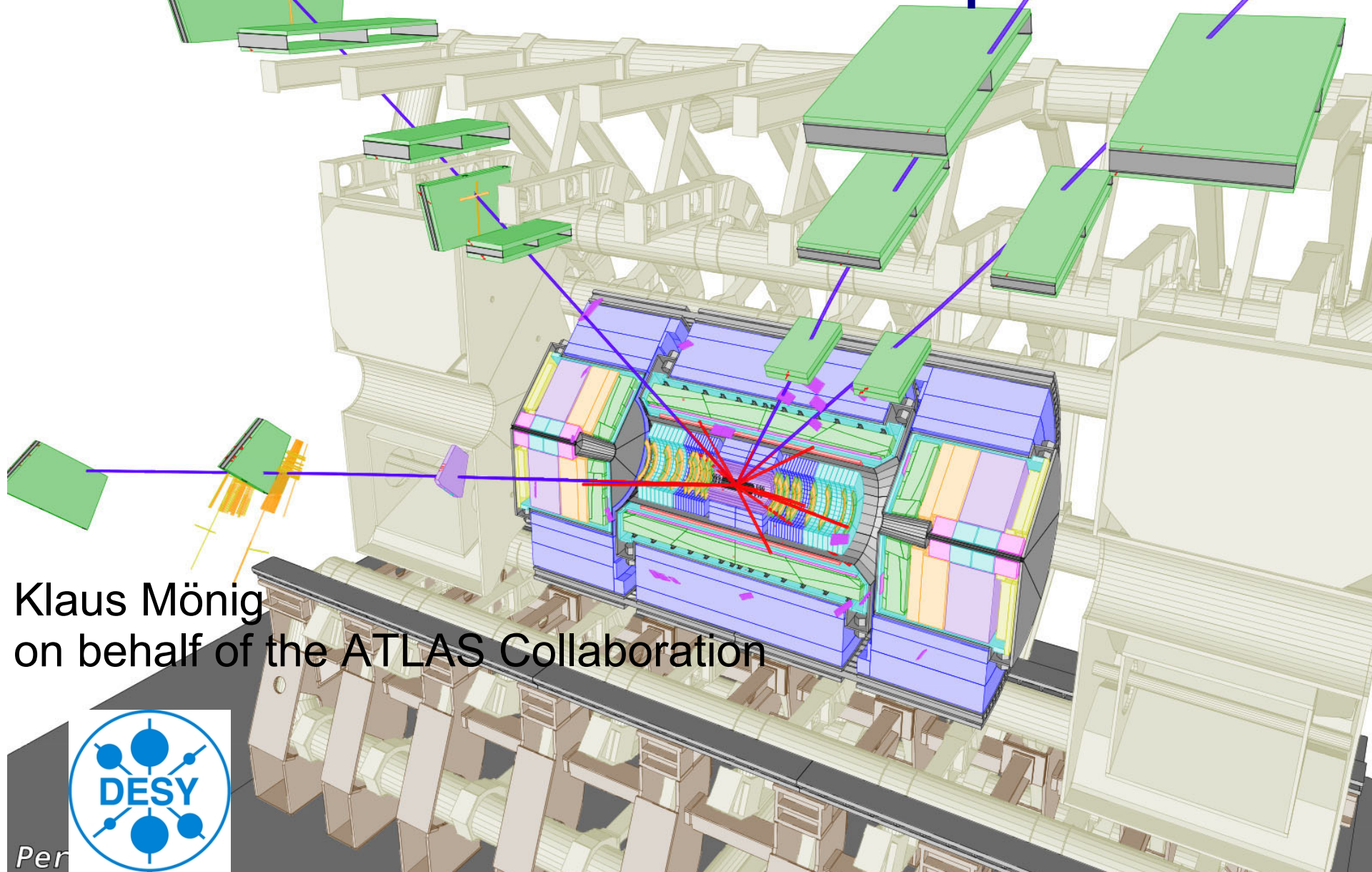


Status of the ATLAS Experiment



Klaus Mönig
on behalf of the ATLAS Collaboration

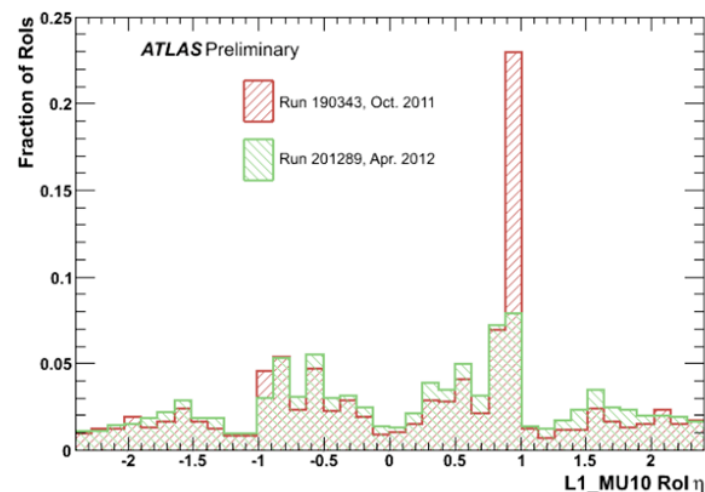
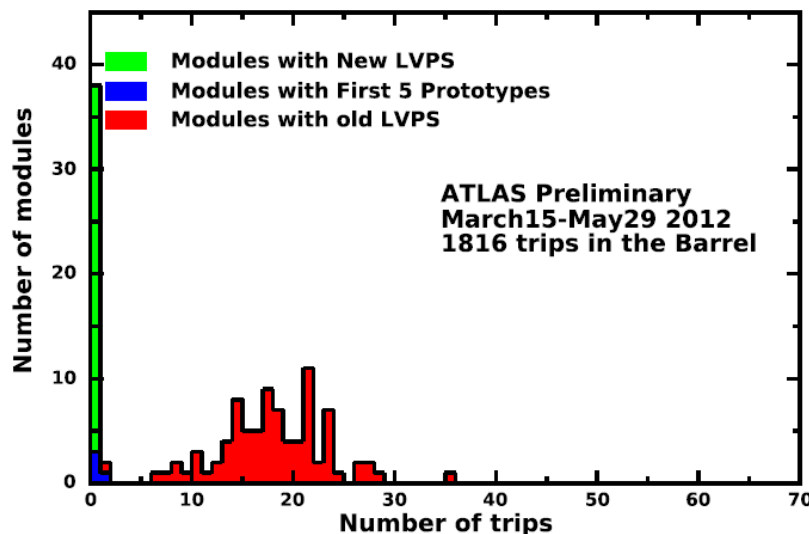
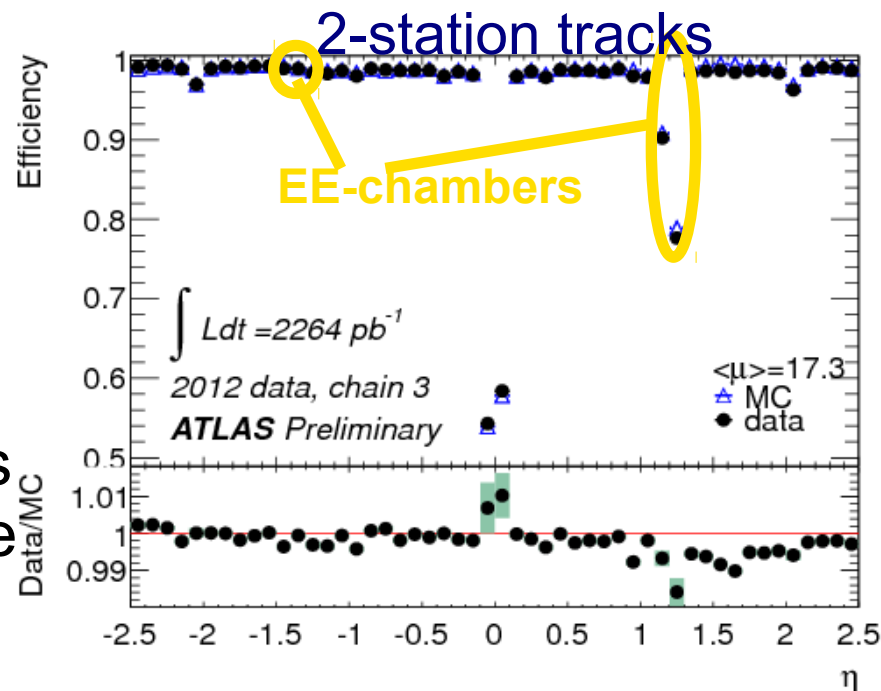


Outline

- Detector status and data taking in 2012 running
- Physics objects under high pileup
- Physics highlights
- Summary

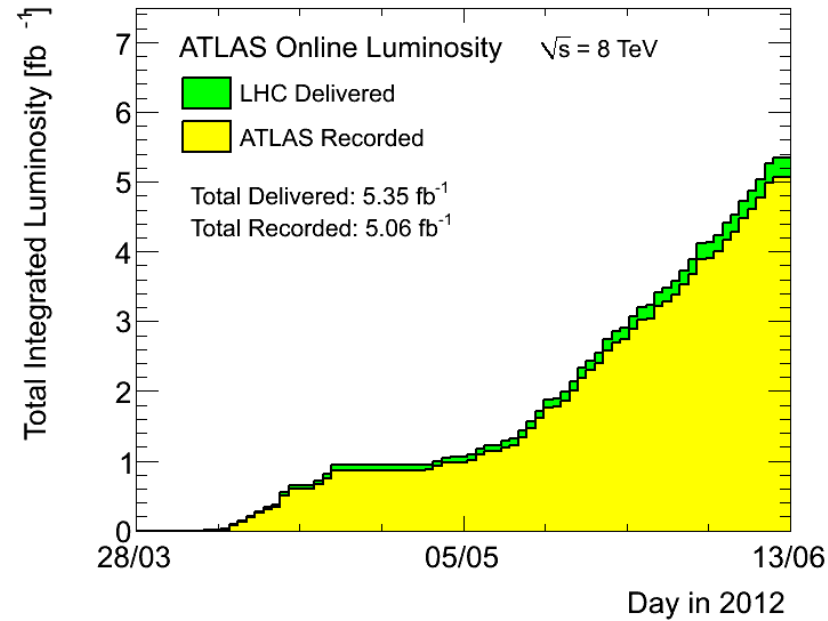
Detector improvements in winter shutdown

- Installed all “EE” chambers in C side and $\sim 1/2$ on A side
- Additional muon shielding
- 40/256 new LV power supplies for Tile calorimeter to eliminate trips and suppress noise



Data taking in 2012

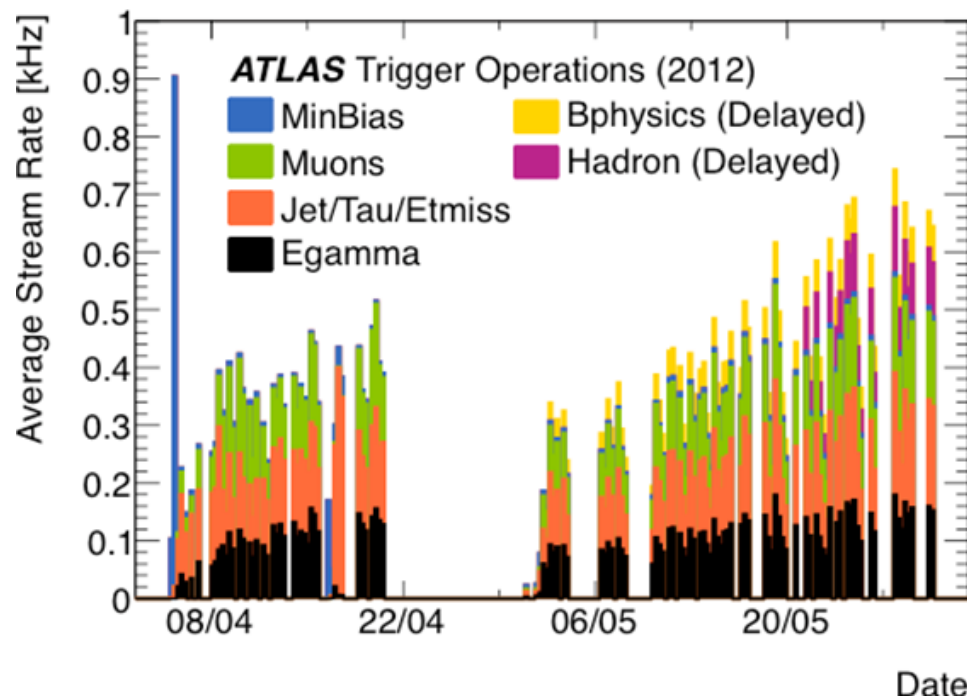
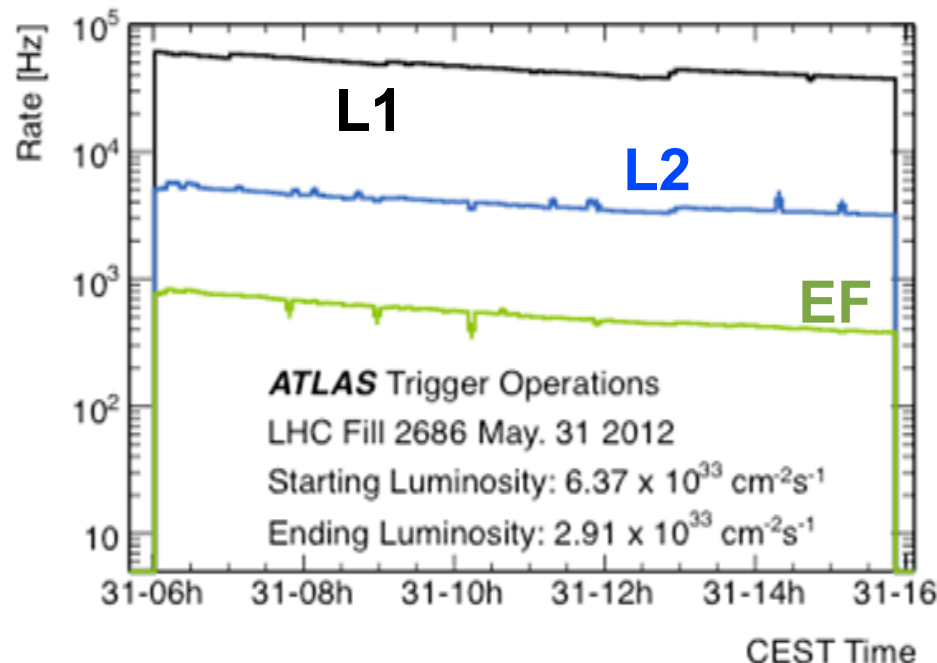
- Data-taking progressing as efficiently as last year ($\sim 94.5\%$)
- Non-working channels: from few per mille to 4%
- Gas leaks in TRT leads to 4l/h gas loss (Xe), with no loss of physics
- Data quality $>90\%$, losses largely recoverable in reprocessing



ATLAS 2012 p-p run										
Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
100	99.4	100	95.0	98.7	100	99.2	100	99.9	100	100
Luminosity weighted relative detector uptime and good quality data delivery during 2012 stable beams in pp collisions at $\sqrt{s}=8$ TeV between April 4 th and May 31 st (in %) – corresponding to 3.5 fb^{-1} of recorded data. The inefficiencies in the LAr calorimeter will partially be recovered in the future.										

