

# A few concluding remarks

PD4LHC Meeting, 4 July 2011, Desy

# Outlook

- Brief reminder of the charges of the PDF4LHC working group
- Status/ achievement
- Open Questions
- Short and long term perspectives

# Charges of the working group

LHC studies will need PDFs AND a good estimate of the uncertainties.

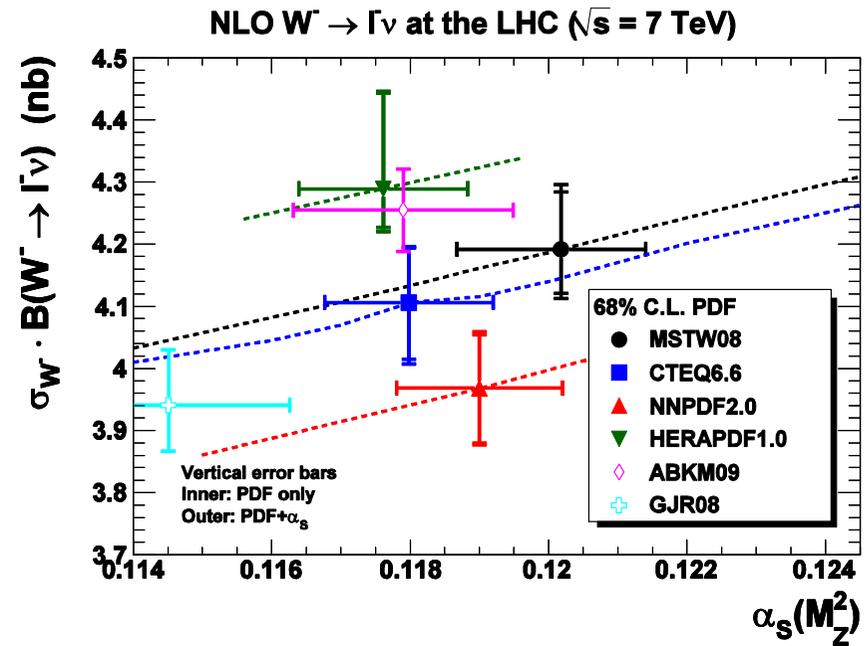
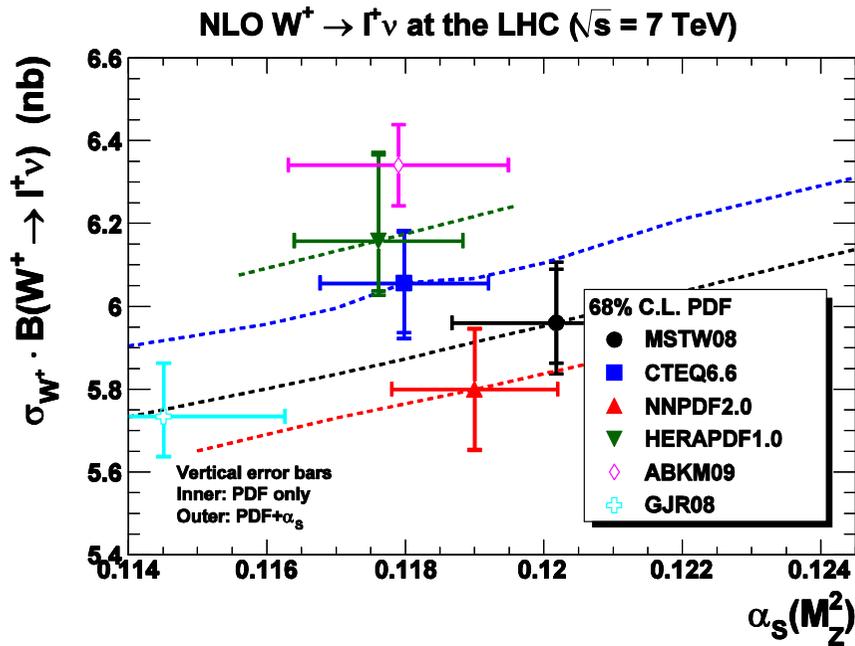
## Proposal for an "PDF4 LHC" study group

- Getting the best PDF(s) + error bands/uncertainties based on present fits and -selected- data (with PDF fitters)
- Use LHC information to improve PDFs. Needs close collaboration with theory colleagues (do we measure what the calculate, NLO, scales...?)

