News from HERAPDF

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PDF4LHC

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News from HERAPDF on adding HERA jet data to the fit–

more information on gluon and alphas

this is on behalf of ZEUS and H1

And news on confronting HERAPDF with Tevatron and LHC data

this can only be blamed on a smaller group of fitters

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

The only fit using just HERA purely proton data:

Information from NC and CC, e+ and e-

Sea (NC) and Valence (CC and NC e-/e+ difference) and gluon from scaling violations

•No need for nuclear/deuterium corrections--- arXiv:1102.3686- uncertainties in deuterium corrections can feed through to the gluon PDF in global fits including jet data

•No need for dubious corrections for FL when extracting F2 –arXiv:1101.5261

• No need for neutrino data heavy target corrections. No assumption on strong isospin

Firstly we have extended our parametrisation

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

	A	B	C	D	E
uv	Sum rule	free	free	var	free
dv	Sum rule	=Buv	free	var	var
UBar	=(1-fs)ADbar	=BDbar	free	var	var
DBar	free	free	free	var	var
glue	Sum rule	free	free	var	var

HERAPDF1.5

A'g	B'g
var	var

extended gluon parametrisation $Ag\ x^{Bg}\ (1-x)^{Cg}\ (1+Dx+Ex^2) - A'g\ x^{B'g}\ (1-x)$

The table summarises our usual parametrisation choices and the parametrisation variations that we consider in our uncertainty estimates (and we also vary the starting scale Q^2_0)

Model uncertainties on mc,mb,fs,Q2cut are also included

Now we chose to free Duv, Bdv and A'g, B'g as part of our standard parametrisation

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

	A	B	C	D	E
uv	Sum rule	free	free	free	free
dv	Sum rule	free	free	var	var
UBar	=(1-fs)ADbar	=BDbar	free	var	var
DBar	free	free	free	var	var
glue	Sum rule	free	free	var	var

HERAPDF1.5f and HERAPDF1.6

A'g	B'g
free	free

extended gluon parametrisation $Ag\ x^{Bg}\ (1-x)^{Cg}\ (1+Dx+Ex^2) - A'g\ x^{B'g}\ (1-x)^{25}$

The table summarises our extended parametrisation choices and the parametrisation variations that we consider in our uncertainty estimates (and we also vary the starting scale Q^2_0). Model uncertainties on mc,mb,fs,Q2cut are also included

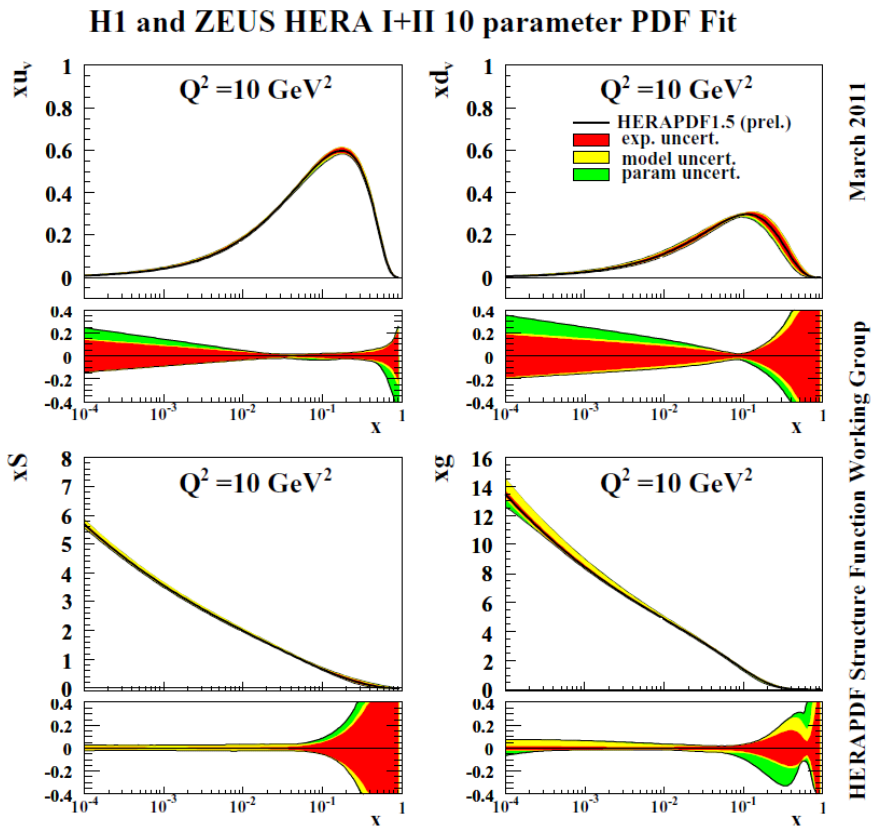
The extended parametrisation gives a $\chi 2$ improvement of $\Delta\chi 2= -5$

The main motivation is to reduce parametrisation bias and to accommodate the addition of new data sets and the move from NLO to NNLO (not today!)

