ENERGY FLOW AND OPEN CHARM PRODUCTION IN DIFFRACTIVE DEEP-INELASTIC SCATTERING

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Measurements of the energy flow and of D^* meson production in diffractive deep-inelastic ep scattering at HERA are presented using data taken in 1994 with the H1 detector. Parton densities dominated by gluons, as obtained from a DGLAP QCD analysis of the diffractive structure function $F_2^{D(3)}(\beta, Q^2, x_{I\!P})$, are used together with a model of deep-inelastic electron pomeron scattering to make predictions for these processes. These predictions are found to be consistent with the present measurements.

1 Introduction

The analysis of the data taken by H1 in 1994 has provided a precise measurement [1] of the diffractive structure function $F_2^{D(3)}(\beta, Q^2, x_{I\!P})$ over an extended kinematical range. In the framework of the DGLAP QCD evolution equations, parton densities are obtained, according to which more than 80% of the momentum in the diffractive exchange is found to be carried by gluons [a]. The gluons exhibit a "leading" behaviour in the distribution of the fractional momentum.

In this contribution new H1 results on the hadronic final state (system X) in the process $ep \to e'XY$ are presented, where the systems X and Y are separated by the largest gap in rapidity, $M_Y < 1.6$ GeV$/c^2$ and $x_{I\!P} = (Q^2+M_X^2)/(Q^2+W^2) < 0.05$. These are the measurements of energy flow and open charm production, which provide sensitivity to the gluonic contribution in the diffractive exchange. They are compared to predictions obtained from the RAPGAP model [2], in which deep-inelastic diffraction is understood in terms of deep-inelastic electron-pomeron ($eI\!P$) scattering [3]. The parton densities used for the simulations are those obtained from the DGLAP QCD analysis [1] of the diffractive structure function $F_2^{D(3)}$.

[a] This observation can be related (within DGLAP) to the observed scaling violations of $F_2^{D(3)}$. For fixed β, $F_2^{D(3)}$ has been found [1] to increase with increasing $\log Q^2$, with the rise persisting up to high values of β.

2 Energy Flow in the $\gamma^* I\!P$ Centre-of-Mass System

In the $\gamma^* I\!P$ centre-of-mass system (which is the rest-frame of system X) the measured energy flow allows direct studies of the final state, avoiding effects of the boost to the laboratory frame. For the central region ($\eta^* \approx 0$) of this system more energy is expected to be produced for a gluon initiated process than for a quark initiated process. In the latter case, the produced two partons are mainly aligned with the $\gamma^* I\!P$ axis, whereas for a gluon initiated process less alignment of the partons is expected.

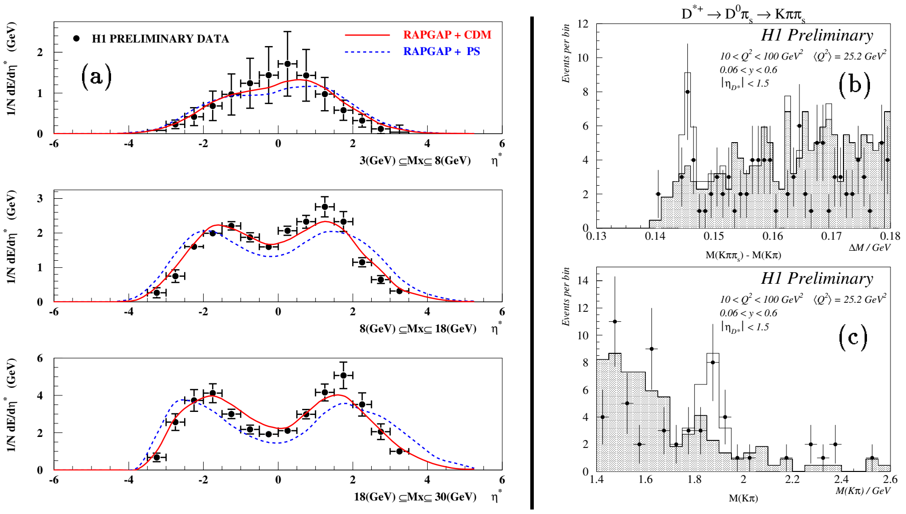

Figure 1: **a)** Energy flow in the $\gamma^* I\!P$ CMS – corrected for detector biases – compared to the predictions of the RAPGAP model using parton densities obtained from a DGLAP QCD analysis of the diffractive structure function $F_2^{D(3)}$; shown are two different approaches to the modelling of QCD cascades (CDM = Colour Dipole Model, PS = Parton Shower). Errors shown are statistical and systematic errors added in quadrature. **b)** mass difference between $K\pi\pi_{slow}$ and $K\pi$, requiring $|M_{K\pi} - M_{D^0}| < 80$ MeV/c^2. **c)** mass of the $K\pi$ system, requiring $|(M_{K\pi\pi_{slow}} - M_{K\pi}) - 145.4$ MeV/$c^2| < 1.5$ MeV/c^2. For **b)** and **c)** the histogram is the prediction of the RAPGAP model using the parton densities obtained from the QCD analysis, the shaded histogram shows the RAPGAP events without a D^* meson

Fig. 1a) shows the measured energy flow (corrected for detector biases) in three bins of M_X compared to the prediction of the RAPGAP model using the parton densities as described above. The data are well described for two different approaches to the modelling of the QCD cascade in the final state (PS = Parton Shower in the "leading log" approximation [4], CDM = Color Dipole Model [5]). Not shown is the prediction of the RAPGAP model with unphysical parton densities (only quarks, no gluons at all), which gives significantly less energy flow in the central region $\eta^* \approx 0$ than in the data.

3 Open Charm Production in Diffractive DIS

For a dominant gluon component in the diffractive exchange, the production of charm quarks via the boson–gluon fusion process is expected. $D^{*\pm}$ meson production has been searched for in the diffractive data by looking for the decay $D^{*\pm} \rightarrow D^0(\bar{D}^0)\pi^{\pm}_{slow} \rightarrow K^{\mp}\pi^{\pm}\pi^{\pm}_{slow}$. A signal for D^* mesons is traditionally searched for in the difference of invariant masses $\Delta M = M_{K\pi\pi_{slow}} - M_{K\pi}$. Here the resolution is dominated by the measurement of the slow pion.

Fig. 1b) shows the mass difference ΔM for (K,π) combinations close to the D^0 mass ($|M_{K\pi} - M_{D^0}| < 80$ MeV/c^2). At the expected value $\Delta M \approx 145.4$ MeV/c^2 a clear signal for D^* production is observed. Fig. 1c) shows the mass spectrum of the (K,π) combinations, which give together with a third pion a D^* candidate ($|(M_{K\pi\pi_{slow}} - M_{K\pi}) - 145.4$ MeV/$c^2| < 1.5$ MeV/c^2). Here a clear signal of D^0 mesons is seen. The D^* (and the D^0) yield in the data is found to be compatible with the prediction by the RAPGAP model (unshaded histogram) using the parton densities obtained.

4 Conclusions

Two measurements of properties of the hadronic final state (energy flow and D^* meson production) in diffractive deep-inelastic scattering have been presented which are sensitive to contributions from a gluonic component in the diffractive exchange. The data were found to be described by a model for deep-inelastic $e\mathbb{P}$ scattering when using parton densities obtained from a DGLAP QCD analysis of $F_2^{D(3)}$ which have a dominant "leading" gluon component.

References

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