



M. Weber  
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LHEP, Bern

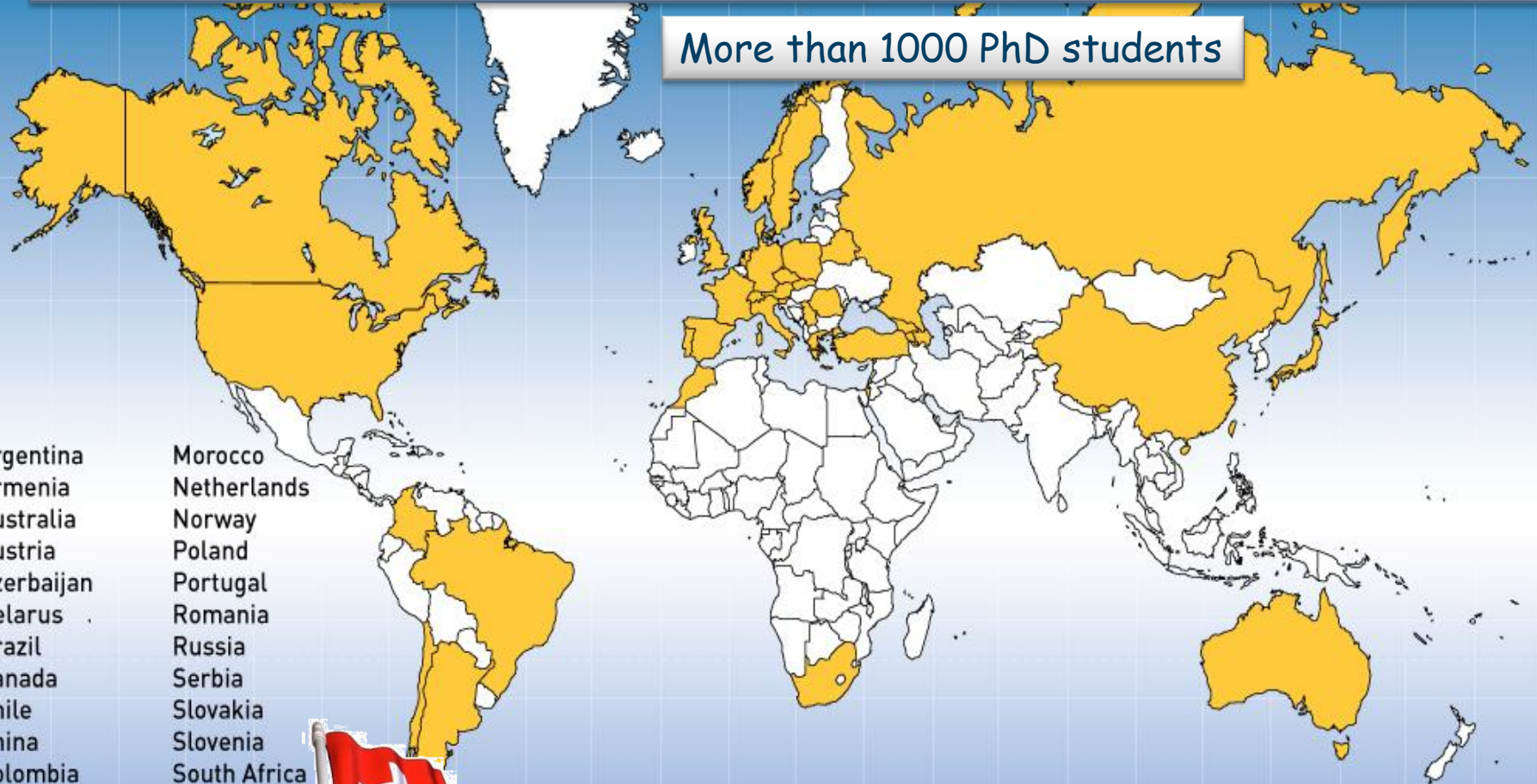
LABORATORIUM FÜR HOCHENERGIEPHYSIK  
**LHEP**  
UNIVERSITÄT BERN



**UNIVERSITÉ  
DE GENÈVE**

~3000 scientists from 174 Institutions and 38 Countries

More than 1000 PhD students



- |                |              |
|----------------|--------------|
| Argentina      | Morocco      |
| Armenia        | Netherlands  |
| Australia      | Norway       |
| Austria        | Poland       |
| Azerbaijan     | Portugal     |
| Belarus        | Romania      |
| Brazil         | Russia       |
| Canada         | Serbia       |
| Chile          | Slovakia     |
| China          | Slovenia     |
| Colombia       | South Africa |
| Czech Republic | Spain        |
| Denmark        | Sweden       |
| France         | Switzerland  |
| Georgia        | Taiwan       |
| Germany        | Turkey       |
| Greece         | UK           |
| Israel         | USA          |
| Italy          | CERN         |
| Japan          | JINR         |



**Bern**  
**Geneva**

**ATLAS**  
**Collaboration**

CHIPP plenary Gersau, 23.8.2010



# Switzerland in ATLAS, people



DPNC - Geneva

Underlined = newcomers



LHEP - Bern

Prof. A. G. Clark  
Prof. A. Blondel  
Prof. M. Pohl  
Dr. L. Rosselet, Dr. X. Wu  
Dr. D. Ferrere, Dr. S. Gadomski

Prof. M. Nessi

Dr. W. H. Bell, Dr. P. Bell, Dr J. Garcia Navarro  
Dr. S. Gonzalez Sevilla, Dr. M. Goulette,  
Dr. A. Hamilton, Dr A. Lister,  
Dr B. Martin dit Latour, Dr G. Pásztor

A. A. Abdelalim, G. Alexandre,  
M. Backes, J. Baret, E. Berglund,  
F. Bucci, V. Dao, C. Mora Herrera,  
S. Nektarijevic, K. Nikolics,  
A. Robichaud-Veronneau, K. Rosbach

F. Cadoux, D. Debieux, D. La Marra

Prof. A. Ereditato  
PD Dr. H. Beck  
PD Dr. M. Weber

Dr. L. Ancu,  
Dr. T. Fonseca-Martin  
Dr. S. Haug

Dr. G. Sciacca

M. Agustoni, I. Badhrees, A. Battaglia,  
C. Borer, V. Gallo, T. Kruker, C. Topfel,  
N. Venturi

J. Casutt

# Switzerland in ATLAS, hardware/software

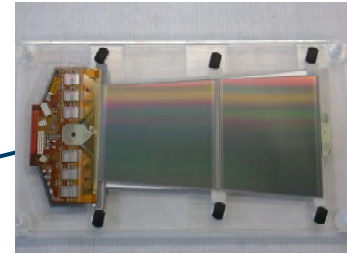
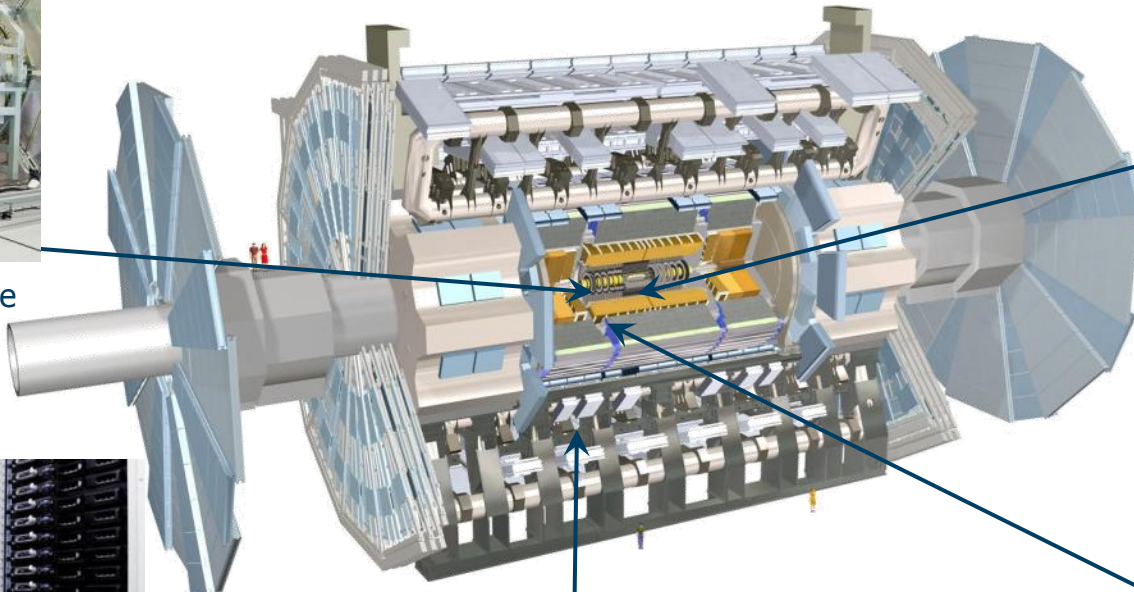
Weight: 7000 tons

Dimensions: 46 x 22 x 22 m<sup>3</sup>

Magnetic Field: 2.0 T (solenoid) and 0.2–2.5 T (toroid)



Tracker Support Structure  
**Geneva**



Semiconductor Tracker  
**Geneva**



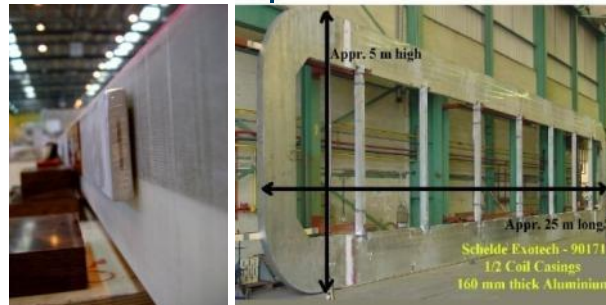
TDAQ - Trigger and Dataflow  
**Bern and Geneva**



Readout Electronics for Calorimeter  
**Geneva**

## Online and Offline Software

**Bern and Geneva**



Superconductor and Casings for Barrel Toroid Coil  
CHIPP plenary Geneva 23.8.2010  
**Bern and Geneva**

## Physics and Computing

**Bern and Geneva**

# Overview

- LHC
- ATLAS operation
- Performance
  - Tracking, Electrons, Jets, Muons, ...
- First Physics
  - Rediscovering the known (first tracks to top...)

<https://twiki.cern.ch/twiki/bin/view/Atlas/AtlasResults>



2010 Hadron  
Collider  
Physics  
Symposium  
August 23-27, 2010  
University of Toronto,  
Toronto, Canada



**CHIPP workshop  
on the High-Energy Frontier**

September 1-2, 2010

Physik-Institut der Universität Zürich  
Irchel Campus  
Winterthurerstrasse 190  
CH-8057 Zürich



Table 2.1: LHC beam parameters relevant for the peak luminosity

		Injection	Collision
<b>Beam Data</b>			
Proton energy	[GeV]	450	7000
Relativistic gamma		479.6	7461
Number of particles per bunch		$1.15 \times 10^{11}$	
Number of bunches		2808	
Longitudinal emittance ( $4\sigma$ )	[eVs]	1.0	2.5 <sup>a</sup>
Transverse normalized emittance	[ $\mu\text{m rad}$ ]	3.5 <sup>b</sup>	3.75
Circulating beam current	[A]	0.582	
Stored energy per beam	[MJ]	23.3	362
<b>Peak Luminosity Related Data</b>			
RMS bunch length <sup>c</sup>	cm	11.24	7.55
RMS beam size at the IP1 and IP5 <sup>d</sup>	$\mu\text{m}$	375.2	16.7
RMS beam size at the IP2 and IP8 <sup>e</sup>	$\mu\text{m}$	279.6	70.9
Geometric luminosity reduction factor $F^f$		-	0.836
Peak luminosity in IP1 and IP5	[ $\text{cm}^{-2}\text{sec}^{-1}$ ]	-	$1.0 \times 10^{34}$
Peak luminosity per bunch crossing in IP1 and IP5	[ $\text{cm}^{-2}\text{sec}^{-1}$ ]	-	$3.56 \times 10^{30}$

→ Nominal  $10^{11}$   
p/bunch reached

## LHC Design Report

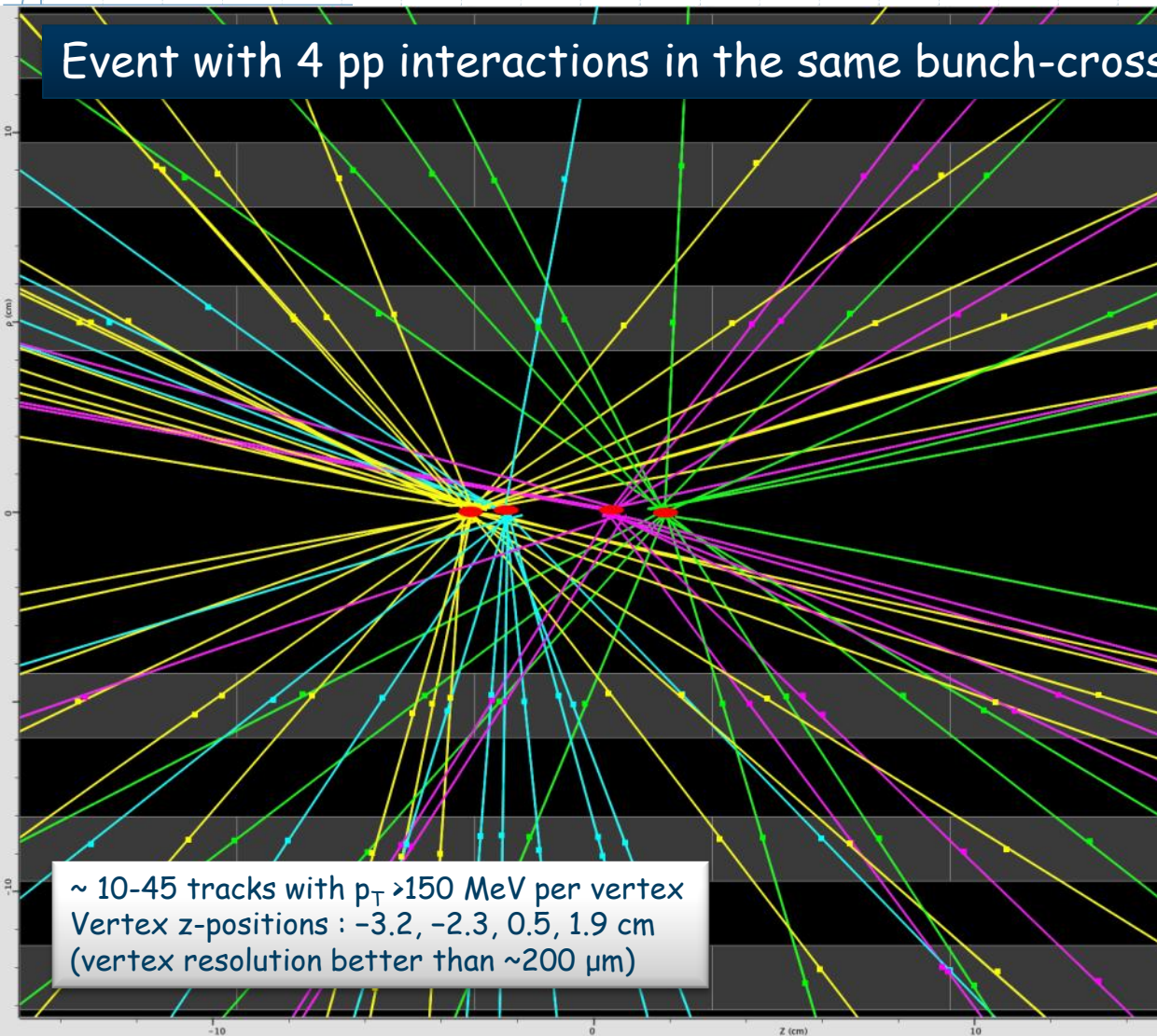
1.4 MJ of stored beam energy at 3.5 TeV

Comparable to Tevatron

6 times more than the previous transverse energy density (dangerous !)

average number of pp interactions per bunch-crossing of about 1.3  
"pile-up" (~40% of the events have > 1 pp interaction per crossing)

