Measurements of Forward Jet Production at low x in DIS

H1 Collaboration

Abstract

New parton dynamics, characterized by an initial state cascade which is non-ordered in parton virtuality, are expected to become important in the kinematic region of small Bjorken-x (x_{Bj}) in ep scattering at HERA. Evidence for this feature of QCD is searched for by studying events with a forward jet produced close to the direction of the outgoing proton beam in the angular range $7^o < \theta_{jet} < 20^o$. The cross section for inclusive forward jet production is presented as a function of x_{Bj}. The energy flow around the forward jet has been studied in different rapidity regions to investigate how the energy compensation is described by models and whether the forward jet profile changes with rapidity. With the present statistics it is possible to measure the triple differential cross section $\frac{d^3\sigma}{dx\,dQ^2\,dp^2_{t\,jet}}$, which covers the phase space region dominated by direct photon interactions ($Q^2 \gg p^2_{t\,jet}$), as well as the two scale 'BFKL' region ($Q^2 \sim p^2_{t\,jet}$) and the 'resolved virtual photon' region ($Q^2 \ll p^2_{t\,jet}$). In addition, events are studied with a hard central di-jet system in addition to the forward jet and the cross section for such topologies is measured as a function of the rapidity separation between the forward jet and the two hard jets. The measurements are compared with the predictions of models generating initial state emissions which are ordered and non-ordered in virtuality.

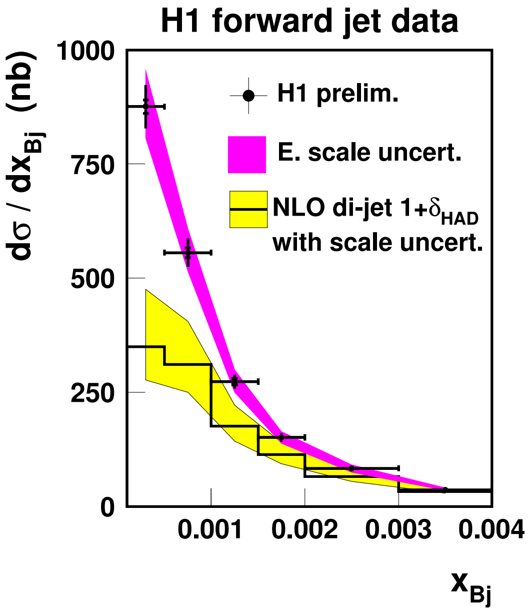

Figure 1: *Inclusive forward jet cross-section (1997 data) as a function of x_{Bj} compared to NLO di-jet calculations (DISENT). The average transverse momentum squared of the forward jet in all events has been used as the re-normalization scale, μ_r^2. The scale uncertainty (yellow band) is calculated by varying μ_r^2 by a factor of 4. The lower limit in x_{Bj} is* 10^{-4}.

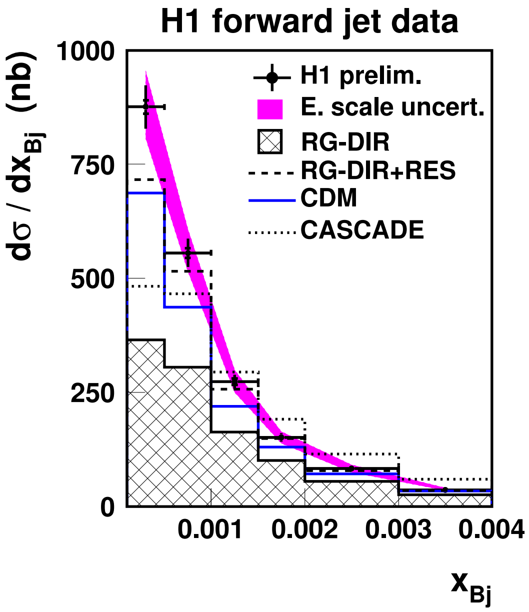

Figure 2: *Inclusive forward jet cross-section as a function of x_{Bj} compared to QCD-based models. For* CASCADE *the version called J2003-set-2 has been used. The lower limit in x_{Bj} is* 10^{-4}.

