Recent Measurements of the Hadronic Final State from H1

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The poster summarizes recent measurements of the hadronic final state in photoproduction and neutral current deep inelastic scattering (NC DIS) data collected with the H1 detector at HERA. The photoproduction analyses cover measurements of prompt photon cross sections, and a study of the underlying event based on charge particle multiplicities in jet data. In low Q^2 DIS, strangeness production is studied through the production of K^*, K^0 and Λ baryons. A first measurement of the charge asymmetry in the hadronic final state in high Q^2 DIS is presented. The different measurements are compared to Monte Carlo models with parton showers as well as fixed order calculations.

1 Charged Particles and the Hadronic Final State Charge Asymmetry [1, 2]

The charge asymmetry of particles in the hadronic final state was investigated [1] in NC DIS in the kinematic range $100 < Q^2 < 8000$ GeV^2. Fig. 1a) shows the normalized distribution, $D(x_p)$, of the scaled particle momentum, $x_p = \frac{2p}{Q}$, for positive (*pos*) and negative (*neg*) charged particles as well as the sum of the two. Fig. 1b) shows the charge particle asymmetry, $(pos - neg)/(pos + neg)$, compared to various models. At large x_p, where the produced particles retain the information from the hard interactions with sea quarks and gluons, a large charge asymmetry is seen. At low x_p the particles produced in the fragmentation process play an important role, and the asymmetry is smaller. This is also seen in Fig. 1c) where the MC prediction with hadronization turned off (CDM-quark) maintain the charge asymmetry at low x_p. Also measured [2] is the average multiplicity and the normalised distribution of the scaled momentum of charged final state hadrons in different regions of x_p. The data agree with e^+e^-

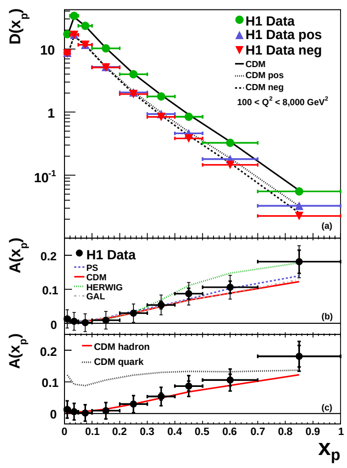

Figure 1: Scaled momentum distributions for positive and negative particles, and the asymmetry between these, compared to various MC models with parton showers.

data and are well described by MC with parton showers.

2 Prompt Photons in Photoproduction [3]

Final states with an isolated photon were analysed in photoproduction ($Q^2 < 1$ GeV^2). The analysis is based on data taken by the H1 experiment in the years 2004-2007, with a total integrated luminosity of 340 pb^{-1}. Cross sections are measured for photons with transverse momenta and pseudorapidities in the range $6 < E_T^\gamma < 15$ GeV and $-1.0 < \eta^\gamma < 2.4$, for events with and without an additional jet. The identification of the photons are based on shower shape variables and the isolation criteria is that the photon carries at least 90% of the energy of the jet containing the photon. A calculation based on the k_t-factorisation approach [7] describes the data better than a NLO QCD prediction [8], but both predictions undershoot the data at low E_T^γ and for backward photons (Fig. 2, left). The data are somewhat better described for events when an additional jet is explicitly required in the event (Fig. 2, right).

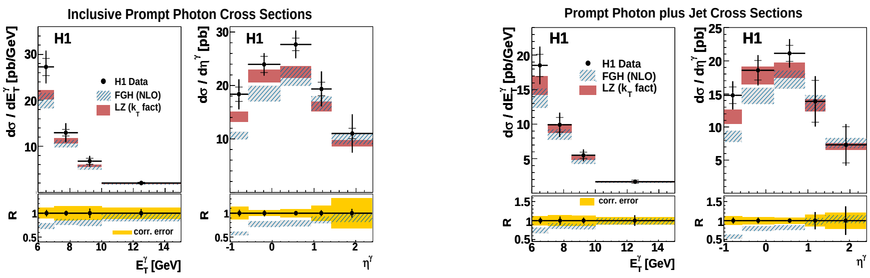

Figure 2: The inclusive prompt photon cross section (left), and the cross section for events with an additional jet (right) compared to theoretical calculations.