Triggering in 2012

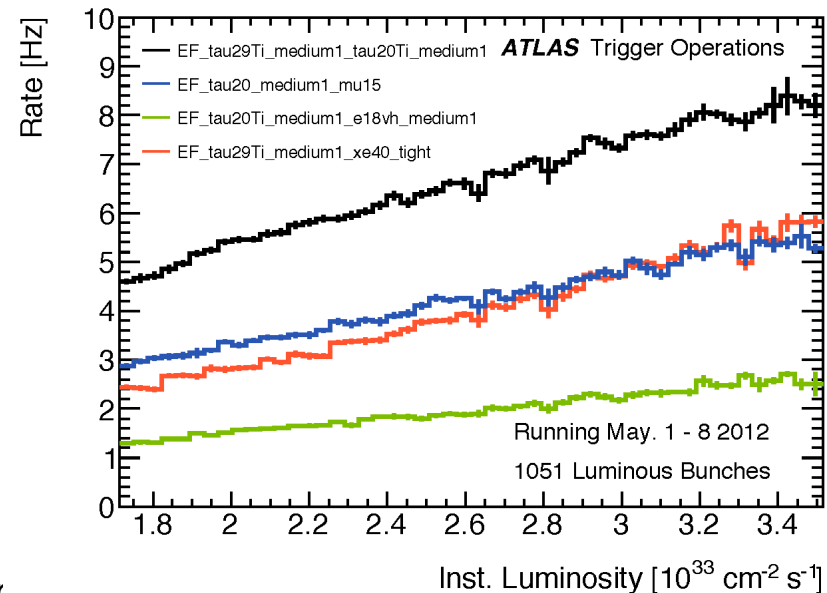
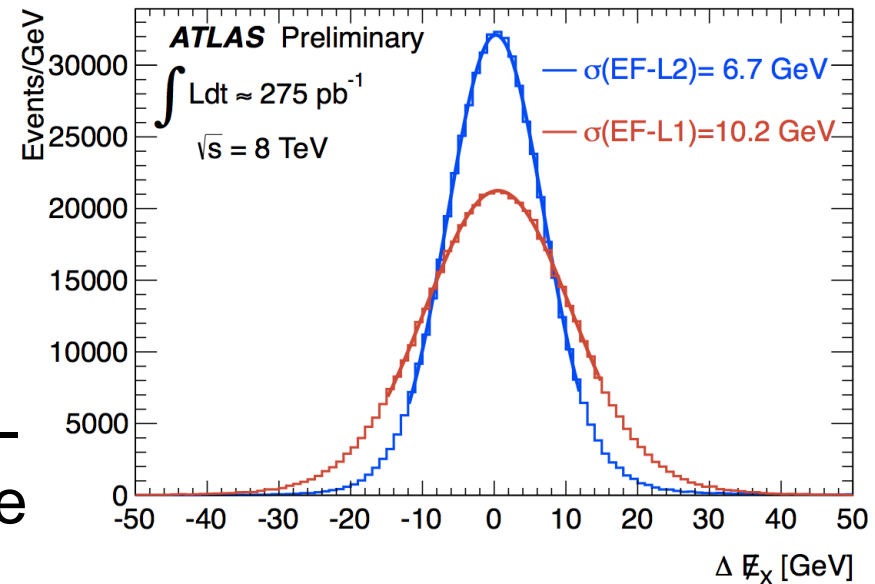
- Trigger menu set for L1 rate up to 75kHz
- Most triggers were retuned to be robust against pileup
- Average output rate of 400 Hz limited by reconstruction and storage
- Additional 140 Hz delayed triggers (mainly B-physics and fully hadronic) to be processed later



Trigger improvements

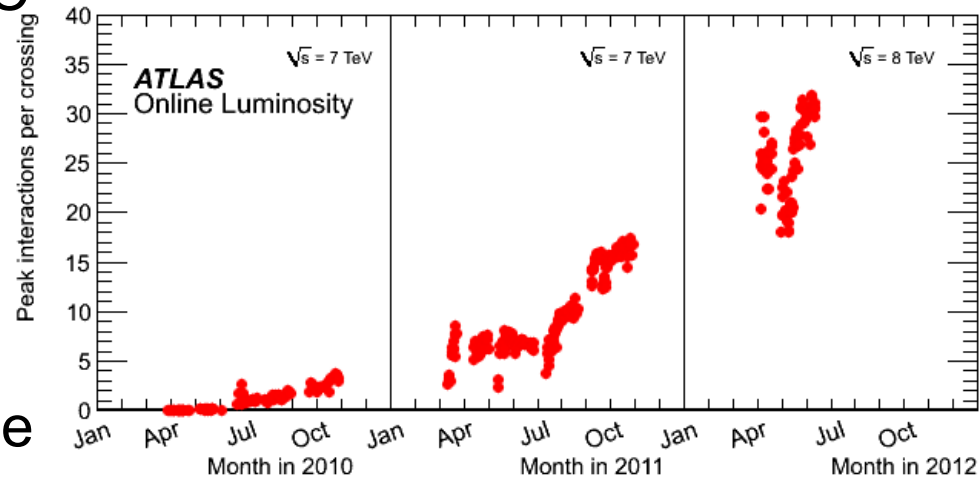
Examples:

- Noise cuts at L1 to suppress pileup lower rate dramatically
- MET threshold has even been lowered using calorimeter Front-End-Board sums at L2 and more sophisticated algorithm at EF
- Retuned tau trigger keeps rate linear with luminosity and efficiency independent of pileup
- Using isolation maintain low single lepton threshold (24 GeV)

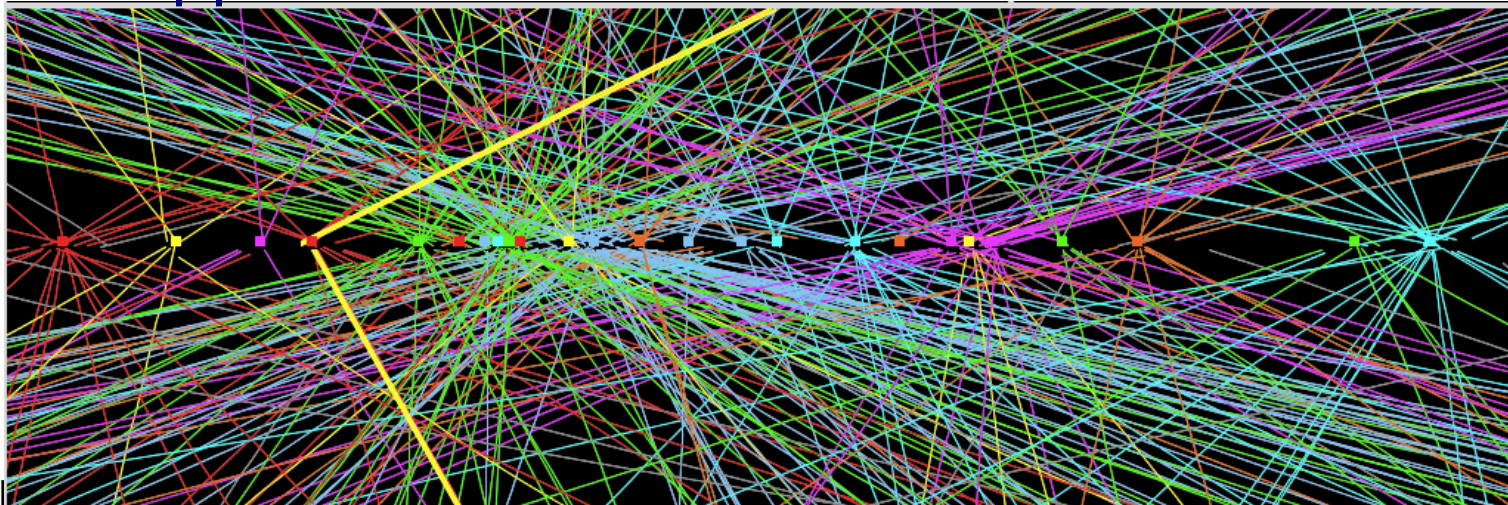


ATLAS under high pileup

- We are very grateful to the LHC operation team for the superb performance of the machine
- The price to pay for the high luminosity is high pileup
- Huge efforts invested over the last months to prepare for these conditions so as to minimise impact on physics

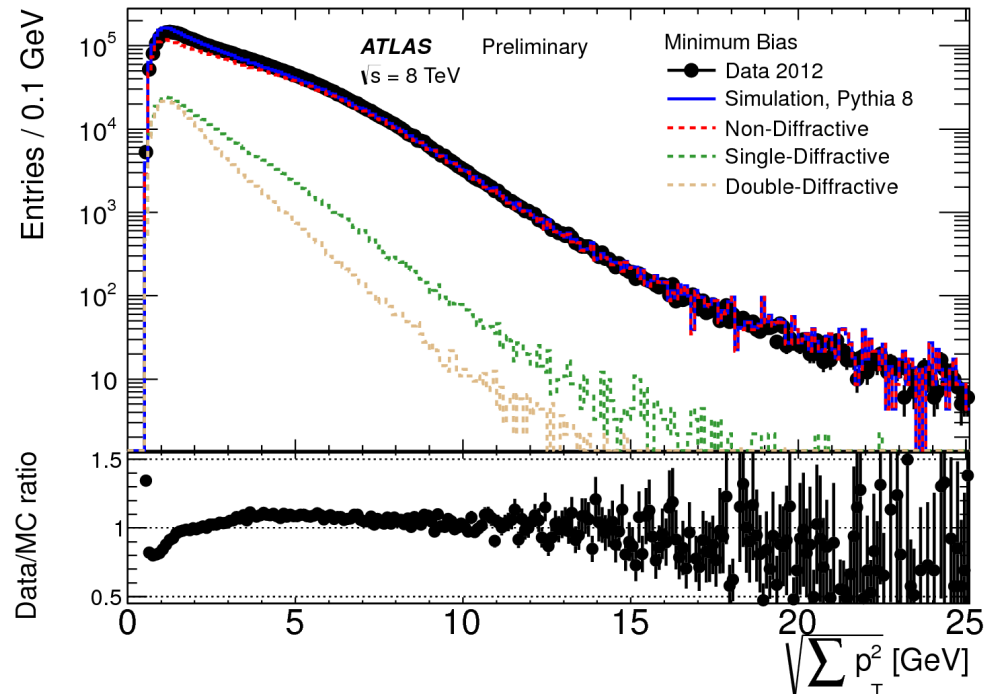
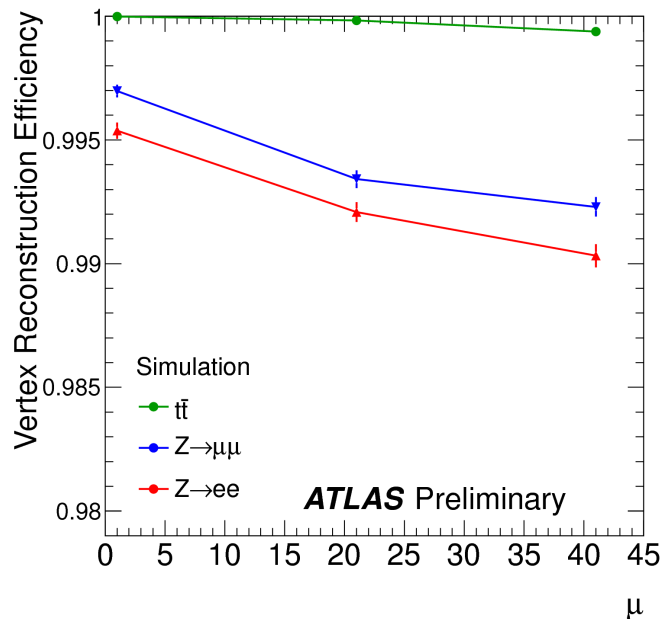


$Z \rightarrow \mu\mu$ event from 2012 data with 25 vertices



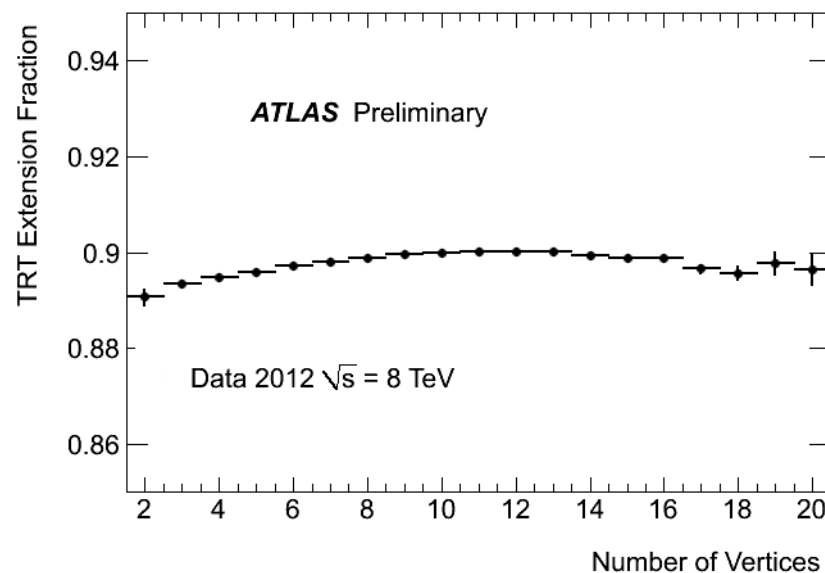
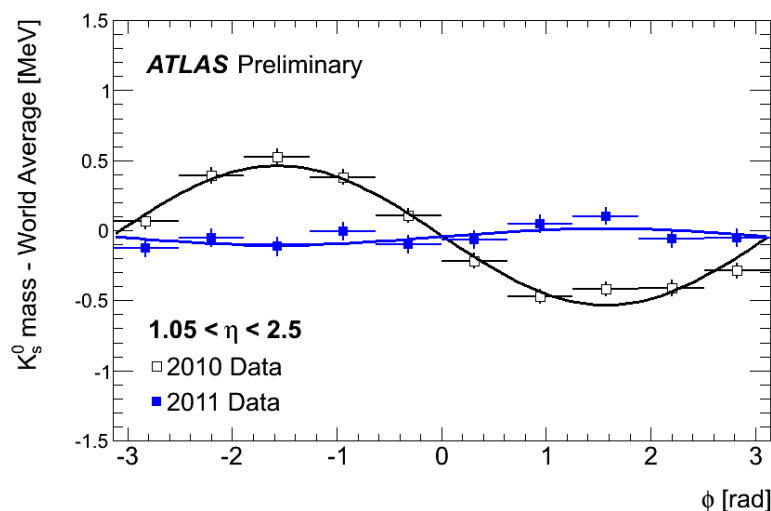
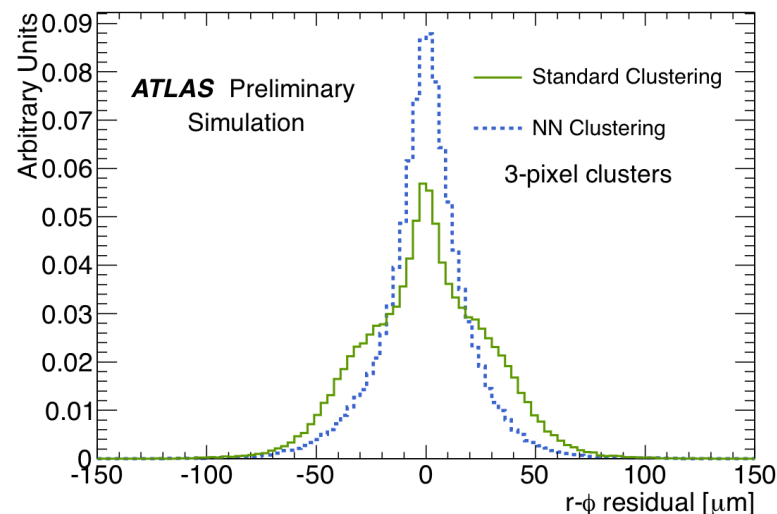
Vertexing under high pileup