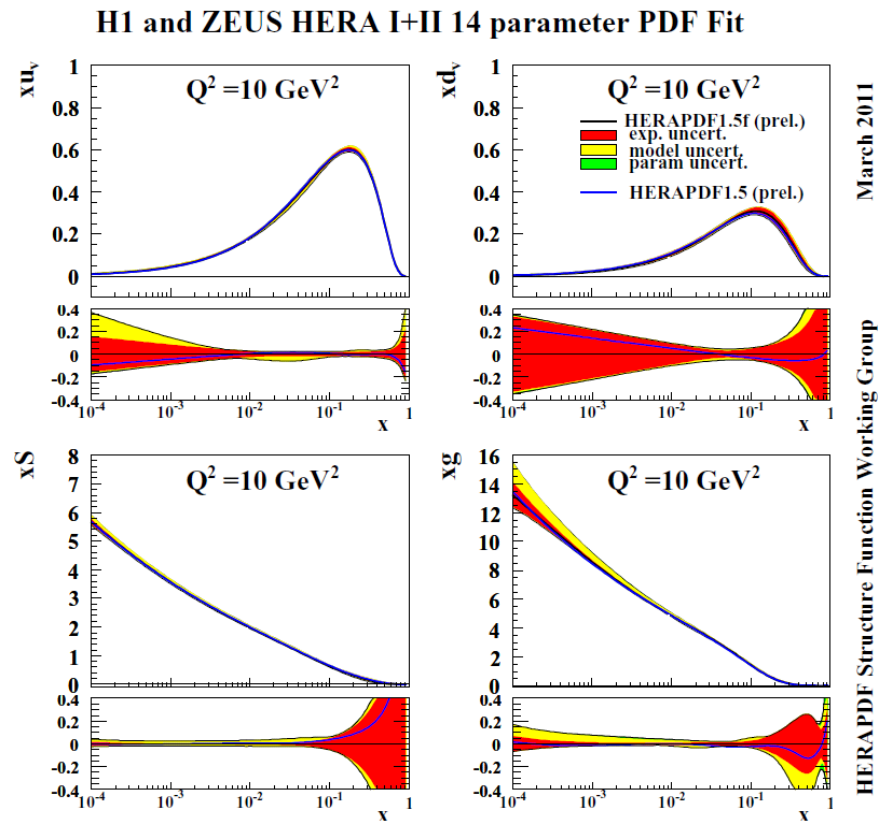
The HERAPDF1.5 with this more flexible parametrisation is called HERAPDF1.5f

Compare HERAPDF1.5 PDFs using 10 (standard) or 14 (extended) parameters

HERAPDF1.5



HERAPDF1.5f

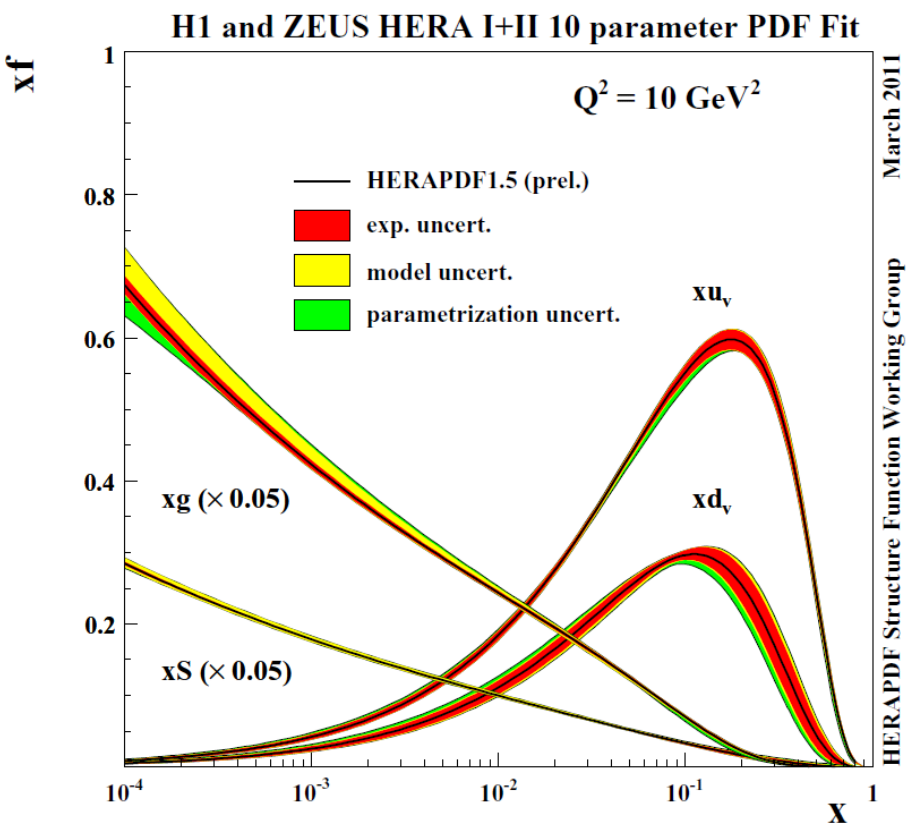


i) The level of total uncertainty is similar- but we swap parametrisation uncertainty for experimental uncertainty

