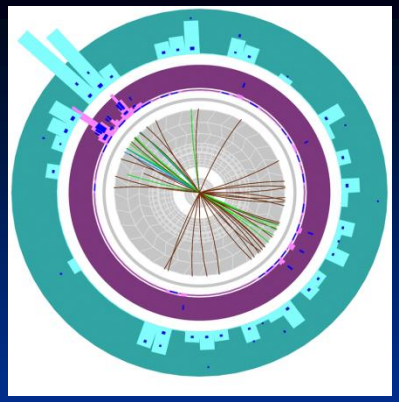

Measurements of the Z boson in lepton pair decays in heavy ion collisions at ATLAS

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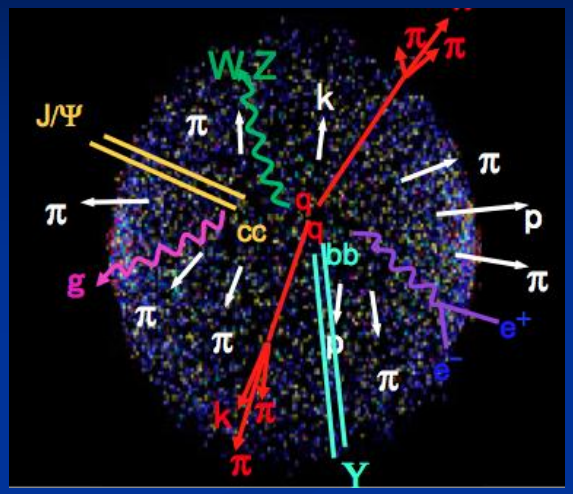
on behalf of ATLAS Collaboration

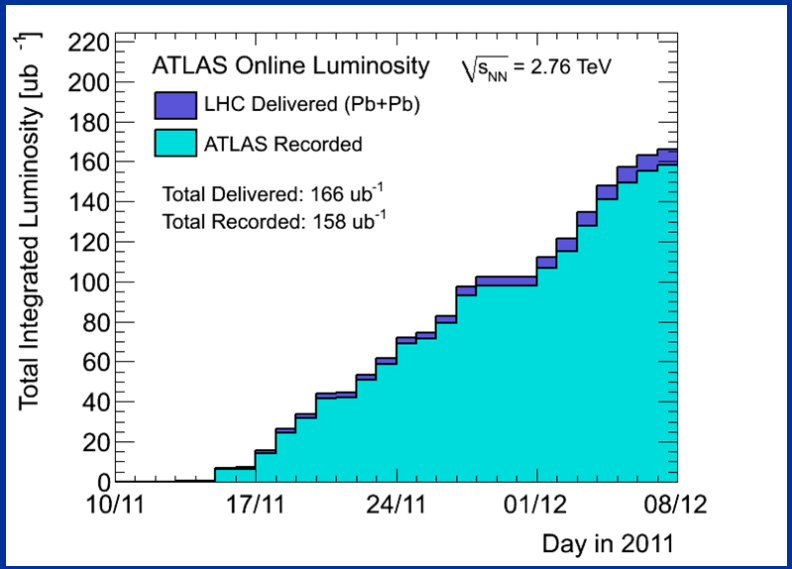
1st International Conference on New Frontiers in Physics
June 10-16th (2012) Kolymbari, Crete, Greece

Heavy ion collisions at the LHC

Many physics process signatures to study dense and hot nuclear matter created in the ion collisions

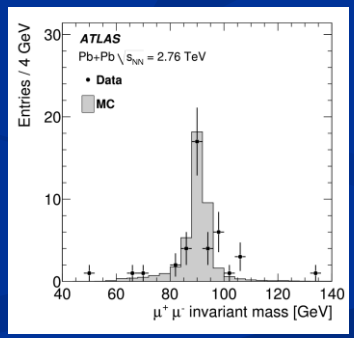
The LHC provides unique possibilities to learn heavy boson production. The analysis of di-lepton decays of Z^0 is attractive since the bosons are produced in hard parton scattering and final state leptons try no strong interactions with nuclear matter and have clean signature.





