



PDF4LHC meeting - CERN 29 May 2009

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Summary

by

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Outline

- Agenda and topics
- Highlights
- Conclusions



Agenda

15 talks covering the following topics:

- News from global fitters (CTEQ, MSTW, NNPDF)
- News from HERA: predictions for the LHC
- Various PDF uncertainties estimates
- News from Generator PDFs

Friday 29 May 2009

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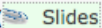
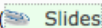
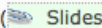
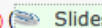
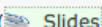
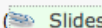
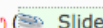
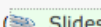
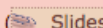
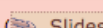
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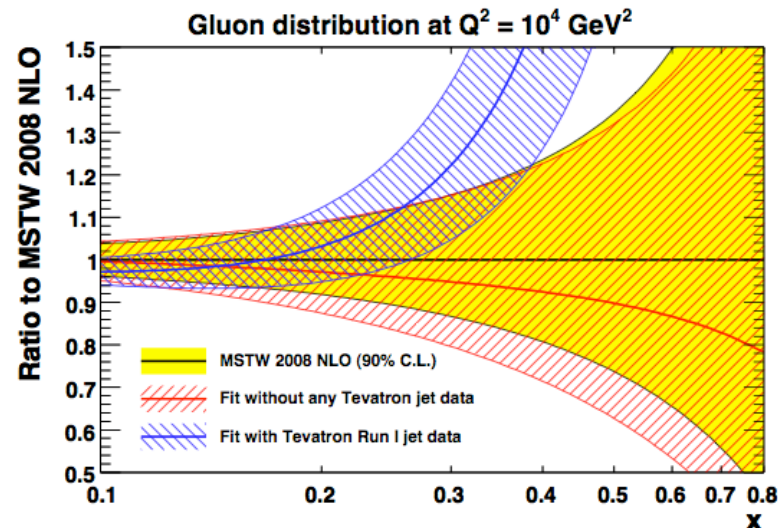


News from Global Fitters (1)

- Different conclusions reached regarding the inclusion of the Tevatron Run II data in the global fits for MSTW and CTEQ groups:

⇒ MSTW 2008

“Unlike CT09G do not find good consistency between fits to Run I and Run II”
(R. Thorne)



- Interesting to observe that inclusion of the new jet data does not have a large impact on the gluon distribution (see plot above with and without jet data)

⇒ CT09:

“Run I and Run II measurements are fairly consistent with each other”
(J. Pumplin)

- A detailed study was presented to back up this statement



News from Global Fitters (2)

- New gluon parametrisation used for the release of CT09:

Gluon parametrizations

CT09 uses

$$g(x, \mu_0) = a_0 x^{a_1} (1-x)^{a_2} \exp(a_3 x + a_4 x^2 + a_5 \sqrt{x})$$

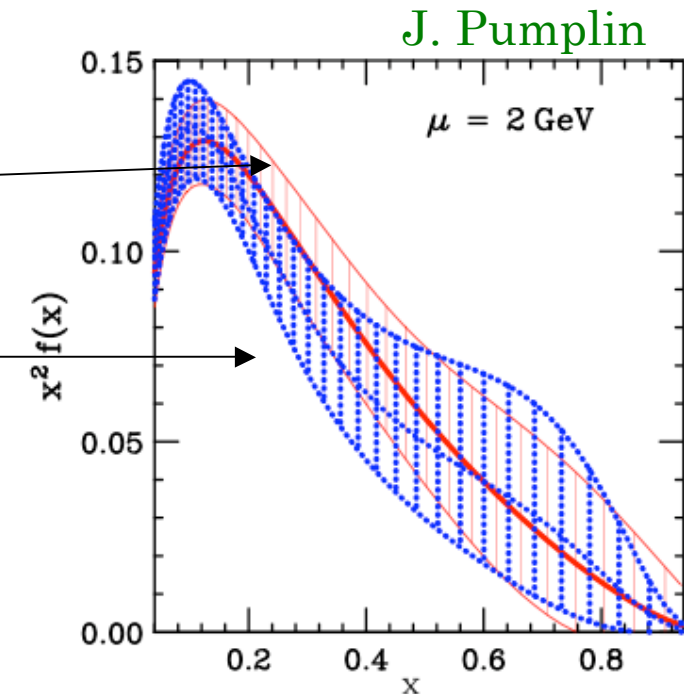
with quartic penalty in χ^2 to force $0.5 < a_2 < 10$.

CTEQ6.6 used less flexible form: $a_5 = 0$, $a_2 = 4$.

