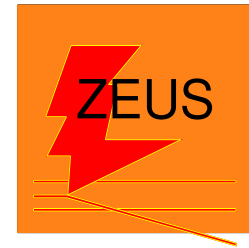


ZEUS results for EPS-HEP 2007 + 1 combined ZEUS+H1 result



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Universität Hamburg



on behalf of the ZEUS (and H1) Collaborations

DESY seminar
July 17, 2007

Results released after ICHEP 2006

Hadronic final states

- Forward Dijets in PHP at HERAI
- Dijets in high Q^2 DIS at HERAII
- Scaled momentum distribution at HERAI+II
- Multi-jet cross sections in CC DIS at HERA II
- Jet substructure in NC DIS
- Measurement of α_s at HERA (**ZEUS+H1**)

EW and BSM Physics

- NC DIS with Polarised e^- at HERAII
- CC with polarised e^+ at HERAII
- Measurement of F_2 at high y at HERAII
- Di-electron production at HERAI+II
- W and high- p_T isolated leptons at HERAI+II
(**ZEUS+H1**)

Heavy Flavours

- D^0 in DIS at HERAI
- F_2^{cc} from D^* and D^+ in DIS at HERAII
- Excited charm mesons at HERAII
- Charm fragmentation functions
- $b \rightarrow e$ dijet in PHP at HERAI
- $b \rightarrow \mu$ dijet in PHP at HERAII
- F_2^{bb} at HERAII

Diffraction

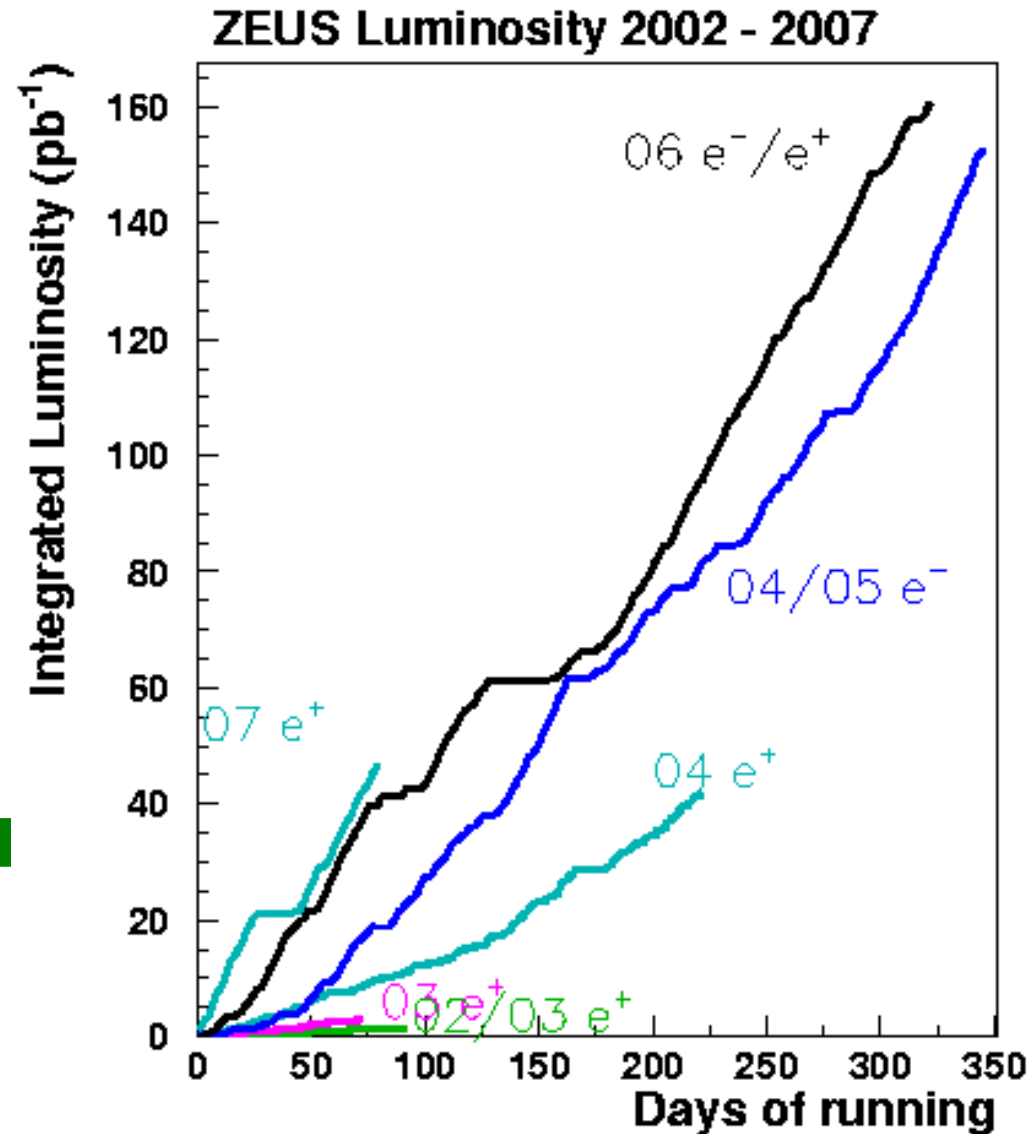
- Diffractive dijets in PHP and DIS at HERAI
- Dijets with a leading neutron at HERAI
- Exclusive ρ electroproduction at HERAI
- b -slope in DVCS using the LPS
- Elastic Y production at HERAI+II

Luminosity

ZEUS has collected(96-07):

- 492 pb⁻¹ of high energy data
- 14 pb⁻¹ of low energy data
- 7 pb⁻¹ of medium energy data.

We have available
HER data (polarised),
LER and MER data for F_L and
 σ_{tot} measurement...

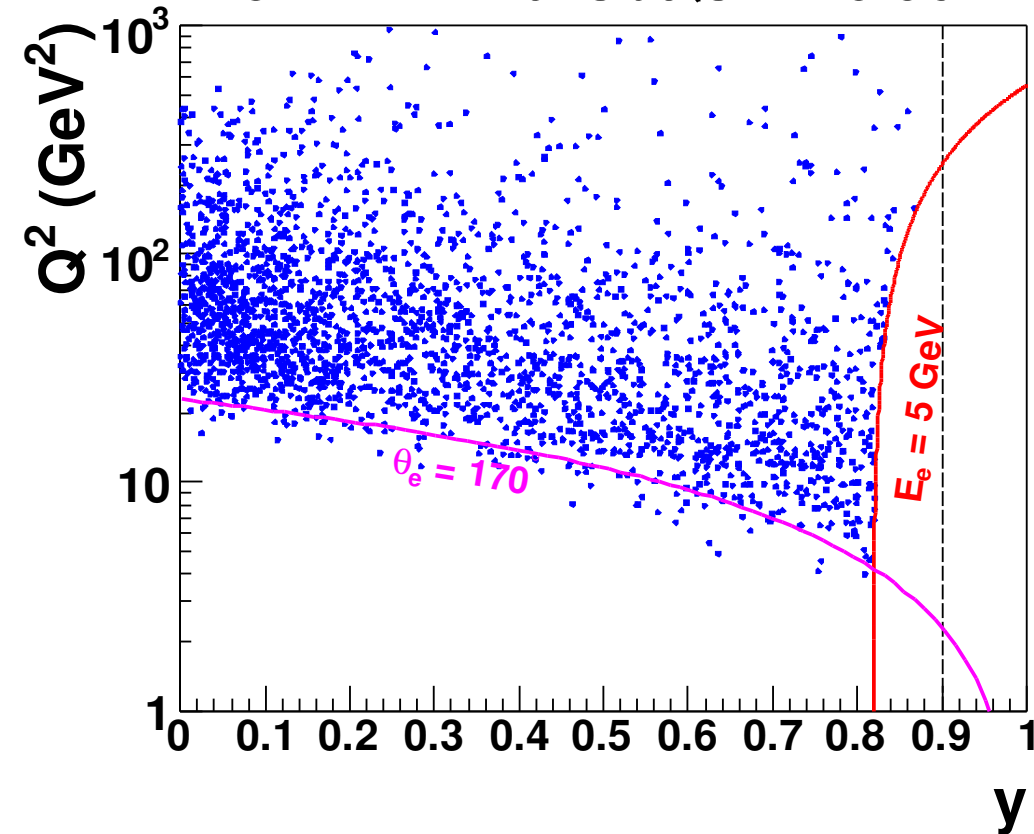


...it's time to concentrate on analysis...

First outcome for LER and MER

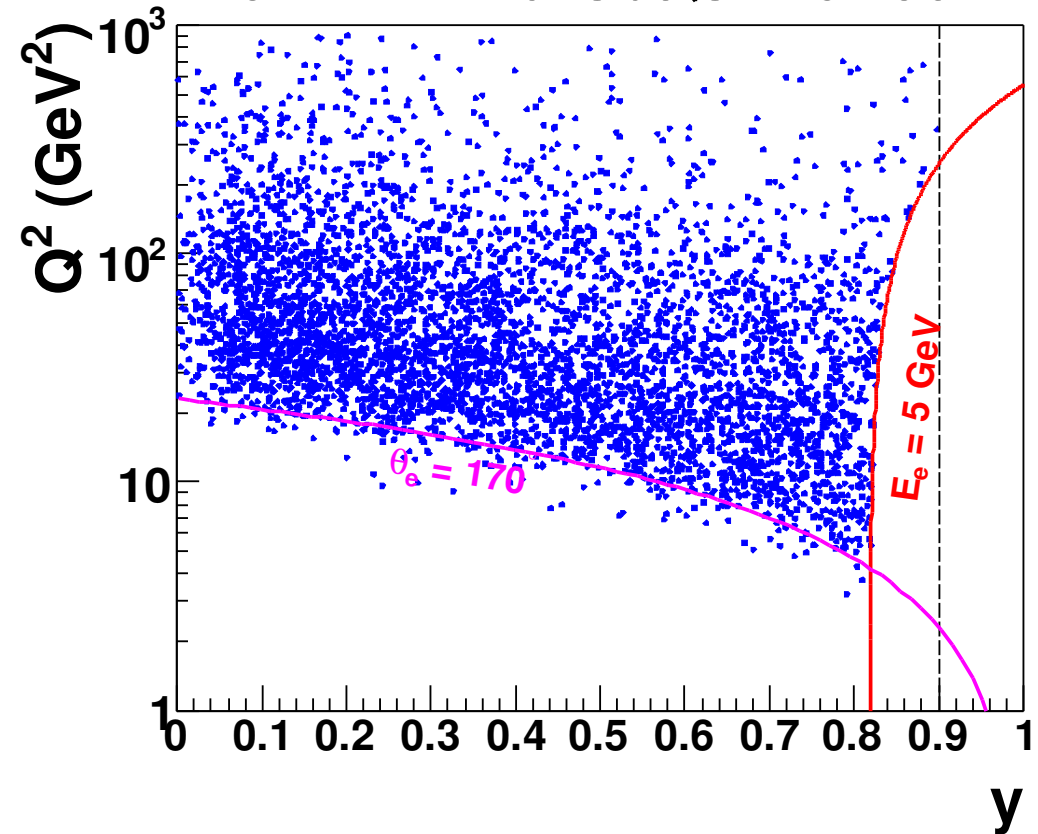
ZEUS First Events

from HERA Runs at $\sqrt{s} = 225$ GeV



ZEUS First Events

from HERA Runs at $\sqrt{s} = 252$ GeV



Good Physics data were provided during LER and MER.

