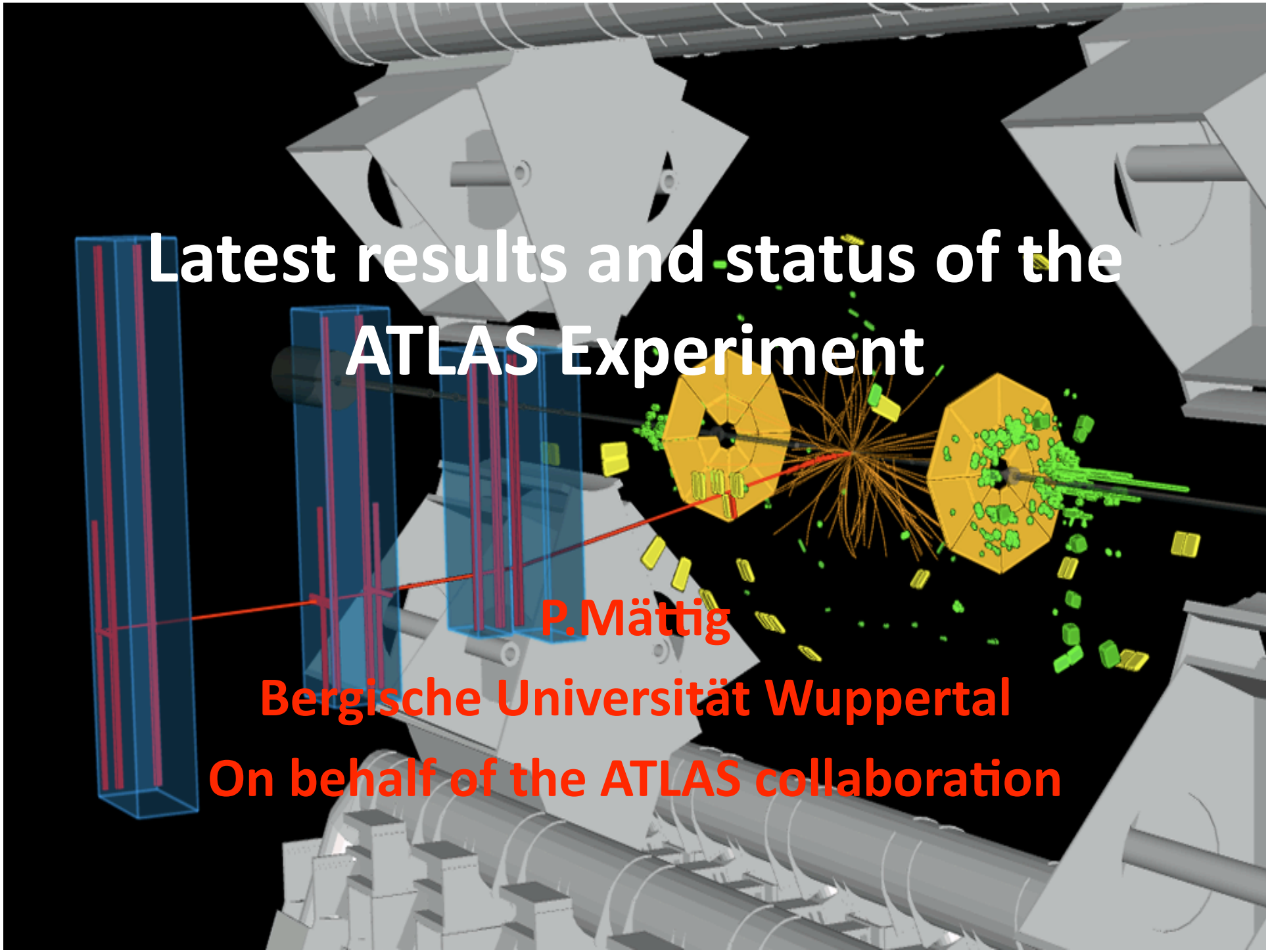
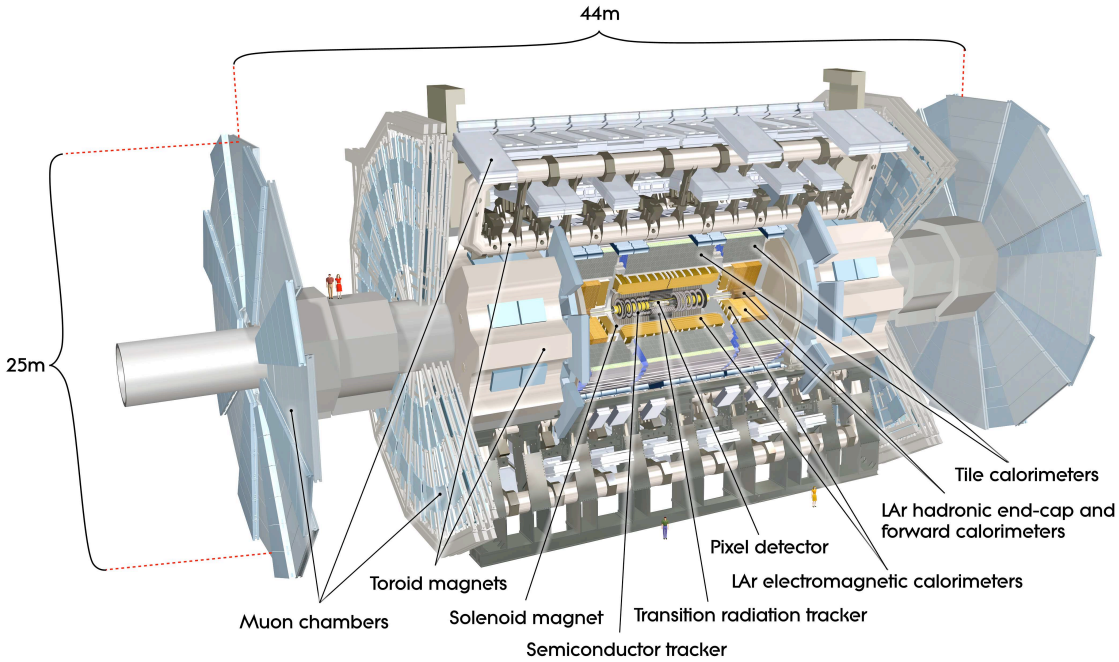


Latest results and status of the ATLAS Experiment

P.Mättig
Bergische Universität Wuppertal
On behalf of the ATLAS collaboration

The ATLAS detector



ATLAS design goals:

Detector component	Required resolution	η coverage	
		Measurement	Trigger
Tracking	$\sigma_{p_T}/p_T = 0.05\%\ p_T \oplus 1\%$	± 2.5	
EM calorimetry	$\sigma_E/E = 10\%/\sqrt{E} \oplus 0.7\%$	± 3.2	± 2.5
Hadronic calorimetry (jets)			
barrel and end-cap	$\sigma_E/E = 50\%/\sqrt{E} \oplus 3\%$	± 3.2	± 3.2
forward	$\sigma_E/E = 100\%/\sqrt{E} \oplus 10\%$	$3.1 < \lvert\eta\rvert < 4.9$	$3.1 < \lvert\eta\rvert < 4.9$
Muon spectrometer	σ_{p_T}/p_T=10% at p_T = 1 TeV	± 2.7	± 2.4

FIRST DATA: DOES THE DETECTOR MEET DESIGN GOALS?

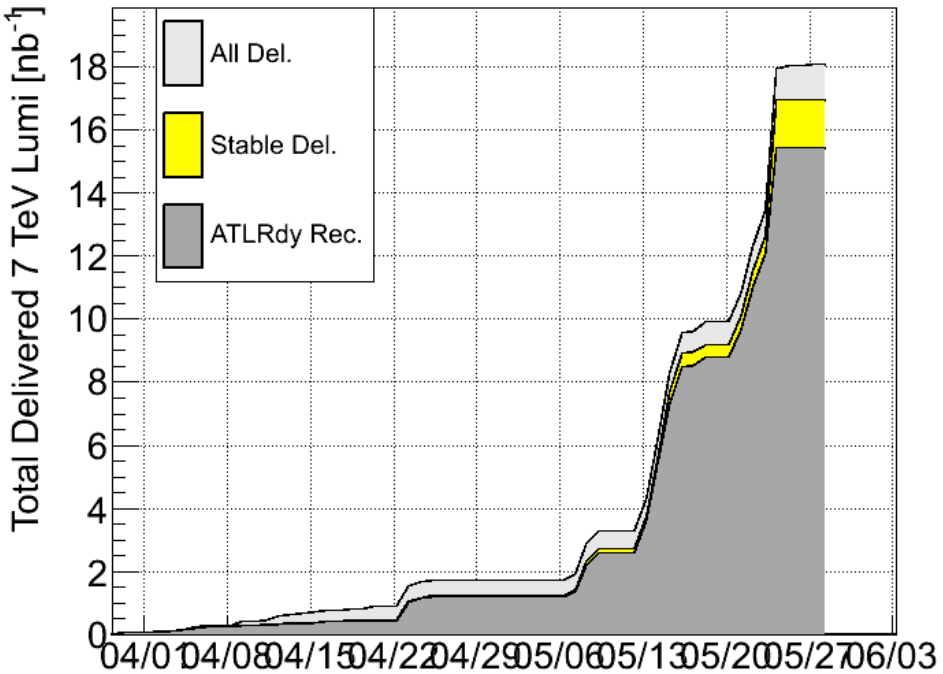
DOES IT BEHAVE ACCORDING TO EXPECTATION?

Luminosity @ ATLAS

LHC machine optimization interleaved with (weekend) physics runs

➔ **typically factor 2 – 5 increase of peak luminosity/week**

➔ **up to 8 coll. bunches in LHC of $2*10^{10}$ protons: peak luminosity $5*10^{29}$**



Recorded: 15 nb^{-1}

Data taking eff ~ 90 %

ATLAS operational fraction

Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	80 M	97.5%
SCT Silicon Strips	6.3 M	99.3%
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	99.8%
LVL1 Muon RPC trigger	370 k	99.7%
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	97.3%
TGC Endcap Muon Chambers	320 k	98.8%

All components of ATLAS to O(98 -100%) operational

Disclaimer:

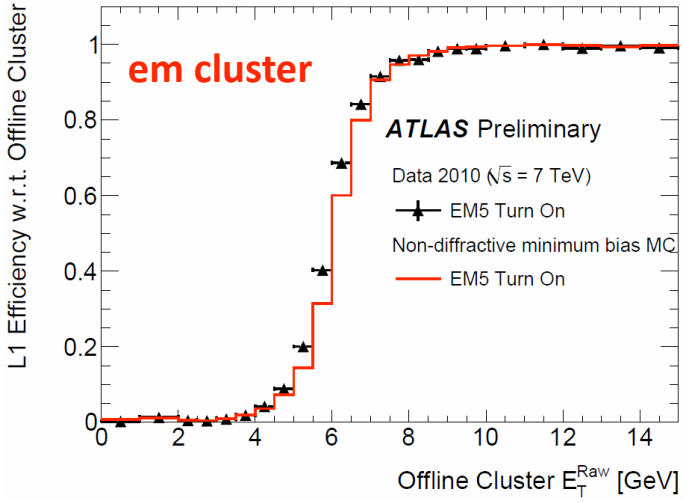
SEVERAL NEW RESULTS IN APPROVAL PROCESS WILL BE RELEASED TO PUBLIC IN THE NEXT DAYS

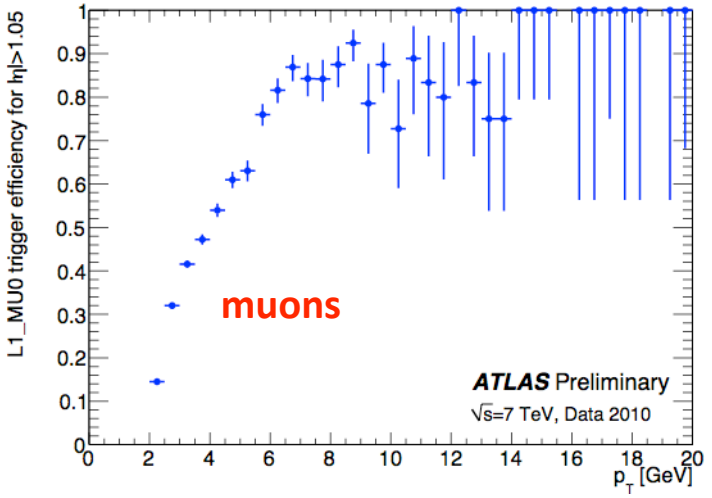
FOCUS ON PERFORMANCE & FIRST SOFT QCD PHYSICS

MOST PLOTS BASED ON O(nb^{-1})

