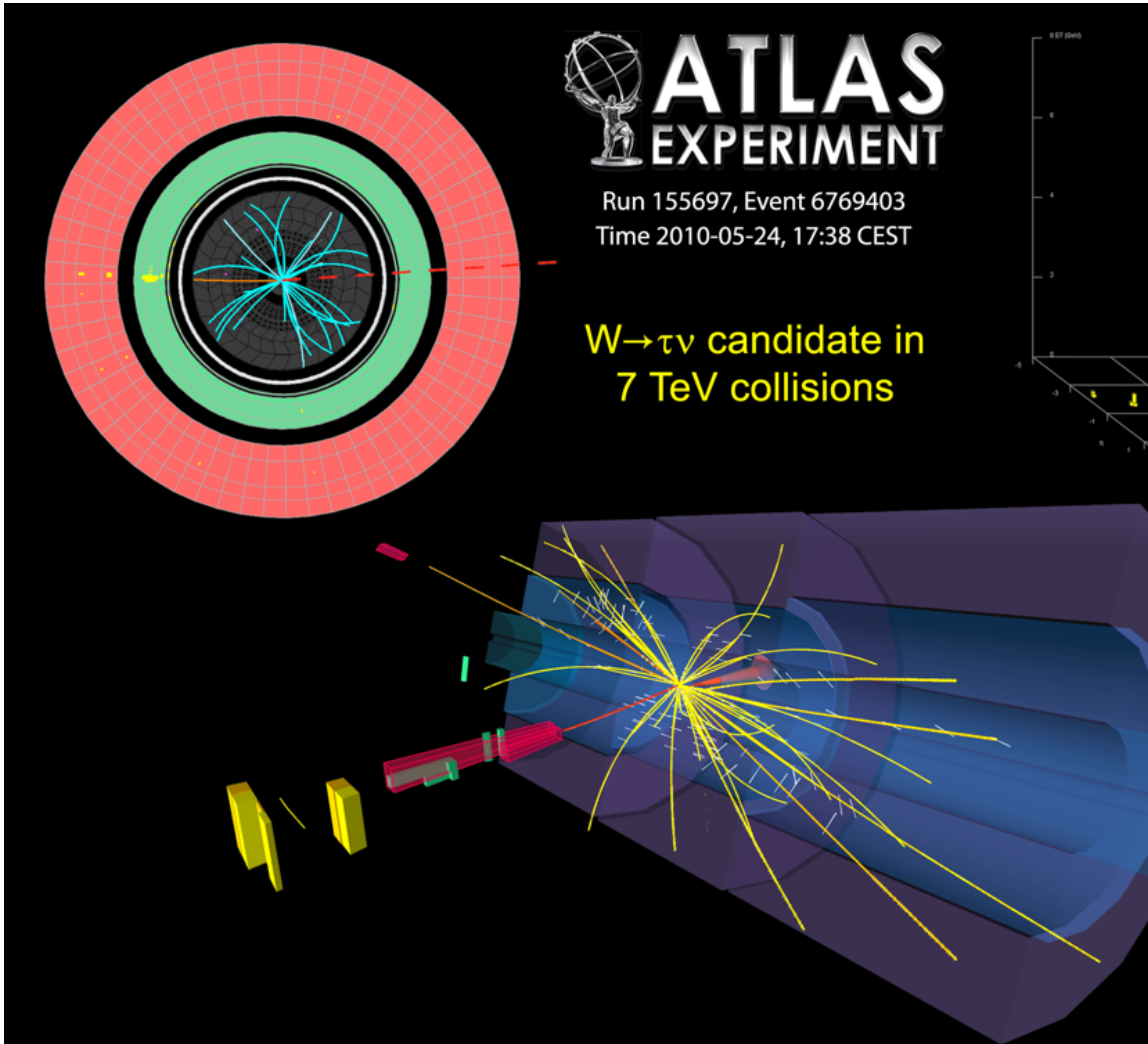
First Results from ATLAS

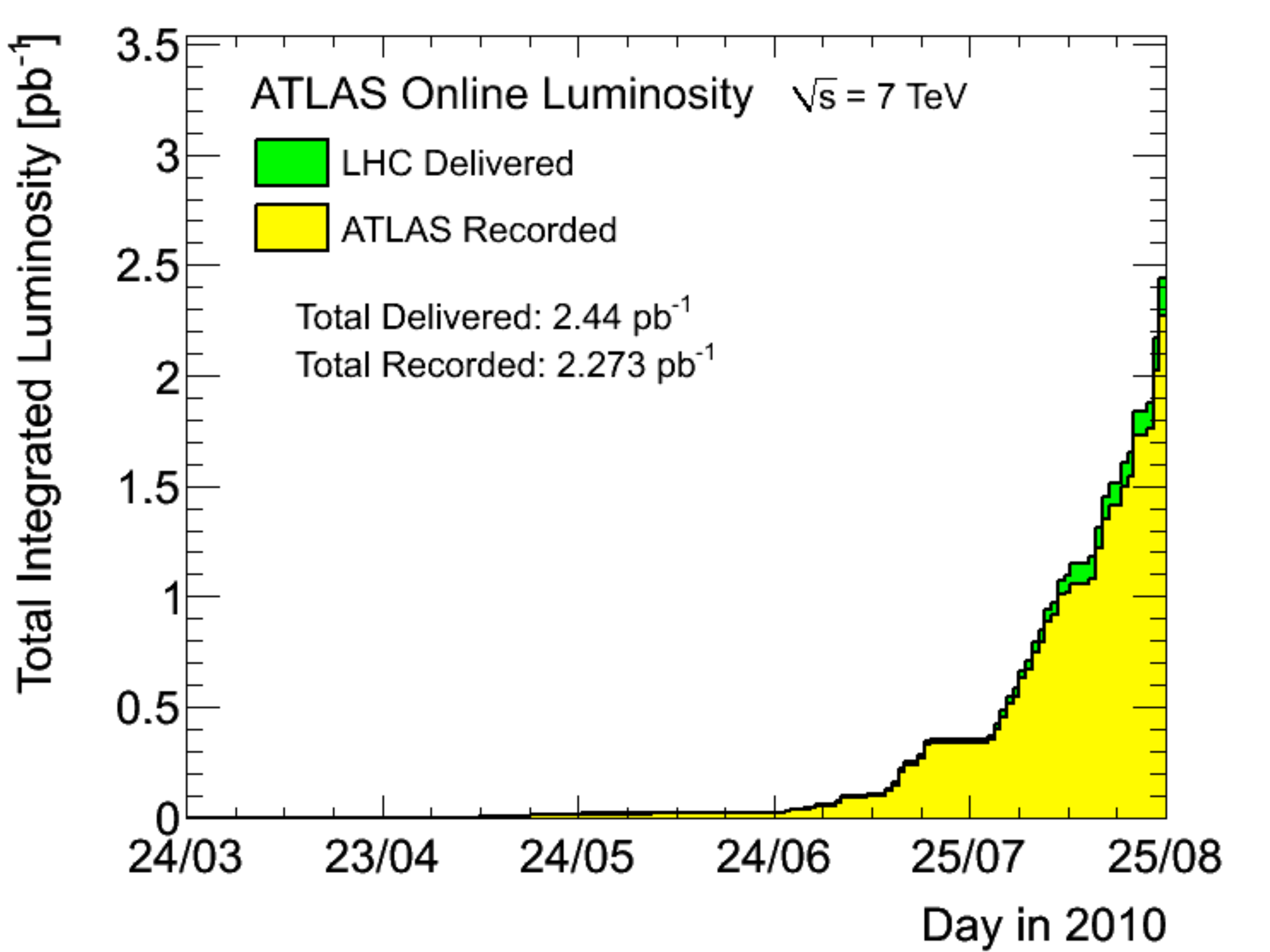
Eric Torrence
University of Oregon

Hadron Collider Physics
Summer School
25 August 2010
Fermilab

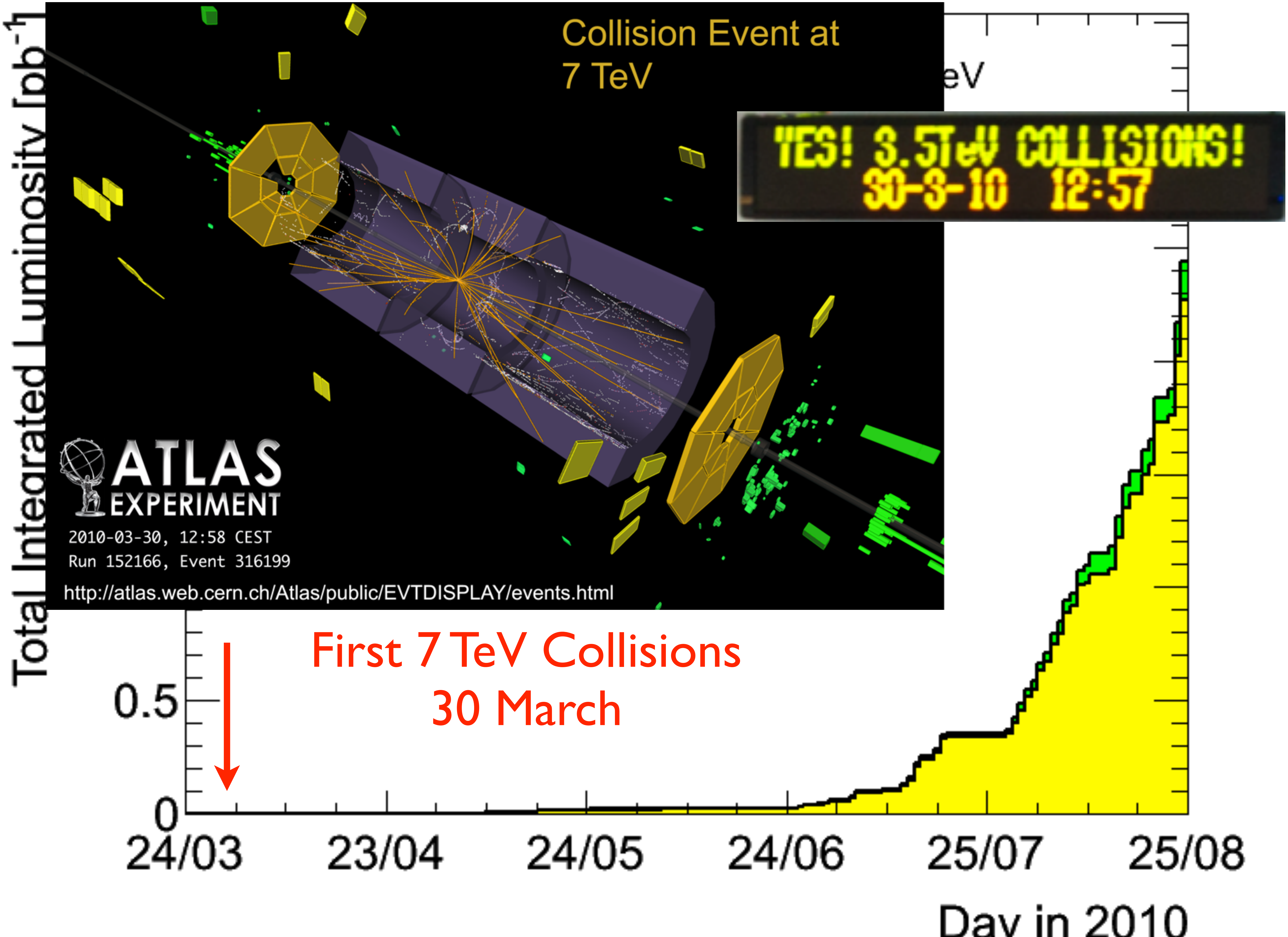


Very special thanks to the 1000s of ATLAS colleagues who have contributed to the quality of these results

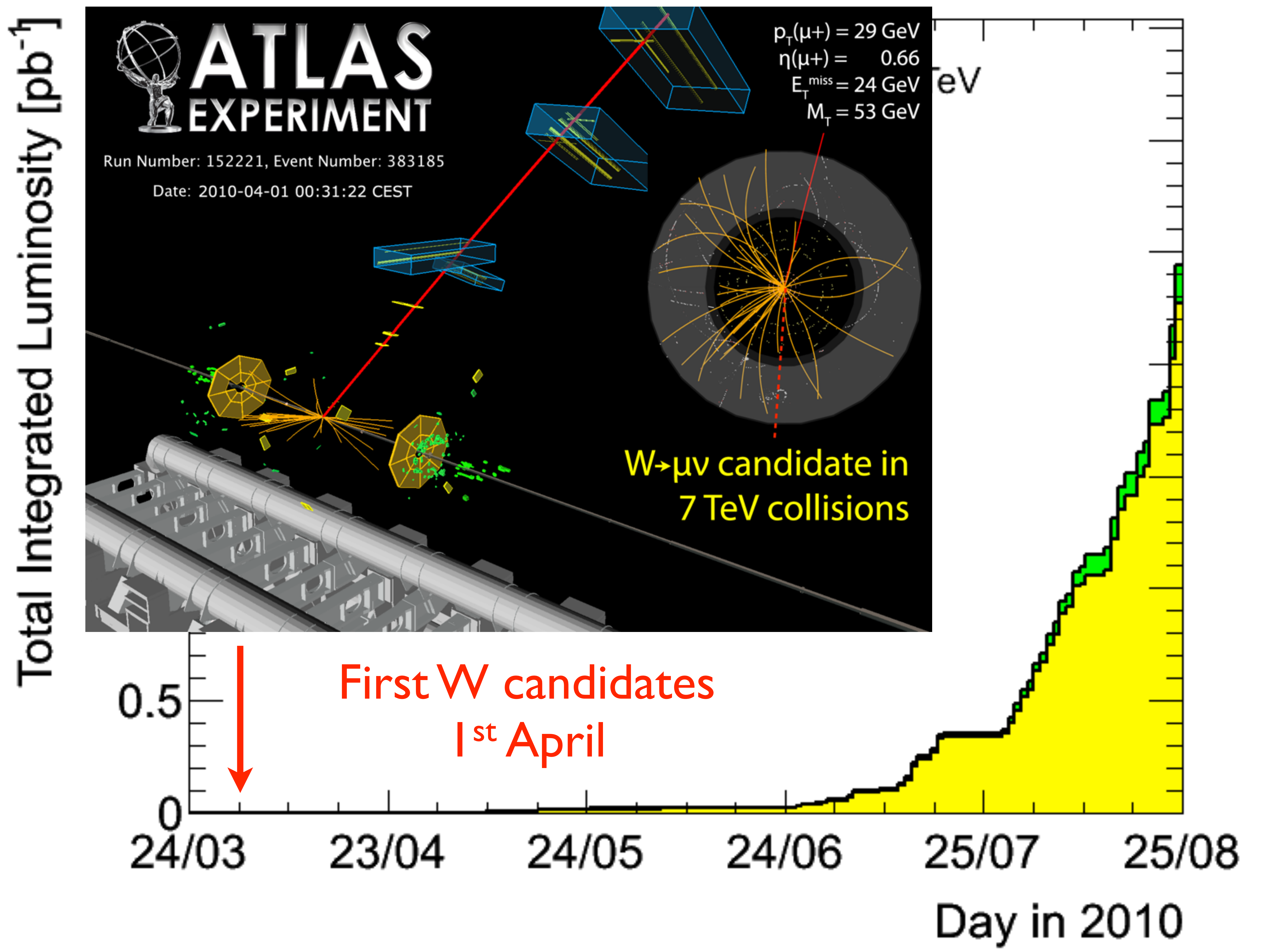
This has been an exciting 5 months at the LHC...



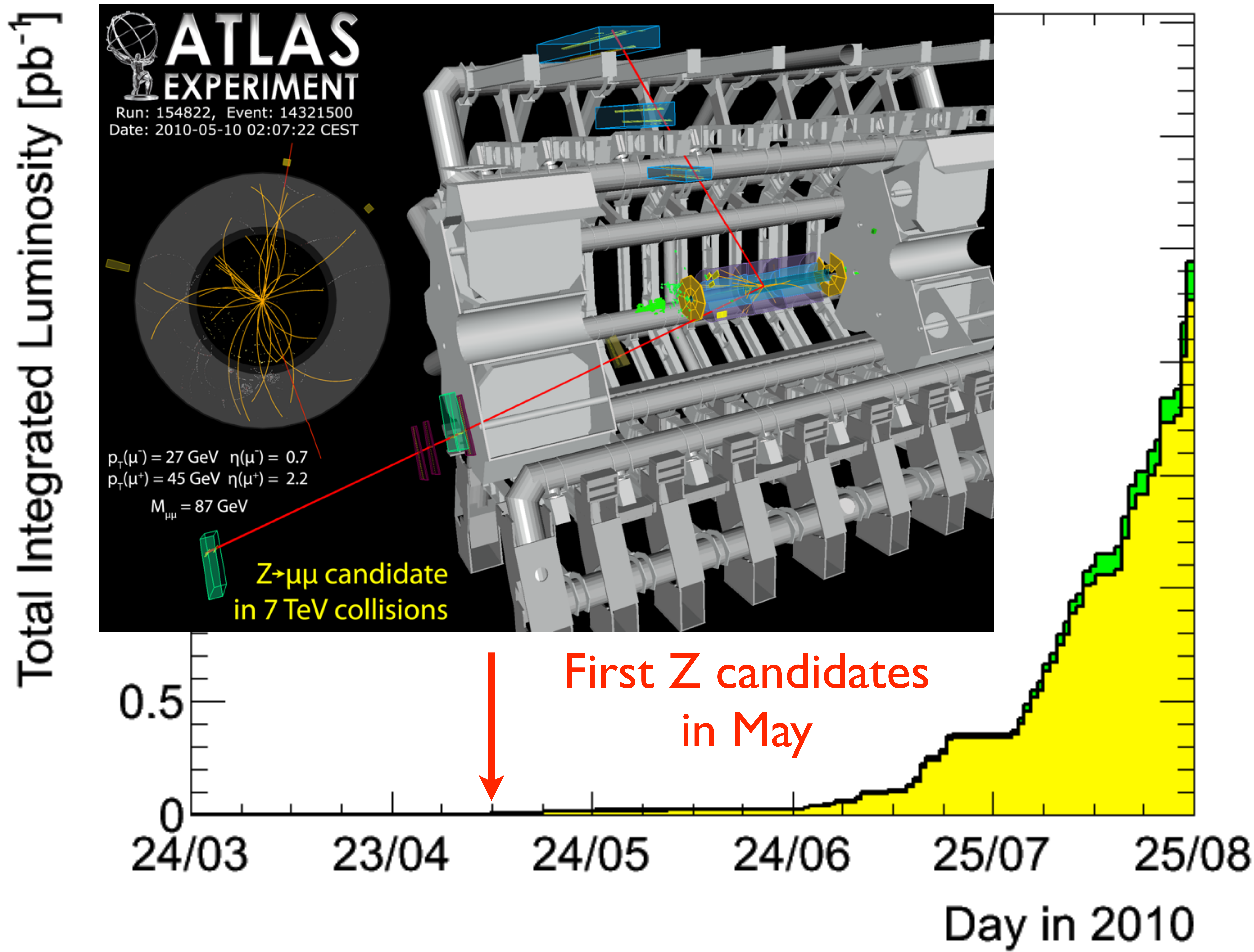
ATLAS Online Luminosity
$\sqrt{s}$ = 7 TeV
LHC Delivered
ATLAS Recorded
Total Delivered: 2.44 pb^{-1}
Total Recorded: 2.273 pb^{-1}
Total Integrated Luminosity [pb^{-1}]
0
0.5
1
1.5
2
2.5
3
3.5
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010

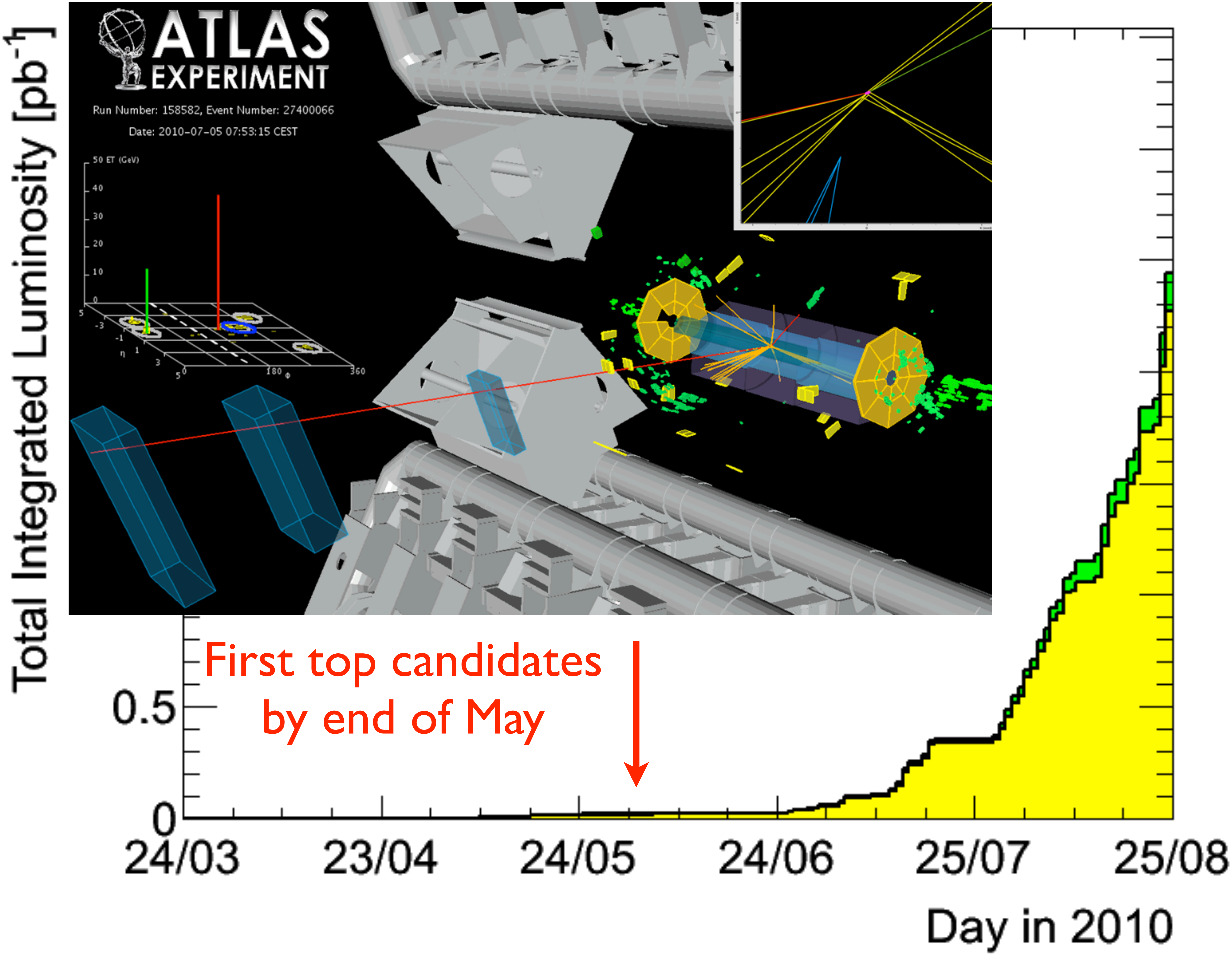


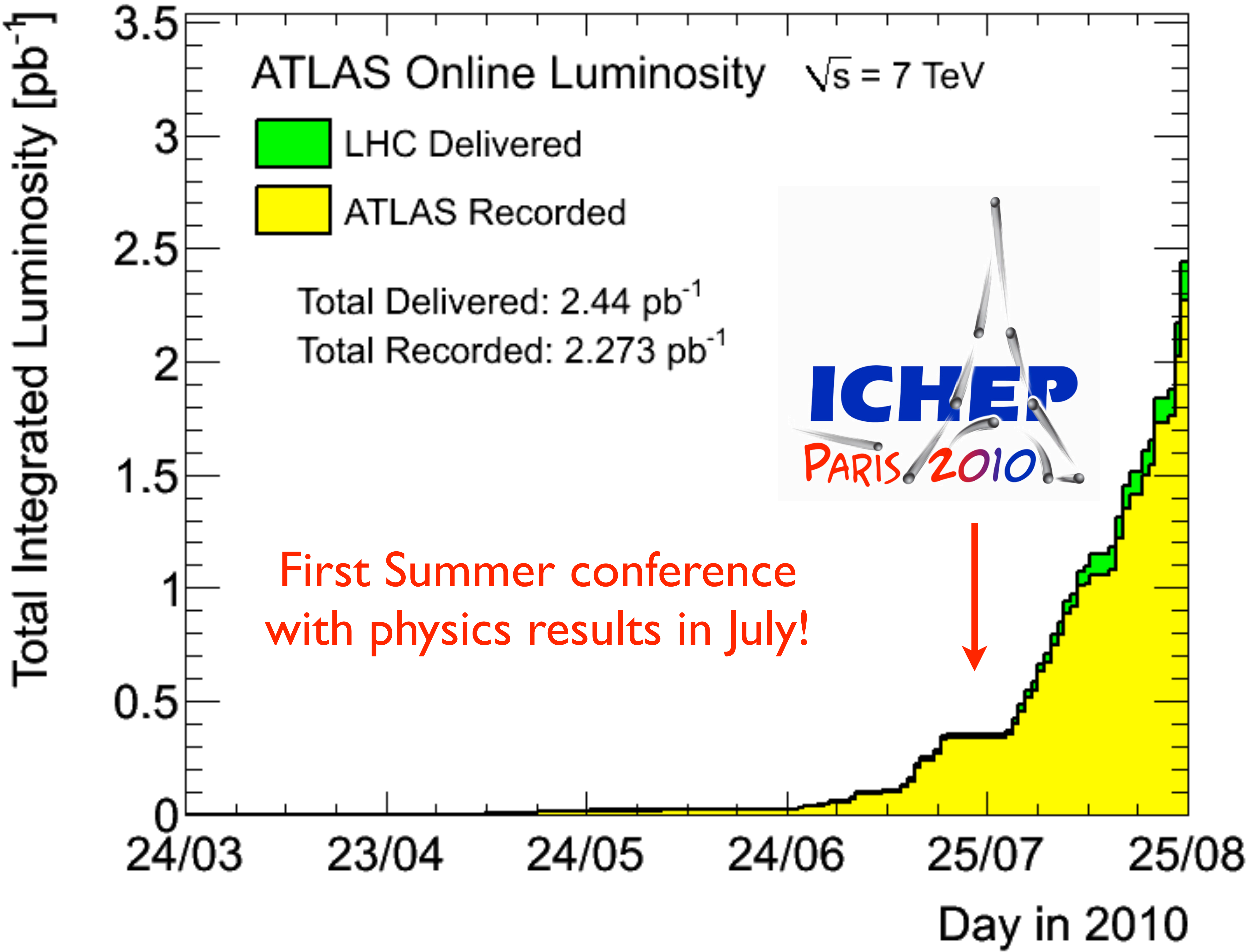
Collision Event at
7 TeV
YES! 3.5TeV COLLISIONS!
30-3-10 12:57
ATLAS
EXPERIMENT
2010-03-30, 12:58 CEST
Run 152166, Event 316199
http://atlas.web.cern.ch/Atlas/public/EVTDISPLAY/events.html
Total Integrated Luminosity [pb-1]
0.5
0
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010
First 7 TeV Collisions
30 March



ATLAS EXPERIMENT
Run Number: 152221, Event Number: 383185
Date: 2010-04-01 00:31:22 CEST
pT(μ+) = 29 GeV
η(μ+) = 0.66
ET miss = 24 GeV
MT = 53 GeV
W→μν candidate in
7 TeV collisions
eV
Total Integrated Luminosity [pb-1]
0.5
0
First W candidates
1st April
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010

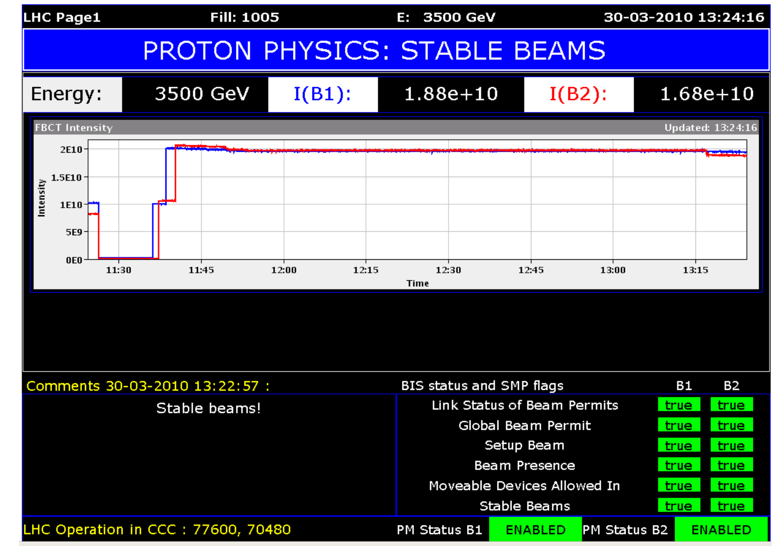

ATLAS EXPERIMENT
Run: 154822, Event: 14321500
Date: 2010-05-10 02:07:22 CEST
$p_T(\mu^-) = 27$ GeV $\eta(\mu^-) = 0.7$
$p_T(\mu^+) = 45$ GeV $\eta(\mu^+) = 2.2$
$M_{\mu\mu} = 87$ GeV
Z→μμ candidate
in 7 TeV collisions
First Z candidates
in May
Total Integrated Luminosity [pb^{-1}]
0.5
0
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010


ATLAS EXPERIMENT
Run Number: 158582, Event Number: 27400066
Date: 2010-07-05 07:53:15 CEST
50 ET (GeV)
First top candidates by end of May
Total Integrated Luminosity [pb-1]
0.5
0
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010

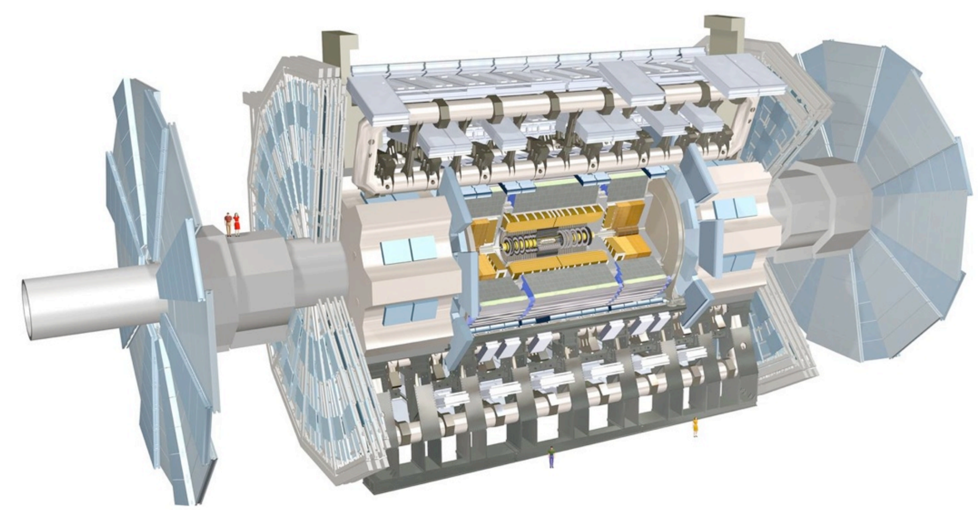

ATLAS Online Luminosity
√s = 7 TeV
LHC Delivered
ATLAS Recorded
Total Delivered: 2.44 pb⁻¹
Total Recorded: 2.273 pb⁻¹
ICHEP
PARIS 2010
First Summer conference
with physics results in July!
Total Integrated Luminosity [pb⁻¹]
0
0.5
1
1.5
2
2.5
3
3.5
24/03
23/04
24/05
24/06
25/07
25/08
Day in 2010

Outline

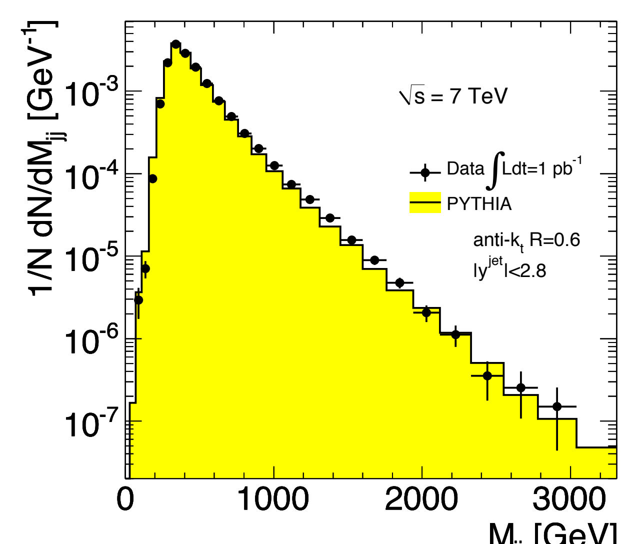
- Brief discussion of machine performance



- Description of ATLAS detector systems and initial performance



- Highlights of first Physics Results



Many more details available

It is impossible to do justice to all of the excellent work currently being done in ATLAS

ATLAS Summer 2010 Results:

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/RESULTS/summer2010.html

ICHEP 2010: http://ichep2010.fr/

Results with ~0.3 pb^{-1}

HCP 2010: http://hcp2010.physics.utoronto.ca/

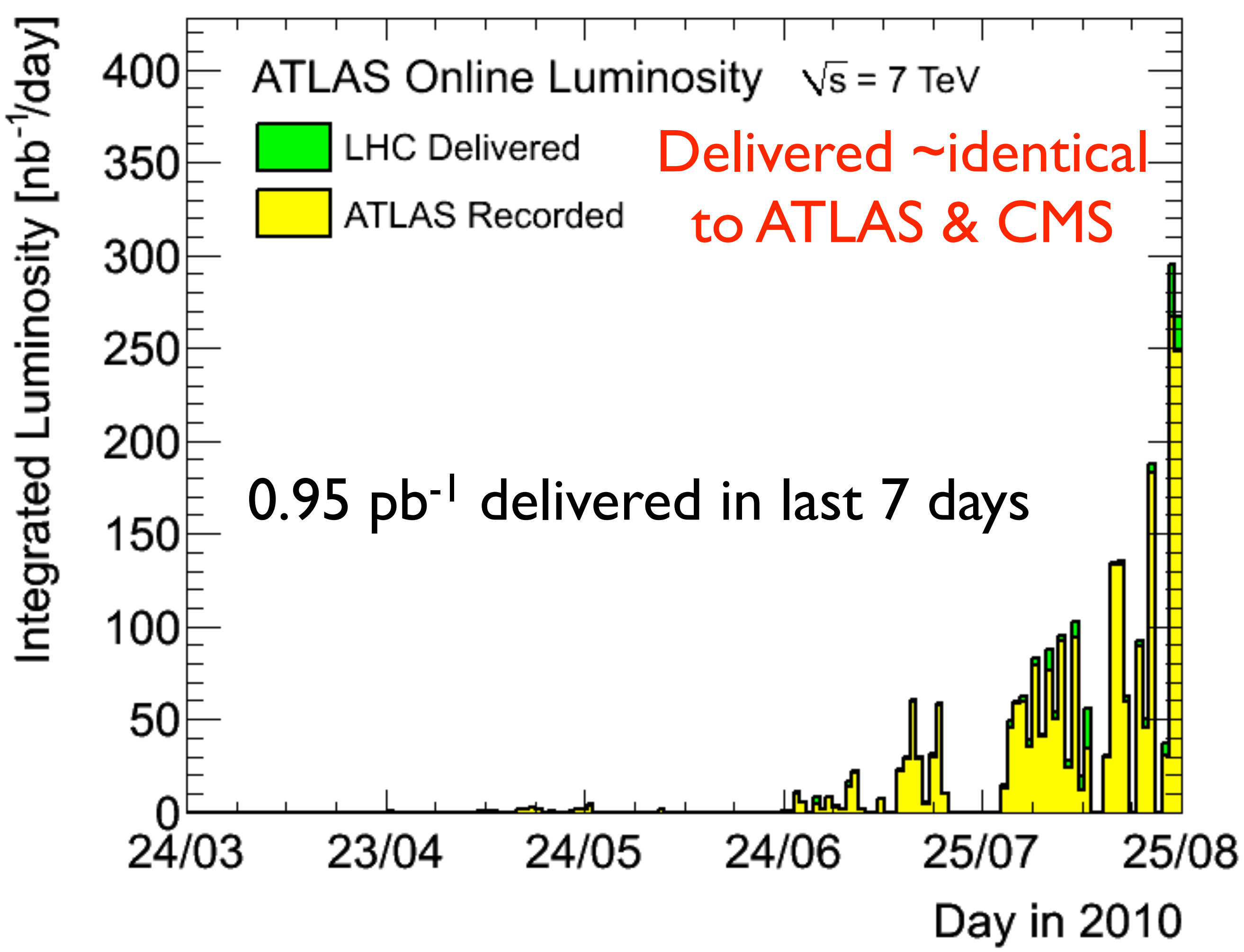
This week!

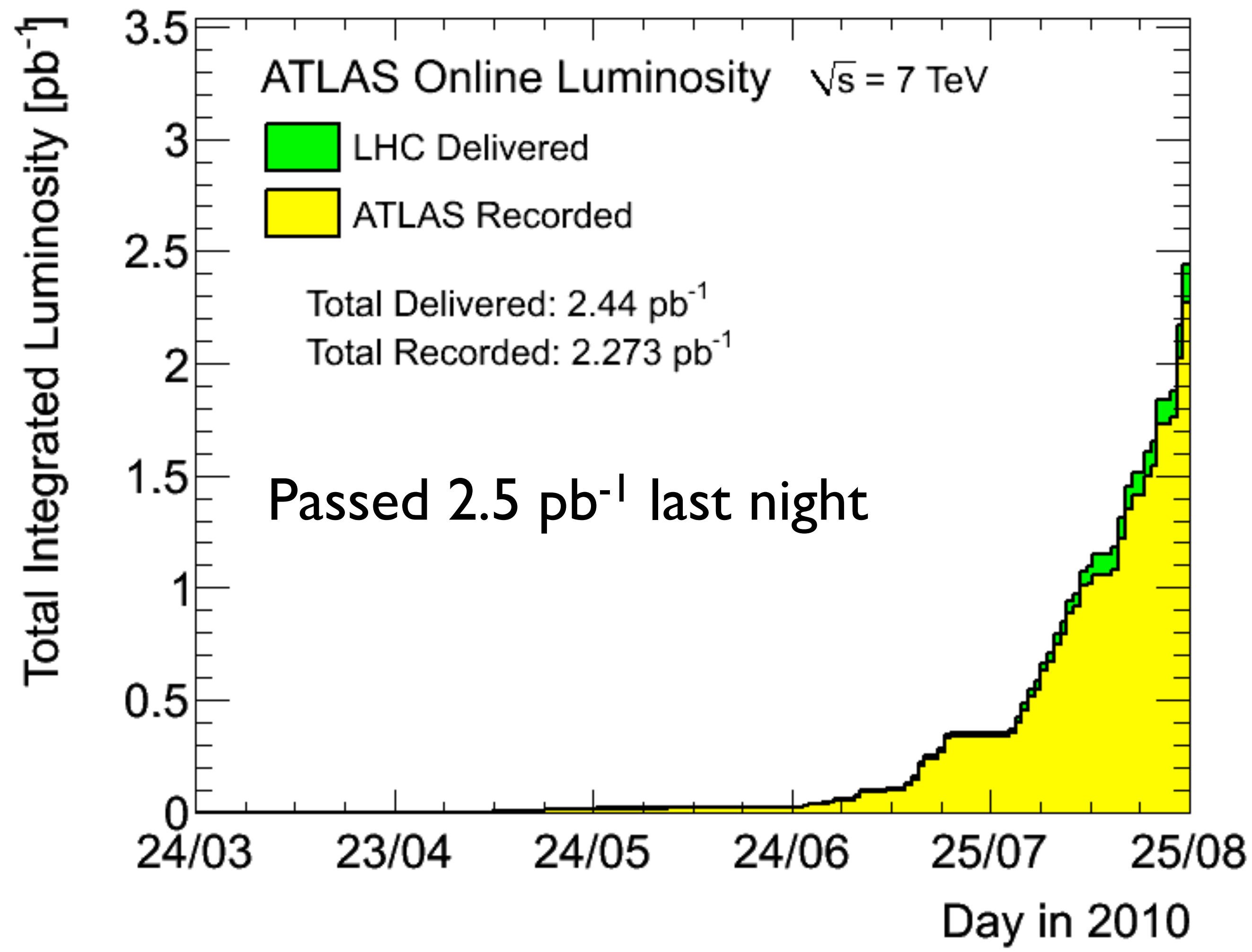
Results with ~1 pb^{-1}

LHC (Re-)Startup

LHC Timeline

- September 2008 - First Beams in LHC
- November 2009 - Beam re-established in LHC
- December 2009 - First collisions @ 0.9 and 2.36 TeV
- January 2010 - Chamonix decision on safe dipole current
- 30 March 2010 - First collisions at $\sqrt{s}$ = 7 TeV





LHC Luminosity

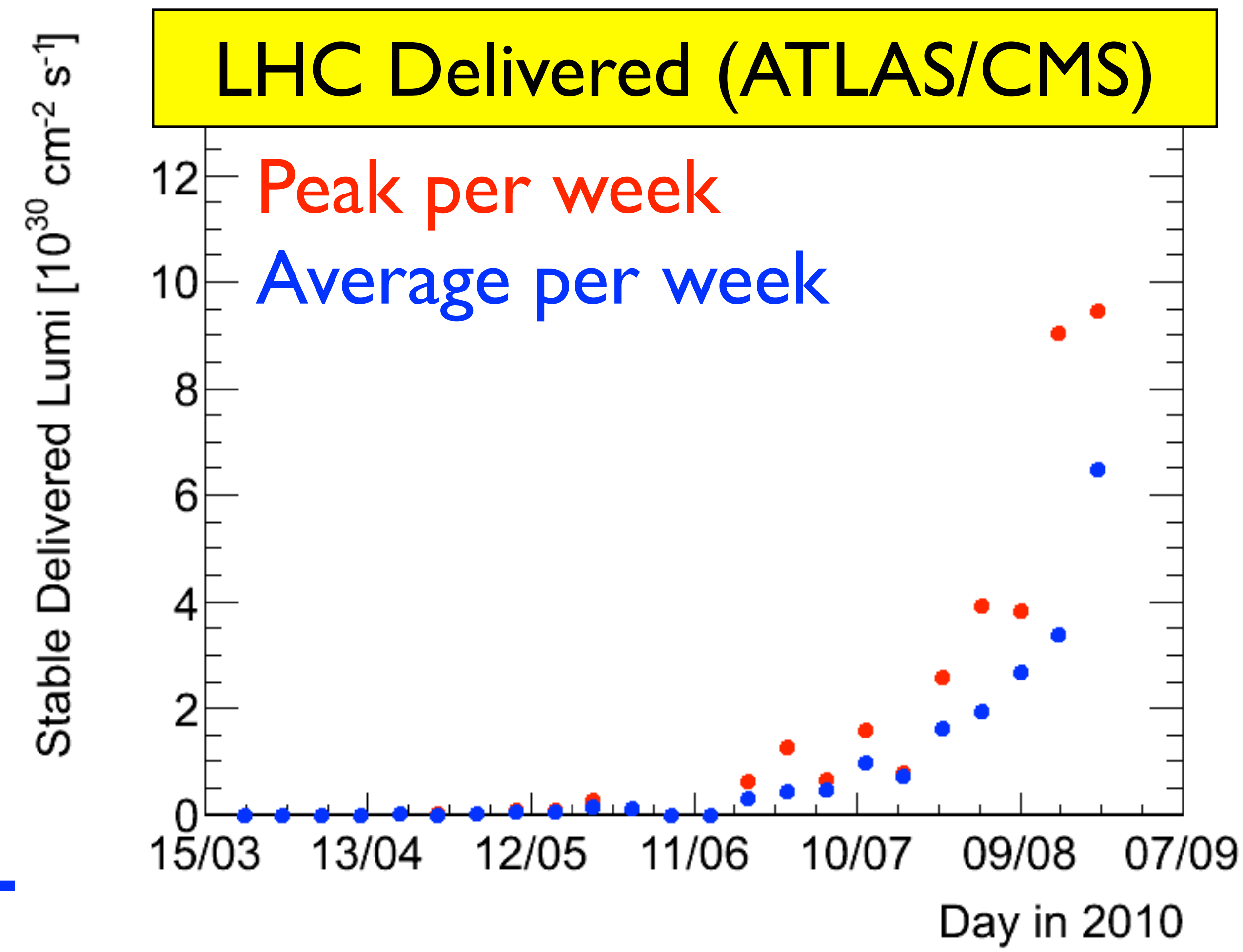
$$\text{Luminosity} = n_b\, f\, N^2/A$$

f - revolution frequency
n_b - bunches colliding
N - protons per bunch
A - cross-sectional collision area

