

Structure Functions Measurements at HERA

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Recent structure functions results from H1 and ZEUS are presented. The measurements cover a wide kinematic range of squared four-momentum transfers Q^2 , from 0.2 GeV^2 to 30000 GeV^2 , and Bjorken x between $5 \cdot 10^{-6}$ and 0.65 . The results of QCD analyses based on these data and their impact on the parton density functions are presented.

1 DIS cross section measurements at low and medium Q^2

The measurements of the DIS cross sections at low Q^2 (from 0.2 GeV^2 to 12 GeV^2) [1] and medium Q^2 (from 12 GeV^2 to 150 GeV^2) [2] are based on data collected by the H1 Collaboration in 1999-2000. In order to access low values of Q^2 around 1 GeV^2 the interaction vertex, for short period of H1 2000 data taking, was shifted by approximately 70 cm along the proton beam direction. This data sample is also used for accessing larger values of x with Initial State Radiation (ISR) events. Data collected by the H1 Collaboration in 1999 with a nominal position of the interaction vertex are used for measurements in the region of high inelasticity y . These data are combined with H1 data taken in 1995-1997 following the prescription introduced in [3]. The H1 measurements at low and medium Q^2 are shown in Figure 1. These are the most precise results of the H1 Collaboration in the given kinematic domain. The accuracy of the combined measurements is typically at the level of 1-2%. The H1 data alone is used in a NLO QCD analysis to determine a new set of parton densities called H1PDF2009.

2 Measurements of the structure function F_L

Figure 2 shows the first measurements of the the structure function F_L performed by H1 [7] and ZEUS [8] Collaborations. They are based on inclusive deep inelastic e^+p scattering cross section measurements with a positron beam energy of 27.5 GeV and proton beam energies of 920 , 575 and 460 GeV . Employing the energy dependence of the cross section, F_L is measured in the range $12 \leq Q^2 \leq 130 \text{ GeV}^2$ and low Bjorken x $0.00024 \leq x \leq 0.007$. The F_L values agree with higher order QCD calculations based on parton densities obtained using cross section data previously measured at HERA.

3 Combined H1 and ZEUS results

A combination [9] is presented of the inclusive DIS cross sections measured by the H1 and ZEUS Collaborations in neutral and charged current unpolarised ep scattering at HERA during the

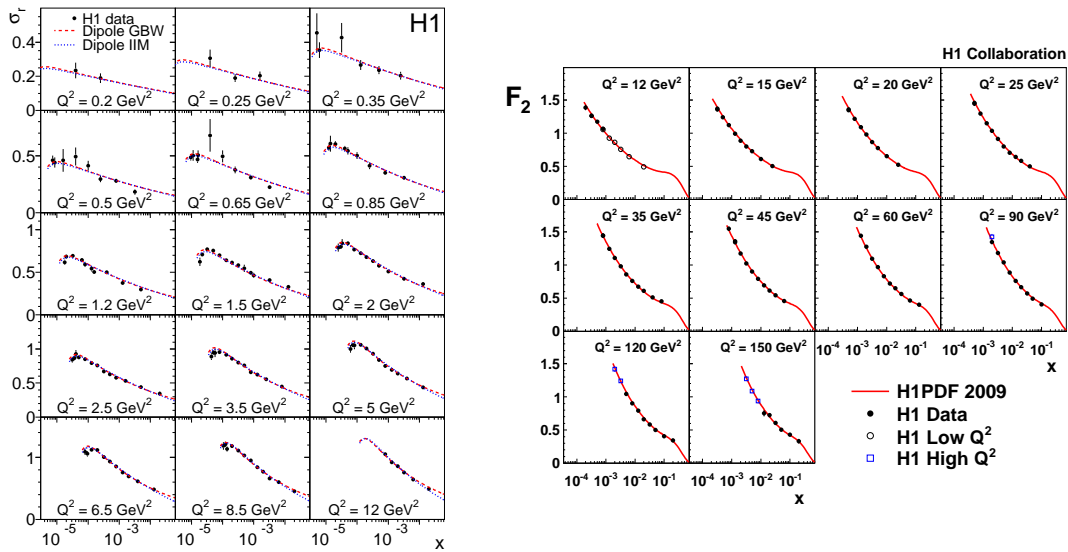


Figure 1: Left: reduced cross section σ_r from combined H1 1995-2000 data [1] compared to GBW [4] and IIM [5] models. Right: structure function F_2 from combined H1 1996-2000 data [2] compared to previously published H1 data [1], [6] and H1PDF2009 fit [2]. The errors represent the statistical and systematic uncertainties added in quadrature.

period 1994-2000. The data cover six orders of magnitude in Q^2 , and in Bjorken x . The combination method used takes the correlations of systematic uncertainties into account, resulting in an improved accuracy. The combined data are the sole input in a NLO QCD analysis which determines a new set of parton distributions HERAPDF1.0 with small experimental uncertainties. This set includes an estimate of the model and parametrisation uncertainties of the fit result as explained in [9]. The combined results are shown in Figure 3.