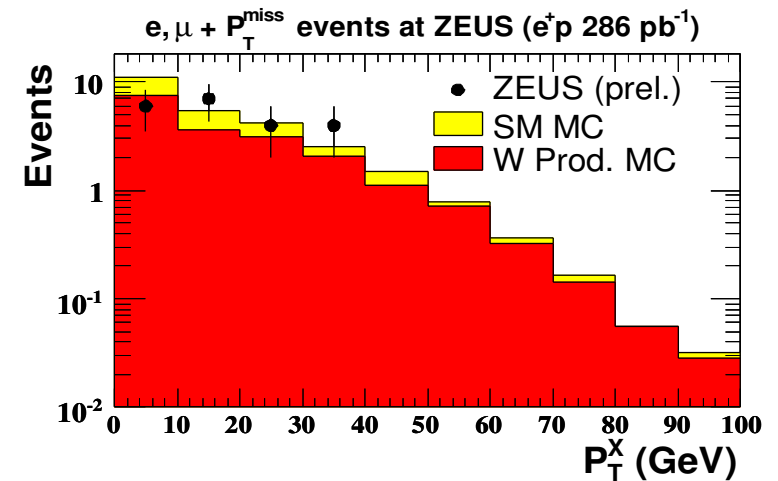
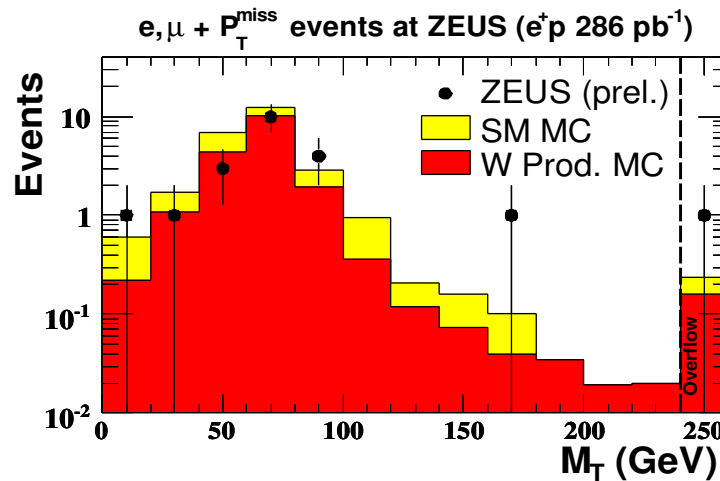
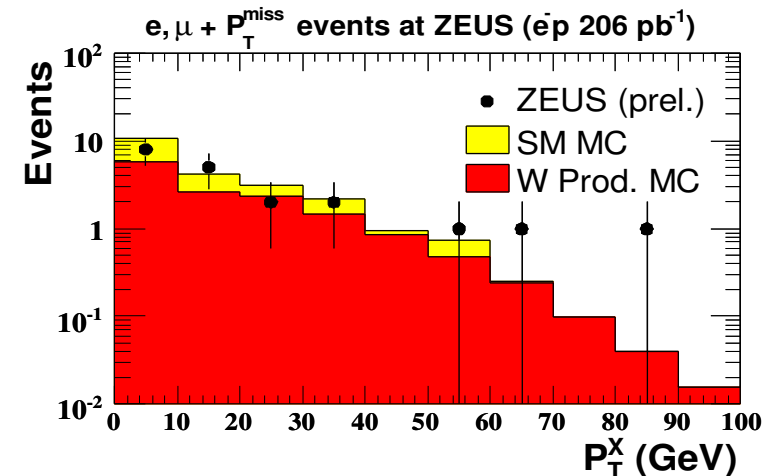
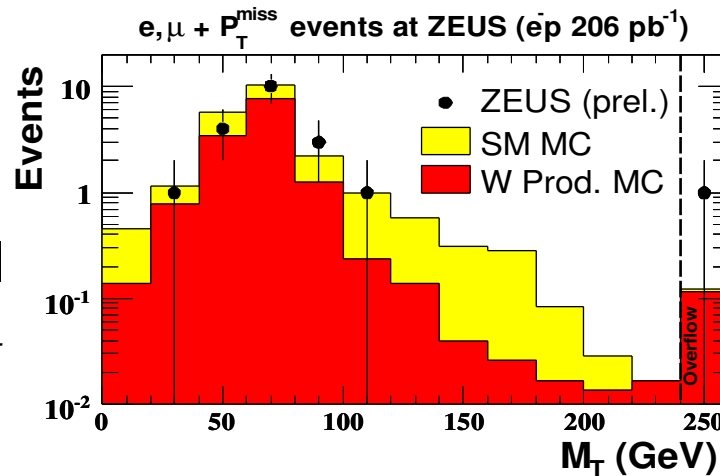
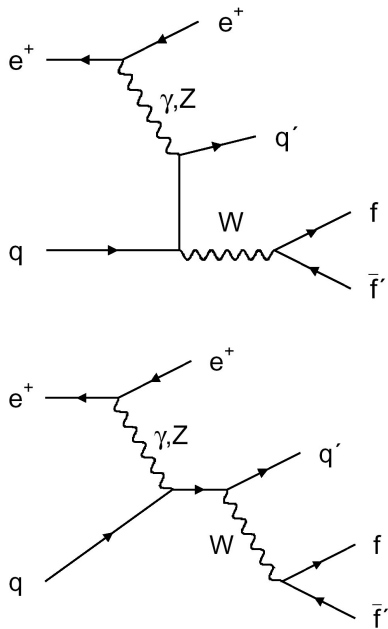
Results on BSM and EW physics

- W production and high- p_T isolated leptons, H1+ZEUS combined (in H1 talk)
- Multi-lepton production
- CC cross section in e^+p collisions (2006/07 data)
 - CC in 2005 e^- : preliminary at ICHEP06
 - NC in 2005/06 e^- : preliminary at DIS07

W production and high- p_T leptons

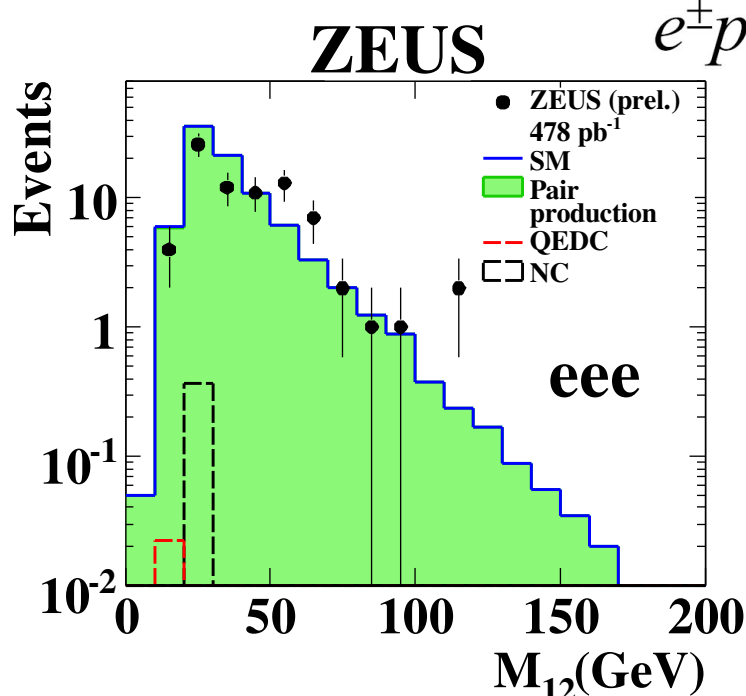
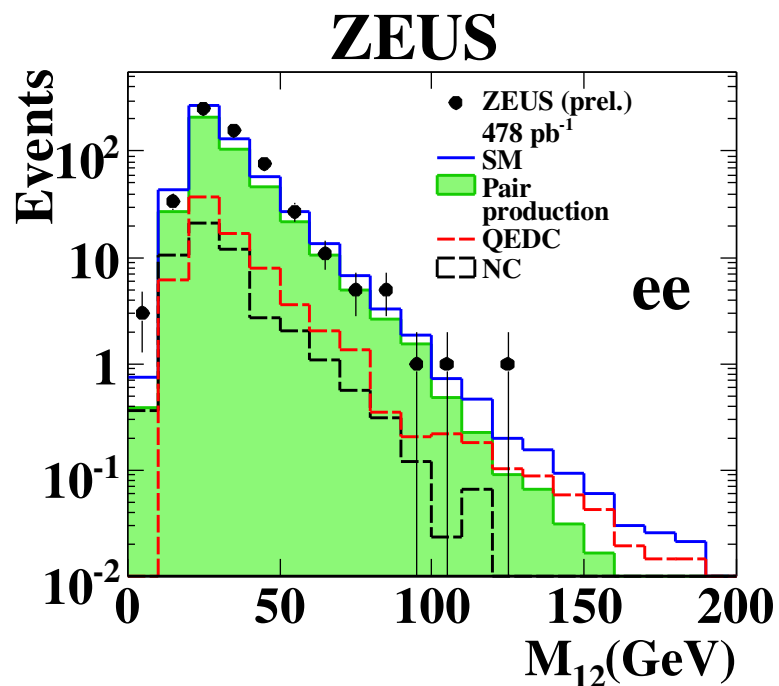
$$W \rightarrow l\nu_l$$

Isolated high- p_T lepton in the final state, missing p_T in the event.

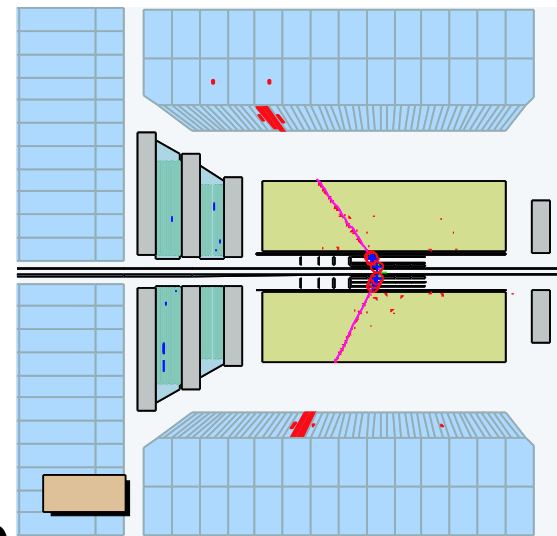


492 pb^{-1} of data analysed. No excess wrt standard model predictions.

Multi-electron production



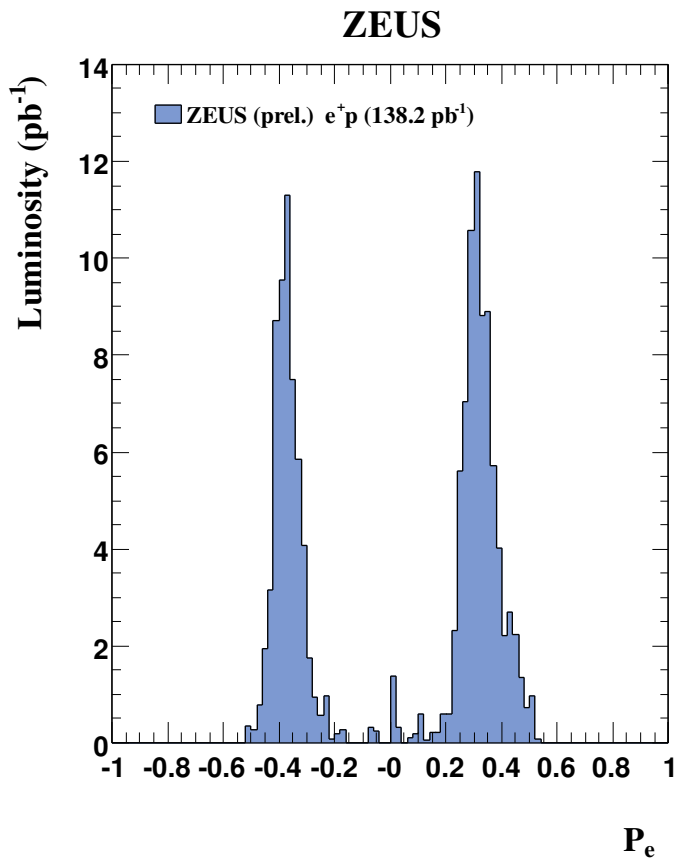
$$e^{\pm}p \rightarrow e^{\pm}l^{+}l^{-}p, e^{\pm}l^{+}l^{-}X$$