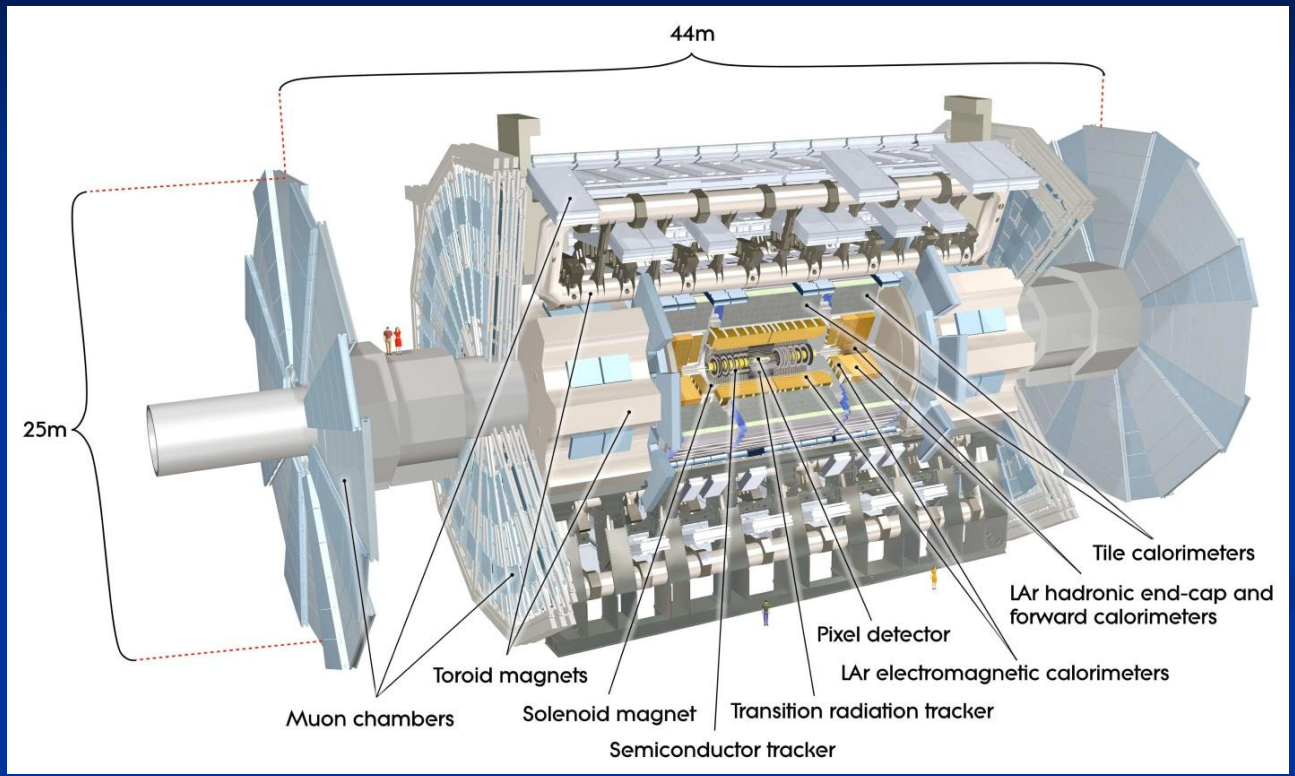
At 2011 heavy-ion run ATLAS recorded 0.15 nb^{-1} of PbPb data at 1.38 TeV/n.

~20 gain in luminosity compared to 2010 data with ~40 Z^0 into muons



taken with dedicated high-level triggers

The ATLAS detector



coverage in |η|

charged particles < 2.5

muon Spectrometer < 2.7

EM Calorimeter < 3.2

Had Calorimeter < 4.9

full coverage over ϕ

Stable data taking with great efficiency

ATLAS 2011 Pb–Pb run

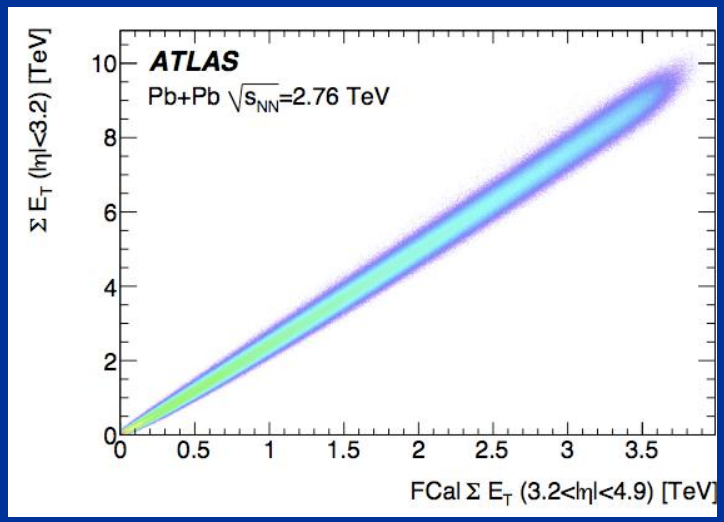
Inner Tracking			Calorimeters				Muon Detectors				Magnets	
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
99.7	99.7	99.5	100	100	100	100	100	100	100	99.9	100	98.5

