The UK groups have been involved in the measurement of the NC e^+p reduced cross-section and the structure function F_2 from the high statistics HERA 1996/7 runs [1]. Fig. 1 shows this data as a function of Q^2 in fixed x bins. Since the statistical precision of the data is $\lesssim 1\%$ (over the range $2.7 < Q^2 < 800 GeV^2$) a detailed evaluation of systematic errors has been necessary and a systematic precision of $\sim 3\%$ has been achieved over much of the kinematic range. Thus ZEUS data now have comparable precision to the fixed target data and have vastly extended the range of precision structure function measurements.

The UK has also been heavily involved in fitting this new high precision data (together with fixed target data) to the predictions of NLO QCD using the DGLAP equations, in order to determine parton distribution functions and the value of $\alpha_s(M_Z^2)$. The increased range ($6.3 \times 10^{-5} < x < 0.65$, $2.7 < Q^2 < 30000 GeV^2$) and precision of the data allow a much improved determination of the gluon and sea distributions compared to previous work [2]. The parton distributions extracted from this fit are shown in Fig. 2 for $Q^2 = 10\text{GeV}^2$. The error bands take full account of uncertainties from experimental correlated systematic errors.

The fit predicts that at low Q^2 ($Q^2 \sim 1\text{GeV}^2$) the $q\bar{q}$-sea distribution is still rising at small x, whereas the extracted gluon distribution is suppressed. This is incompatible with the hypothesis that the rapid rise of F_2 is driven by the rapid increase in gluon density at small x through $g \to q\bar{q}$ splitting. The new precision data exhibit these trends more strongly than the previous data set, and allow us to come to more definite conclusions regarding the lower Q^2 limit of validity of the NLOQCD DGLAP formalism. If the fit is extrapolated back into the kinematic region of the precise ZEUS BPT 1997 data [3] it is clear that the fit is unable to describe the data for $Q^2 \leq 0.65 \ \text{GeV}^2$.

The fit can also determine the value of $\alpha_s(M_Z^2)$ taking full account of the correlations between the shape of the parton distribution functions and α_S, giving

$$\alpha_s(M_Z^2) = 0.1172 \pm 0.0008(stat + uncorr) \pm 0.0054(corr),$$

where the first error represents statistical and uncorrelated systematic errors and the second error represents the correlated systematic errors from all the contributing experiments, including their normalization errors.

The ZEUS data are crucial in determining the gluon and the sea distributions but they also have some impact on the valence distributions. A fit can be made to ZEUS data alone if the high Q^2 CC cross-section data for e^+p [4] are included. This fit produces a larger d valence distribution at high x than the standard fit which includes fixed target data, but there is no disagreement at the current level of statistical precision of the CC data. We look forward to post-upgrade data.