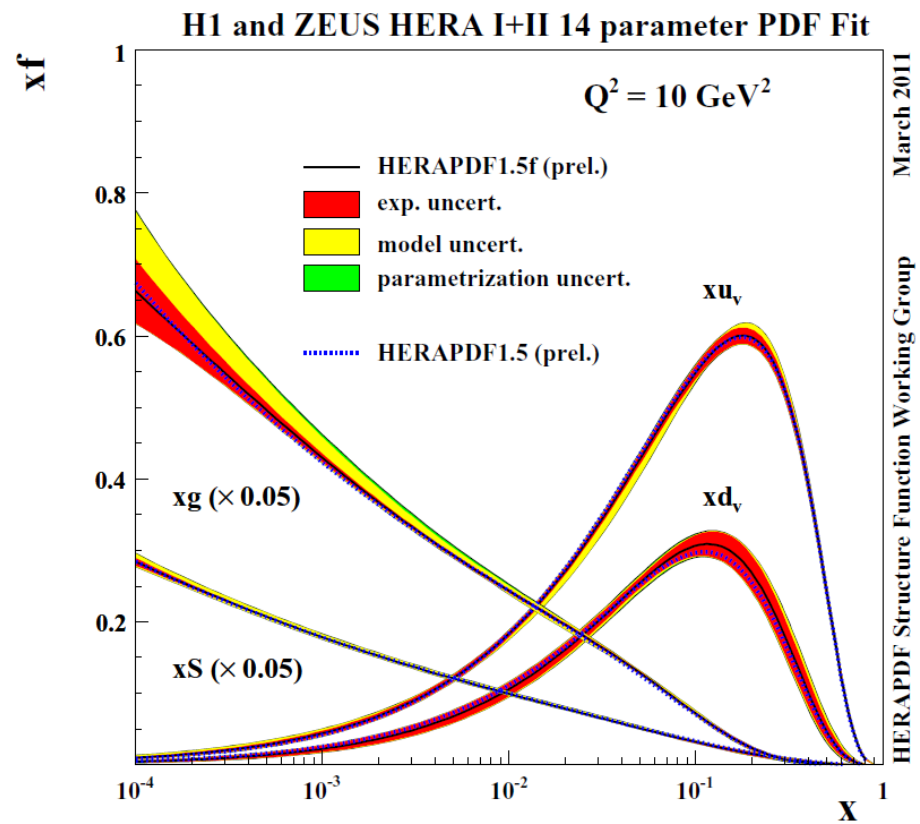
ii) The central values have shifted such that the flexible parametrisation has a softer high-x Sea and a suppressed low-x d-valence- but these changes are within our error bands

Compare HERAPDF1.5 PDFs using 10 (standard) or 14 (extended) parameters

HERAPDF1.5



HERAPDF1.5f



Now add the HERA jet data

What jet data sets?

We have now included 4 jet data sets

ZEUS DIS	96-97	DESY-02-112
ZEUS DIS	98-00	DESY-06-128
H1 high-Q2 normalised	99-07	DESY-09-032
H1 low Q2	99-00	DESY-09-162

Now add the HERA jet data

The HERAPDF1.5f with jet data added is called HERAPDF1.6

HERAPDF1.6 has 674 inclusive data points from the HERA I+II NC and CC, e+ and e- cross-sections AND 106 jet data points

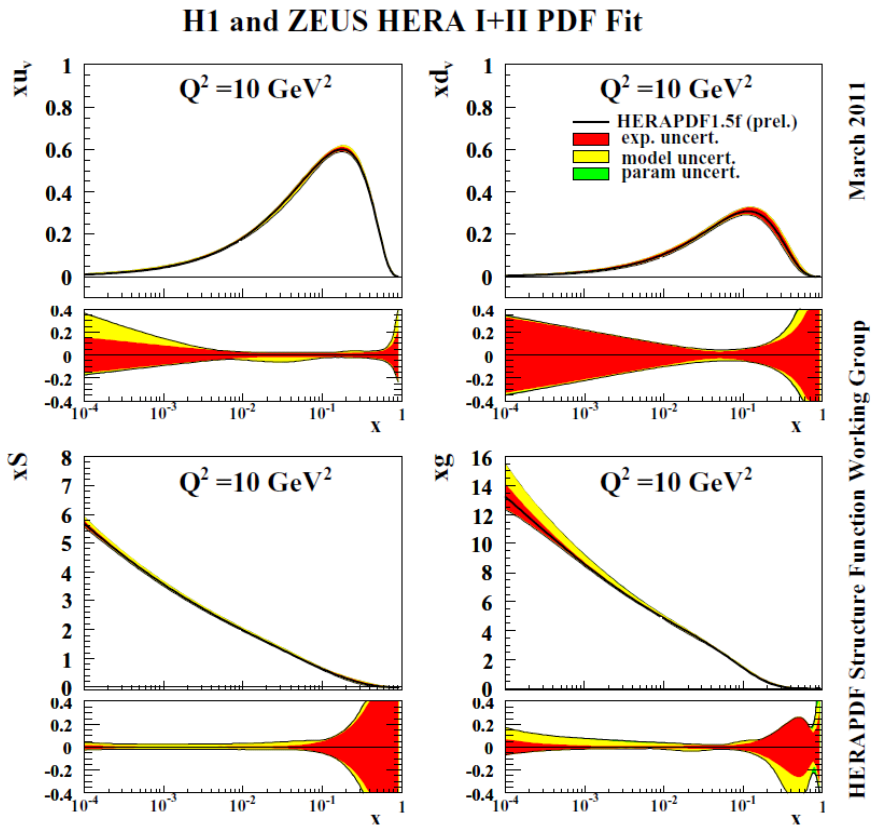
The partial $\chi 2$ for the inclusive data is 730.2 for 674 data points

The partial $\chi 2$ for the jets is 81.3 for 106 data points.