References

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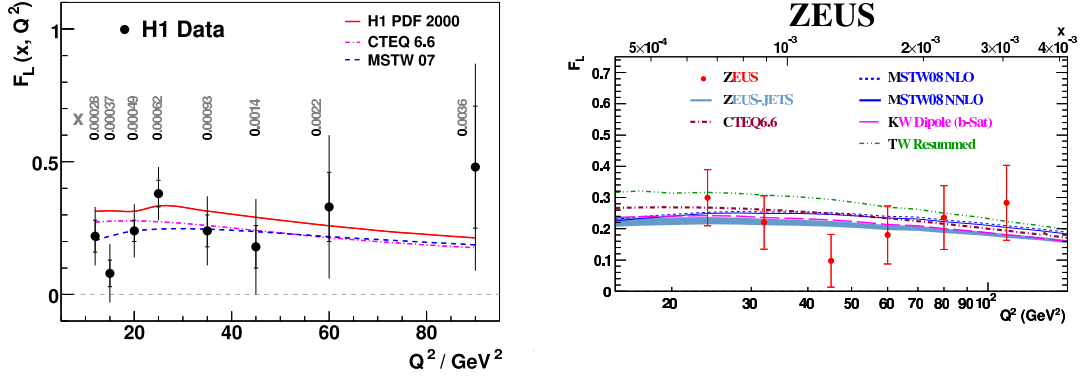


Figure 2: F_L from the H1 data [7] (left) and ZEUS data [8] (right) compared to the different theoretical predictions. The full error bars include the statistical and systematic uncertainties added in quadrature.

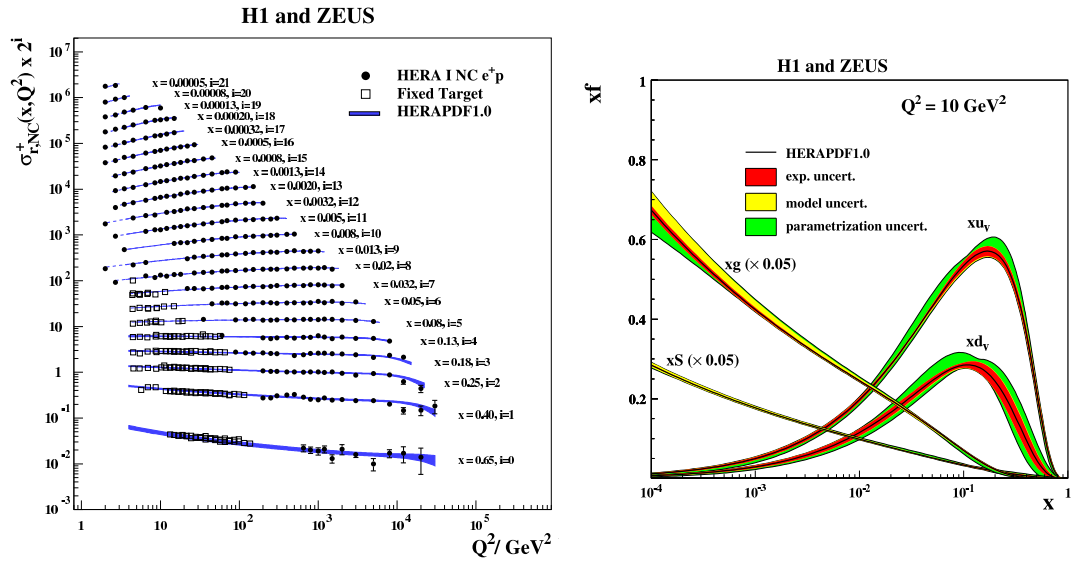


Figure 3: Left: HERA combined neutral current reduced cross section [9] and fixed-target data compared to the HERAPDF1.0 fit. The bands represent the total uncertainty of the fit. Right: the parton distribution functions from HERAPDF1.0 at $Q^2 = 10 \text{ GeV}^2$. The gluon and sea distributions are scaled down by a factor 20. The experimental, model and parametrisation uncertainties are shown separately (see [9]).