A still less flexible form has been used at HERA:

$$g(x, \mu_0) = a_0 x^{a_1} (1-x)^{a_2} (1 + a_3 x)$$

That form is too restrictive, as is seen when one attempts to fit the Tevatron jet data with it:



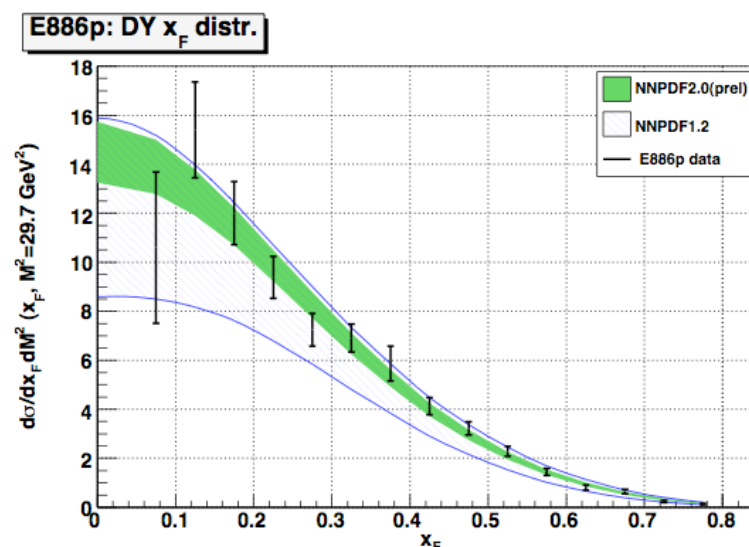
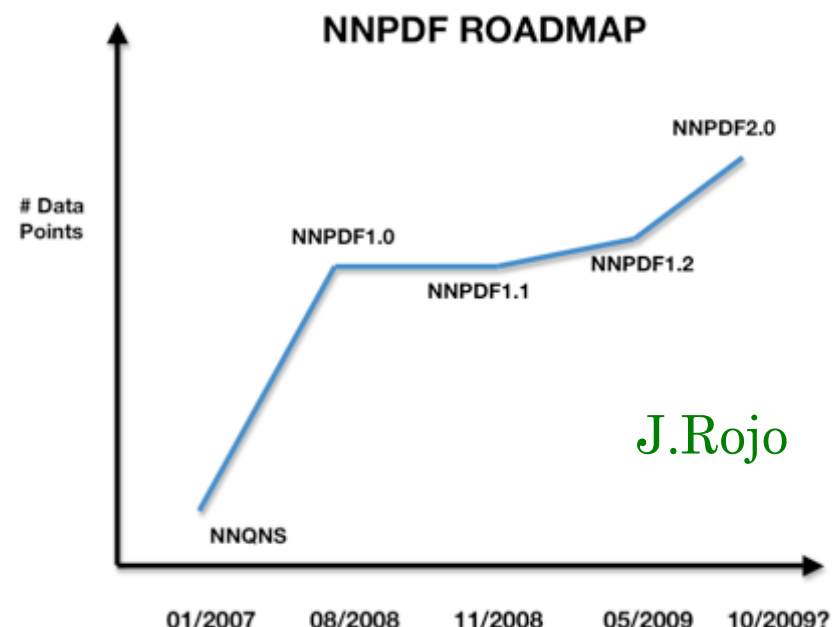
J. Pumplin

- ⇒ Criticism to the HERA PDF parametrisation
 - however, for HERAPDF0.2 extended forms of PDF parametrisations were tested



News from NNPDF group

- **NNQNS**: first determination of a single PDF
- **NNPDF1.0**: PDF set for inclusive DIS data (185 parameters)
- **NNPDF1.1**: independent parametrisation of the strange PDF
- **NNPDF1.2**: precision determination of the strange PDFs and EW parameters:
 - ⇒ Includes recent HERA II Zeus data of large Q^2 (NC/CC)
 - ⇒ Using the dimuon data from NuTeV prompts to most accurate direct determination of $|V_{cs}|$
$$|V_{cs}| = 0.93 \pm 0.06^{\text{PDFs}} \pm 0.05^{\text{theo}}$$
- **NNPDF2.0**: first NNPDF global parton analysis
 - ⇒ Will include: fixed target Drell-Yan data, Tevatron EW gauge boson production, Run II inclusive jet data





News from HERA (I)

- Impressive precision on the low-x sea and gluon of the HERAPDF0.2 is relevant for W,Z production at the LHC (see Mandy's talk)

W^+ rapidity (at 14 TeV!)

