Single inclusive high E_T jet cross–sections in photoproduction at HERA

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- Jet photoproduction at HERA:physics and experimental issues
- Measurement of single inclusive high E_T jets : physics motivation
- Results, comparison with NLO QCD
- Conclusions

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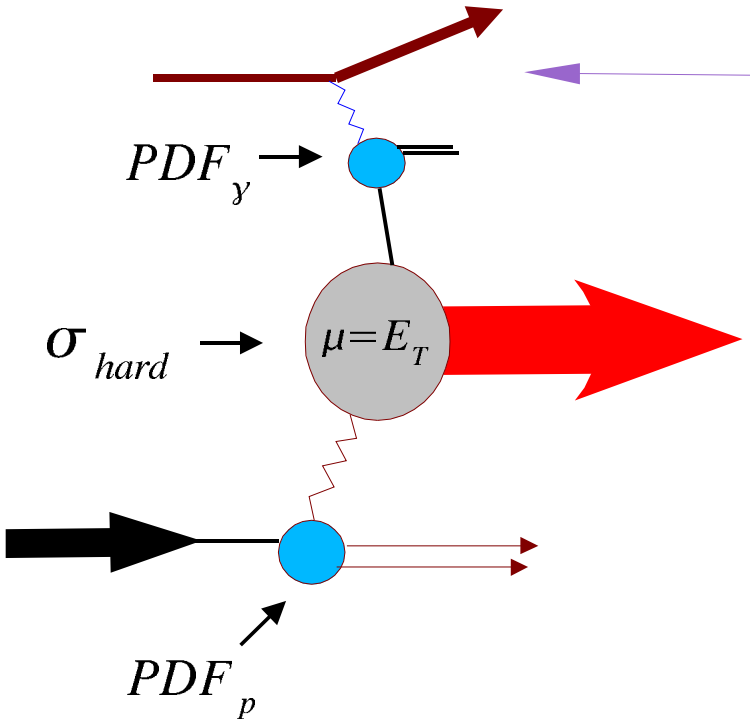
Photoproduction at HERA

$e(27.6\,GeV)$ → ← $p(820\,GeV)$

$\sqrt{s} = 300\,GeV$



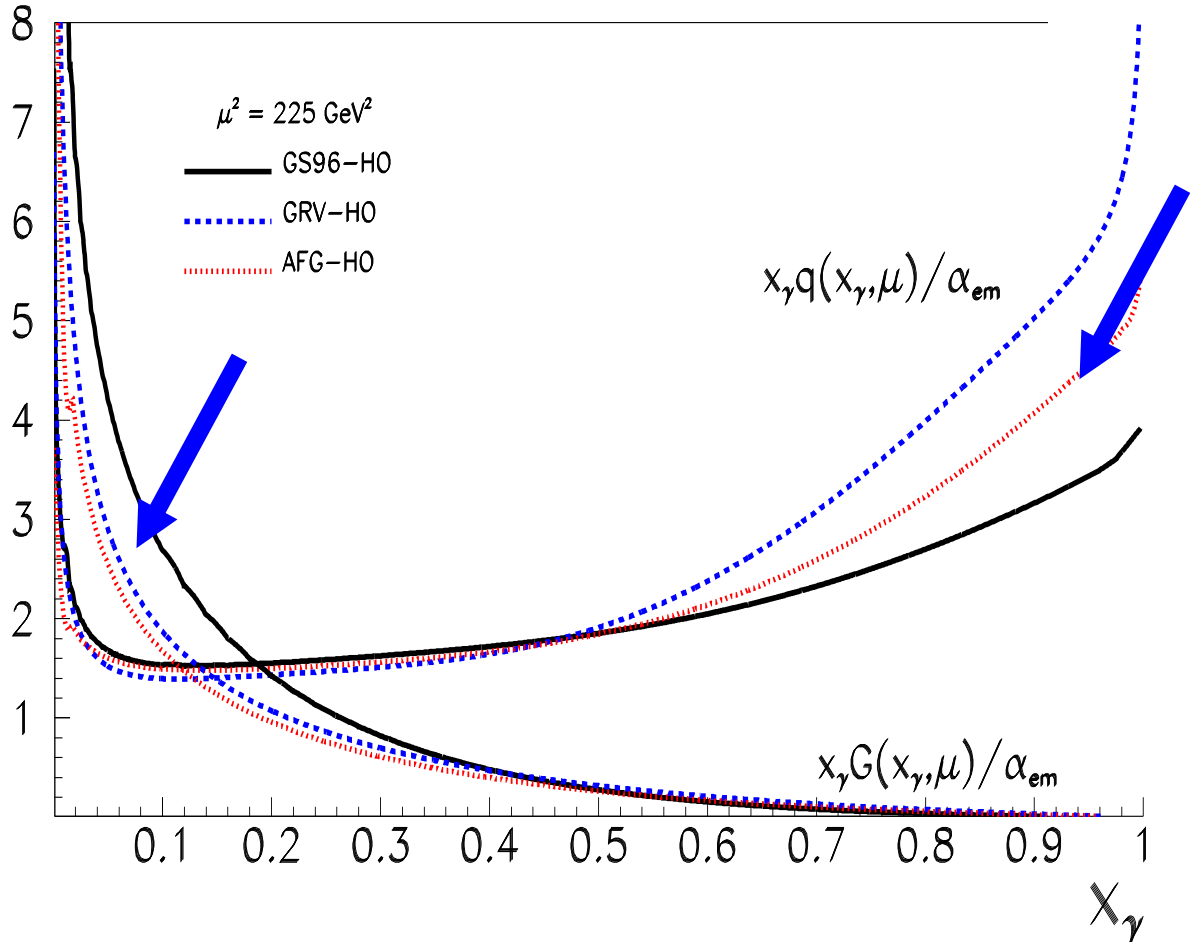
Photon:

- Small virtuality
- Inelasticity y from hadronic final state (untagged electron)
- Direct or resolved

$$\sigma_{Jet} = flux(y, Q^2) \times PDF_\gamma \times PDF_p \times \sigma_{hard}$$

Why inclusive jets in photoproduction ?

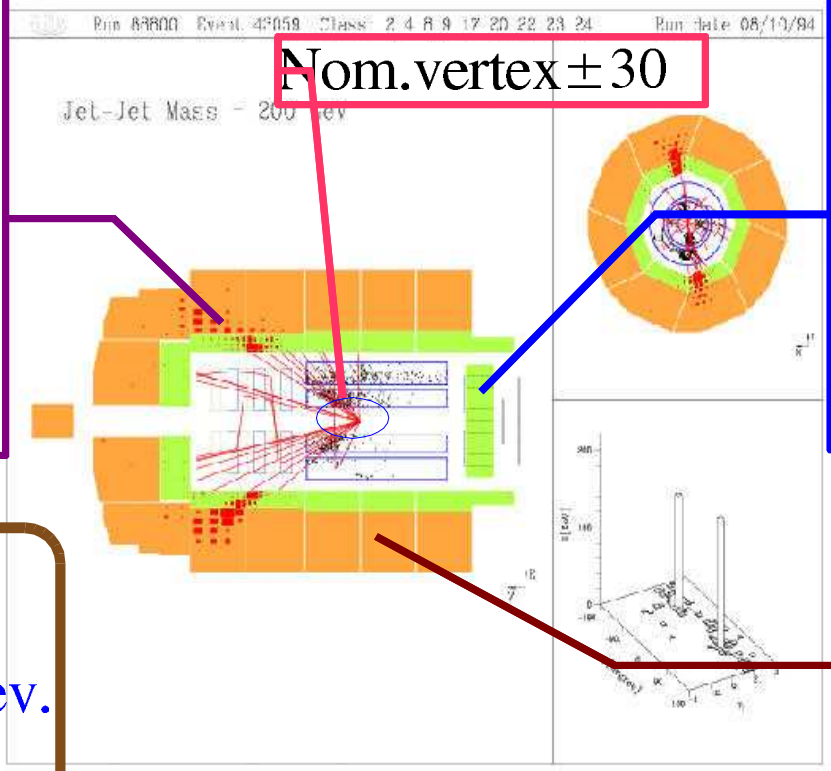
- At high E_T & high statistics precision test of PQCD.
- easier than low E_T jets because
  - ✔Influence of the soft underlying event is reduced
  - ✔fragmentation/hadronisation effects small
- Probe photon at highest scales



Photoproduction of high E_T jets

Jets reconstructed from combined (calo + tracker) objects with k_t algorithm in the range

$E_T > 21\,GeV \wedge -1 < \eta_{Jet} < 2.5$



Anti–selection for electrons in SPACAL

$Q^2 < 1\,GeV^2$

y(inelasticity) reconstructed from final state objects (J–B)

$0.1 < y < 0.9$

Anti–electron selection in LAr (~~NC~~)

Anti–select for ~~P_T~~

→reject CC

Sample purity ~ 99%

Final sample:

➔17466 jets in 13389 ev.