Event with 4 pp interactions in the same bunch-crossing

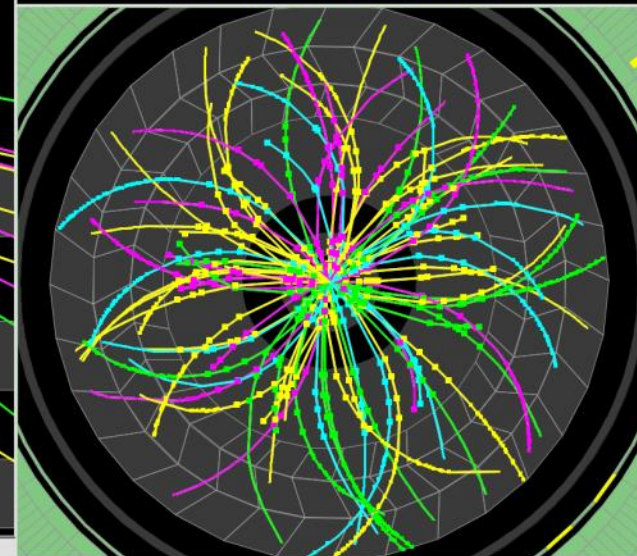


# ATLAS EXPERIMENT

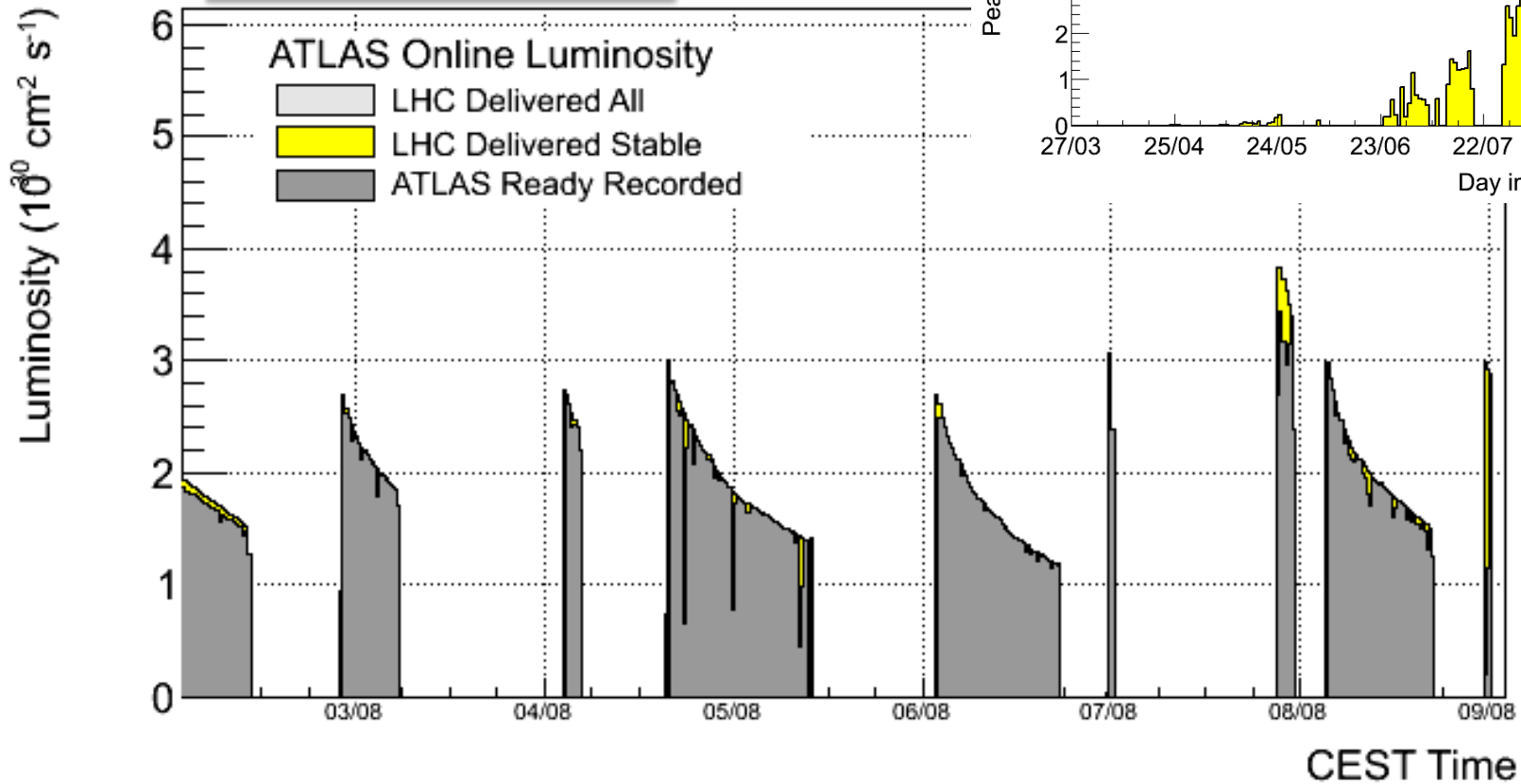
Run Number: 153565, Event Number: 4487360

Date: 2010-04-24 04:18:53 CEST

Event with 4 Pileup Vertices  
in 7 TeV Collisions



Peak luminosity in ATLAS  
 $L \sim 6 \times 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$

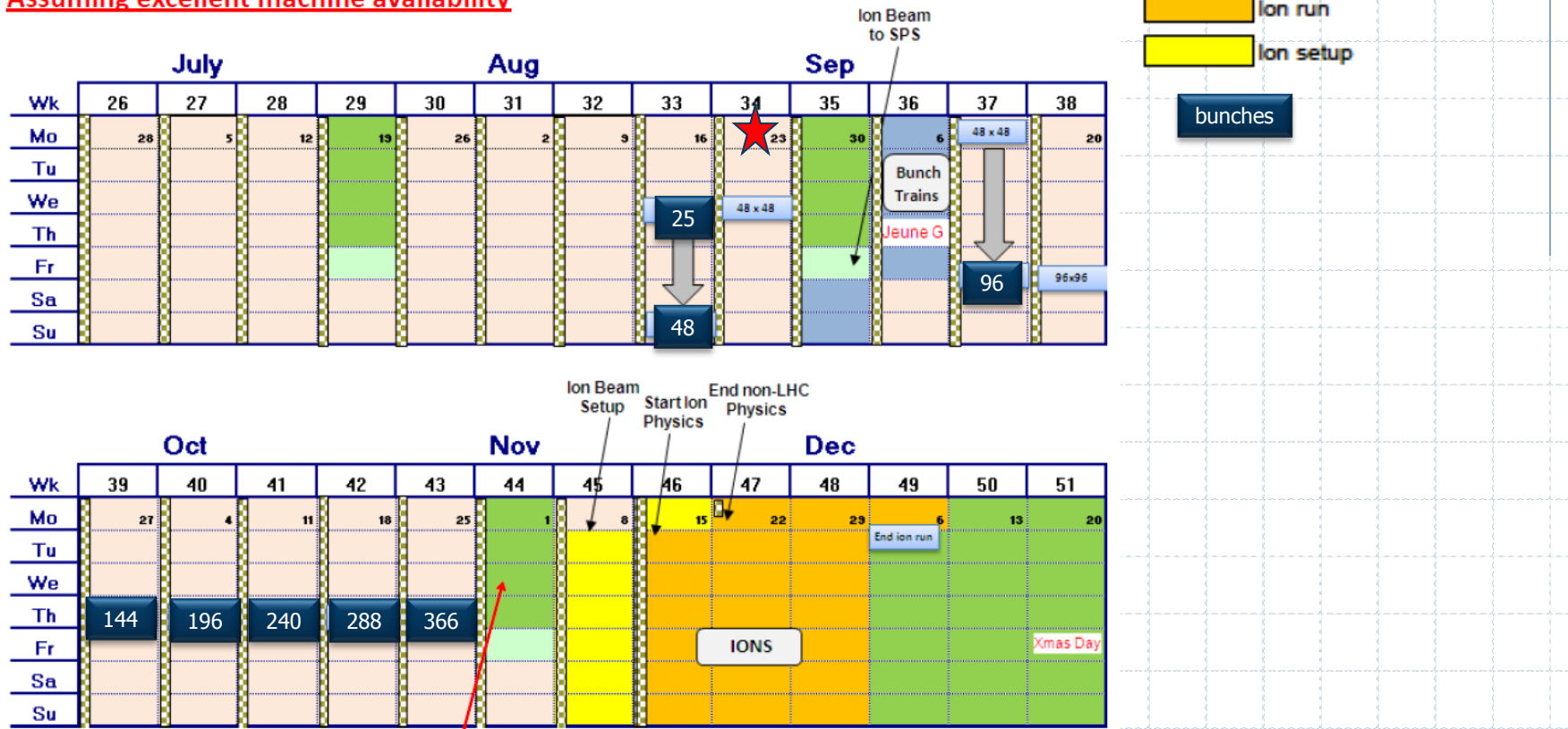


A couple of weeks of stable running after initial rapid luminosity increase



# LHC schedule

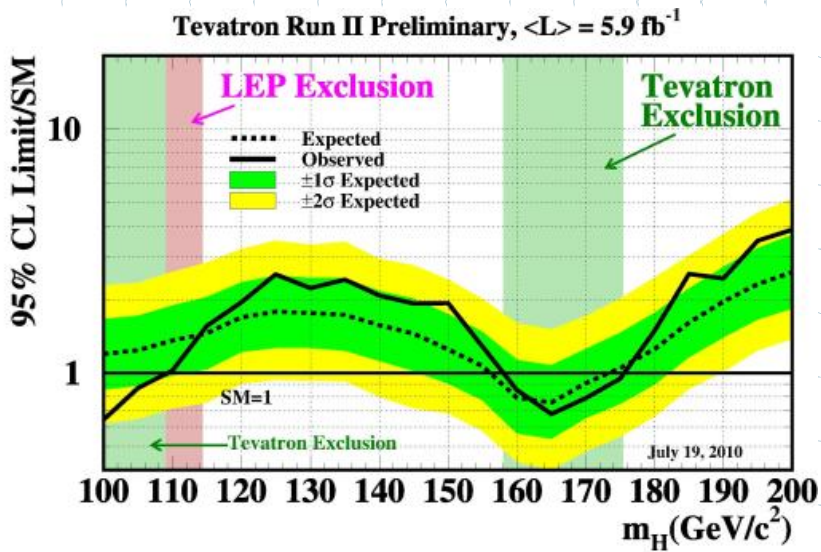
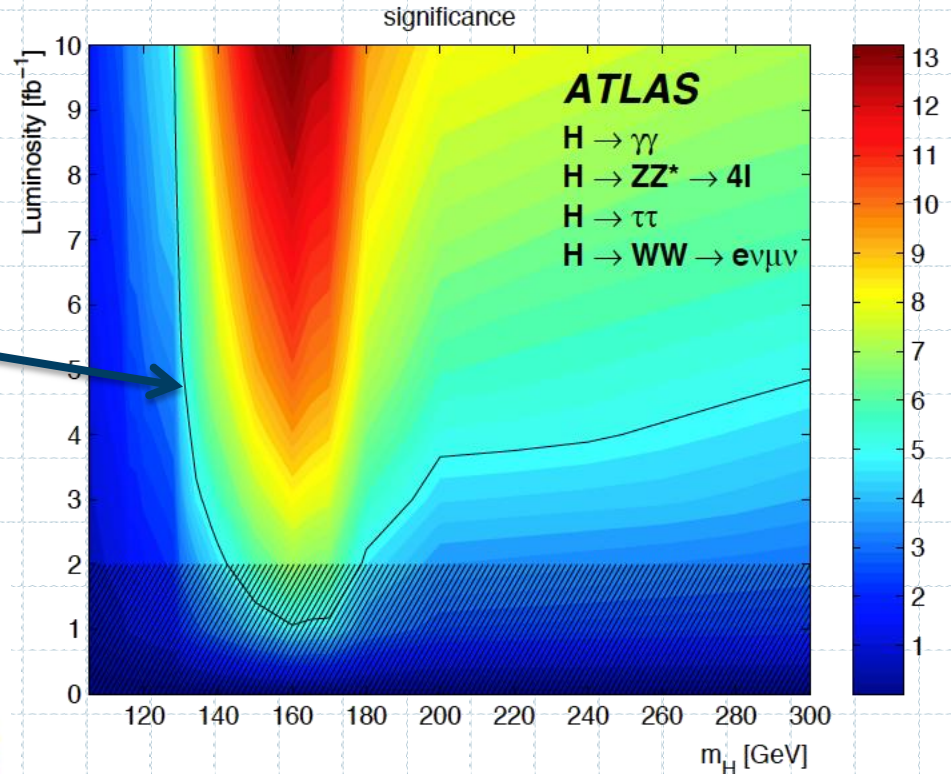
Assuming excellent machine availability



- Plan to reach  $L=10^{32} \text{ cm}^{-2}\text{s}^{-1}$ , **336+336 bunches, 10 pb<sup>-1</sup>/day this year**
- Four weeks of heavy ion beams before the X-mas break
- Reach **1 fb<sup>-1</sup> by the end of 2011**, followed by a longer (1 year) break for repairs and upgrades
- Reach **10 fb<sup>-1</sup> at 14 TeV by 2014**

# The Higgs...

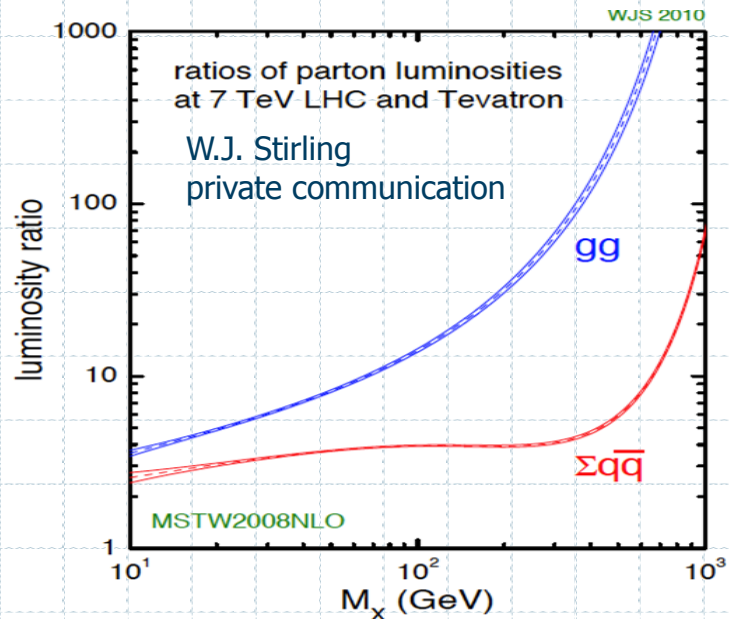
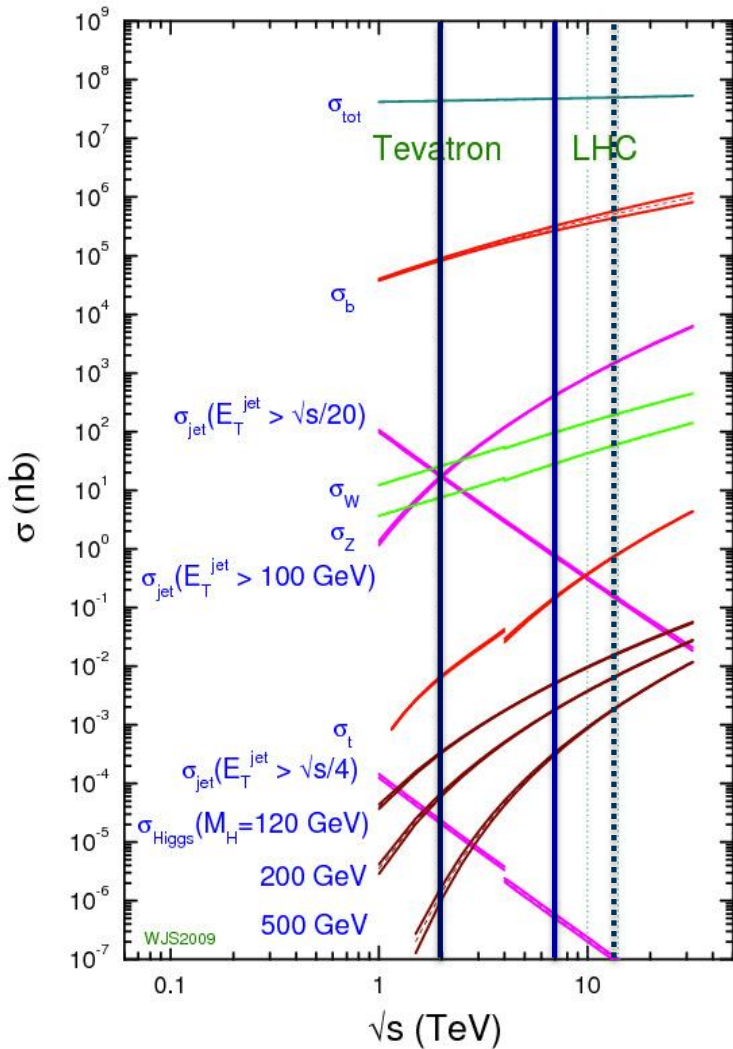
5 sigma discovery line