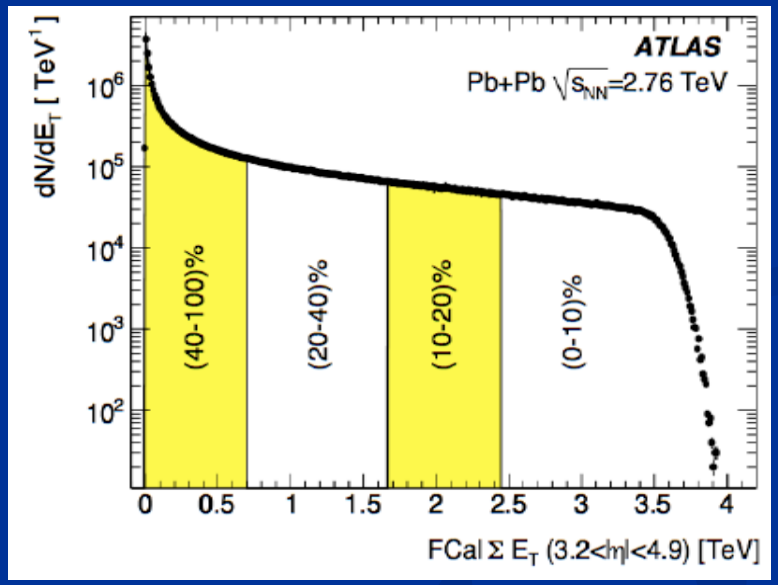
Luminosity weighted relative detector uptime and good quality data delivery during 2011 stable beams in Heavy Ion collisions at $\sqrt{s}$=2.76 TeV per nucleon between November 12th and December 7th (in %).

Centrality of heavy ion interactions

peripheral

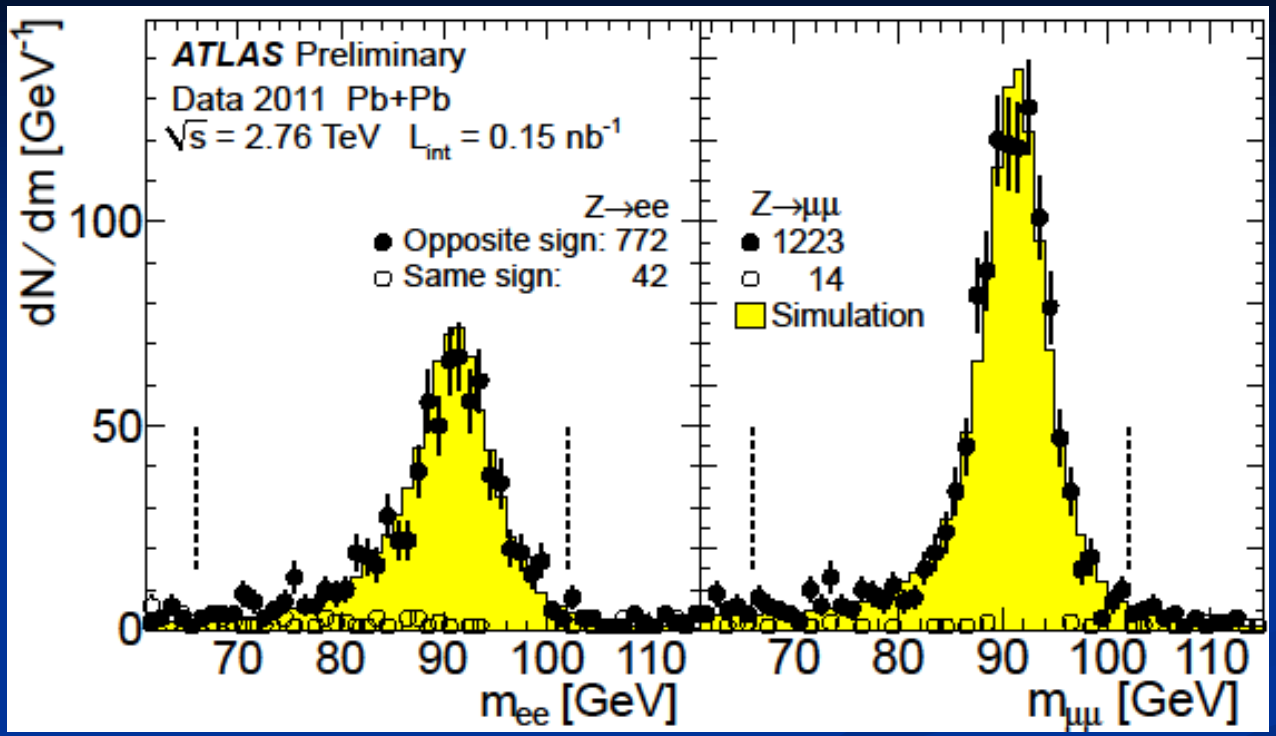
central



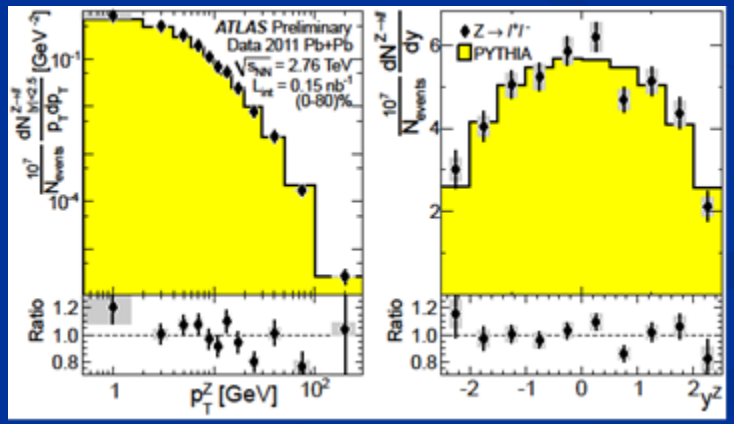


The centrality correlates with
the number of participating nucleons in both nuclei <Npart> and
the number of binary collisions between the nucleons <Ncol>
both calculated based on Glauber model

