PROCEEDINGS OF SCIENCE

Heavy Flavor production at HERA with ZEUS

Olena Bachynska *†

Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, D-22607, Hamburg, Germany
E-mail: olena.bachynska@desy.de

Many measurements of heavy flavor production at HERA collider at DESY were performed using the ZEUS detector. Charm production is of special interest due to its non negligable contribution to the total cross section of the ep collisions. Measurements of the D^+, Λ_c^+, D^* meson final state are presented for the deep inelastic scattering regime, $5 < Q^2 < 1000$ GeV^2, where Q^2 is the photon virtuality, differential cross section are presented and compared to NLO QCD predictions. The charm contribution to the proton structure fucntion, $F_2^{c\bar{c}}$, and the charm fragmentation fraction $f(c \to \Lambda_c^+)$ are also shown and compared to previous results from ZEUS and other experiments. The new results are in agreement the older ones.

The 2011 Europhysics Conference on High Energy Physics-HEP 2011,
July 21-27, 2011
Grenoble, Rhône-Alpes France

*Speaker.
†On behalf of the ZEUS collaboration

PoS(EPS-HEP2011)298

1. Introduction

One of the dominant processes in ep collisions at HERA is deep inelastic scattering (DIS), where incomming lepton scatters of a proton and thephoton virtuality, Q^2, is larger than 1 GeV. Charm production in DIS can be descibed as the interaction of the virtual photon with a gluon (boson-gluon fusion). Hence, it is directly sensitive to the gluon content of the proton. The charm contribution, $F_2^{c\bar{c}}$, to the insclusive proton structure function can be derived from the double-differential cross sections in Q^2,x, where x is the Bjorken scaling. Since the hadronisation of charm quarks to hadrons cannot be calculated by perturbative QCD, related quantaties, such as fragmentation fractions, must be extracted from the experimental data. A precise determination of the inclusive structure function and its charm contribution is very important for the the proton parton density function.

2. Fragmentation fraction and measurements at low P_T threshold

Measurements were performed by reconstructing the hadronic decays $D^+ \to K^0_S, \pi^+$, $\Lambda_c^+ \to pK^0_S$, $\Lambda_c^+ \to \Lambda\pi^+$ and their charge conjugates. The presence of a neutral strange hadron in the final state reduced the combinatorial background and allowed extension of the measurement to the low transverse momentum, p_T, region. Thus, the production of D mesons was studied for the first time at HERA for $p_T(D^+) < 1.5$ GeV. The measured cross section was found to be reasonably well described by NLO predictions. The fraction of c quarks hadronising into Λ_c^+ hadrons was extracted from a combination of the results for both decay channels mentioned above: $f(c \to \Lambda_c^+) = 0.117 \pm 0.033(stat.)^{+0.026}_{-0.022}(syst.) \pm 0.027(BR.)$. This value obtained in DIS is consistent with a previous ZEUS measurement in the photoproduction regime and with the e^+e^- average value [1].

3. Charm contribution to a proton structure

Charm production was also studied via $D^+ \to K^-\pi^+\pi^-$ and $D^{*+} \to K^+\pi^-\pi^+_s$ mesons decays and their charge conjugates, which were reconstructed in the the region of $5 < Q^2 < 1000$ GeV^2, $0.02 < y < 0.7$. The purity of the D^+ signal [2] was improved by using lifetime information available from the micro vertex detector. The D^+ and D^* meson were recontsracted in restricted pseudorapidity, $\eta = -ln(tg\frac{\theta}{2})$ and p_T ranges: $|\eta(D^+)| < 1.6$ and $1.5 < p_T(D^+) < 15$ GeV/c, $\eta(D^*)| < 1.5$ and $1.5 < p_T(D^*) < 20$ GeV/c. The measured differential cross sections were reasonably described (Fig. 1) with the NLO Hvqdis [3] predictions where fixed flavor number scheme ZEUS-S NLO QCD fit [4] was used for the parametrisation of the proton PDFs, the charm quark mass was set to 1.5 GeV/c and the renormalisation and factorisation scales were set to $\mu_R = \mu_f = \sqrt{Q^2 + 4m_c^2}$. To extract $F_2^{c\bar{c}}$ double differential cross sections were used: $\frac{d^2\sigma}{dydQ^2} = \frac{2\pi\alpha^2}{xQ^4}(1 + (1-y))F_2^{c\bar{c}}$. To extrapolate to the full kinematic region, the NLO HVQDIS was used according to: $F^{c\bar{c}}_{2,meas.}(x_i, Q_i^2) = \frac{\sigma_{meas.,i}}{\sigma_{Hvqdis,i}} \times F^{c\bar{c}}_{2,Hvqdis}(x_i, Q_i^2)\ F_2^{c\bar{c}}$ (Fig. 2) was extracted from both D^+ and D^* measurements. The results were found to be in reasonable agreement with the HERA combination [5] and with the HERAPDF1.0 [6].

