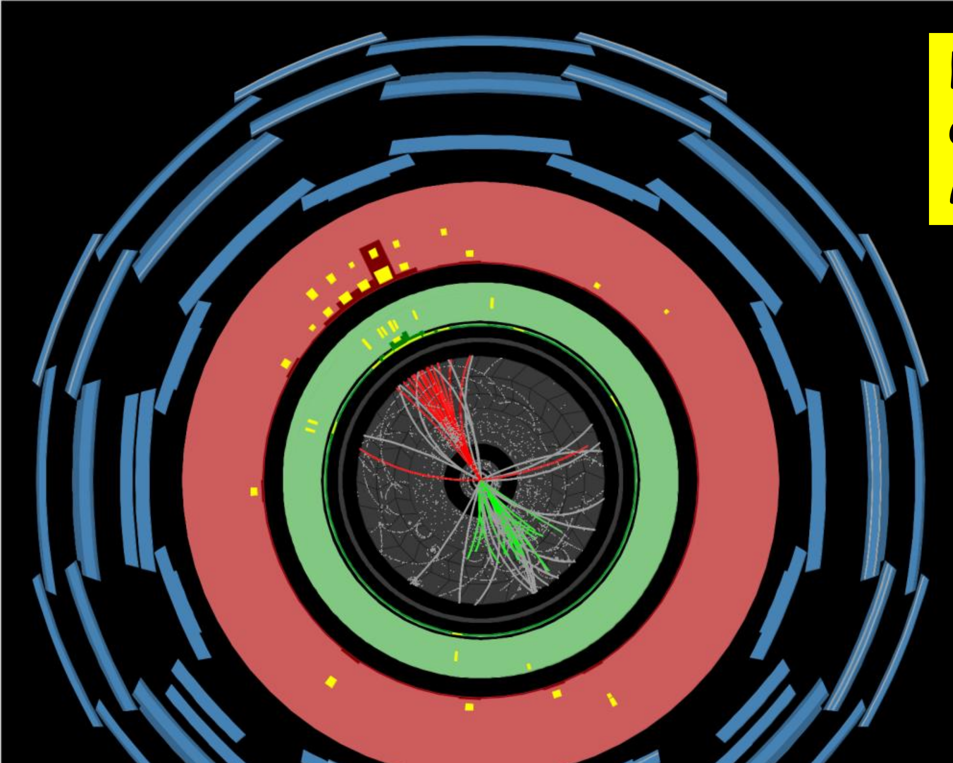
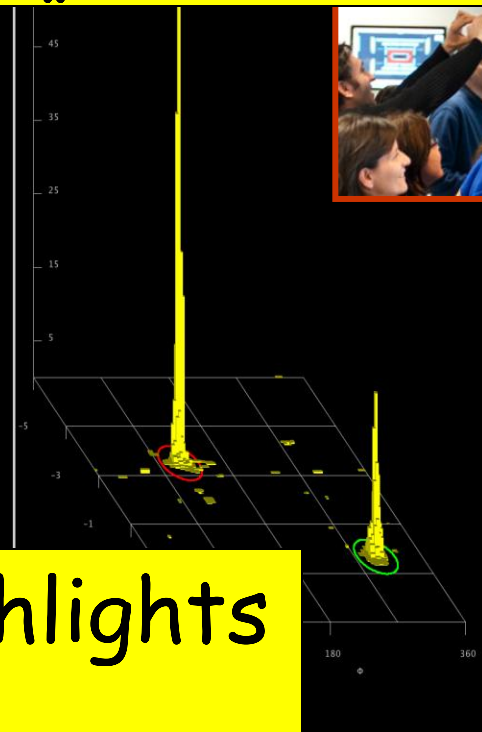
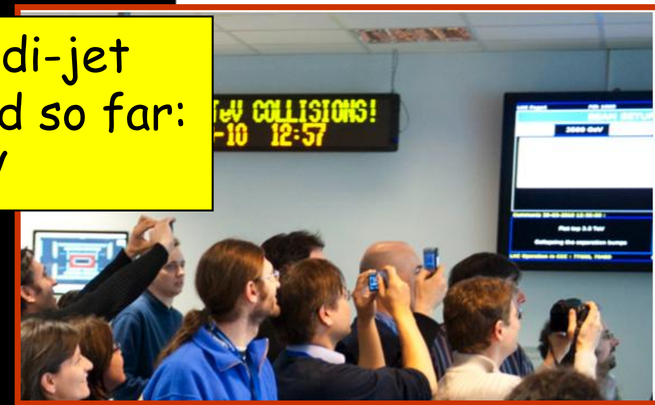


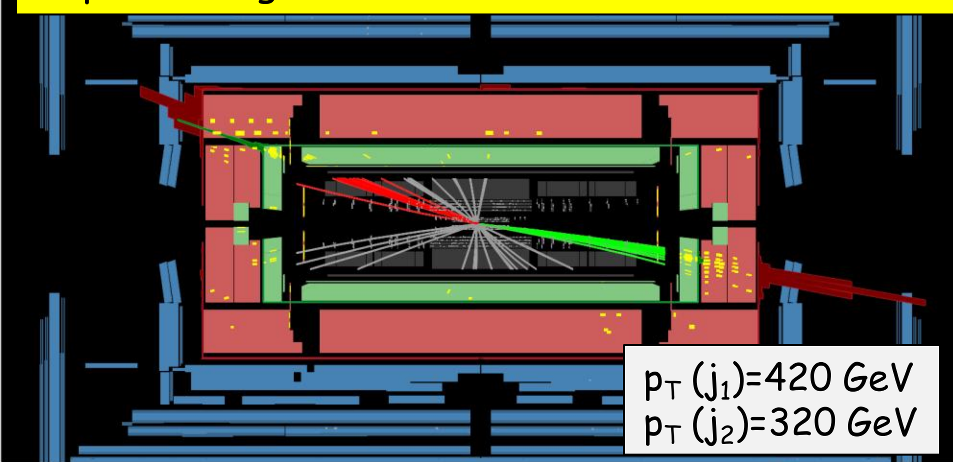




Highest-mass di-jet event observed so far: M_{jj} = 2.55 TeV

ATLAS status and highlights

Fabiola Gianotti (CERN)
Representing the ATLAS Collaboration



$p_T(j_1)$=420 GeV
$p_T(j_2)$=320 GeV

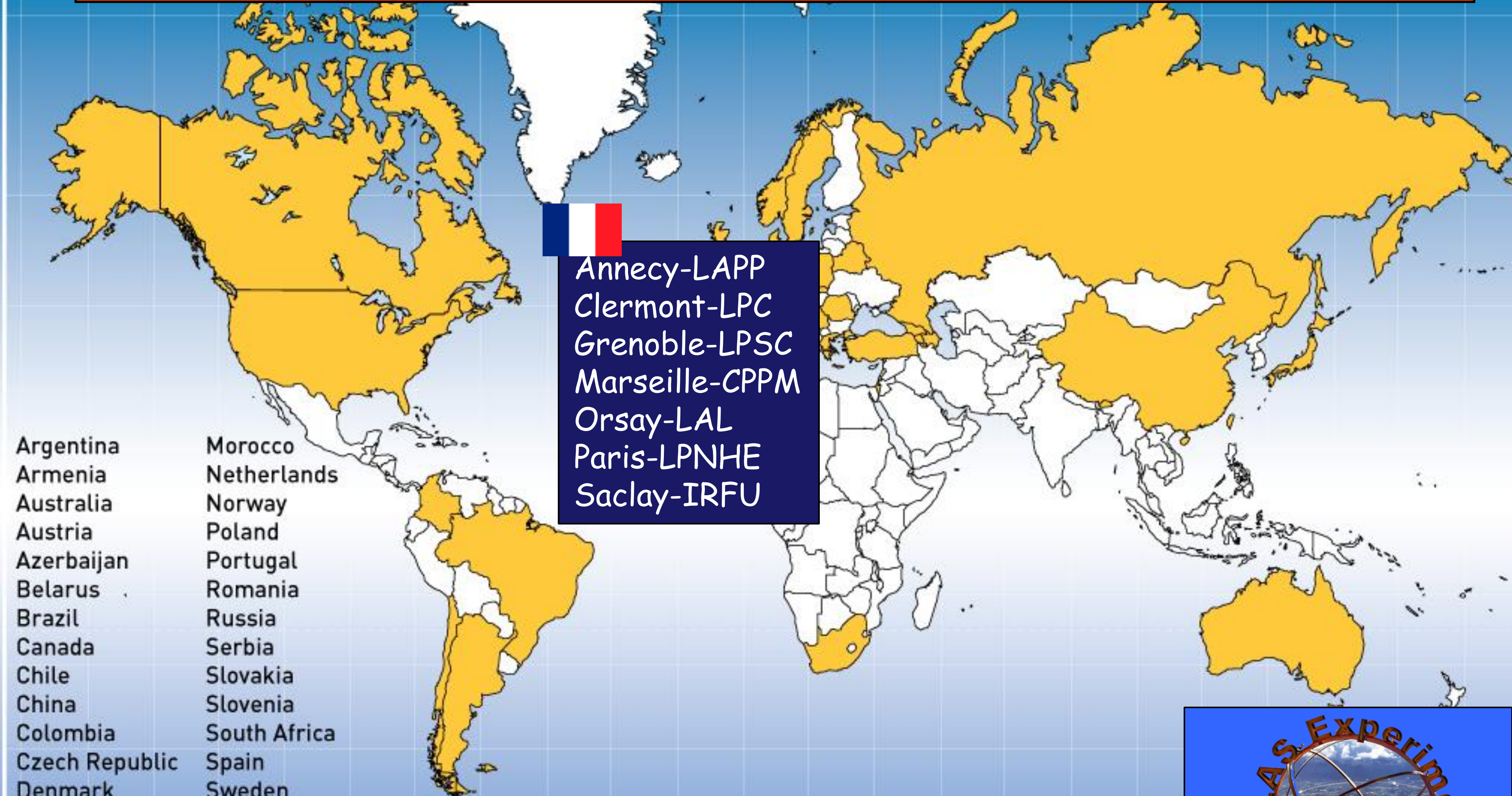
ATLAS EXPERIMENT

Run Number: 158548, Event Number: 5917927

Date: 2010-07-04 07:24:40 CEST

Event display shows uncalibrated energies

~3000 scientists from 174 Institutions and 38 Countries

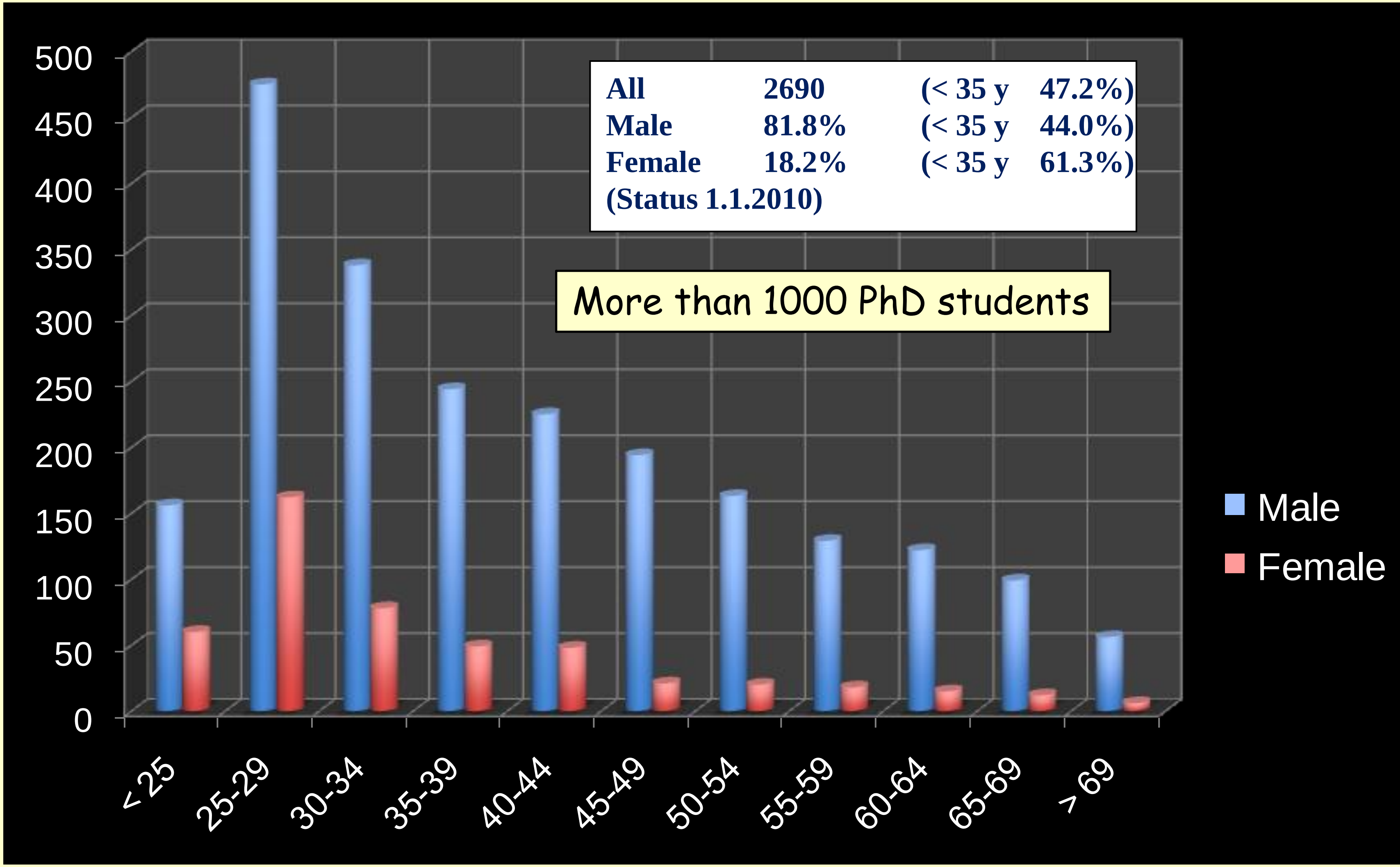


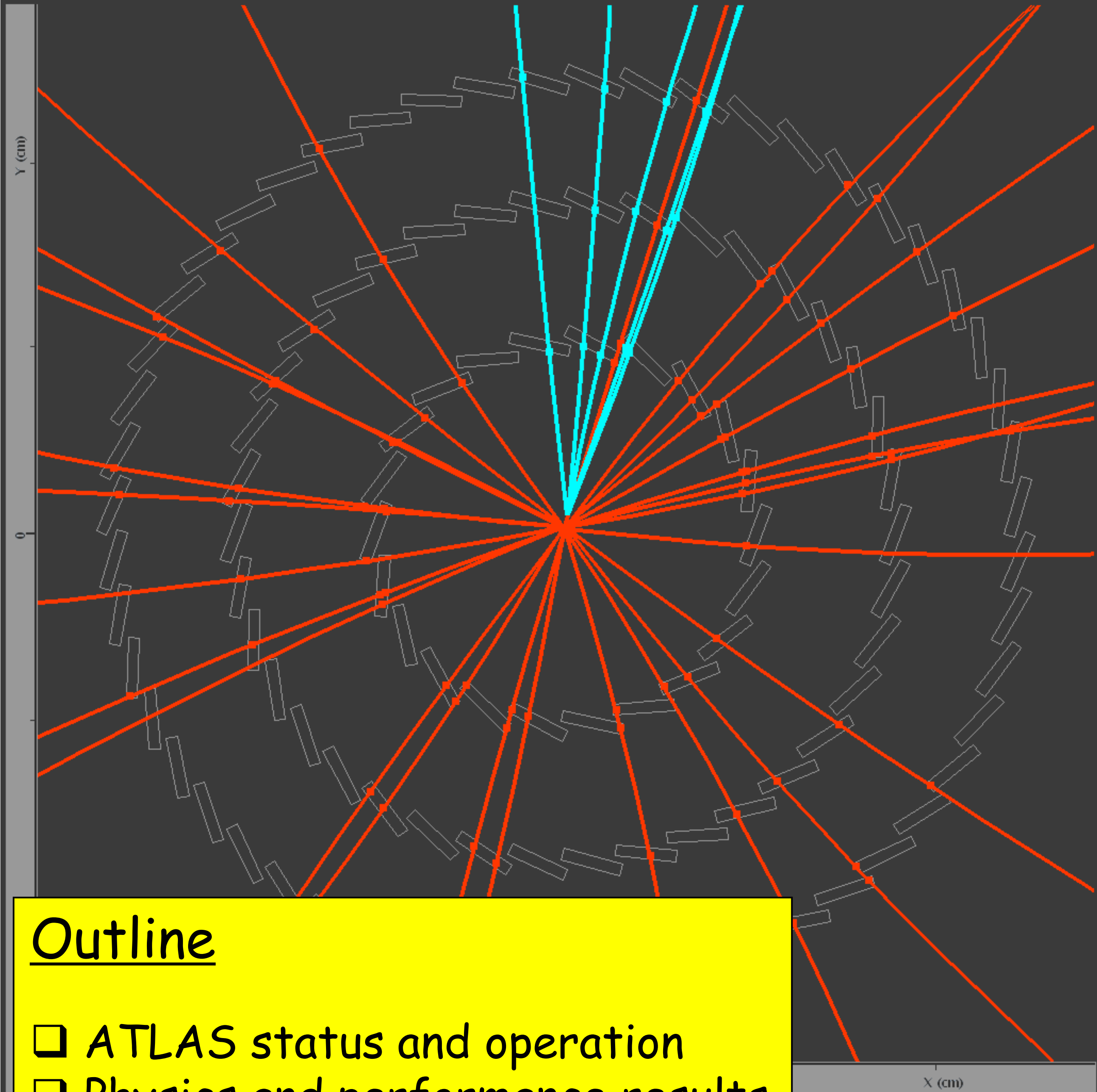
Annecy-LAPP
Clermont-LPC
Grenoble-LPSC
Marseille-CPPM
Orsay-LAL
Paris-LPNHE
Saclay-IRFU

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

ATLAS Collaboration

Age distribution of the ATLAS population





ATLAS EXPERIMENT

Run 142195, Event 284154

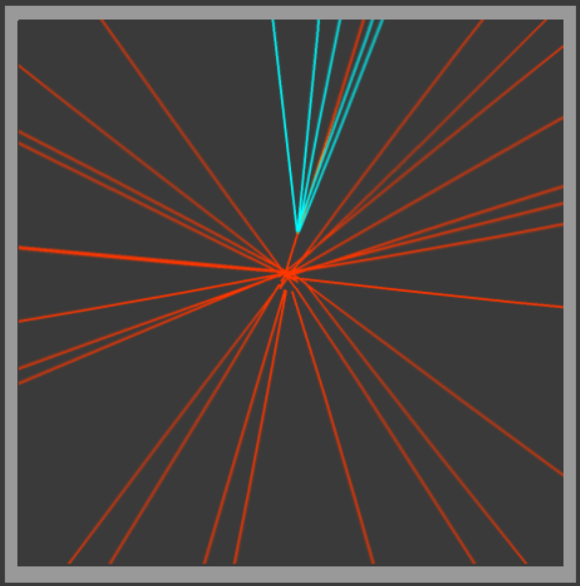
Decay length = 3.7 mm

Decay length signficance = 22

Lifetime = 3.1 ps

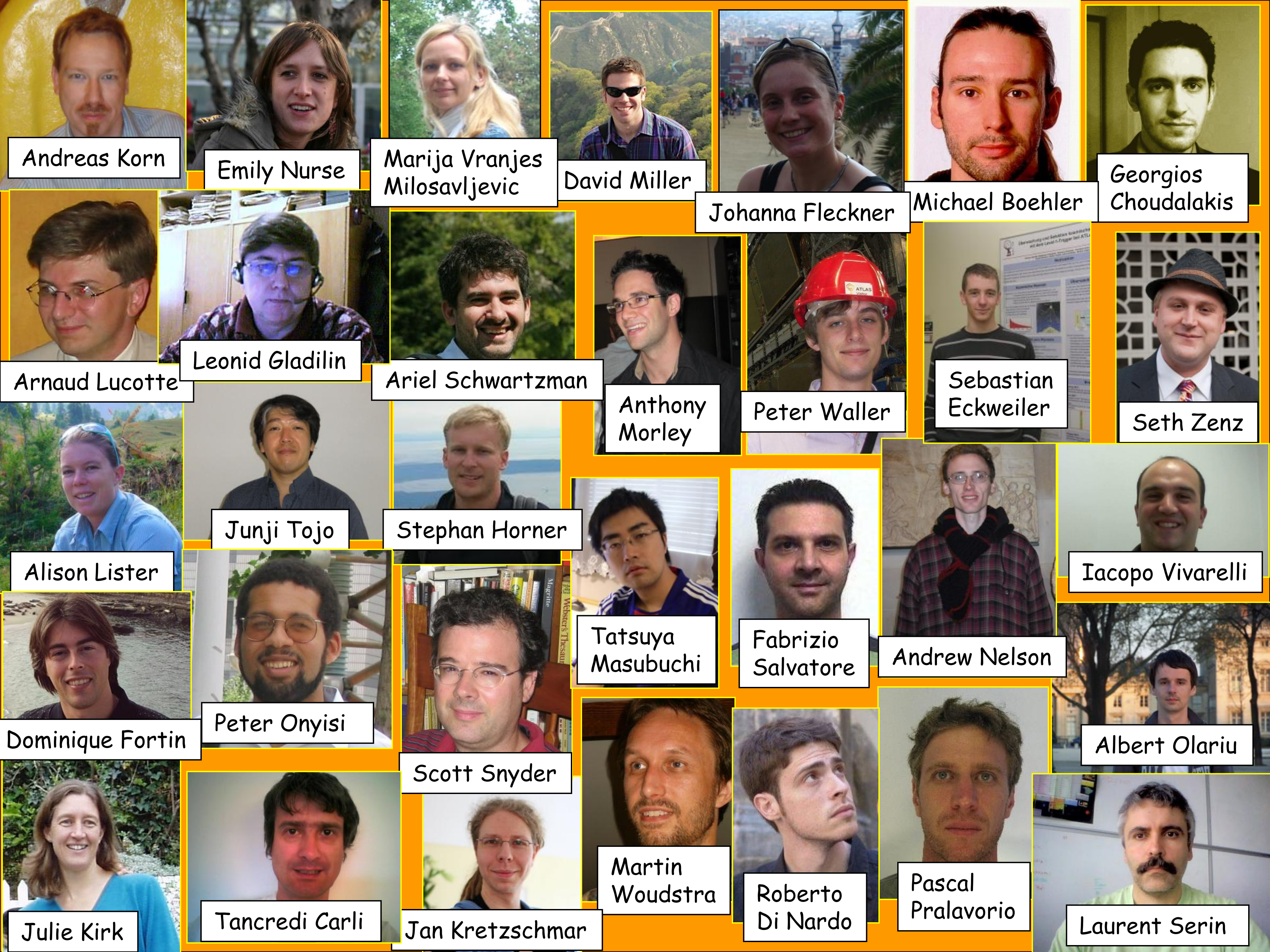
Vertex mass = 2.5 GeV

Number of tracks = 5



Outline

- ATLAS status and operation
- Physics and performance results
  (a few examples …)

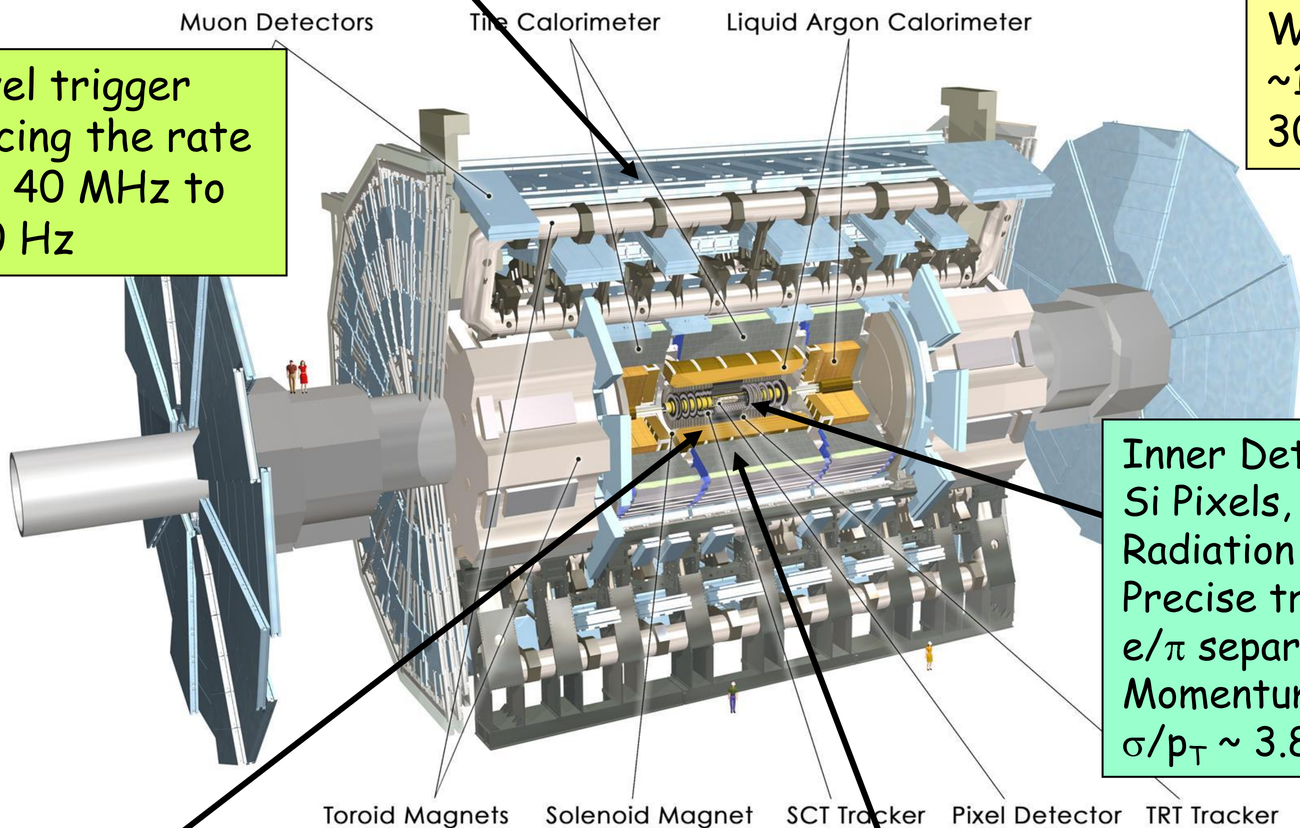

Andreas Korn
Emily Nurse
Marija Vranjes Milosavljevic
David Miller
Johanna Fleckner
Michael Boehler
Georgios Choudalakis
Arnaud Lucotte
Leonid Gladilin
Ariel Schwartzman
Anthony Morley
Peter Waller
Sebastian Eckweiler
Seth Zenz
Alison Lister
Junji Tojo
Stephan Horner
Tatsuya Masubuchi
Fabrizio Salvatore
Andrew Nelson
Iacopo Vivarelli
Dominique Fortin
Peter Onyisi
Scott Snyder
Albert Olariu
Julie Kirk
Tancredi Carli
Jan Kretzschmar
Martin Woudstra
Roberto Di Nardo
Pascal Pralavorio
Laurent Serin

