Preview of ZEUS Results

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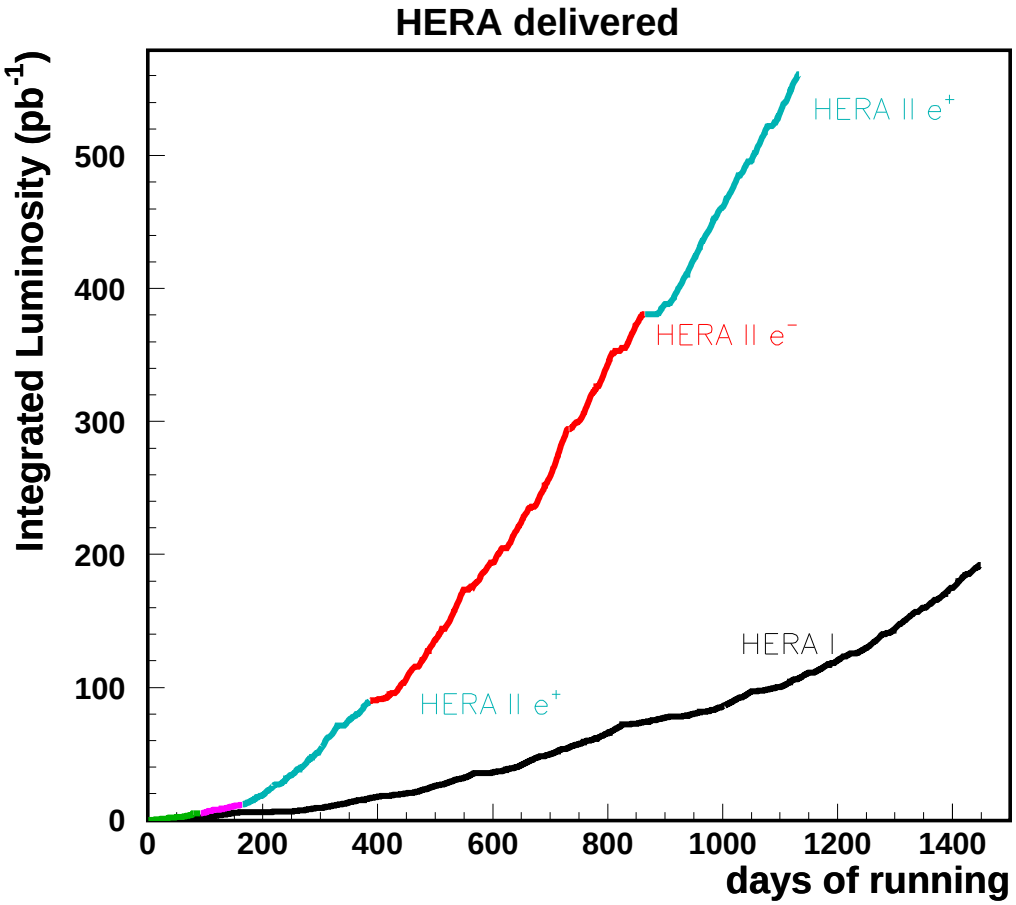
Luminosity



Switch $e^- p \rightarrow e^+ p$ in June 2006

High Energy Running (HER)
($\sqrt{s} = 300 - 320$GeV)
ended on March 20, 2007

Total HER luminosity delivered by HERA
1993-2007: $\mathcal{L} = 758$ pb^{-1}

Low Energy Running (LER)
($\sqrt{s} = 225$GeV)
ongoing, 3 pb^{-1} up to now...

End of HERA on July 2nd

Useful physics luminosity collected by ZEUS:

period	e^+p	e^-p
HERA-I	115 pb^{-1}	17 pb^{-1}
HERA-II (polarised)	182 pb^{-1}	190 pb^{-1}
Total	297 pb^{-1}	207 pb^{-1}

Total ZEUS physics luminosity
L=0.50 fb^{-1}

New ZEUS results since DIS2006

Publications
- NC DIS at High Bjorken-x
- Prompt Photons plus Jets in PhP
- Inclusive-jets and Dijets in DIS
- Azimuthal Asymmetries in NC DIS
- Search for Stop in R_p-violating SUSY
- Open Beauty in the D^*-μ Final State
- Rapidity Gaps Between Jets in PhP
- K^0_S and Λ Production in DIS and PhP
- Jet Radius Dependence of Incl.-jet Cross-sections
- Leading Neutron E and P_T in DIS and PhP
- $D^{*\pm}$ Production at low Q^2
- Diffractive PhP of $D^{*\pm}$

New Final results for DIS07 (paper soon)
- Diffractive Dijet PhP
- Forward Jets
- Multijets at Low x
- D Mesons in DIS
- p, $\bar{p}$, d, $\bar{d}$ in DIS
- Bose-Einstein correl. of Kaons