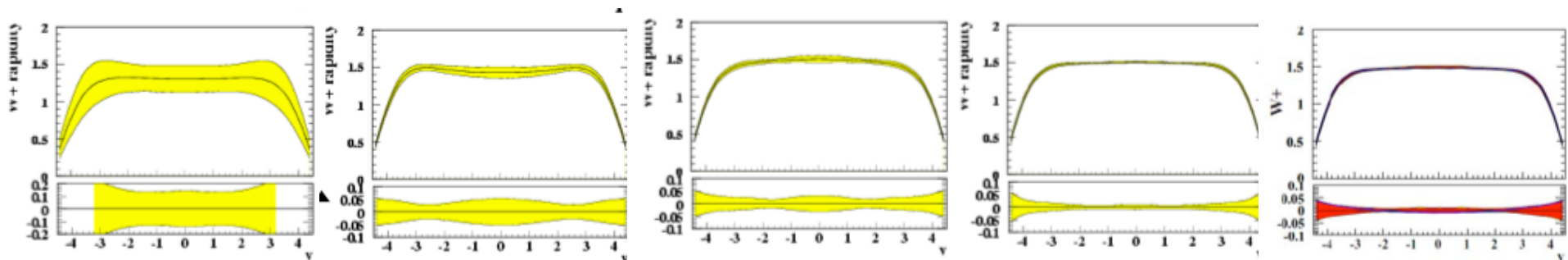
Prior HERA

post HERA
ZEUS data

prior HERA
data comb.

HERAPDF0.1
Data comb.

HERAPDF0.2
Data comb.



⇒ Inclusion of HERA data shows the tremendous improvement on the predictions for W (and Z) production at the central rapidity.

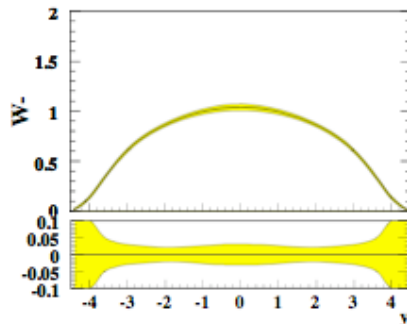
- However, in the above plots only the experimental errors were considered, the errors increase when also the model and PDF parametrisation uncertainties are taken into account.
 - ⇒ comparable to the global fits (see next slide)



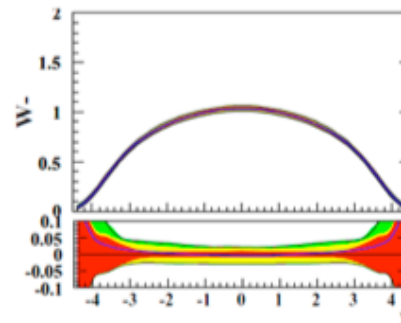
News from HERA (II)

- W^- rapidity distributions for

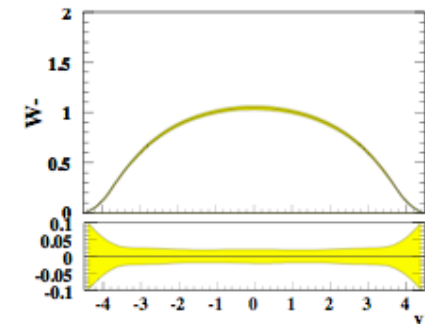
CTEQ6.6



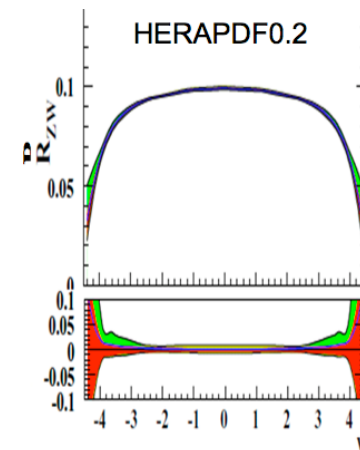
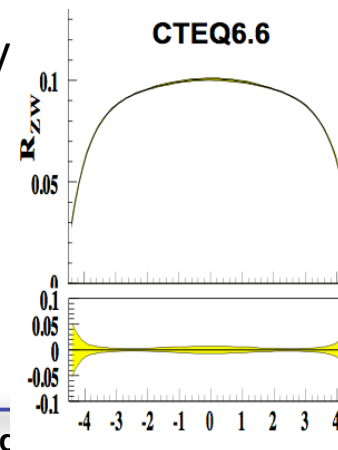
HERAPDF0.2



MSTW 2008



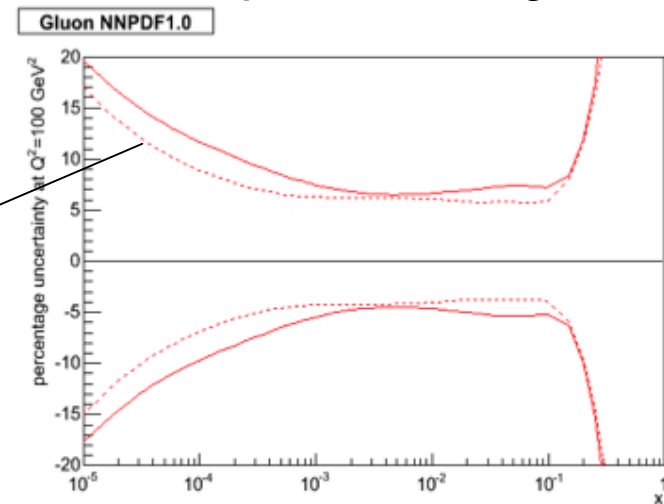
- impact of the HERAPDF0.2:
 - ⇒ Very small experimental uncertainty $<1\%$
 - ⇒ Model uncertainty $<2\%$
 - ⇒ PDF parametrisation uncertainty $<2\%$
- The ratio Z/W is a “golden benchmark measurement”:
 - ⇒ Uncertainties due to the gluon, luminosity cancels out
 - very small experimental uncertainty $<1\%$
 - The total errors are similar to CTEQ, but separation in different sources is important for correlations of PDFs.