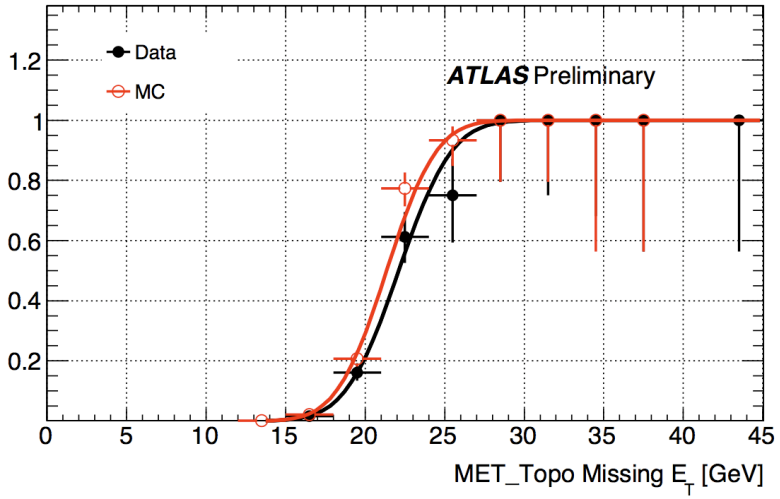
Trigger: Level 1 & combining objects in higher levels

Level1: Trigger turn – on curves wrt off – line reconstruction



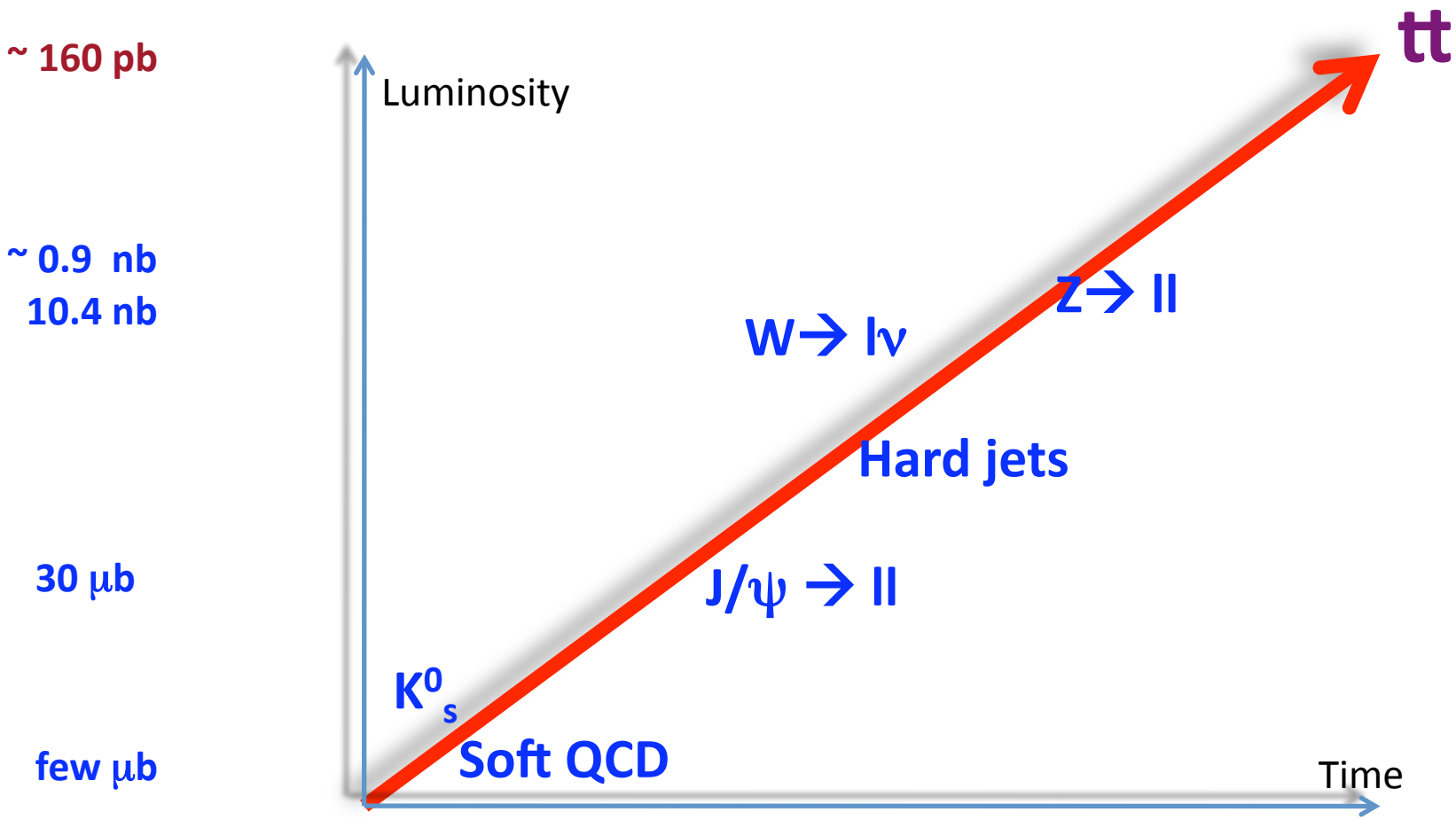


Combining information/ higher level: Missing Transverse Energy



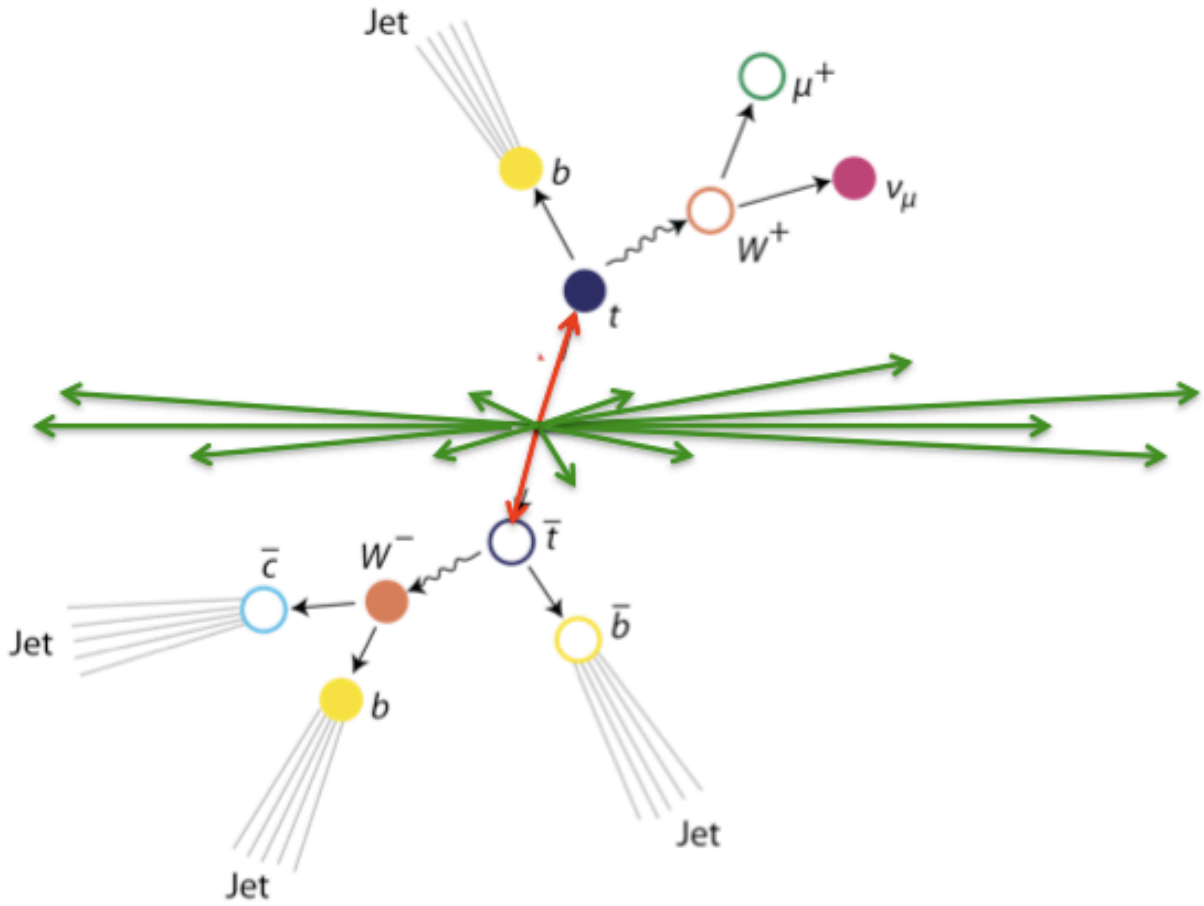
High efficiency and very good agreement with expectation

The road to the top (and beyond):



From physics ➔ calibrating and understanding the detector

Steps towards top - rediscovery

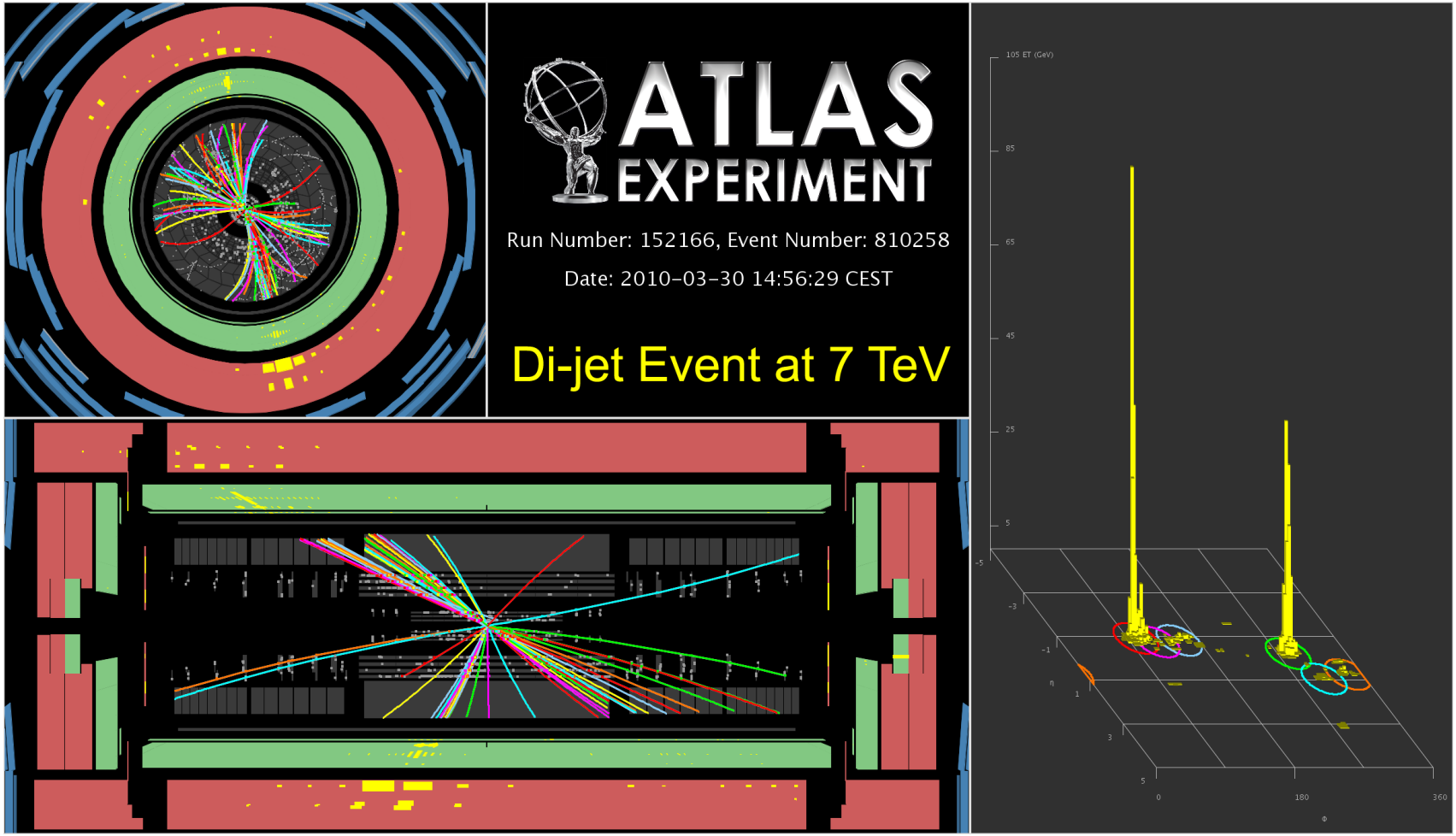


Our homework:

Detector performance:
Jets
Electron, muons
MET
B – tagging

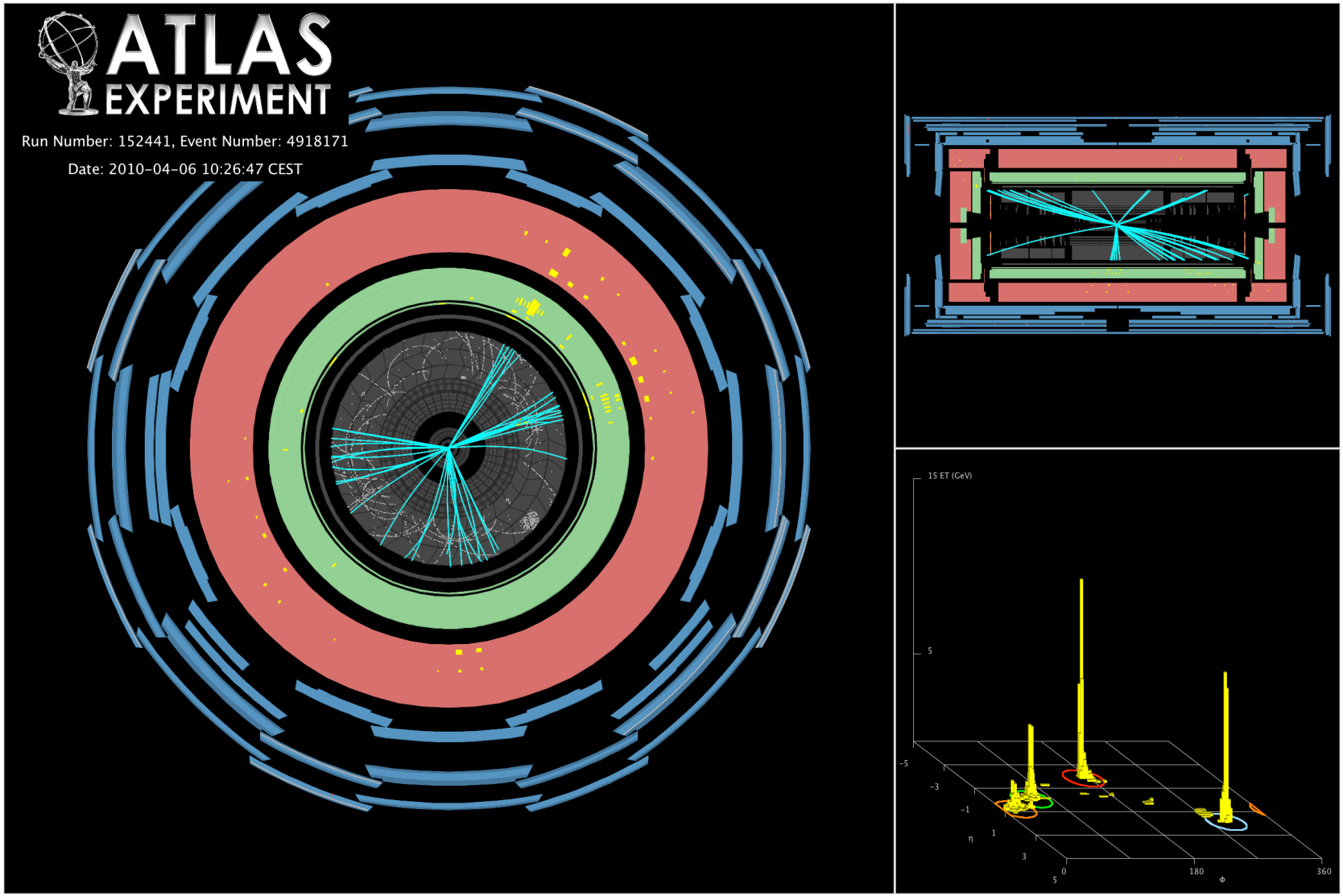
Soft physics:
Pile – up
underlying event

Jets I: approaching the TeV scale



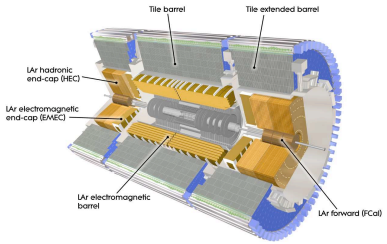
Centrally produced, back – to – back: M_{jj} ~ 800 GeV

Jets II: .... and approaching multi – jet physicss

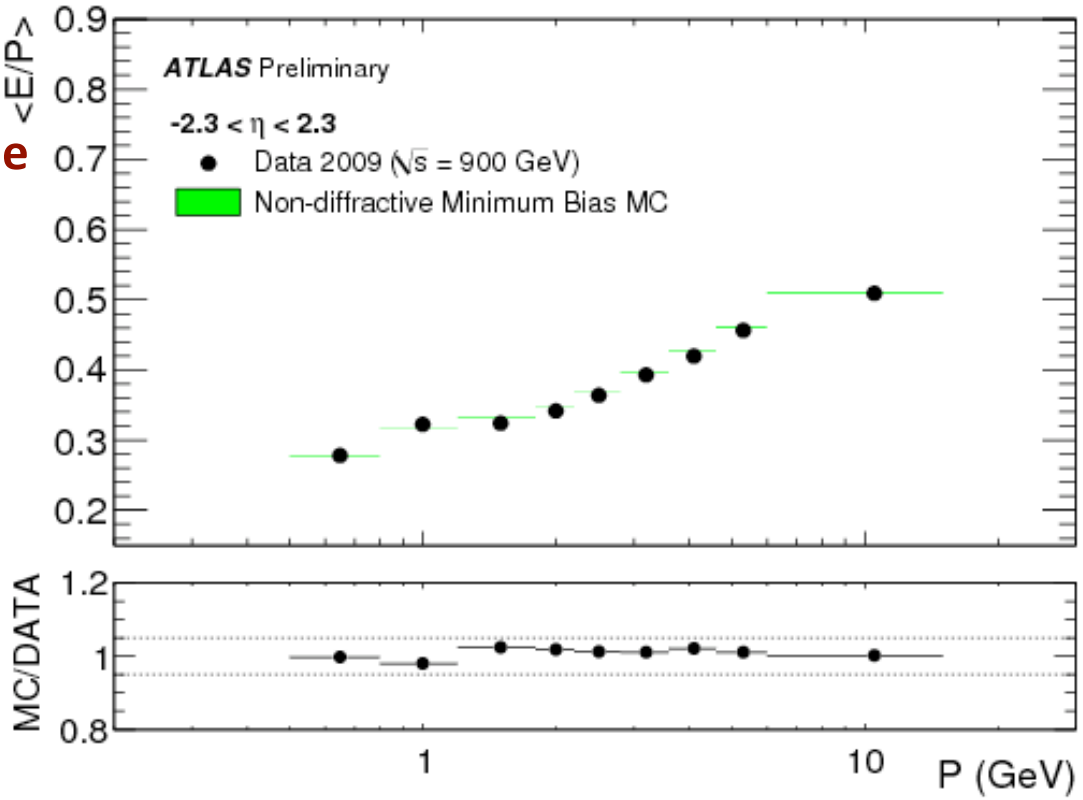


Jets

ATLAS: fine granularity calorimeter
liquid argon + scintillator



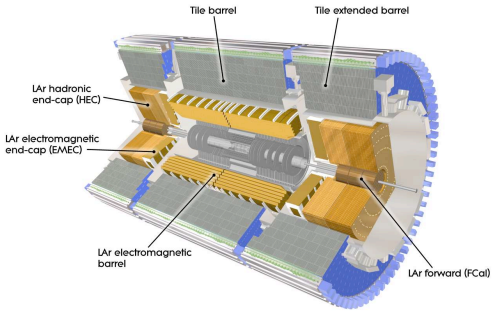
Step 1:
Calorimeter response to single particle

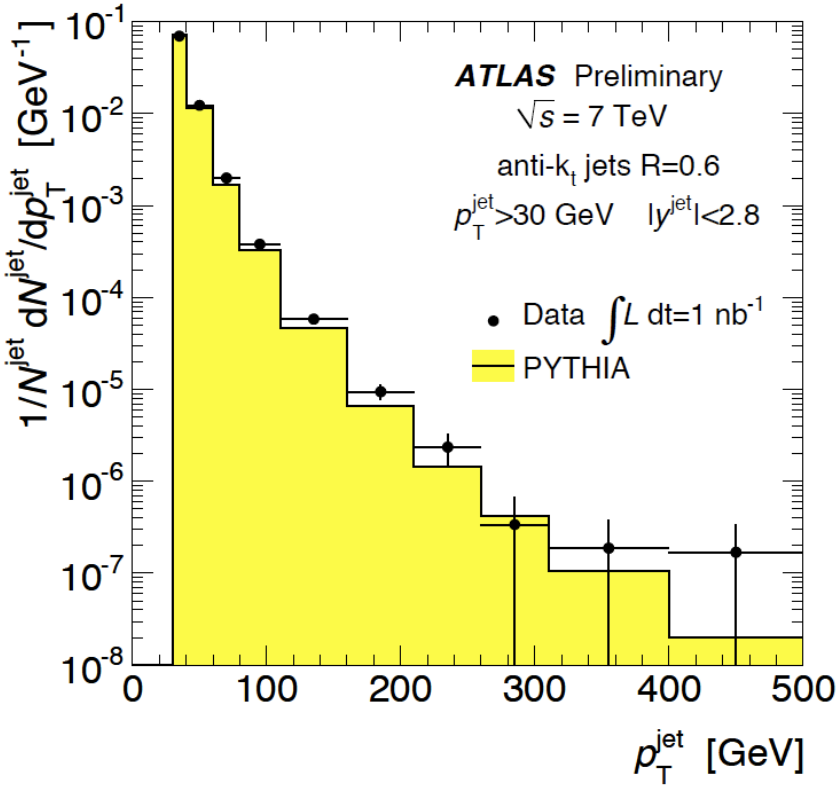


Better than 5% description of calorimeter response

Jets IV:

Step 2: use electromagnetic scale
+ correction for hadronic part and dead material

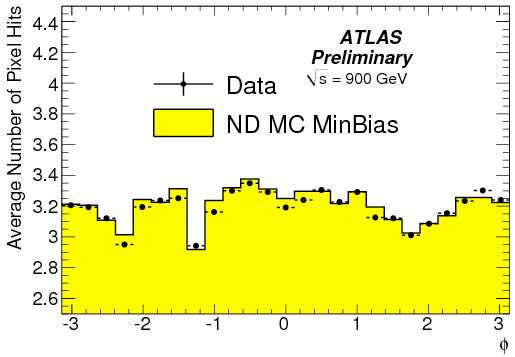


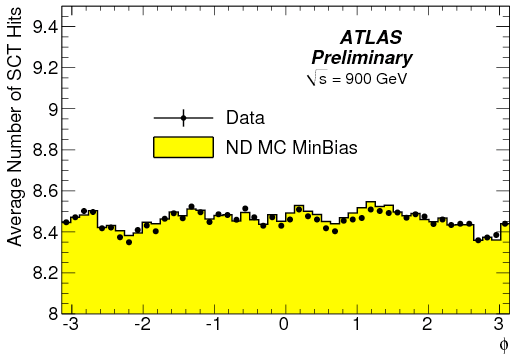


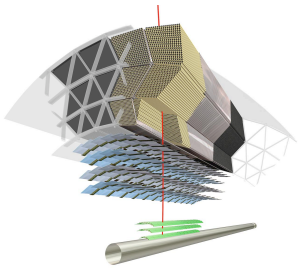
Good agreement over
7 orders of magnitude
with expectation