Updated Higgs predictions:  
 Aahrens, Becher, Neubert, Yang, arXiv:1008.3162v1

# The LHC is in operation !

proton - (anti)proton cross sections



## Tevatron-LHC Comparison 2011:

Tevatron at 10 fb<sup>-1</sup> vs. LHC 1 fb<sup>-1</sup> at 7 TeV

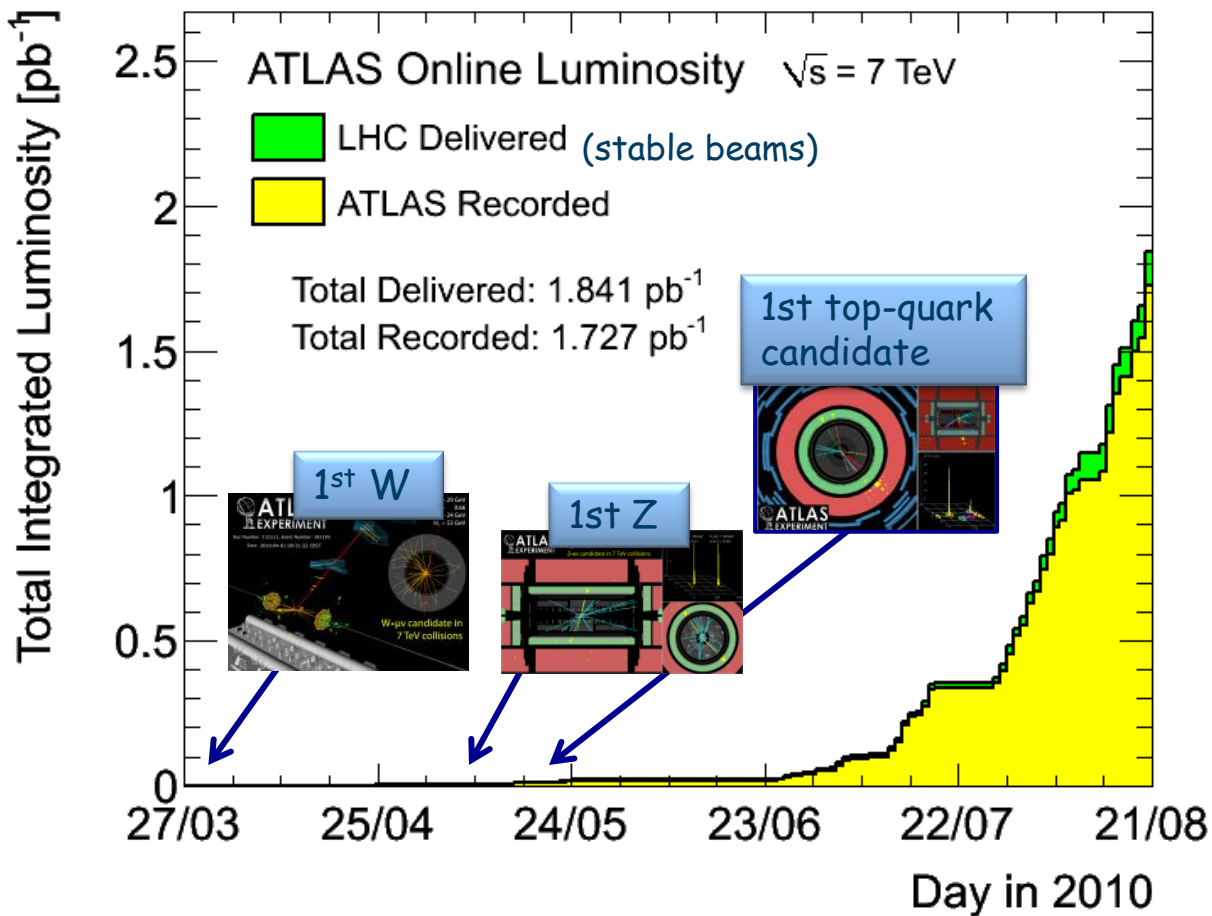
LHC has **2.5 x top**

LHC has **10 x heavier objects**

**More statistics ! Better limits !**

**Discoveries are not excluded !**

# ATLAS integrated luminosity



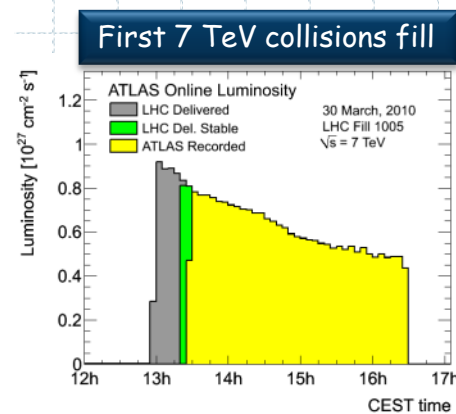
Aug 22<sup>nd</sup> 2010:

**Delivered 1.8 pb<sup>-1</sup>**

**Recorded 1.7 pb<sup>-1</sup>**

**Up to 1.1 pb<sup>-1</sup> in results**

0.2 pb<sup>-1</sup> recorded on Aug 20<sup>th</sup>



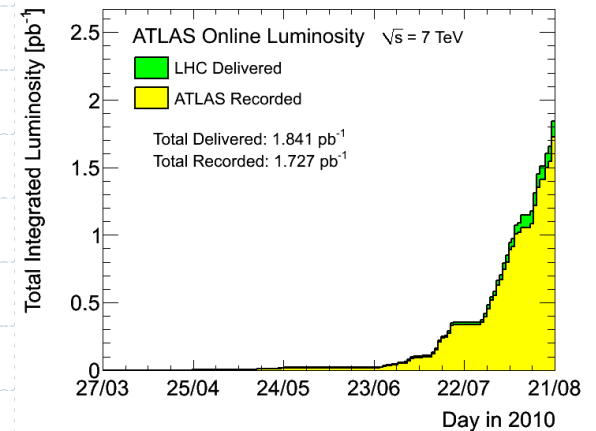
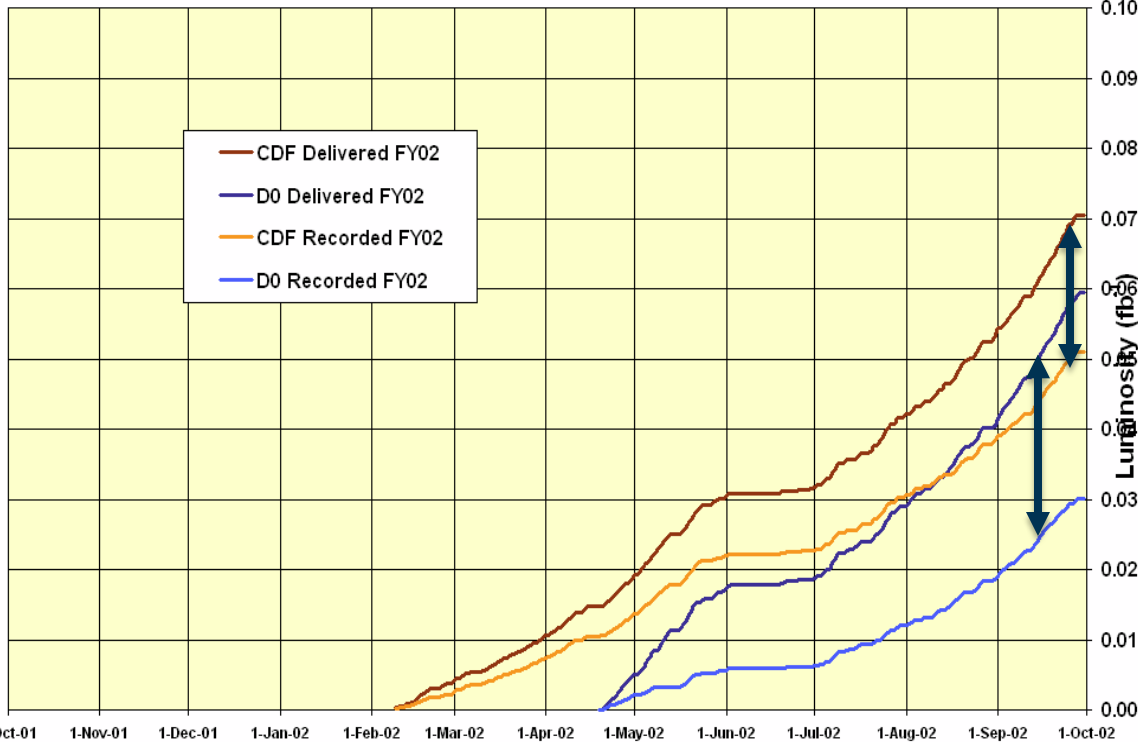
Overall data taking efficiency (with full detector on): 94%

# Tevatron startup for RunII in 2002

- D0 and CDF had 50%-70% efficiency. Good !  
Currently D0 and CDF are at >90%
- ATLAS has 94% from the beginning ! Fantastic !

D0 & CDF Run II Integrated Luminosity

Fiscal Year 2002



# Good data quality for analysis

Inner Tracking Detectors			Calorimeters				Muon Detectors			
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile	MDT	RPC	TGC	CSC
97.7	96.4	100	94.4	98.7	99.3	99.2	98.5	98.3	98.6	98.3
<b>1.13 pb<sup>-1</sup></b>										
Luminosity weighted relative detector uptime and good quality data delivery during 2010 stable beams at $\sqrt{s}=7$ TeV between March 30 <sup>th</sup> and August 14 <sup>th</sup> (in %)										

Data quality inefficiencies:  
 HV ramps in Silicon and Muon, HV trips and bursts in calorimeter, ...

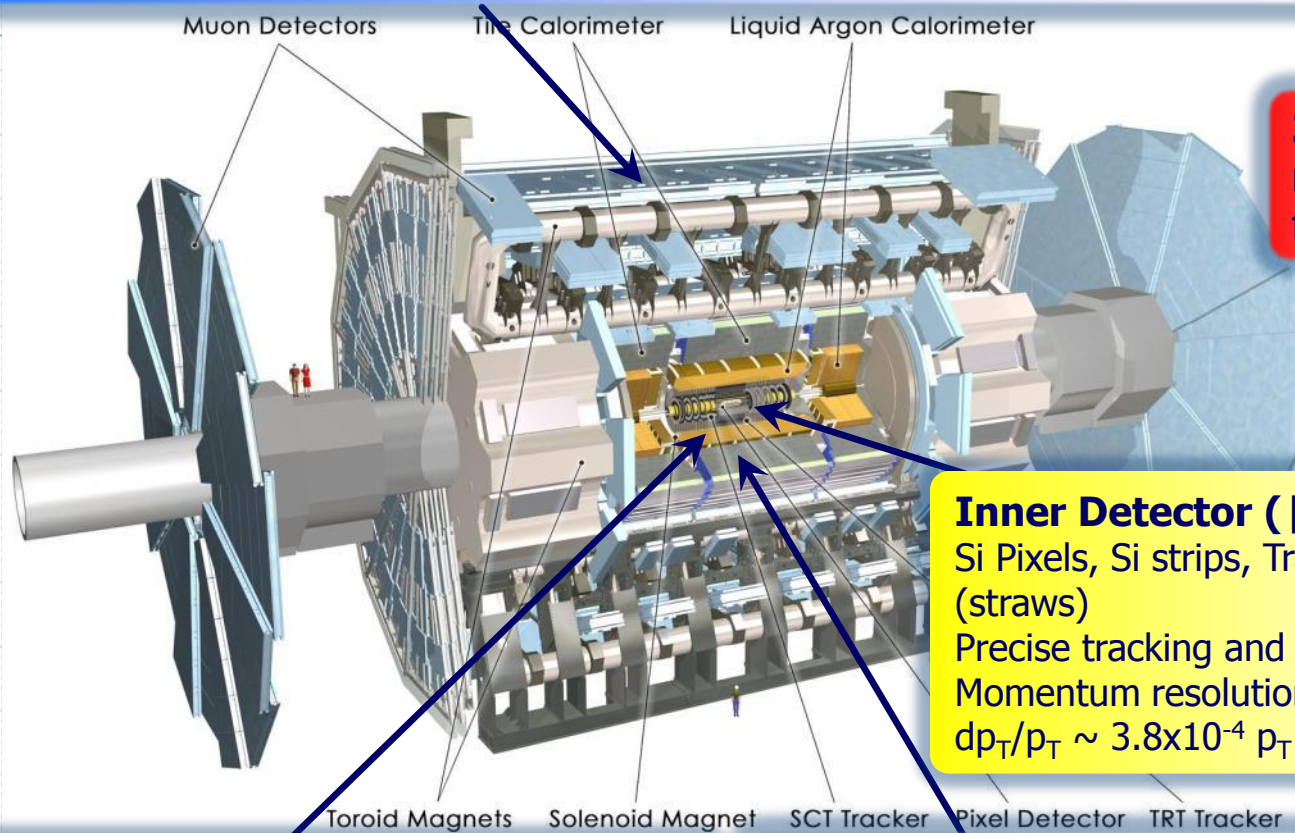
Subdetector	Approximate Operational Fraction
Pixels	97.4%
SCT Silicon Strips	99.2%
TRT Transition Radiation Tracker	98.0%
LAr EM Calorimeter	98.5%
Tile calorimeter	97.3%
Hadronic endcap LAr calorimeter	99.9%
Forward LAr calorimeter	100%
LVL1 Calo trigger	99.9%
LVL1 Muon RPC trigger	99.5%
LVL1 Muon TGC trigger	100%
MDT Muon Drift Tubes	99.7%
CSC Cathode Strip Chambers	98.5%
RPC Barrel Muon Chambers	97.0%
TGC Endcap Muon Chambers	98.6%

## **Concern:** long-term reliability

Low-voltage power supplies for LAr and Tile calorimeters, Pixel, SCT, LAr readout optical links, inner detector cooling.

Back-up solutions are being prepared for installation at end of the year technical stop and in future shut-downs.

