The impact of the LHC nuclear program on nPDFs

(work in progress, in collaboration with H. Paukkunen)

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Outline

- A short digression on nPDFs

- New LHC data: can we learn something from it?

- Some results:

  W: ATLAS & CMS

  Z: ATLAS & CMS

- Summaries

nPDFs

- Several sets available at NLO with error sets

(DSSZ, EPS09, HKN, nCTEQ)

- Mostly valence distribution through DIS

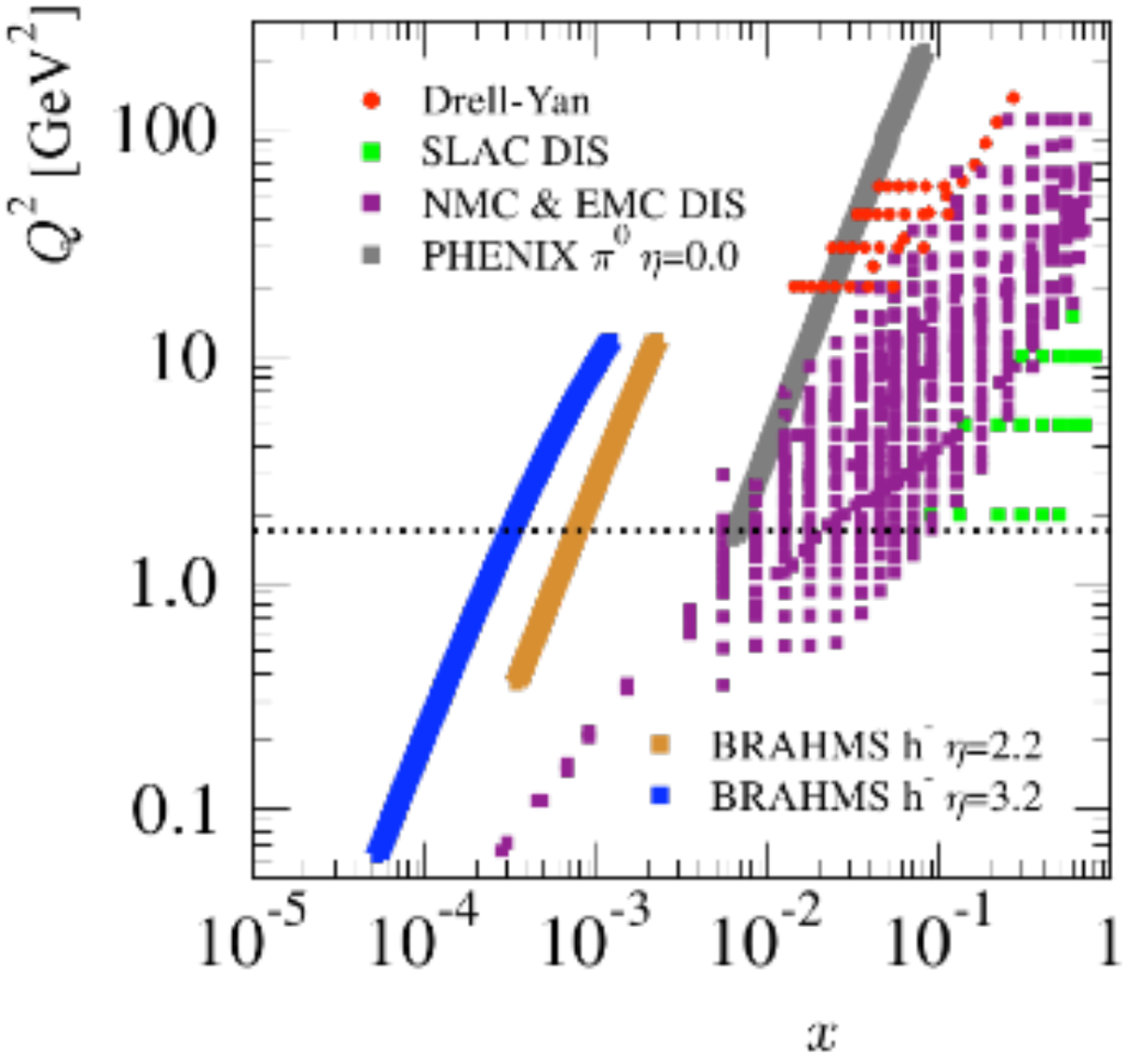
- Sea determination strongly relies on assumptions

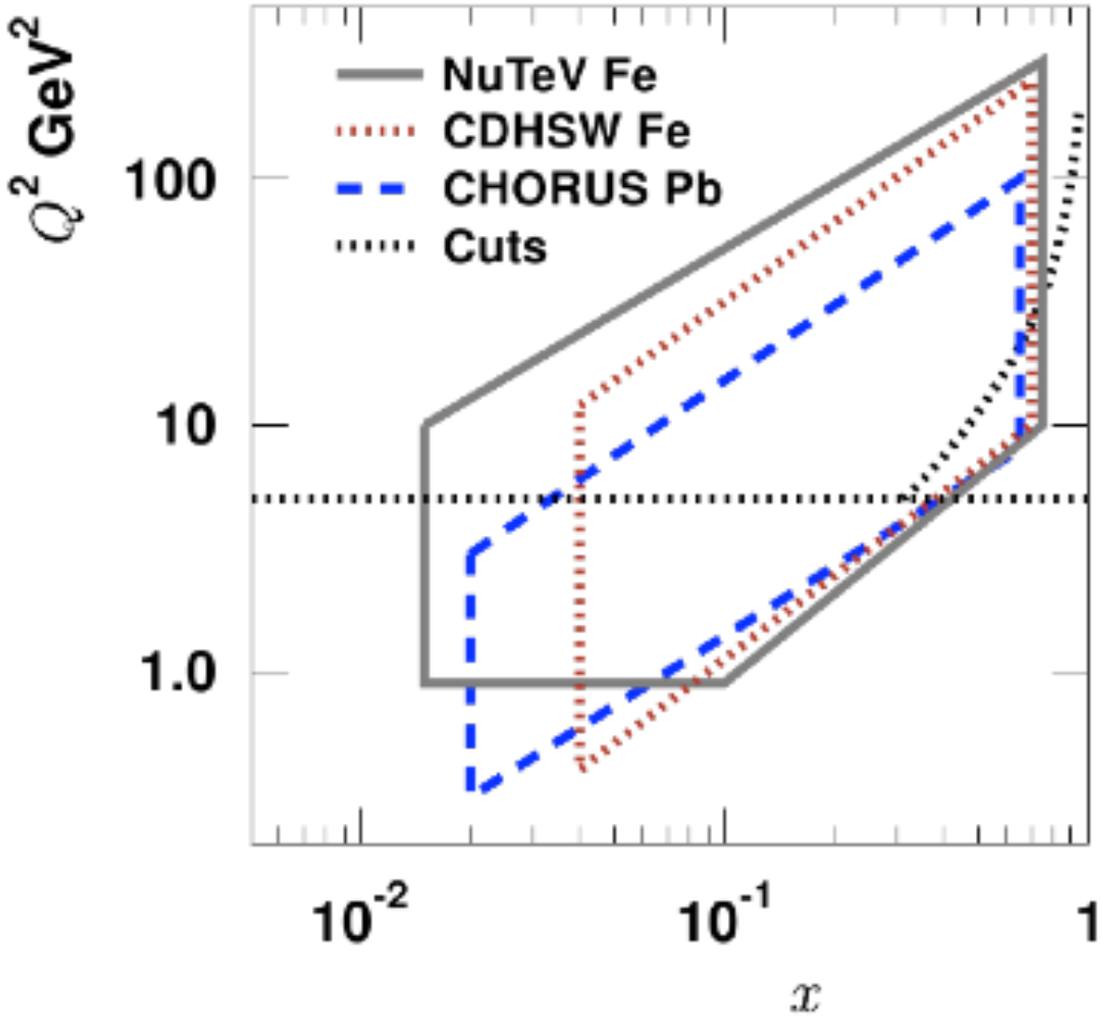
(even for proton PDFs)

