Low-x discussion Pt II

1. Jet data at medium to large x – more comparison of PDFs
2. Predictions for F_L vs Q^2 and measurements
3. Some LHC prospects and calculations

4. Geometric scaling, dipoles and GLAP
5. Form of PDF parameterisation
6. How reliable are the DGLAP analyses for low-x even with BFKL improvement
   - assumption that this works for moment N, $N > \alpha(Q^2)\, 4 \ln 2$ - so certainly not near N=0

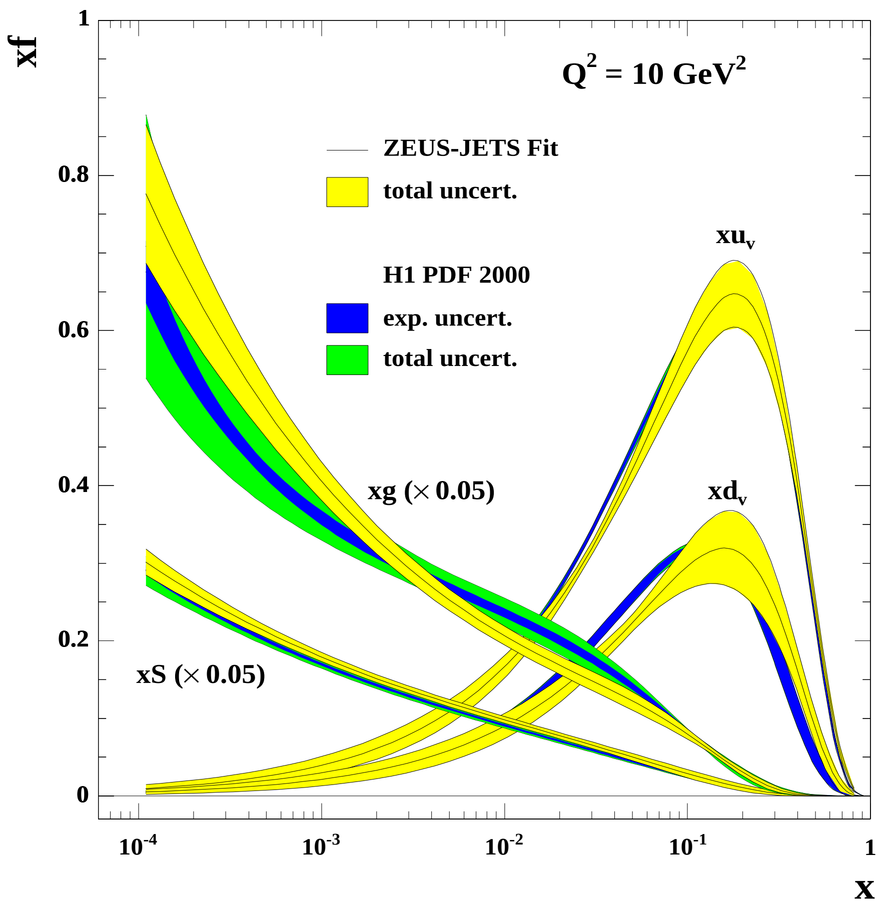
What should be done and by whom?