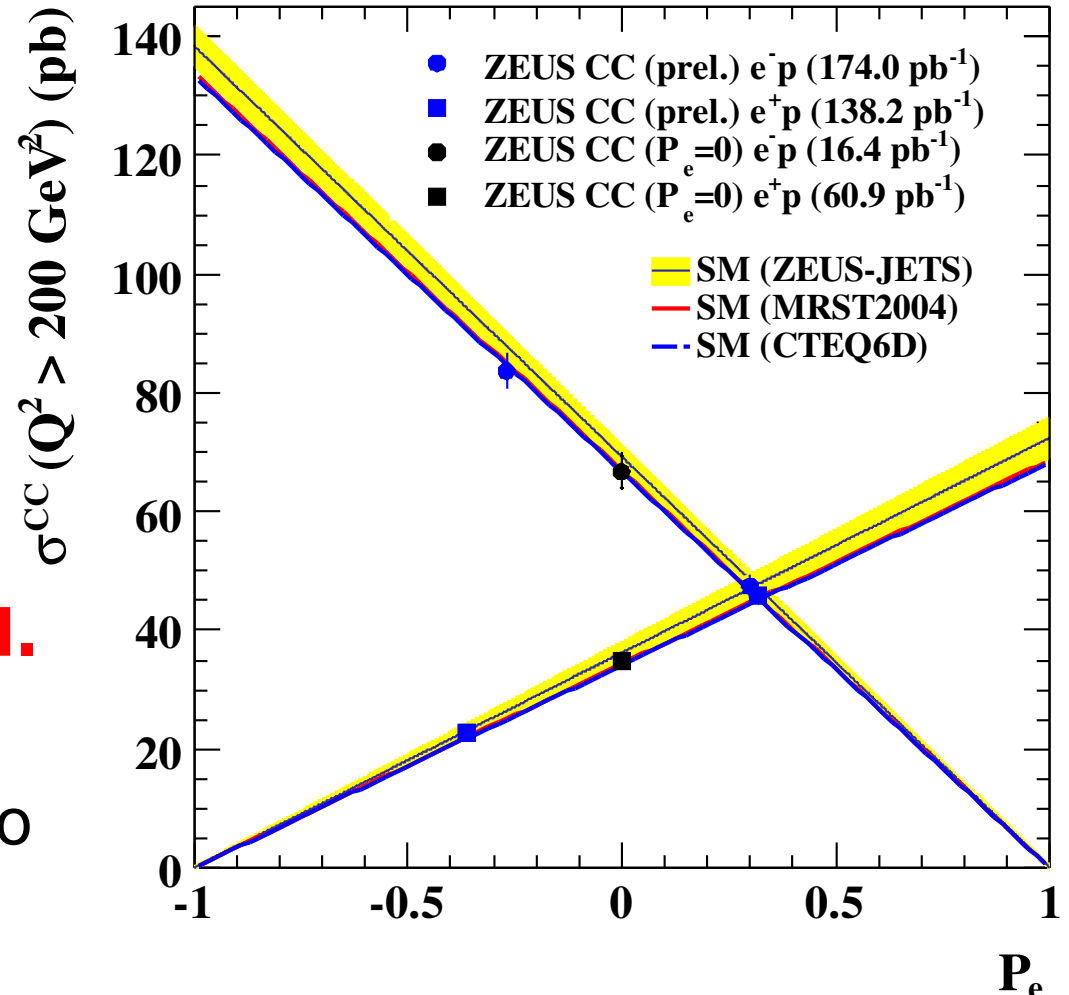
M12>80GeV					
Topology	DATA	SM	Di-electron	QEDC	NC
ee	8	7.1 ^{+0.7} _{-0.6}	5.1±/0.5	1.4 ^{+0.5} _{-0.3}	0.5±/0.1
eee	4	3.1 ^{+0.6} _{-0.3}	3.1±/0.3	<0.04	<0.5
M12>100GeV					
Topology	DATA	SM	Di-electron	QEDC	NC
ee	2	1.9±/0.2	0.9±/0.13	0.8±/0.2	0.1±/0.05
eee	2	1.0 ^{+0.5} _{-0.1}	1.0±/0.1	<0.01	<0.5

No excess wrt standard model predictions observed.

CC in e^+p collisions



ZEUS 2006/07 e^+ data



Parity violation is tested.

Polarised cross section in e^+p collisions is expected to grow with the polarisation.

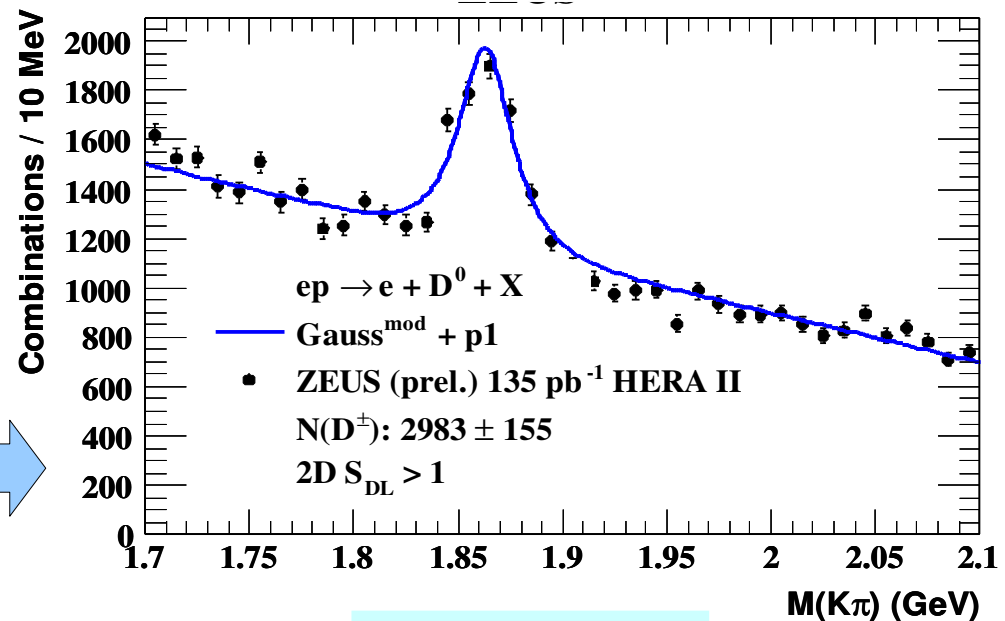
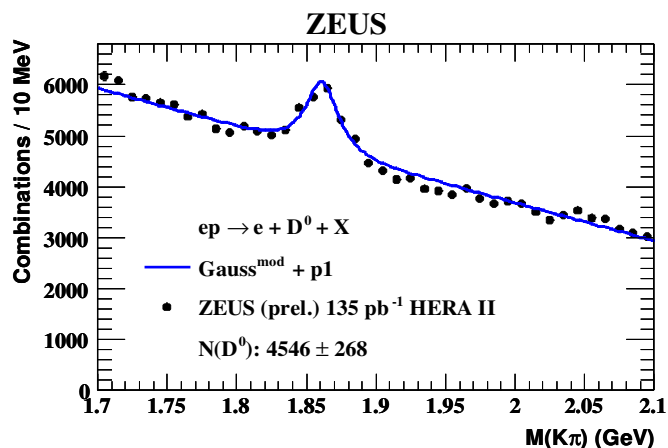
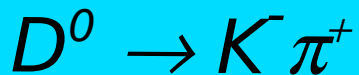
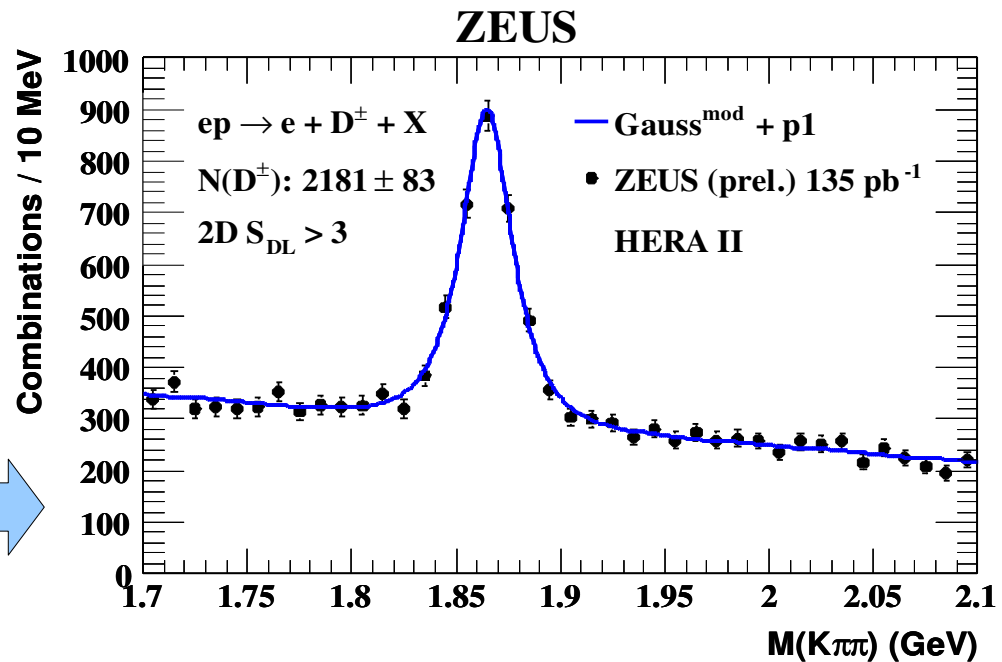
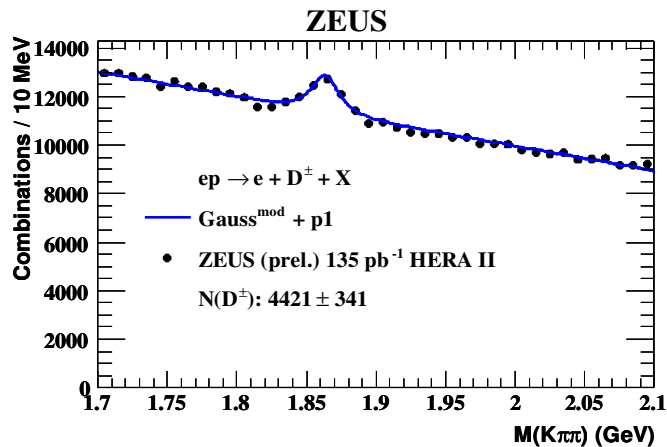
Good agreement with the SM is observed.

$$\frac{d^2\sigma(e^+p)}{dx dQ^2} = (1+P) \frac{G_F^2}{2\pi} \frac{M_W^4}{(Q^2 + M_W^2)^2} [(\bar{u} + \bar{c}) + (1-y)^2(d+s)]$$

Heavy Flavour results

- D^0 and D^+ production in DIS, F_2^{cc}
- Excited charmed mesons
- Beauty PHP with semi-leptonic decay into electrons
- Beauty PHP with semi-leptonic decay into muons

