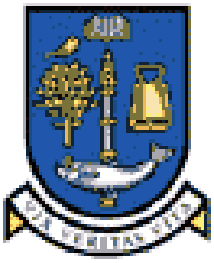
INCLUSIVE JETS AND α_s AT HERA.

P J BUSSEY



UNIVERSITY
of
GLASGOW

CONTENTS

(1) Inclusive jets in Photoproduction and DIS

(2) Evaluation of α_s

(3) Prompt photons

(4) Multijets (if time).

Theoretical Issues

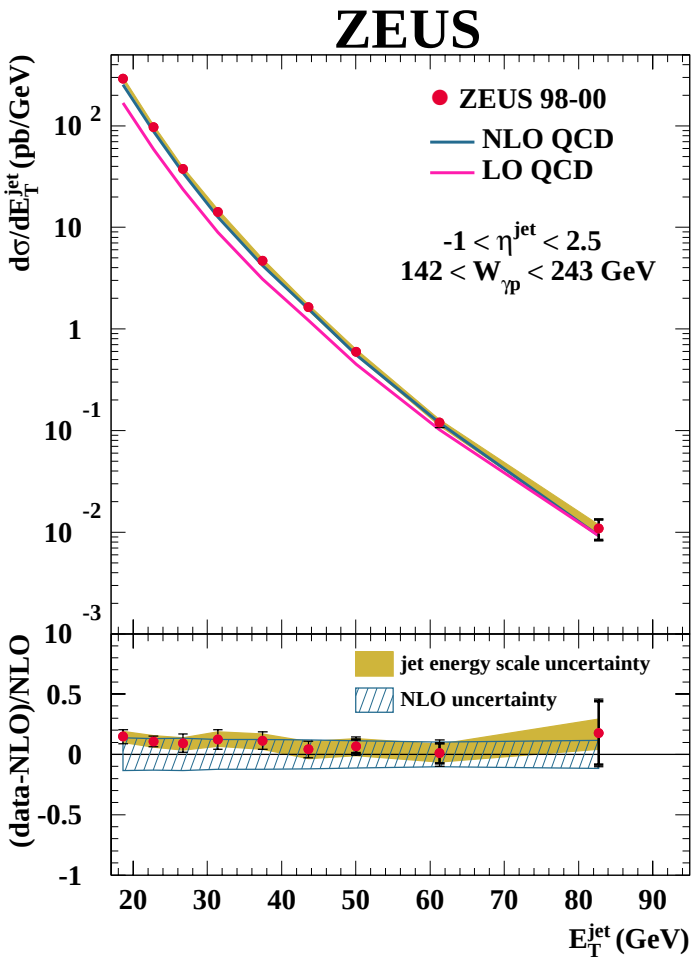
— QCD description: is NLO satisfactory?

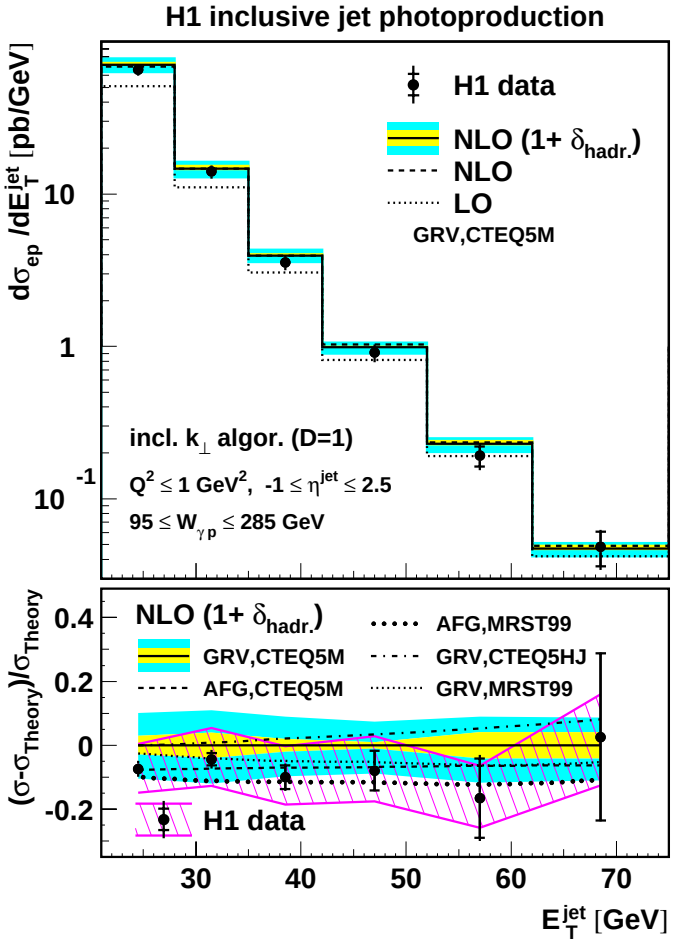
— Hadronisation effects

— Parton densities (PDF) in incoming proton, photon

— Determination and running of α_s

INCLUSIVE JETS in PHOTOPRODUCTION





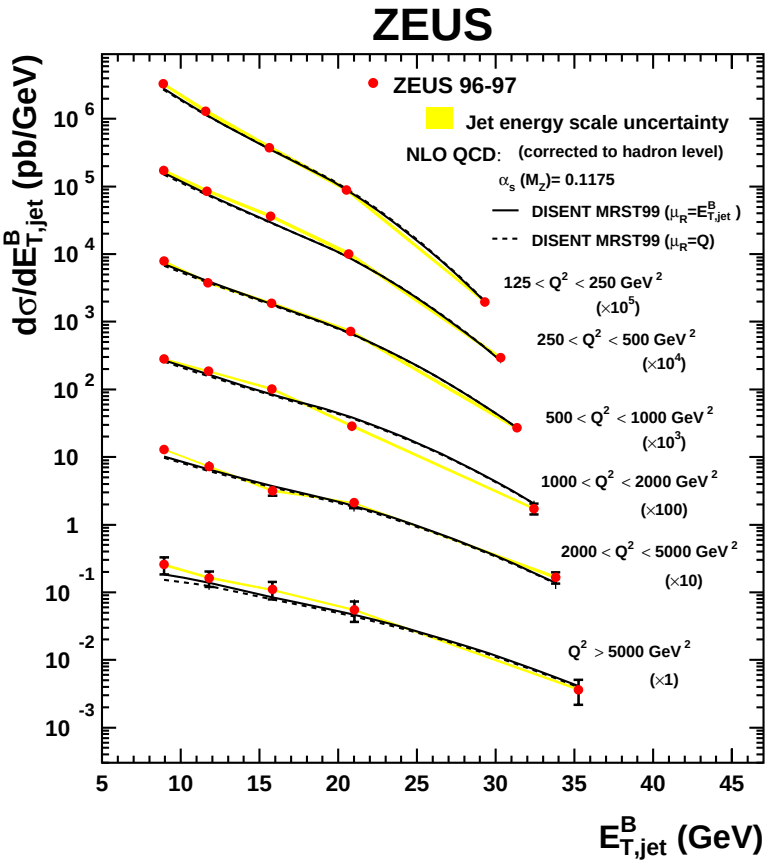
Wide range of E_T values now measurable!
Small experimental and theoretical uncertainties.

