SM measurements at ATLAS

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on behalf of the ATLAS collaboration

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Standard Model at ATLAS

- We perform SM measurements:
  - to validate the SM in a **new energy** regime.
  - to understand the **background** for other studies.
  - to improve the **precision** of SM parameters.
  - to constrain **new physics** contributions (like anomalous couplings)

69 SM studies have been published since LHC started!!

- Categories:
  - Soft and Non-perturbative QCD (tunes,PDFs)
  - Jet Physics (pQCD)
  - Electroweak: W and Z, Dibosons, ….
  - Direct Photons

Soft QCD

Hard double-parton interactions in W(→ lυ)+2 jet events

J. Phys. 15 (2013) 033038

L= 36 pb^{-1} √s = 7 TeV

Two hard parton interactions in the same hadron-hadron collision.

$f^{(D)}_{DP}$=0.08±0.01(stat.)±0.02(syst.)

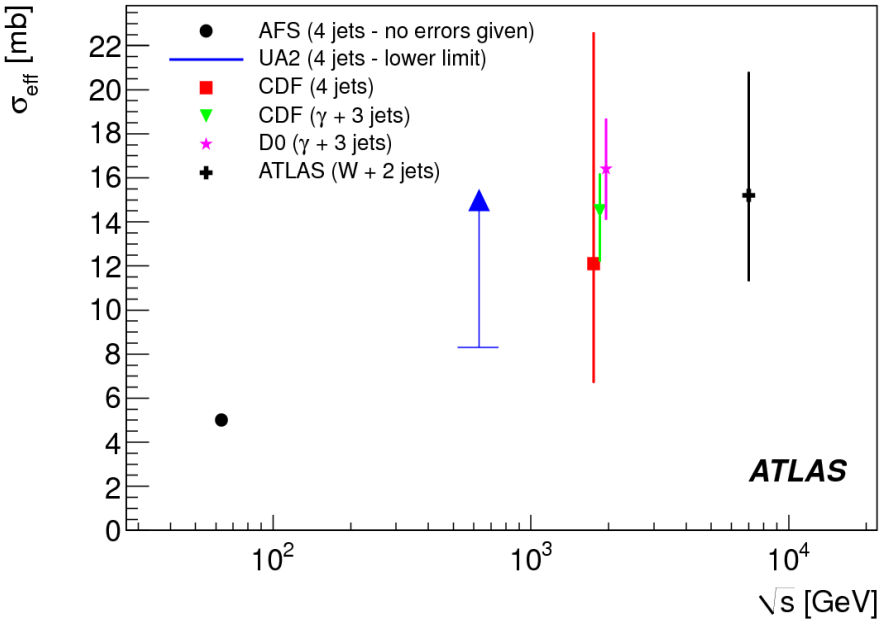
Effective area parameter:

σ_{eff} = 15±3(stat.)$^{+5}_{-3}$(syst.) mb

Consistent with previous measurements at lower √s.

DPI as **background** for many other Hard scales processes like W cross-section

Fraction of W+2jets from hard double parton interaction at detector level: $f^{(D)}_{DP}$