**Muon Spectrometer ( $|\eta| < 2.7$ ):** air-core toroids with gas-based muon chambers  
 Muon trigger and measurement with momentum resolution  $dp_T/p_T < 10\%$  up to  $p_T \sim 1$  TeV



**3-level trigger**  
 reducing the rate  
 from 40 MHz to  $\sim 200$  Hz

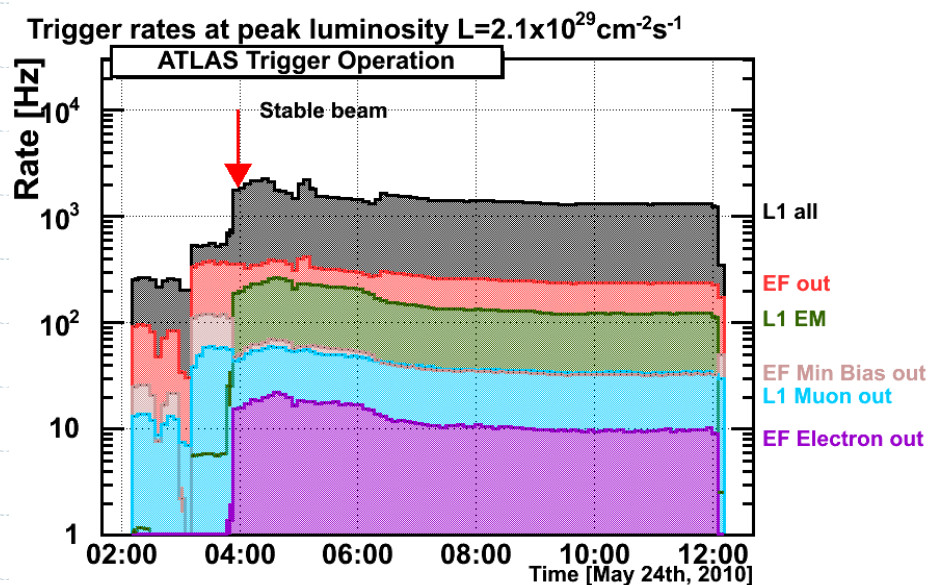
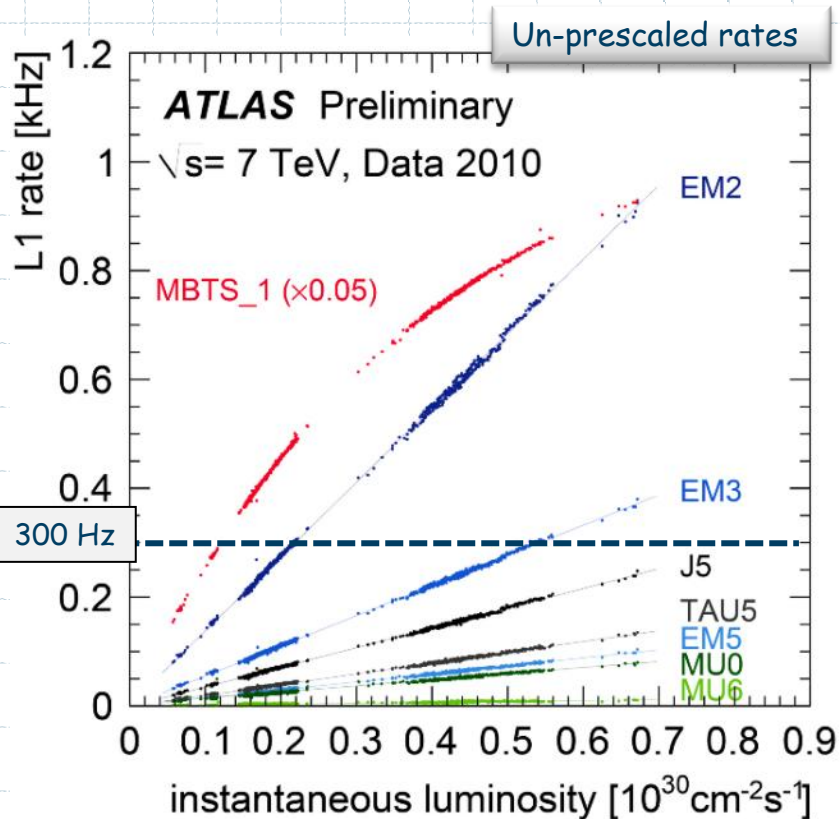
**Inner Detector ( $|\eta| < 2.5$ ,  $B=2T$ ):**  
 Si Pixels, Si strips, Transition Radiation detector (straws)  
 Precise tracking and vertexing, e/pi separation  
 Momentum resolution:  
 $dp_T/p_T \sim 3.8 \times 10^{-4} p_T (\text{GeV}) \oplus 0.015$

**EM calorimeter ( $|\eta| < 3.2$ ):**  
 Pb-LAr Accordion  
 e/g trigger, identification and measurement  
 E-resolution:  $dE/E \sim 10\%/\sqrt{E}$

**HAD calorimetry ( $|\eta| < 5$ ):**  
 segmentation, hermeticity, Fe/scintillator Tiles (central),  
 Cu/W-LAr (fwd), Trigger and measurement of jets and  
 missing  $E_T$   
 E-resolution:  $dE/E \sim 50\%/\sqrt{E} \oplus 0.03$

# Trigger/DAQ system works well

3 levels: LVL1, LVL2, Event Filter (EF) High-Level-Trigger (HLT): LVL2 and EF





# ICHEP... 1000 PhDs...



## ATLAS Results for Summer 2010

See also [ATLAS Public Results page](#) and links therefrom, which contain supplementary material such as performance-related plots

[Soft QCD](#) - [Hard QCD](#) - [Electroweak](#) - [b and c Physics](#) - [Tau](#) - [Searches](#) - [Luminosity and beamspt](#) - [Performance - trigger](#) - [Performance - tracking](#) - [Performance - flavour tagging](#) - [Performance - muons](#) - [Performance - jets and missing-Et](#) - [Performance - taus](#)

### Soft QCD

ATLAS-CONF-2010-046	<i>Charged particle multiplicities in pp interactions for track PT &gt; 100 MeV at sqrt(s) = 0.9 and 7 TeV measured with the ATLAS detector at the LHC</i>	20 July 2010
ATLAS-CONF-2010-047	<i>Charged particle multiplicities in pp interactions at sqrt(s) = 2.36 TeV measured with the ATLAS detector at the LHC</i>	16 July 2010
ATLAS-CONF-2010-024	<i>Charged particle multiplicities in pp interactions at sqrt(s) = 7 TeV measured with the ATLAS detector at the LHC</i>	21 April 2010
Publication	<i>Charged particle multiplicities in pp interactions at sqrt(s) = 900 GeV measured with the ATLAS detector at the LHC</i>	15 March 2010
ATLAS-CONF-2010-031	<i>Charged particle multiplicities in pp interactions at sqrt(s) = 0.9 and 7 TeV in a diffractive limited phase-space measured with the ATLAS detector at the LHC and new PYTHIA8 tune</i>	31 May 2010
ATLAS-CONF-2010-048	<i>Studies of Diffractive Enhanced Minimum Bias Events in ATLAS</i>	20 July 2010
ATLAS-CONF-2010-029	<i>Track-based underlying event measurements in pp collisions at sqrt(s) = 900 GeV and 7 TeV with the ATLAS Detector at the LHC</i>	28 May 2010

### Hard QCD

ATLAS-CONF-2010-059	<i>Measurement of jet production in proton-proton collisions at 7 TeV centre-of-mass energy with the ATLAS Detector</i>	16 July 2010
ATLAS-CONF-2010-049	<i>Measurement of differential cross section and fragmentation of jets from tracks in proton-proton collisions at centre-of-mass energy sqrt(s) = 7 TeV with the ATLAS detector</i>	16 July 2010
ATLAS-CONF-2010-080	<i>Search for new particles decaying into dijets in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector</i>	23 July 2010
ATLAS-CONF-2010-074	<i>High-pT dijet angular distributions in pp interactions at sqrt(s) = 7 TeV measured with the ATLAS detector at the LHC</i>	20 July 2010
ATLAS-CONF-2010-077	<i>Evidence for prompt photon production in SppS collisions at Sqrt(s) = 7 TeV with the ATLAS detector</i>	21 July 2010

### Performance - tracking

ATLAS-CONF-2010-067	<i>Alignment Performance of the ATLAS Inner Detector Tracking System in 7 TeV proton-proton collisions at the LHC</i>	20 July 2010
ATLAS-CONF-2010-072	<i>Performance of the ATLAS Silicon Pattern Recognition Algorithm in Data and Simulation at Sqrt(s) = 7 TeV</i>	20 July 2010
ATLAS-CONF-2010-069	<i>Performance of primary vertex reconstruction in proton-proton collisions at sqrt(s) = 7 TeV in the ATLAS experiment</i>	21 July 2010
ATLAS-CONF-2010-061	<i>Properties of tracks in jets observed in proton-proton collisions at Sqrt(s) = 7 TeV in the ATLAS detector</i>	15 July 2010
ATLAS-CONF-2010-019	<i>Study of the Material Budget in the ATLAS Inner Detector with Kshort decays in collision data at sqrt(s) = 900 GeV</i>	14 April 2010
ATLAS-CONF-2010-058	<i>Mapping the material in the ATLAS Inner Detector using secondary hadronic interactions in 7 TeV collisions</i>	7 July 2010
ATLAS-CONF-2010-033	<i>Kinematic Distributions of Kshort and Lambda decays in collision data at sqrt(s) = 7 TeV</i>	4 June 2010
ATLAS-CONF-2010-032	<i>Observation of Xi, Omega baryons and K*(890) meson production at sqrt(s) = 7 TeV</i>	4 June 2010
ATLAS-CONF-2010-023	<i>SPhi (1020) meson production in Sqrt(s) = 900 GeV collision data</i>	5 May 2010
ATLAS-CONF-2010-034	<i>D(*) mesons reconstruction in pp collisions at sqrt(s) = 7 TeV</i>	5 June 2010
ATLAS-CONF-2010-078	<i>Ipsit Performance of the ATLAS Inner Detector</i>	21 July 2010

### Electroweak

ATLAS-CONF-2010-051	<i>Measurement of the W -&gt; l nu production cross-section and observation of Z -&gt; ll production in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector</i>	21 July 2010
ATLAS-CONF-2010-076	<i>Measurement of the Z -&gt; ll production cross section in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector</i>	23 July 2010

### Performance - jets and missing-Et

ATLAS-CONF-2010-038	<i>Data-Quality Requirements and Event Cleaning for Jets and Missing Transverse Energy Reconstruction with the ATLAS Detector in Proton-Proton Collisions at a Center-of-Mass Energy of sqrt(s) = 7 TeV</i>	4 June 2010
ATLAS-CONF-2010-052	<i>ATLAS Calorimeter Response to Single Isolated Hadrons and Estimation of the Calorimeter Jet Scale Uncertainty</i>	16 July 2010
ATLAS-CONF-2010-053	<i>Properties of Jets and Inputs to Jet Reconstruction and Calibration with the ATLAS Detector Using Proton-Proton Collisions at sqrt(s) = 7 TeV</i>	17 July 2010
ATLAS-CONF-2010-054	<i>Jet energy resolution and reconstruction efficiencies from in-situ techniques with the ATLAS Detector Using Proton-Proton Collisions at a Center of Mass Energy sqrt(s) = 7 TeV</i>	20 July 2010
ATLAS-CONF-2010-055	<i>In-situ pseudorapidity intercalibration to evaluate jet energy scale uncertainty and calorimeter performance in the forward region</i>	19 July 2010
ATLAS-CONF-2010-056	<i>Jet energy scale and its systematic uncertainty for jets produced in proton-proton collisions at Sqrt(s) = 7 TeV and measured with the ATLAS detector</i>	22 July 2010
ATLAS-CONF-2010-057	<i>Performance of the Missing Transverse Energy Reconstruction and Calibration in Proton-Proton Collisions at a Center-of-Mass Energy of Sqrt(s) = 7 TeV with the ATLAS Detector</i>	13 July 2010

### Performance - taus

ATLAS-CONF-2010-059	<i>Reconstruction of hadronic tau candidates in QCD events at ATLAS with 7 TeV proton-proton collisions</i>	10 July 2010
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### Luminosity and beamspt

ATLAS-CONF-2010-060	<i>Luminosity Determination Using the ATLAS Detector</i>	20 July 2010
ATLAS-CONF-2010-027	<i>Characterization of Interaction-Point Beam Parameters Using the pp Events-Vertex Distribution Reconstructed in the ATLAS Detector at the LHC</i>	17 May 2010

### Performance - trigger

ATLAS-CONF-2010-068	<i>Performance of the Minimum Bias Trigger in pp Collisions at Sqrt(s) = 7 TeV</i>	19 July 2010
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### Performance - flavour tagging

ATLAS-CONF-2010-070	<i>Tracking Studies for b-tagging with 7 TeV Collision Data with the ATLAS Detector</i>	19 July 2010
ATLAS-CONF-2010-041	<i>Impact parameter-based S/B-tagging algorithms in the 7 TeV collision data with the ATLAS detector: the TrackCounting and JetProb algorithms</i>	4 June 2010
ATLAS-CONF-2010-042	<i>Performance of the ATLAS Secondary Vertex S/B-tagging Algorithm in 7-TeV Collision Data</i>	2 June 2010

### Performance - e/gamma

ATLAS-CONF-2010-073	<i>Observation of inclusive electrons in the ATLAS experiment at Sqrt(s) = 7 TeV</i>	21 July 2010
ATLAS-CONF-2010-077	<i>Evidence for prompt photon production in SppS collisions at Sqrt(s) = 7 TeV with the ATLAS detector</i>	21 July 2010
ATLAS-CONF-2010-037	<i>Probing the response of the ATLAS electromagnetic calorimeter and material upstream with energy flow from Sqrt(s) = 7 TeV minimum bias events</i>	7 June 2010

### Performance - muons

ATLAS-CONF-2010-064	<i>Muon Reconstruction Performance</i>	23 July 2010
ATLAS-CONF-2010-075	<i>Extraction of the prompt muon component in inclusive muons produced at sqrt(s) = 7 TeV</i>	21 July 2010

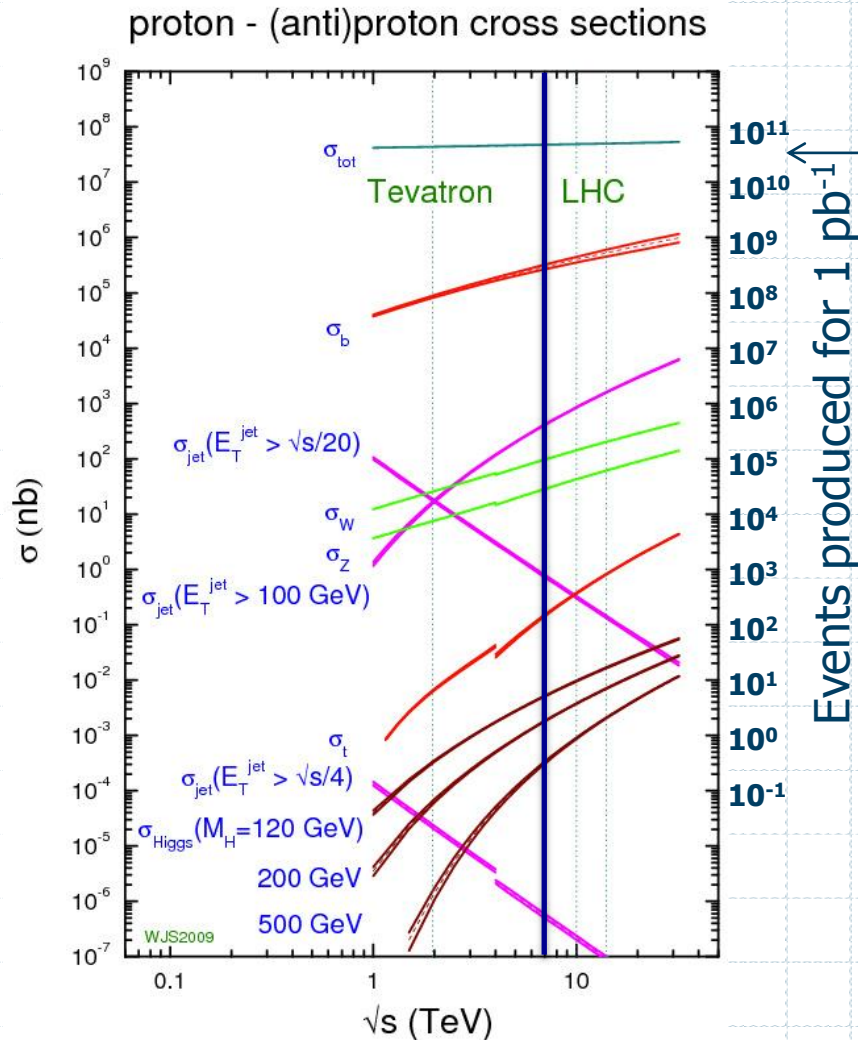
### Top

LAS-2010-063	<i>Search for top pair candidate events in ATLAS at sqrt(s) = 7 TeV</i>	21 July 2010
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### Searches

LAS-2010-080	<i>Search for new particles decaying into dijets in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector</i>	23 July 2010
LAS-2010-074	<i>High-pT dijet angular distributions in pp interactions at sqrt(s) = 7 TeV measured with the ATLAS detector at the LHC</i>	20 July 2010
LAS-2010-065	<i>Early supersymmetry searches in channels with jets and missing transverse momentum with the ATLAS Detector</i>	20 July 2010
LAS-2010-066	<i>Early supersymmetry searches with jets, missing transverse momentum and one or more leptons with the ATLAS Detector</i>	20 July 2010
ATL-PHYS-PUB-2010-010	<i>Prospects for Supersymmetry discovery based on inclusive searches at a 7 TeV centre-of-mass energy with the ATLAS detector</i>	17 July 2010
	<i>long-lived stopped particles decaying out-of-time with LHC collisions</i>	21 July 2010
	<i>for Higgs Boson Production at the LHC Running at 7 TeV</i>	16 July 2010