ADR, first PD4LHC Meeting, 22/02/2008

# A written interim report (2010)

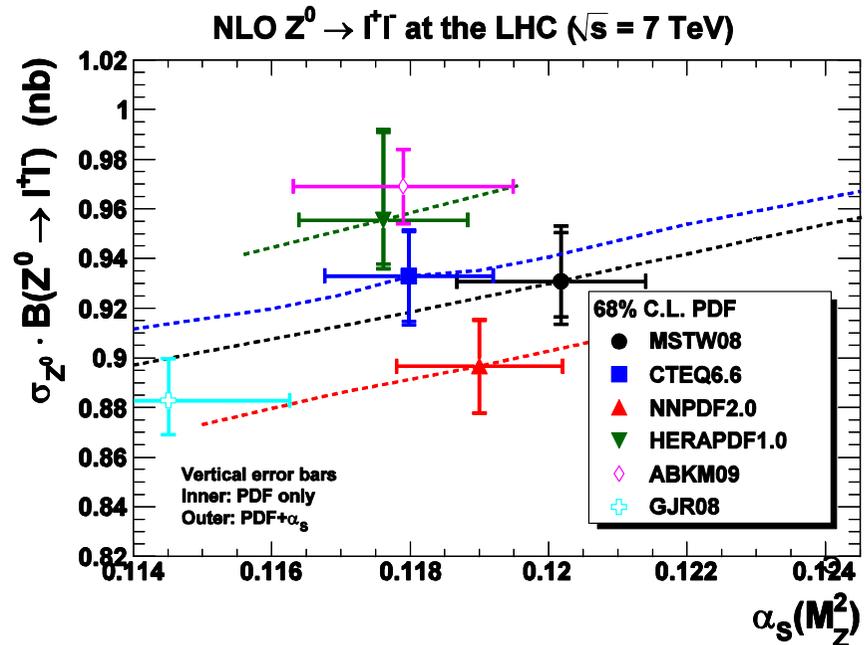
- Quite instructive in understanding of the several PDFs analyses
  - Experimental and model uncertainties
  - Theoretical uncertainties
  - PDF correlations
- Very useful benchmarking exercise:
  - Good point : broad agreement on size of uncertainties
  - Bad point : large differences on central values, not fully understood
- Interim Recommendation:
  - Misunderstood
  - Evaluation of systematics :  
debatable, complicated and obsolete at NNLO



In 2010 the PDF4LHC group considered:  
MSTW08    CTEQ66  
HERAPDF1.0    NNPDF2.0  
ABKM09    GJR08

Plots from G.Watt – 68%CL

Overall disagreement  $\sim 8\%$  in W, Z cross-sections  
The PDF4LHC recommendation was to take the envelope of the NNPDF, MSTW, CTEQ predictions --even this may not be enough!



[Mandy DIS 2011]

# Well identified differences in the PDF analyses

- Selection of physical processes and of input data
- Statistical treatment of experimental errors
- Input parameterisations
- Treatment of heavy quarks
- Values of charm mass parameter (fix or optimal)
- Treatment and value of  $\alpha_s$  (fix or optimal)

# Differences in the PDF analyses

A few questions :

Any hope to obtain consensus on the many differences ?

- There is some ongoing progress (i.e. general move to NNLO as seen this afternoon, but jet NNLO cross sections not fully known. Large K factors!!)
- There are still some arbitrary choices.

Can the identified differences explain all the observed disagreements on predictions of LHC cross sections ?

Not fully. Not all model and theoretical uncertainties have been explored :  
resummation, scales,...

Can data from Tevatron, LHC or final HERA data validate some of the arbitrary choices or simply bring additional constraints?

Some partial preference appear but not yet decisive.

Reduction of uncertainty has been observed,

50 x more LHC data on tape !!

# Next steps (personal view)

- Add new data sets from LHC, HERA, Tevatron
- Further studies of theoretical and model uncertainties
- Further studies to **understand** differences and more effort to **converge** on some of the debatable choices :
  - revisiting fixed target data sets: error correlations? remove some datasets?
  - selection of data sets and physical processes,
  - $\alpha_s$ ,
  - heavy quark handling,
  - charm mass parameter
  - ...
- Benchmarking exercise with up-to-date NNLO PDFs.
- Update of the recommendation at NNLO (and at NLO ?)
- Update of LO PDFs(?), not a big enthusiasm

**Aim to a full understanding and reduction of the overall uncertainties which hopefully could be relevant when LHC will find deviations from the STD model !!**