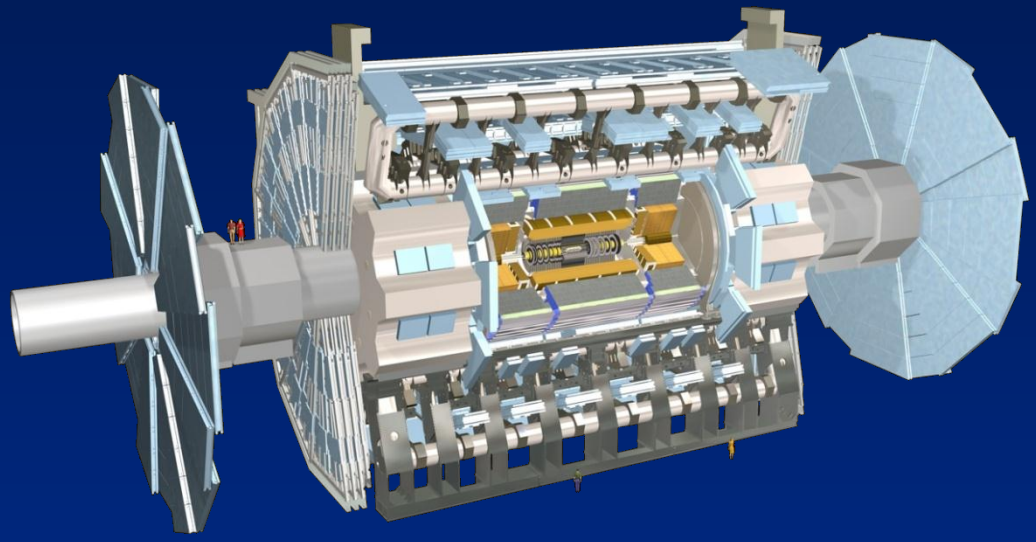
W and *Z* boson measurements

in *Pb*+*Pb* collisions at $\sqrt{s_{\mathrm{NN}}}$=2.76 TeV

with the ATLAS detector



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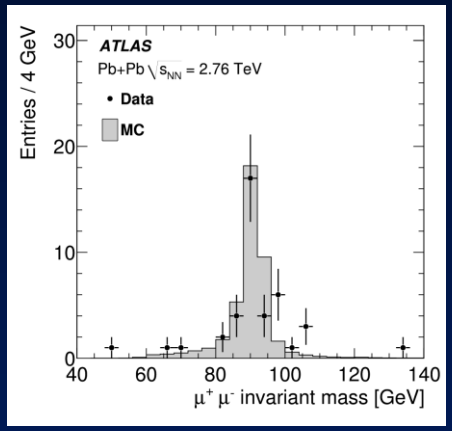
for the ATLAS collaboration

QM 2012, Washington DC

Z boson production

Run 2010: $Z \rightarrow \mu\mu$ decays using 6.7 μb^{-1}
(Phys.Lett. B697 (2011) 294-312)
Run 2011: $Z \rightarrow \mu\mu$ and $Z \rightarrow ee$ using 0.15 nb^{-1}



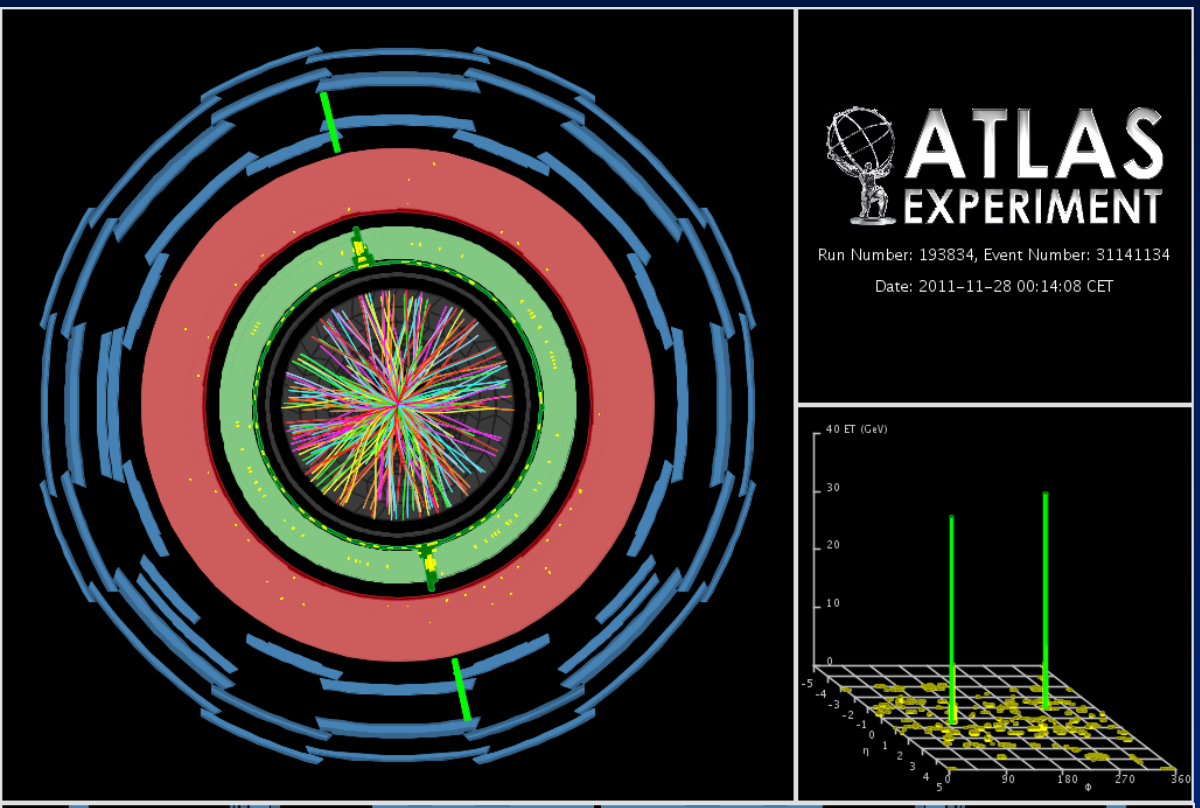
W boson production

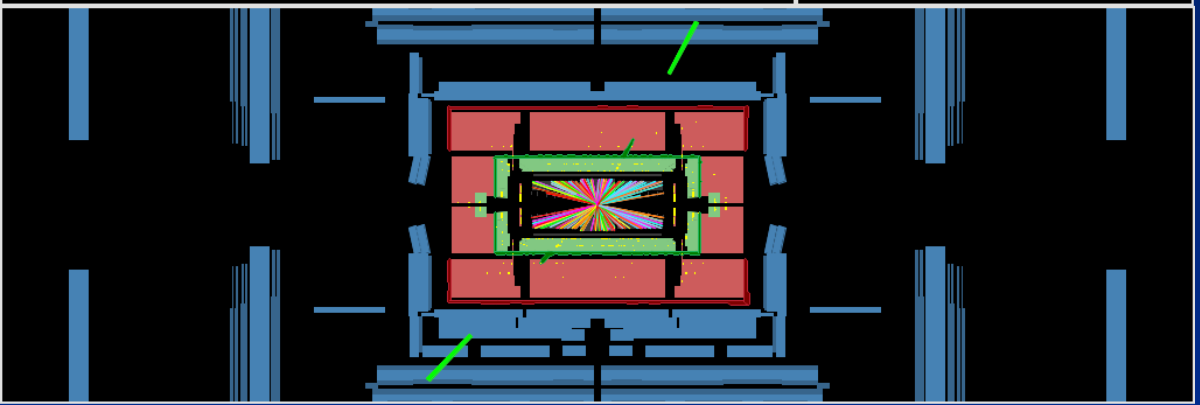
measured via single muons ($W \rightarrow \mu\nu$) from 5 μb^{-1} of 2010 run.