# What can we do with the recorded data ?

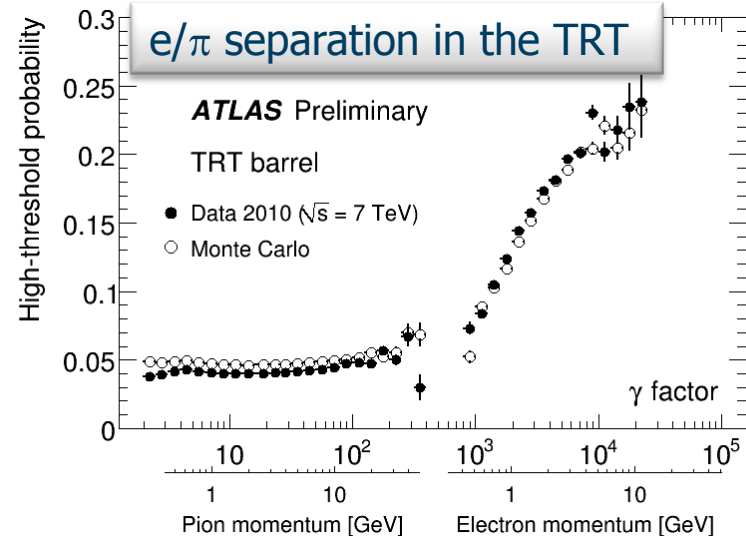
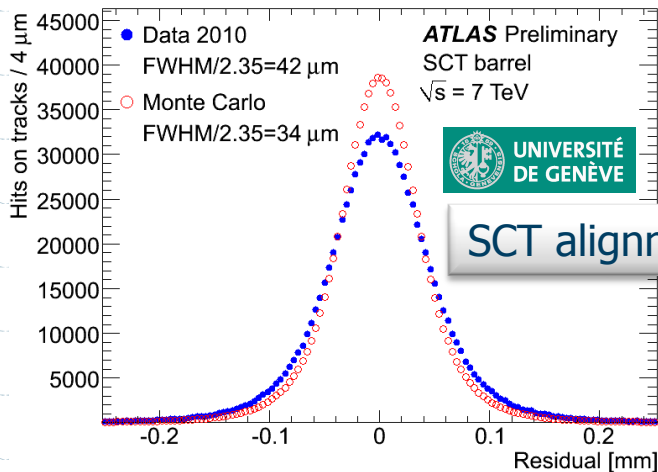
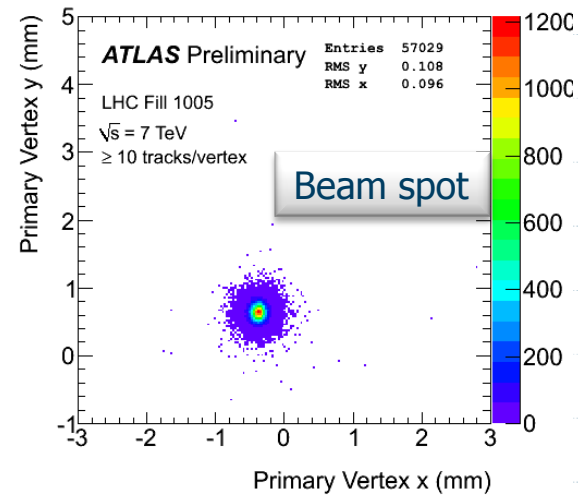
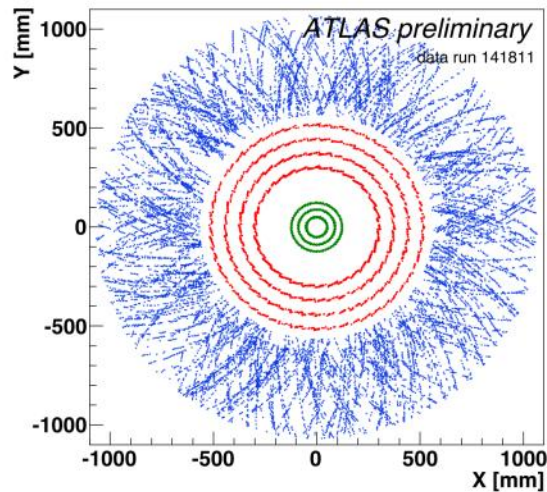


Plenty of collision events  
for **performance studies**

There is physics here too!

# Tracking performance

Scatter Plot of Hits on Tracks



# Charged particle multiplicities

Physics Letters B 688 (2010) 21–42



Contents lists available at ScienceDirect

Physics Letters B

www.elsevier.com/locate/physletb



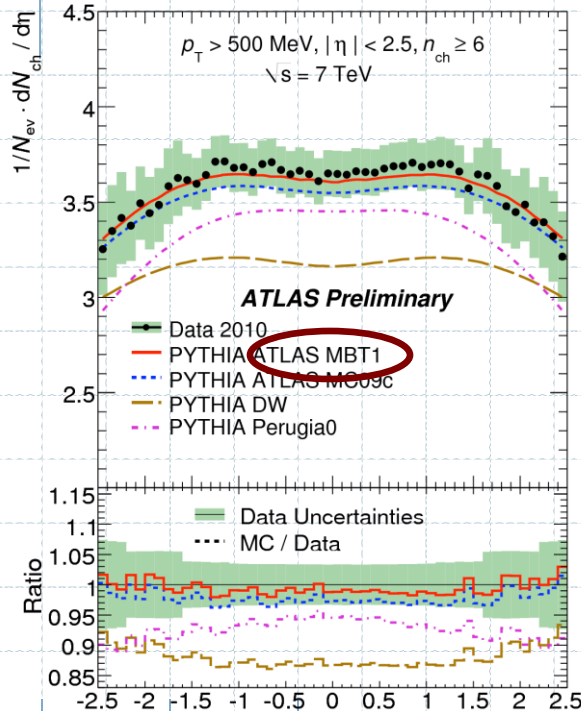
**First ATLAS physics paper**  
(tracking only)

Phys Lett **B688(2010) 21**

Charged-particle multiplicities in  $pp$  interactions at  $\sqrt{s} = 900$  GeV measured with the ATLAS detector at the LHC ☆☆☆

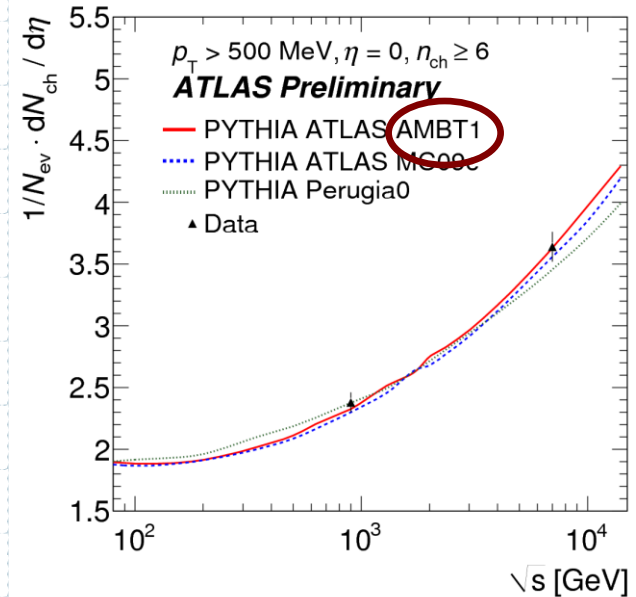
ATLAS Collaboration

In the mean time, analysis re-done at  $\sqrt{s} = 7$  TeV



MC tunes to Tevatron data with PDFs for  $\sqrt{s} = 7$  TeV predict 5-20% lower charged track multiplicities than observed.

⇒ ATLAS tune to Pythia6: **AMBT1** to describe the observed collision data



The Durham HepData Project

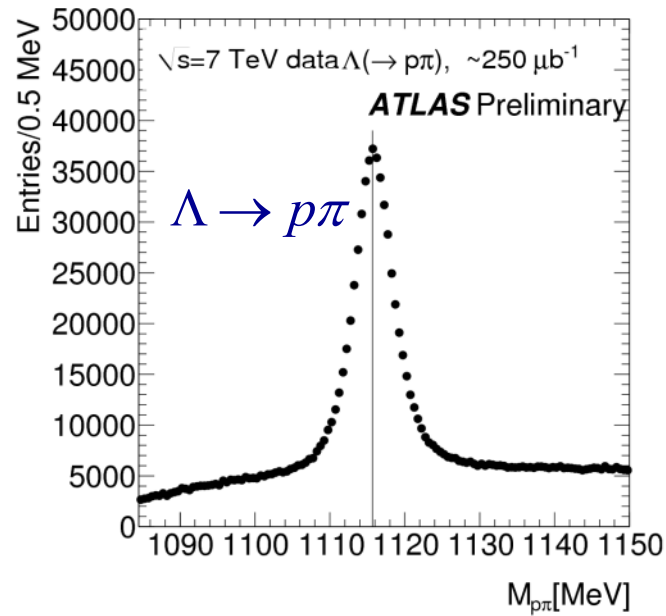
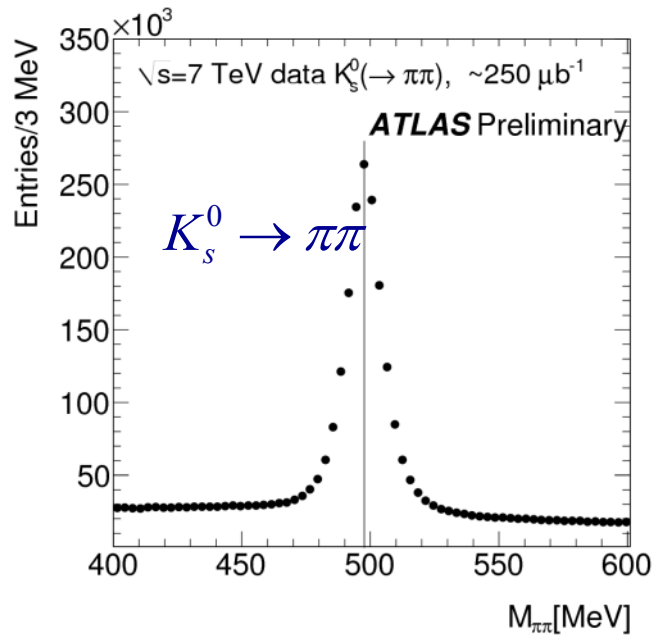


REACTION DATABASE • DATA REVIEWS • PARTON DISTRIBUTION FUNCTION SERVER • OTHER HEP RESOURCES

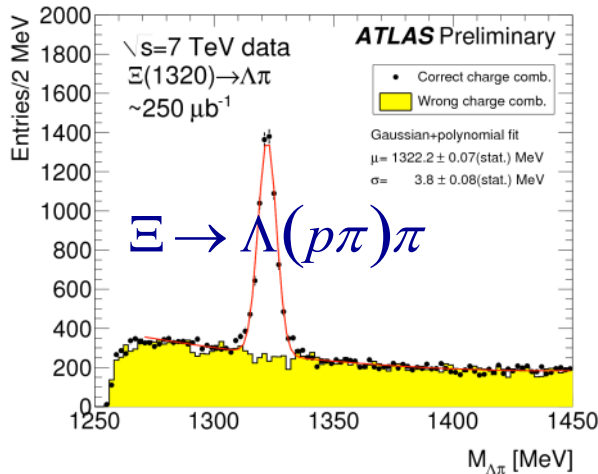
Reaction Database Full Record Display

View short record or as: plain text, AIDA, PyROOT, YODA, ROOT or mpl

# Rediscovering mesons and baryons



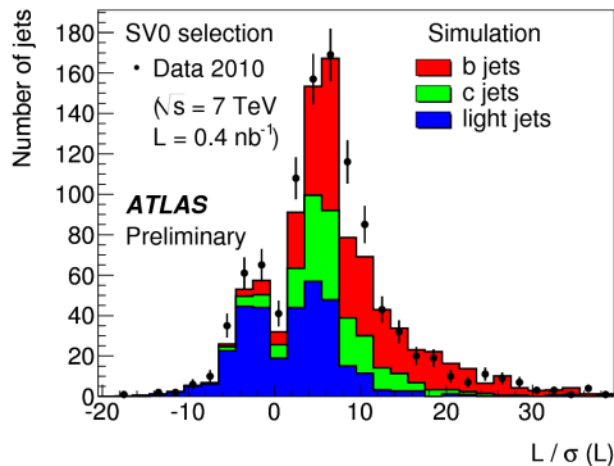
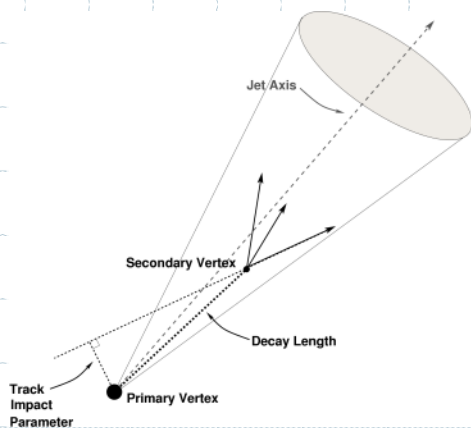
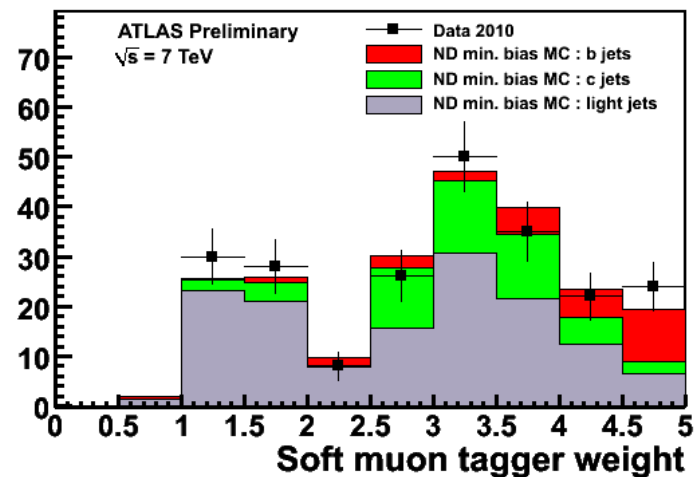
Vertical lines are the PDF averages



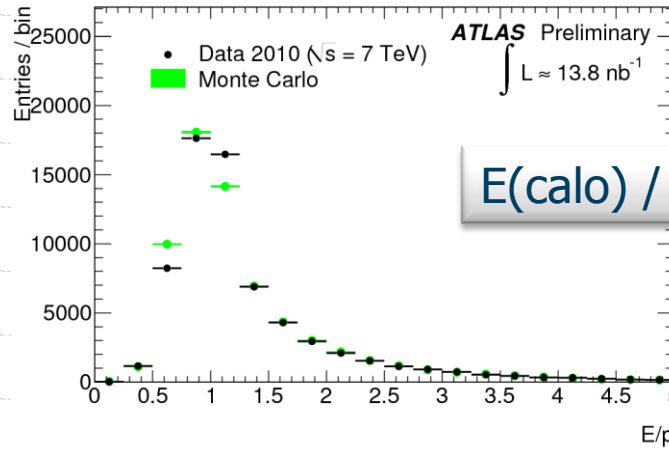
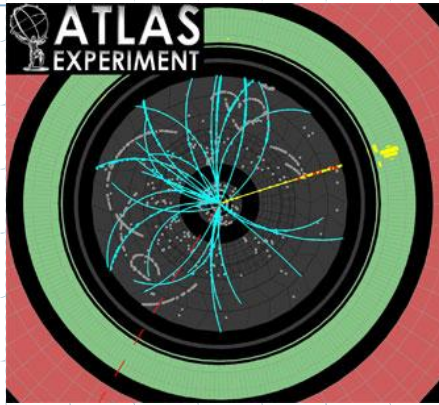
Examples... !  
More results for  $\Omega$ ,  $K^*$ ,  $D^\pm, D^0, \Phi, \dots$

