DIFFRACTIVE CHARM PRODUCTION WITH THE H1 DETECTOR AT HERA

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New measurements are presented of diffractive open charm production at HERA. The analyzed data were collected with the H1 detector in the years 1999 and 2000 and correspond to an integrated luminosity of approximately $48\,\mathrm{pb}^{-1}$. In the first analysis the charm quark is tagged by the reconstruction of a $D^{*\pm}(2010)$ meson. This is used for the first measurement by H1 of diffractive charm in photoproduction. In the second analysis a displaced track method is used to measure the open charm contribution to the inclusive diffractive cross section in DIS. New results on this are also obtained with the $D^{*\pm}(2010)$ meson technique.

1. Introduction

Figure 1 shows the dominant mechanism for diffractive charm production in ep collisions at HERA in the resolved pomeron model [1]. QCD factorisa-

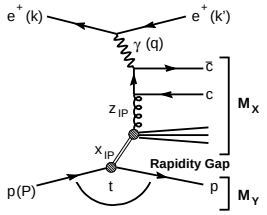

Figure 1. Diffractive charm production at HERA in the resolved Pomeron model.

tion [2] is assumed to hold and charm production is directly sensitive to the density of gluons from the diffractive exchange which enter the hard subprocess $g\gamma \to c\bar{c}$. At this conference H1 presents new results of diffractive parton densities (DPDFs) determined from inclusive diffractive scattering in DIS [3] and for the first time from a combined fit to inclusive and dijet diffractive data in DIS [4]. The dijets provide direct information on

the diffractive gluon density similar as for charm. The two different sets of DPDFS given in [3] are used to obtain predictions for the charm measurements presented here. This provides an interesting test of the validity of QCD factorisation for diffractive hard processes. Diffractive events are selected in the analyses by the absence of hadronic activity above noise thresholds in the most forward part of the LAr calorimeter ($\eta > 3.2$) and in the forward detectors.

2. Diffractive D^* photoproduction

$D^{*\pm}$ mesons are fully reconstructed using the decay channel $D^{*+} \rightarrow D^0\pi^+_{slow} \rightarrow (K^-\pi^+)\pi^+_{slow}$ (+C.C.). Photoproduction events are selected by requiring the scattered positron to be measured in the electron tagger positioned at -33 m. The integrated ep cross section of diffractive $D^{*\pm}$ production in the kinematic range of $Q^2 < 0.01$ GeV^2, $0.3 < y < 0.65$, $x_{I\!P} < 0.04$, $M_Y < 1.6$ GeV, $|t| < 1$ GeV^2, $p_t(D^*) > 2$ GeV and $|\eta(D^*)| < 1.5$ is measured to be $\sigma(ep \rightarrow eD^{*\pm}X'Y)_{\gamma p} = 265 \pm 50(\text{stat.}) \pm 41(\text{syst.})$ pb. This is in good agreement with the value $360 \pm^{90}_{70}$ pb obtained from a calculation in the resolved Pomeron model using the FMNR [5] program (taking a value of 1.5 GeV for the charm mass) to calculate the hard scattering in Next to Leading Order (NLO) perturbative QCD and the diffractive parton densities of the H1 2006 DPDF FIT A [3]. Differential cross sections as functions of the diffractive kinematic observables $x_{I\!P}$ and $z_{I\!P}$ are shown in fig. 2. The

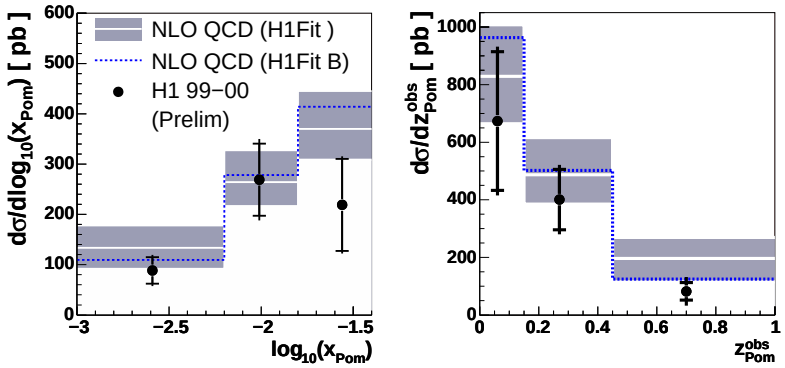

Figure 2. Selection of differential cross section results for diffractive D^* meson production in photoproduction.

data are well described by the NLO prediction using as input the H1 2006 DPDF FIT A [3] (denoted as H1Fit in the figure legend) or the alternative

H1Fit B [3], which provides a significantly better description of diffractive dijet data in DIS as discussed in [4]. In summary, within the limited precision of both the data and the calculation, QCD factorisation is observed to be valid, i.e. there is no sign of a suppression by a factor ~ 0.6 as was seen for diffractive dijets in photoproduction [6]. Similar observations were made in a recent measurement [7] of D^* diffractive photoproduction by ZEUS.