W & *Z* bosons are expected to be produced in initial NN collisions and their decay products to traverse the dense and hot medium unaffected …

- **Yields scaling with the number of binary *NN* collisons can and should be tested**
- **W&Z can be used as a tag for jets**
- **Production can provide information on nuclear PDF's**

Z boson production

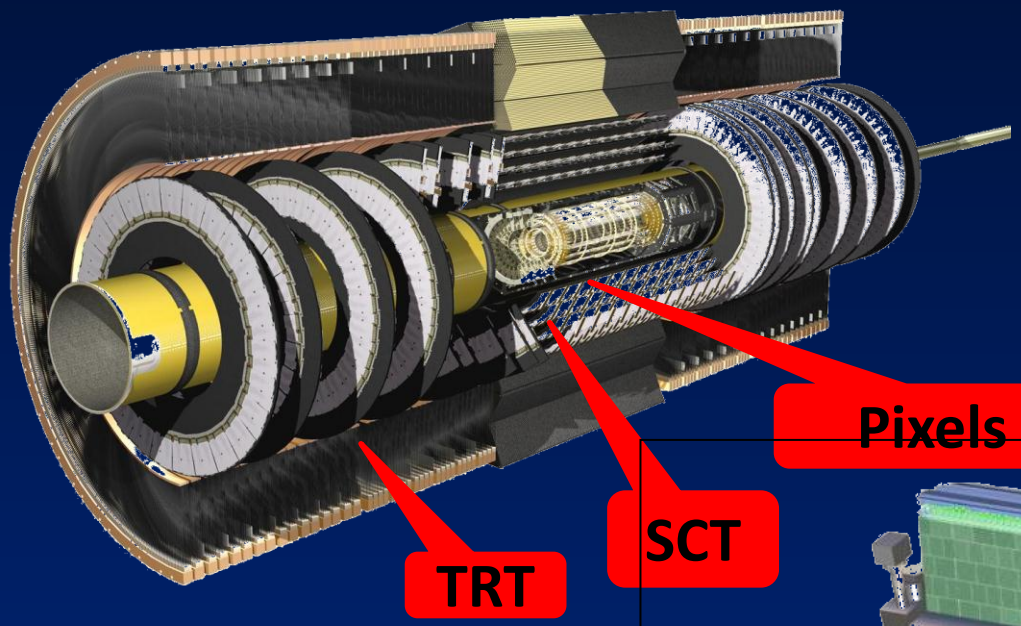




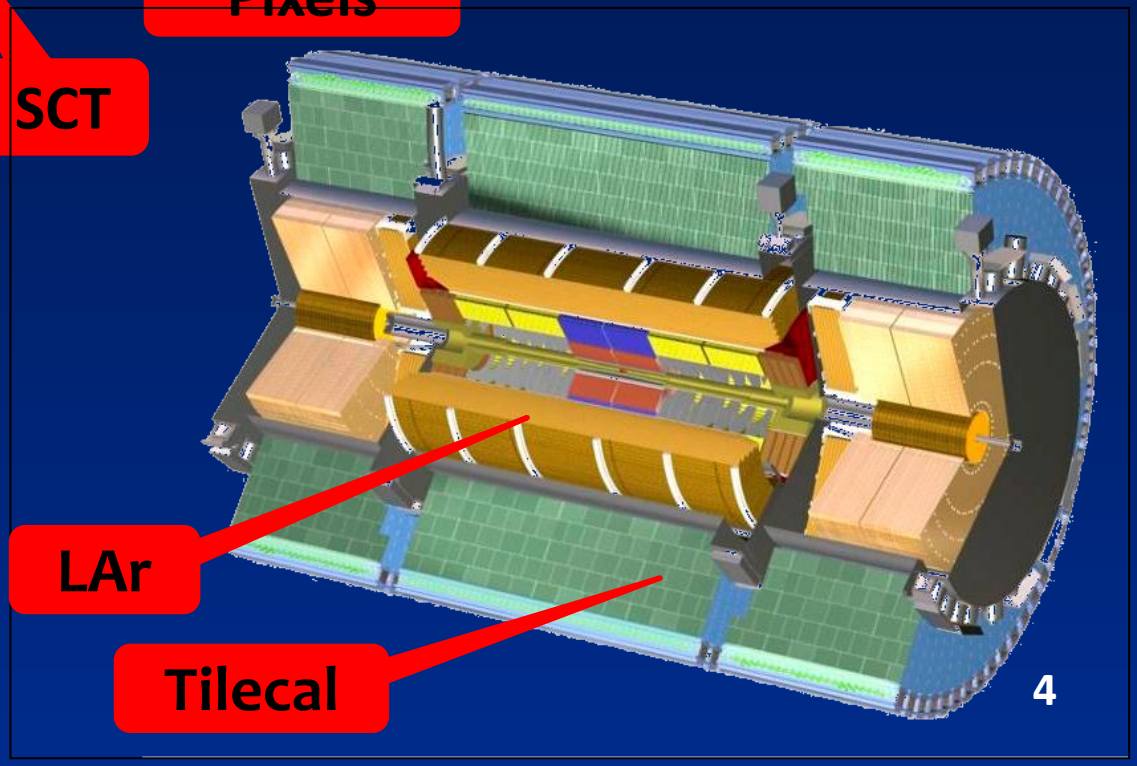
***Z*→ *ee* candidate.**

FCal Sum E_T = 0.42 TeV
(40-50 % Centrality),
m_{ee} = 90.8 GeV,
p_T of Z = 1.6 GeV,
y_Z = -0.2.