ATLAS status and operation

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

Length : ~ 46 m
Radius : ~ 12 m
Weight : ~ 7000 tons
~10^8 electronic channels
3000 km of cables

3-level trigger reducing the rate from 40 MHz to ~200 Hz

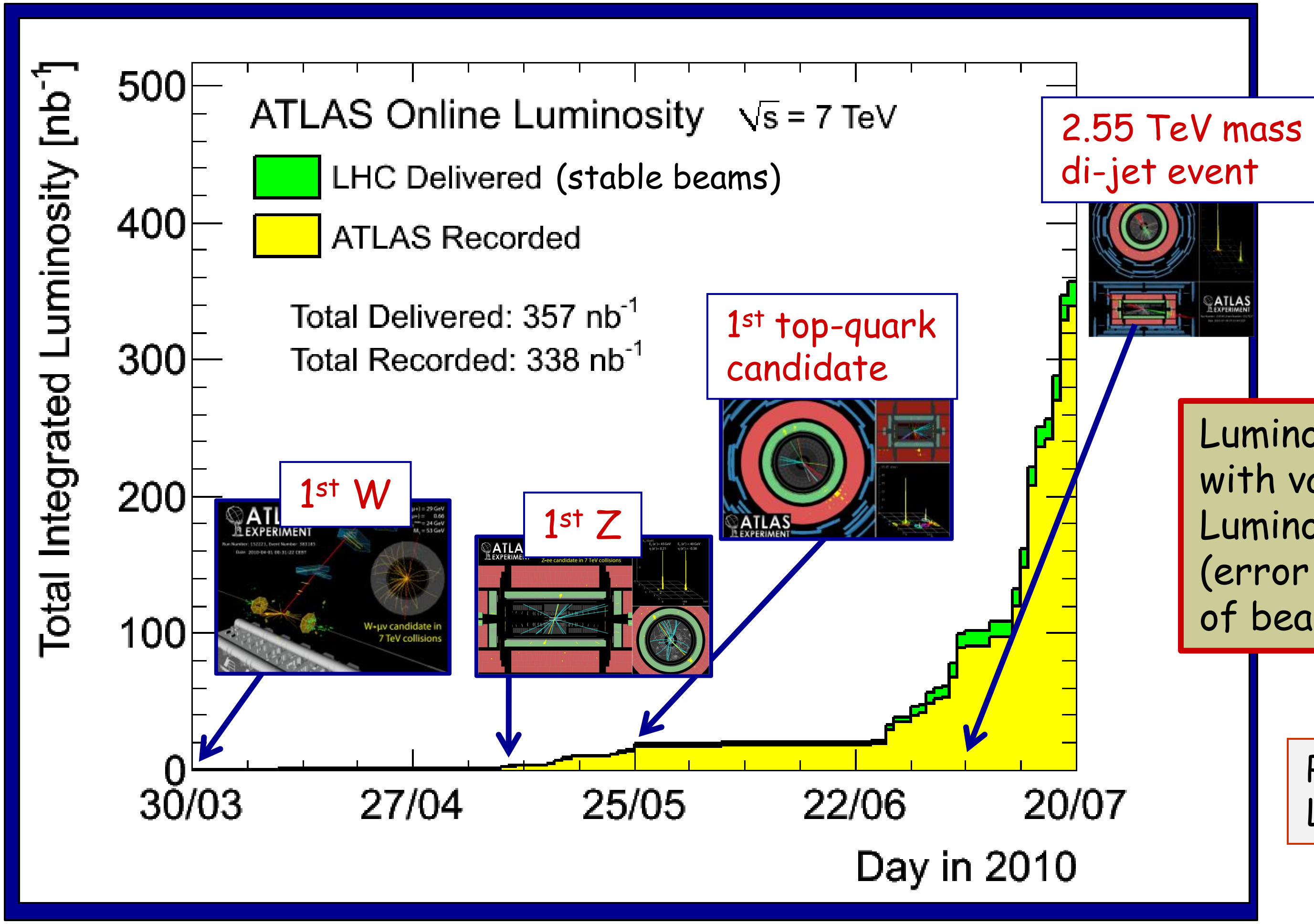


Inner Detector ($|\eta|<2.5$, B=2T):
Si Pixels, Si strips, Transition Radiation detector (straws)
Precise tracking and vertexing,
e/π separation
Momentum resolution:
$\sigma/p_T \sim 3.8\times10^{-4}\, p_T(\text{GeV}) \oplus 0.015$

EM calorimeter: Pb-LAr Accordion
e/γ trigger, identification and measurement
E-resolution: $\sigma/E \sim 10\%/\sqrt{E}$

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: $\sigma/E \sim 50\%/\sqrt{E} \oplus 0.03$

Integrated luminosity vs time
(from first √s =7 TeV collisions on 30 March to beginning of ICHEP on 22 July)



Luminosity detectors calibrated with van der Meer scans. Luminosity known today to 11% (error dominated by knowledge of beam currents)

Peak luminosity in ATLAS $L \sim 1.6 \times 10^{30}$ cm^{-2} s^{-1}

Overall data taking efficiency (with full detector on): 95%

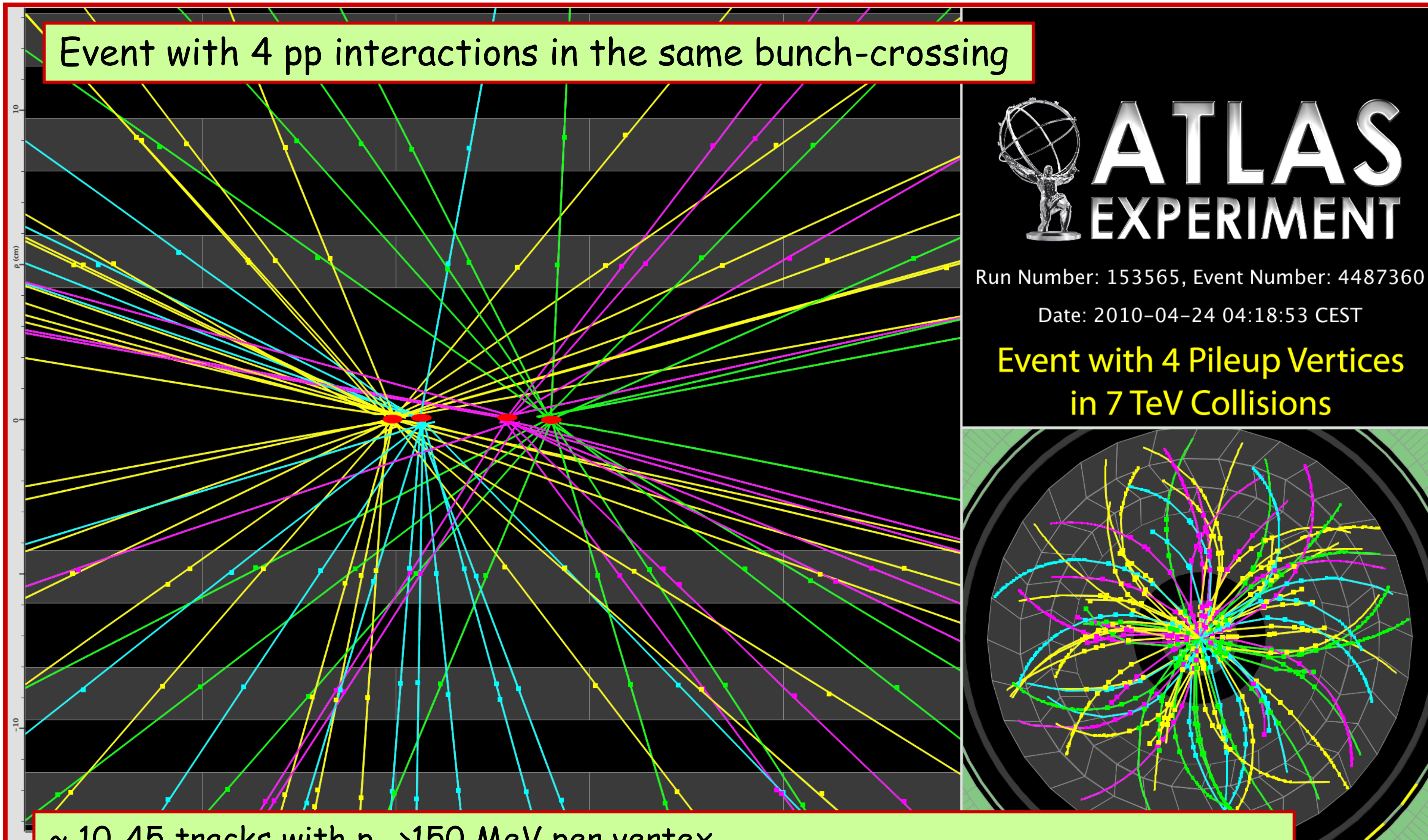
Results presented here based in many cases on whole data sample recorded until the beginning of ICHEP

Max peak luminosity: $L \sim 1.6 \times 10^{30}\ cm^{-2}s^{-1}$

→ average number of pp interactions per bunch-crossing: up to 1.3

→ "pile-up" (~40% of the events have > 1 pp interaction per crossing)

Event with 4 pp interactions in the same bunch-crossing



~ 10-45 tracks with p_T >150 MeV per vertex

Vertex z-positions : −3.2, −2.3, 0.5, 1.9 cm (vertex resolution better than ~200 μm)

Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	80 M	97.4%
SCT Silicon Strips	6.3 M	99.2%
TRT Transition Radiation Tracker	350 k	98.0%
LAr EM Calorimeter	170 k	98.5%
Tile calorimeter	9800	97.3%
Hadronic endcap LAr calorimeter	5600	99.9%
Forward LAr calorimeter	3500	100%
LVL1 Calo trigger	7160	99.9%
LVL1 Muon RPC trigger	370 k	99.5%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.7%
CSC Cathode Strip Chambers	31 k	98.5%
RPC Barrel Muon Chambers	370 k	97.0%
TGC Endcap Muon Chambers	320 k	98.6%

Total fraction of good quality data (green "traffic light")

Inner Tracking Detectors			Calorimeters				Muon Detectors			
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile	MDT	RPC	TGC	CSC
97.1	98.2	100	93.8	98.8	99.1	100	97.9	96.1	98.1	97.4

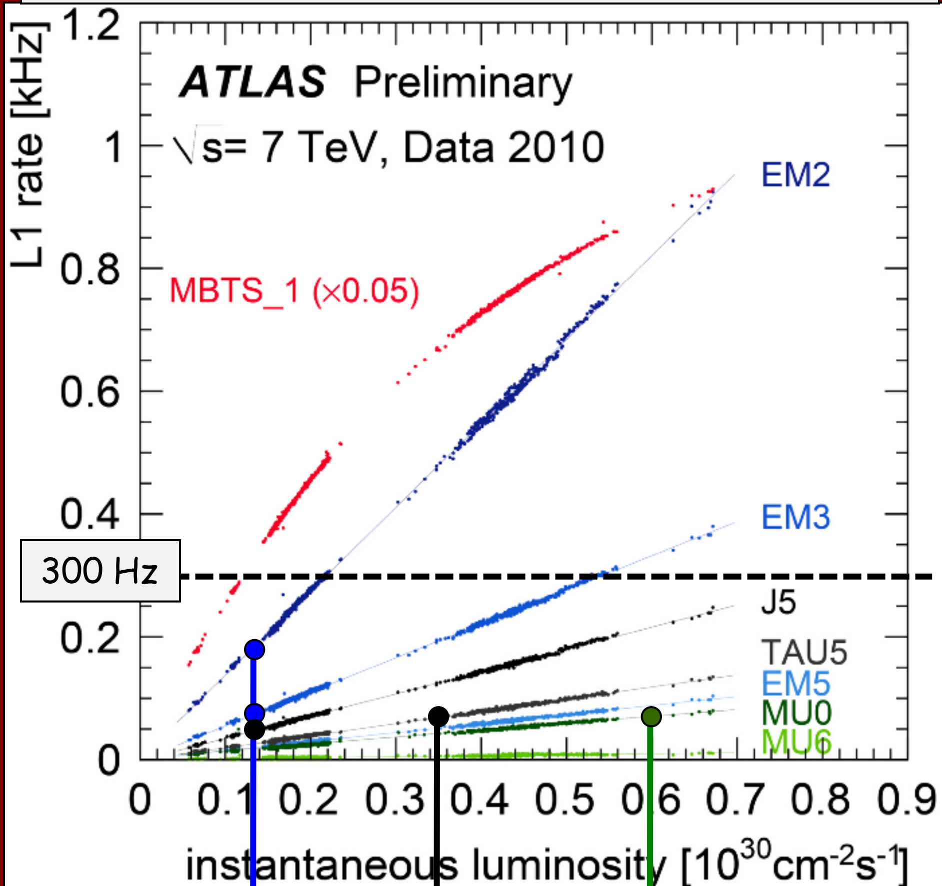
Luminosity weighted relative detector uptime and good quality data delivery during 2010 stable beams at √s=7 TeV between March 30th and July 16th (in %)

Few percent losses in Silicon and Muon detectors due to time to ramp up HV after stable beams are declared

Trigger commissioning and operation

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

Un-prescaled rates of some LVL1 items vs L



HLT on (e/γ) for EM2, EM3 J5 pre-scaled

HLT on (τ) for TAU5

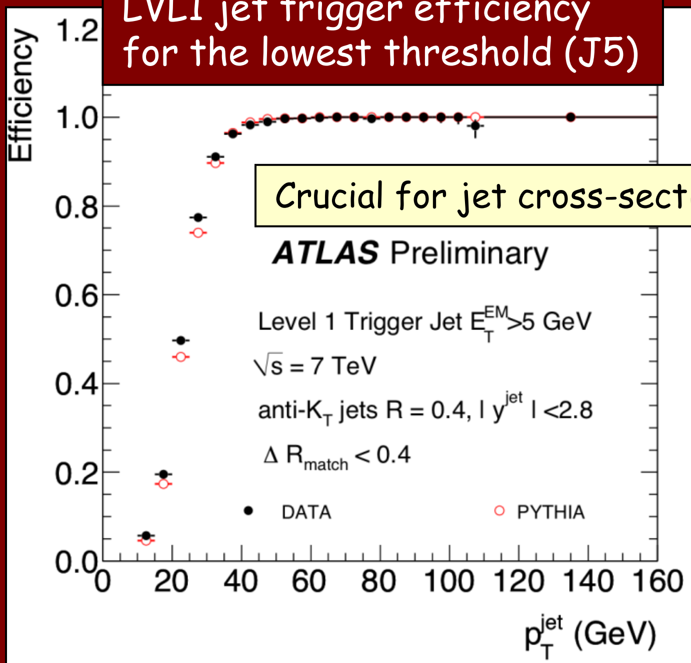
HLT on (μ) for MU0 fwd

Trigger output: typically 300 Hz

History:

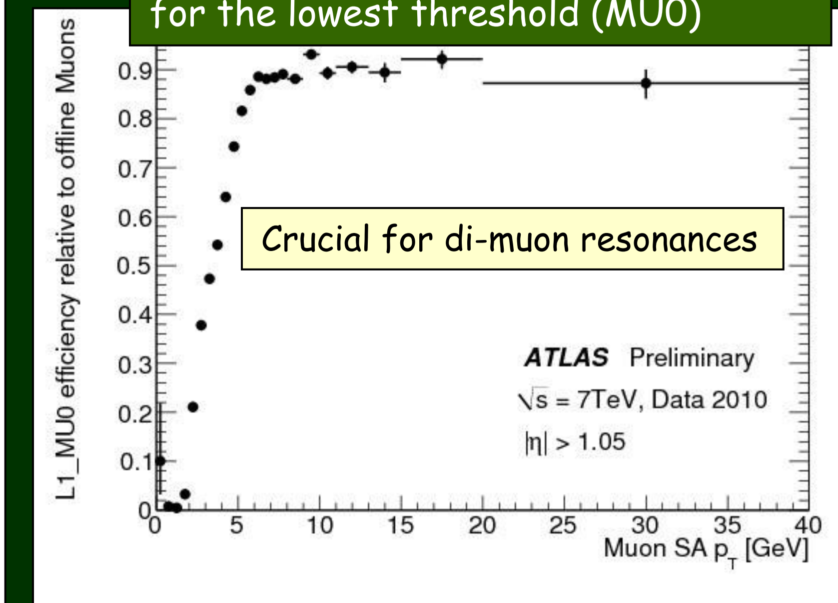
- L < few 10^{27} cm^{-2} s^{-1}: minimum-bias
  LVL1 trigger: hits in scintillator counters (MBTS) located at Z=± 3.5 m from collision centre
  HLT running in transparent mode
- L > 10^{27} cm^{-2} s^{-1} : MBTS prescaled
  (only fraction of events recorded)
  Others items (EM2, J5, TAU5, MU0, ...): un-prescaled
- L ~ 10^{29} cm^{-2} s^{-1}: start to activate HLT chains to cope with increasing rate while running with low LVL1 thresholds.
  Jet items: lowest thresholds prescaled (HLT rejection small)
  Figure gives examples for L up 7x10^{29}

LVL1 jet trigger efficiency for the lowest threshold (J5)



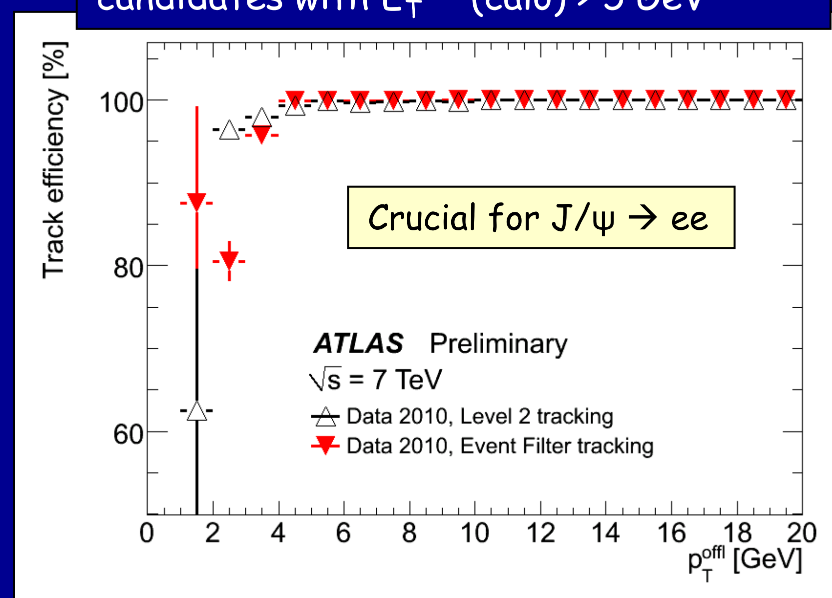
Crucial for jet cross-section

LVL1 forward muon trigger efficiency for the lowest threshold (MU0)



Crucial for di-muon resonances

Tracking efficiency at HLT for electron candidates with E_T^{off} (calo) > 5 GeV

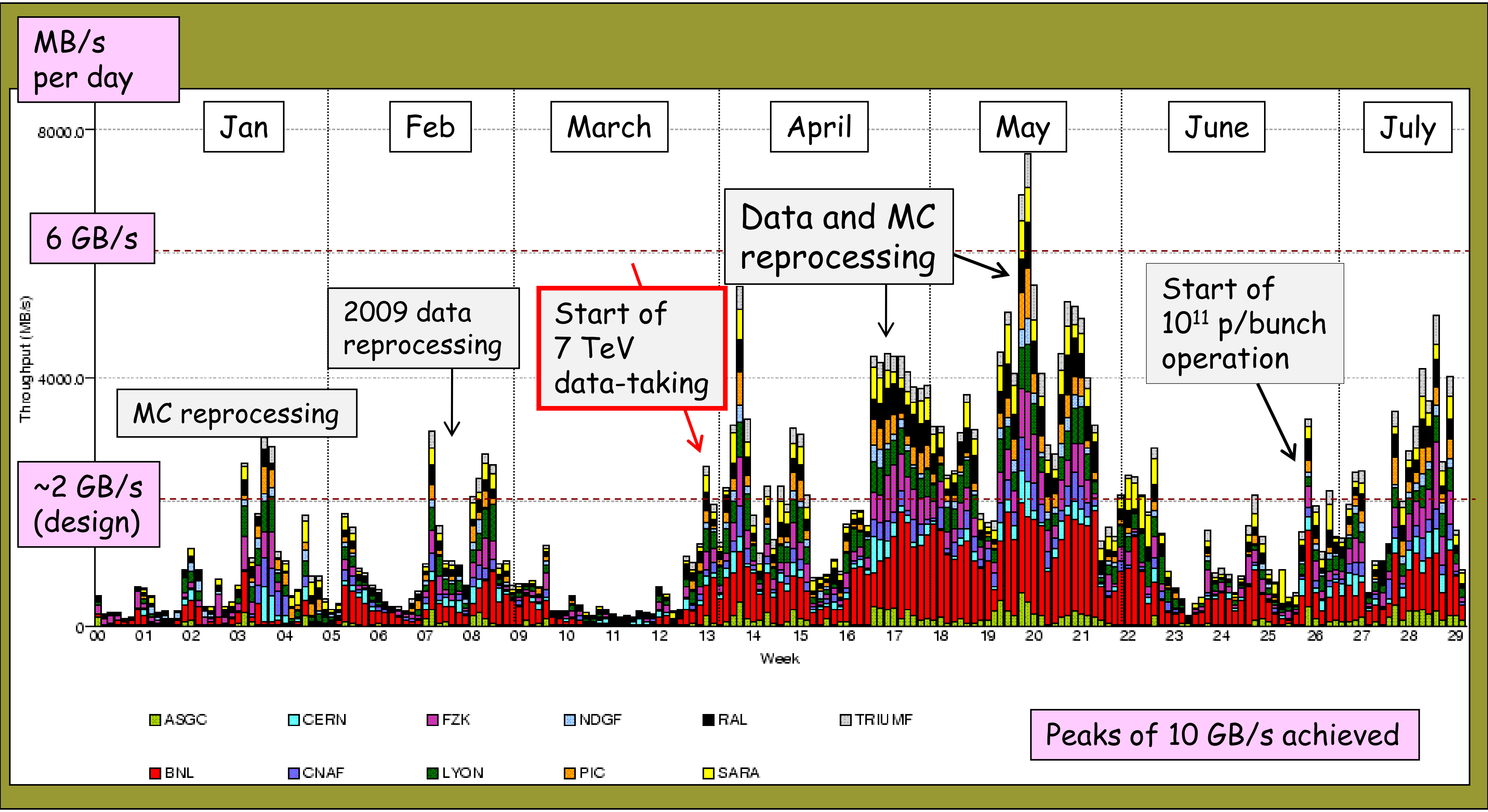


Crucial for $J/\psi \rightarrow ee$

Examples of trigger performance studies

Worldwide data distribution and analysis

Total throughput of ATLAS data through the Grid: from 1st January until yesterday



GRID-based analysis in June-July 2010:
> 1000 different users, ~ 11 million analysis jobs processed

Physics results and highlights of detector performance

- A few examples (much more in ATLAS talks and posters):
  -- Soft physics
  -- Jets
  -- J/ψ and di-muon resonances
  -- W/Z
  -- Top-quark candidates
  -- First searches for New Physics

- Emphasis on detailed ongoing work to lay foundations for solid physics measurements

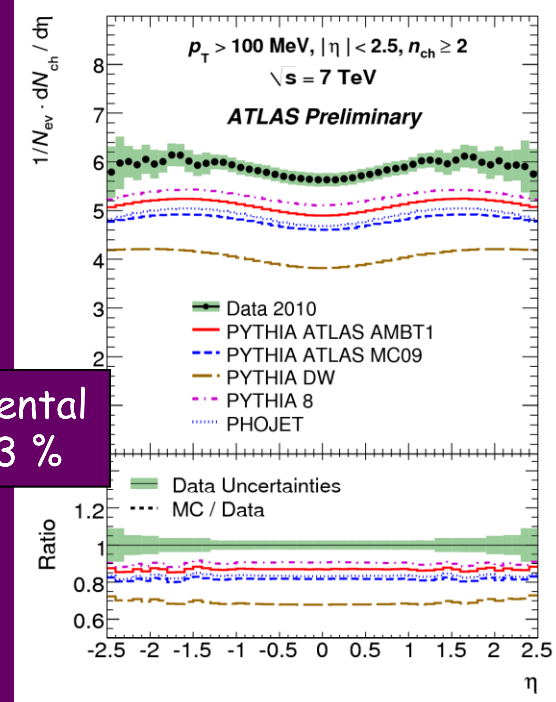
Soft physics

Particle multiplicities and momentum spectra in pp minimum-bias events

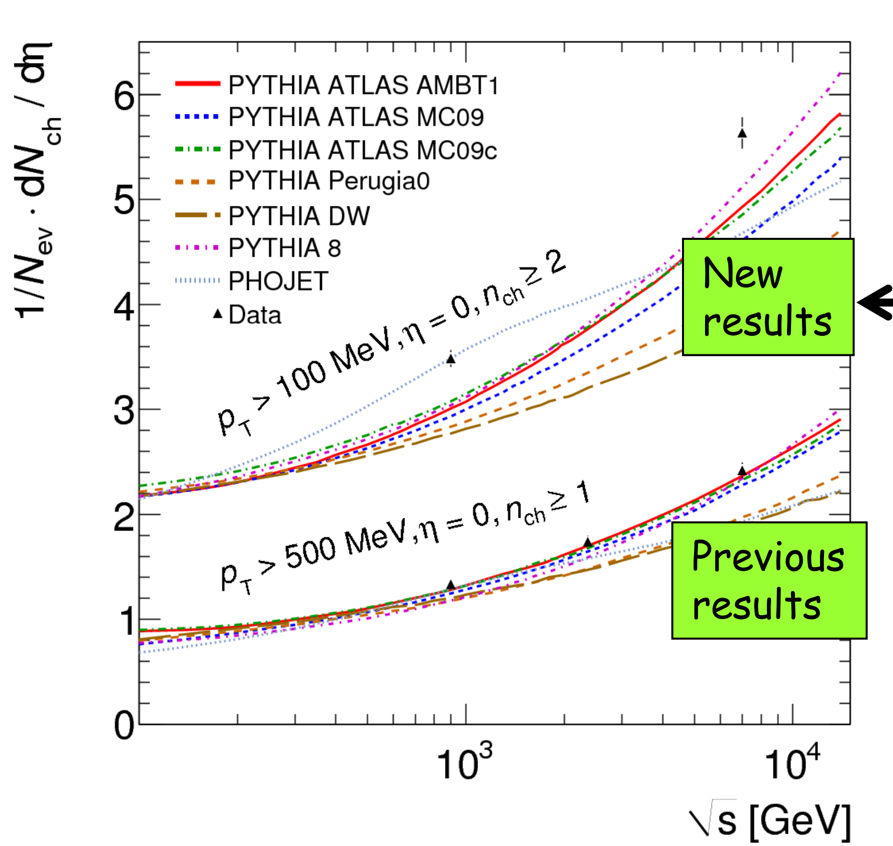
- ❑ Measured over a well-defined kinematic region: ≥ 2 charged particle with p_T > 100 MeV, |η| <2.5
- ❑ No subtraction for single/double diffractive components
- ❑ Distributions corrected back to hadron level