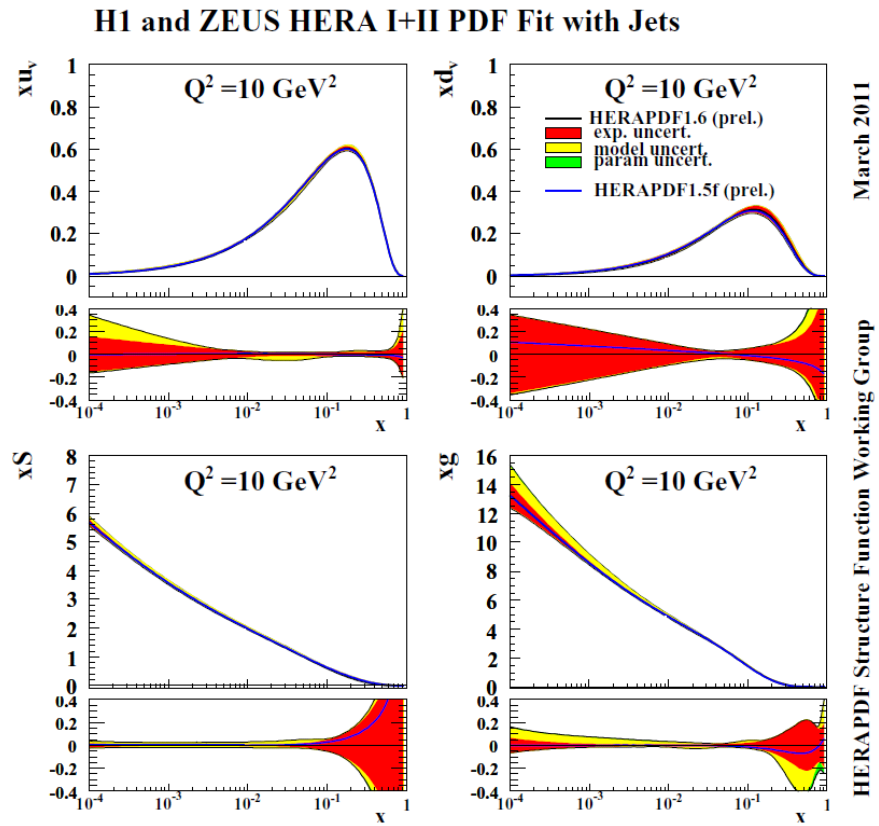
Compare partial $\chi 2$ for the inclusive data of 729.8 for 674 data points for the fit without the jet data HERAPDF1.5f

Compare fits with and without jets with fixed $\alpha_S(M_Z) = 0.1176$.

HERAPDF1.5f



HERAPDF1.6



Without jets

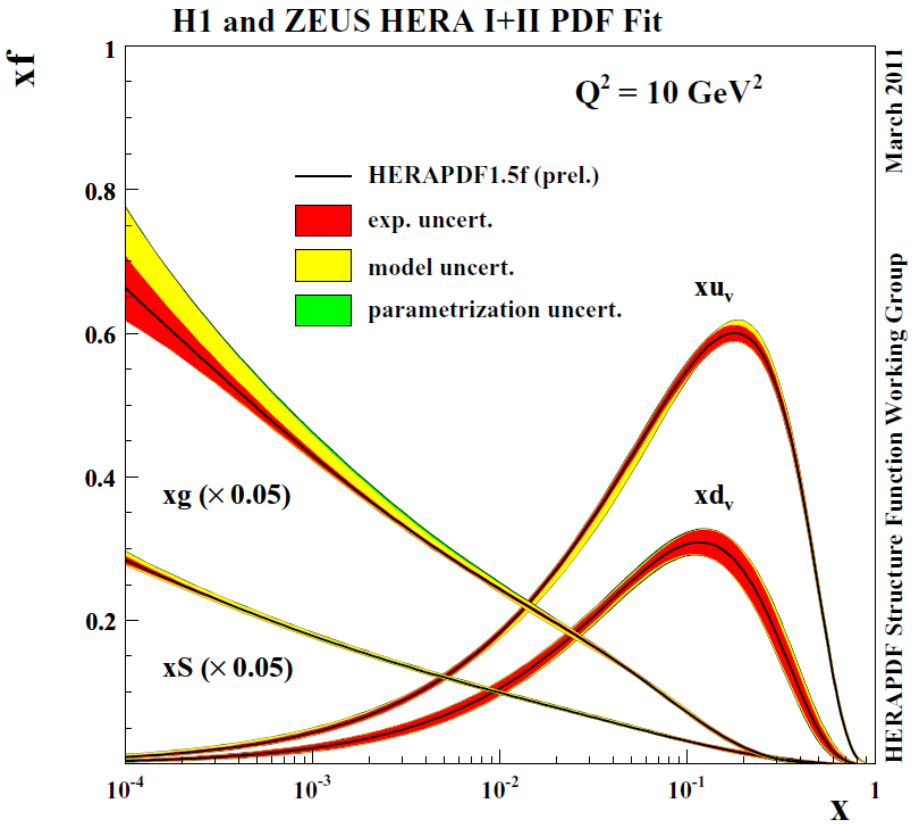
With jets

There is little difference in the size of the uncertainties after adding the jet data –but there is a marginal reduction in high-x gluon uncertainty.