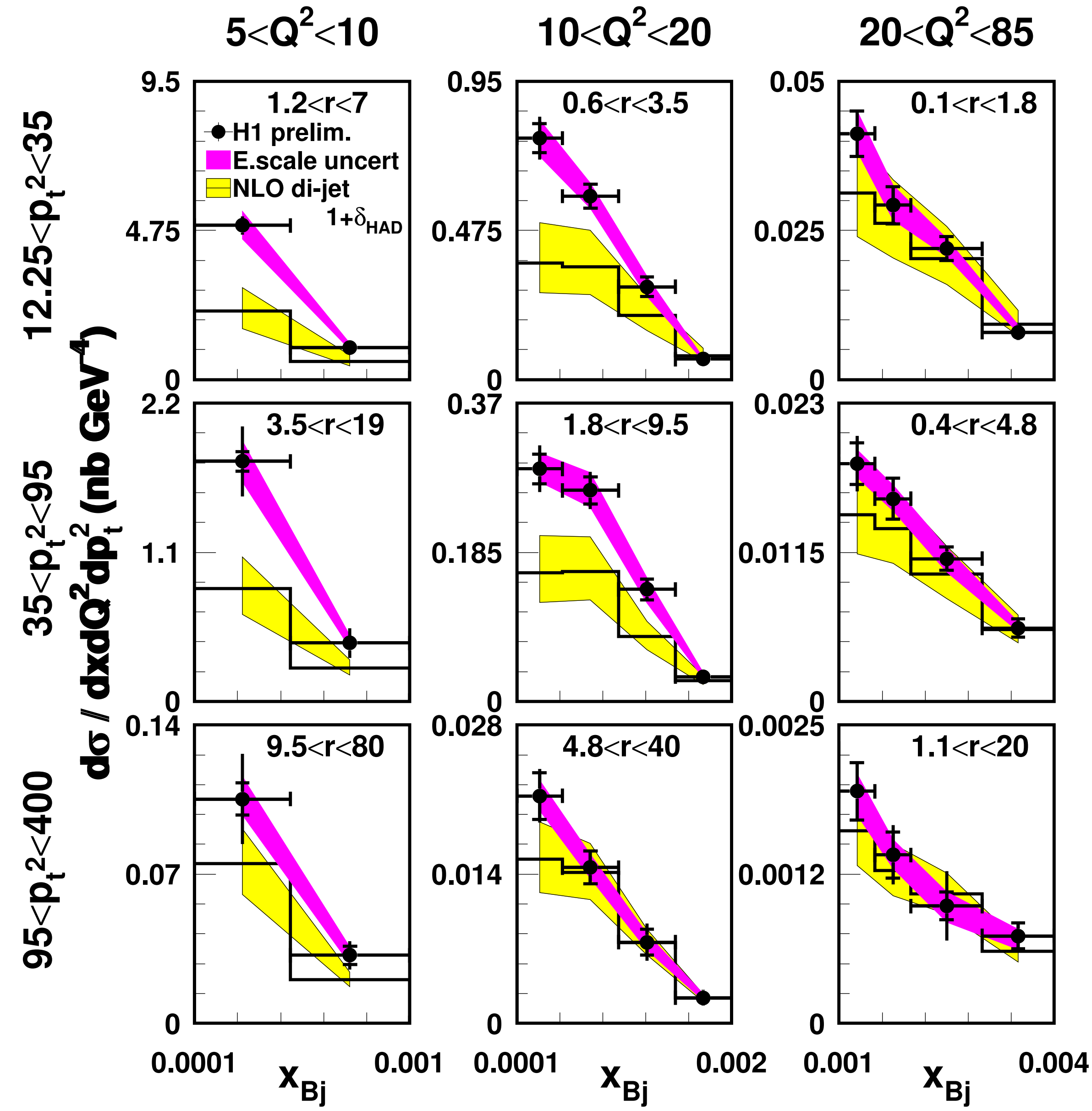

Figure 3: *The triple differential forward jet cross-section as a function of x_{Bj} in bins of p_t^2 of the forward jet and Q^2. The cross-section is compared to NLO di-jet calculations.*