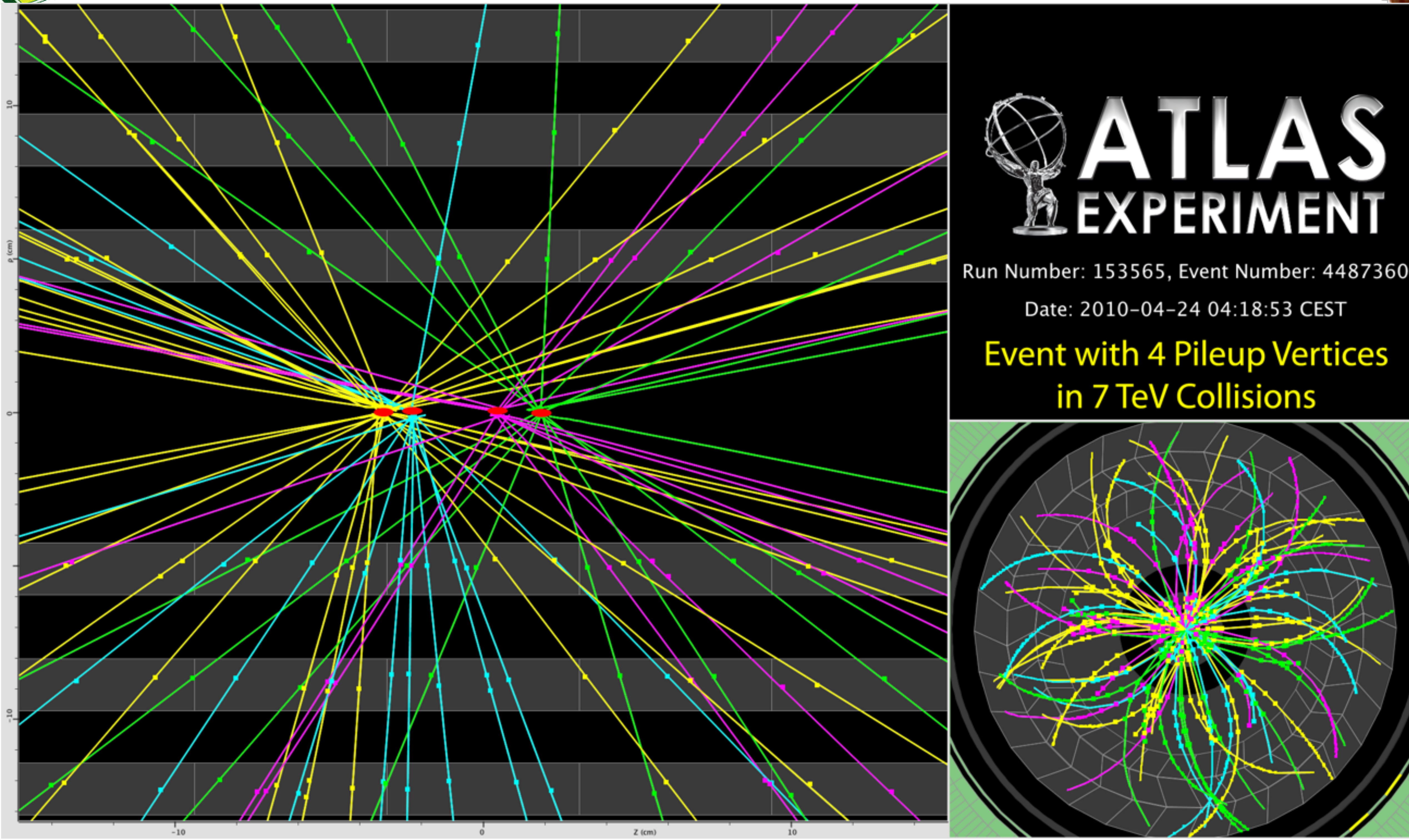
	Start	Now	2010/11 Goal	2015 Goal
E_{beam} (TeV)	3.5			7
n_b (ATLAS/CMS)	1	36	796	2808
N (protons)	1×10^{10}	0.9×10^{11}	1×10^{11}	1.2×10^{11}
$1/\beta^*$ (m^{-1})	0.1	0.5→0.3	0.5	~2
Peak Lumi ($cm^{-2}\,s^{-1}$)	1×10^{27}	9×10^{30}	2×10^{32}	1×10^{34}
Stored Energy (MJ/beam)	0.01	~2.5	36	365

From S.Meyers, ICHEP

Need another factor of ~20
Increasing n_b is key for 2010/11



Multiple Interactions

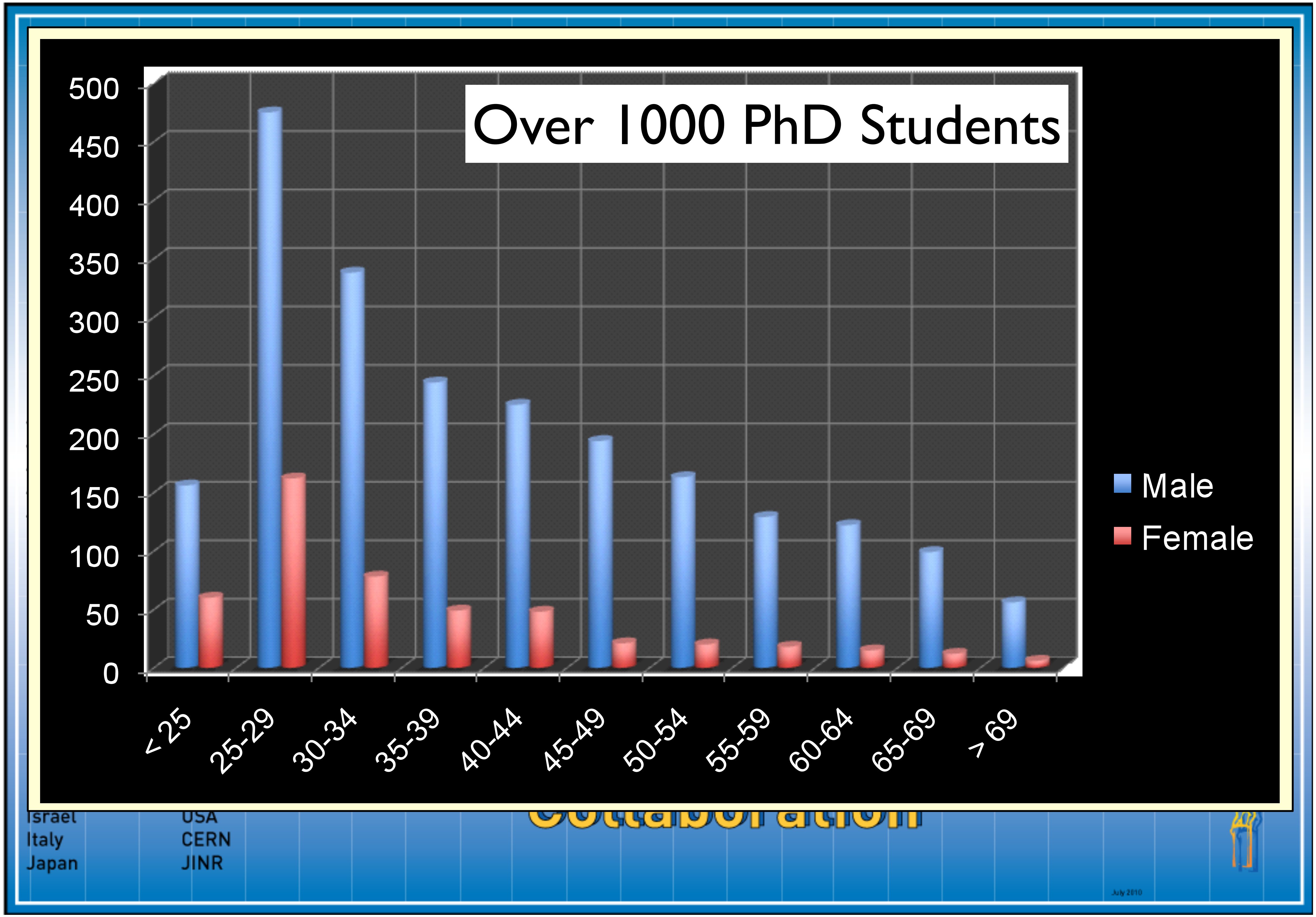


LHC design: average ~20 interactions/BX

Current average ~ 1.5/BX - likely won't change much through 2011!

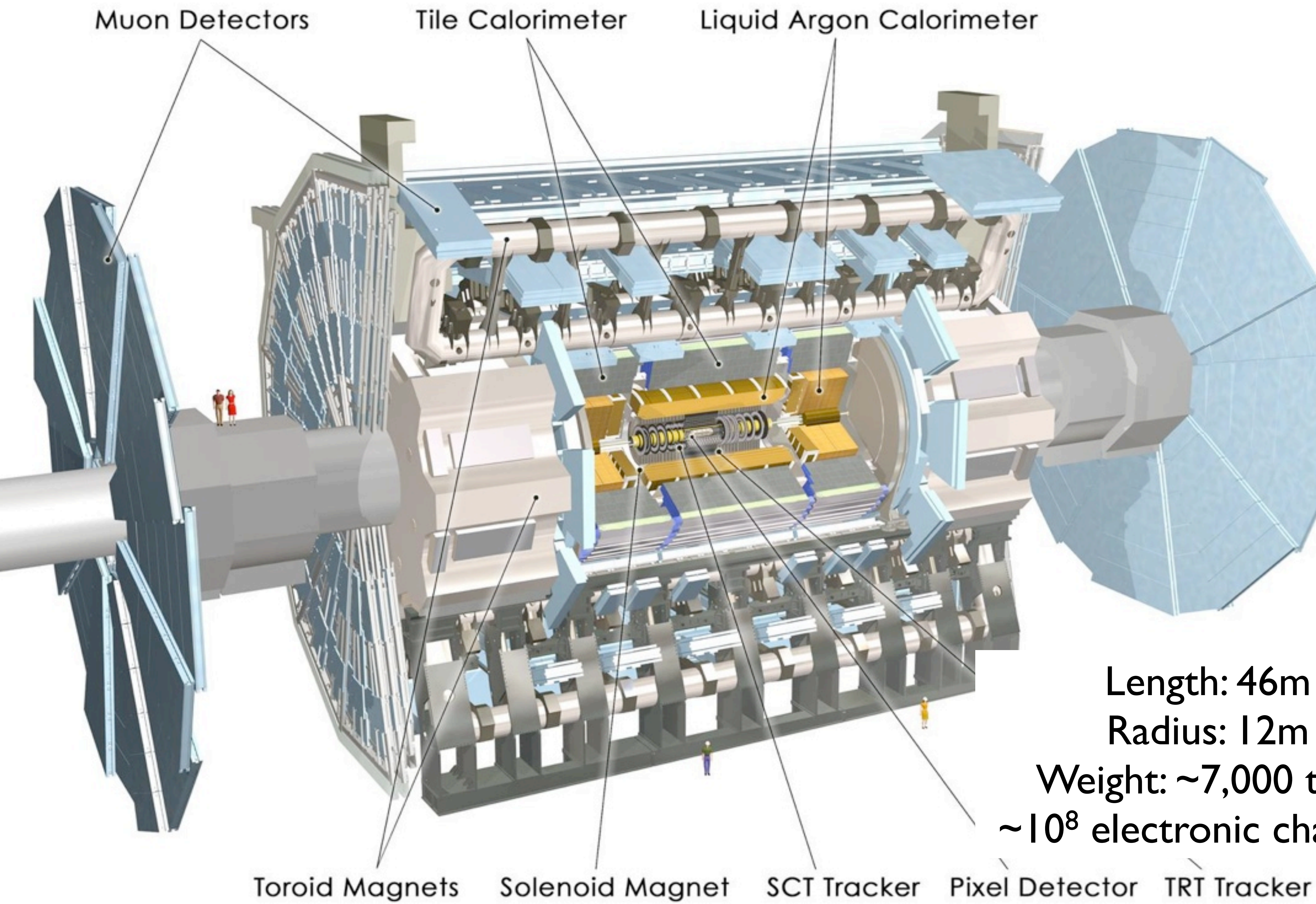
The ATLAS Collaboration and Detector

~3000 scientists, 174 institutions, 38 countries, every continent (except Antartica)



~3000 scientists, 174 institutions, 38 countries, every continent (except Antartica)

ATLAS Detector Overview



Length: 46m
Radius: 12m
Weight: ~7,000 tons
~10^8 electronic channels

Detector Status

~100 million channels

All sub-detector systems > 97% operational

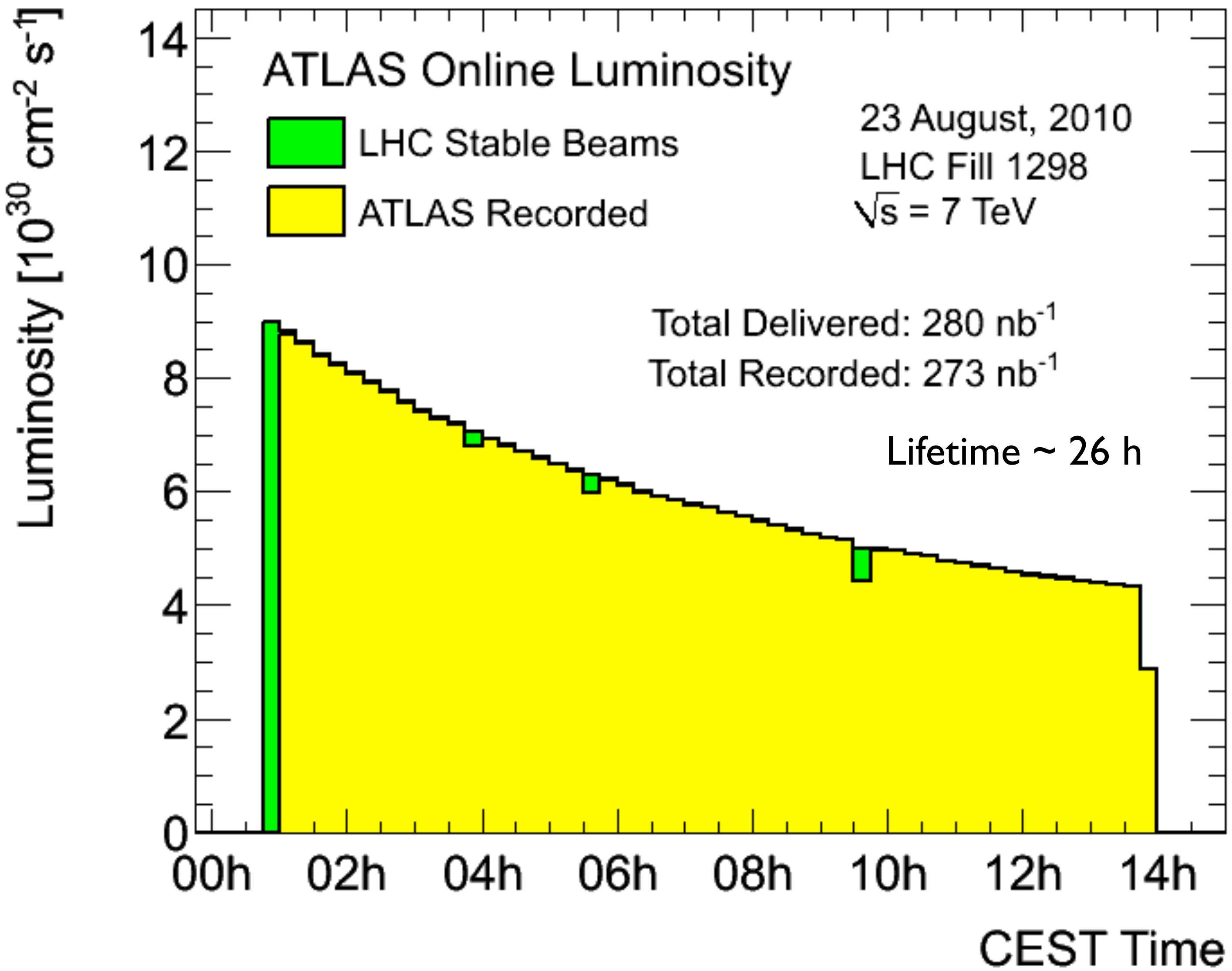
Sub-Detector	Channels	Operational Fraction
Pixels	80 M	97.4%
Silicon Central Tracker	6.3 M	99.2%
Transition Rad. Tracker	350 k	98.0%
LAr EM Calo	170 k	98.5%
Tile Calo	9,800	97.3%
LAr Had Endcap	5,600	99.9%
Forward LAr	3,500	100%
L1 Calo Trigger	7,160	99.9%
L1 Muon RPC Trigger	370 k	99.5%
L1 Muon TGC Trigger	320 k	100%
MDT Chambers	350 k	99.7%
Cathode Strip Chambers	31 k	98.5%
RPC Barrel Muons	370 k	97.0%
TGC Endcap Muons	320 k	98.6%

Working fraction, end of June 2010

Operational Efficiency

ATLAS Recorded/LHC Delivered ~94% overall for 2010

- 5-10 minutes to ramp voltages (warm-start) at start of fill
- Occasional DAQ busy, automatically recovered
- Very low trigger deadtime at current 1 μs bunch spacing (will get worse with n_b)



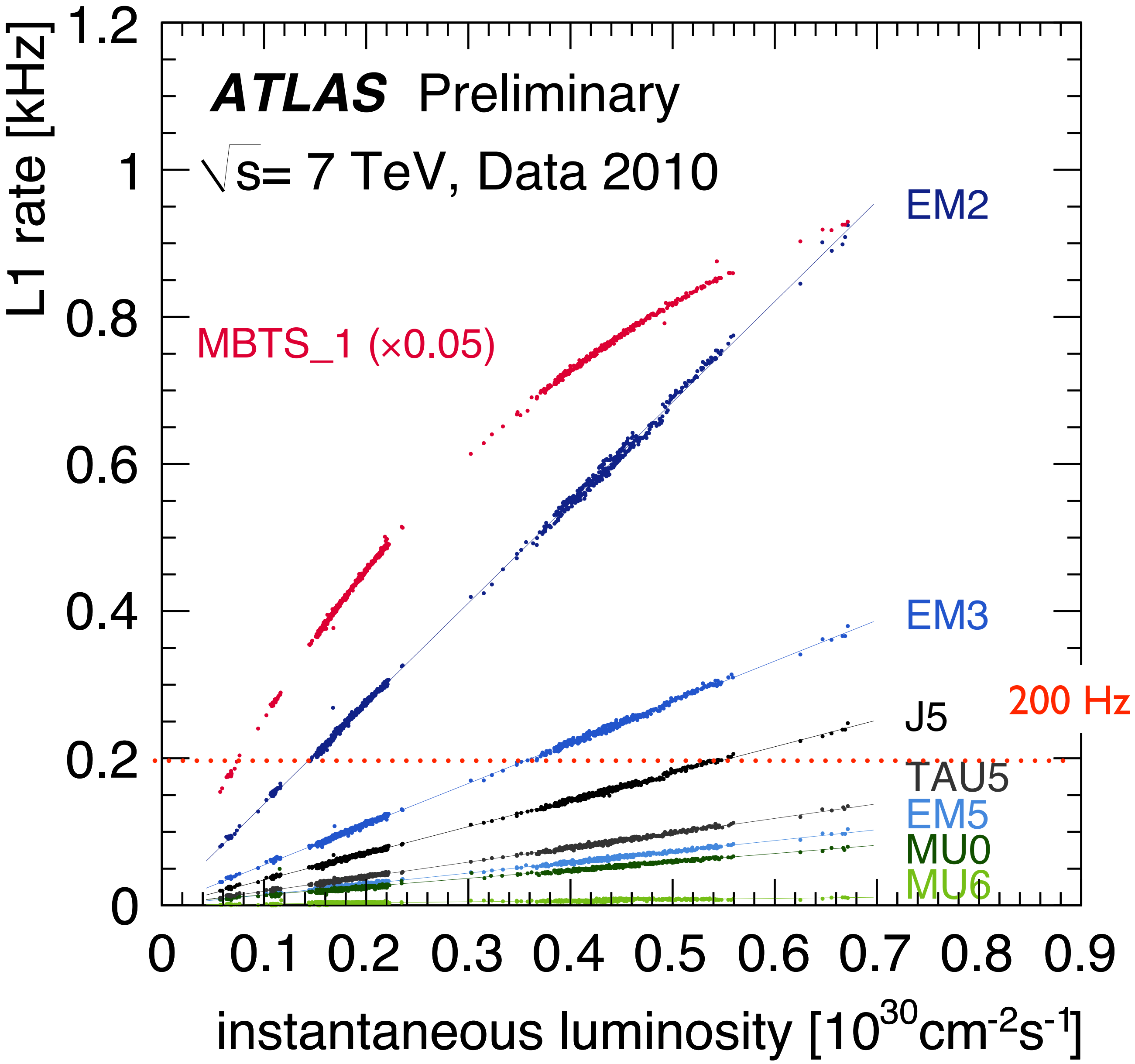
Overall ATLAS Data Quality (deadtime excluded)

HV trips, hot towers, and warm-start

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

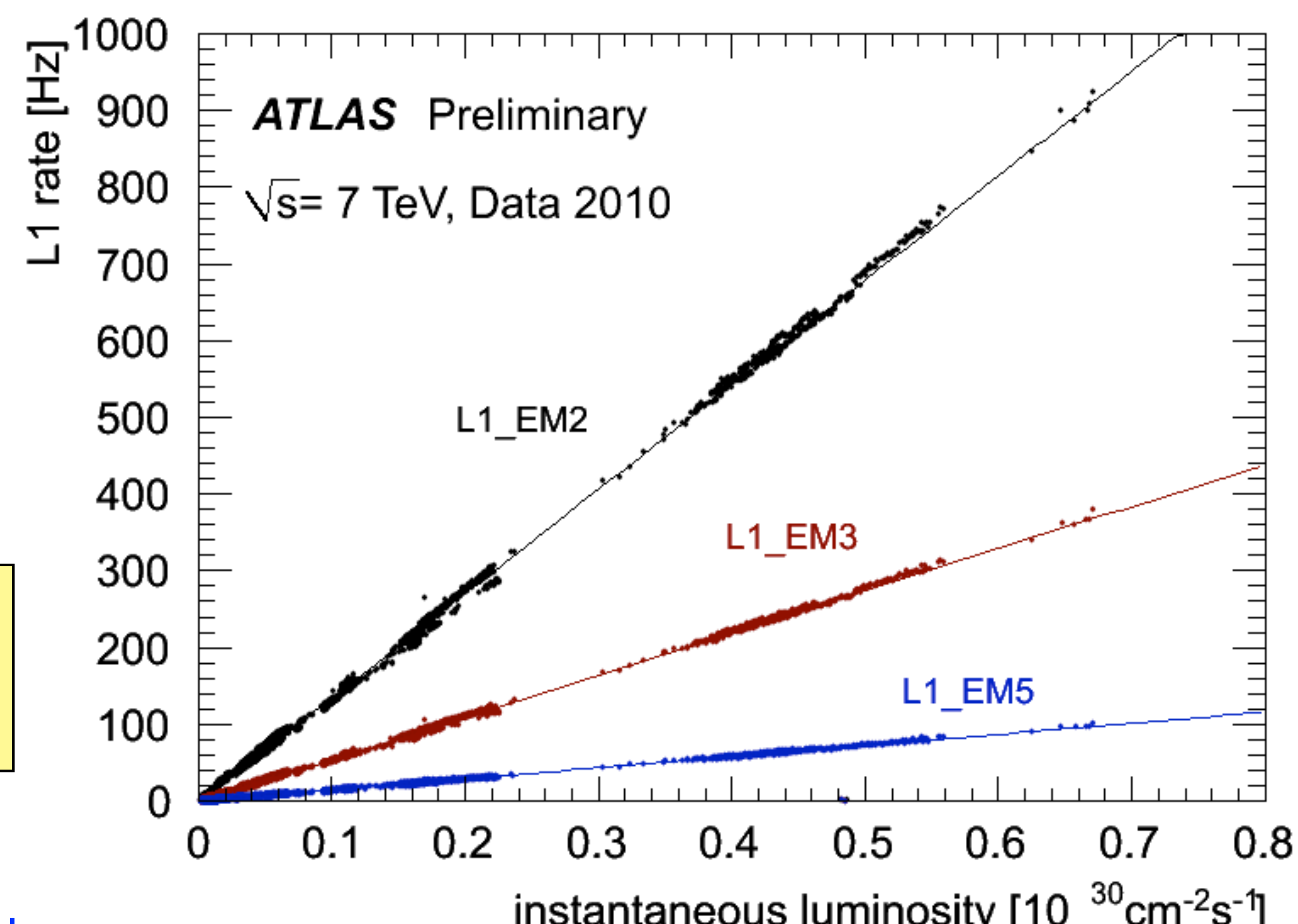
Luminosity weighted relative detector uptime and good quality data delivery during 2010 stable beams at √s=7 TeV between March 30th and August 14th (in %)

ATLAS Trigger



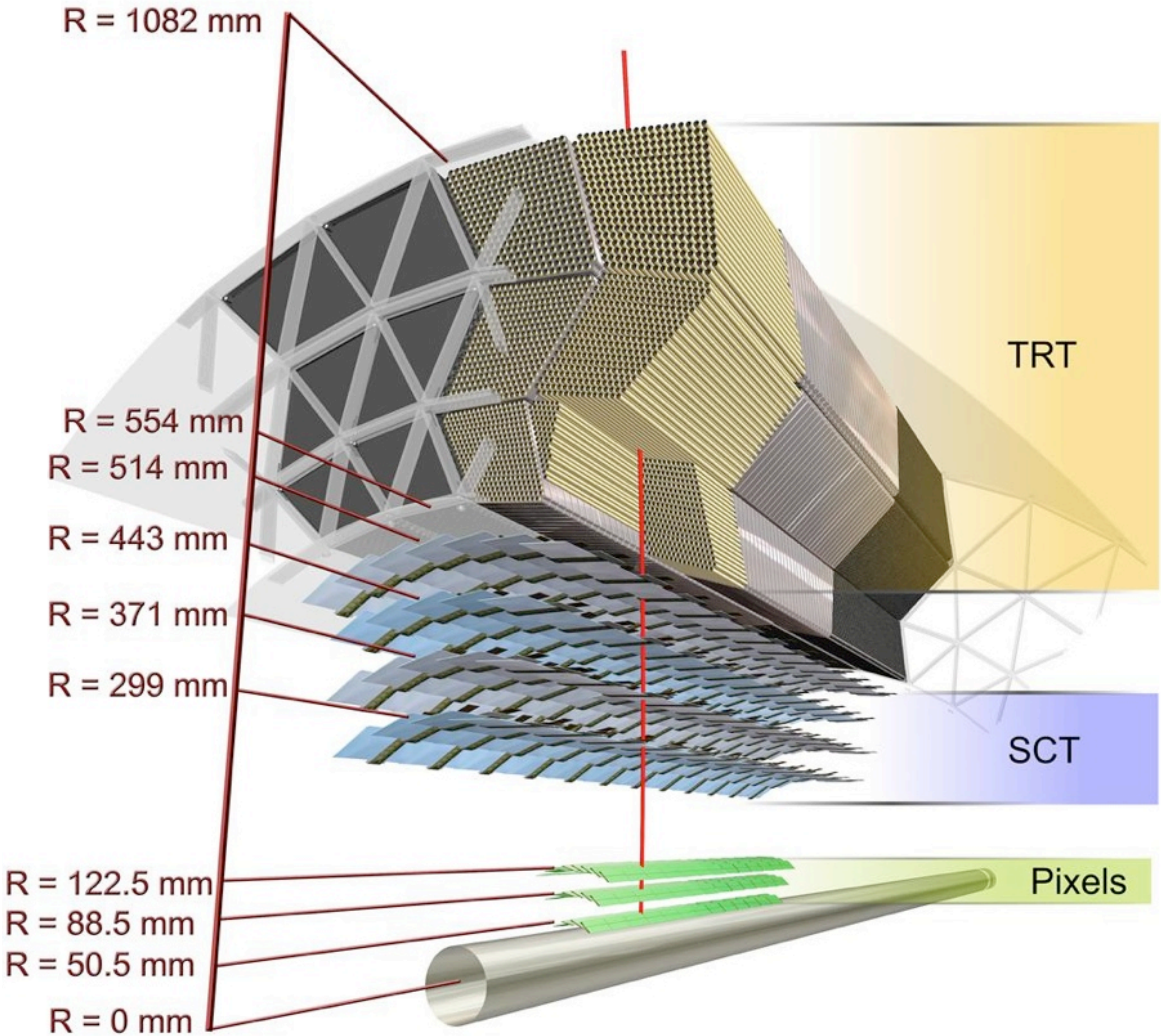
3-stage trigger to reduce
40 MHz crossing rate to 200-300 Hz

- Designed for much higher rates
- Very low thresholds for now
- Enhanced calibration samples (J/ψ)
- L = 10^{32} cm^{-2} s^{-1} menus ready



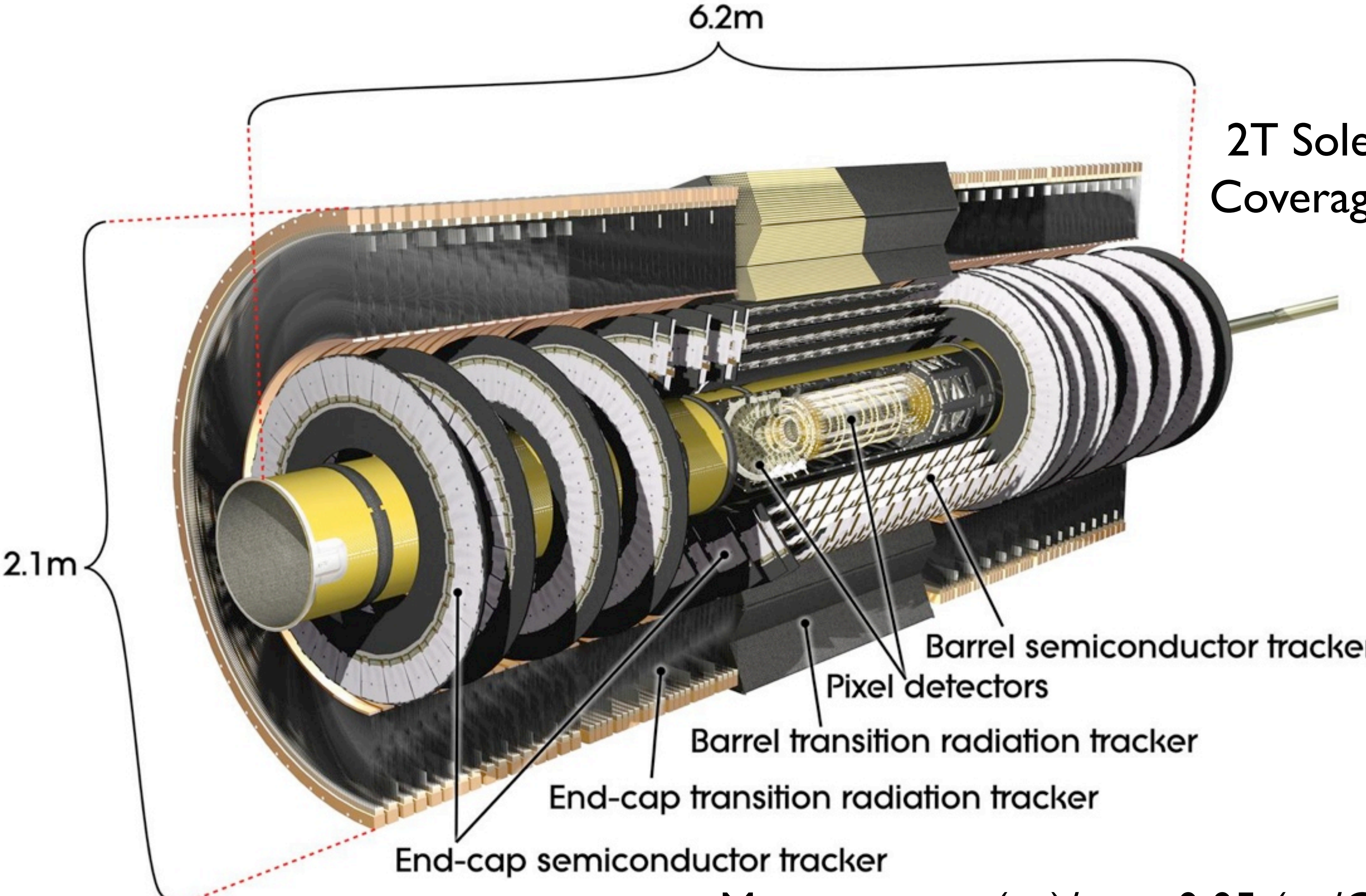
Slowly raising thresholds and enabling HLT (software) rejection with lumi

Inner Detector



- Transition Radiation Tracker
  - 73 barrel layers + 2x160 endcap layers
  - 350k ch. (straw tubes)
  - $\sigma_{r\varphi}$ = 130 μm
  - e/π separation, |η| < 2
- SemiConductor Tracker
  - 4 barrel layers + 2x9 endcap disks
  - 6M silicon strips
  - $\sigma_{r\varphi}$ = 17 μm
  - σ_z = 580 μm
- Pixel Detector
  - 3 barrel layers + 2x3 endcap disks
  - 80M pixels
  - $\sigma_{r\varphi}$ = 10 μm
  - σ_z = 115 μm

Inner Detector



2T Solenoidal Field

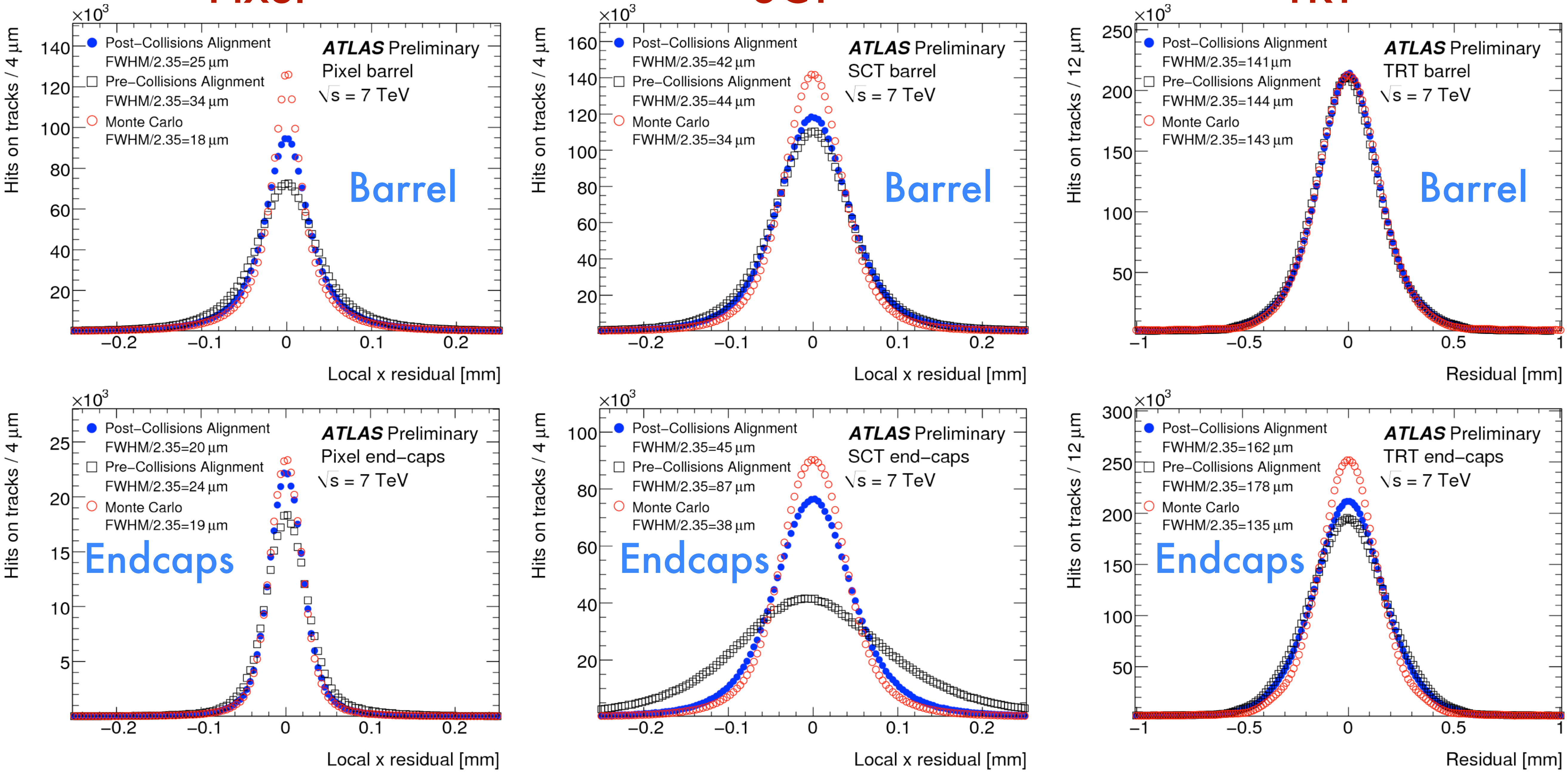
Coverage: $|\eta| < 2.5$

Momentum: $\sigma(p_T)/p_T \sim 0.05\ (p_T/\text{GeV})\% \oplus 1\%$

Impact Parameter: $\sigma(d0) \sim 10\ \mu m \oplus 140\ \mu m/(p_T/\text{GeV})$

Detector Alignment

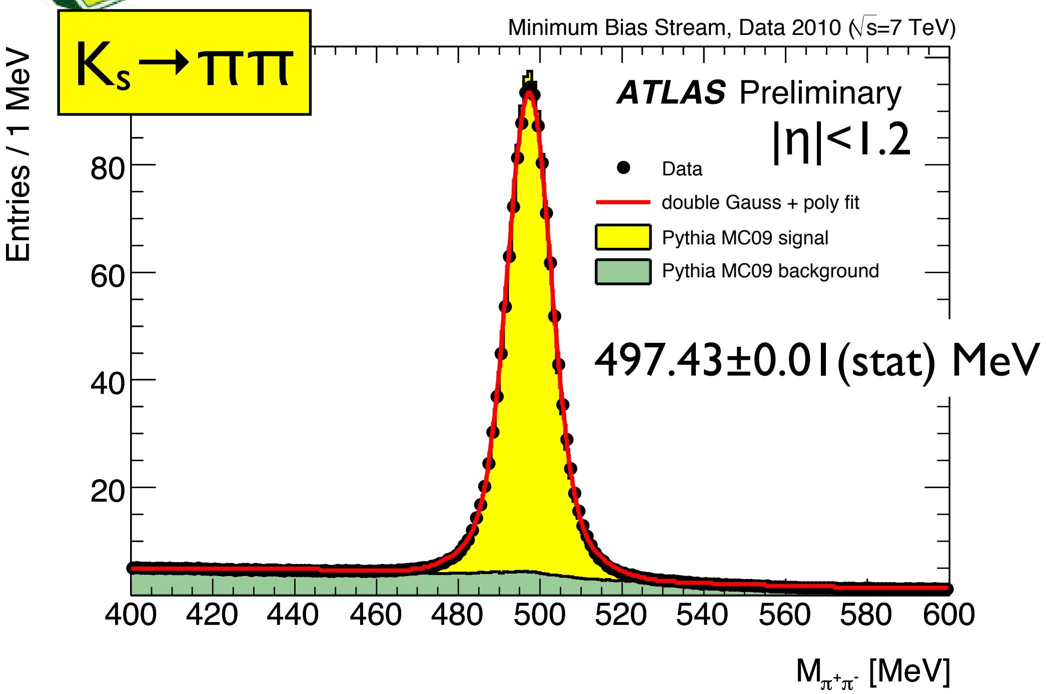
Pixel | SCT | TRT

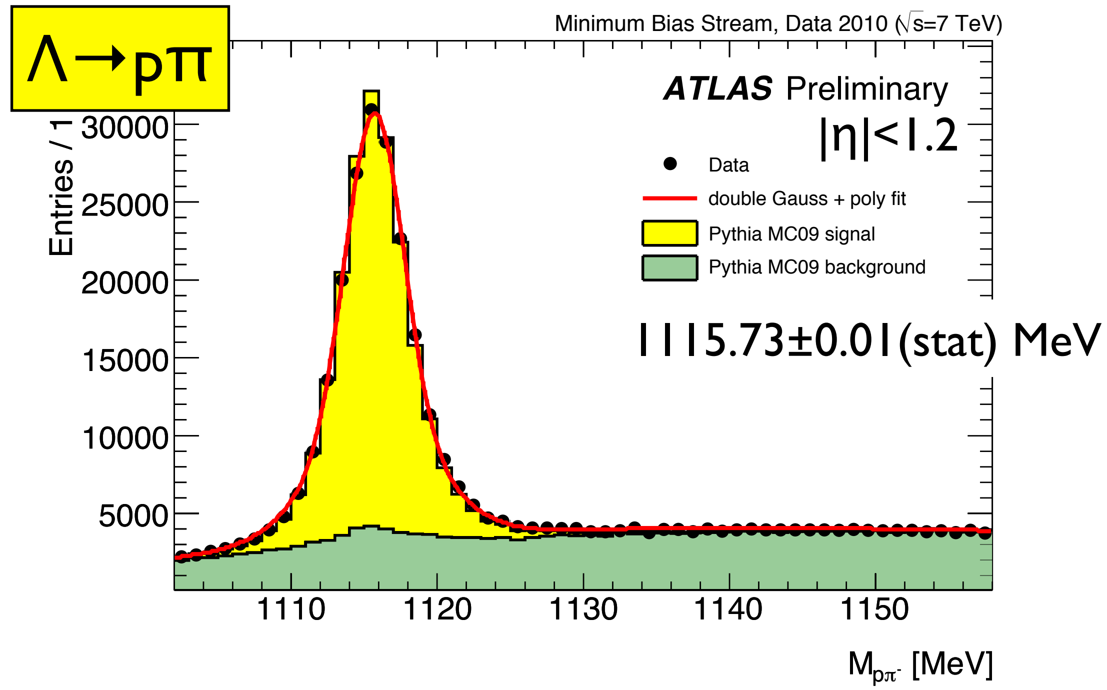


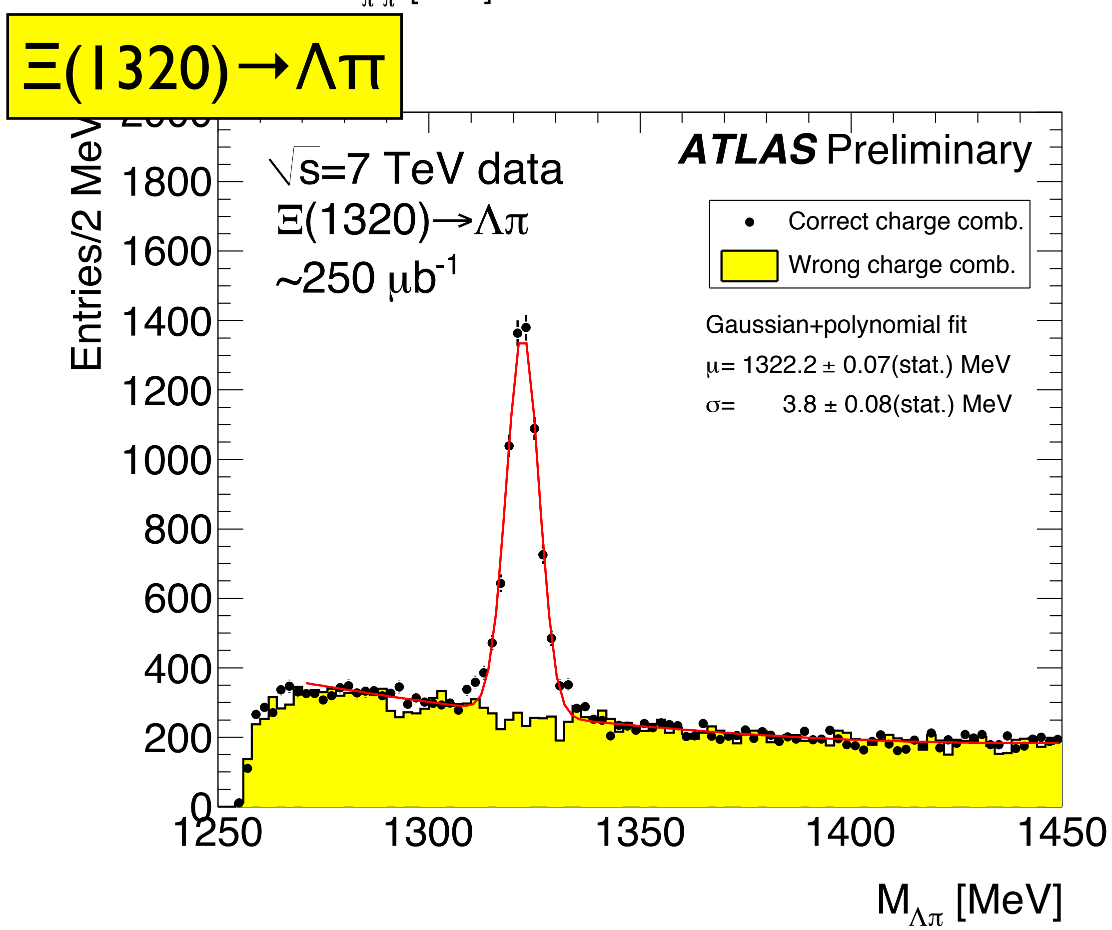
Started with cosmics,
refined with first collision data,
approaching design (MC)

