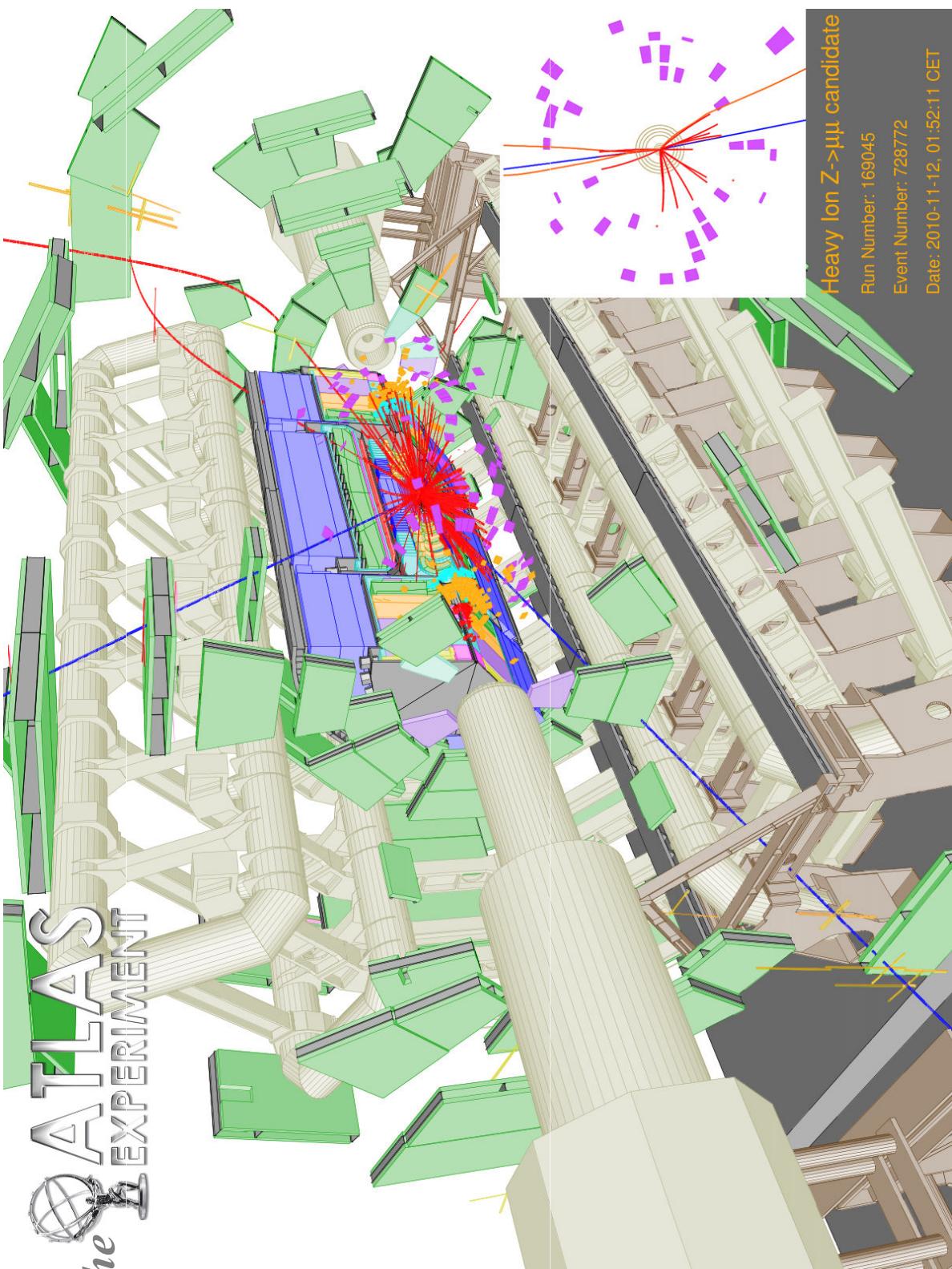


# Atlas Status and Perspectives

Bruno Mansoulié (IRFU-Saclay)

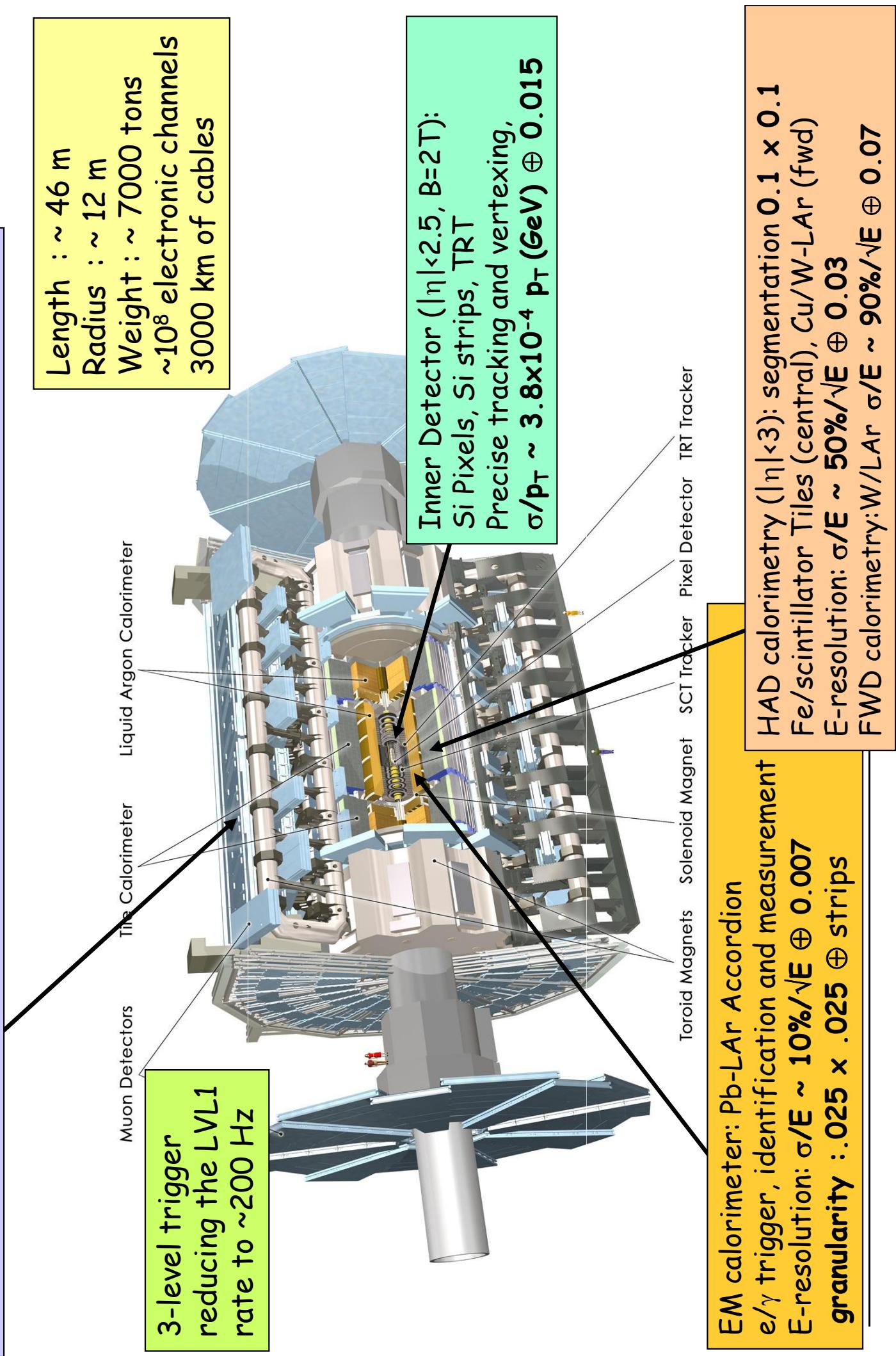
*On behalf of the ATLAS Experiment*



# Topics

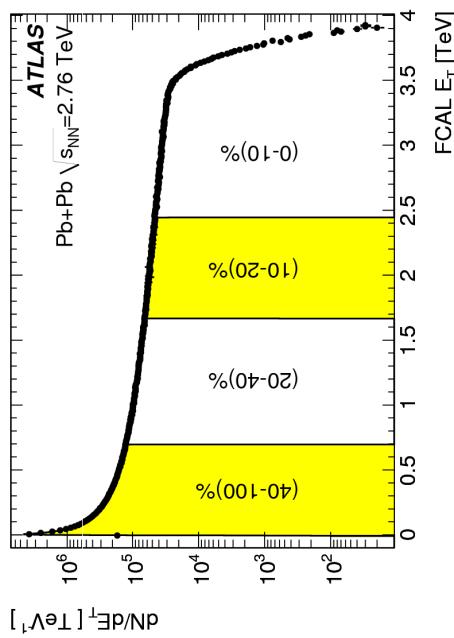
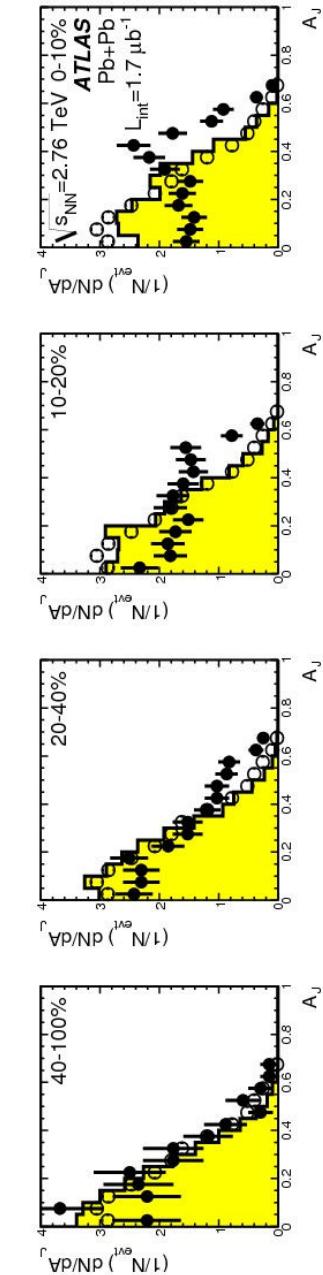
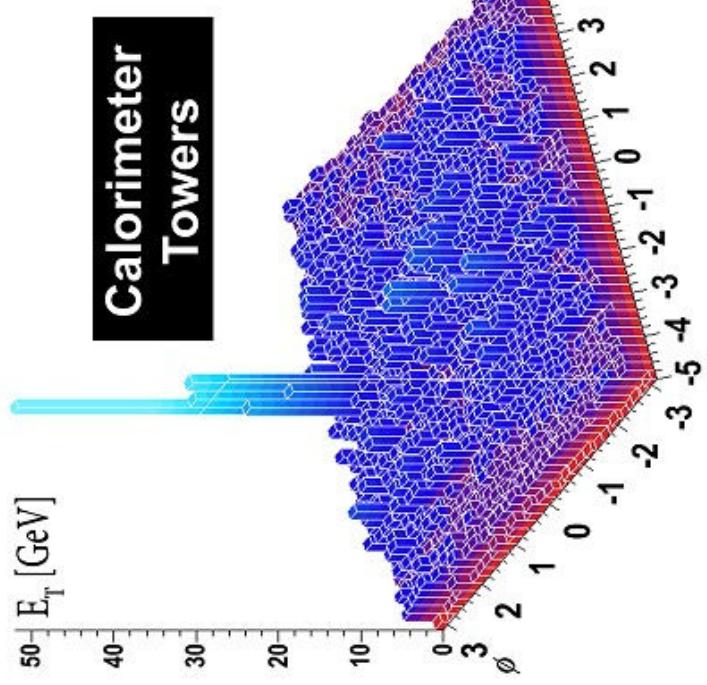
- *The hot news: Heavy Ion analysis*
- **Data taking in 2010**
  - Luminosity, Data taking & quality, trigger
- **Detector performance**
  - $e, \gamma, \mu, \tau, \text{jets}, E_T\text{-miss}, b\text{-tag}\dots$
- **Physics analyses and results**
  - Jets, W, Z,  $\gamma$ , top
- **Prospects for Higgs search**

## Muon Spectrometer ( $|\eta| < 2.7$ ): air-core toroids with gas-based muon chambers Muon trigger and measurement with momentum resolution $< 10\%$ up to $E_\mu \sim 1 \text{ TeV}$



# Heavy Ions

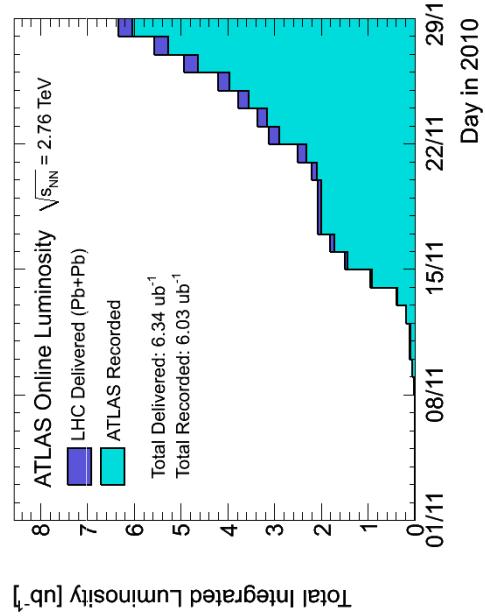
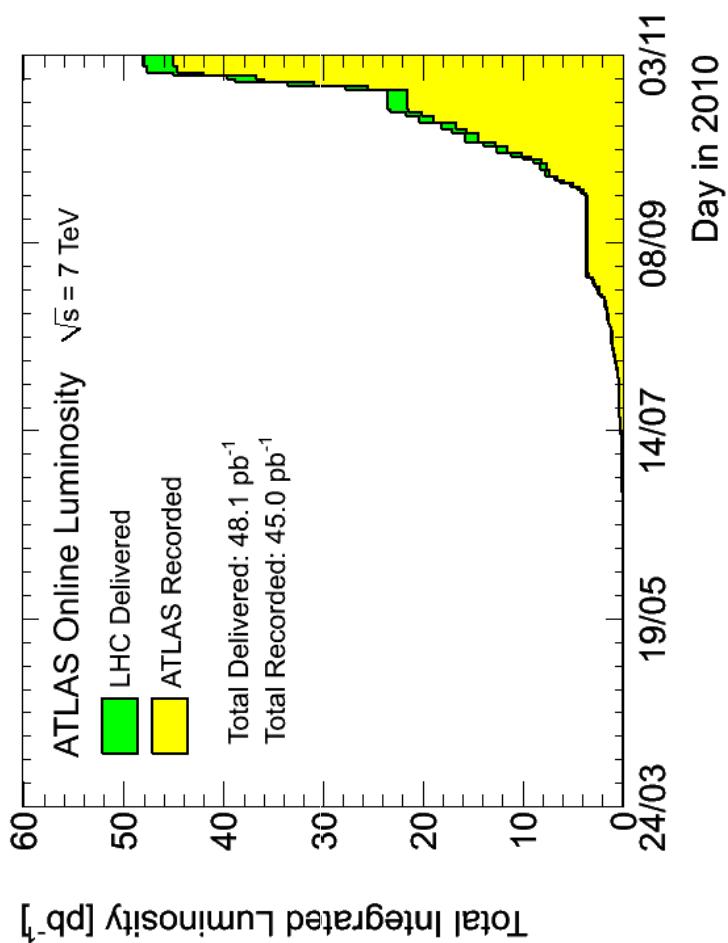
- Observation of a Centrality-Dependent Dijet Asymmetry in Lead-Lead Collisions at  $\sqrt{s_{\text{NN}}} = 2.76 \text{ TeV}$



