MEASUREMENT OF CHARM PRODUCTION IN DEEP INELASTIC SCATTERING WITH THE ZEUS DETECTOR

SVEN SCHAGEN
ON BEHALF OF THE ZEUS COLLABORATION
NIKHEF-Amsterdam The Netherlands

We present measurements of charm production in DIS using the ZEUS detector. Data with $\int \mathcal{L}dt = 83$ pb^{-1} have been analysed. For the channel $D^{*+} \to D^0\pi_s^+ \to K^-\pi^+\pi_s^+(+c.c.)$ a cross section has been extracted, differential in the kinematical variables Q^2 and Bjorken x. In addition the decay $\overline{c}q \to e^-\overline{\nu}_e X$ has been studied in a data sample of $\int \mathcal{L}dt = 34$ pb^{-1}. This results in a cross section, differential in Q^2,x and W of the event and in p_T and η of the decay electron. The structure function $F_2^{c\overline{c}}$ has also been determined for this channel. All measured cross sections show good agreement with NLO pQCD predictions from HVQDIS.

1 Introduction

For deep inelastic electron-proton scattering perturbative QCD predicts that heavy quarks will mainly be produced by the boson-gluon fusion process: a photon emitted by the electron interacts with a gluon inside the proton to produce a $q\overline{q}$-pair, i.e. $\gamma g \to c\overline{c}$. The HVQDIS[1] program uses NLO calculations in the DGLAP scheme at fixed order in α_s, assuming three active flavours in the proton[2]. The charm-quark is then only produced by the boson-gluon fusion.

2 Analysis of the decay chain $D^{*+} \to D^0\pi_s^+ \to K^-\pi^+\pi_s^+(+c.c.)$

For the analysis of the D^* decay DIS events are selected that with $Q^2 > 10$ GeV^2. By combining all available fully reconstructed tracks D^0 and D^* candidates are reconstructed. A clean sample of D^*'s can be extracted from the data by constraining the reconstructed D^0 mass (D^0: $1.80 < M < 1.92$ GeV) and by cutting on the reconstructed D^* kinematics (D^*: $1.5 < p_T < 15.0$ GeV and $|\eta| < 1.5$). For the full analysis, data with an integrated luminosity of 83 pb^{-1} was used. The events were collected during the 1995-1997 running period, at which HERA was operated with a 27.5 GeV positron beam and a 820 GeV proton beam, and during the 1999-2000 running period when the beam energies were 27.5 and 920 GeV, respectively. The resulting differential cross sections are shown in Fig. 1.

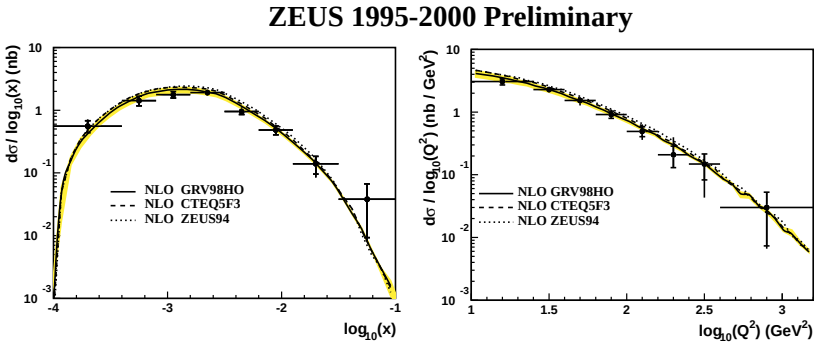

Figure 1. (*left*) Charm production cross section differential in x and (*right*) Q^2 as measured with the D^*-decay chain. The differential cross sections are compared to HVQDIS predictions for various proton structure functions sets. All of them agree with data.

3 Semi-leptonic decay of charmed hadrons ($\overline{c}q \to e^-\overline{\nu}_e X$)

To study the semi-leptonic decay of charmed hadrons events with $1 < Q^2 < 1000$ GeV^2 and $0.03 < y < 0.7$ are selected. The electron candidates are identified based on the properties of the calorimeter cluster that is associated with them. We then consider the dE/dx of all candidates (the electron-enriched sample in Fig. 2 (*left*)) . The (large) hadronic background that is still within this sample is determined using the dE/dx distribution of a sample containing only hadronic tracks. After subtracting this hadronic background from the electron-enriched sample, a clean electron signal is visible (Fig. 2 (*right*)). This distribution still contains electrons coming from photon conversions,

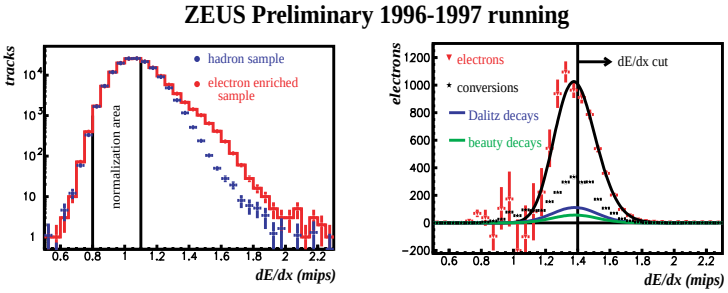

Figure 2. *left*: The dE/dx distributions for the electron enriched sample (histogram) and the hadronic sample (points). *right*: The resulting dE/dx distributions after the subtraction of the hadron distribution from the electron enriched sample with all contributions.