Good agreement with NLO QCD

ZEUS – Klasen, Kleinwort & Kramer
PDFs: proton = MRST99, photon = GRV
$\rightarrow \alpha_s$ (see later)

H1 –Frixione & Ridolfi (various PDFs)

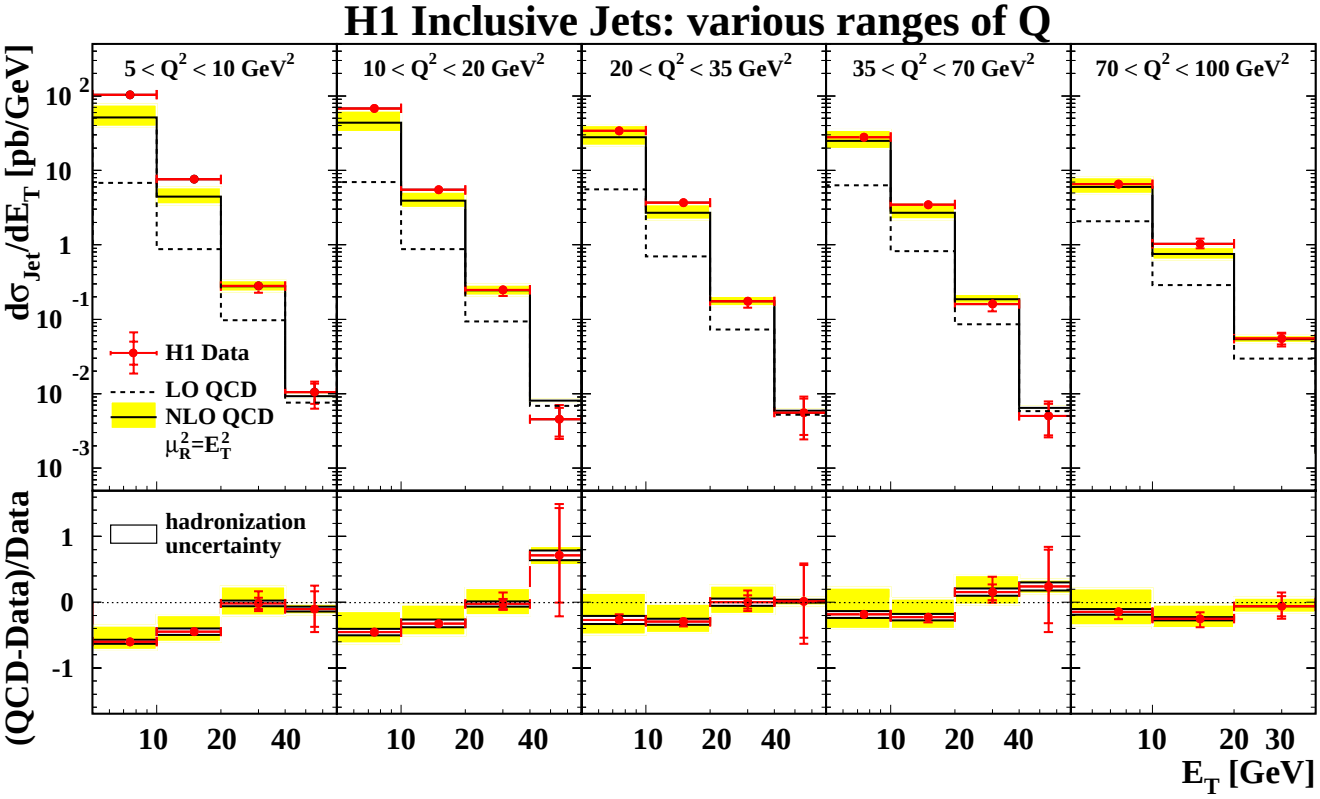
INCLUSIVE JETS in DIS



Breit frame jet Xsecs can exclude proton remnant effects, suppress quark-parton jets O (α_s^0) .

Well described in NLO QCD (DISENT) Scaling violations

$\rightarrow \alpha_s$ (see later)