→ High-precision *minimally* model-dependent measurements

→ Provide strong constraints on MC models



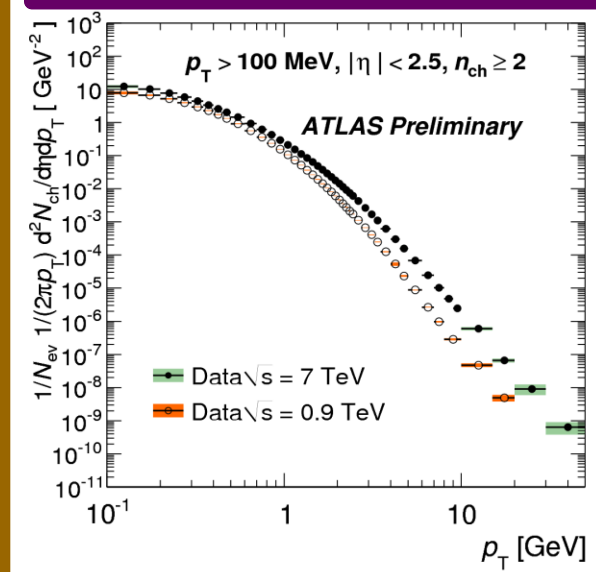
Experimental error: < 3 %



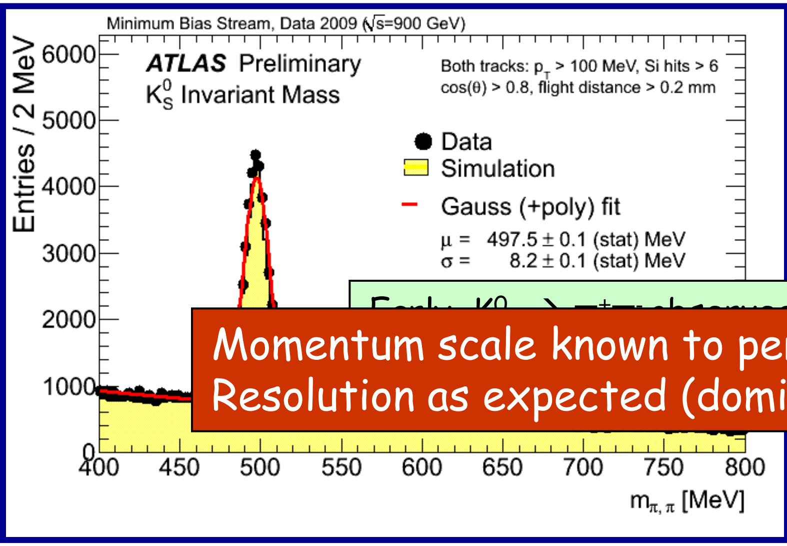
New results

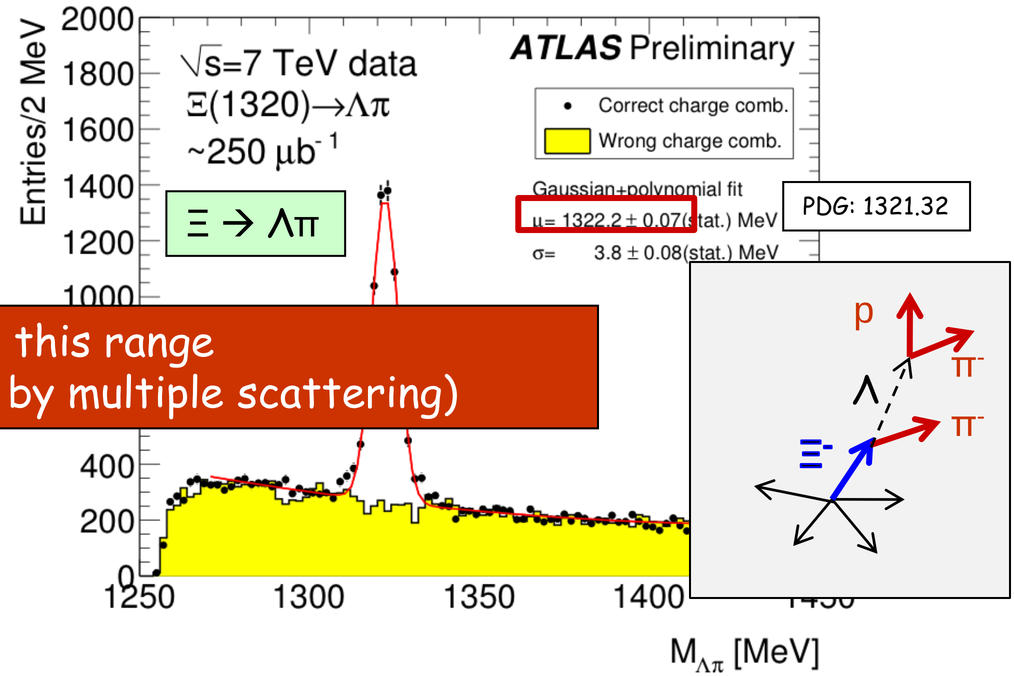
Previous results

lower p_T
→ larger diffractive component
→ poorer description by models

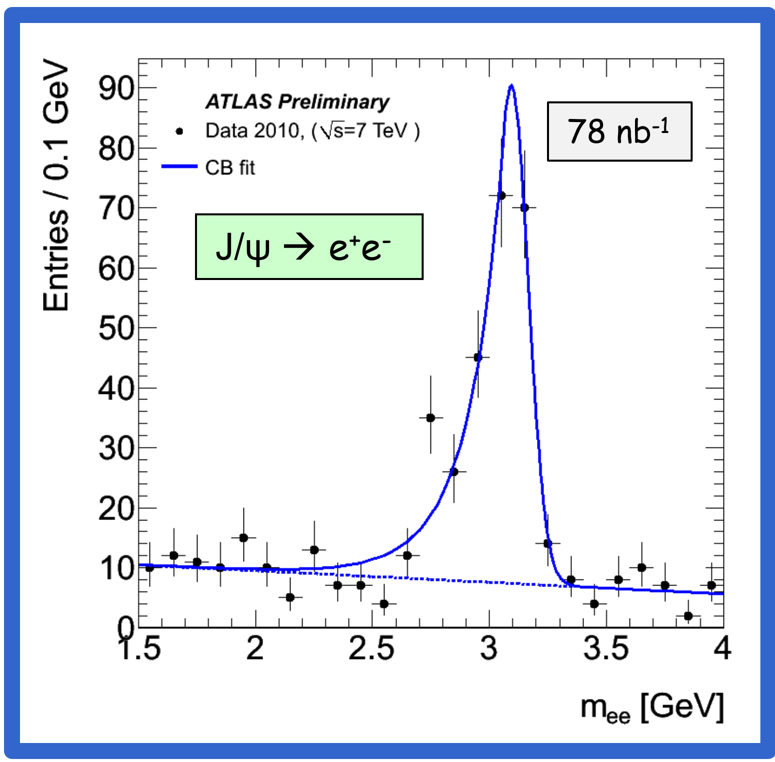


Inner Detector: from early observation of peaks to cascade decays and J/ψ → ee





Momentum scale known to permil in this range
Resolution as expected (dominated by multiple scattering)



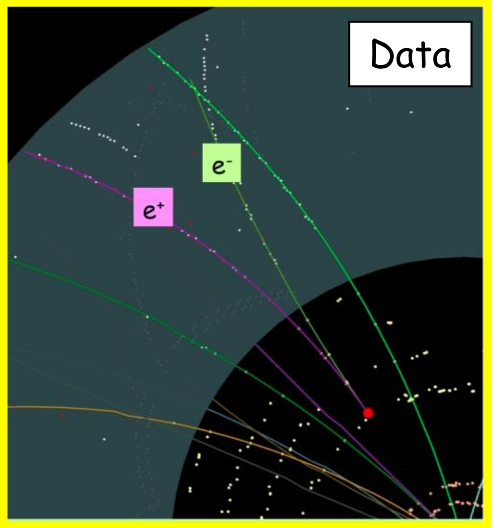
To extract signal from background:
- 2 EM clusters matched to tracks
- p_T ($e^\pm$ tracks) > 4, 2 GeV
- track quality, calo shower shapes
- key handle: large transition radiation in TRT
- invariant mass from track parameters after Brem recovery (GSF)

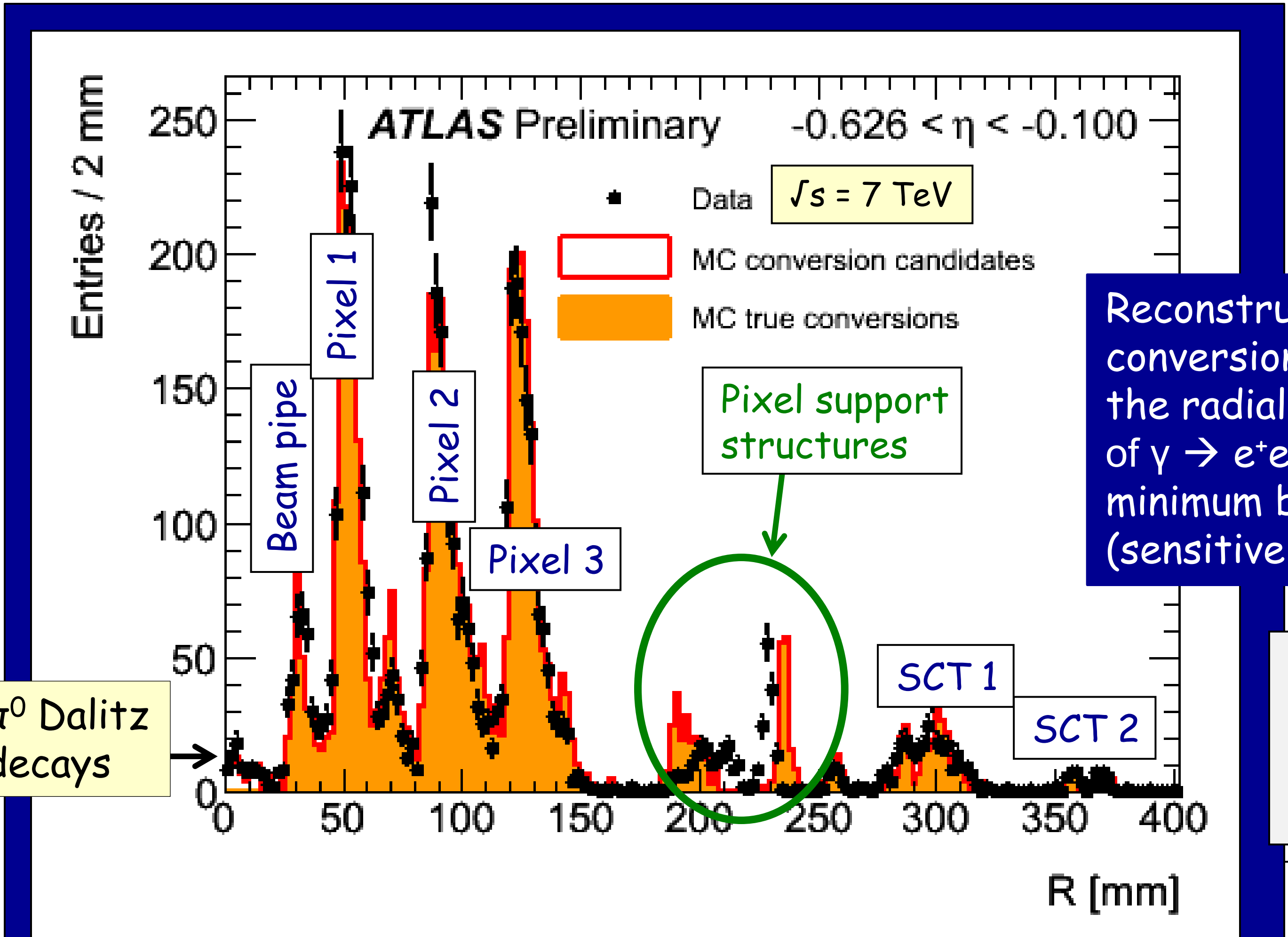
Signal	: 222 ± 11 events
Background	: 28 ± 2 events
Mass peak	: 3.09± 0.01 GeV
Mass resolution	: 0.07 ± 0.01 GeV

Mapping the Inner Detector material with $\gamma \rightarrow e^+e^-$ conversions and hadron interactions

… and using data to find geometry imperfections in the simulation

Goal is to know material to better than 5%
(over-constraining with several methods)
Present understanding: at the level of ~ 10%

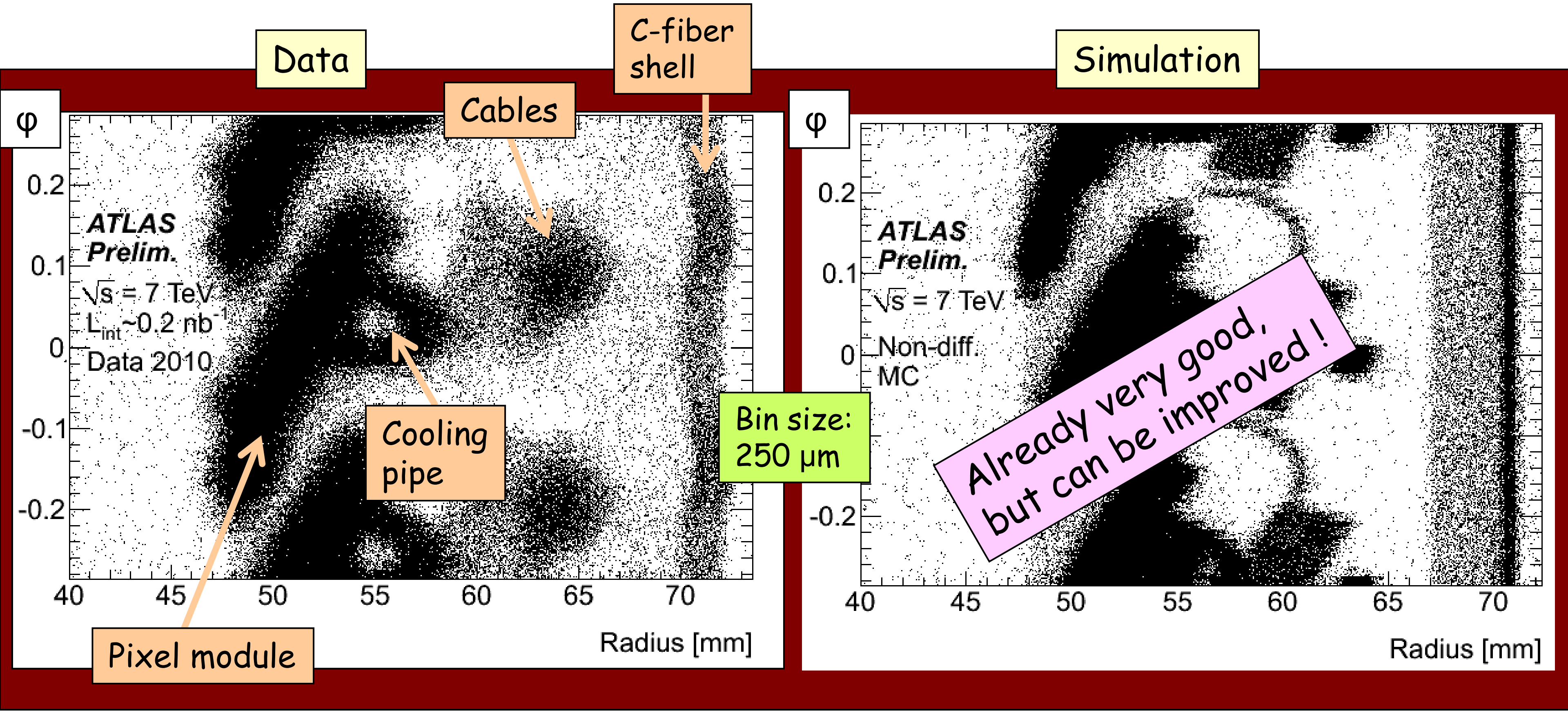




Reconstructed conversion point in the radial direction of $\gamma \rightarrow e^+e^-$ from minimum bias events (sensitive to X_0)

Data show that Pixel supports are displaced in the simulation
→ to be fixed

Reconstructed secondary vertices due to hadronic interactions in minimum-bias events in the first layer of the Pixel detector (sensitive to interaction length λ → complementary to γ conversion studies)

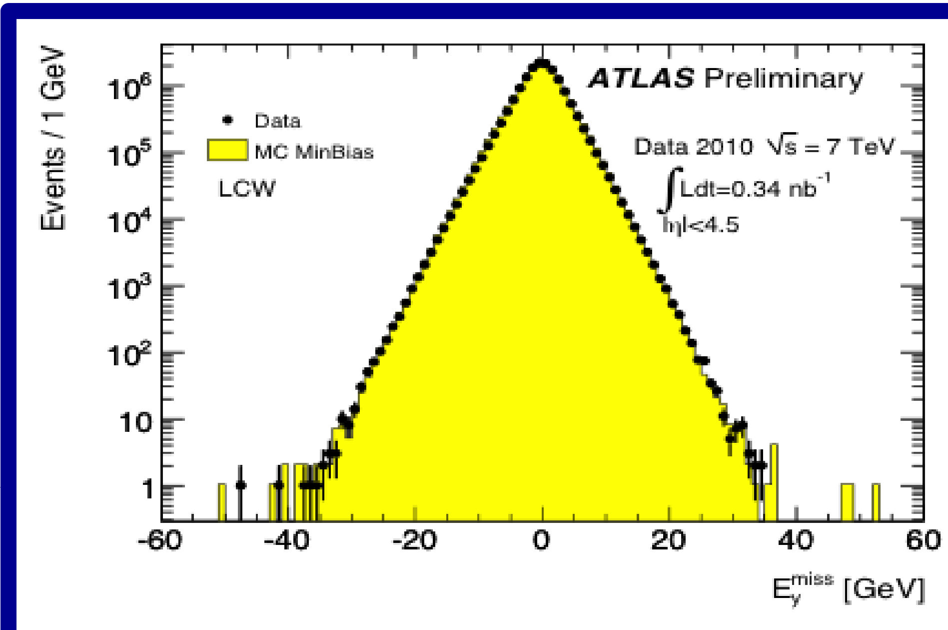


- Vertex mass veto applied against $\gamma \to ee$, K_S^0 and Λ
- Vertex (R, Z) resolution ~ 250 μm (R <10 cm) to ~1 mm

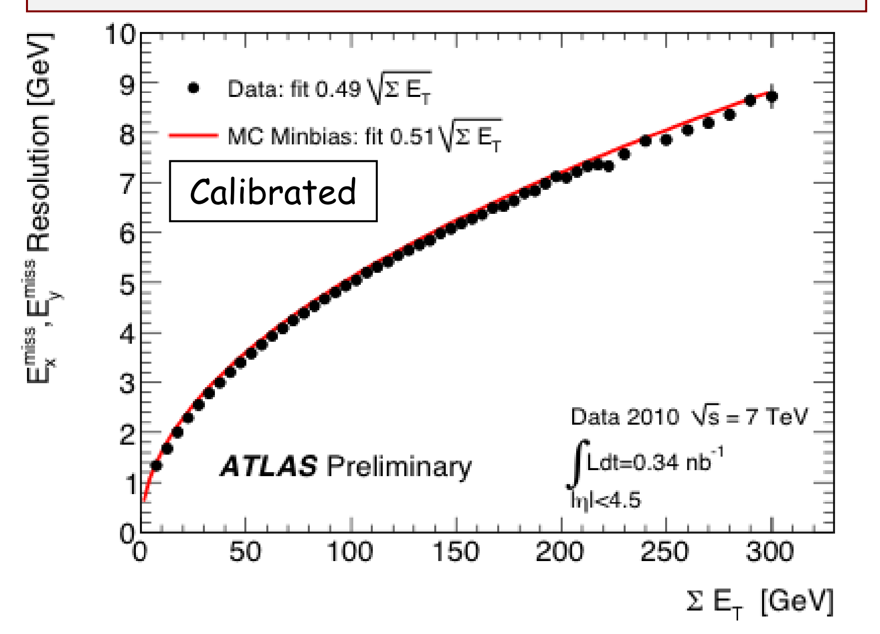
Missing transverse energy in the calorimeters

Sensitive to calorimeter performance (noise, coherent noise, dead cells, mis-calibrations, cracks, etc.), and cosmics and beam-related backgrounds

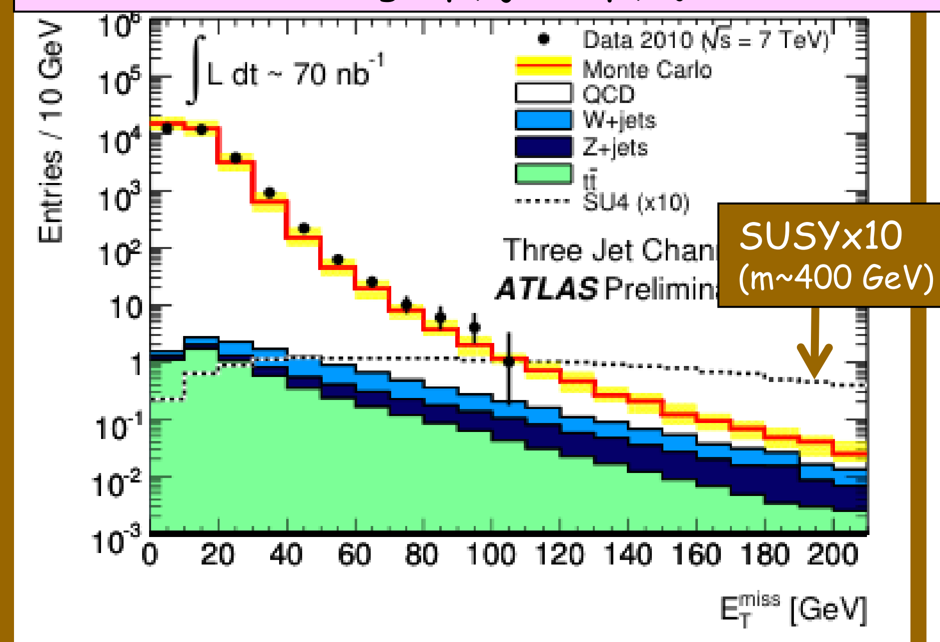
Calibrated E_T^{miss} from minimum-bias events



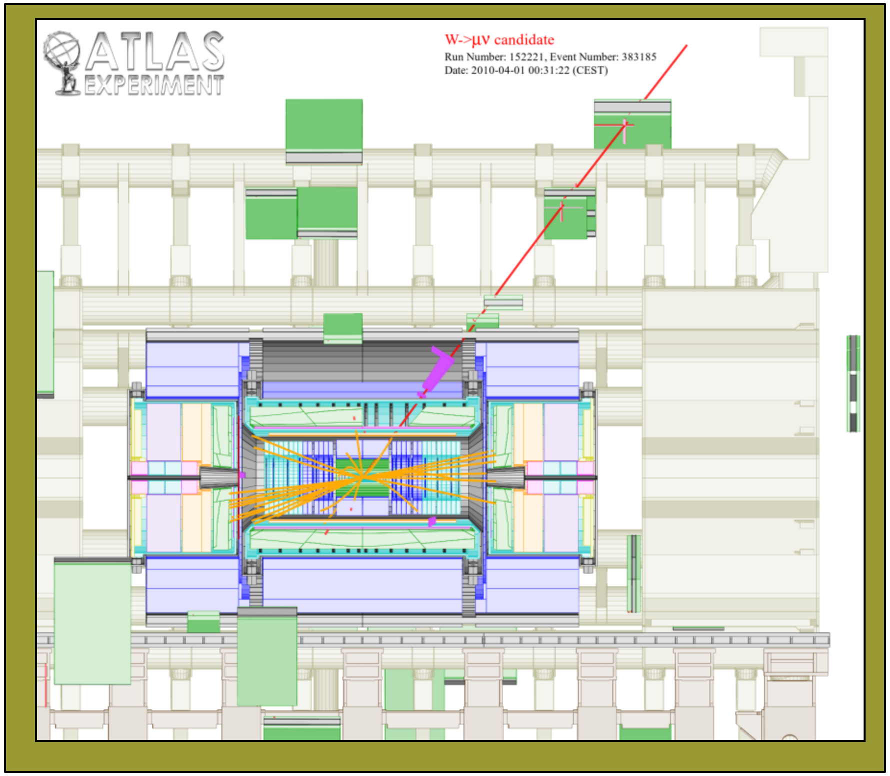
Measured over ~ full calorimeter coverage (360^0 in φ, |η| < 4.5, ~ 200k cells)

