

# Final $ep$ DIS cross sections from H1 and ZEUS and HERAPDF

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**Abstract.** HERA was the first and only  $ep$  collider. It was in operation from 1992 to 2007 and the two collaborations ZEUS and H1 collected about  $0.5 \text{ fb}^{-1}$  of integrated luminosity each. Inclusive data from both collaborations were combined and used to determine the set of parton distribution functions called HERAPDF2.0. The history of HERA is presented as well as the long path to the final data combination and HERAPDF2.0. The proton remains full of wonders and parton distribution functions might have nothing to do with them. The legacy of HERA are the precise  $ep$  data which can be plotted as legacy plots.

## 1 Introduction

Sometimes it makes no sense to rewrite what was previously written. Please consult the original paper [1] from H1 and ZEUS for the full story of HERA data combination and HERAPDF2.0.

For a discussion on whether parton distribution functions at low Bjorken  $x$  have anything to do with the proton, please see [2].

## 2 Legacy Plots

As I have decided not to rewrite the data combination and HERAPDF2.0 paper, I just provide some HERA legacy plots.

## 3 Conclusions

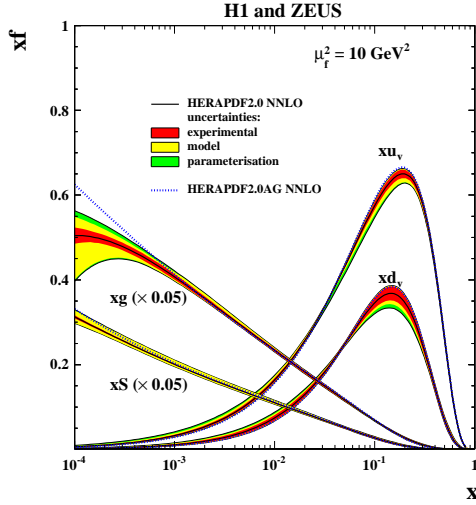
The publication of their combined data together with the new PDF set HERAPDF2.0 was a major milestone for the ZEUS and H1 collaborations. If you need more than some plots, please consult the paper [1].

## References

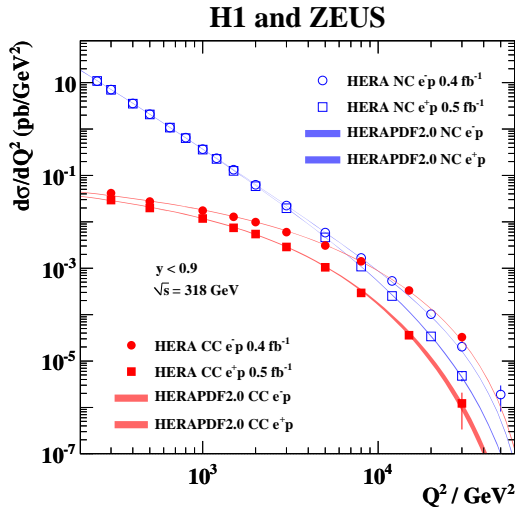
- [1] ZEUS and H1 Collaborations, H. Abramowicz et al, Eur. Phys. J. **C 75**, 580 (2015)
- [2] A. Caldwell and G. Grindhammer, Physik Journal **6**, 39 (2007)

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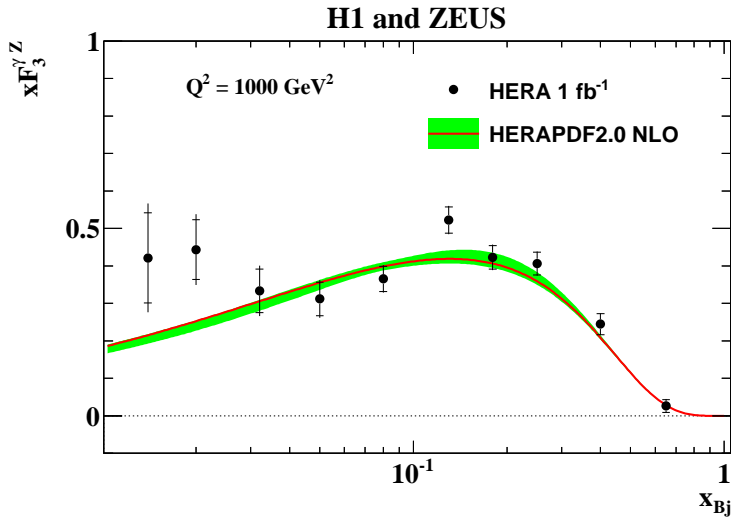
<sup>a</sup>e-mail: isa@mpp.mpg.de



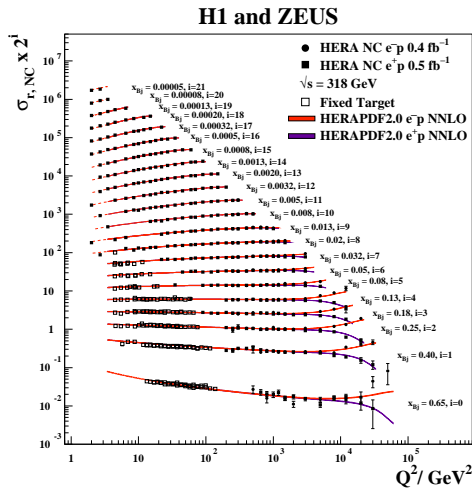
**Figure 1.** The parton distribution functions  $xu_v$ ,  $xd_v$ ,  $xS = 2x(\bar{U} + \bar{D})$  and  $xg$  of HERAPDF2.0 NNLO at  $\mu_f^2 = 10 \text{ GeV}^2$ . The gluon and sea distributions are scaled down by a factor 20. The experimental, model and parameterisation uncertainties are shown. The dotted lines represent HERAPDF2.0AG NNLO with an alternative gluon parameterisation preventing a turn-over.



**Figure 2.** The combined HERA NC and CC  $e^-p$  and  $e^+p$  cross sections,  $d\sigma/dQ^2$ , together with predictions from HERAPDF2.0 NLO. The bands represent the total uncertainty on the predictions.



**Figure 3.** The structure function  $x F_3^{YZ}$  connected to the valence quarks averaged over  $Q^2 \geq 1000 \text{ GeV}^2$  at the scale  $Q^2 = 1000 \text{ GeV}^2$  together with the prediction from HERAPDF2.0 NLO. The band represents the total uncertainty on the prediction.



**Figure 4.** The combined HERA data for the inclusive NC  $e^+p$  and  $e^-p$  reduced cross sections together with fixed-target data and the predictions of HERAPDF2.0 NNLO. The bands represent the total uncertainties on the predictions. Dashed lines indicate extrapolation into kinematic regions not included in the fit.