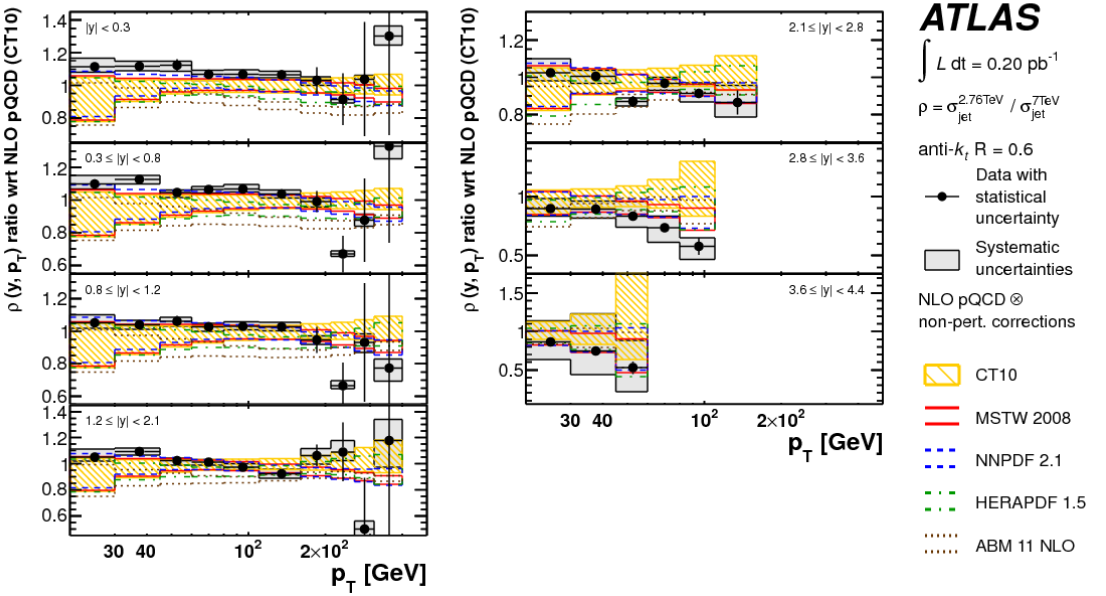
Jet Physics

Inclusive jet cross section comparison

Ref: arXiv:1304.4739

Ratio at √s=2.76 TeV(L = 0.20 pb-1) and √s =7 TeV agrees with fixed order **NLO pQCD.**

pQCD can describe jet production at High pT. **Ratio** starts to show preference for **certain PDF sets**.



Jet Physics

k_t splitting scales in $W \to l\nu$ events

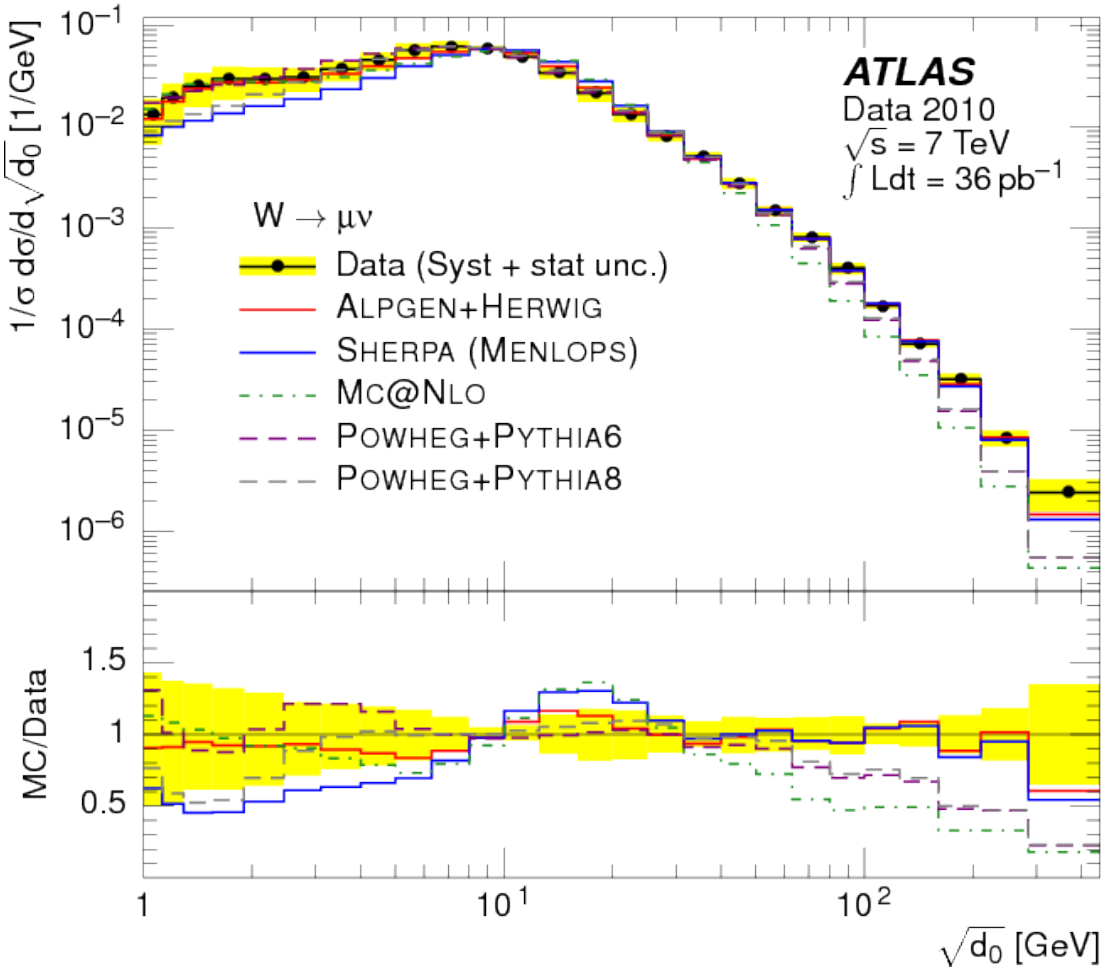
Eur. Phys. J. C, 73 5 (2013) 2432

L= 36 pb^{-1} $\sqrt{s}$ = 7 TeV

Four hardest **splitting scales** in K_t clustering.