- Vertexing efficiency for the hard scattering process stays high
- Resolution degradation is small
- pt spectrum of tracks fitted to vertices agrees with MC prediction



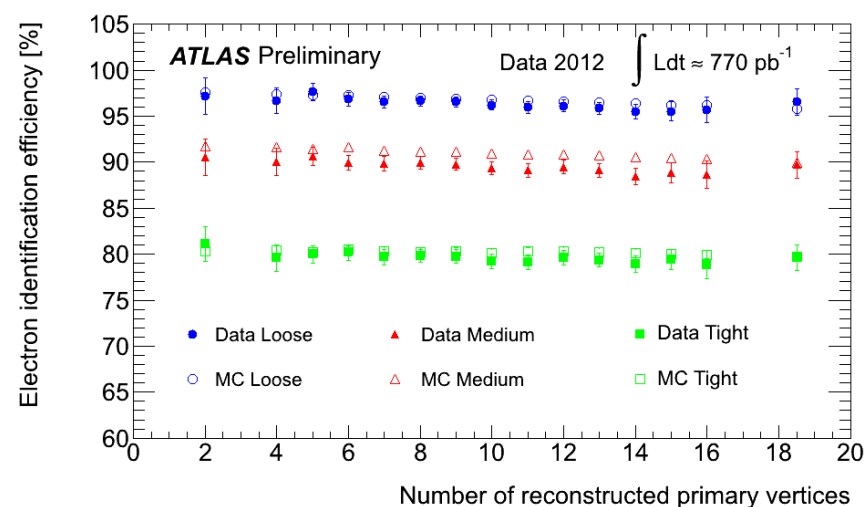
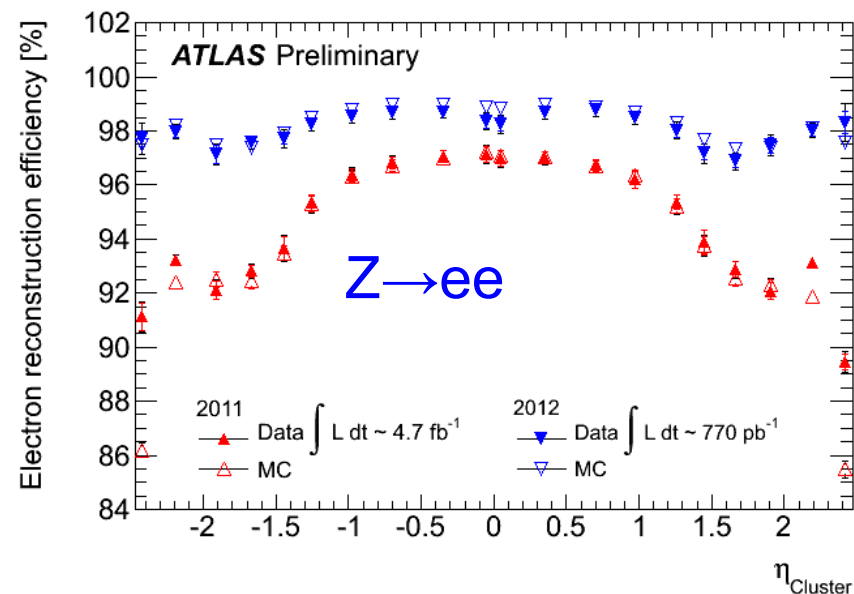
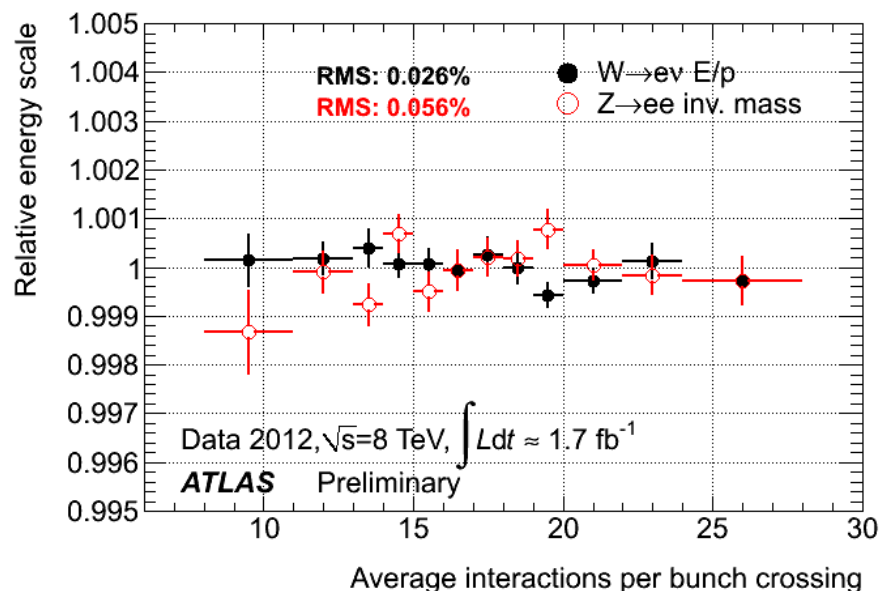
Tracking performance

- Pixel resolution was improved with NN clustering
- Alignment systematics have been reduced substantially
- Efficiency of track extrapolation to the TRT stays constant despite higher occupancy with high pileup



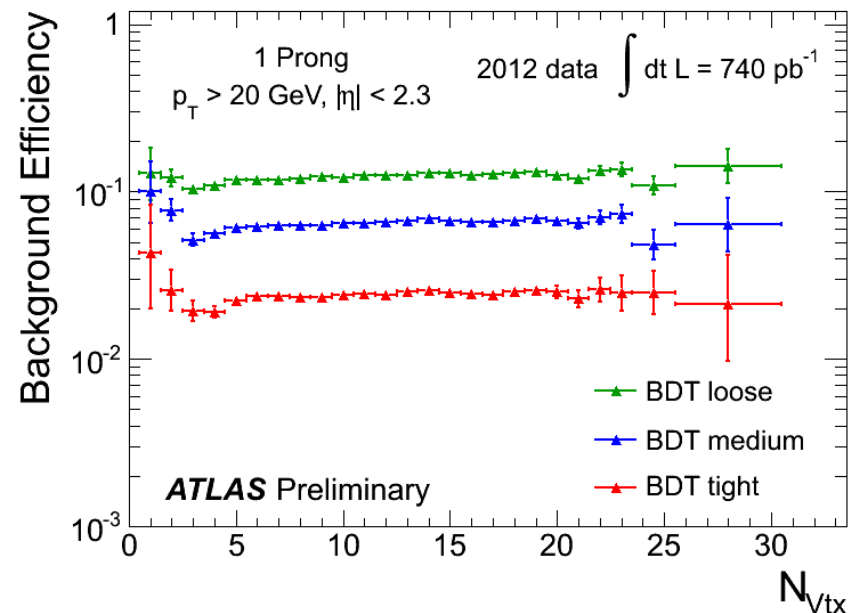
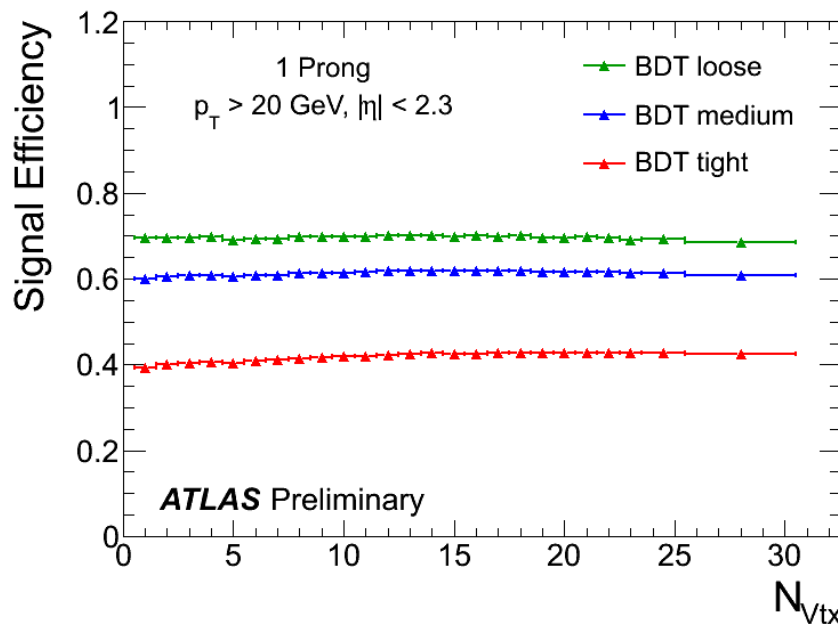
Electrons in 2012

- Electron reconstruction (track, cluster matching) improved with better treatment of brem losses
- Retuning of cuts results in efficiency stable against pileup
- Energy scale stable as well



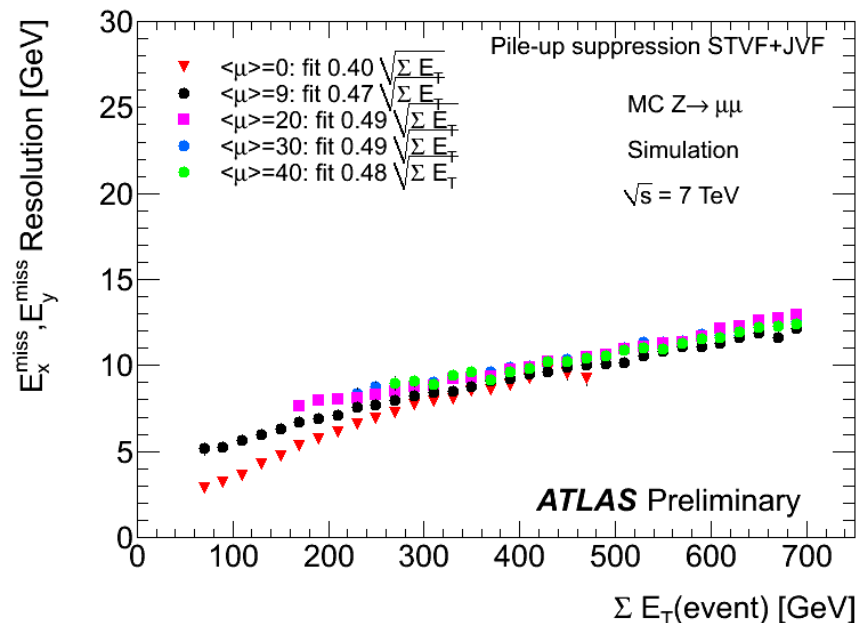
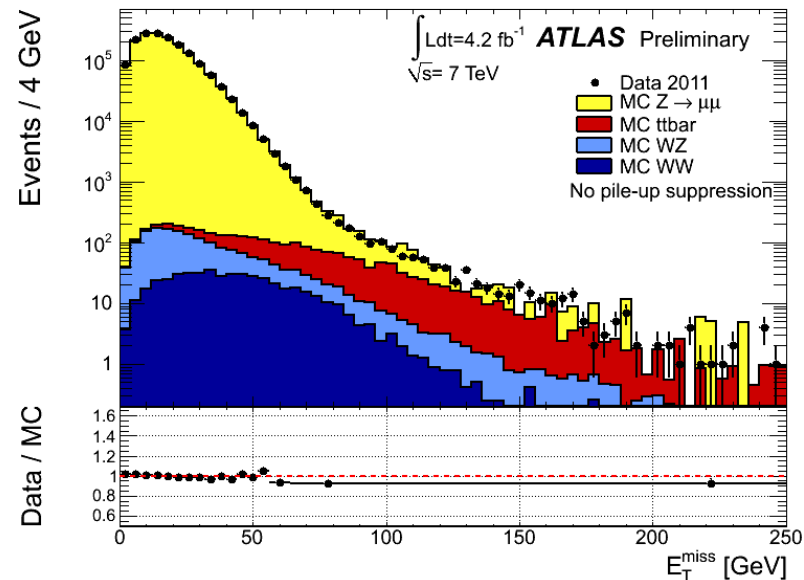
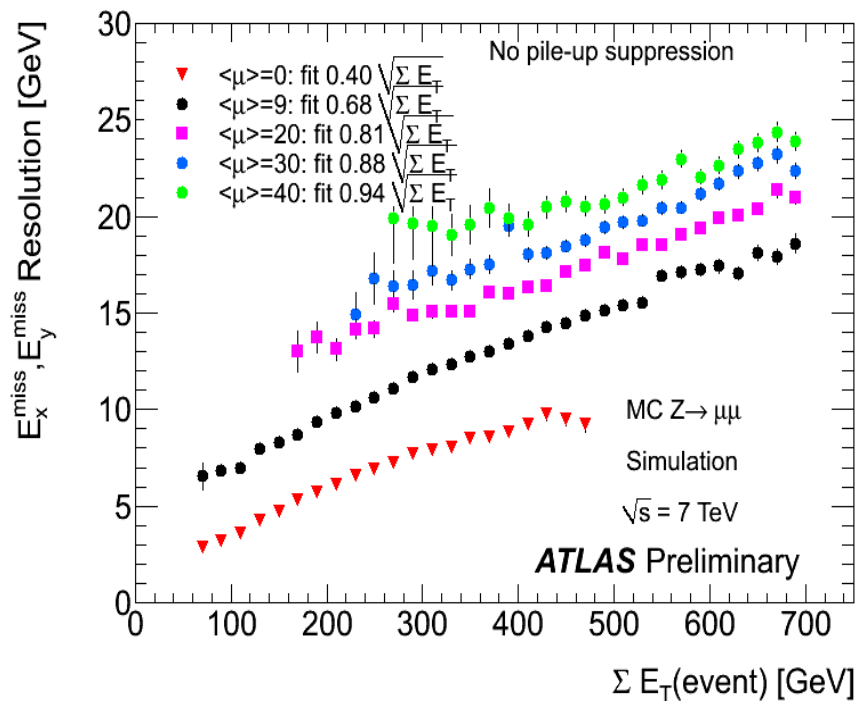
Tau performance

- Trigger and reconstruction algorithms retuned in 2012 to be pile-up robust and keep similar efficiencies and rejections as at low μ
- Achieved by tighter cones and corrections based on the number of vertices