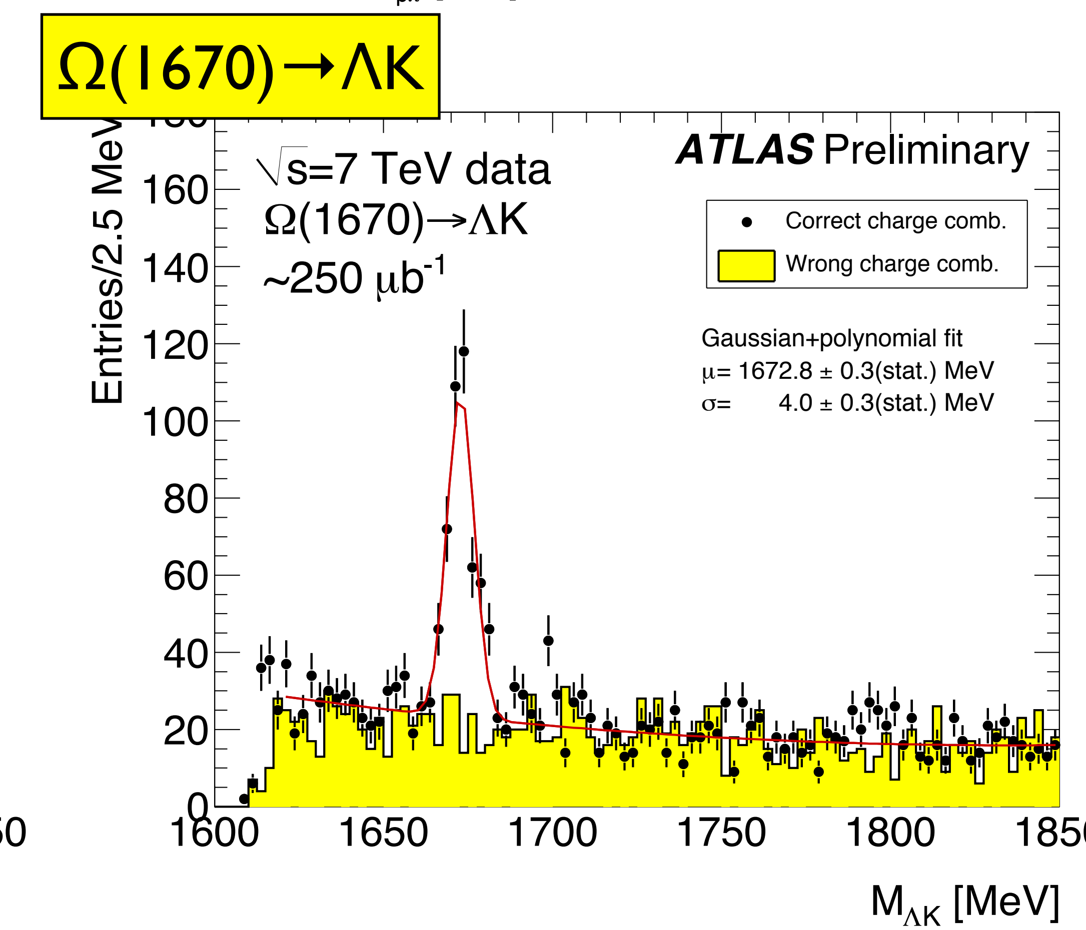
	Barrel (data/MC)	Endcap (data/MC)
Pixels	25/18 um	20/19 um
SCT	42/34 um	45/38 um
TRT	141/143 um	162/135 um

Resonance Studies









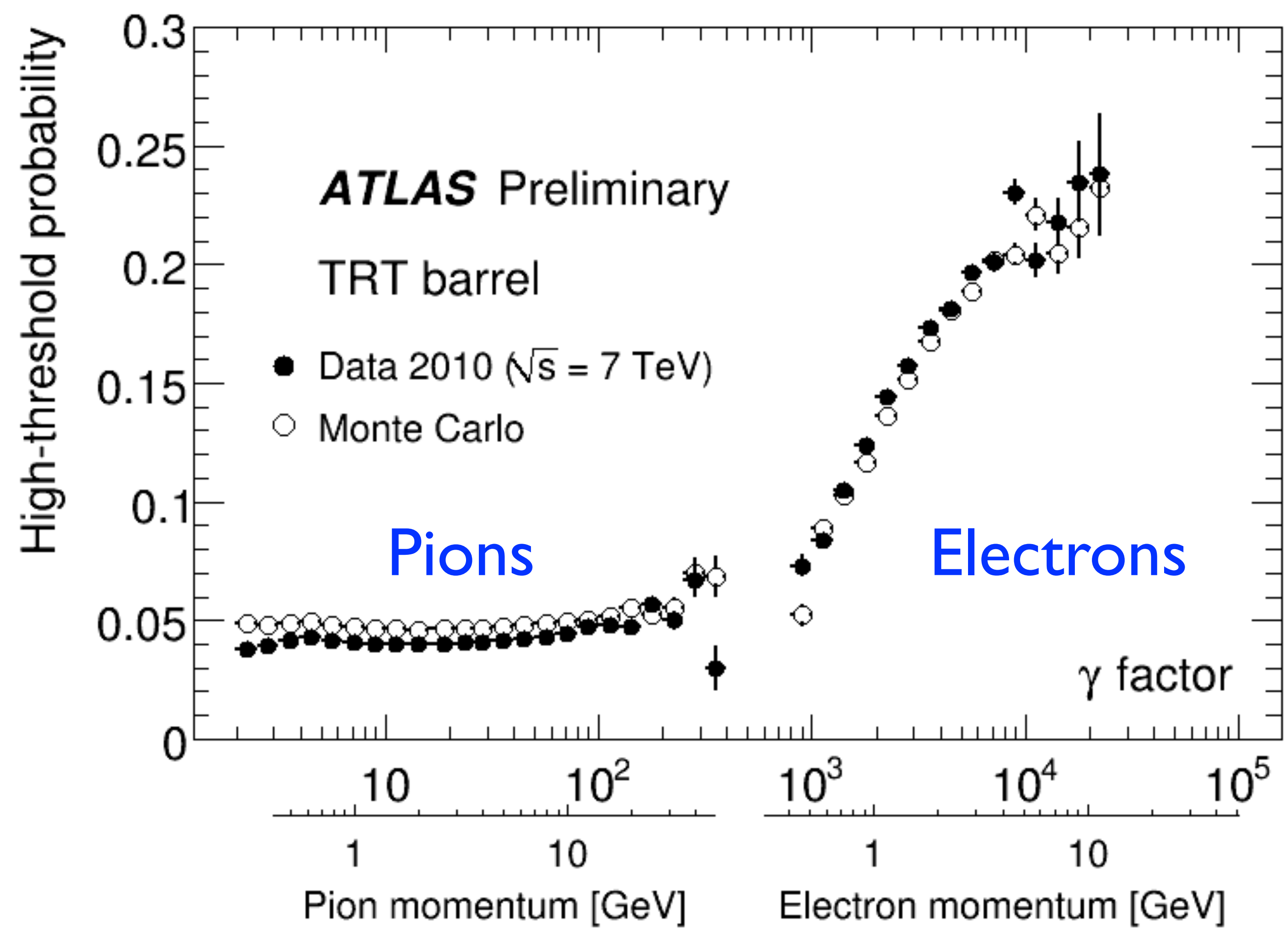
Momentum scale verified at per-mille level, resolution as expected

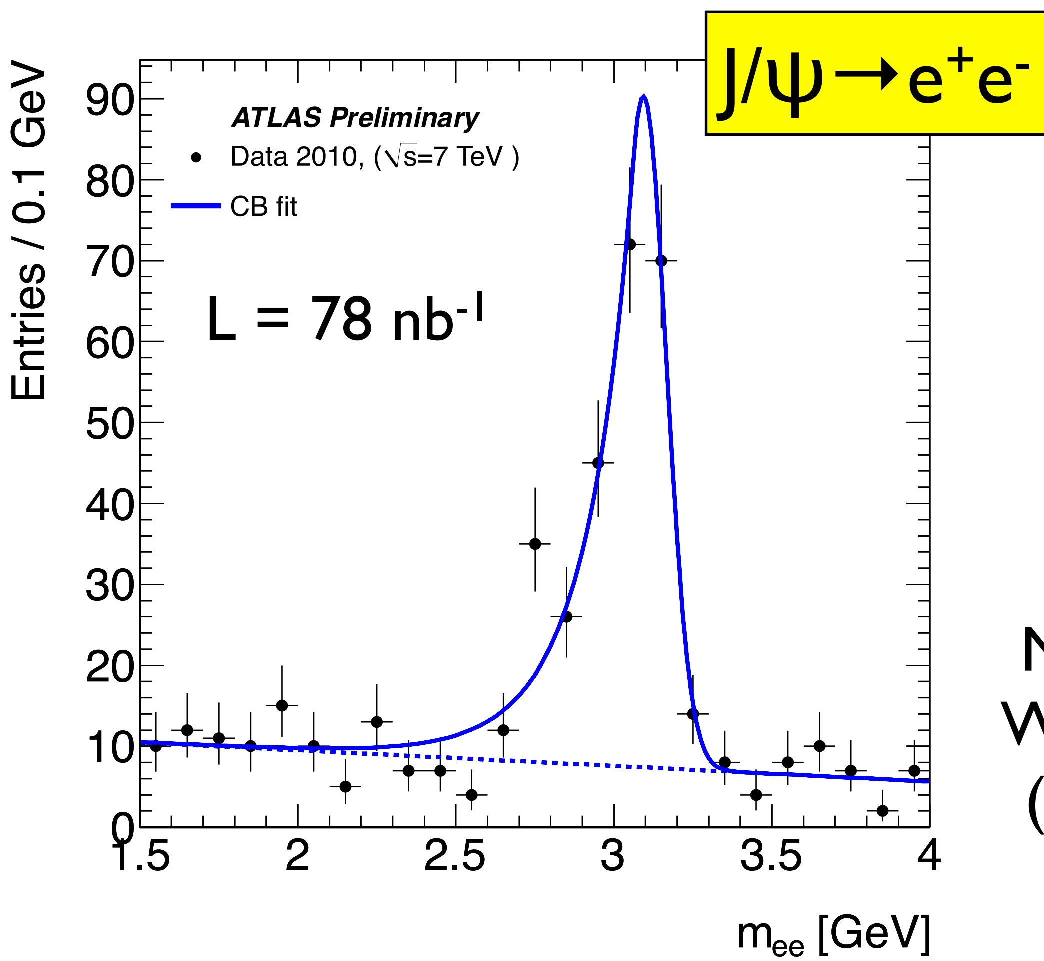
Transition Radiation

Dielectric in TRT produces
transition radiation

Higher energy deposition in
straw tubes for electrons vs pions

Number of high-threshold hits
per track key electron ID variable

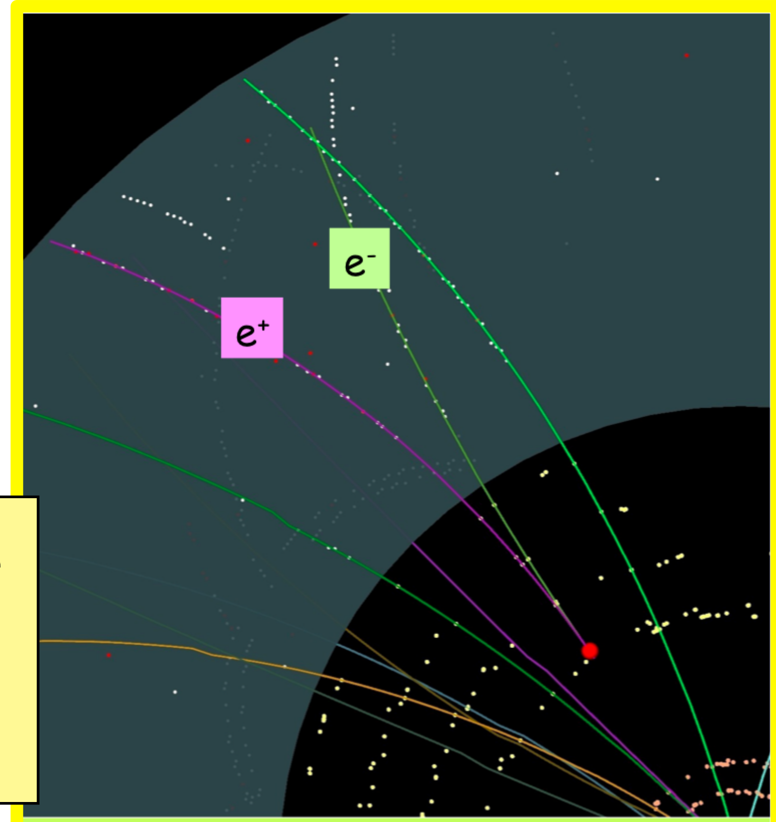


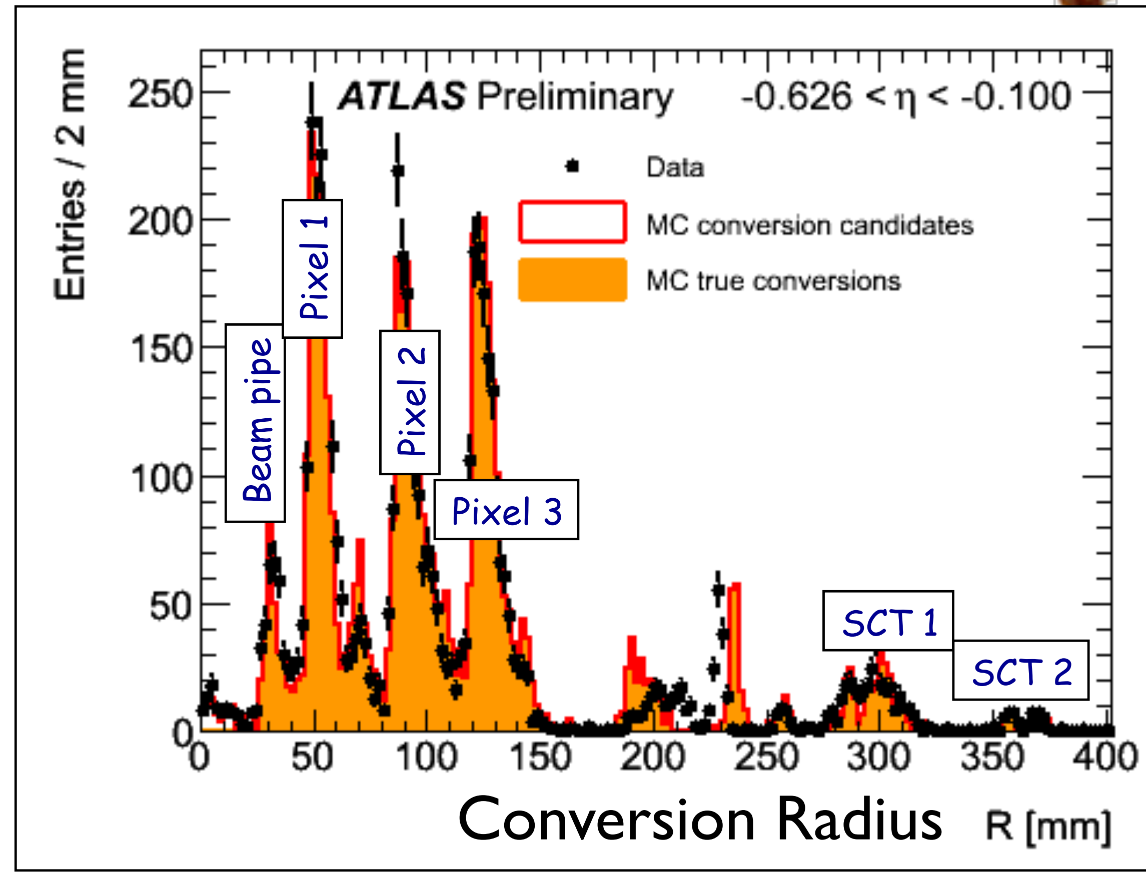


Tracking-based mass
Mass: 3.09 ± 0.01 GeV
Width: 0.07 ± 0.01 GeV
(after brem. recovery)

Material Mapping

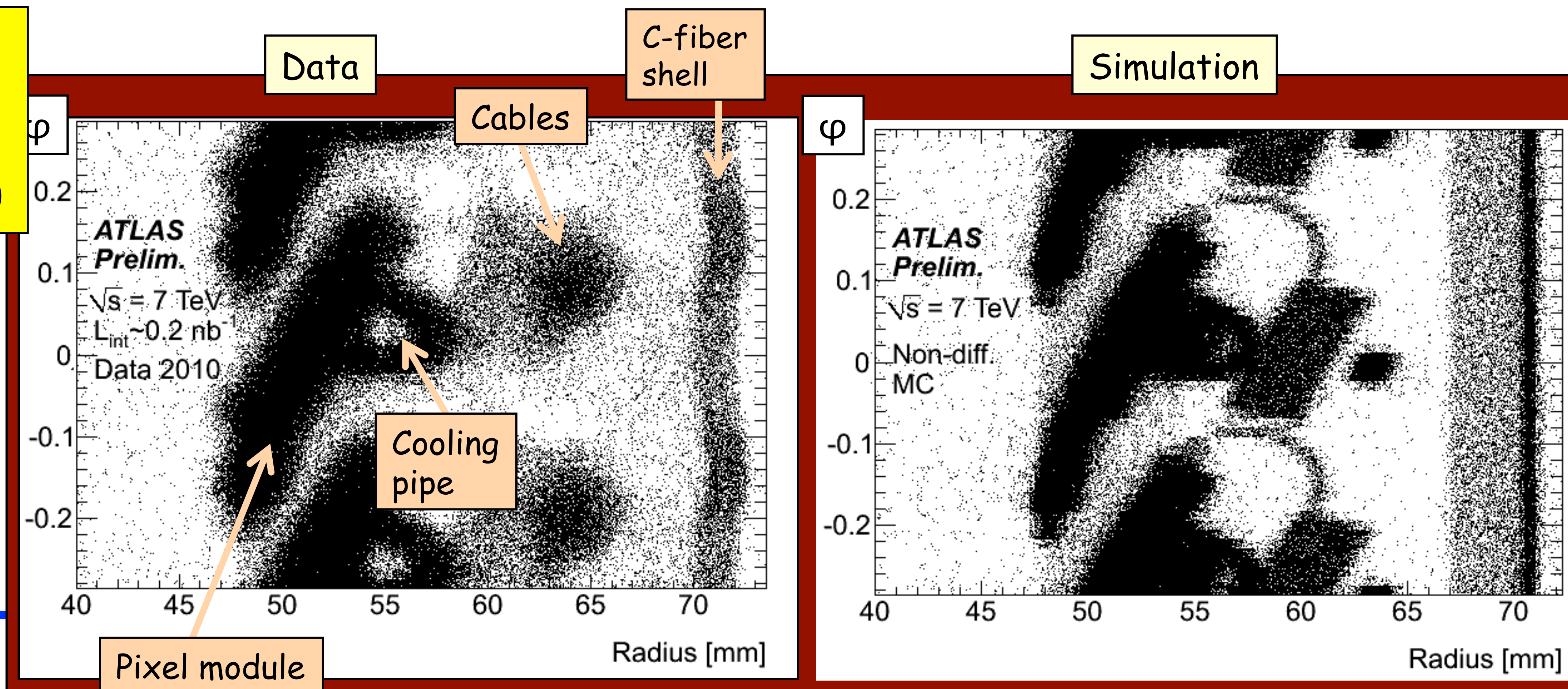
Conversions
(sensitive to X_0)





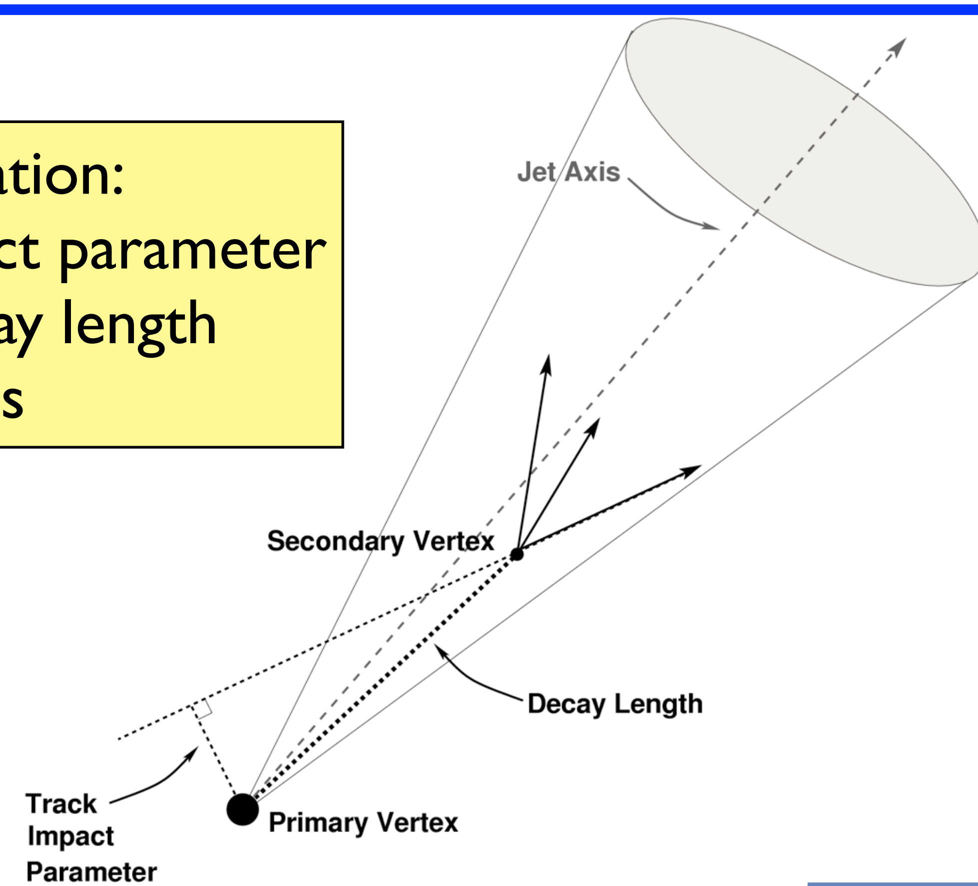
Material Knowledge
Current: ~10%
Goal: 5%

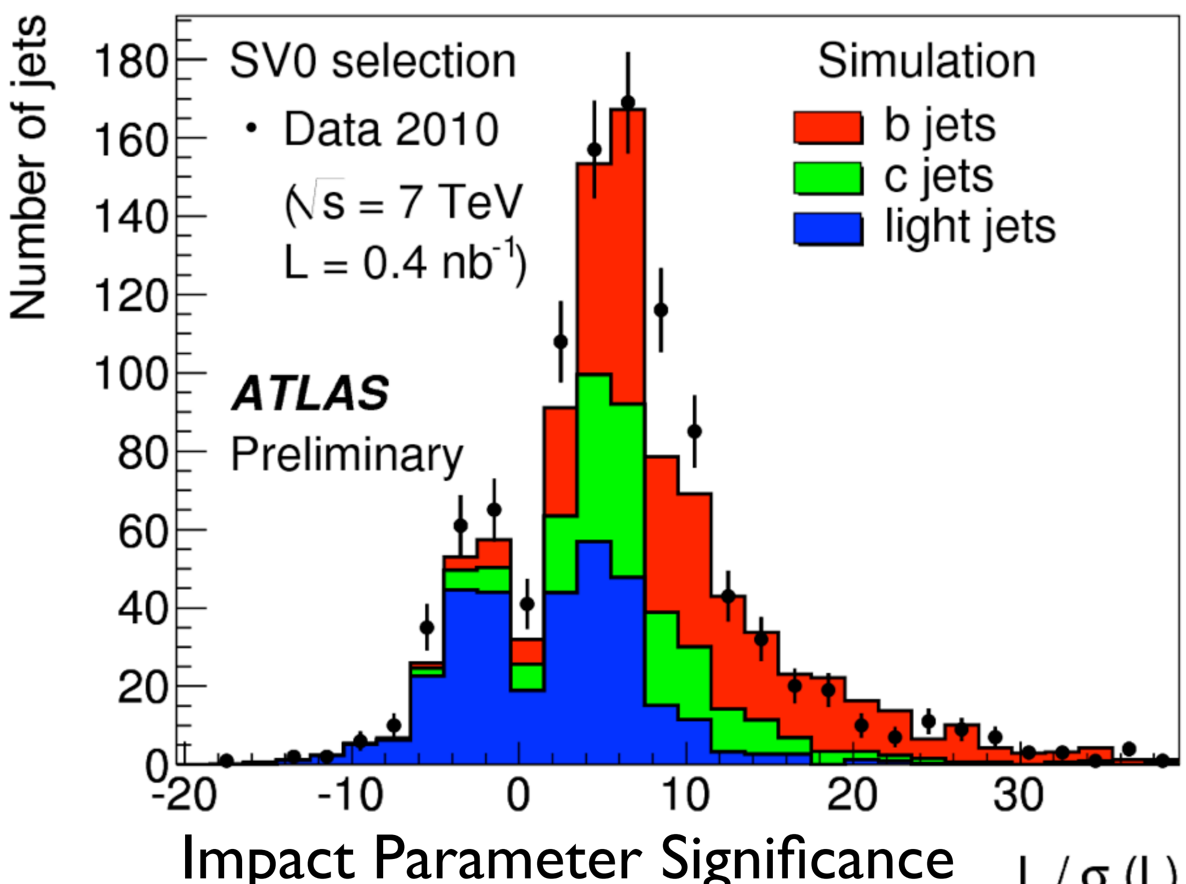
Nuclear
Interactions
(sensitive to λ)

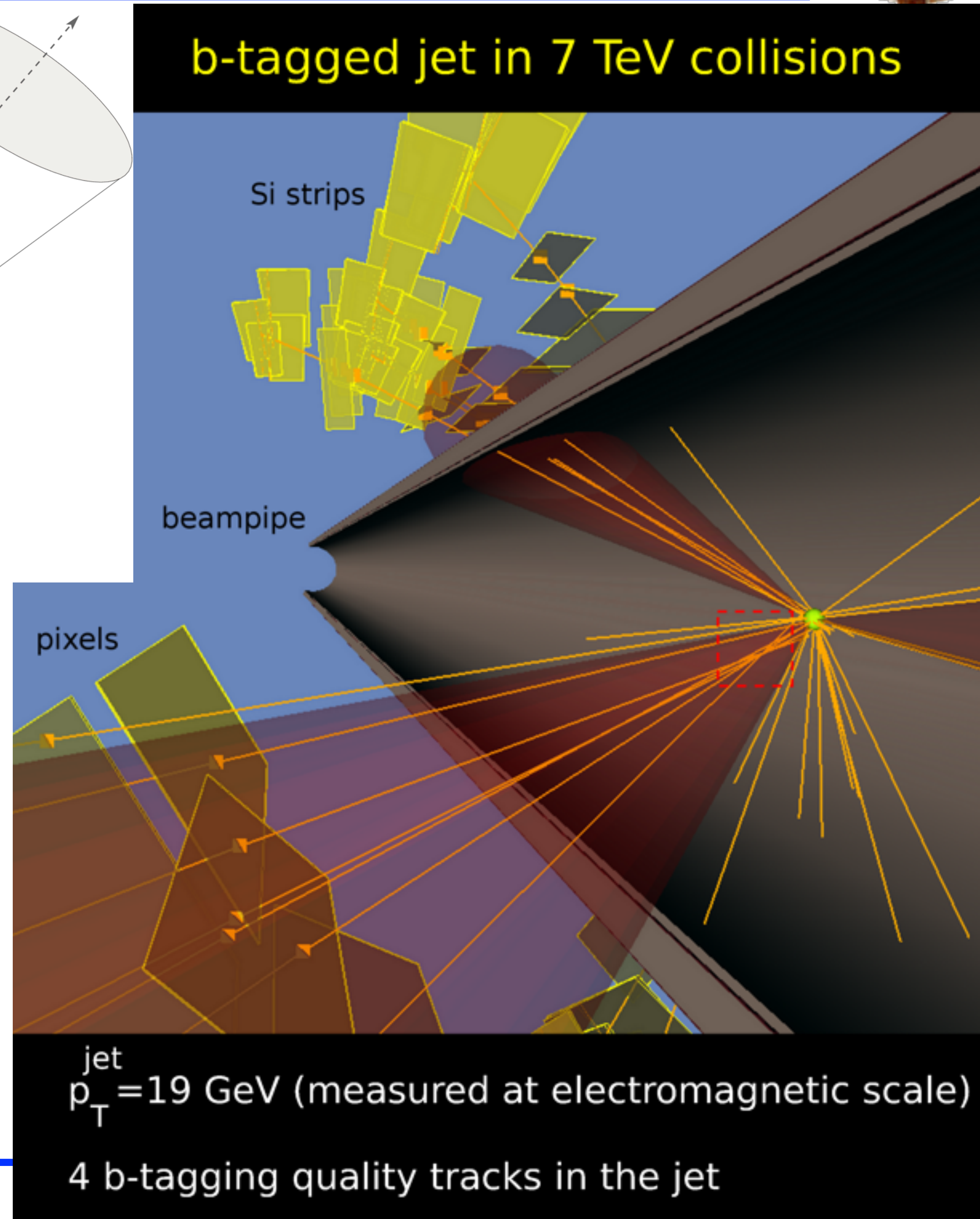


B-tagging

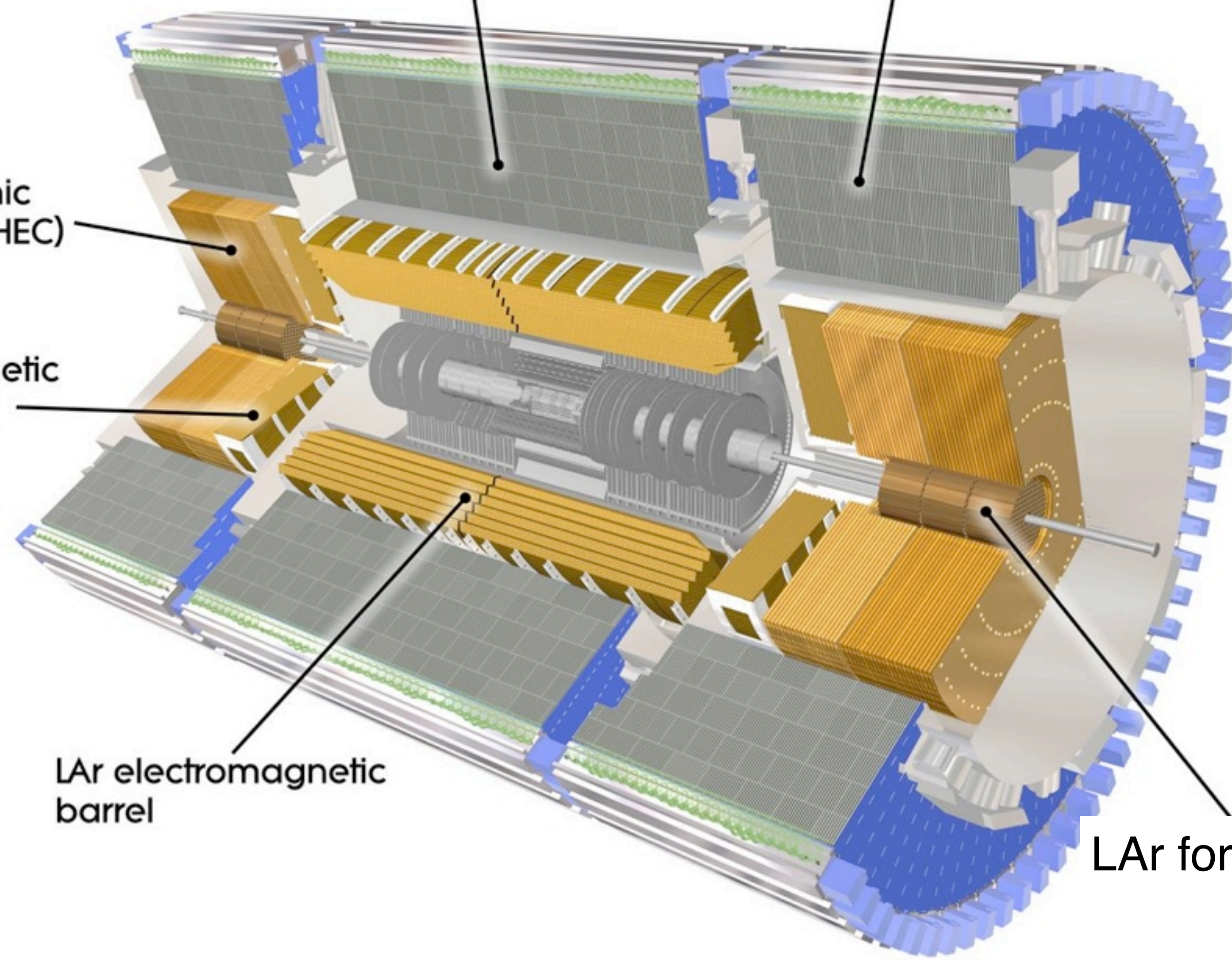
B-jet identification:
- Track impact parameter
- Vertex decay length
- Vertex mass







Calorimetry



- EM Calo - LAr/Pb
  - $|\eta| < 3.2$
  - $\sigma_E/E \sim 10\%/\sqrt{E} \oplus 0.7\%$
- Hadronic Barrel - Scin/Fe
  - $|\eta| < 1.7$
  - σ_E/E (jet) $\sim 50\%/\sqrt{E} \oplus 3\%$
- Hadronic Endcap - LAr/Cu
  - $1.5 < |\eta| < 3.2$
  - σ_E/E (jet) $\sim 50\%/\sqrt{E} \oplus 3\%$
- Forward - LAr/Cu,W
  - $3.1 < |\eta| < 4.9$
  - σ_E/E (jet) $\sim 100\%/\sqrt{E} \oplus 10\%$

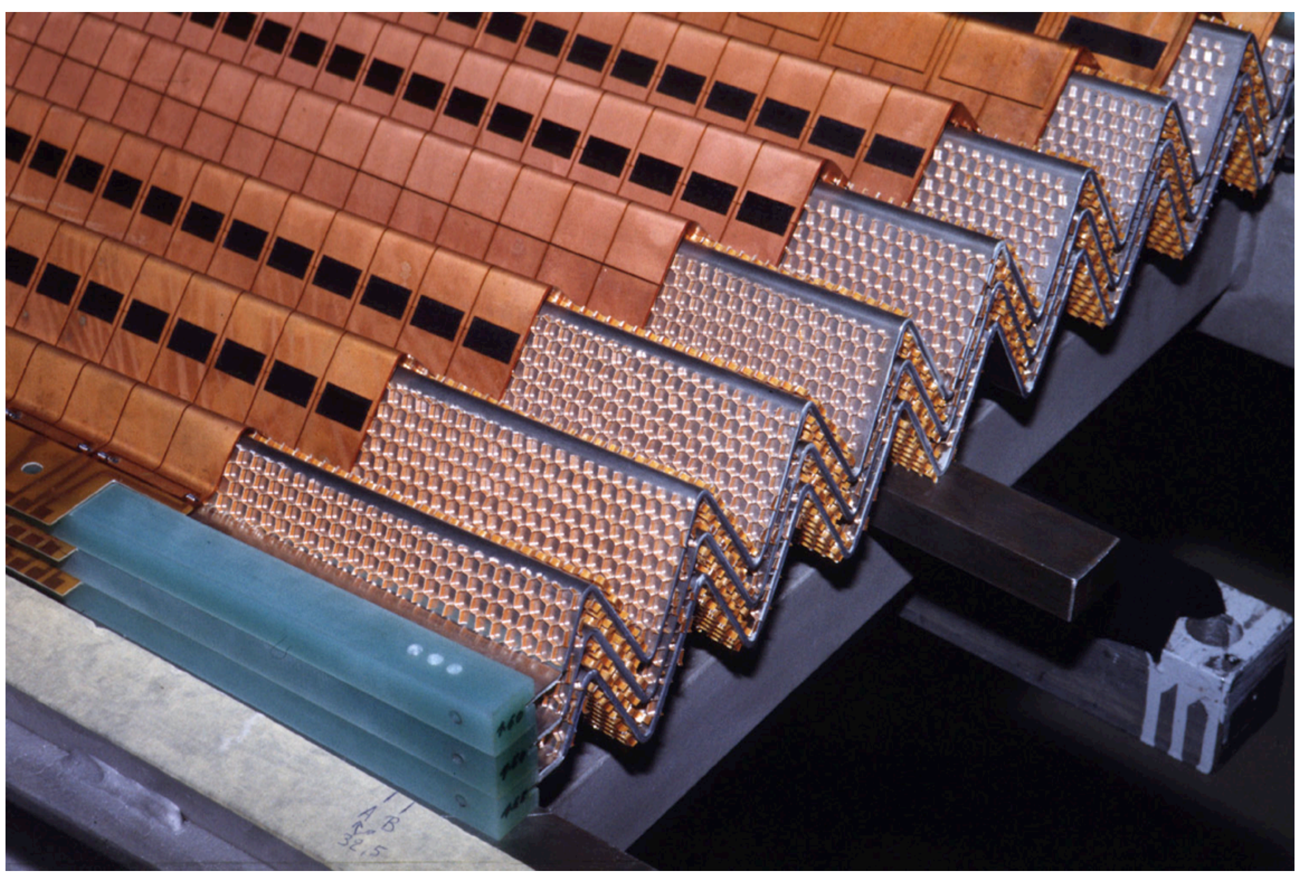
Based on LAr with 'accordion' geometry
Coverage: $|\eta| < 4.9$, Depth: $> 22\ \chi_0$, $>10\ \lambda$
EM Resolution: $\sigma_E/E \sim 10\%/\sqrt{E} \oplus 0.7\%$

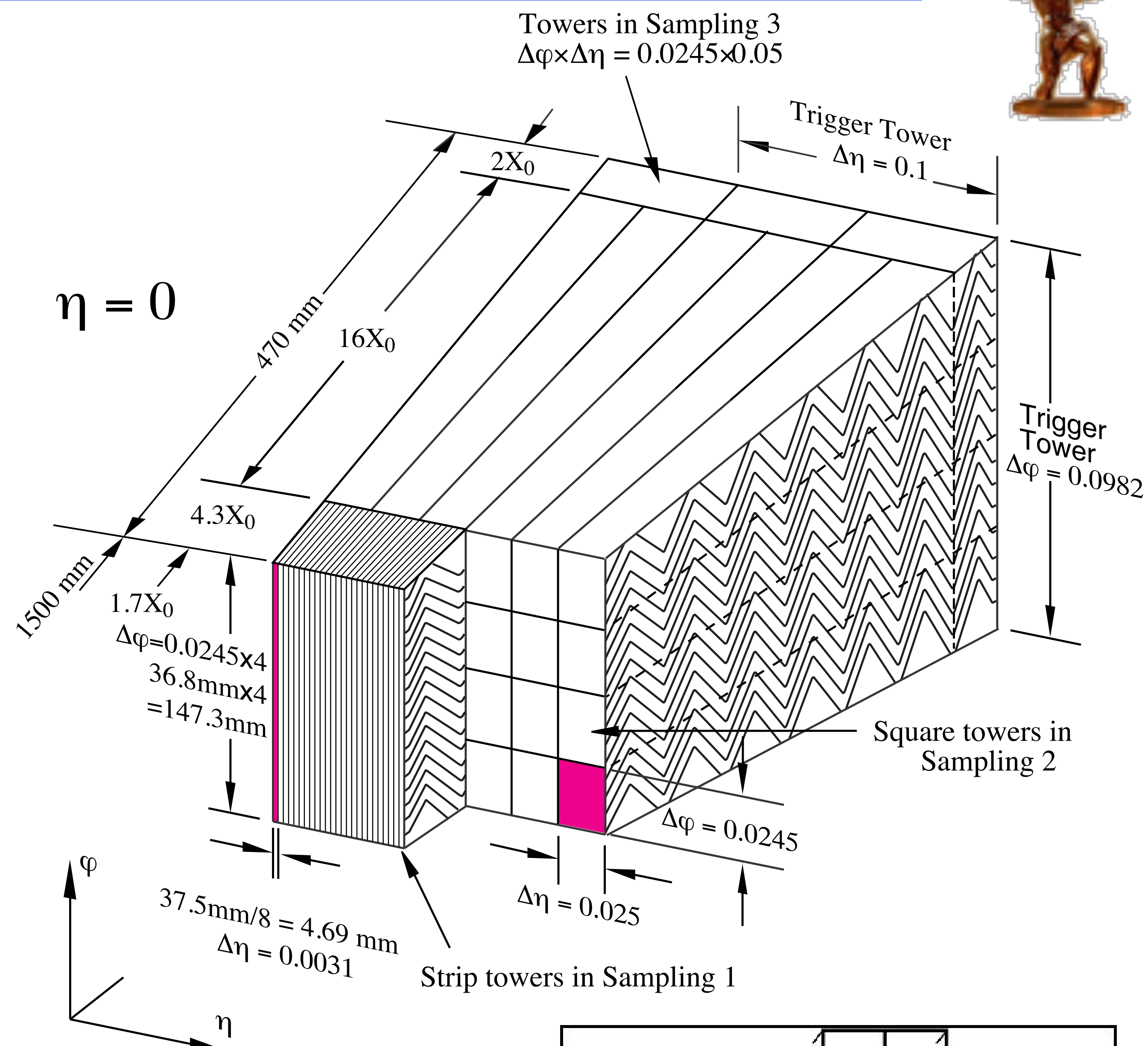
LAr Geometry

Accordion geometry provides very hermetic "no crack" coverage

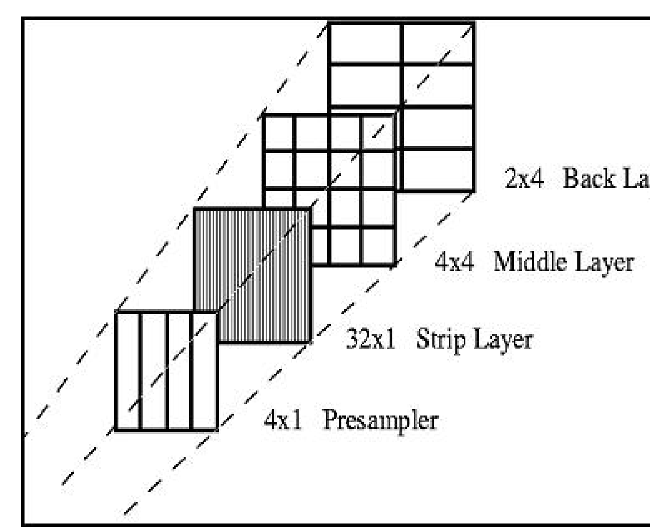
High degree of 3D spatial granularity including 4 longitudinal layers