# b-jet tagging

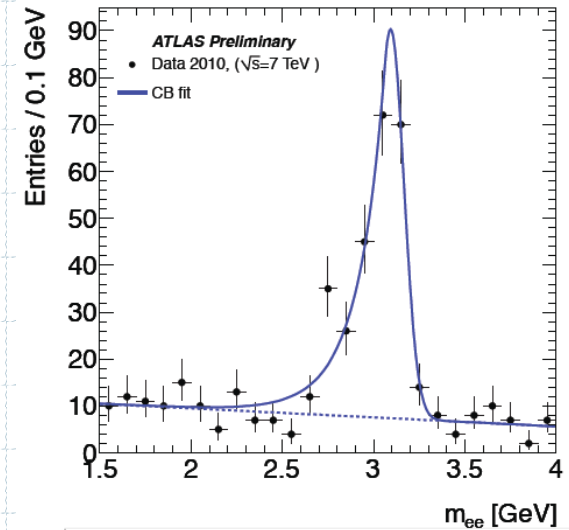
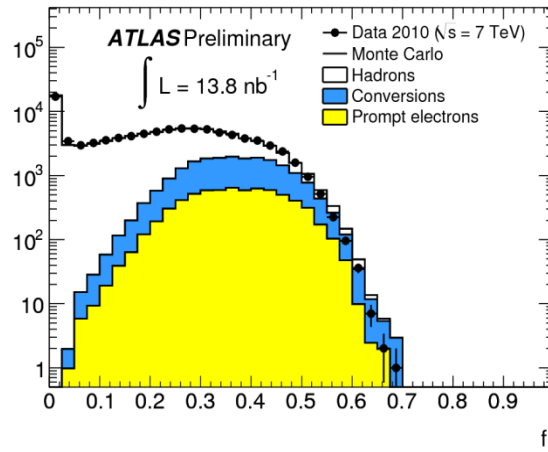
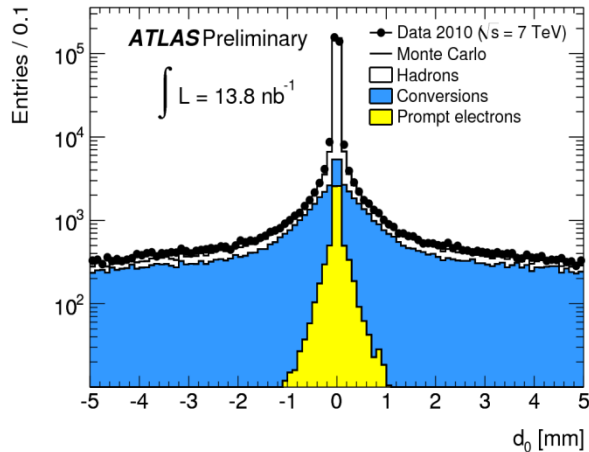
- Several algorithms
  - Muon based (from B meson decay)
  - Track based (impact parameter, counting)
  - Vertexing based (secondary vertex)
- Good agreement of data with expectation from MC !



# Electrons

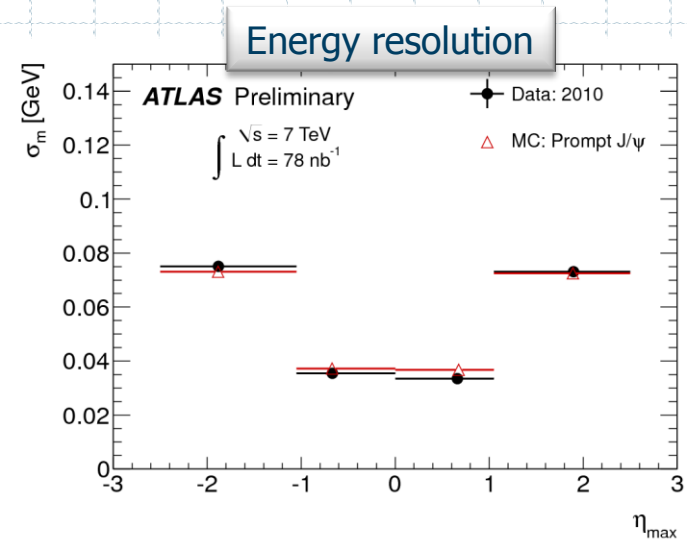
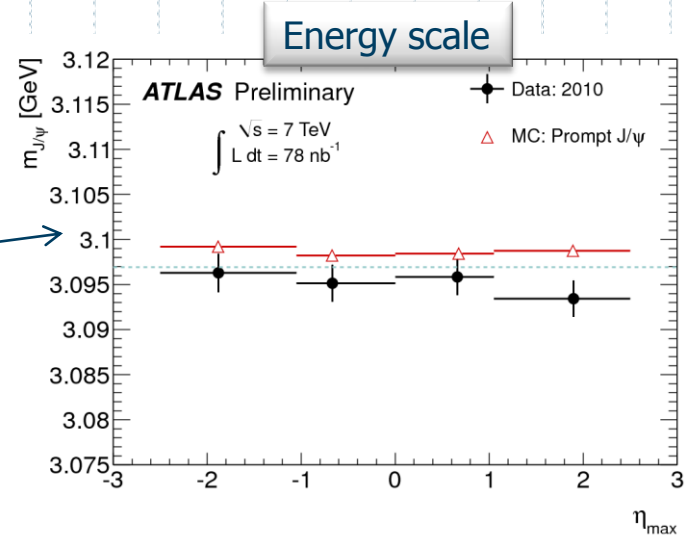
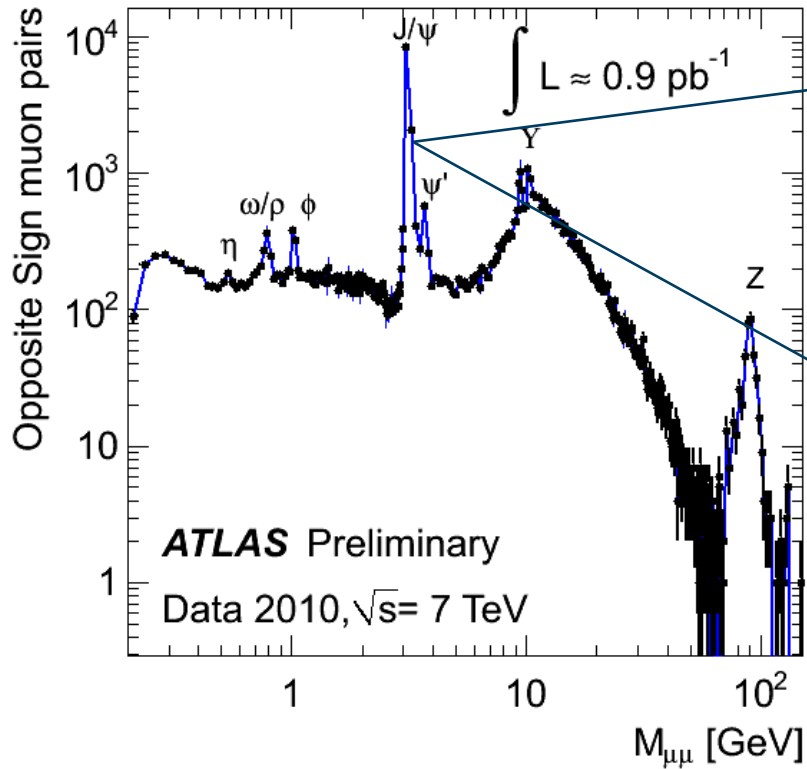
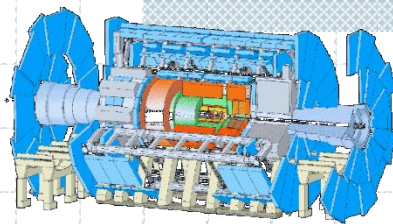


Finding the source of the electron:



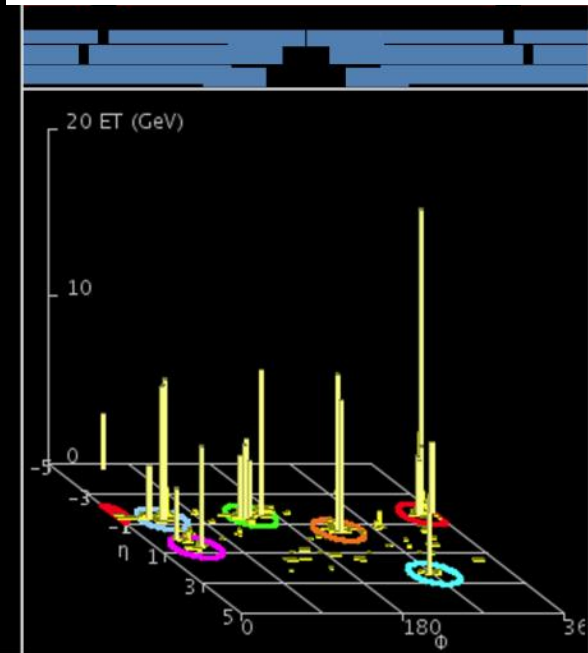
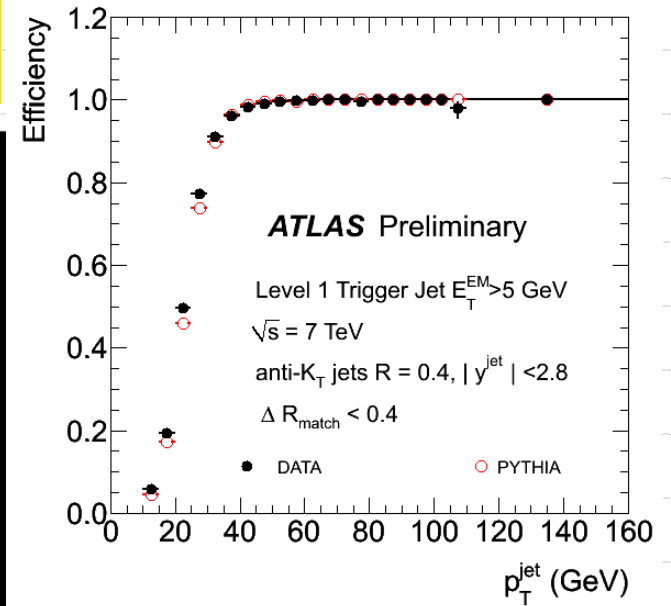
Mass from tracks after  
correction for bremsstrahlung

# Muons



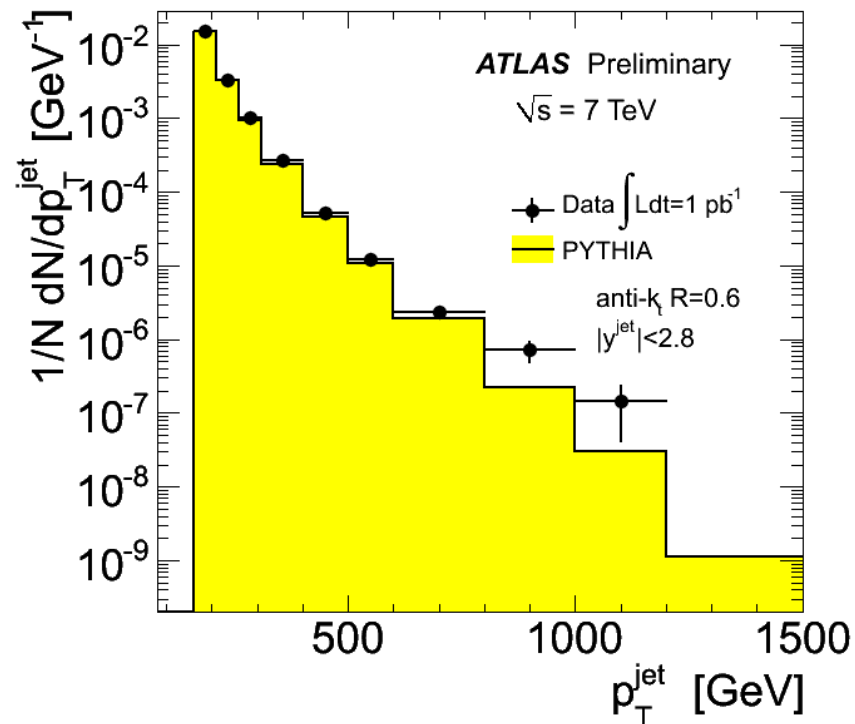
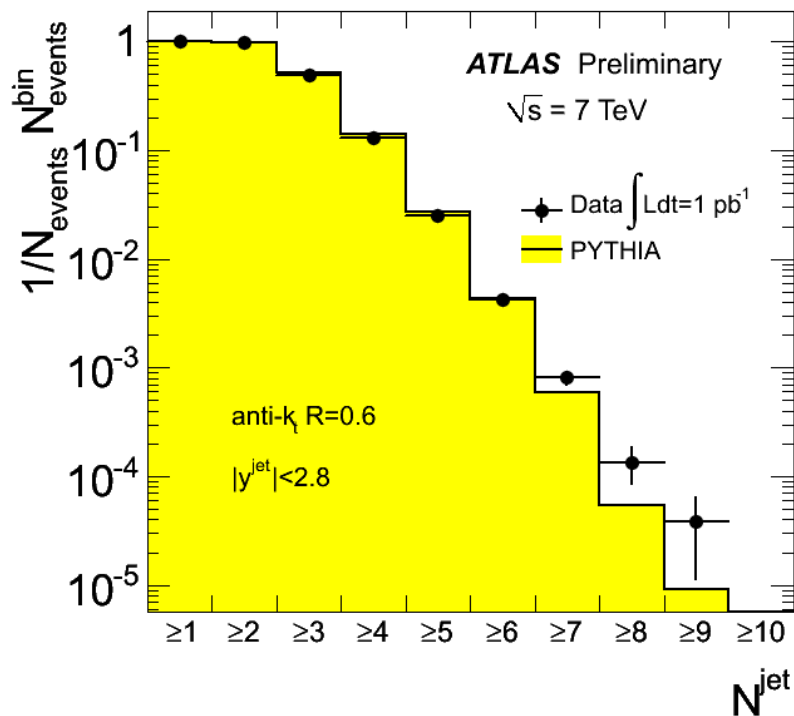