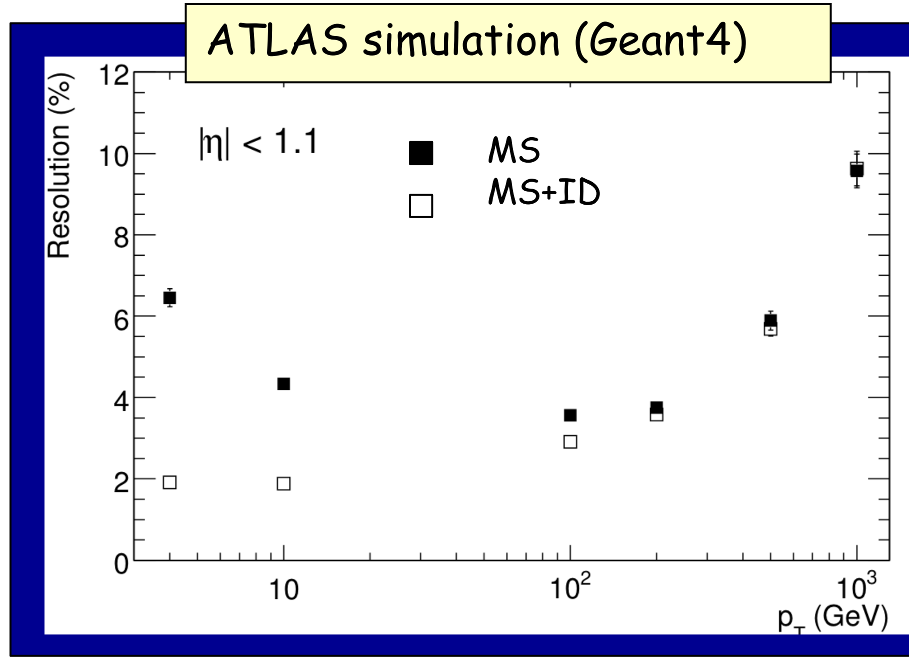


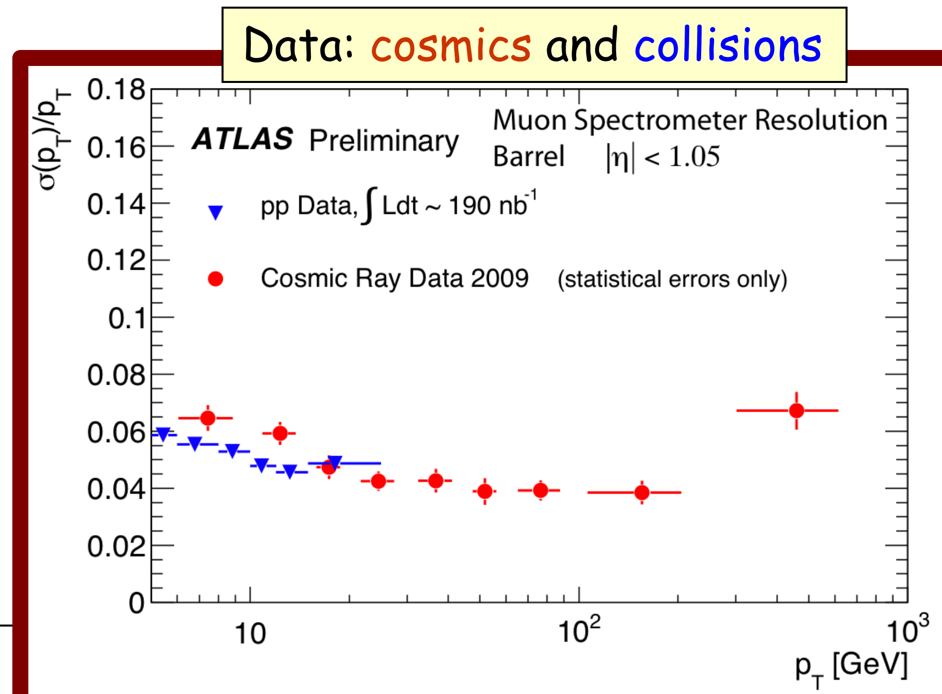
E_T^{miss} spectrum from SUSY searches: events with ≥ 3 high-p_T jets, p_T (j1) > 70 GeV



Muon Spectrometer (MS)





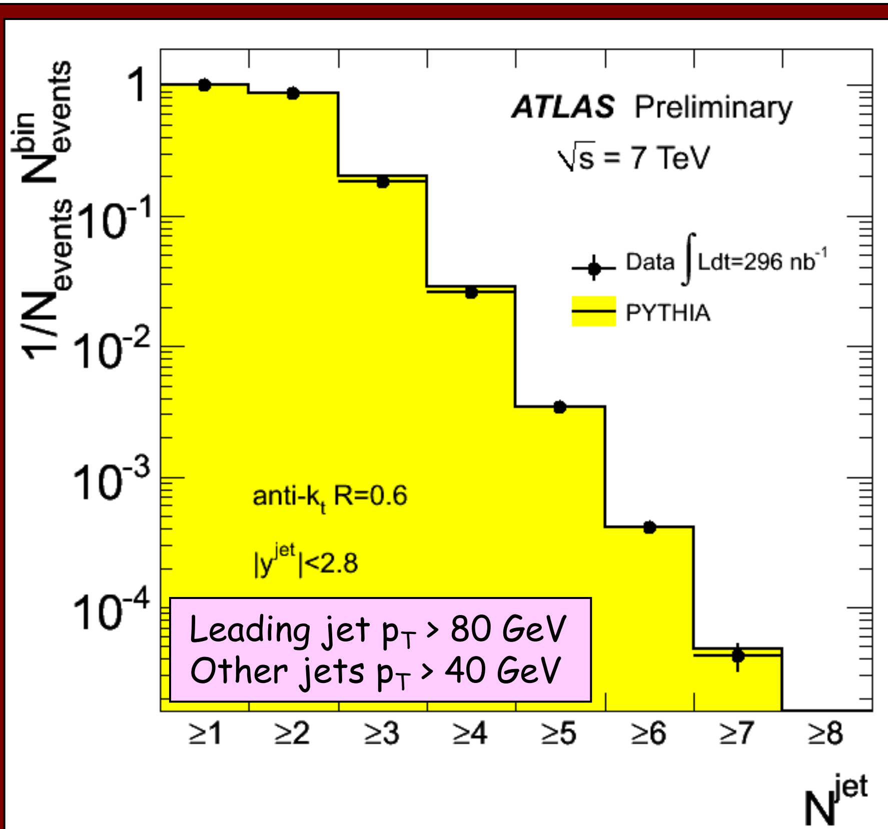


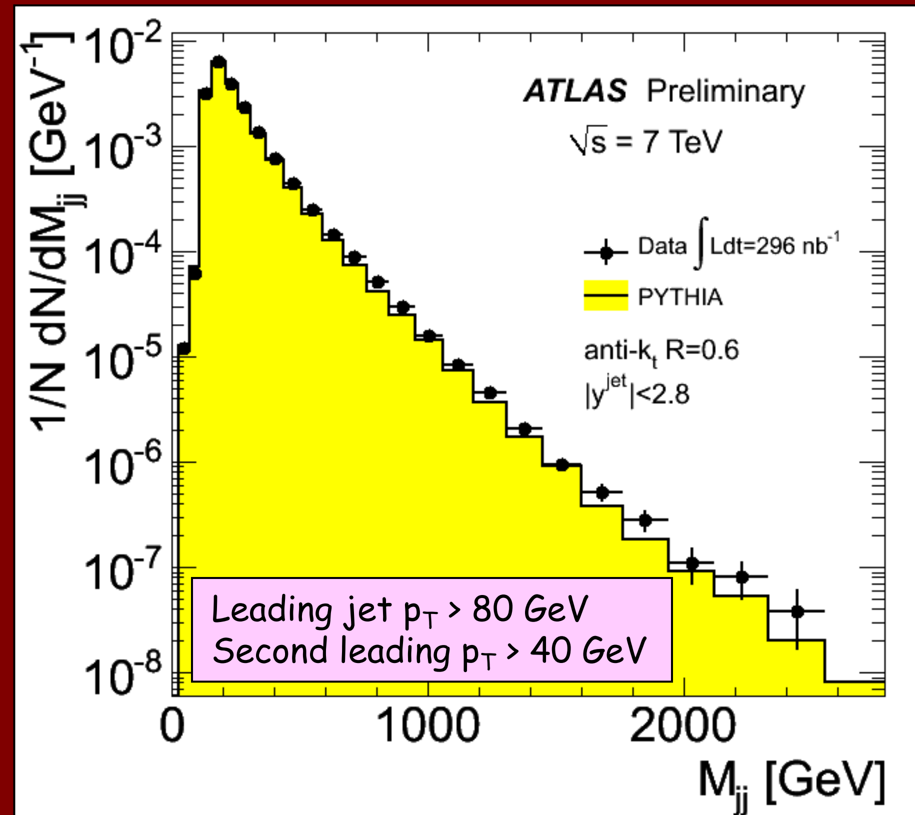
Momentum resolution of MS standalone:

- cosmics: resolution from splitting muon tracks crossing the detector from top to bottom
- muons from collisions: resolution from comparing MS with ID measurement (ID resolution not subtracted, negligible at low p)

Jets physics

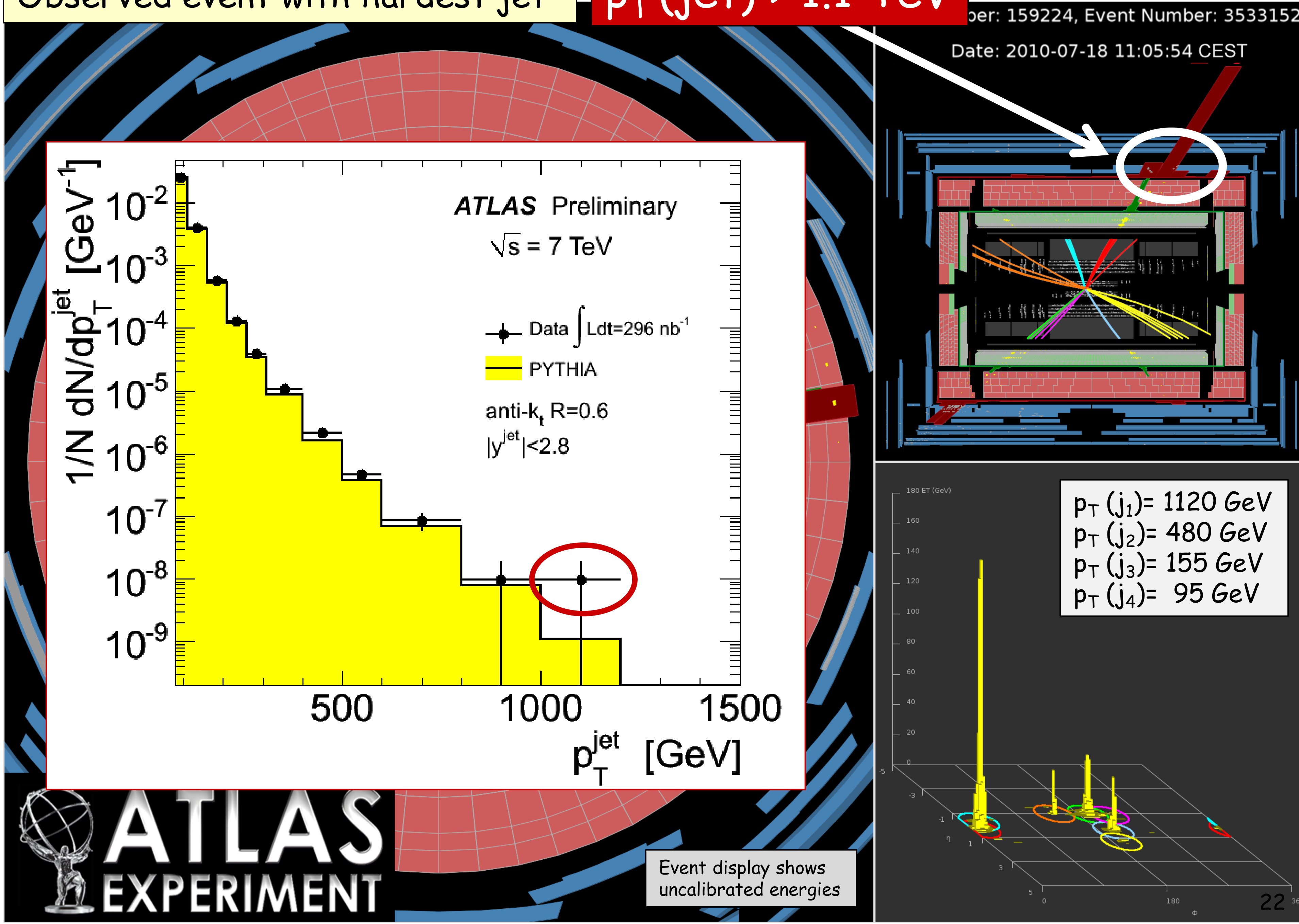
Full data sample



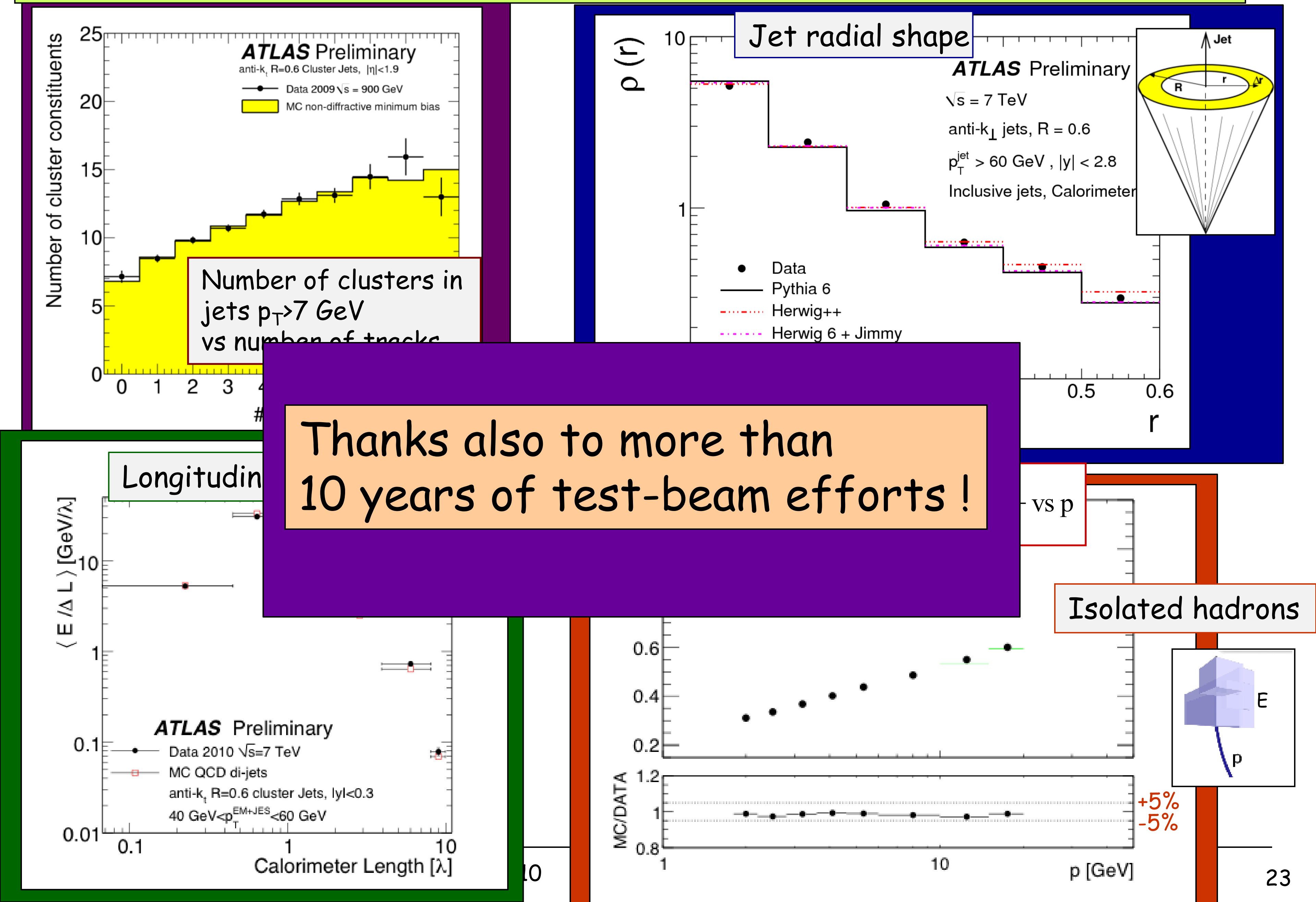


Shape comparisons between data and parton-shower MC (distributions normalized to unity)

Observed event with hardest jet p_T (jet) > 1.1 TeV



For precise jet measurements → need detailed understanding of jet constituents and properties as well as validation of simulation through extensive data/MC comparisons

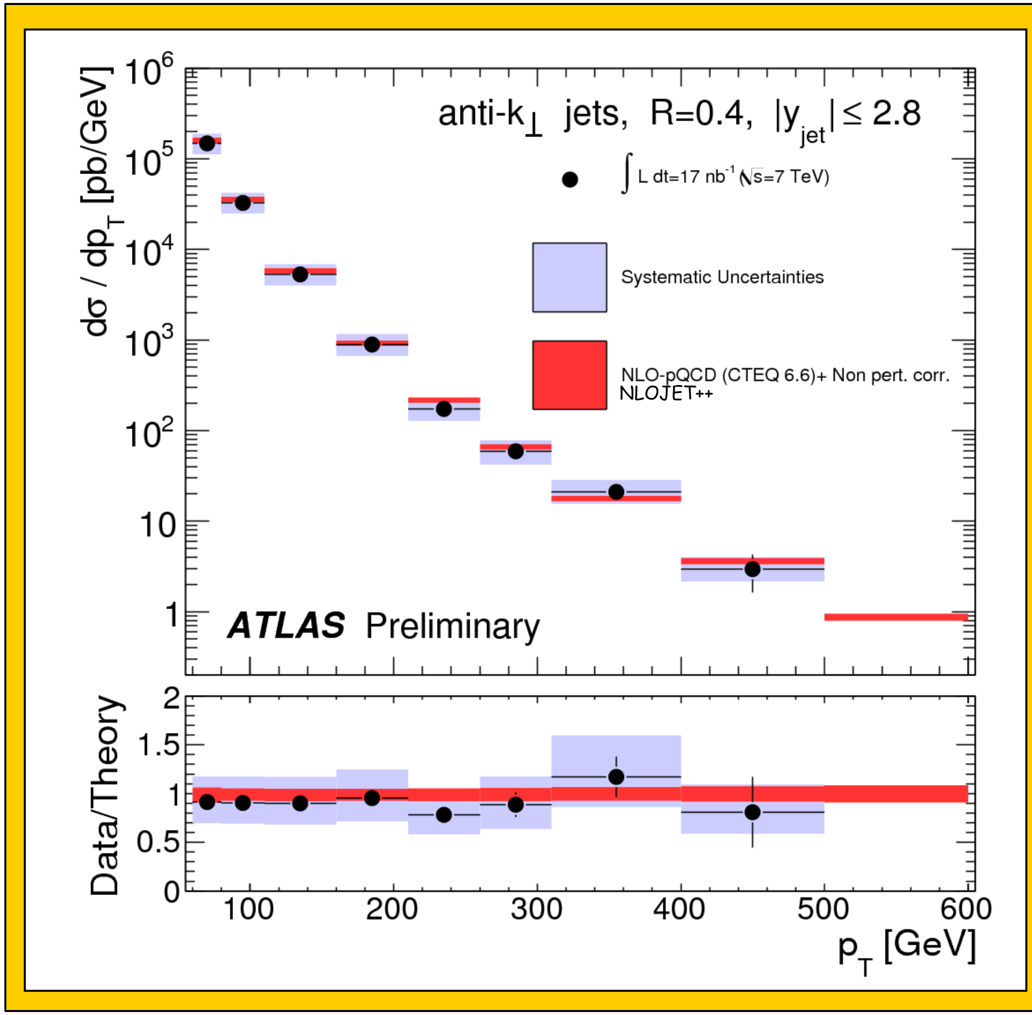


Thanks also to more than 10 years of test-beam efforts !

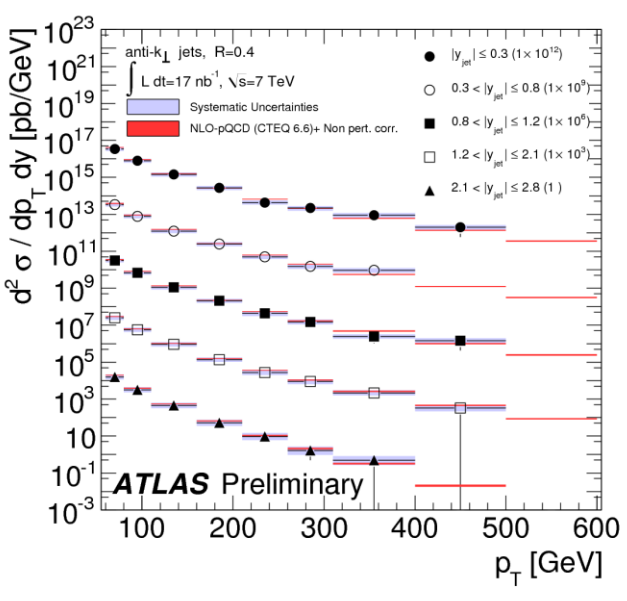
Inclusive jet cross-section

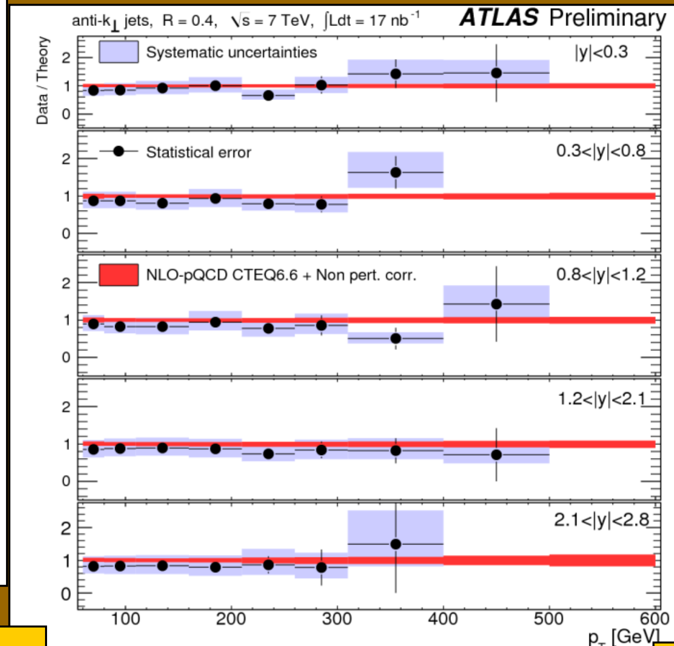
$p_T^j > 60$ GeV, $|y^j| < 2.8$

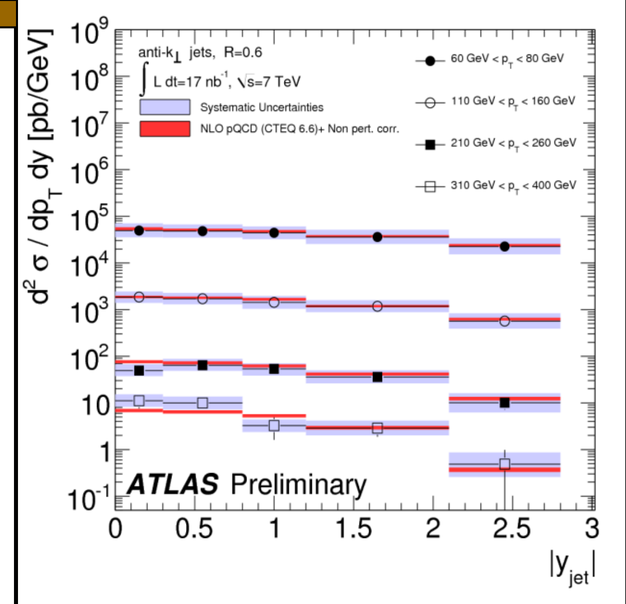
- Measured jets corrected to particle-level using parton-shower MC (Pythia, Herwig): justified by detailed comparison studies and good agreement with data
- Results compared to NLO QCD prediction after corrections for hadronization and underlying event
- Theoretical uncertainty: ~20% (up to 40% at large $|y_j|$) from variation of PDF, α_s, scale (μ_R, μ_F)
- Experimental uncertainty: ~30-40% dominated by Jet E-scale (known to ~7%) Luminosity (11%) not included



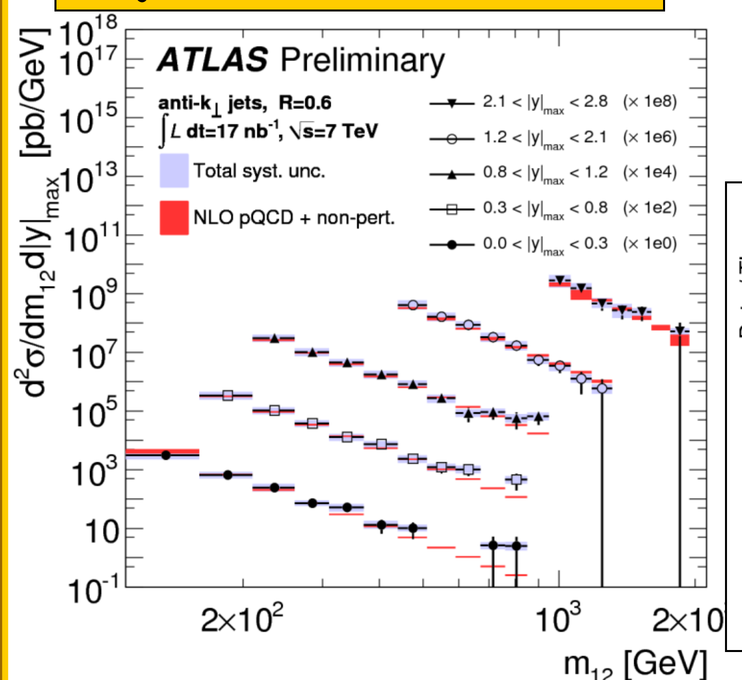
Good agreement data-NLO QCD over 5 orders of magnitude



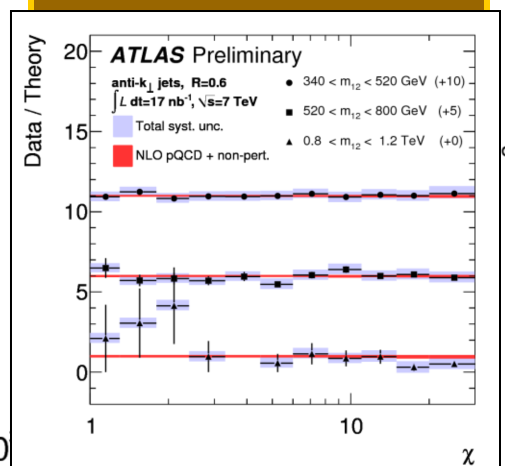




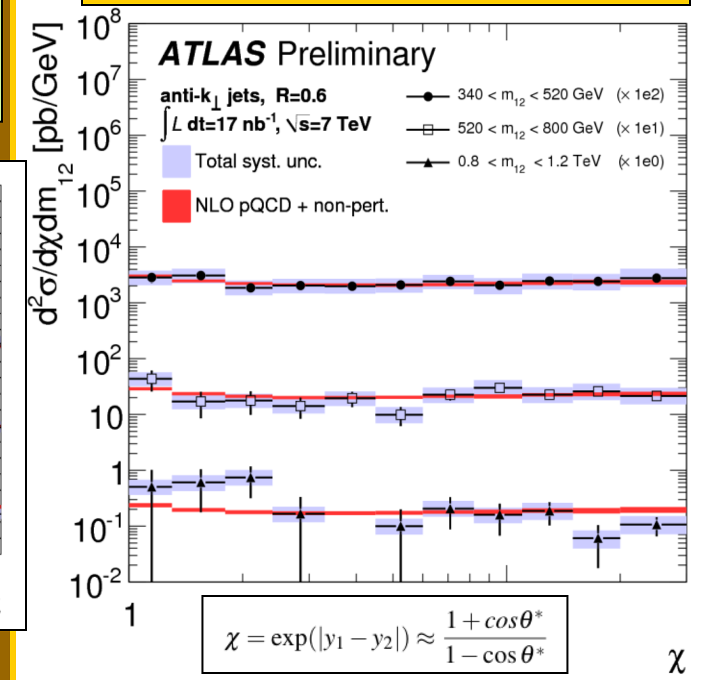
Di-jet cross-section vs mass



Many other Measurements !