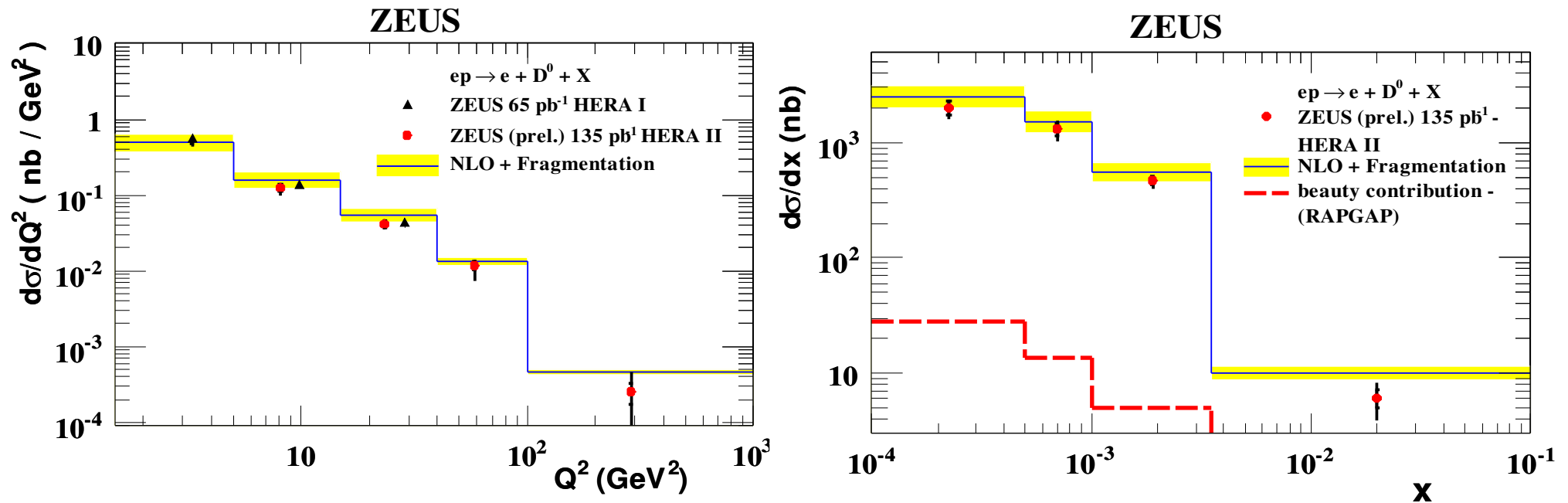
Charm mesons at HERA II: MVD tagging



Without Micro Vertex Detector lifetime info

With MVD

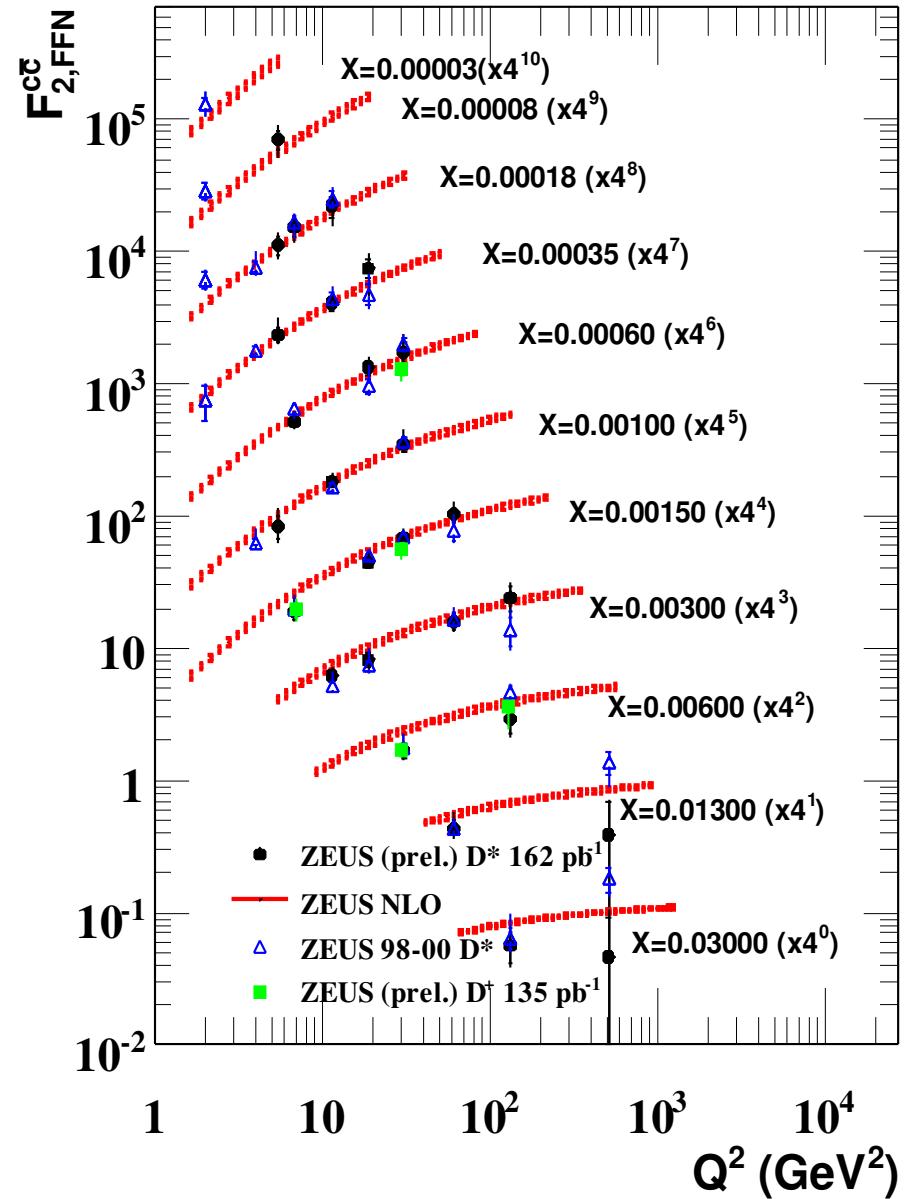
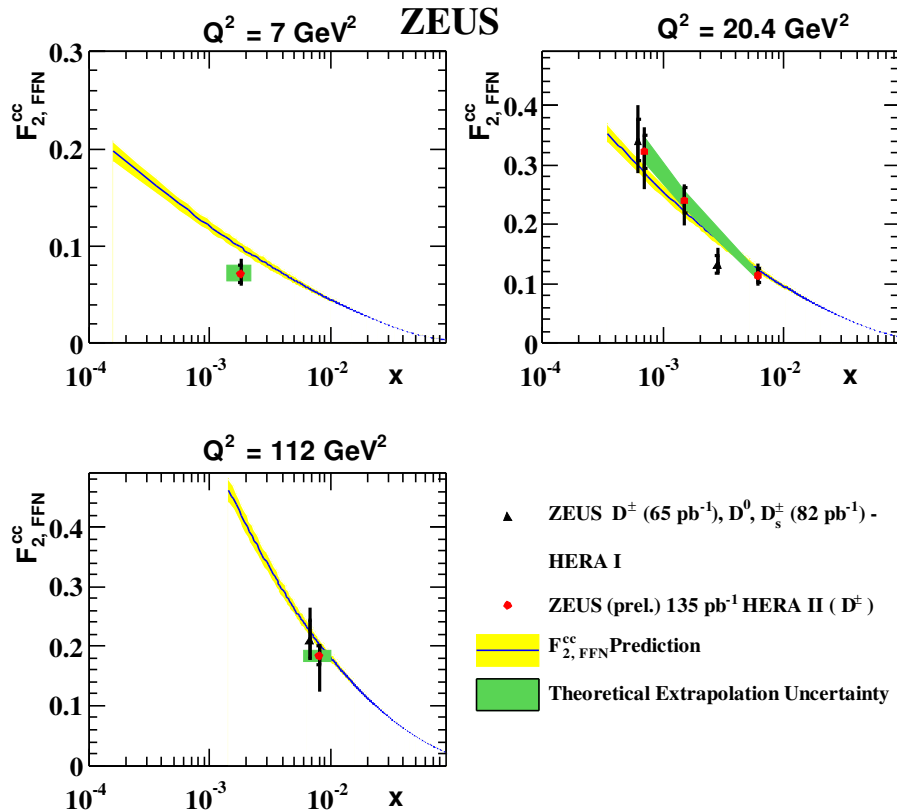
D^0 production in DIS at HERA II



- Good description of the data by NLO.
- Charm mesons can be used to measure F_2^{cc} .

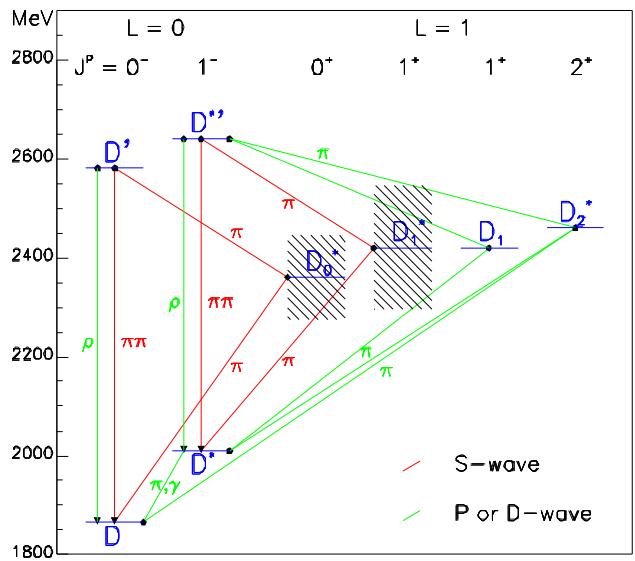
$$F_2^{CC}$$

ZEUS



Improving precision wrt HERA I.

Look forward to results from different D mesons combined!



Excited D mesons (HERAI)

Masses and properties of D_1 (2420), D_2^* (2460), D_s^1 (2536) are measured.

$$M(D_1^0) = 2419.8 \pm 2.0(\text{stat.})_{-1.0}^{+0.8}(\text{syst.}) \text{ MeV},$$

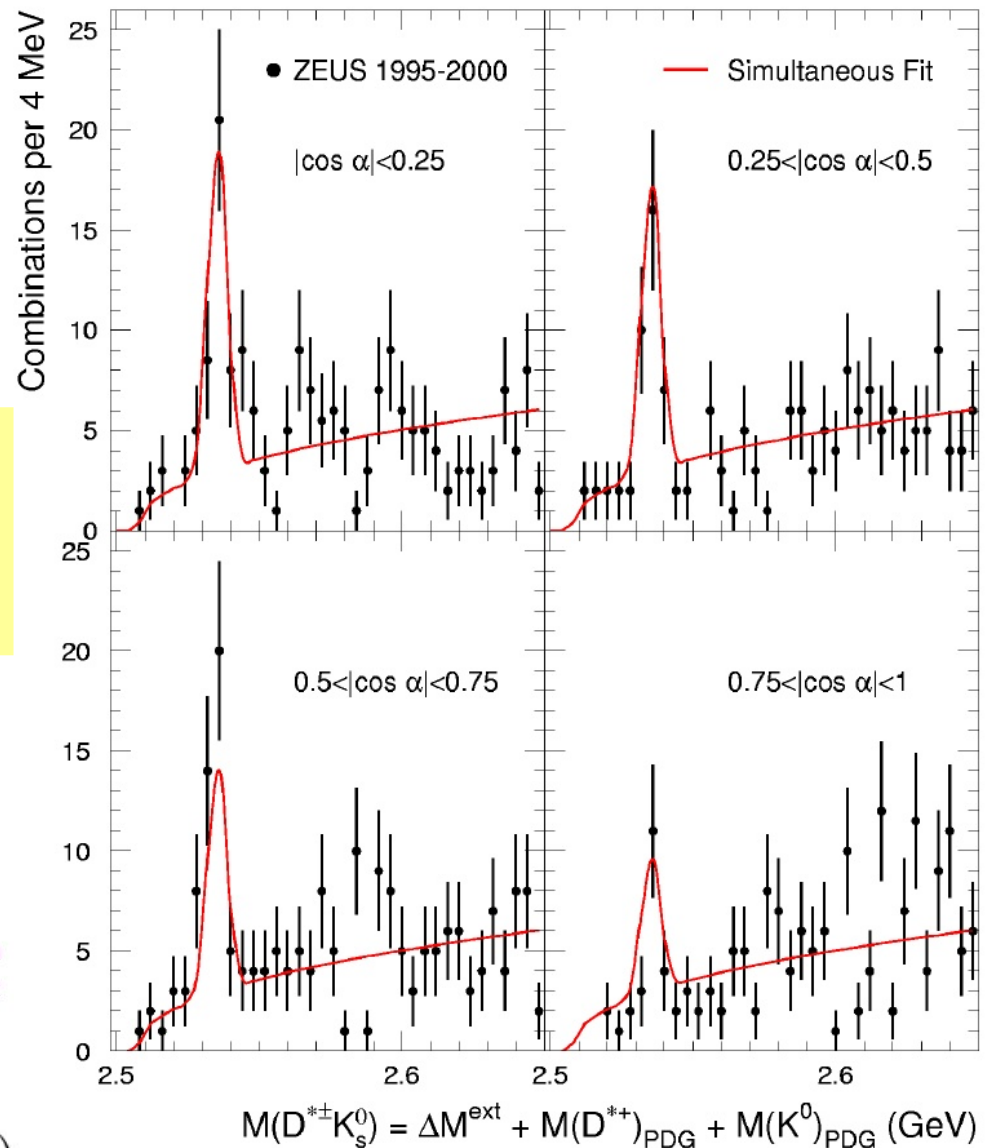
$$M(D_2^{*0}) = 2468.4 \pm 3.6(\text{stat.})_{-1.3}^{+1.1}(\text{syst.}) \text{ MeV},$$

$$M(D_{s1}^+) = 2535.30_{-0.41}^{+0.44}(\text{stat.})_{-0.08}^{+0.09}(\text{syst.}) \text{ MeV}$$

$$\text{CLEO } (D_{s1}^+ \rightarrow D^{*0} K^+) : R = -0.23_{-0.32}^{+0.40}$$

$$\text{Belle prel.} : R = -0.70 \pm 0.03$$

$$R(D_{s1}^+) = -0.74_{-0.17}^{+0.23}(\text{stat.})_{-0.05}^{+0.06}(\text{syst.})$$



$$D_{s1}^+ \rightarrow D^{*+} K_s^0$$

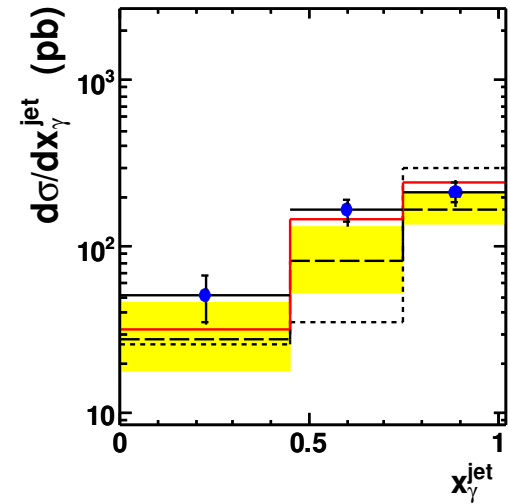
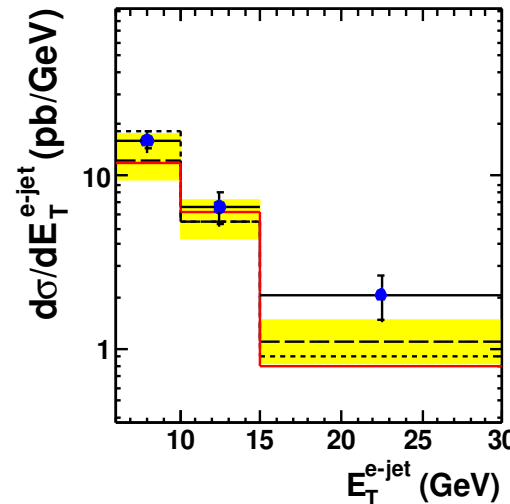
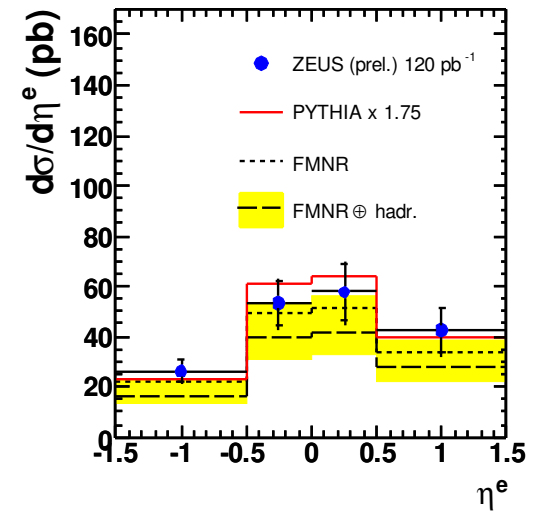
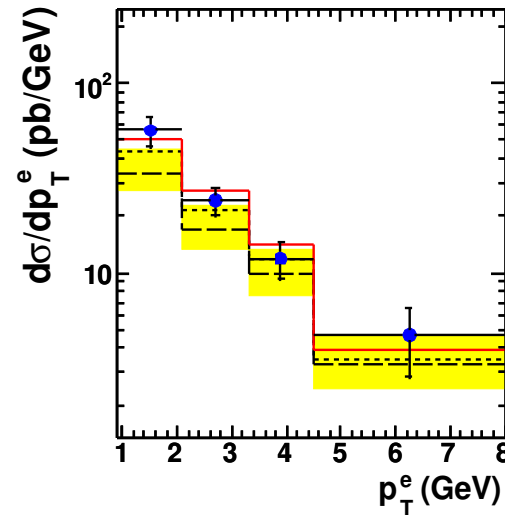
b PHP with *s/l* decay into electrons (HERAI)