- Use of the excellent jet and hadron calorimetry

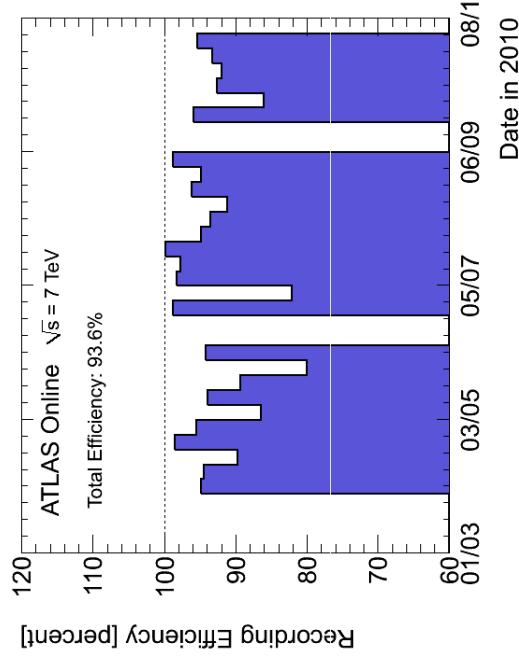
# Luminosity

- Measured by several different detectors and methods, consistency to ~2%.
- Present uncertainty on absolute luminosity determination (p-p): 11%
- Limited by the measurement of beam current.
- Prospects to reduce strongly soon (5 to 6 %)



# Data taking and data quality

- Very good recording efficiency
  - Stable beams to disk  
**(includes ID voltages rise, dead time, etc.)**



Inner Tracking Detectors		Calorimeters				Muon Detectors			
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile MDT	RPC	CSC	TGC
99.0	99.9	100	90.5	96.6	97.8	94.3	99.9	99.8	96.2

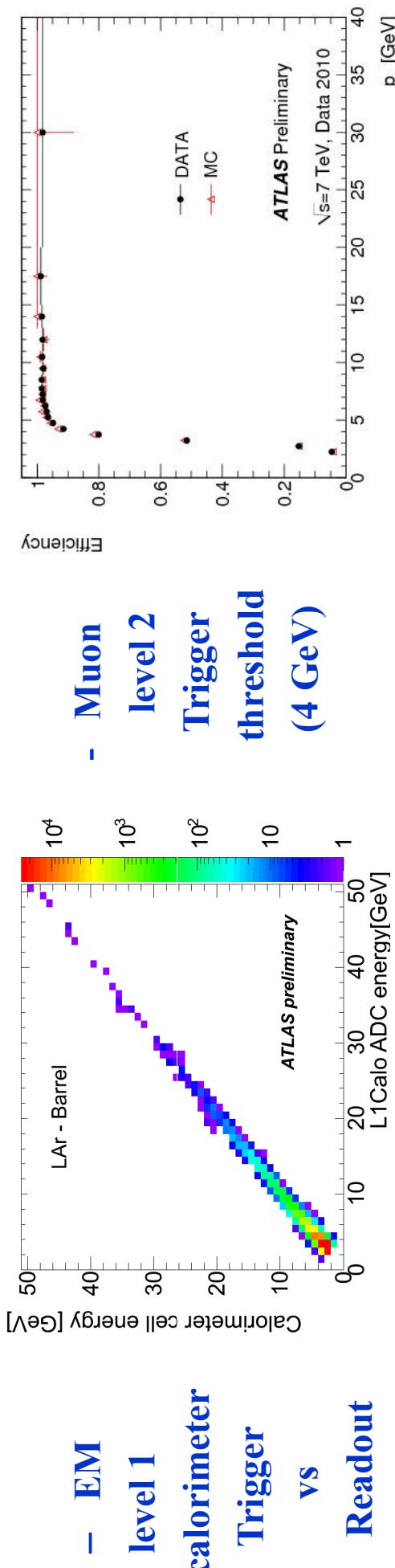
- And data quality
  - Disk to physics analysis
  - Latest reprocessing even better

Luminosity weighted relative detector uptime and good quality data delivery during 2010 stable beams in pp collisions at  $\sqrt{s}=7 \text{ TeV}$  between March 30<sup>th</sup> and October 31<sup>st</sup> (in %). The inefficiencies in the calorimeters will largely be recovered in a future data reprocessing.

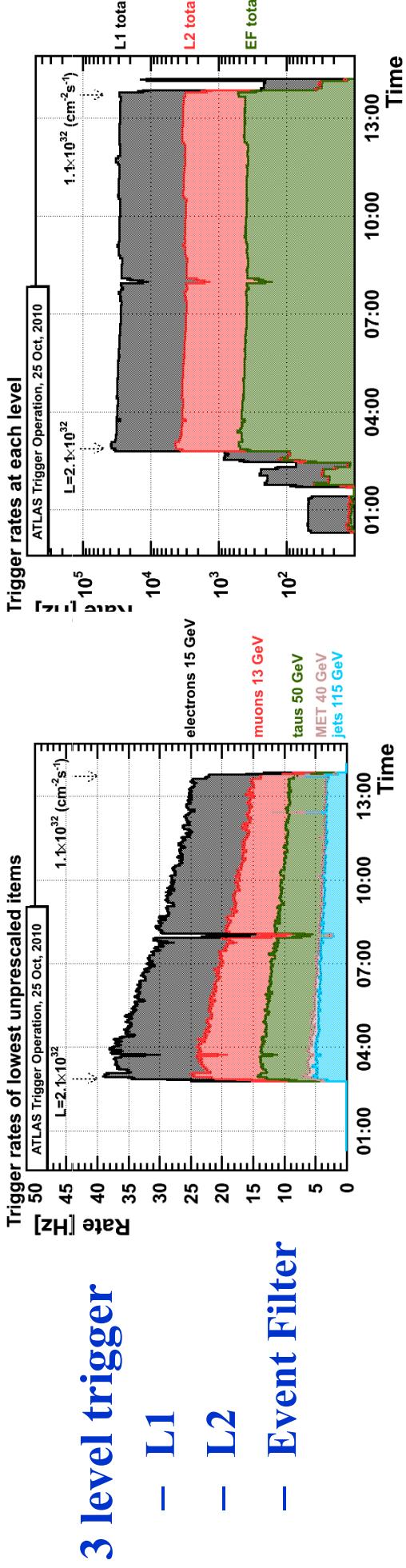
- Operational channels: 97 to 100 % depending on system

# Trigger

- Good understanding of trigger primitives, thresholds...

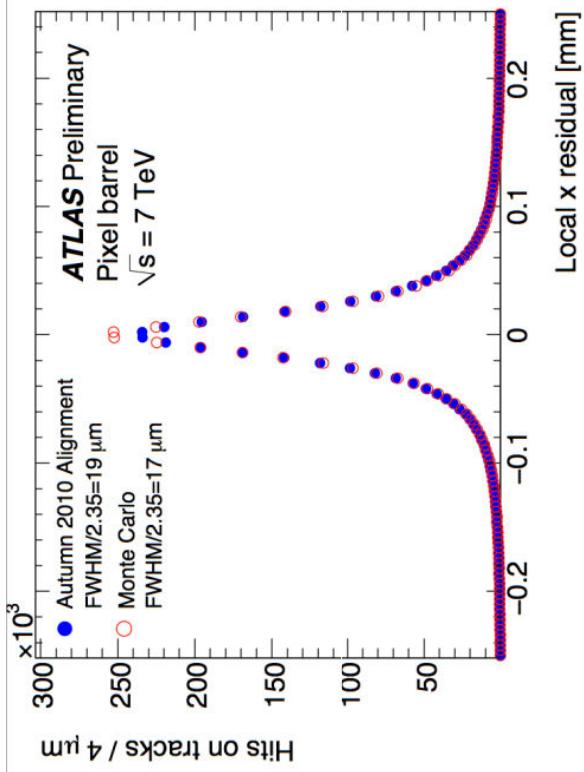


- Good control of rates, evolution with luminosity...

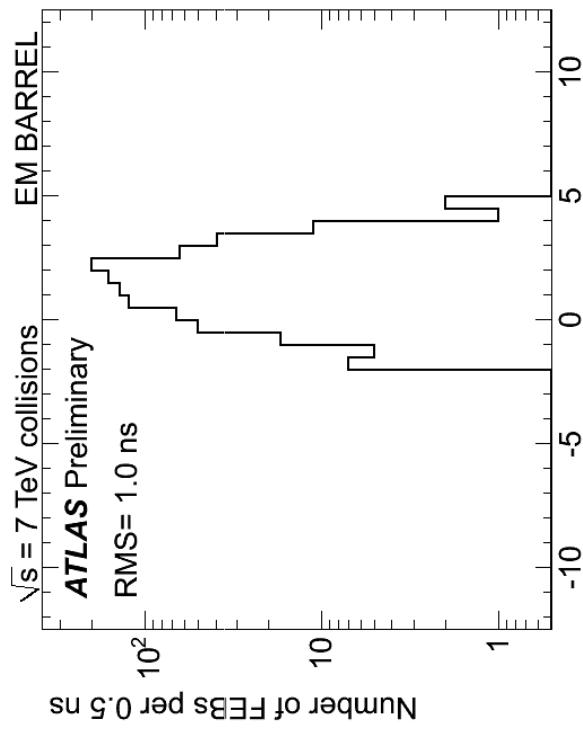
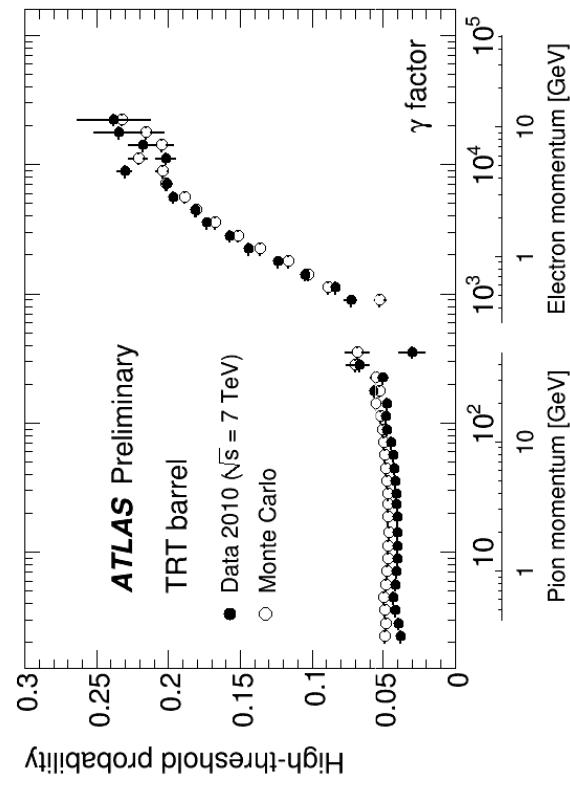


# Understanding the Detector: a few examples

- Pixel detector alignment  
(transverse plane, autumn reprocessing)