Multi-leg+PS (ALPGEN-HERWIG, SHERPA) agrees **well** with data,

NLO+PS (MC@NLO/POWHEG+PYTHIA) products significantly **less hard** activity than observed.



Jet Physics

Jet Substructure

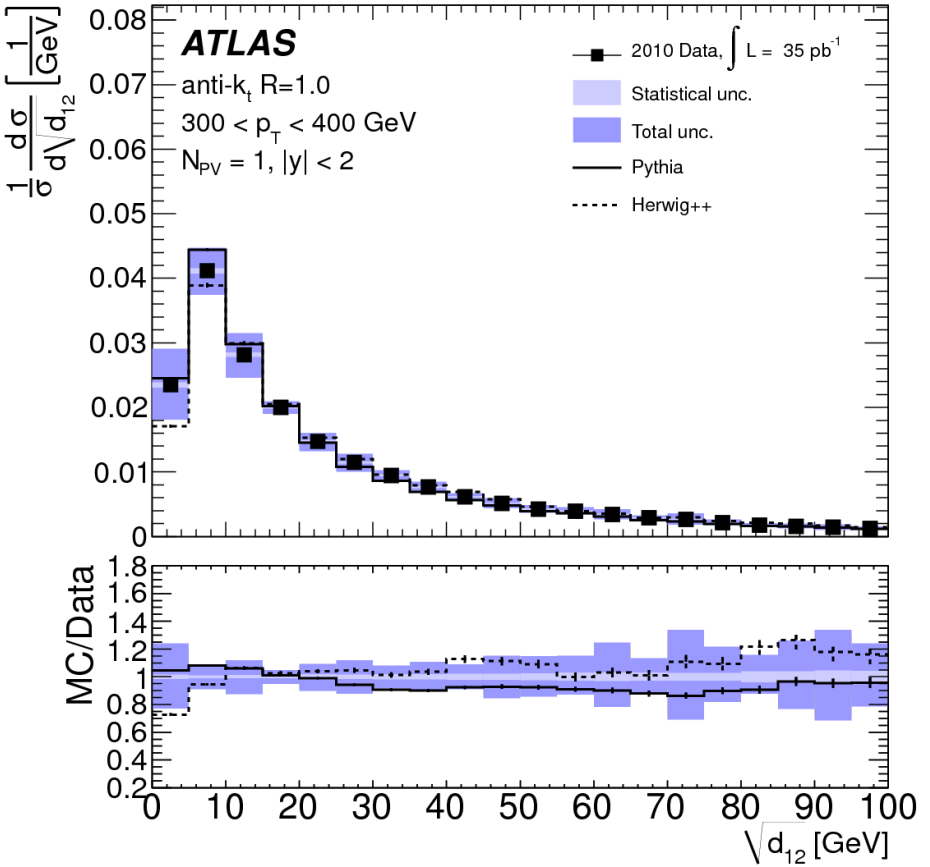
JHEP 1205 (2012) 128

L = 35 pb^{-1} $\sqrt{s}$ = 7 TeV

First particle-level **measurement** of these variables at the LHC

Parton shower provides **adequate description** of the data.

Jet mass exhibits the largest disagreements with Monte Carlo simulations.