Overview of ATLAS subdetectors

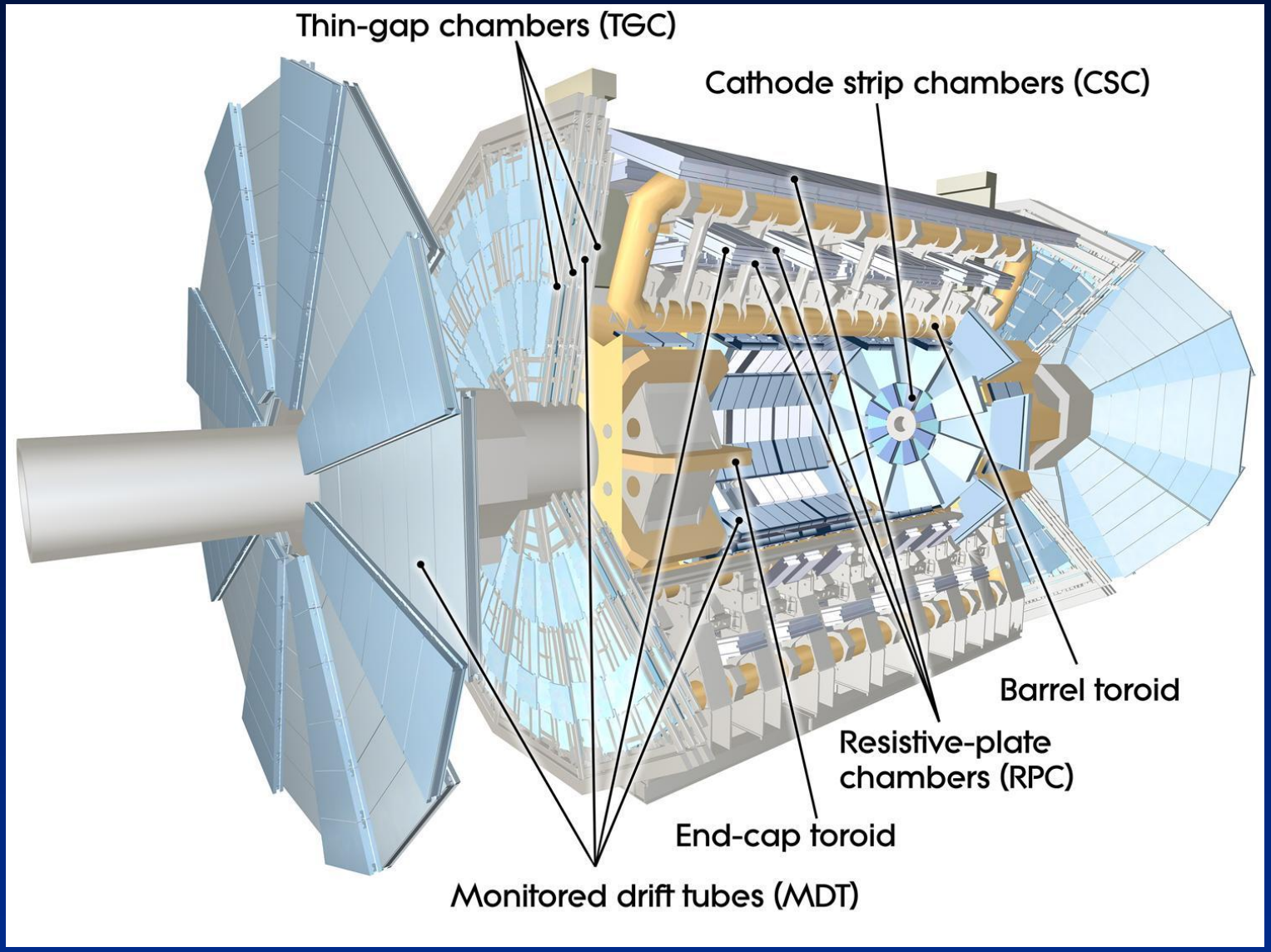


Inner Detector:
Tracking in 2 T field
in the range $|\eta| < 2.5$



Calorimeters:
EM LAr $|\eta| < 3.2$
Tilecal $|\eta| < 1.7$
LAr hadronic EC
$1.5 < |\eta| < 3.2$
LAr FCal $3.1 < |\eta| < 4.9$

Overview of ATLAS subdetectors



Muon system

Precision tracking (MDT, CSC) for $|\eta| < 2.7$

Trigger (RPC, TGC) within $|\eta| < 2.4$

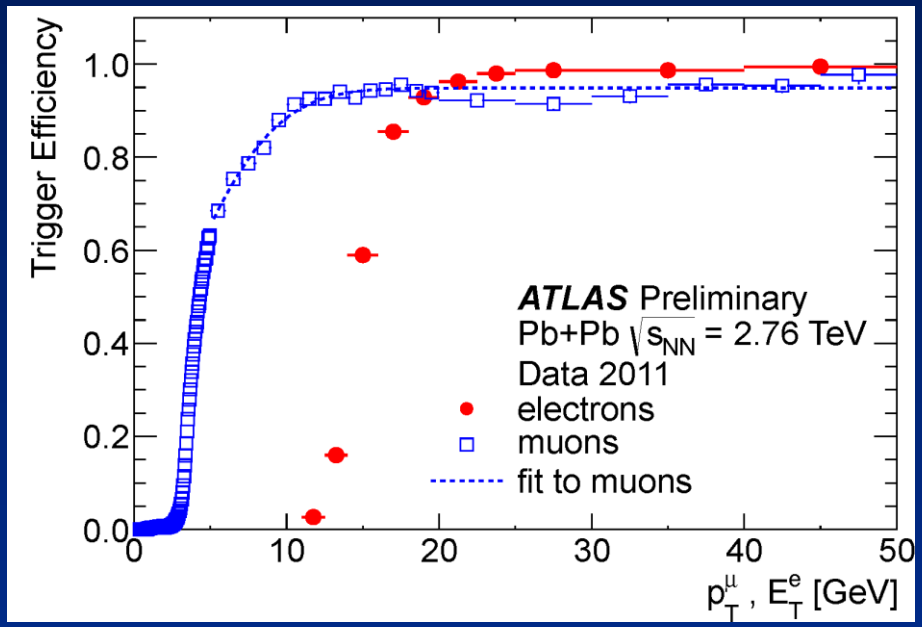
Z boson production – event selection

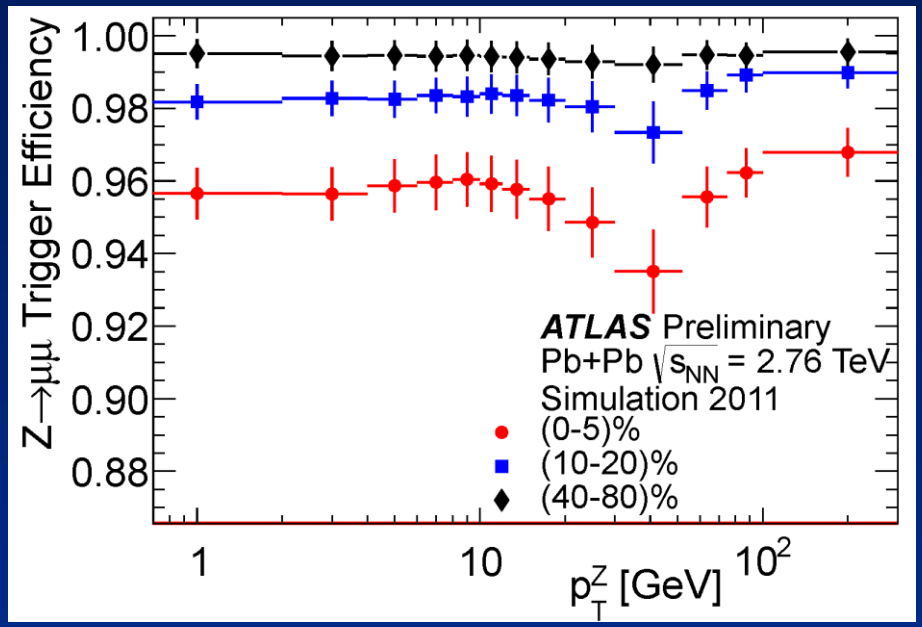
Trigger:

Minimum Bias: E_T > 50 GeV OR both ZDC & ID track

e-candidates: L1 EMcalo clusters E_T > 14 GeV

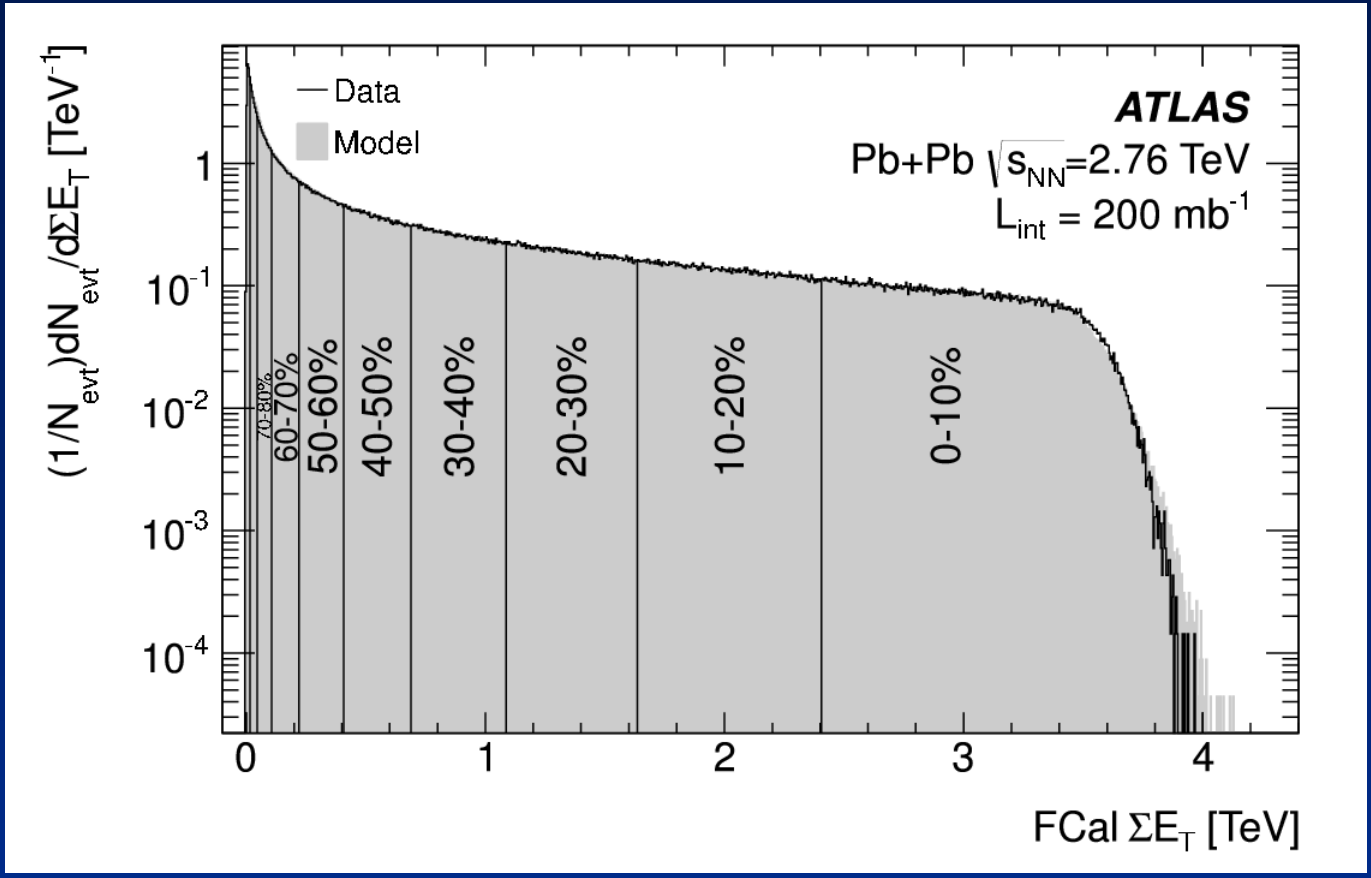
μ-candidates: L1 μ trigger with p_T > 4 GeV, HLT (MS OR MS + ID), additional p_T > 10 GeV muon scan