Future:
improved calibration by exploiting details of local energy deposition

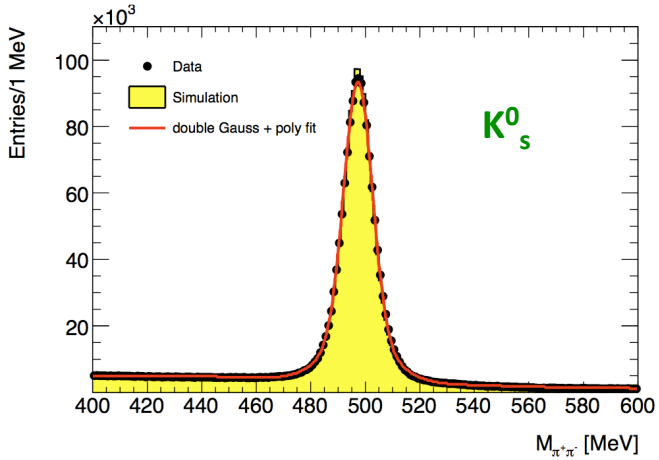
Tracking: performance

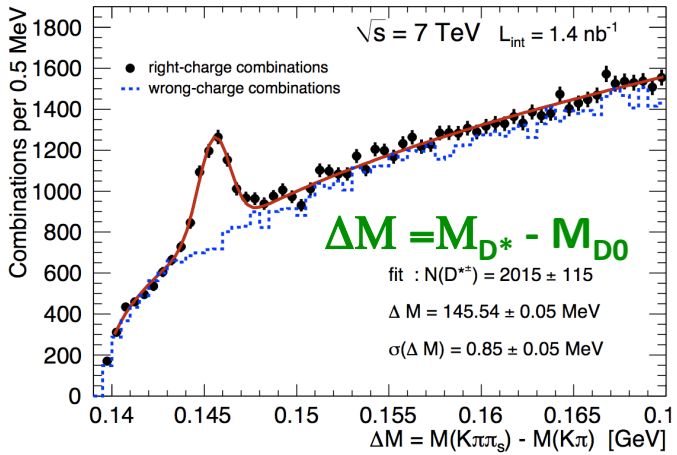






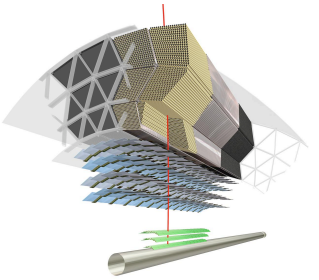
A lot of detailed studies of track properties:
very good agreement with simulation

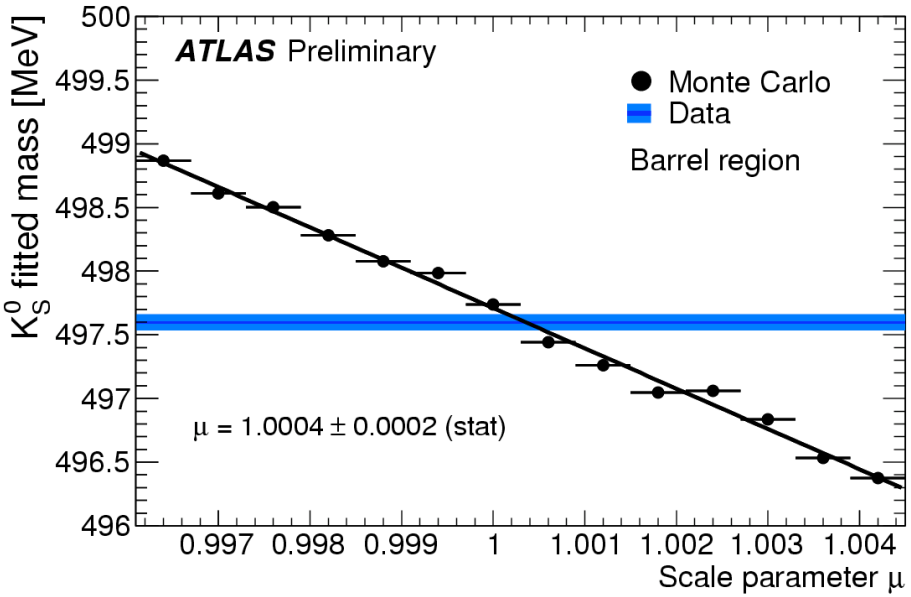




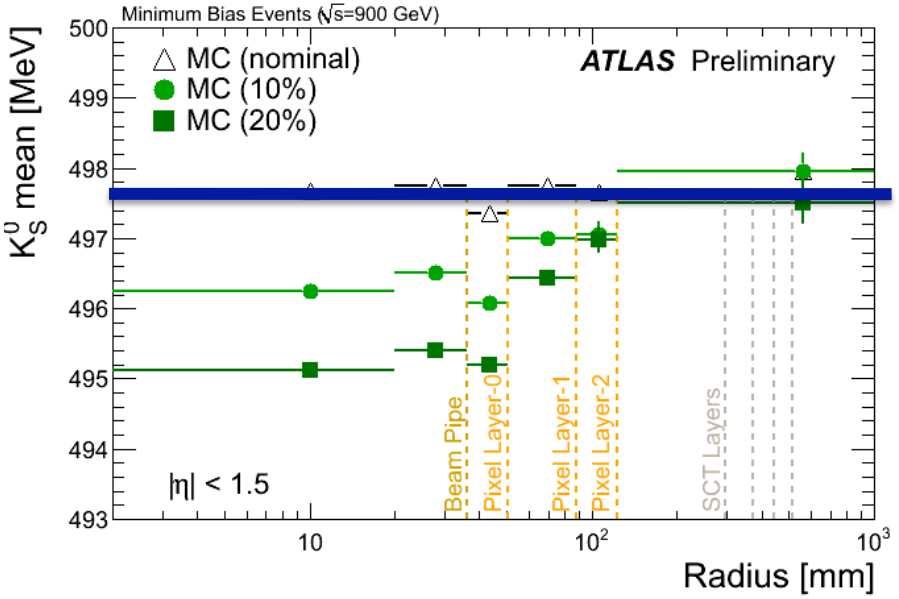
Millions of K^0_s, 10 thousands of charmed paricles .....
and many more resonances .... (eventually to be see in top decays ?)

Tracking: K^0_s to calibrate inner detector





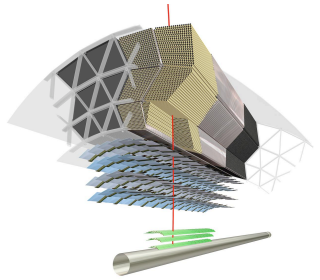
K^0_s mass value:
measure of momentum scale
Excellent agreement



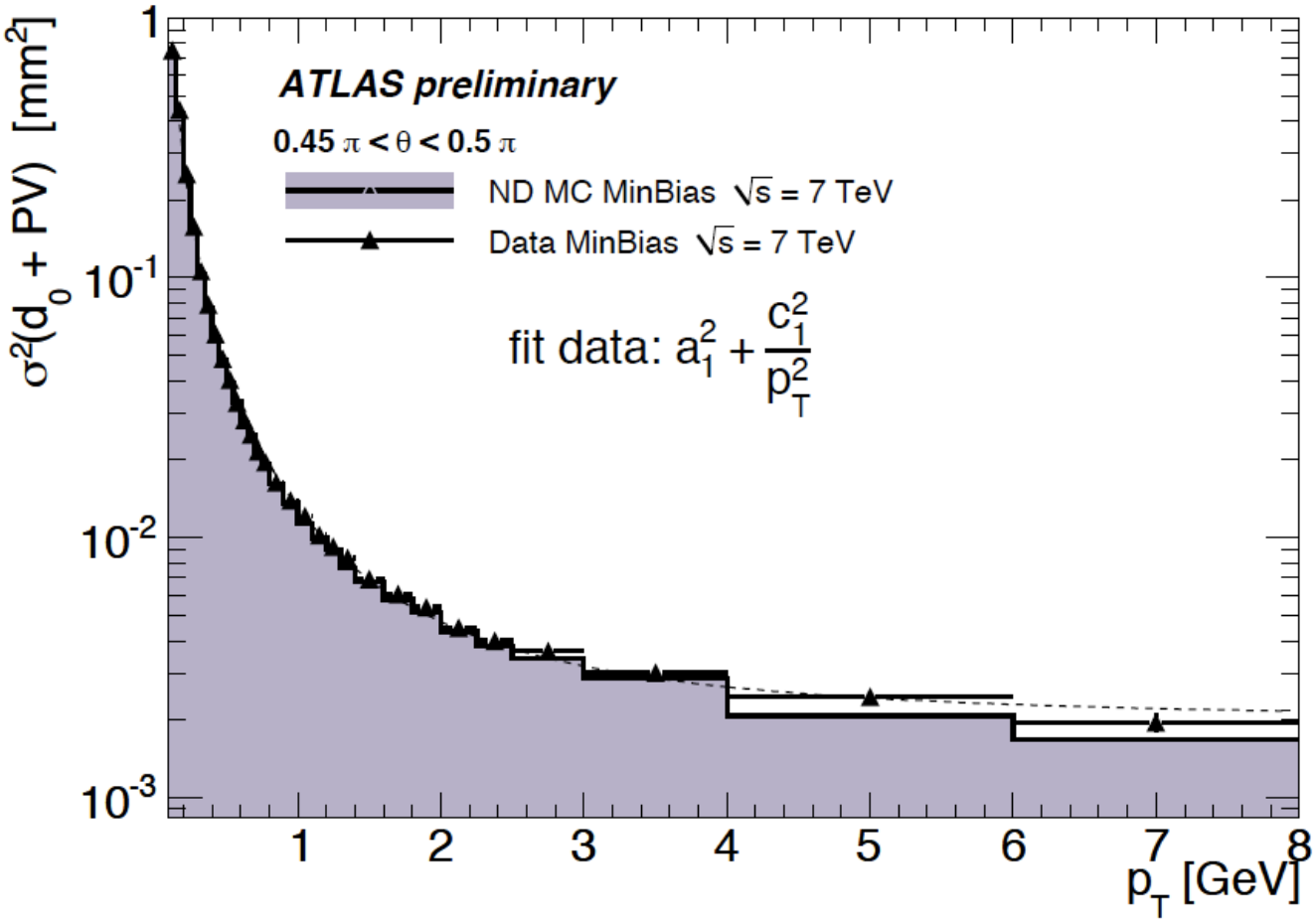
Reconstructed K^0_s mass
probe of amount of material in detector