Typical (Δη,Δφ): 0.025x0.025
Strip Layer Δη: 0.0031



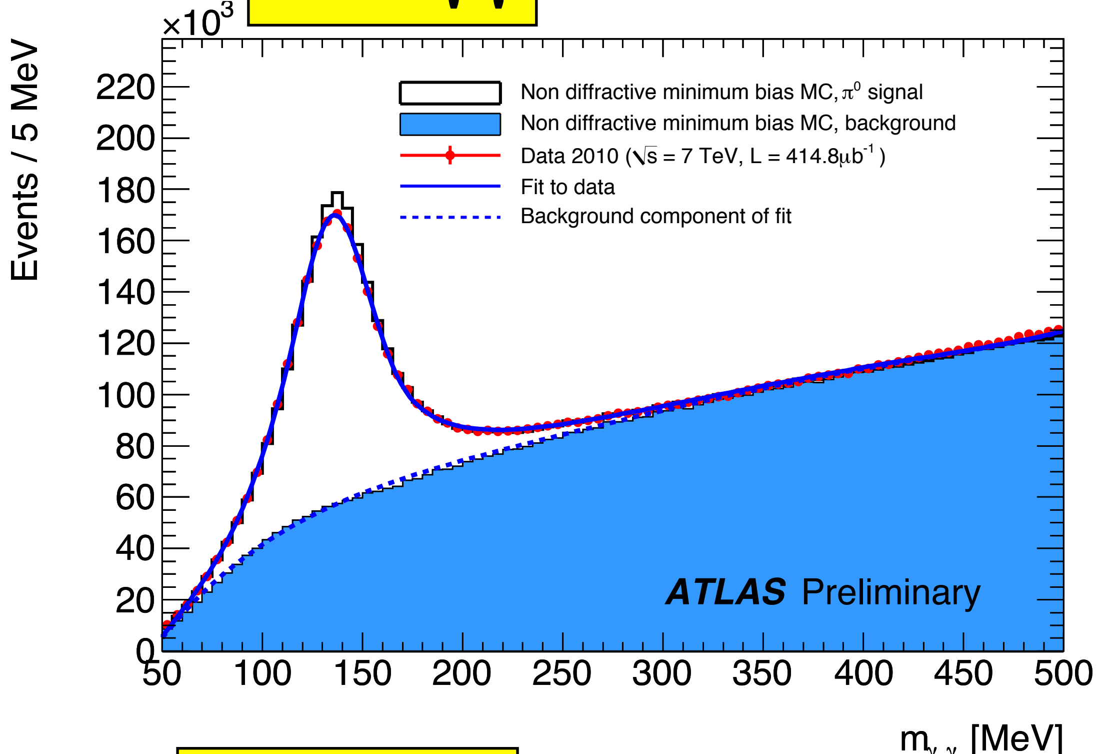


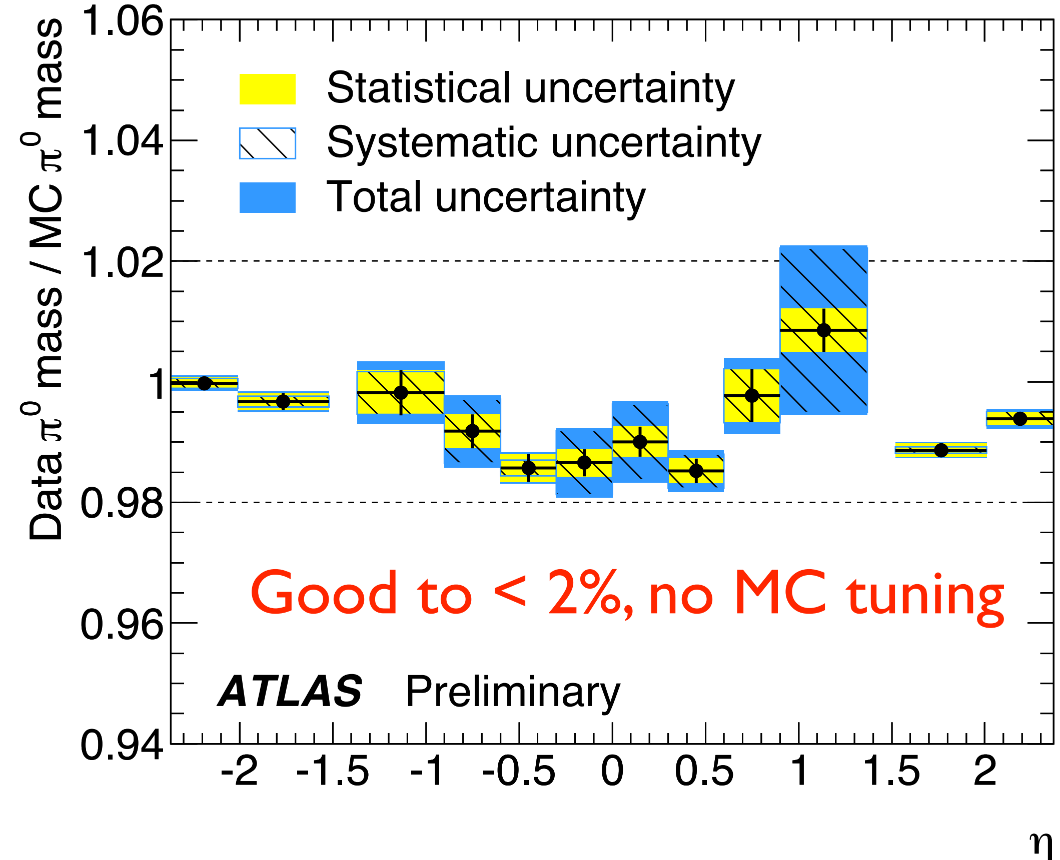
compared to (Δη,Δφ): 0.1x0.1 trigger tower



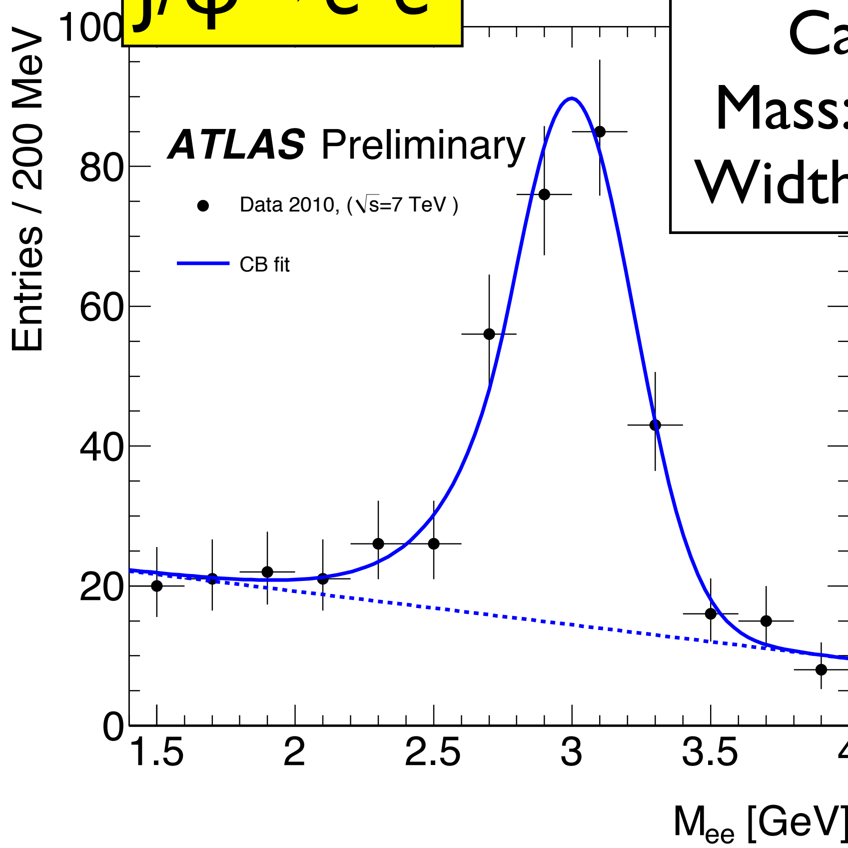
Electromagnetic Response

$\pi^0 \to \gamma\gamma$

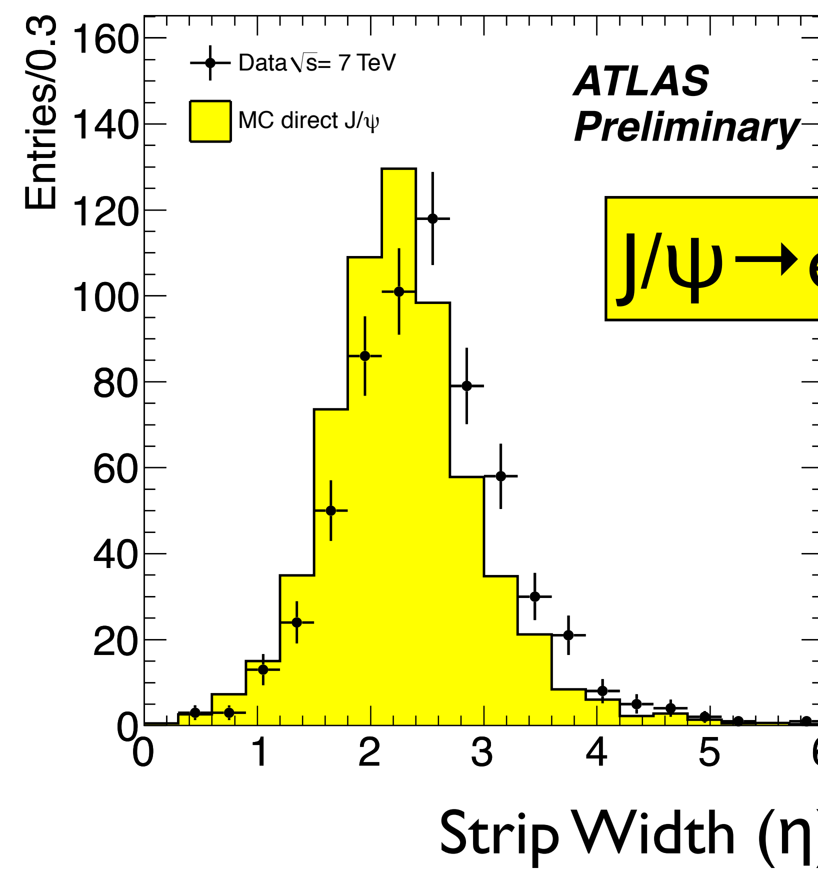




$J/\psi \to e^+e^-$



Calo-based mass
Mass: 3.00 ± 0.03 GeV
Width: 0.22 ± 0.03 GeV

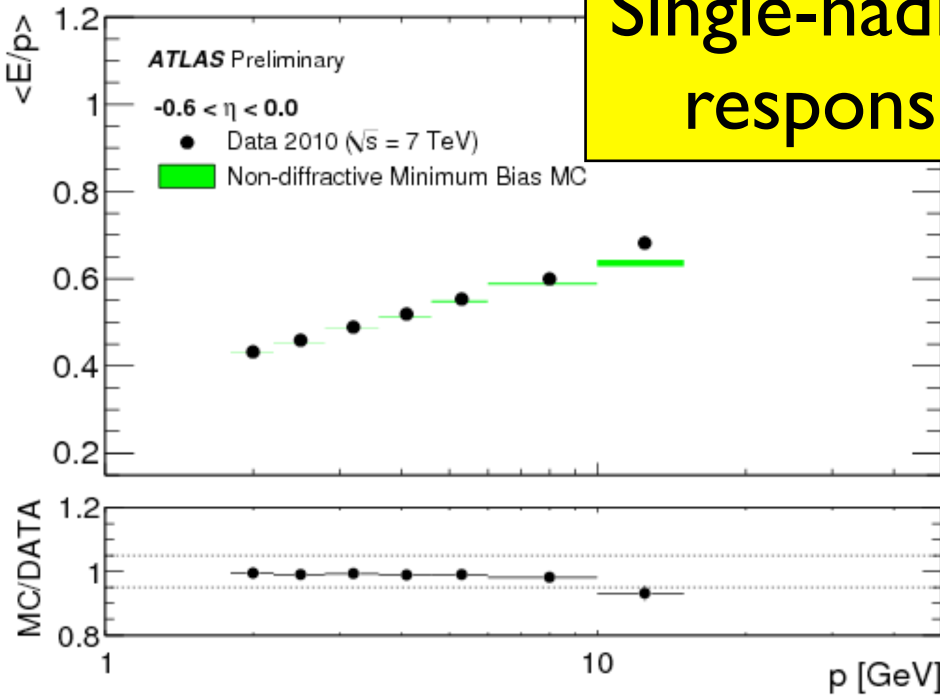


$J/\psi \to e^+e^-$

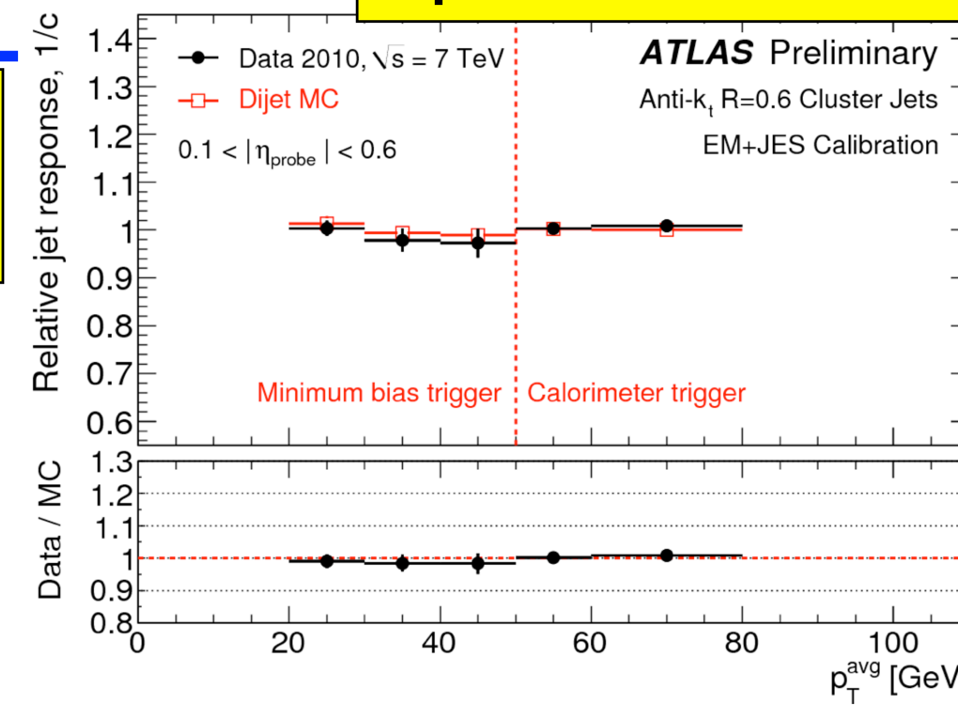
Jet Energy Scale

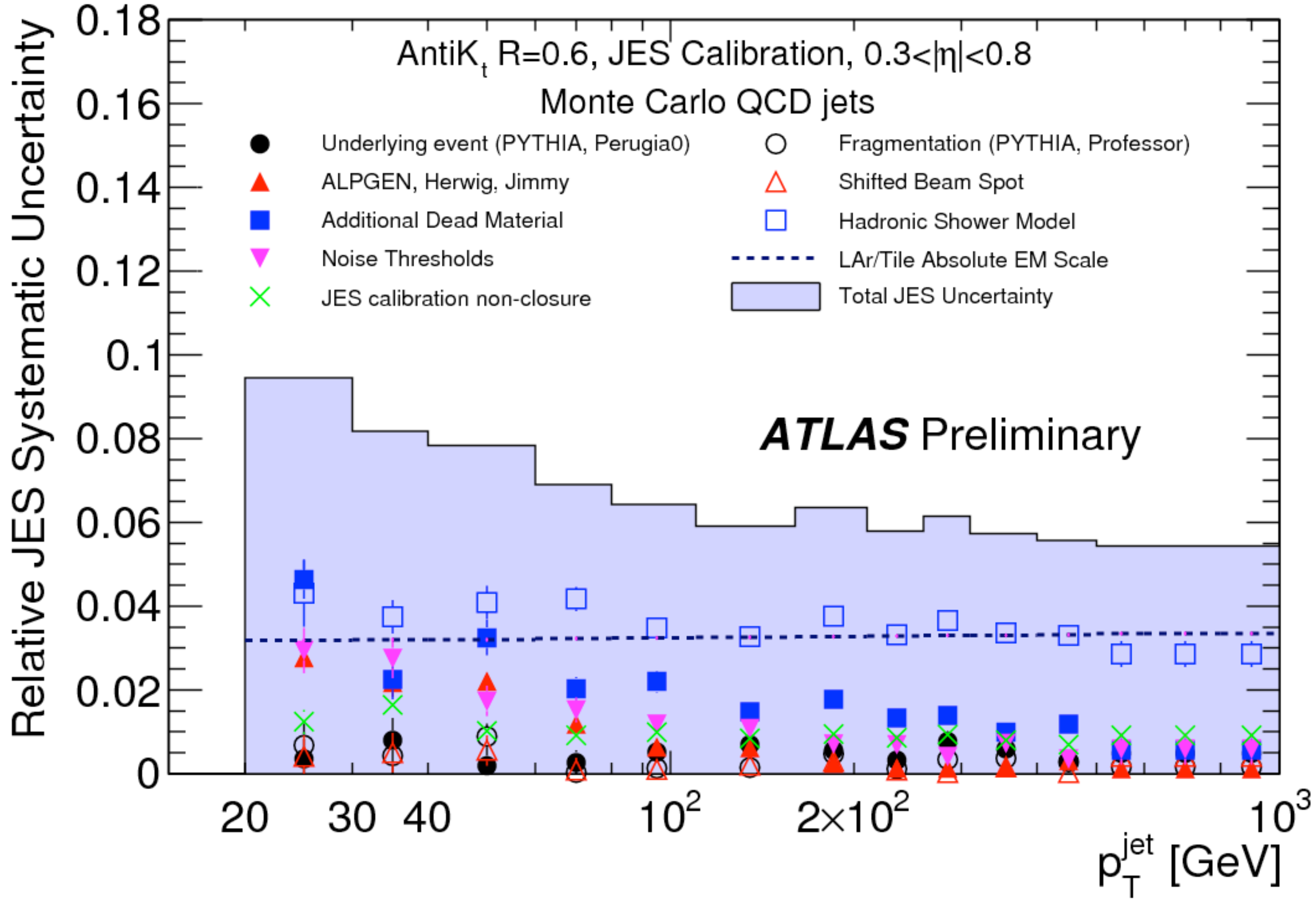
Huge amount of work, many individual factors considered

Single-hadron response

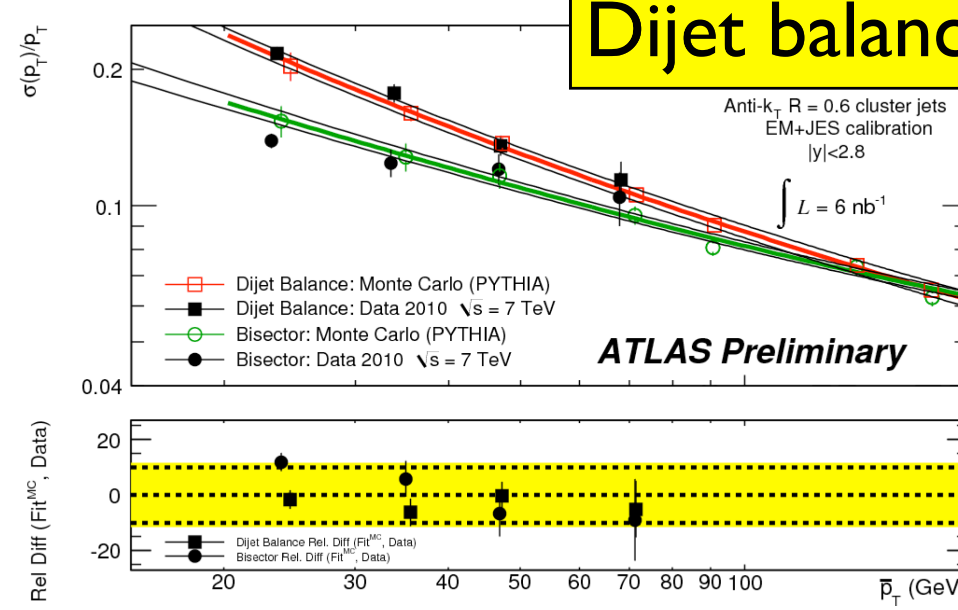


η intercalibration





Dijet balance



Current JES uncertainty 6-7% for p_T > 60 GeV

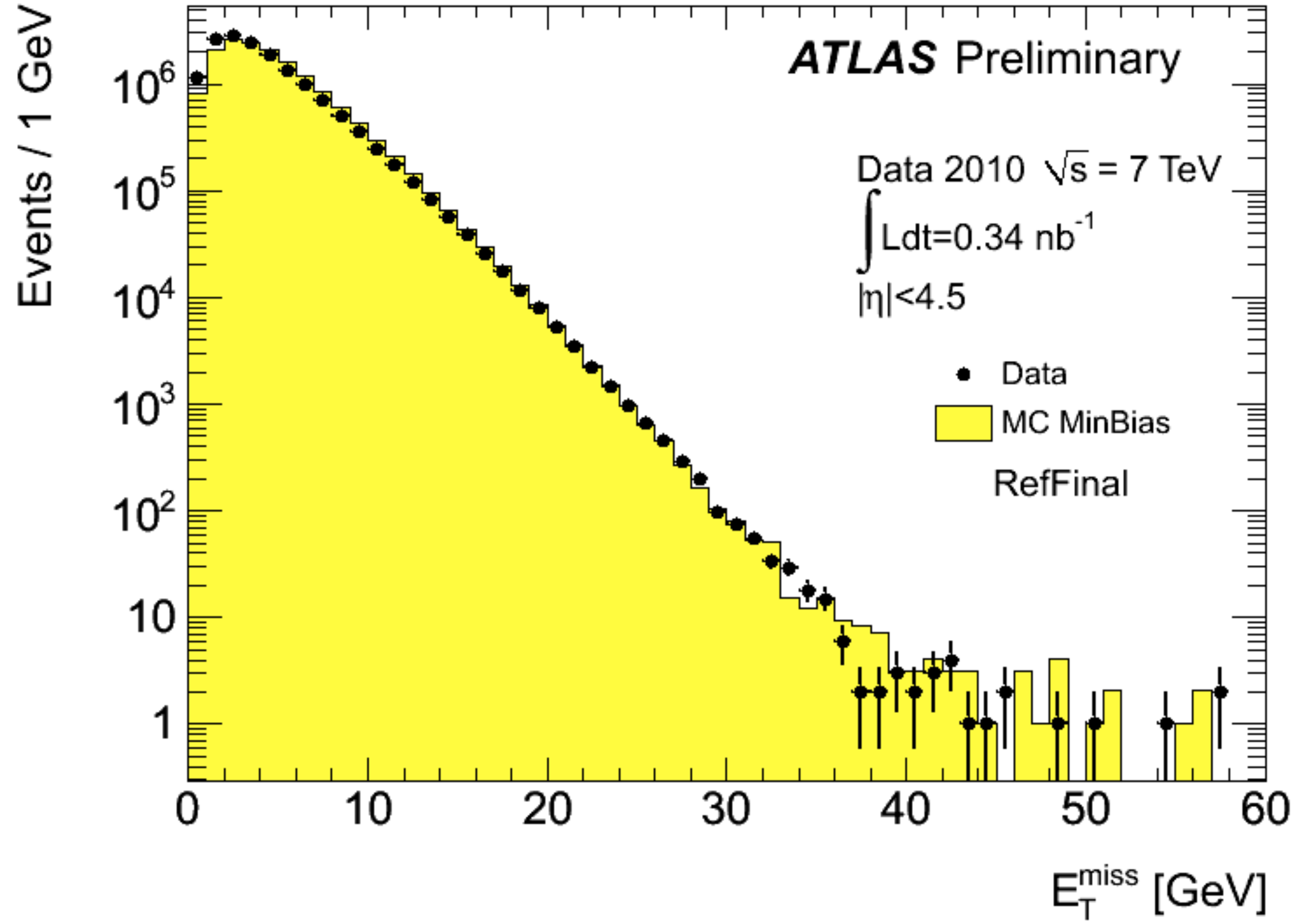
Missing Energy

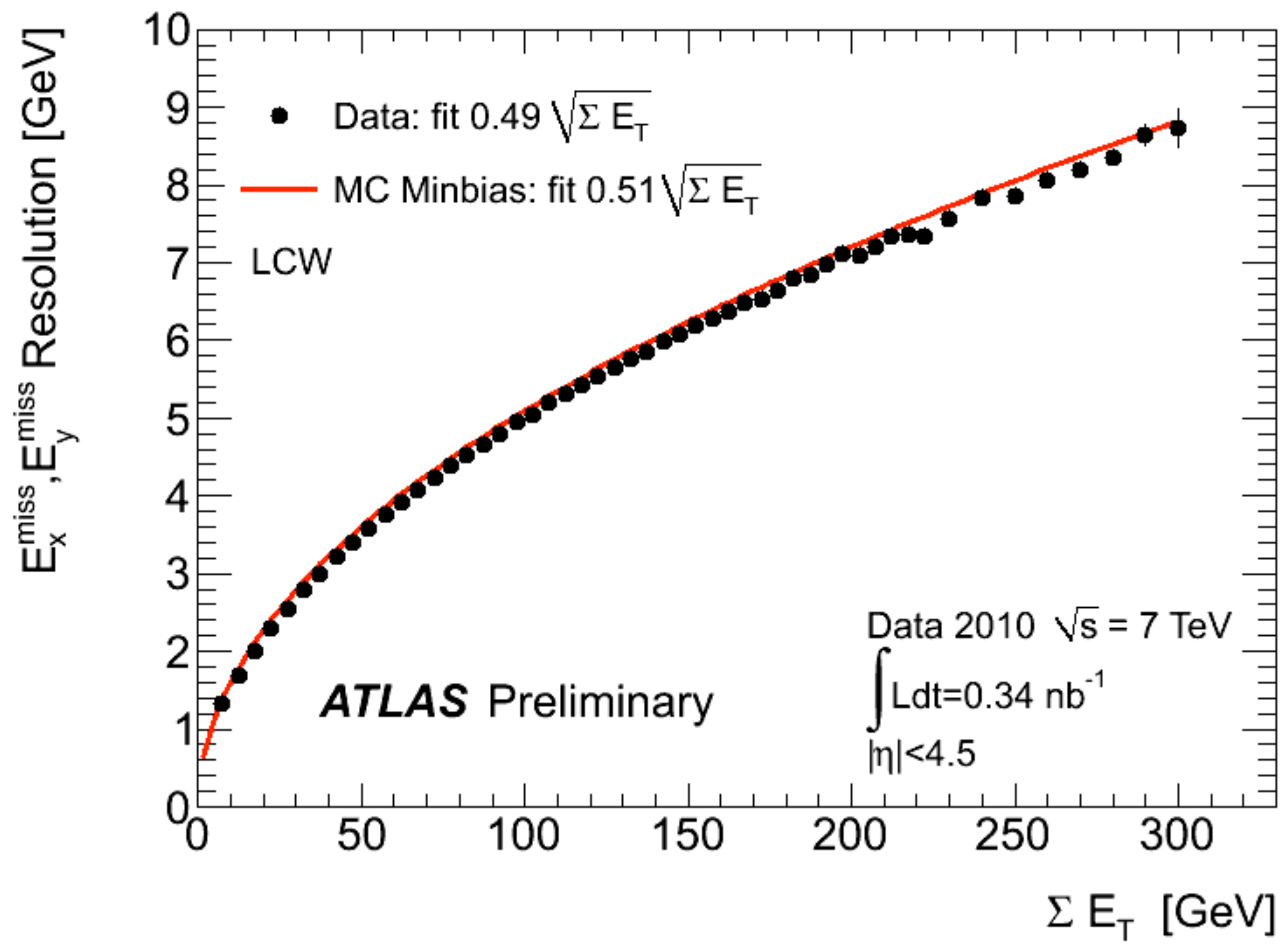
Critical tool for many new physics searches

3D calorimeter 'topoclusters' used to reduce noise

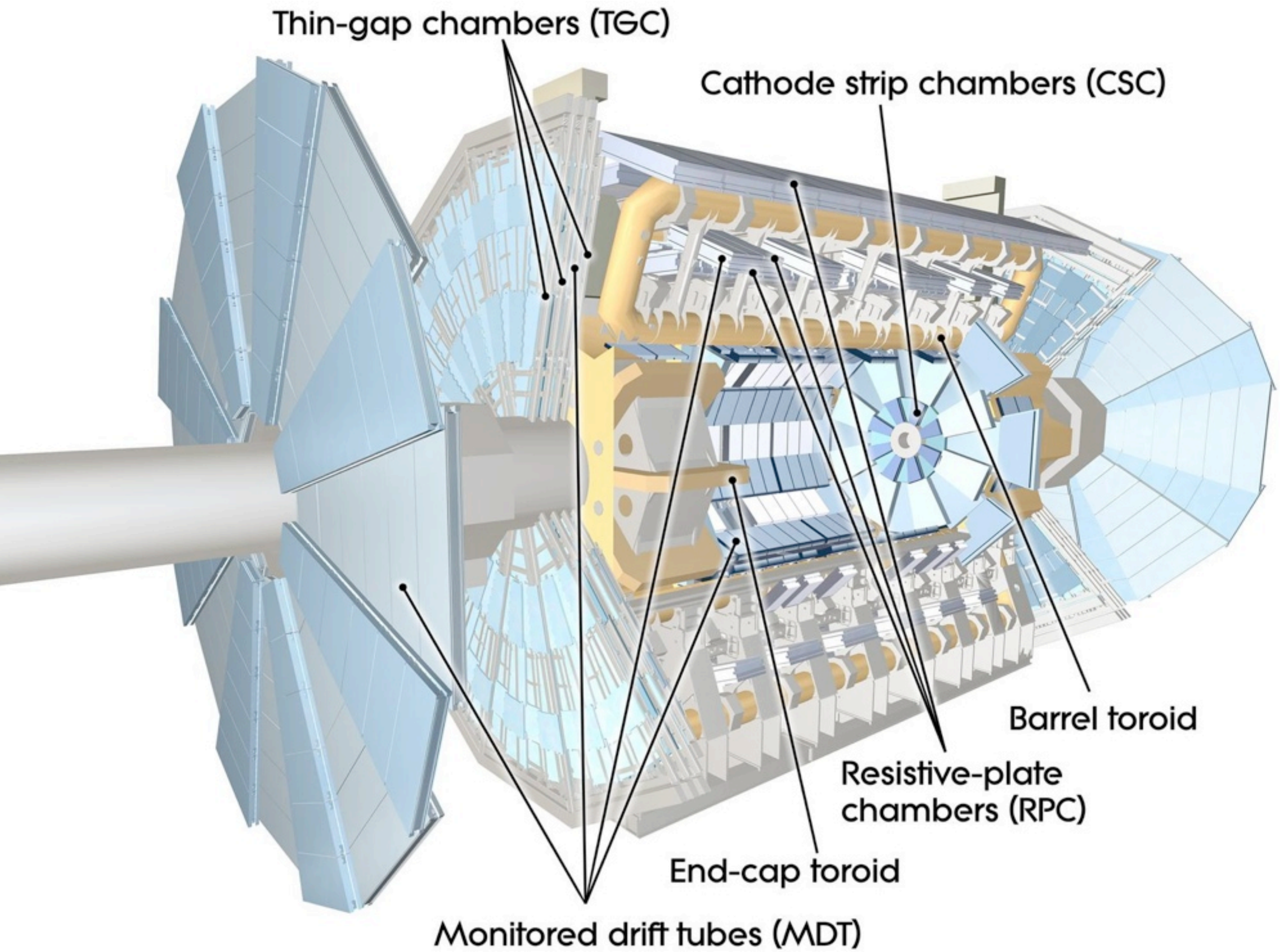
'Refined' algorithms with object corrections (e/μ/τ) under study

Very good data-MC agreement over 6 orders of magnitude!





Muon System



- Trigger Chambers
  - Resistive Plate Chambers
  - Thin-gap Chambers
- Precision Chambers
  - Monitored Drift Tubes
  - Cathode strip Chambers

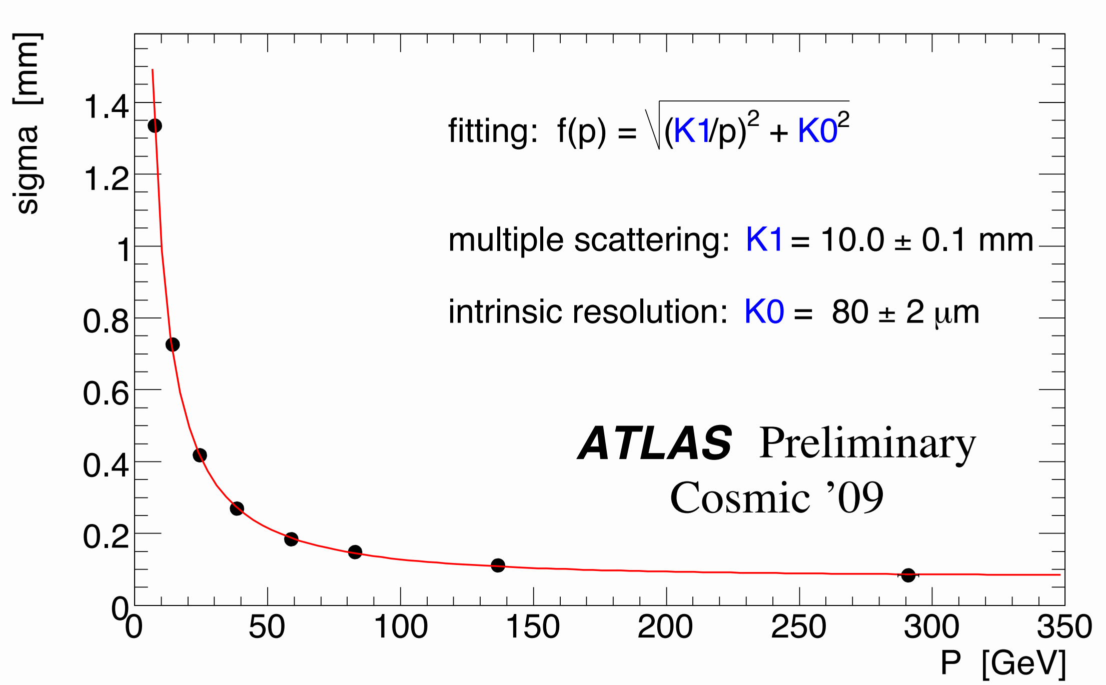
0.5 T Toroidal field

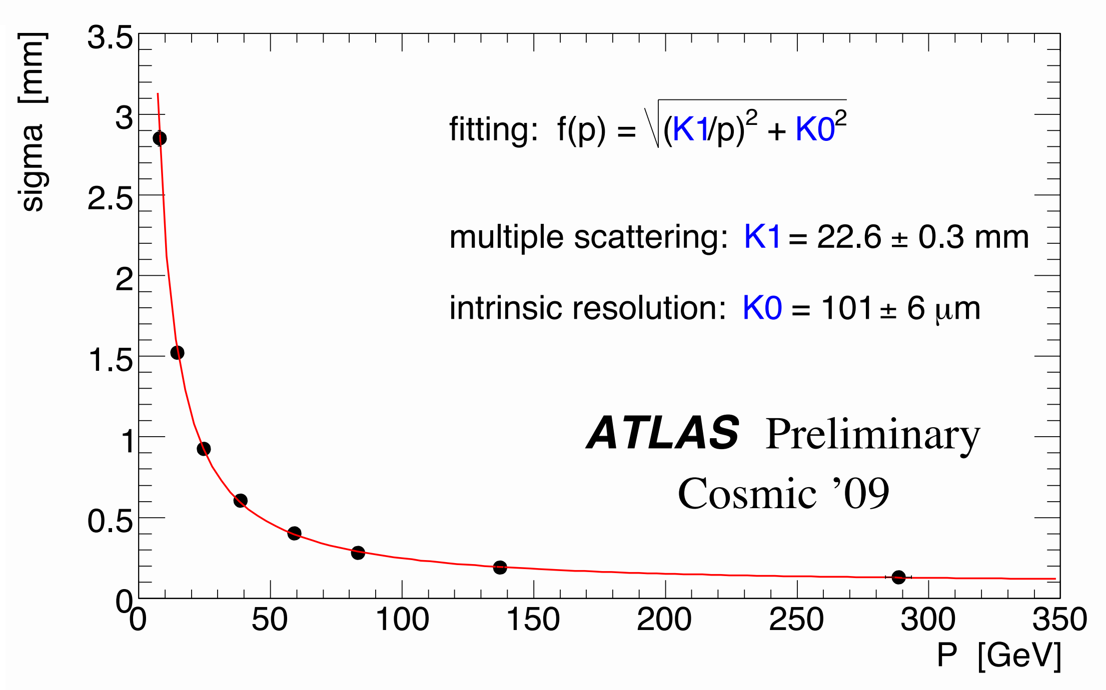
Coverage: $|\eta| < 2.7$

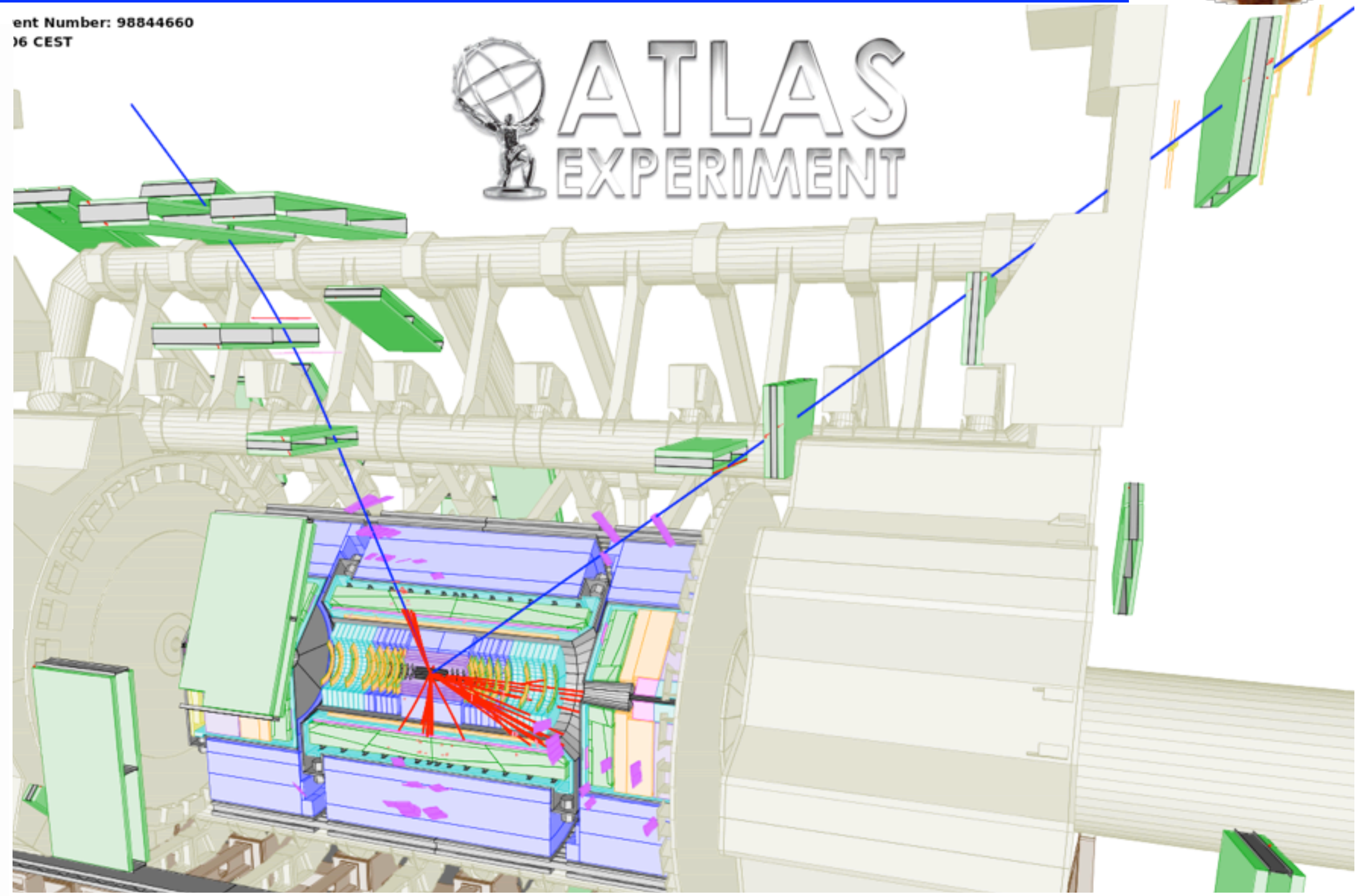
Bend Strength: 2-6 Tm barrel, 4-8 Tm forward

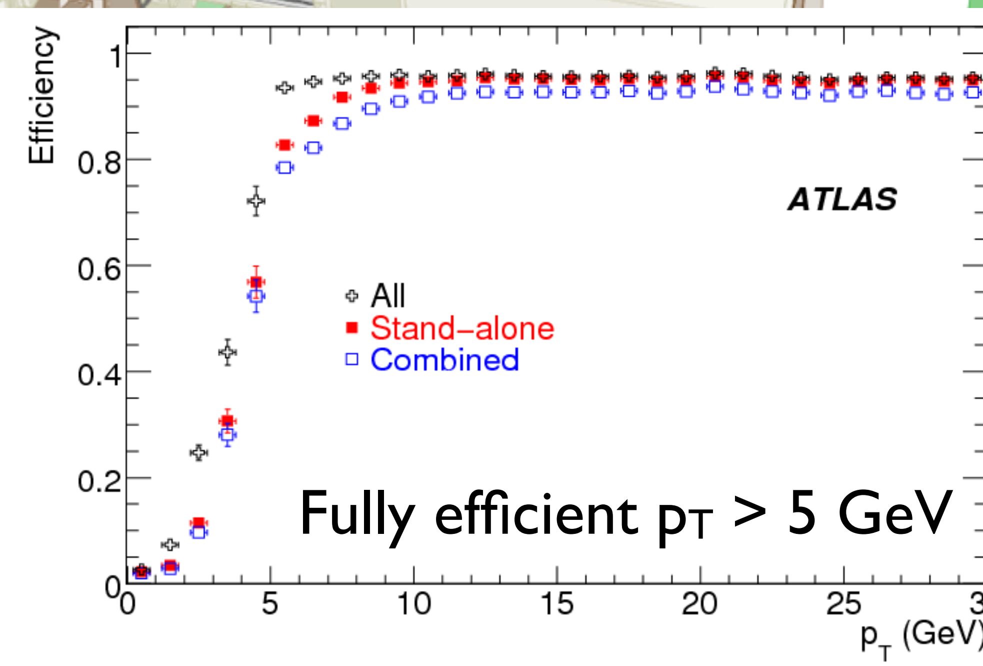
Stand-alone Resolution: $\sigma(p_T)/p_T < 10\%$ up to 1 TeV