ZEUS

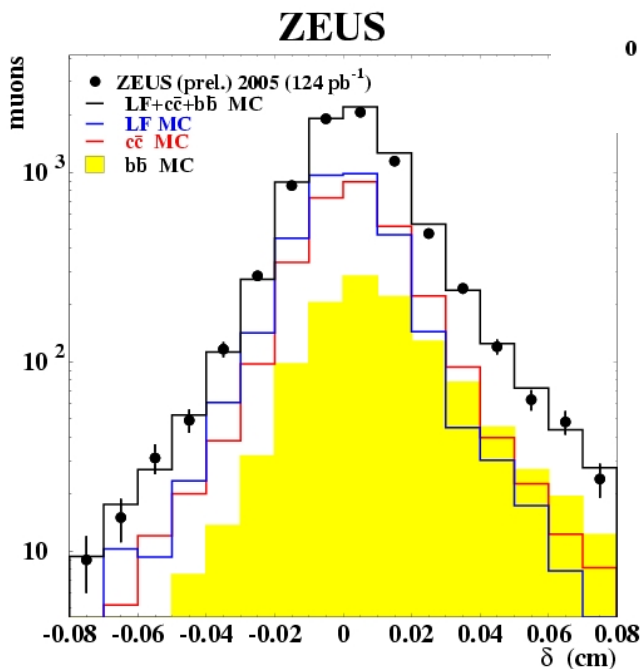
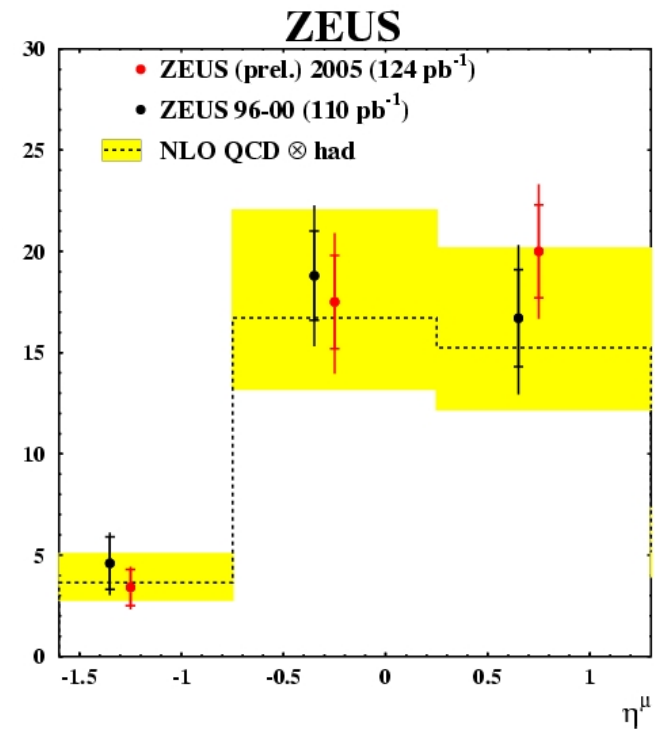
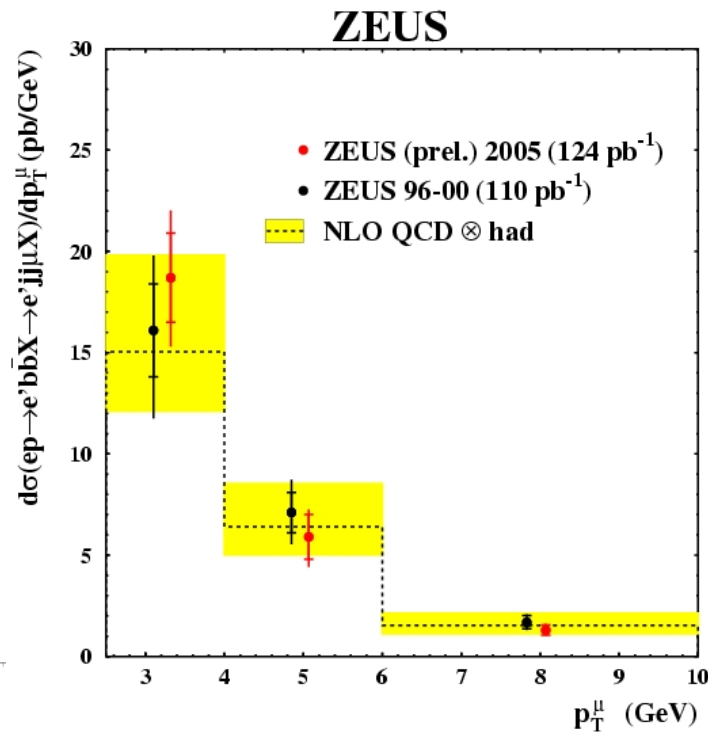
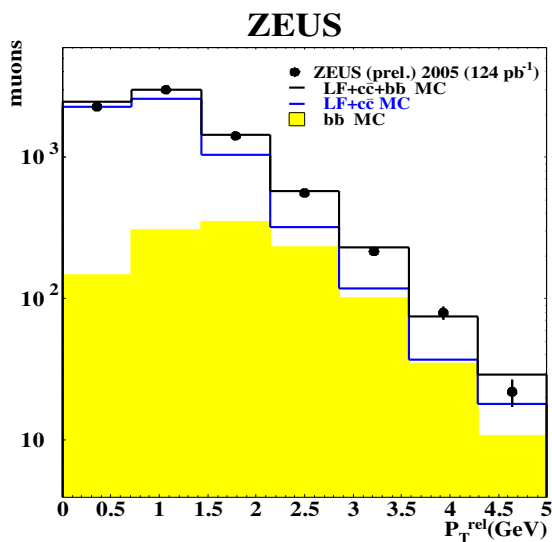
Beauty reconstructed from semi-leptonic decay into e^{\pm} . Separation between signal and background based on a likelihood function.

The kinematic region is extended to lower p_T of the electron and the jet.

Good agreement between data and NLO.

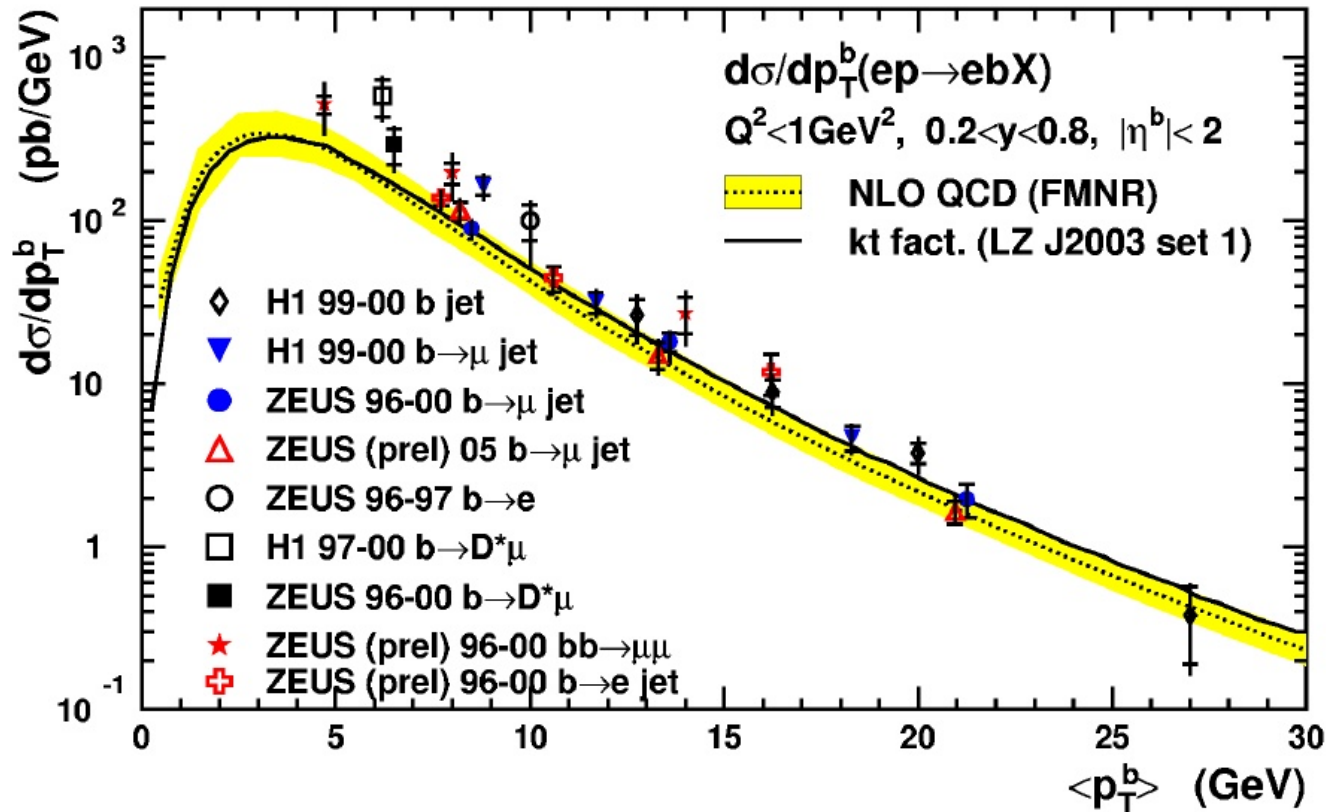


b PHP with s/l decay into muons (HERAII)



The measurement has been obtained combining p_T^{rel} and lifetime information. Nice agreement with HERAI (similar statistics) and with NLO.

b summary plot

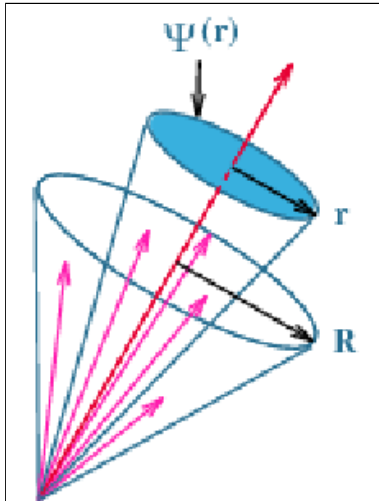


Measurements done with very different methods are in agreement and well described by NLO.