Properties:
Jet mass, Splitting scales, N-subjettines

W/Z Physics

High-mass Drell-Yan differential cross-section

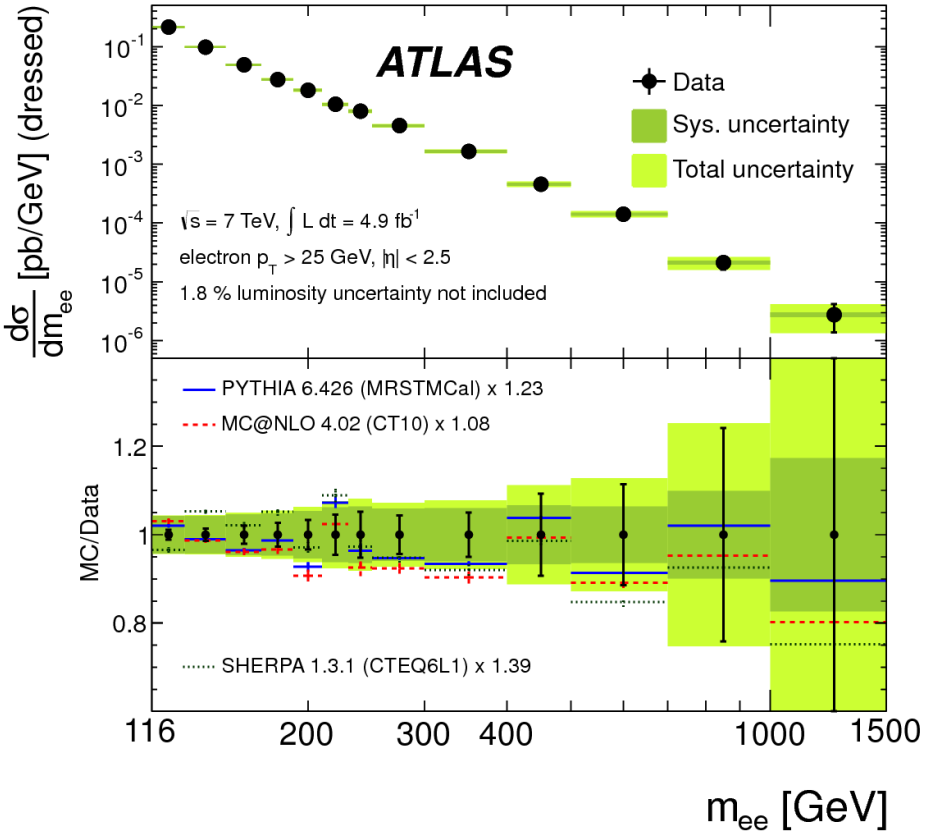
arXiv:1305.4192

L=4.9 fb^{-1} $\sqrt{s}$ =7 TeV

FEWZ NNLO QCD productions compatible with data for 5 PDF sets

Potential to constrain **large anti-quark PDFs** at large x

MC predictions consistent with shape of measured m_{ee} distribution.