Material simulated much better than 10%
➔ Will be used to map material in η, ϕ

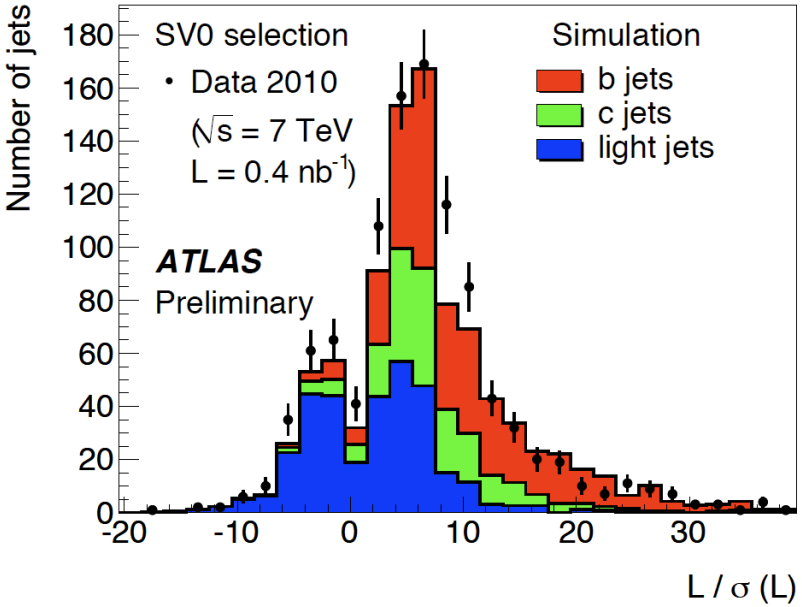
Tracking: Impact parameter resolution



Measure d_0 distribution as function of p_T & η

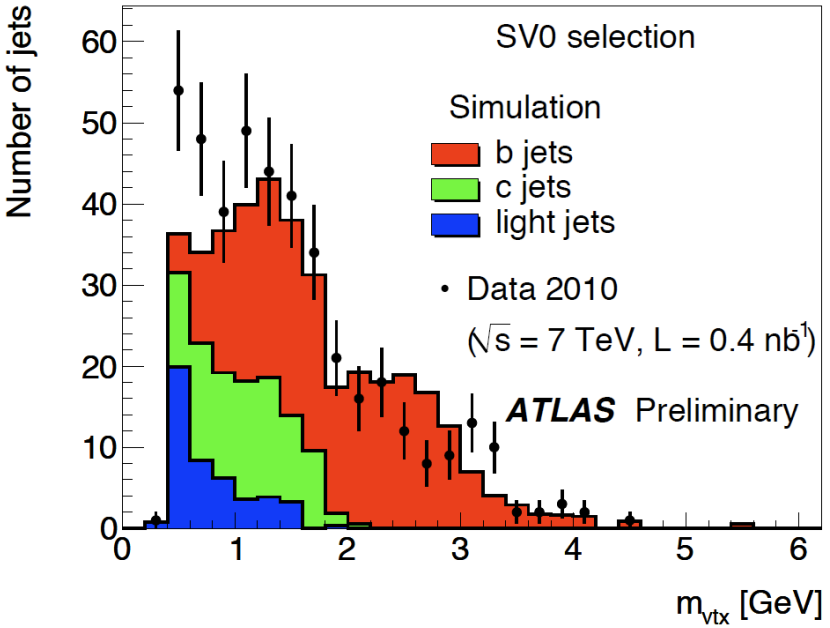


Towards efficient Bottom – Tagging: secondary vtx tagger

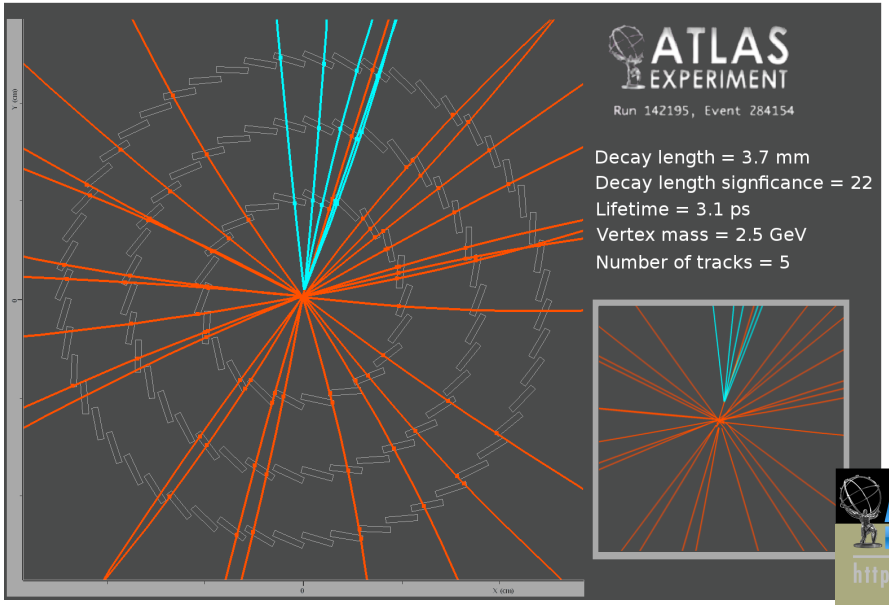


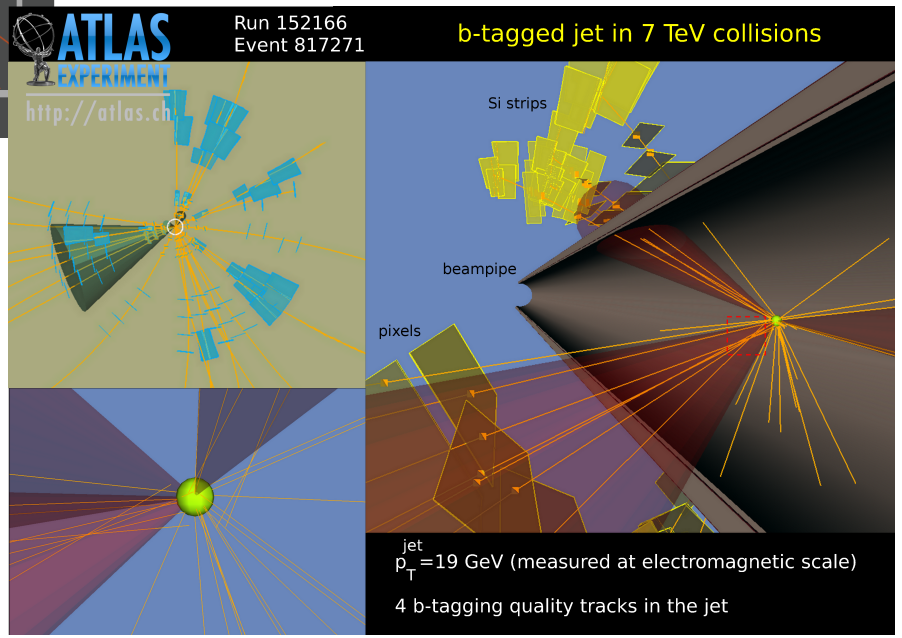
Decay length significance:
Shape in good agreement with expectation
clear indication of excess of positive life times, i.e. bottom candidates

Mass distribution at vertex for L/σ(L)>7:
- **Charm vtx < 2 GeV**
- **Bottom mass up to 4 GeV**

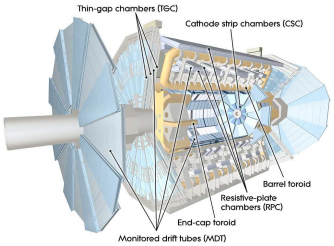


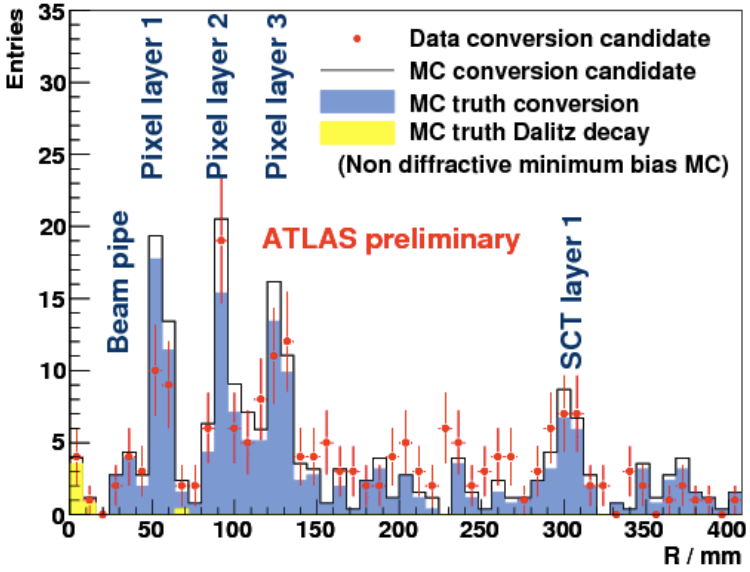
Secondary vertices





Electrons & muons

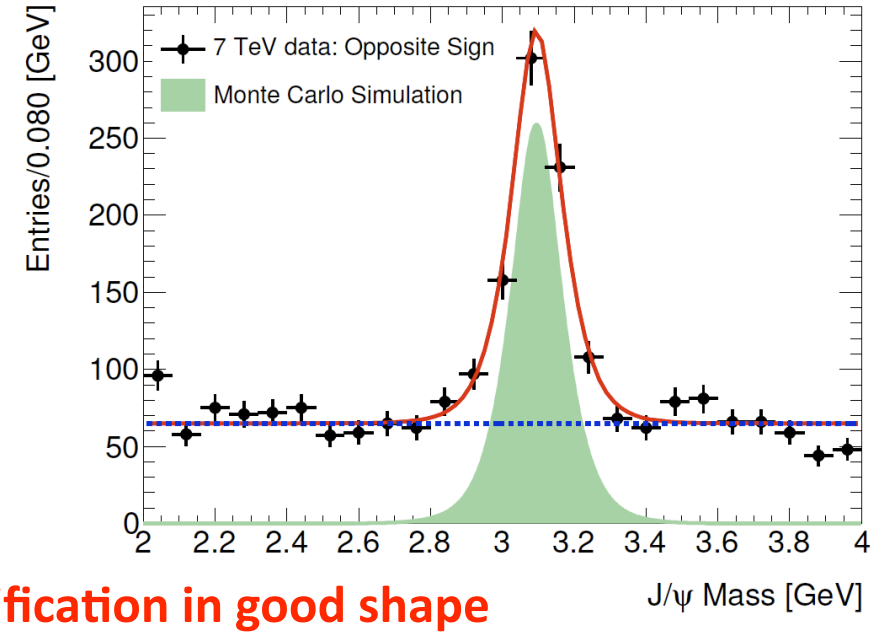




Conversion electrons tool to verify calorimeter response:

➔ multivariate discriminator

….. in progress



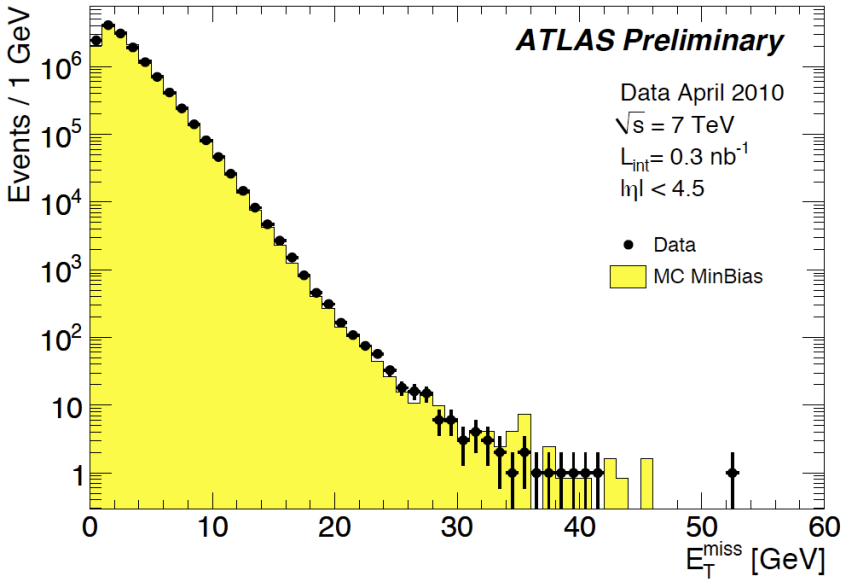
$J/\psi \rightarrow \mu^+ \mu^-$

M = 3.095 ± 0.002 GeV

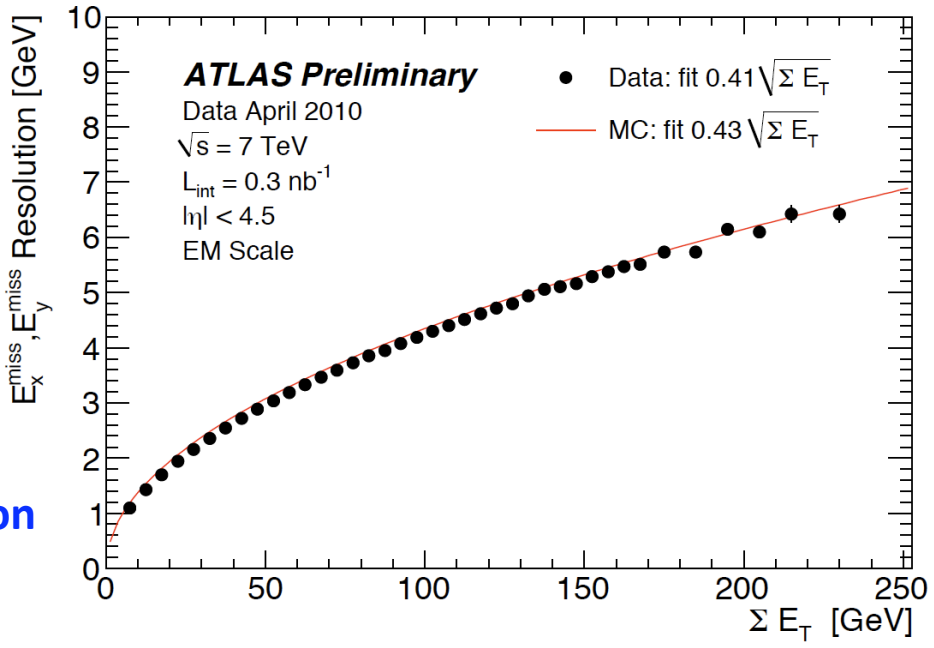
Prompt electrons and muons identification in good shape

τ ' s being worked on

Adding all information together: Missing Transverse Energy



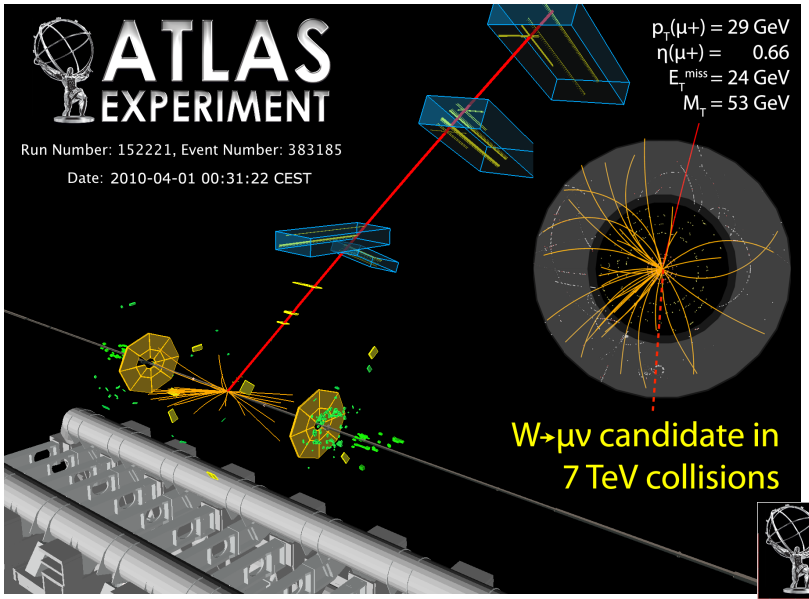
After some cleaning
excellent agreement, with expectation
no tails observed!