➔99% pure photoprod.

➔Kinematic range:

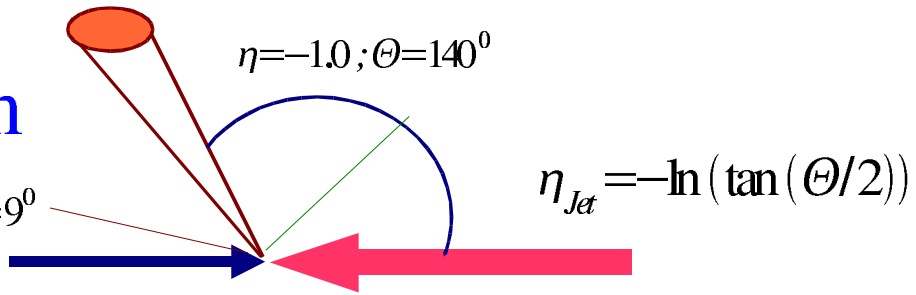
$Q^2 < 1\,GeV^2$

$0.1 < y < 0.9$

➔Jets: $21\,GeV < E_T < 75\,GeV$

$-1 < \eta_{Jet} < 2.5$

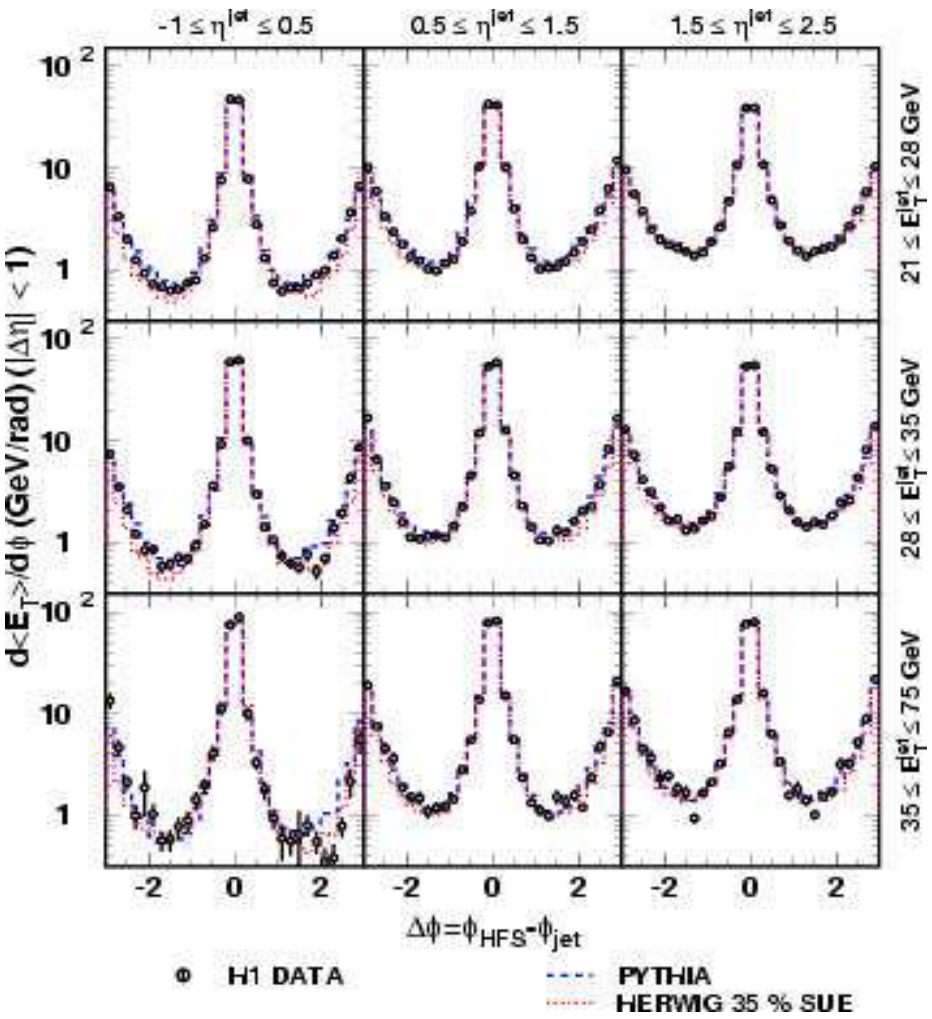
Lab system



Monte Carlo (detector corrections)