W/Z Physics

Production of a W boson in association with a charm hadron

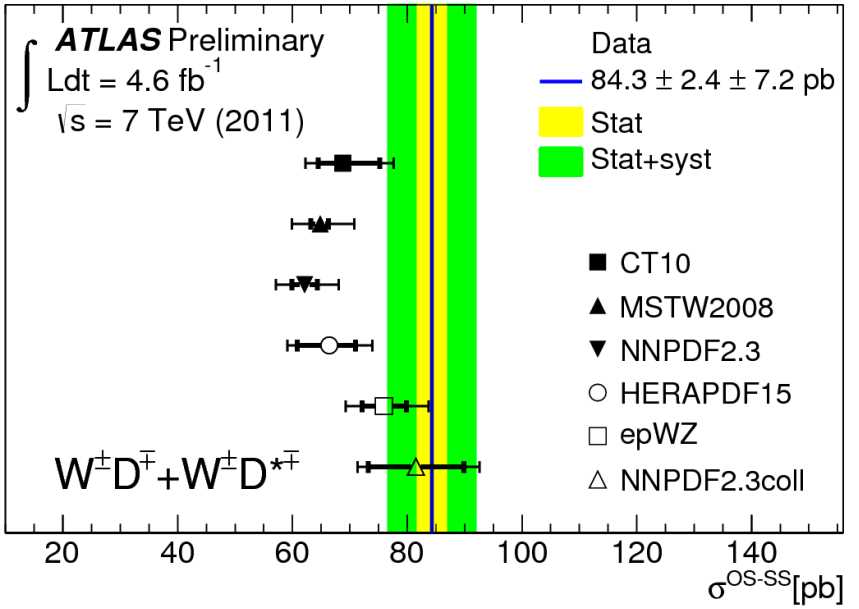
ATLAS-CONF-2013-045

L=4.6 fb-1 $\sqrt{s}$=7 TeV

Predicted cross section depend on the choice of PDF

Data agree with predictions for the epWZ and NNPDF2.3coll

Larger discrepancies with MSTW2008, HERAPDF15 and NNPDF2.3



$\sigma(W^{\pm}D^{*\mp})+\sigma(W^{\pm}D^{\mp})=84.3\pm2.4(stat)\pm7.2(syst)pb$

Direct Photons

Isolated-photon pair production in pp collisions

arXiv:1211.1913

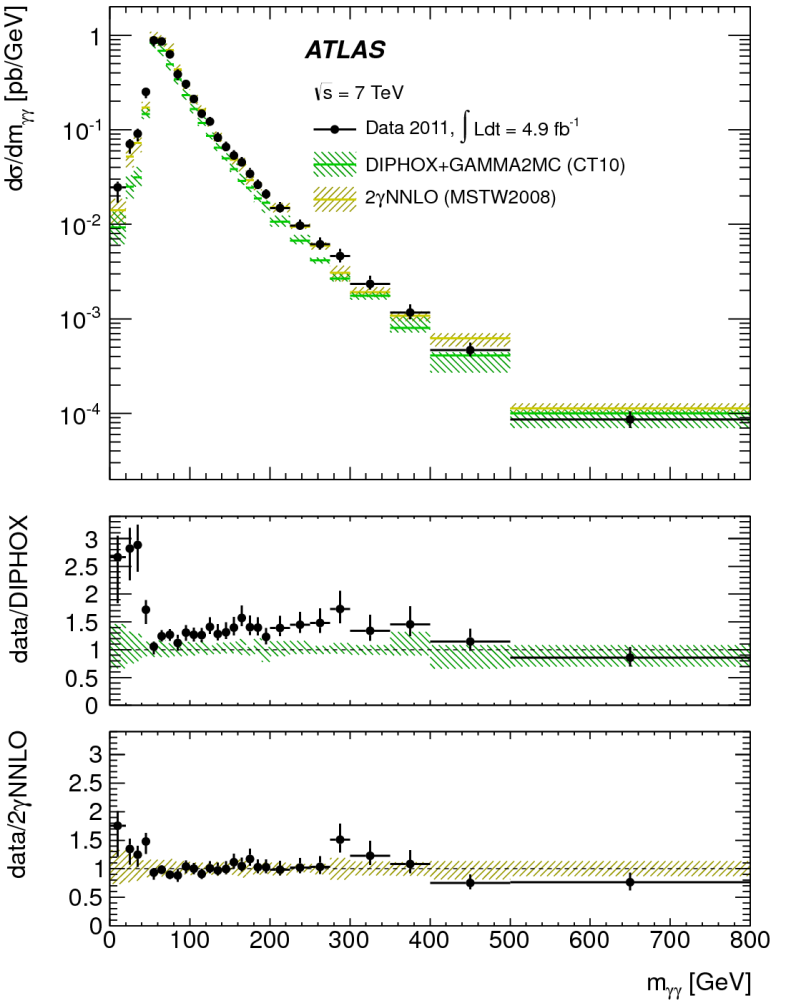
L= 4.9 fb^{-1} $\sqrt{s}$ = 7 TeV

Motivation: test of **QCD background** for H → γγ

$\sigma = 44.0\ pb^{+3.2}_{-4.2}$

LO → 36 pb (20%)

2γNNLO → 44^{+6}_{-5} pb
(excellent agreement)



Electroweak

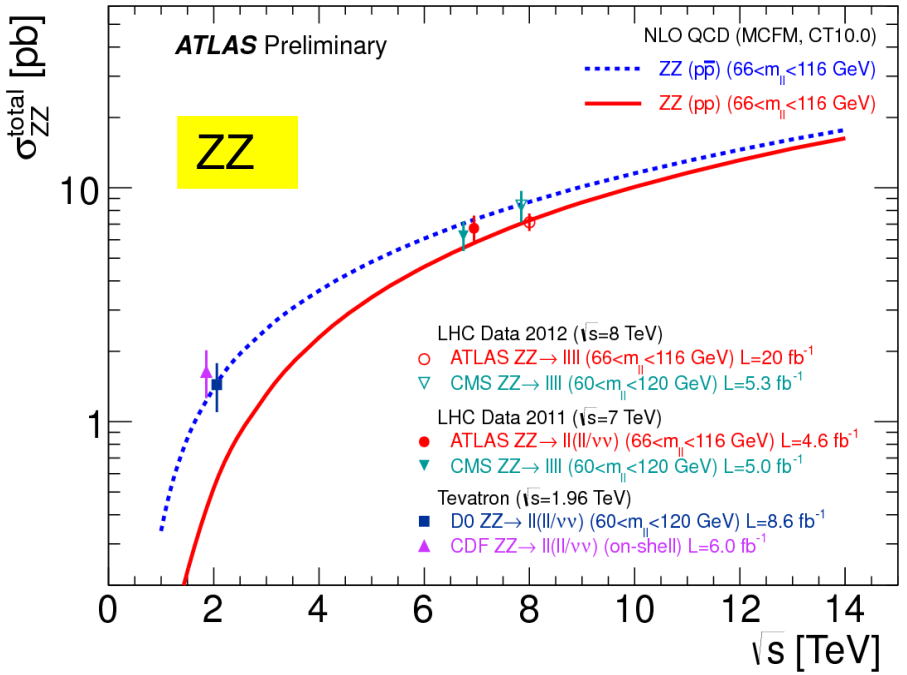
Total ZZ and WZ production cross sections