Z boson production – event selection

Collision centrality is characterised by classes according to the FCal $\sum E_{\mathrm{T}}$ (model is based on Glauber MC)

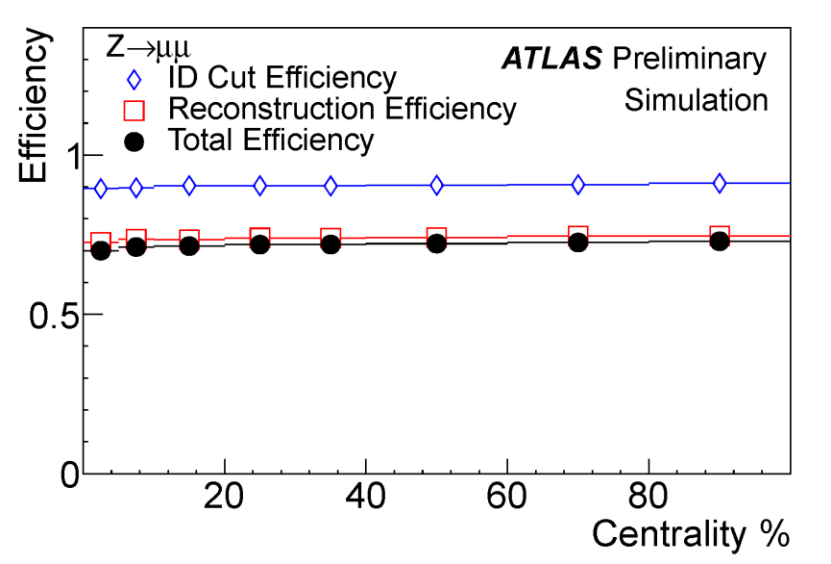


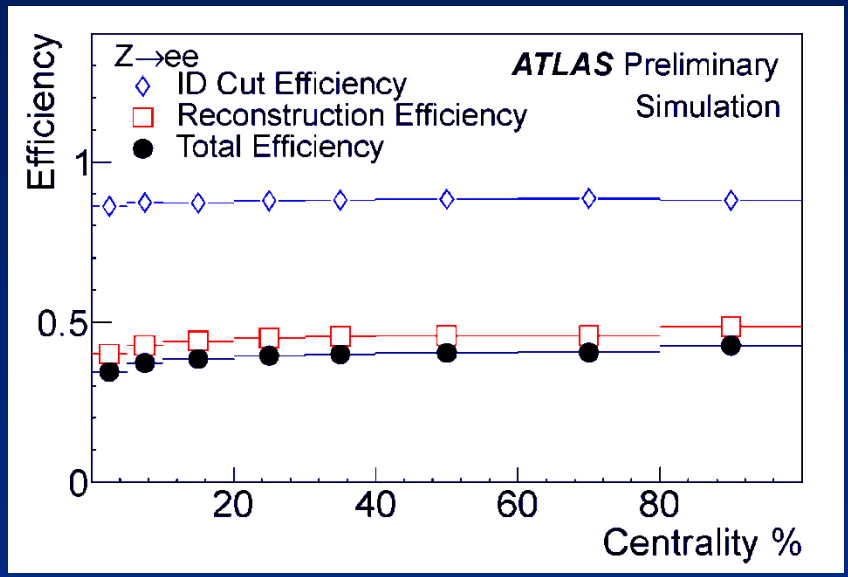
Centrality parameters like $\langle N_{\mathrm{part}} \rangle$, $\langle N_{\mathrm{coll}} \rangle$ calculated from Glauber MC

Z production – *e*, μ selection and efficiencies

e: $|\eta| < 2.5$, $E_T > 20$ GeV, ID track matching LAr cluster, matching criteria modified wrt *pp*, underlying event subtracted

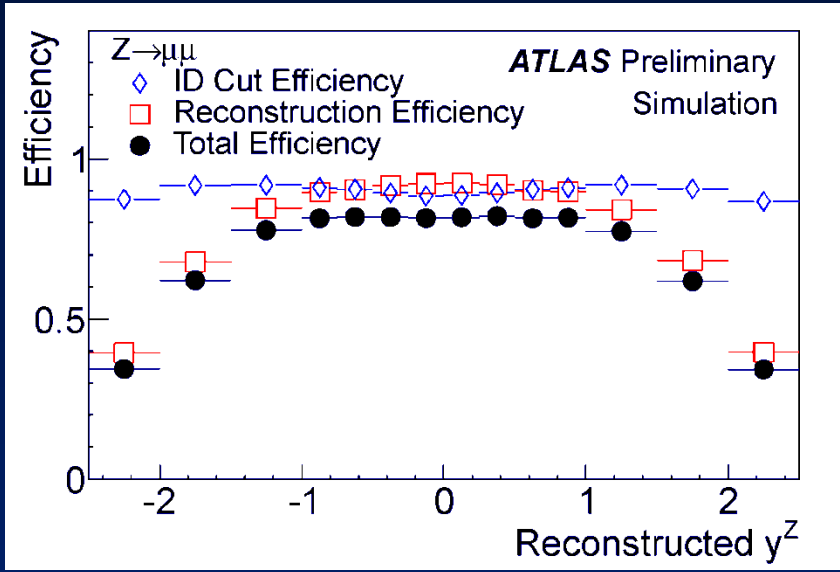
μ: „high quality“… MS & ID, combined.
When both μ's h.q. $p_T > 10$ GeV required for both,
When only one h.q. $p_T > 20$ GeV required for both.