Results on hadronic final states

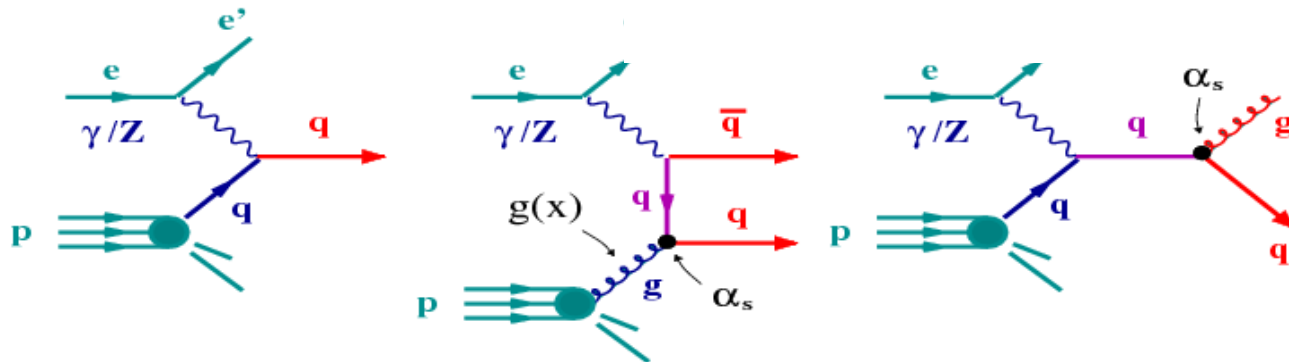
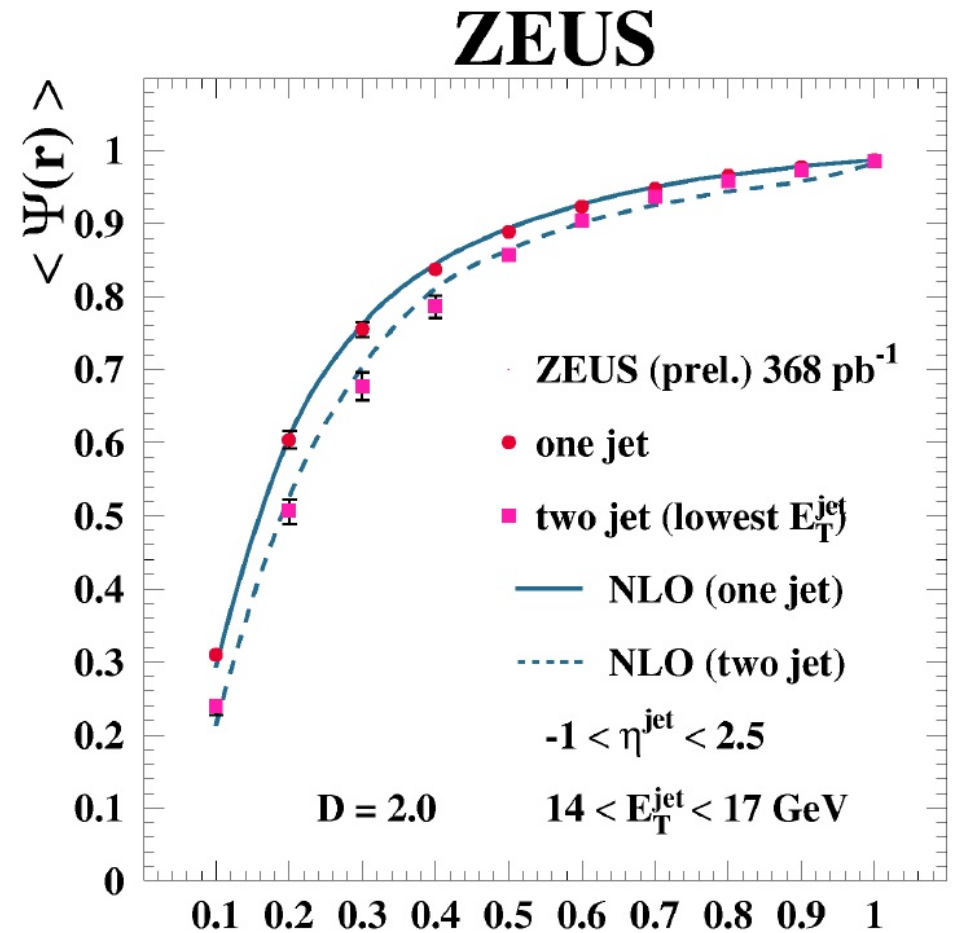
- Jet substructure in NC DIS at HERAII
- Measurement of α_s (ZEUS+H1 combined)

Jet substructure in NC DIS



Perturbative QCD predicts that gluon initiated jets are broader than quark initiated jets.

Difference in the jet shape observed in events with one jet (quark enriched) and two jets, looking at the second jet, close to the first (gluon enriched)



r

Measurement of α_s (ZEUS+H1 combined)

Idea: combine the most precise measurements from both experiments and make a simultaneous fit to both data sets, instead of combining $\alpha_s(M_Z)$ values.

The most precise determination of $\alpha_s(M_Z)$ comes from the measurement of inclusive jet cross section in NC DIS at high- Q^2 .

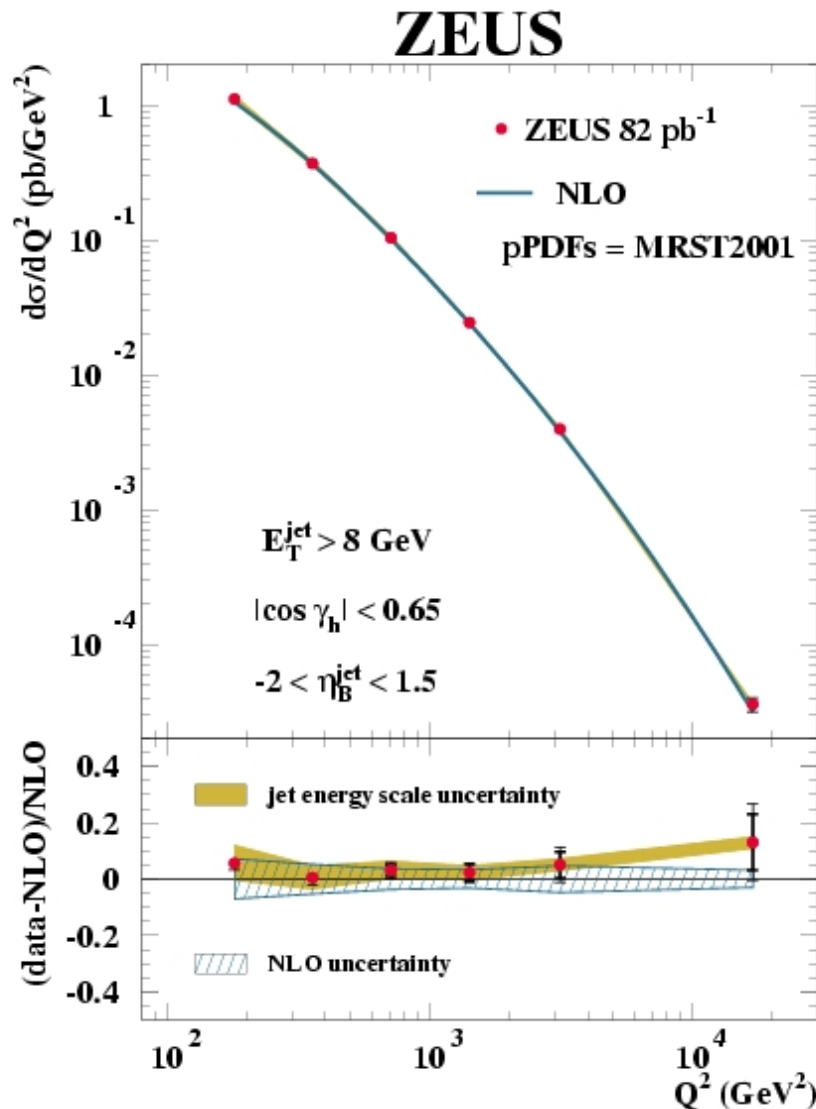
$$\alpha_s(M_Z) = 0.1207 \pm 0.0014 \text{ (stat.) } \begin{matrix} +0.0035 \\ -0.0033 \end{matrix} \text{ (exp.) } \begin{matrix} +0.0022 \\ -0.0023 \end{matrix} \text{ (th.)} \quad \text{ZEUS, err.}=3.6\%$$

$$\alpha_s(M_Z) = 0.1193 \pm 0.0014 \text{ (exp.) } \begin{matrix} +0.0049 \\ -0.0034 \end{matrix} \text{ (th.)} \quad \text{H1, err.}=4.3\%$$

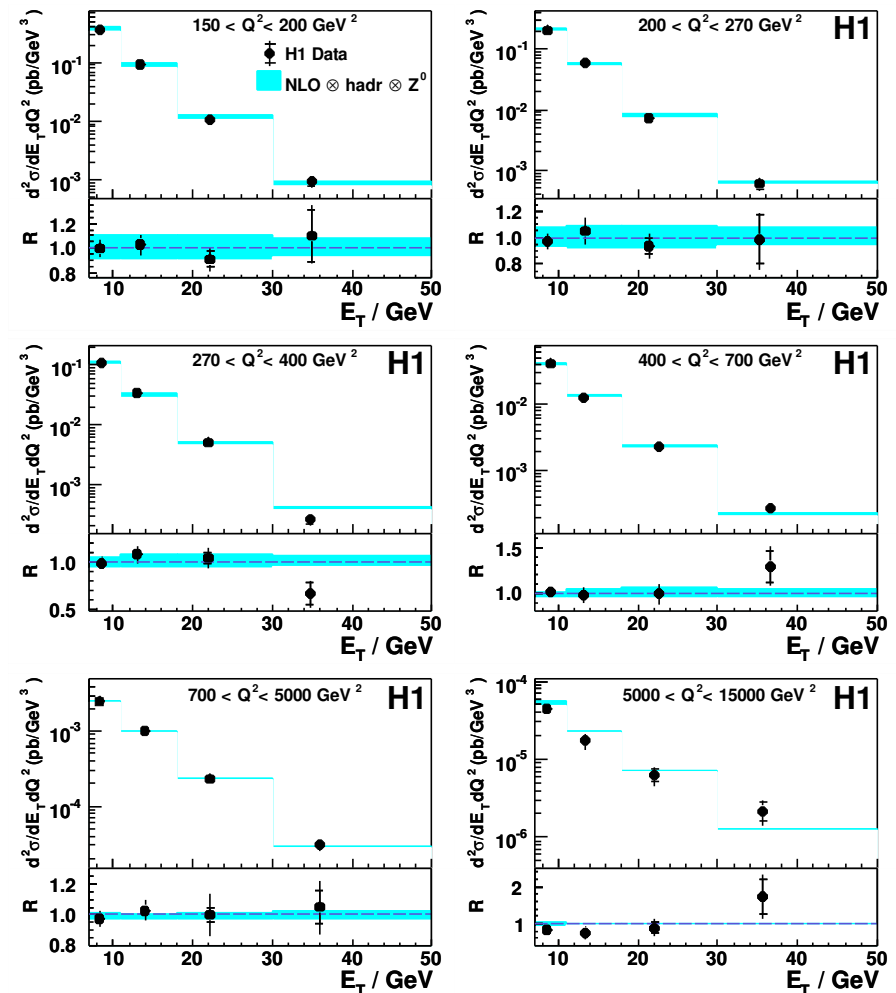
Fit to data

ZEUS: inclusive jet cross section in NC DIS ($125 < Q^2 < 100000 \text{ GeV}^2$)

H1: inclusive jet cross section in NC DIS ($125 < Q^2 < 15000 \text{ GeV}^2$)



Inclusive Jet Cross Section



Extraction of α_s

The idea is to use NLO calculations to parametrise the dependence of an observable on α_s , and then to extract the α_s value from the measured value using the obtained parametrisation.

Experimental uncertainties:

- energy scale, luminosity, model dependence...

Theoretical uncertainties:

- terms beyond NLO (dominant), factorisation scale, PDFs, hadronisation corrections.