- ... and don't ask about the gluon

limited kinematical coverage

limited sensibility to gluon and sea densities





Can the LHC

p-Pb and Pb-Pb

runs improve this?

Kinematics @ LHC

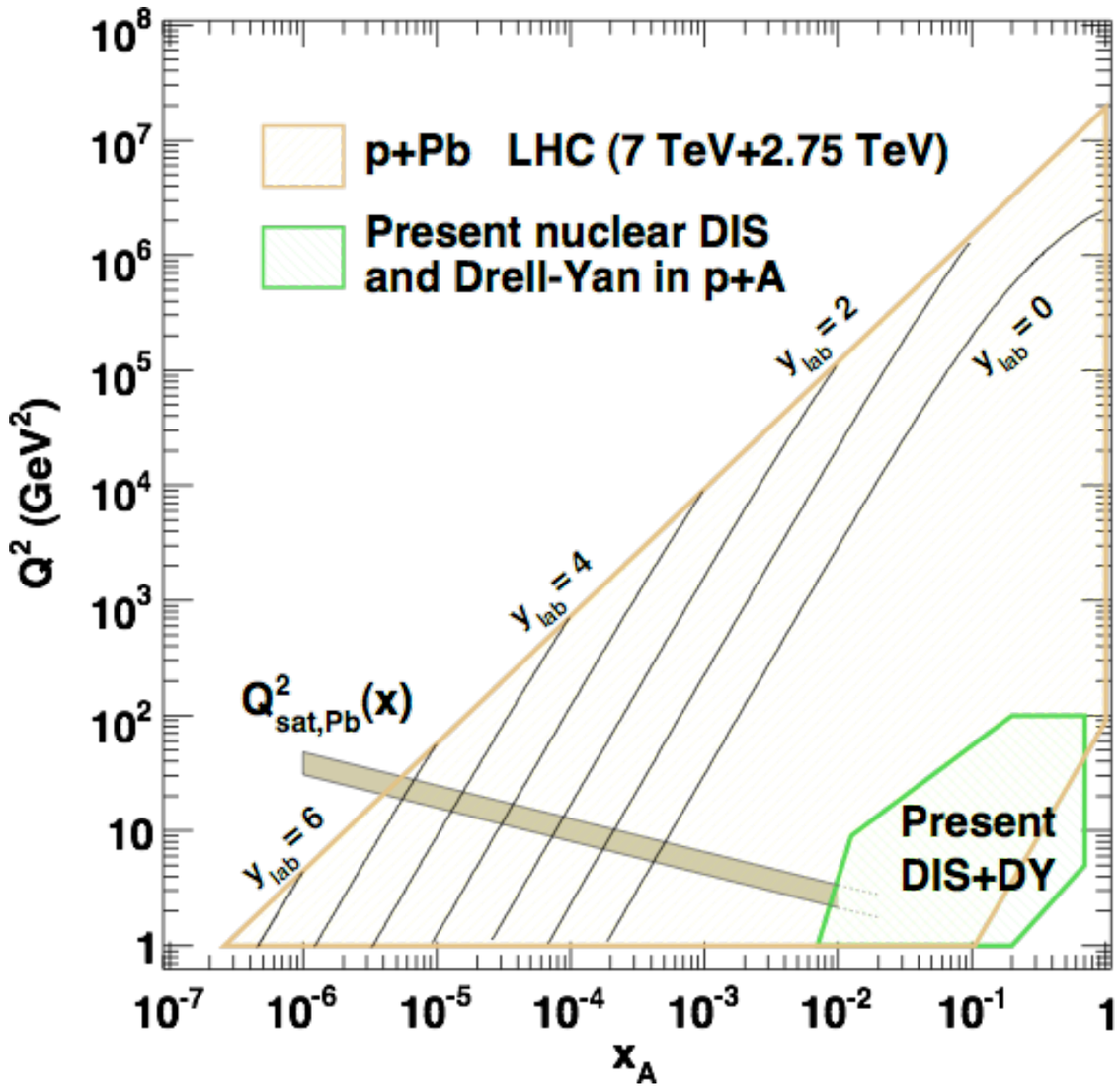
up to **5** o.o.m. in Q^2

up to **4** o.o.m. in x

$y \neq 0$ not in the fits

lots of data to analyze

Yes!



Hadro-production

- Most sensitive to gluon distribution

- Too few points from RHIC (~ 100)

- Rely on knowledge of FFs:

  none “good” at 7 TeV
  nuclear FFs?

- Interesting & controversial results from LHC

W and Z for the sea

ATLAS: Z in p-Pb, W in Pb-Pb

CMS: W and Z in both p-Pb and Pb-Pb

check their impact on nPDFs sets

what do we do?