Muon Performance









Fully efficient p_T > 5 GeV

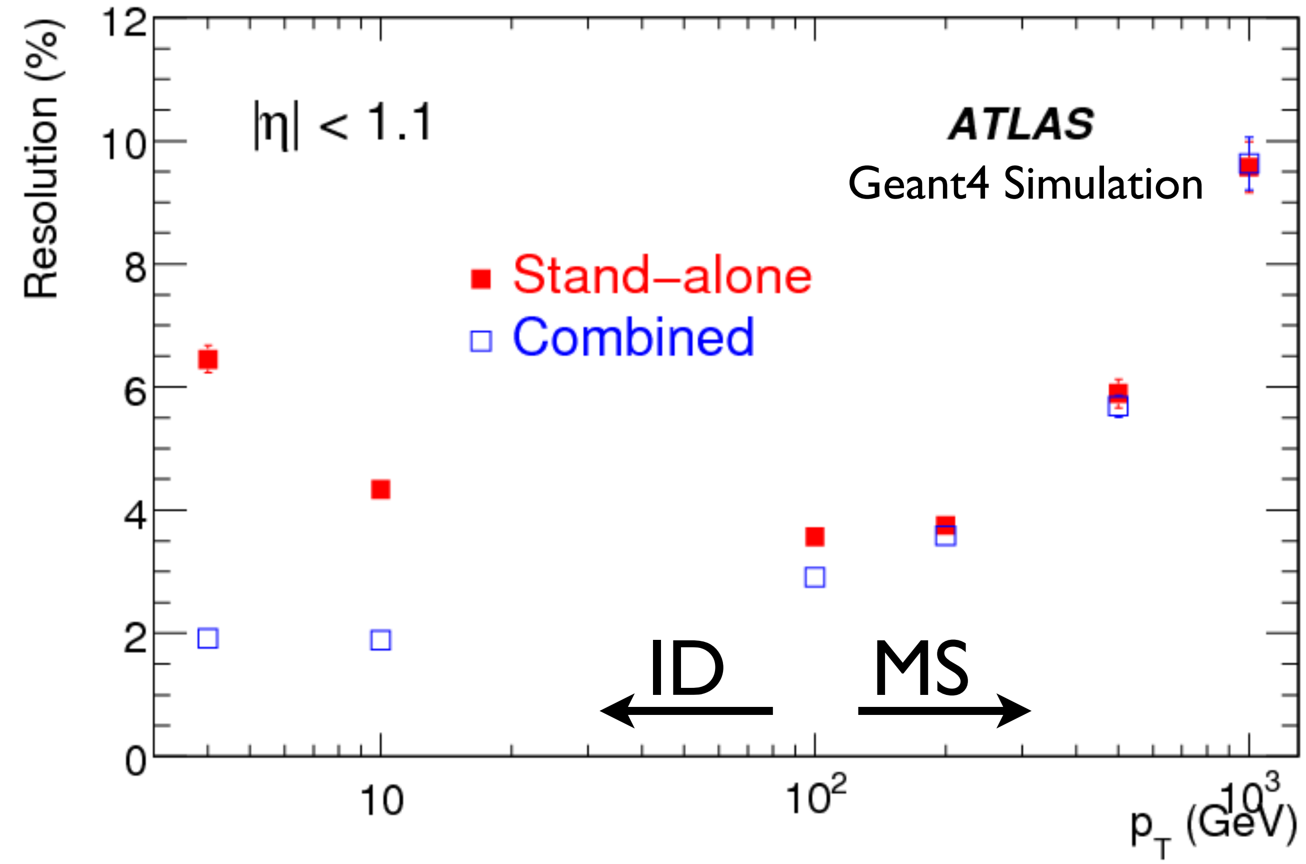
2009 cosmic barrel alignment

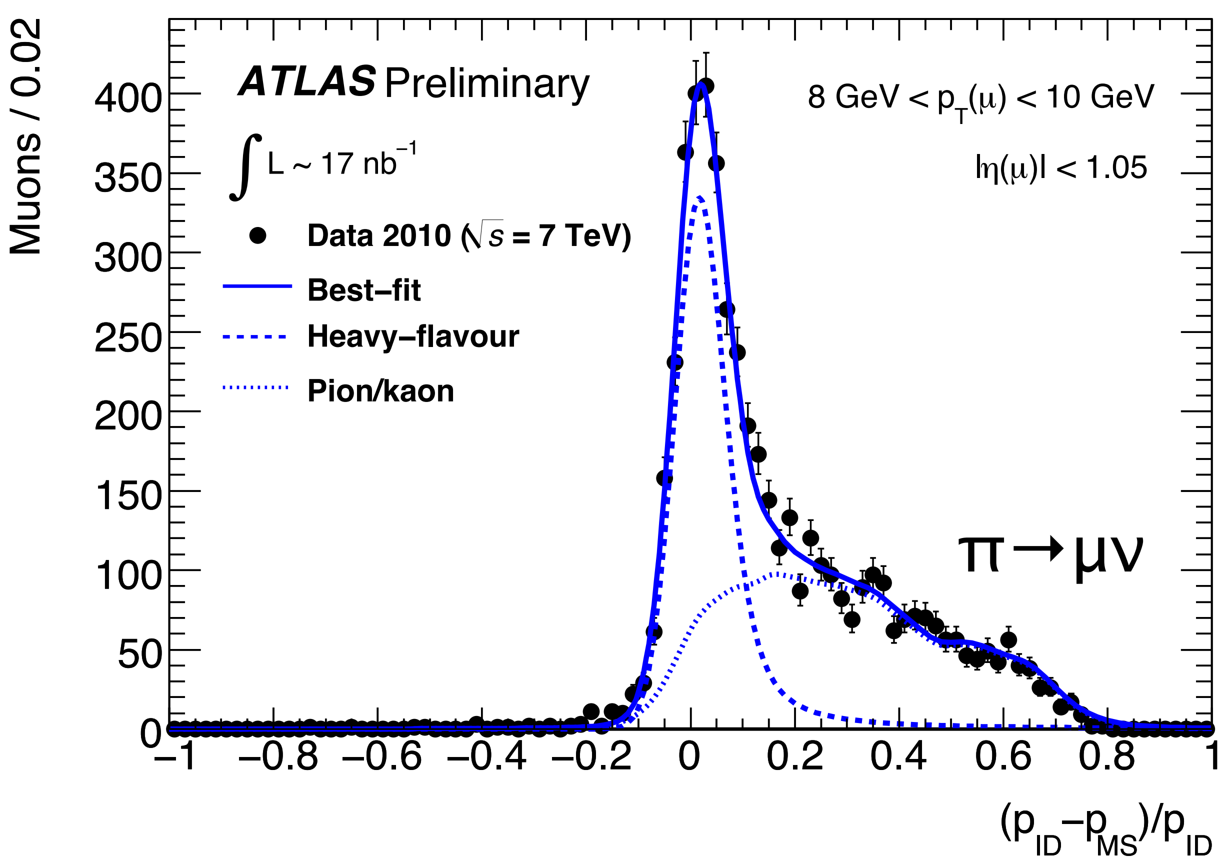
Large sectors: 80 ± 2 μm

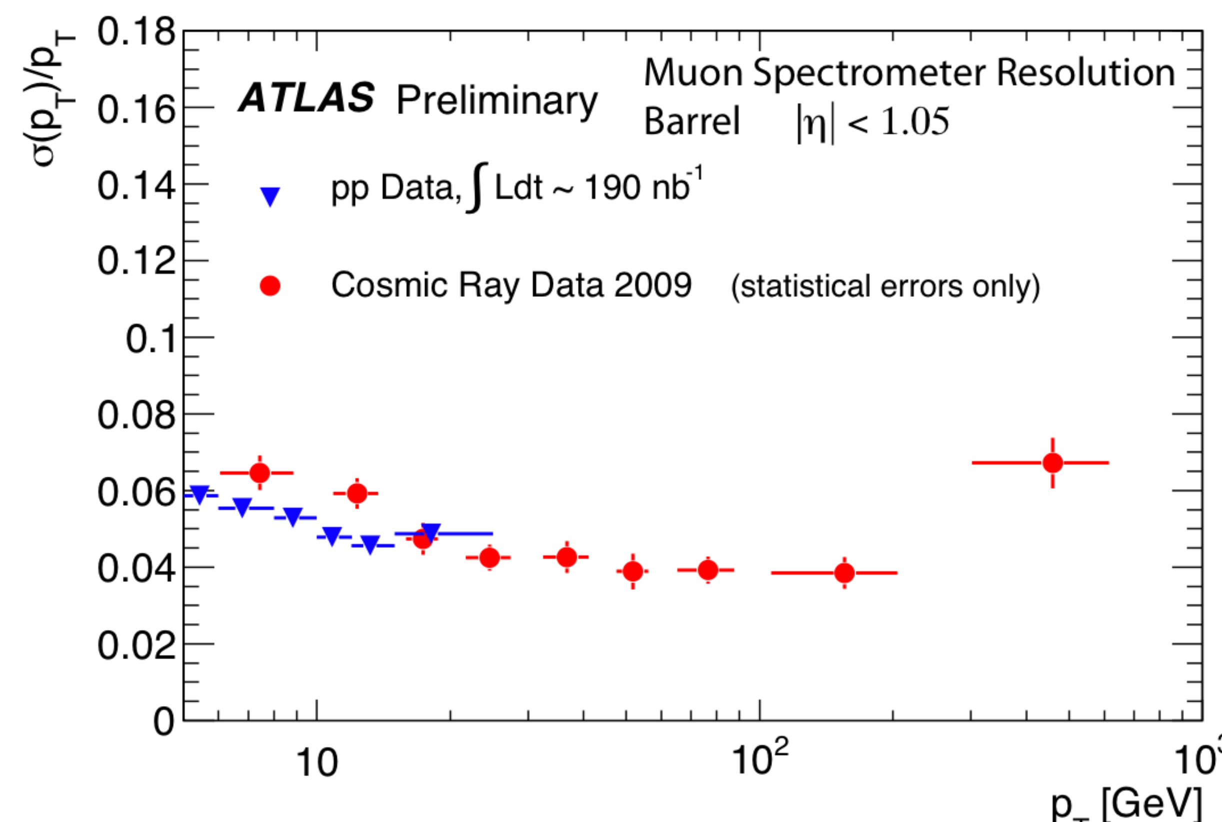
Small sectors: 101 ± 6 μm

Momentum Resolution

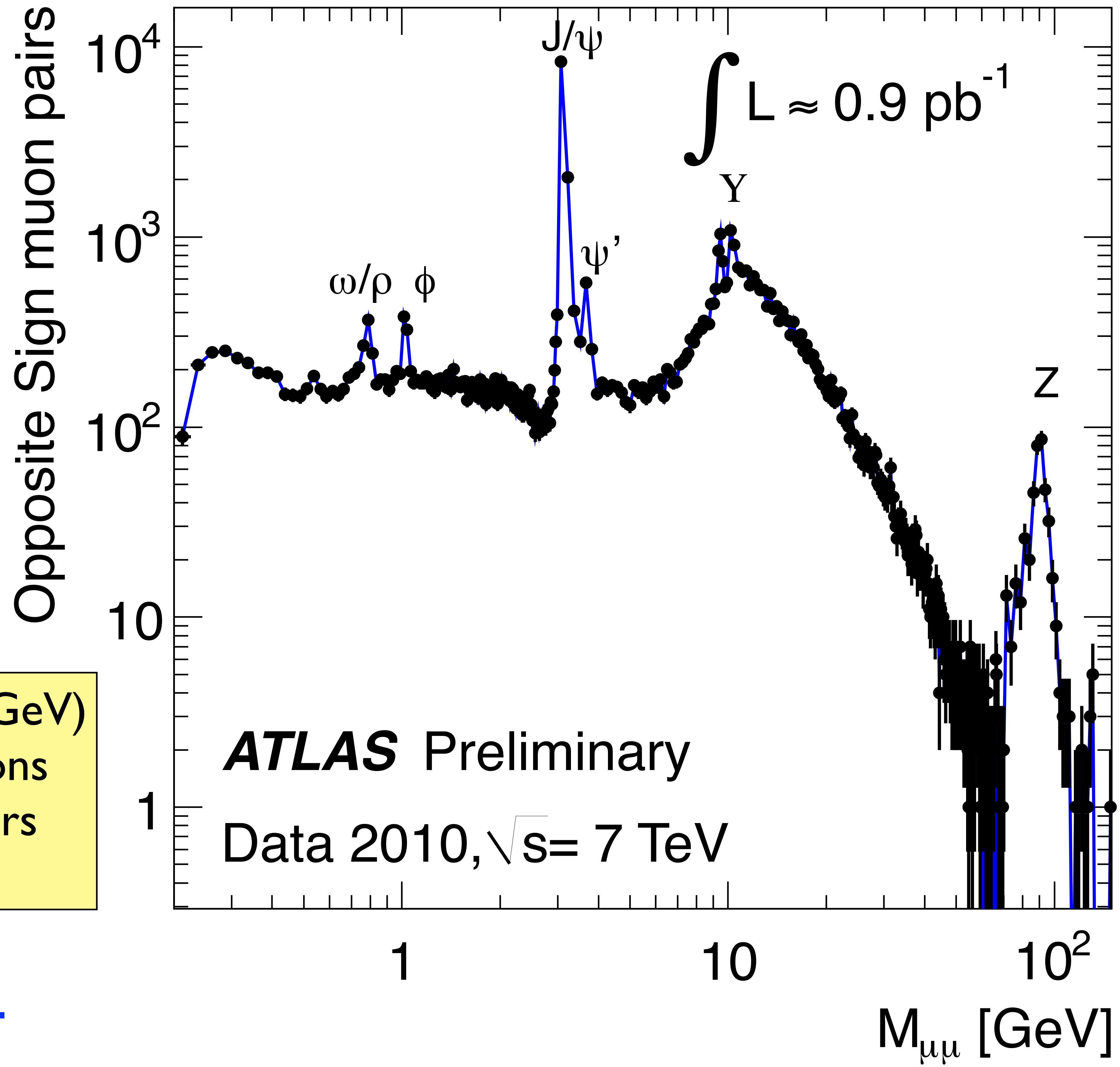
- Combined MS + ID for best resolution over full p_T range
- Comparison of MS to ID provides resolution at low p_T
- ID-MS difference can identify $\pi/K \to \mu\nu$ decays in flight







Di-muon mass spectrum



L1_MU6 trigger (6 GeV)
ID+MS (comb.) muons
All opposite-sign pairs
p_T > 4, 2.5 GeV

Detector Conclusions

- The ATLAS detector is performing well in first data
- MC description of the data is remarkably good

Payoff from ~10 years of testbeam data

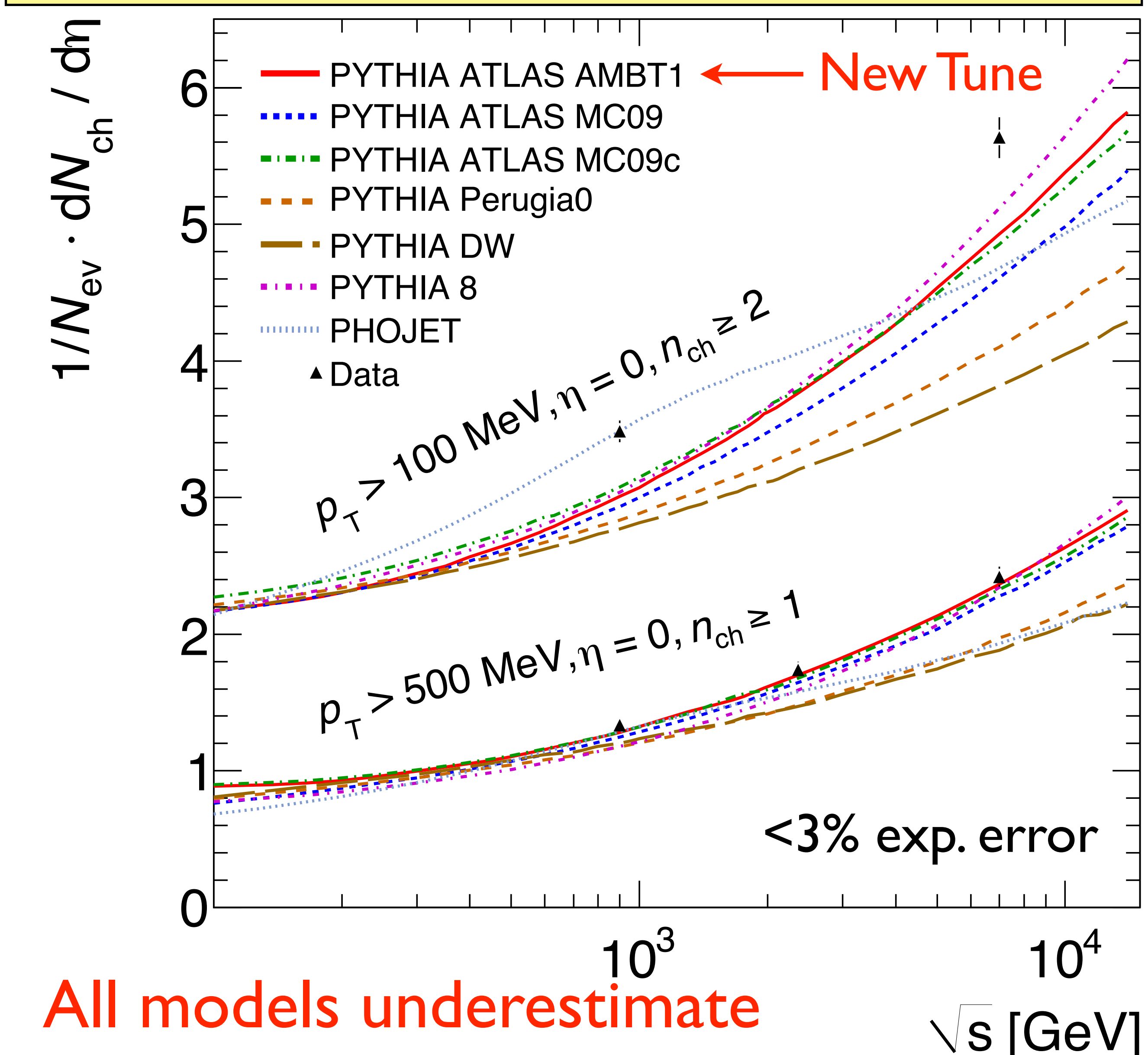
- Initial calibrations/alignments are adequate for first results
- Still plenty to improve in detail

First ATLAS Physics Results

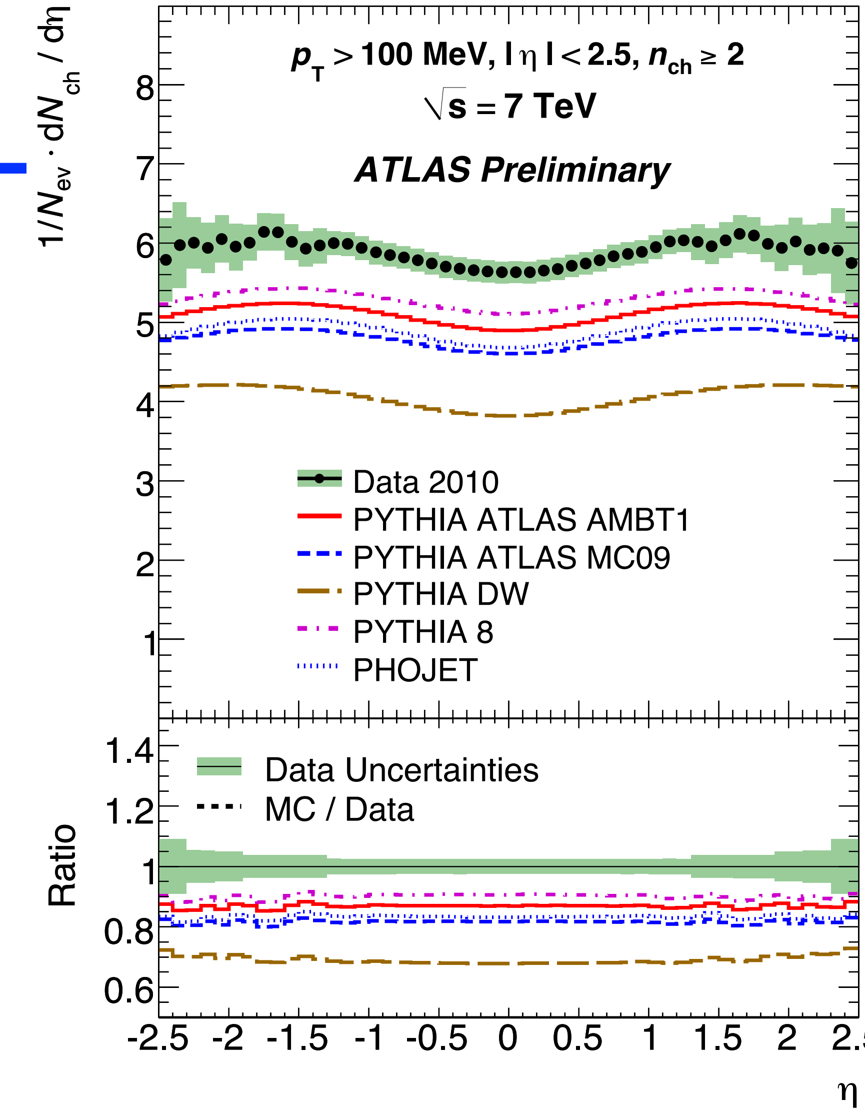
Updates occurring almost daily (even in August)

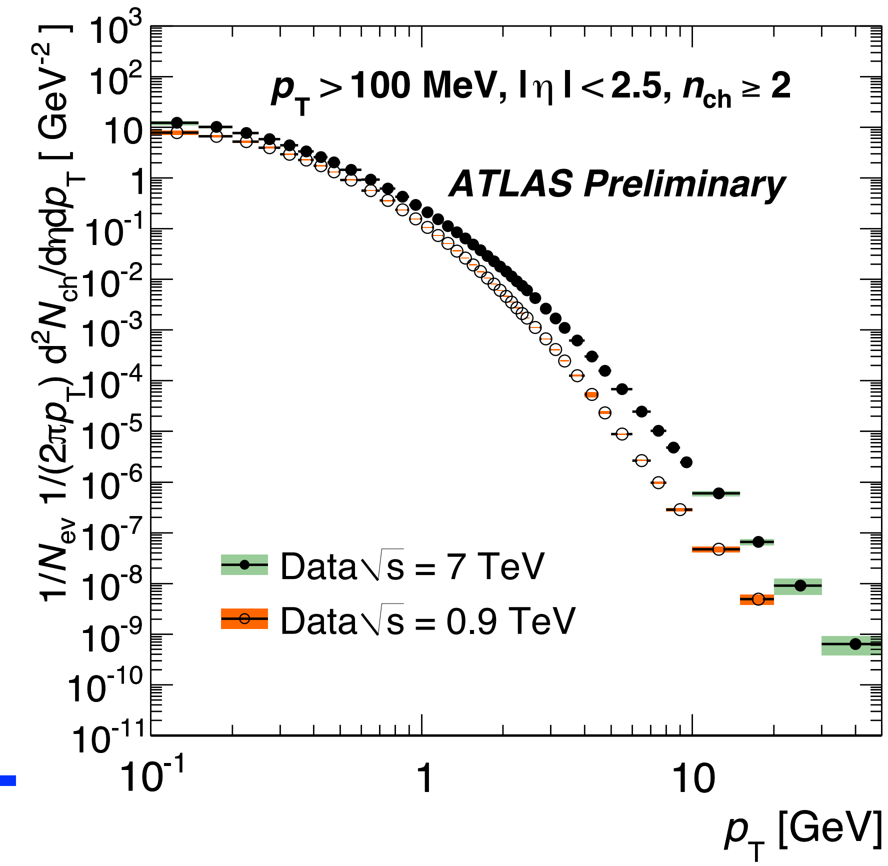
Soft QCD

Inclusive particle spectra in Minbias pp
Nch ≥ 2, p_T > 100 MeV, |η| < 2.5
Corrected to hadron level
No single/double diffractive corrections



All models underestimate
low p_T (diffractive) regime

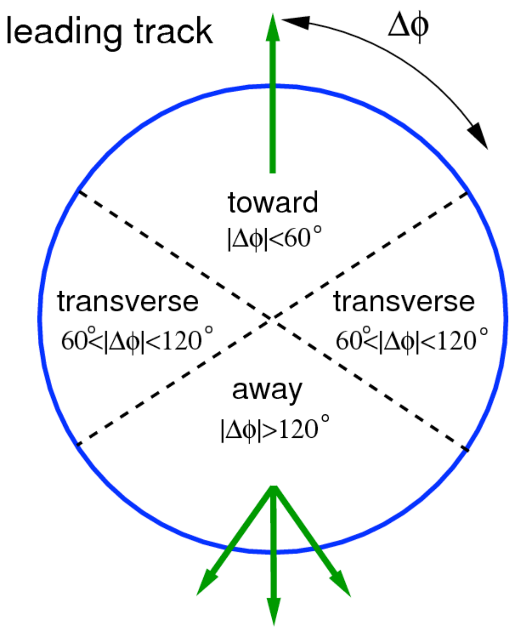


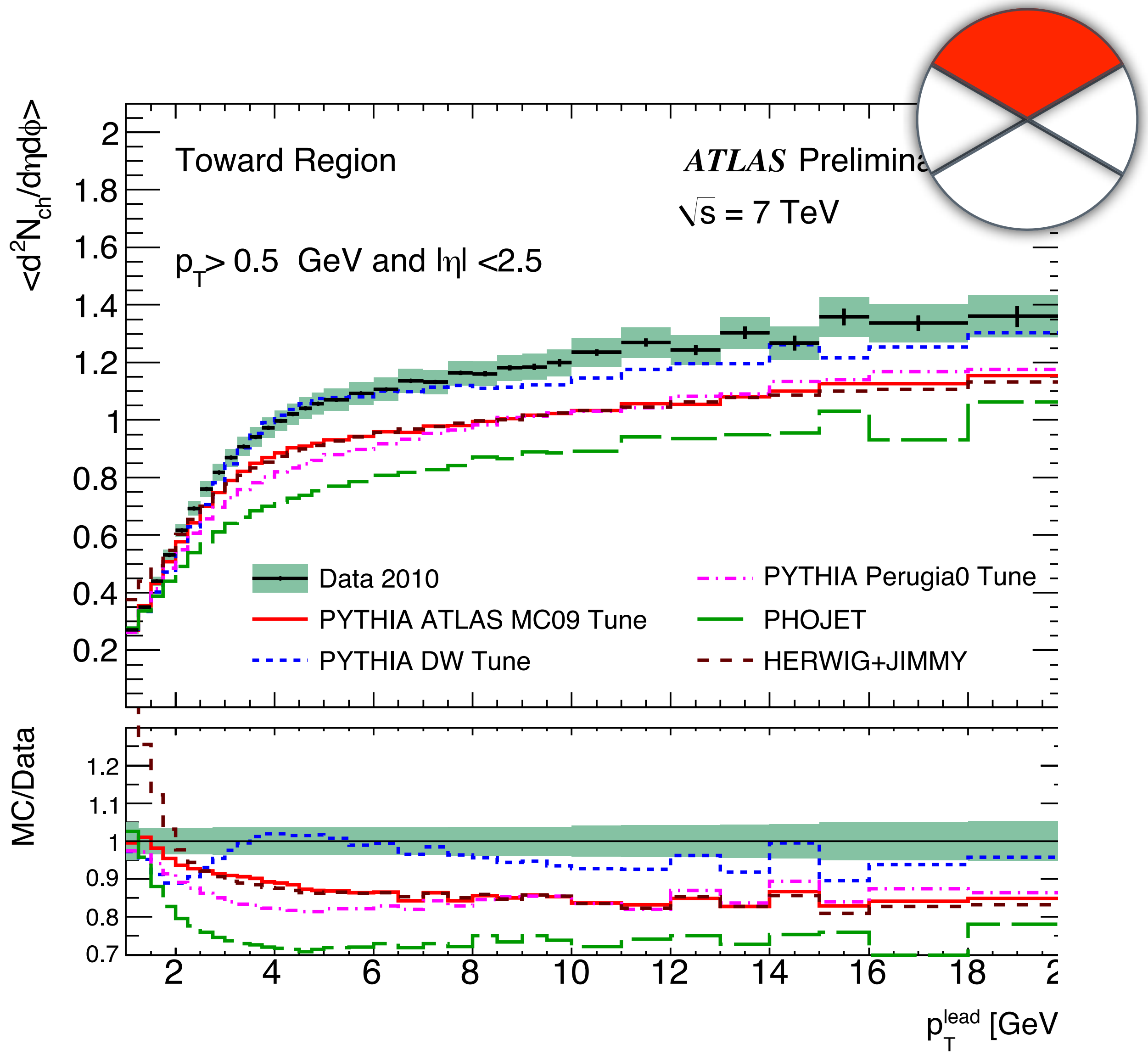


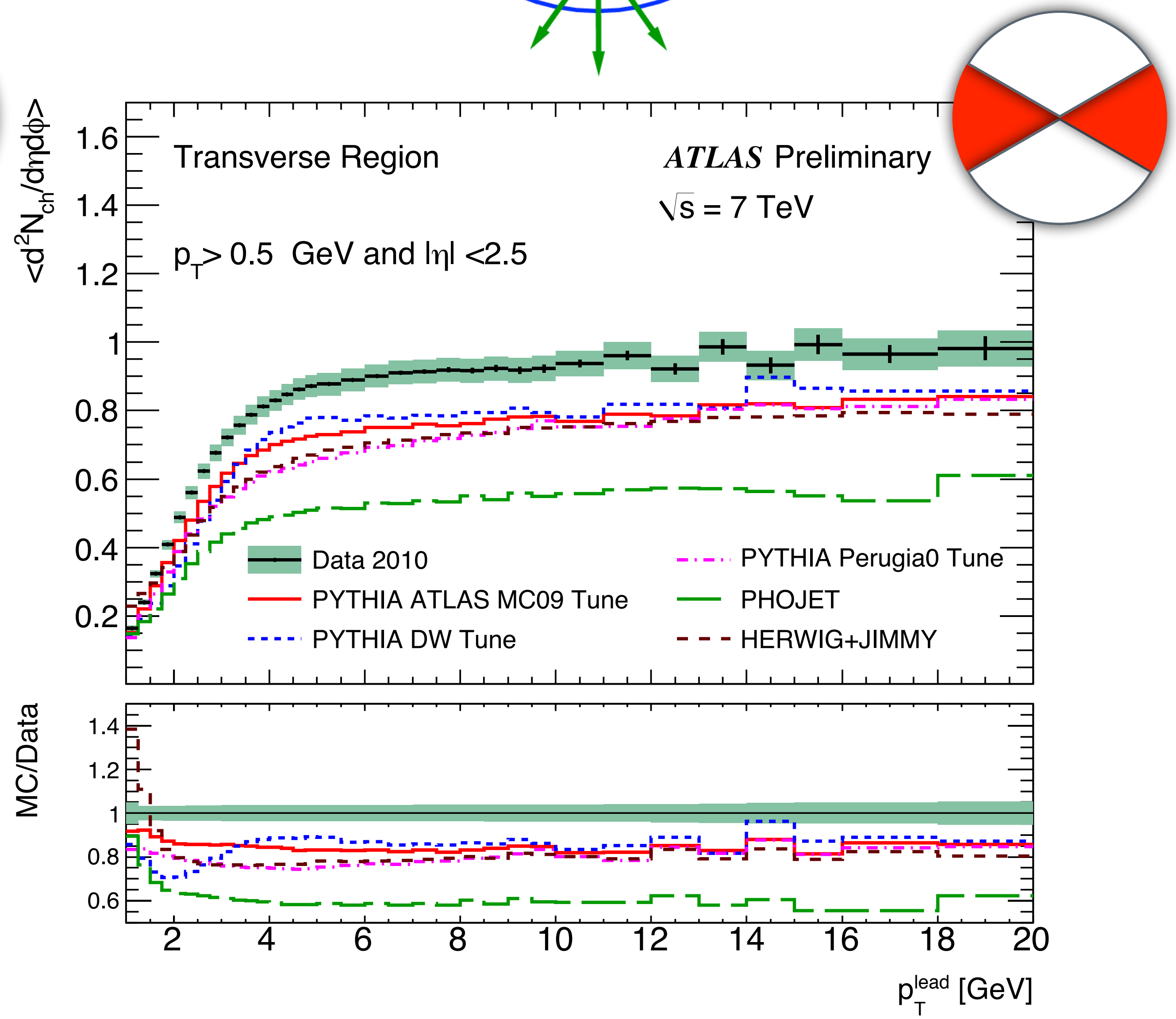
Underlying Event Studies

Particle density vs. leading p_T
$p_T > 500$ MeV, $|\eta| < 2.5$
Corrected to hadron level

More UE activity seen at $\sqrt{s} = 7$ TeV than predicted by MC tunes

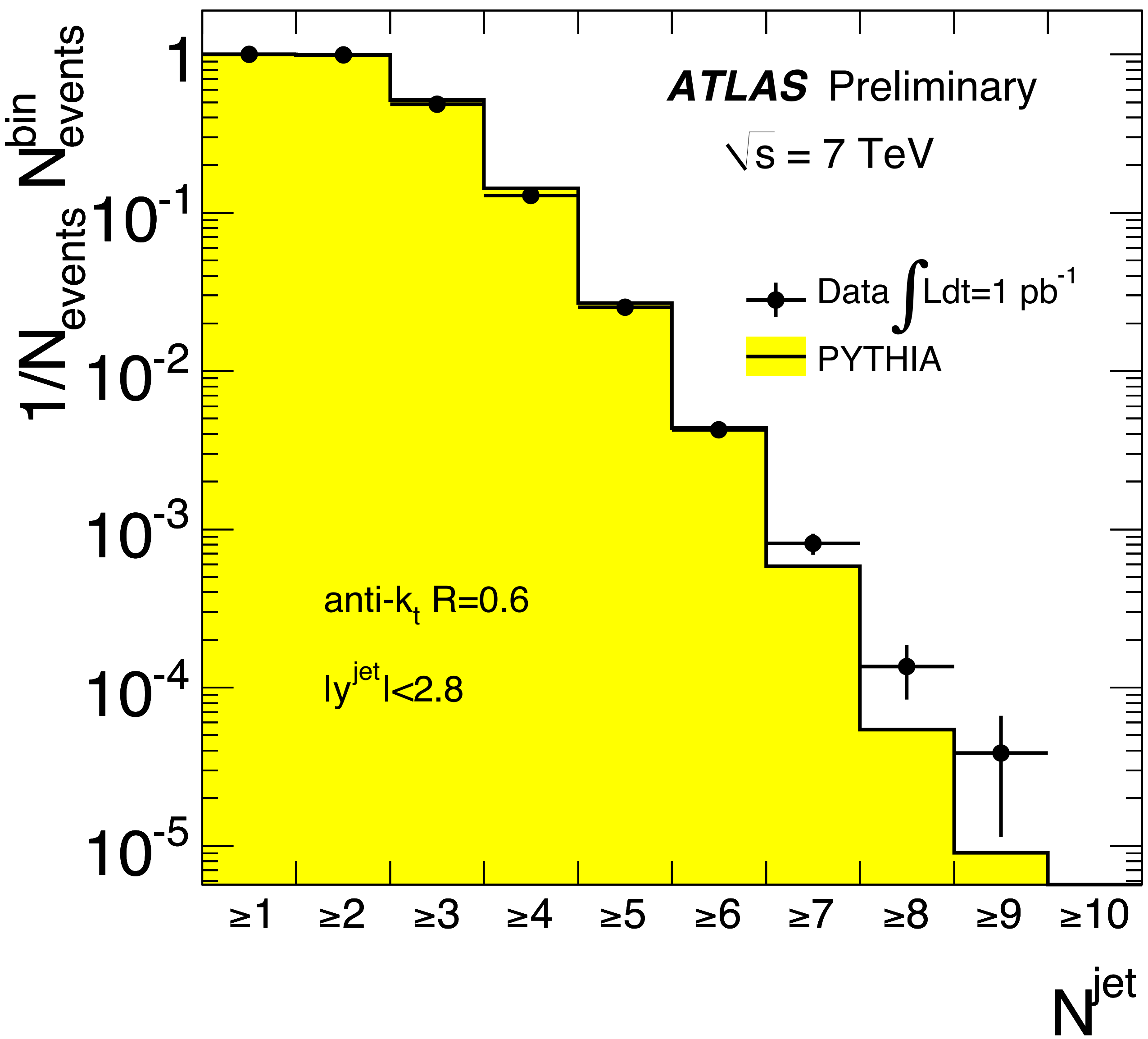


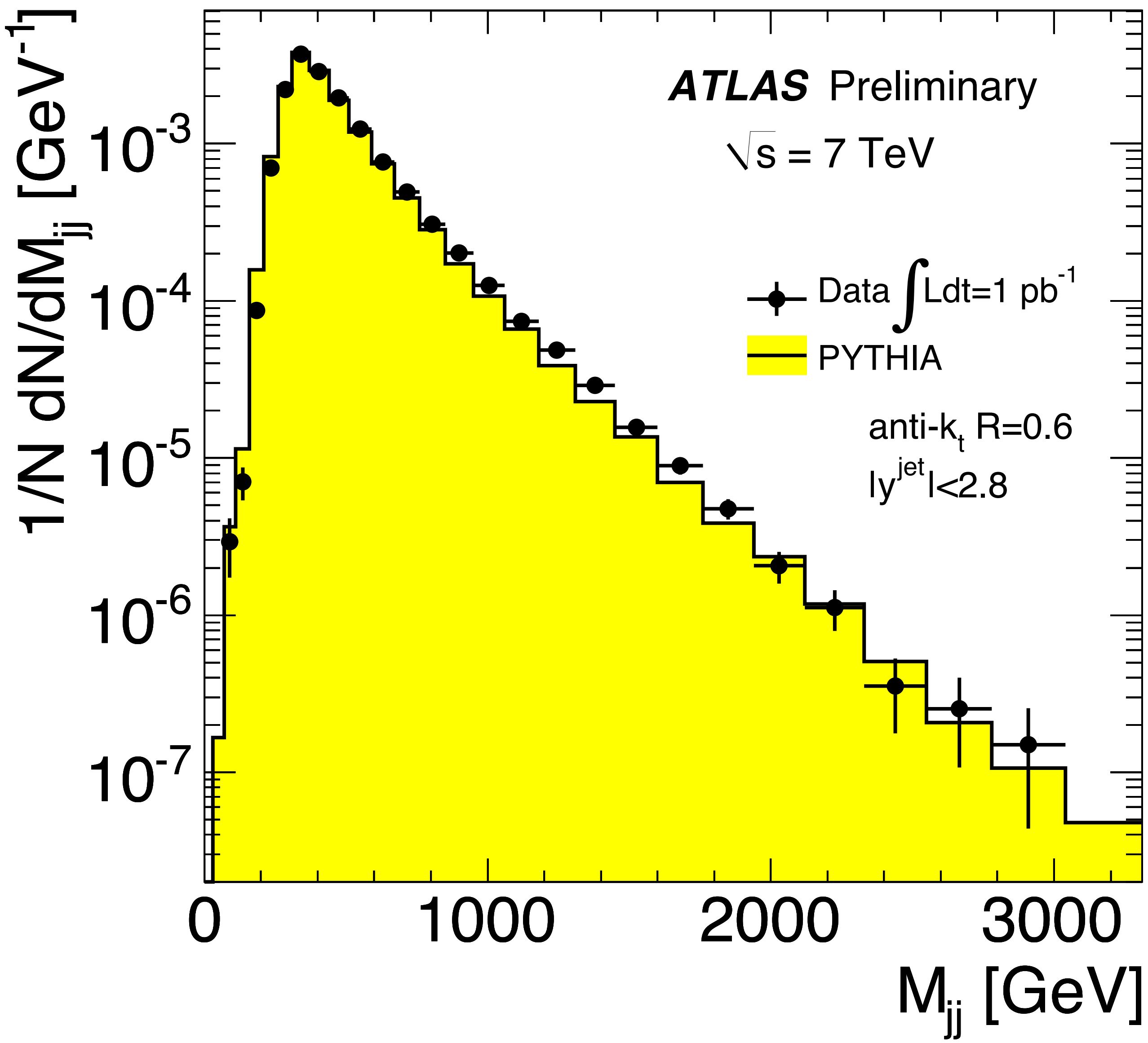




HCP: Soft QCD: findings and surprises from the first LHC data - R.Field (Monday)

Jet Distributions

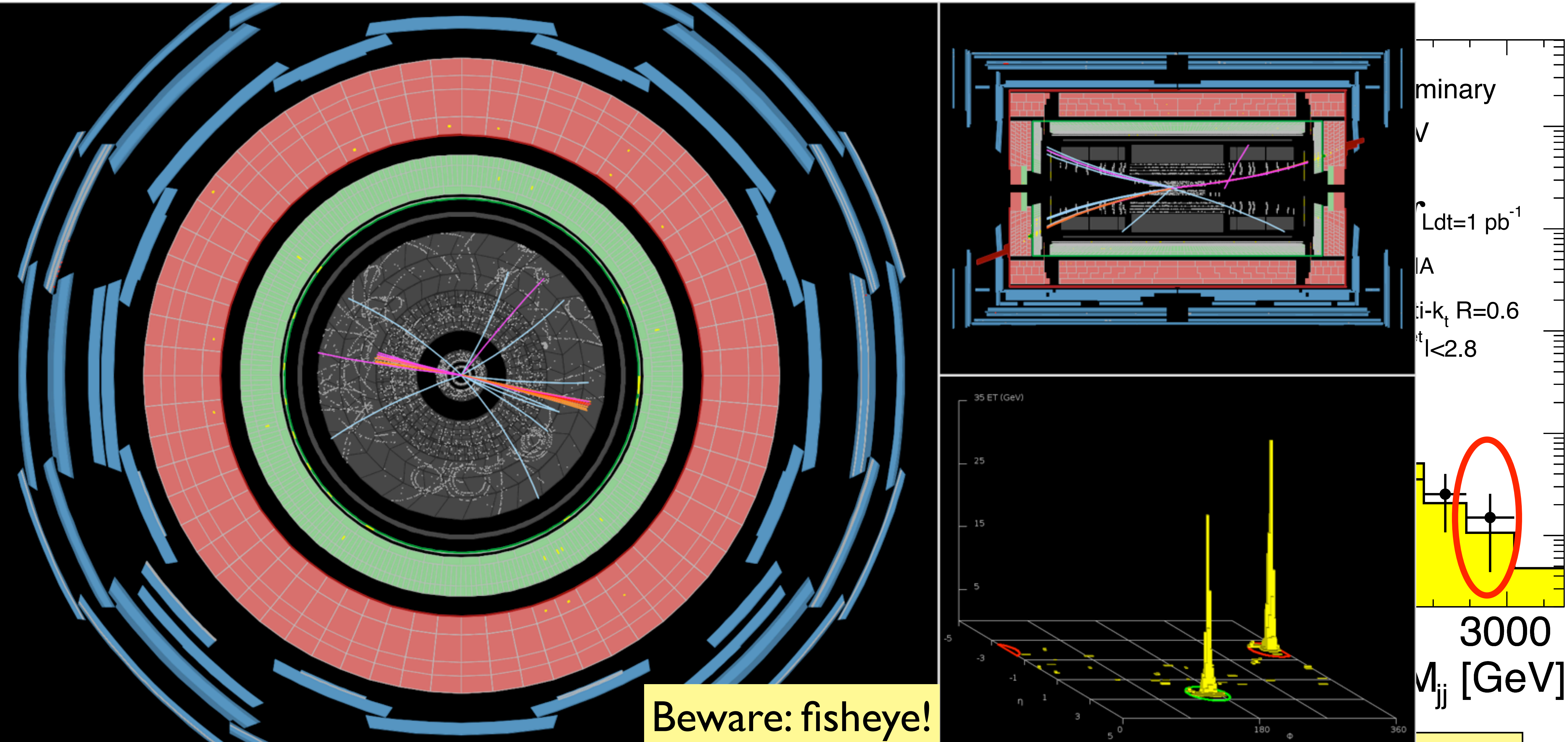




Dijet masses to ~ 3 TeV

Anti-k_t, R=0.6, $|\eta| < 2.8$
Leading p_T > 160 GeV
Sub-leading p_T > 40 GeV
Statistical errors only

Jet Distributions



Hadronic Endcap Calorimeter (LAr/Cu)

