Confronting HERAPDF with Tevatron data and LHC data
PDF4LHC march 7th 2011
A M Cooper-Sarkar

- +Tevatron W-asymmetry and Z0 rapidity spectrum
- +Tevatron jets--- with apologies to D0, so far only CDF data fitted
- LHCb lepton asymmetry
- CMS lepton asymmetry
- ATLAS lepton asymmetry

AMCS, A Glazov, V Radescu, S Whitehead, A Sapronov

How good or bad is the HERAPDF description of the Tevatron data?.

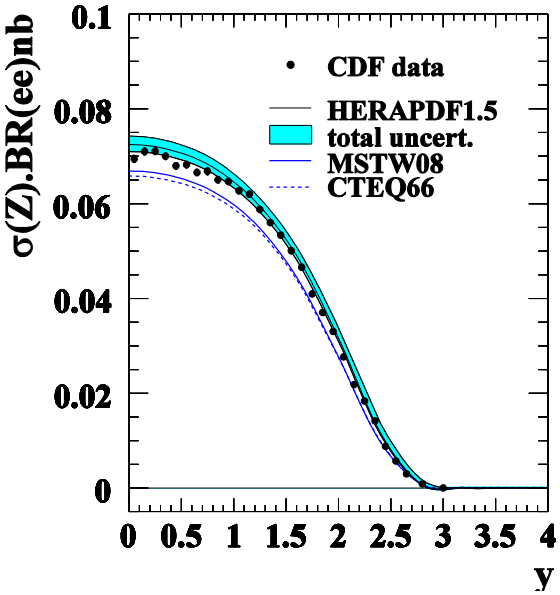
We usually just show you plots. Let's calculate χ2- and then FIT the data.

Can the error bands of HERAPDF!.5 cover the variation due to input of new data?

The description of the CDF Z0 rapidity LOOKS OK but what is the χ2 for these data points to HERAPDF1.5 central values?

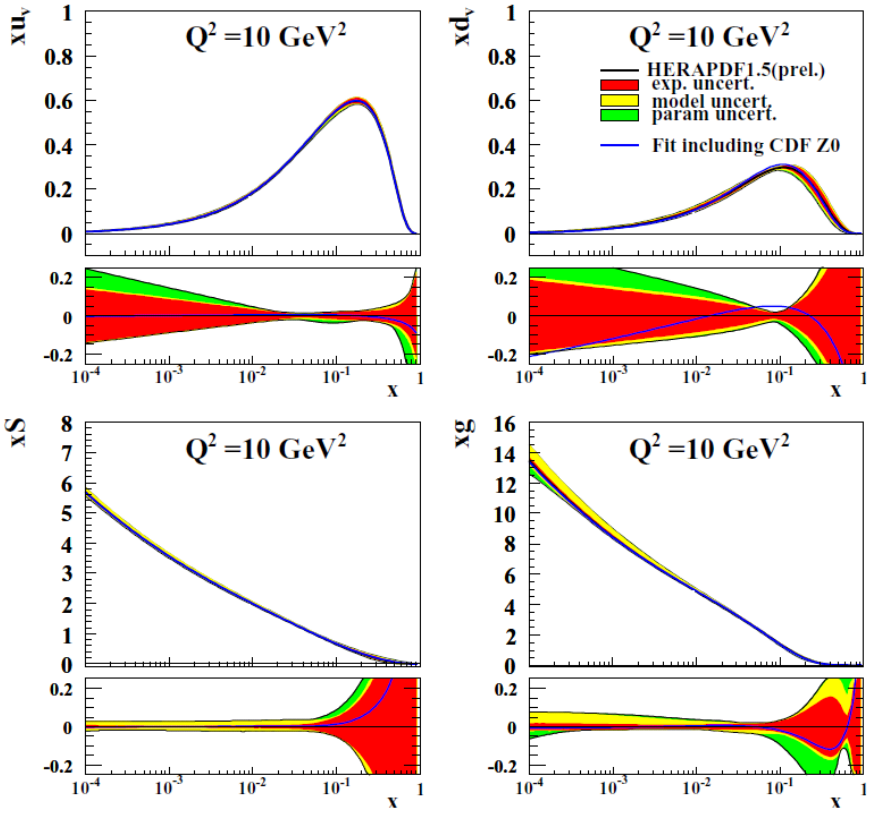
36/28 -acceptable

But this does NOT account for the error band of the HERAPDF fit



So FIT the CDF Z0 rapidity data: χ2/ndp =30.5/28

And look to see if the resulting PDF has shifted outside error bands. Here the HERADF+CDF Z0 rapidity fit is the blue line– it does NOT move outside the HERAPDF1.5 error bands