Selected sample of Z^0



Z^0 generated with PYTHIA were embedded into HIJING simulation for heavy-ion collisions



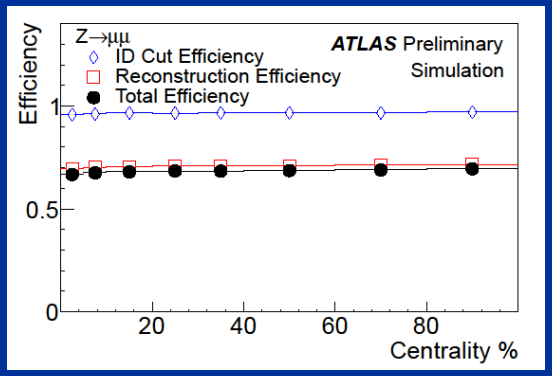
Systematics (%) to Z yield corrections

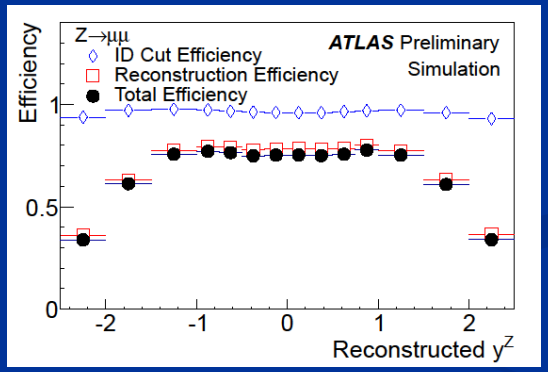
μμ, ee

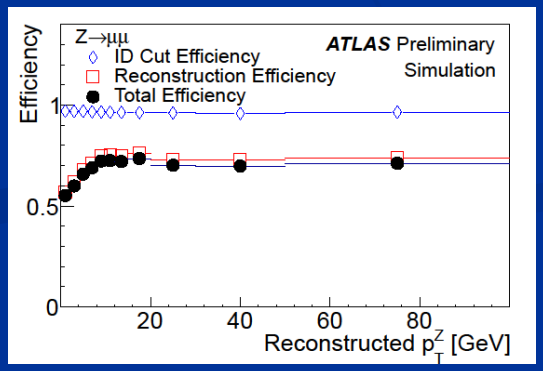
- ✓ **Reconstruction efficiency and event selection criteria:** 2.5 , 7-20
- ✓ **Difference in shape between data and PYTHIA MC:** 3-8, 1-12
- ✓ **Momentum resolution of the setup:** 2.5 2.5
- ✓ **Trigger efficiencies:** 0.6-0.9 neglible

The uncertainties depend on the event centrality and final state kinematics. The flow measurement systematic uncertainty is dominated by ReactionPlane resolution.

