

# Studies of HERA deep inelastic scattering data at low $Q^2$ and low $x_{Bj}$

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A phenomenological study of the final combined HERA data on inclusive deep inelastic scattering (DIS) has been performed. The data are presented and investigated for a kinematic range extending from values of the four-momentum transfer,  $Q^2$ , above  $10^4$   $\text{GeV}^2$  down to the lowest values observable at HERA of  $Q^2 = 0.045$   $\text{GeV}^2$  and Bjorken  $x$ ,  $x_{Bj} = 6 \times 10^{-7}$ . The data are well described by fits based on perturbative quantum chromodynamics (QCD) using collinear factorisation and evolution of the parton densities encompassed in the DGLAP formalism from the highest  $Q^2$  down to  $Q^2$  of a few  $\text{GeV}^2$ . The standard DGLAP evolution was augmented by including an additional higher-twist term in the description of the longitudinal structure function,  $F_L$ . This additional term,  $F_L A_L^{\text{HT}}/Q^2$ , improves the description of the reduced cross sections significantly. The resulting predictions for  $F_L$  suggest that further corrections are required for  $Q^2$  less than about  $2$   $\text{GeV}^2$ . The Regge formalism can describe the data up to  $Q^2 \sim 0.65$   $\text{GeV}^2$ . The complete data set can be described by a new fit using the ALLM parameterisation. The region between the Regge and the perturbative QCD regimes is of particular interest.

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