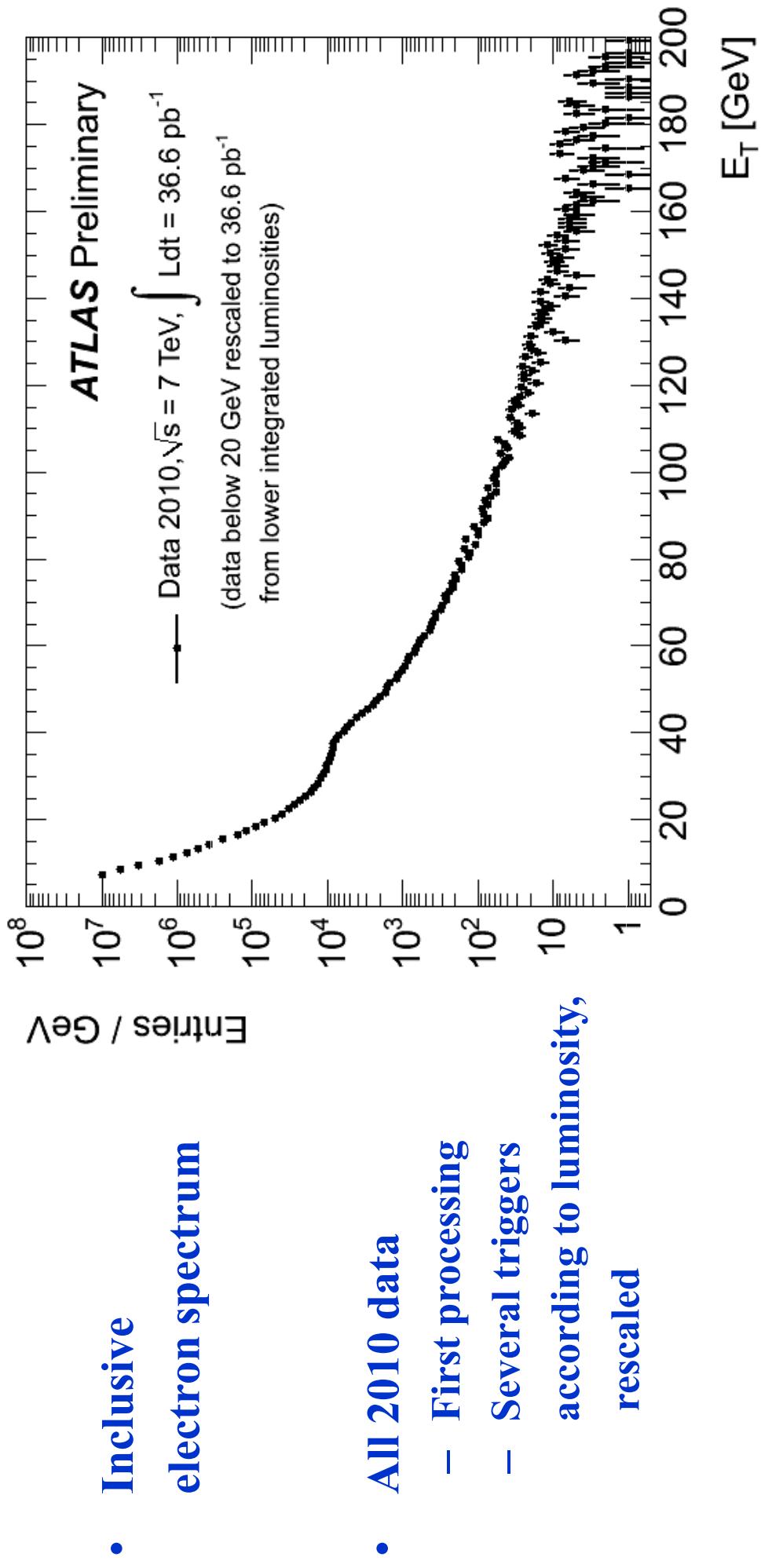


- Transition Radiation threshold



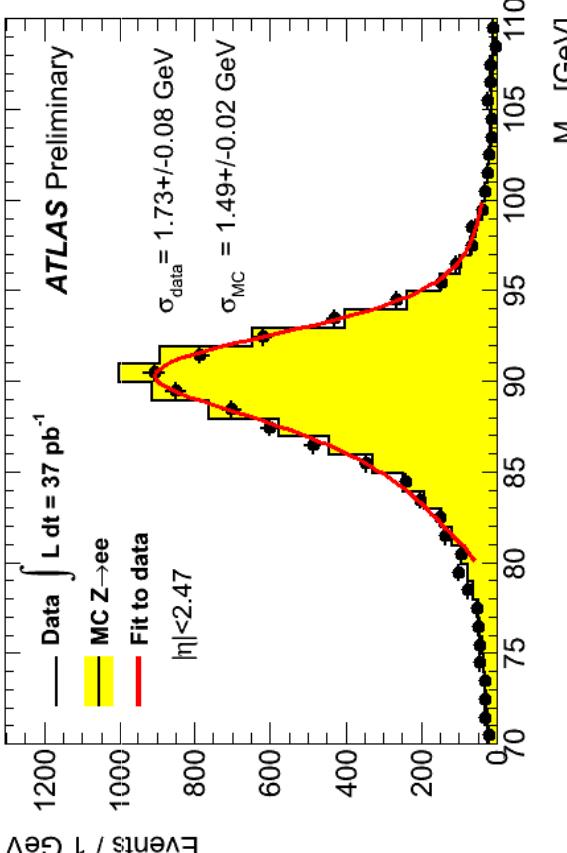
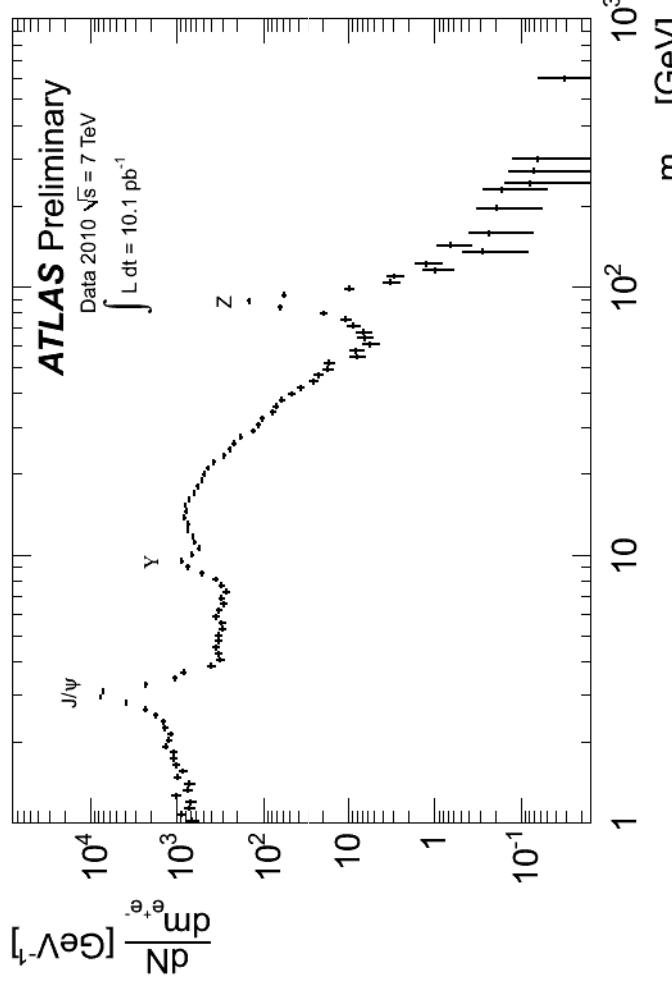
- EM calorimeter: timing

# Electrons and photons



# Di-electron mass

- **5 GeV di-electron trigger**
  - prescaled in later data
  - produces shoulder at 15 GeV



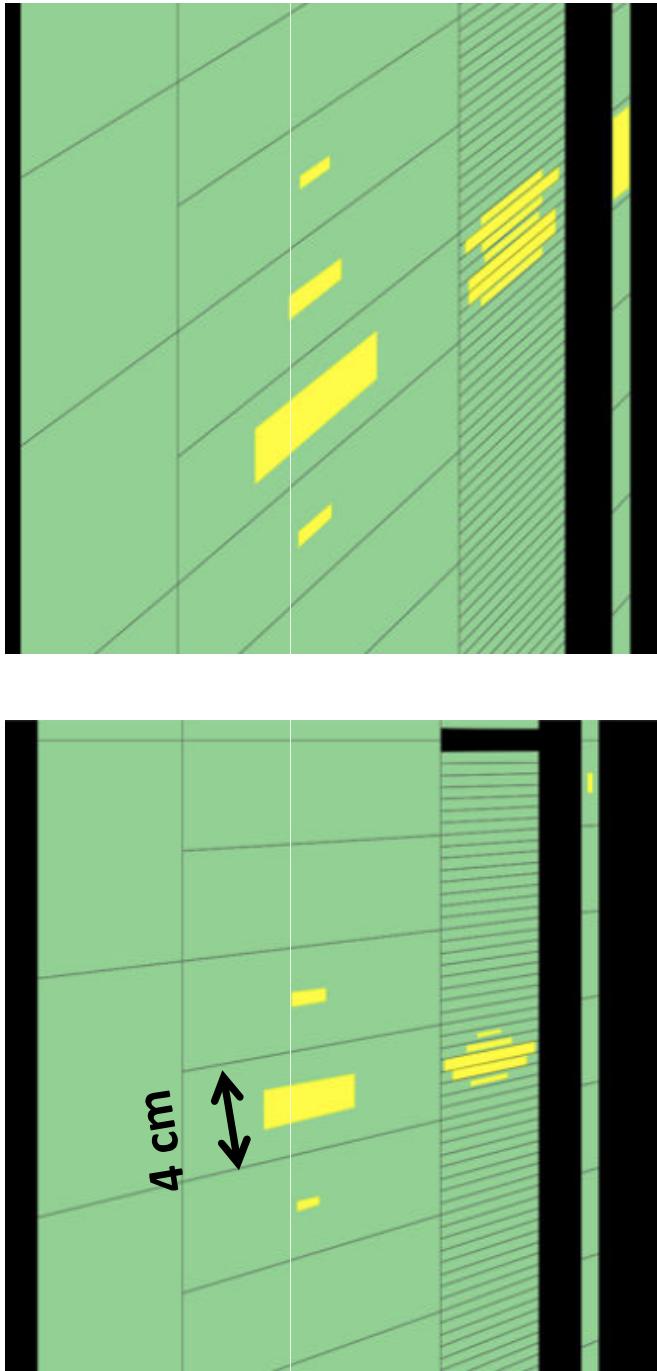
- **Z peak with full 2010 data**
  - All EM calorimeter
  - Autumn reprocessing
  - Fit : Breit-Wigner  $\otimes$  Crystal Ball
  - $\sigma$  quoted : Crystal Ball right

# Direct photons

- Data: photon /  $\pi^0$

Very fine granularity  
first compartment  
in EM calorimeter

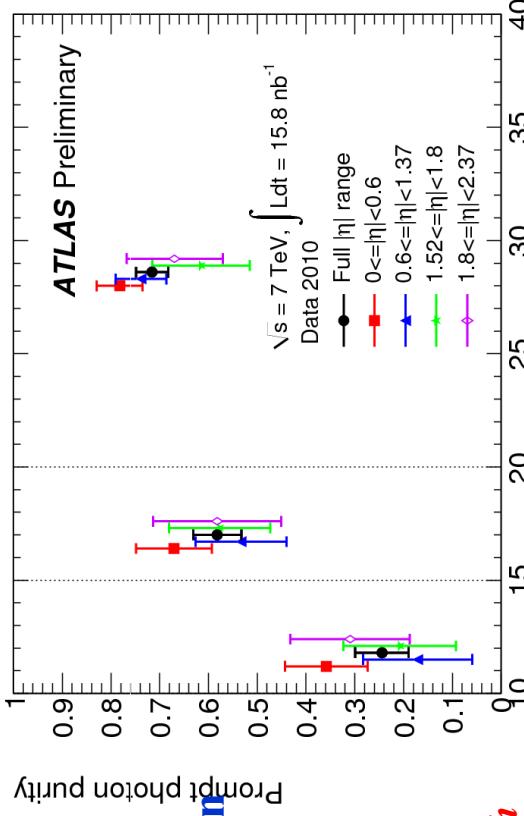
(This 21 GeV  $E_T \pi^0$   
would pass cuts in S2!)



- Preliminary analysis of direct photons  
Isolated

Background : fake photons ( $\pi^0, \eta$ ), QED radiation

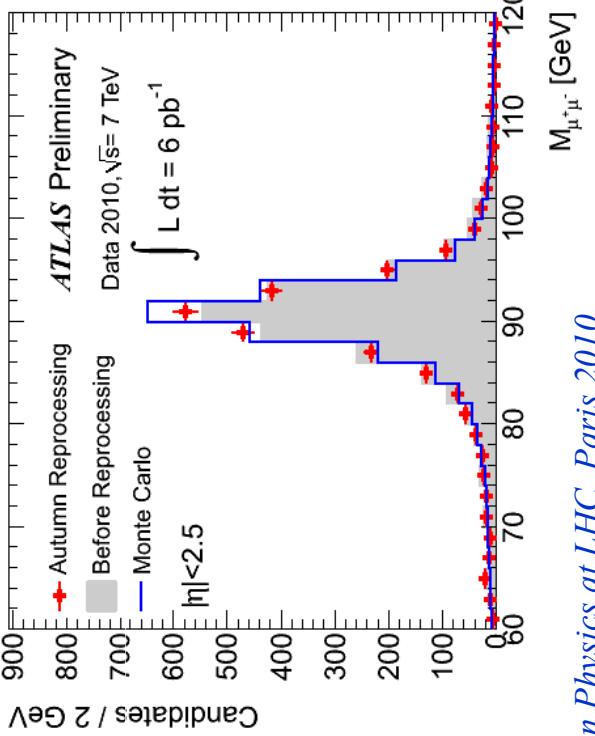
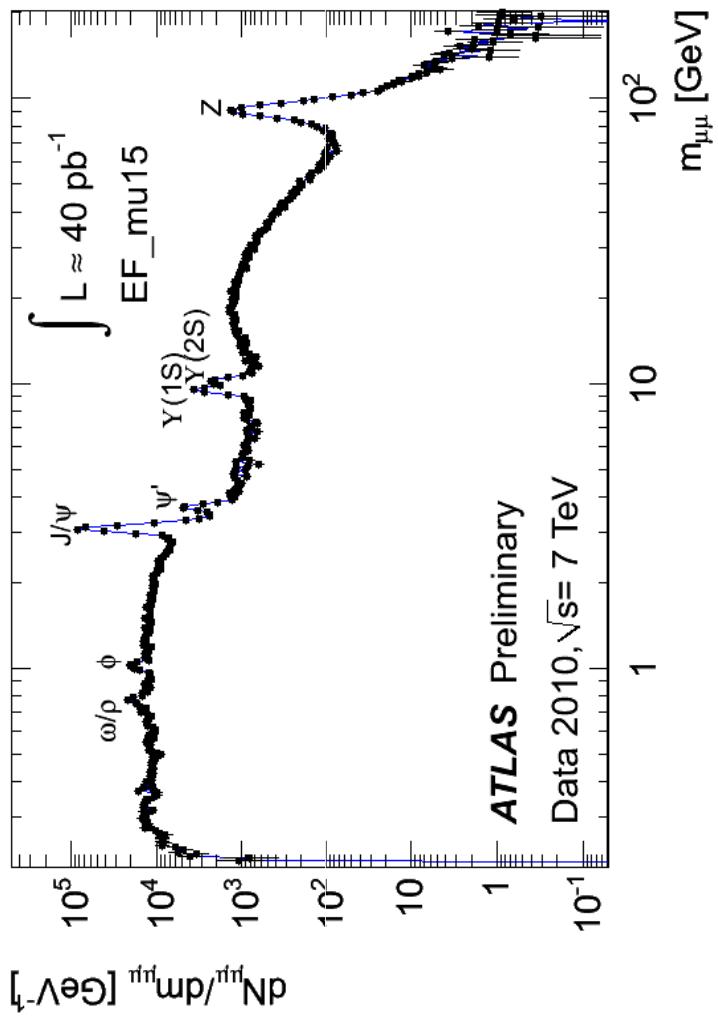
Purity reaches ~70% at 25 GeV  $E_T$



- Just released: cross-section on 880 nb<sup>-1</sup>  
see F Bucci's Talk at Ann Arbor Dec 14<sup>th</sup>