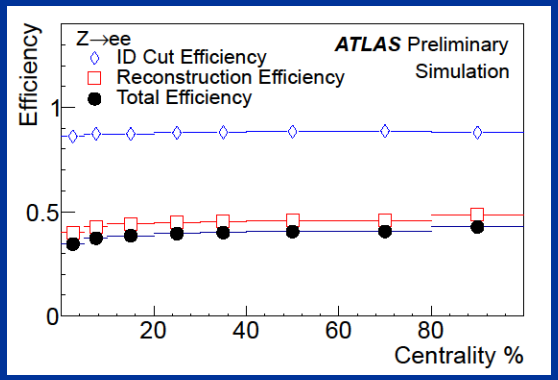
μ

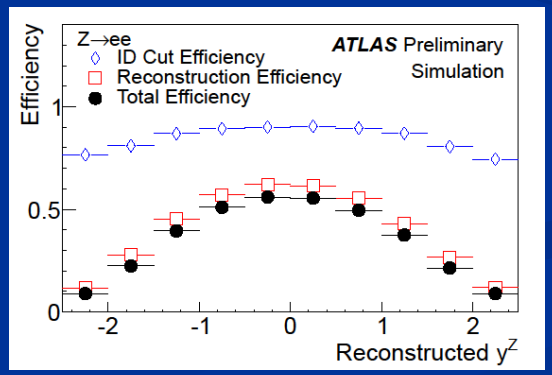


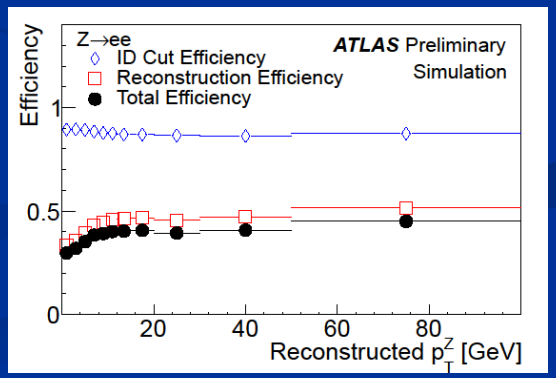




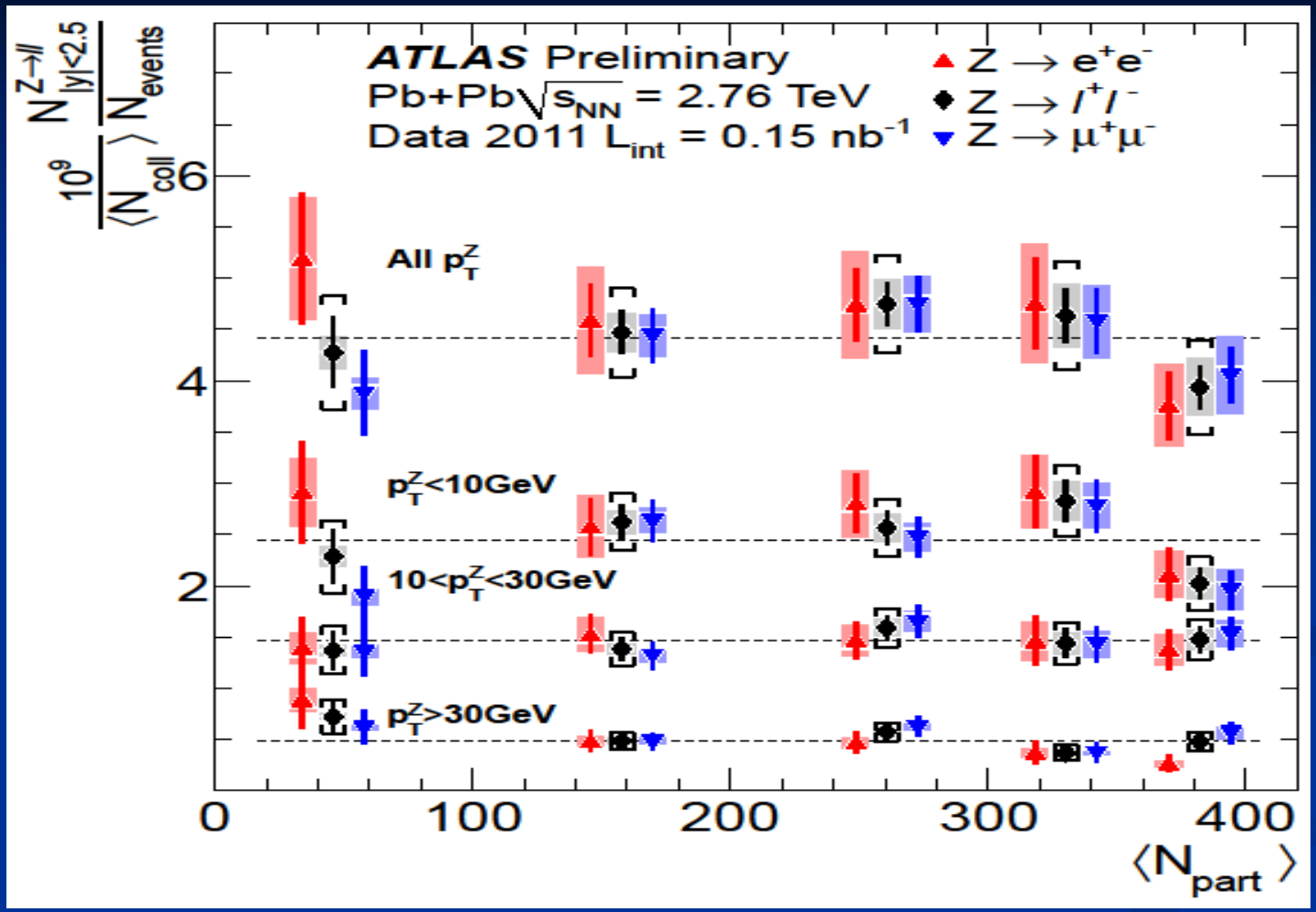
e







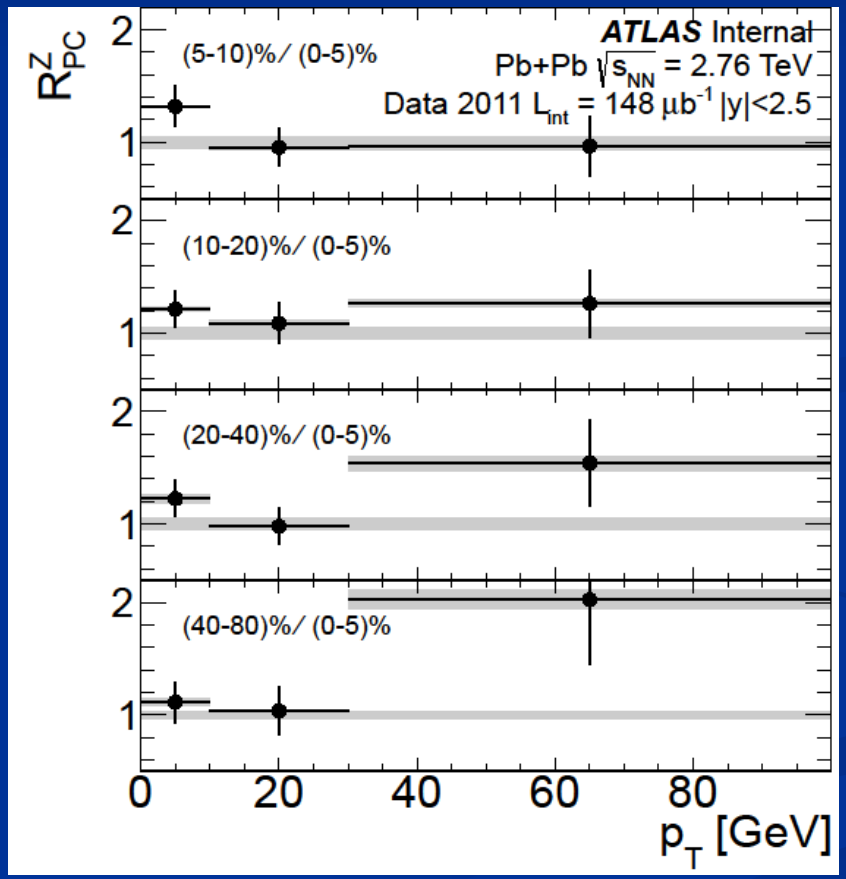
Z^0 yield scaled by number of participants



Centrality,%	40-80	20-40	10-20	5-10	0-5
<Npart>	46(3)	158(4)	261(4)	330(3)	382(2)
<Ncol>	78(7)	441(32)	923(68)	1318(99)	1683(131)

