QCD FITS OF DIFFRACTIVE STRUCTURE FUNCTIONS AT HERA

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The proton diffractive structure function $F_2^{D(3)}$ measured in the H1 and ZEUS experiments at HERA is analyzed in terms of both Regge phenomenology and perturbative QCD evolution. A *global fit* analysis where a higher twist component taken from models allow to use data in the whole available range in diffractive mass, gives quite different gluon distributions for H1 and ZEUS. An extrapolation to the Tevatron range is compared with CDF data on single diffraction.

1 Regge fits and determination of intercepts

The diffractive structure function $F_2^{D(3)}$ can be expressed as a sum of two factorized contributions corresponding to a Pomeron and secondary Reggeon trajectories. The value of the pomeron exponent is found to be $\alpha_{\mathbb{P}}(0) = 1.20 \pm 0.02$ with H1 data and $\alpha_{\mathbb{P}} = 1.13 \pm 0.04$ with ZEUS data in agreement with those obtained in Ref. [1] and is significantly larger than values extracted from soft hadronic data ($\alpha_{\mathbb{P}} \sim 1.08$). Also, we find $\alpha_{\mathbb{R}}(0) = 0.62 \pm 0.02$ with H1 data. A well-known technical problem for the determination of the Regge fit at each β and Q^2 point is the correct identification of the actually free parameters. For this sake, we use a new method described in Ref. [2].

2 Extraction of parton distributions in the Pomeron

The Q^2 evolution of the diffractive structure functions may be understood in terms of parton dynamics [3], i.e. as coming from leading twist, perturbative QCD contributions where parton densities are evolved according to DGLAP NLO equations [4].

We assign parton distribution functions to the Pomeron and to the reggeon. A simple prescription is adopted in which the parton distributions of both the Pomeron and the reggeon are parameterised in terms of non-perturbative input distributions at some low scale $Q_0^2 = 3$ GeV^2. For the Pomeron, a quark flavour singlet distribution and a gluon distribution are parameterized in a sum of three Chebyshev polynomials. To get solvable evolution equations, the parton distribution functions must tend to zero as $z \to 1$. This is achieved by introducing an exponential decreasing term [2].

The contribution to $F_2^{I\!P}(\beta, Q^2)$ from charm quarks is calculated in the fixed flavour scheme using the photon-gluon mechanism. We use the results of Ref. [5] to subtract the higher twist component from the $F_2^{D(3)}$ measurements at high β.

The resulting parton densities of the Pomeron are presented in figure 1 using H1 or ZEUS sets of data. We notice some large discrepancies between H1 and ZEUS results, especially on the gluon density. The gluon density derived from ZEUS measurements is lower that the H1 fit results due to differences in the F_2^D measurements.

Charm predictions show large differences between the ZEUS and H1 fit results since this measurement is directly sensitive to the gluon density.

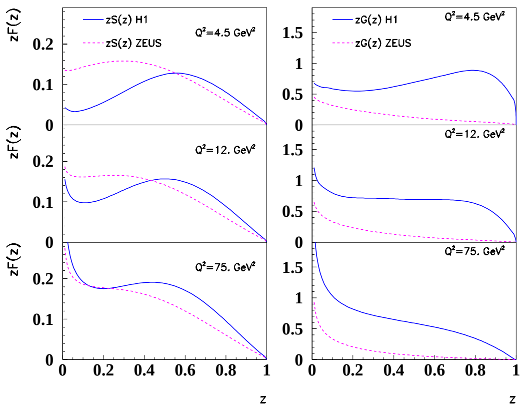

Figure 1: Normalized parton distributions derived from H1 diffractive data (χ^2/dof = 177.1/154 = 1.15, full lines) and ZEUS diffractive data (χ^2/dof = 29.3/(30 − 6) = 1.22, dashed lines).

3 Extrapolation to Tevatron and comparison with CDF data

The QCD fits we obtained from HERA data allow us to make direct comparisons for measurements at Tevatron by extrapolating H1 and ZEUS fits to Tevatron. It is quite challenging to be able to test directly factorisation breaking between HERA and Tevatron using the measurements performed at both accelerators. The result is given in Figure 2. We note a large discrepancy both in shape and normalization between H1 predictions and CDF data, showing clearly factorisation breaking. However, the ZEUS fits are more compatible in normalization with the CDF measurement. We know that the ZEUS gluon density is between 2 and 3 times smaller than the H1 one. The predictions for Tevatron are thus expected to be very much different by a factor 4 to 9 between H1 and ZEUS. If the large statistic and systematic uncertainties on the gluon density are taken into account (about 50% for ZEUS, 25% for H1), ZEUS data are in the compatibility domain of factorization at low β.

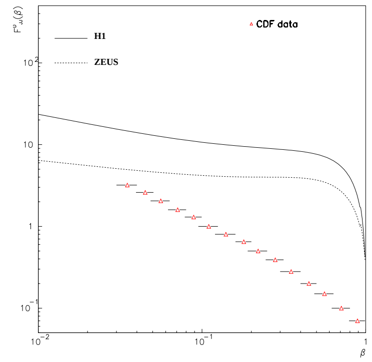

Figure 2: CDF data β distributions compared with extrapolations from the parton densities of the proton extracted from diffractive $F_2^{D(3)}$ measurements from H1 and ZEUS collaborations

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