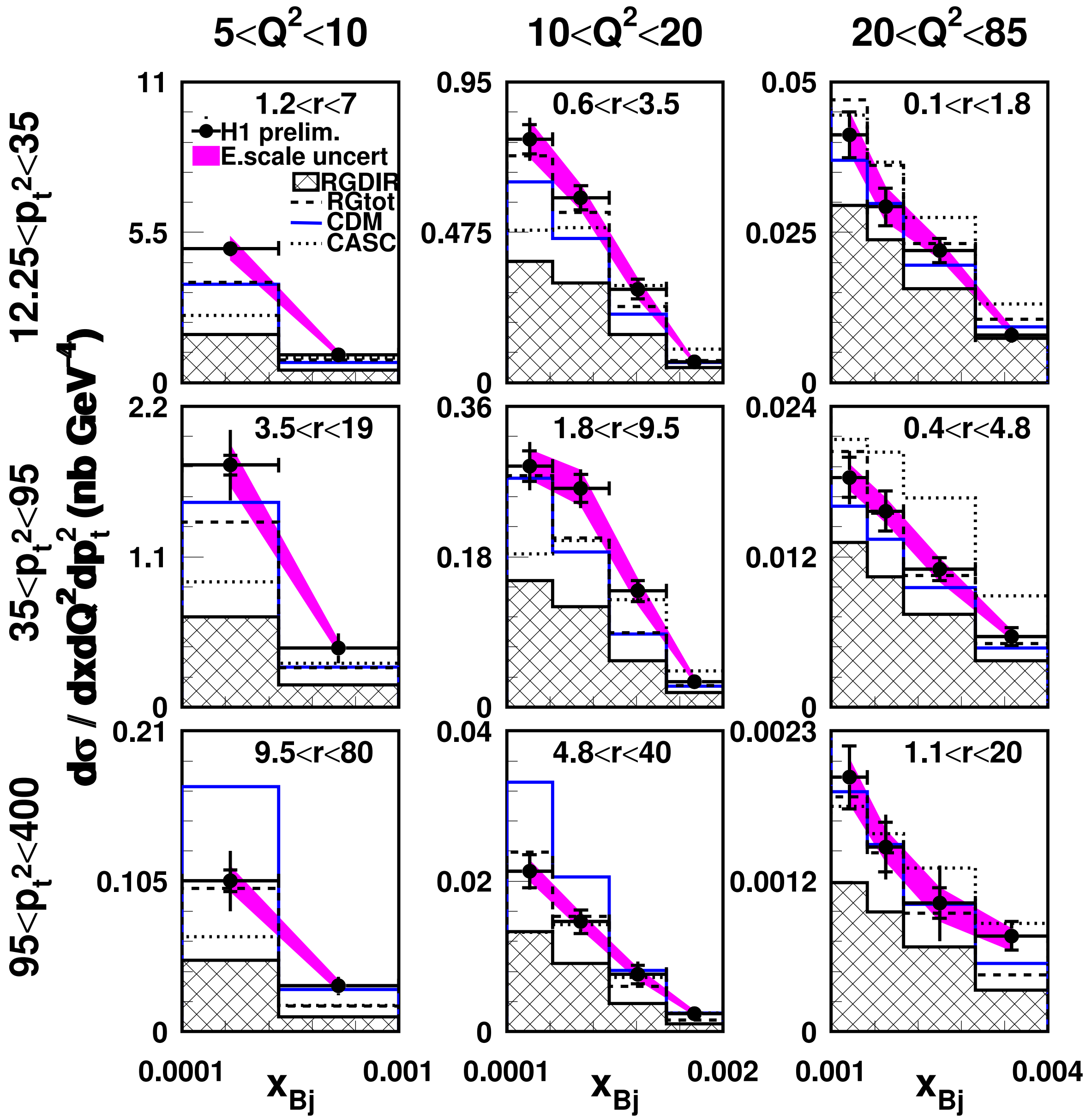

Figure 4: *The triple differential forward jet cross-section as a function of x_{Bj} in bins of p_t^2 of the forward jet and Q^2. The cross-section is compared to QCD-based models.*