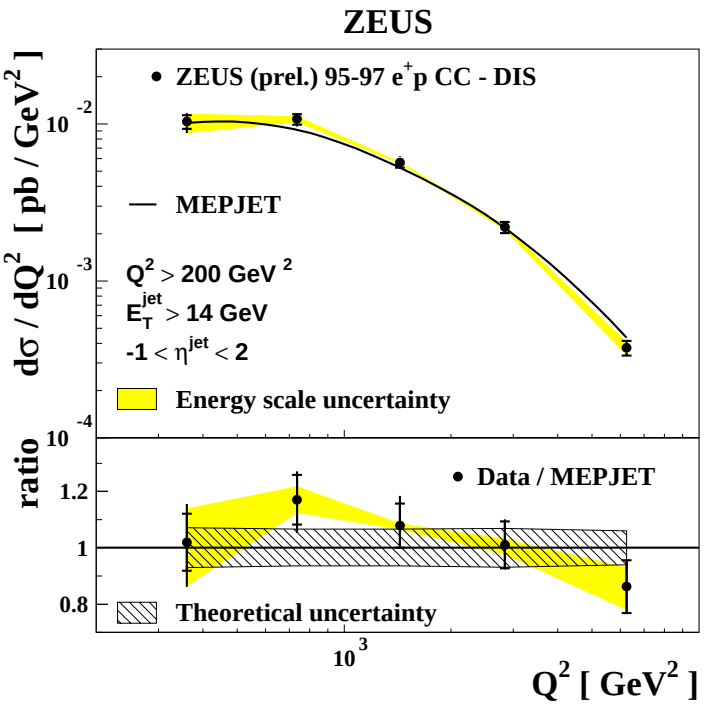
INCLUSIVE JETS in DIS

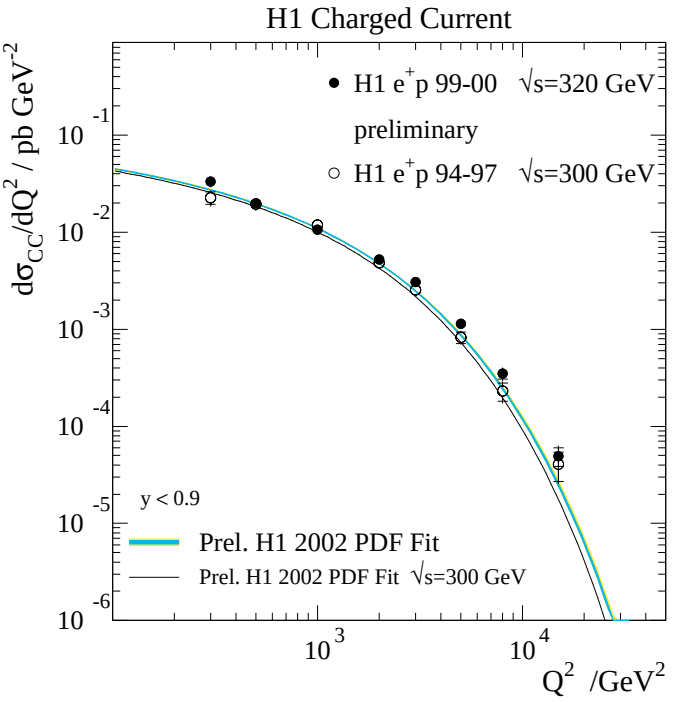
Charged current process

$Q^2 > 200$ GeV ^{2}

MEPJET

'reasonable'





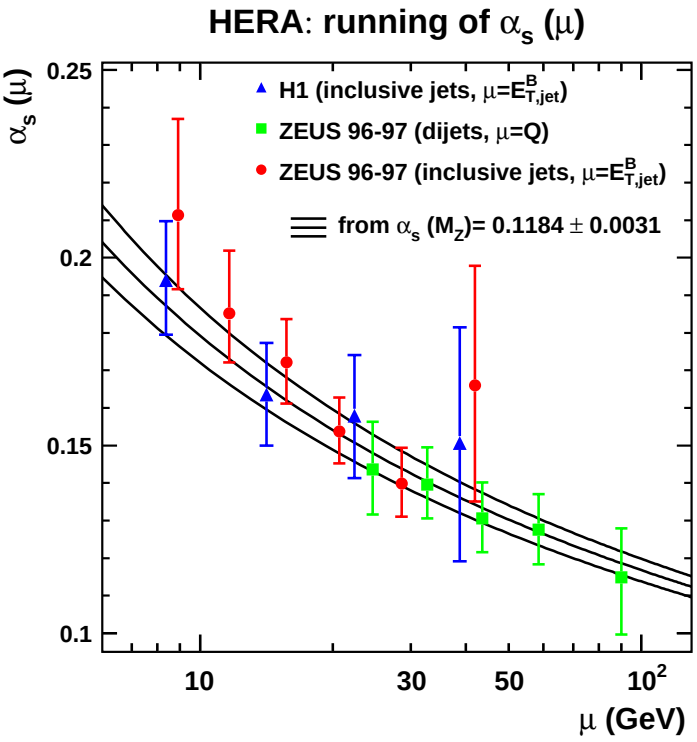
H1 successfully use their own NLO/PDF fit.

α_s MEASUREMENTS

HERA is a good facility for α_s studies:

(1) ZEUS Inclusive Breit Frame jets

k_T cluster jets in Breit Frame
Allow proton PDF variation at NLO with α_s
Fit Xsec using DISENT NLO



Plot vs scale of measurement = μ :

This measurement + H1 inclusive jets: jet E_T
ZEUS DIS dijets: Q

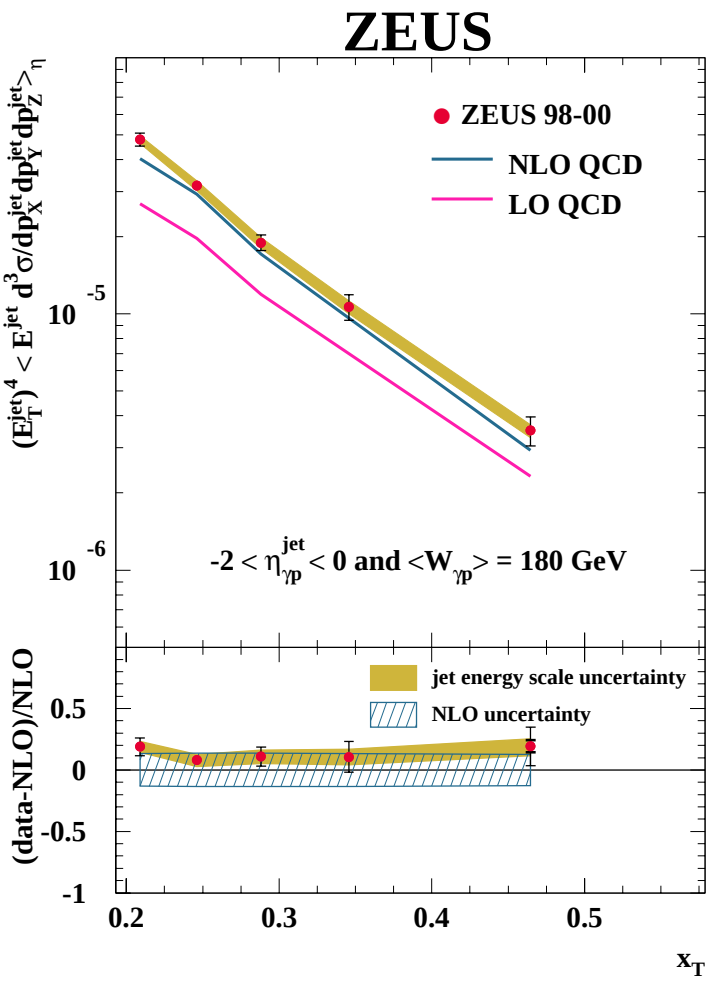
Consistent results confirm that α_s runs!