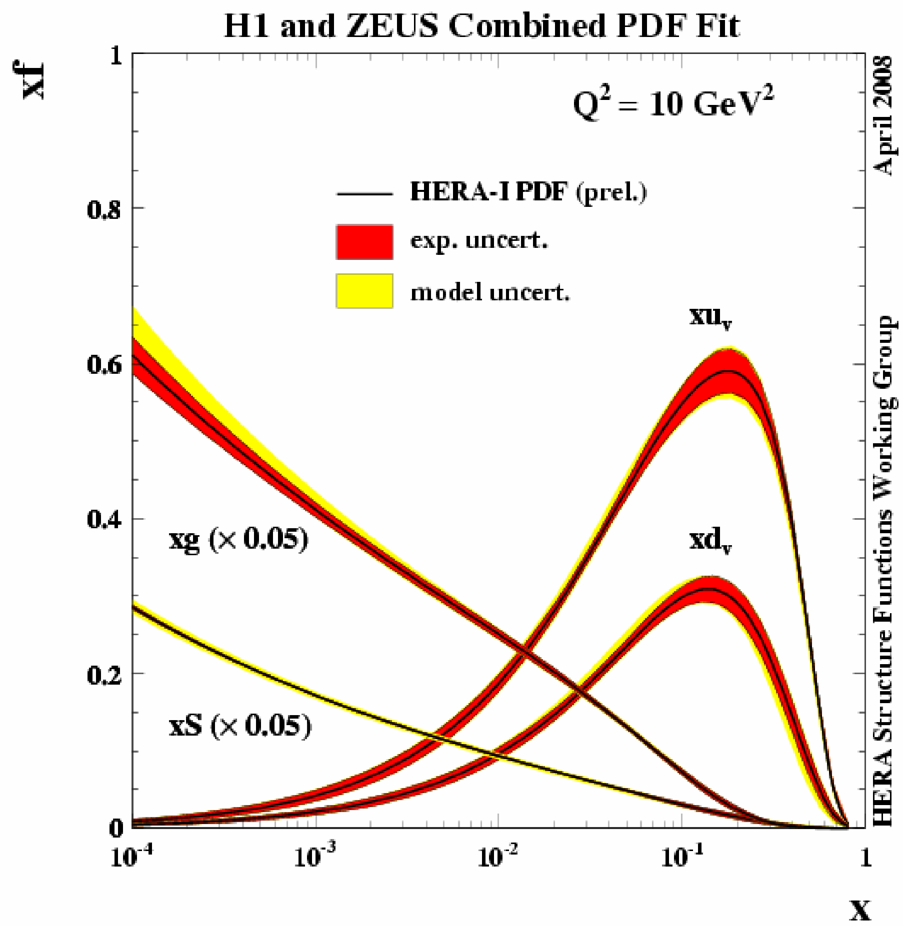
HERAPDF0.1

more comparison

Comparisons I: with H1 & ZEUS fits

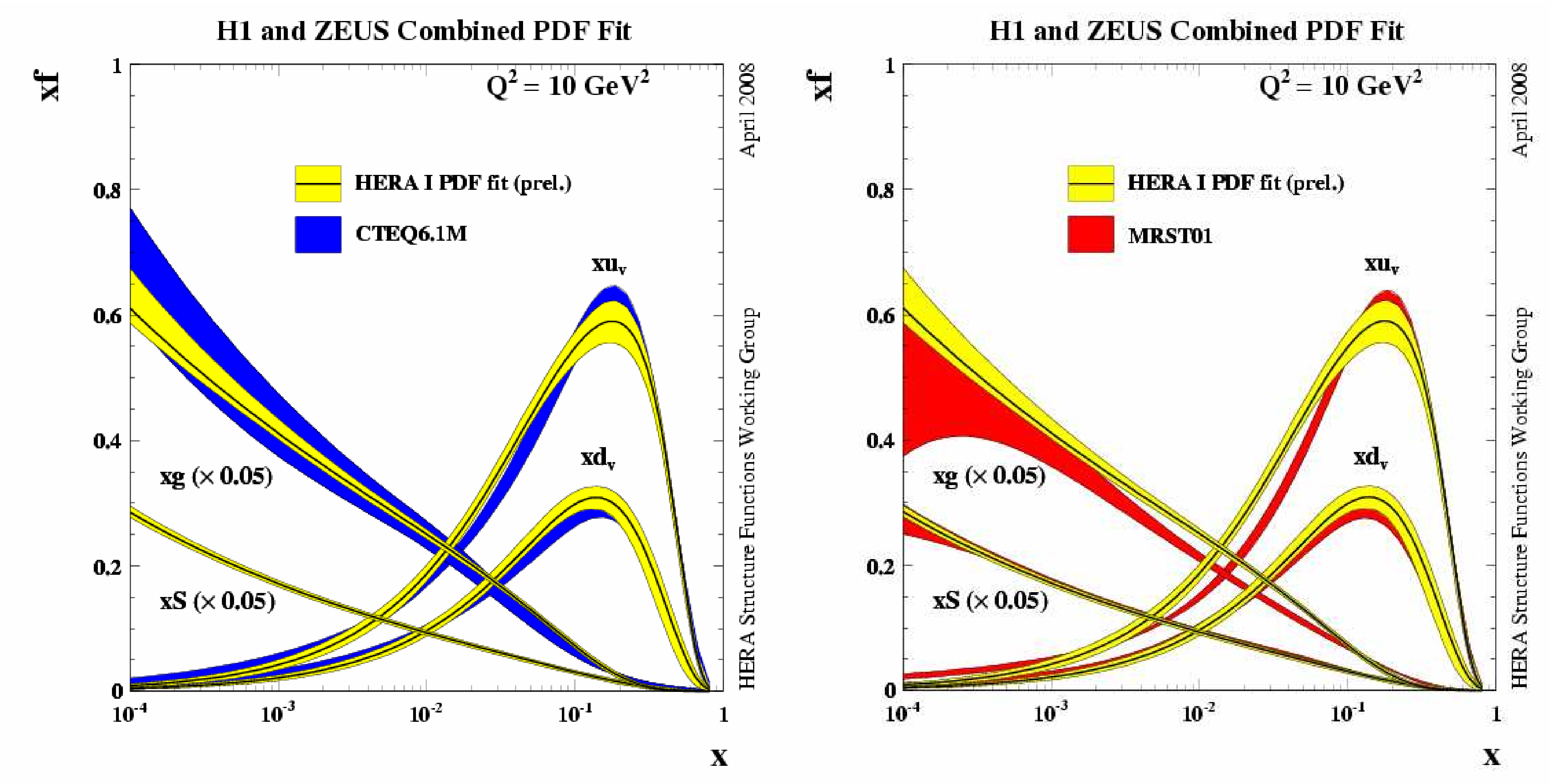
NB: H1PDF2k has α_S variation included in model error, ZEUS-Jets does not.





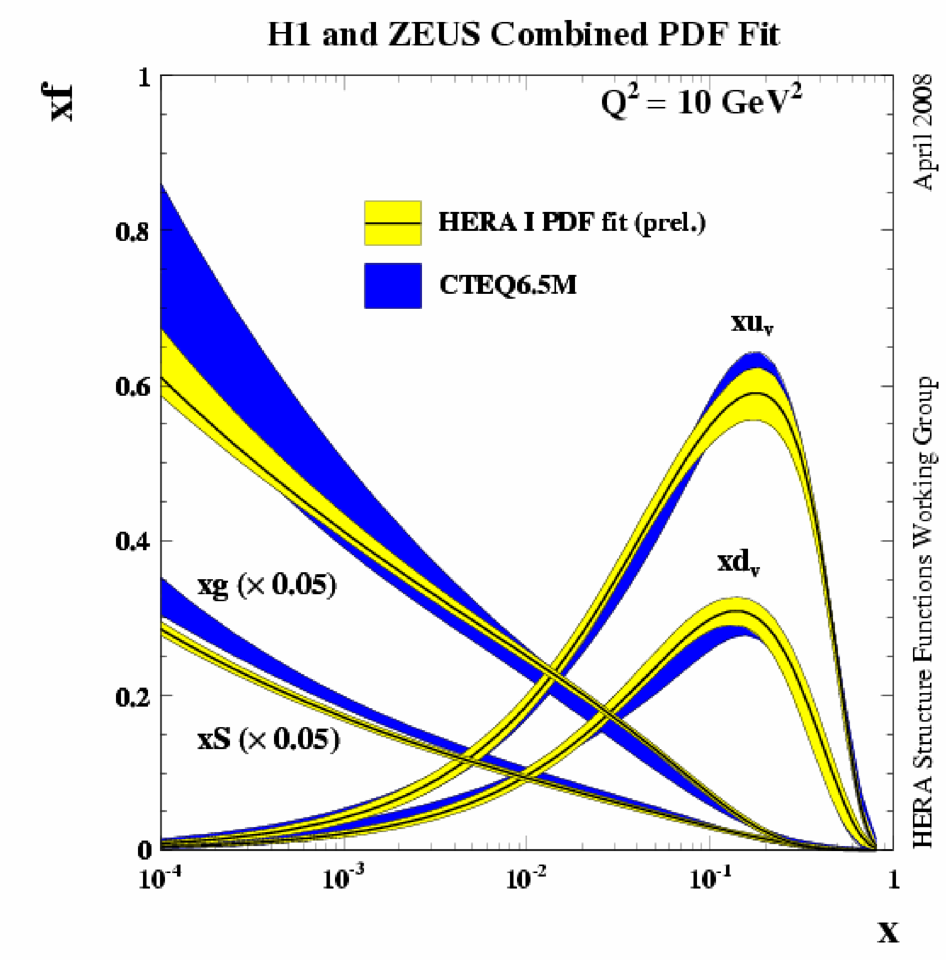
Improved precision and resolution of a discrepancy

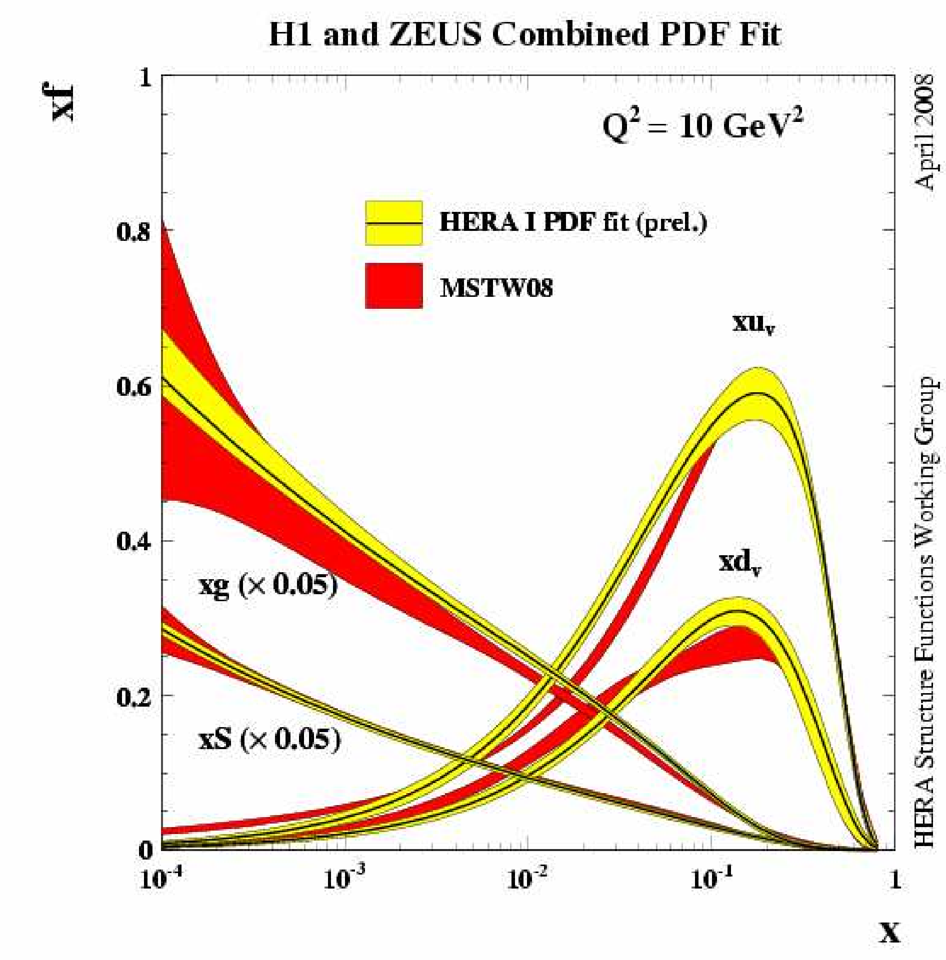
Comparisons II: with CTEQ & MRST



Difference between HERAPDF0.1 and MRST01 *xg* at low *x* is due in part to parameterisation