# Jets

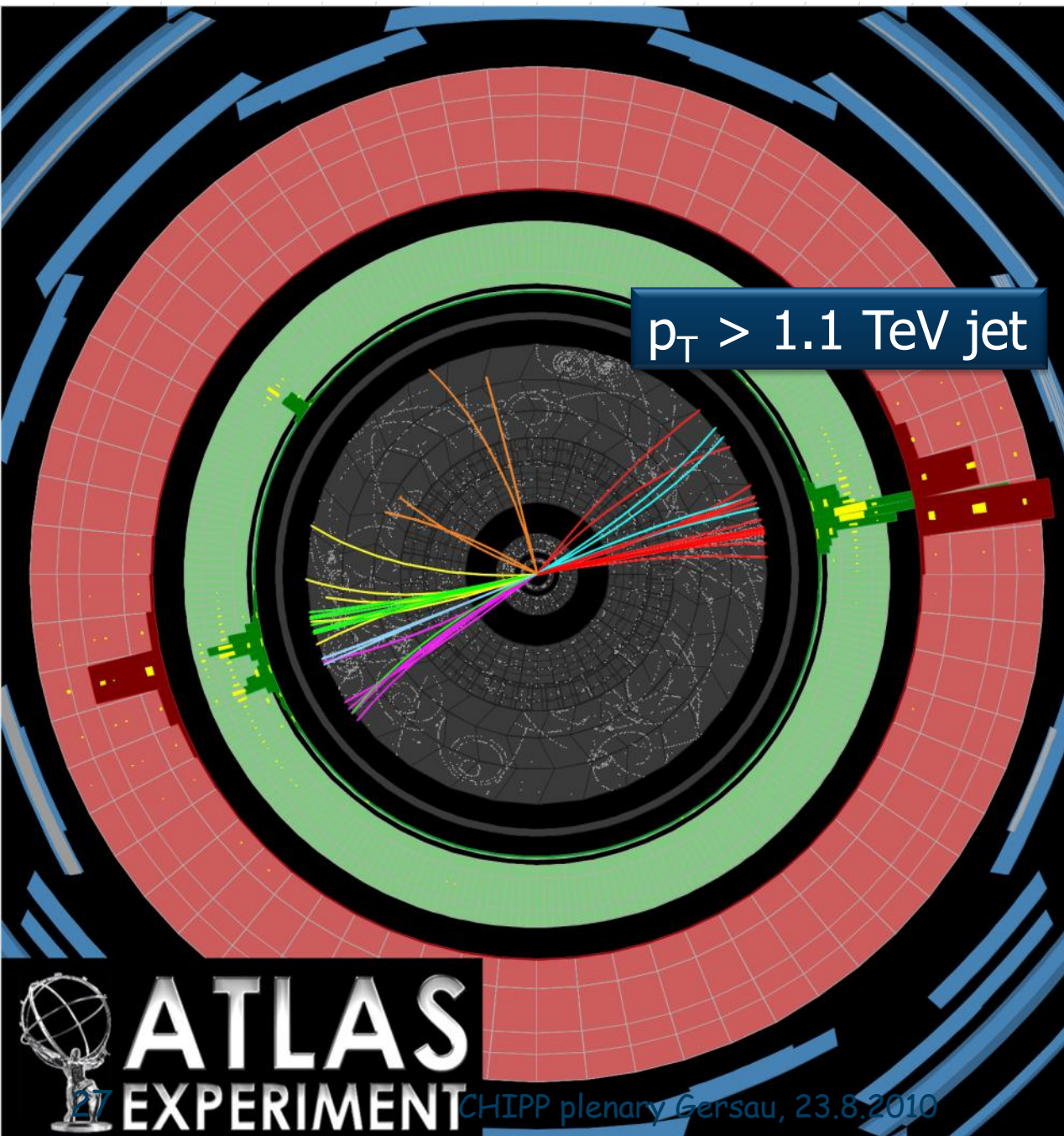


# Jet multiplicity and transverse momentum

Leading jet  $p_T > 80$  GeV, other jets  $p_T > 40$  GeV

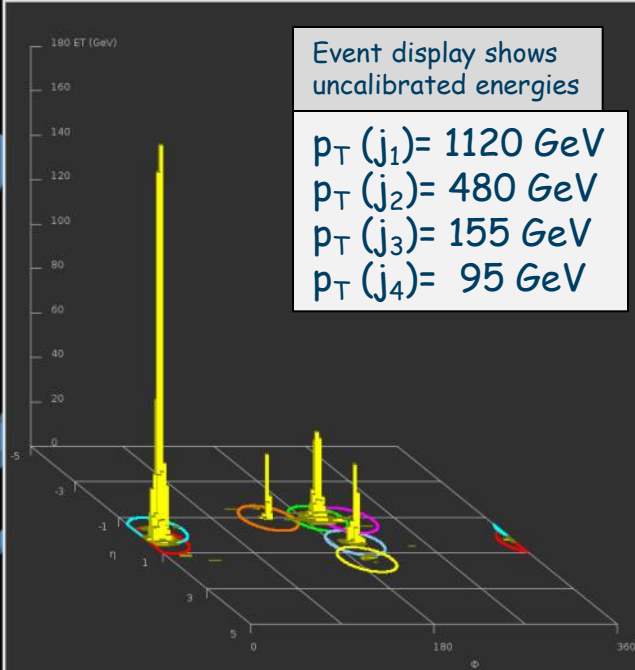
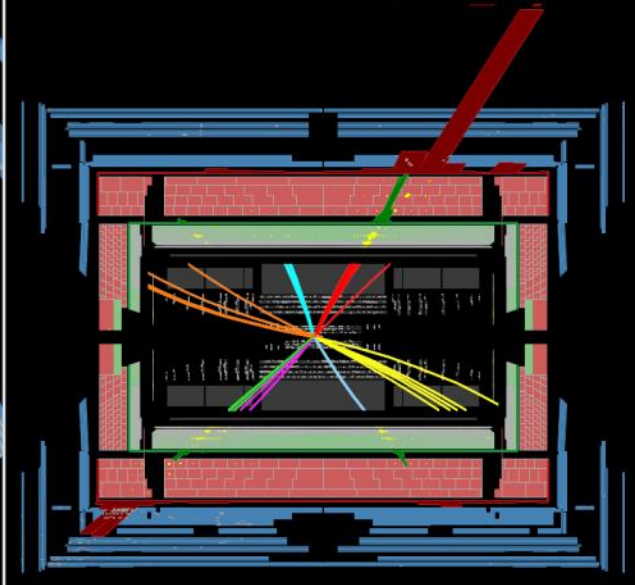


Shape comparisons between data and parton-shower MC  
(distributions normalized to unity)



Run Number: 159224, Event Number: 3533152

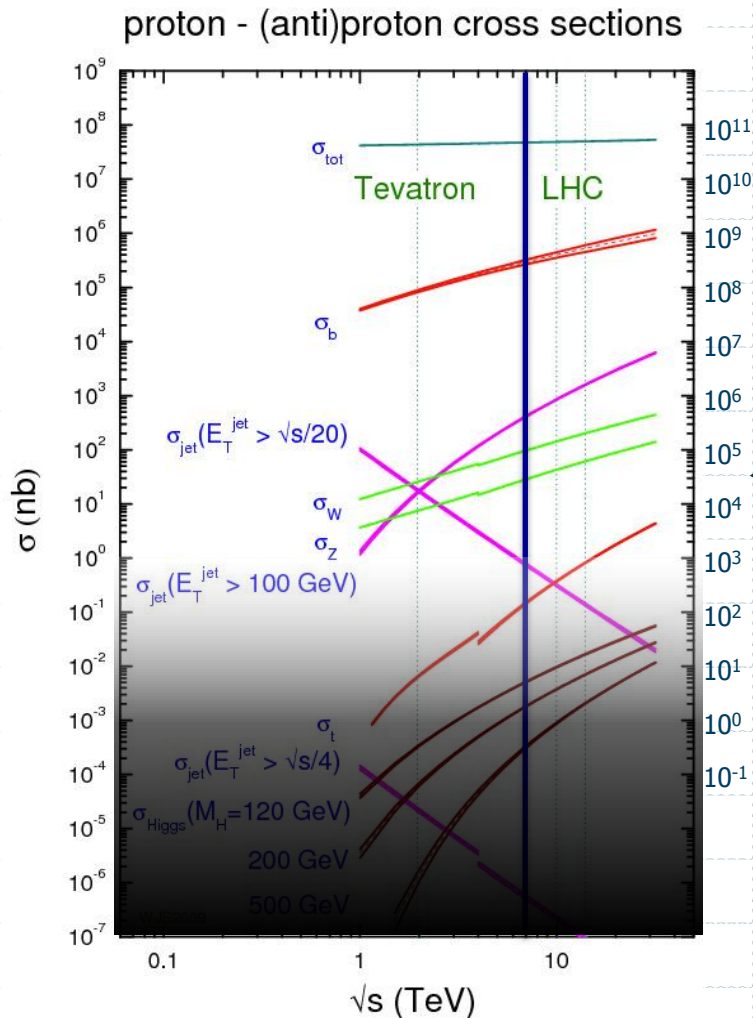
Date: 2010-07-18 11:05:54 CEST



**ATLAS**  
EXPERIMENT

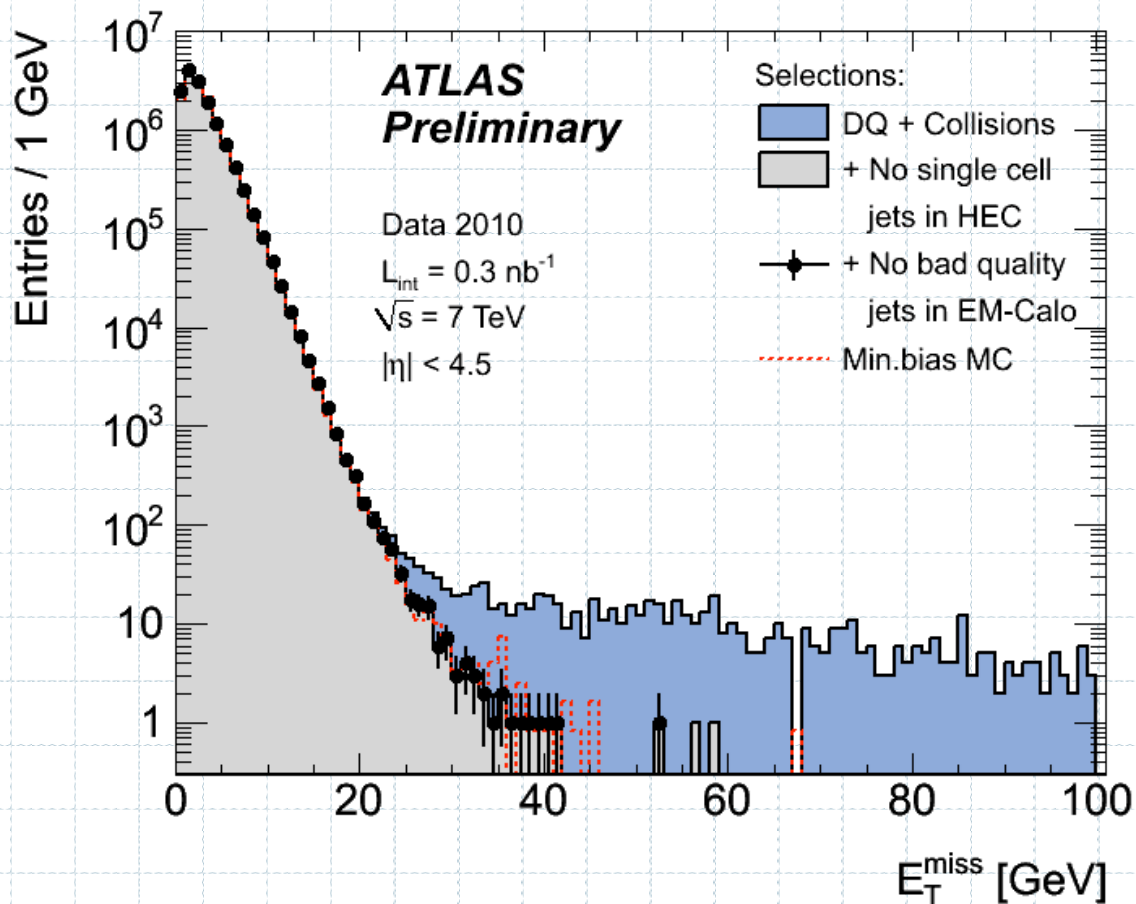
CHIPP plenary Gersau, 23.8.2010

# High $p_T$ physics



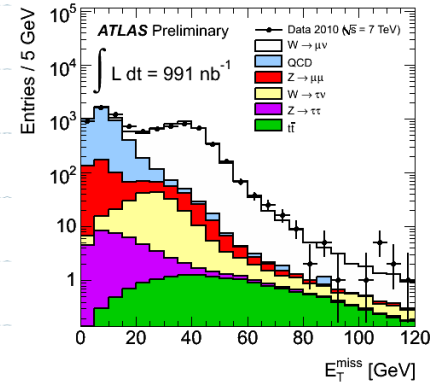
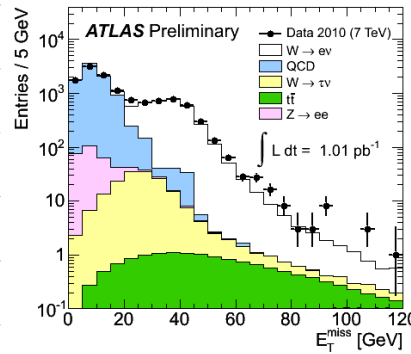
**Lots of events  
for physics**

# Missing transverse energy

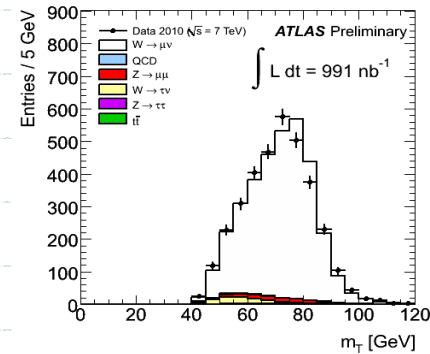
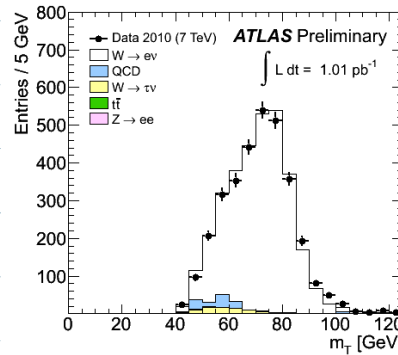
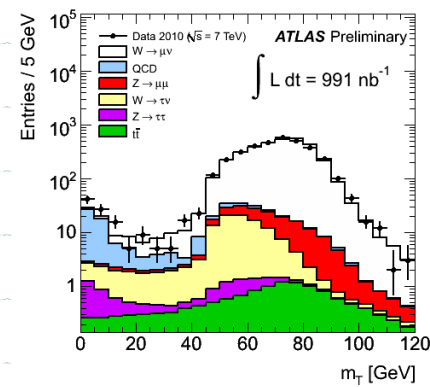
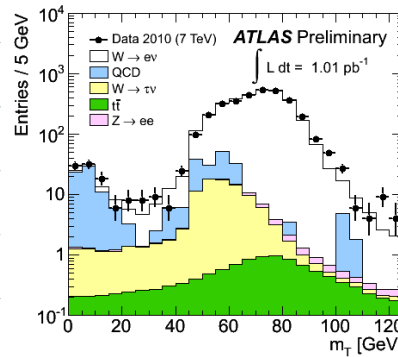


# W boson

Missing Et



Transverse Mass



**Selection**  
(isolated lepton  
with 20 GeV  $p_T$ )

$E_T^{miss} > 25$

**Linear scale**  
 $M_T > 40$  GeV

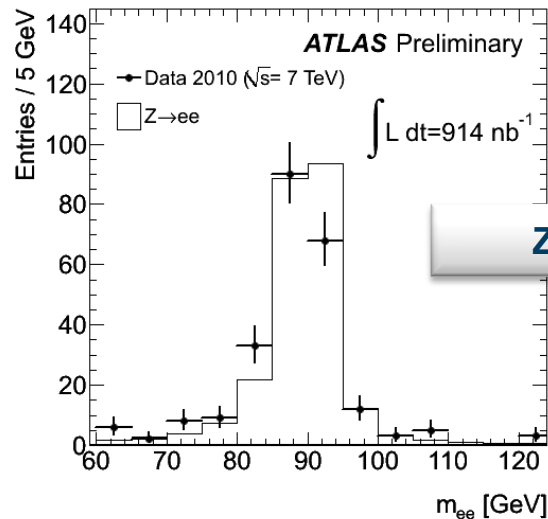
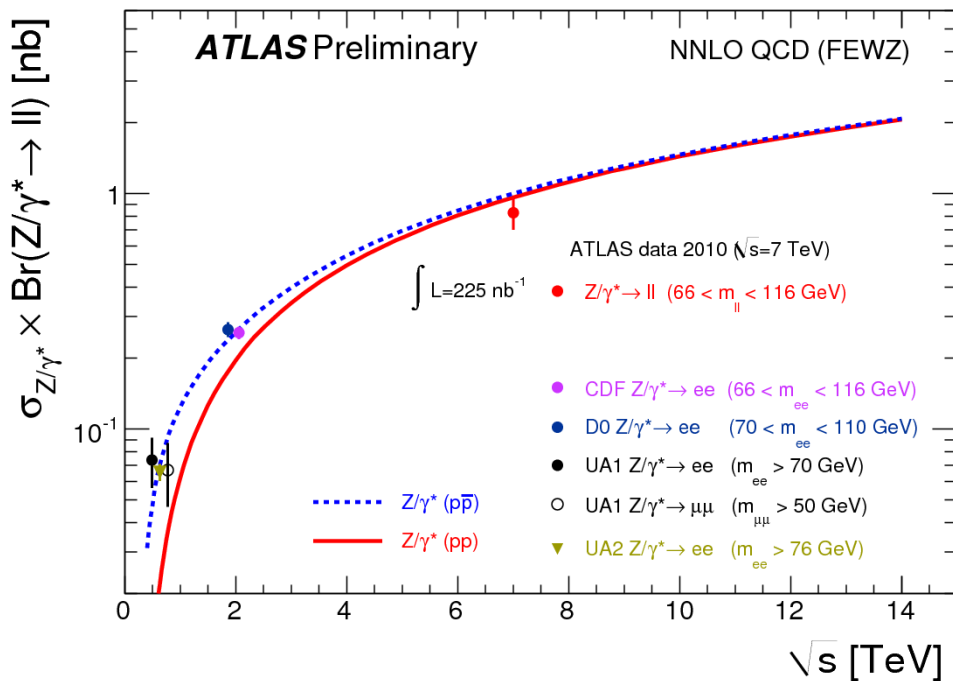
**Electron channel**