Monte Carlo for detector corrections

- PYTHIA 5.7 + SUE +JETSET 7.4
- HERWIG 5.9 +SUE+ cluster algo.
- Very good description of jet profile



NLO Theory and measurement uncertainties

NLO Theory:

➔ NLO QCD substraction method (Frixione and Ridolfi)

➔Proton PDF: CTEQ5M

➔Photon PDF: GRV–HO AFG and GSG for comparison

➔Scale: $\mu_R = \mu_F = 1/2 \sum E_T^{parton}$ varied by factor 2 up and down (theory uncertainty)

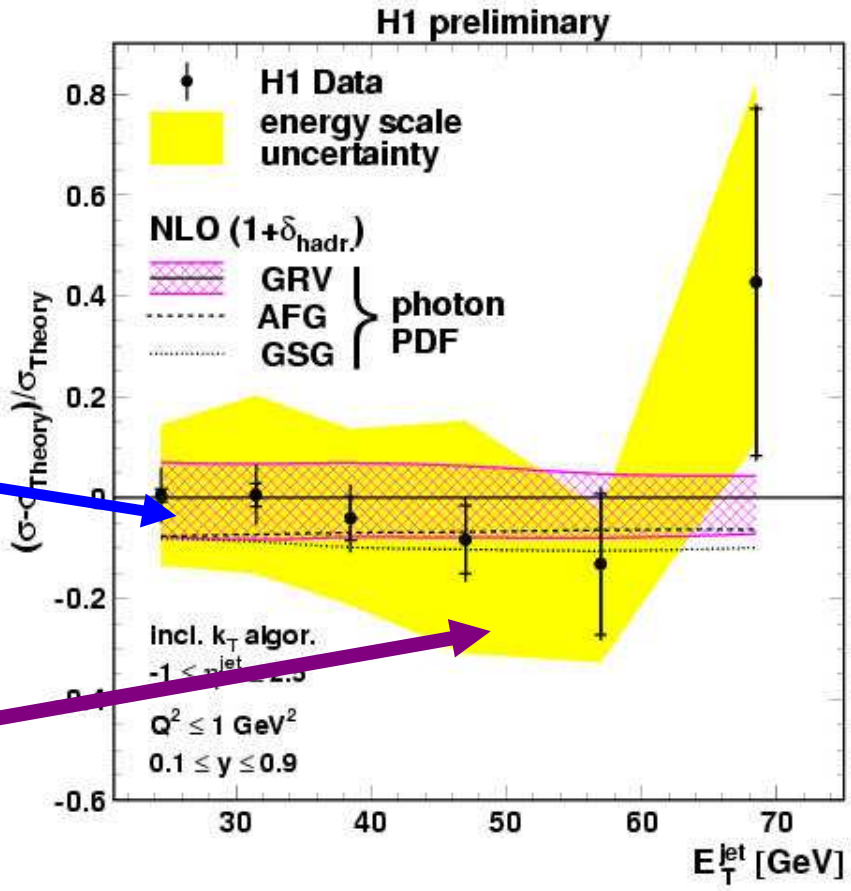
Measurement uncertainties:

✔ hadronic energy scale 15–20%

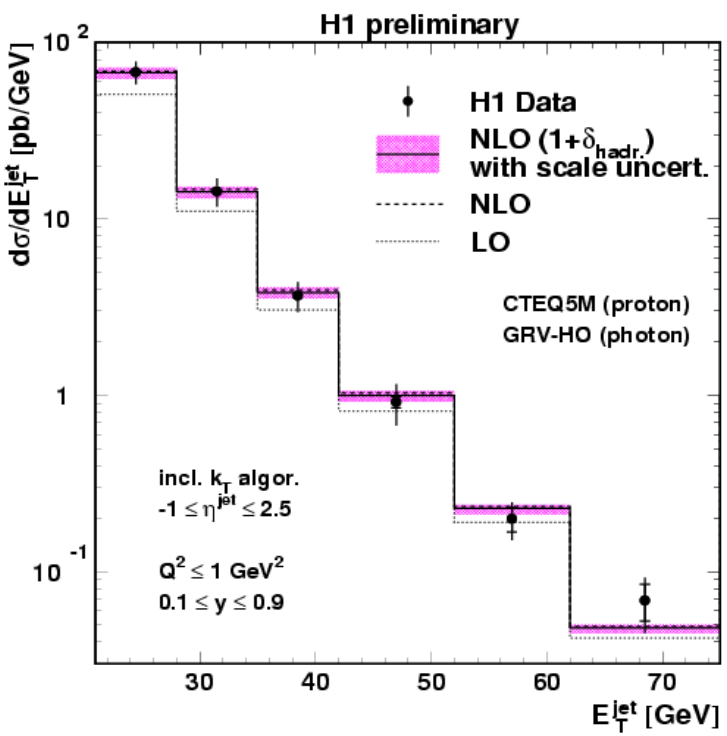
✔Model dep. of correction ~ 10%

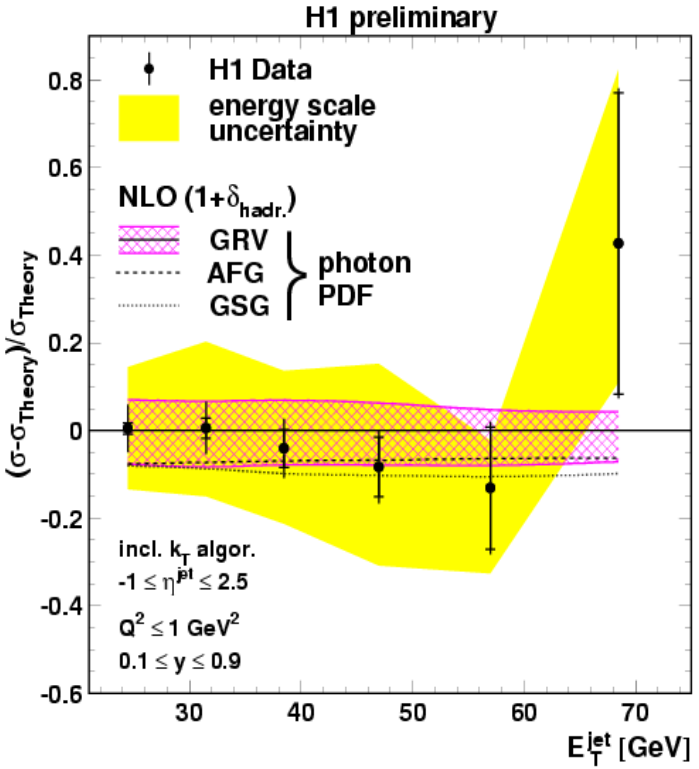
✔Trigger efficiency ~5%

✔ luminosity determination 1.5%



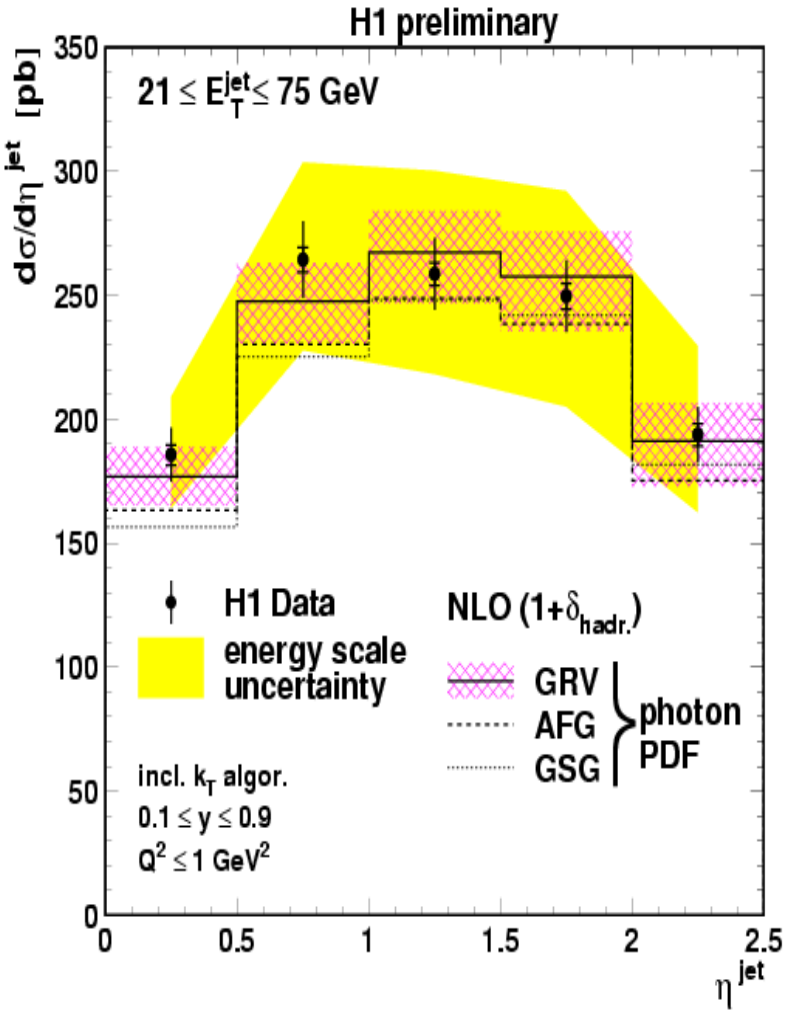
Single Inclusive Jet Cross Section at High E_T

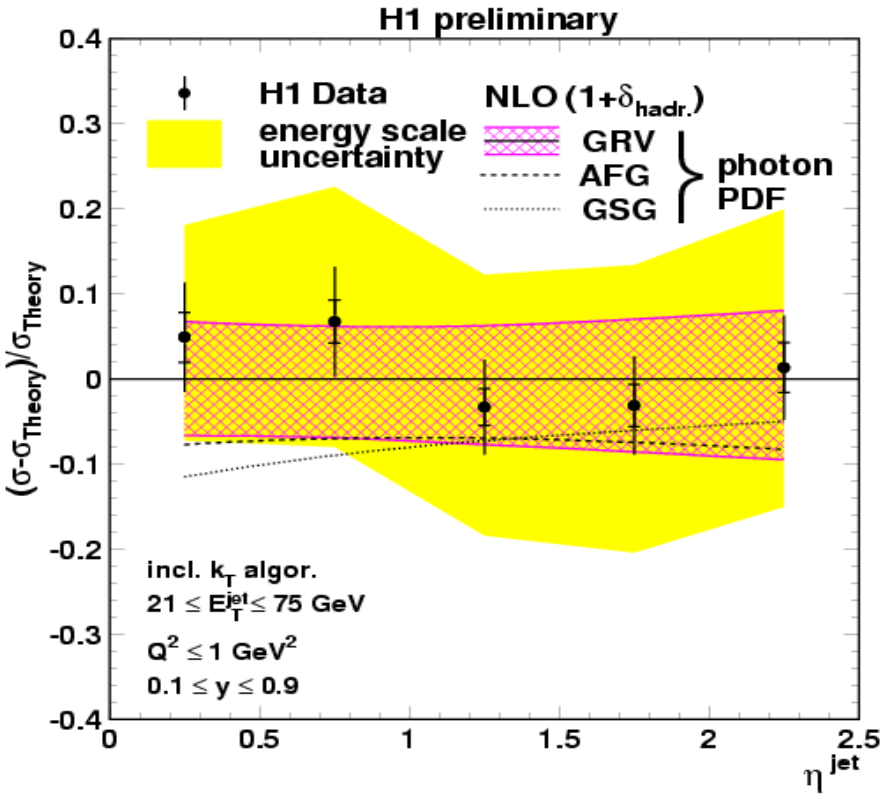




- Cross section falls by three orders of magnitude in the E_T^{Jet} range between 21 and 75 GeV, very well described by NLO QCD
- Higher order correction significant only in the first bin of E_T^{Jet} but consistently improves data description elsewere
- Systematics dominate the error for $E_T^{Jet} < 40$ GeV, statistics for $E_T^{Jet} > 40$ GeV