Compare to CTEQ and MRST analyses: newer



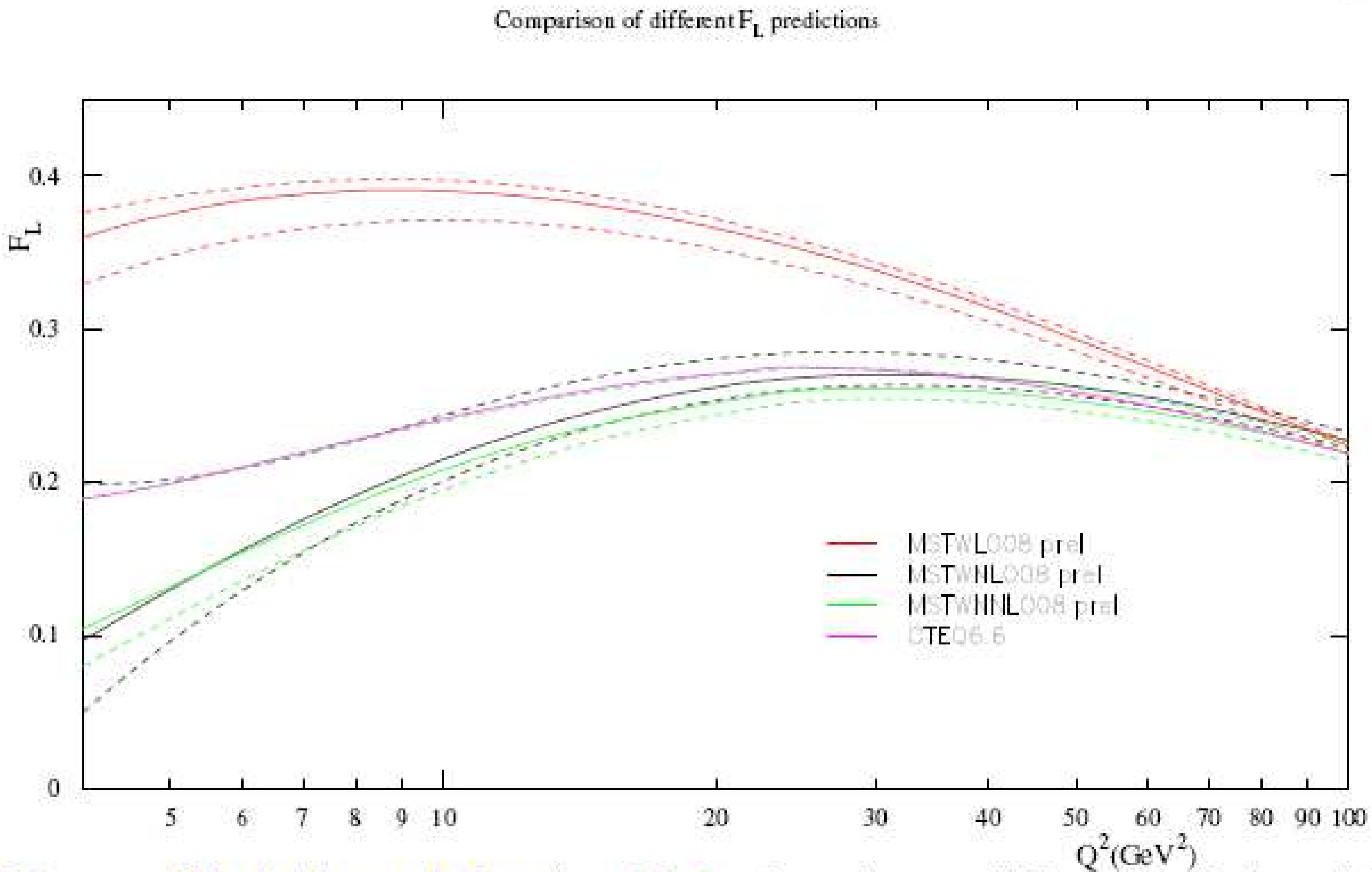


Note MSTW08 is as yet unpublished – this is a pre-release

Predictions for F_L

MSTW (R Thorne DIS08 & H)

Look at variations in predictions for HERA range of measurement. Use $x = Q^2/35420$.