# Muons

- Di-muon mass spectrum
  - Heavily used in resolution studies



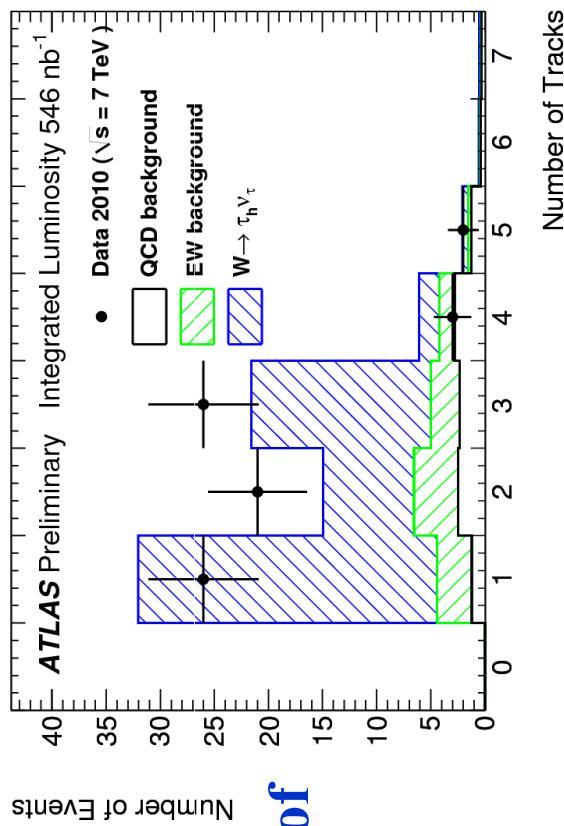
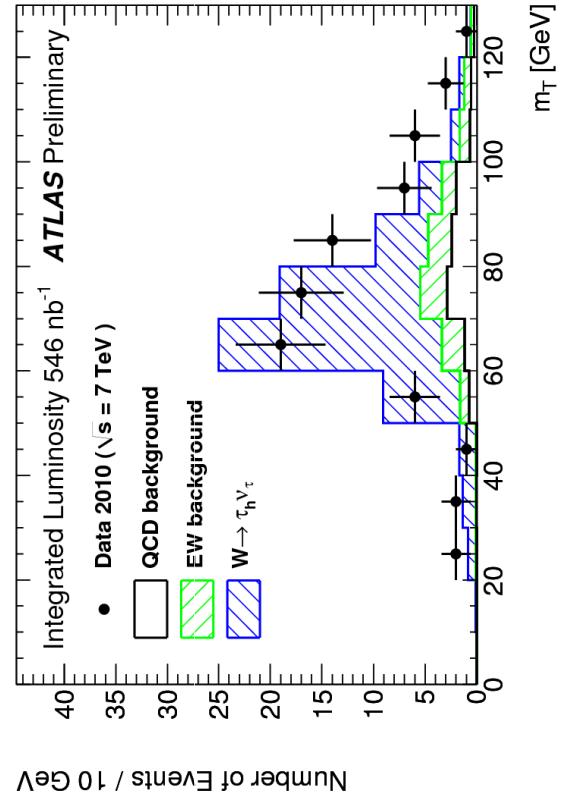
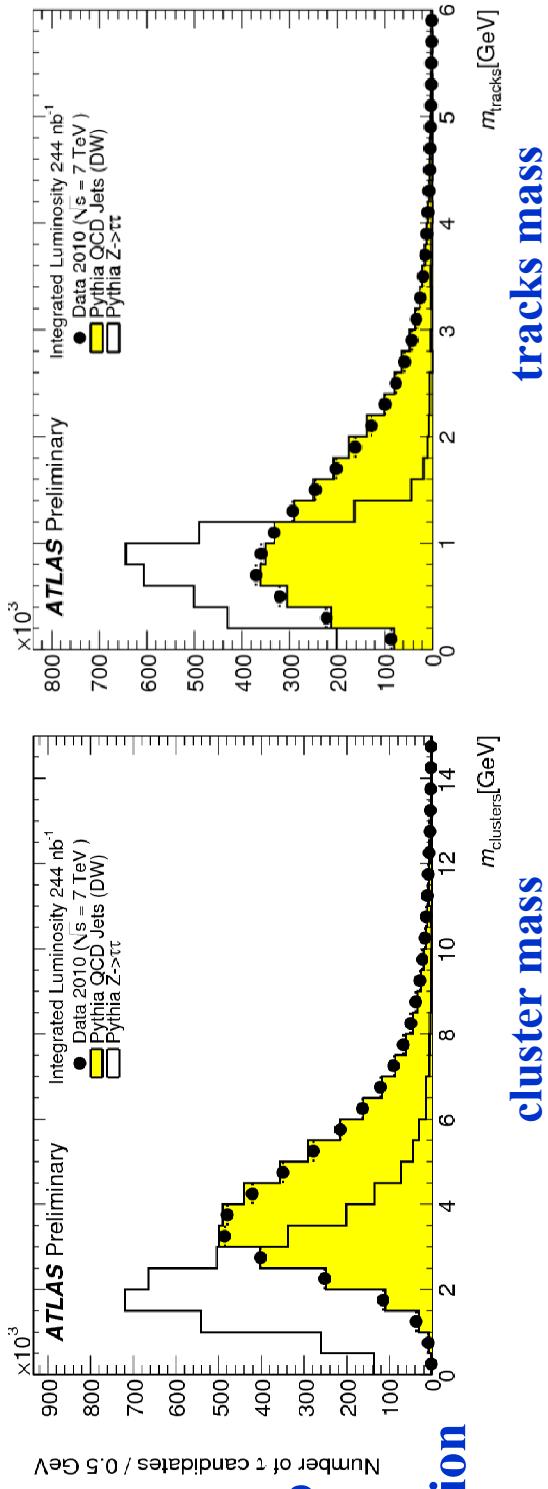
- **Z peak**
  - quite close to ultimate (expected) performance

# Taus

- Tau-Identification

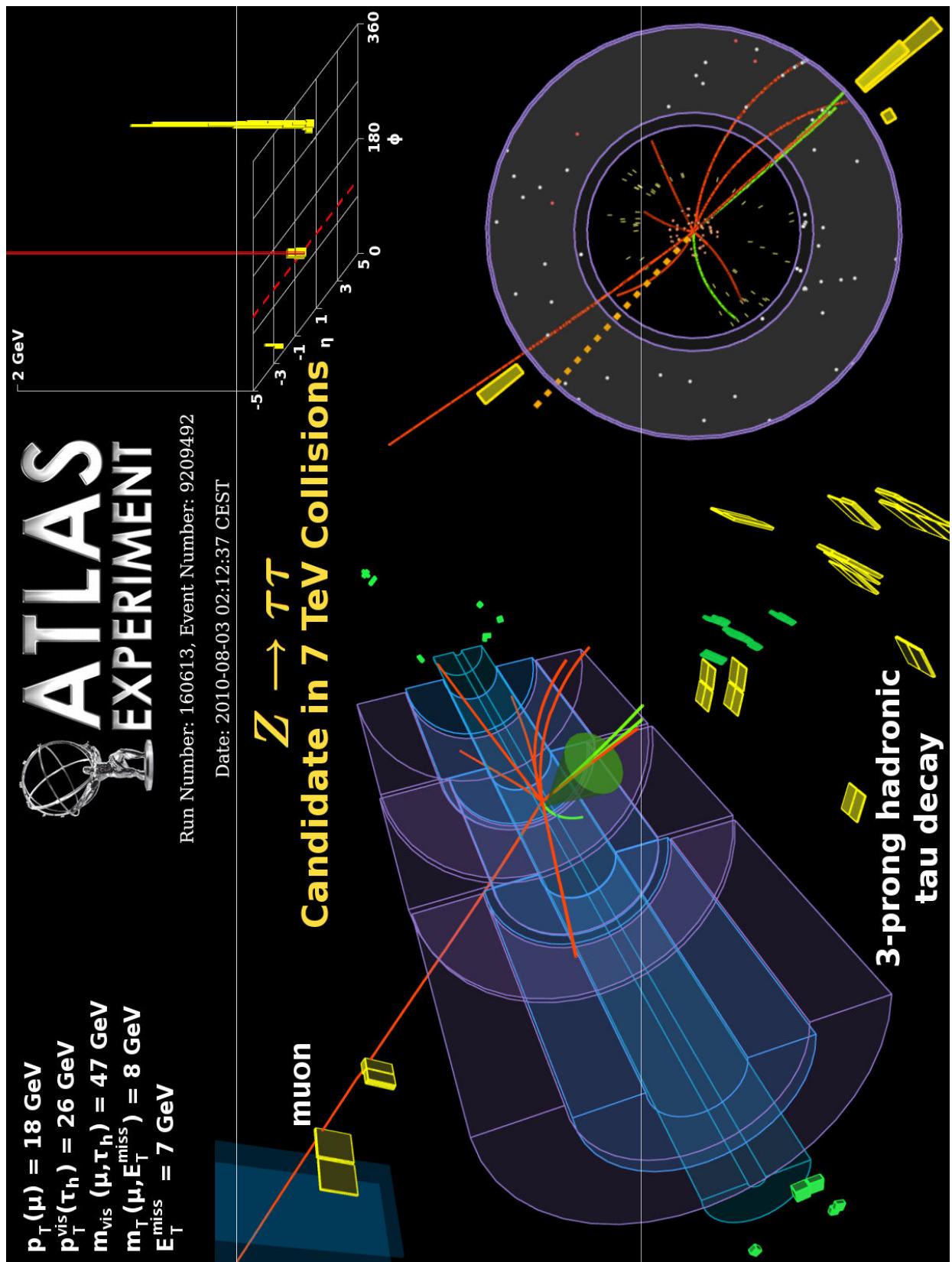
- Tracking  
+ fine grained calo

- Very good simulation



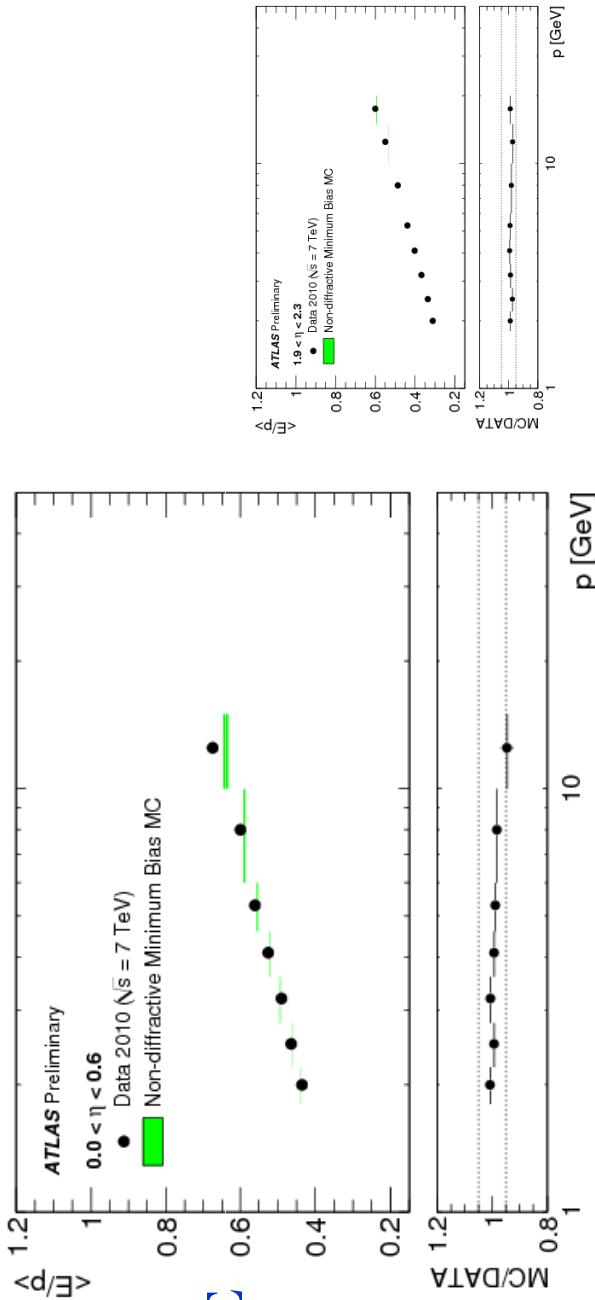
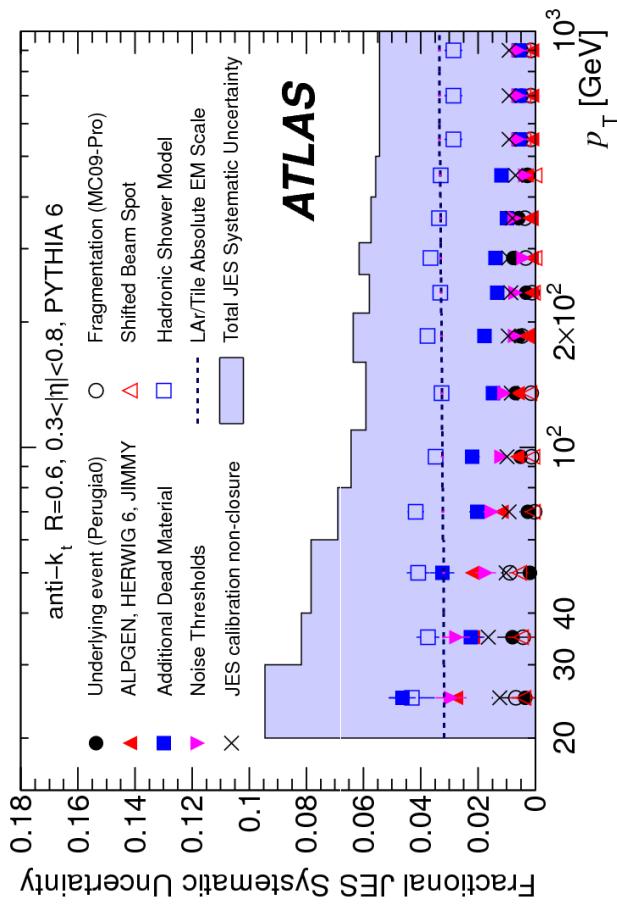
- Observation of  $W \rightarrow \tau V$  (small statistics)