Di-jet cross-section vs angle



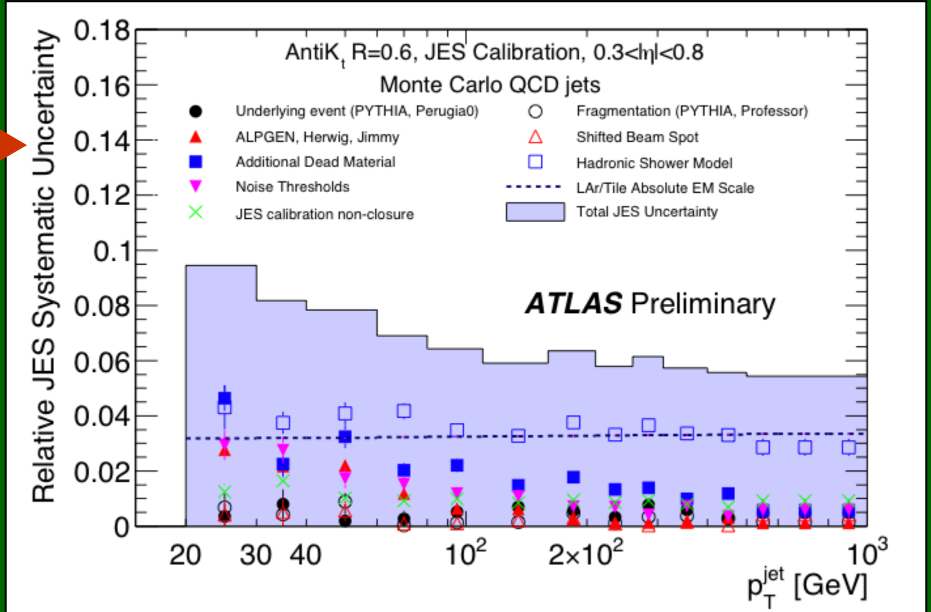
$$\chi = \exp(|y_1 - y_2|) \approx \frac{1+\cos\theta^*}{1-\cos\theta^*}$$

Jet Energy Scale uncertainty

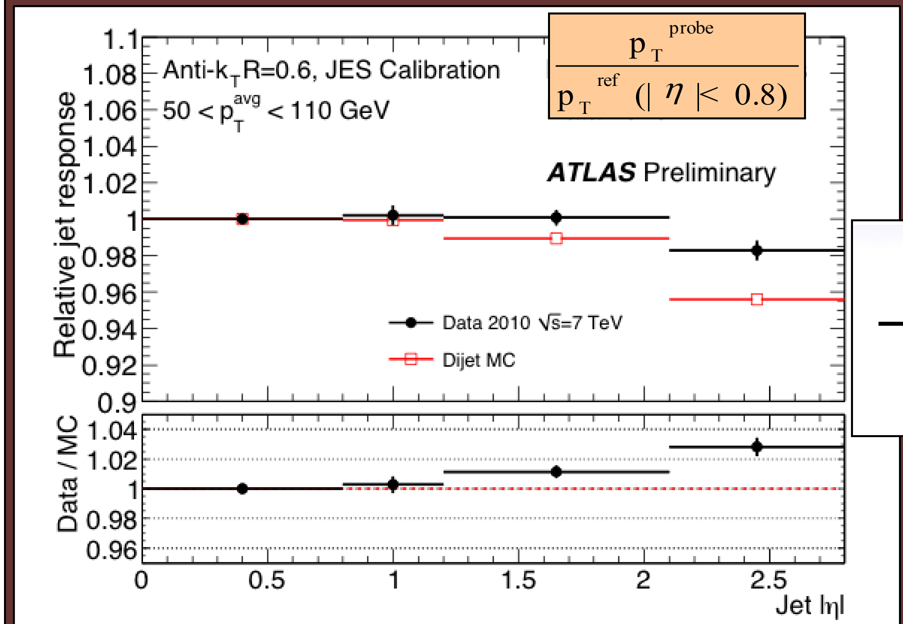
Dominant uncertainty on jet cross-section measurement

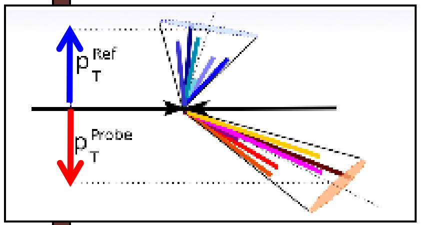
Jet momenta corrected (for calorimeter non-compensation, material, etc.) using η/p_T dependent calibration factors derived from MC (need ~ 1 pb^{-1} for precise in-situ γj balance)

- Builds on detailed foundation work to understand main ingredients by comparing MC/data (see before)
- Many sources of systematic uncertainties studied in detail



Inter-calibration central-forward checked using jet p_T-balance



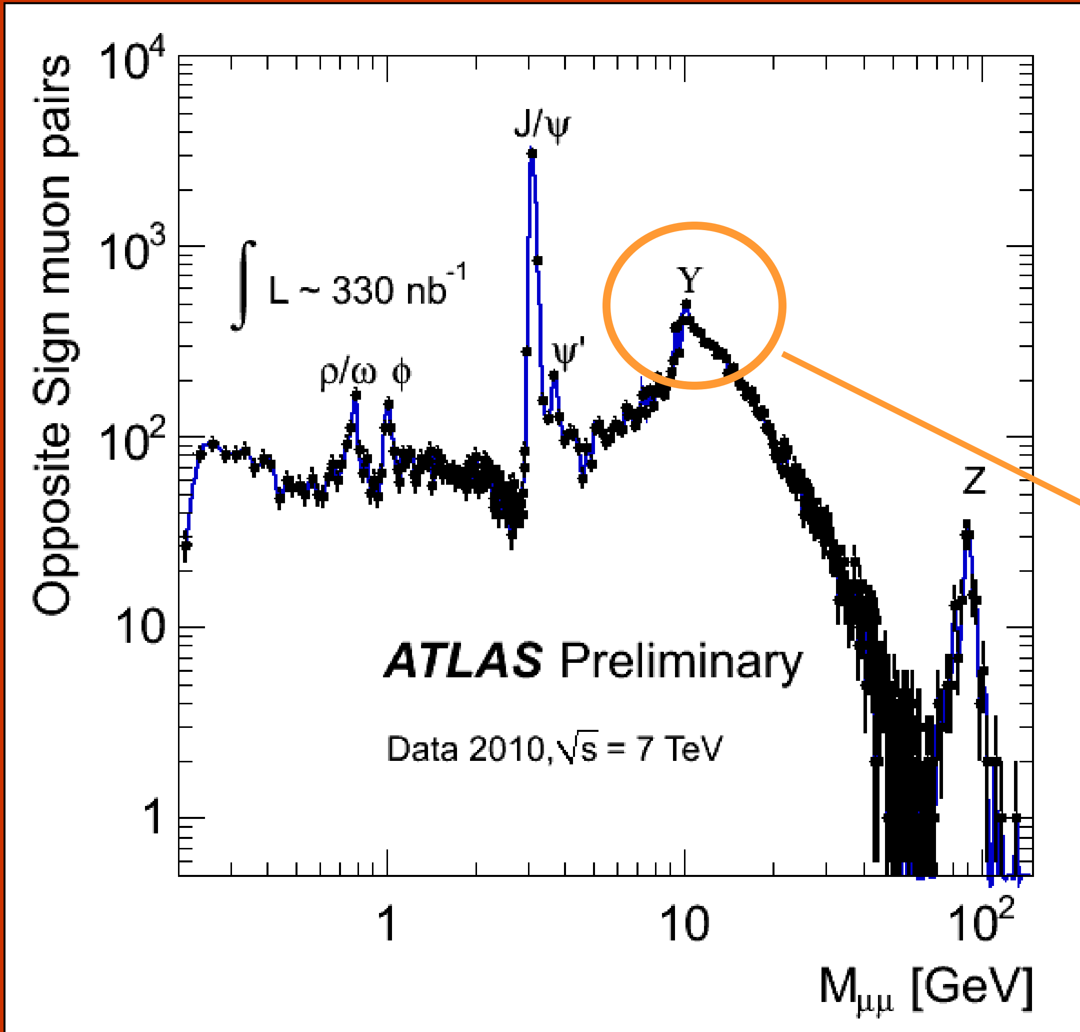


Today JES known to : ~ 7%

Ultimate goal: ~1%

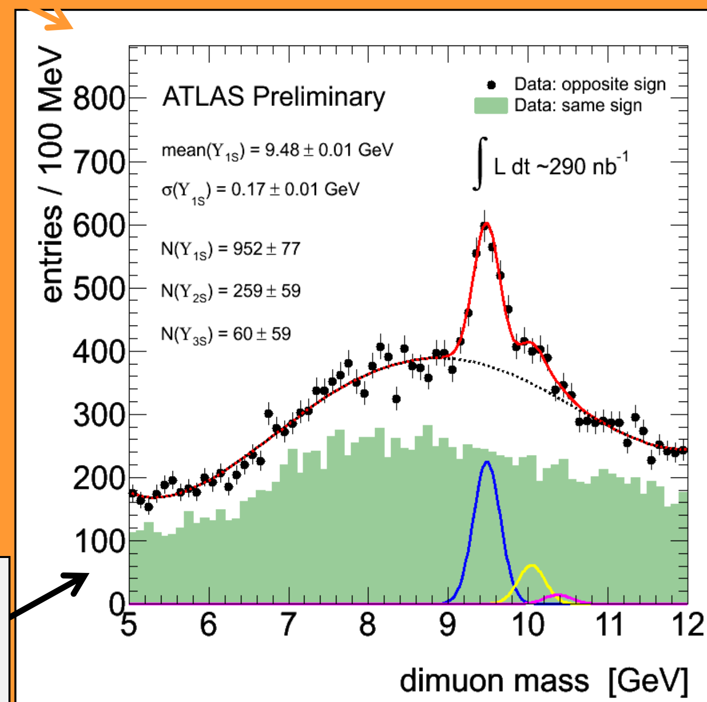
Di-muon resonances

Full data sample



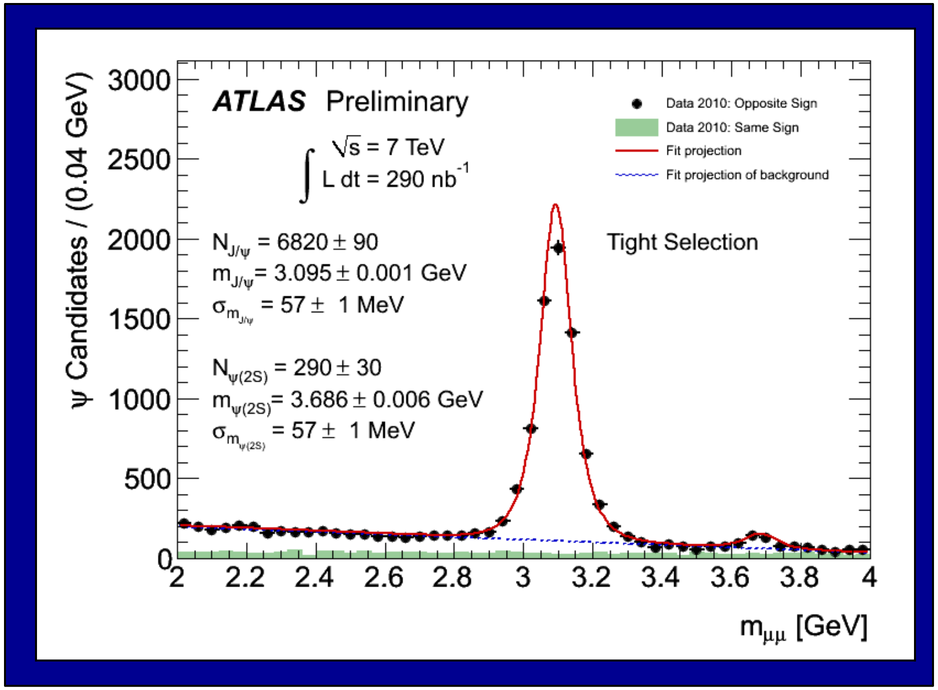
Simple analysis:

- LVL1 muon trigger with p_T ~ 6 GeV threshold
- 2 opposite-sign muons reconstructed by combining tracker and muon spectrometer
- both muons with |z|<1 cm from primary vertex



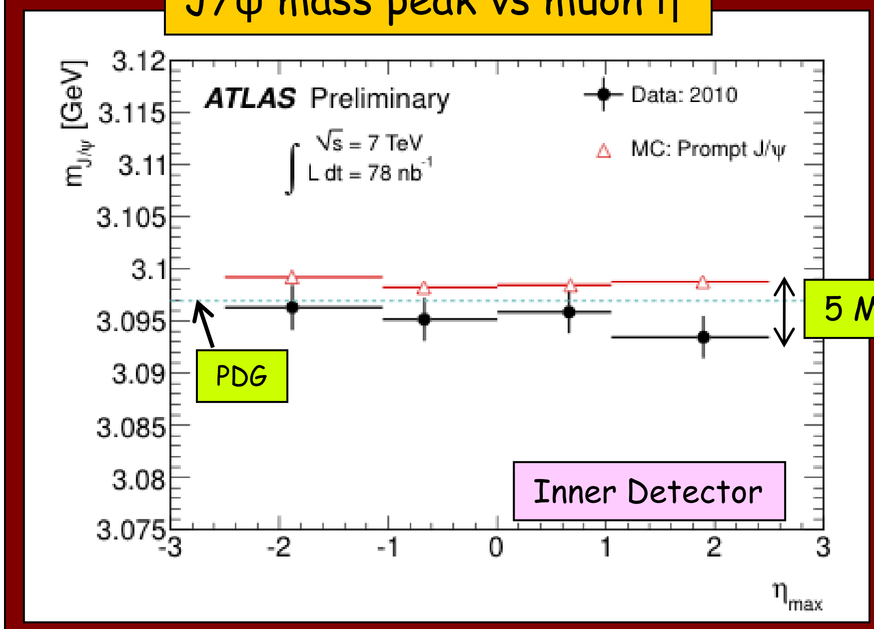
- Looser selection: includes also muons made of Inner Detector tracks + Muon Spectrometer segments
- Distances between resonances fixed to PDG values; Υ(2S), Υ(3S) resolutions fixed to Υ(1S) resolution

J/ψ is one of the first "candles" for detector commissioning and early physics (B-physics, QCD).
Provides large samples of low-p_T muons to study μ trigger and identification efficiency, resolution and absolute momentum scale in the few GeV range

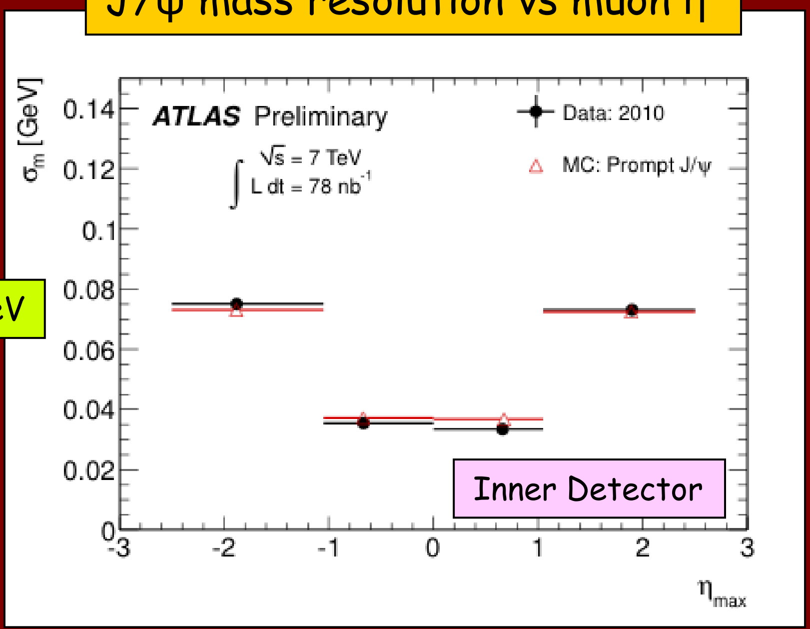


From J/ψ mass peak and resolution reconstructed in the Inner Detector: absolute momentum scale known to ~ 0.2% and momentum resolution to ~2 % in the few GeV region

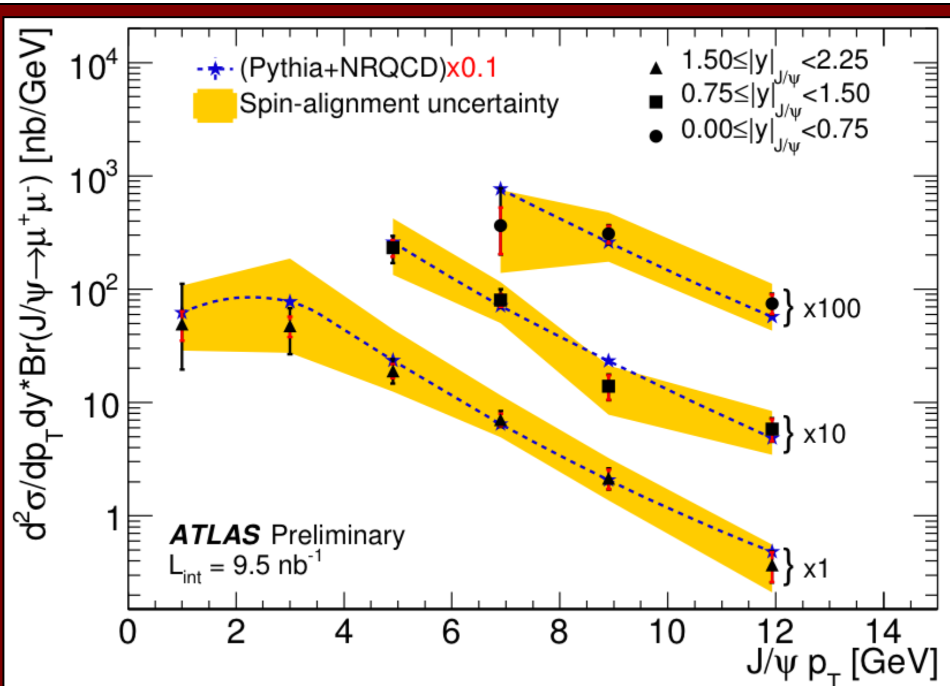
J/ψ mass peak vs muon η



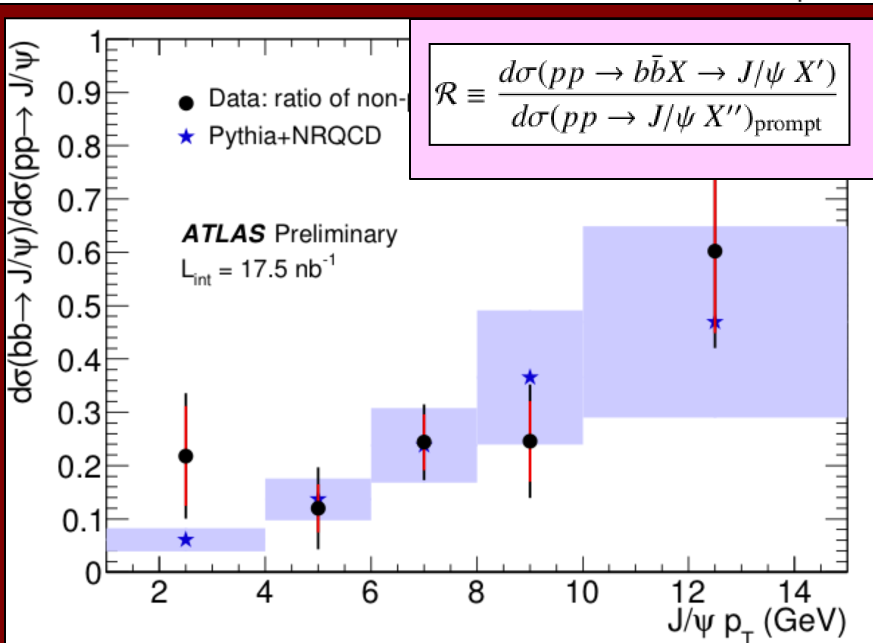
J/ψ mass resolution vs muon η



J/ψ → μ⁺μ⁻ cross-section and indirect/prompt ratio measurements

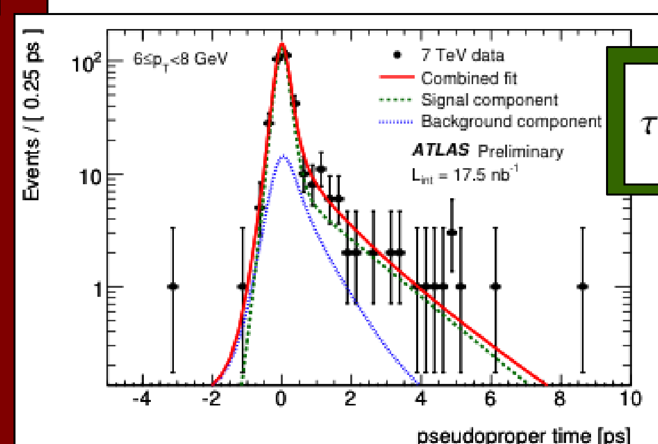


- Measured over $|y\ (J/\psi)|<2.25$, down to $p_T\ (J/\psi)\sim 1$ GeV in forward region (p larger → higher acceptance)
- Dominant error (50-100%): unknown J/ψ polarization → impact on μ acceptance
- Experimental error (only relevant in lowest p_T bin): from data (mainly) and MC
- Total cross-section measured in the studied kinematic region: ~ 1.2 μb
- Pythia (Colour Octet Model): ~ 10 larger, good agreement in shape



$$\mathcal{R} \equiv \frac{d\sigma(pp \to b\bar{b}X \to J/\psi\ X')}{d\sigma(pp \to J/\psi\ X'')_{\rm prompt}}$$

- From fit of pseudo proper decay time τ in inclusive J/ψ sample.
- Many uncertainties cancel in the ratio



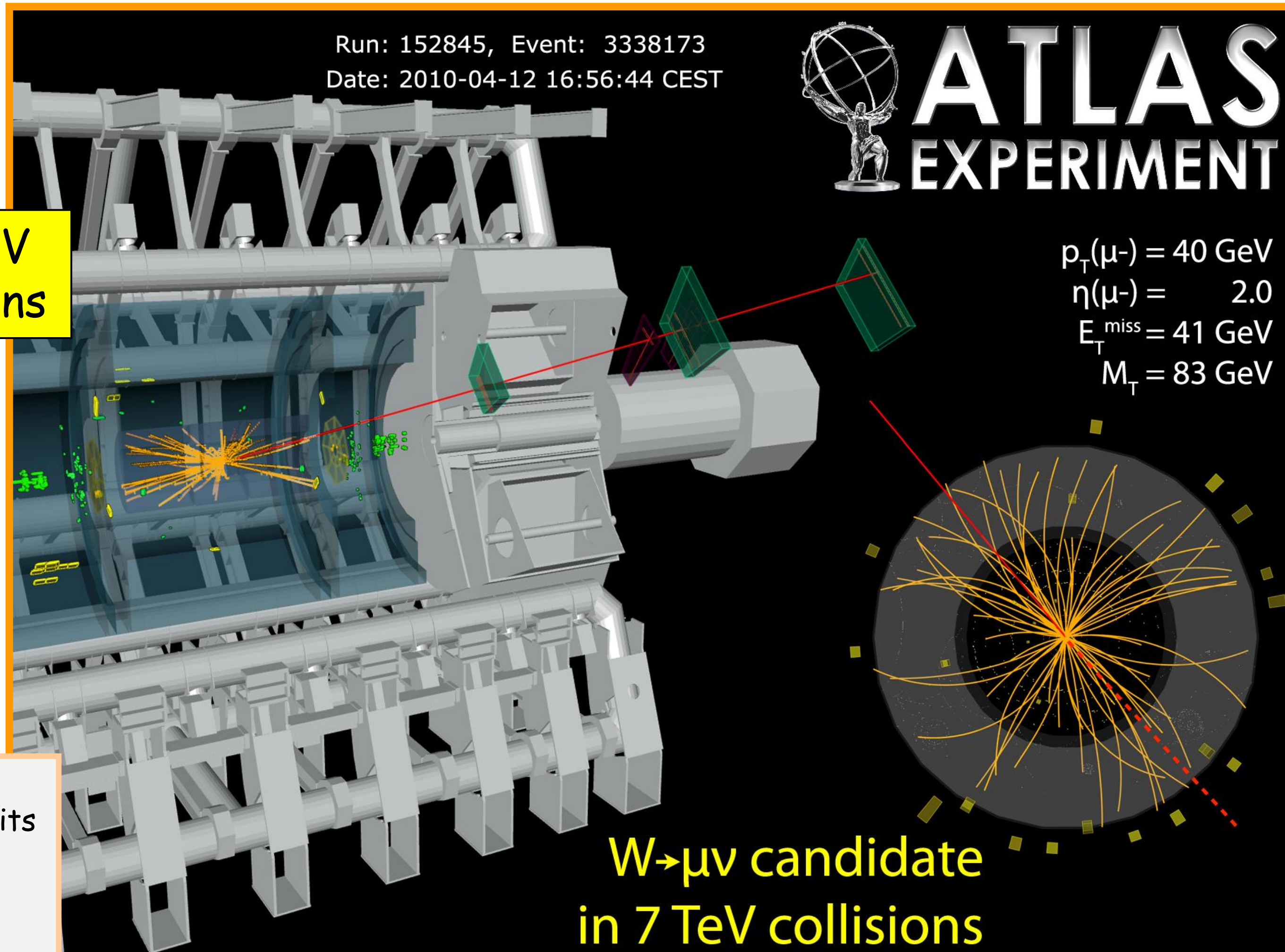
$$\tau = \frac{L_{xy}\ m(J/\psi\ )}{p_T(J/\psi\ )}$$

W and Z physics

- Fundamental milestones in the "rediscovery" of the Standard Model at $\sqrt{s}$ = 7 TeV
- Powerful tools to constrain q,g distributions inside proton (PDF)
- Z → ll is gold-plated process to calibrate the detector to the ultimate precision
  (E and p scales and resolutions in EM calo, tracker, muon spectrometer; lepton identification, …)
- Among dominant backgrounds to searches for New Physics

NEW!