Nuclear modification factor R_{pc}

RPC = (yield in peripheral collisions) / (yield in central collisions)
Look at ratio to a fixed centrality (i.e. 0-5%)



Z^0 flow

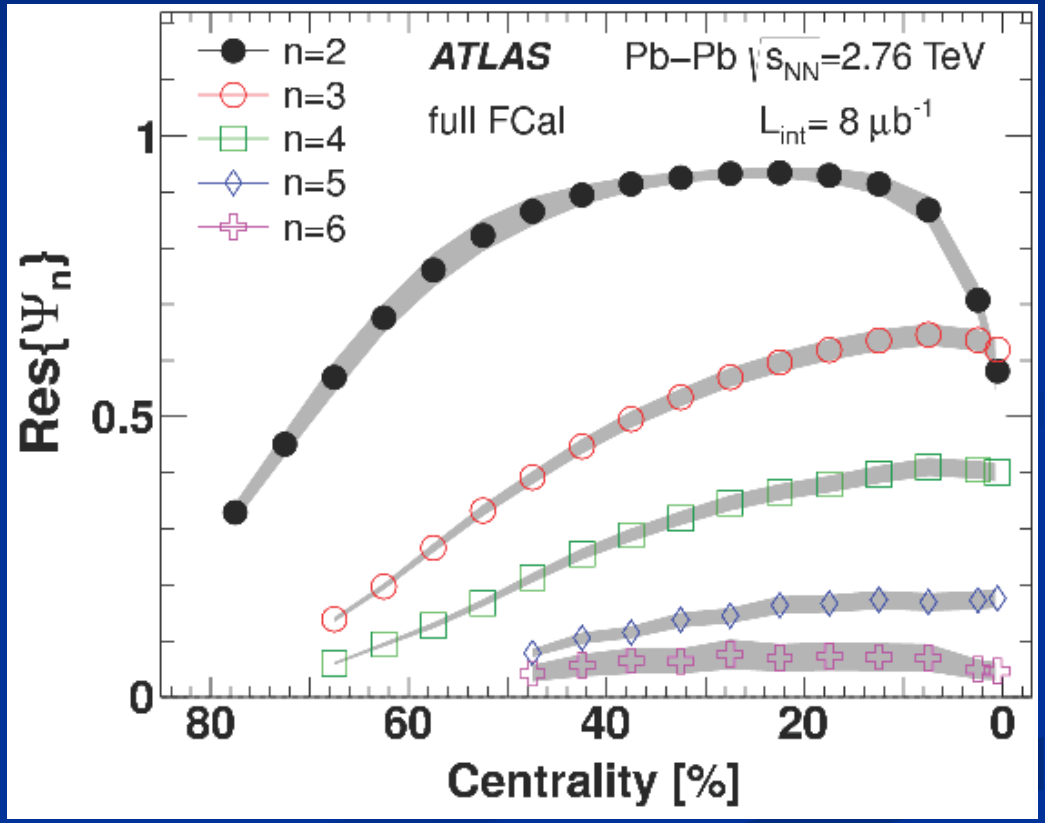
The particle flow is defined as

$$dN/d\phi = N\left(1 + 2\sum v_n \cos\left(n\left(\phi - \phi_n^{\text{reaction-plane}}\right)\right)\right)$$