$Z \rightarrow \tau\tau$



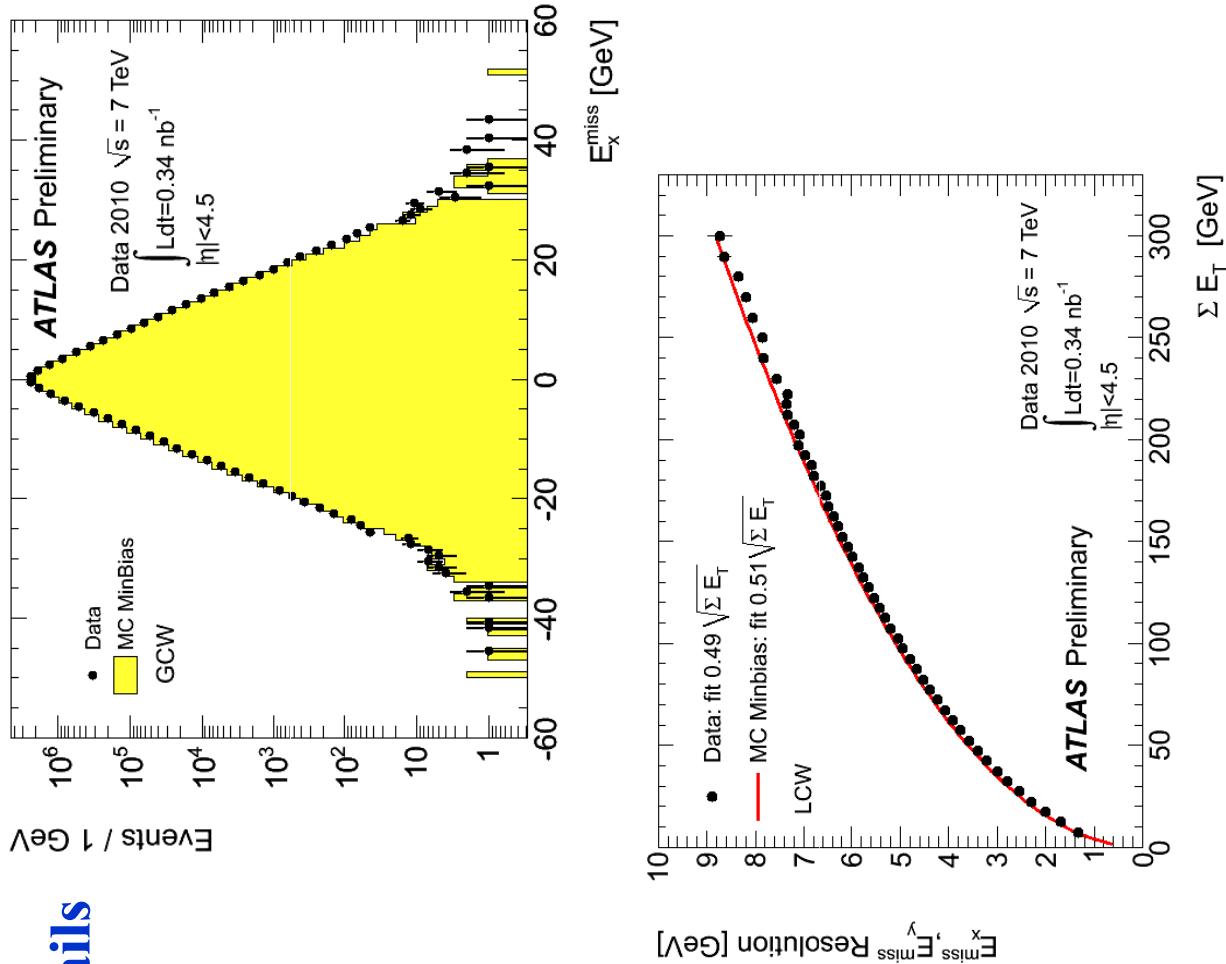
# Jets

- Jet Energy Scale
  - Initial uncertainty < 10%
  - From test-beam, M-C



# missing $E_T$

- Excellent control of tails



- Very good resolution  
(as expected)

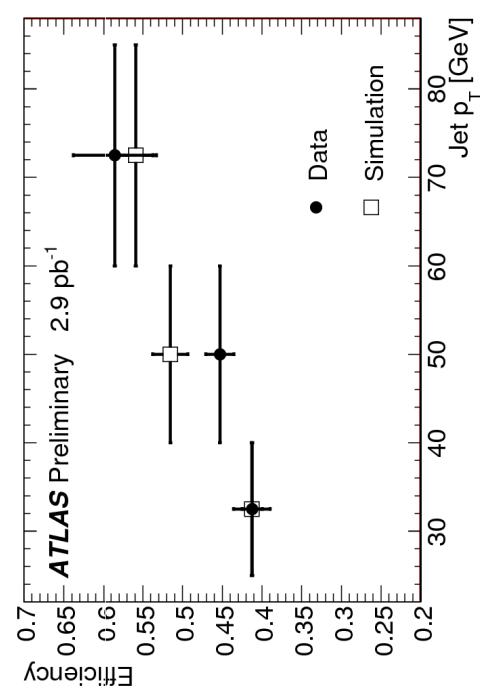
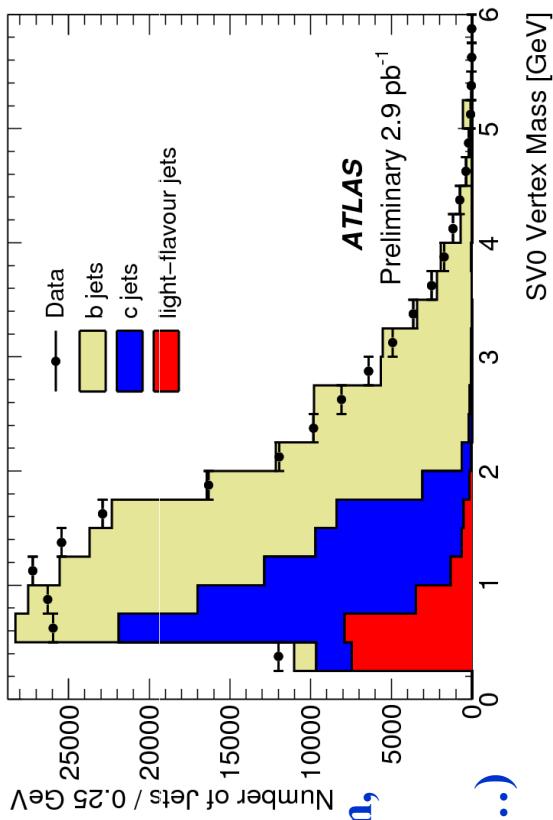
# B-tagging

- Algorithms already quite under control

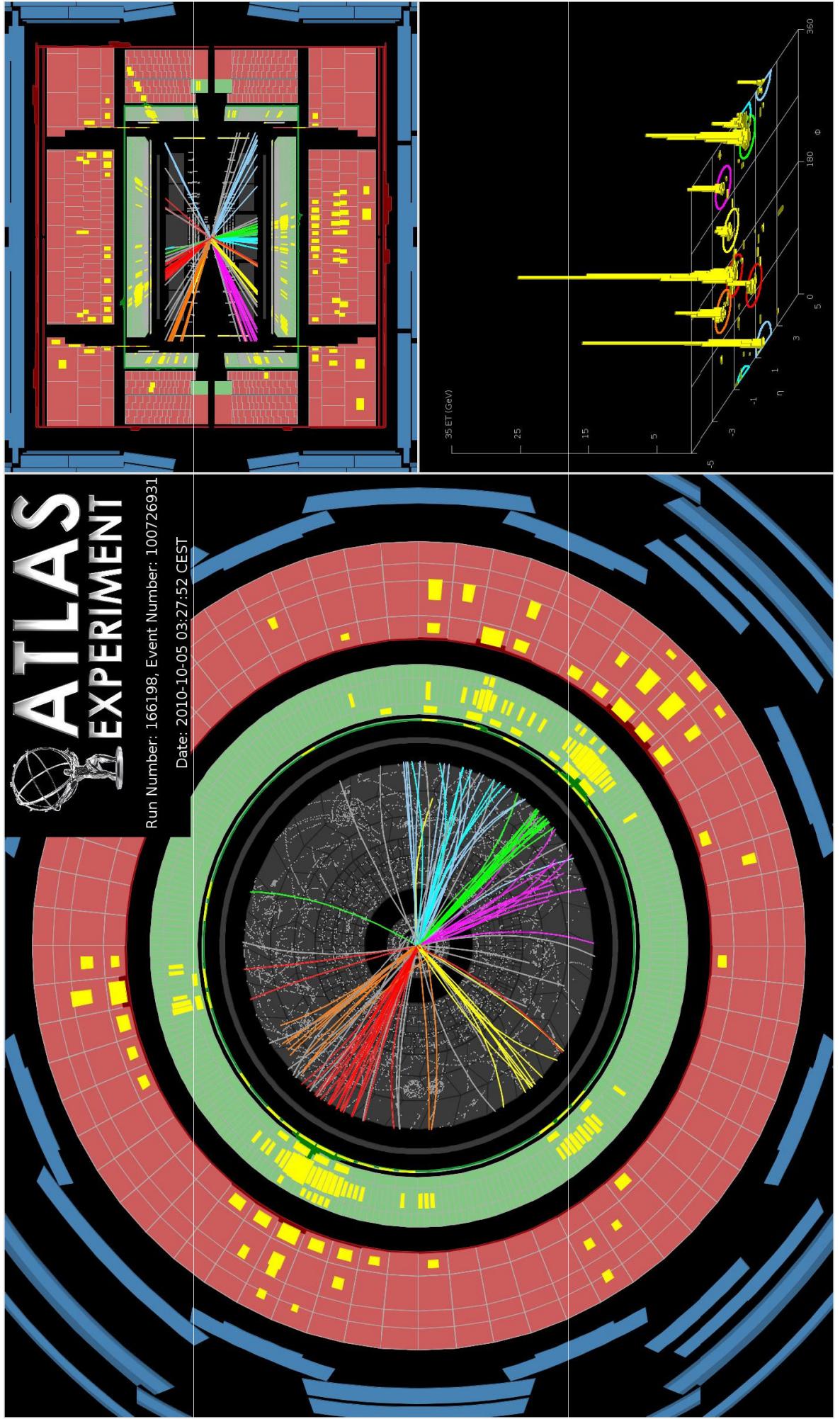
– Good pixel alignment

Detail  
 $\text{top} \rightarrow e-\mu$   
candidate

– Calibration  
with data  
(jets  
with muons)



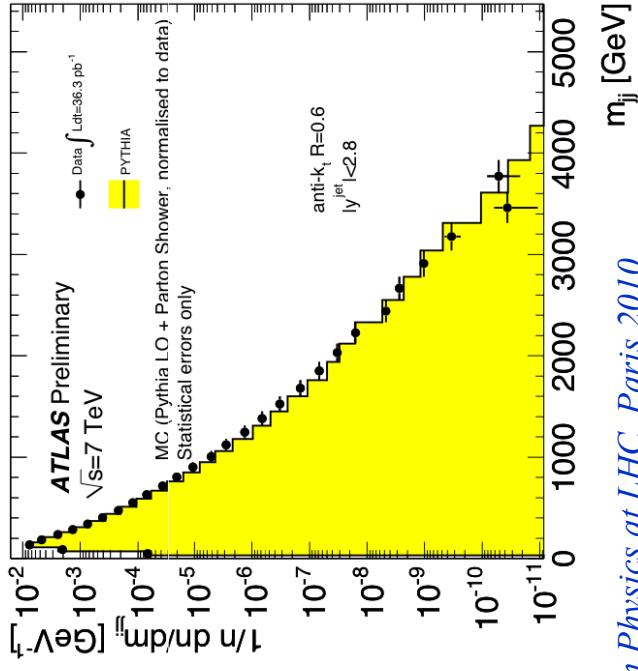
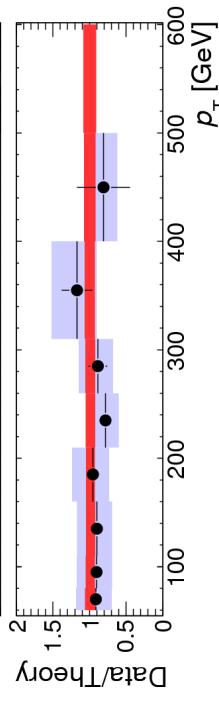
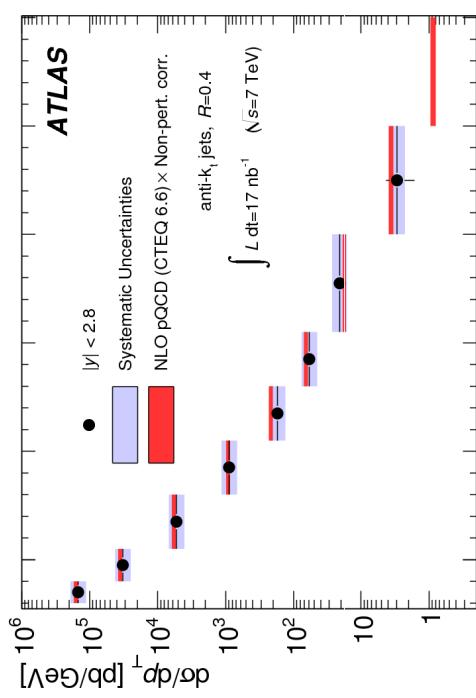
# Physics



# Jets

- Early measurement of jet cross-section (published)

- Up to 500 GeV
- Excellent agreement with NLO QCD

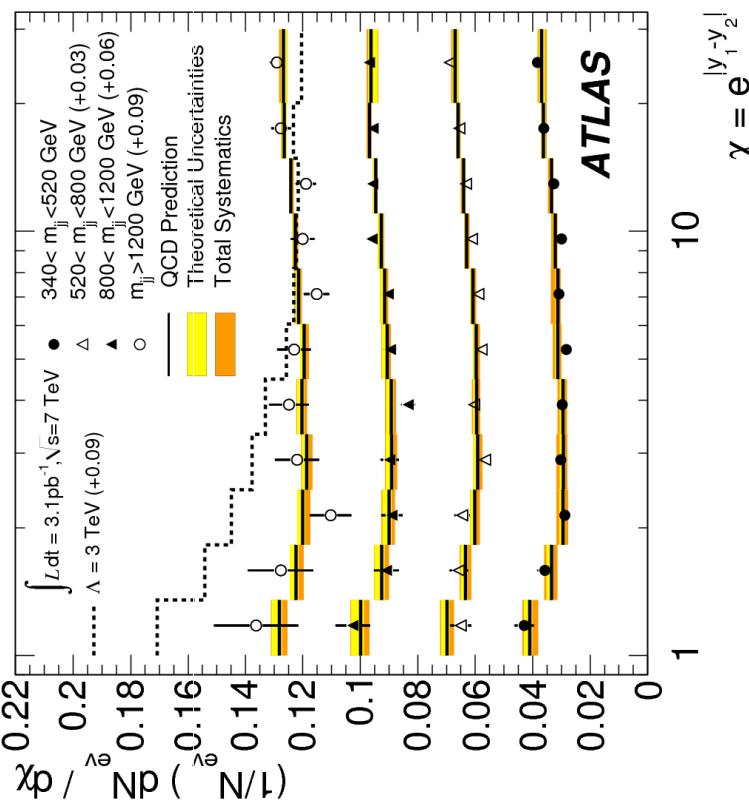
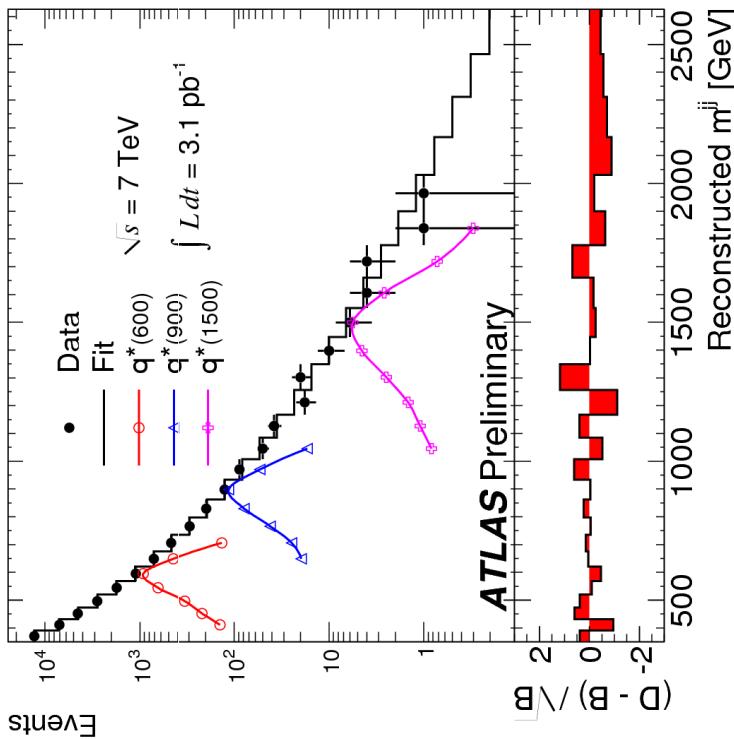