M_{jj} ~ 2.8 TeV

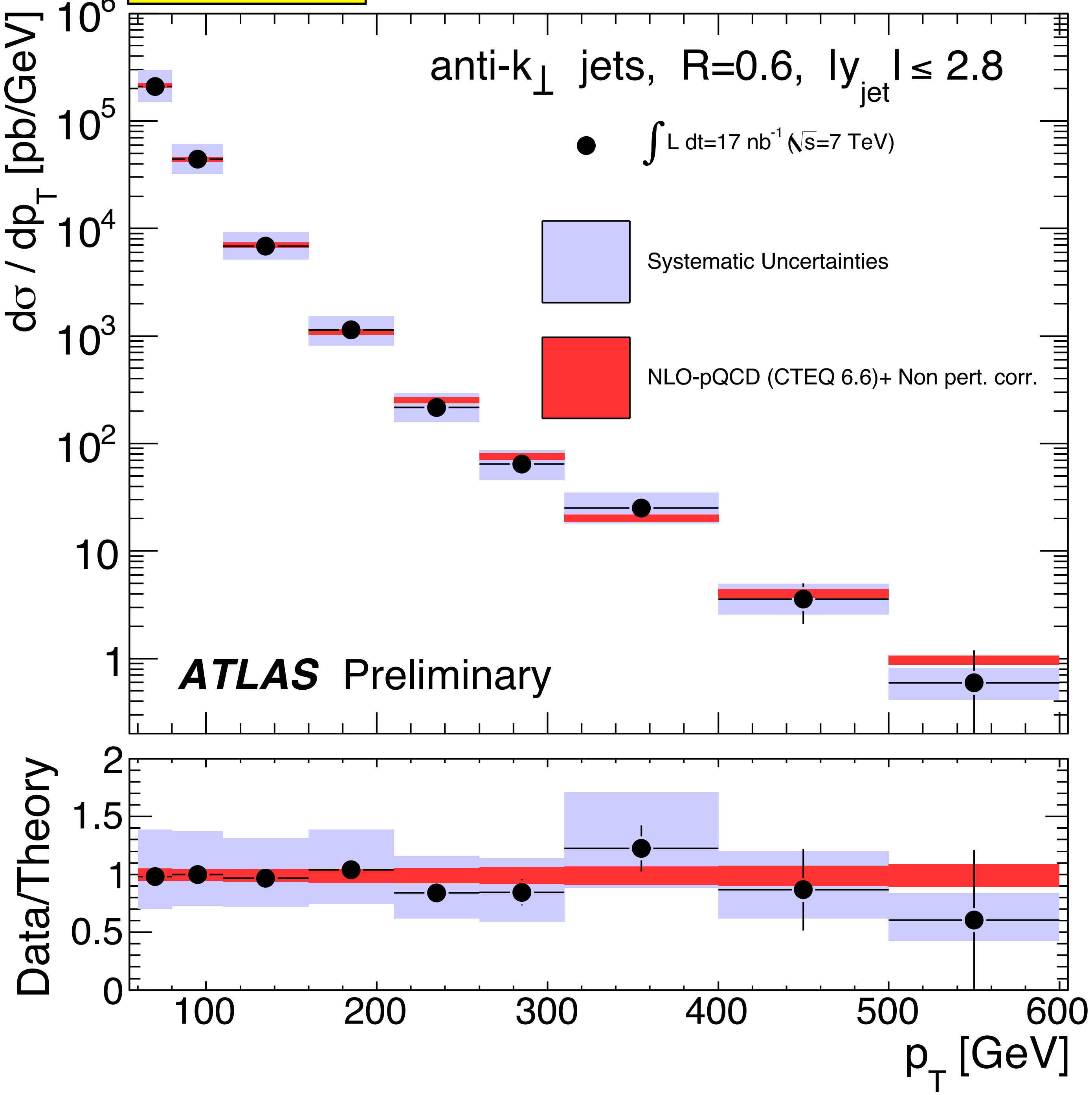
E_1 ~ 310 GeV, η_1 = -2.0

E_2 ~ 280 GeV, η_2 = +2.5

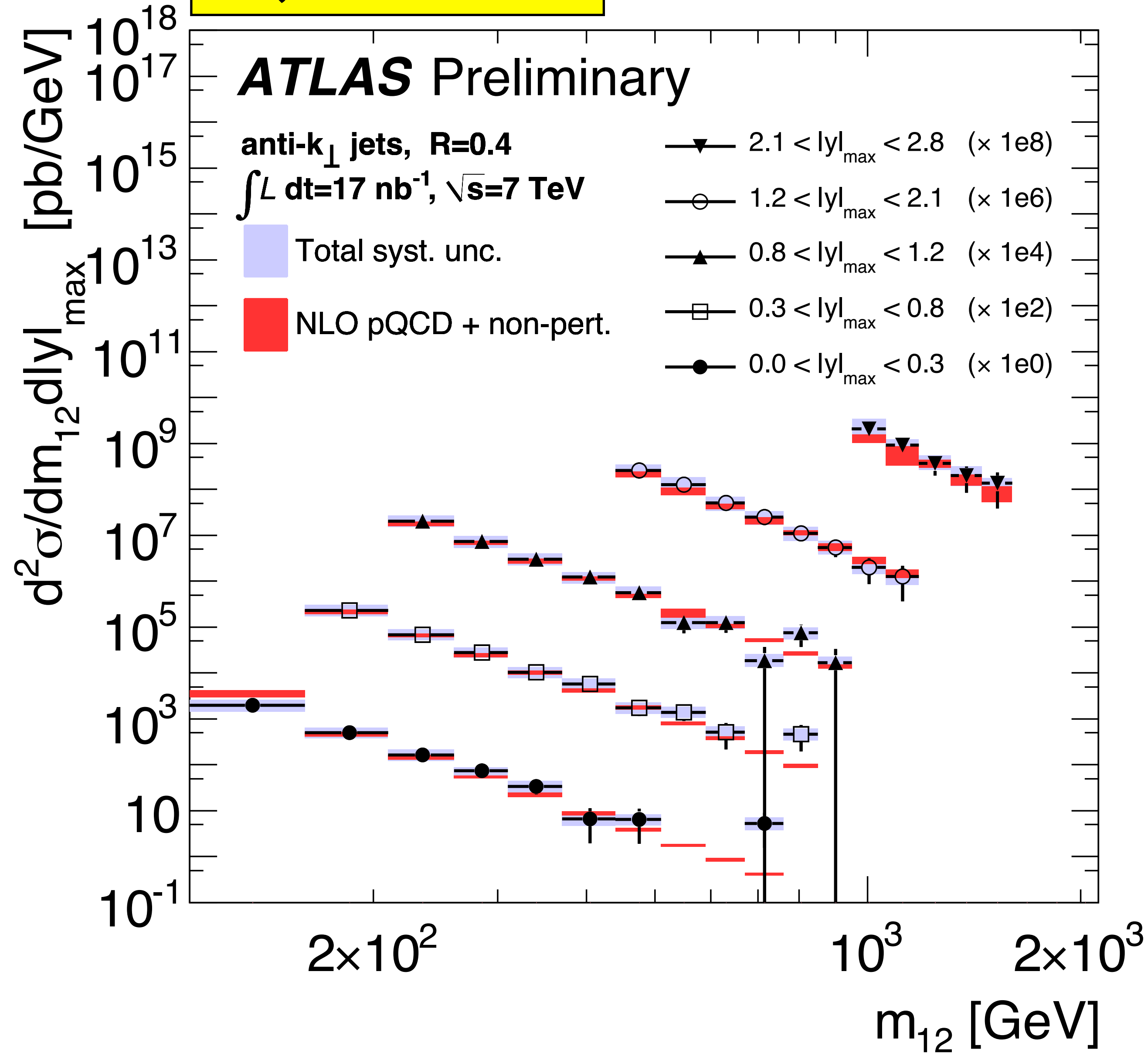
Anti-k_t, R=0.6, $|\eta|$ < 2.8
Leading p_T > 160 GeV
Sub-leading p_T > 40 GeV
Statistical errors only

Jet cross-sections

Inclusive



di-jet vs. mass

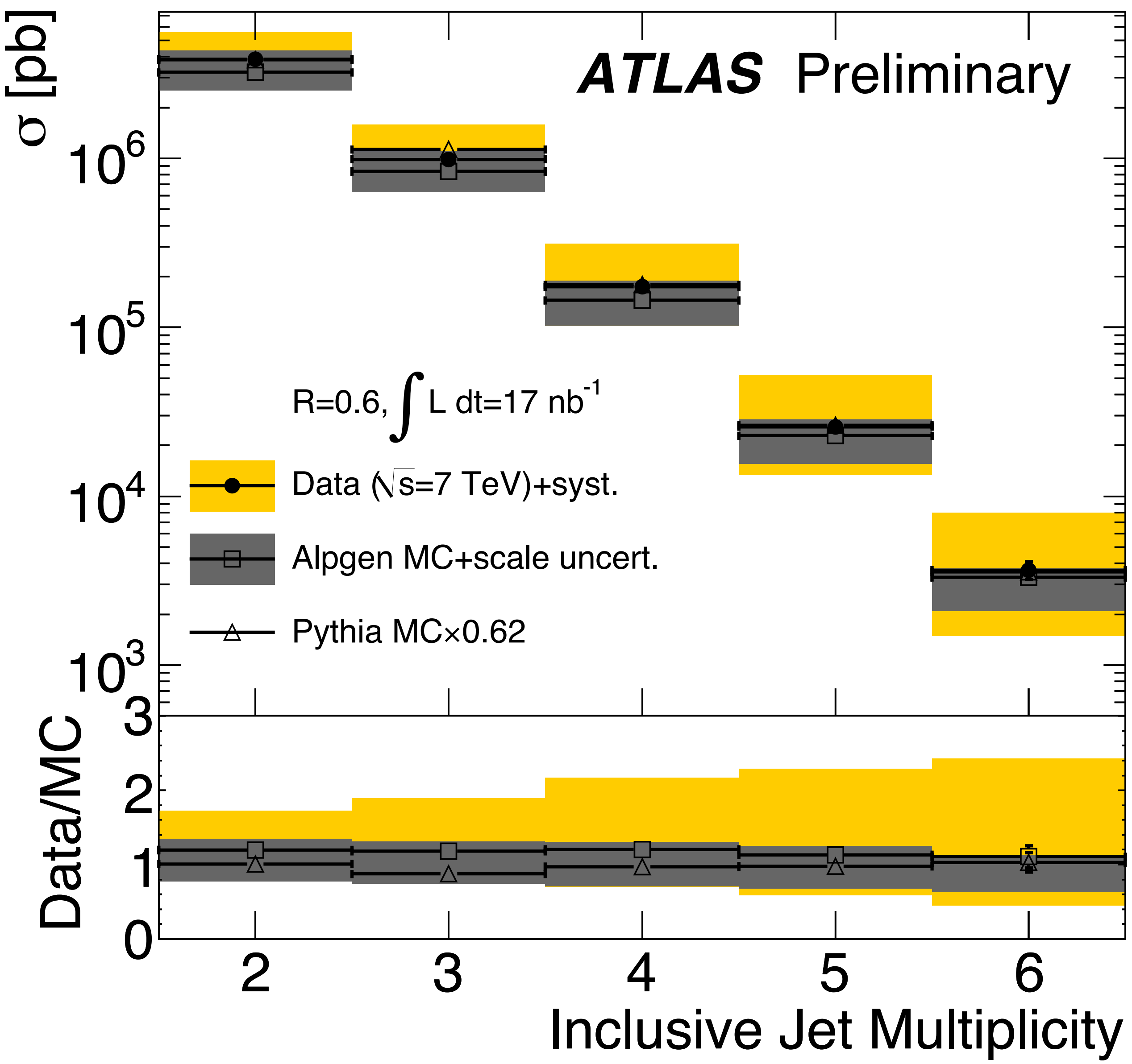


pQCD models
describe our data well so far...

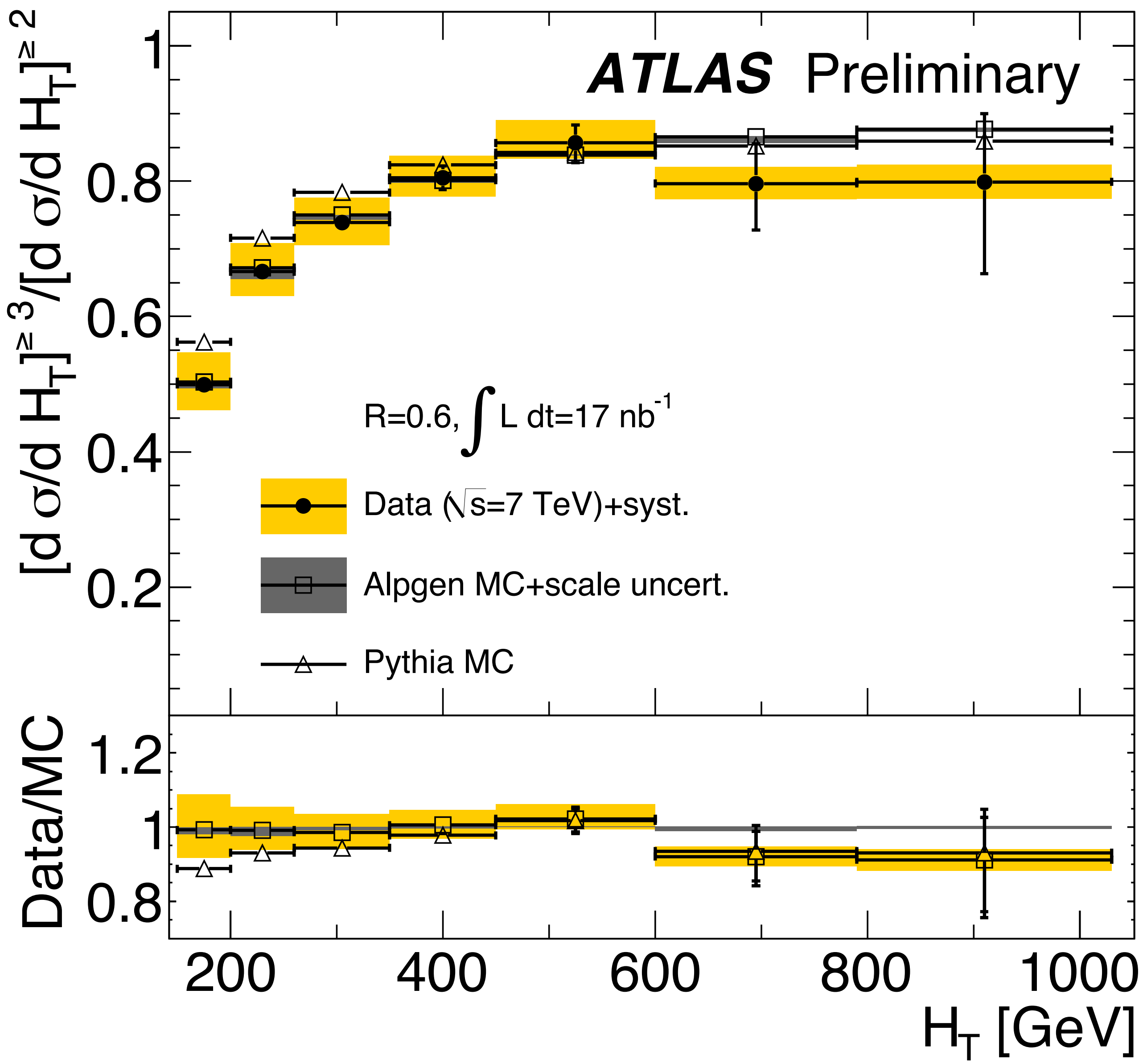
Data corrected to particle level
Compared to NLO MC after corrections for hadronization and UE
Exp. error dominated by JES, Lumi

Multi-jet cross-sections

Inclusive jet multiplicity spectrum



3-jet/2-jet cross-section ratio

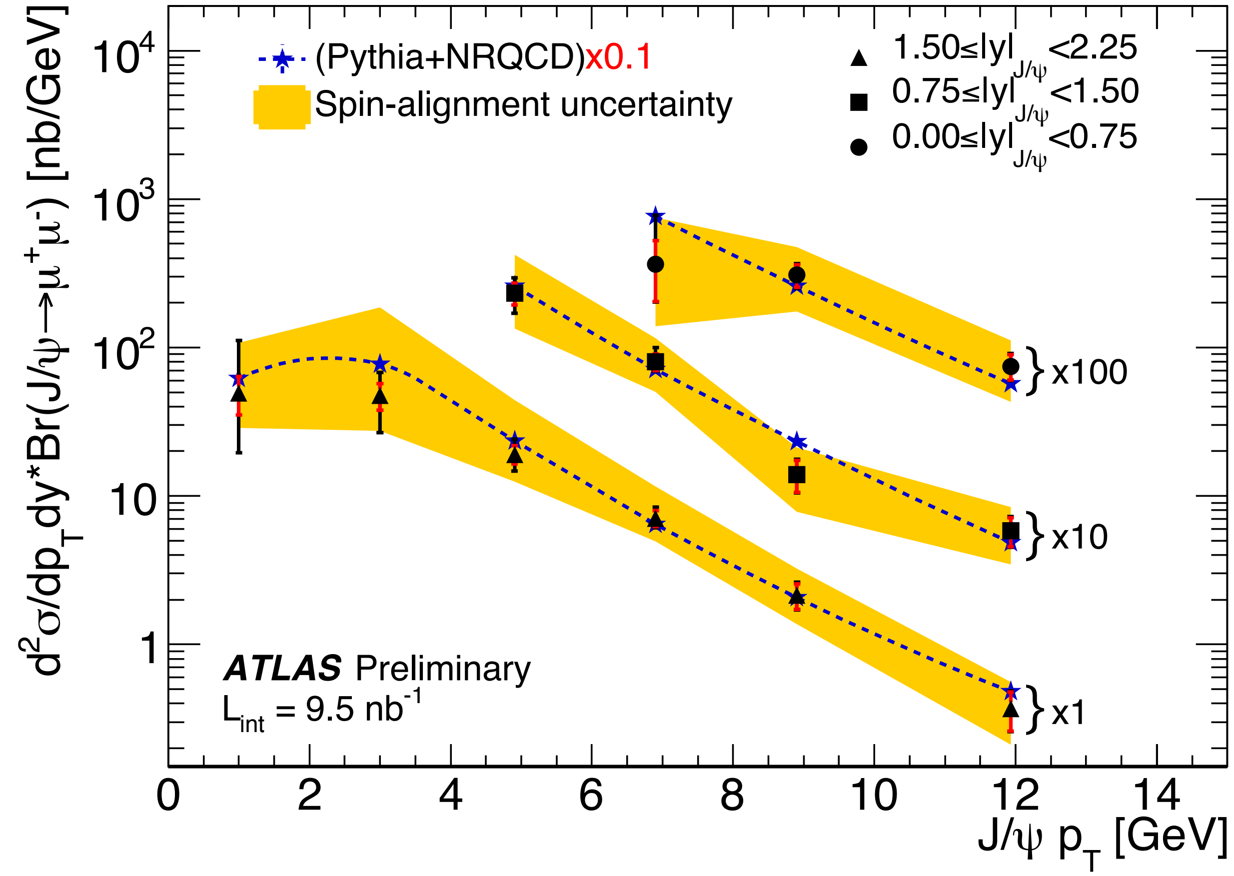


$$H_T = \sum_{\text{jets}} p_T$$

See HCP talk: Minbias + early QCD (ATLAS) for this and more

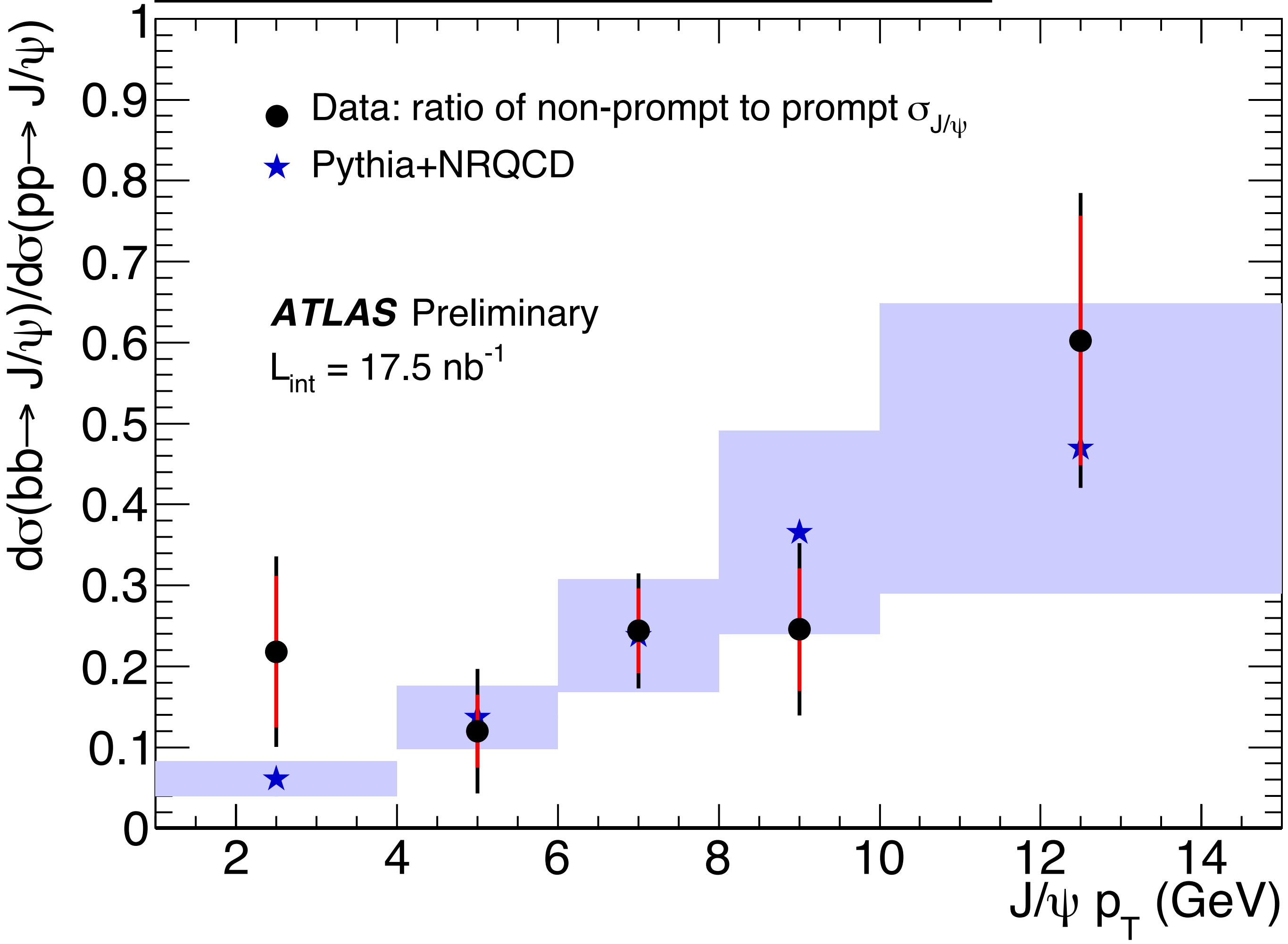
J/ψ → μ⁺μ⁻

Inclusive Cross-Section

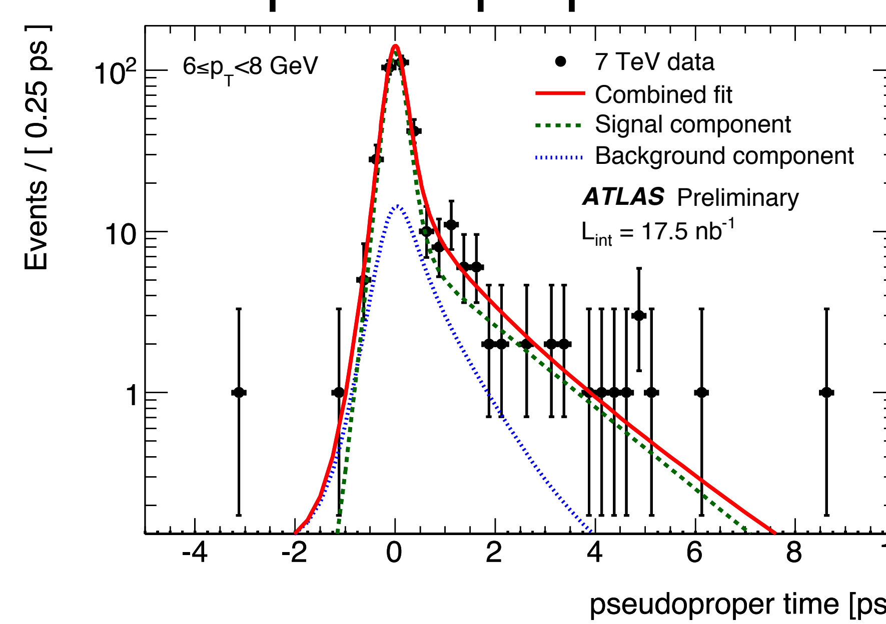


$|\eta(J/\psi)| < 2.25$, $p_T(J/\psi) > 1$ GeV
Spin-alignment uncertainty on μ eff.

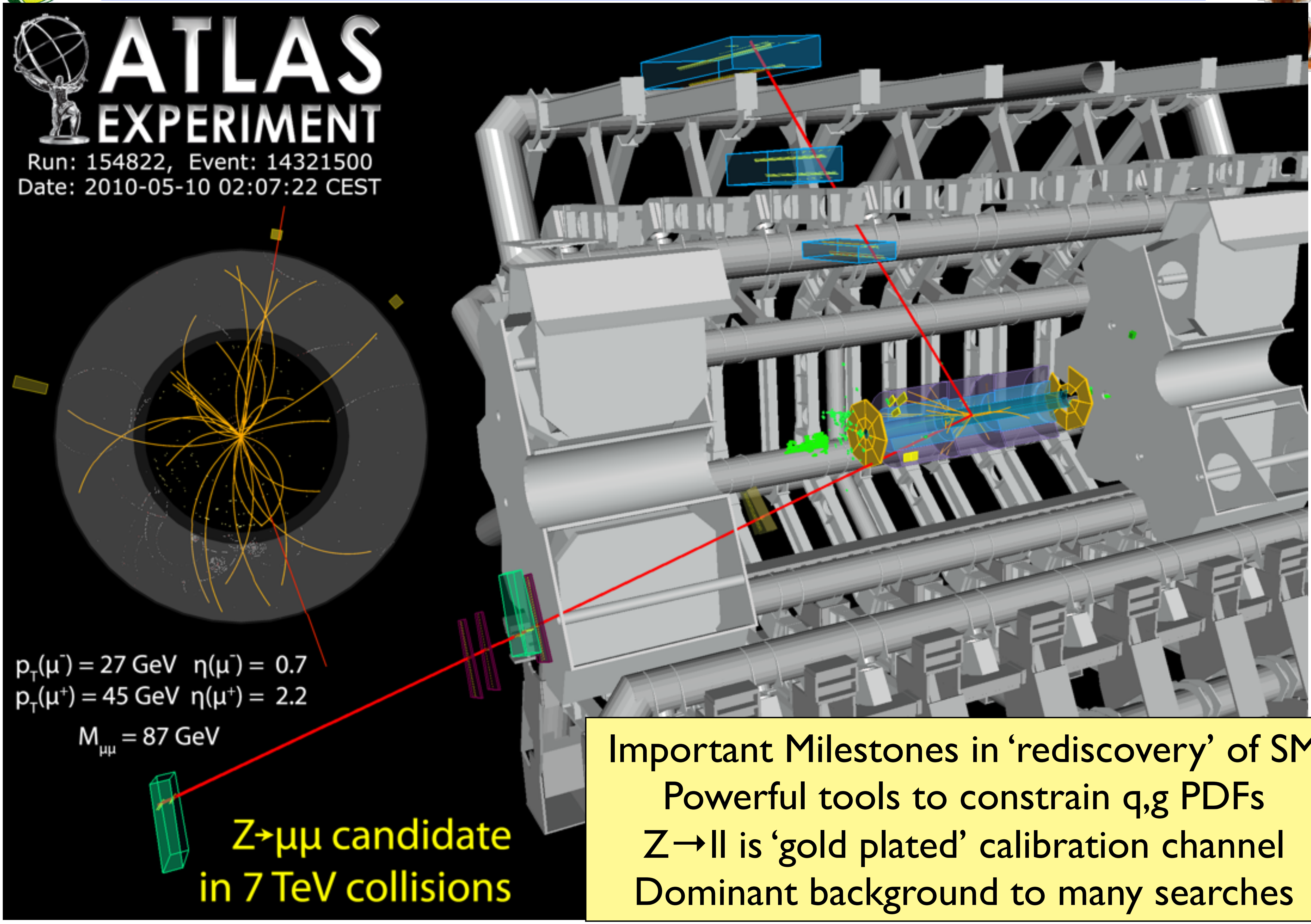
Non-prompt/prompt ratio



Distinguish non-prompt using pseudo-proper time

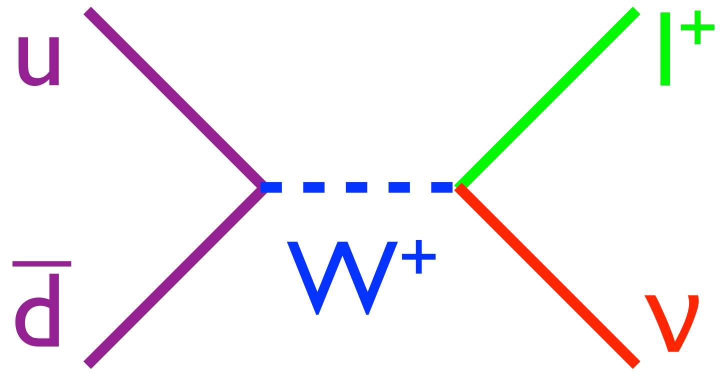


W/Z Physics



Important Milestones in ‘rediscovery’ of SM
Powerful tools to constrain q,g PDFs
Z→ll is ‘gold plated’ calibration channel
Dominant background to many searches

W→lν Signature

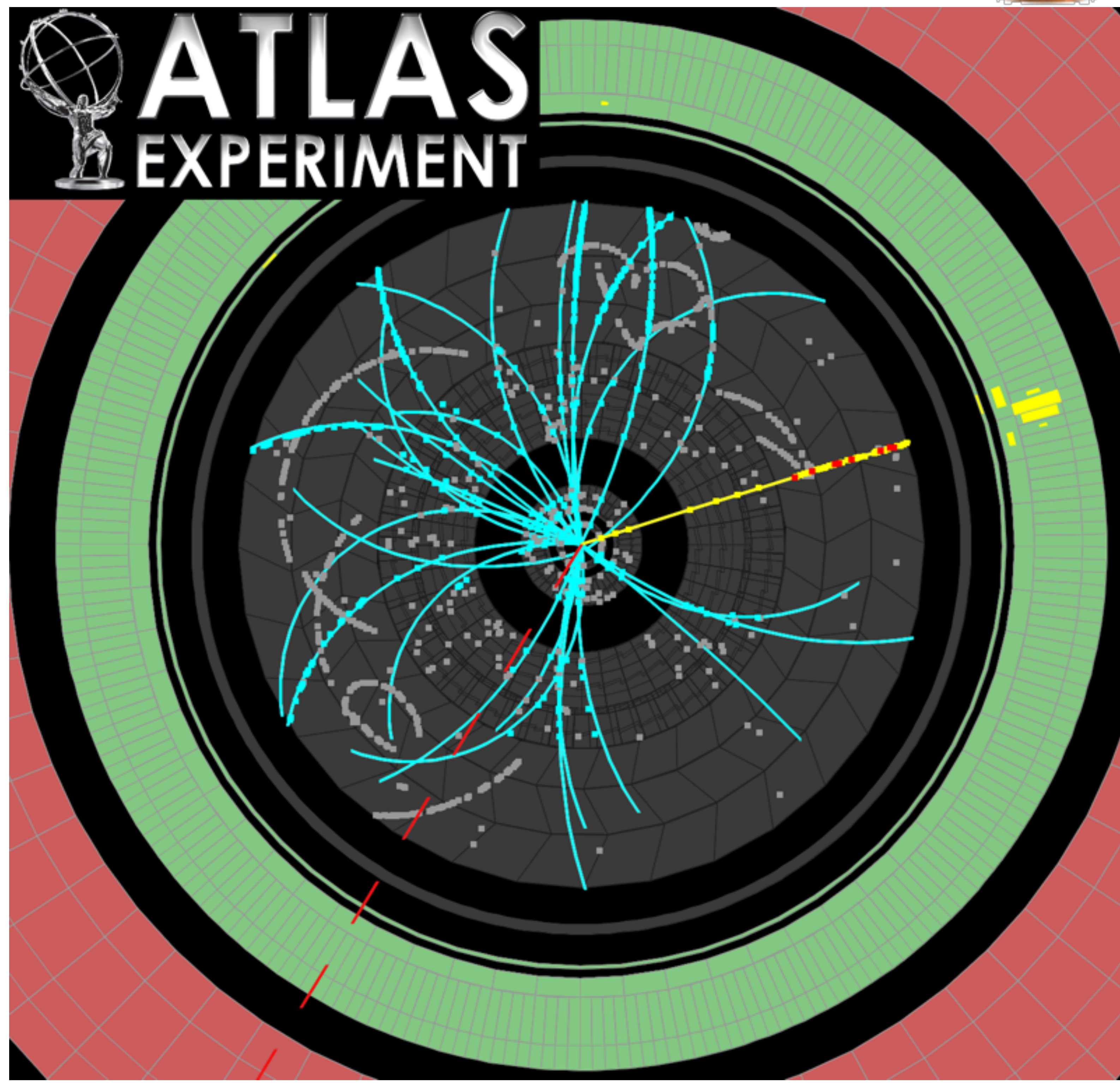


Always need one sea quark
Expect more W^+ than W^-

Key Observables

- Lepton identification
- Missing Transverse Energy
- Transverse Mass

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



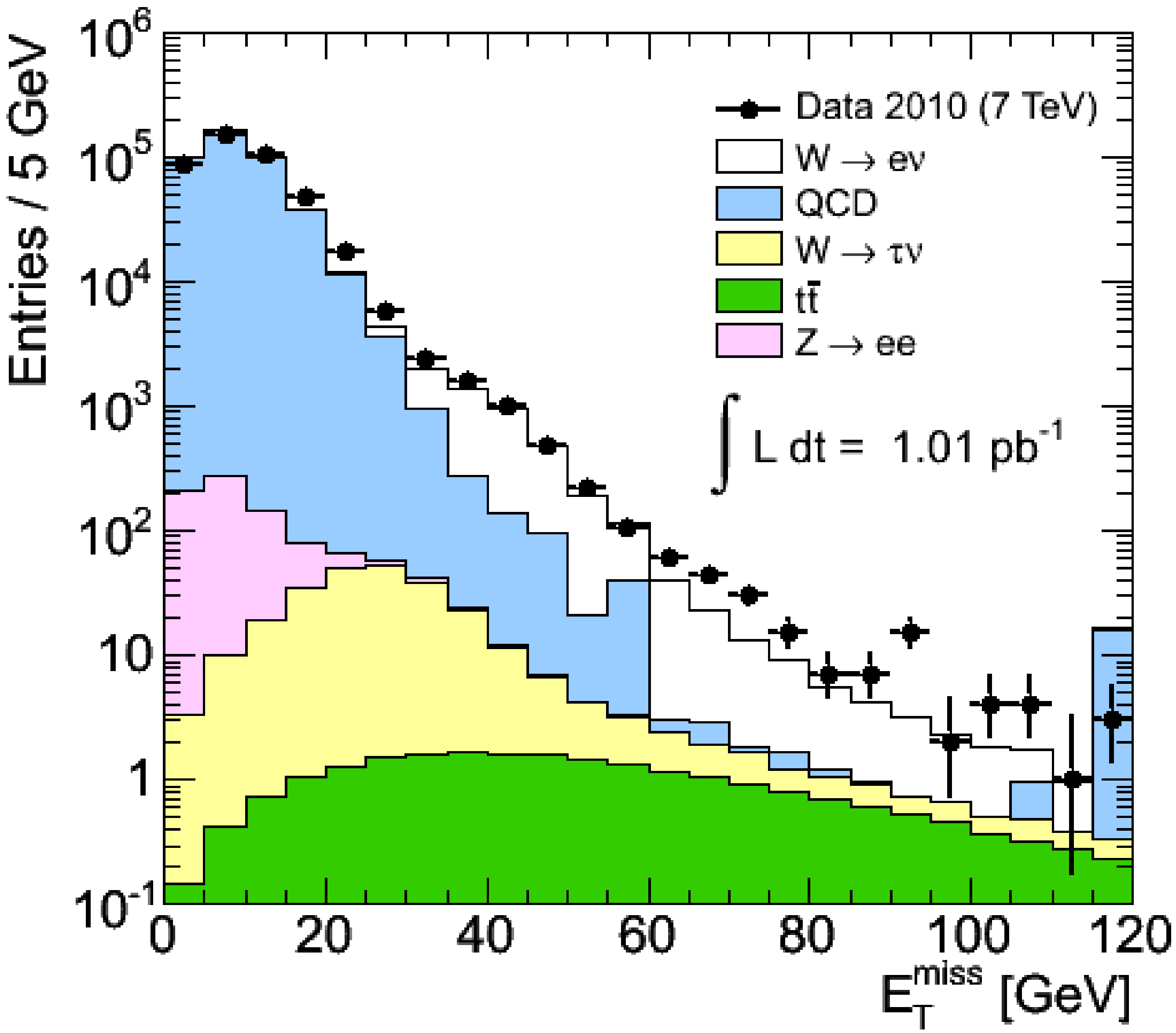
High p_T leptons

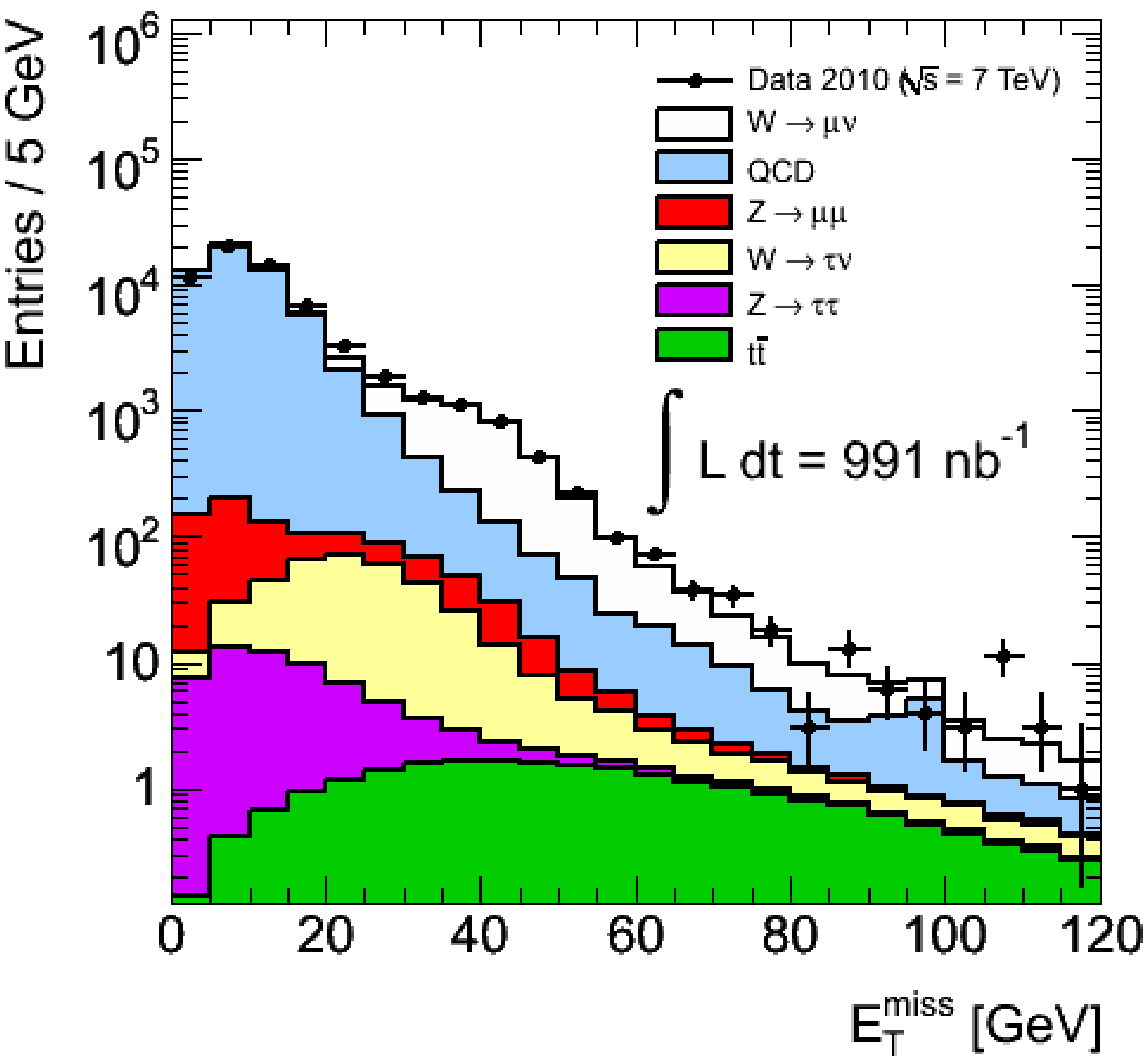
$W \to e\nu$

E_T > 20 GeV, |η| < 2.5
Loose electron selection

$W \to \mu\nu$

p_T > 15 GeV, |η| < 2.4
$|\Delta p_T(\text{ID-MS})|$ < 15 GeV



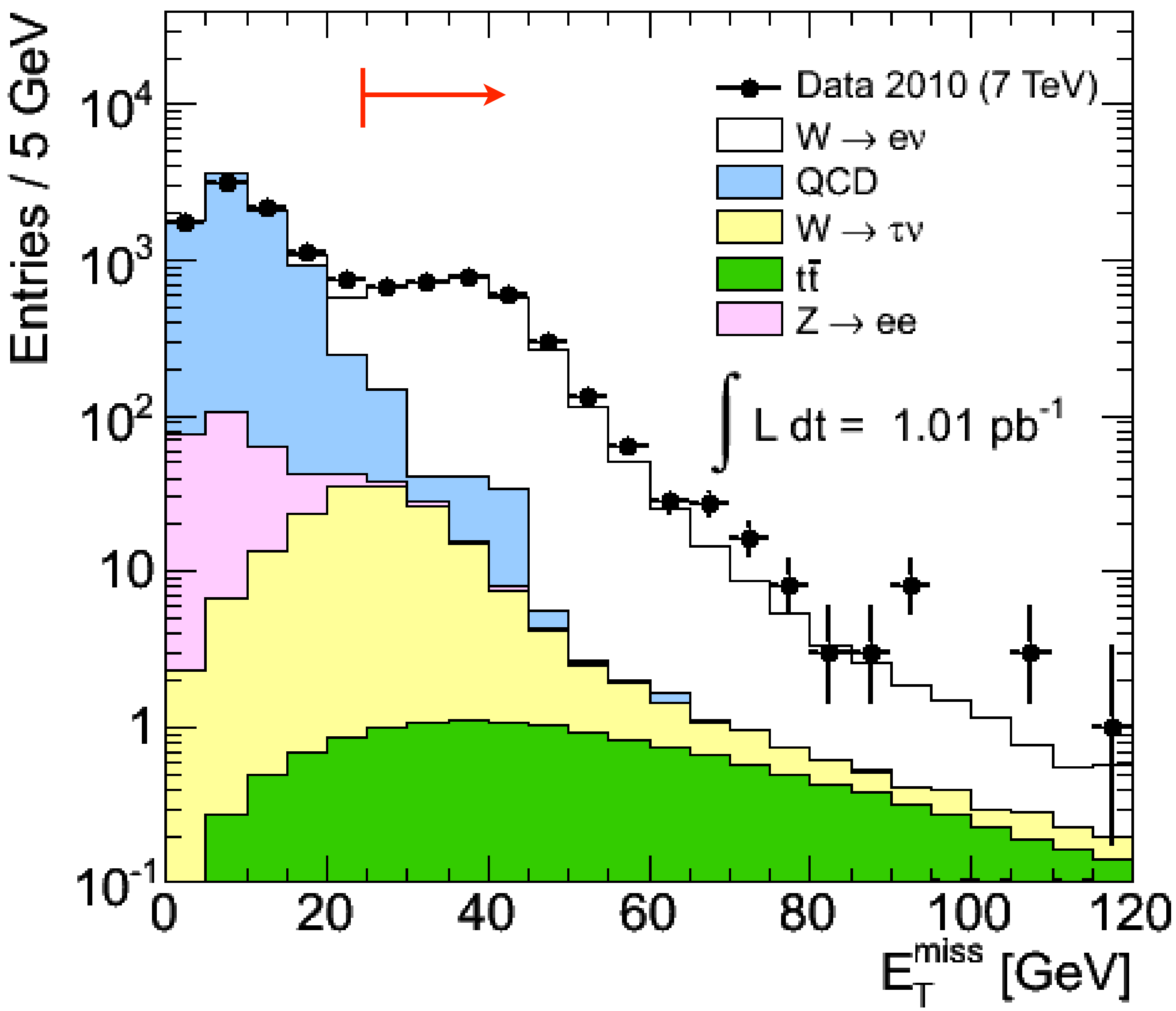


MC simulation includes pileup contribution

W→lν selection

W → eν

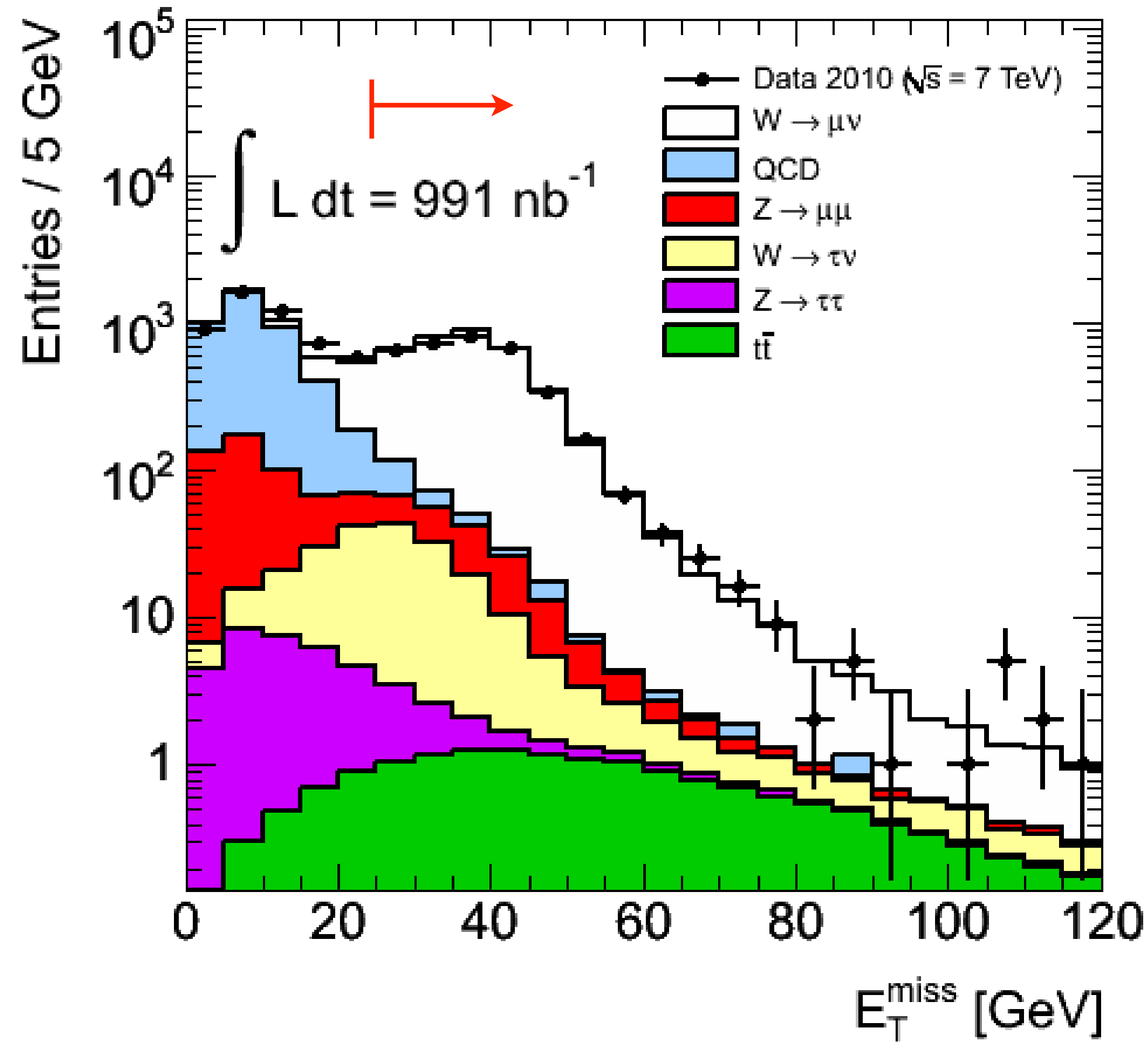
M_T > 40 GeV
E_T^{miss} > 25 GeV
Tight electron selection