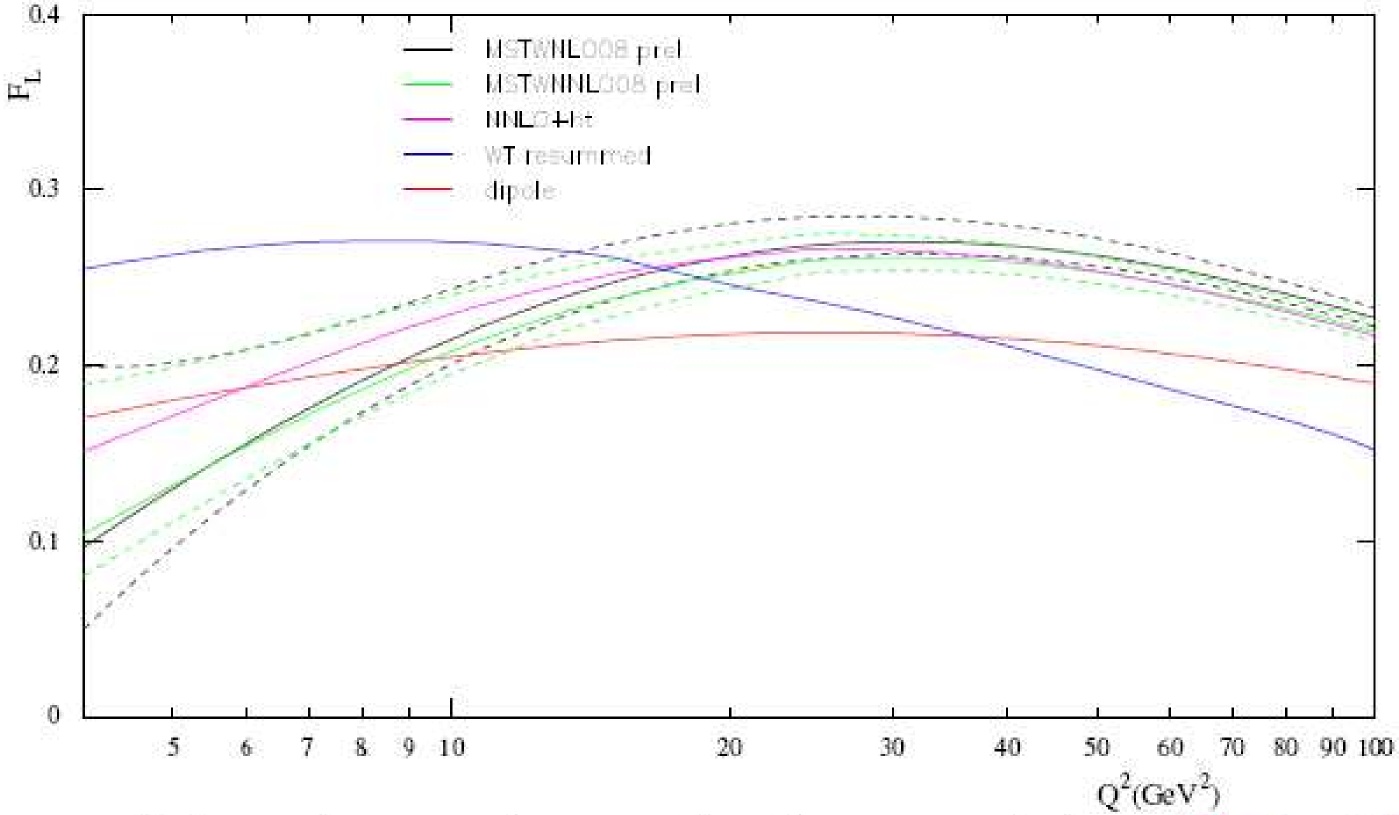


CTEQ6.6 curve (Nadolsky and Tung) at NLO, though uses different ordering definition → slight comparative increase. Within MSTW uncertainties.

Not too much variation between NLO and NNLO until lower Q^2 and x.

Look at variations in additional predictions for HERA range of measurement. Use $x = Q^2/35420$.

Comparison of different F_L predictions



Within range higher twist corrections smaller than uncertainties at NLO and NNLO. Resummations and dipole model different shape. Possible to distinguish former at lower Q^2 perhaps. Is measurement accurate enough at higher Q^2?

R Thorne DIS08 - F_L

From conclusions – R Thorne DIS08 F_L

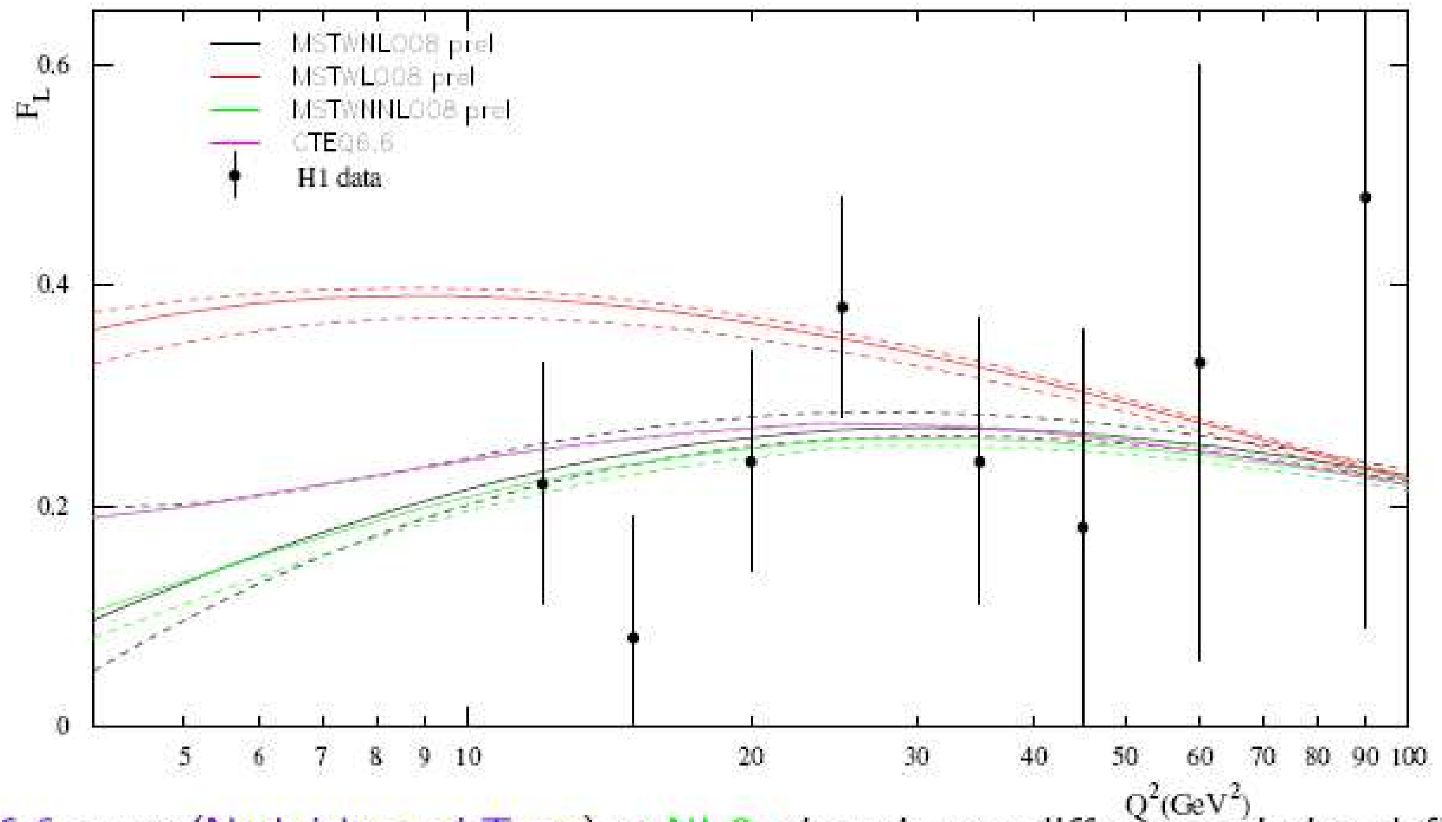
At $Q^2 \geq 10 GeV^2$ (for the x probed) the uncertainty on fixed order predictions is a few percent. An $F_L(x, Q^2)$ measurement will not add to the direct constraint on the gluon. However, there may be deviations from NLO/NNLO predictions of $20 - 30\%$ due to e.g. resummations or dipole models. Data may see some sign of deviations.

For $Q^2 \leq 10 GeV^2$ the uncertainty in NLO/NNLO predictions for $F_L(x, Q^2)$ due to gluon uncertainty increases to $> 20\%$. A good measurement of $F_L(x, Q^2)$ will automatically improve the gluon determination.

Resummations/dipole models suggest a higher low-Q^2 $F_L(x, Q^2)$ by an absolute value of up to 0.15. This is well outside even the large fixed-order uncertainties. A good measurement of $F_L(x, Q^2)$ will start to discriminate between theories.

Look at variations in predictions for HERA range of measurement. Use $x = Q^2/35420$.