- All 2010 stats
- Dijet masses up to 3.7 TeV!  
(MC is LO Pythia, normalized to data)

# Jets: search for new phenomena

- Strongly coupled new physics: accessible with few data

Published



## Resonance search

$0.50 < m(q^*) < 1.53 \text{ TeV}$  @ 95% CL

## Contact interaction (angular dist.)

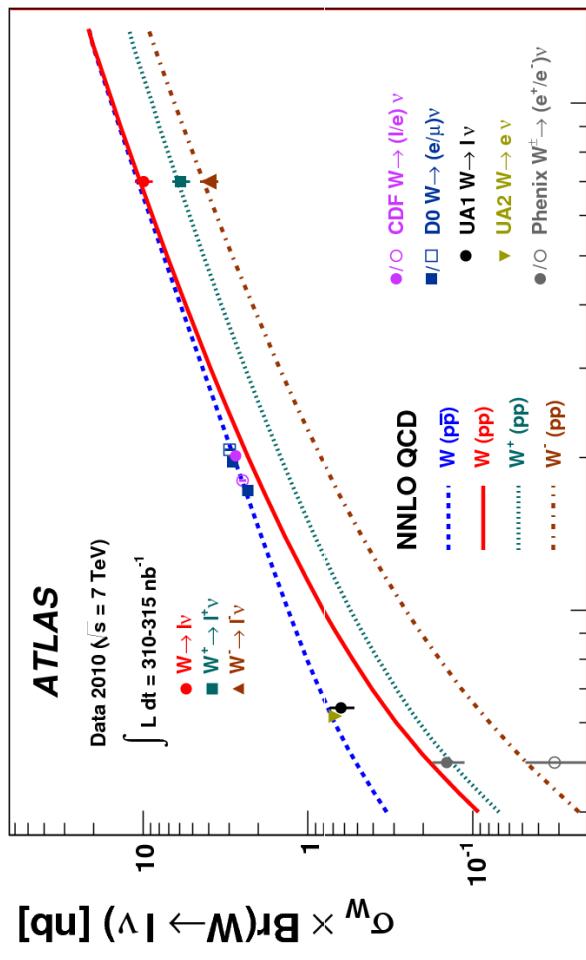
$\Lambda < 3.4 \text{ TeV}$  @ 95% CL

- Exceed TeVatron limits

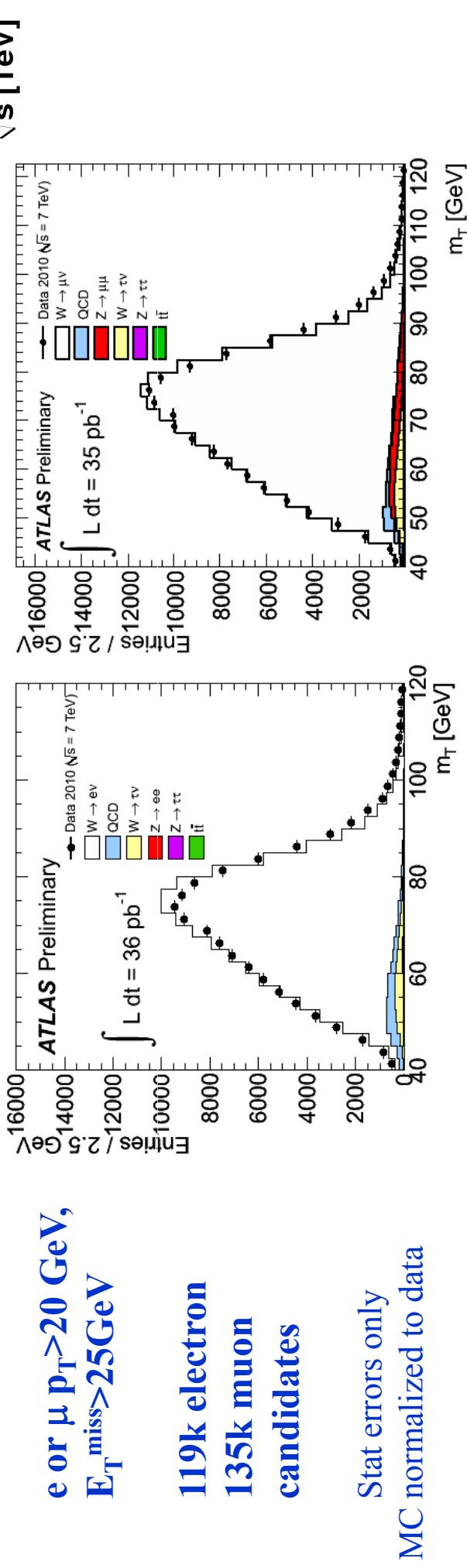
# W

- Published cross-section on early data  
(with Z cross-section)

- limited by luminosity uncertainty
- Excellent agreement with NNLO QCD



- Full data 2010

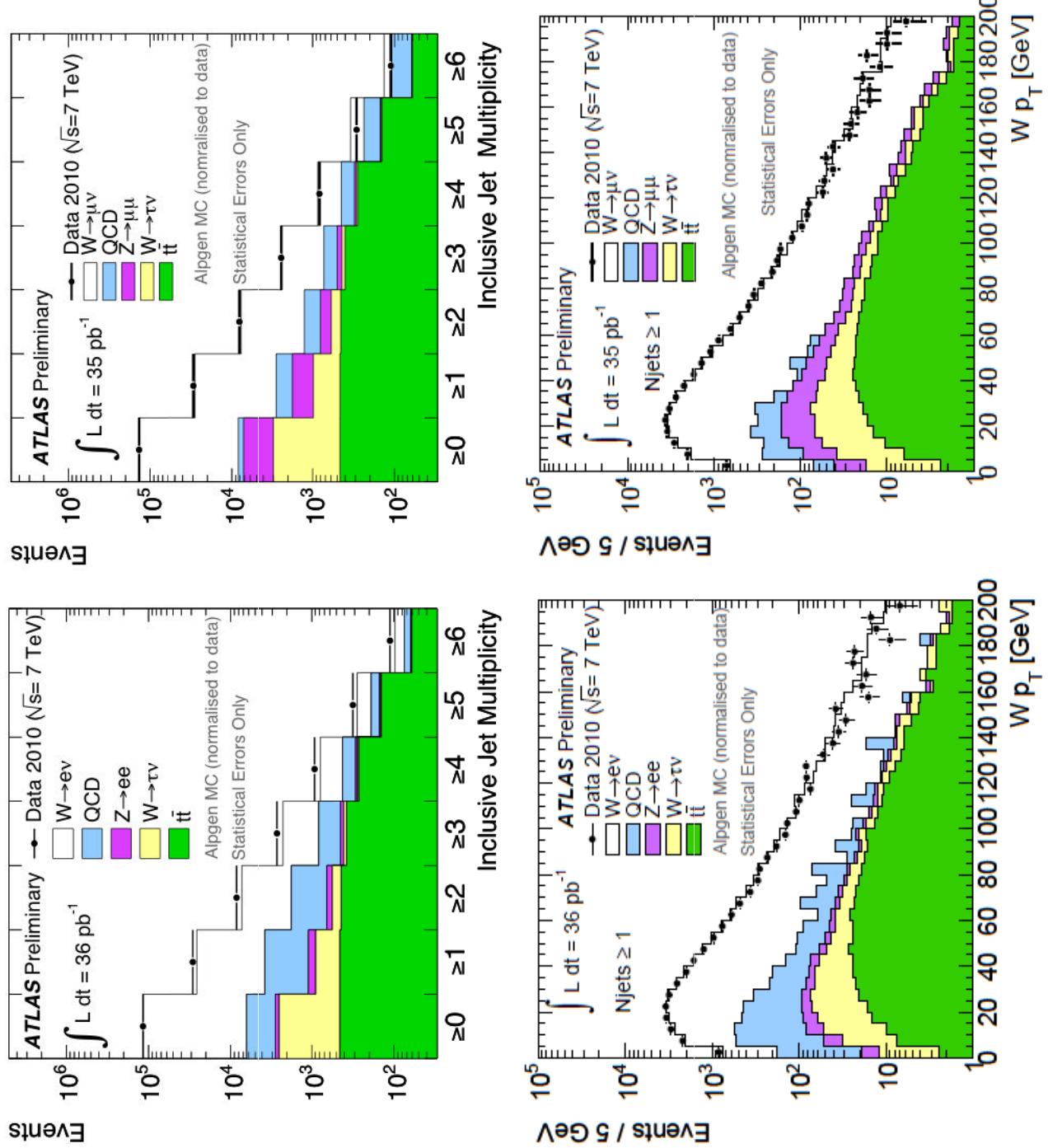


# $W + jets$

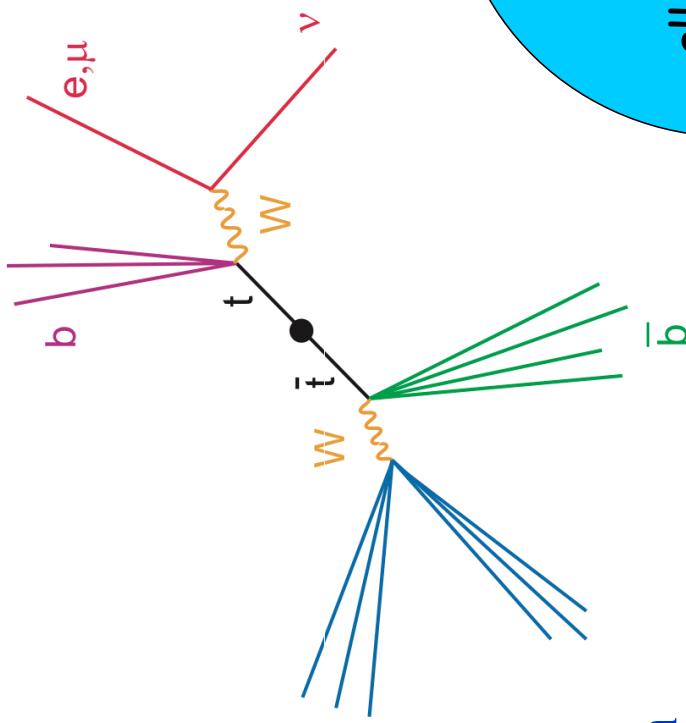
- Jet multiplicity

Stat error only  
MC normalized  
to data

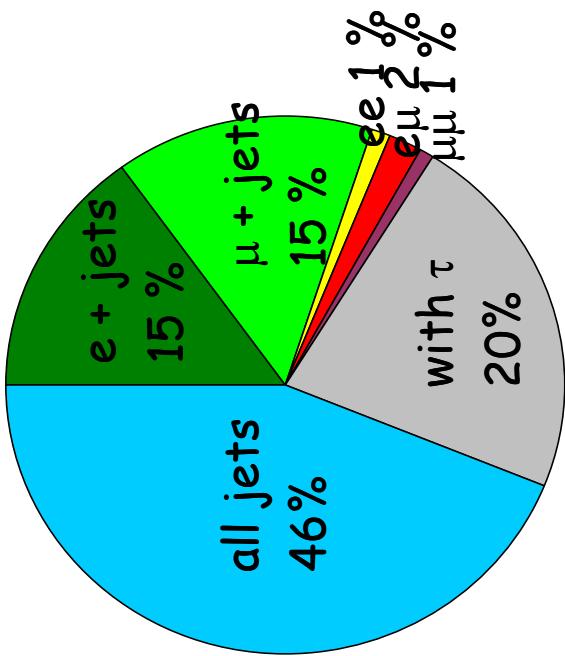
- $W p_T$



# Top

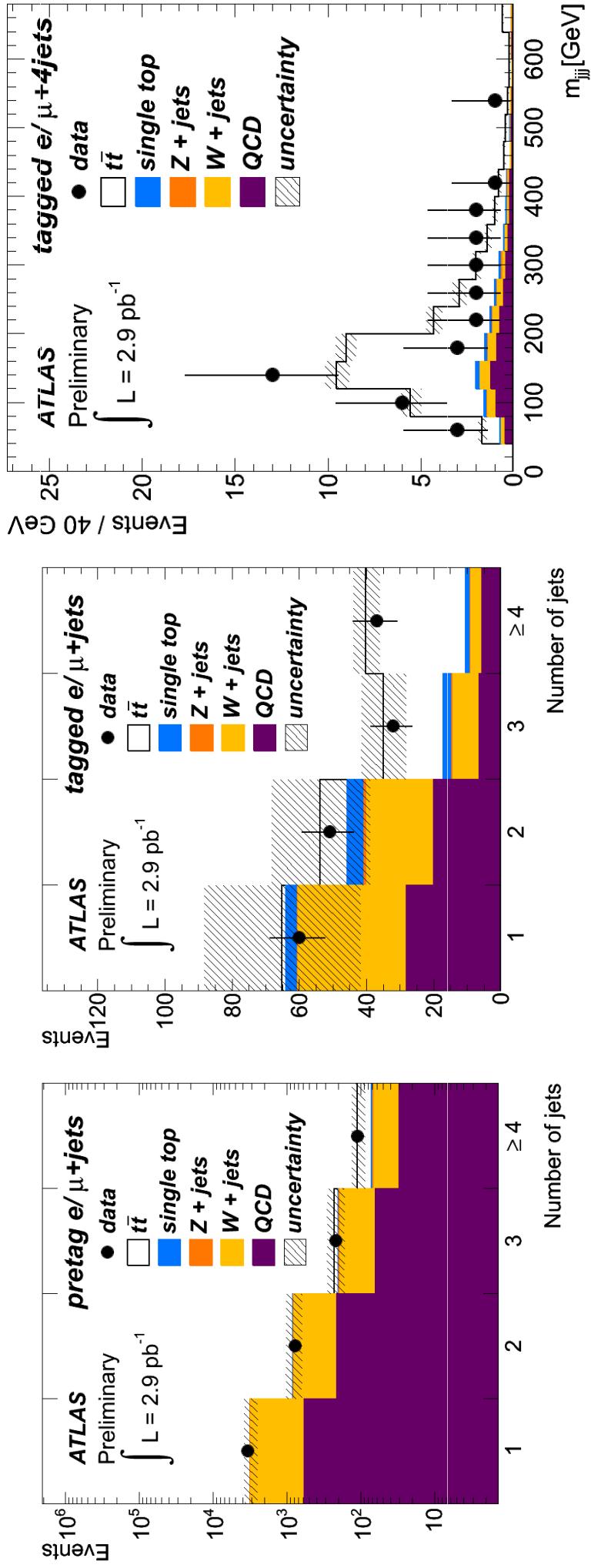


- Final state includes several ingredients of analyses:  
 $e, \mu, E_T^{\text{miss}}, b\text{-tag}$
- Sizeable backgrounds from QCD and  $W + \text{jet}$   
=> (mostly) data-driven estimates
- Cross-section from combined likelihood fit  
on  $3 \text{ pb}^{-1}$  data



