Photon 2001

PHOTOPRODUCTION OF NEUTRAL STRANGE HADRONS AT ZEUS

STEWART BOOGERT
FOR THE ZEUS COLLABORATION
Nuclear and Astrophysics Laboratory, Keble Road, Oxford, OX1 3RH, UK
E-mail: sboogert@mail.desy.de

Measurements of K^0_S meson and Λ baryon production in γp interactions containing at least two high transverse energy jets at ZEUS using an integrated luminosity of 38.64 pb^{-1} are presented and compared with the predictions of leading order (LO) Monte Carlo models. Strange hadron production provides detailed information on both the hadronization mechanism and hard sub-process for interactions containing photon and proton hadronic remnants in the final state.

1 Introduction

Strange particle production at HERA provides an important instrument, for the study of the hadronization mechanism in processes containing photon and proton remnants in the final state and can yield important information on the universality of the strange particle fragmentation functions.

After pions, kaons are the most copiously produced hadrons at HERA, representing a significant proportion of the energy flow. By considering strange particle production in conjunction with the production of high E_T jets in the hadronic final state, it is possible to study the dependence of the hadronization mechanism on the underlying kinematics of the perturbative QCD sub-process.

Previous measurements of strange particle production by ZEUS, in both deep inelastic scattering[1] and photoproduction[2], were performed using integrated luminosities of 0.55 pb^{-1} and 2.6 pb^{-1}, respectively, similar results have also been reported by H1[34]. The results presented here are based on data taken between 1996-1997 with the ZEUS detector at HERA, which collided beams of 27.5 GeV positrons with 820 GeV protons and represent an integrated luminosity of 38.64 pb^{-1}.

For the analysis presented here, dijet photoproduction events are identified by the presence of two high transverse energy jets in the ZEUS uranium calorimeter and an absence of an observed scattered positron. The photon virtuality and fractional energy transfer are measured in the ranges, $Q^2 < 1$ GeV^2 and $0.2 < y < 0.8$, respectively. The two jets are selected in the following rapidity and transverse energy regions: $-2.4 < \eta^{jet1,2} < 2.0$ and

$E_T^{jet1,2} > 10, 9$ GeV.

Charged tracks are reconstructed in the central tracking detector (CTD) and used to identify secondary vertices from the decays: $K_S^0 \to \pi^+\pi^-$ and $\Lambda \to p\pi^-$. To ensure the strange particle was well reconstructed in the CTD, it was required to lie in the following kinematic region, $p_T(K_S^0, \Lambda) > 0.3$ GeV and $|\eta(K_S^0, \Lambda)| < 1.5$.

2 Neutral kaon production

The differential K_S^0 cross-section $d\sigma(ep \to dijet + K_S^0 + X)/dx_\gamma^{obs}$ in three bins of leading jet transverse energy (E_T^{jet1}) is shown in figure 1. The variable x_γ^{obs} is defined as the fraction of the photon momentum contributing to the production of the two highest transverse energy jets. The HERWIG[5] and PYTHIA[6] predictions agree well in shape with the measured cross-section. As the transverse energy of the jets is increased there is a clear reduction in the leading order resolved (low x_γ^{obs}) contribution to the cross-section.

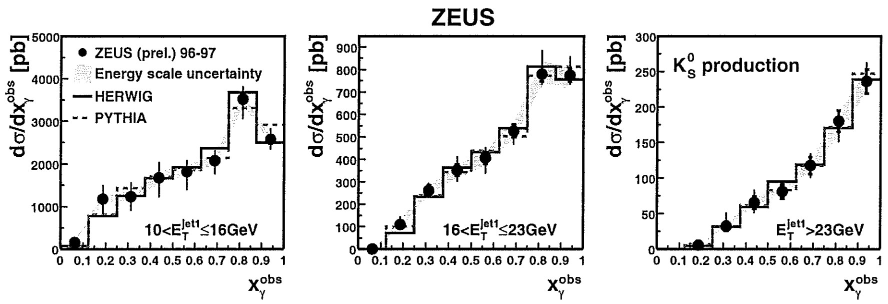

Figure 1. Differential K_S^0 cross-section $d\sigma/dx_\gamma^{obs}$ in the interval $|\eta(K_S^0)| < 1.5$ and $p_T(K_S^0) > 0.3$ GeV in bins of E_T^{jet1}, compared with predictions from HERWIG and PYTHIA. In this and all subsequent figures, the inner error bars represent the statistical errors and the outer error bars display the statistical and systematic uncertainties added in quadrature. The shaded band is the uncertainty due to the uncertainty in the calorimeter energy scale of $\pm 2\%$, which is not included in the overall systematic error.

In figure 2 the differential cross-section $d\sigma(ep \to dijet + K_S^0 + X)/d\eta$ is shown, where again the Monte Carlo simulation is in good agreement with the measured cross-section, including the forward[a] region ($\eta \sim 1.5$). In general,

[a] The forward (+Z) direction is defined as the proton beam direction.