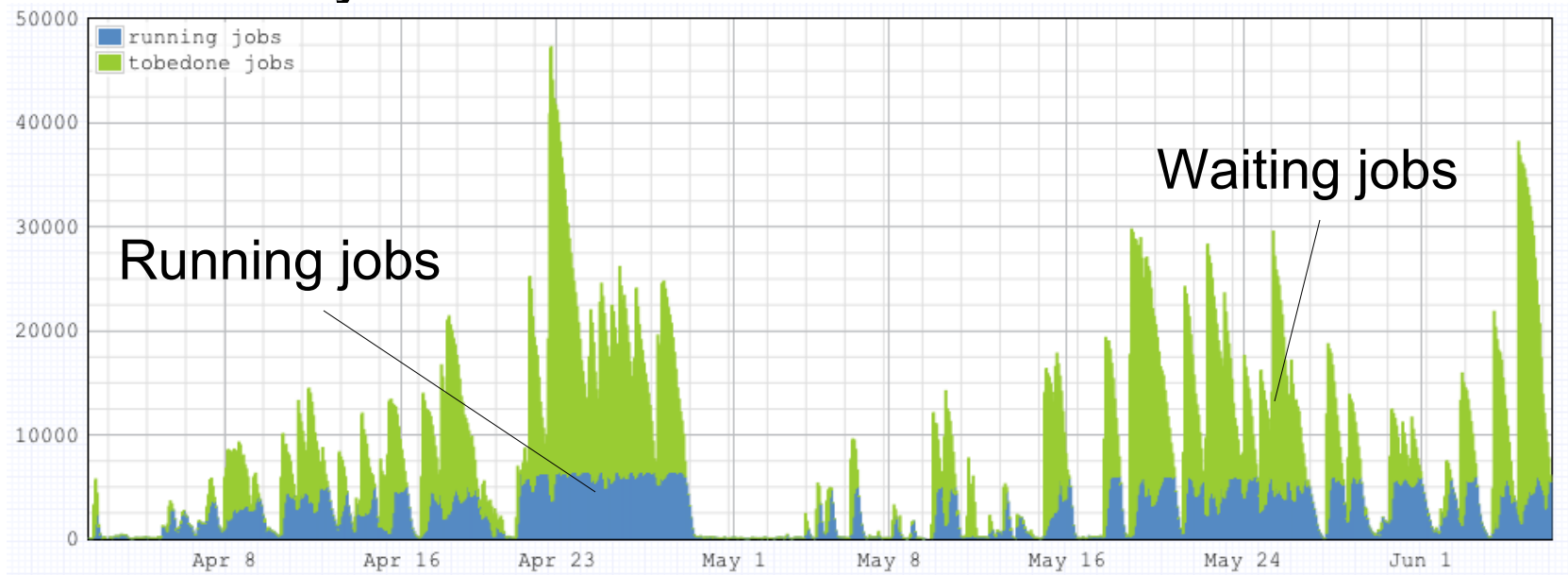
MET under pileup

- MET resolution degrades due to additional noise from pileup
- Can be largely recovered using tracking, vertexing and optimising cuts in the calorimeter



ATLAS computing

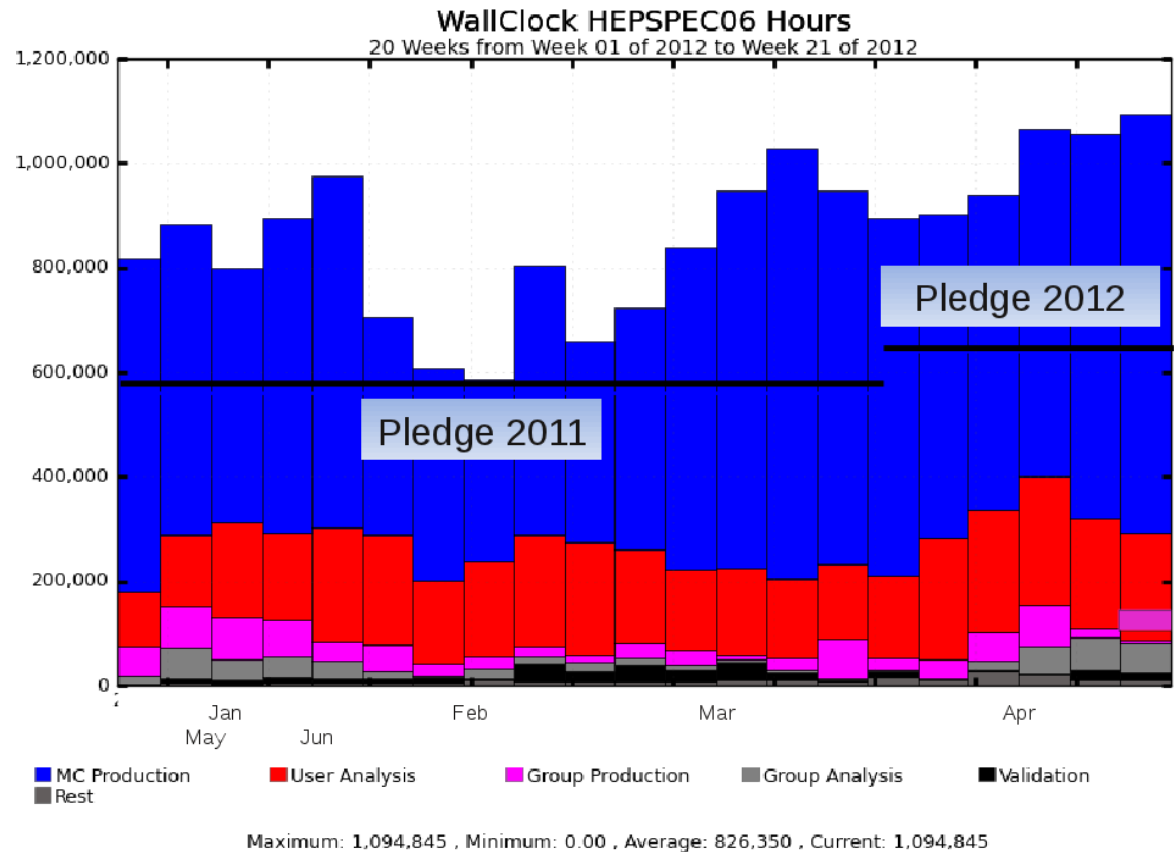
- Tier-0 running smoothly
- Increased resources allow to cope with higher luminosity

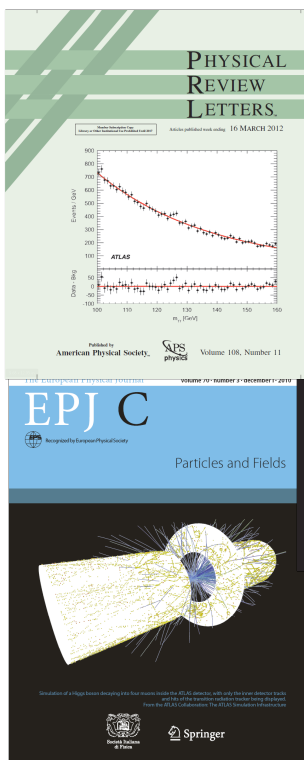


No physics events lost in data processing!

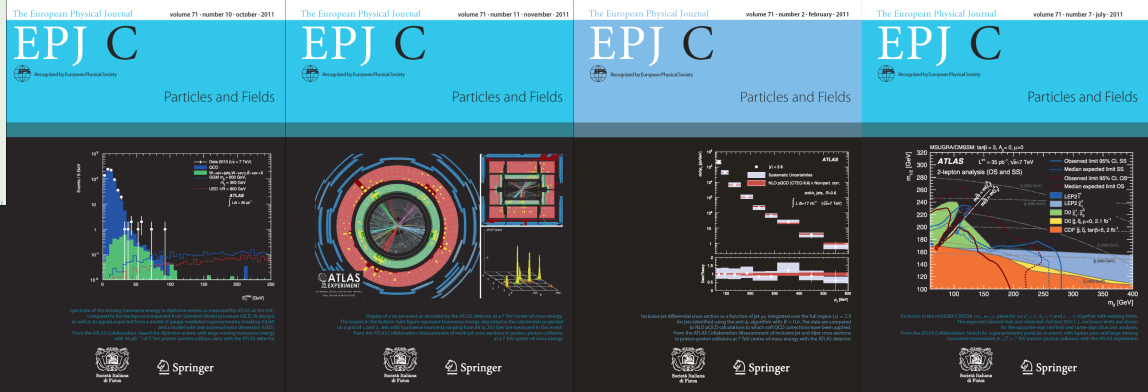
ATLAS computing (II)

- Tier-1&2 heavily used for MC production and user analysis
- Resources beyond pledges allow simulations for a deeper physics program
- Thanks to the computing centres!

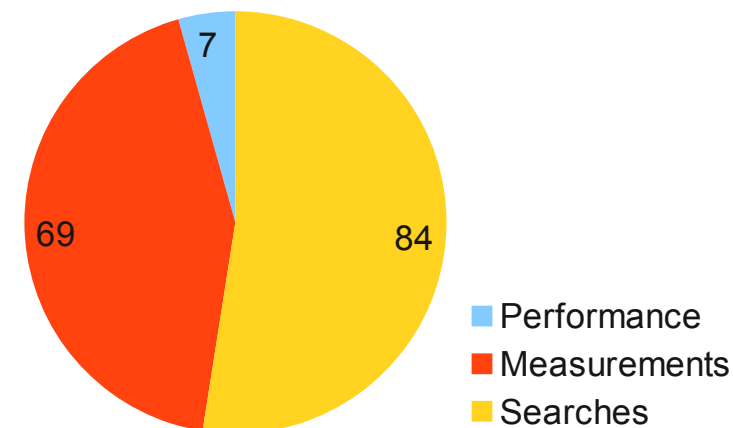
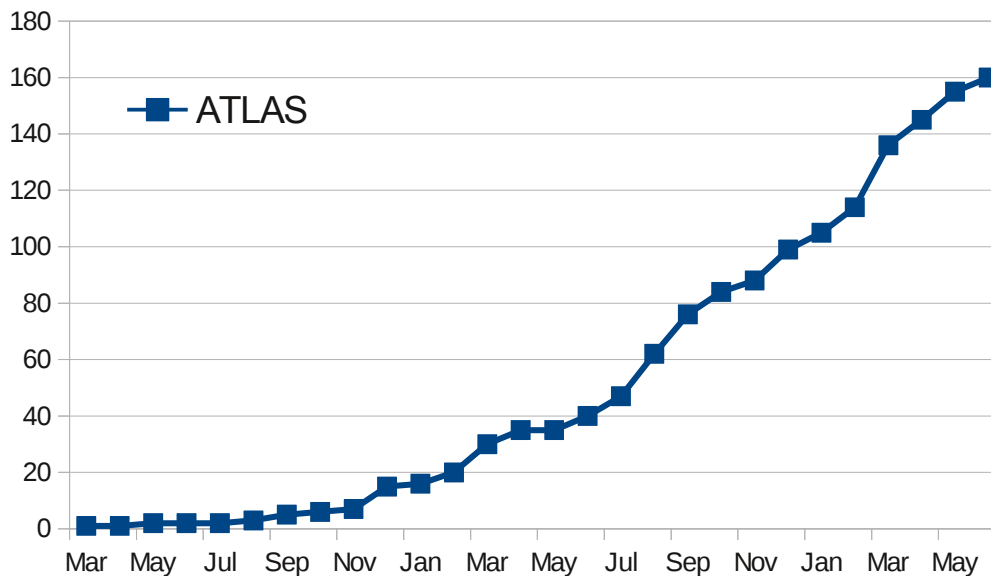




ATLAS publications



- 160 papers on collision data
- 325 conference notes, 60 in 2012
- ~2 papers/week in the last months

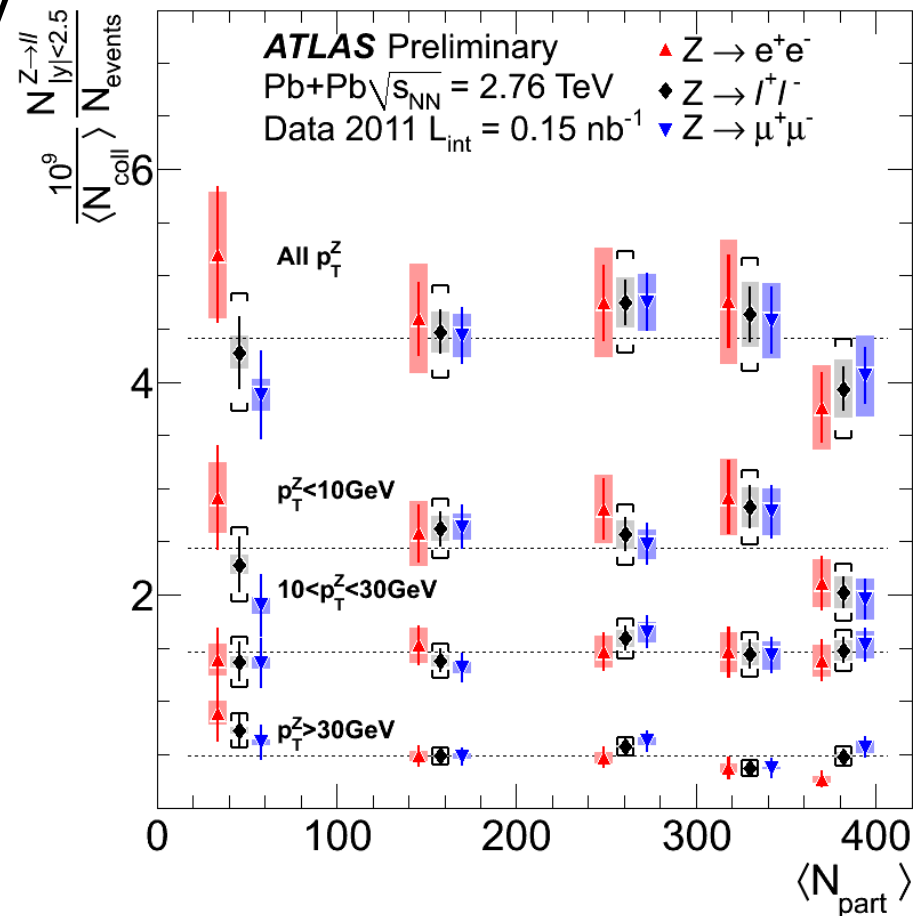
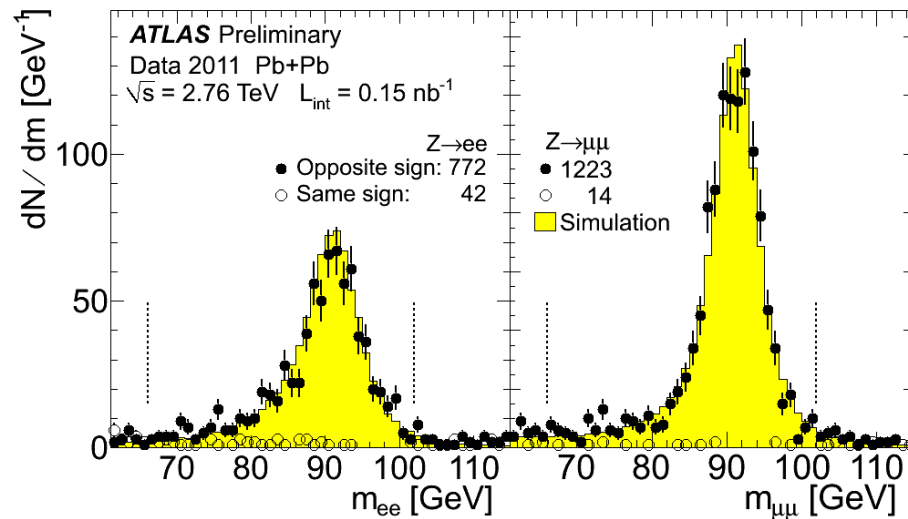