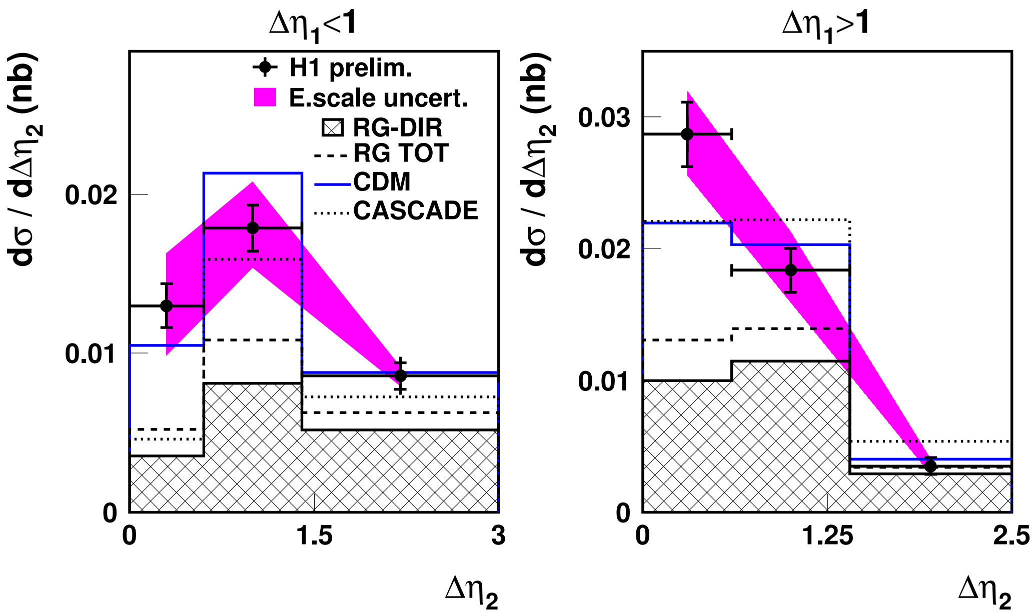

Figure 5: *The cross-section for the production of forward jets in association with an additional hard dijet system in the central region. The cross section is measured as a function of* $\Delta\eta_2$ *for* $\Delta\eta_1 < 1$ *and* $\Delta\eta_1 > 1$ *, where* $\Delta\eta_1$ *is the pseudorapidity separation between the two jets in the central region and* $\Delta\eta_2$ *is the pseudorapidity separation between the forward jet and the more forward central jet. The cross-section is compared to QCD-based models.*