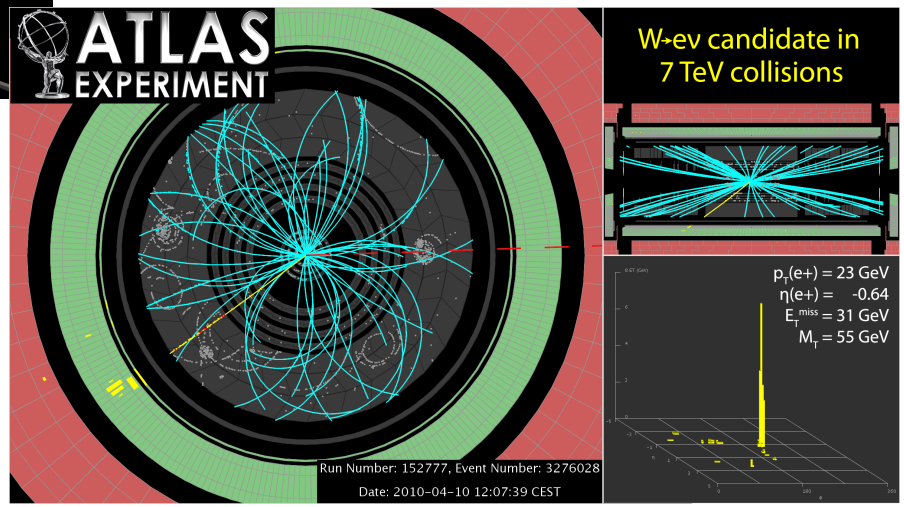
Testing the resolution of E_T
well understood cpd. to simulation

Overall: detector highly performant
and understood to an amazing degree

MET + leptons: several W - candidates

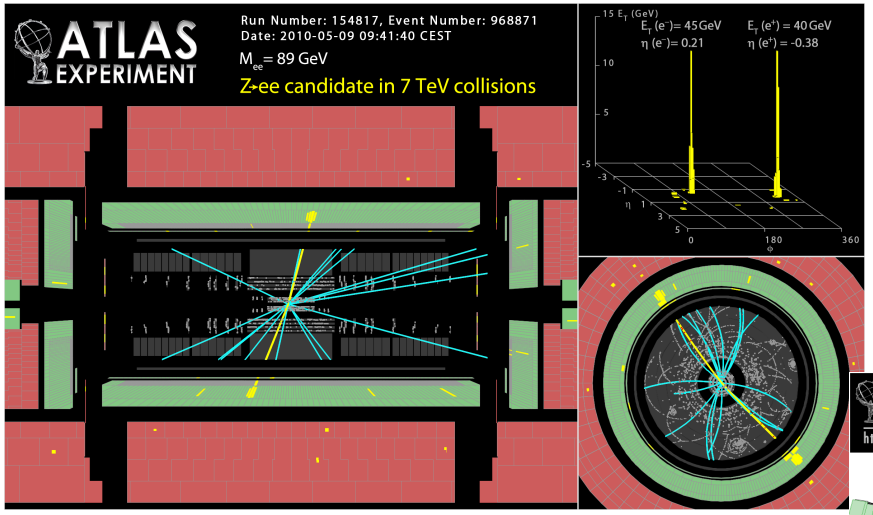


Two examples:
Decay into μ / electron

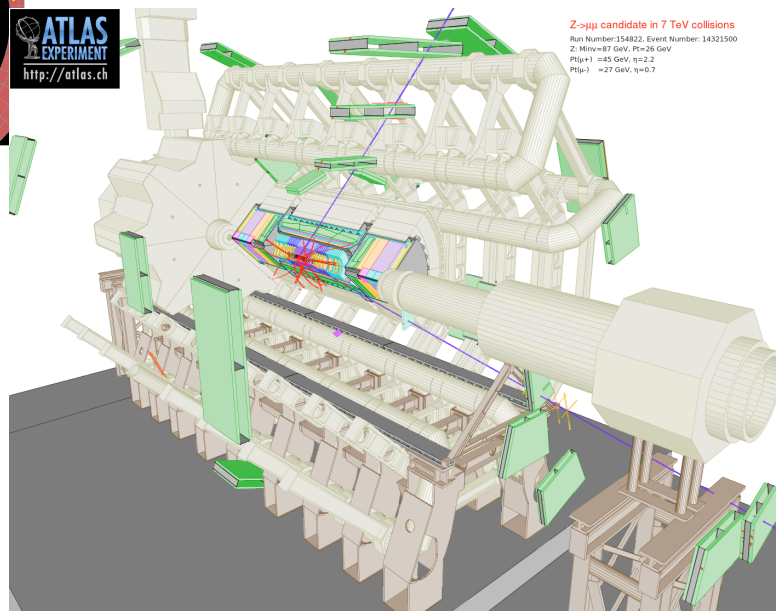


..... more details to come out soon !

.... and also Z candidates



Two examples of Z decays:
- electrons
- μ

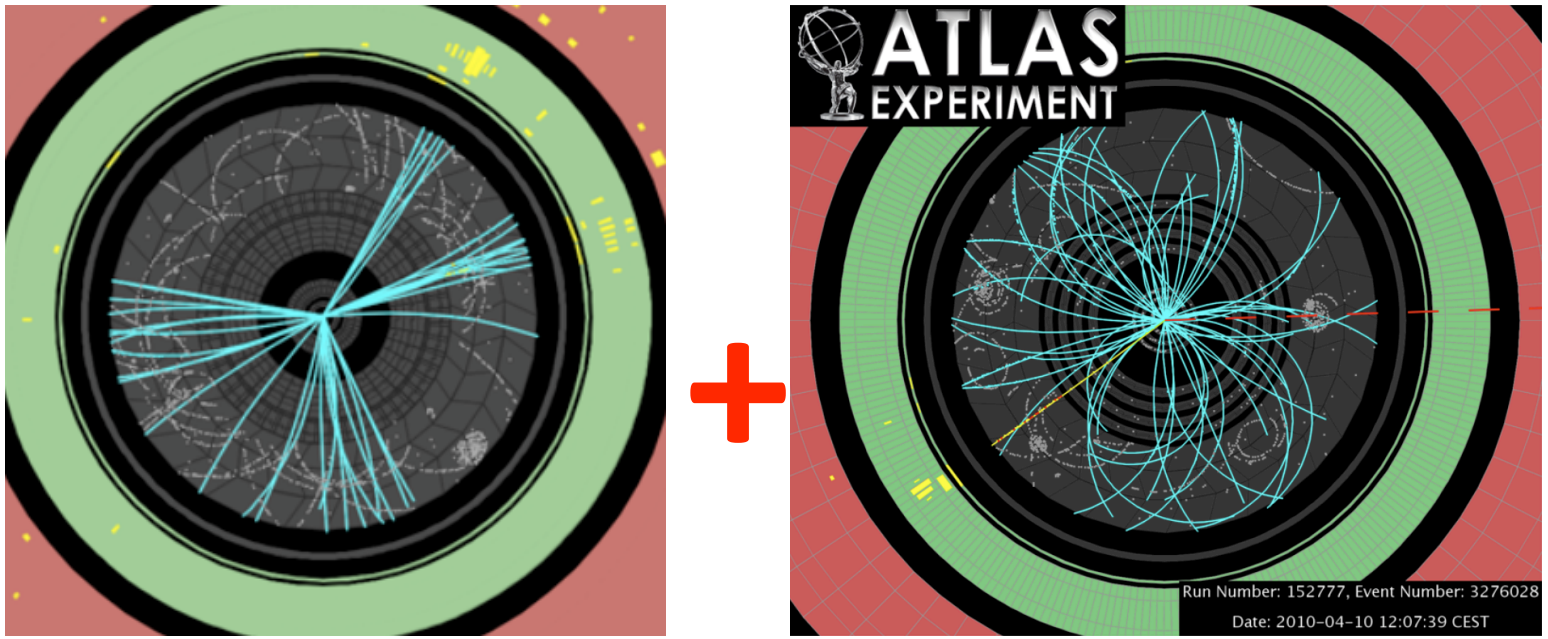


Entering the electroweak physics phase .....

Every ingredient for finding top quarks at hand .....

Top =

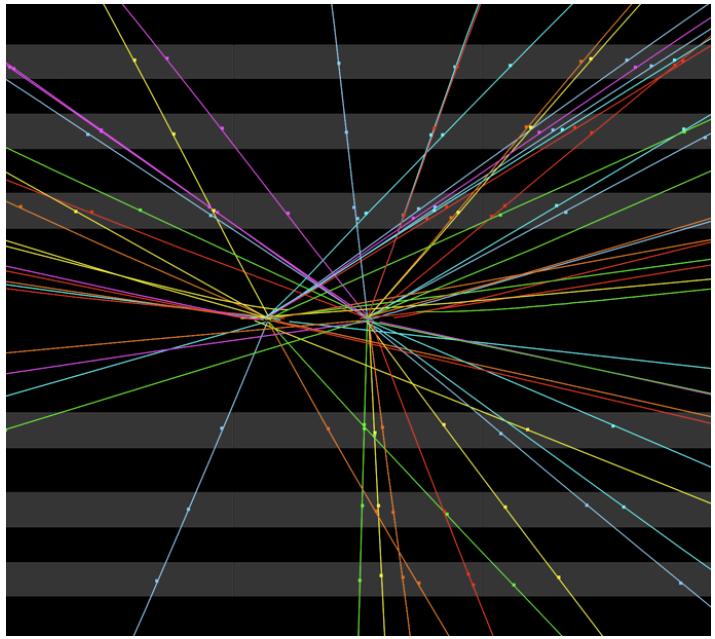
4 jet **W**



But should be both in ONE event!

..... just luminosity missing

For a precise understanding of Top Quark (and others)
how do the remnant event(s) look like?



Event with two high multiplicity Vertices

Clear identification of events with many vertices

increasingly relevant if LHC produces high intensity bunches

$1^* 10^{11}$ p/bunch, $\beta^* = 5$ m
<pile – up >: 2 events

Minimum Bias events @ 0.9 and 7 TeV

Basic selections:

-Primary vertex found

- at least one good track, i.e.
  a. pT > 500 MeV
  b. close to primary vertex, i.e. $|d_0| < 1.5$ mm, $|z_0 * \sin\theta| < 1.5$ mm
  c. $|\eta| < 2.5$
  d. ≥ (1 pixel hit + 6 SCT hits)

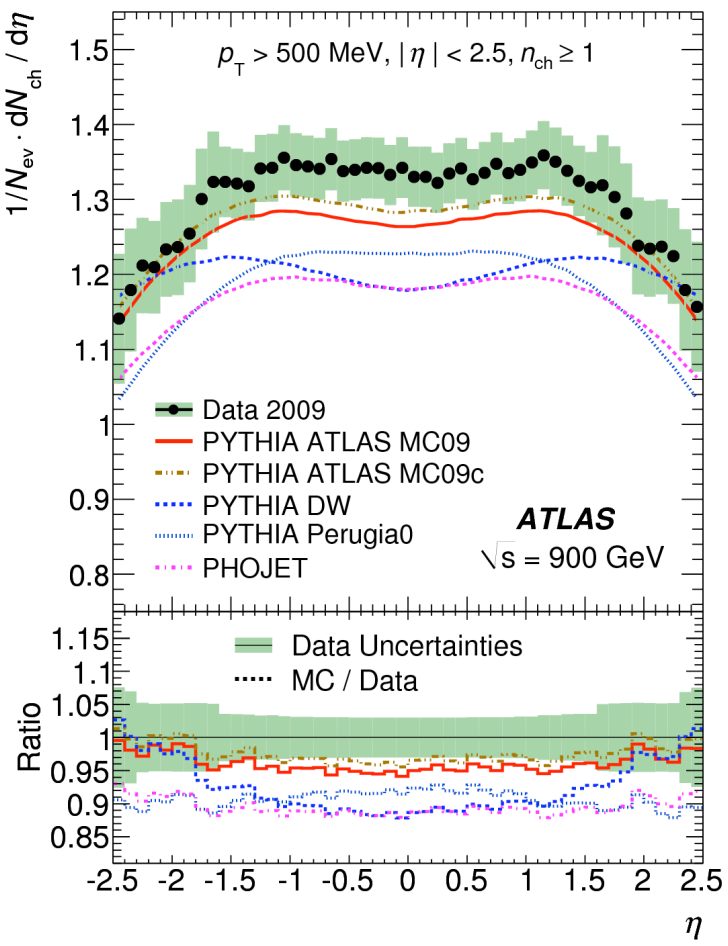
➔ About 300 K events (few μb) selected for public result