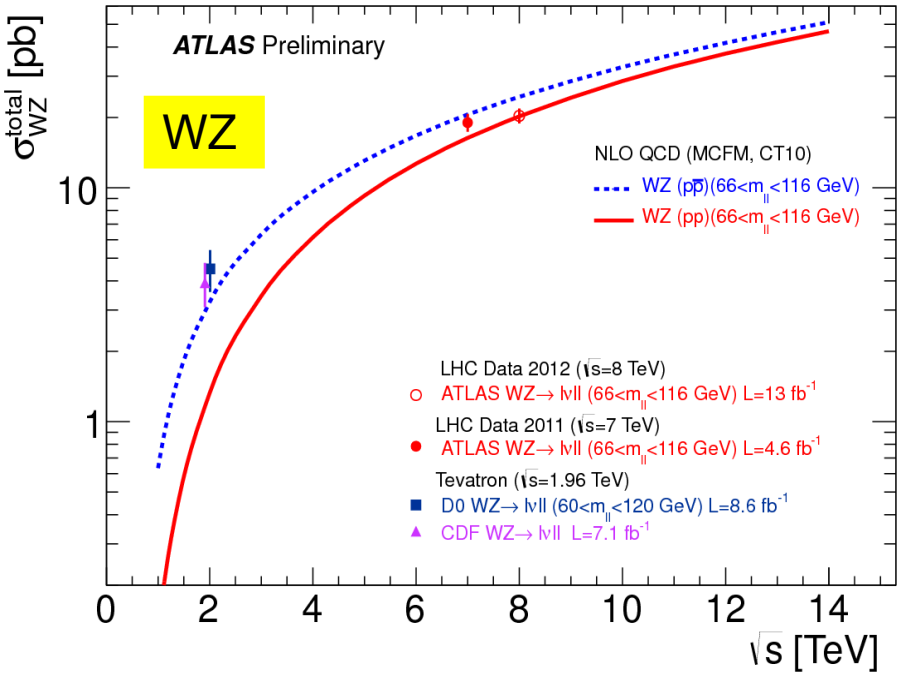
ATLAS-CONF-2013-020 (ZZ) L=20 fb^{-1} √s =8 TeV ATLAS-CONF-2013-021(ZW) L=13 fb^{-1} √s =8 TeV

Consistent with the SM **expectations**

$\sigma^{tot}_{ZZ}=7.1^{+0.5}_{-0.4}(stat.)\pm0.3(syst)\pm0.2(lumi.)pb$

$\sigma^{tot}_{WZ}=20.3^{+0.8}_{-0.7}(stat.)^{+1.2}_{-1.1}(syst.)^{+0.7}_{-0.6}(lumi.)\ pb$





Electroweak

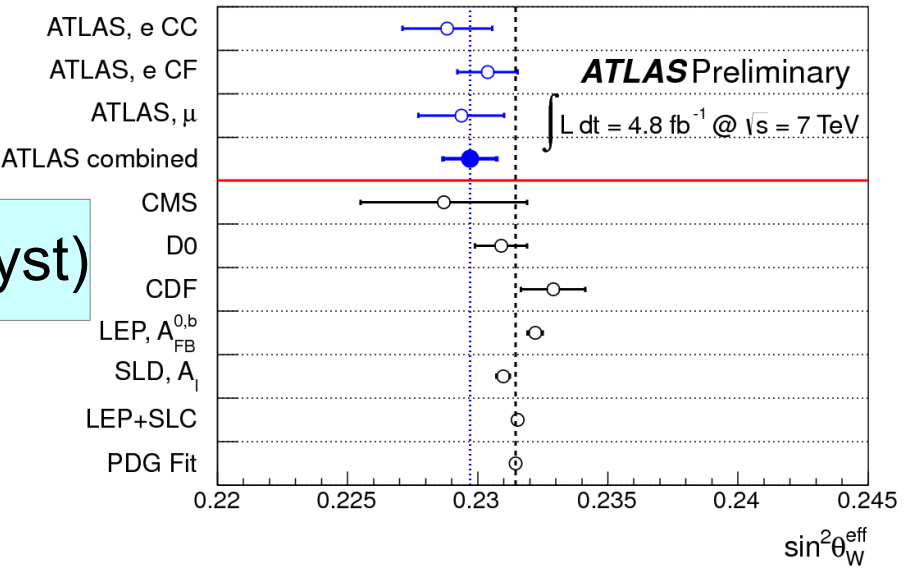
Forward-backward asymmetry of Z/γ* bosons

ATLAS-CONF-2013-043

L=4.8 fb^{-1} $\sqrt{s}$ = 7 TeV

Use asymmetry to determine the **effective weak mixing angle**:

$$\sin^2\theta_W^{eff}=0.2297\pm0.0004(stat)\pm0.0009(syst)$$



Consistent with previous measurements.

Precision comparable with Tevatron.