# Top: 1 lepton + jets

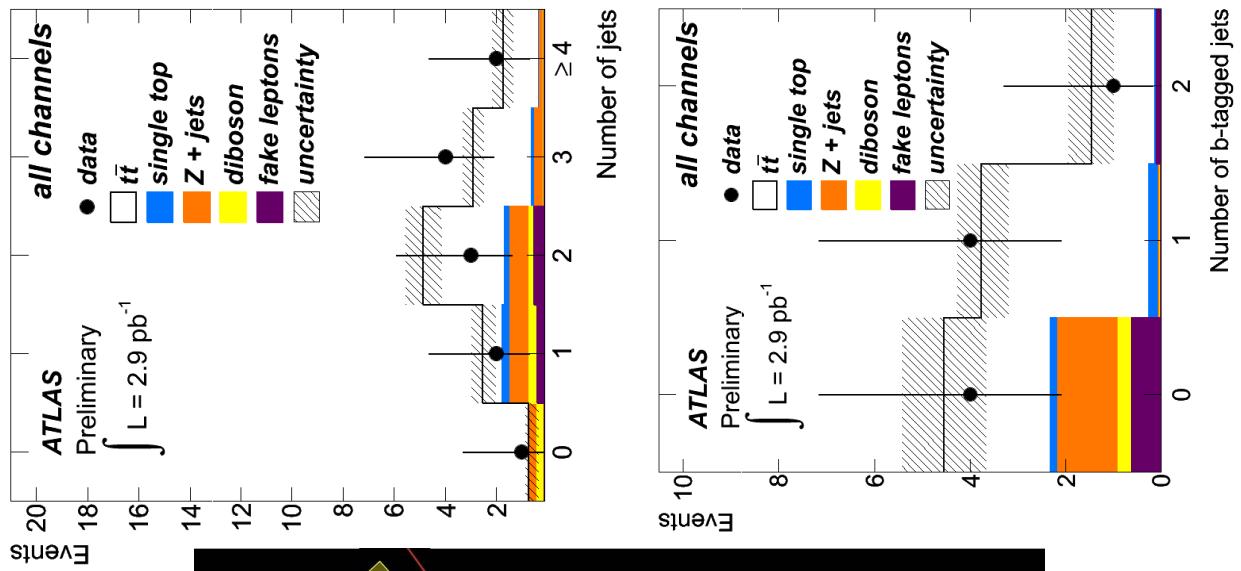
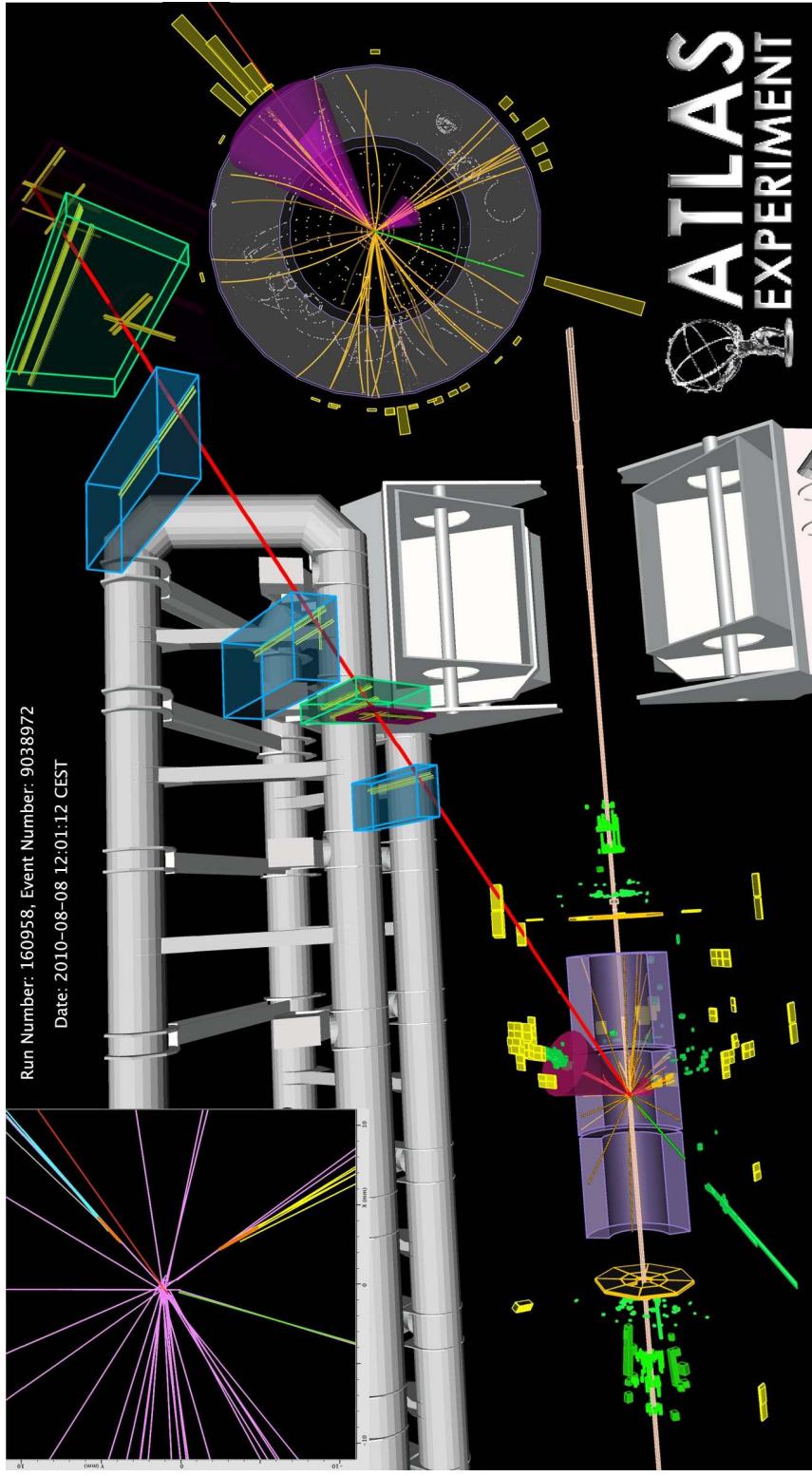
- $1 \text{ e or } \mu \text{ } p_T > 20 \text{ GeV}, \quad E_T^{\text{miss}} > 20 \text{ GeV}, \quad E_T^{\text{miss}} + m_T(W) > 60 \text{ GeV}$



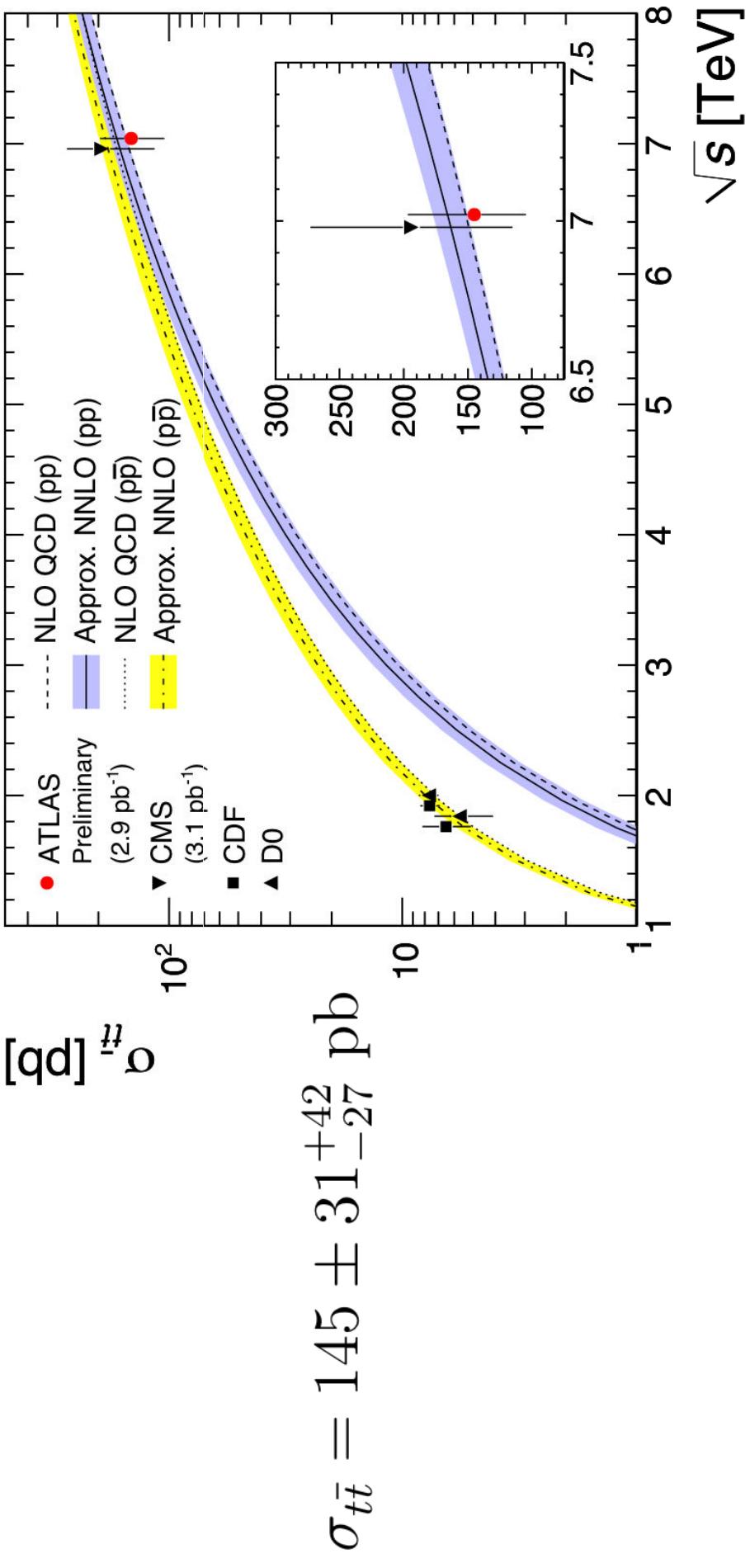
- **Signal :** 4-jets + 1 b-tag ; 3-jets used as cross-check.

# Top: 2 leptons + jets

- $e e$  or  $\mu \mu$   $p_T > 20$  GeV,  $E_T^{\text{miss}} > 40$  (resp 30) GeV, exclude  $M(Z)$  region
- $e \mu : p_T > 20$  GeV, Total  $E_T$  (scalar)  $> 150$  GeV



# Top cross-section (combined)



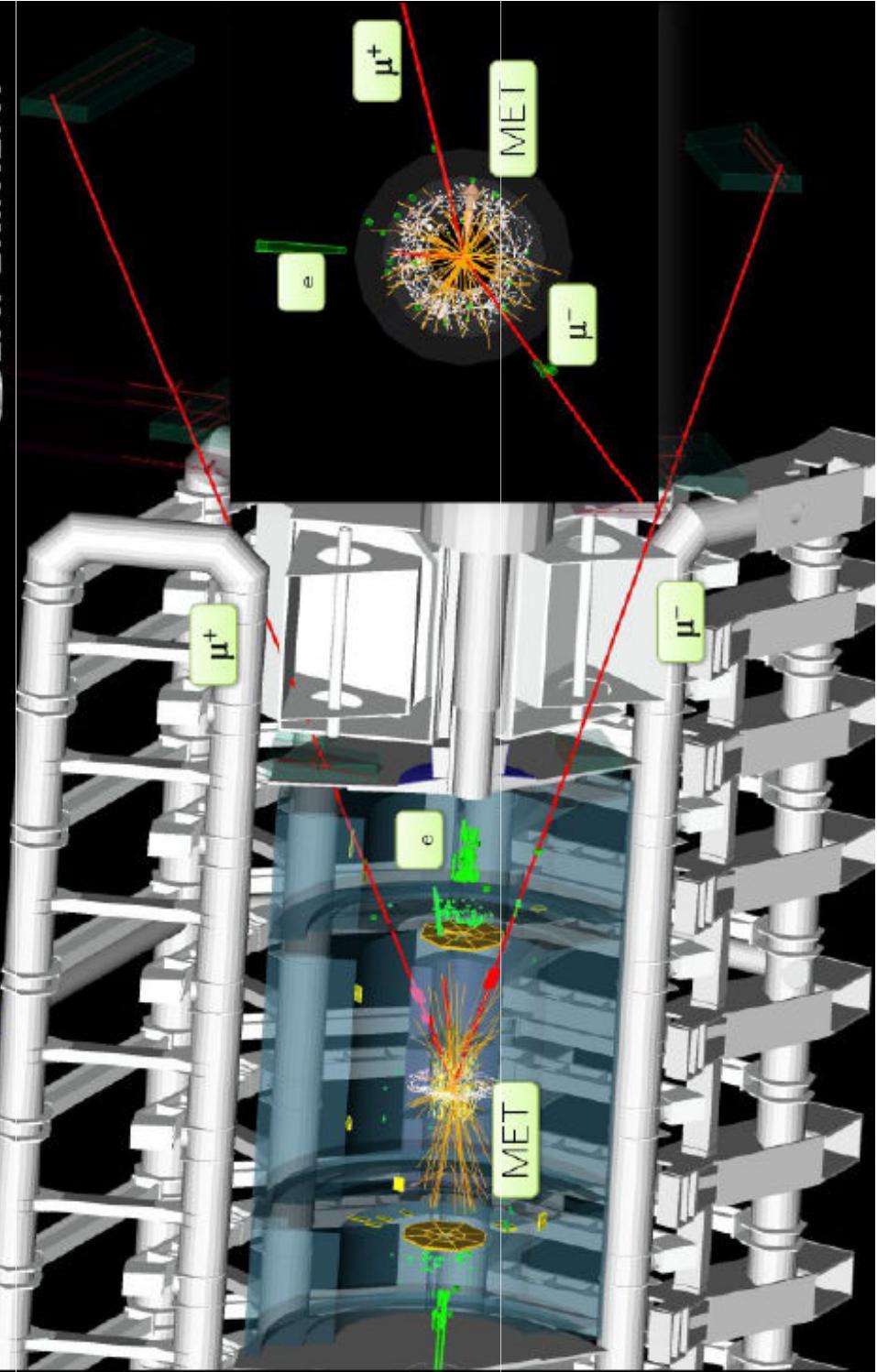
- Significance  $\sim 4.8 \sigma$  (with respect to background only hypothesis).