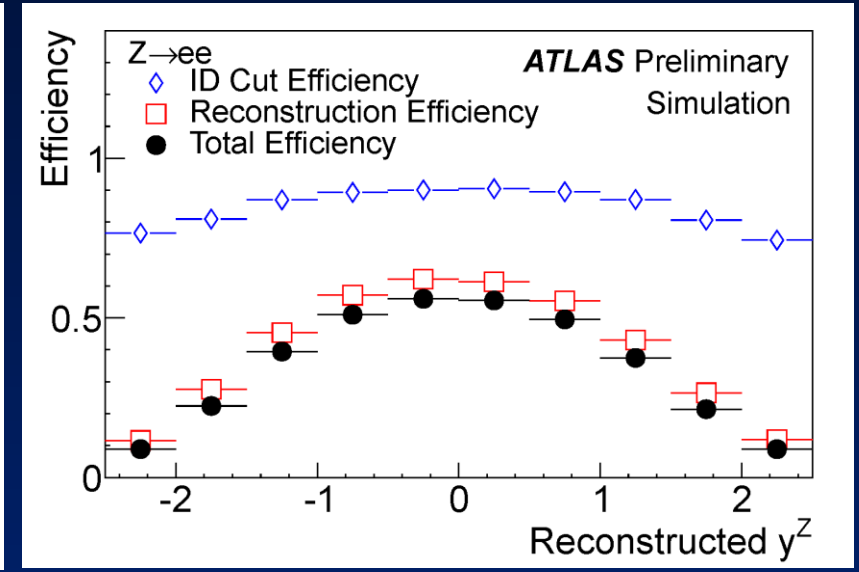


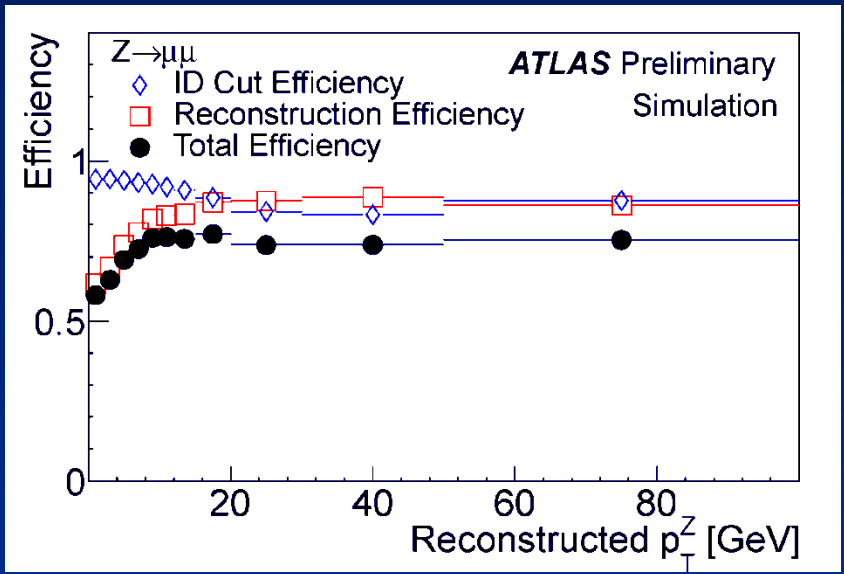


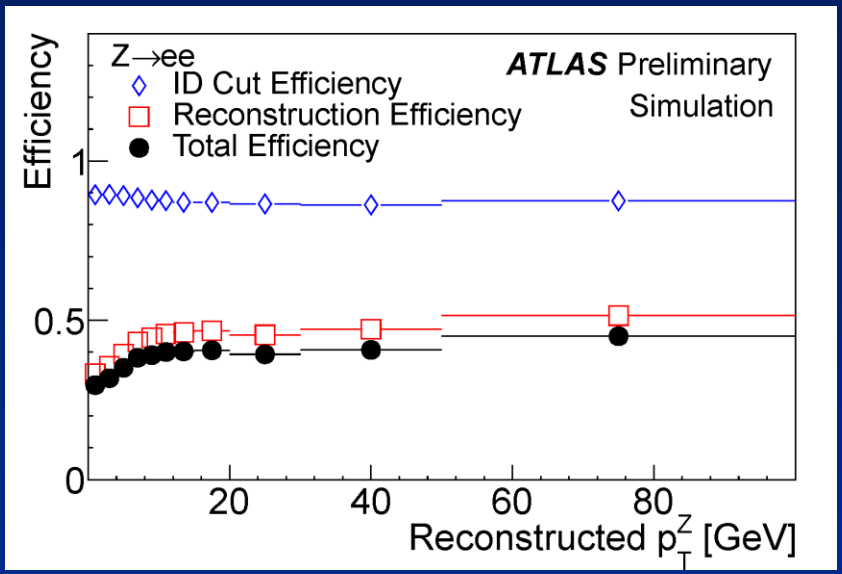
… very weak centrality dependence

Z boson production – efficiencies

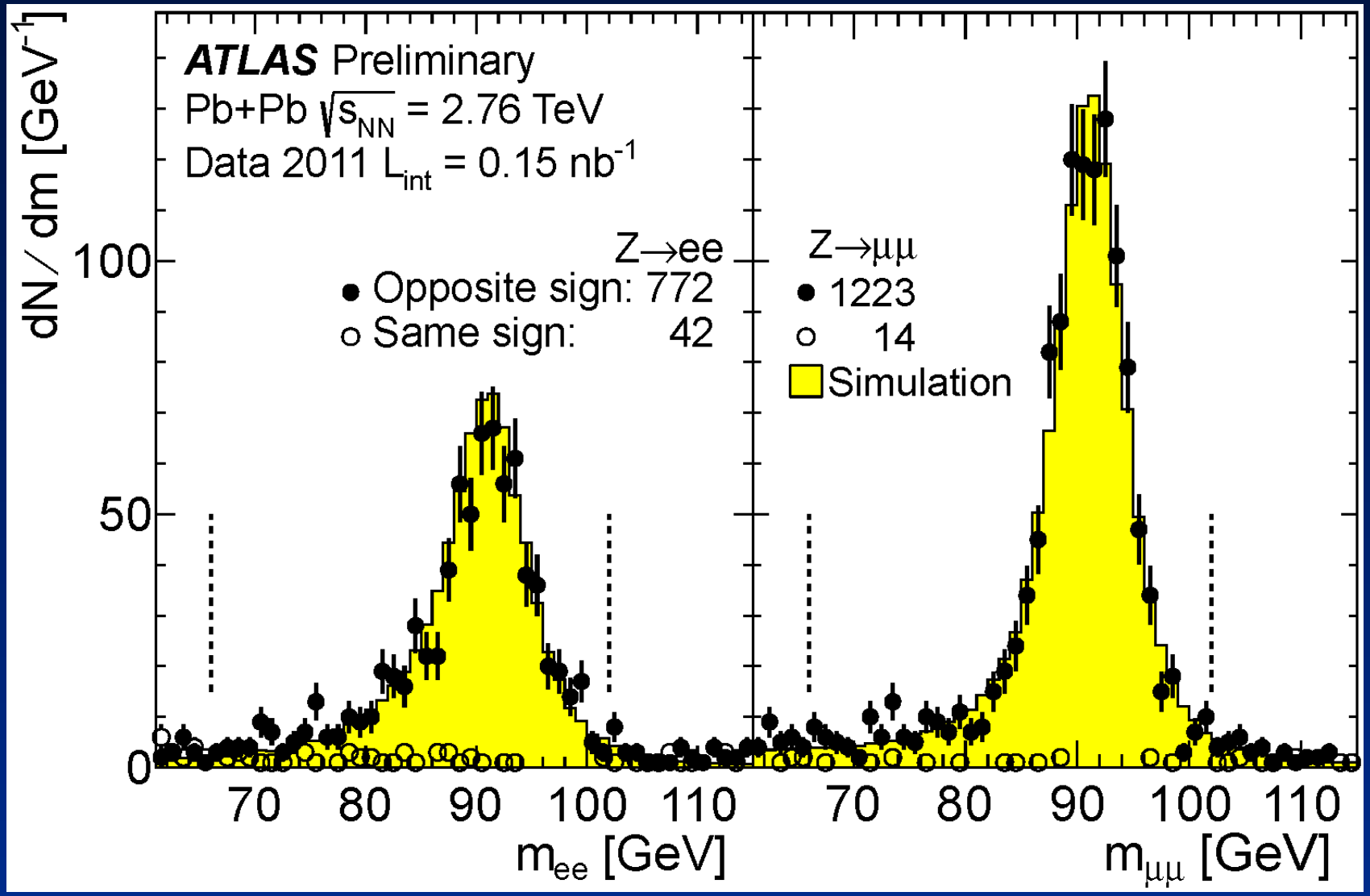




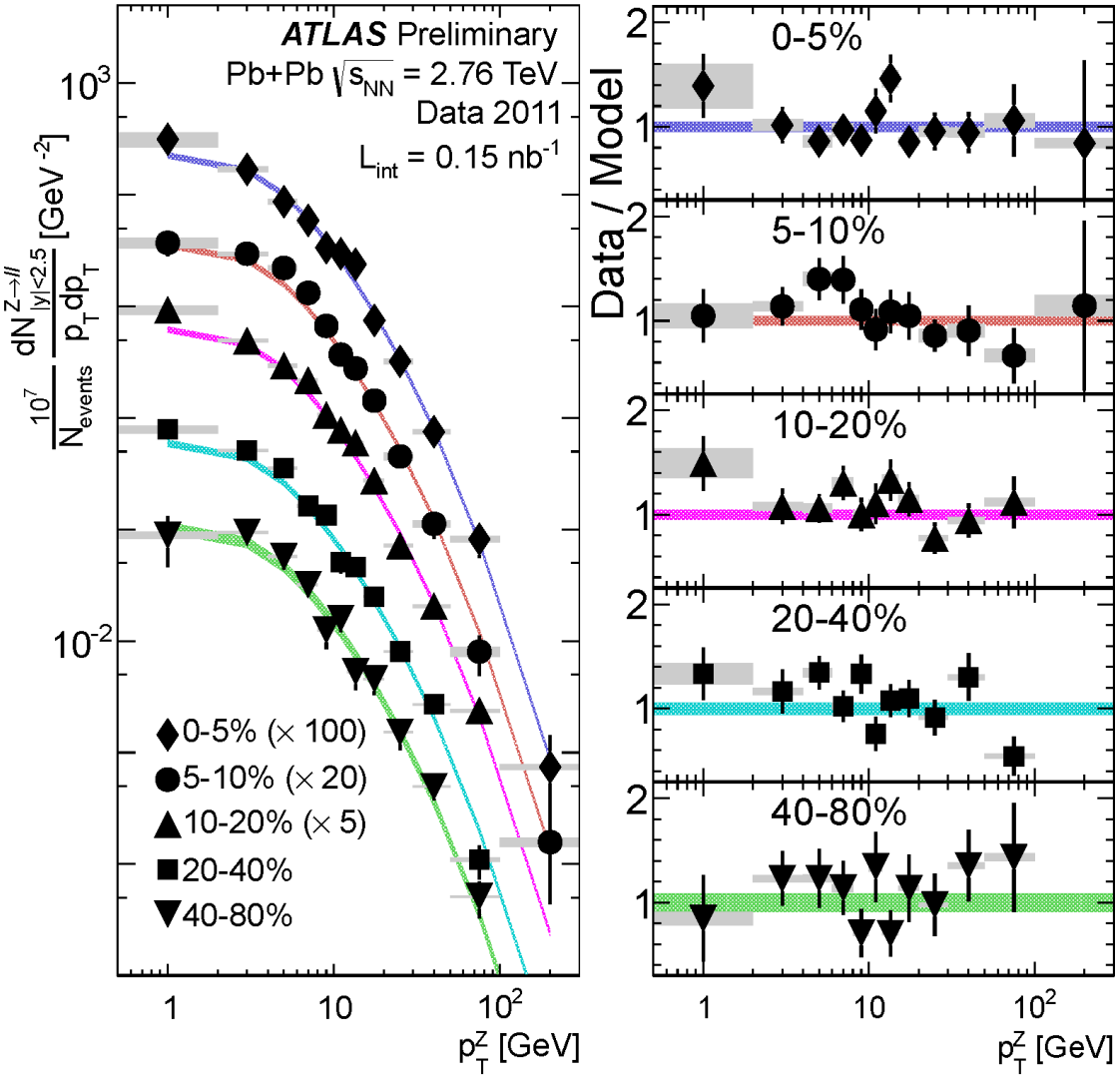