The fit with jets has a softer high-x Sea this is illustrated by the blue line on the right hand side plot– this shows the central value of the PDF without jets

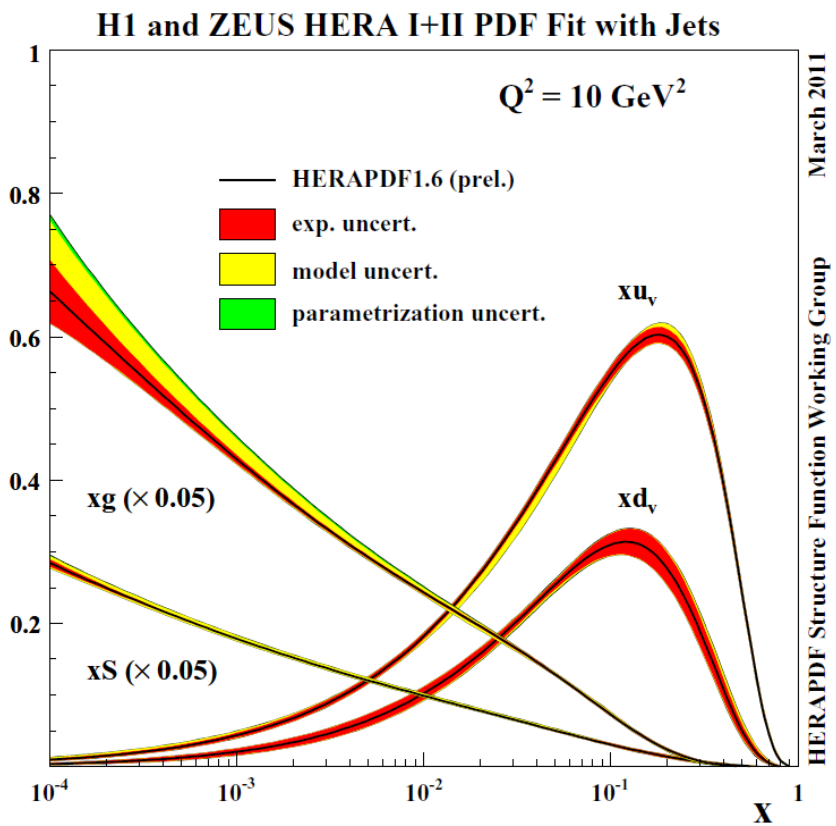
Compare fits with and without jets with fixed $\alpha_S(M_Z) = 0.1176$.

HERAPDF1.5f



Without jets

HERAPDF1.6



With jets

Now free $\alpha_S(M_Z)$

The partial χ2 for the inclusive data is 730.0 for 674 data points
The partial χ2 for the jets is 77.6 for 106 data points.

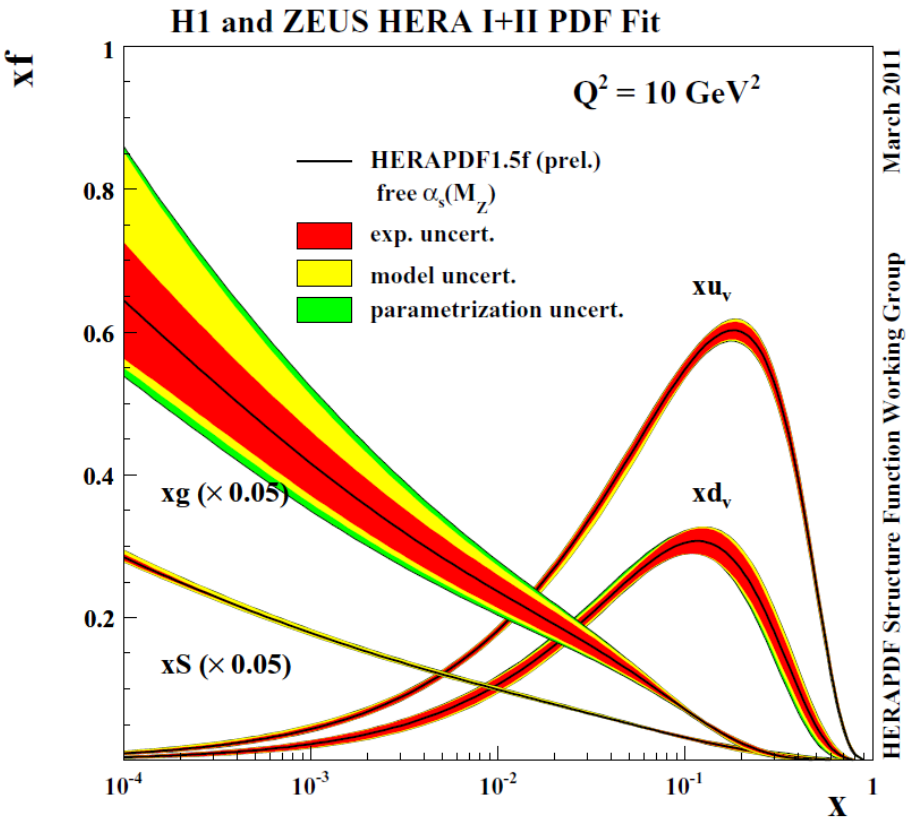
$\alpha_S(M_Z)$ =0.1202 ± 0.0013 (exp) ± 0.0007(model/param) ± 0.0012(hadronisation)