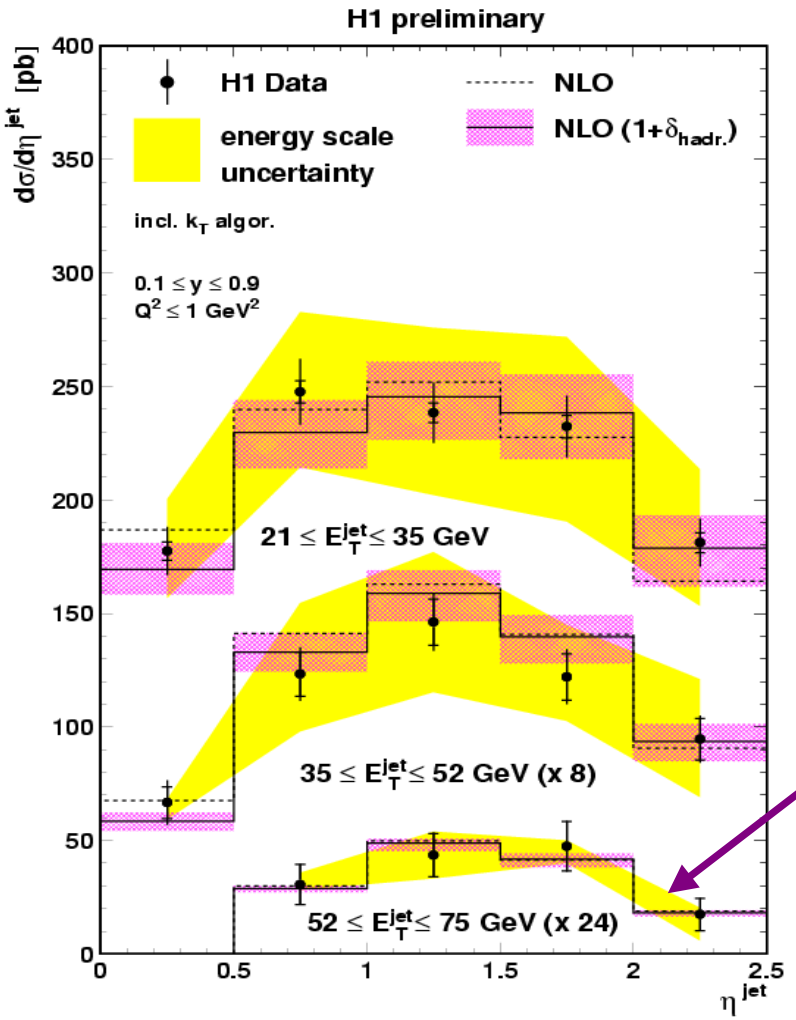
Dependence of $d\sigma/d\eta^{Jet}$ on the photon PDF





GRV–HO fair description of the data, AFG–HO ~10% below

Importance of hadronisation corrections



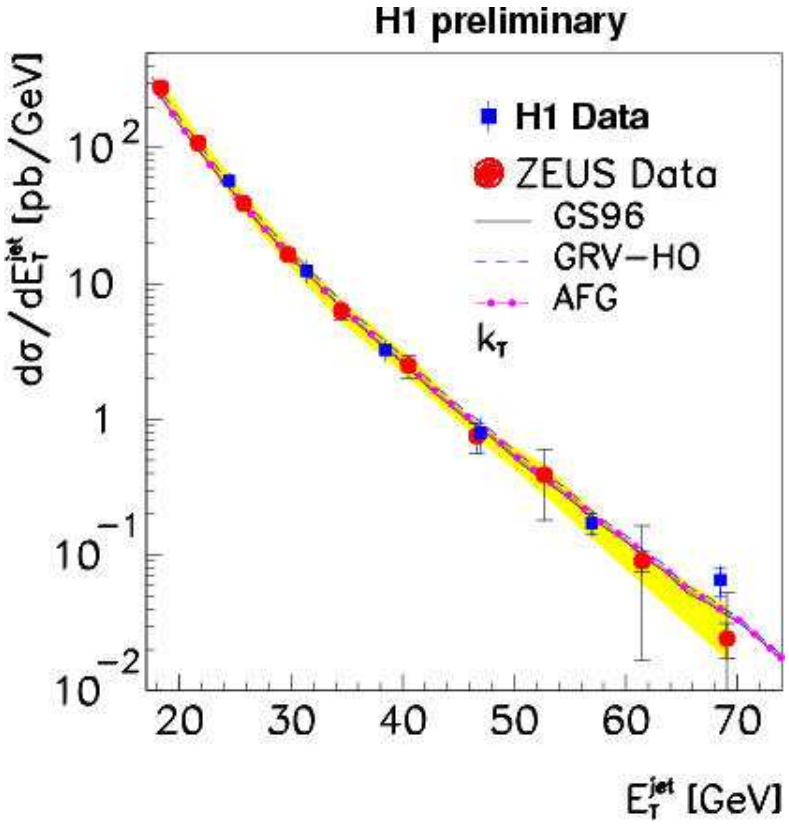
- $d\sigma/d\eta^{Jet}$ very well described by NLO theory
- Hadronisation correction improves agreement with the data :