First time at $\sqrt{s}$ = 7 TeV
First time in pp collisions



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

$W \to e\nu$, $\mu\nu$ measurements

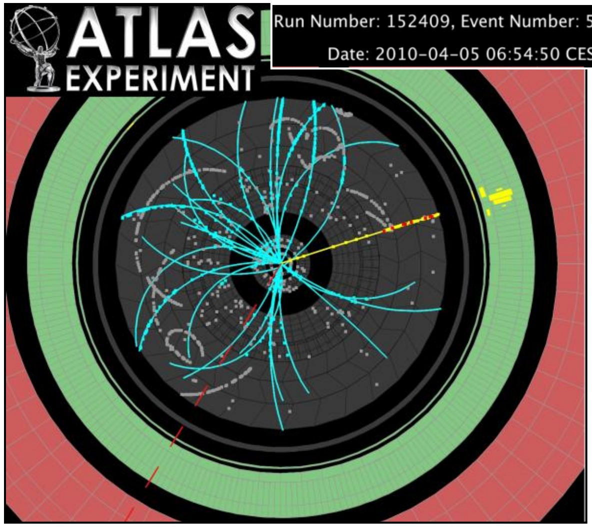
$\sigma^{NNLO}(W \to l\nu)$ = 10.46 nb per family

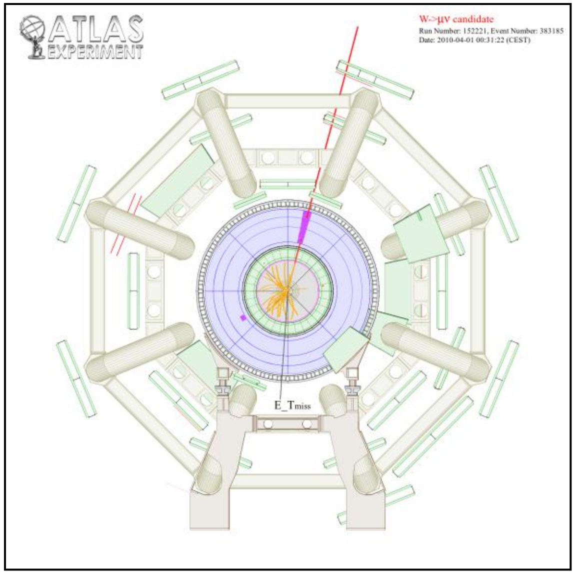
Main selections : $W \to e\nu$
- $E_T(e) > 20$ GeV, $|\eta|<2.47$
- tight electron identification criteria
- $E_T^{miss} > 25$ GeV
- transverse mass $m_T > 40$ GeV

Acceptance x efficiency : ~ 30%
Main background: QCD jets
Expected S/B: ~ 20

Main selections : $W \to \mu\nu$
- $p_T(\mu) > 20$ GeV, $|\eta|<2.4$
- $|\Delta p_T$ (ID-MS)$| < 15$ GeV
- isolated; $|Z_\mu - Z_{vtx}|<1$ cm
- $E_T^{miss} > 25$ GeV
- transverse mass $m_T > 40$ GeV

Acceptance x efficiency: ~ 40%
Main background: $Z \to \mu\mu$ and QCD
Expected S/B ~ 20



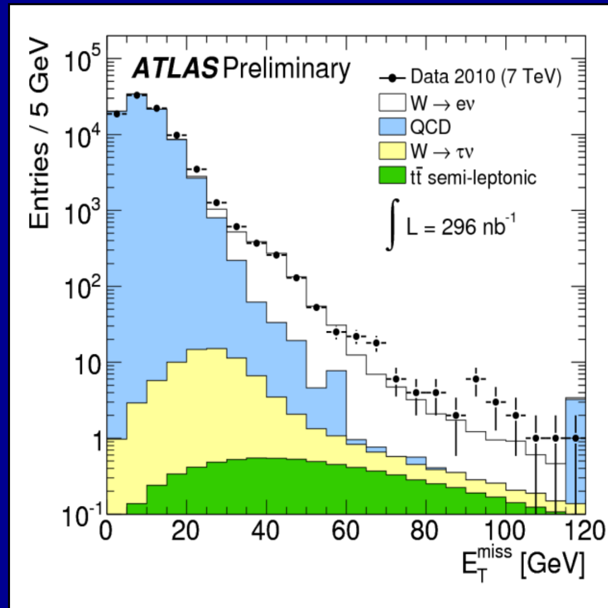


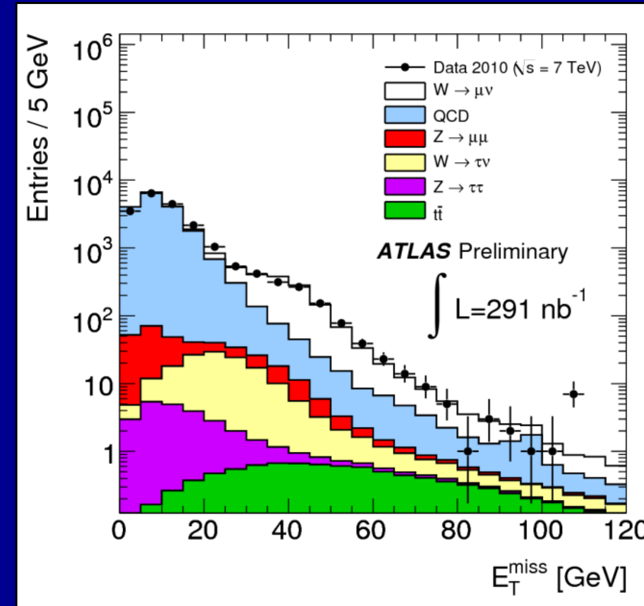
QCD background estimation: several methods used, mostly data-driven: based on control-samples in background-enhanced regions (low E_T^{miss}, non-isolated leptons, …).
Main uncertainties from low-statistics of data control samples and MC model (Pythia)

Full data sample

After pre-selection:

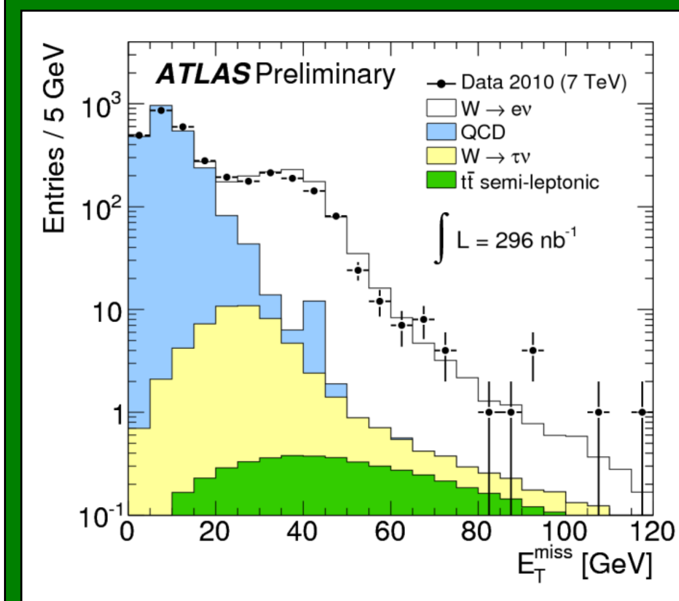
- $W \to e\nu$:
  loose $e^{\pm}$, $E_T > 20$ GeV
- $W \to \mu\nu$:
  $p_T(\mu) > 15$ GeV
  $|\Delta p_T(\text{ID-MS})| < 15$ GeV
  $|Z_{\mu}-Z_{vtx}| < 1$ cm

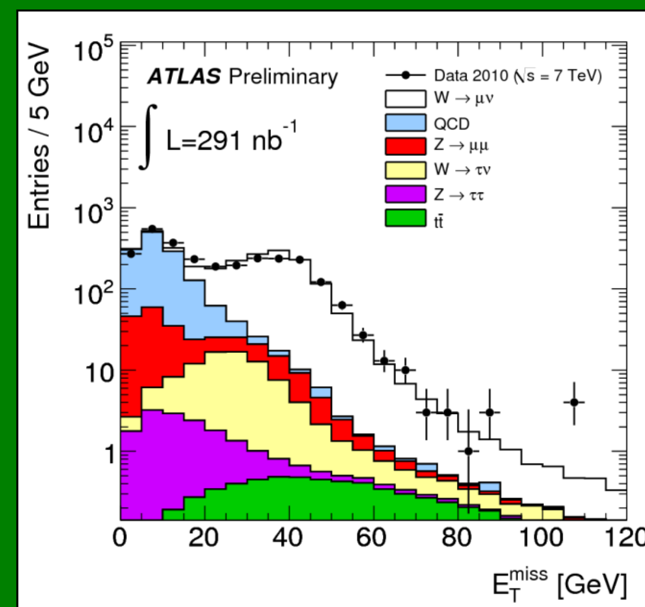




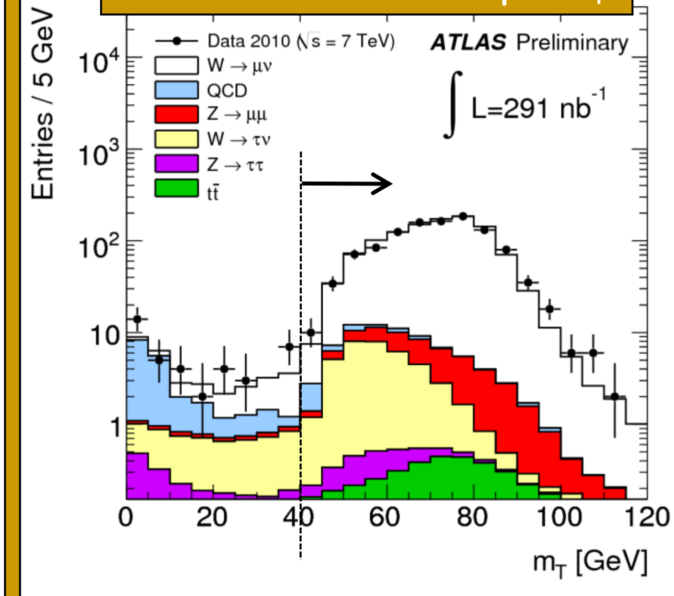
MC normalised to data

After all cuts but E_T^{miss} and m_T





After all cuts except m_T

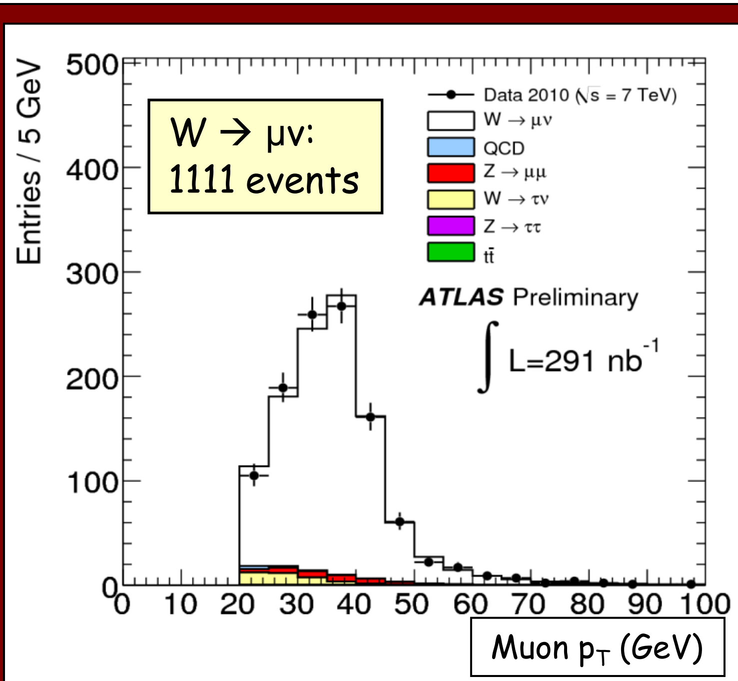


MC normalised to data

Full data sample

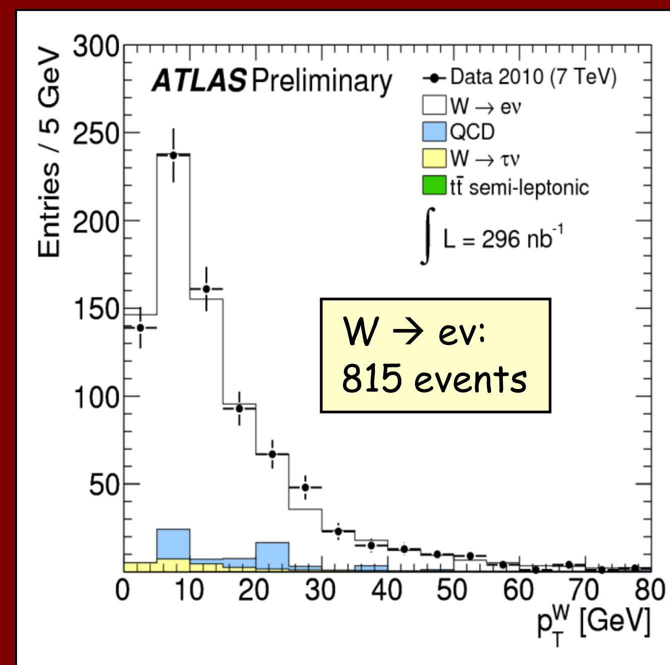
$$m_{\mathrm{T}} = \sqrt{2 p_{\mathrm{T}}^{\ell} p_{\mathrm{T}}^{\nu} (1 - \cos(\phi^{\ell} - \phi^{\nu}))}$$

Work to determine systematic uncertainties (E_T^{miss}, …) in the presence of pile-up ongoing
→W cross-section measurements presented here are based on first 17 nb^{-1} (recorded at lower instantaneous luminosity)



After all selections

Observed in data
W→ eν (296 nb^{-1}): 815 events
W→ μν (291 nb^{-1}): 1111 events



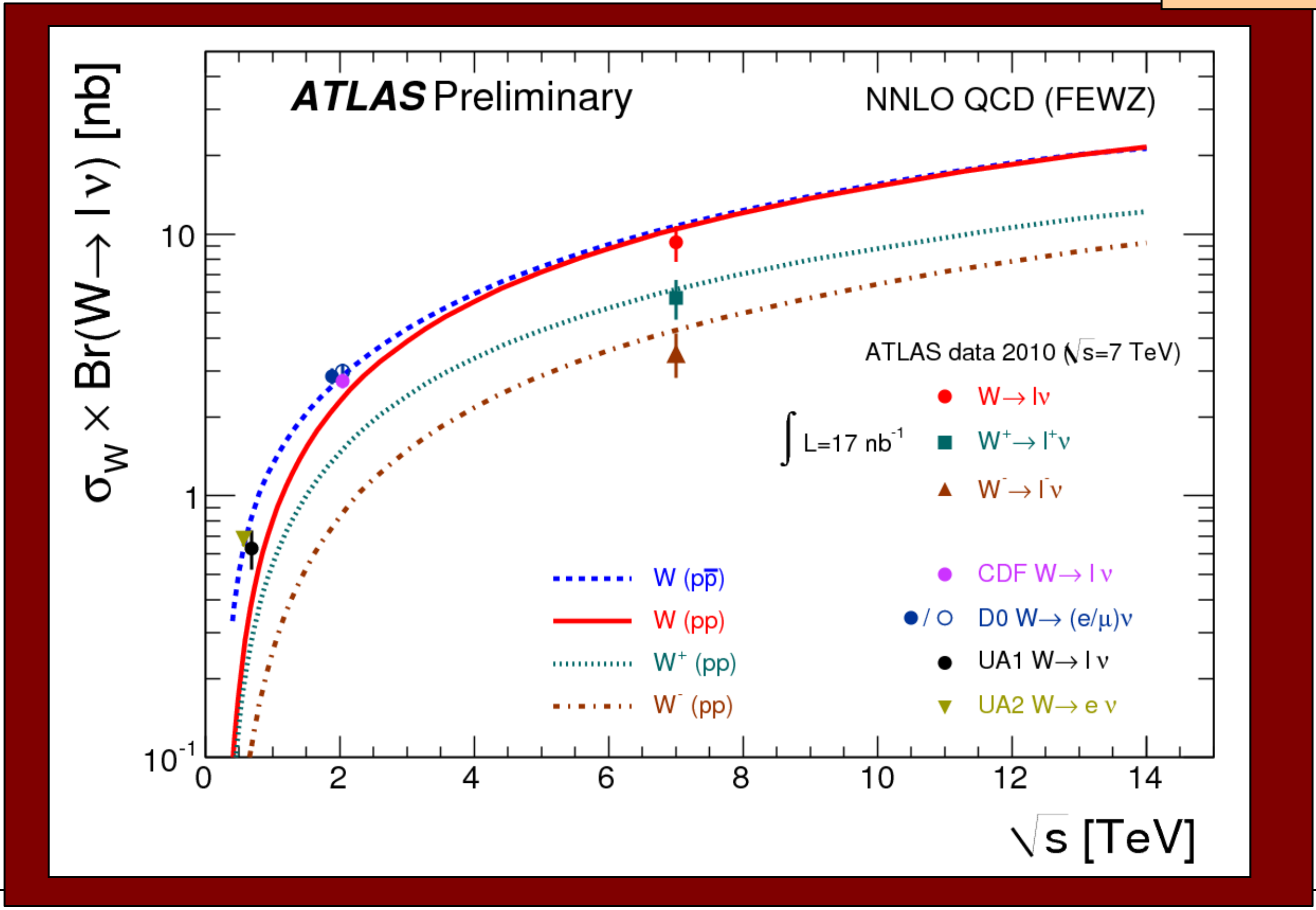
W cross-section and asymmetry measurements

118 events:
47 W→ eν
72 W→ μν

σ (W → lν) = 9.3 ± 0.9 (stat) ± 0.6 (syst) ± 1.0 (lumi) nb

σ (W → eν) = 8.5 ± 1.3 (stat) ± 0.7 (syst) ± 0.9 (lumi) nb
σ (W → μν) = 10.3 ± 1.3 (stat) ± 0.8 (syst) ± 1.1 (lumi) nb

Dominant experimental uncertainties:
e: identification efficiency
μ: trigger and reconstruction efficiency



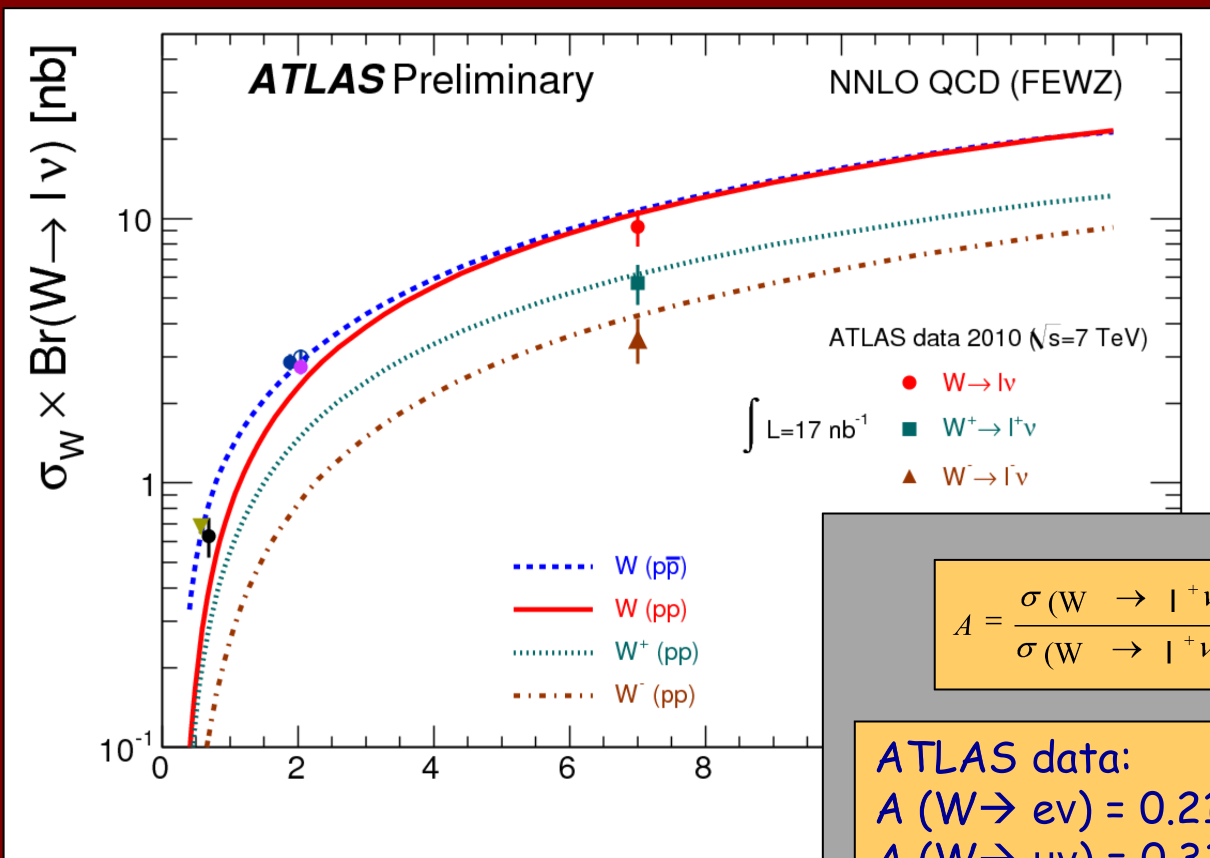
W cross-section and asymmetry measurements

118 events:
47 W→ eν
72 W→ μν

$\sigma(W \rightarrow l\nu) = 9.3 \pm 0.9\ (stat) \pm 0.6\ (syst) \pm 1.0\ (lumi)$ nb

$\sigma(W \rightarrow e\nu) = 8.5 \pm 1.3\ (stat) \pm 0.7\ (syst) \pm 0.9\ (lumi)$ nb
$\sigma(W \rightarrow \mu\nu) = 10.3 \pm 1.3\ (stat) \pm 0.8\ (syst) \pm 1.1\ (lumi)$ nb

Dominant experimental uncertainties:
e: identification efficiency
μ: trigger and reconstruction efficiency