Comparison of different F_L predictions



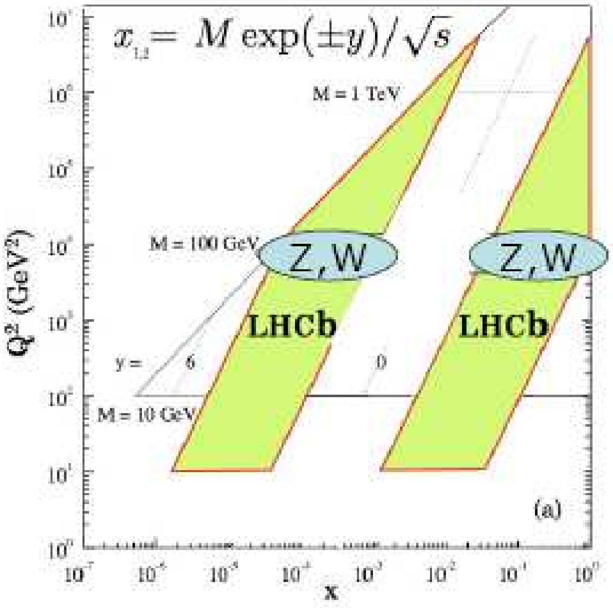
CTEQ6.6 curve (Nadolsky and Tung) at NLO, though uses different ordering definition $\rightarrow$ slight comparative increase. Within MSTW uncertainties.

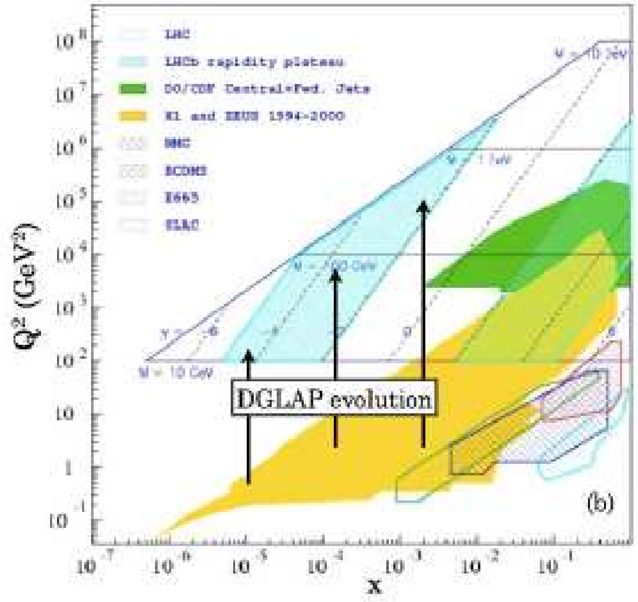
Not too much variation between NLO and NNLO until lower Q^2 and x.

HERA - LHC

LHCb – W Z @ low x (R McNulty DIS08 talk)
W Z using HERAPDF0.1 (Cooper-Sarkar & Perez)

Range in (x,Q²)



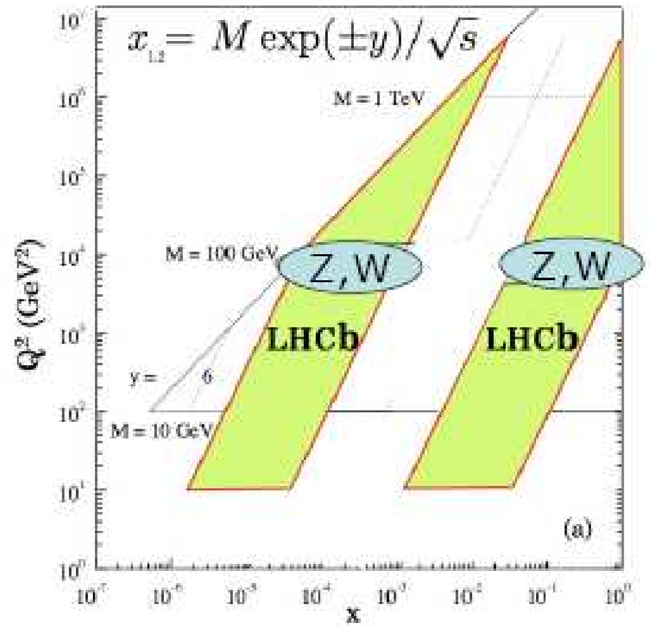


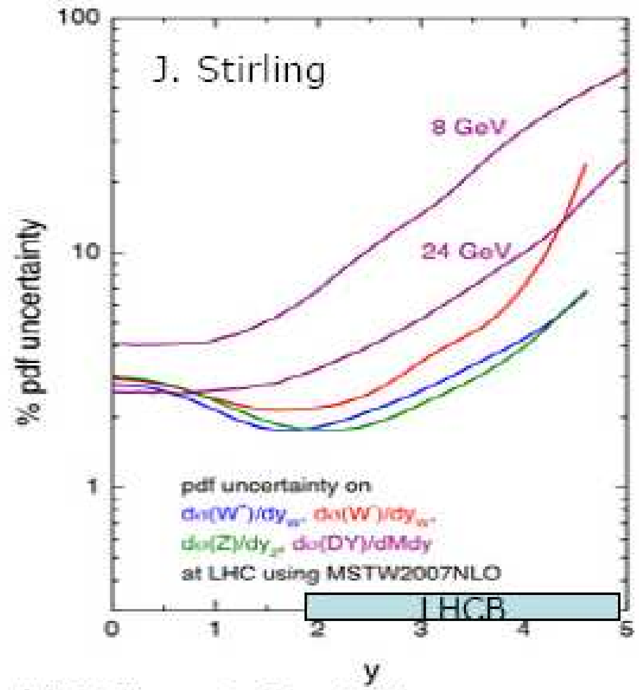
x-reach down to 10^{-6}

(if we can experimentally distinguish low mass γ^*)

8th April 2008

Range in (x,Q²)