$xf(x,Q_0^2)=Ax^B(1-x)^C(1+Dx+Ex^2)$

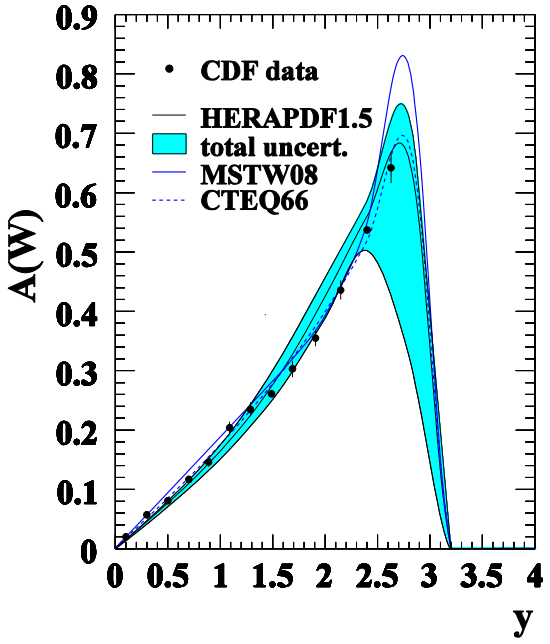
The fit is done with HERAPDF standard parametrisation BUT with the low-x Bdv parameter of the d-valence freed so that Bdv ≠ Buv

(note this was one of our standard parametrisation variations)

The description of the CDF W-asymmetry LOOKS OK but what is the χ2 for these data points to HERAPDF 1.5 central values?

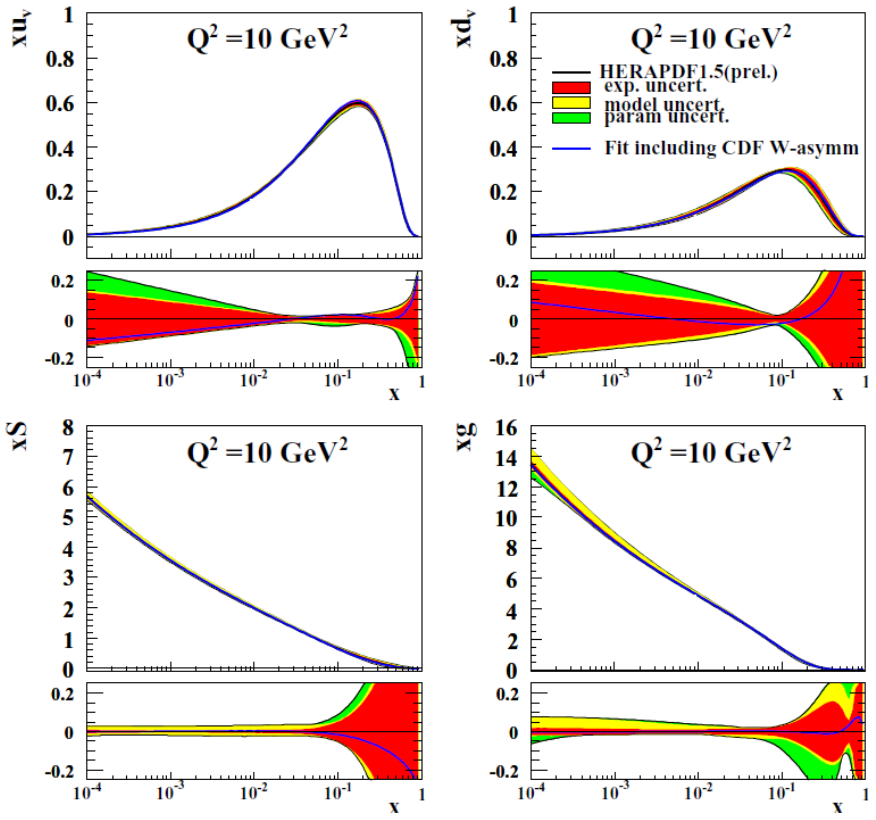
40/13 --not very good

But this does NOT account for the error band of the fit



So FIT the CDF W-asymmetry data: $\chi^2 = 21/13$

And look to see if the resulting PDF has shifted outside our error bands. Here the HERADF+CDF W- asymmetry fit is the blue line– it does NOT move outside the HERAPDF1.5 error bands