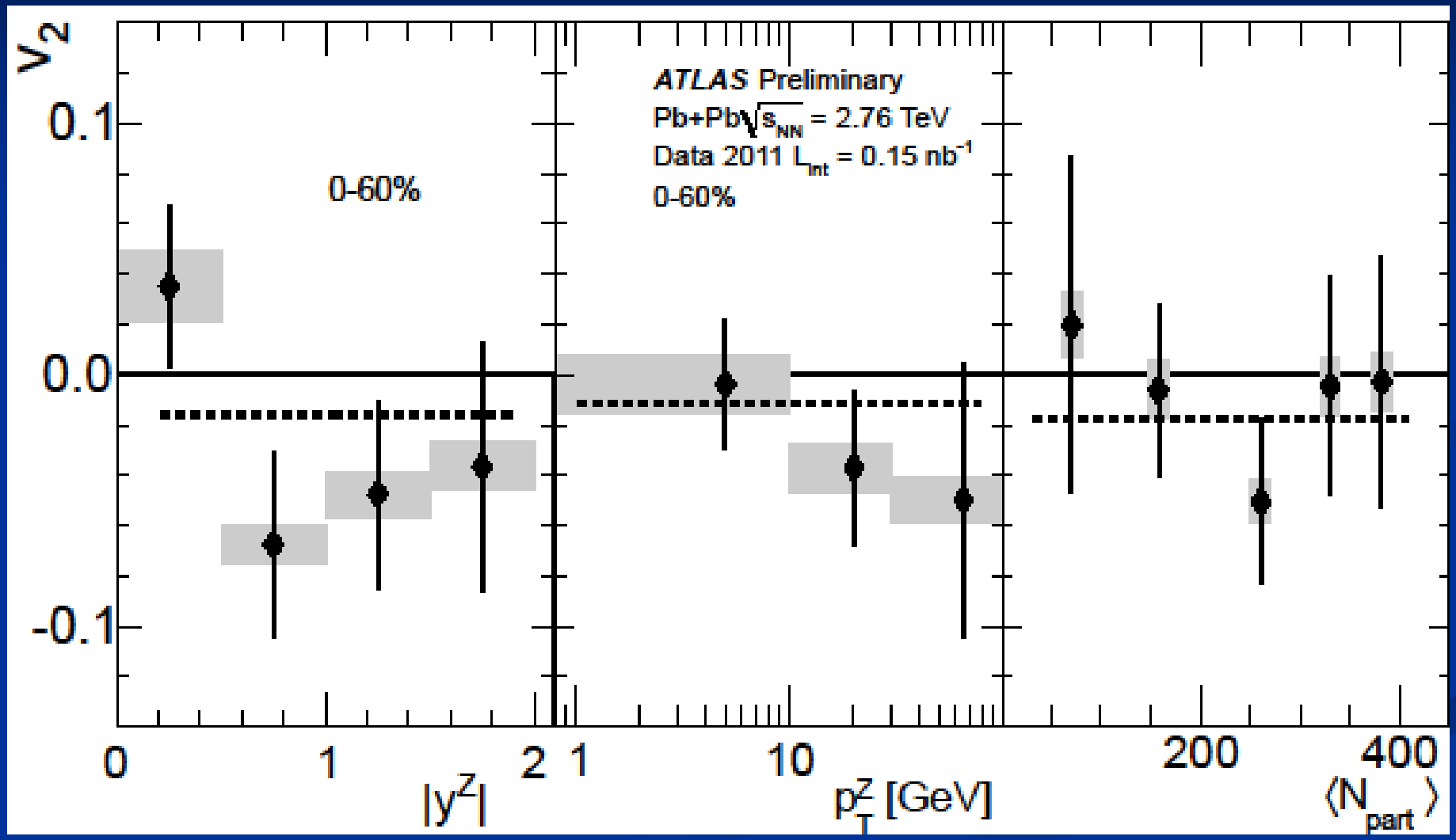
Reaction (event) plane is determined for an event using azimuthal angle distribution in the forward calorimeters

The resolution depends on centrality and the harmonic order considered.

