

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

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We present measurements of charm production in DIS using the ZEUS detector. Data with $\int \mathcal{L} dt = 83 \text{ pb}^{-1}$ have been analysed. For the channel $D^{*+} \rightarrow D^0 \pi_s^+ \rightarrow K^- \pi^+ \pi_s^+ (+c.c.)$ a cross section has been extracted, differential in the kinematical variables Q^2 and Bjorken x . In addition the decay $\bar{c}q \rightarrow e^- \bar{\nu}_e X$ has been studied in a data sample of $\int \mathcal{L} dt = 34 \text{ pb}^{-1}$. 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 $F_2^{c\bar{c}}$ 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 $q\bar{q}$ -pair, i.e. $\gamma g \rightarrow c\bar{c}$. The HVQDIS¹ program uses NLO calculations in the DGLAP scheme at fixed order in α_s , assuming three active flavours in the proton². The charm-quark is then only produced by the boson-gluon fusion.

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

For the analysis of the D^* decay DIS events are selected that with $Q^2 > 10 \text{ GeV}^2$. 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 : $1.80 < M < 1.92 \text{ GeV}$) and by cutting on the reconstructed D^* kinematics (D^* : $1.5 < p_T < 15.0 \text{ GeV}$ 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.

ZEUS 1995-2000 Preliminary

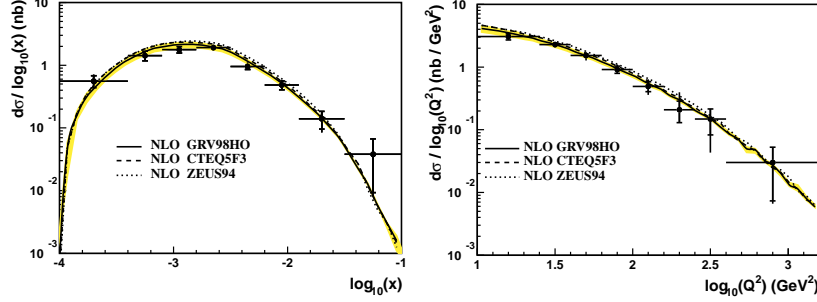


Figure 1. (*left*) Charm production cross section differential in x and (*right*) Q^2 as measured with the D^* -decay chain. The differential cross sections are compared to HVQDIS predictions for various proton structure functions sets. All of them agree with data.

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

To study the semi-leptonic decay of charmed hadrons events with $1 < Q^2 < 1000 \text{ GeV}^2$ 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,

ZEUS Preliminary 1996-1997 running

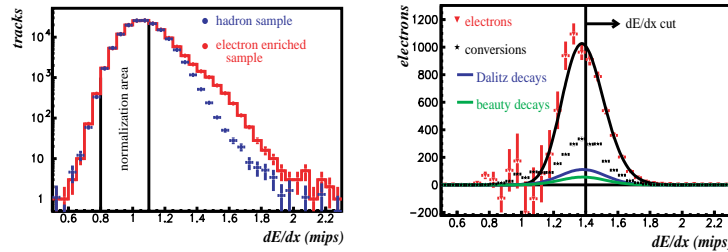


Figure 2. *left*: The dE/dx distributions for the electron enriched sample (histogram) and the hadronic sample (points). *right*: The resulting dE/dx distributions after the subtraction of the hadron distribution from the electron enriched sample with all contributions.

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 data³. Good agreement between the two analysis can be observed.

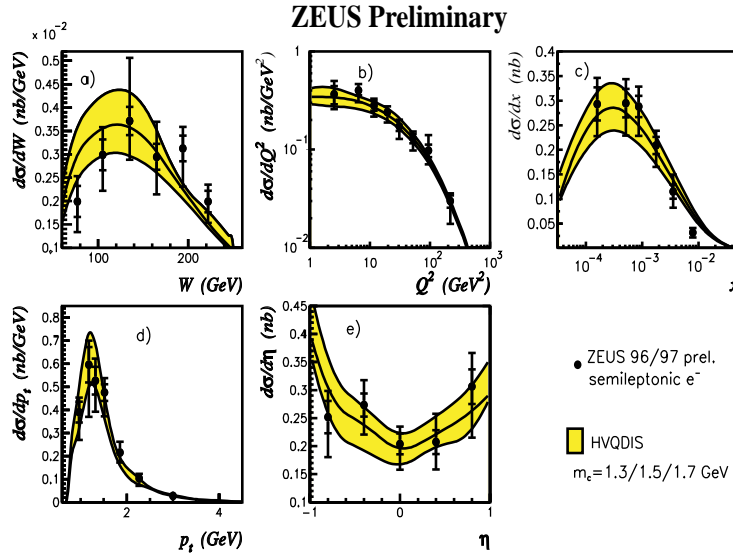


Figure 3. Charm production cross sections differential in a) W , b) Q^2 , c) x , d) p_t^{sle} and e) η^{sle} as measured through the semi-leptonic decay of charmed hadrons. The data are compared to predictions of the HVQDIS program for the GRV94HO parton distributions.

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.

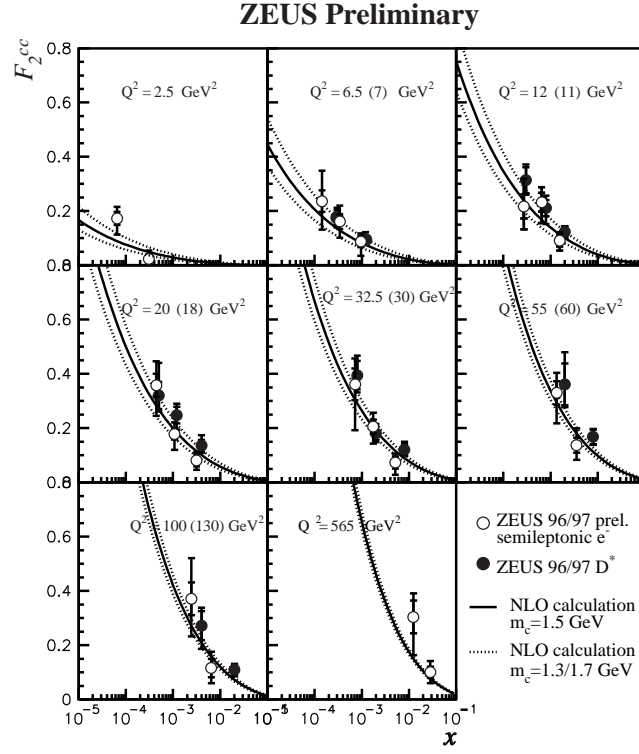


Figure 4. The charm structure function $F_2^{c\bar{c}}$ extracted from the semi leptonic decay of charmed hadrons. The results are compared to previously published ZEUS results on the $F_2^{c\bar{c}}$ from the D^* decay chain analysis. In parentheses one can find the central Q^2 values of the D^* results.

References

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