# Di-bosons

Other event  
displays on Atlas  
public web page:  
 $WW \Rightarrow ee, \mu\mu, e\mu$   
candidates

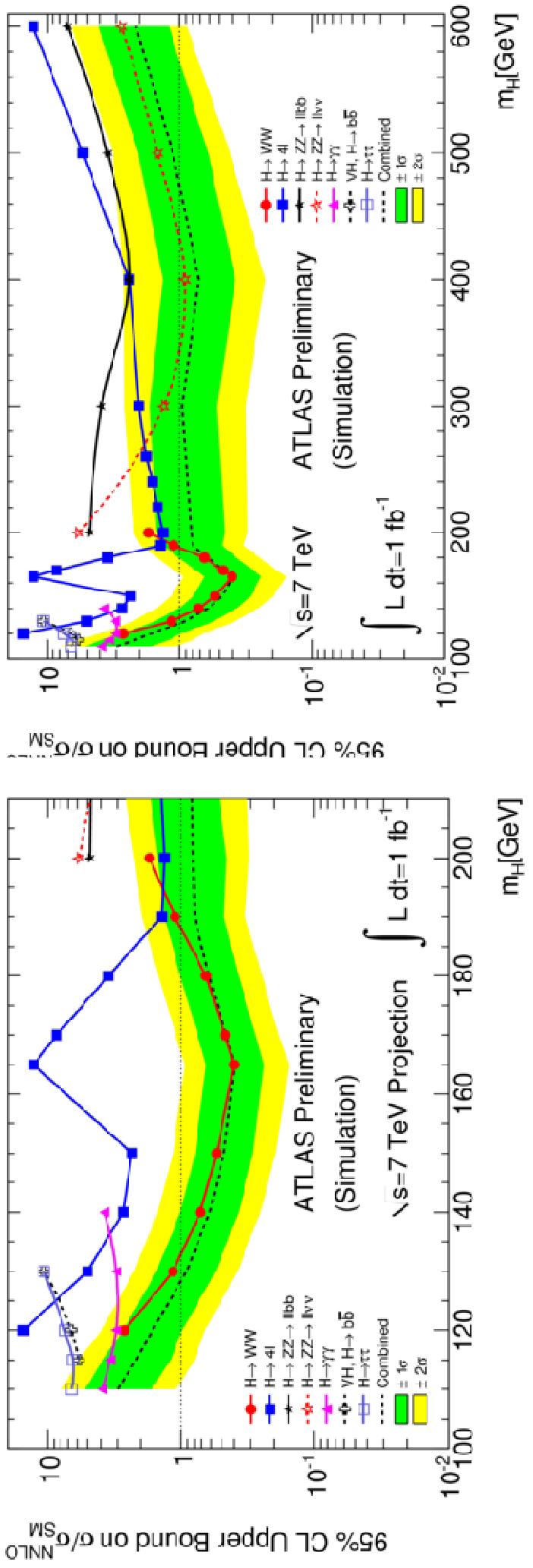


Run=165956 Event=7869239 LBN=20  
 $ZW \rightarrow \mu\mu e\nu$



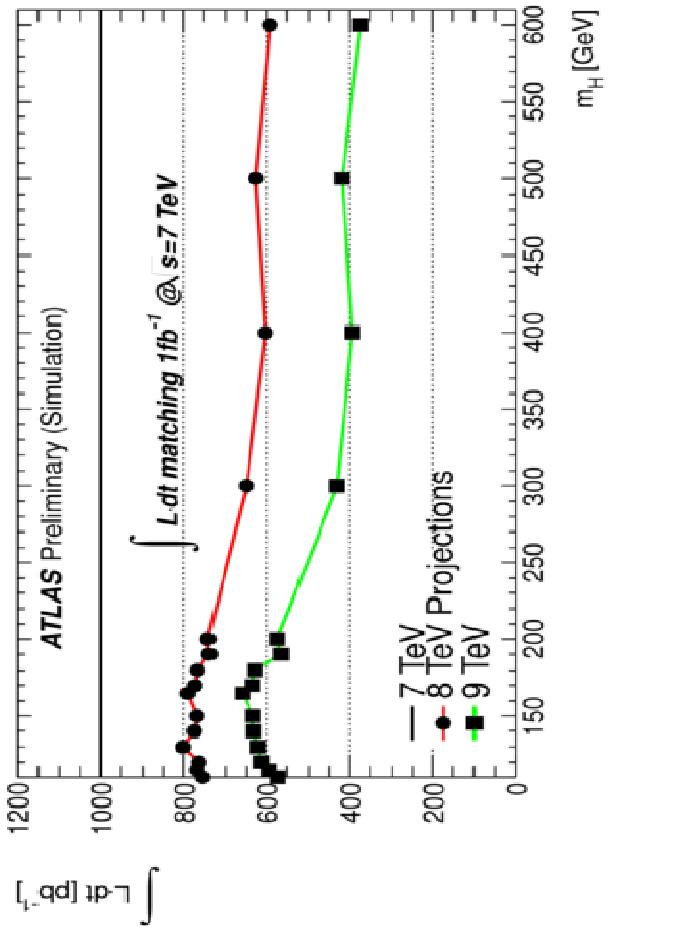
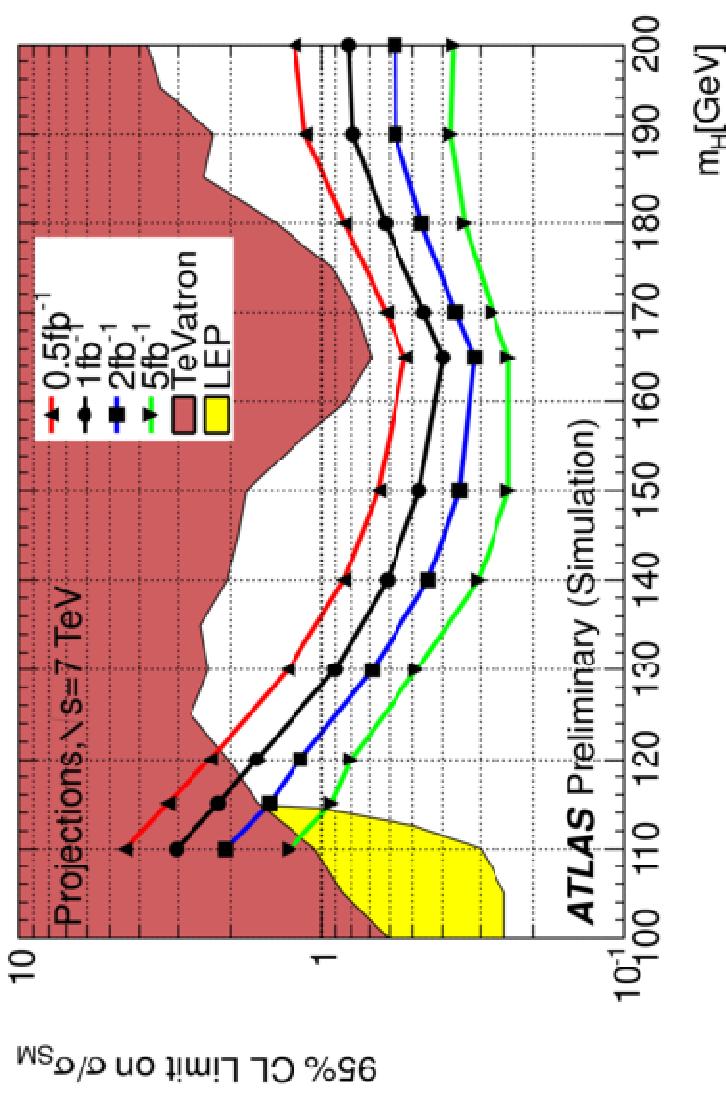
# Prospects for Higgs search

- Recently updated sensitivity at 7, 8, 9 TeV for strategy evaluation
  - New cross-sections (ex  $gg \rightarrow H$  : + 30% [NNLO + NNLL])
  - New modes studied and/or added to combination



- Median exclusion region at 7 TeV for  $1 \text{ fb}^{-1}$ : 129-460 GeV

# Higgs search versus luminosity and c.o.m energy



- At 7 TeV c.o.m., 5  $\text{fb}^{-1}$  allows to “close the gap” with LEP limit
- + 1 TeV => equivalent to + 20% luminosity for Higgs sensitivity

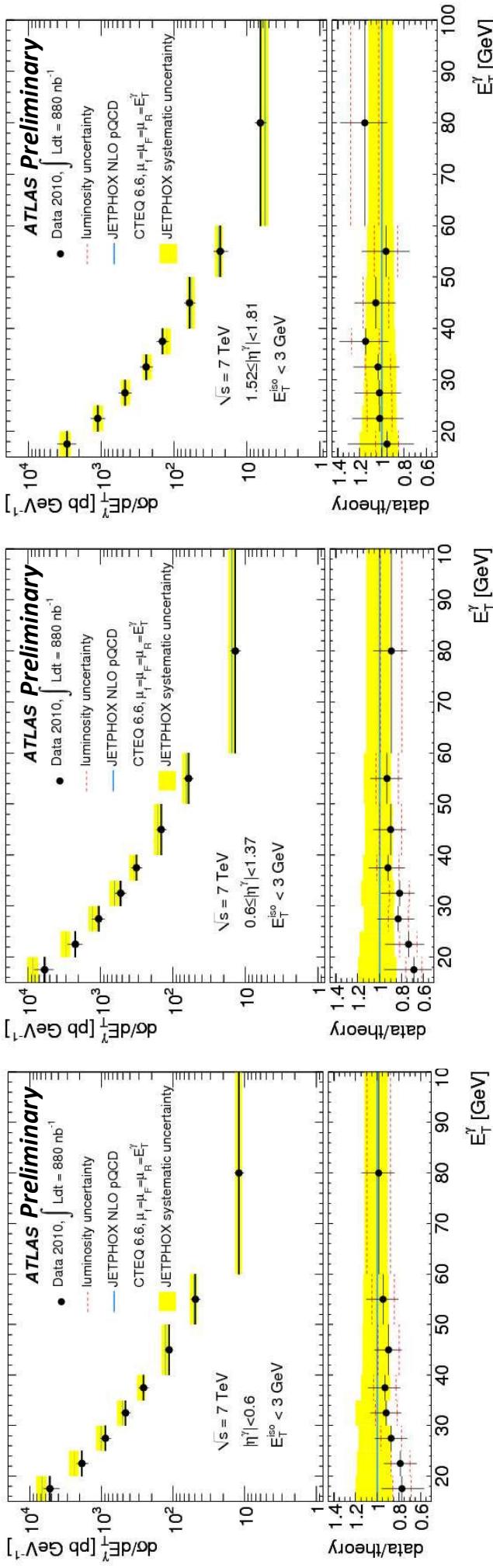
# Conclusion

- Powerful detector, excellent status
  - Published results with limited statistics
    - Jets cross-section
    - W, Z cross-section
  - Many preliminary results to be published soon
    - Direct photon cross-section, Top cross-section...
  - Large scope of results with 2010 data
    - *Also extensive work on backgrounds, min bias, underlying event, pileup*
- => Entering discovery range, but also precision measurements!
- All results available on <https://twiki.cern.ch/twiki/bin/view/AtlasPublic>

## **Additional slides**

# Direct photon measurement

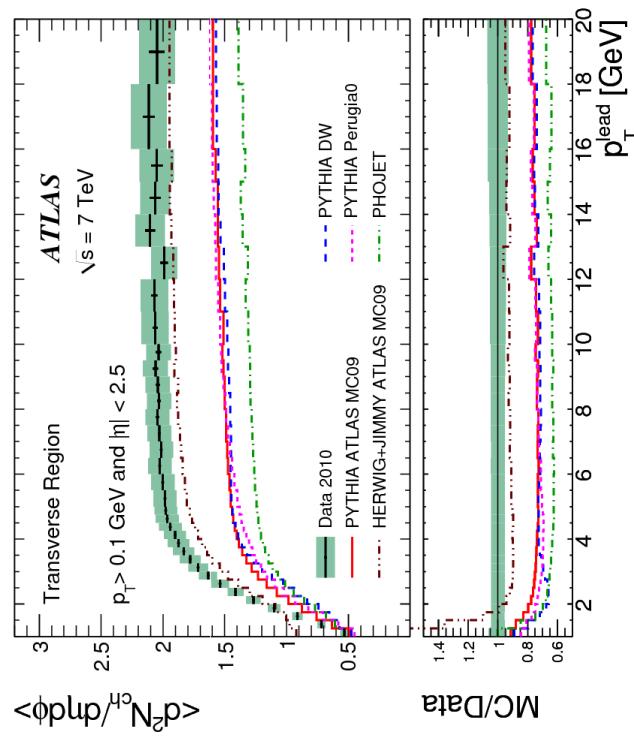
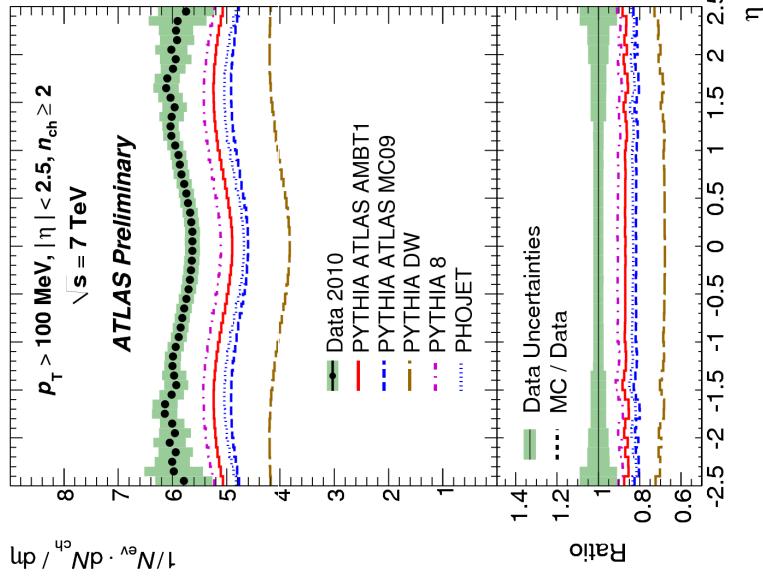
- Photons selected and isolated ( $E_T [ \Delta R < 0.4 ] < 3 \text{ GeV}$ )



- Good agreement with Jetphox (NLO QCD) above 25 GeV  $E_T$
- more systematics below (data *and* prediction)
- Cross-section 30 times higher than TeVatron.

# Minimum Bias, Underlying event

- charged particle multiplicity in Min Bias events: higher than expected



Same is true for the underlying event

-