- generate predictions for the observables using different sets of proton and nuclear PDFs

- apply a re-weighting strategy to the data

- check the results

- W.T. Giele and S. Keller, PRD58 (1998) 094923.
- R. D. Ball et al. [NNPDF Collaboration], NPB 849 (2011) 112, NPB 855 (2012) 608.
- G. Watt and R. S. Thorne, JHEP (2012) 052.
- N. Sato, J.F. Owens and H. Prosper, arXiv:1310.1089.
- B.J.A. Watt, P. Motylinski and R.S. Thorne, arXiv:1311.5703.
- H. Paukkunen and C. A. Salgado, Phys. Rev. Lett. 110, 212301 (2013).
- N. Armesto, J. Rojo, C.A. Salgado, and P. Z., JHEP 1311 (2013) 015.
- H. Paukkunen and P.Z., arXiv:1402.6623.

(some)

results

Disclaimer:

preliminary results

using EPS09 & CT10

relevant H&P uncertainties

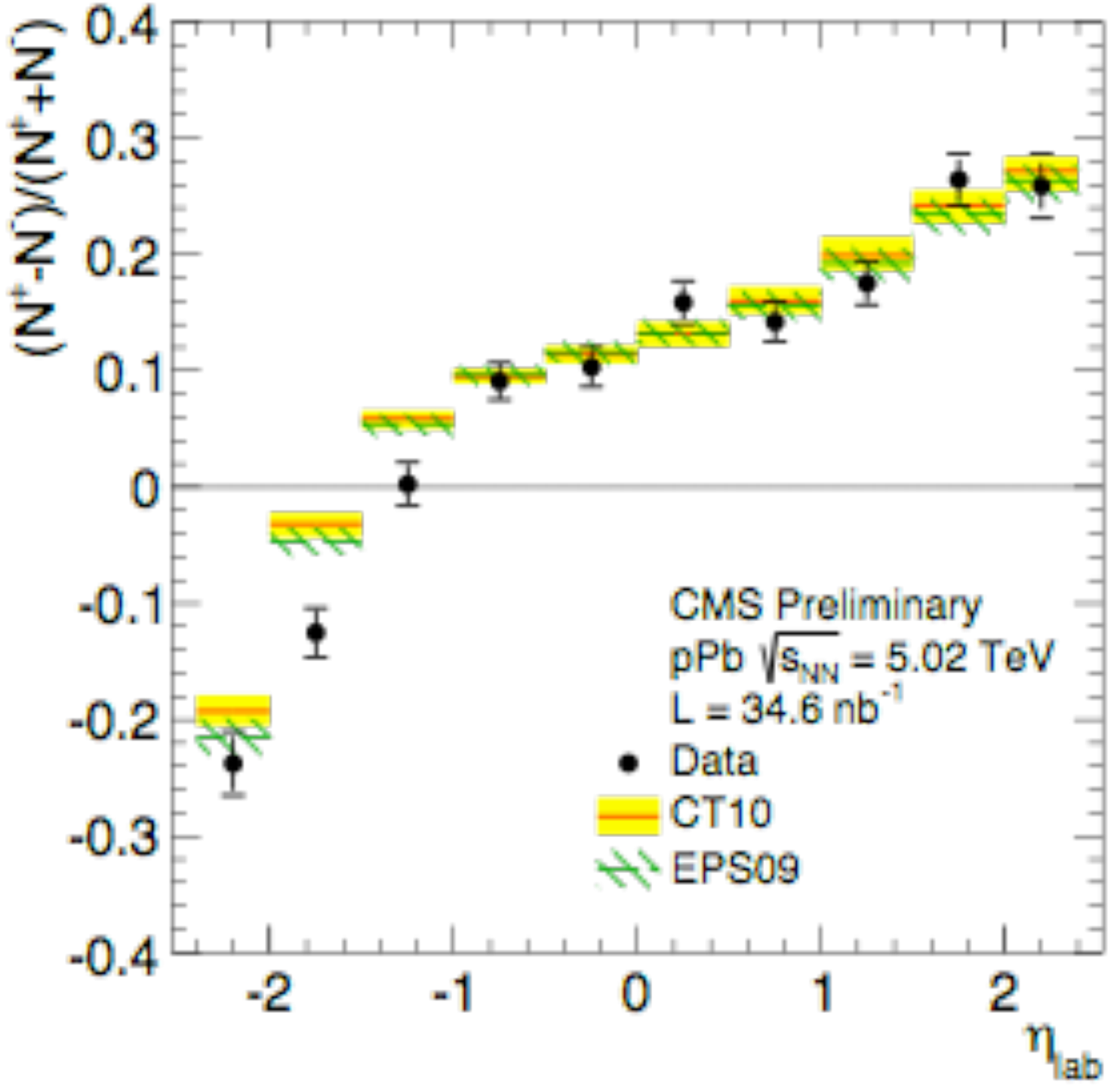
take what follows with a pinch of salt

CMS W boson in p-Pb @ 5.02 TeV

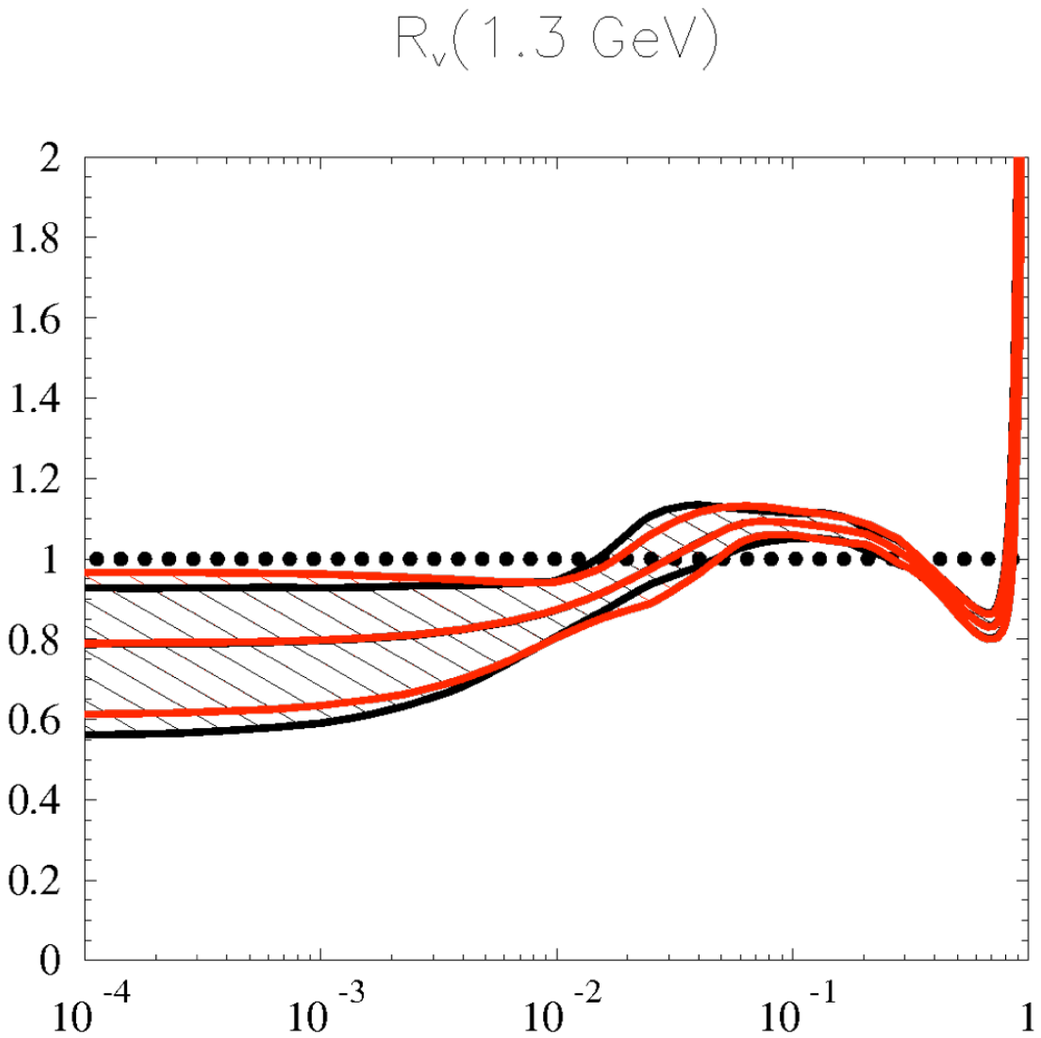
CMS PAS HIN-13-007

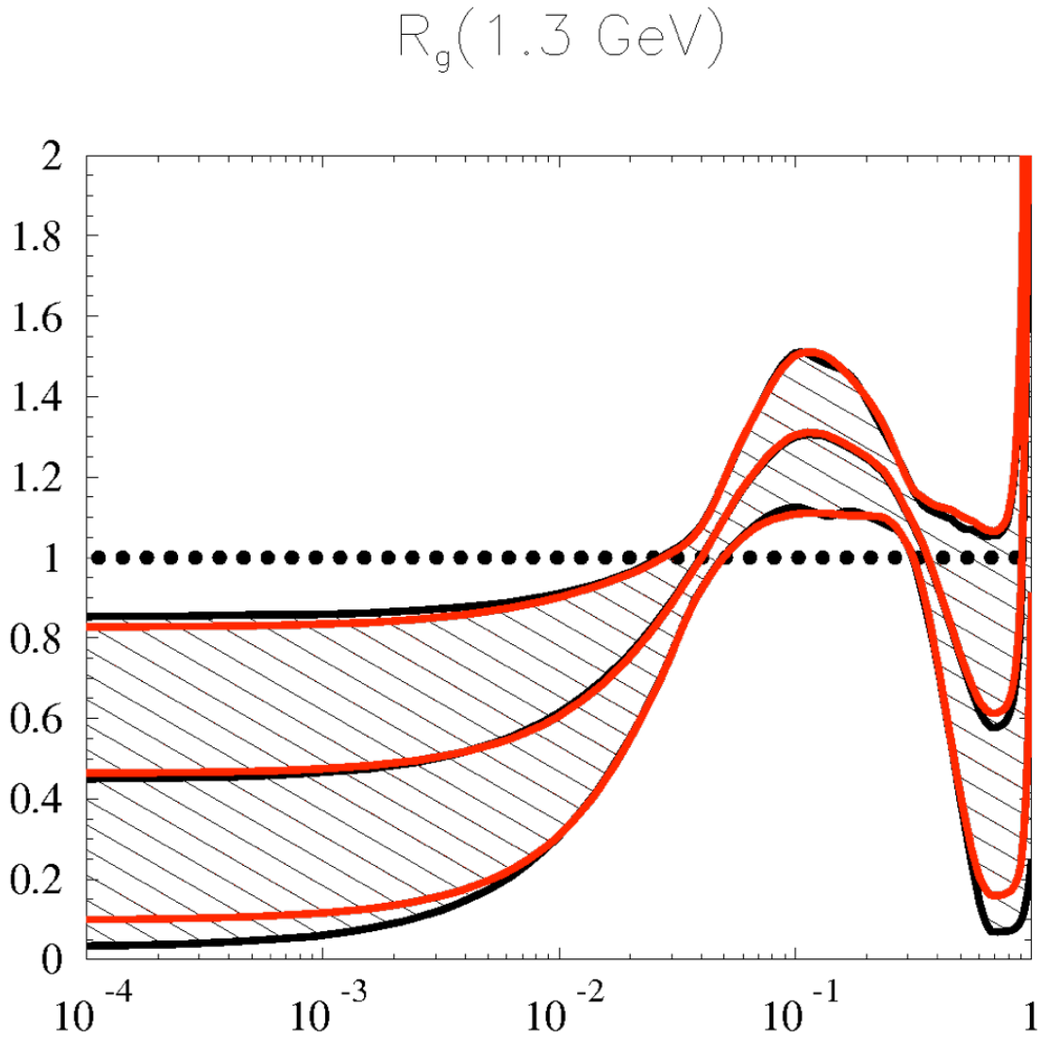
- discrepancies in some bins for the distributions