Note the χ^2 is comparable to that of NNPDF 24/13

$$xf(x,Q_0^2)=Ax^B(1-x)^C(1+Dx+Ex^2)$$

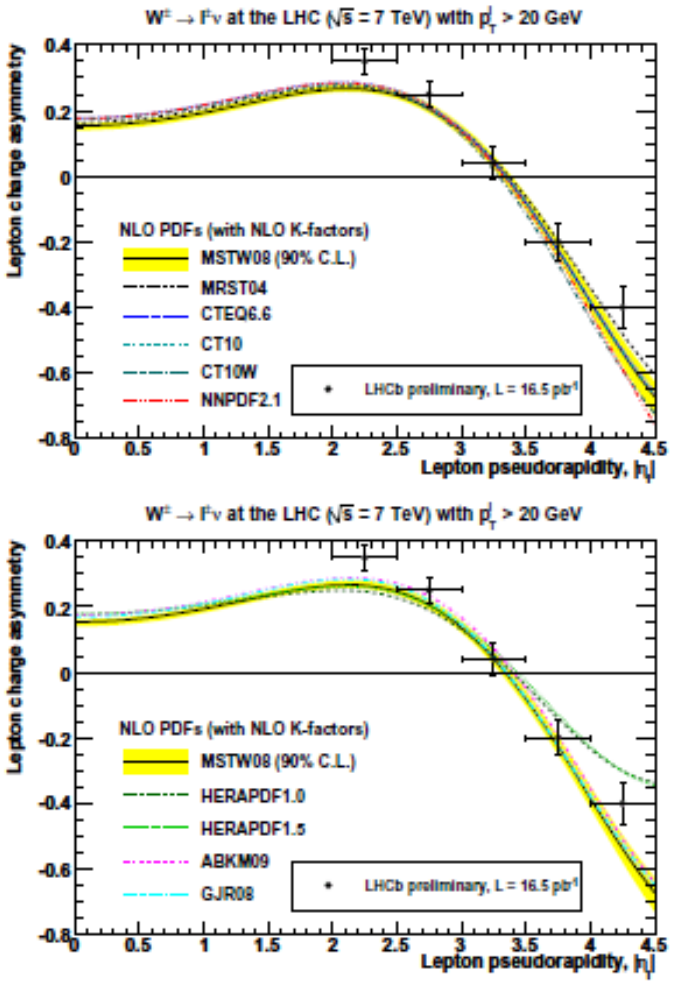
The fit is done with HERAPDF standard parametrisation BUT with the low-x Bdv parameter of the d-valence freed so that Bdv ≠ Buv

Since the W-asymmetry measures uv-dv is is desirable to allow more freedom in the valence sector

(note this was one of our standard parametrisation variations)