α_s MEASUREMENTS

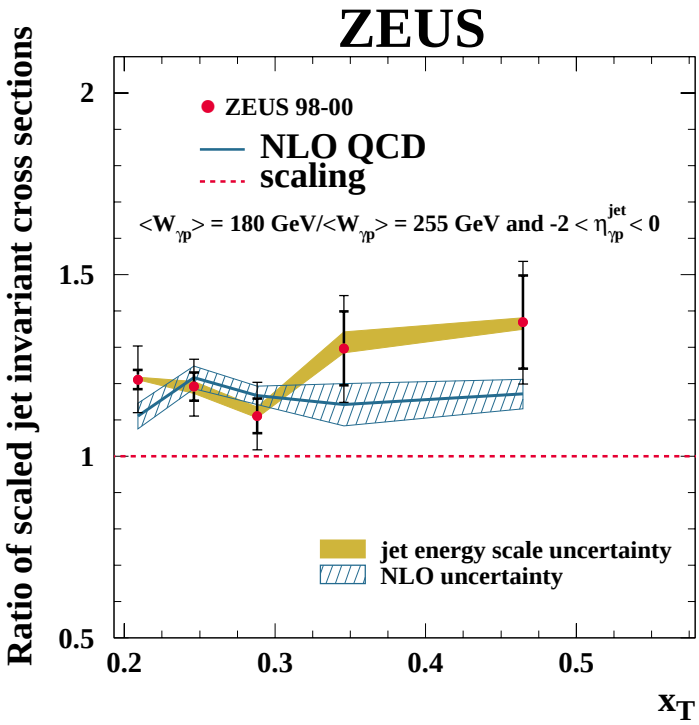
(2) Scaling violations in photoproduced jets

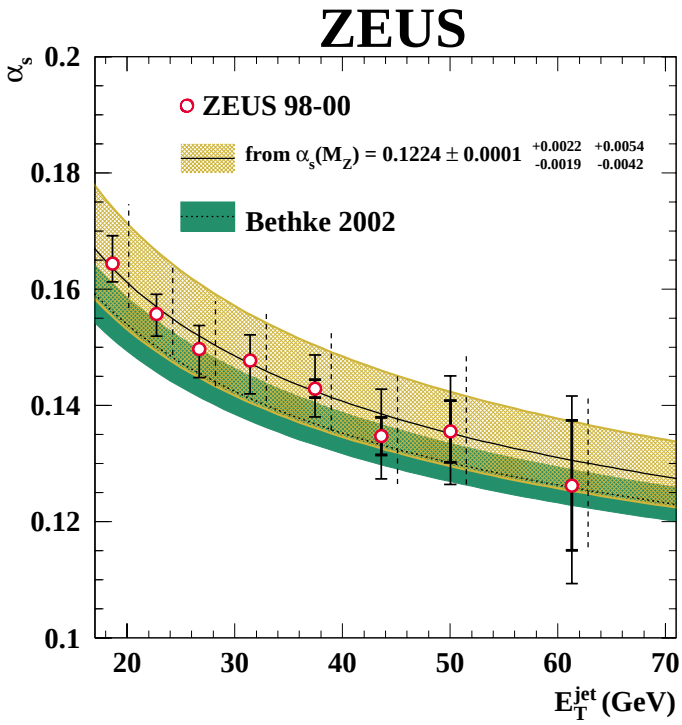
k_T cluster jets (lab)
Correct with PYTHIA:
detector $\rightarrow$ hadrons
partons $\rightarrow$ hadrons
(NLO KK&K theory)