3. Reduced diffractive charm cross section in DIS

The open charm contribution to the inclusive diffractive cross section in DIS is investigated with the same charm tagging technique that was used in [8] to measure the total inclusive charm and beauty cross sections in DIS. This method distinguishes events containing heavy quarks from those containing only light quarks by reconstructing the displacement of tracks from the primary vertex in the transverse plane (impact parameter), caused by the long lifetimes of the charm and beauty flavoured hadrons, using the precise spatial information from the H1 central silicon detector. Tracks are selected if they have a transverse momentum of more than 0.5 GeV. Due to the low beauty fraction in the diffractive data sample, it is not possible to make a measurement of the beauty cross section. The beauty component is instead fixed to the prediction of the RAPGAP [9] Monte Carlo simulation program and varied by $\pm^{400}_{100}\%$ as a systematic error. The analysis is performed in the kinematic phasespace $x_{I\!P} < 0.03$, $M_Y < 1.6$ GeV, $|t| < 1$ GeV^2, $M_X > 6$ GeV, $15.8 < Q^2 < 100$ GeV^2 and $0.07 < y < 0.7$. The diffractive reduced charm cross section is defined from

$$\tilde{\sigma}_D^{c\bar{c}}(x_{I\!P}, \beta, Q^2) = \frac{\mathrm{d}^3\sigma_D^{c\bar{c}}}{\mathrm{d}x_{I\!P}\,\mathrm{d}\beta\,\mathrm{d}Q^2} \frac{\beta Q^4}{2\pi\alpha^2(1+(1-y)^2)},$$

where $\beta = x/x_{I\!P}$. The differential cross section measurements are performed in three bins of M_X and converted (using the NLO QCD expectation) to bin centre corrected reduced cross sections for three values of $x_{I\!P}$, β and Q^2. The results are shown in fig. 3 (H1 Lifetime Data). The results of a new D^* meson measurement by H1 are also presented. The D^* analysis is performed in the same $Q^2 - y - M_x^2$ inverals as the displaced track method (and using the same kinematic cuts for the D^* meson as in the above photoproduction analysis). The D^* cross sections are extrapolated with a NLO calculation outside the visible $p_t(D^*)$–$|\eta(D^*)|$ range to extract the differential open charm cross section. The H1 data are also compared with D^* measurements from ZEUS [10] which are interpolated to the same kinematic range and corrected for the different range in M_Y. The measurements from

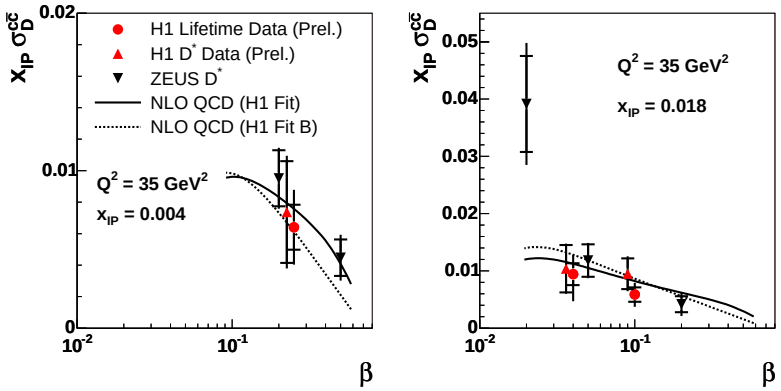

Figure 3. Results for the reduced cross section $\tilde{\sigma}_D^{c\bar{c}}$.

the displaced track analysis and the D^* extraction methods from both H1 and ZEUS are in good agreement. They are also in agreement with the predictions based on the NLO DPDFs [3] thus confirming the validity of the QCD factorisation picture.

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