- yet good description of the charge asymmetry



Charge asymmetry doesn't seem to bring anything change in the sea

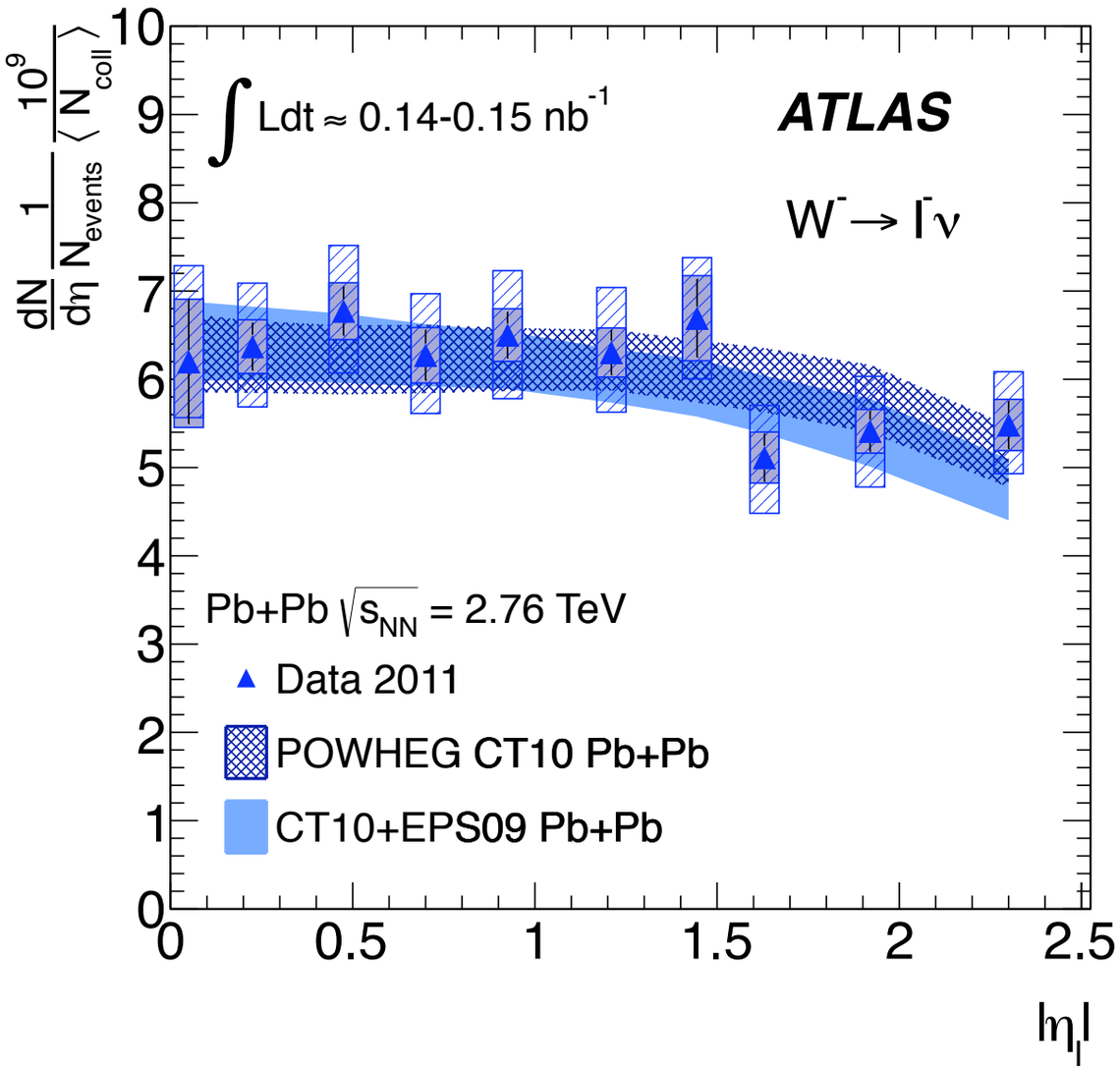


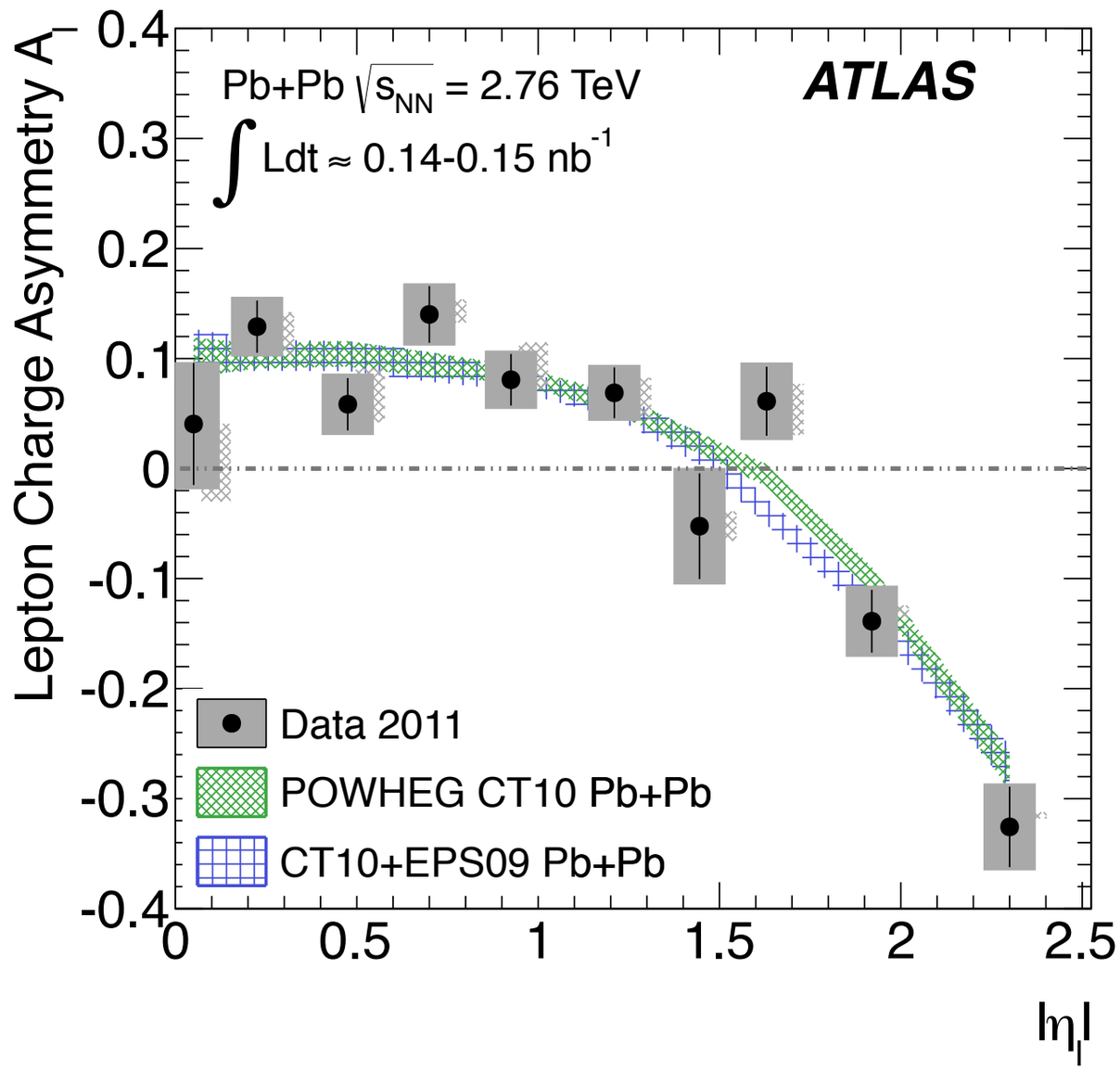


black: original EPS09
red: re-weighted

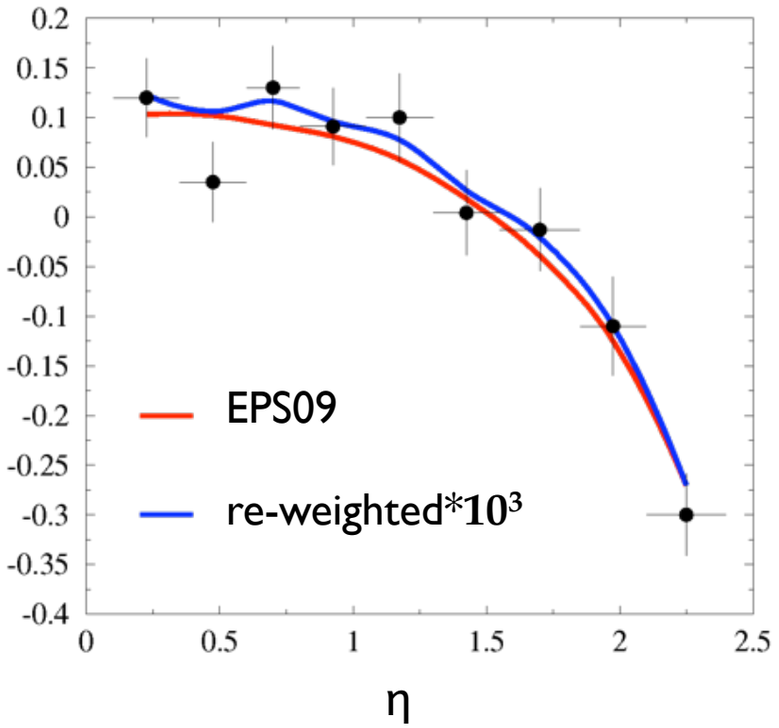