Sticking with W and Z data move to the LHC

HERAPDF1.0 and 1.5 compared to LHCb lepton asymmetry data- no time to fit yet

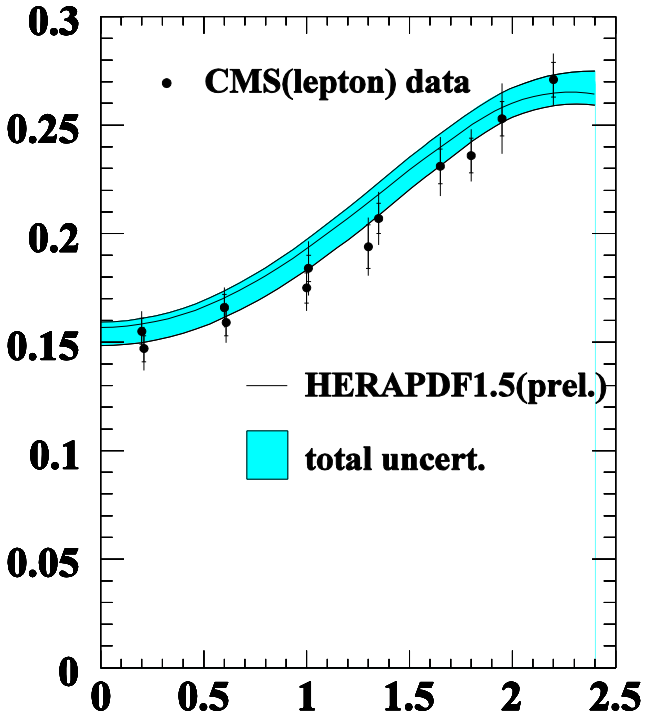


From G. Watt

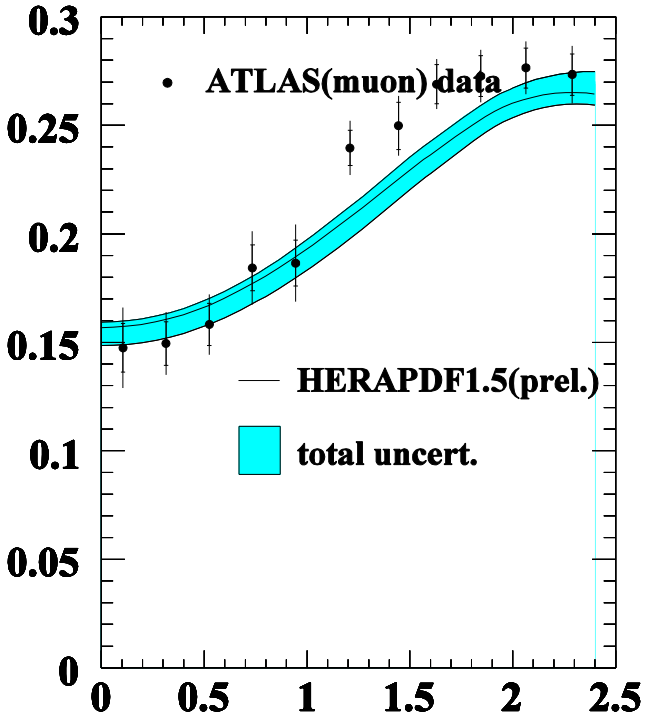
HERAPDF1.5 compared to CMS lepton asymmetry
data- go the data points from La Thuile

no time to fit yet- but it looks pretty good

Pt lepton > 25 GeV?
Also Etmiss > 25 GeV?



HERAPDF1.5 compared to ATLAS muon asymmetry data– this I have had time to fit(!)



What is the χ2 for these data points to HERAPDF 1.5 central values?