Z boson production – mass distribution



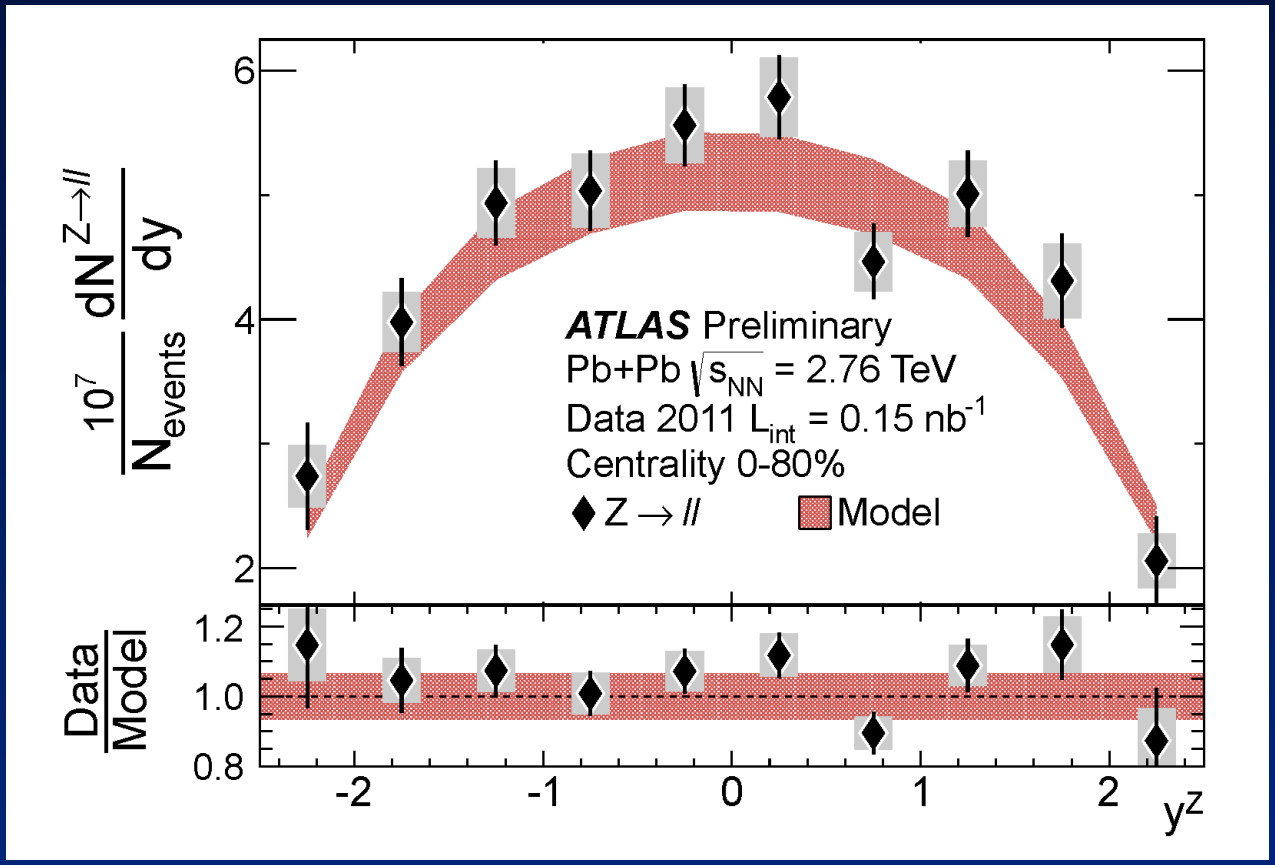
Z boson production – corrected distributions



Yields for each centrality bin are compared to model … Pythia NNLO with proper T_{AA}

Spectra in all centrality bins are consistent with the model employing the binary scaling