+0.0045/-0.0036 (scale)

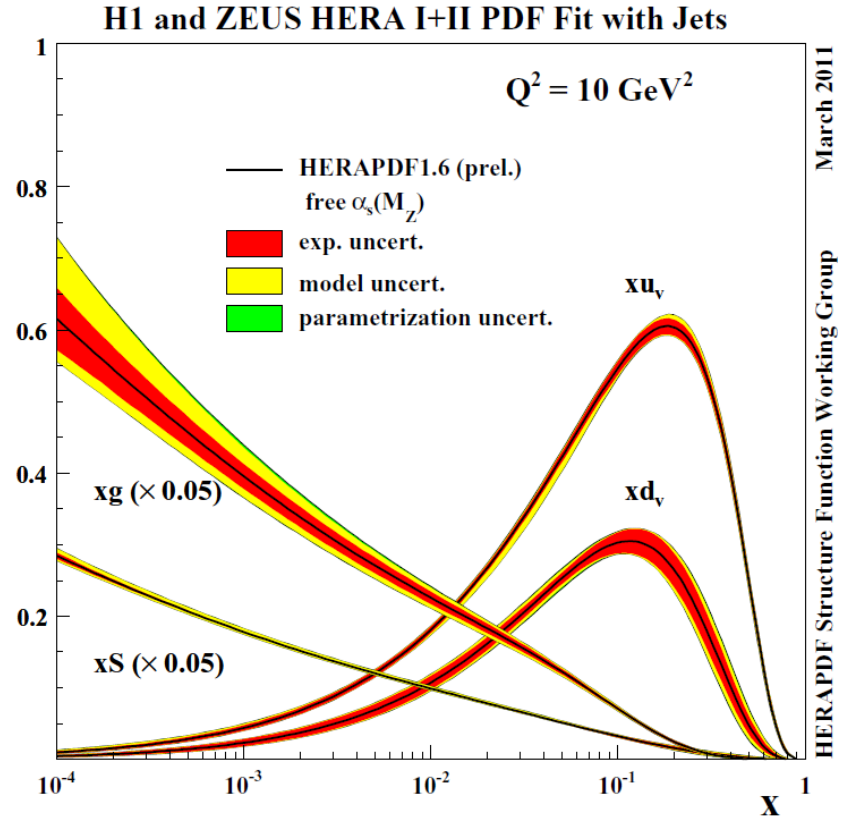
Where the scale error is evaluated by changing the renormalisation and factoristaion scales of both the inclusive and the jet data by a factor of 2.
The dominant contribution to scale error is from the jet renormalisation scale.

Compare the fit with fixed $\alpha_S(M_Z)$ = 0.1176:
The partial χ2 for the inclusive data is 730.2 for 674 data points
The partial χ2 for the jets is 81.3 for 106 data points.

Compare HERAPDF1.5f (no jets) and HERAPDF1.6 (with jets) both with free $\alpha_S(M_Z)$



