HERAPDF2.0NNLOJets
January 2020

Small update addressing point raised in November meeting concerning the new low pt points for H1 inclusive high-Q2 jets, which were issued along with the H1 inclusive low-Q2 jets

The plan for work to complete the analysis is outlined in the talk from November 29th: IN SUMMARY

- Finish the NNLO analysis much in the way that the DIS19 preliminary was done but with new mc,mb settings accounting for the new c,b combined data
- Using the same data sets, same cuts, same scale choice, same parametrisation ---(all checks done --ie settings and parametrisation choice iterated) –

FOR:

- $\alpha_S(M_Z)$ =0.115
- $\alpha_S(M_Z)$ =0.118
- Free alphas

- All model/ parametrisation uncertainties treated as agreed: vary Q^2_0 down ONLY and symmetrise; vary Mc up ONLY and symmetrise

- Hadronisation by offset consistently ie set hadronisation uncertainty of H1 2016 low Q2 jets=zero for central job (it was the 13th systematic uncertainty)

- Scale uncertainty ½ correlated , ½ uncorrelated as for HERAPDF2.0NLOJets

- Do not revisit NLO other than to say that the current scale choice would have resulted in $\alpha_S(M_Z)$ =0.121 rather than 0.118
- Maybe also say not revisiting it because the most significant new data set—H1 low Q2 jets 2016 is not well fitted at NLO

After the Friday 29th November meeting

The only remaining question was about the NEW low-pt data points for 2013 H1 high Q2 a new low pt bin has been added for each of the 6 Q2 regions.

- I have looked and actually they do not fail the μ cut. ($\mu = \sqrt{(ptave^2+Q^2} > 13.5$ GeV)
- Nor do they have large or unreliable scaling violations, the largest are around 6.5% for renormalisation scale up or down by 2 --and these are smaller than the NLO values which are around 8%.
- So probably we have to implement the extra 6 data points
- the NNLO predictions were already in the prediction grids
- the statistical correlations- can be obtained from the H1 web page

- First I implemented without stat correlations
- Then I implemented with stat correlations.
- We can also look at the new treatment of the hadronisation uncertainty -set to zero for low Q2 2016 H1 jets consistently with other data sets---was done ½ correlated and ½ uncorrelated before.

Further possibly useful comments, which make little difference

- I use 'official' grids from Ploughshare now these give *slightly* lower overall chisq mostly from H1 HERA-II high Q2 jets but it doesn't matter much. Dijets are not on Ploughshare but Mark did give me higher stats grids—again made little difference.
- A further issue arose concerning normalised jets:the γ/Z, ZZ and xF3 terms were not used in the NNLO jet predictions for the numerators, hence they also should not be used for the denominators for consistency. BUT this made almost no difference at all!!

Do not implement 6 extra H1 highq2 incl points

Total chisq 1607.6
Correlated pieces of χ2
sumsqhinc= 89.9 sumsqhjet= 16.4

Data set	ndp	partial χ2
X/N CCEP =	39	45.9
X/N CCEM =	42	53.8
X/N NCEP 920=	377	451.7
X/N NCEP 820=	70	64.9
X/N NCEM=	159	220.7
X/N NCEP 460 =	204	215.7
X/N NCEP 575 =	254	219.0
ZEUS di-jets =	16	17.1
ZEUS inc 96/97 =	30	30.2
H1norm highQ2 99/00 =	24	16.5
H1 low-Q2 =	16	19.1
H1 HERA2 highq2 incl =	**24**	**22.2**
H1 HERA2 highq2 dijet =	**24**	**40.1**
H1 HERA2 lowq2 incl =	32	51.1
H1 HERA2 lowq2 dijet =	32	33.2

Implement 6 extra H1 highq2 incl points
But no stat matrix so far

Total chisq 1615.6
Correlated pieces of χ2
sumsqhinc= 89.8 sumsqhjet= 13.9

Data set	ndp	partial χ2
X/N CCEP =	39	46.0
X/N CCEM =	42	53.6
X/N NCEP 920=	377	451.1
X/N NCEP 820=	70	64.9
X/N NCEM=	159	220.5
X/N NCEP 460 =	204	215.9
X/N NCEP 575 =	254	219.1
ZEUS di-jets =	16	17.1
ZEUS inc 96/97 =	30	30.0
H1norm highQ2 99/00 =	24	16.5
H1 low-Q2 =	16	12.4
H1 HERA2 highq2 incl =	**30**	**36.4**
H1 HERA2 highq2 dijet =	**24**	**43.7**
H1 HERA2 lowq2 incl =	32	51.1
H1 HERA2 lowq2 dijet =	32	33.2

So the extra 6 points puts 2013 high Q2 **χ2** up by ~18 which seems a lot but the **partial χ2 is not unacceptable and PDF parameters don't change much**

NOTE in the treatment of the 2016 low Q2 here the hadronisation uncertainty is set=0 because we will offset it