Physics results

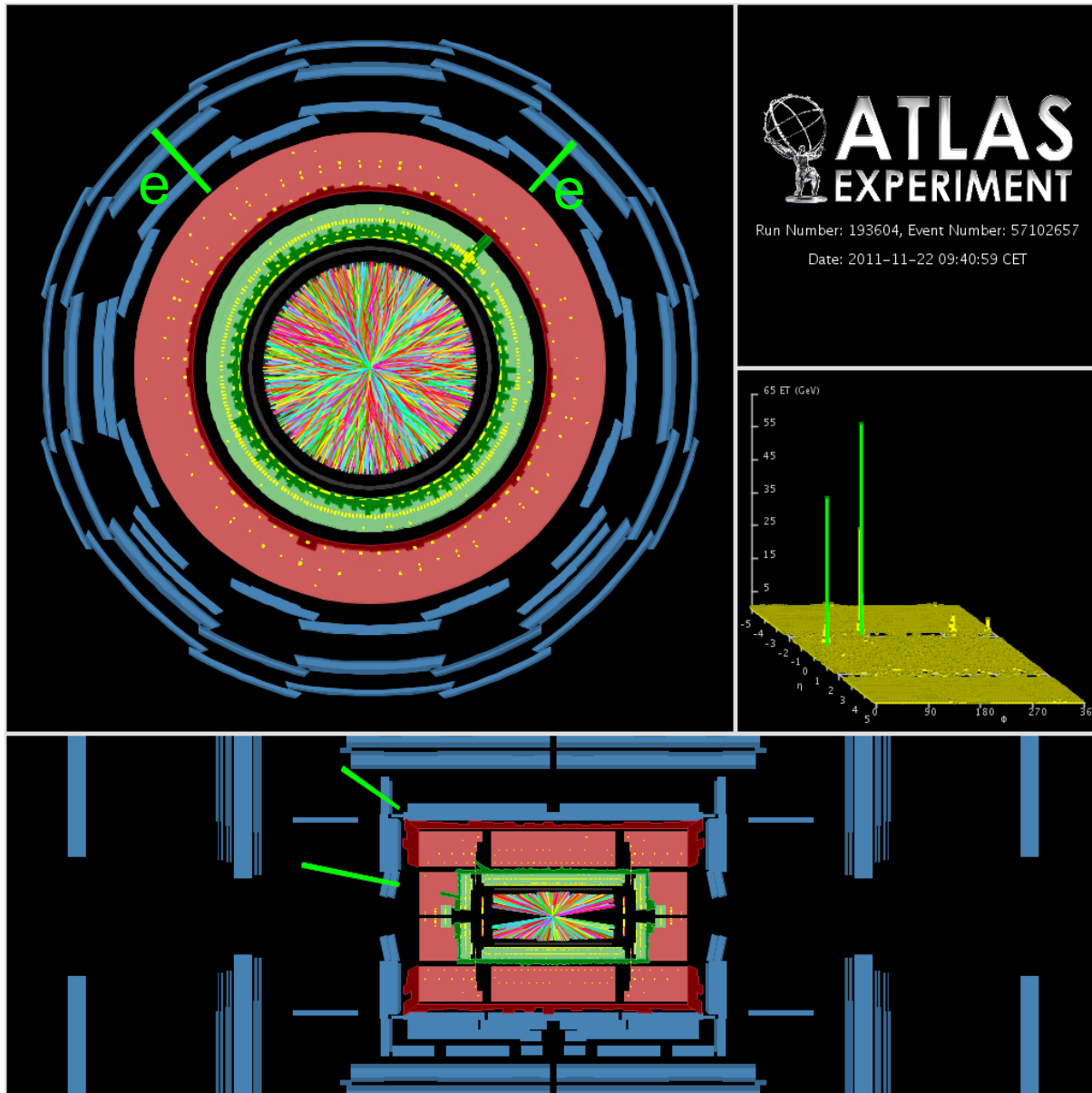
- Many important results presented at the 2012 Winter conferences
- Steady output of new results since then
- Used luminosity depends on complexity of analysis, sensitivity to pileup, need for low pt triggers, etc.
- Will show selected examples from all areas

Z production in Heavy Ion

- Z production in the electron and muon channel has been studied with the full 2011 statistics
- As expected for the weakly interacting bosons no suppression is visible

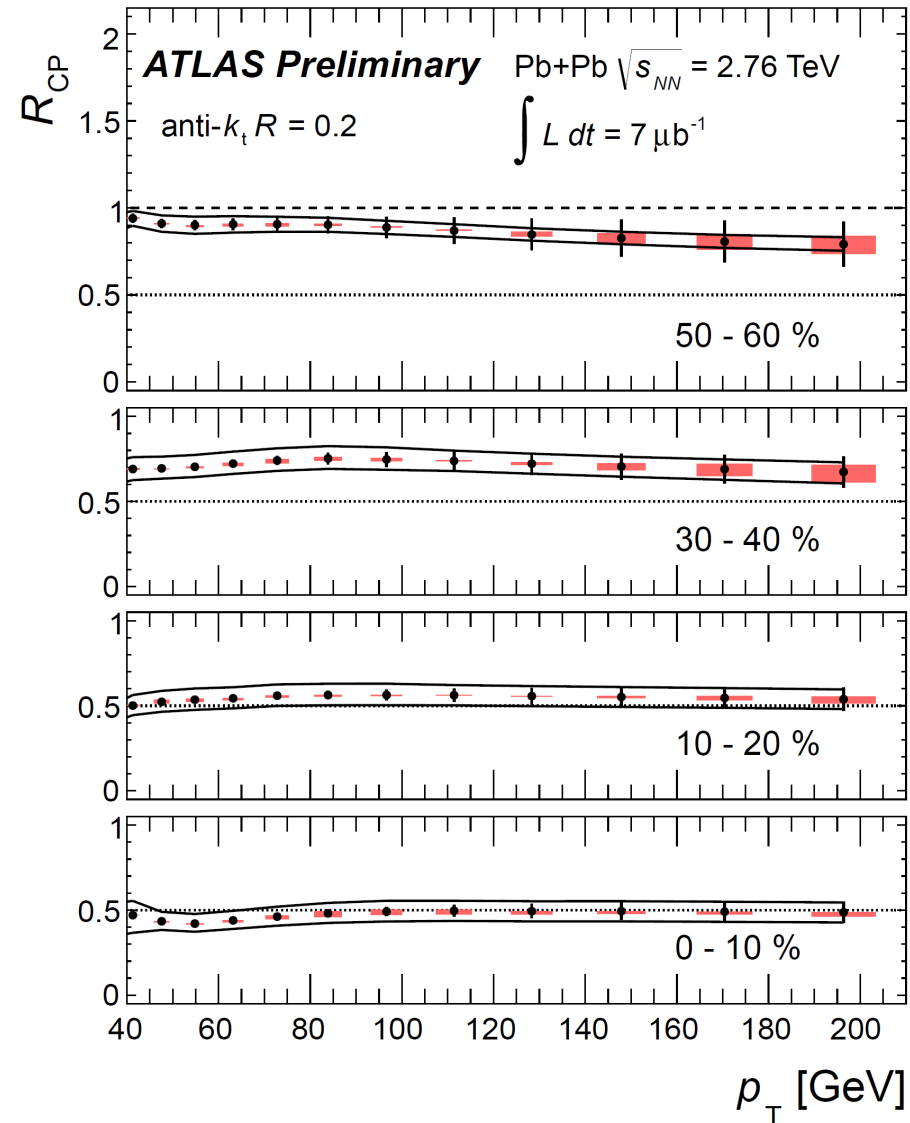
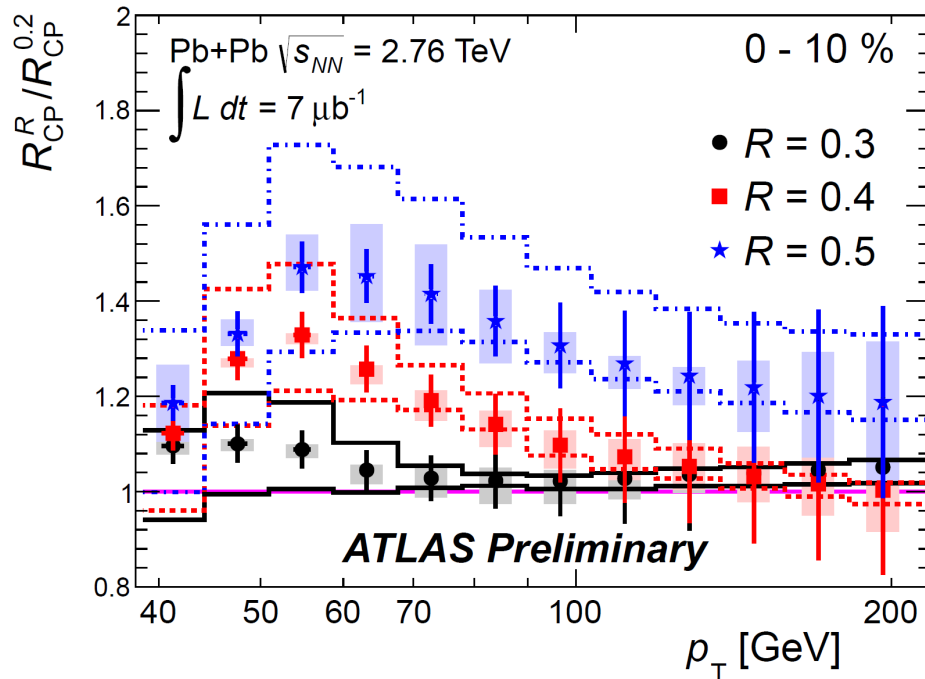


$Z \rightarrow ee$ event in HL



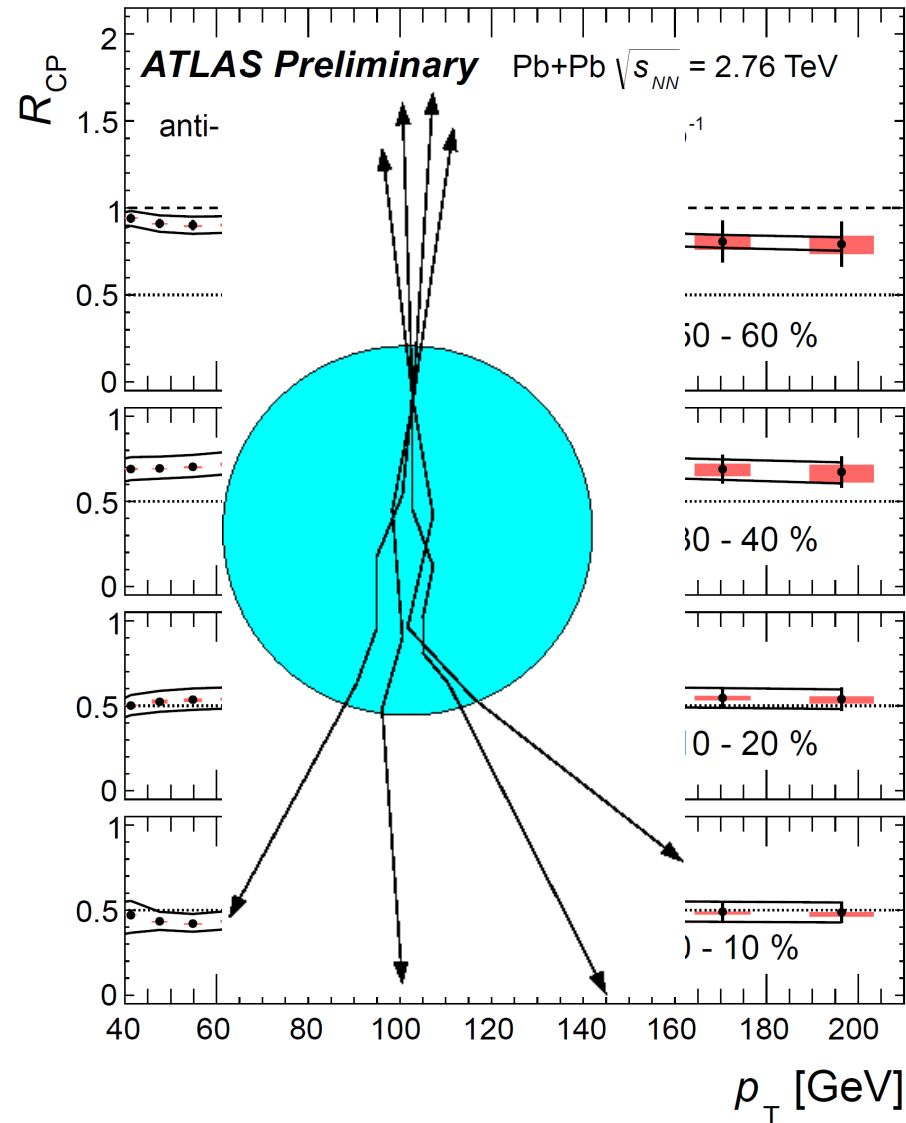
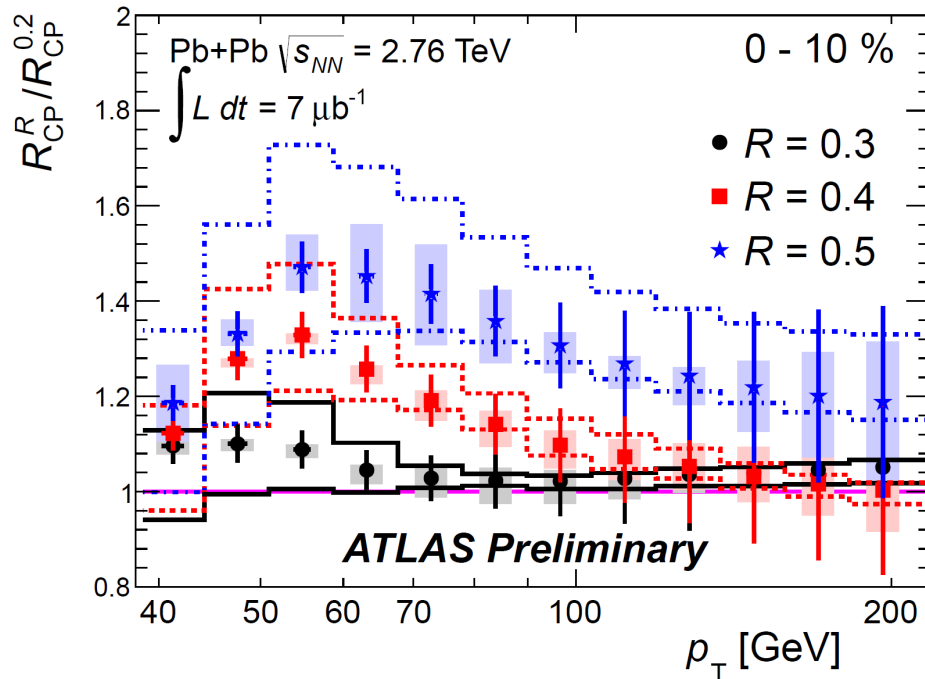
Jet quenching in Heavy Ion

- Jet quenching confirmed with higher statistics and corrected to hadron level
- Suppression is stronger for narrow jets