ATLAS W bosons in Pb-Pb @ 2.76 TeV

arXiv:1408.4674

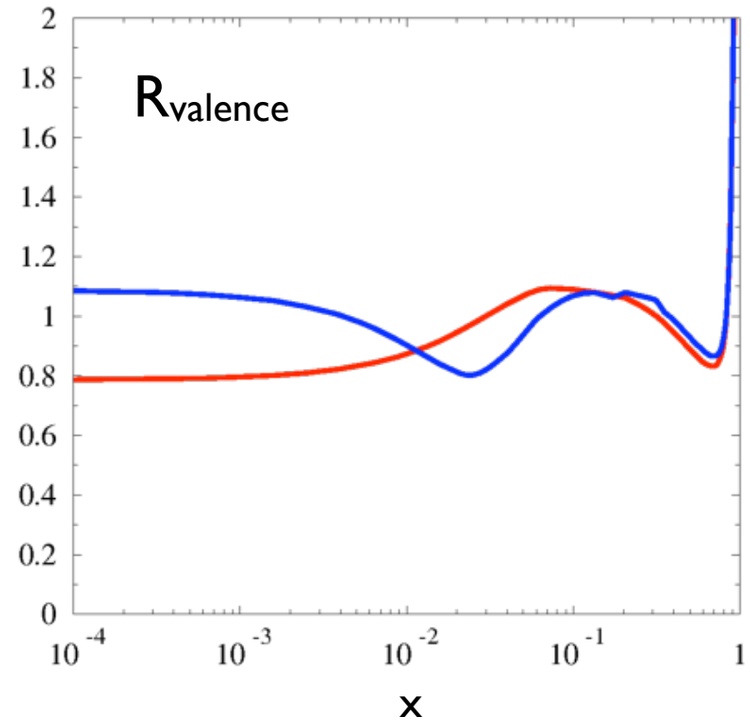


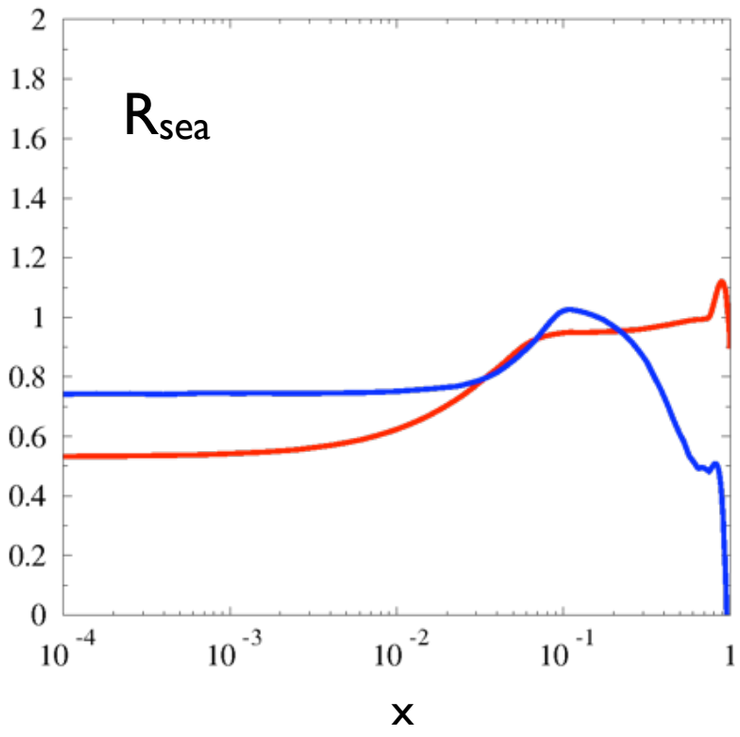


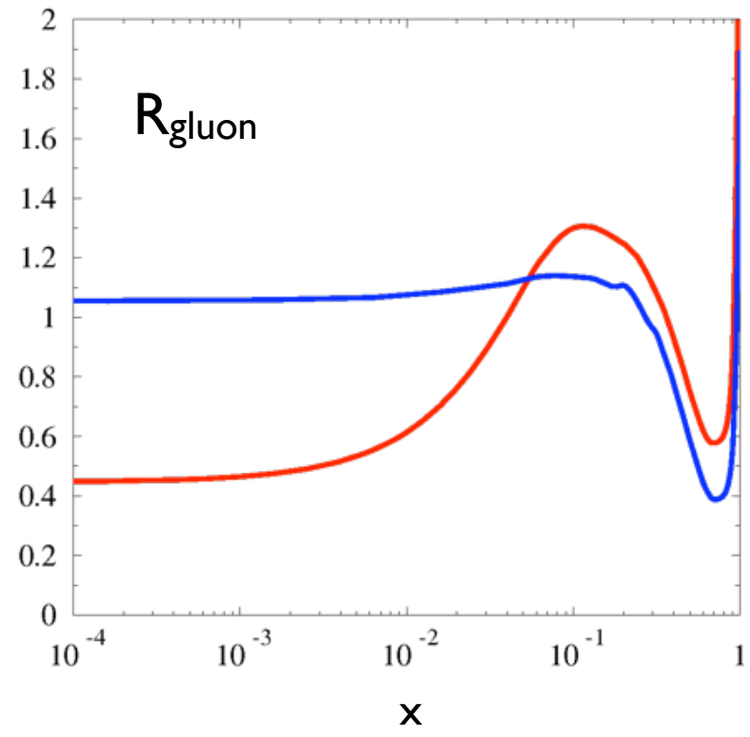
Asymmetry



$Q^2 = 1.69\ GeV^2$



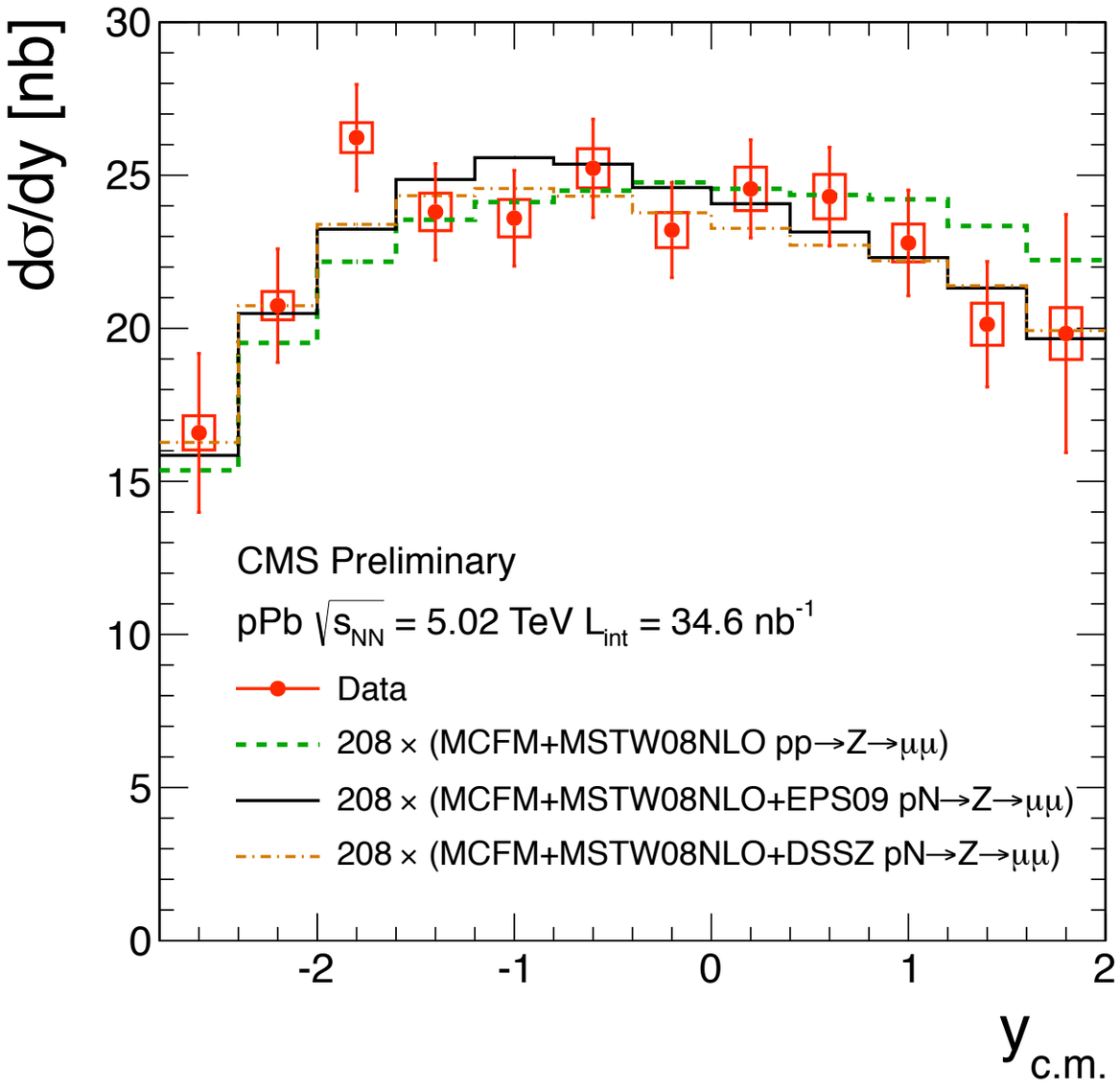


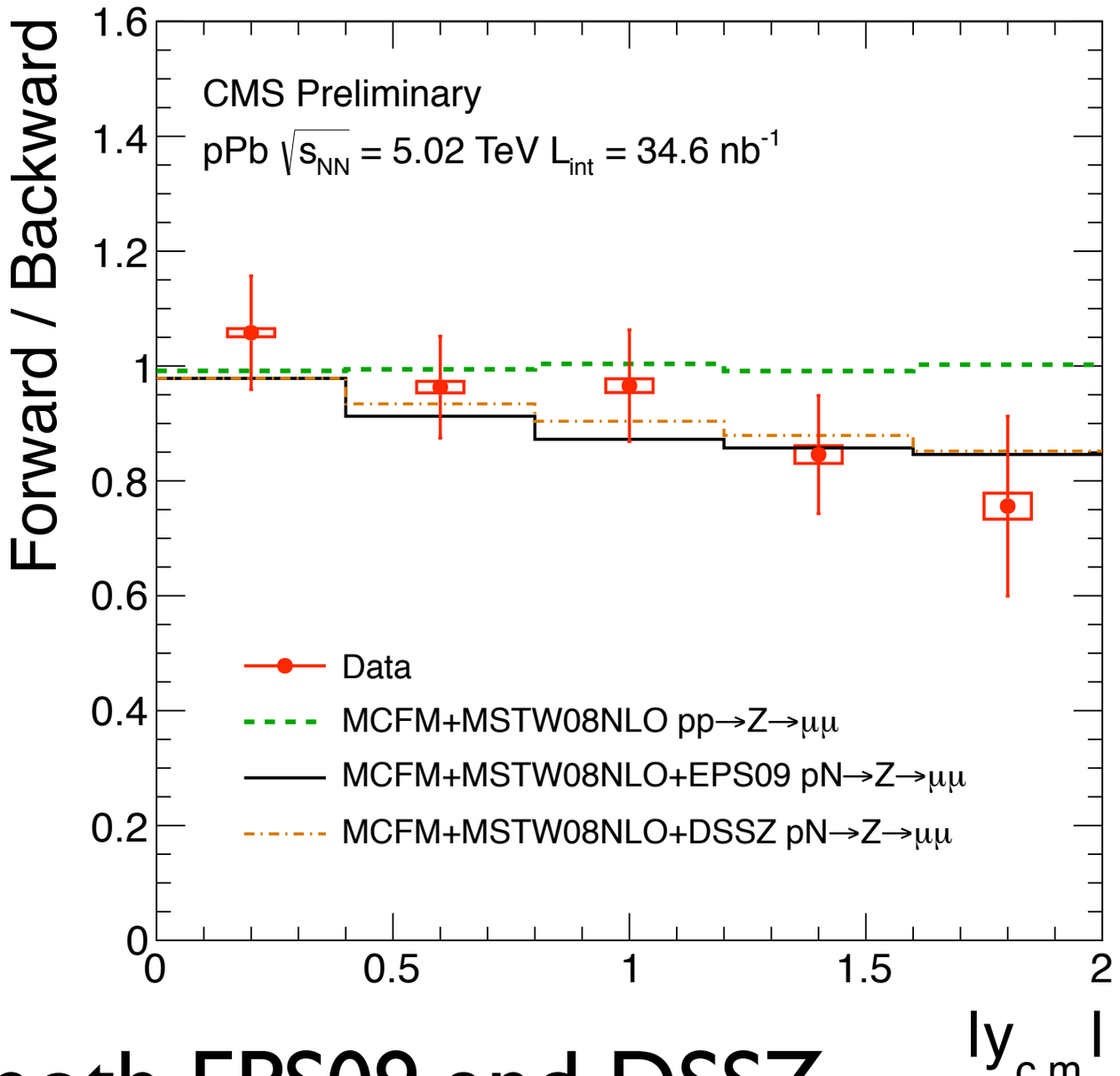


nothing
new
from