Result

HERA combined (new analysis):

$$\alpha_s(M_Z) = 0.1198 \pm 0.0019 \text{ (exp.)} \pm 0.0026 \text{ (th.)}$$

HERA average:

Error: 2.7%

$$\alpha_s(M_Z) = 0.1186 \pm 0.0011 \text{ (exp.)} \pm 0.0050 \text{ (th.)}$$

World average:

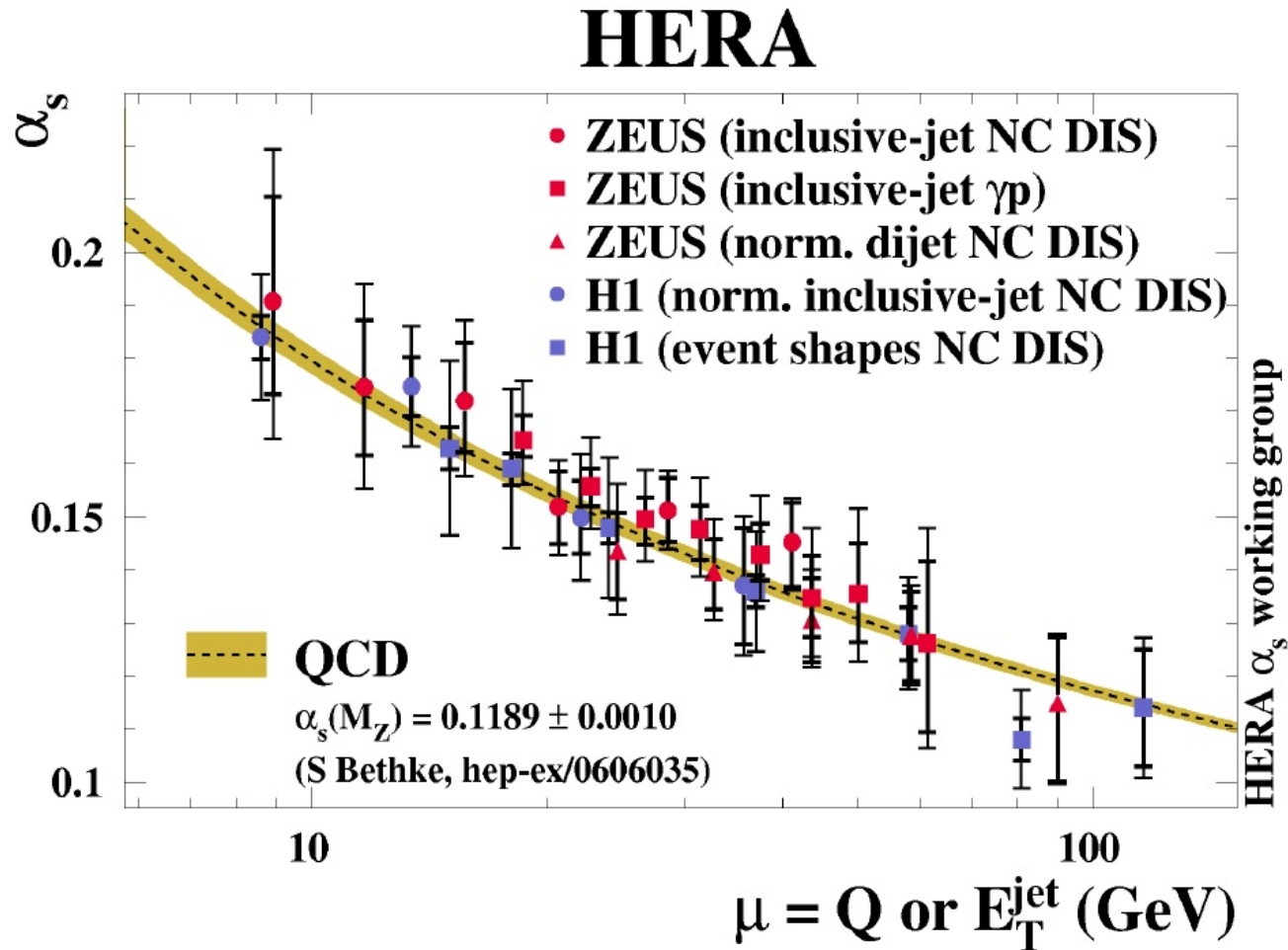
Error: 4.3%

$$\alpha_s(M_Z) = 0.1189 \pm 0.0010$$

Error: 0.8%

**The measurements are consistent
with the world average.**

Running of α_s at HERA



HERA alone data show the running of α_s .

Results on diffraction

- Diffractive dijets in DIS
- Dijets with a leading neutron
- b -slope of DVCS using the LPS
- Elastic Υ photoproduction

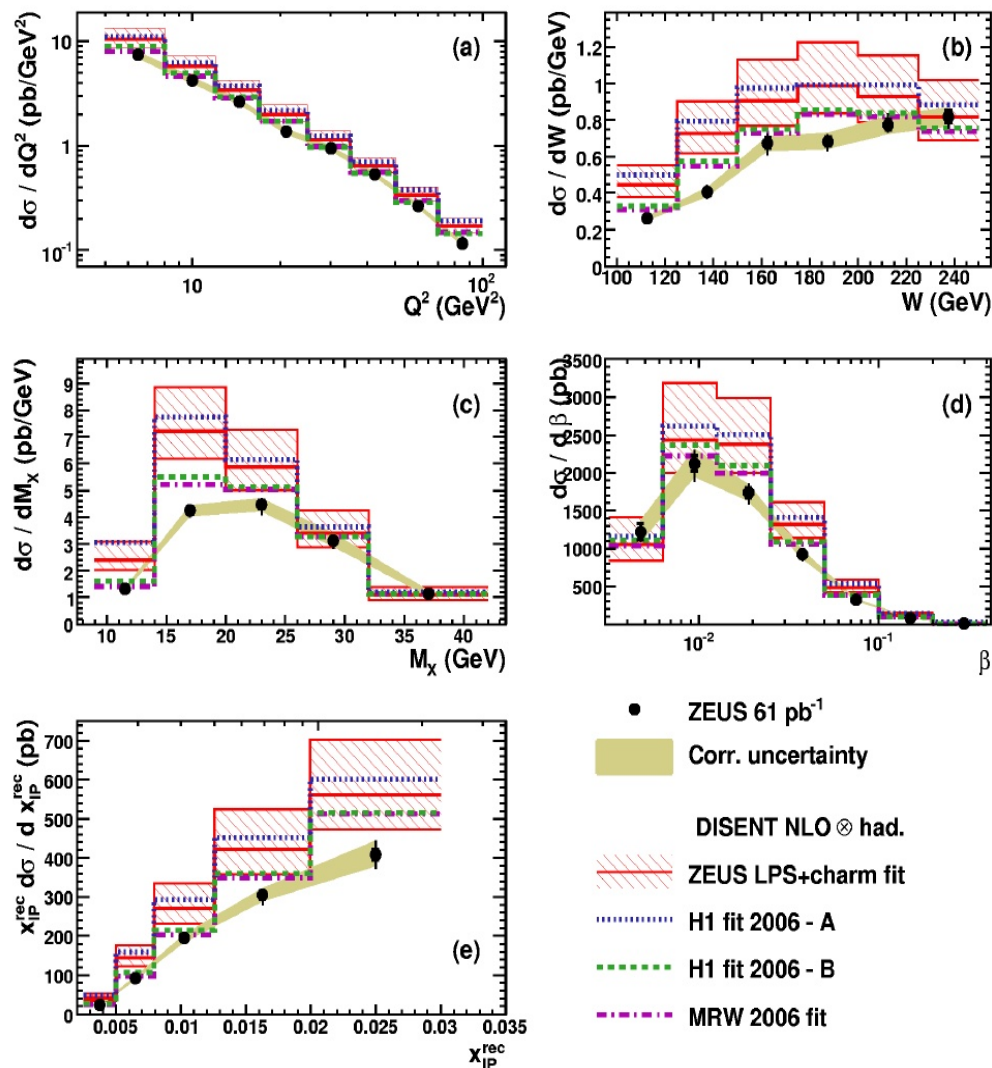
Diffraction dijets in DIS

The data are described by the NLO predictions within theoretical uncertainties.

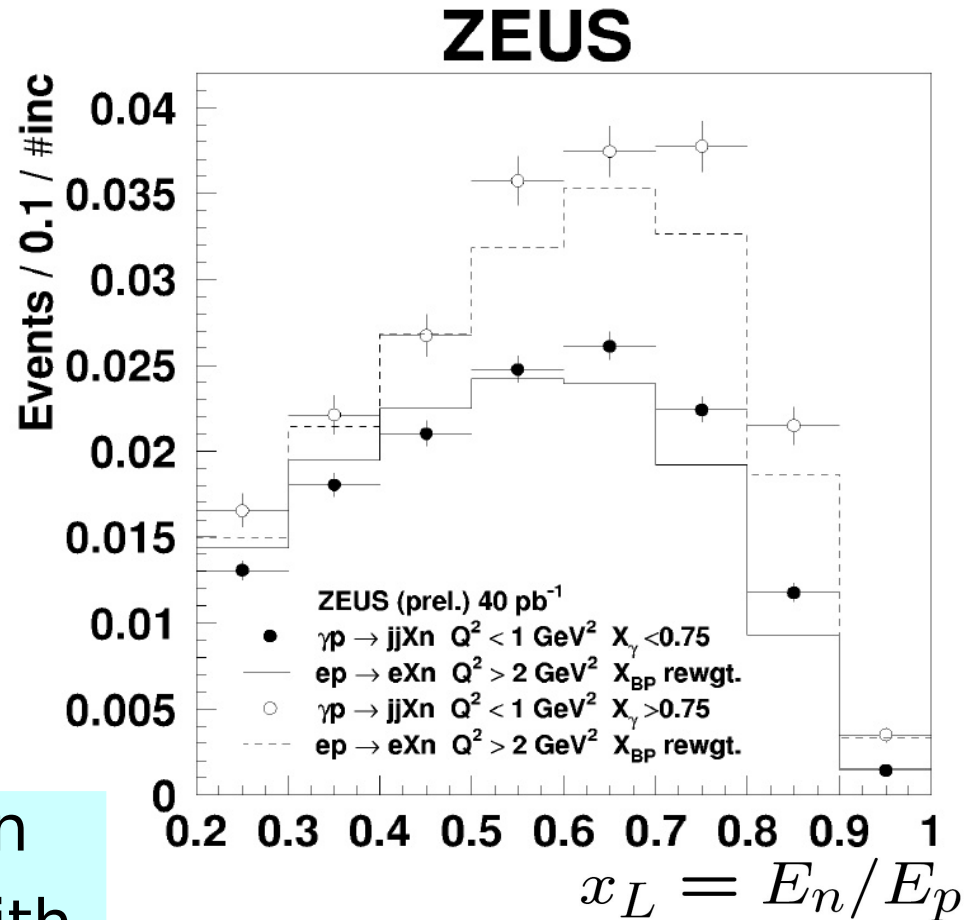
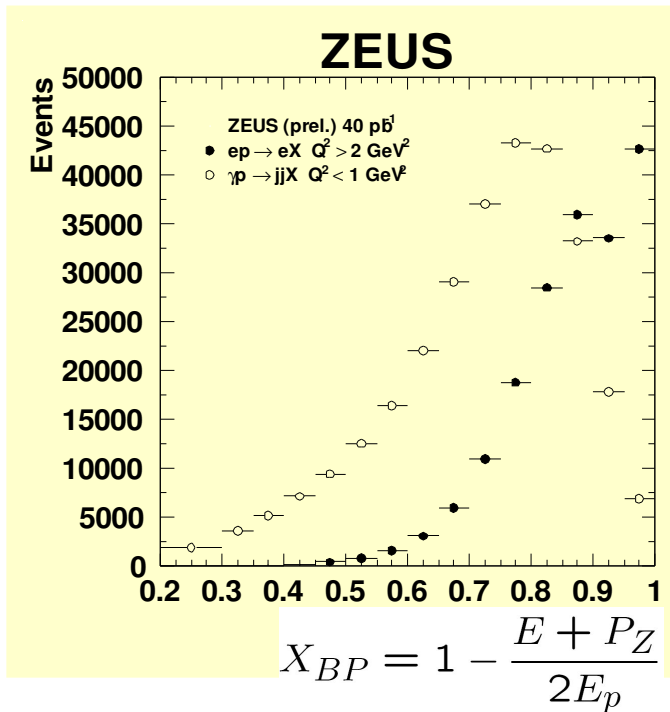
Data are better described by the H12006 FitB and MRW 2006 dPDFs.

The data are able to discriminate between NLO predictions based on different dPDFs.