3 Strangeness Production at low Q^2 [4, 5]

Measurements on strangeness production give direct information about fragmentation parameters and knowledge of hadronization. $K^{*\pm}$, K_s^0 and Λ productions were analysed by using low Q^2 NC DIS events. One of the cross sections for $K^{*\pm}$ production [4], observed through the decay $K^{*\pm} \to K^0\pi^\pm$ is shown in Fig. 3 as a function of the transverse momentum of the $K^{*\pm}$ in laboratory frame. The MC prediction from DJANGO with the Color Dipole Model (CDM [9]) gives a decent description of the data, and also seen is that the largest contribution to the strange quark production comes from the fragmentation. The cross sections for K_s^0 and Λ production [5] are compared to Monte Carlo predictions with different values of the strangeness

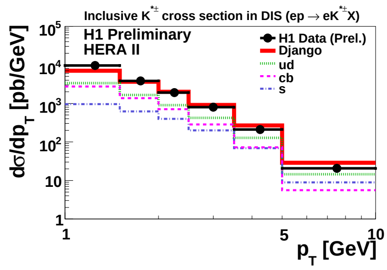

Figure 3: Cross section for $K^{*\pm}$ production as a function of the transverse momentum of the $K^{*\pm}$s. The MC predictions are decomposed into the contributions of the various quark flavours of the primarily incoming particles of the hard subprocess from the proton side.

suppression factor λ_s. Although no single combination of model and λ_s describes the data in all kinematic bins, the overall best description of the data is obtained with the CDM and $\lambda_s = 0.3$. Furthermore, the asymmetry between Λ and $\bar{\Lambda}$ production is flat within the errors of the measurement and thus no baryon number transfer from the proton beam to the hadronic final state is observed.

4 The Underlying Event in Photoproduction [6]

The underlying event (UE) in tagged photoproduction ($Q^2 < 0.01$) is analysed in a TEVATRON inspired way. The average multiplicity of charged particles in di-jet events with $E_{T,\mathrm{Jet}} > 5$ GeV is measured in different azimuthal regions with respect to the leading jet. When the energy fraction of the photon carried by the interacting parton, x_γ, is low the photon has a large hadronic-like substructure, and the contribution from multi-parton interactions (MPI) is largest. In this kinematic region MPI simulations need to be included in PYTHIA [10] in order to describe the data. Remarkable is that the data description provided by CASCADE [11], a MC generator with parton showers based on the k_t-factorisation approach, but without any MPI simulated, is in competition with the predictions from PYTHIA with MPI.

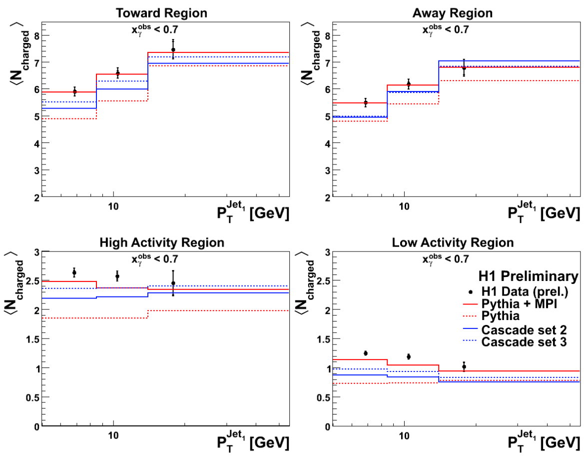

Figure 4: The average mulitplicity of charged particles as a function of the transverse momentum of the leading jet, in different azimuthal regions with respect to the leading jet.

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