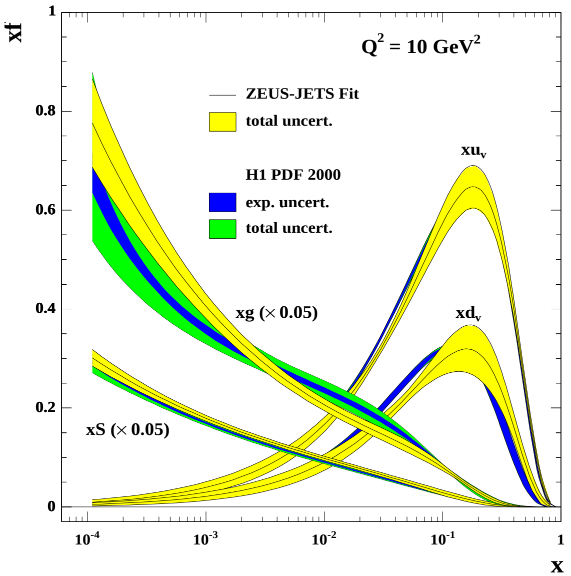


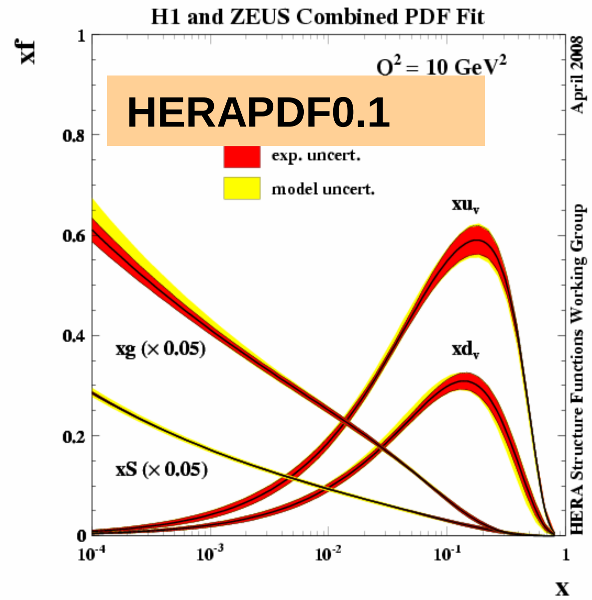


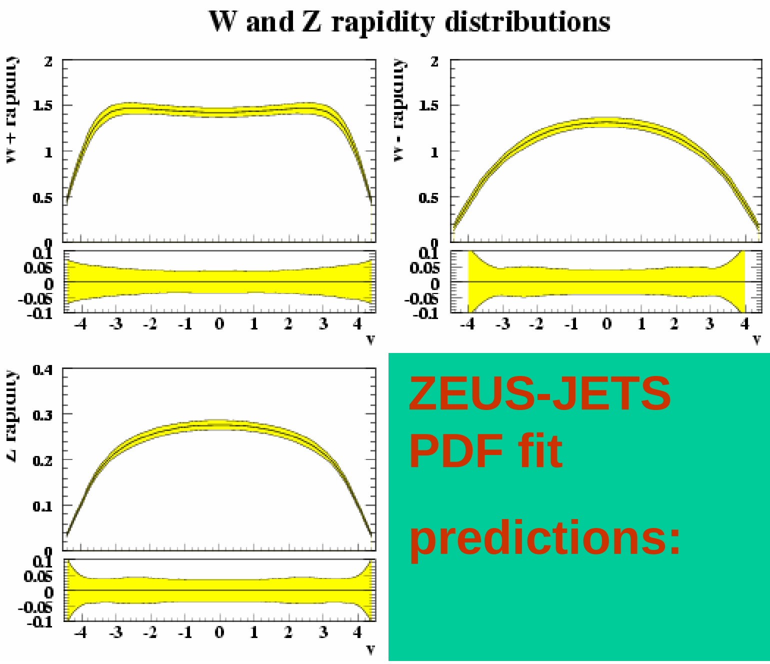
PDF uncertainty around Z,W+: 1.5- 4%

PDF uncertainty at low Q2: -> 100%

And we have just seen another dramatic improvement in our knowledge of the low-x gluon from the combined HERAPDF0.1

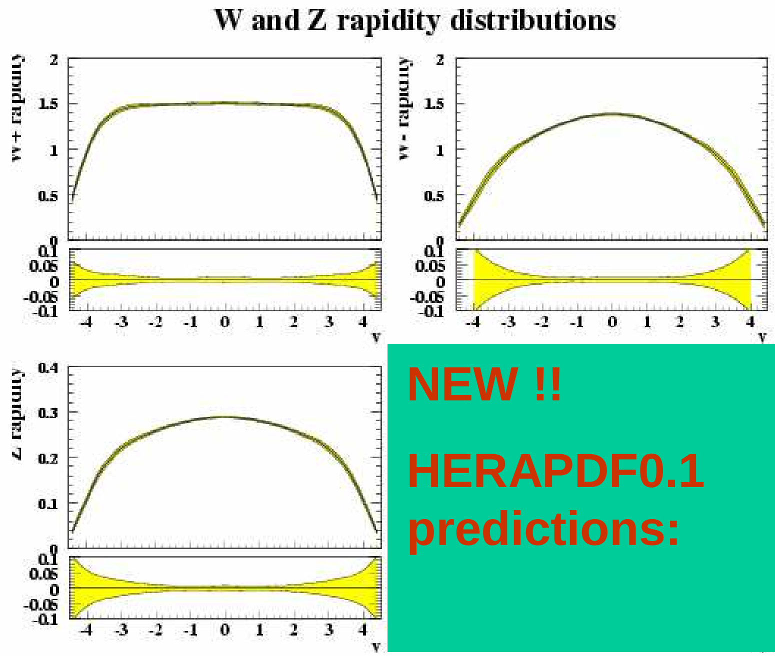






ZEUS-JETS
PDF fit

predictions:

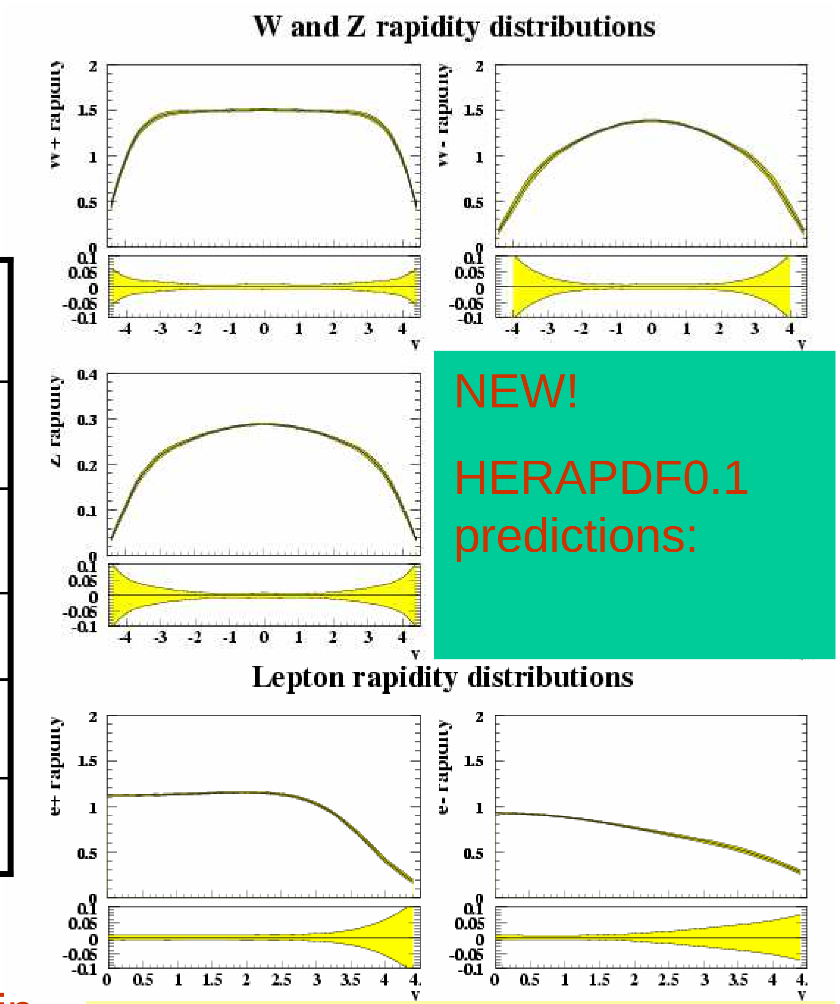


NEW !!

HERAPDF0.1
predictions:

Compare to other PDF predictions for W/Z production at the LHC

PDF set	$\sigma_{W+} B_{W\to l\nu}$ (nb)	$\sigma_{W-} B_{W\to l\nu}$ (nb)	$\sigma_{Z} B_{Z\to ll}$ (nb)
ZEUS-2005	11.87±0.45	8.74±0.31	1.97±0.06
MRST01	11.61±0.23	8.62±0.16	1.95±0.04
HERA-I	**12.13±0.13**	**9.13±0.15**	**2.01±0.025**
CTEQ65	12.47±0.47	9.14±0.36	2.03±0.07
CTEQ61	11.61±0.56	8.54±0.43	1.89±0.09