$$x_T = 2E_T^{\text{jet}}/W_{\gamma p}$$

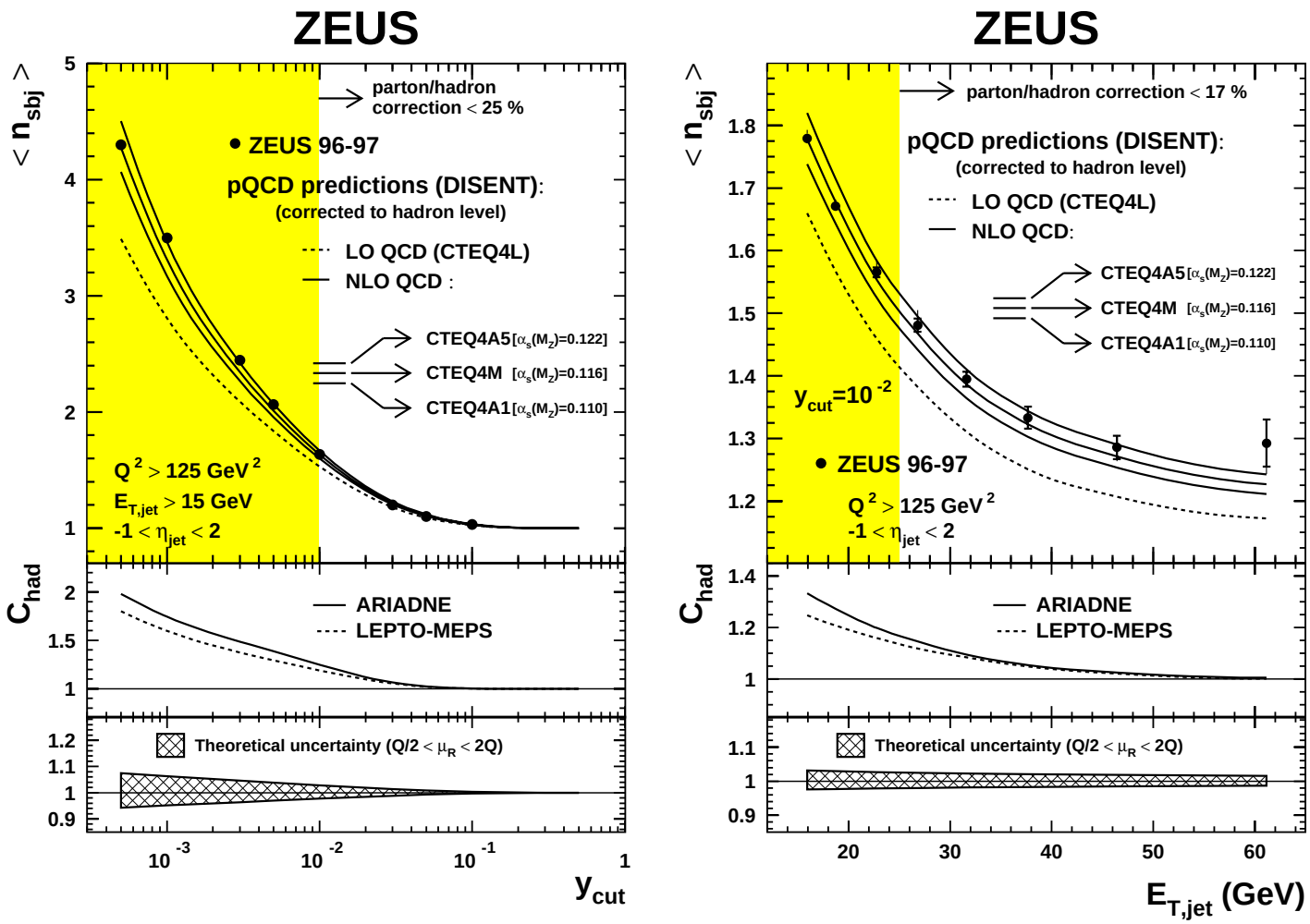


Sensitivity to running:





(3) Subjet multiplicities in DIS



— Study properties of final state DIS jet in lab.

— k_T cluster algorithm uses parameter y_{cut} (=1)

— Smaller $y_{cut} \rightarrow$ more jets (subjets)

— Mean no. of subjets $< n_{sbj} >$ is sensitive to α_s

— Data well described by DISENT (NLO)

— Correct to hadron level using ARIADNE

— Use $y_{cut} = 0.01$, main jet E_T = [25, 71] GeV

— Insensitive to proton PDFs

α_s MEASUREMENTS

α_s results obtained:

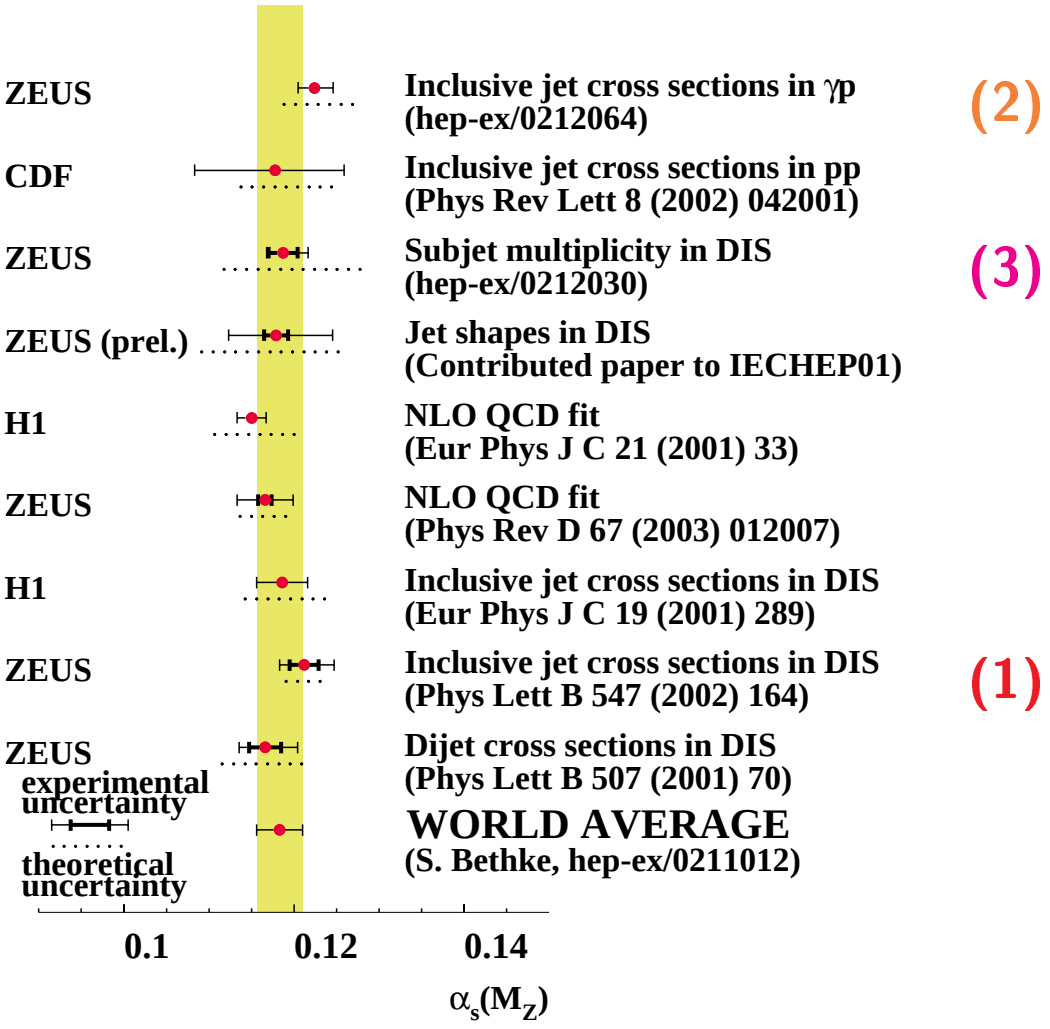
(1) $0.1212 \pm 0.0017\ ^{+0.0003}_{-0.0001}\ ^{+0.0028}_{-0.0027}$