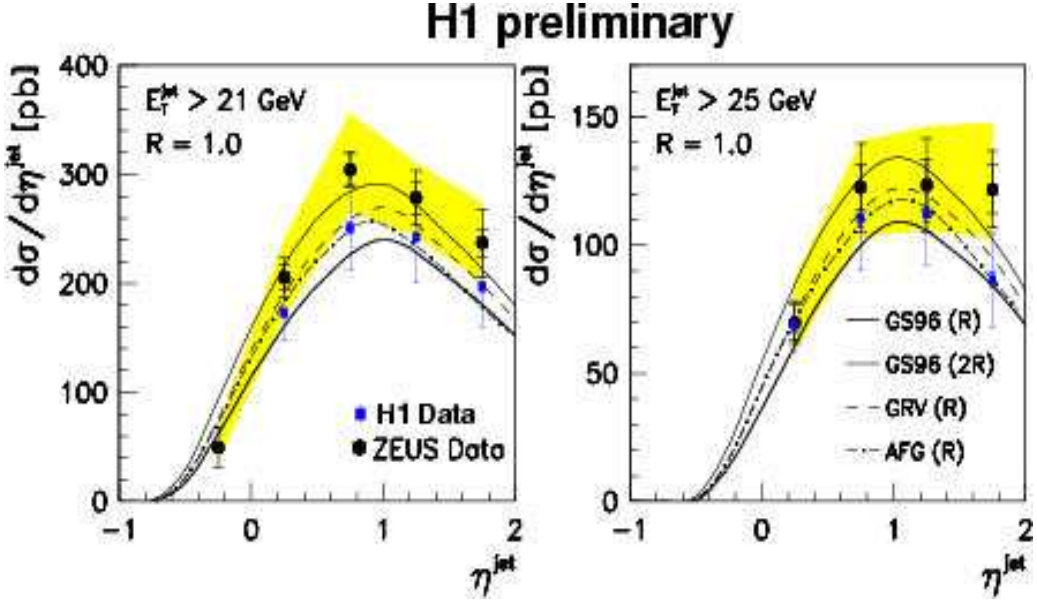
forward $\delta_{hadr.} > 0$

backward $\delta_{hadr.} < 0$

At highest scale hadronisation correction is negligible –we measure almost directly cross section at parton level.
Precision of the measurement remains to be a big challenge for high lumi measurements at HERA II

Comparison with ZEUS data





ZEUS kinematic range:

$$0.2 < y < 0.85$$

$$-0.75 < \eta^{Jet} < 2.5$$

Complete ZEUS analysis chain: cone with radius R=1

$$E_T^{Jet} > 21\,GeV, E_T^{Jet} > 25\,GeV$$

Conclusions

✔A new measurement of inclusive high E_T jet production cross section in quasireal photoproduction ($Q^2 < 1\ GeV^2$) ep interactions has been presented, based on $L = 24\ pb^{-1}$ collected by H1 in 1996–1997

✔Within the experimental and theoretical uncertainties the measured distributions are well described by NLO QCD

✔Current precision of experiment and theory does not allow discrimination between the different photon PDF although GRV–HO gives marginally better results

✔The hadronisation corrections to NLO calculation are well understood and improve the agreement with the data, however they do not play an essential role

✔H1 data are in agreement with previously presented ZEUS results