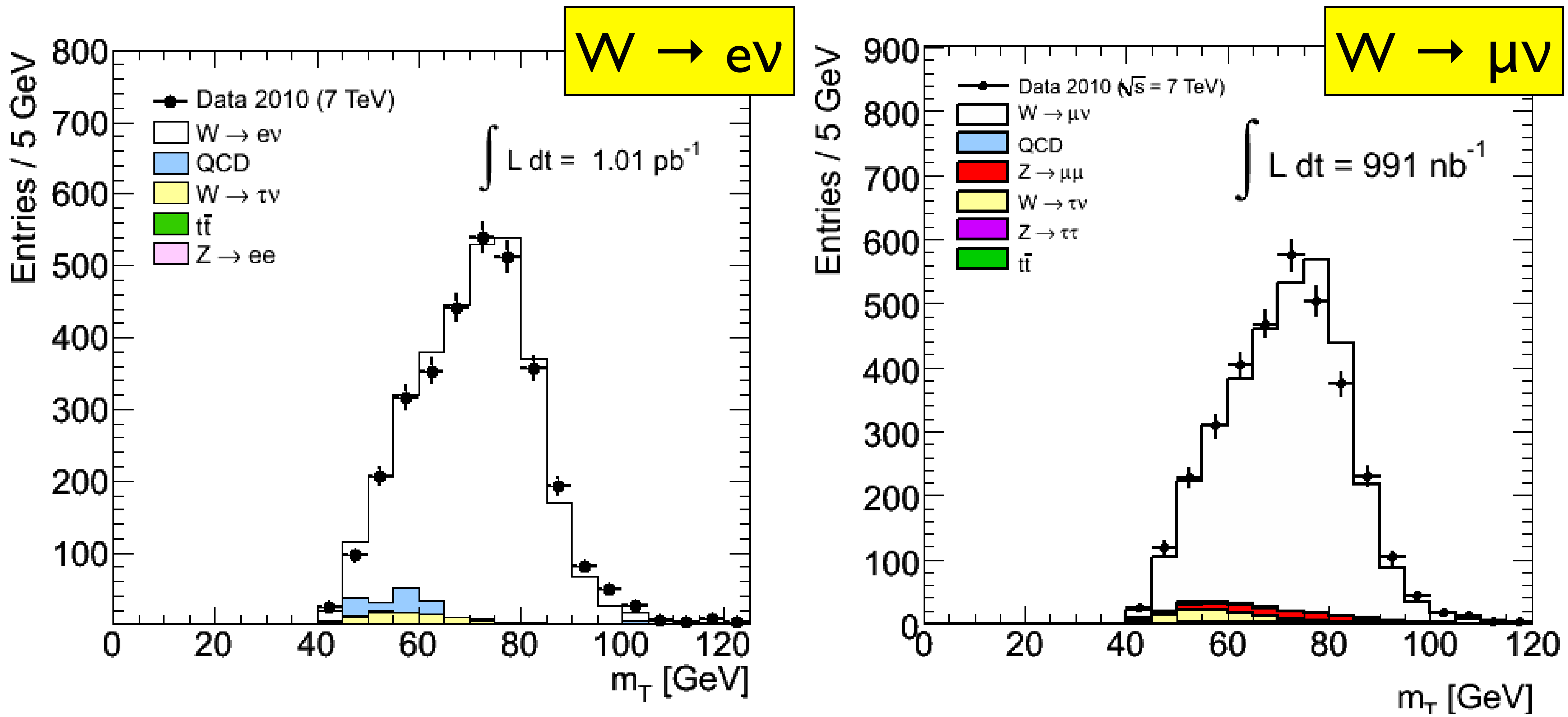
MC simulation includes pileup contribution

W → μν

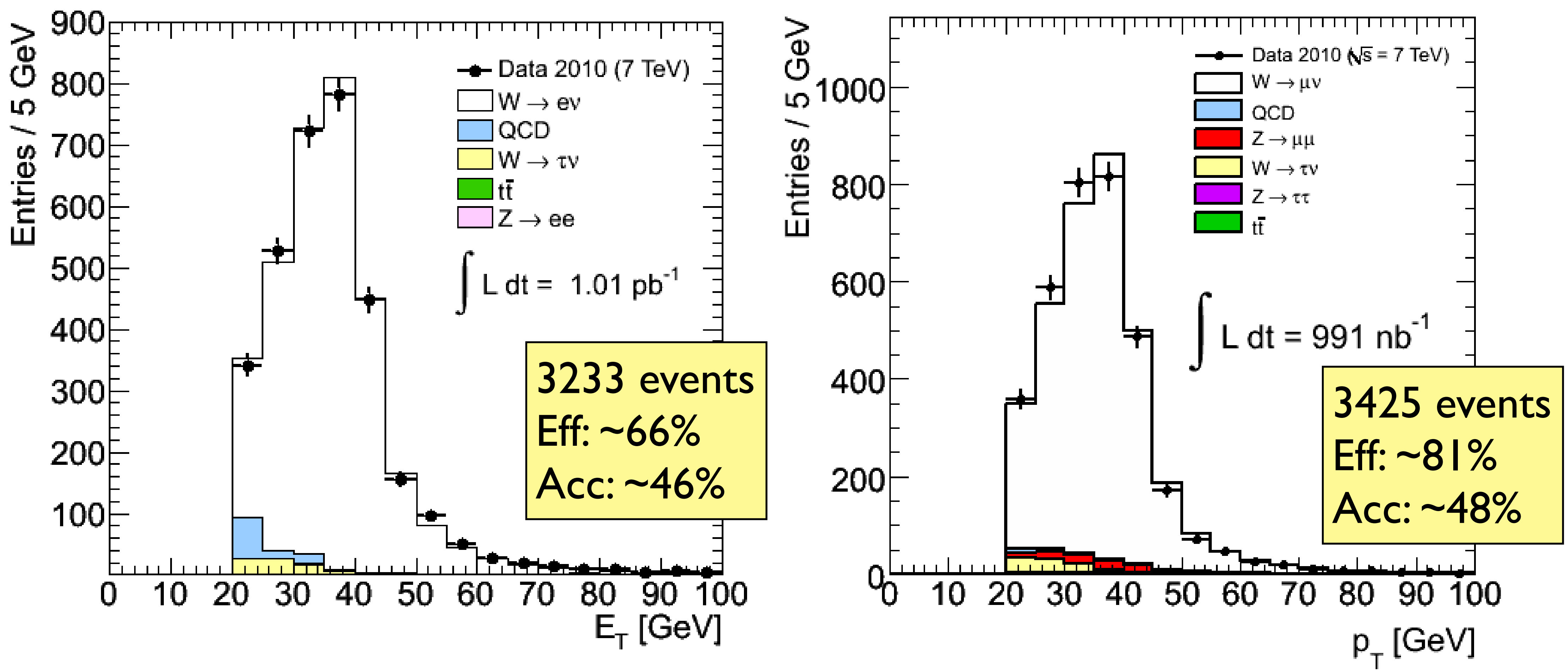
M_T > 40 GeV
E_T^{miss} > 25 GeV
p_T > 20 GeV, isolation



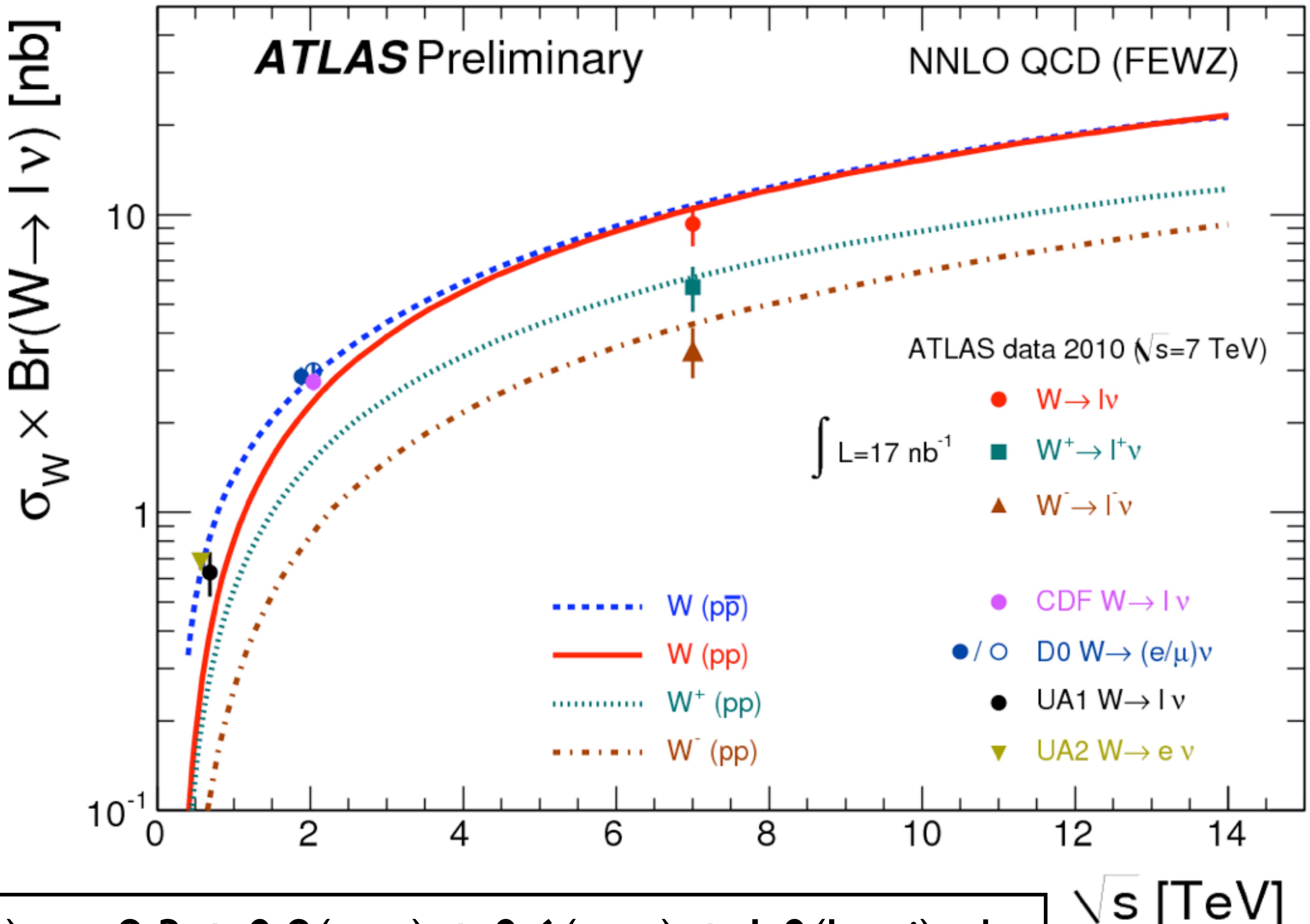
Transverse Mass



Lepton E_T/p_T



W→lν cross-section



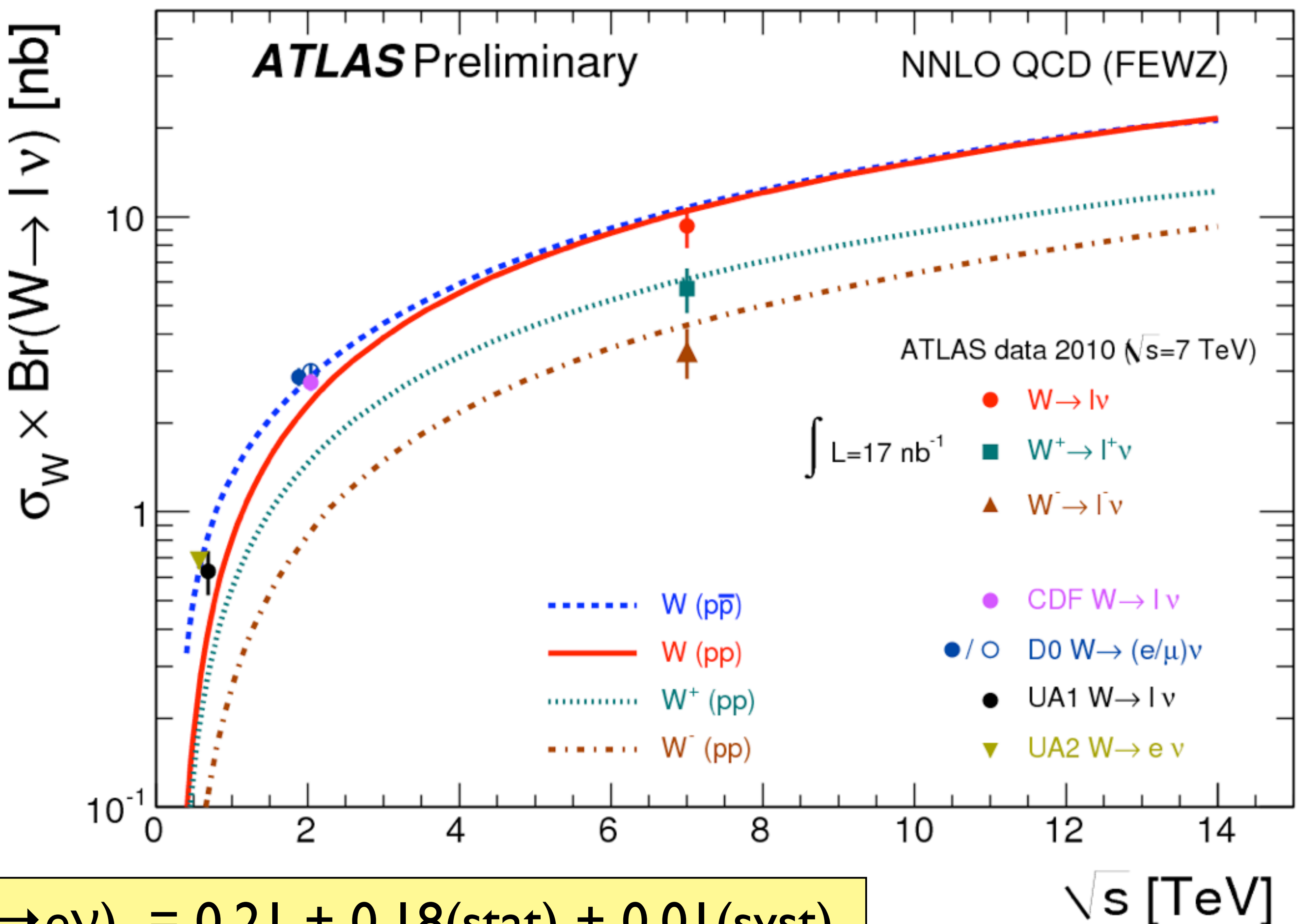
L=17 nb^{-1}

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

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

Syst errors dominated by lepton efficiencies

W→lν cross-section



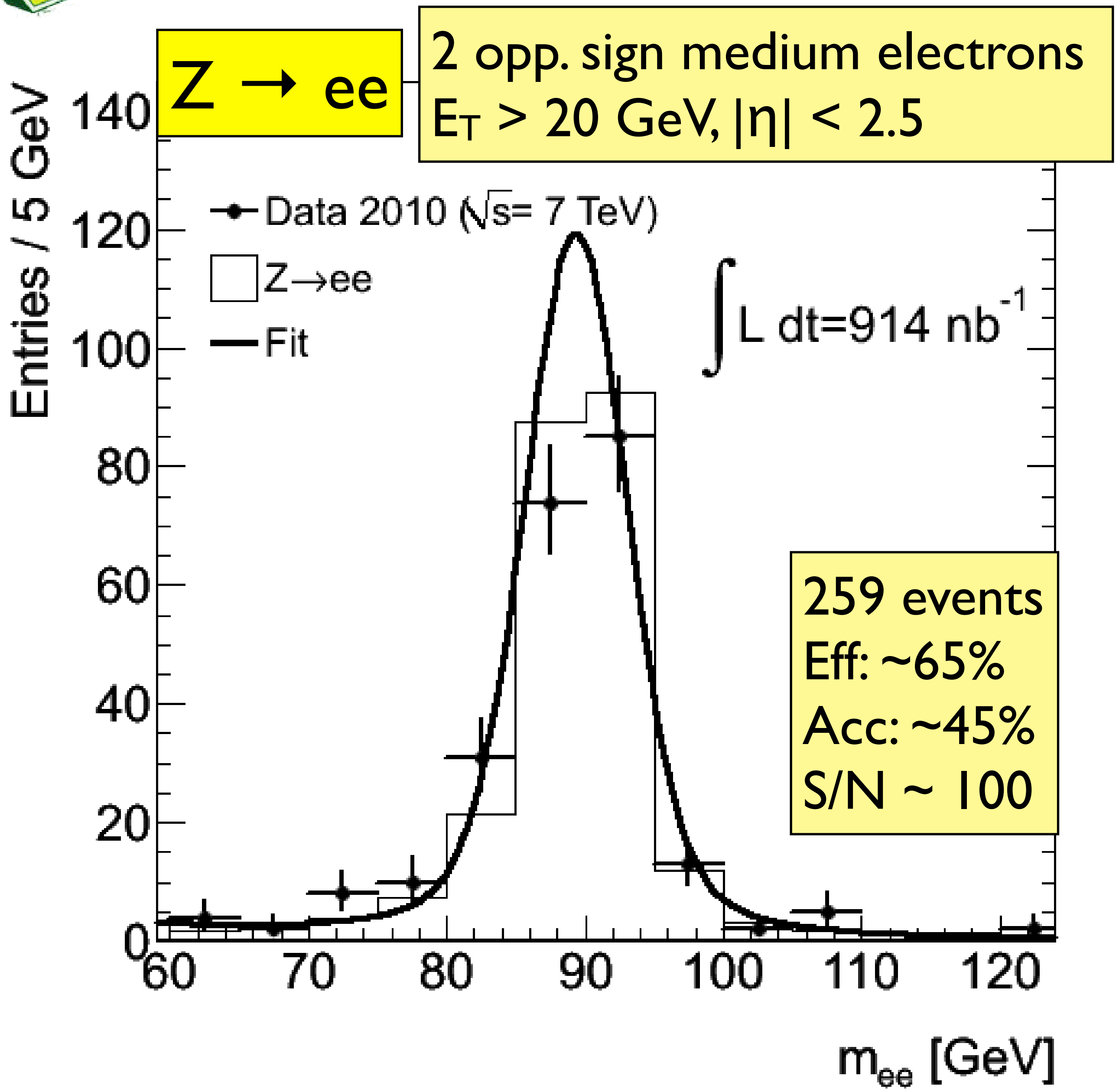
L=17 nb^{-1}

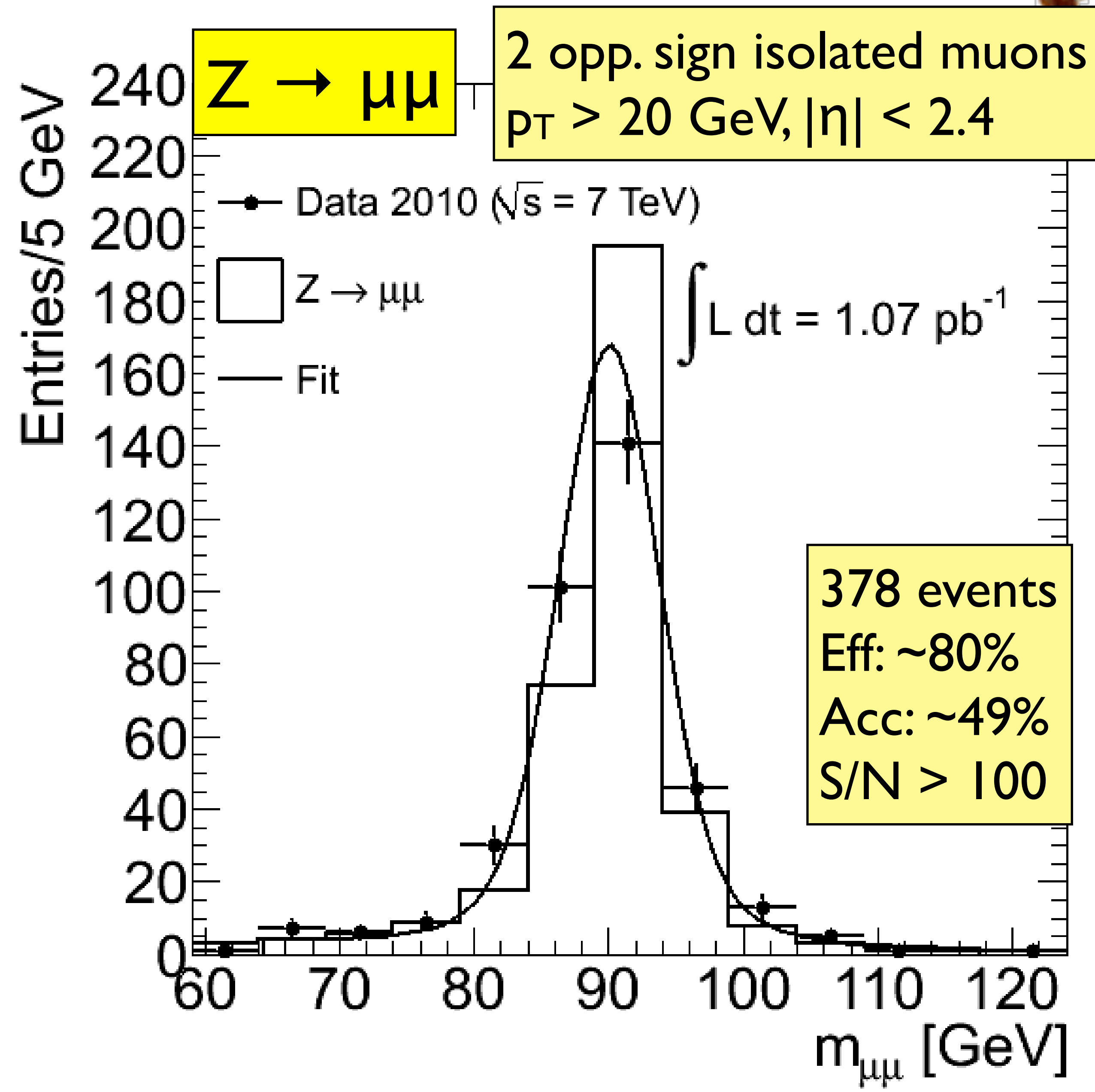
A(W→eν) = 0.21 ± 0.18(stat) ± 0.01(syst)
A(W→μν) = 0.33 ± 0.12(stat) ± 0.01(syst)

Expect 0.2 from NNLO MC

$$A = \frac{\sigma(W^+) - \sigma(W^-)}{\sigma(W^+) + \sigma(W^-)}$$

Z→ll selection





Lineshape + Gaussian resolution fit results, compared to MC

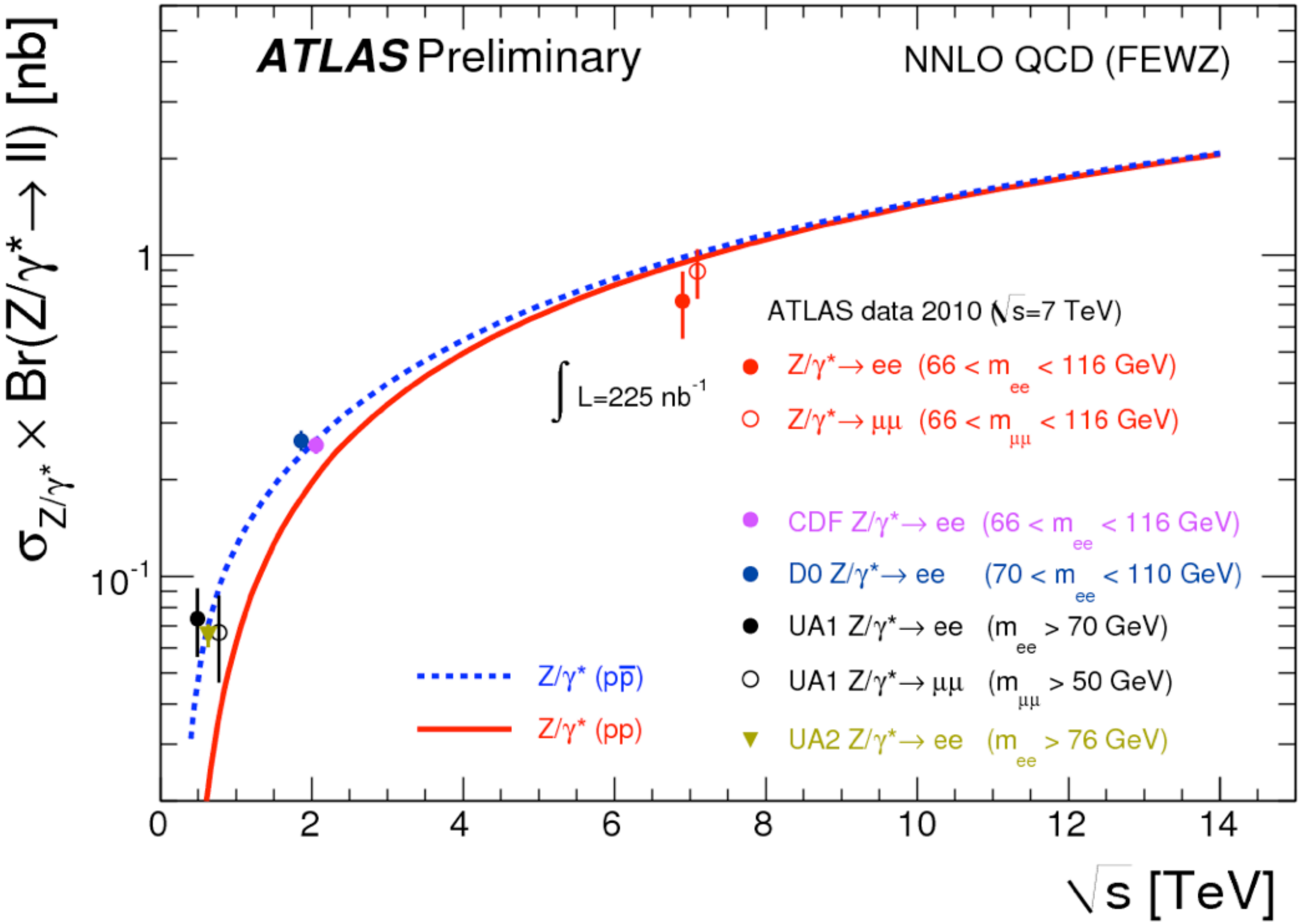
Consistent with current understanding of calibration/alignment, still some work to do...

	Data	MC
Mass (GeV)	90.9 ± 0.3	91.6
Resolution (GeV)	3.2 ± 0.3	1.8

	Data	MC
Mass (GeV)	90.8 ± 0.3	91.3
Resolution (GeV)	3.3 ± 0.3	1.5

Z→ll cross-section

L=225 nb^{-1}



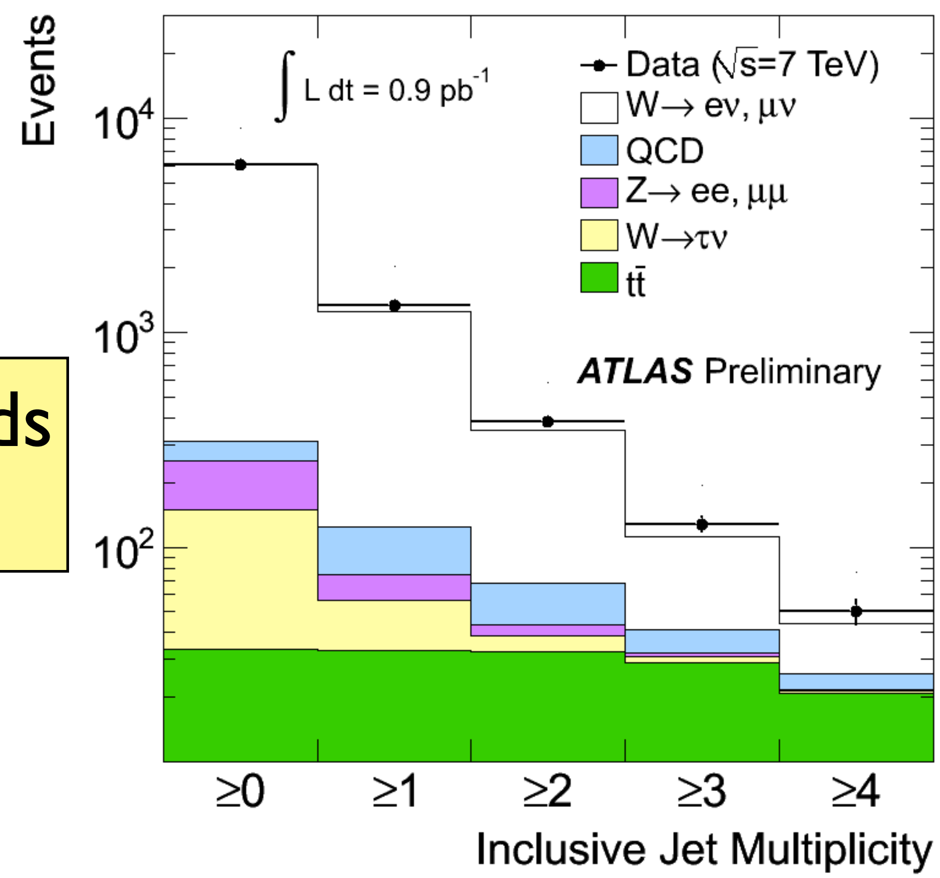
$$\sigma(Z/\gamma^* \to ll) = 0.83 \pm 0.07(\text{stat}) \pm 0.06(\text{syst}) \pm 0.09(\text{lumi})\ \text{nb}$$

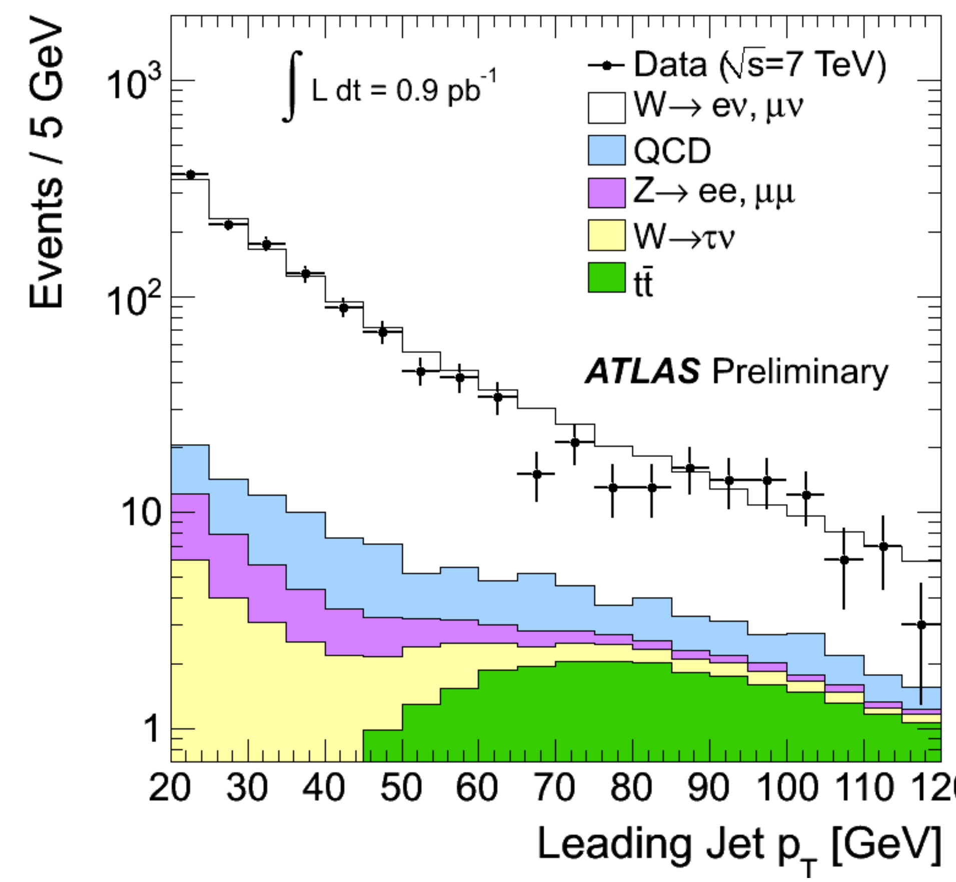
$$\sigma(Z/\gamma^* \to ee) = 0.72 \pm 0.11(\text{stat}) \pm 0.10(\text{syst}) \pm 0.08(\text{lumi})\ \text{nb}$$

$$\sigma(Z/\gamma^* \to \mu\mu) = 0.89 \pm 0.10(\text{stat}) \pm 0.07(\text{syst}) \pm 0.10(\text{lumi})\ \text{nb}$$

W/Z + Jets

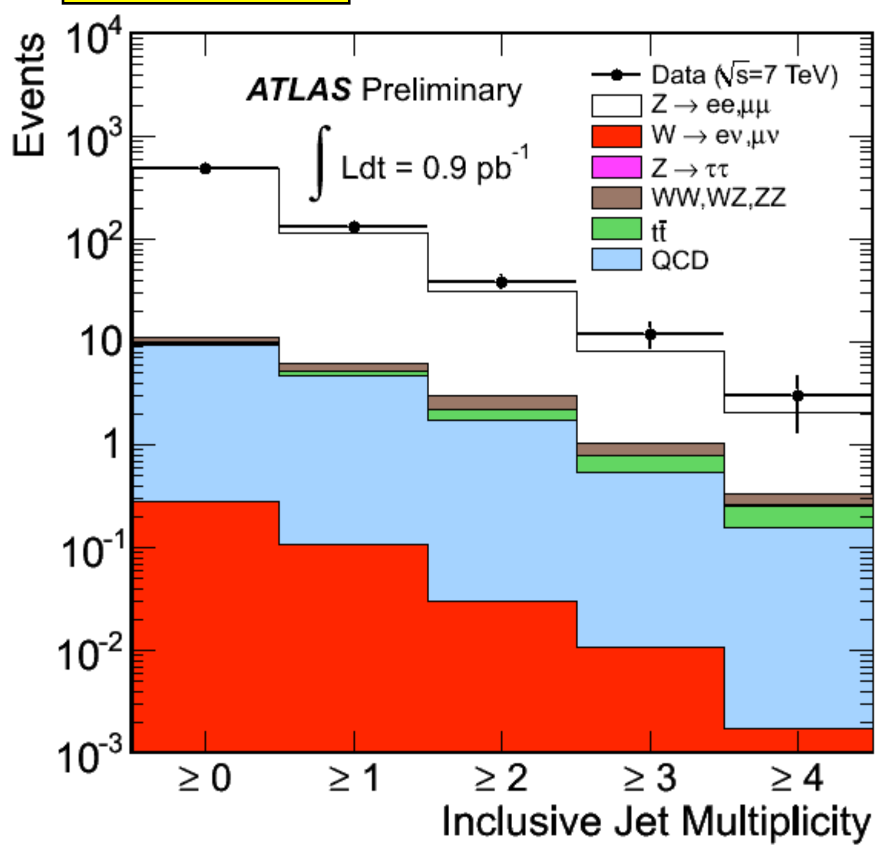
W + Jets

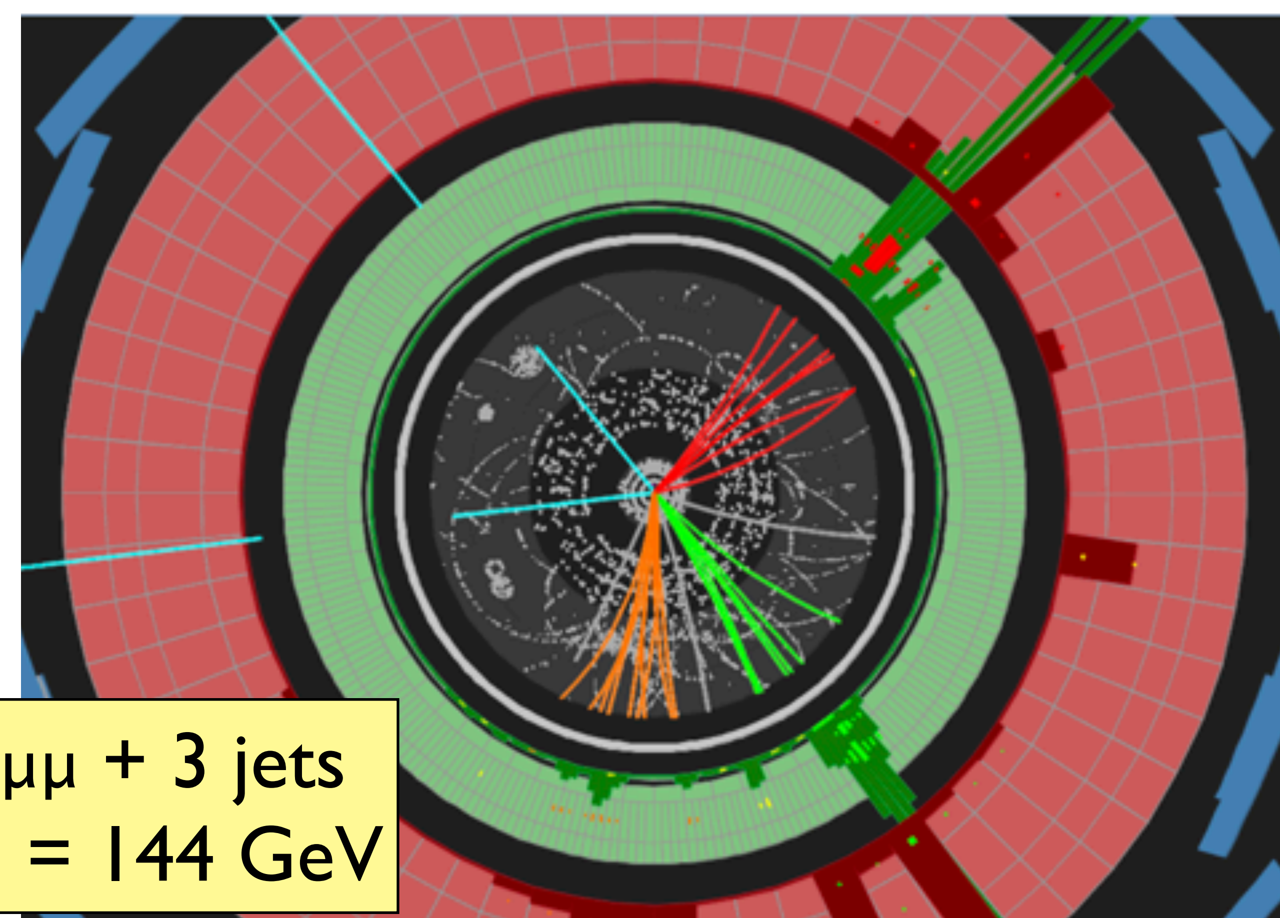




Important backgrounds for many searches!