(2) $0.1224 \pm 0.0001\ ^{+0.0022}_{-0.0019}\ ^{+0.0054}_{-0.0042}$

(3) $0.1187 \pm 0.0017\ ^{+0.0024}_{-0.0009}\ ^{+0.0093}_{-0.0076}$

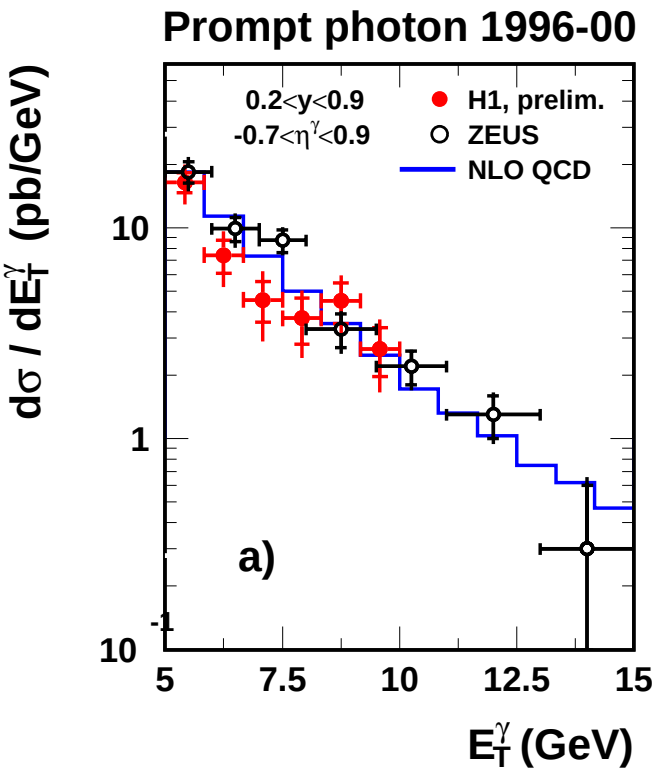
(stat.) (sys.) (theory)

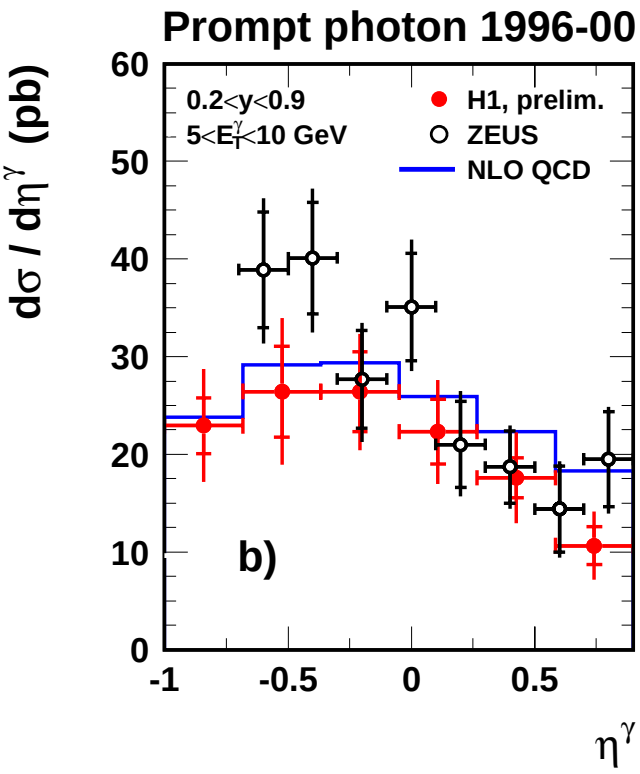
HERA is very competitive in determining α_s



PROMPT PHOTON PRODUCTION

New photoproduction results from H1.





Results compared with ZEUS and with NLO theory of **Fontannaz, Guillet and Heinrich**

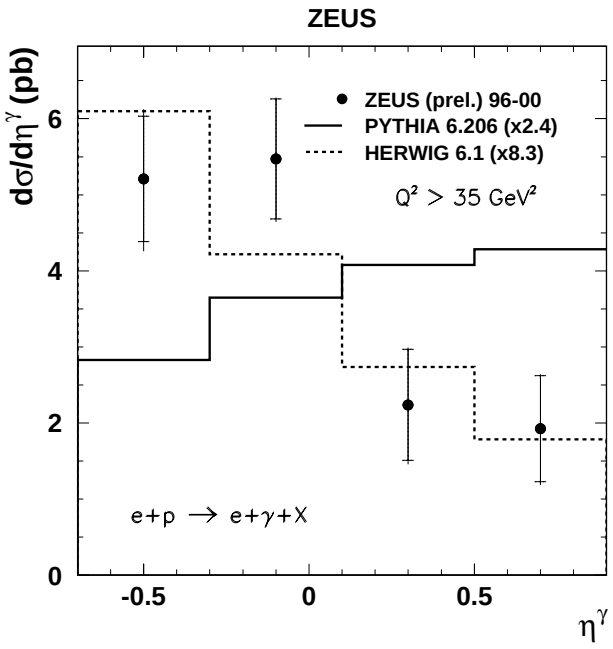
Different calorimetric techniques in ZEUS and H1

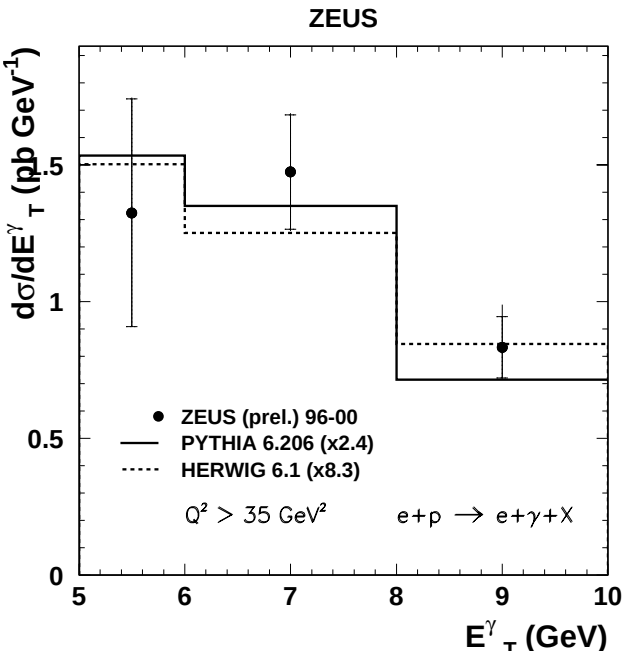
Reasonable agreement. More statistics desirable.