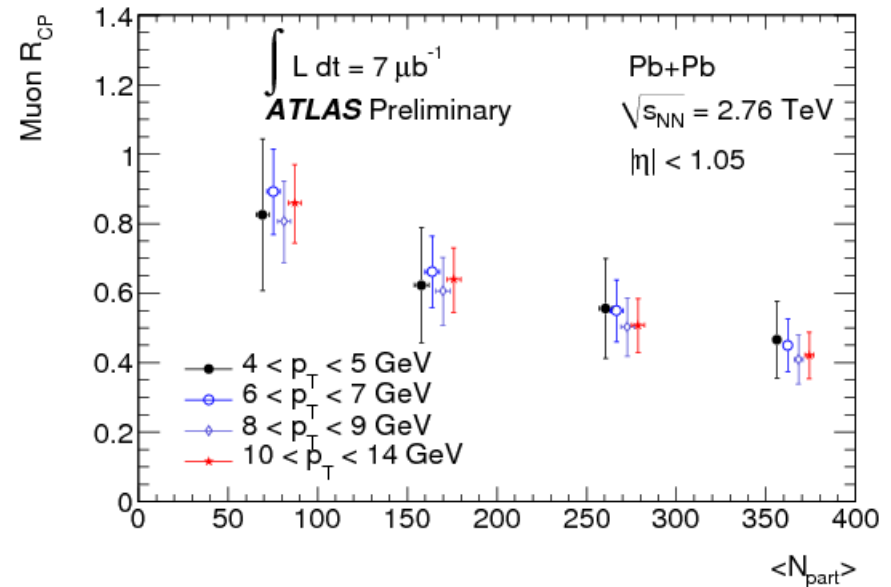
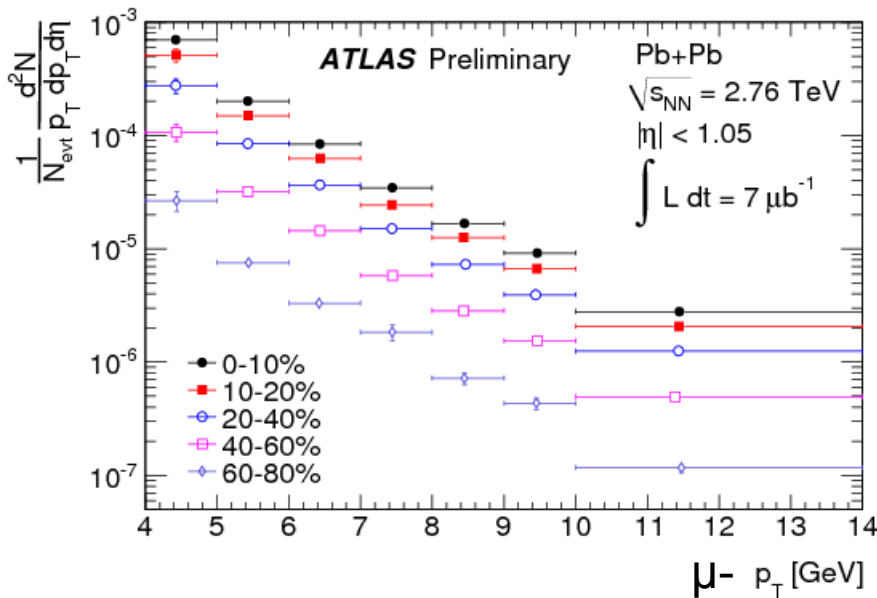
Jet quenching in Heavy Ion

- Jet quenching confirmed with higher statistics and corrected to hadron level
- Suppression is stronger for narrow jets



Heavy flavour production in HI

- Medium energy muons are a good tagger for heavy flavour jets
- Heavy flavour jets show a similar suppression as all jets

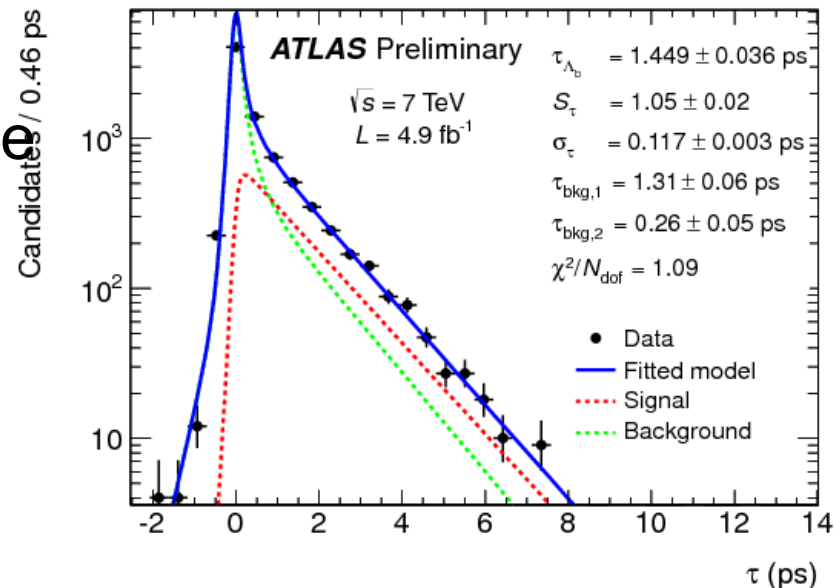
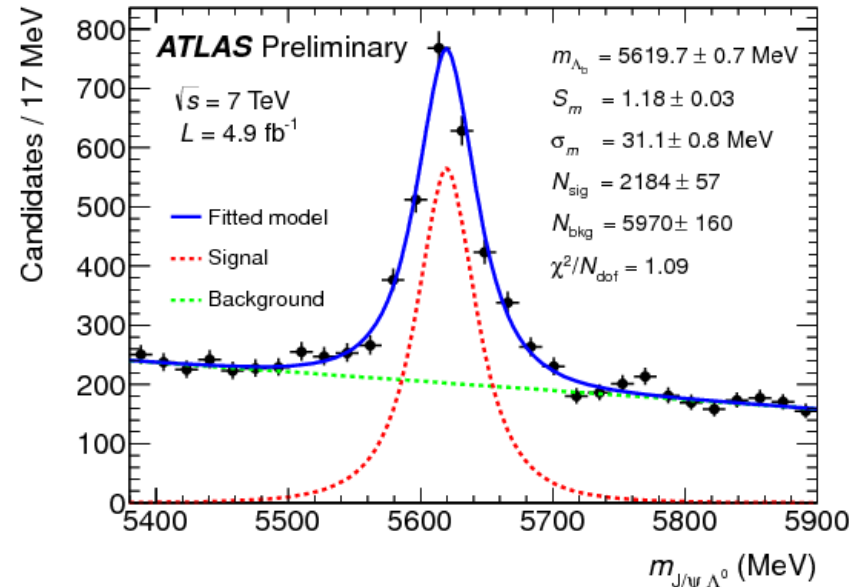


Λ_b mass and lifetime

- The Λ_b mass and lifetime have been measured from $\Lambda_b \rightarrow J/\psi \Lambda$ constraining the masses of the track pairs to the Λ and J/ψ masses
- The B^0 mass and lifetime have been measured as a cross check
- The results are compatible and competitive with the world average and LHCb

$$m(\Lambda_b) = 5619.7 \pm 0.7 \pm 1.1 \text{ MeV}$$

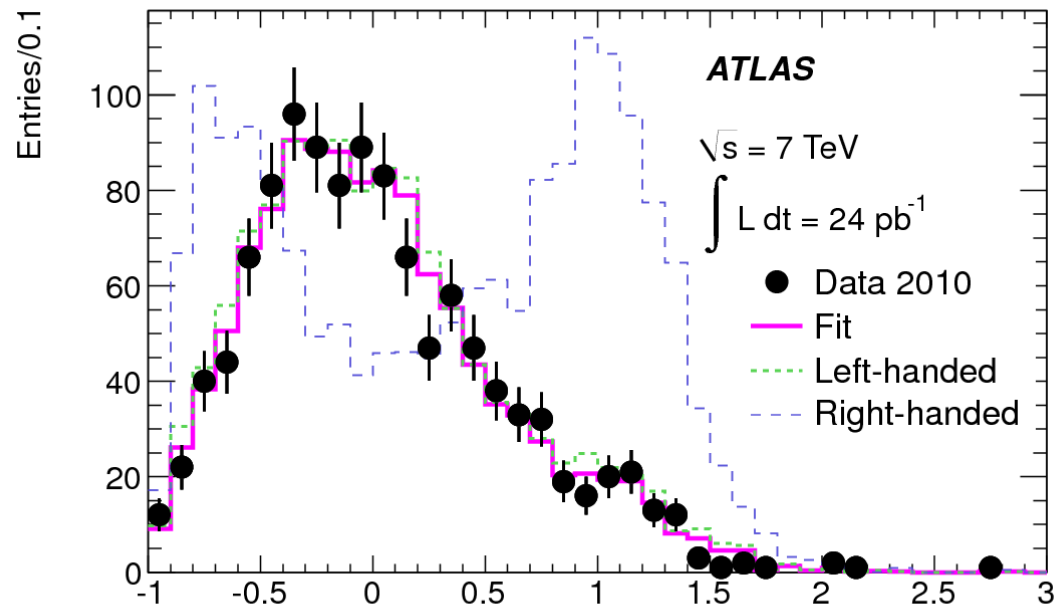
$$\tau(\Lambda_b) = 1.449 \pm 0.036 \pm 0.017 \text{ ps}$$



τ -Polarisation in W decays

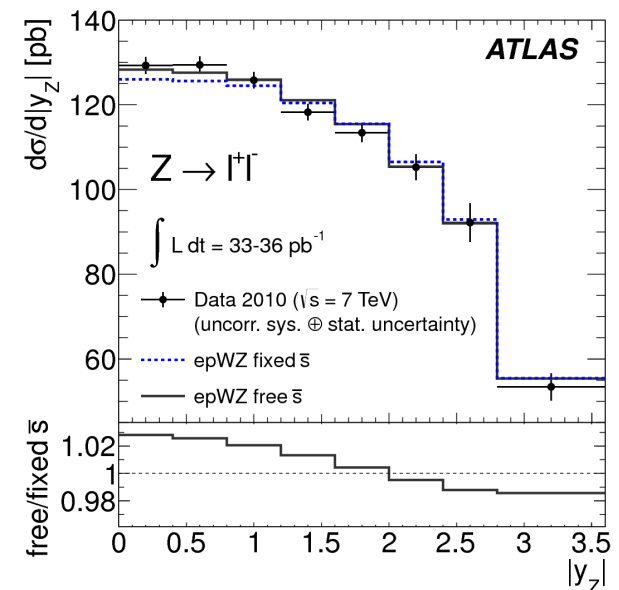
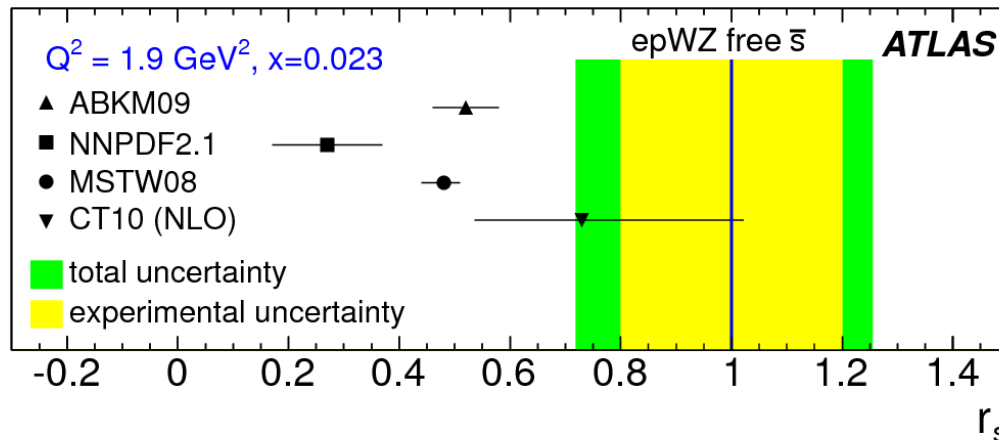
- Measurement of τ -polarisation in W-decays using ρ -polarisation
- Not surprisingly the τ is left-handed
 $(P_{\tau} = -1.06 \pm 0.04 \text{ (stat)} +0.05 -0.07 \text{ (syst)})$
- Proof of principle that τ -polarisation measurement is possible at hadron colliders to measure Higgs, SUSY... properties

γ measures ρ -polarisation from track and shower energies of 1-prong hadronic τ -decays



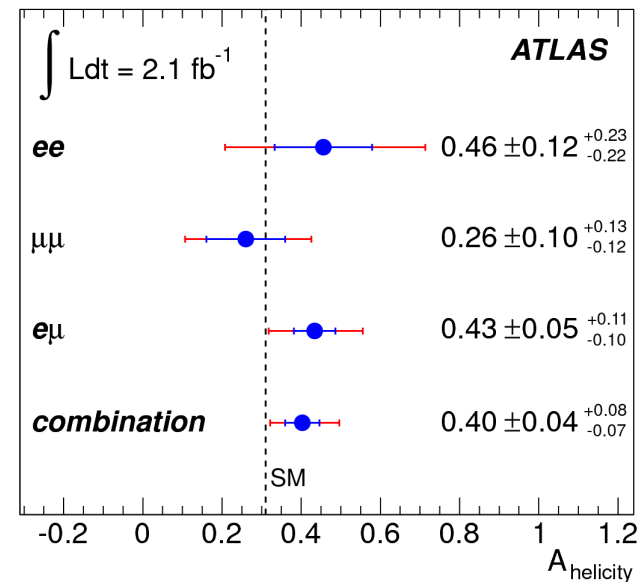
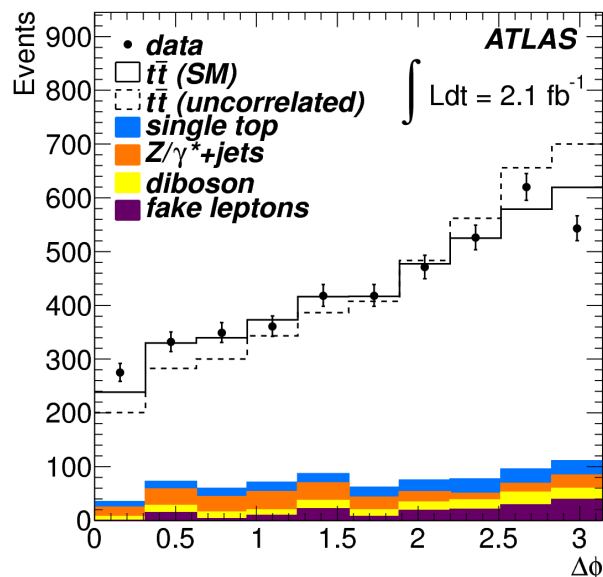
Measurement of the strange-quark density

- W- and Z-distributions at ATLAS give information on PDFs complementary to HERA
- Especially the s-quark density can be measured from the W/Z y-distributions
- Common fit with HERA indicates that s is unsuppressed compared to u/d