PDF uncertainties estimation

- Hessian and Monte Carlo method give the same results in the linear (error propagation) approximation
 - ⇒ Note: MC must be done in the space of data (100 replicas enough), not in the space of parameters (a huge number of replicas is needed) - see S.Forte's talk
- Uncertainties using LHCb pseudo-data shows little impact on the gluon distributions at low- x :
 - ⇒ Effect of fit to 1fb^{-1} of LHCb using NNPDF1.0 (see R. McNulty's talk)
 - Fit includes the LHCb pseudo data
- Criticism of the dynamic tolerance method for error estimation which can produce unexpected results depending on number of input data points, etc.





PDFs for Generators

- Rico v. Samson-Himmelstjerna presented a study fitting PDFs using MC Generators:
 - ⇒ Using RAPGAP and PYTHIA in QPM leads to PDFs consistent with CTEQ6L
 - ⇒ including in addition the parton showers:
 - RAPGAP fit does not change
 - PYTHIA fit leads to changes in PDFs

- Joey Huston presented the Modified LO PDFs for MC (and Andy Buckley presented tunes of PYTHIA 6):
 - ⇒ Idea is to have PDFs that at $x \rightarrow 0$ behave like LO and at $x \rightarrow 1$ as NLO PDFs, therefore the momentum sum rule is relaxed and NLO α_s running
 - ⇒ ATLAS is including it.



Conclusions

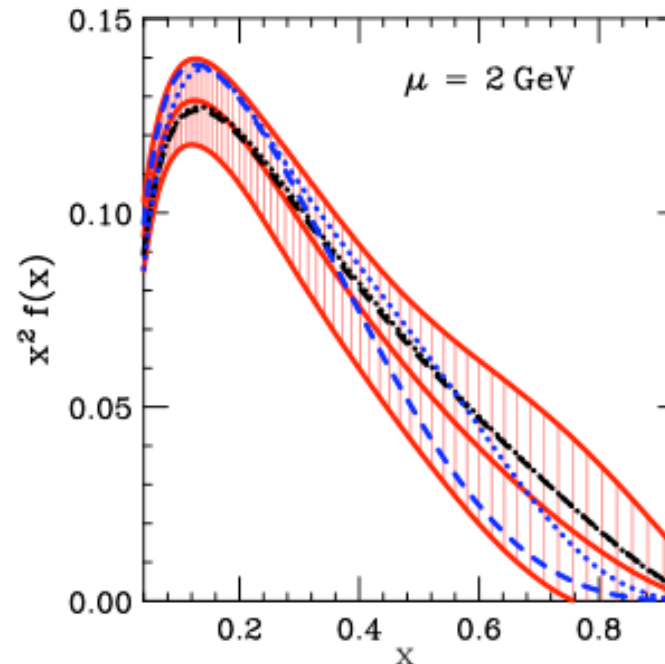
- Presented the main highlights from the PDF4LHC meeting held at CERN on 29 May 2009
 - ⇒ List of speakers:
 - Jon Pumplin, Joey Huston, Robert Thorne, Stefano Forte, Juan Rojo, Manuela Venturi, Sasha Glazov, Mandy Cooper-Sarkar, Federico von Samson-Himmelstjerna, Ronan McNulty, Andy Buckley, Mieczyslaw Krasny
 - ⇒ Covered topics:
 - news from global fitters
 - impact of the new combined HERA data on the LHC predictions.
 - Estimation of the PDF uncertainties
 - PDFs for Generators
- **Announcement:**
 - ⇒ Next meeting at CERN in August, date to be yet confirmed.
 - ⇒ **PDF4LHC meeting at DESY 23 October 2009 (after PDF school)**



Extra: CT09 vs MSTW 2008

Comparison with MSTW

J.Pumplin



Red shaded: CT09

Black: like CT09 but $\alpha_s(m_Z) = 0.12018$ (MSTW)

Blue dashed: MSTW2008NLO

Blue dotted: MSTW2004NLO

- Larger $\alpha_s \Rightarrow$ smaller quark $\Rightarrow$ larger gluon
- Once again, differences in methodology (CTEQ v. MSTW) are as large as the estimated error.