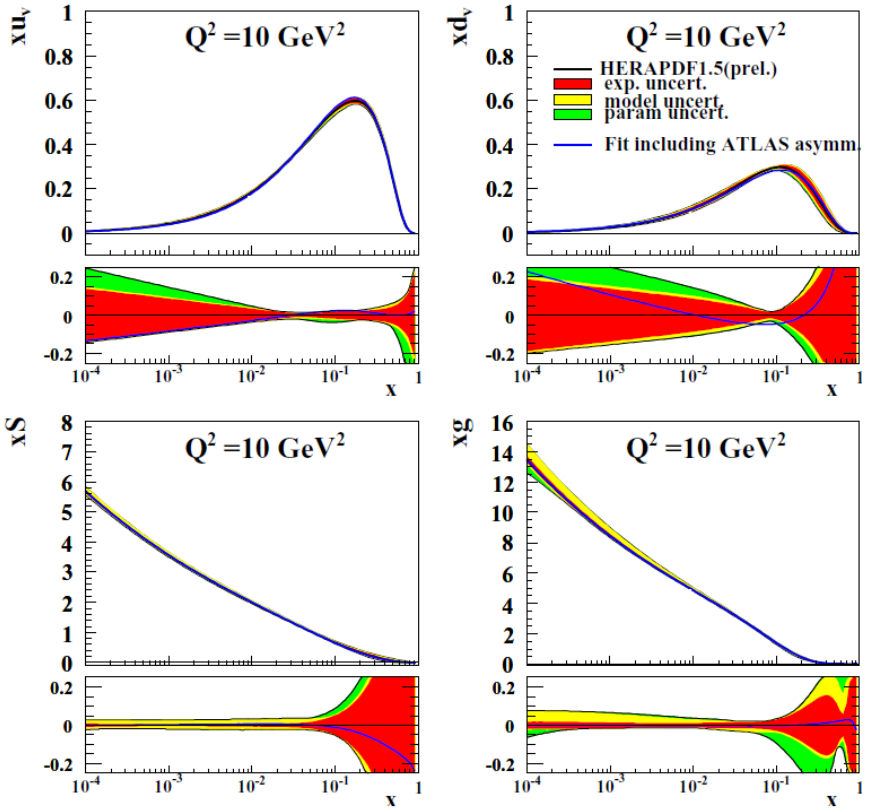
27/11 --not very good

But this does NOT account for the error band of the fit

Ptmuon > 20 GeV
Et miss > 25 GeV

So FIT the ATLAS muon asymmetry data: χ^2 = 13.5/11

And look to see if the resulting PDF has shifted outside our error bands. Here the HERADF+CDF W- asymmetry fit is the blue line– it does NOT move outside the HERAPDF1.5 error bands



$$xf(x,Q_0^2)=Ax^B(1-x)^C(1+Dx+Ex^2)$$

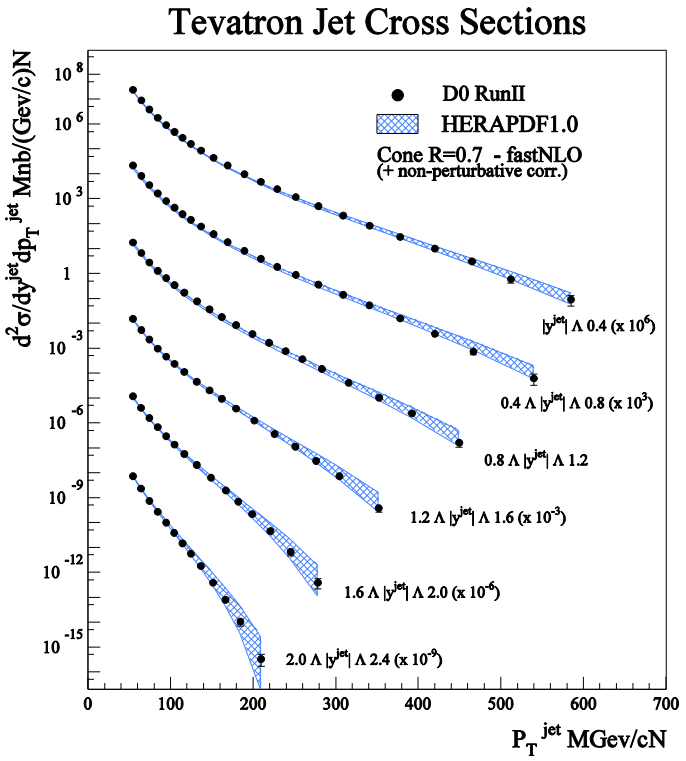
The fit is done with HERAPDF standard parametrisation BUT with the low-x Bdv parameter of the d-valence freed so that Bdv ≠ Buv

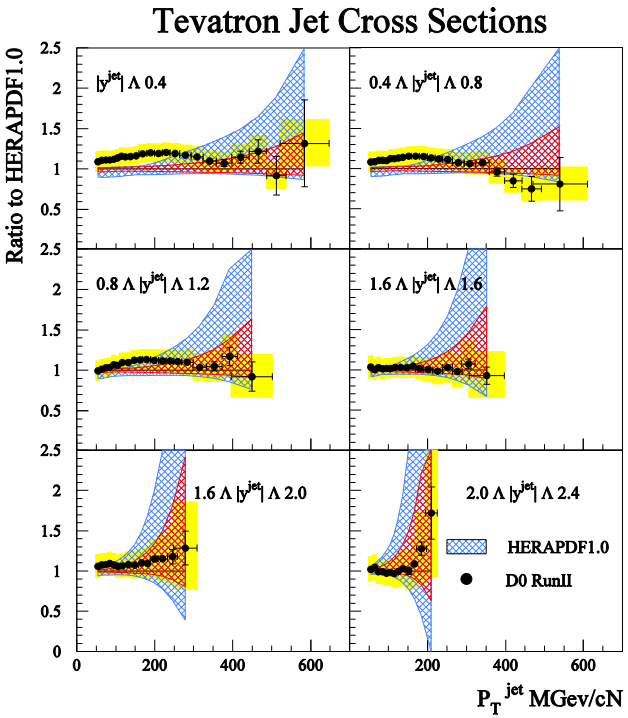
Since the W-asymmetry measures uv-dv is is desirable to allow more freedom in the valence sector