PROMPT PHOTON PRODUCTION

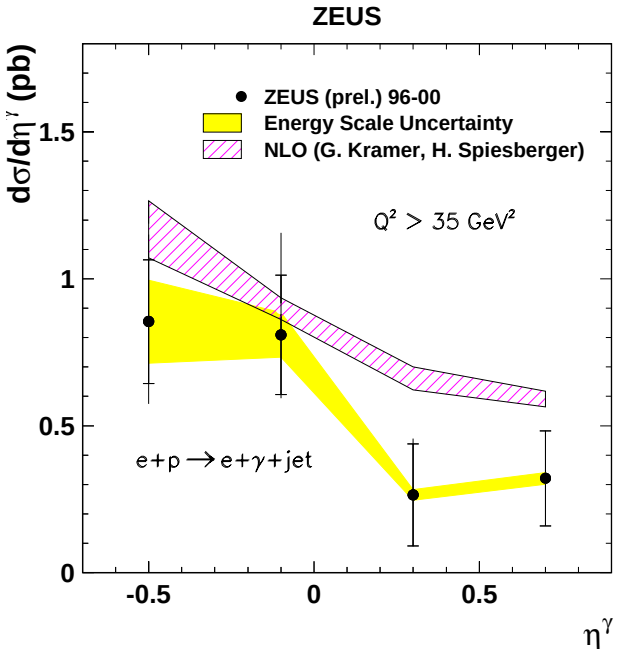
First measurements in DIS from ZEUS.

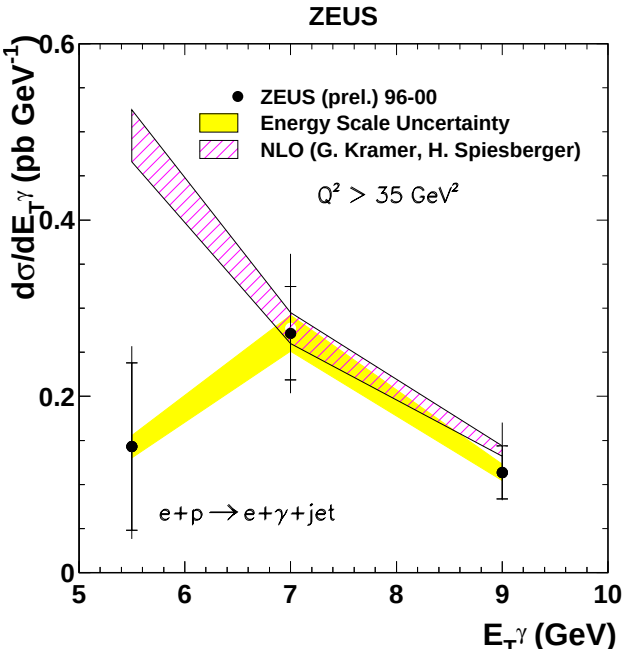
(1) Inclusive prompt photons





(2) Prompt photon + jet

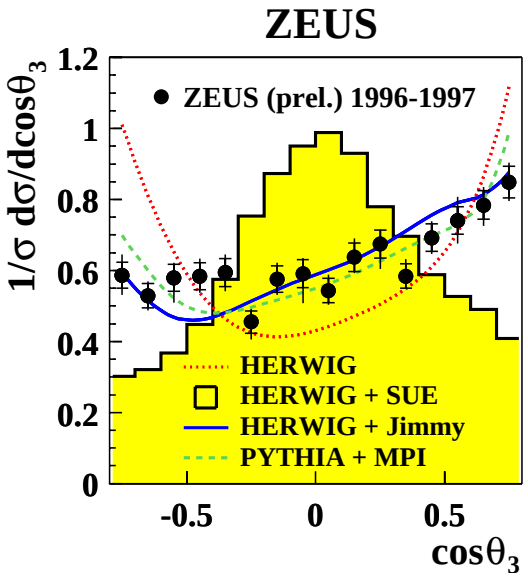


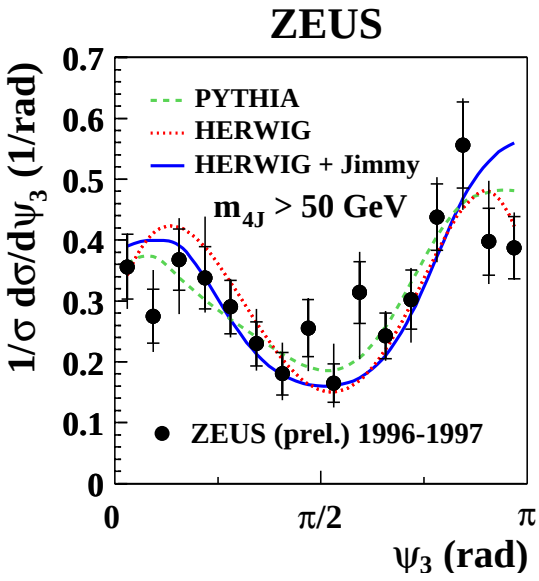


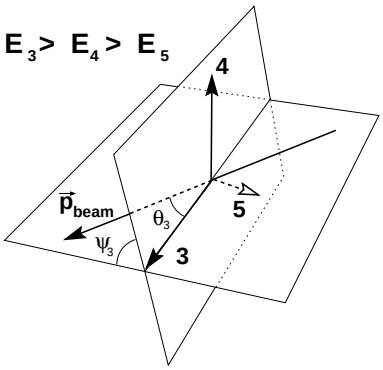
compare to NLO QCD theory of Kramer & Spiesberger.

Fair overall agreement within large errors.