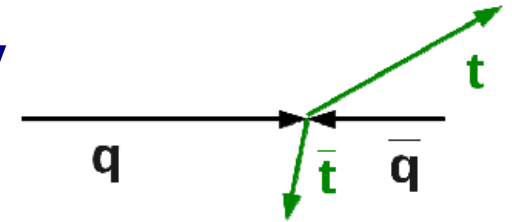


Measurement of $t\bar{t}$ spin correlations

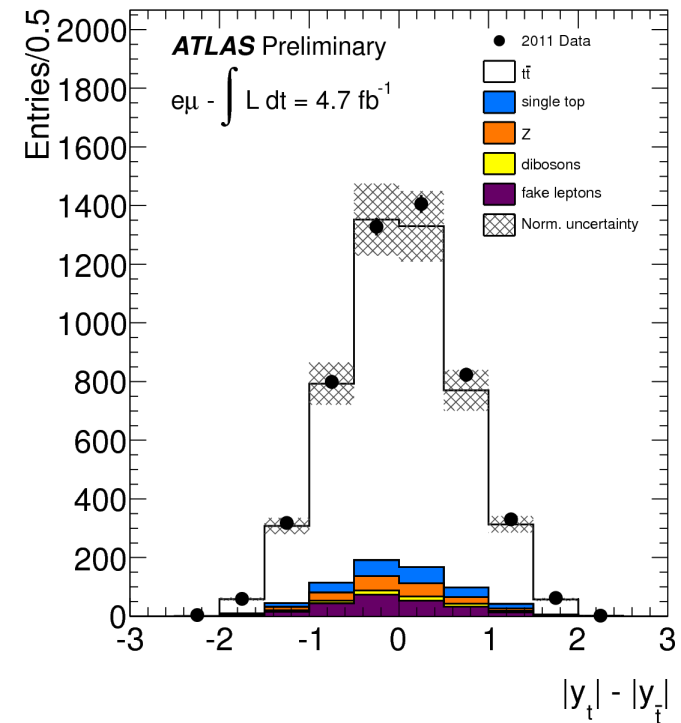
- In strong production the tops are unpolarised
- However the $t\bar{t}$ spins are correlated due to the production process
- ATLAS measurement establishes spin correlation to 5.1σ (4.2σ expected)



Top charge asymmetry



- Top charge asymmetry at the Tevatron on the edge of being significant
- At LHC the asymmetry translates into a forward-central asymmetry
- ATLAS measured the asymmetry in the 2-lepton channel with 5 fb^{-1}
- The asymmetry was measured for both, the decay leptons and the reconstructed top direction
- The top asymmetry was combined with the 2 fb^{-1} 1-l analysis



$$A^{\text{ll}} = 0.023 \pm 0.012 \pm 0.008$$

$$\text{SM: } 0.004 \pm 0.001$$

$$A^{\text{tt}} = 0.029 \pm 0.018 \pm 0.014$$

$$\text{SM: } 0.006 \pm 0.002$$

Single top measurements

- ATLAS sees evidence for single top in Wt -channel (3.3σ , $V_{tb}=1.03+0.16-0.19$)
- t -channel has been measured separately for top and anti-top
- Individual channels agree with SM, ratio starts to be sensitive to u/d ratio

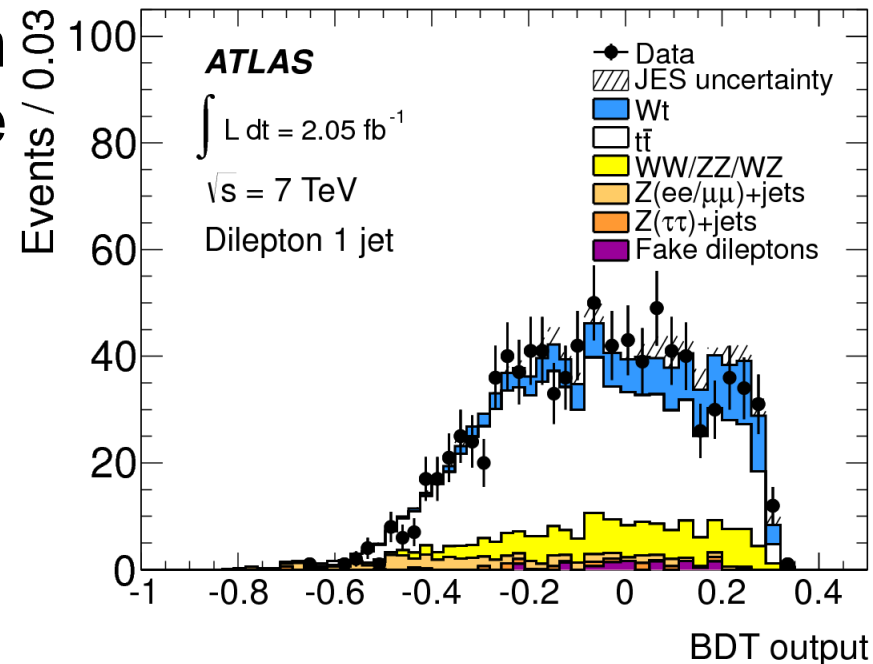
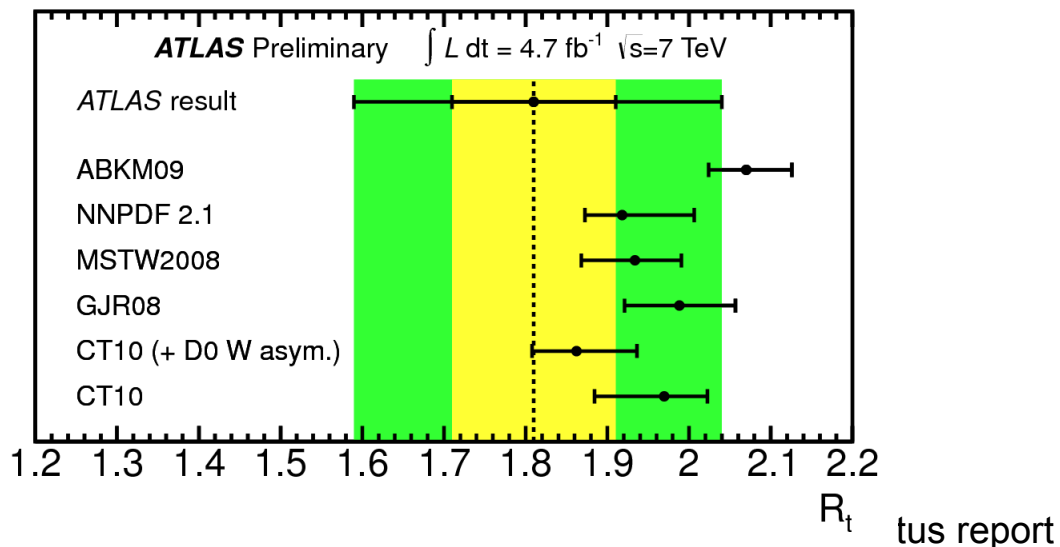
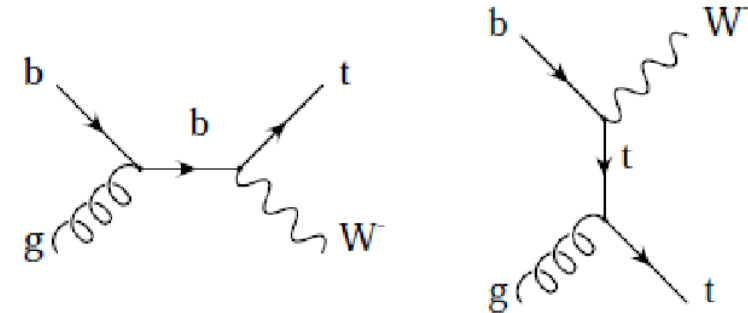
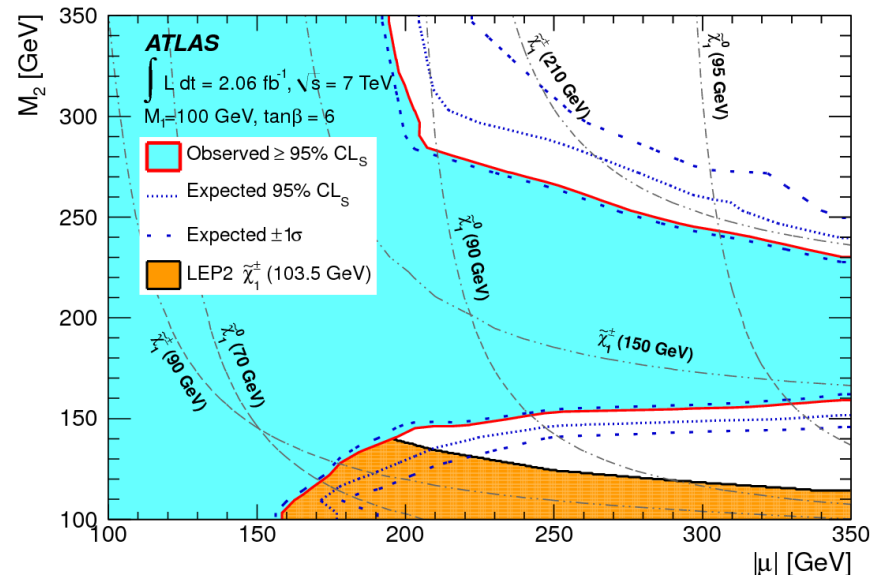
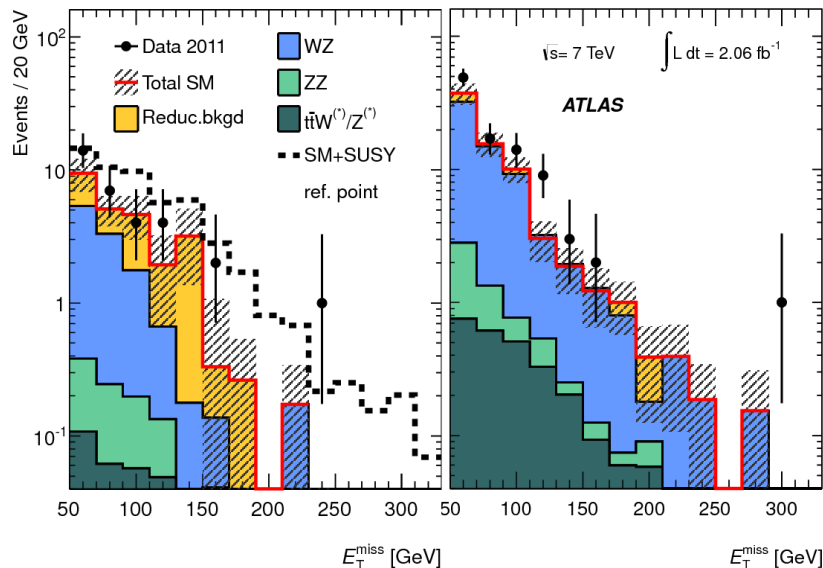


Figure 1: A log-log plot showing the total cross-section σ_{tot} [pb] for $pp \rightarrow \text{SUSY}$ as a function of the average mass m_{average} [GeV]. The x-axis ranges from 100 to 900 GeV, and the y-axis ranges from 10^{-3} to 10 pb. The plot shows several curves for different particle pairs: $q\bar{q}$ (red), $q\bar{q}$ (green), $q\bar{q}^*$ (blue), $g\bar{g}$ (cyan), $l\bar{l}^*$ (magenta), and $Z\bar{Z}$ (purple). A red arrow points to the right, indicating the direction of increasing energy, and a blue arrow points downwards, indicating the direction of decreasing cross-section. The plot is labeled "Prospino2.1" in the top right corner.

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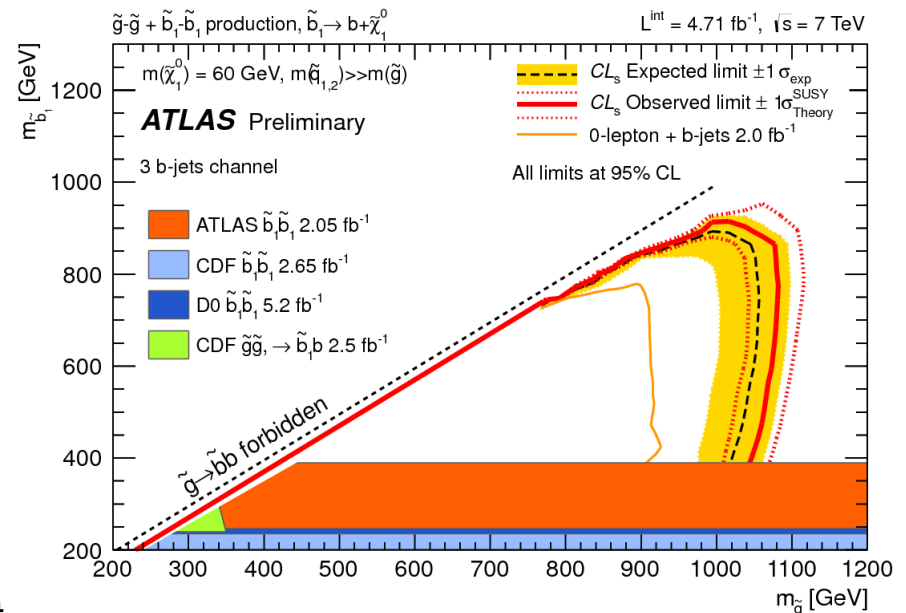
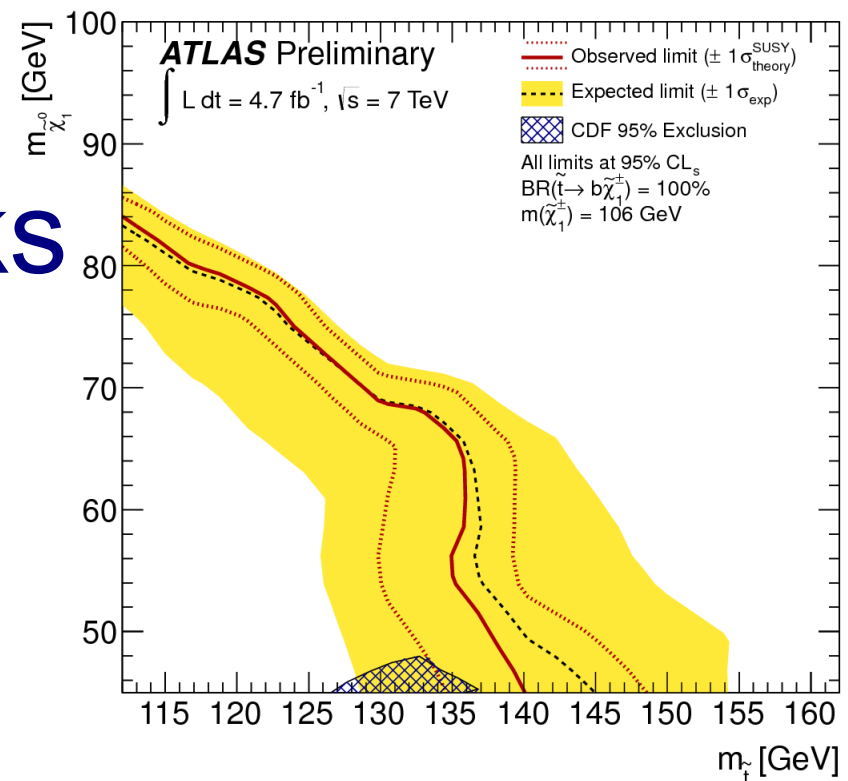
Searches for charginos/neutralinos