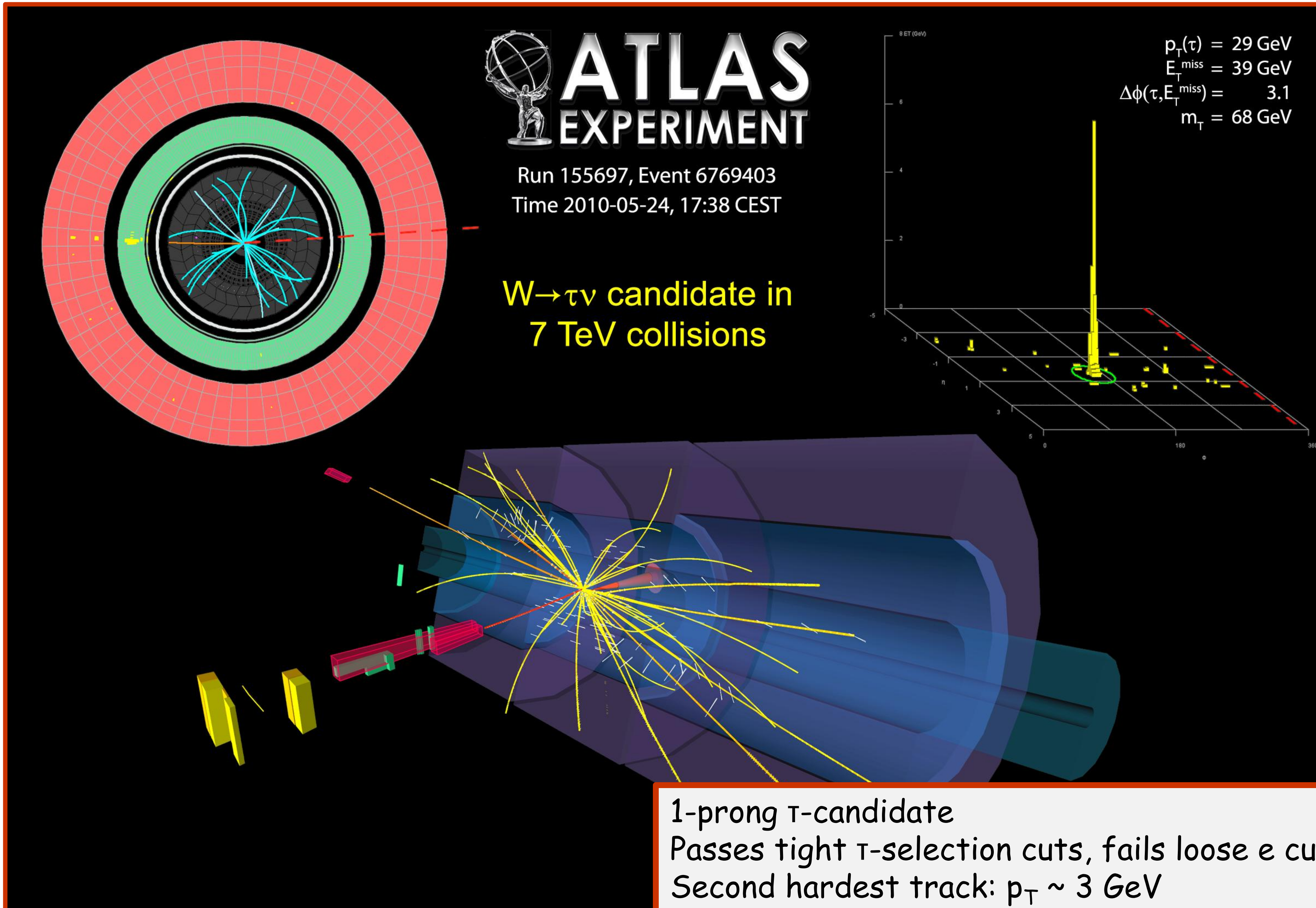


$$A = \frac{\sigma(W \rightarrow l^+\nu) - \sigma(W \rightarrow l^-\nu)}{\sigma(W \rightarrow l^+\nu) + \sigma(W \rightarrow l^-\nu)} \neq 0$$

ATLAS data:
$A(W \rightarrow e\nu) = 0.21 \pm 0.18\ (stat) \pm 0.01\ (syst)$
$A(W \rightarrow \mu\nu) = 0.33 \pm 0.12\ (stat) \pm 0.01\ (syst)$
NNLO theory prediction: A=0.2

W → τν candidate

W → τν signal more difficult to observe due to softer spectrum and larger backgrounds (jets, W→ eν, Z→ ττ): signal efficiency < 1%, S/B ~ 7



1-prong τ-candidate
Passes tight τ-selection cuts, fails loose e cuts
Second hardest track: p_T ~ 3 GeV

$Z \rightarrow ee, \mu\mu$ measurements

$\sigma^{NNLO}(\gamma^*/Z \rightarrow ll) \sim 0.99$ nb per family for $M(ll) > 60$ GeV

Main selections : $Z \rightarrow ee$

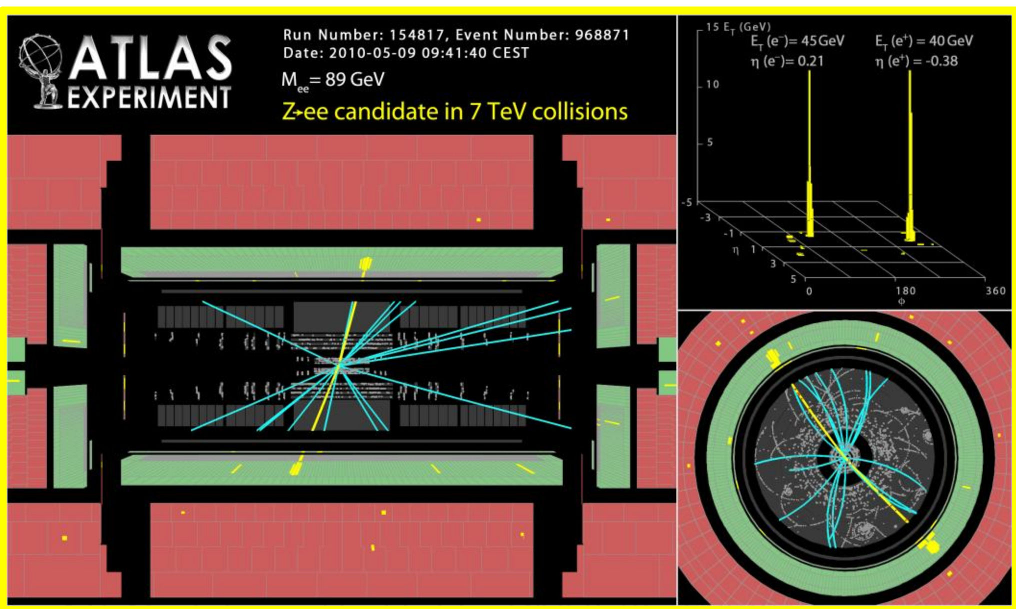
- 2 opposite-sign electrons
- $E_T > 20$ GeV, $|\eta| < 2.47$
- medium electron identification criteria
- $66 < M(e^+e^-) < 116$ GeV

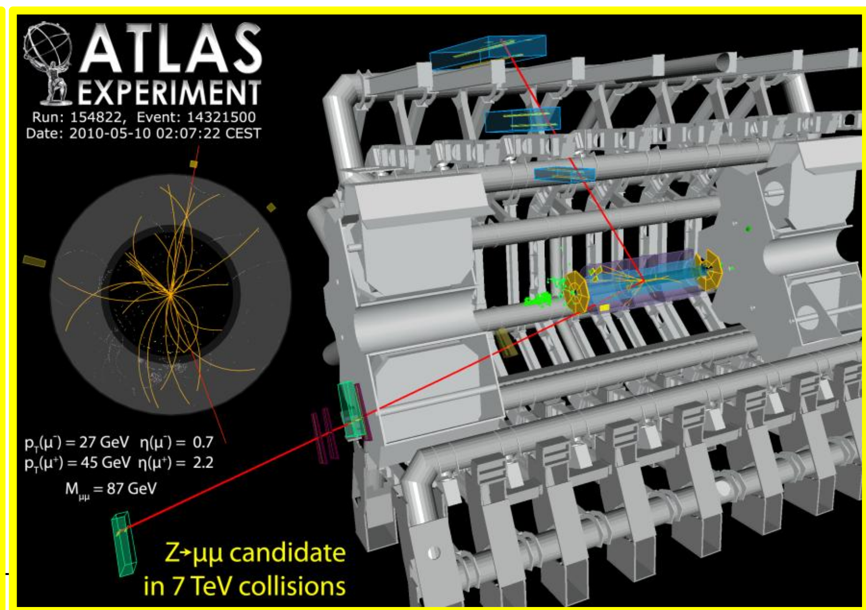
Acceptance x efficiency : ~ 30%
Main background: QCD jets
Expected S/B ~ 100

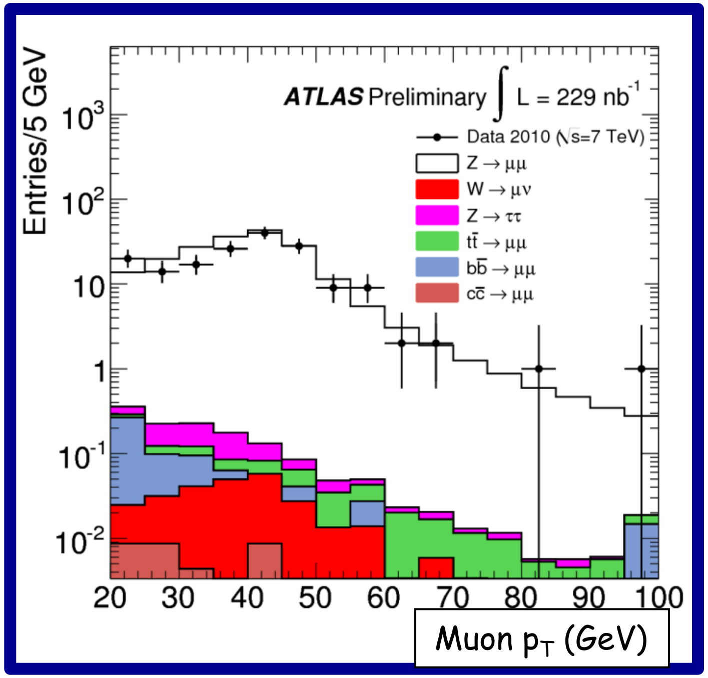
Main selections : $Z \rightarrow \mu\mu$

- 2 opposite-sign muons
- $p_T > 20$ GeV, $|\eta| < 2.4$
- $|\Delta p_T \text{ (ID-MS)}| < 15$ GeV
- isolated; $|Z_\mu - Z_{vtx}| < 1$ cm
- $66 < M(\mu^+\mu^-) < 116$ GeV

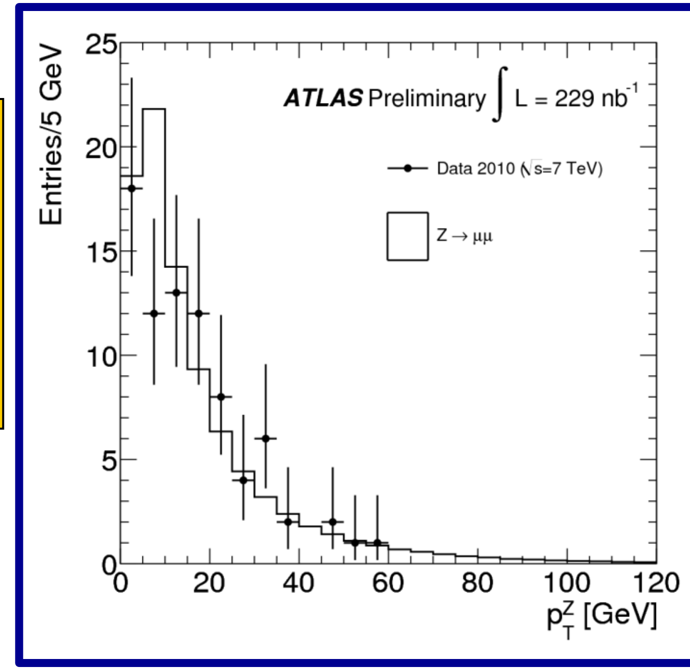
Acceptance x efficiency: ~ 40%
Main background: $t\bar{t}$, $Z \rightarrow \tau\tau$
Expected S/B > 100

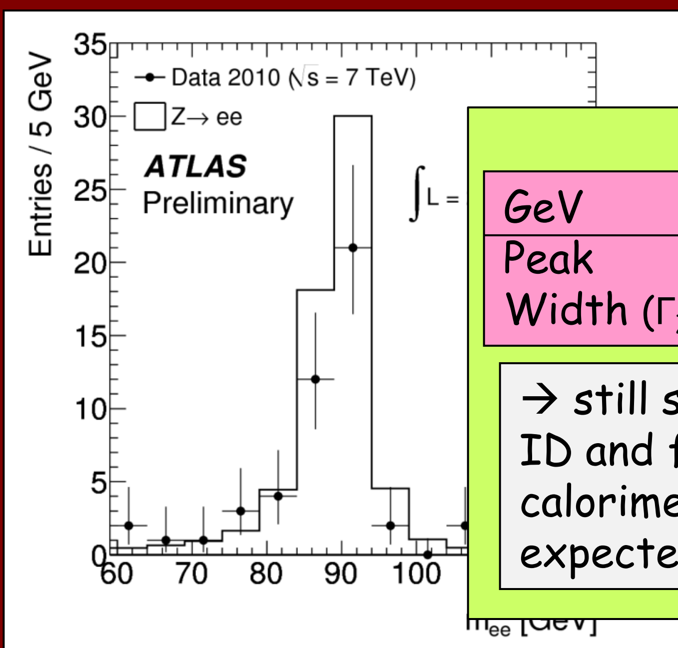


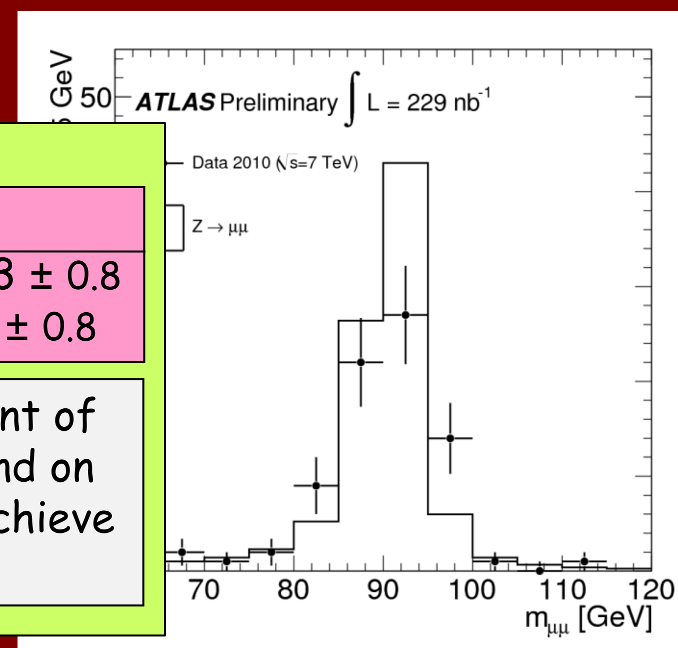




After all selections, observed in data
Z→ ee (219 nb^{-1}): 46 events
Z→ μμ (229 nb^{-1}): 79 events







GeV	ee	μμ
Peak	88.7± 0.8	90.3 ± 0.8
Width (Γ_Z unfolded)	3.6 ± 0.8	4.2 ± 0.8

→ still some work to do on alignment of ID and forward muon chambers, and on calorimeter inter-calibration, to achieve expected resolution

Z cross-section measurement

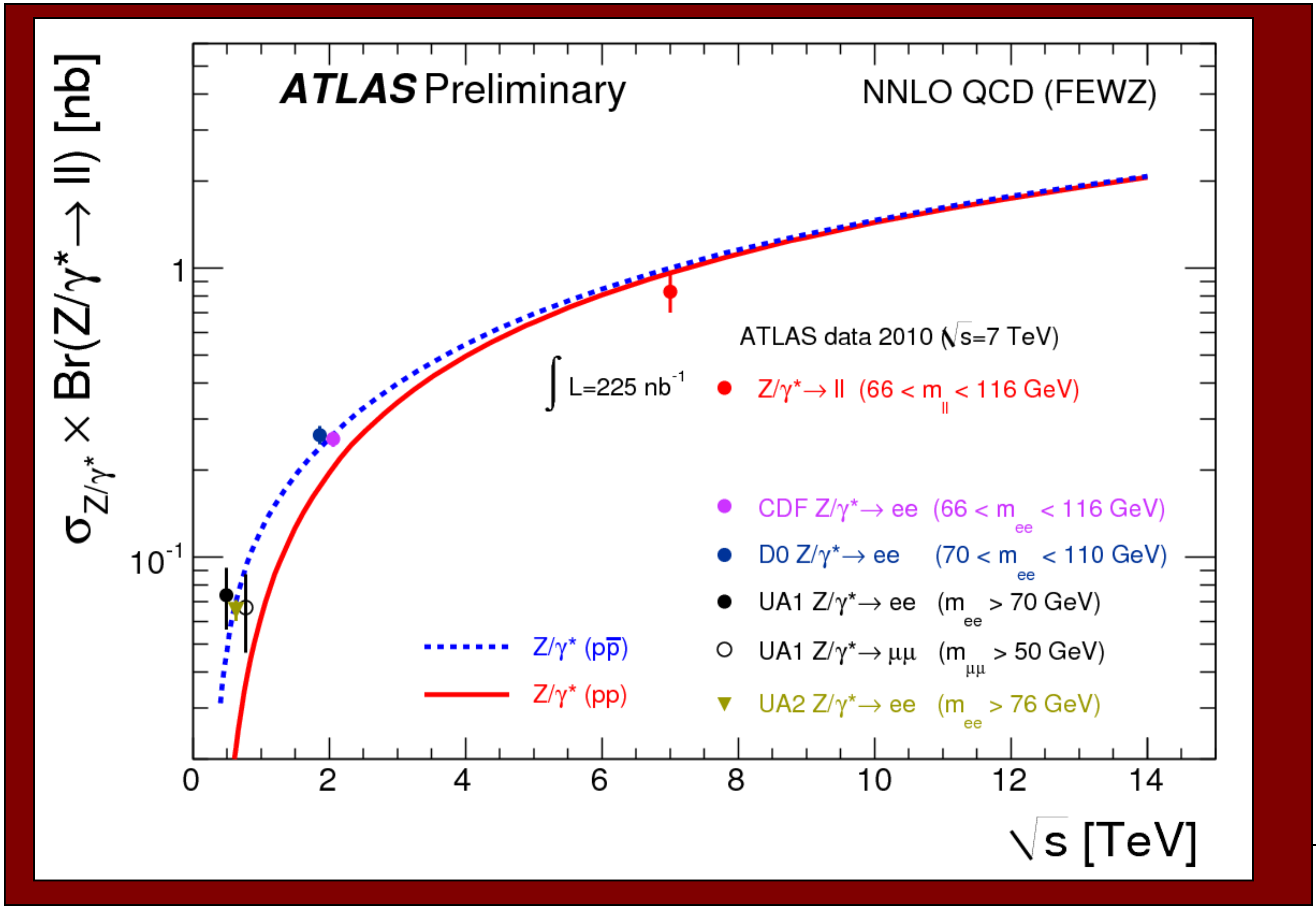
~225 nb^{-1}

$\sigma (Z \rightarrow ll) = 0.83 \pm 0.07$ (stat) ± 0.06 (syst) ± 0.09 (lumi) nb

$\sigma (Z \rightarrow ee) = 0.72 \pm 0.11$ (stat) ± 0.10 (syst) ± 0.08 (lumi) nb
$\sigma (Z \rightarrow \mu\mu) = 0.89 \pm 0.10$ (stat) ± 0.07 (syst) ± 0.10 (lumi) nb

125 events:
46 $Z \rightarrow ee$
79 $Z \rightarrow \mu\mu$

Dominant experimental uncertainty: lepton reconstruction and identification



Top-quark candidates

$\sigma(t\bar{t}) \cong 160$ pb $\sqrt{s} = 7$ TeV

Full data sample analysed

lepton + jets channel
tt → bW bW → blν bjj
σ ~ 70 pb

1 isolated lepton $p_T > 20$ GeV
$E_T^{miss} > 20$ GeV
≥ 4 jets $p_T > 20$ GeV
≥ 1 b-tag jet

Acceptance x efficiency ~ 30%

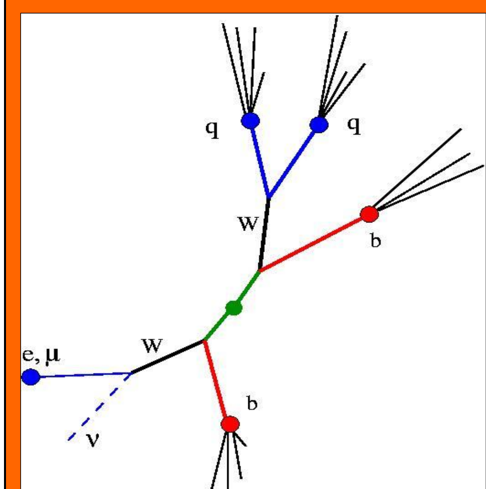
Expect ~ 5 signal events

2-lepton channel
tt → bW bW → blν blν
σ ~ 10 pb

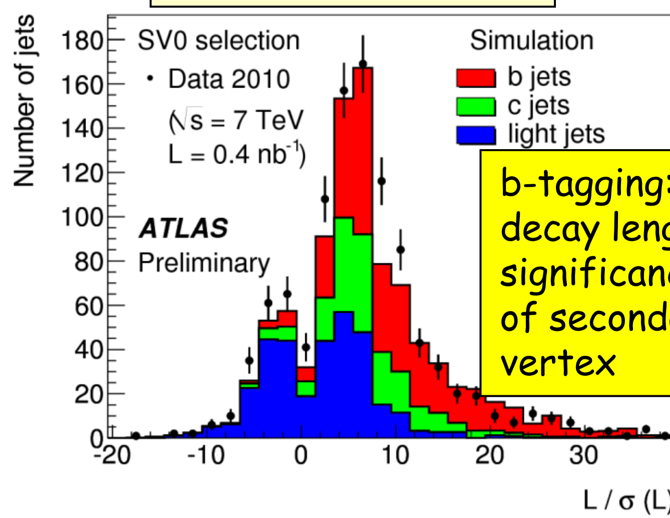
2 opposite-sign leptons: ee, eμ, μμ
both leptons $p_T > 20$ GeV
≥ 2 jets $p_T > 20$ GeV
ee: $E_T^{miss} > 40$ GeV $|M(ee)-M_Z| > 5$ GeV
μμ: $E_T^{miss} > 30$ GeV $|M(\mu\mu)-M_Z| > 10$ GeV
eμ: $H_T = \Sigma E_T$ (leptons, jets) > 150 GeV

Acceptance x efficiency ~ 25%

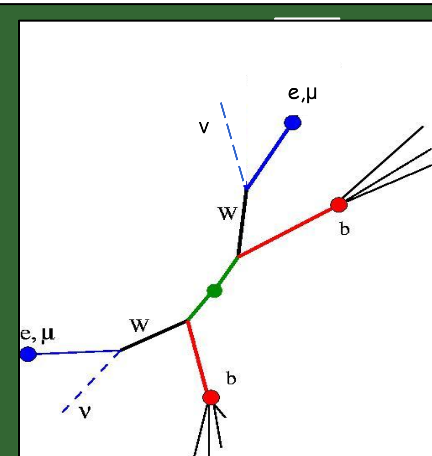
Expect ~ 0.7 signal events



Minimum-bias events



b-tagging:
decay length
significance
of secondary
vertex



Observed candidates : 9

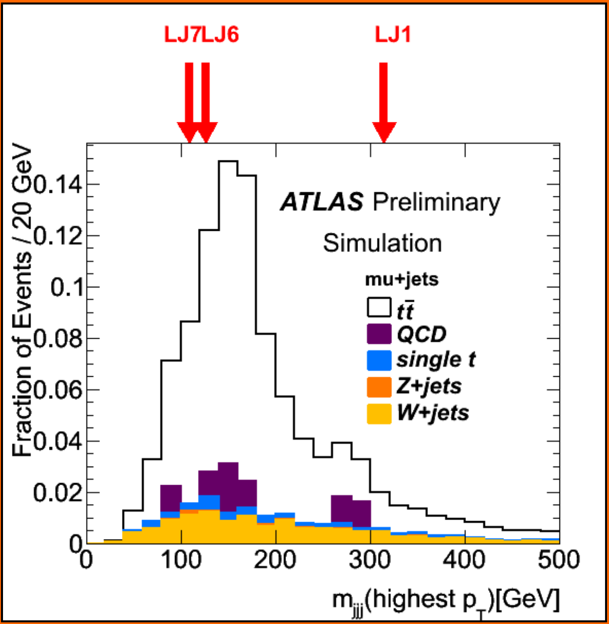
Full data sample analysed

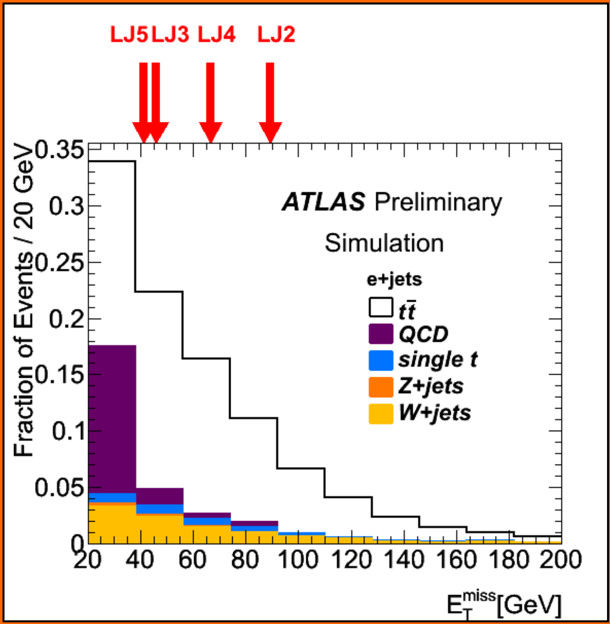
2 di-lepton

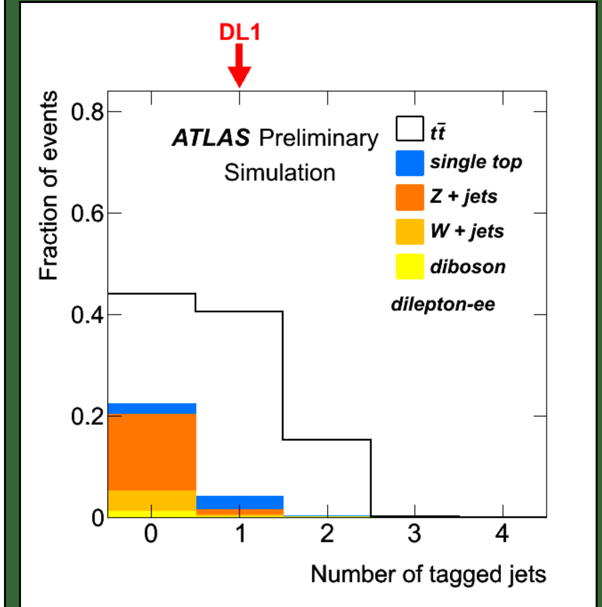
ID	Run number	Event number	Channel	p_T^{lep} (GeV)	E_T^{miss} (GeV)	H_T (GeV)	#jets $p_T > 20$ GeV	#b-tagged jets
DL1	155678	13304729	ee	55.2/40.6	42.4	271	3	1
DL2	158582	27400066	$e\mu$	22.7/47.8	76.9	196	3	1