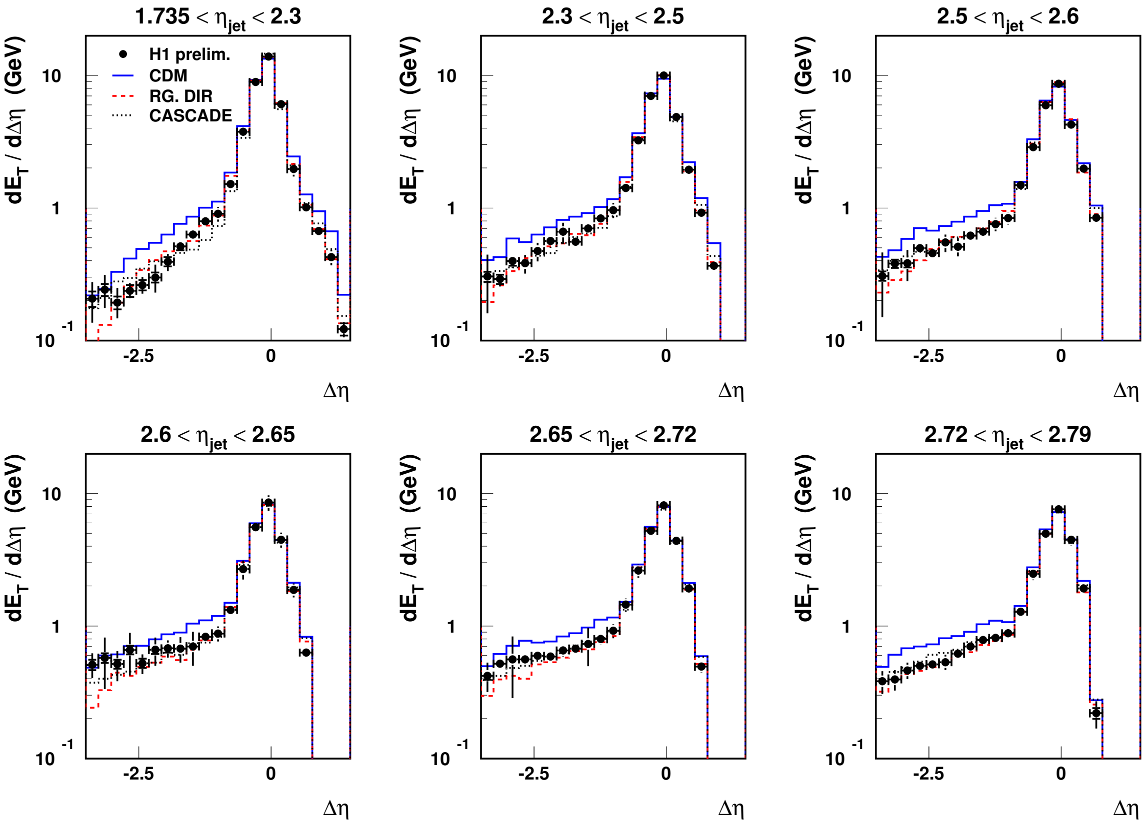

Figure 6: *Observed jet profiles at the hadron level as a function of the pseudorapidity distance* $\Delta\eta$ *from the forward jet axis, shown in bins of the forward jet pseudorapidity. The jet profiles are based on the transverse energy within one unit of azimuth from the jet axis. The results are compared to QCD-based models.*

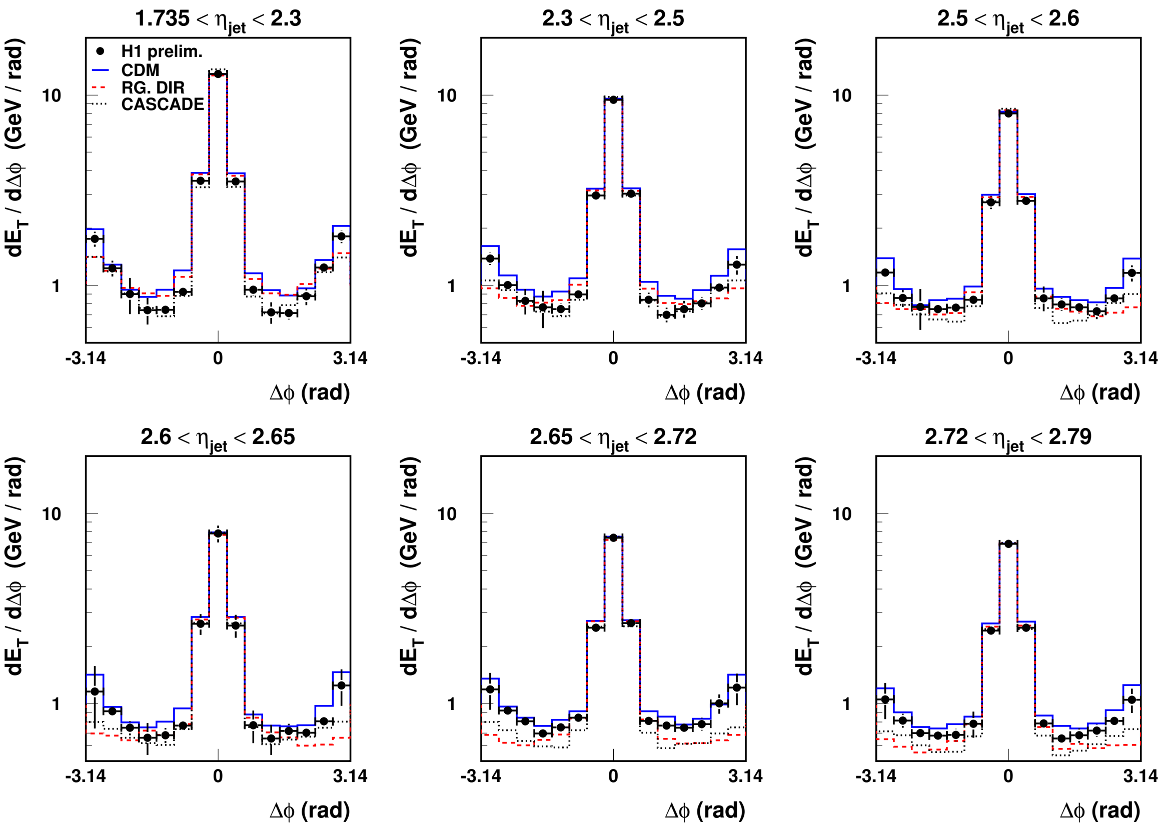

Figure 7: *Observed jet profiles at the hadron level as a function of the azimuthal distance* $\Delta\phi$ *from the forward jet axis, shown in bins of the forward jet pseudorapidity. The jet profiles are based on the transverse energy within one unit of pseudorapidity from the jet axis. The results are compared to QCD-based models.*