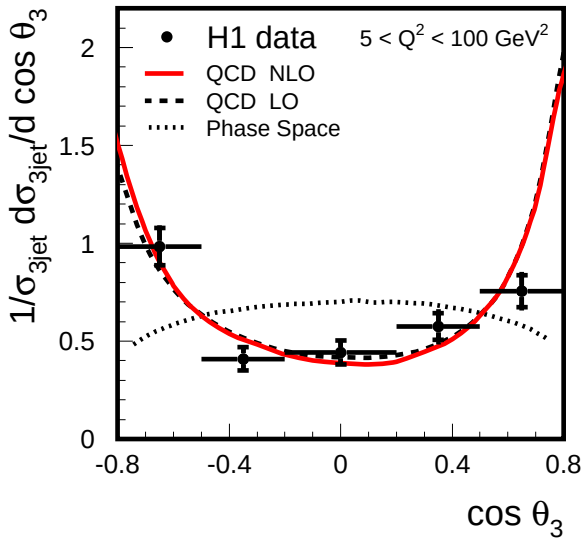
MULTIJETS in PHOTOPRODUCTION & DIS

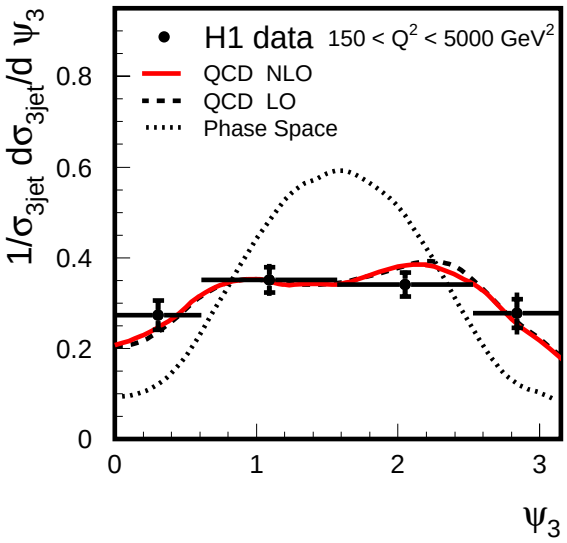






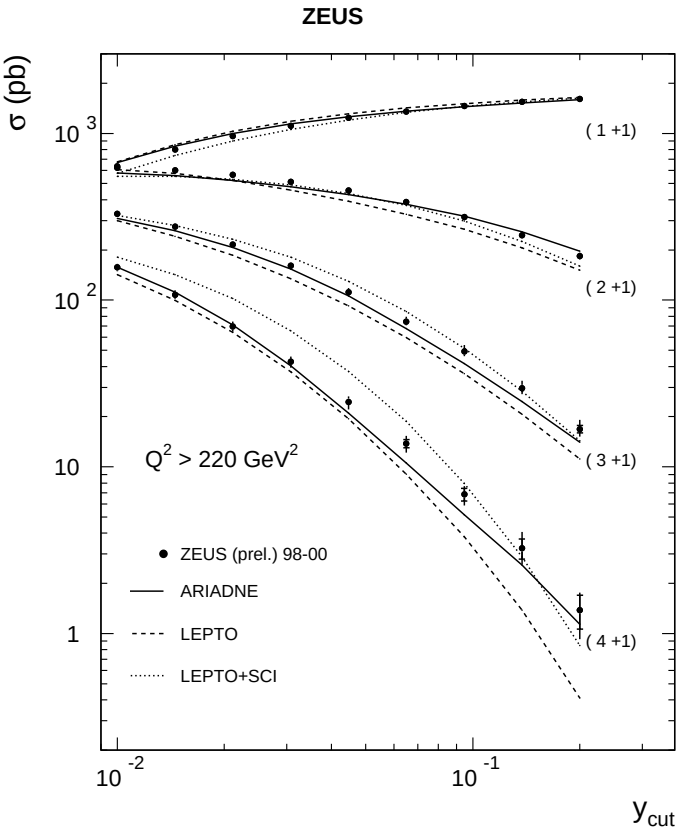
ZEUS study 4-jets in γp but merge 2 lowest- M jets to use 3-jet kinematics.
PYTHIA + MPI good at low M_{jets} .
At high M_{jets} MPI unimportant.





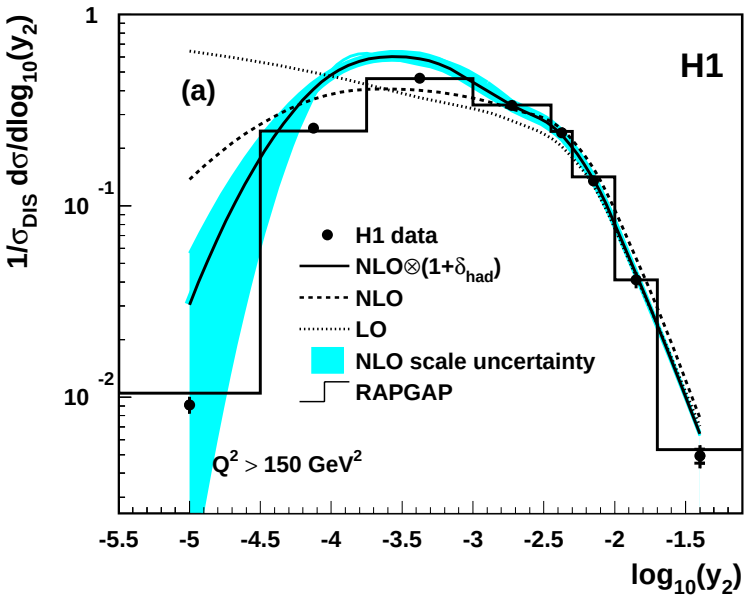
3-jet DIS results from H1 (typical plots).
Shapes well described by LO and NLO.

MULTIJETS/DIJETS IN DIS



ZEUS plot 3-jet cross section vs y jet separation parameter

ARIADNE (Colour Dipole Model + hadronisation) OK (less good at parton level)
MEPJET: NLO OK if corrected to hadron level.



H1 measure dijets at small separation y RAPGAP (LO + parton showers) better than NLO.

CONCLUSIONS

HERA provides an environment in which a wide range of jet physics can be investigated.
Many processes are unique to HERA.
QCD is studied from various angles.

— Jets at high E_T using suitable algorithms and cuts show no problems.

— QCD highly successful.

— α_s competitively determined in a number of ways.

— Prompt photons studied in photoproduction and DIS.

— Multiparton Interactions studied.