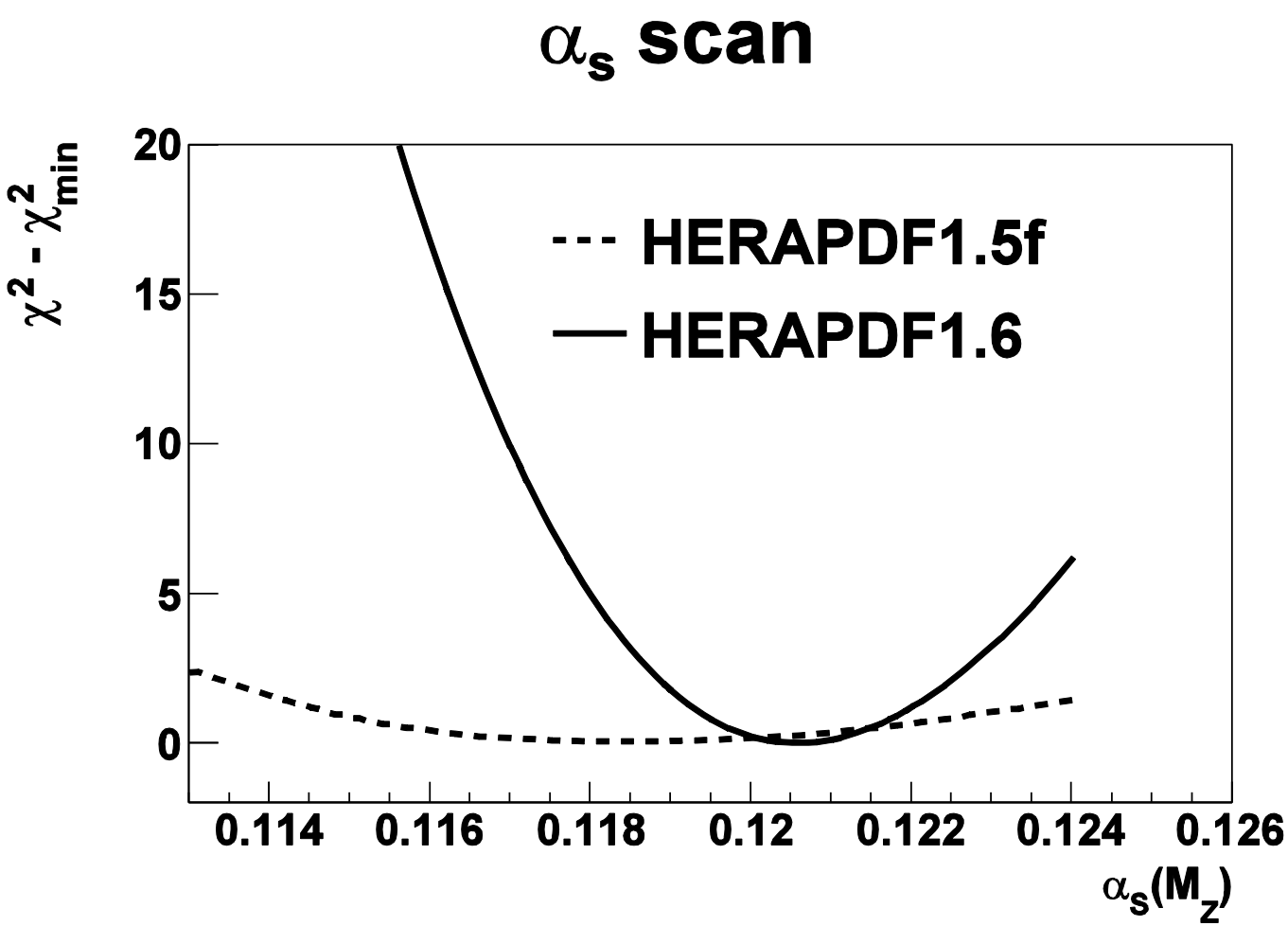
Without jets



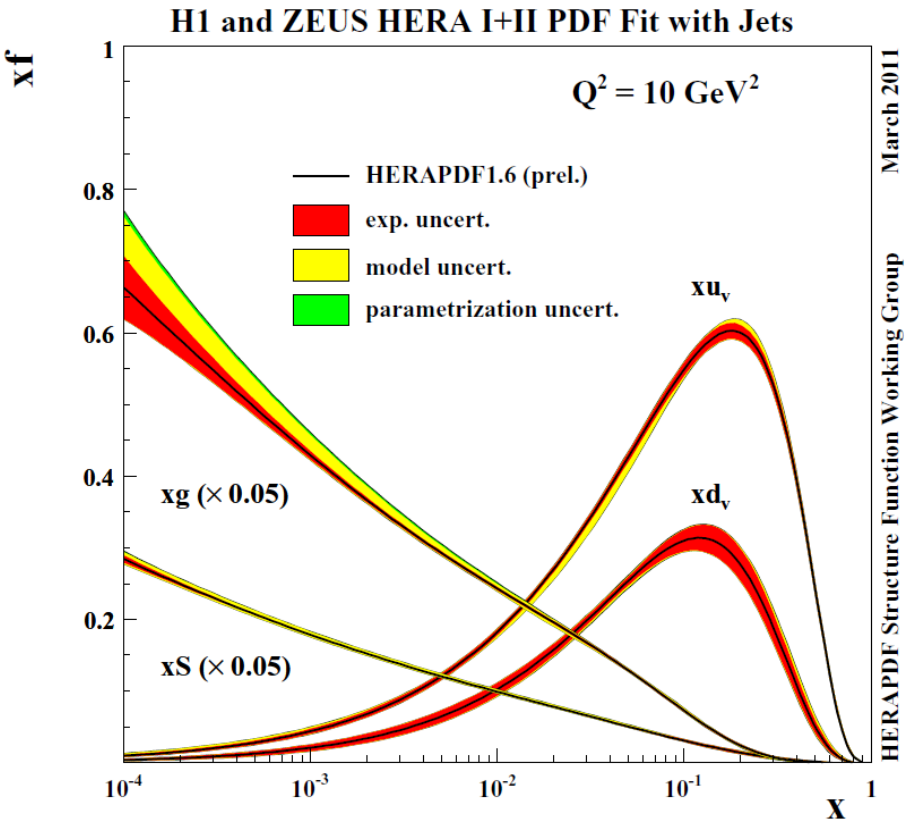
With jets

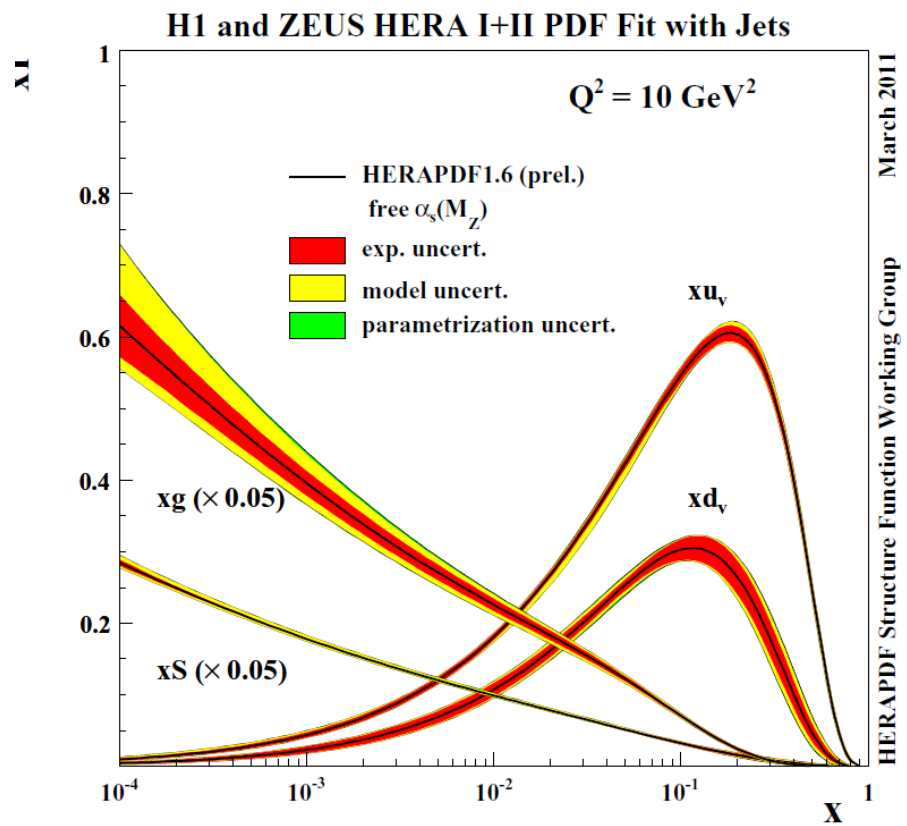
Jets decrease uncertainty on the low-x gluon dramatically- without jets the correlation of the gluon PDF and αS(MZ) is very strong and the χ2 has only a shallow dependence on αS(MZ)

The $\chi 2$ scan of HERAPDF1.5f (no jets) and HERAPDF1.6 (with jets) vs $\alpha_s(M_Z)$



Finally compare the HERAPDF1.6 fit with fixed αS(MZ) to that with free αS(MZ)