- Direct chargino/neutralino production has cross section in the pb range
- ATLAS has searched for this in 3-lepton final state
- Limits in the $m(\tilde{\chi}_1^\pm/\tilde{\chi}_2^0) \sim 150\text{GeV}$ region have been set



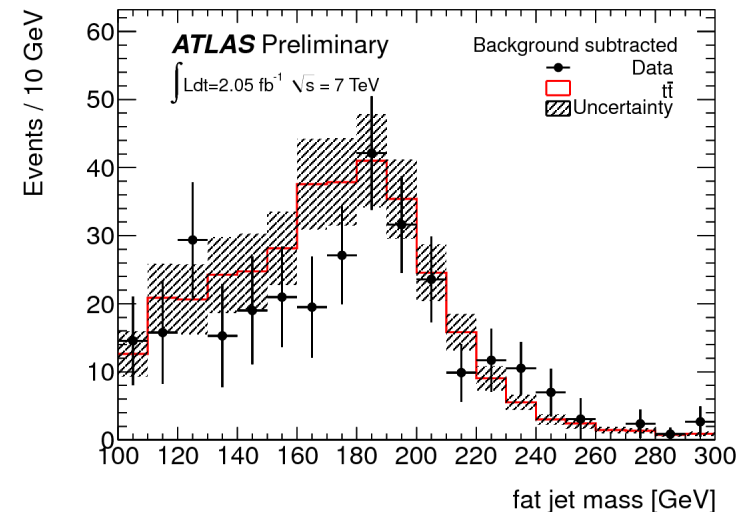
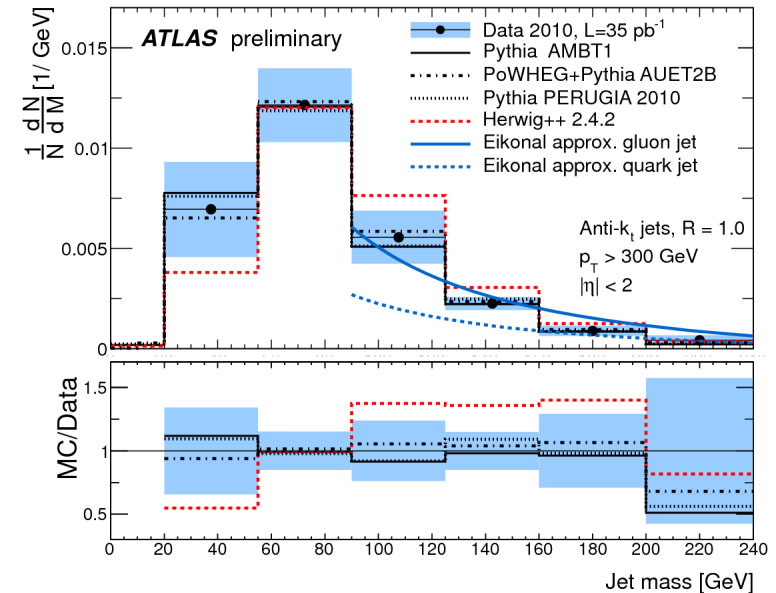
Searches for 3rd generation squarks

- Due to L-R mixing 3rd generation squarks can be light
- ATLAS has searched for very light stops in direct production using 2 leptons+MET and in gluino mediated production for stops and sbottom using events with ≥ 3 b-jets+MET
- No signal found \rightarrow limits



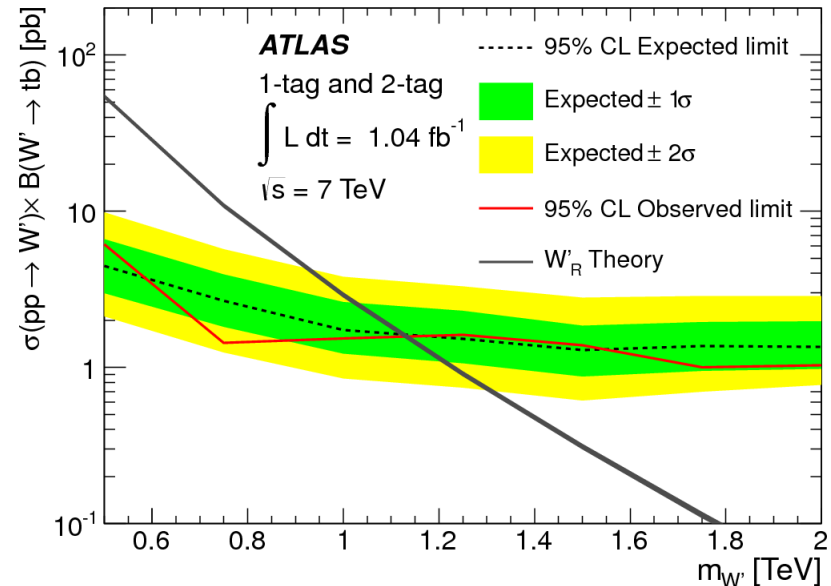
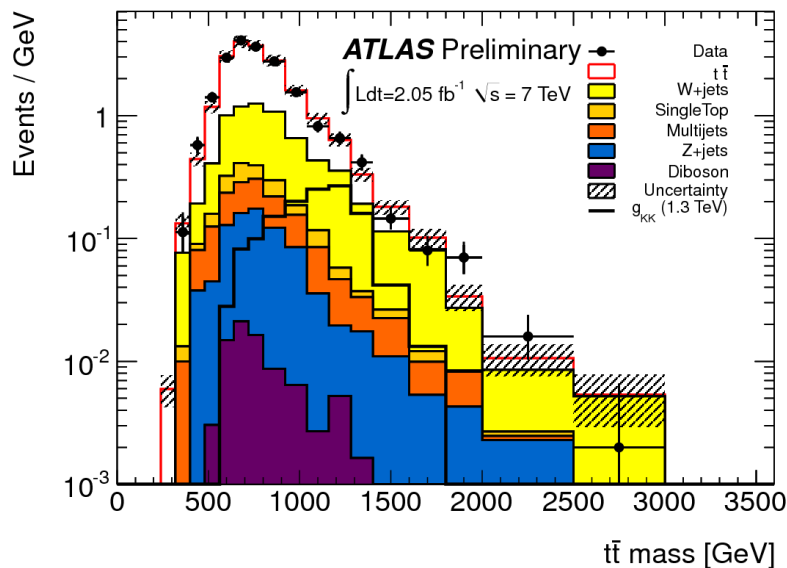
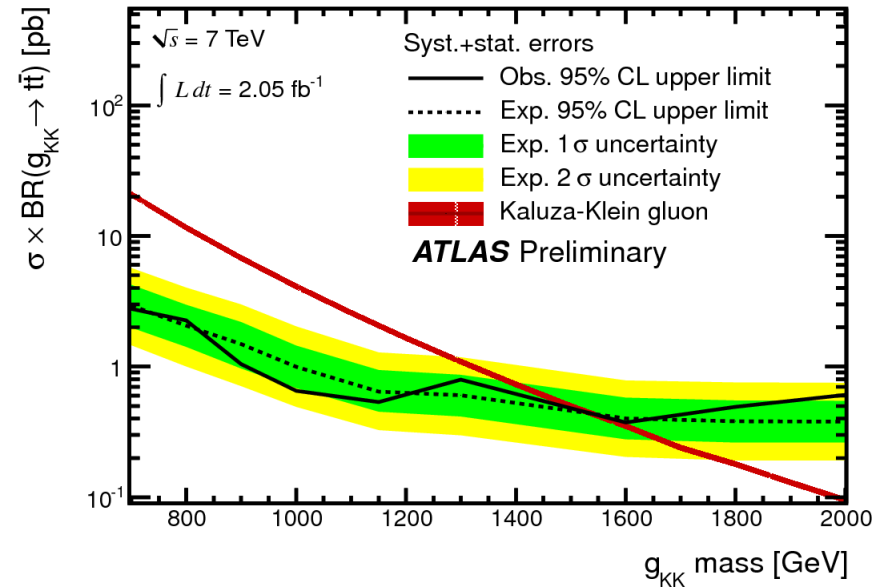
Properties of boosted jets

- For high mass resonances decaying into gauge bosons or top quarks the intermediate states become so much boosted that the decay products merge into one jet
- This needs special reconstruction algorithms
- It must be shown that standard QCD jets are understood in this regime
- Measurements provide information for further MC tuning



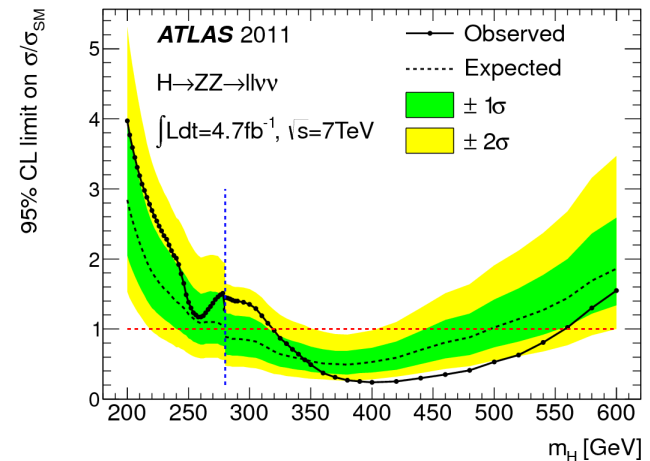
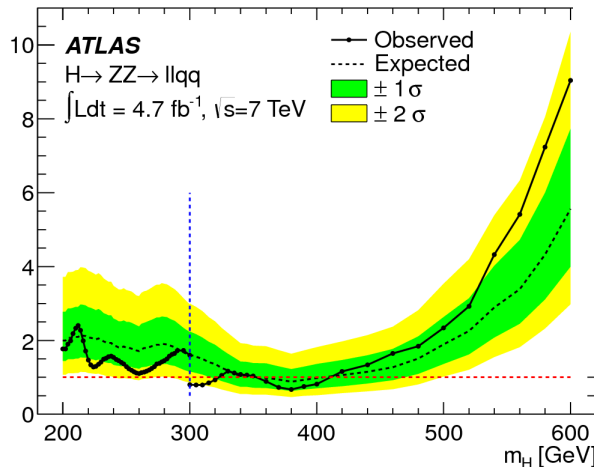
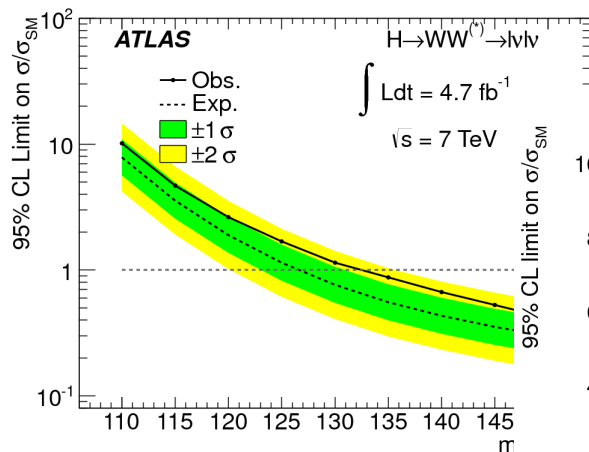
Search for $t\bar{t}$ and $t\bar{t}$ resonances

- ATLAS has searched for $t\bar{t}$ and $t\bar{t}$ resonances
- For $t\bar{t}$ normal and boosted techniques have been used
- The boosted techniques are more sensitive, however the normal ones contribute at low mass



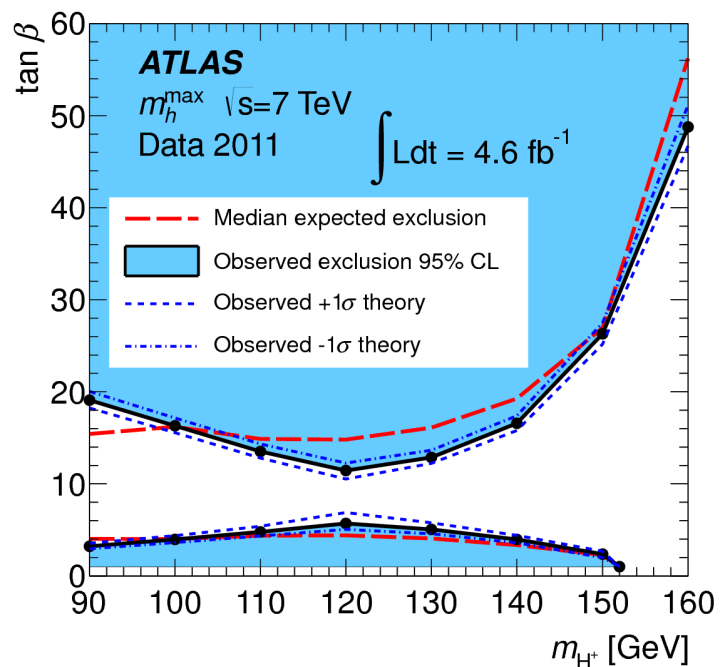
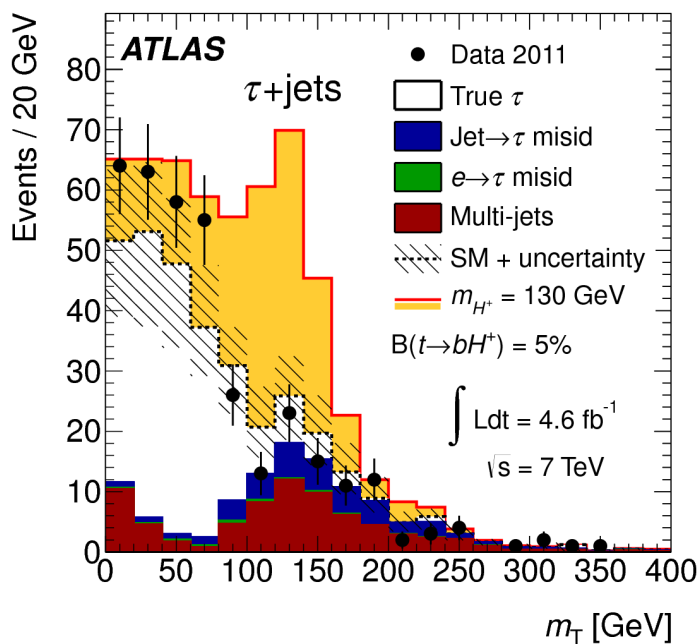
Search for the SM Higgs

- 2011 analyses are published now or will be published in the next 1-2 weeks
- Some improvements in the different channels and in the combination
- However the general picture doesn't change



Search for a charged Higgs

- SUSY predicts a charged Higgs with $m_{H^\pm} > m_W$
- ATLAS has searched for $t\bar{t} \rightarrow H^\pm b W b$ with $H^\pm \rightarrow \tau \nu$
- Exclusion e.g. in m_{H^\pm} - $\tan\beta$ plane of MSSM



Summary

- ATLAS is very grateful to the LHC operation team for the outstanding performance of the machine in the first months of 2012
- ATLAS is using this luminosity very efficiently ($\sim 95\%$ data-taking efficiency, $\sim 90\%$ of data quality)
- After a lot of work, the effects of pileup are under control and small
- Many results based on the full 2011 dataset ($\sim 5/\text{fb}$) have been released. The foundations for an exciting and broad physics programme based on the 2012 data have been laid