**Muon channel**



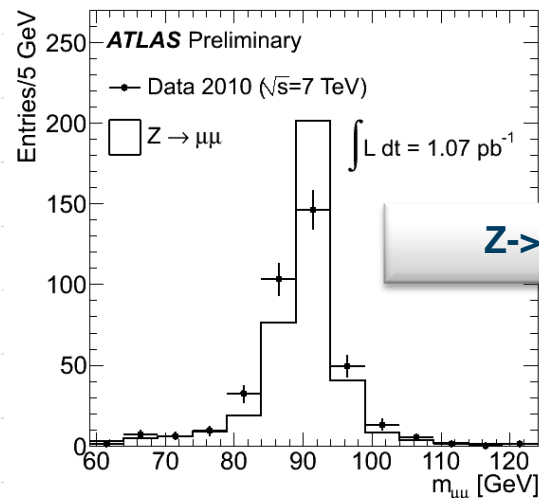
# Z boson

## Cross section measurement:



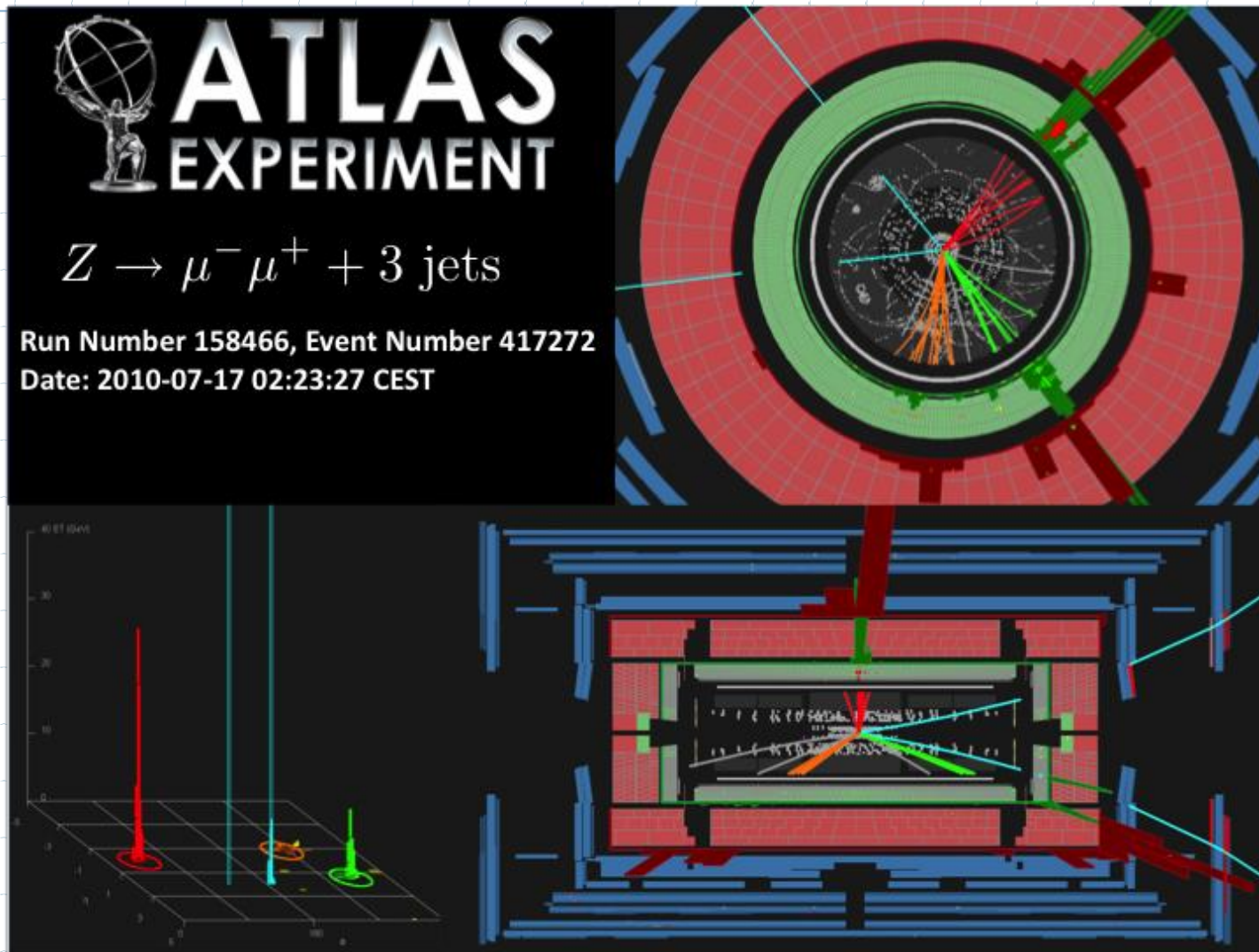
**Z → ee**

## Latest plots with up to 1.1 pb<sup>-1</sup>



**Z → mu mu**

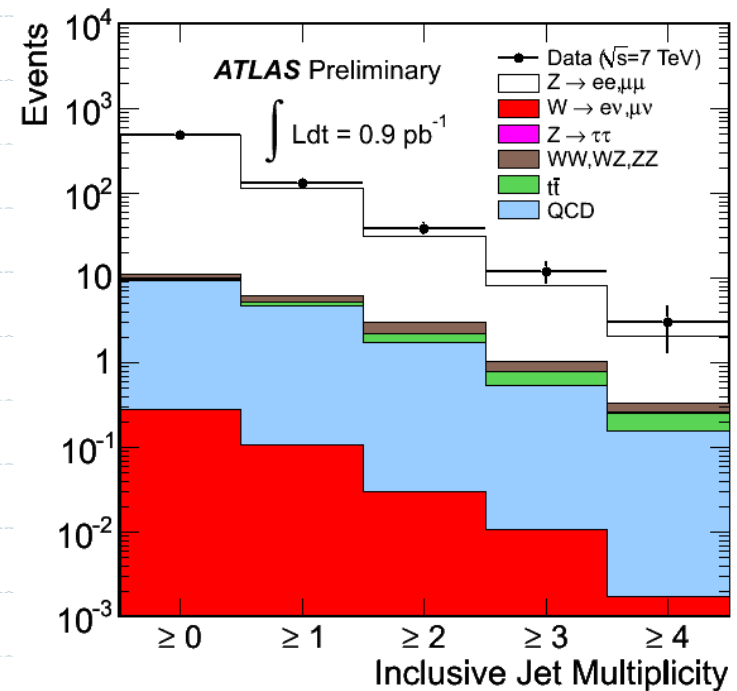
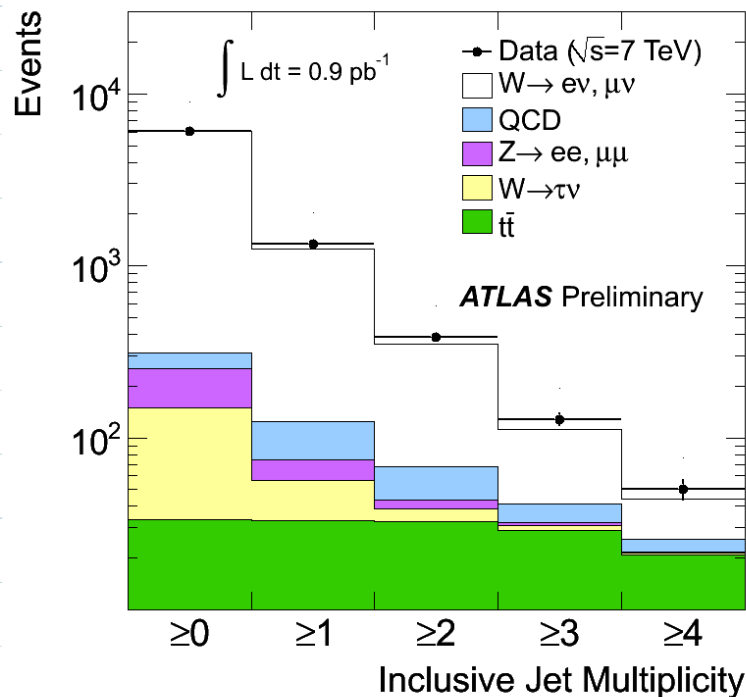
# Z+jets





# W/Z+jets

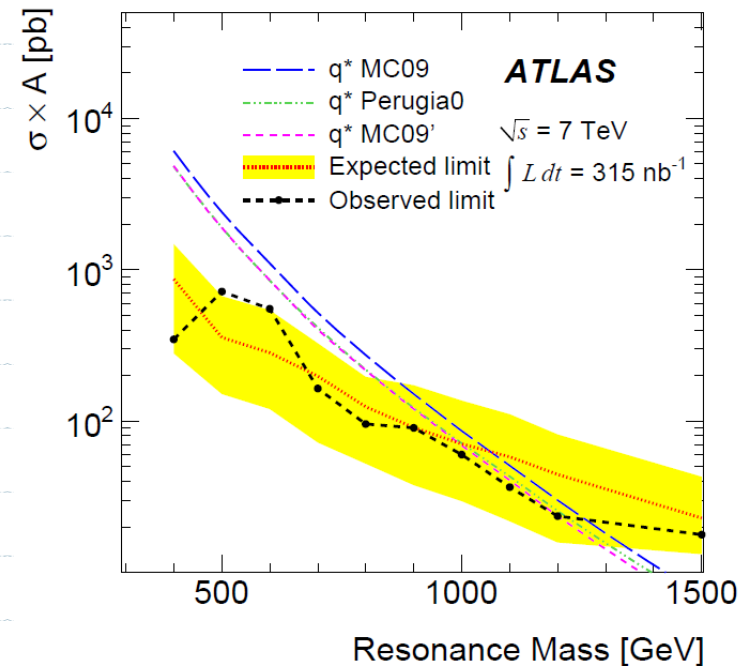
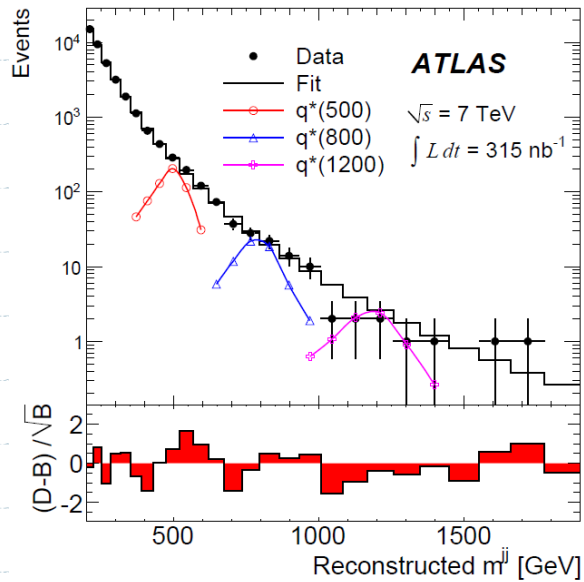
- Events with lepton(s), missing transverse energy and jet(s)
- **This is the road to Higgs / SUSY**



- A considerable sample
- Ratio measurements ( $(W+n)/(W+n+1)$ ,  $Z+n/W+n$ , ...) underway

# Search for new particles

- **Search bumps** in the reconstructed **di-jet mass** distribution  $m(jj)$
- Compare to prediction of excited quarks  $q^*$  decaying into two jets

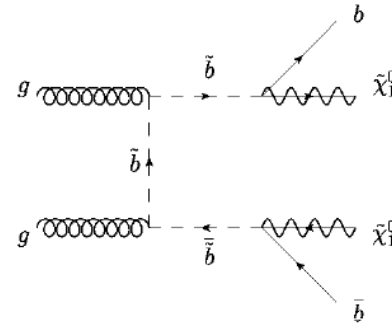
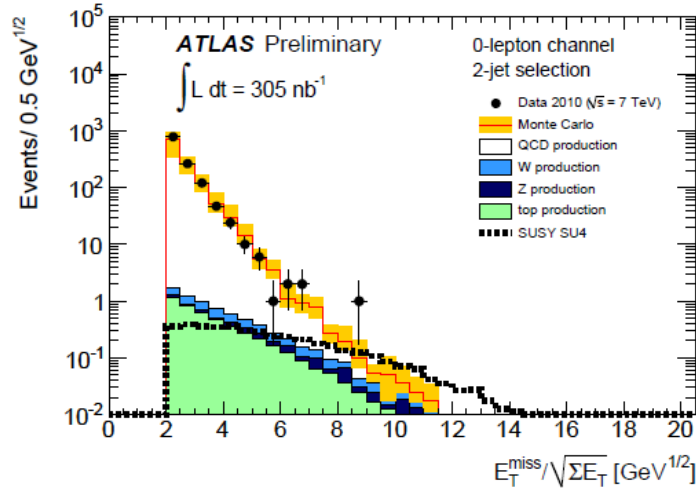


- Distribution is compatible with a smooth monotonic function  $\rightarrow$  no bumps
- **Exclude (95% CL)  $q^*$  with mass  $0.40 \text{ TeV} < m(q^*) < 1.26 \text{ TeV}$**
- arXiv:1008.2461v1, submitted to PRL Aug 14<sup>th</sup> 2010

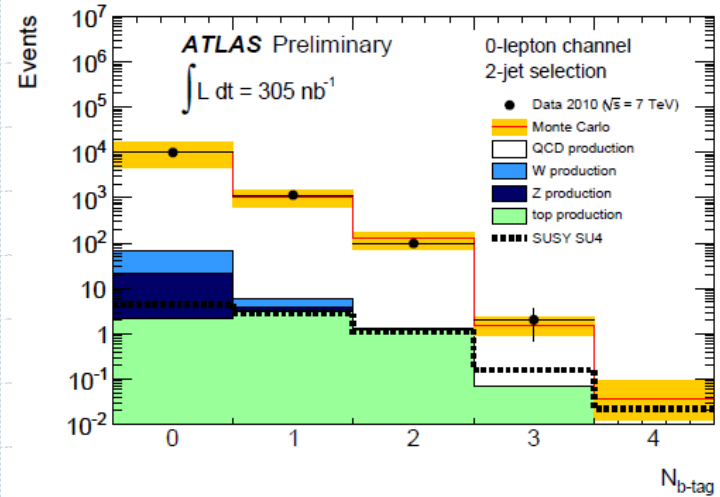
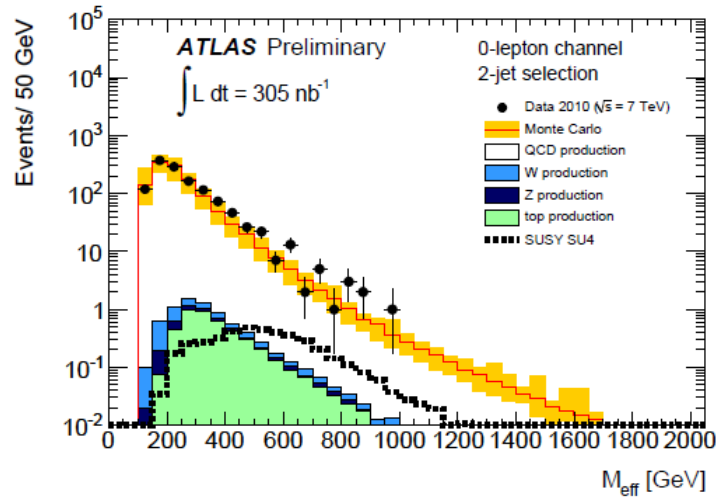
Latest published limit:  
 CDF:  $260 < M(q^*) < 870 \text{ GeV}$

## SU4 SUSY benchmark point

$M_0=200$  GeV  
 $M_{1/2}=160$  GeV  
 $A_0=-400$  GeV  
 $\tan\beta=10$   
 $\text{Sign}(\mu)=+1$



Selection with  
0 leptons, 1 b-jet



## Conclusions

- The LHC is in operation !
- Got the first  $\text{pb}^{-1}$
- Going for  $\text{fb}^{-1}$
- Plenty of data for performance studies, plenty of studies
- Lots of data for SM studies, measurements ongoing, more publications to follow
- We start already to push some limits for new physics: start to be sensitive !

New physics ?