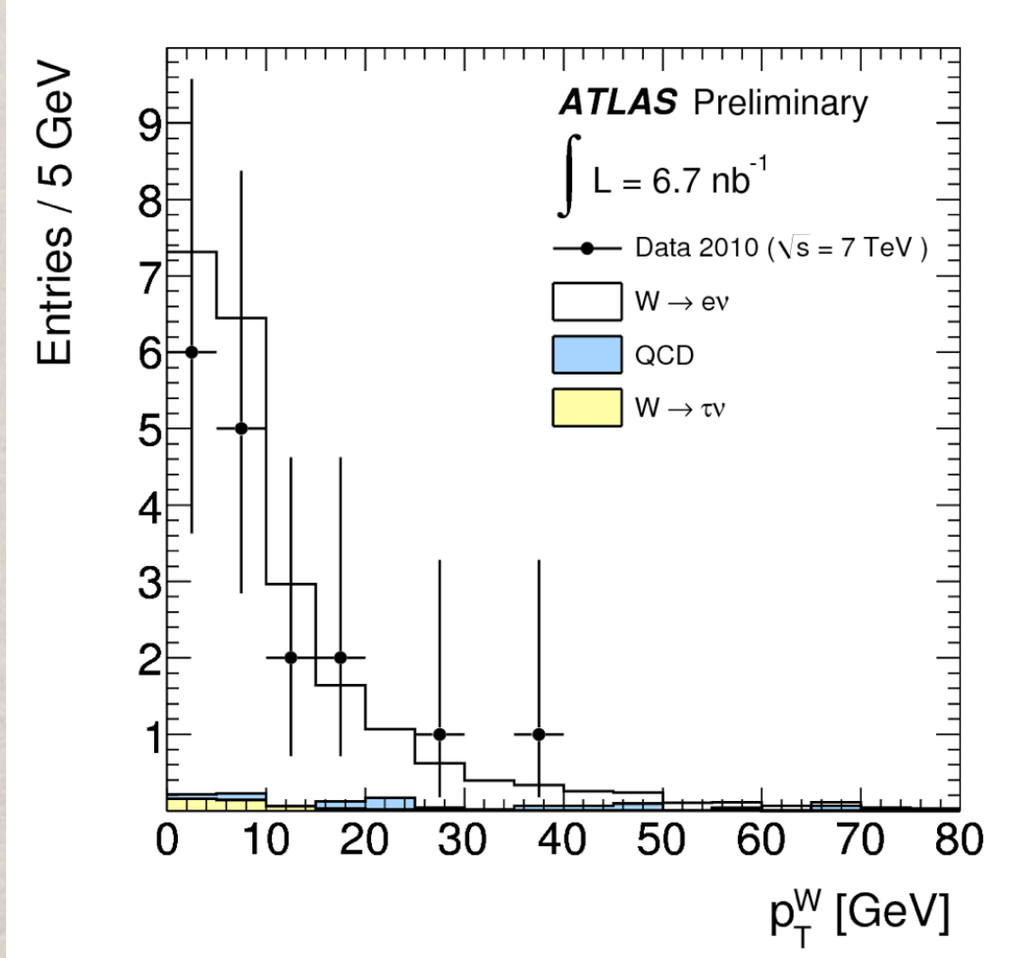


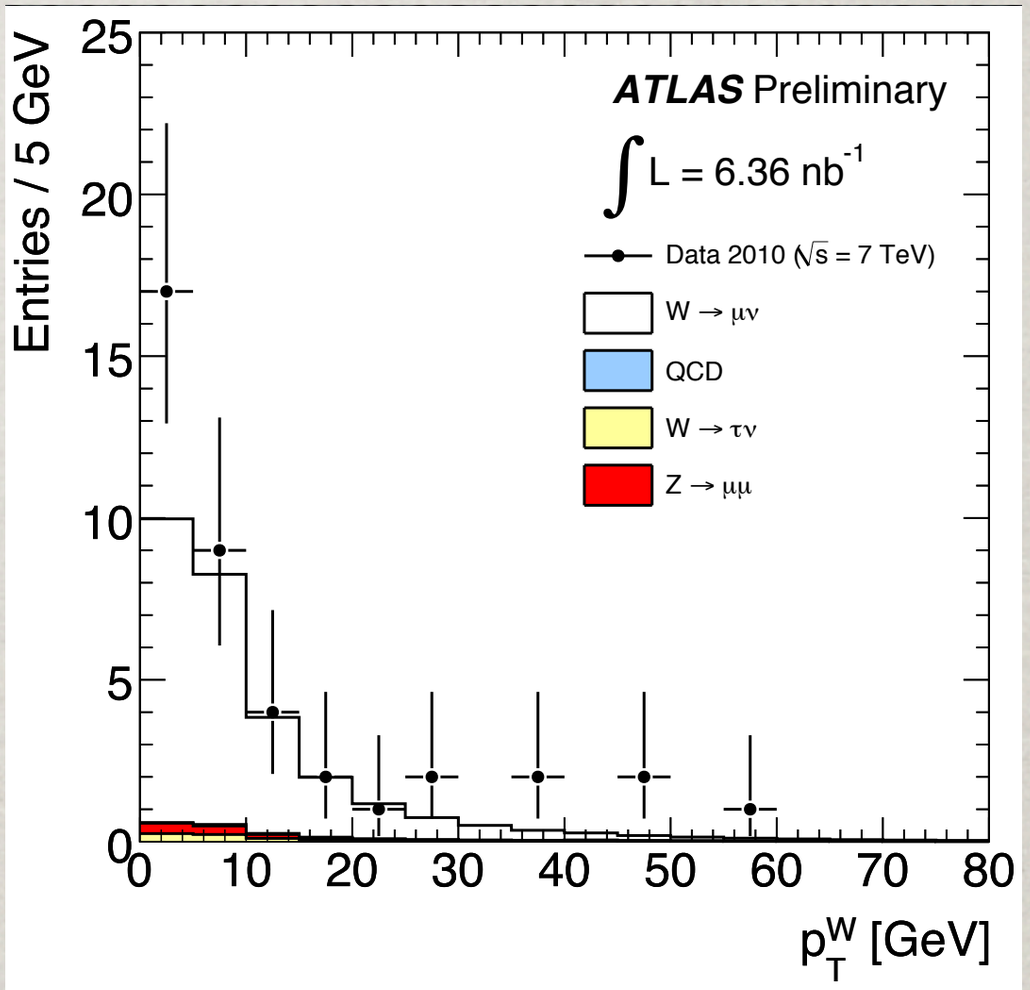


W Expectations

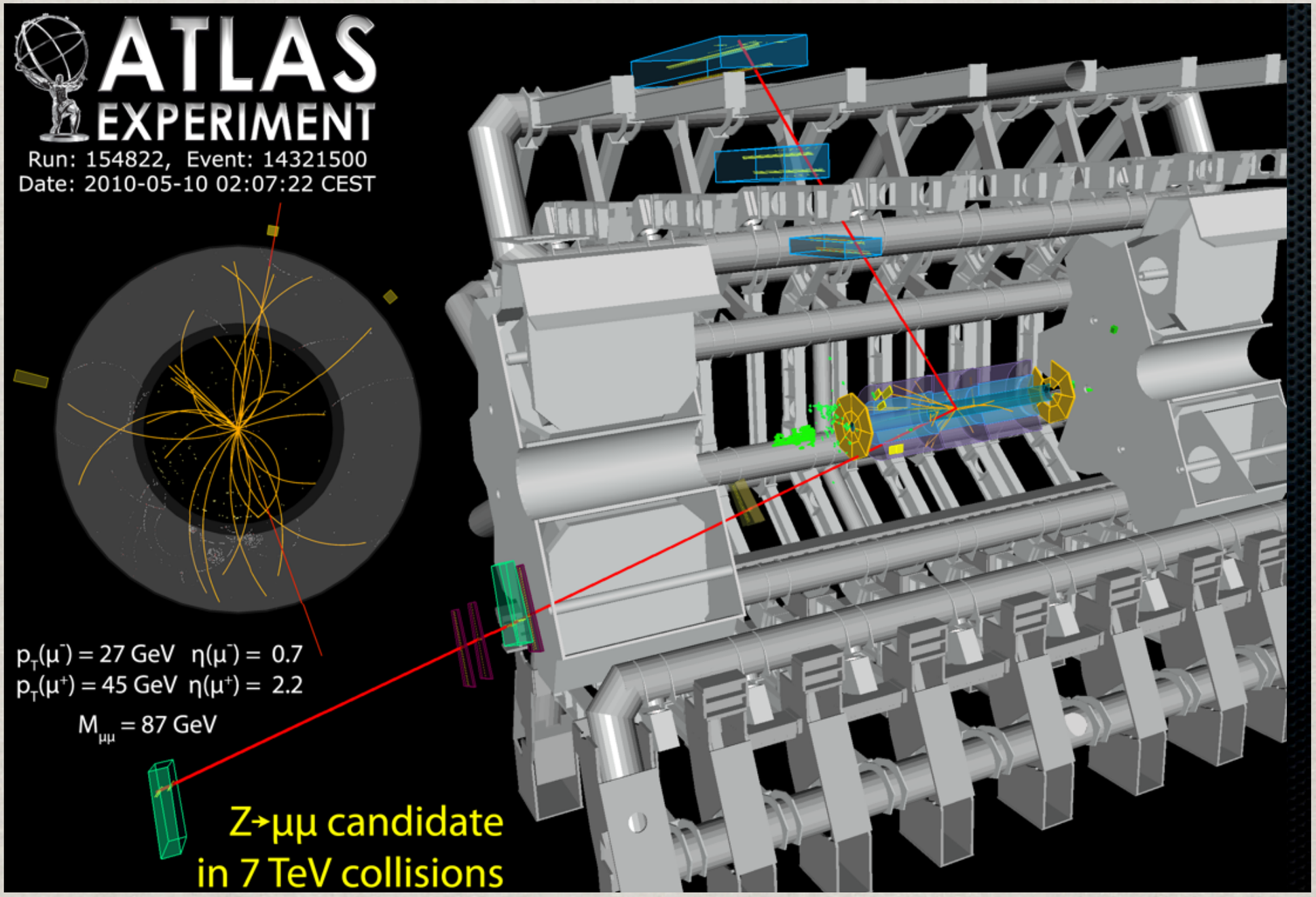
	Electrons	Muons
Signal	20.7±1.7(syst)±4.5(lumi)	25.9±3.6(syst)±5.2 (lumi)
Background	2.0 ±1.2(stat)±0.4(syst)±0.2 (lumi)	2.8±0.5 (stat)±0.8(syst)±0.6 (lumi)
Total Expected	22.7±1.2(stat)±1.7(syst) ±4.5(lumi)	28.7±0.5(stat)±3.9 (syst)±5.7 (lumi)
Observed	17	40