Implement 6 extra H1 highq2 incl points
But **no stat matrix**

Total chisq 1615.6
Correlated pieces of χ2
sumsqhinc= 89.8 sumsqhjet= 13.9

Data set	**ndp**	**partial χ2**
X/N CCEP =	39	46.0
X/N CCEM =	42	53.6
X/N NCEP 920=	377	451.1
X/N NCEP 820=	70	64.9
X/N NCEM=	159	220.5
X/N NCEP 460 =	204	215.9
X/N NCEP 575 =	254	219.1
ZEUS di-jets =	16	17.1
ZEUS inc 96/97 =	30	30.0
H1norm highQ2 99/00 =	24	16.5
H1 low-Q2 =	16	12.4
H1 HERA2 highq2 incl =	**30**	**36.4**
H1 HERA2 highq2 dijet =	**24**	**43.7**
H1 HERA2 lowq2 incl =	32	51.1
H1 HERA2 lowq2 dijet =	32	33.2

Implement 6 extra H1 highq2 incl points
But **with stat matrix**

Total chisq 1621.7
Correlated pieces of χ2
sumsqhinc= 90.2 sumsqhjet= 13.6

Data set	**ndp**	**partial χ2**
X/N CCEP =	39	45.8
X/N CCEM =	42	53.8
X/N NCEP 920=	377	451.2
X/N NCEP 820=	70	64.8
X/N NCEM=	159	220.9
X/N NCEP 460 =	204	215.8
X/N NCEP 575 =	254	219.0
ZEUS di-jets =	16	17.5
ZEUS inc 96/97 =	30	29.9
H1norm highQ2 99/00 =	24	16.6
H1 low-Q2 =	16	12.5
H1 HERA2 highq2 incl =	**30**	**32.6**
H1 HERA2 highq2 dijet =	**24**	**52.9**
H1 HERA2 lowq2 incl =	32	51.4
H1 HERA2 lowq2 dijet =	32	32.7

Implementing the stat matrix makes the 2013 highq2 jet partial **χ2** increase from 80.1 to 85.5 for 54 points but does not otherwise change much

Just in case you are wondering what difference setting the hadronisation uncertainty to zero for 2016 low Q2 jets makes it basically changes **the χ2** for the 2016 low q2 jets and not much else

lowq2 hadronisation uncertainty-0

Total chisq 1615.6
Correlated pieces of χ2
sumsqhinc= 89.8 sumsqhjet= 13.9

Data set	**ndp**	**partial χ2**
X/N CCEP =	39	46.0
X/N CCEM =	42	53.6
X/N NCEP 920=	377	451.1
X/N NCEP 820=	70	64.9
X/N NCEM=	159	220.5
X/N NCEP 460 =	204	215.9
X/N NCEP 575 =	254	219.1
ZEUS di-jets =	16	17.1
ZEUS inc 96/97 =	30	30.0
H1norm highQ2 99/00 =	24	16.5
H1 low-Q2 =	16	12.4
H1 HERA2 highq2 incl =	30	36.4
H1 HERA2 highq2 dijet =	24	43.7
H1 HERA2 lowq2 incl =	**32**	**51.1**
H1 HERA2 lowq2 dijet =	**32**	**33.2**

lowq2 hadronisation uncertaity **½ correlated and ½ uncorrelated**

Total chisq 1607.7
Correlated pieces of χ2
sumsqhinc= 89.7 sumsqhjet= 18

Data set	**ndp**	**partial χ2**
X/N CCEP =	39	46.3
X/N CCEM =	42	53.4
X/N NCEP 920=	377	452.6
X/N NCEP 820=	70	64.8
X/N NCEM=	159	220.4
X/N NCEP 460 =	204	215.5
X/N NCEP 575 =	254	219.0
ZEUS di-jets =	16	16.8
ZEUS inc 96/97 =	30	30.2
H1norm highQ2 99/00 =	24	16.4
H1 low-Q2 =	16	12.0
H1 HERA2 highq2 incl =	30	36.3
H1 HERA2 highq2 dijet =	24	43.4
H1 HERA2 lowq2 incl =	**32**	**48.8**
H1 HERA2 lowq2 dijet =	**32**	**24.6**

So using hadronisation uncertainty =0 for low Q2 jets slightly increases their **χ2** a bit --that's all

FINALLY compare PDF parameters

PDF parameters for this job **with 6 extra points** and stat matrix implemented and hadronisation uncertainty=0 for low Q2 H1 jets

PARAM, VAL, ERR =	1	0.771	0.027	Buv 0.772
PARAM, VAL, ERR =	2	4.873	0.086	Cuv 4.858
PARAM, VAL, ERR =	3	10.75	1.48	Euv 10.72
PARAM, VAL, ERR =	5	0.957	0.085	Bdv 0.977
PARAM, VAL, ERR =	6	4.673	0.378	Cdv 4.759
PARAM, VAL, ERR =	7	-0.427	0.059	Bg' -0.434
PARAM, VAL, ERR =	8	0.1387	0.1117	Ag' 0.1380
PARAM, VAL, ERR =	9	0.857	0.033	Asea 0.858
PARAM, VAL, ERR =	10	-0.126	0.005	BDbar -0.123
PARAM, VAL, ERR =	11	7.259	1.607	CUbar 7.000
PARAM, VAL, ERR =	12	9.124	1.65	CDbar 9.775
PARAM, VAL, ERR =	13	-0.101	0.06	Bg -0.108
PARAM, VAL, ERR =	14	6.2541	0.49	Cg 5.77
PARAM, VAL, ERR =	16	2.585	2.458	Dubar 2.024
PARAM, VAL, ERR =	17	0.115	fixed	Dubar 0.115

These are similar to before we made any such changes

CONCLUSION

Probably we should implement these extra points?

Back-up