F_2 in the transition region from small to medium x [a]

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1 Introduction

Previously [1] it has been found that $F_2(x,Q^2) = u_1(x) \cdot q$ describes concisely all low-x F_2-data of H1 and ZEUS, when the empirical scaling variable q=log$(1+Q^2/Q_0^2)$ with $Q_0^2 \approx 0.5$ GeV^2 is applied.

The restriction to data with $x < 0.001$ is now relaxed. In the parton picture of the proton it is then expected that with increasing x the sea dominance will cease and the valence contribution will emerge more and more prominently. In addition to previously used data now also large-x measurements are included from the precise fixed target lepton-proton [2] and the high-Q^2 HERA experiments [3]. Deeply inelastic ep or μp scattering - not differentiating between quarks and antiquarks - always measures the sum of sea and valence. This challenges an attempt at delineating the two contributions to F_2 in the transition region by intrapolating into this region from below and above.

2 Q^2-dependence of F_2

The F_2-data of the above experiments are still linear in q up to $x \approx 0.1$ (see fig. 1 for some examples) and well fitted by the form $F_2(x,q) = u_0(x) + u_1(x) \cdot (q - \langle q \rangle)$. The x-information of the F_2-data is then contained in the two uncorrelated functions $u_0(x)$ and $u_1(x)$. The data in the transition region manifest the new feature that the linear extrapolation of $F_2(x,q)$ in q towards 0 is no longer consistent with 0 (see fig. 1).

3 The two components of F_2

The logarithmic form [1] of the derivative $\partial F_2(x,q)/\partial q = u_1(x) \sim \log x_0/x$ (see left fig. 2) continues to describe well the data until it approaches the limit of validity near to the value of the parameter x_0 (ref. [1]), i.e. 0.04. At large x the slopes agree, as expected, with the slopes of the valence alone as seen from the comparison with the MRST parametrization [4].

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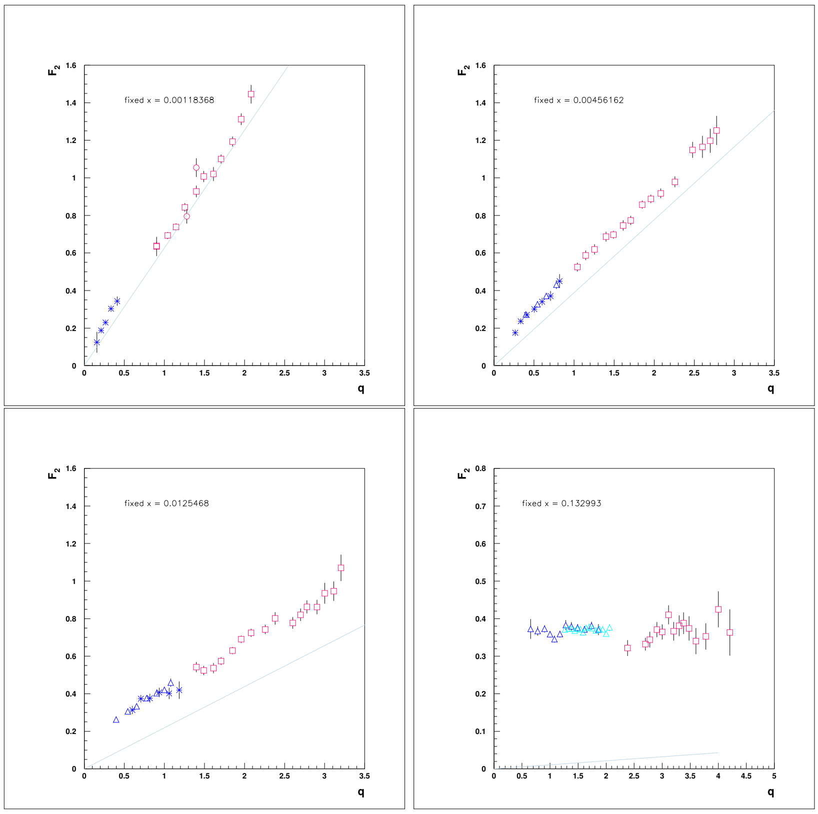

Figure 1: $F_2(x,q)$ for selected x-bins versus q.

In conclusion, $\partial F_2(x,q)/\partial q$ is nearly unaffected by the valence for x up to about 0.1 and motivates the extension to large x : $S(x,q) = (\partial F_2(x,q)/\partial q - \partial F_2^{VAL-mrst}(x,q)/\partial q) \cdot\ q$.

The other piece of information makes use of the absolute values of F_2 and is defined by $F_2(x,q) - S(x,q)$ (see right fig. 2). It vanishes gradually for decreasing x, while for large x a prominent valence-like contribution emerges, which is without sizeable residual q-dependence (see fig. 1). Fig. 2 shows also the valence part to F_2 obtained from the MRST-parametrization[4] at the Q^2-scale 4.5 GeV^2. The striking feature is that $F_2 - S$ agrees well for large x, but exceeds significantly the valence below x about 0.2.

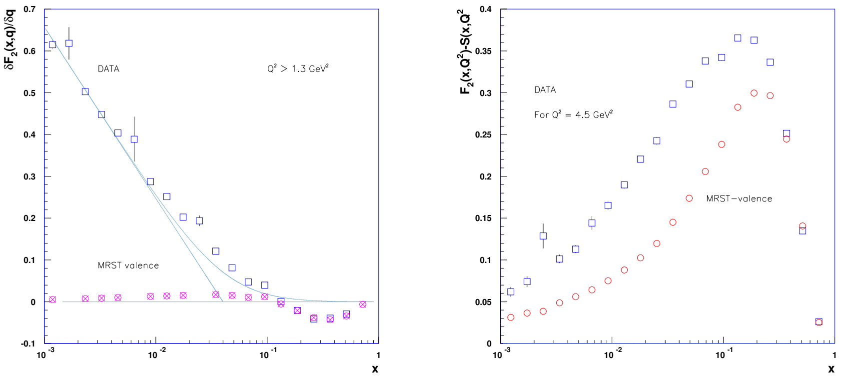

Figure 2: Left :the derivative of F_2 w.r.t q versus x, the steep line is the log-fit to $x < 10^{-3}$ from ref.[1]; right : valence-like distribution

4 Results

A phenomenological study of the proton structure function F_2 in charged lepton proton scattering is presented which covers the x-range from 10^{-6} up to about 0.1 without restricting the data in Q^2. On the basis of the q-dependence of the F_2-data two components can be distinguished, a logarithmic low-x component proportional to q and a large-x valence-like component consisting of the valence plus an almost Q^2-independent intrinsic sea.

Acknowledgement

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References

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