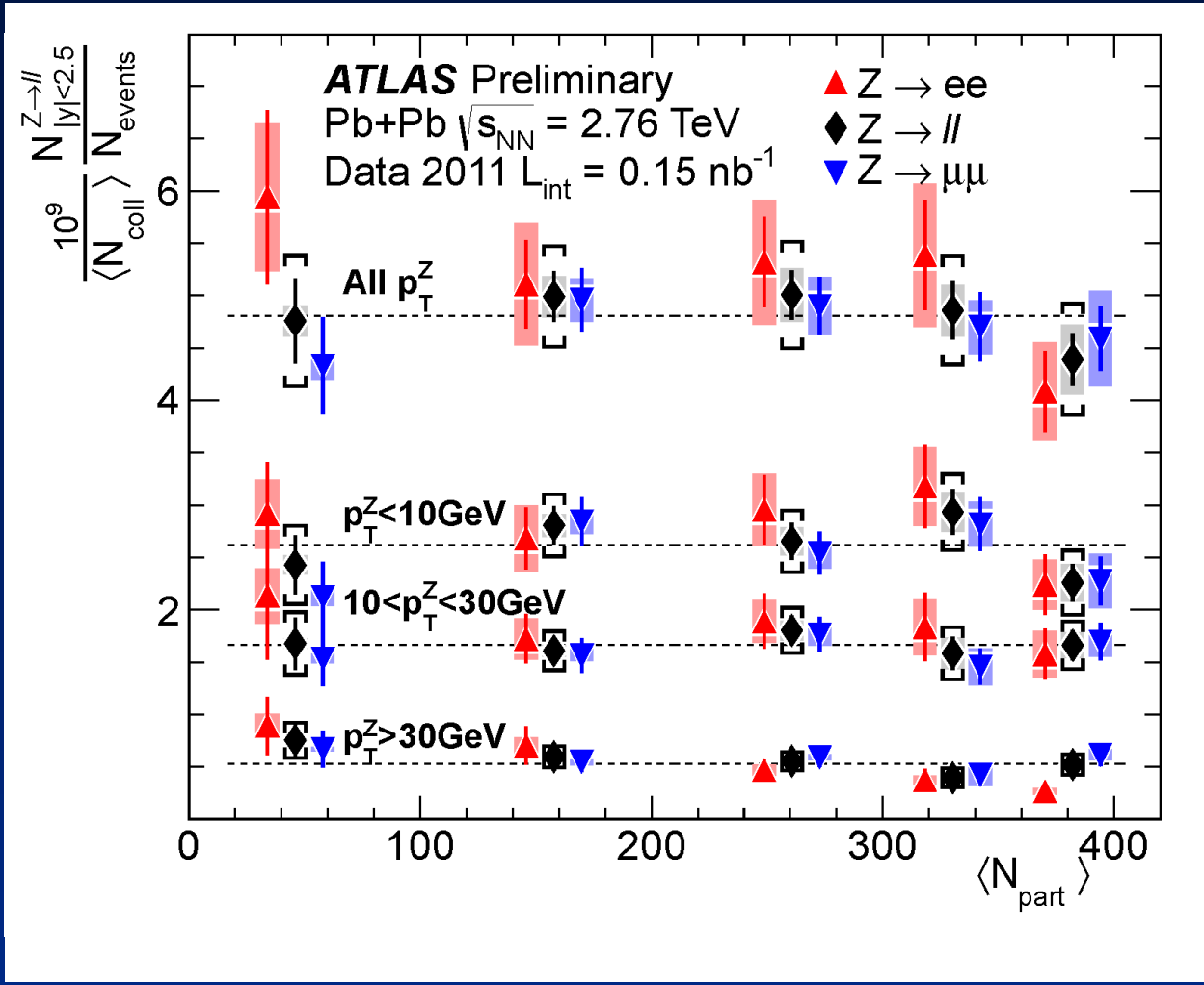
Z boson production – corrected distributions