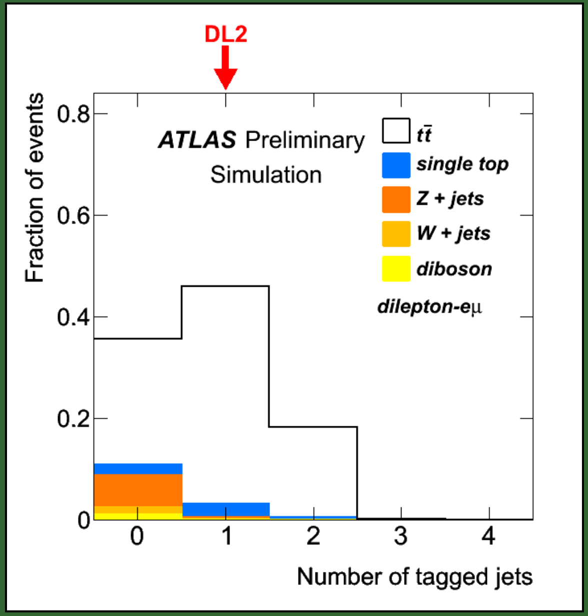
7 lepton + jets

ID	Run number	Event number	Channel	p_T^{lep} (GeV)	E_T^{miss} (GeV)	m_T (GeV)	m_{jjj} (GeV)	#jets $p_T > 20$ GeV	#b-tagged jets
LJ1	158801	4645054	μ+jets	42.9	25.1	59.3	314	7	1
LJ2	158975	21437359	e+jets	41.4	89.3	68.7	106	4	1
LJ3	159086	12916278	e+jets	26.2	46.1	62.6	94	4	1
LJ4	159086	60469005	e+jets	39.1	66.7	102	231	4	1
LJ5	159086	64558586	e+jets	79.3	43.4	86.7	122	4	1
LJ6	159224	13396261	μ+jets	29.4	65.4	64.1	126	5	1
LJ7	159224	13560451	μ+jets	78.7	40.0	83.7	108	4	1

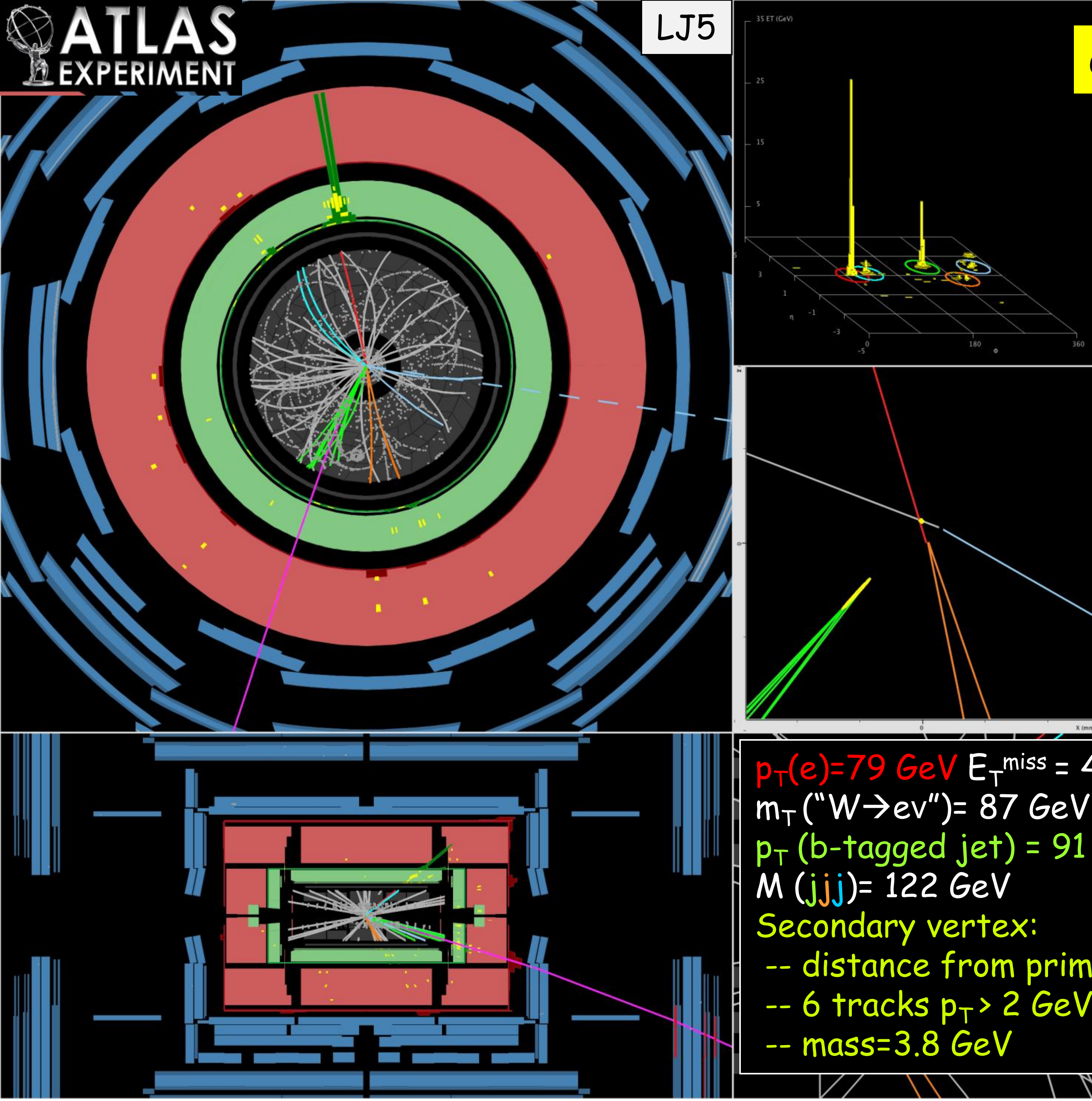






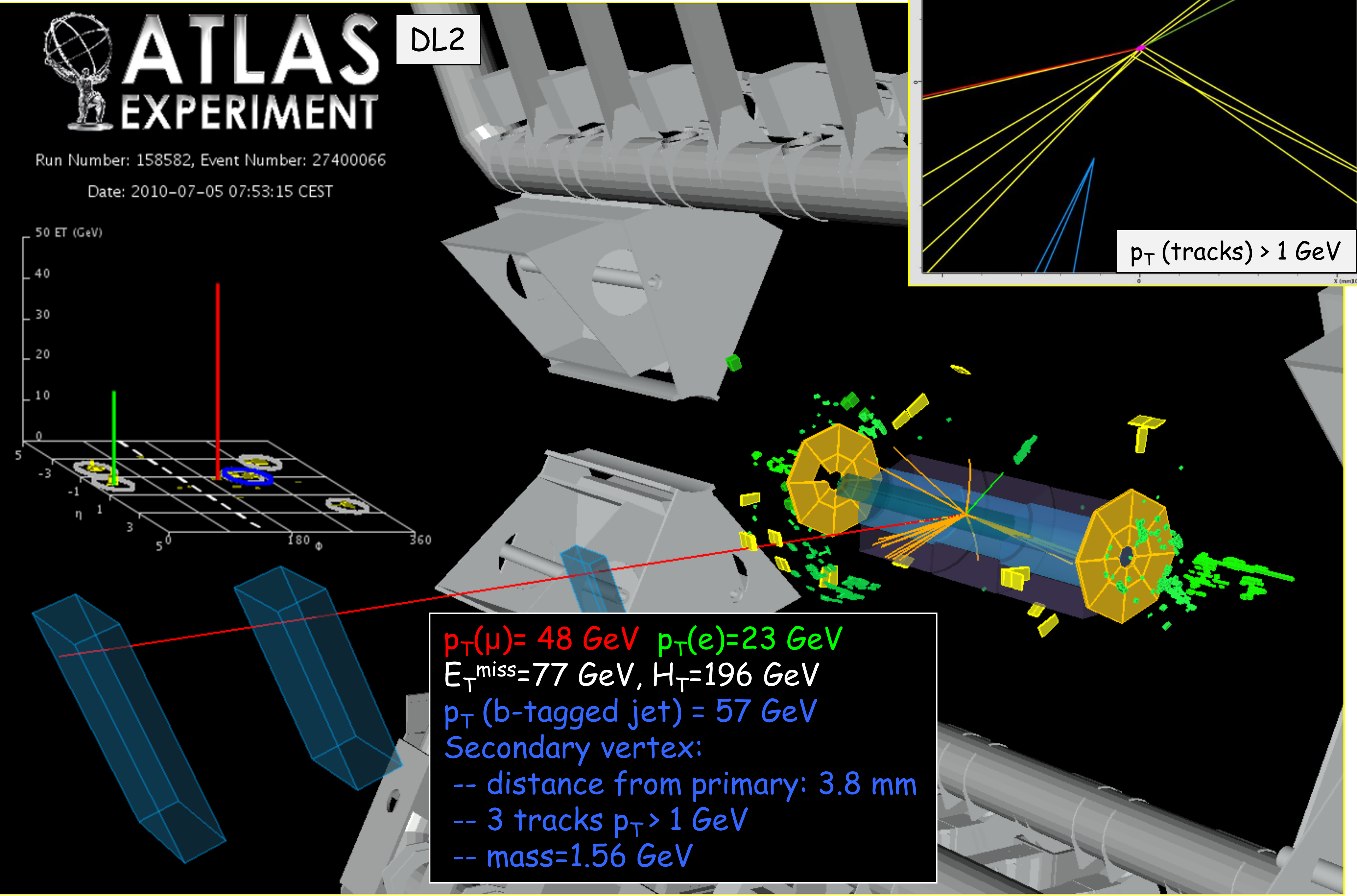


e+jets candidate

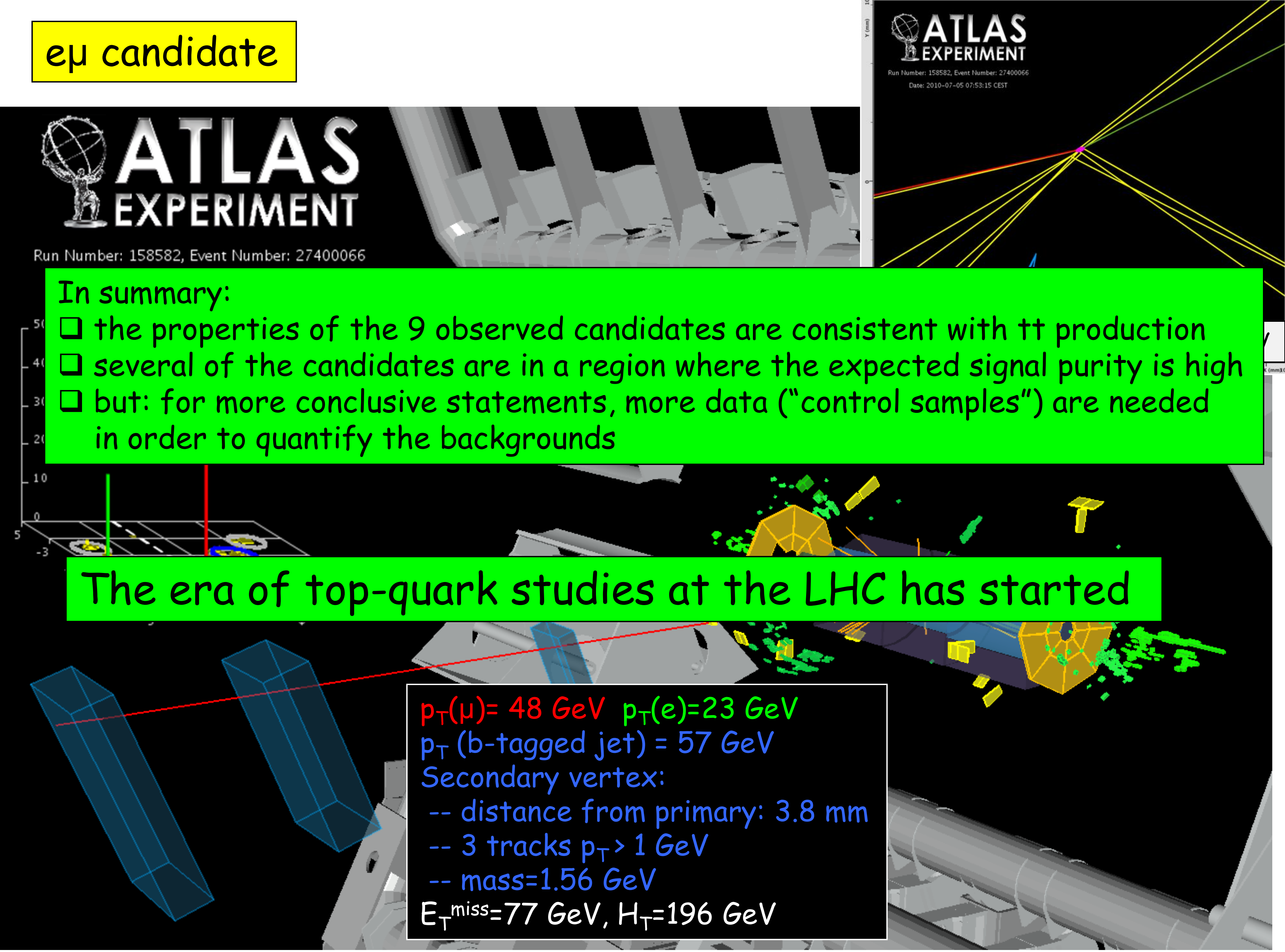


$p_T(e)$=79 GeV E_T^{miss} = 43 GeV
m_T ("W→eν")= 87 GeV
p_T (b-tagged jet) = 91 GeV
M (jjj)= 122 GeV
Secondary vertex:
- distance from primary: 5 mm
- 6 tracks p_T > 2 GeV
- mass=3.8 GeV

eμ candidate



eμ candidate



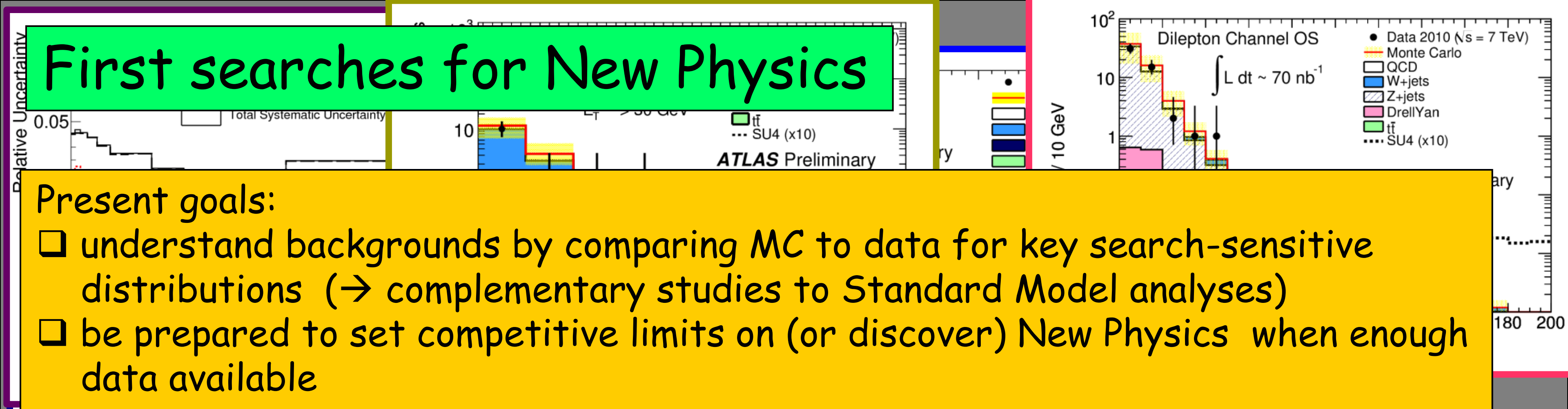
In summary:

- the properties of the 9 observed candidates are consistent with $t\bar{t}$ production
- several of the candidates are in a region where the expected signal purity is high
- but: for more conclusive statements, more data ("control samples") are needed in order to quantify the backgrounds

The era of top-quark studies at the LHC has started

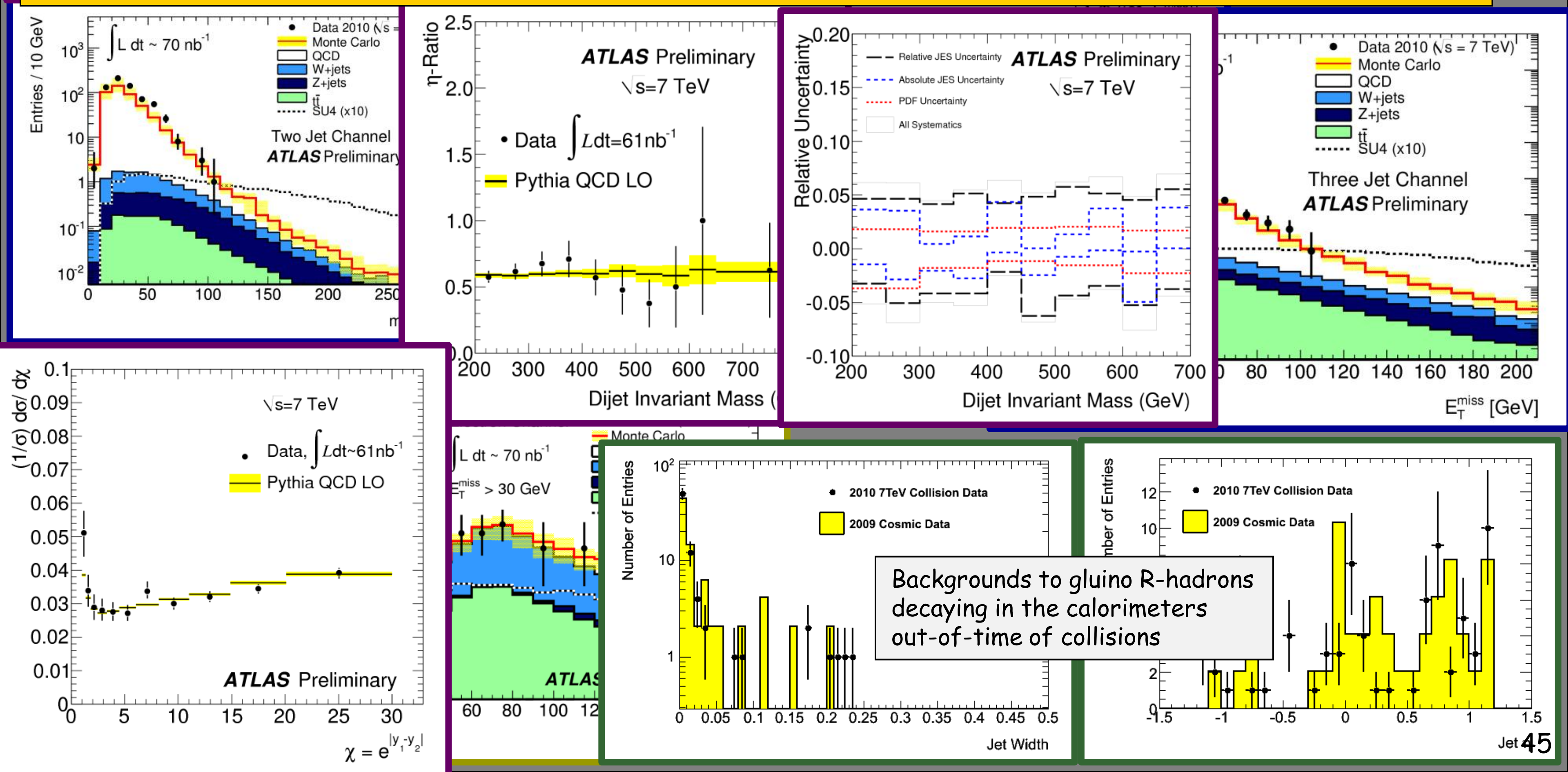
$p_T(\mu)$= 48 GeV $p_T(e)$=23 GeV
p_T (b-tagged jet) = 57 GeV
Secondary vertex:
-- distance from primary: 3.8 mm
-- 3 tracks p_T > 1 GeV
-- mass=1.56 GeV
E_T^{miss}=77 GeV, H_T=196 GeV

First searches for New Physics



Present goals:

- understand backgrounds by comparing MC to data for key search-sensitive distributions (→ complementary studies to Standard Model analyses)
- be prepared to set competitive limits on (or discover) New Physics when enough data available



Backgrounds to gluino R-hadrons decaying in the calorimeters out-of-time of collisions

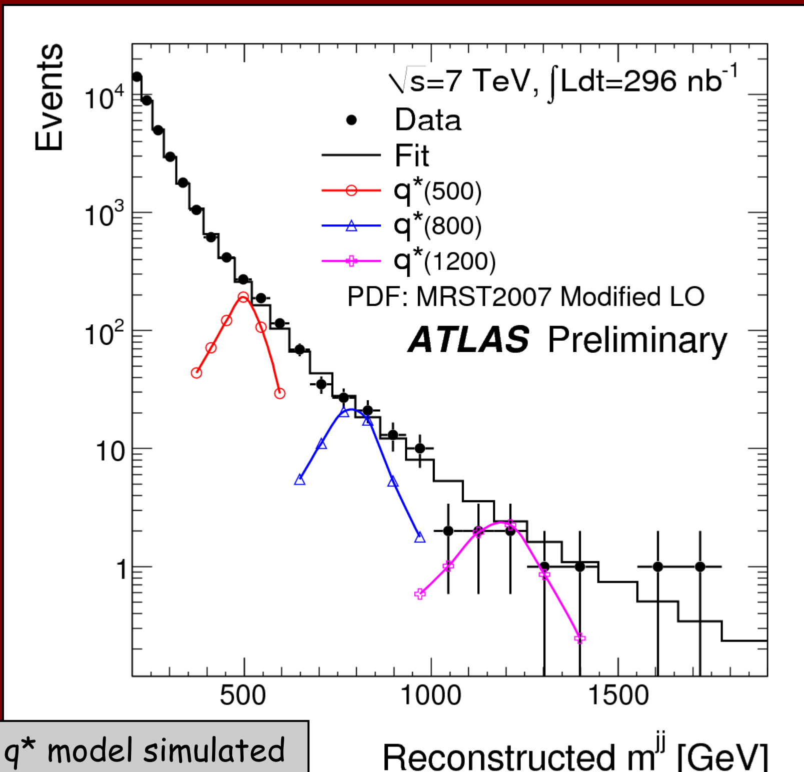
Searches for excited quarks: q*→ jj

Full data sample analysed

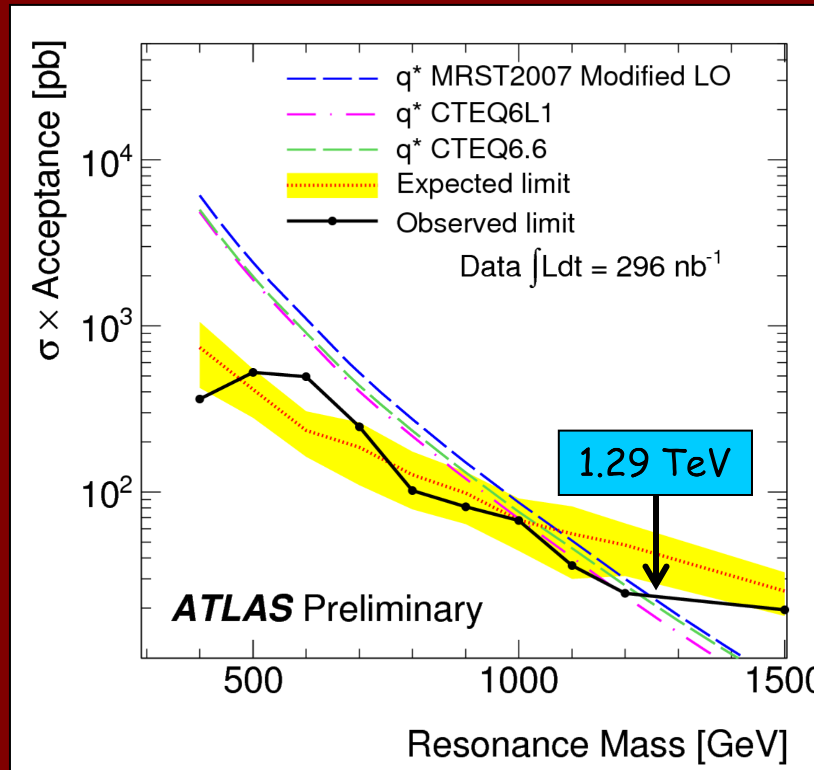
Looked for di-jet resonance in the measured M(jj) distribution
→ spectrum compatible with a smooth monotonic function → no bumps

0.4 < M (q*) < 1.29 TeV excluded at 95% C.L.

Latest published limit:
CDF: 260 < M (q*) < 870 GeV



q* model simulated with Geant4



- ❑ Experimental systematic uncertainties included: luminosity, JES (dominant), background fit, ..
- ❑ Impact of different PDF sets studied → with CTEQ6L1: 0.4 < M (q*) < 1.18 TeV

Conclusions

ATLAS Control Room, first beams, 20 November 2009

Since 30 March, ATLAS has been successfully collecting data during the first LHC run at $\sqrt{s}$ =7 TeV → a total of ~ 340 nb^{-1} have been recorded

We are very grateful to the LHC team for their effort to bring the machine to such excellent performance !

- ❑ The whole experiment has worked efficiently and fast, from data taking at the pit (with efficiency ~ 95%), through data processing and transfer worldwide, to delivery of performance and physics results.
  → many of the results presented at this conference are based on the full data sample collected up to the beginning of ICHEP

- ❑ The first data demonstrate that the performance of the detector and the quality of the reconstruction and simulation software are better than expected at this (initial) stage of the experiment (close to nominal in some cases).
  Years of test beam activities, increasingly realistic simulations, and commissioning with cosmics were fundamental for such a good turn-on.

First physics results presented at this conference include:

- ❑ measurements of the jets, J/ψ, W, Z cross-sections
- ❑ observation of top-quark candidates
- ❑ searches for New Physics → best present limit on q* production (beyond 1 TeV)
- ❑ and many more …

→ The exploitation of the LHC physics potential has started in earnest.
Results will become more and more rich and exciting in the months to come