PHOTOPRODUCTION OF $D^{*\pm}$ MESONS IN ELECTRON-PROTON COLLISIONS AT HERA

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The inclusive $D^{*\pm}$ meson photoproduction cross section has been measured with the H1 detector at HERA for $\langle W_{\gamma p}\rangle \approx 142$ GeV, 200 GeV, 230 GeV. The results compare reasonably well with NLO QCD calculations. Evidence for diffractive photoproduction of charm quarks is presented.

1 Introduction

Photoproduction of open charm occurs via direct photon gluon fusion *(PGF)*, i.e. $\gamma g \longrightarrow c\overline{c}$, or via resolved processes where a parton in the photon target is scattered off from a parton emitted by the proton, e.g. $gg \longrightarrow c\overline{c}$. Therefore D mesons may act as a probe for the gluon content in the proton and in the photon. The current analysis is sensitive mainly to PGF.

Recently, much interest has been focused on diffraction in ep scattering. Open charm also provides information on the partonic structure of this process.

2 Results

The H1 analysis [1] of 94 data exploits a D^* signal of more than 200 events in the kinematic region $p_t(D^*) > 2.5$ GeV/c and rapidity $-1.5 < \hat{y} < 1$. In γp events the positron is either detected in the luminosity system ("tagged"), or not seen at all ("untagged"). The total charm cross section σ_{tot} is shown as a function of the center-of-mass energy $W_{\gamma p}$ in Fig. 1a, together with the ZEUS 1993 data [2] and fixed target measurements [3]. The cross section increases from fixed target to HERA energies by more than one order of magnitude.

However, the extrapolation from the visible range to the full phase space introduces large systematic errors on σ_{tot}, due to the uncertainties in the parton densities in the proton and the photon. The choice of the parton densities strongly affects the measured σ_{tot} and the QCD prediction in the same way. Hence σ_{tot} is not well suited to determine the gluon densities.

Therefore, in Fig. 1b the cross section $d\sigma/dp_t$, restricted to the visible kinematic range, is compared to NLO QCD calculations. The data is plausibly described by QCD. Also shown is the dependence on the charm quark mass m_c, which mainly affects the region at small p_t, not accessible in this analysis.

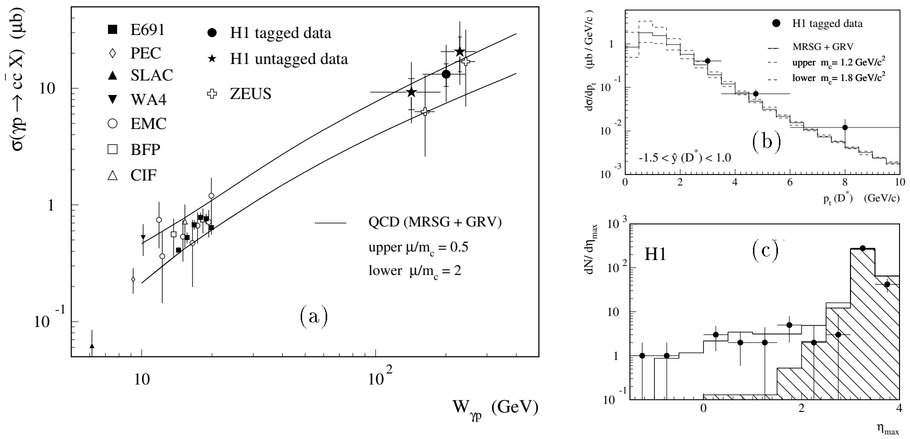

Figure 1: a) Total $\gamma p \rightarrow c\bar{c}X$ cross section versus $W_{\gamma p}$. The curves are different NLO QCD predictions for different factorization and renormalization scales μ. b) Differential γp cross section $d\sigma/dp_t$. The histograms show the NLO QCD predictions for different values of m_c. c) Background subtracted η_{max} distribution of D^{*+} events. The histograms show the Monte Carlo expectations from PYTHIA (hatched) and RAPGAP,normalised to the data.

Diffractive charm photoproduction is studied by searching for D^{*+} mesons in untagged γp events with a rapidity gap. In Fig. 1c the distribution of the pseudo-rapidity η_{max} of the most forward energy deposition for events containing D^{*+} mesons is compared to Monte Carlo predictions. Obviously, PYTHIA [4] fails to describe the data at low η_{max}, while RAPGAP [5] may account for the excess of events. The number of observed events disfavors a quark-dominated exchange, whereas it is consistent with a gluon-dominated structure.

References

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