Z + Jets



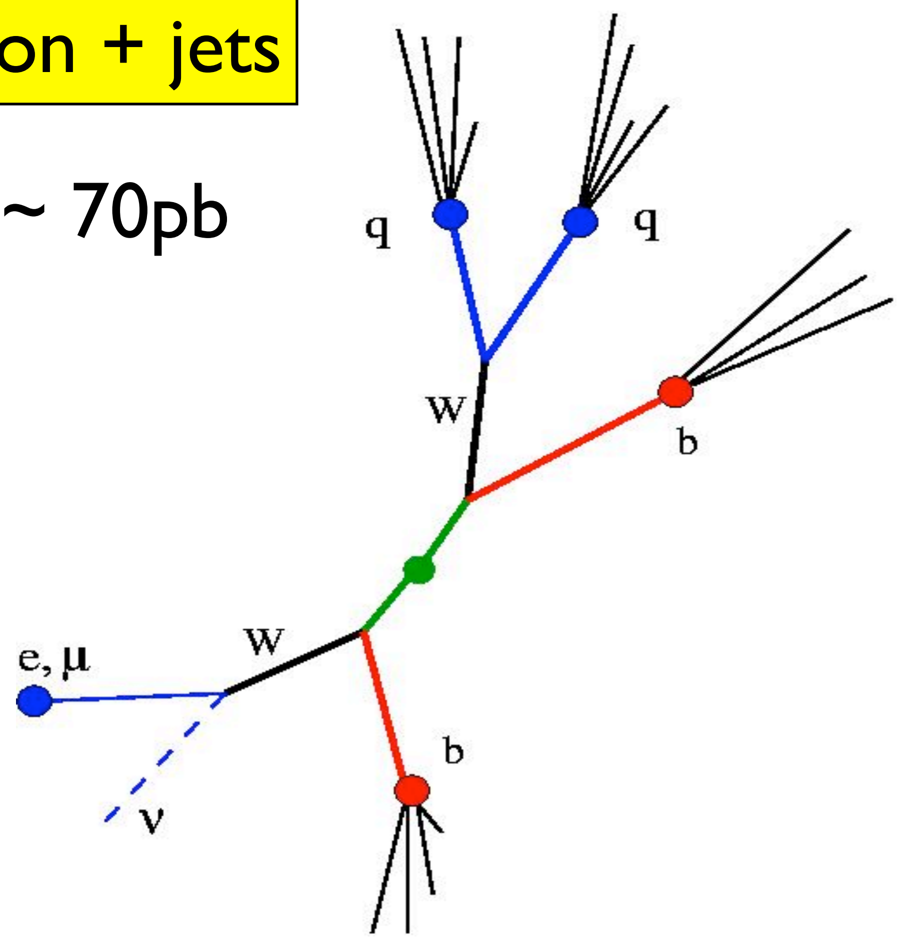


Z →μμ + 3 jets
$p_T(Z)$ = 144 GeV

Top Selection

lepton + jets

$\sigma \sim 70$pb

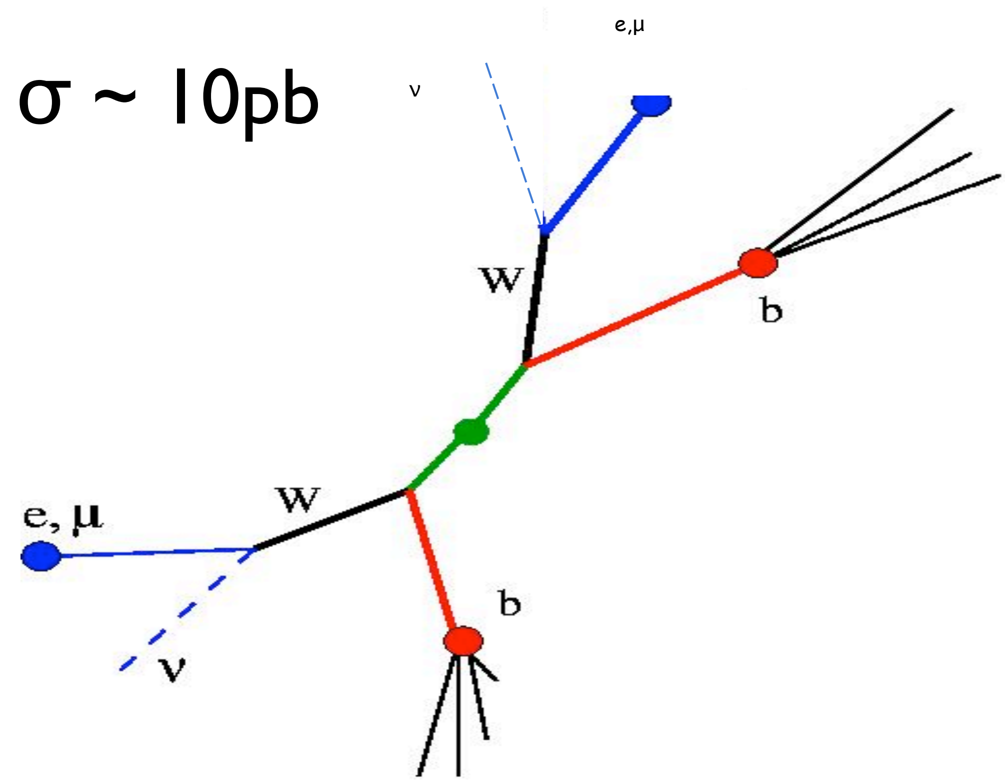


- isolated lepton
  $p_T > 20$ GeV, $|\eta| < 2.5$
- ≥ 4 jets $E_T > 20$ GeV
- $E_T^{miss} > 20$ GeV

Eff. x Acc. ~ 30%

di-lepton

$\sigma \sim 10$pb



- 2 isolated leptons
  $p_T > 20$ GeV, $|\eta| < 2.5$
- ≥ 2 jets $E_T > 20$ GeV
- ee: $E_T^{miss} > 40$ GeV, $|M_{ee}-M_Z| > 5$ GeV
- μμ: $E_T^{miss} > 30$ GeV, $|M_{ee}-M_Z| > 10$ GeV
- eμ: $\sum E_T > 150$ GeV

Eff. x Acc. ~ 25%

$t\bar{t}$ Candidates

L = 280nb^{-1}

lepton + jets

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

Observe: 7
Expect: ~5

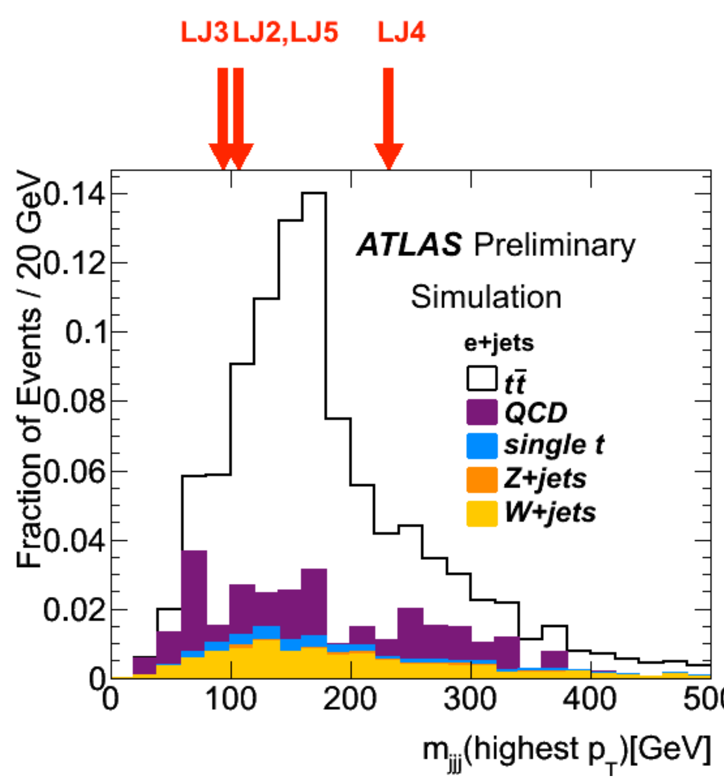
di-lepton

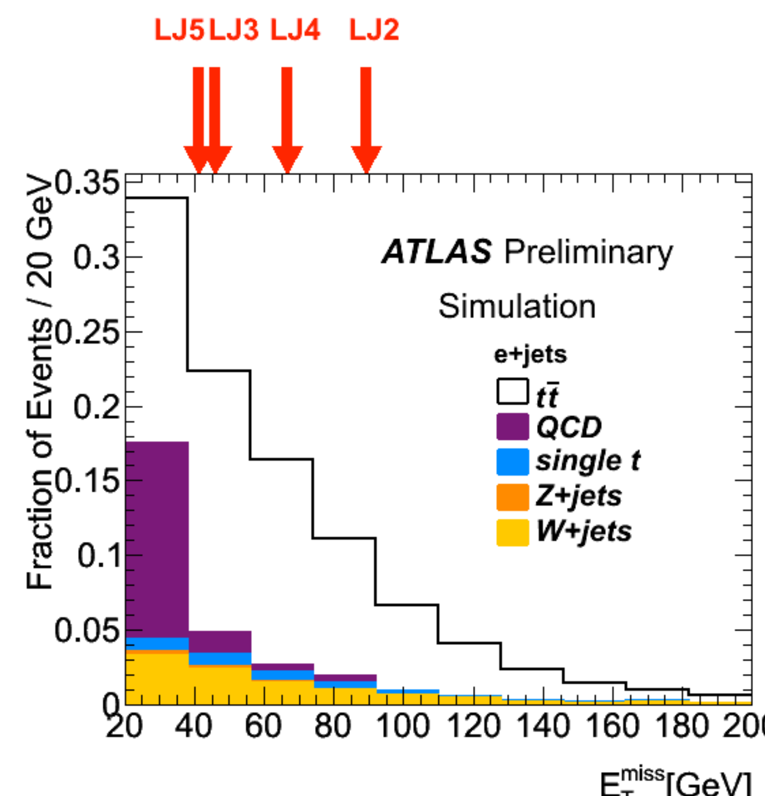
ID	Channel	p_T^{lep} (GeV)	E_T^{miss} (GeV)	H_T (GeV)	#jets $p_T > 20$ GeV	#b-tagged jets
DL1	ee	55.2/40.6	42.4	271	3	1
DL2	$e\mu$	22.7/47.8	76.9	196	3	1

Observe: 2
Expect: ~1

Events look signal-like in key kinematic distributions

All candidates have 1 b-tag





e+jet candidate (LJ5)

$p_T(e)$=79 GeV E_T^{miss} = 43 GeV

m_T (“W→eν”)= 87 GeV

p_T (b-tagged jet) = 91 GeV

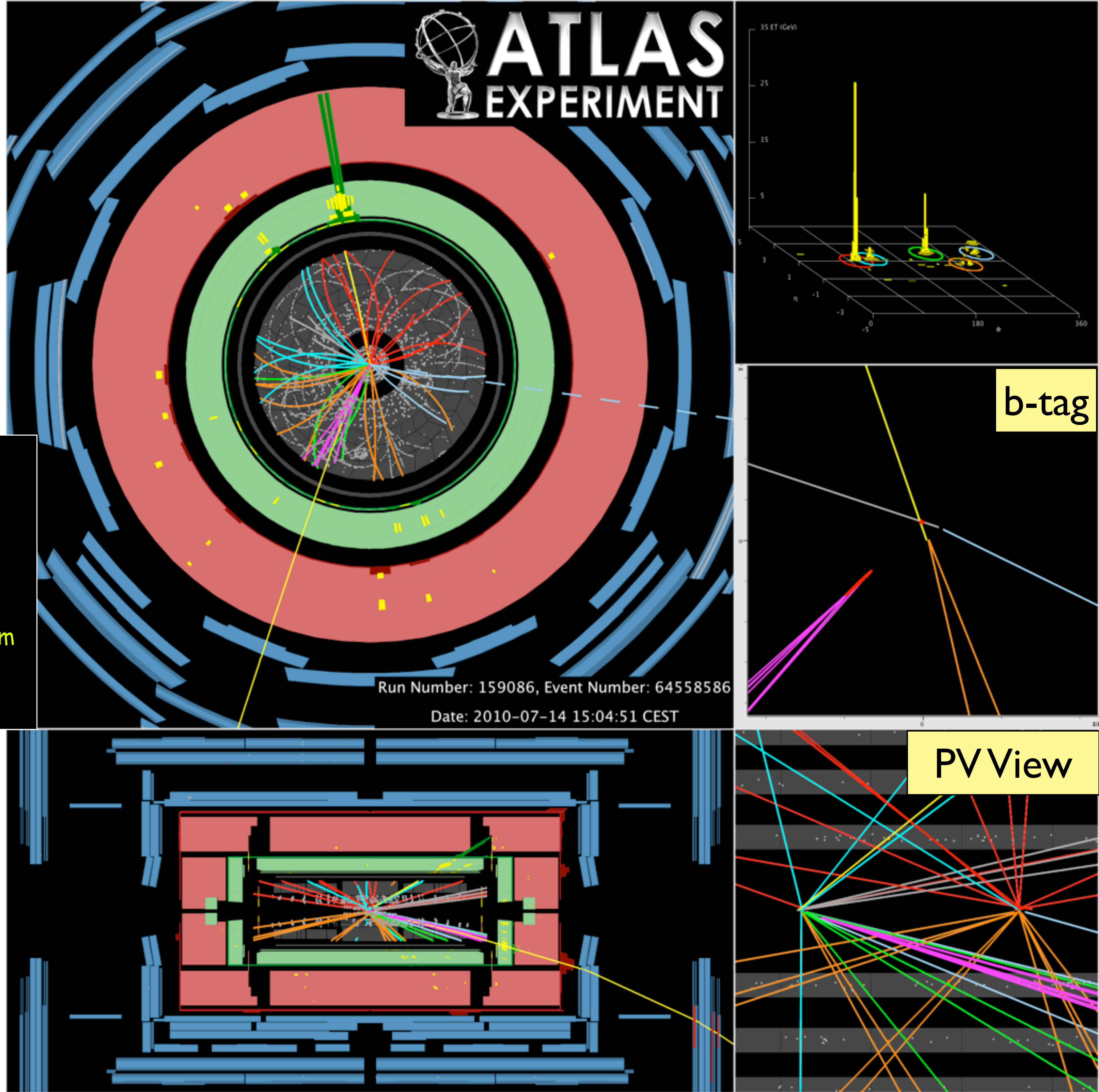
M (jjj)= 122 GeV

Secondary vertex:

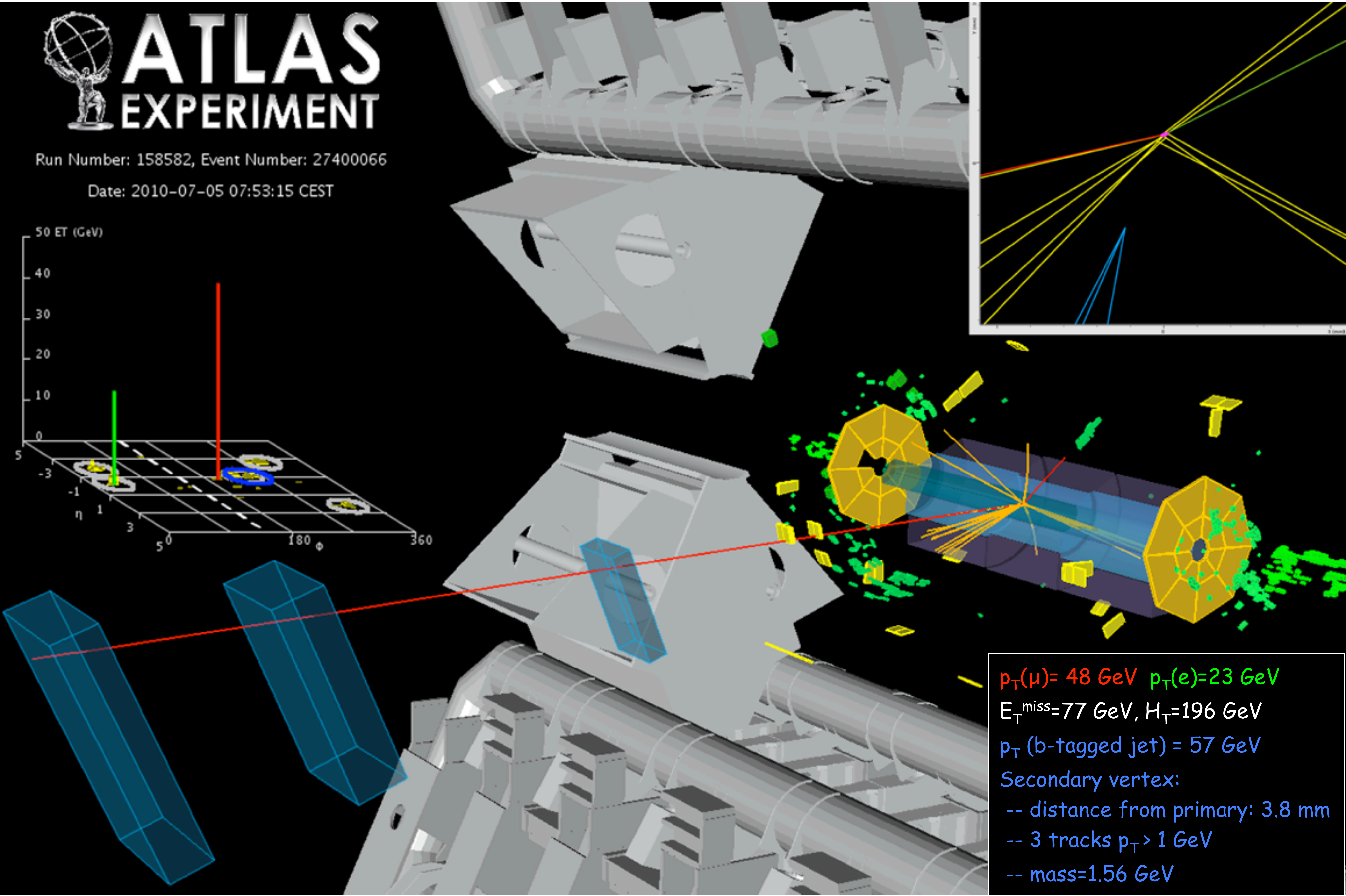
-- distance from primary: 5 mm

-- 6 tracks p_T > 2 GeV

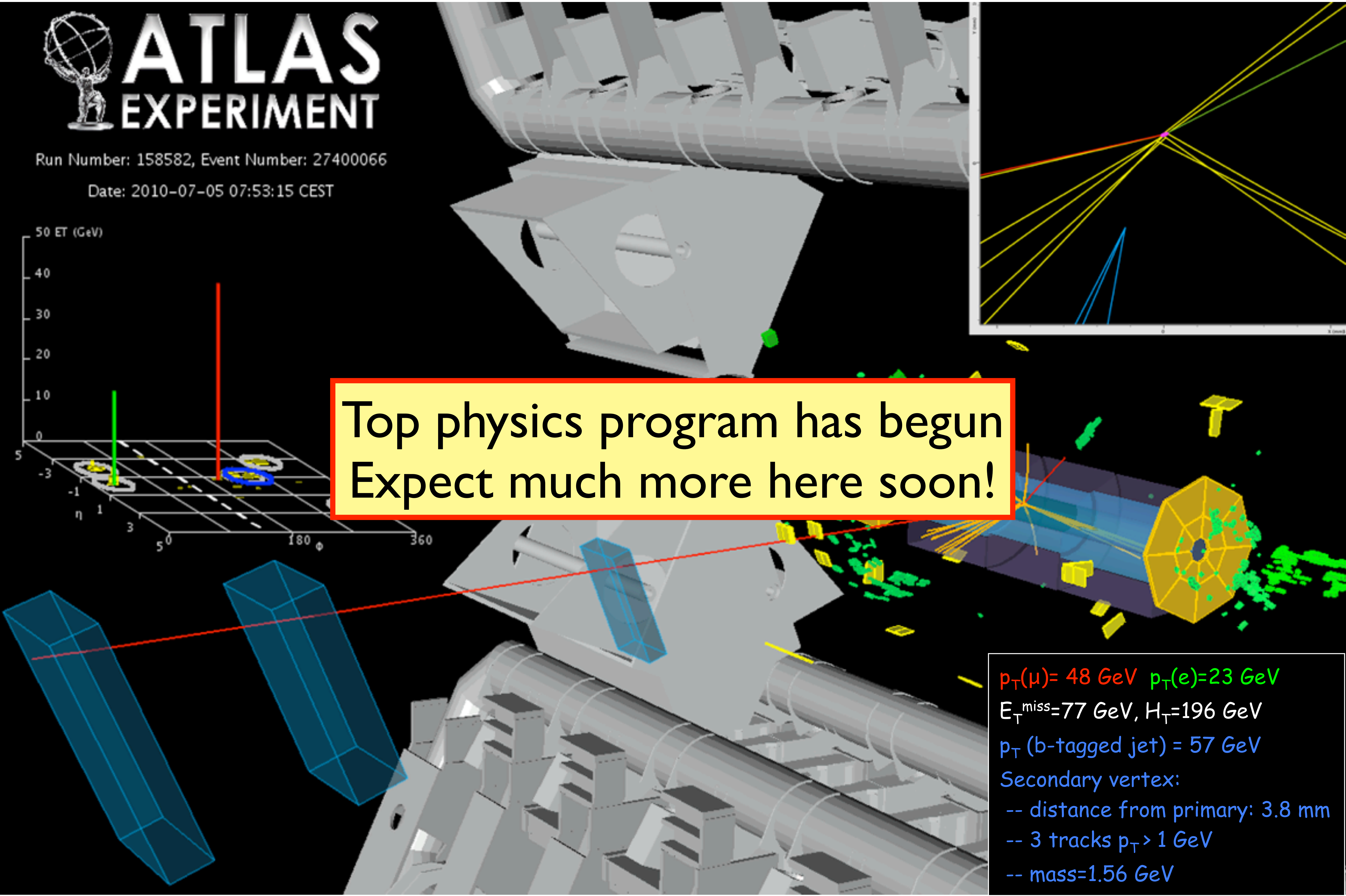
-- mass=3.8 GeV



e-μ candidate (DL2)



e-μ candidate (DL2)



Top physics program has begun
Expect much more here soon!

$p_T(\mu)$= 48 GeV $p_T(e)$=23 GeV
E_T^{miss}=77 GeV, H_T=196 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

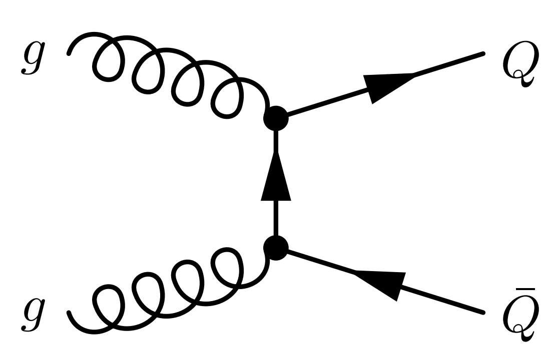
First Searches

Current Goals:

- Study backgrounds by comparing MC in sensitive distributions
- Be prepared to set limits (or discover) with increased Luminosity

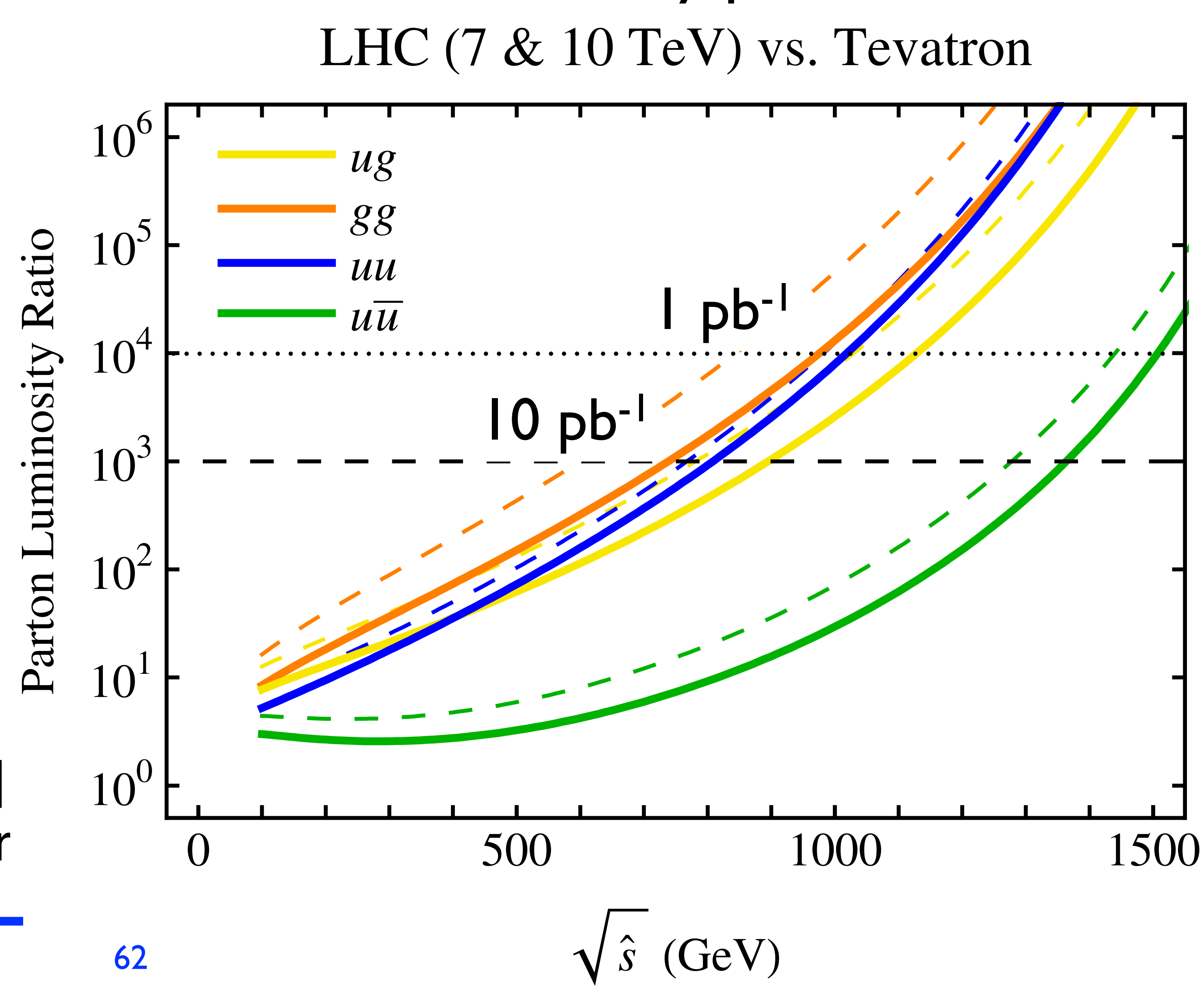
Supermodels:

LHC already competitive ~1 TeV especially in gg



PLB 690 (2010) 280 [arXiv:0909.5213]
Bauer, Ligeti, Schmaltz, Thaler, Walker

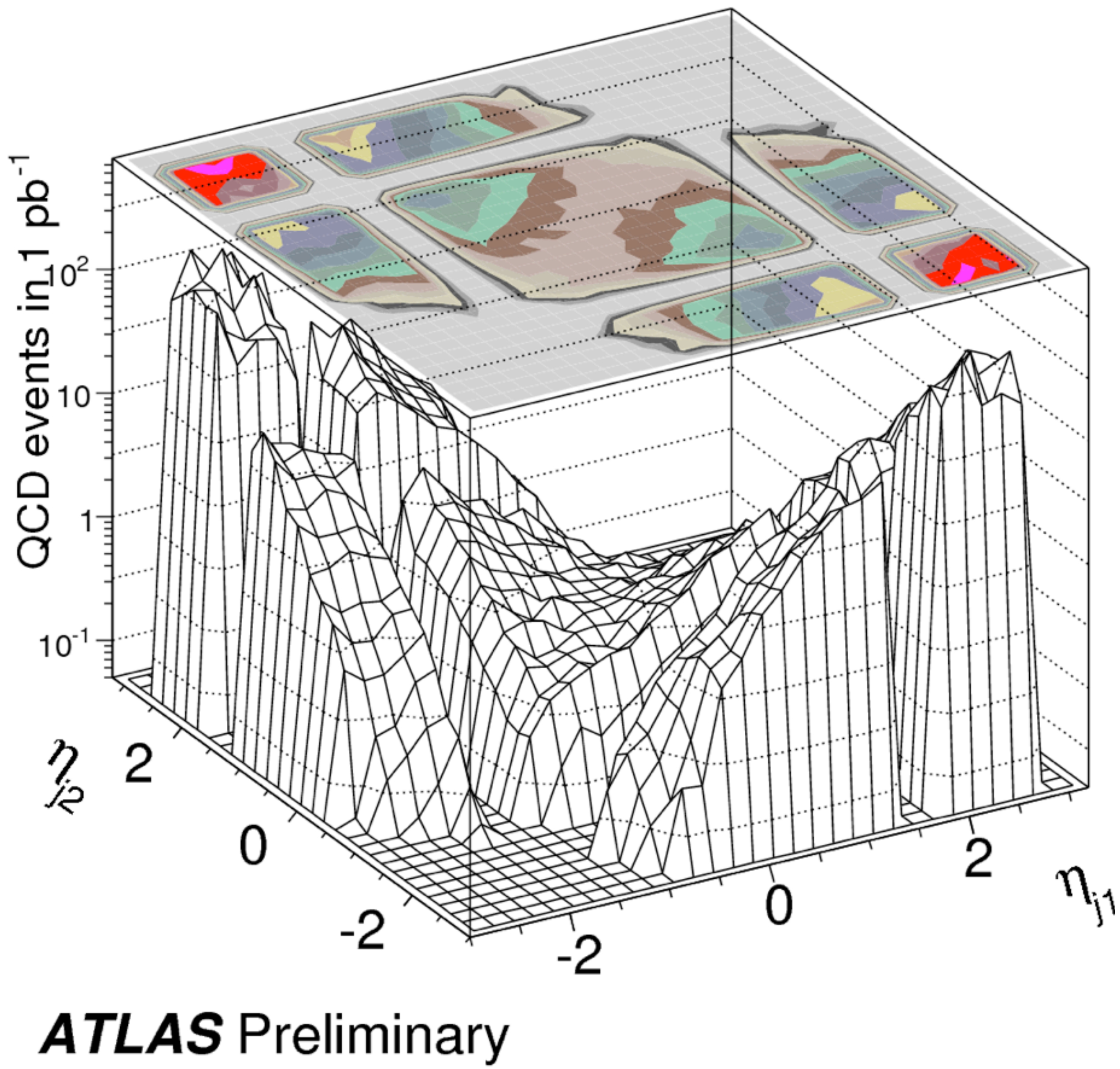
$\sigma_{LHC}/\sigma_{TEV}$ by process



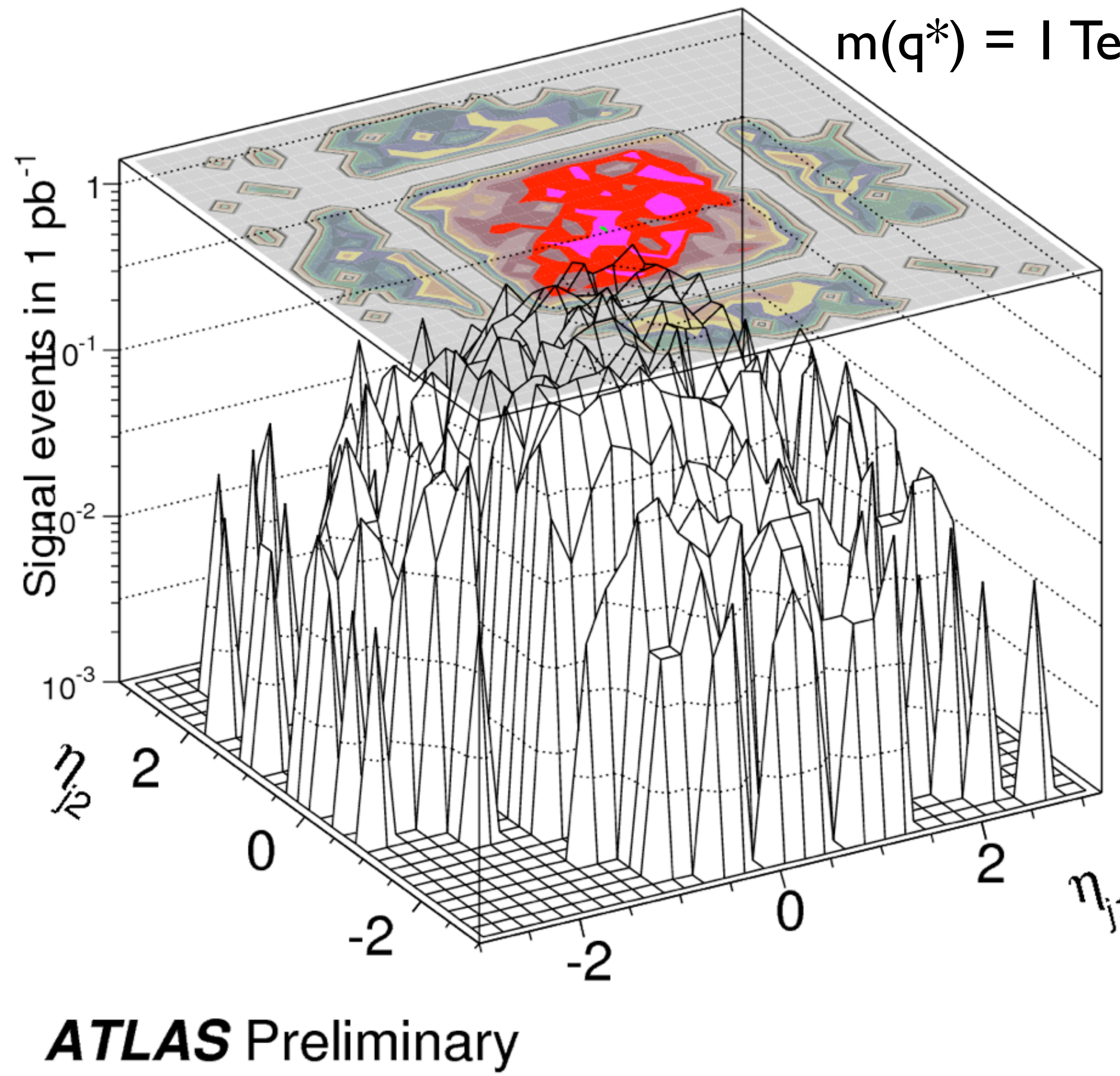
Excited Quarks $q^* \to jj$

QCD di-jets: more forward

Excited quarks: more central



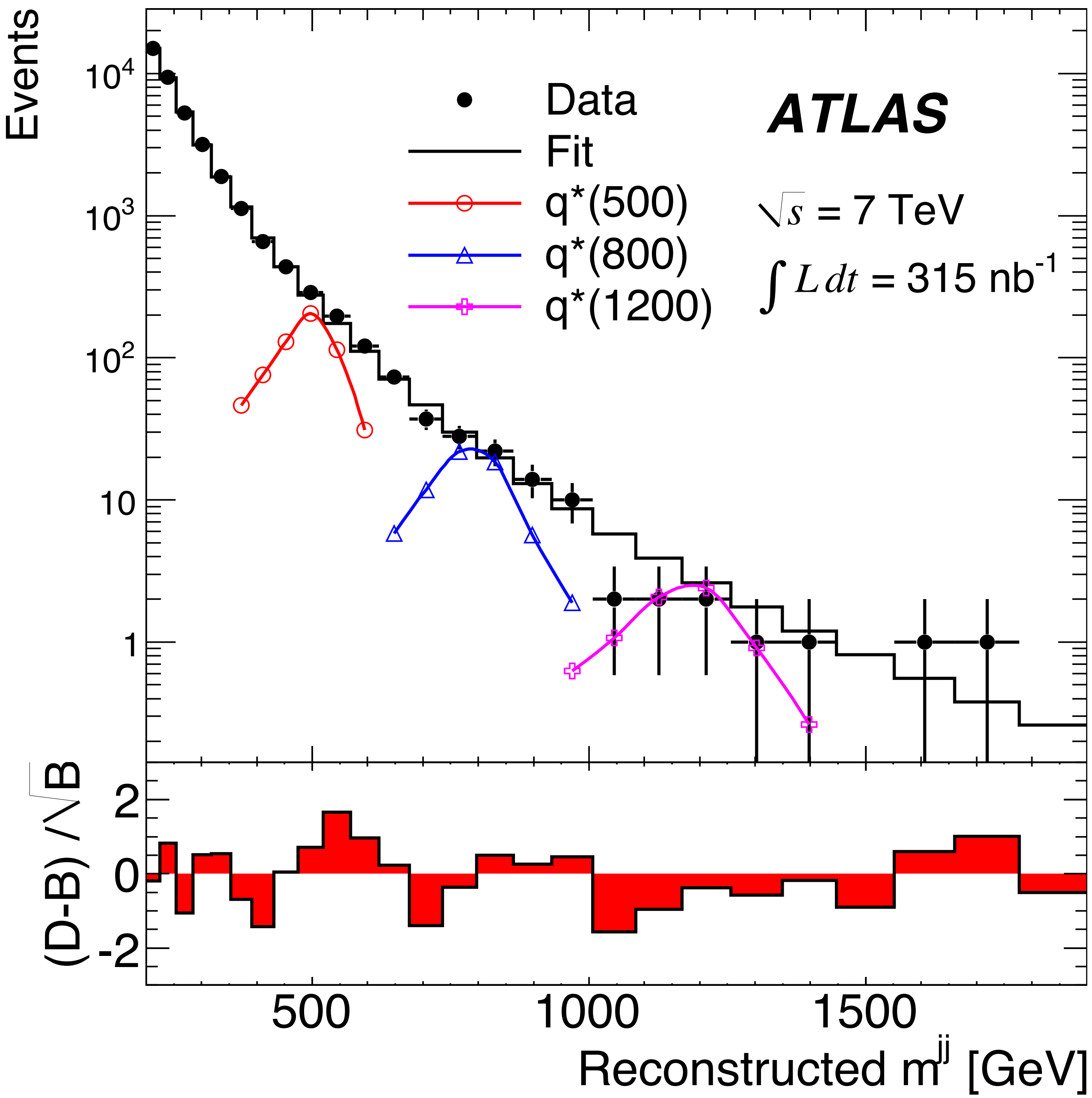
m(q*) = 1 TeV

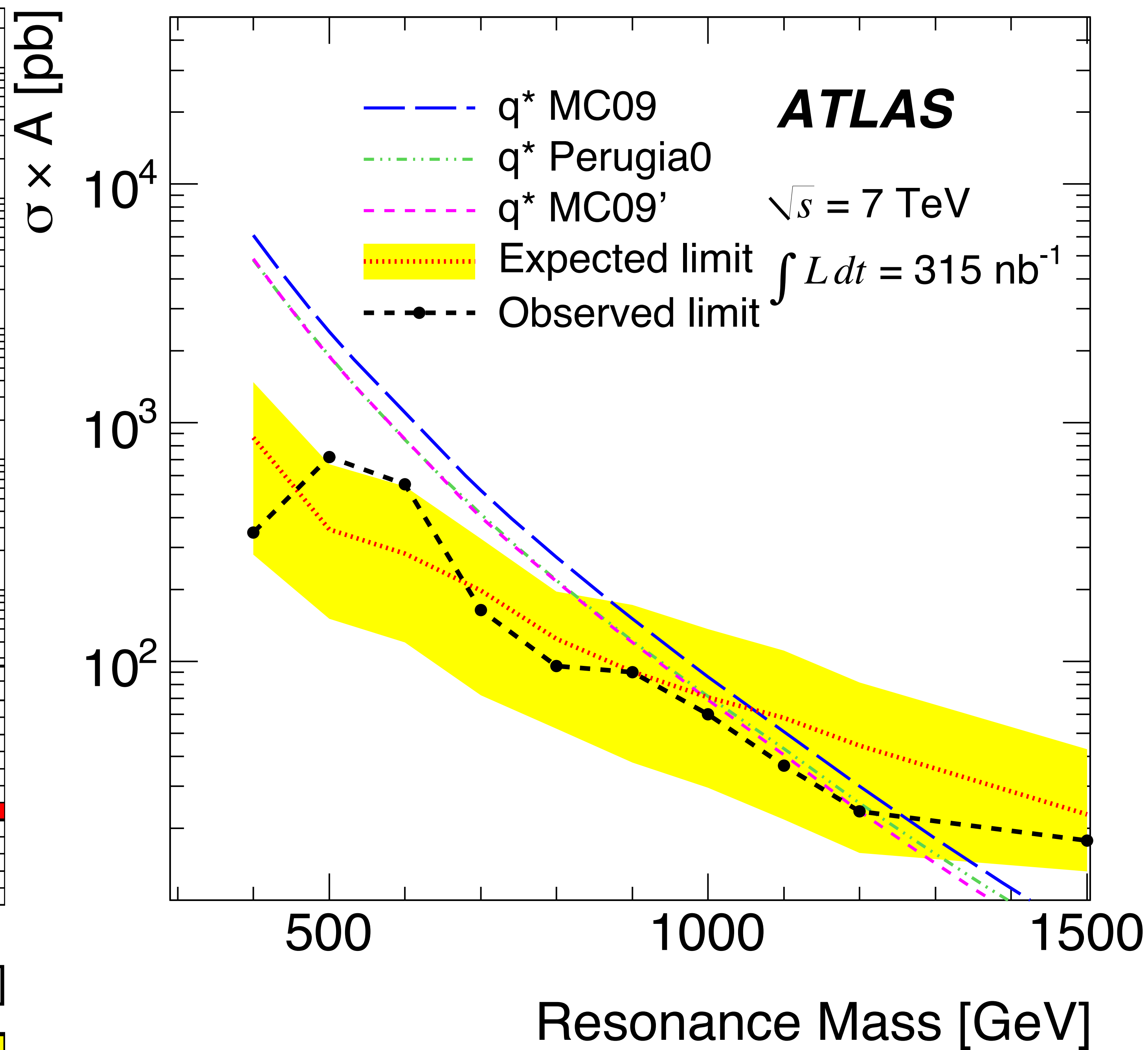


Standard Dijet analysis
anti-k_T R=0.6 jets
$|\eta| < 2.5$

Additionally Require: $|\eta_1 - \eta_2| < 1.3$

Excited Quark Results





0.4 < M(q*) < 1.26 TeV excluded (MRST2007) at 95% CL

First competitive ATLAS search! c.f. CDF: M(q*) > 870 GeV, 1 fb^{-1}

arXiv:1008.2461v1, submitted to PRL

Other Searches and Sensitivities

Several nice talks at HCP:

ATLAS Higgs studies - M. Schram (today)

BSM prospects/limits (ATLAS) - P. Savard (tomorrow)

Physics prospects at LHC for 2011++ (CMS/ATLAS) - A. Clark (Friday)

And ICHEP:

Early Searches with Jets - G. Choudalakis

Early Searches with Leptons and Photons - D. Fortin

ATLAS Higgs Sensitivity with 1 fb^{-1} - T. Masubuchi

Conclusions

- After ~15 years of preparation, the ATLAS detector (and collaboration) has performed well

- Initial calibrations/alignments performed, remarkably good agreement with Geant4 Monte Carlo

Payoff from ~10 years of testbeam data

- First physics results presented this Summer, many more results coming out almost daily

- Still a ways to go in luminosity, but first competitive physics results have started

Apologies if I didn't cover your favorite topic...

The LHC and ATLAS are off to a good start. We look forward to many more champagne opportunities soon...

Fin

Luminosity Scale

Absolute $\mathcal{L}$ Calibration by beam-separation scans: principle

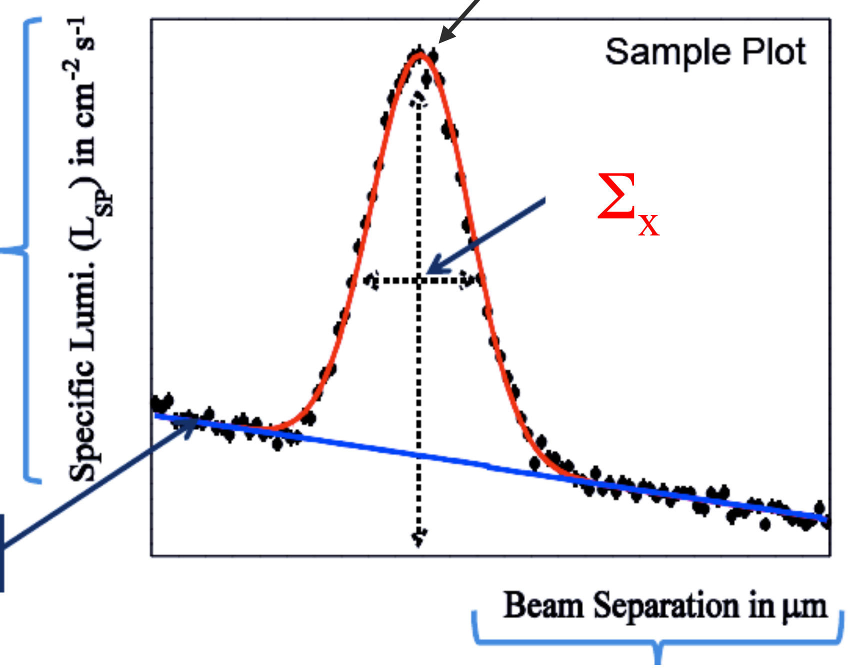
Principle: measure simultaneously

$\mathcal{L} = f\,(I_1, I_2, \Sigma_x, \Sigma_y)$

R_{max} = peak collision rate (arb. u.)

From HF, vtx counting, LUCID, MBTS, ZDC ...

$R_{max} \sim \mathcal{L}\, \sigma_{inel}\, \varepsilon_{det}$



$$\mathcal{L} = \frac{n_b f_r I_1 I_2}{2\pi \Sigma_x \Sigma_y}$$

Simplest case: $\Sigma_x = (\sigma^2_{1x} + \sigma^2_{2x})^{1/2}$

$\mathbf{k = \sigma_{vis} = R_{max} / \mathcal{L}}$

$\Delta k/k \sim \Delta I_{1,2} / I_{1,2}$

$\sim \Delta\Sigma_{x,y} / \Sigma_{x,y}$

$\sim \Delta R_{max} / R_{max}$

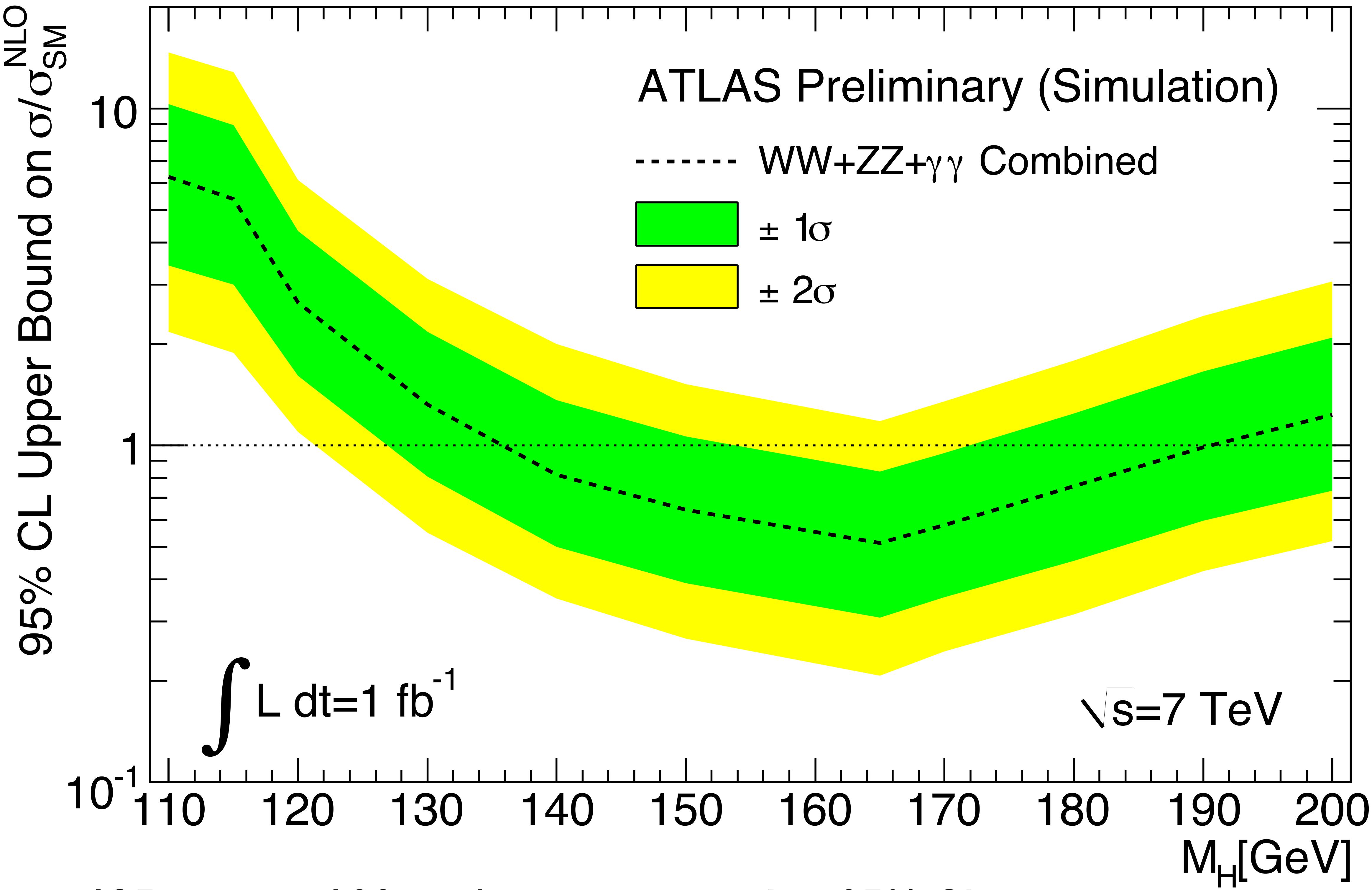
See HCP talk (~now!):
Prospects for Luminosity precision at LHC
W. Kozanecki

W. Kozanecki *Slide 9* *HCP Symposium, Toronto, 23-28 August 2010*

Beam Separation 'Van de Meer' Scans

Current uncertainty 11% (beam current uncertainty)

Expected Higgs Sensitivity



135 < m_H < 188 exclusion expected at 95% CL

Inner Detector Material