(note this was one of our standard parametrisation variations)

Now return to Tevatron jets

The description of the D0 jet data LOOKS OK but what is the χ2 for such jet data to HERAPDF1.5 central values?





Description of CDF II inclusive jet (k_T) data [hep-ex/0701051]

- Values of $\chi^2/N_{\text{pts.}}$ with (without) accounting for correlations:

NLO PDF	$\mu = p_T/2$	$\mu = p_T$	$\mu = 2p_T$
MSTW08	0.75 (0.30)	0.68 (0.28)	0.91 (0.84)
CTEQ6.6	1.25 (0.14)	1.66 (0.20)	2.38 (0.84)
CT10	1.03 (0.13)	1.20 (0.19)	1.81 (0.84)
NNPDF2.1	0.74 (0.29)	0.82 (0.25)	1.23 (0.69)
HERAPDF1.0 ($\alpha_S = 0.1176$)	2.43 (0.39)	3.26 (0.66)	4.03 (1.67)
ABKM09	1.62 (0.52)	2.21 (0.85)	3.26 (2.10)
GJR08	1.36 (0.23)	0.94 (0.13)	0.79 (0.36)

NNLO PDF	$\mu = p_T/2$	$\mu = p_T$	$\mu = 2p_T$
MSTW08	1.39 (0.42)	0.69 (0.44)	0.97 (0.48)
HERAPDF1.0 ($\alpha_S = 0.1145$)	2.64 (0.36)	2.15 (0.36)	2.20 (0.46)
HERAPDF1.0 ($\alpha_S = 0.1176$)	2.24 (0.35)	1.17 (0.32)	1.23 (0.31)
ABKM09	2.55 (0.82)	2.76 (0.89)	3.41 (1.17)
JR09	0.75 (0.37)	1.26 (0.41)	2.21 (0.49)

- Similar trends for CDF II (cone) data and DØ II (cone) data.