With jets and fixed $\alpha_S(M_Z) = 0.1176$

With jets and free
$\alpha_S(M_Z) = 0.1202 \pm 0.0019$
(excluding scale error)

The freedom in alphas affects only the gluon

SUMMARY

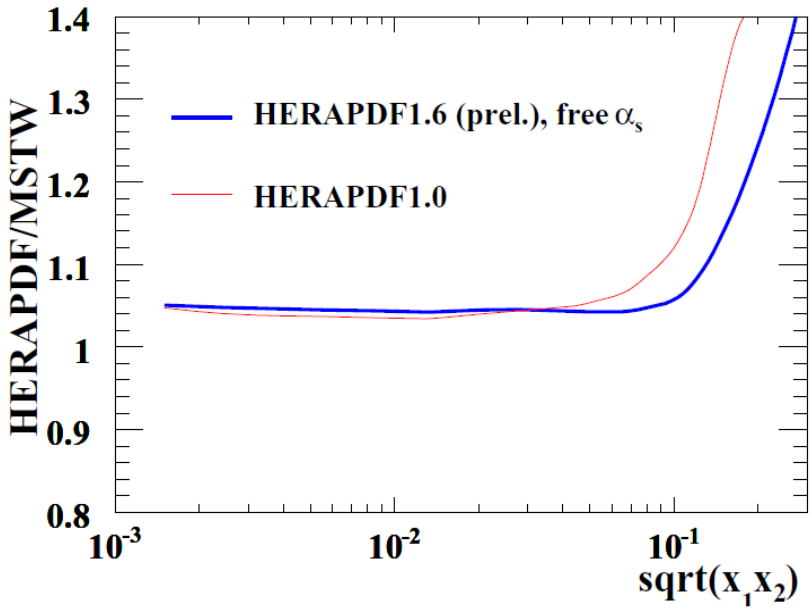
HERAPDF moves to a more flexible parametrization

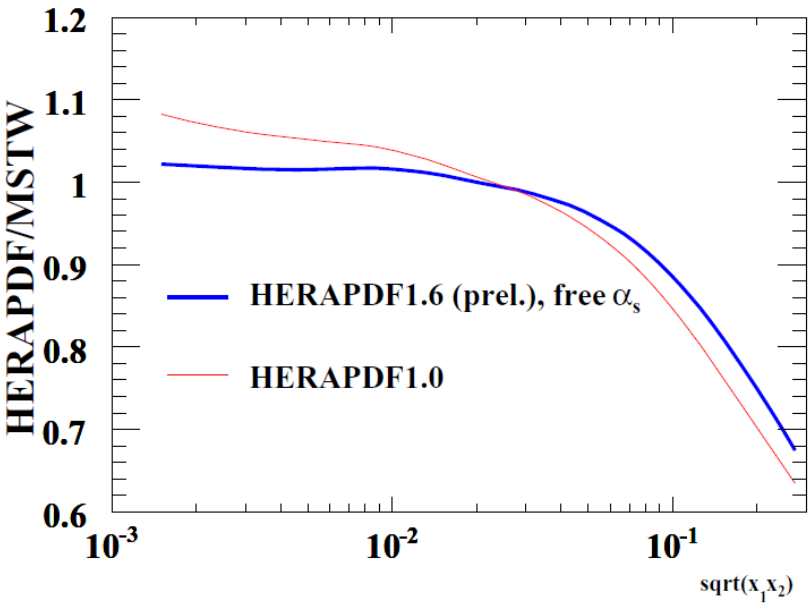
Results are backward compatible

HERAPDF now adds jet data

This allows an αS(MZ) determination from the DIS data

q-qbar and g –g luminosity plot update





extras