ZEUS



Dijets with a leading neutron

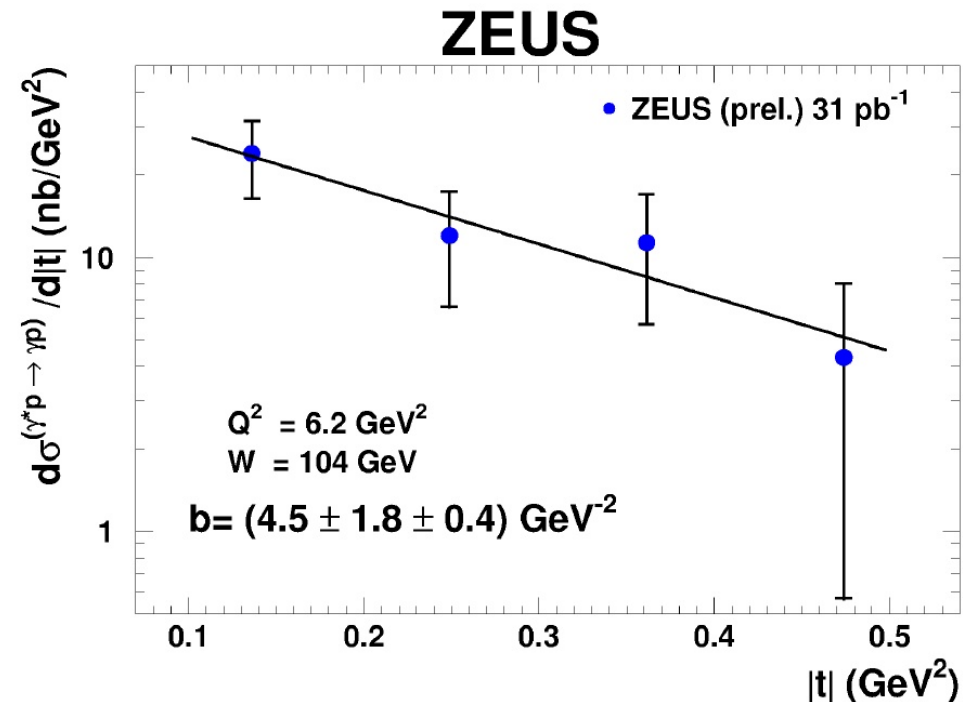
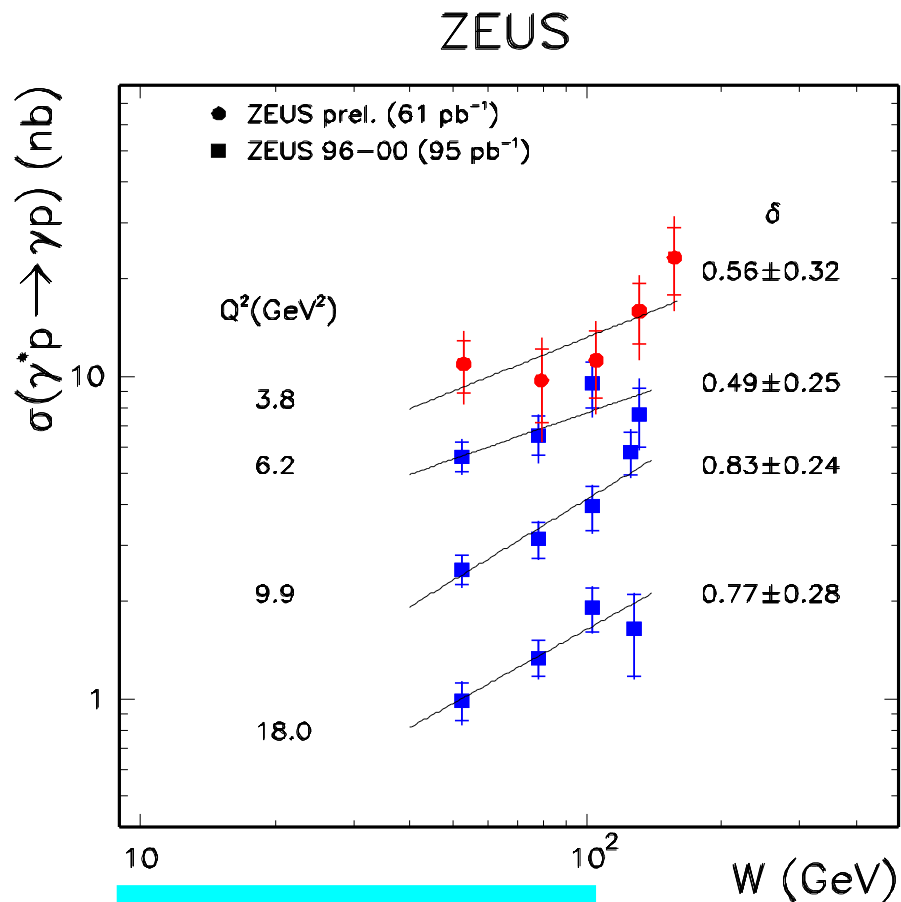


DIS inclusive x_L distribution
reweighted in x_{BP} agrees with
both the direct and resolved
parts of dijet PHP

**No clear evidence
for absorption**

DVCS with the LPS at HERA I

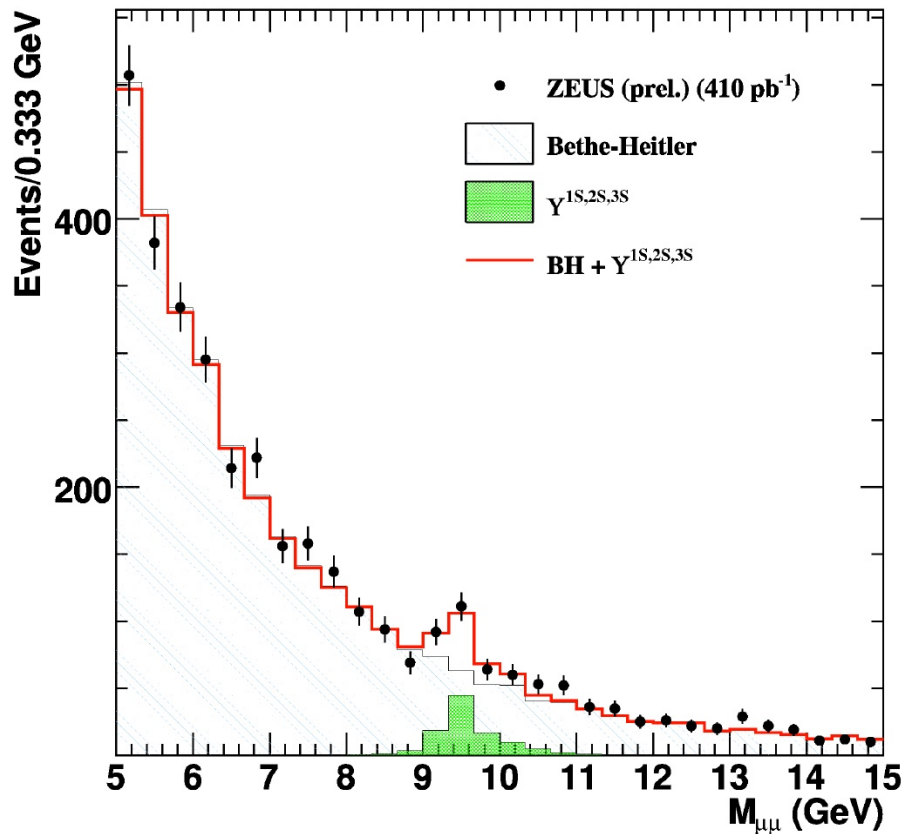
The kinematic region has been extended to lower Q^2 values



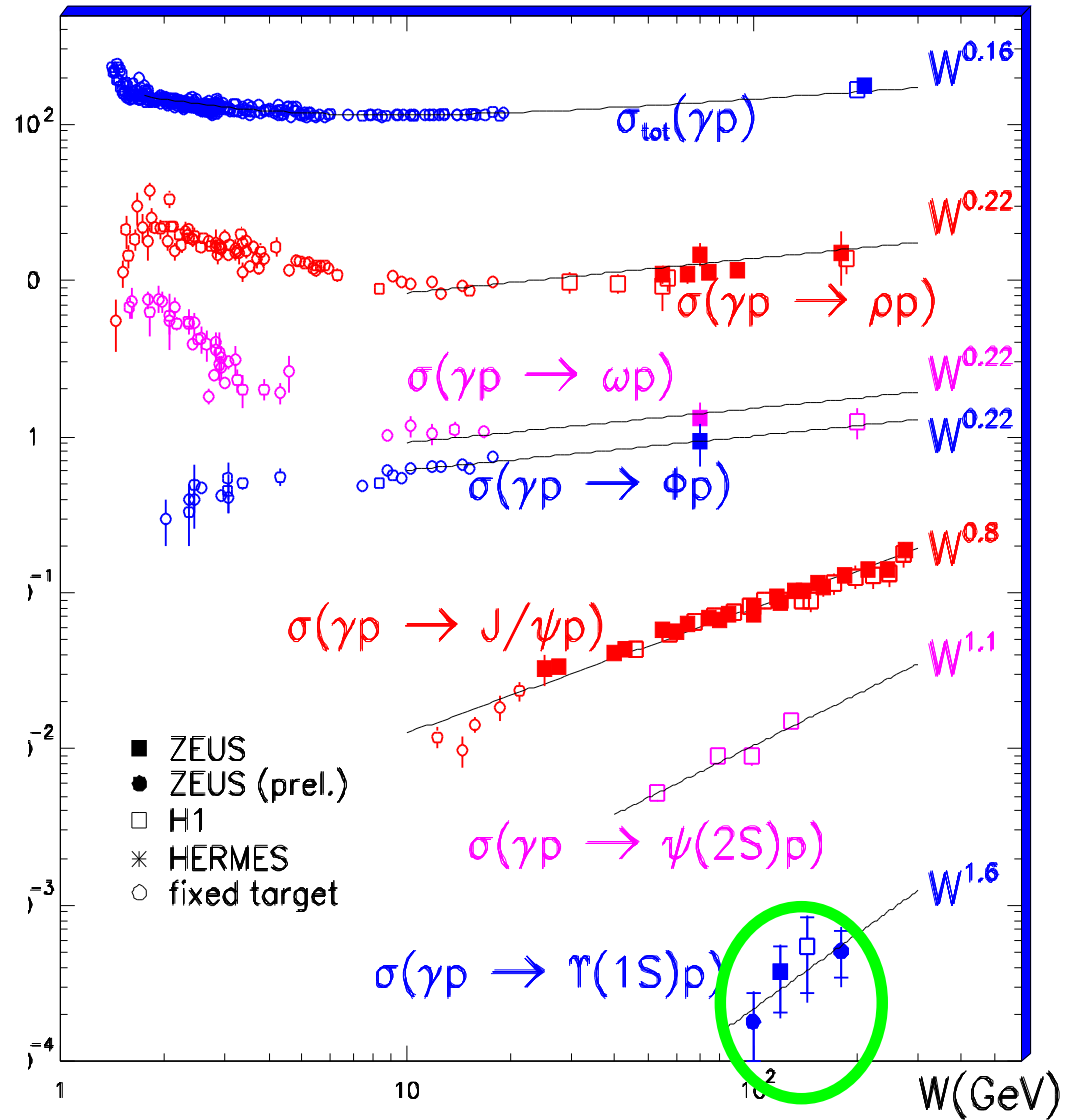
The b slope is measured directly using events tagged by the LPS
 (34 events have a proton tagged in the LPS)

Elastic Y production

$\gamma p \rightarrow Yp$



ction (μb)



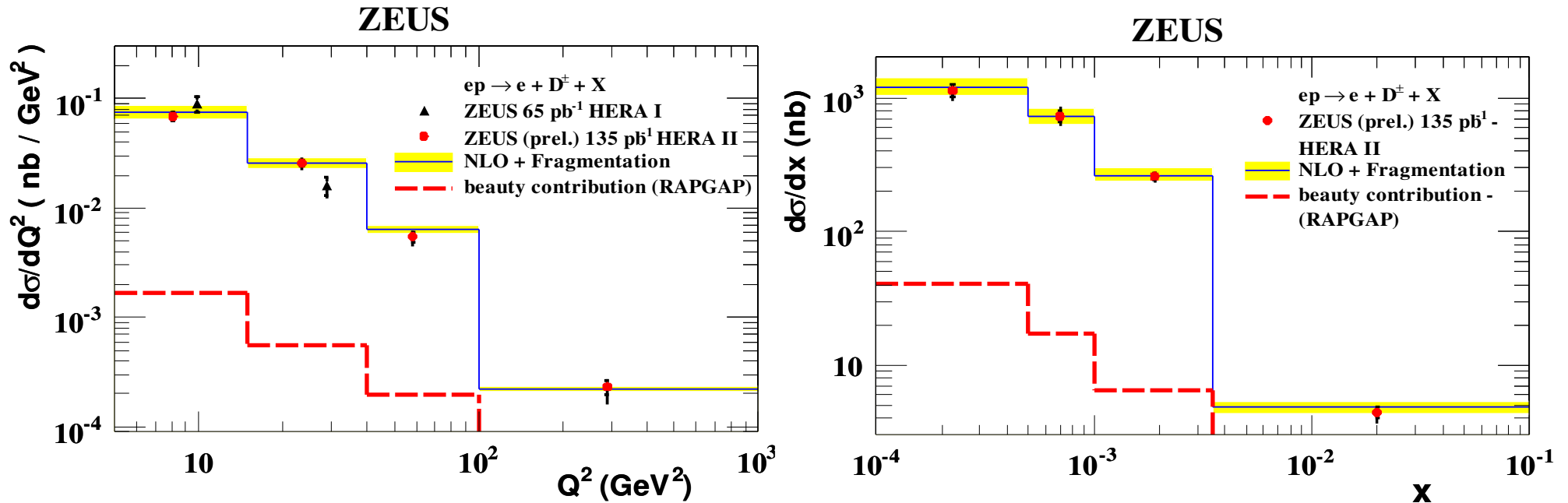
Cross section has been measured in two W bins, using 240 pb⁻¹ of data. It is consistent with previous measurements, and more precise.

Summary

- Many analyses are combining HERAI and HERAII data, others are on the way to.
- Interesting results are coming out of high energy data, also using the polarisation information.
- The LER and MER running have provided good quality data.
- Time to focus on analysis! The amount of available data is pretty high :-)

Backup slides

D^+ production in DIS at HERA II



- Data are well described by NLO QCD predictions.
- Precision is better than for HERA I

Diffractive dijets in PHP

Reasonable agreement between data and NLO QCD predictions.

No evidence for a suppression of the cross section in the resolved-enriched sample ($x_\gamma^{\text{obs}} < 0.75$)