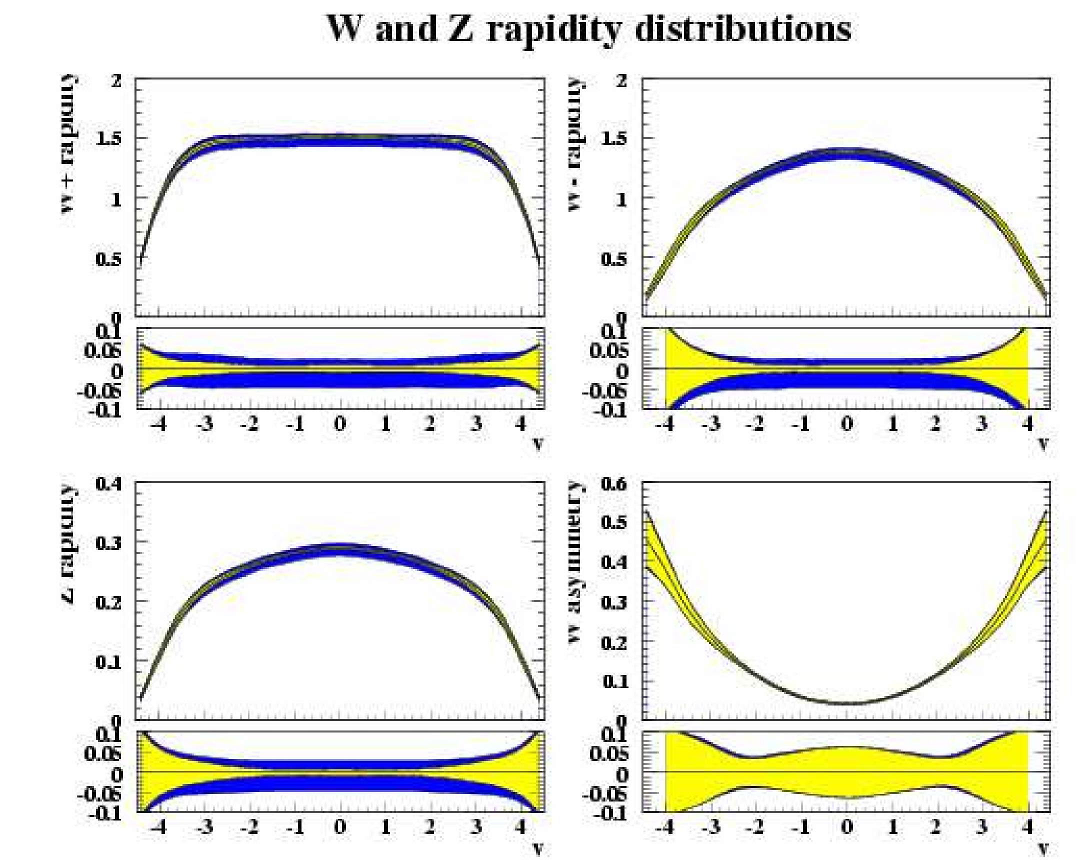
NEW!

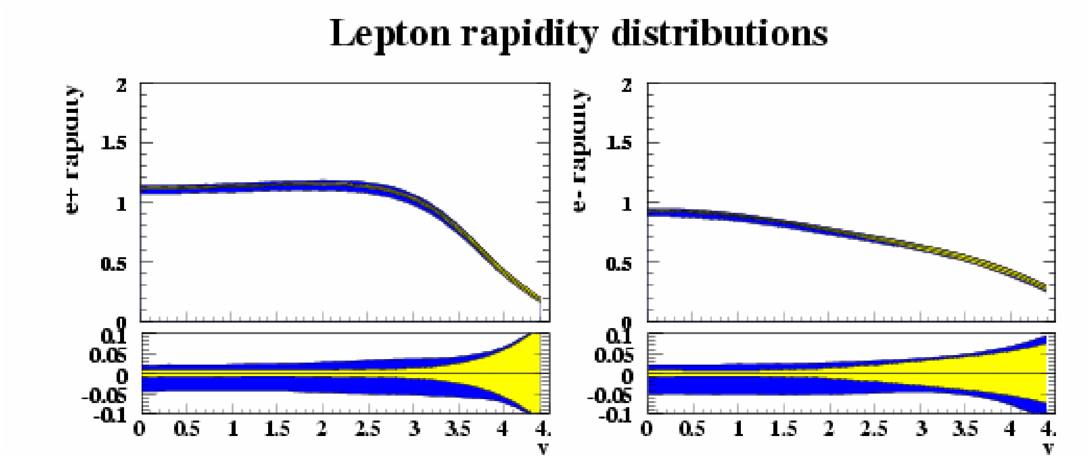
HERAPDF0.1 predictions:

The new predictions are very precise ~1.5% error in the central region

But wait.. this does NOT have model dependence

Remember we will actually measure lepton spectra not W.
Lepton +, lepton- spectra retain similar features to the W+, W-
(lepton pt cut > 25 GeV)





model dependence as a function of y:

Experimental uncert. (yellow)

Model uncert. (blue):

Q^2_0, Q^2_{min}, fs, fc, mb, mc

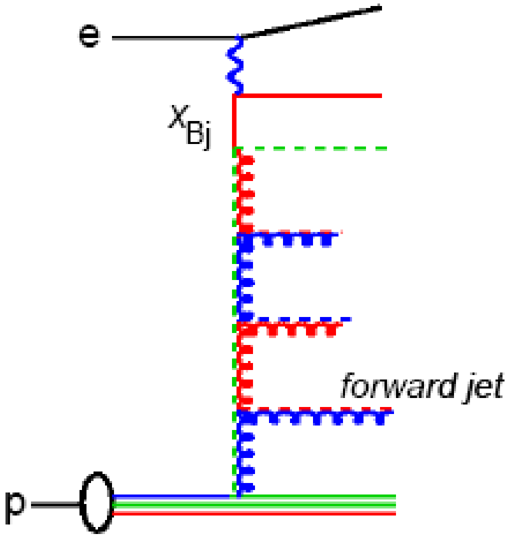
Variation of Q^2_0 most significant model uncertainty in the measurable range

These slides from AMCS & EP @ HERA-LHC May 08

Forward jets at CMS

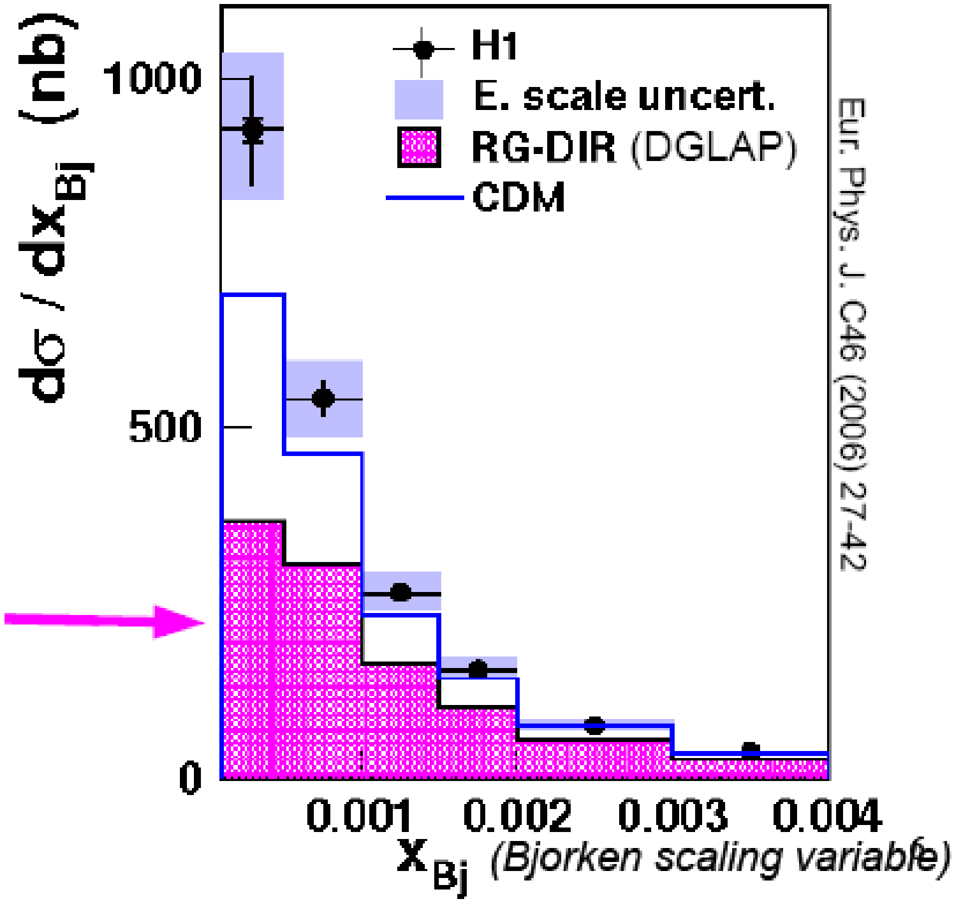
A Knutsson (HERA-LHC May 08)