In the present analysis the second – elliptic - harmonic is measured



Z^0 flow

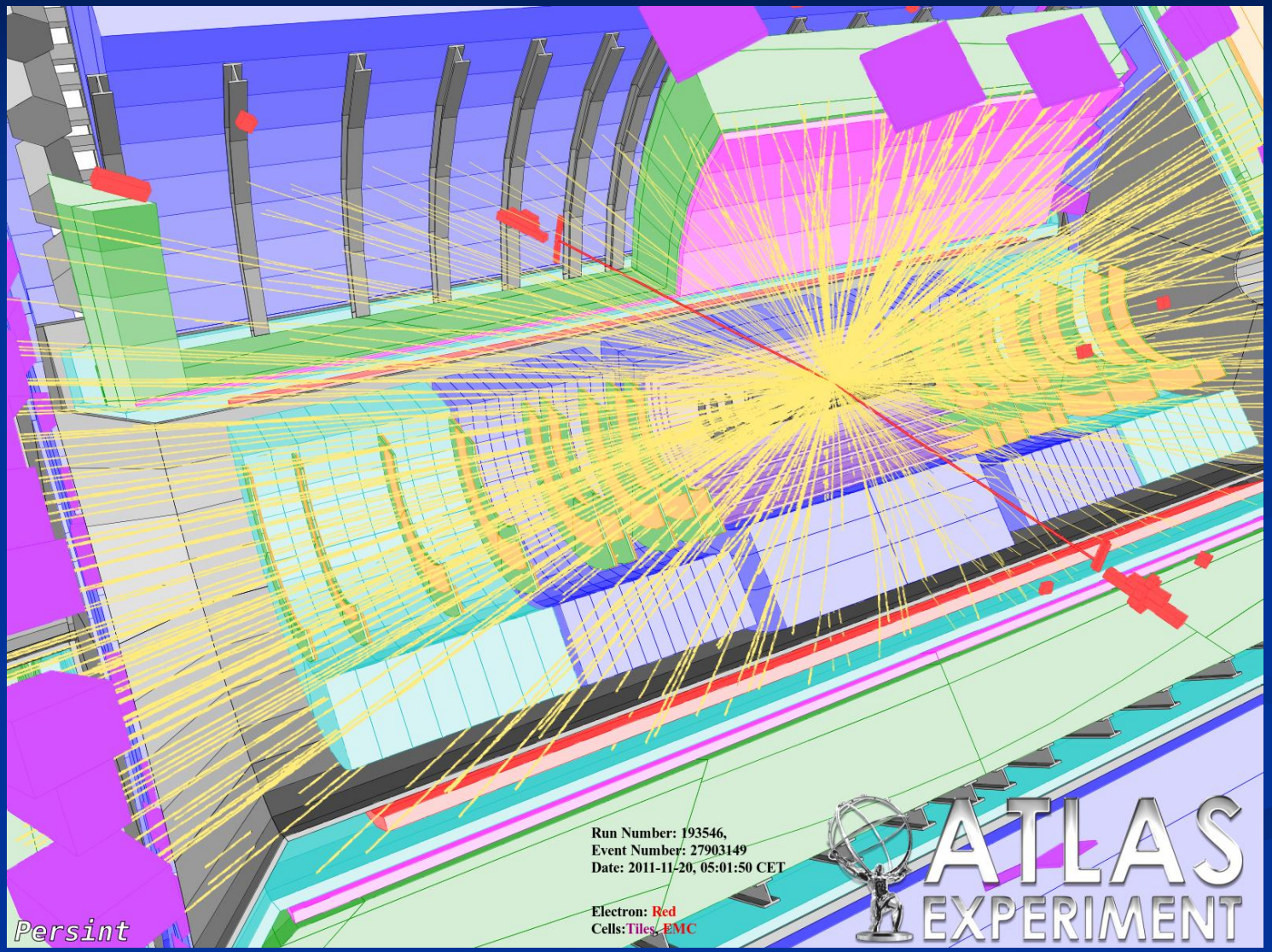

v_2
0.1
0.0
-0.1
0-60%
ATLAS Preliminary
Pb+Pb $\sqrt{s_{NN}}$ = 2.76 TeV
Data 2011 L_{int} = 0.15 nb^{-1}
0-60%
0
1
2
$|y^Z|$
1
10
p_T^Z [GeV]
200
400
$\langle N_{part} \rangle$

Summary

- around 2000 events with produced Z^0 were reconstructed in the ATLAS PbPb data taken at $\sqrt{s_{NN}}$=2.76 TeV. The data correspond to an integrated LHC luminosity of 0.14 nb^{-1}
- boson production was identified via di-lepton decays
- kinematical variables of bosons are well reproduced by the PYTHIA prediction made for pp collisions
- the data confirm the binary collision scaling
- no elliptic flow of produced Z^0 had been found

Backup slides

M_{ee}= 92.2 GeV, p_T = 4.8 GeV, y_Z=-0.2
FCal ΣE_T = 1.6 TeV (10-20% Centrality)



$M_{\mu\mu}$= 102 GeV, p_T = 5 GeV, y_Z=-0.1
FCal ΣE_T = 2.2 TeV (10-20% Centrality)