Conclusions

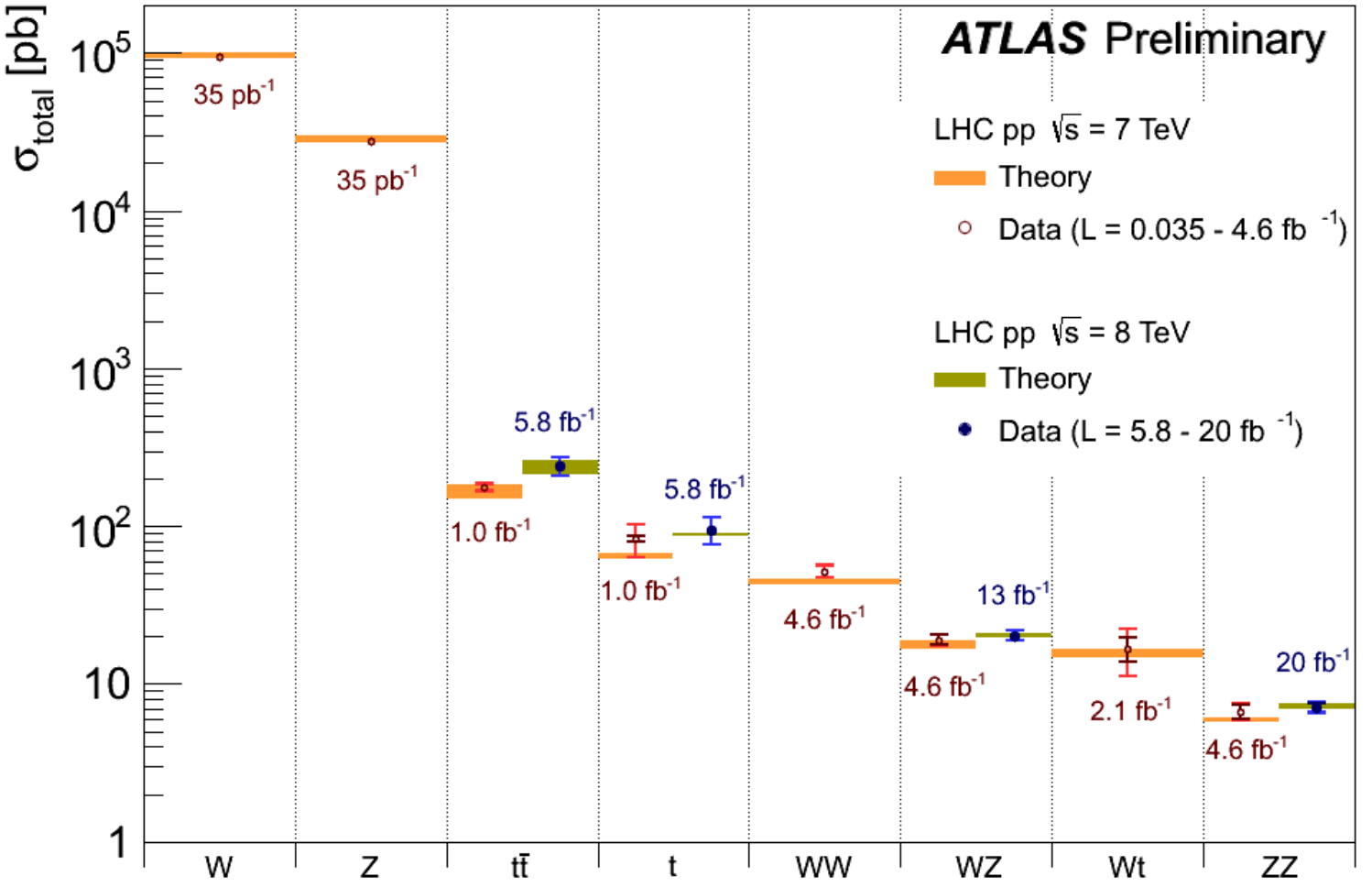
- **SM measurements** are important to explore **new regimes**, to test theoretical predictions and PDFs and to improve precision of the **SM parameters**.
- **New measurements** for soft QCD, Jet production, Electroweak studies and Direct Photons.
- **All** ATLAS SM measurements can be **found here**:

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/StandardModelPublicResults

Thanks for your attention

Backup

Moriond Summary SM Results



W/Z Physics

Production cross section of jets in association with a Z boson

arXiv:1304.7098

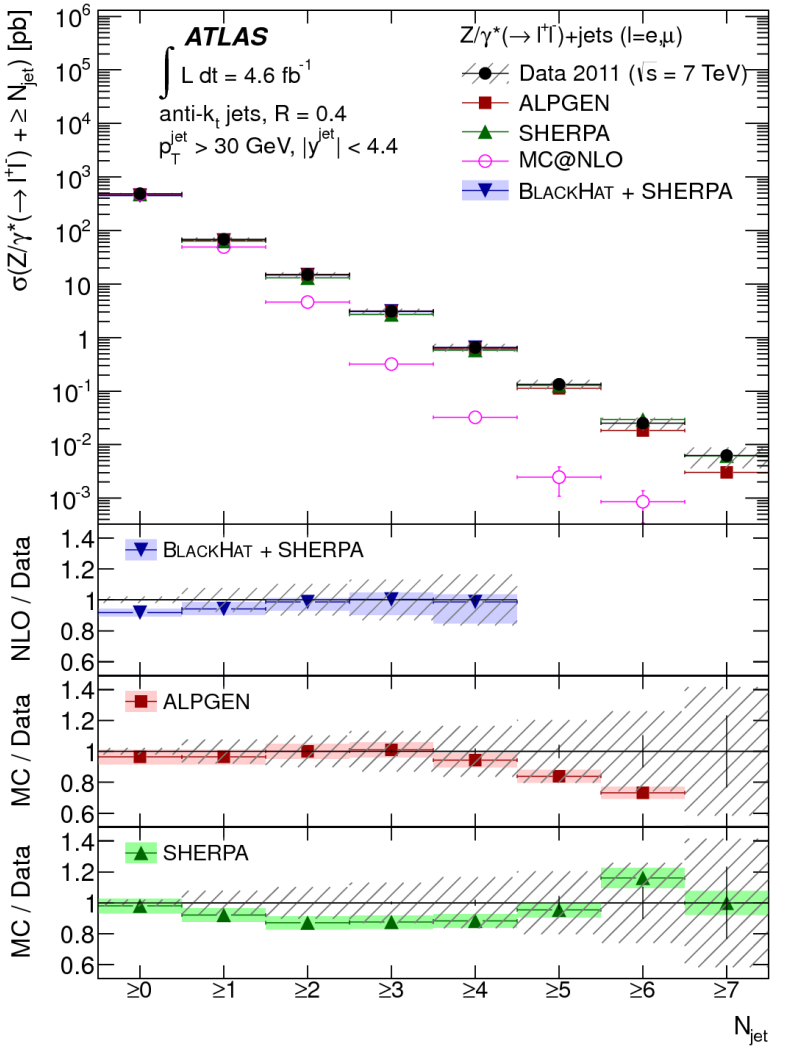
L = 4.6 fb^{-1} $\sqrt{s}$ = 7 TeV

Large jet multiplicities, larger p_T

MC@NLO+PS clearly insufficient

Multi-leg+PS generally **consistent** with data.

Fixed order **NLO QCD** struggles to predict distribution of **H_T, S_T, P_T^{ll}**

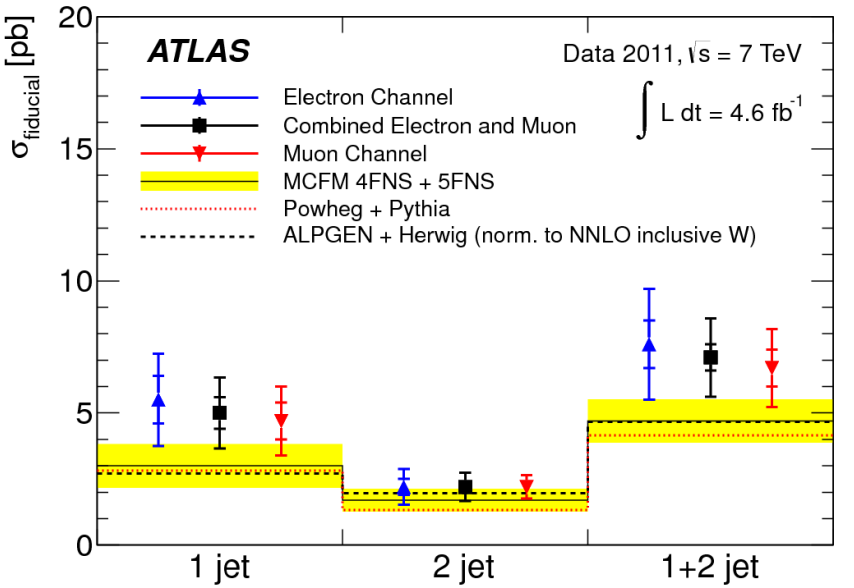


W/Z Physics

Cross-section for W boson production in association with b-jets

arXiv:1302.2929

L = 4.6 fb^{-1} $\sqrt{s}$ = 7 TeV



Better with low p_T of b-jet

$\sigma = 7.1 \pm 0.5(\text{stat.}) \pm 1.4(\text{syst.})\text{pb}$

Consistent within 1.5σ with

MCFM σ =

$4.70 \pm 0.09(\text{stat})^{+0.60}_{-0.49}(\text{scal}) \pm 0.06(\text{PDF}) \pm 0.16(\text{non-pert})^{+0.52}_{-0.38}(\text{DPI})\text{pb}$