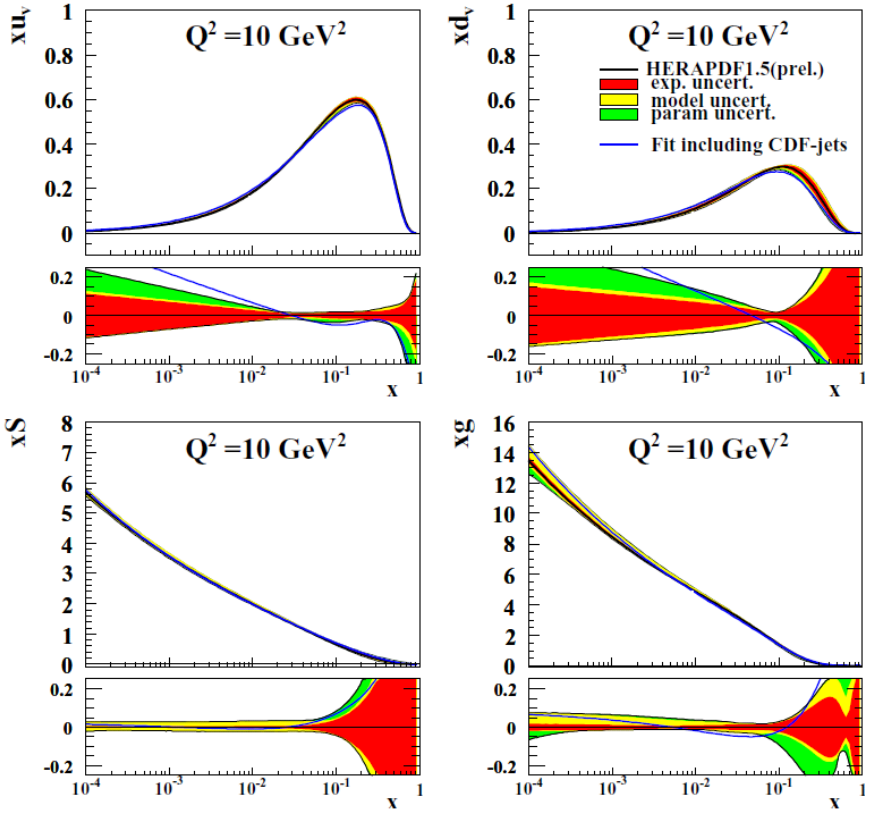
Table from G Watt

The χ2 to these CDF data for HERAPDF1.5 is 176/76 –close to Watt's value for HERAPDF1.0 – not surprising since high-x gluon does not change much 1.0 to 1.5

After fitting these CDF jet data the $\chi 2 = 113/76$

And look to see if the resulting PDF has shifted outside our error bands. Here the HERADF+CDF D0 rapidity fit is the blue line– it does NOT move much outside the HERAPDF1.5 error bands- does have a hard high-x gluon- at the edge of the error band.

Better $\chi 2$ would come from the use of the flexible parametrisation and free alphas… future work

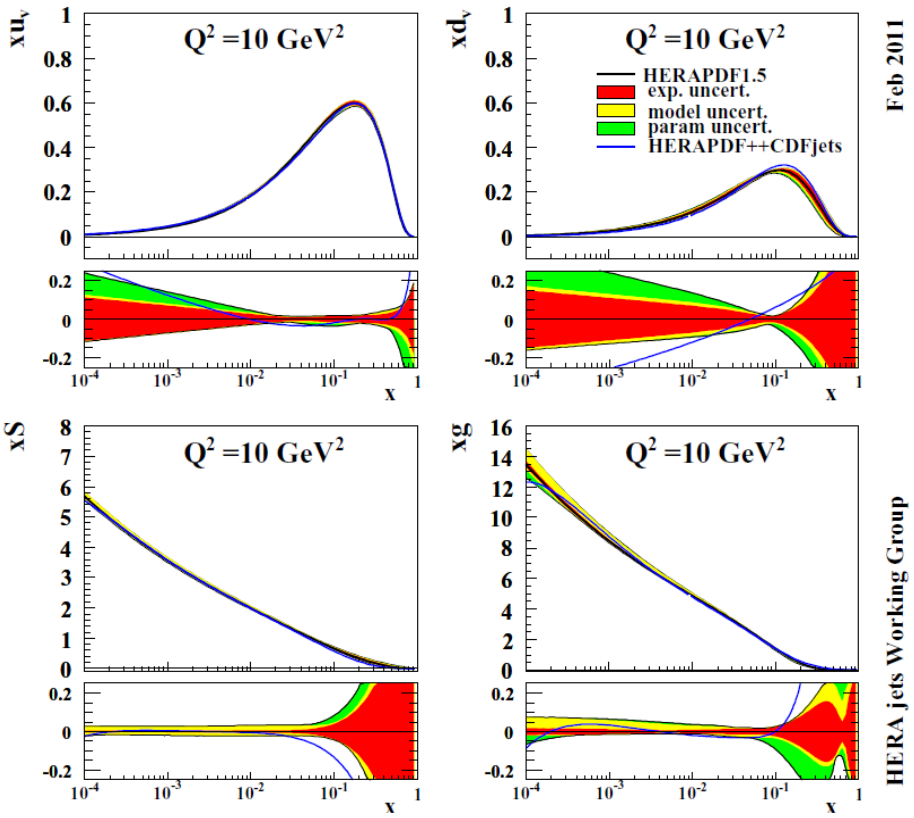


The message is that the HERAPDF1.5 describes the Tevatron and early LHC data well – within its error bands

But of course we are working on improved HERAPDF fits

And NNLO HERAPDF1.5f with uncertainty bands is on its way..

extras



Fit to CDF jets data with very flexible paraemtrisation

Chisq= 78/76..

But outside HERAPDf1.5 !

Could also try fitting alphas on less flexible param