this

CMS Z boson in p-Pb @ 5.02 TeV

CMS PAS HIN-14-003



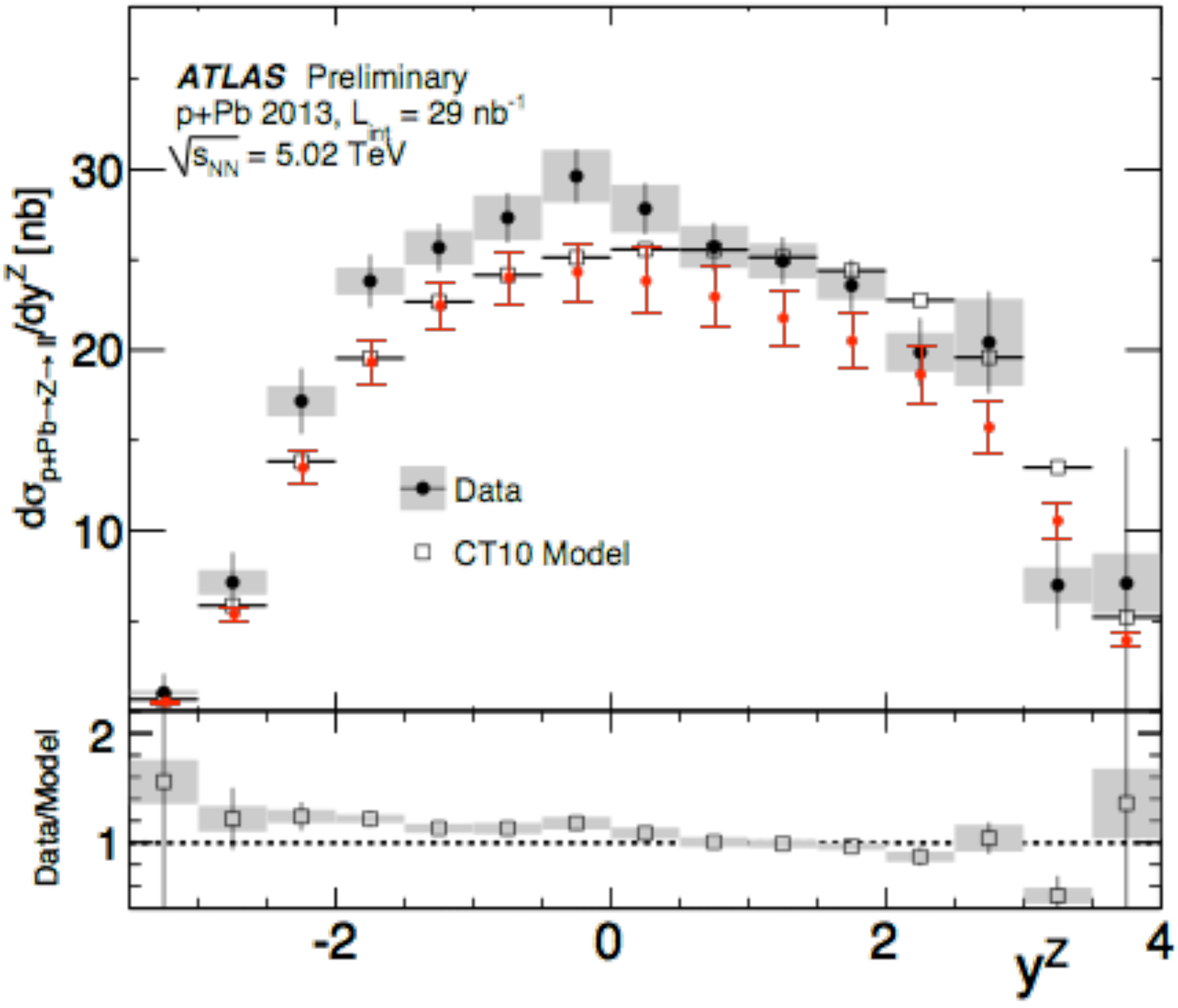


good agreement with both EPS09 and DSSZ

not enough precision to differentiate

ATLAS Z boson in p-Pb @ 5.02 TeV

ATLAS-CONF-2014-020



Summary (I)

- Jets seem promising (K. Eskola, H. Paukkunen and C. A. Salgado, JHEP 1310 (2013) 213, based on the results from CMS PAS HIN-13-001)

- Z & W do not seem to be quite sensitive to nPDFs
- Large uncertainties
- Best observables to be found
- Hadro & photo production really interesting

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- Stay tuned!