In ep physics at HERA DGLAP describes inclusive measurements (e.g. F_2) successfully.
but fails for more exclusive final states, for example forward jet production:

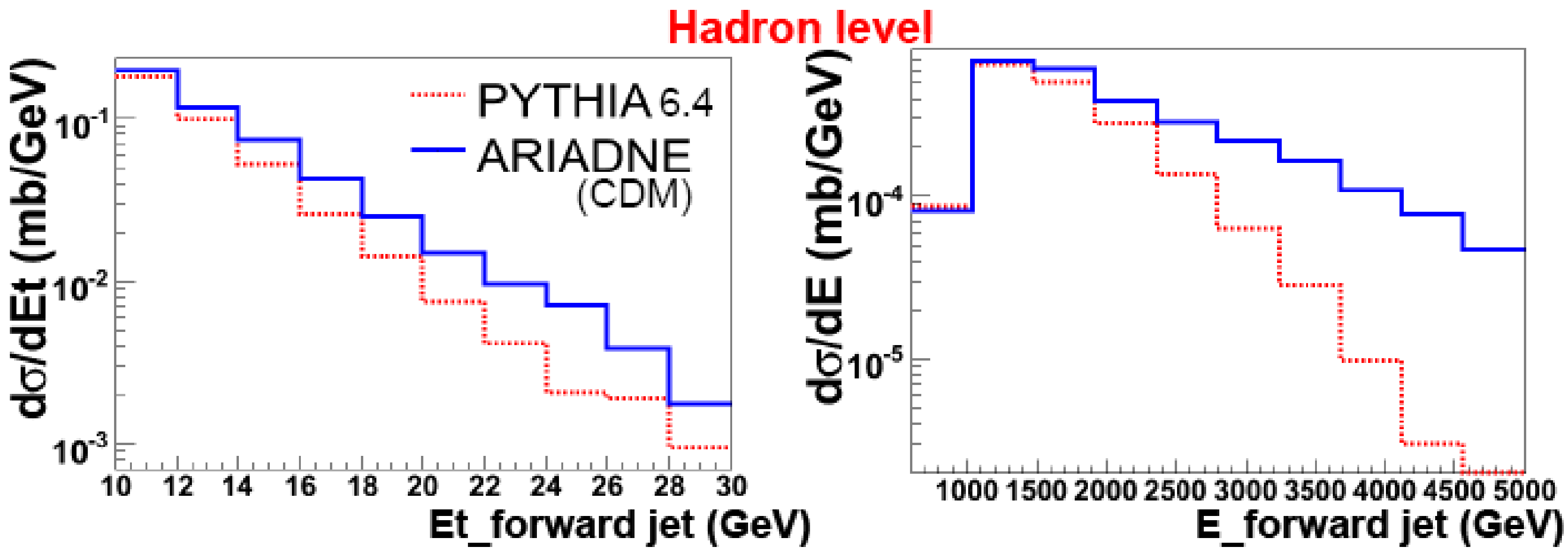


Ordering of kt of emissions (DGLAP) are not sufficient.

Need more hard emissions in forward region.



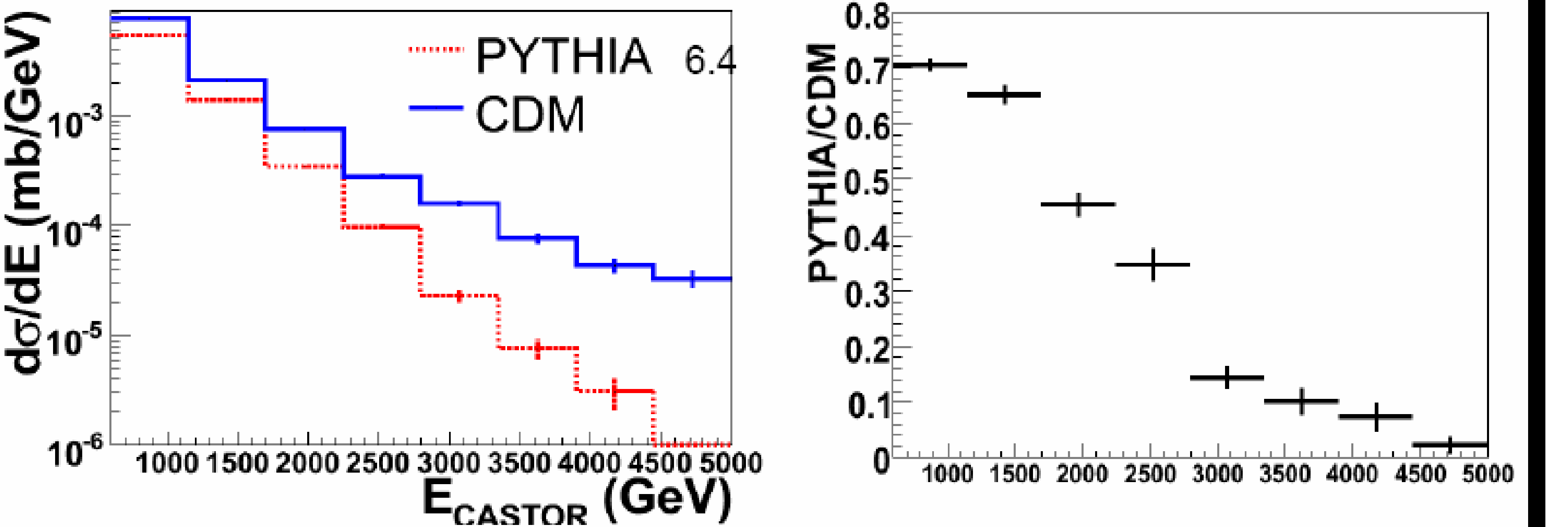
Selection: 2 central jets, 1 jet in CASTOR region $(5.2 < \eta < 6.6)$
with $E_t > 10$ GeV



ARIADNE with the Color Dipole Model – giving a more BFKL like final state – with partons unordered in kt (with respect to rapidity) – predicts more hard jets in the CASTOR region.

Both PYTHIA and ARIADNE are run together with Multipartoninteractions Tune A. (Tune A = One of the R. Field tunes to TEVATRON data.)

After: -Energy smearing of particles
-Noise cut of particles (E_particles > 10 GeV)
-Summing up energy in most active CASTOR segment+neighbours



→ **By using CASTOR we can make measurements that distinguish between the different QCD models (DGLAP/non-DGLAP).**