Properties of W Candidates

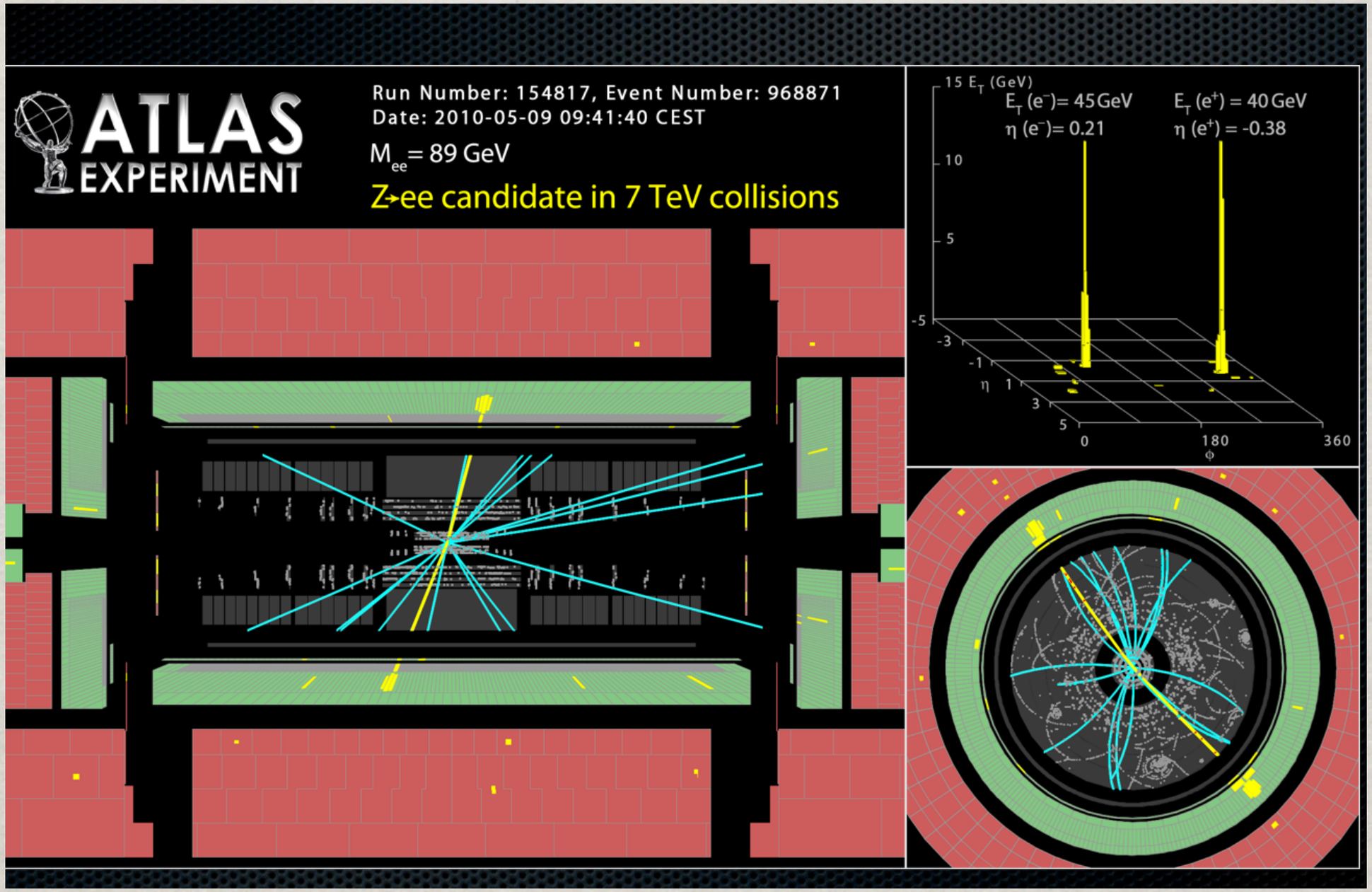




First Z Candidates



First Z Candidates



Z Summary

in 80-100 GeV window

	electron	muon
expected signal	$1.6 \pm 0.1(syst) \pm 0.3(lumi)$	$3.2 \pm 0.7(syst) \pm 0.6(lumi)$
expected background	0.01	$(2.1 \pm 0.8(syst) \pm 0.4(lumi)) \times 10^{-4}$
observed	1	2

Summary

- ATLAS detector functioning well
- Excellent performance and turn around time on analysis
- Standard Model particles being rediscovered
- Era of High Pt physics has started
- Luminosity expected to increase by orders of magnitude so stay tuned!
- Expect many new results for ICHEP