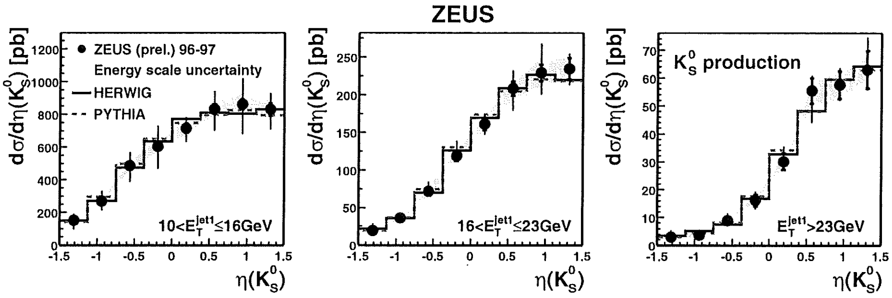

Figure 2. Differential K_S^0 cross-section $d\sigma/d\eta$, $p_T(K_S^0) > 0.3$ GeV in bins of E_T^{jet1}, compared with Monte Carlo predictions from HERWIG and PYTHIA.

the K_S^0 mesons are produced within the jets, with increased production in the forward direction at higher jet E_T.

3 Lambda hyperon production

Differential cross-sections $d\sigma(ep \to dijet + \Lambda + X)/dx_\gamma^{obs}$ have been measured in two bins of jet transverse energy, shown in figure 3. Normalizing the HERWIG and PYTHIA predictions to the measured $d\sigma(ep \to dijet + \Lambda + X)/dx_\gamma^{obs}$ cross-section, gives a good description of the shape of the data. When the overall Monte Carlo normalization is taken from the measured K_S^0 cross-section, HERWIG significantly overestimates the measured cross-section, while PYTHIA slightly underestimates the measured cross-section. At higher jet energies, the difference persists, but overall the agreement between the measured cross-section and Monte Carlo predictions is slightly better.

4 Conclusions

Differential cross-sections are presented for K_S^0 and Λ production in high transverse energy photoproduction. The K_S^0 meson production is well described by HERWIG and PYTHIA leading order Monte Carlo generators, over a large range of jet transverse energies. Normalizing the Monte Carlo predictions to the measured Λ cross-section, gives a reasonable shape description. Fixing the Monte Carlo predictions to the K_S^0 cross-section, HERWIG overestimates and PYTHIA underestimates the Λ cross-section.

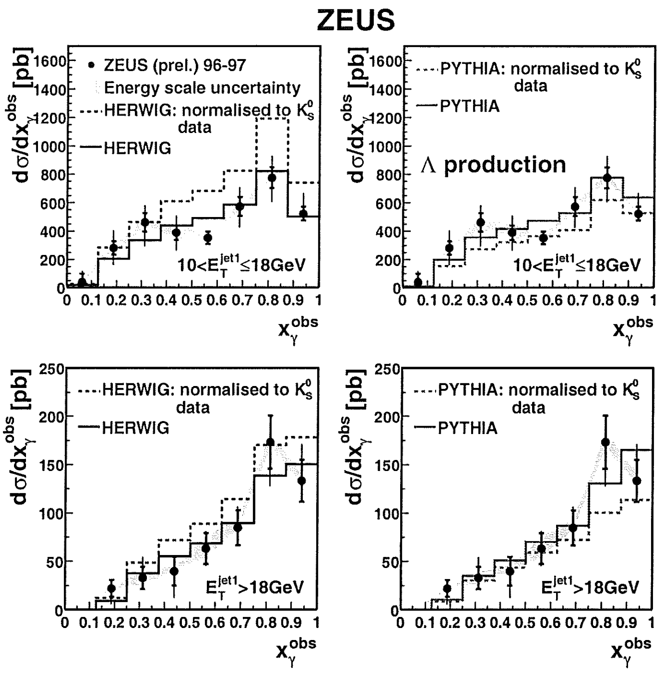

Figure 3. Differential Λ cross-section $d\sigma/dx_\gamma^{obs}$ in 2 bins of E_T^{jet1} with $p_T(\Lambda) > 0.3$ GeV and $|\eta(\Lambda)| < 1.5$. The left and right pairs of plots show the same data points compared with HERWIG and PYTHIA, respectively.

References

1. ZEUS Collaboration, J. Breitweg et al, Eur. Phys. J. **C2**, 77 (1998).
2. ZEUS Collaboration, M. Derrick et al, Zeit. f. Phys. **C68**, 29 (1995).
3. H1 Collaboration, C. Adloff et al, Nuc. Phys. **B480**, 3 (1996)
4. H1 Collaboration, S. Aid et al, Zeit. f. Phys. **C76**, 213 (1997)
5. G. Corcella et al, hep-ph/0011363.
6. T. Sjöstrand et al, Computer Phys. Commun. **135**, 238 (2001).