Dalitz decay of the π^0 and semi-leptonic decay of beauty. These contributions are all subtracted from the sample. For the 1996-1997 data from ZEUS (integrated luminosity of 34 pb^{-1}), the differential cross sections, as shown in Fig. 3 are obtained. The measurement shows good agreement with the predictions from the HVQDIS program. In addition, the charm structure function has been unfolded from the cross section differential in Q^2 and x_{BJ}. These results are compared to previously published ZEUS results from the D^* analysis of the 1996-1997 data [3]. Good agreement between the two analysis can be observed.

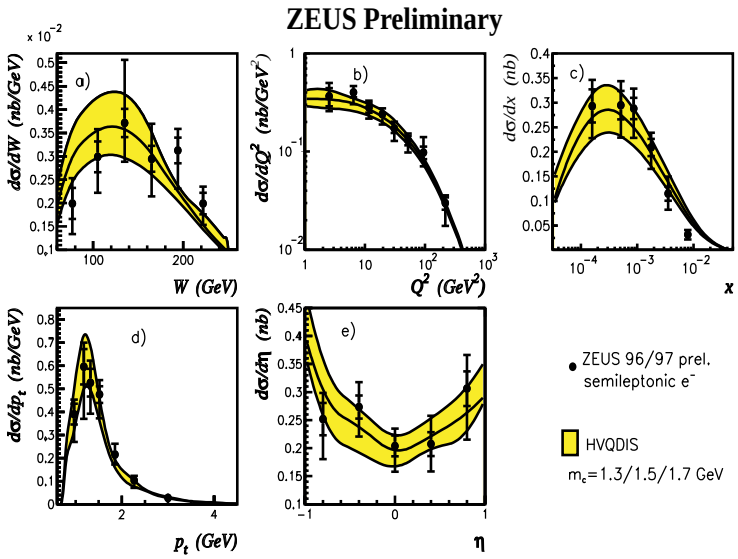

Figure 3. Charm production cross sections differential in *a*) W, *b*) Q^2, *c*) x, *d*) p_t^{sle} and *e*) η^{sle} as measured through the semi-leptonic decay of charmed hadrons. The data are compared to predictions of the HVQDIS program for the GRV94HO parton distributions.

4 Conclusions

Results on charm production in DIS using the D^* meson or the semi leptonic decay into electrons have been reported. The data show good agreement with NLO DGLAP predictions for charm production through the boson-gluon fusion process as calculated by the HVQDIS program.

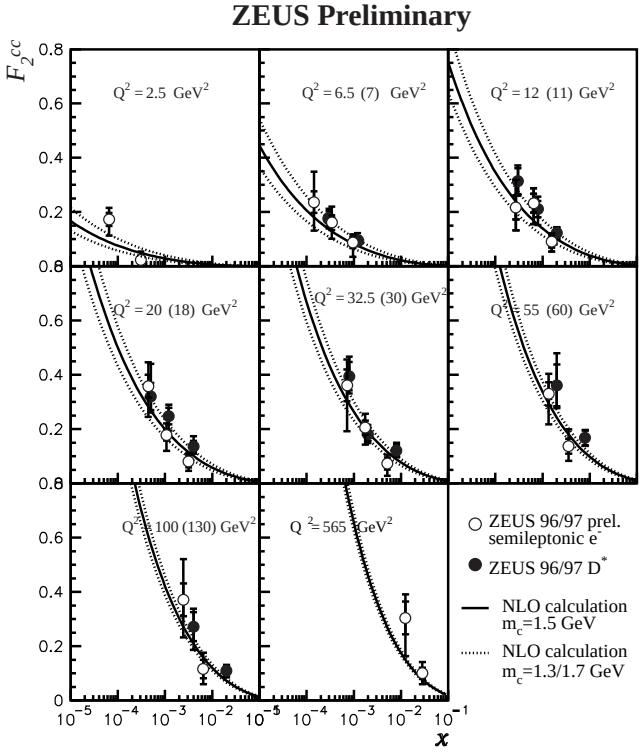

Figure 4. The charm structure function $F_2^{c\bar{c}}$ extracted from the semi leptonic decay of charmed hadrons. The results are compared to previously published ZEUS results on the $F_2^{c\bar{c}}$ from the D^* decay chain analysis. In parentheses one can find the central Q^2 values of the D^* results.

References

1. B.W. Harris and J. Smith, *Phys. Rev.* D **57**, 2806 (1998)
2. E. Laenen *et al*, *Nucl. Phys.* B **392**, 162 (1993), E. Laenen *et al*, *Nucl. Phys.* B **291**, 325 (1992), S. Riemersma, J. Smith and W.L. van Neerven, *Phys. Lett.* B **347**, 143 (1995)
3. ZEUS Coll., *J.Breitweg et al*, *Eur. Phys. J. C* **12**, 35 (2000)
4. ZEUS Coll., Contributed paper 451, XXXth ICHEP, Osaka, Japan, July 2000
5. ZEUS Coll., Contributed paper 447, XXXth ICHEP, Osaka, Japan, July 2000