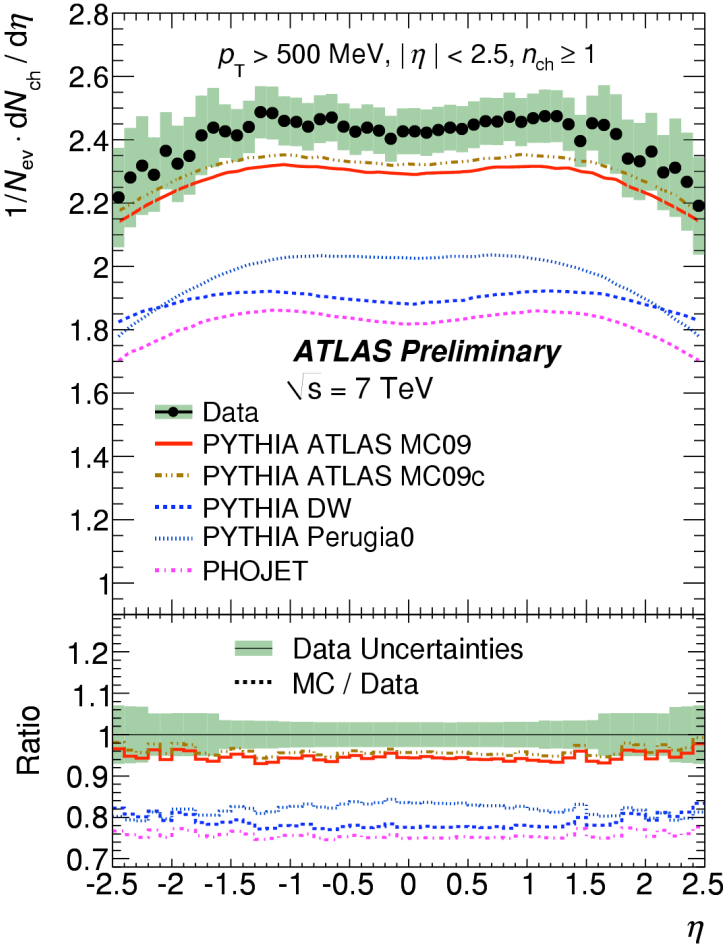
Basic philosophy:

-As much as possible detector performance/corrections from data

- no corrections for physics models
  ➔ unfolding to hadron level
  ➔ comparison with PHOJET and PHYTHIA with various tunes

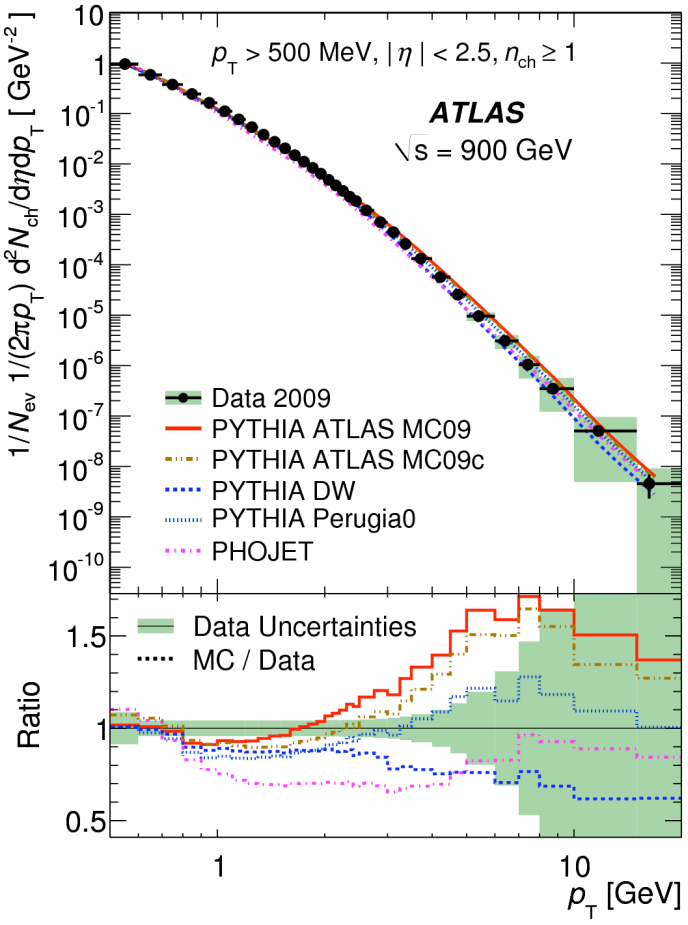
Minimum Bias events: η - distribution

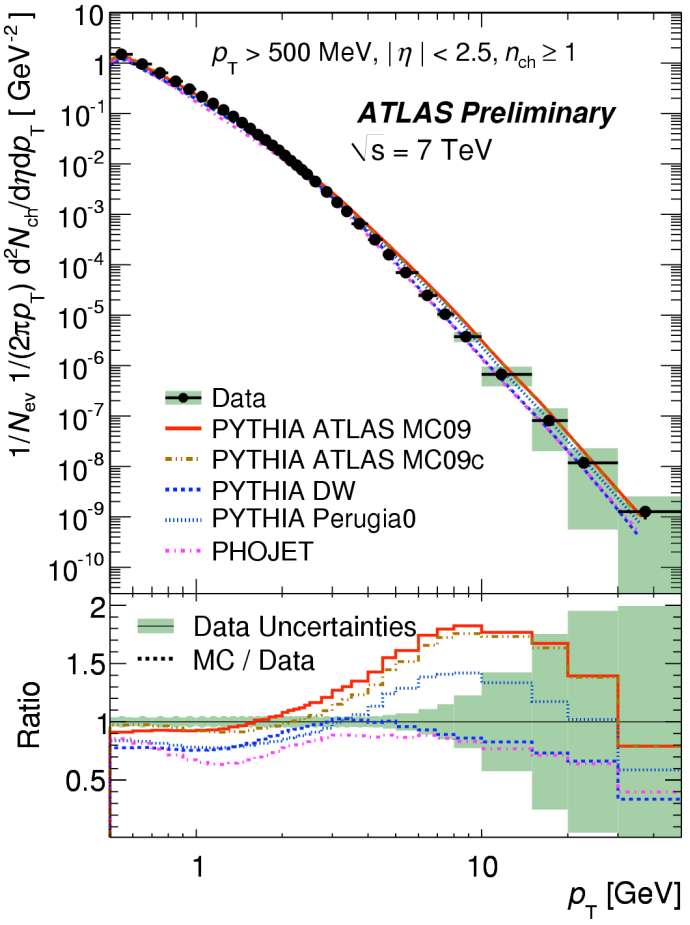




Significantly less yields in frequently used Phythia Perugia/DW tune

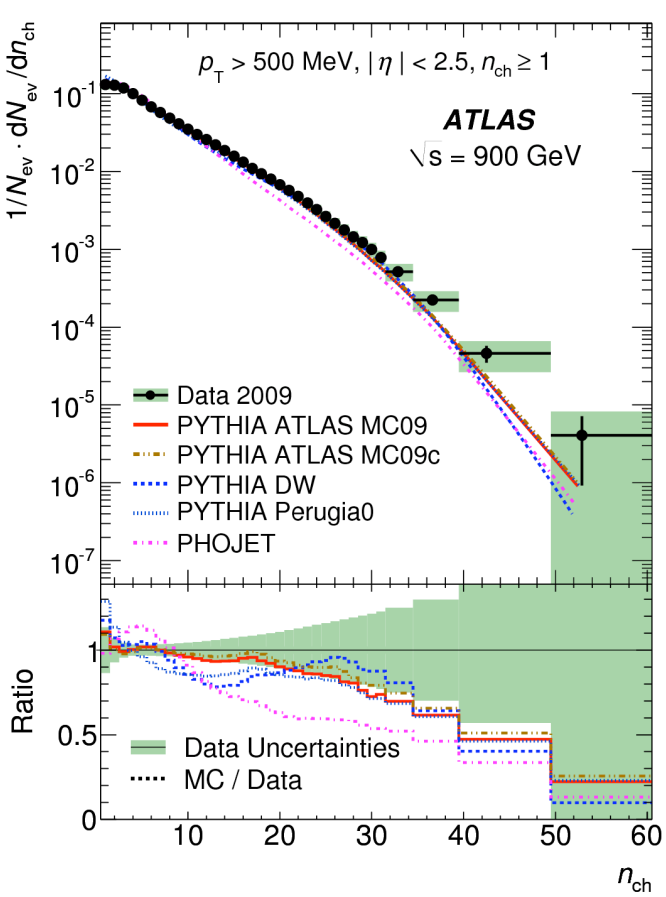
Minimum Bias events: pT - distribution

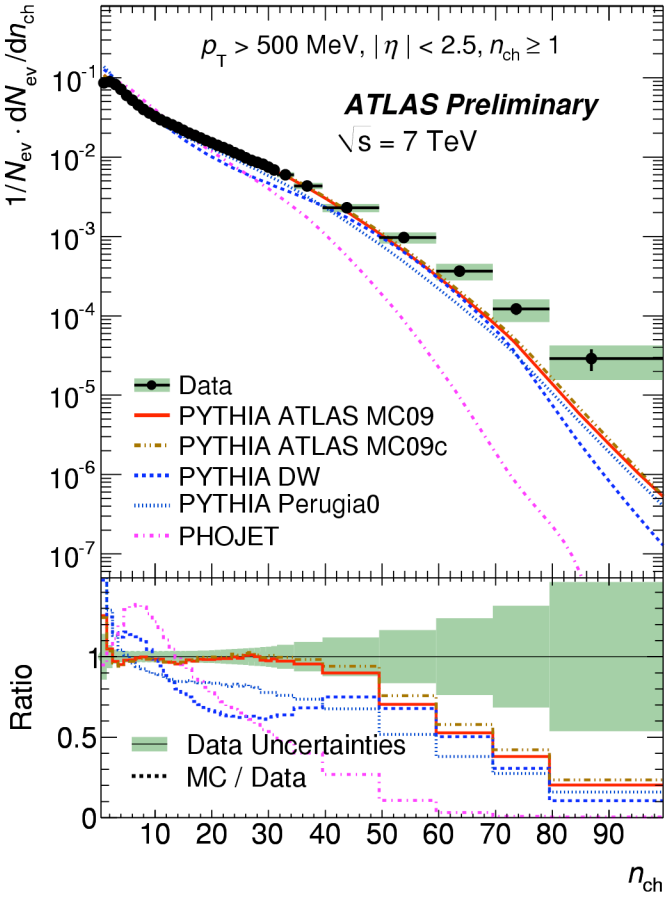




Discriminating between tunes, shape inconsistent with data

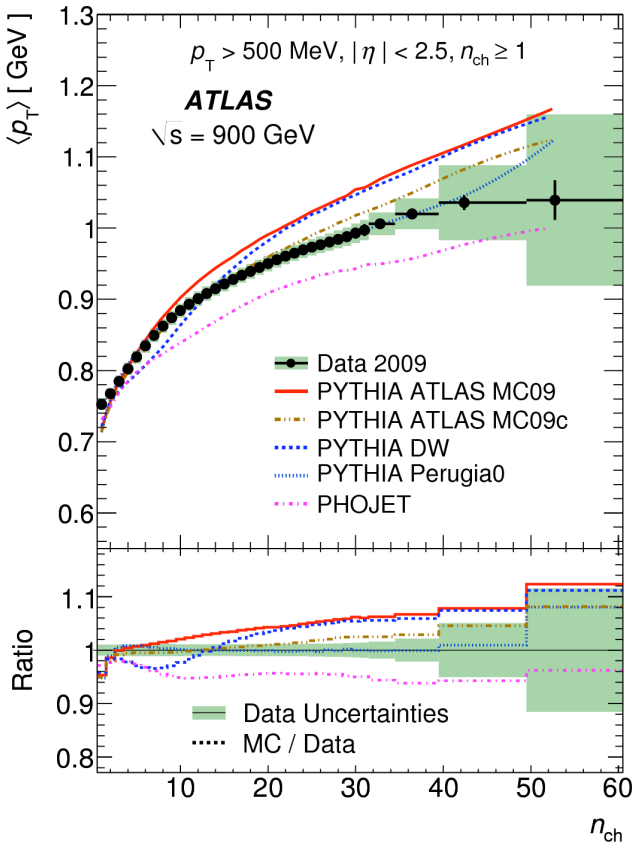
Minimum Bias events: event -multiplicity - distribution

