

# Hadronic Final State, Jet Production and $\alpha_s$ Measurements at HERA \*

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Several analysis of the hadronic final state produced in electron-proton collisions at HERA are presented including jet and event shapes measurements. The results are compared with QCD predictions and used for a precise determination of the strong coupling constant  $\alpha_s$ .

## 1. INTRODUCTION

HERA is a world unique positron- or electron-proton collider with a center-of-mass energy of  $\sqrt{s} = 319$  GeV. The two collider-mode detectors, H1 and ZEUS have been used to measure the hadronic final state in deep inelastic scattering (DIS) regime. In this paper inclusive jet production, multi-jet production and event shape variables measurements are described.

The jets are reconstructed in the Breit frame using the  $k_{\perp}$  algorithm. The cross section at parton level is calculated as a convolution of the proton parton density functions (PDF's) and the hard scattering cross section integrated over all possible momentum fraction and summed over different type of the interacting parton:

$$\sigma = \sum_{i=q,\bar{q},g} \int dx f_i(x, \mu, \alpha_s) \cdot \hat{\sigma}(x, \mu, \alpha_s). \quad (1)$$

The PDF's are extracted from inclusive data measurements while the cross section can be expressed as a power series of  $\alpha_s$  and calculated to a fixed order. Up to now only next-to-leading order (NLO) calculations are available for jet production at HERA. The uncertainty from neglecting the higher order contributions is estimated by varying the renormalization and factorisation scale.

In order to compare with data, the calculated cross section must be corrected to hadron level. The hadronisation corrections are relatively small

in jet measurements. They are obtained from Monte Carlo event generators as the ratio of the cross sections at hadron and parton level.

To account for non-perturbative hadronisation effects the analytical power correction approach is used in the case of event shape analysis.

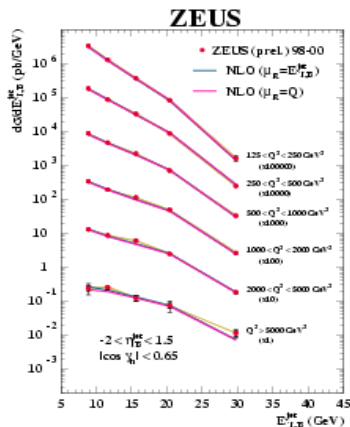


Figure 1. The measured differential cross-section  $d\sigma/dE_{T,B}^{jet}$  for inclusive-jet production.

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