Model …
… Pythia NNLO with proper T_{AA}

Rapidity spectrum is consistent with the model employing the binary scaling

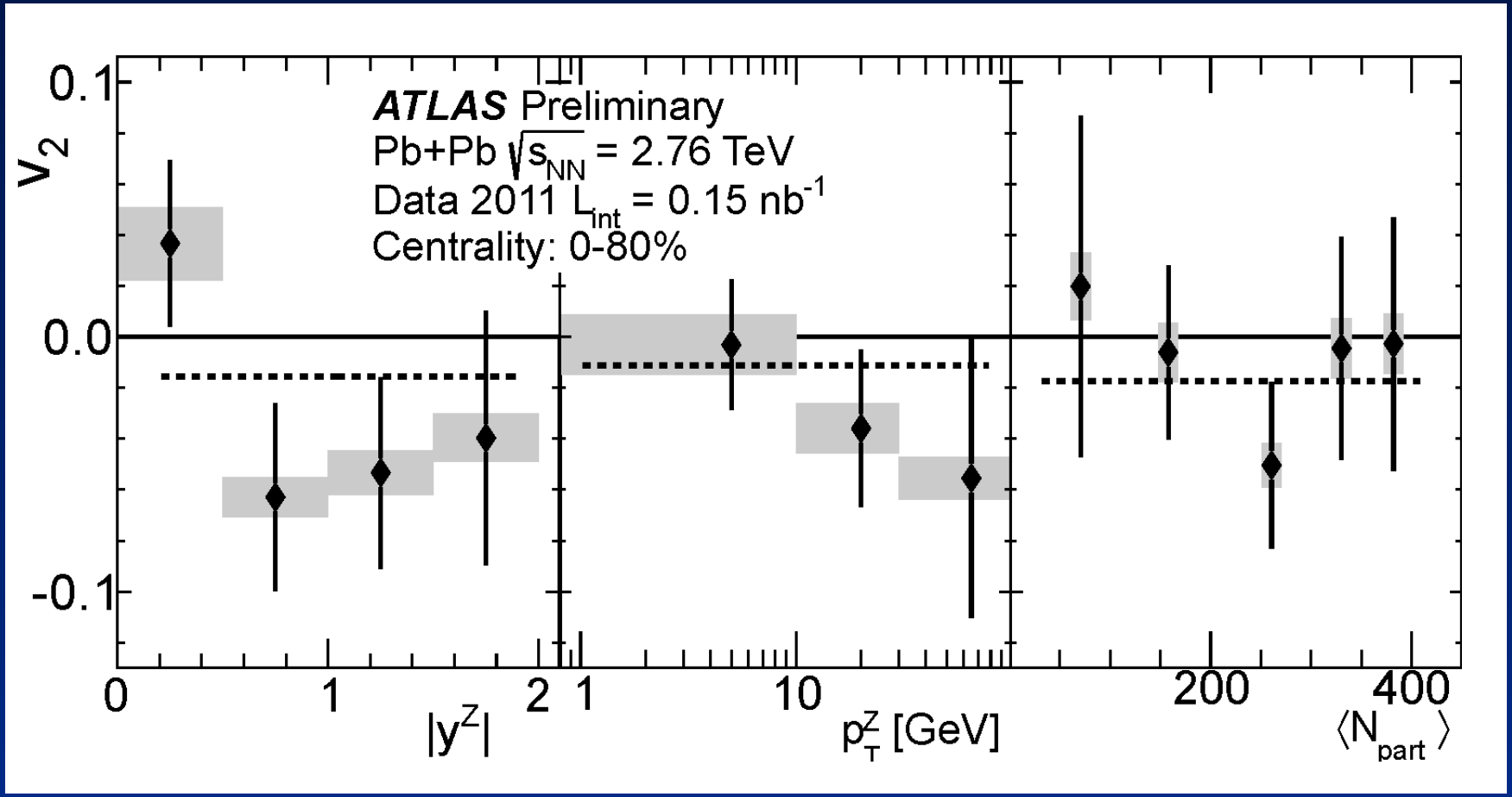
Z boson production – binary scaling



***Z* yields from $Z \to ee$ and $Z \to \mu\mu$ are consistent with each other and are consistent with binary scaling.**

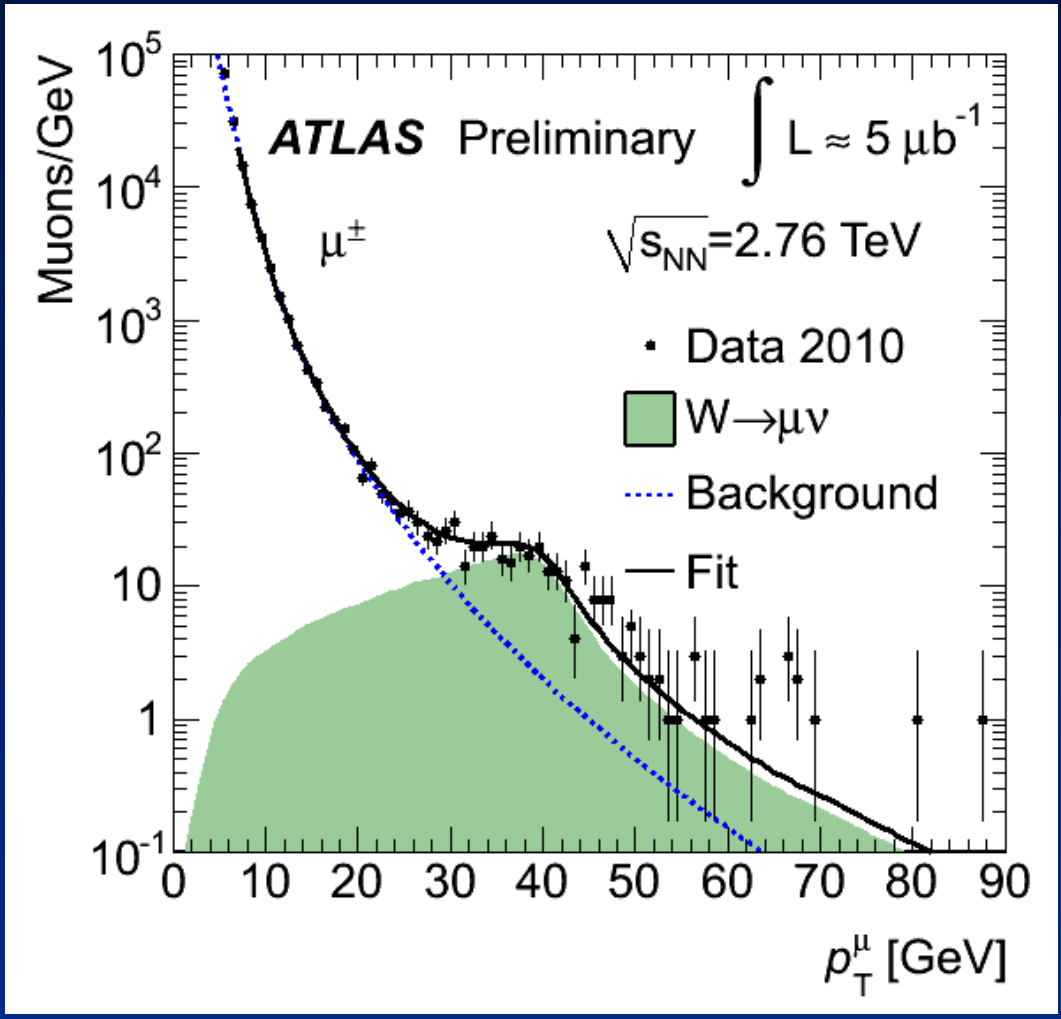
Z boson production – zero flow?

$v_2 = -0.015 \pm 0.018(\text{stat}) \pm 0.014(\text{sys})$



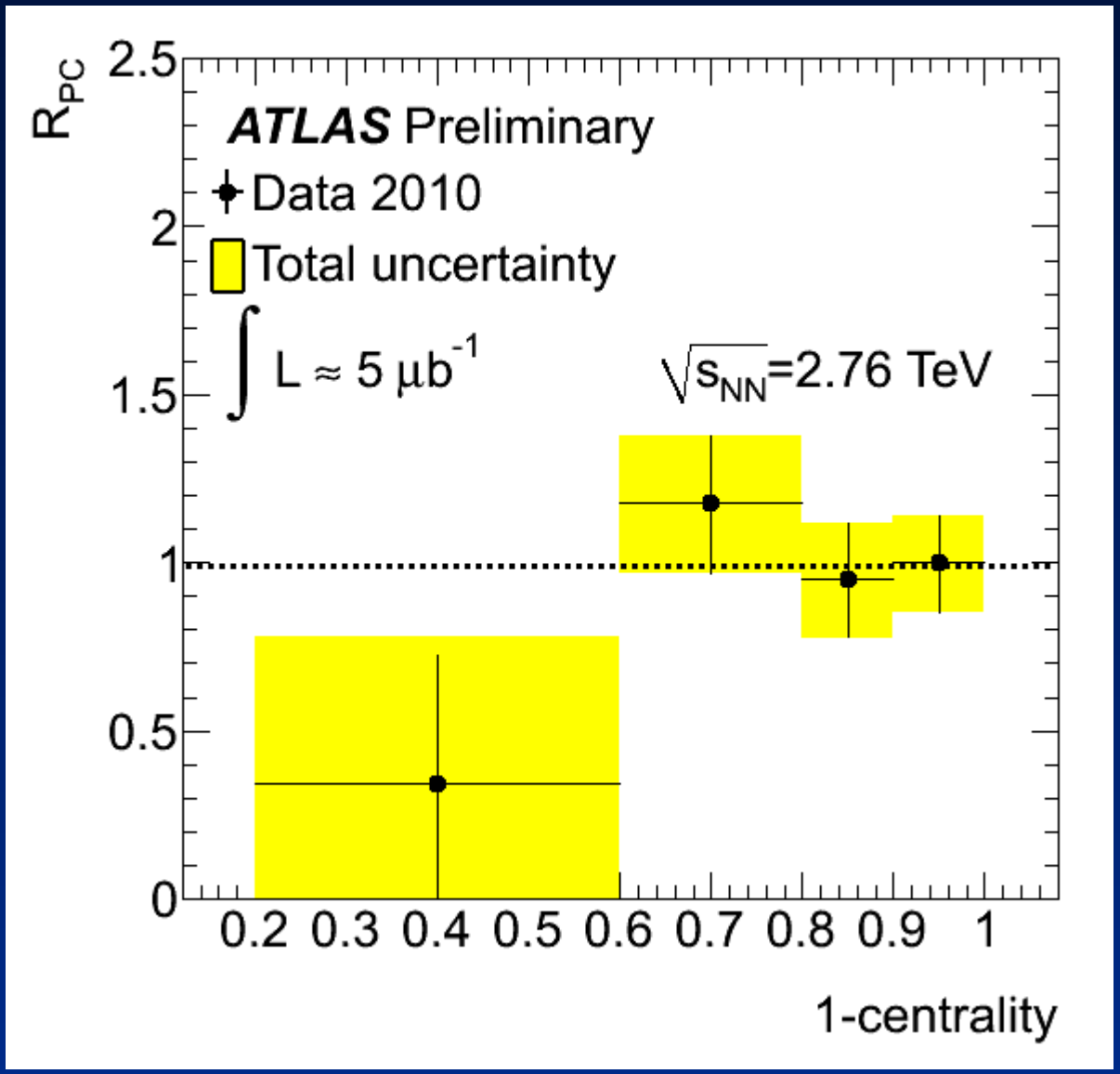
W boson production in $\mu\nu$ channel

… single muon measurements in Minimum Bias events



Uncorrected inclusive muon p_T spectrum .
Fit (solid line) with two components:
signal $W \to \mu\nu$ (shaded area) simulated with PYTHIA in *NN*,
and a **background** parametrisation (dashed line) from
$cc \to \mu + X$ and $bb \to \mu + X$ in *pp* simulations.

W boson production – binary scaling



Yields for each centrality bin are normalized to the the most central bin.

R_{PC} (peripheral to central ratio) consistent with unity

W boson production – *W+*/*W-* and *W*/*Z*

Measured ratio $R_{W+/W-}$ = 0.97 + 0.18 - 0.19,

to be compared with $R_{W+/W-}$ = 1.65 ± 0.03 for *pp* and $R_{W+/W-}$ = 0.62 ± 0.03 for *nn* calculated with NNLO QCD using MSTW2008 PDF's*.

Measured $R_{W/Z}$ = 10.5 + 2.3 - 2.4,

to be compared with abovementioned NNLO QCD* giving $R_{W/Z}$ = 11.3 ± 0.6 for *pp* and $R_{W/Z}$ = 10.8 ± 0.6 for *nn.*

*A.D.Martin et al. Eur. J. Phys. **C 14** (2000) 133

Summary

- ATLAS measured a total of 772 $Z \rightarrow ee$ and 1223 $Z \rightarrow \mu\mu$ candidates within $|y_Z| < 2.5$ and $66 < m_{ll} < 102$ GeV in the 2011 *PbPb* data.
- ATLAS measured a total of 399 +36-38 W bosons in the 2010 PbPb data.
- The total *Z* and W yields integrated over rapidity are consistent with binary scaling.
- *Z* elliptic flow consistent with zero.
- ATLAS measured ratia $R_{W+/W-}$ and $R_{W/Z}$.

Sources of further information

ATLAS Public Results

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

Especially notes

ATLAS-CONF-2012-052 and ATLAS-CONF-2011-078