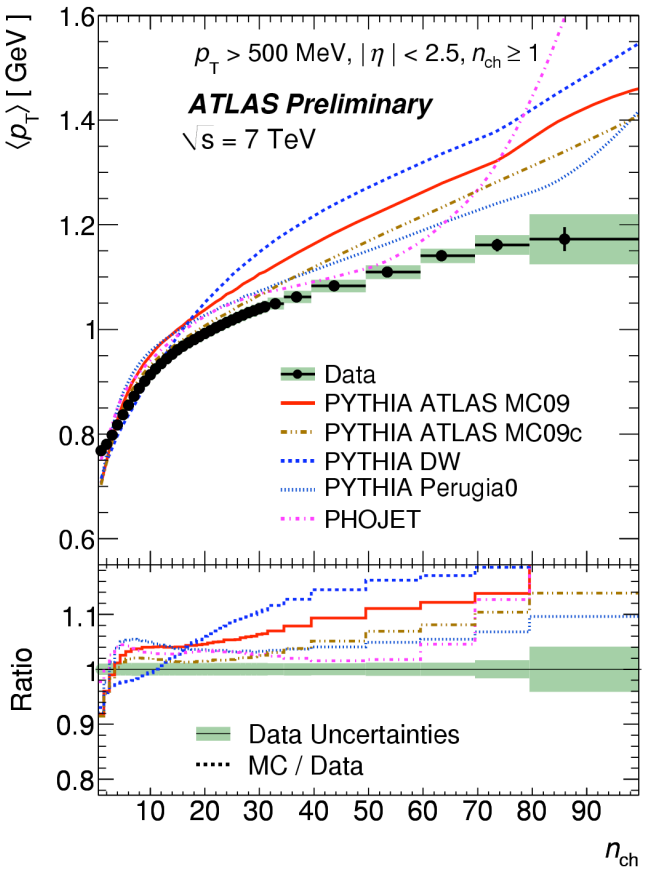




More high multiplicity events than predicted

Minimum Bias events: event -multiplicity - distribution

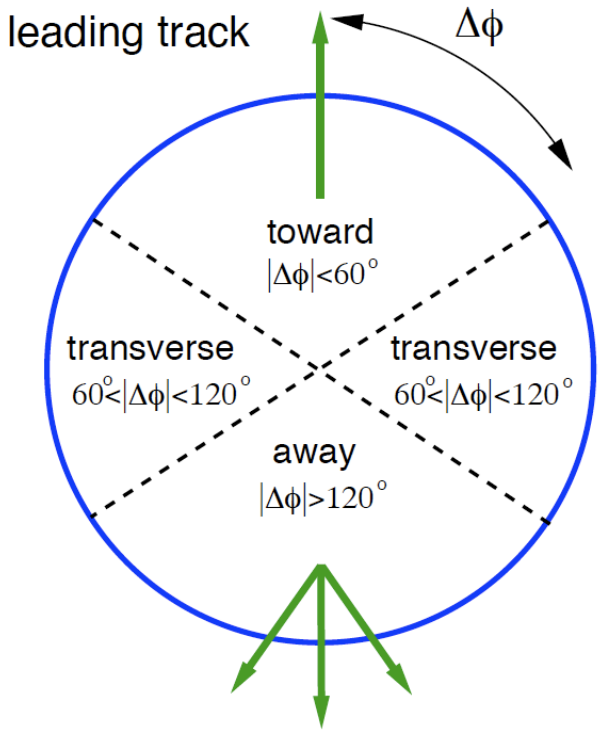




Dependence on √s weaker than predicted

➔ **Provides information on pile up - events**

Track based study on underlying event

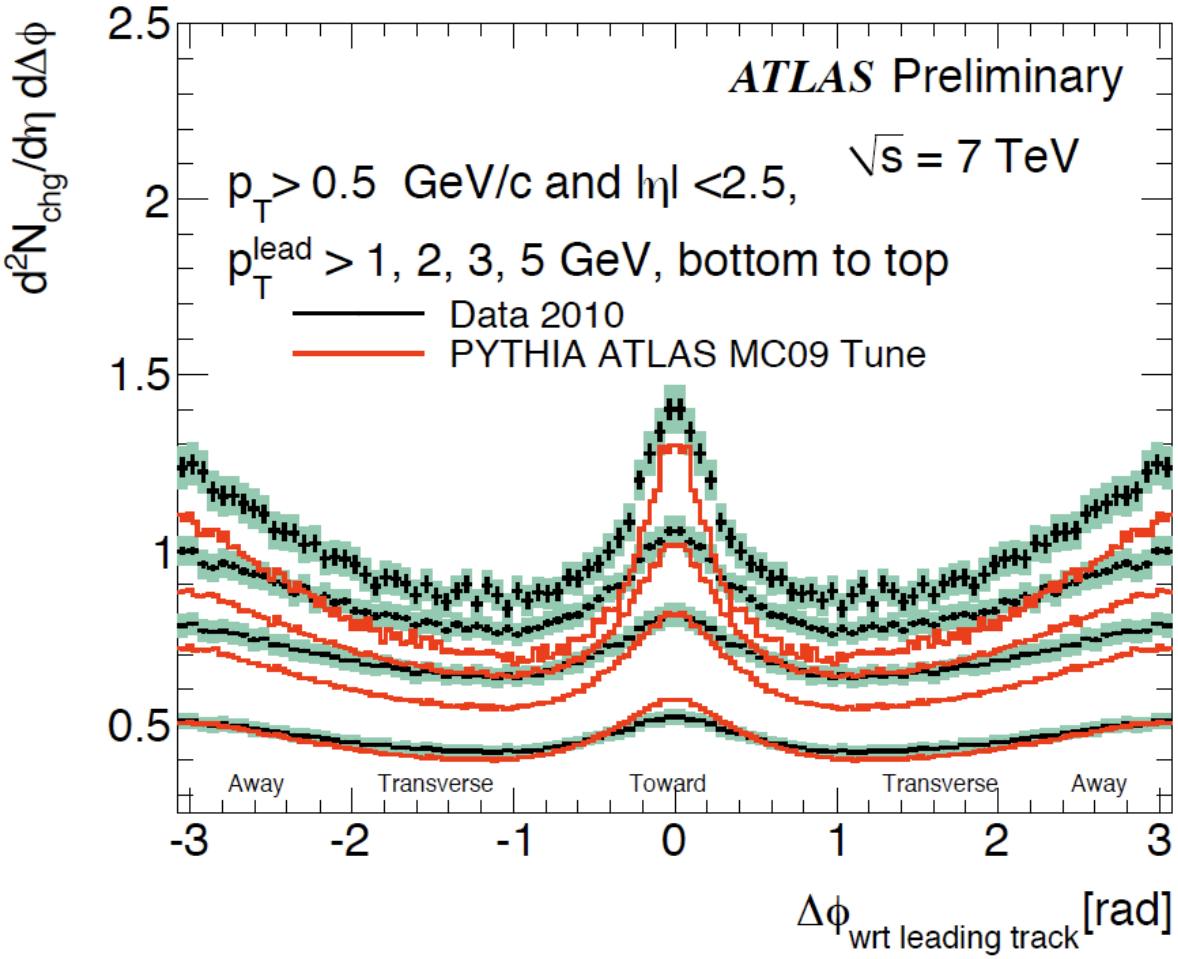


Following procedure of R. Field:
- **define ‚leading' direction**
  (here: highest pT track)
- **study transverse particle/energy density**

Basic idea:
transverse direction unaffected by hard process, i.e. ‚underlying event'

Connection to Min Bias??

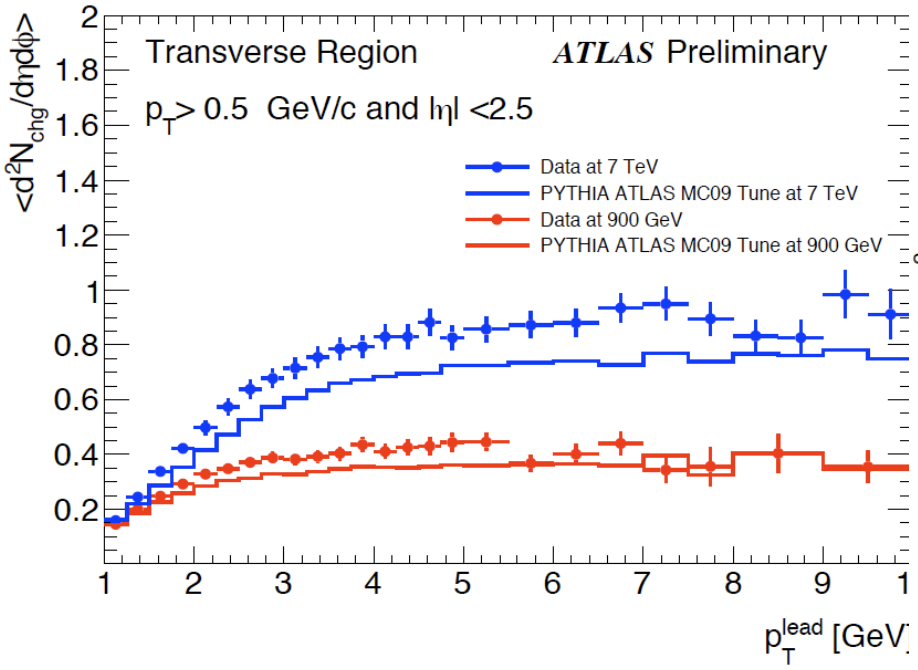
Particle flow wrt leading track



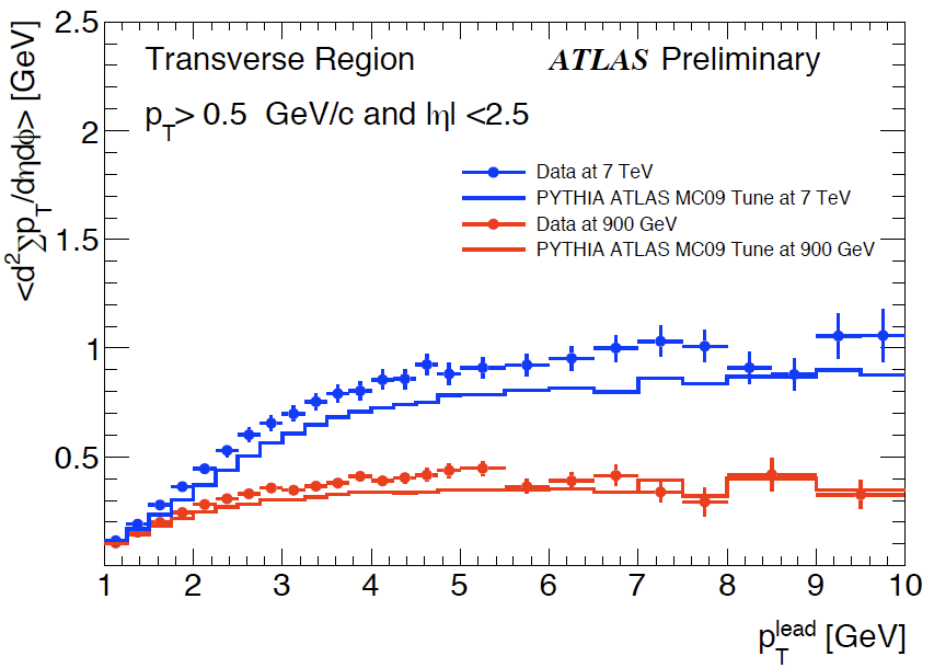
Hard component visible and more apparent with higher leading p_T

The transverse region

particle density



pT density



Densities enter plateau for larger p_T
Higher density in data than expected
More pronounced with higher √s

Conclusions

LHC vigorously improving performance

The whole ATLAS detector working highly efficiently

- After just collison data worth a few weeks:

remarkable understanding of detector

tracking performance, jet p_T, missing transverse energy ... as expected

lepton reconstruction very well simulated

➔ A great achievement of thousands of physicist, students, post – docs, ...

- Entering electroweak and hard QCD physics

meaningful W, Z sample in our hands

jj – masses approaching the TeV range

- First physics results on soft QCD: minimum bias events & undelying events

higher multiplicity than expected, will affect pile – ups

FIRST TOE IN A NEW TERRITORY!

MORE TO COME SOON ....

ATLAS IS PREPARED FOR FIRST TOP DATA (IN THE NEXT WEEKS) .... AND MORE!