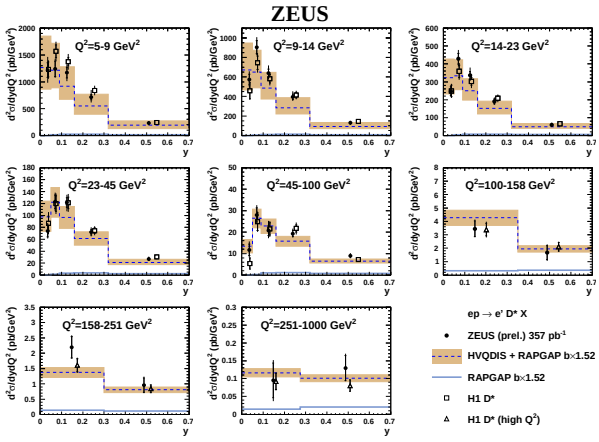

Figure 1: D^* double differential cross sections $\frac{d^2\sigma}{dQ^2dy}$ compared to the NLO HVQDIS predictions and to the H1 measurements [7], [8].

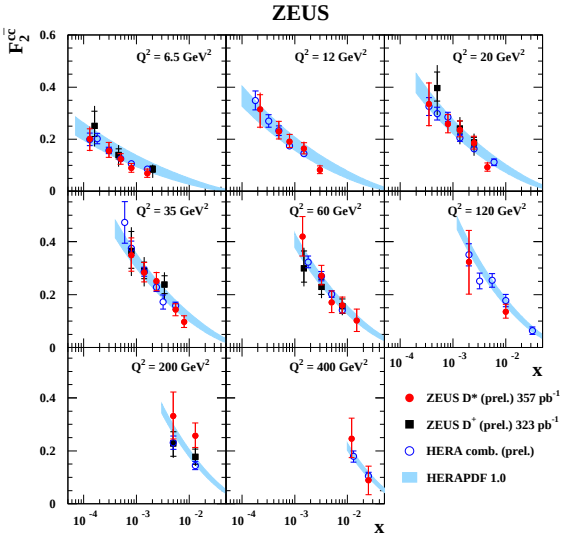

Figure 2: Charm contribution to the proton structure function. Recent results from the ZEUS are compared to the HERA combination preliminary result and to the predictions from HERAPDF1.0.

4. Summary

Differential cross sections of D^+, $D^{*\pm}$, Λ_c^+ mesons production at DIS regime were measured and compared to theoretical predictions as well as to other experiments. They found to be in agreement. The charm structure function was measured and compared to the combined HERA results.

References

[1] ZEUS Coll., H. Abramowicz et al., *Measurement of D^+ and Λ_c^+ production in DIS at HERA, JHEP* **11**, 009 (2010).

[2] ZEUS Coll., *Measurement of the $D^\pm$ production and $F_2^{c\bar{c}}$ extraction in DIS at ZEUS*. ZEUS-prel-10-005 (2010).

[3] B. W. Harris and J. Smith, *Charm quark and D^* cross sections in DIS at DESY HERA, Phys. Rev.* **D** 57, 2806 (1998).

[4] ZEUS Coll., S. Chekanov et al., *ZEUS next-to-leading-order QCD analysis of data on deep inelastic scattering, Phys. Rev.* **D** 67, 012007 (2003).

[5] H1 Coll. and ZEUS Coll., *Measurements of $F_2^{c\bar{c}}$ in DIS at HERA*. ZEUS-prel-09-015 (2009), H1prelim-09-171 (2009).

[6] H1 Coll. and ZEUS Coll., F. D. Aaron, *Combined measurement and QCD analysis of the inclusive $e^\pm$scattering cross sections at HERA, JHEP* **01**, 109 (2010).

[7] H1 Coll., F. D. Aaron et al. *Measurement of $D*^\pm$ Meson Production and Determination of $F_2^{c\bar{c}}$ at low Q2 in DIS at HERA* [arxiv:1106.1028].

[8] H1 Coll., F. D. Aaron et al., *Measurement of the $D^{*\pm}$ Meson Production Cross Section and $F_2^{c\bar{c}}$, at High Q2, in ep Scattering at HERA Phys. Lett.* **B** 686 (2010) 91.