References

[1] ZEUS Collaboration, S.Chekanov et al, DESY 01-064,

[2] J.Breitweg et al,

[3] J.Breitweg et al.,

[4] J.Breitweg et al,

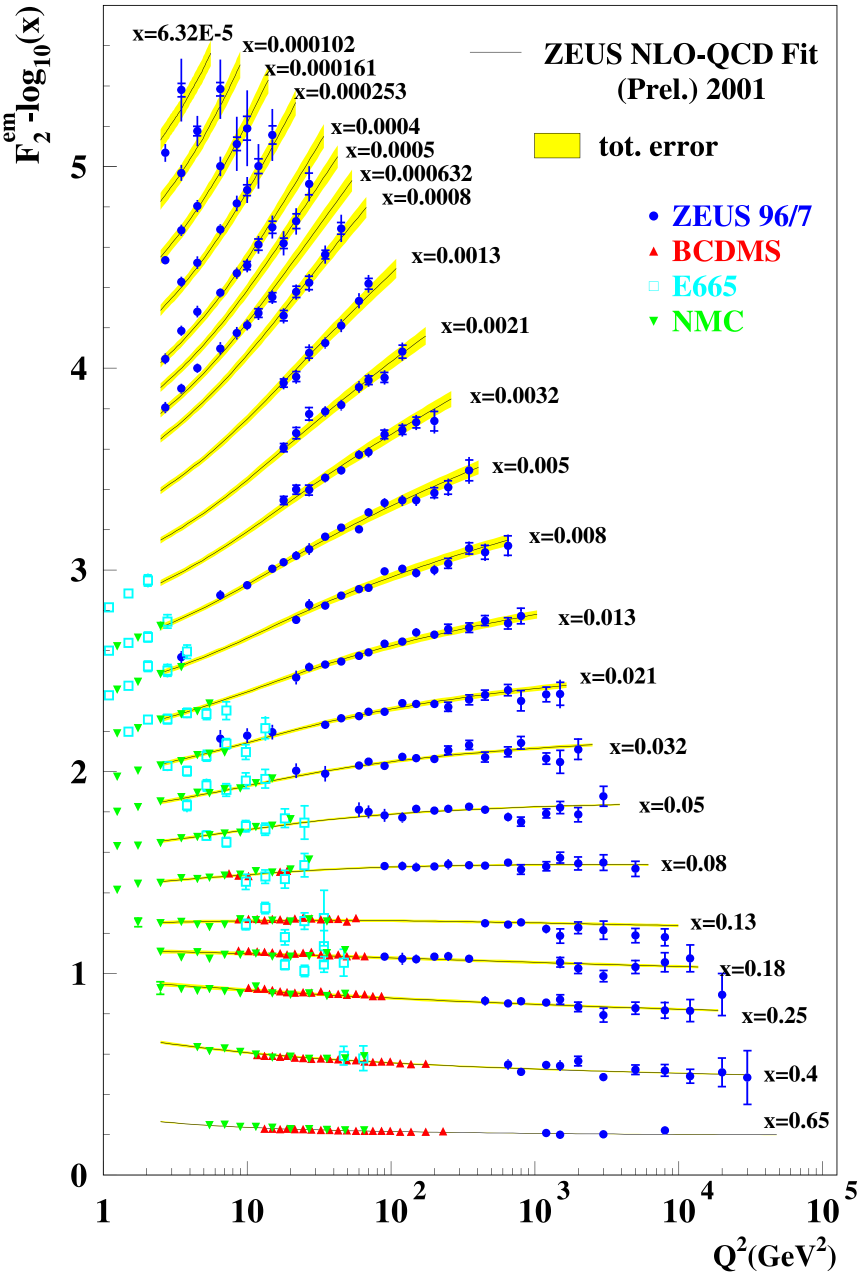

Figure 1: ZEUS 96/7 F_2 data and fixed target data compared to the ZEUS NLOQCDfit

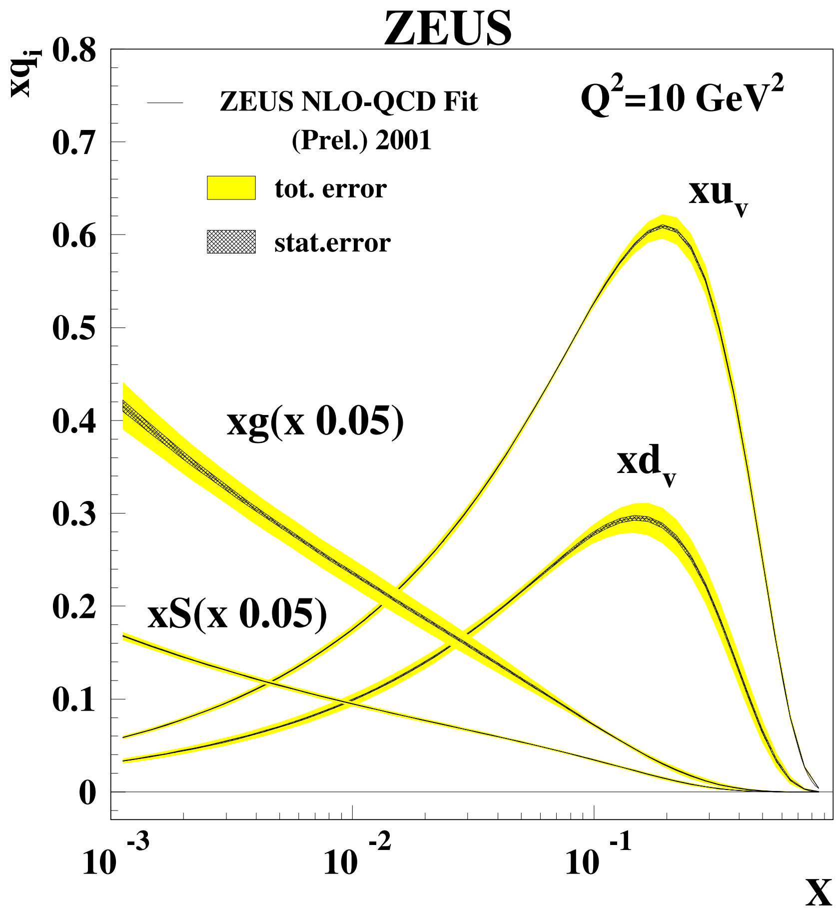

Figure 2: The glue, sea, u and d valence distributions extracted from the standard ZEUS fit, at $Q^2 = 10\mathrm{GeV}^2$, with the error bands resulting from statistical, uncorrelated and correlated systematic errors.