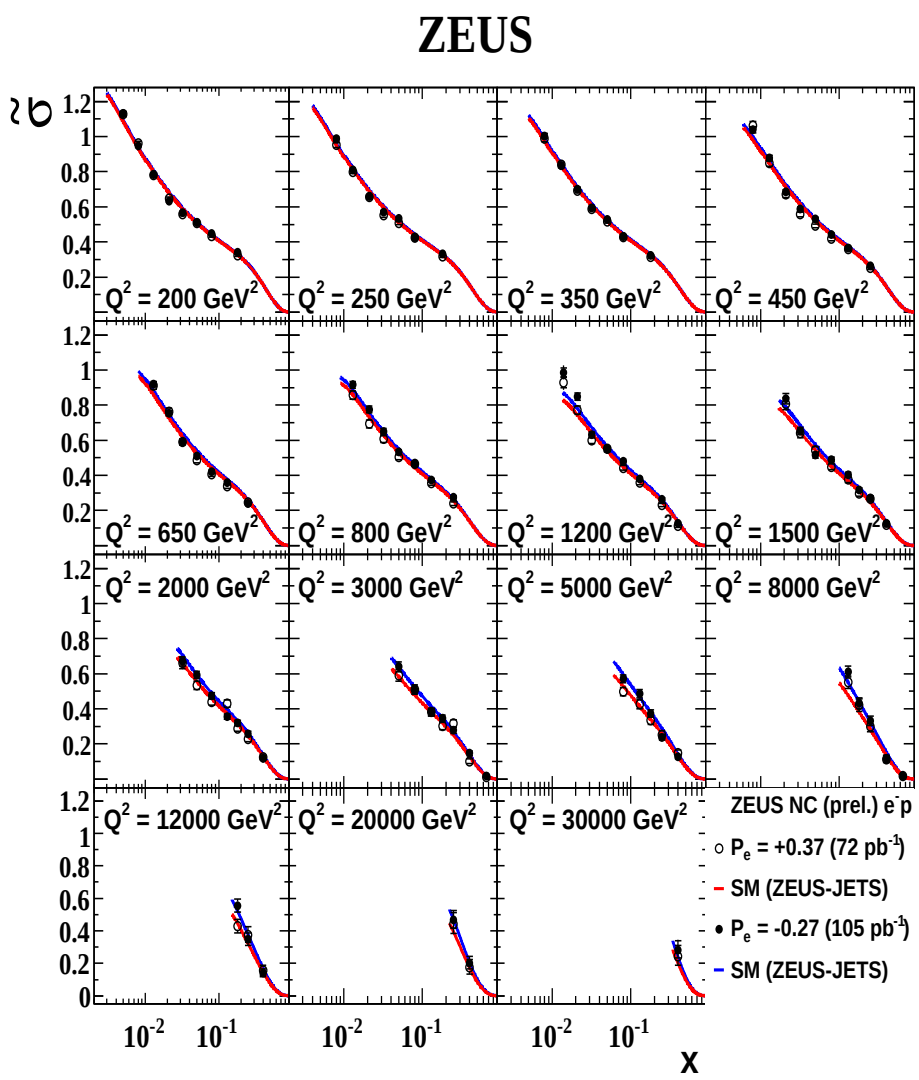
Preliminary results
- Contact Interactions
- Isolated leptons
- D^* in DIS
- Inelastic J/ψ Helicity
- σ_b from $\mu\mu$
- inclusive diffraction
- scaled momentum distributions

New Prel. results for DIS07
- F_2^b, F_2^c from D^*
- NC DIS with polarised e^-
- Multieleptons
- Jets in CC DIS
- Dijets in NC DIS
- D^+ in DIS
- D^* fragmentation
- DIS at high-y
- Exclusive ρ in DIS
- High-E_T Dijets in PhP

In red the results mentioned here

Neutral currents with polarised e^-

Full polarised e^- sample: $\mathcal{L}_R$=72 pb^{-1}, P_R = +0.30; $\mathcal{L}_L$=105 pb^{-1}, P_L = -0.27

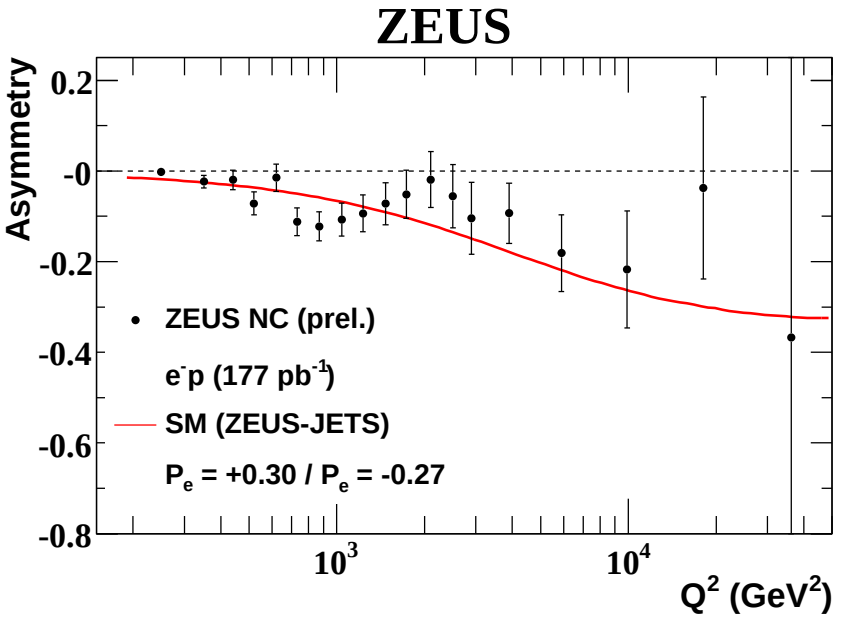


Difference between L/R-handed cross section due to γZ interference:

$$\tilde{\sigma}(e_L^- p) - \tilde{\sigma}(e_R^- p) \sim 2F_2^P \simeq 2\sum(q+\bar{q})2e_q a_e v_q \chi_Z$$

$$(\chi_Z = \frac{Q^2}{Q^2+M_Z^2}\frac{1}{\sin^2 2\theta_W})$$

sensitivity to vector coupling of u, d to Z^0



$$A = \frac{2}{P_R - P_L}\frac{\sigma(P_R) - \sigma(P_L)}{\sigma(P_R) + \sigma(P_L)}$$

Combined H1, ZEUS, e^-p and e^+p

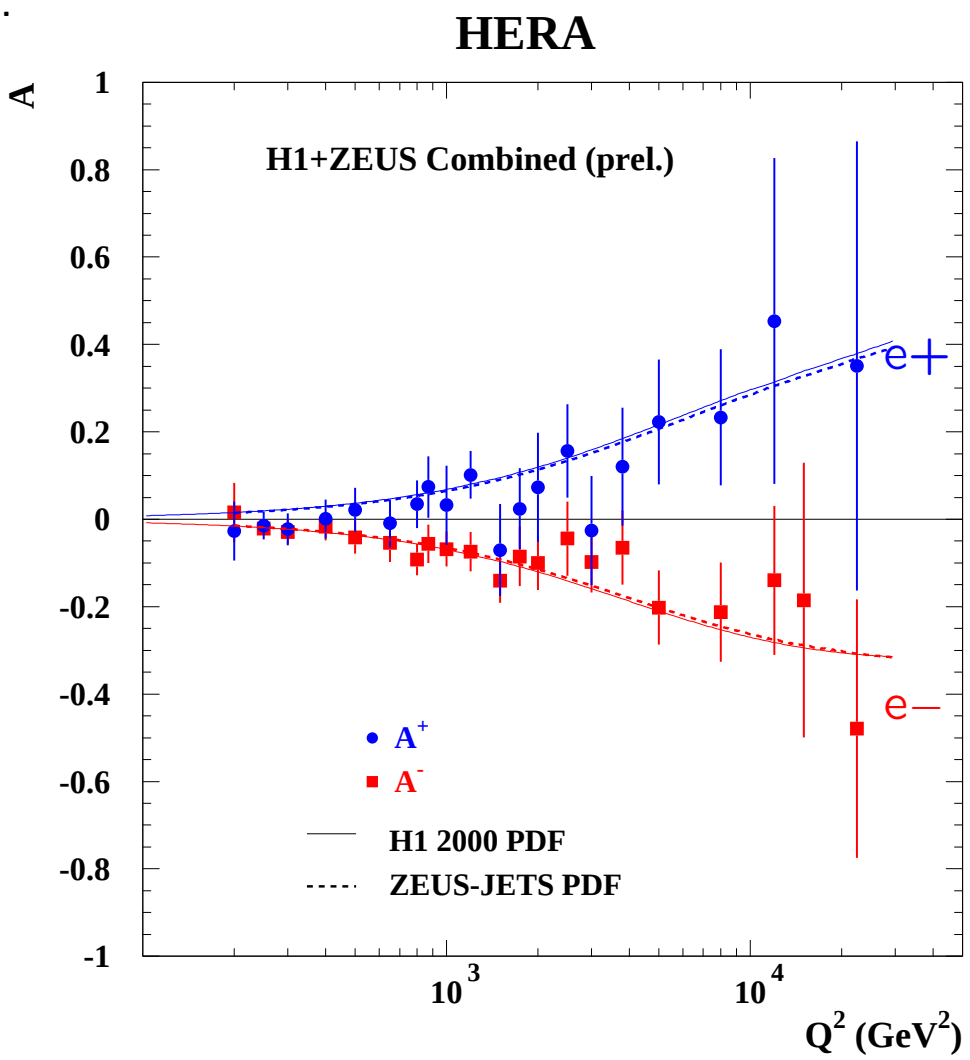
Improve significance on A combining H1 and ZEUS, e^+p and e^-p

$A^{\pm} = A(e^{\pm}p)$

Status of ICHEP06
Total H1+ZEUS Lumi 478 pb^{-1}

Parity violation in NC at high Q^2 clearly established

$P(\chi^2 \geq \chi^2(\text{data})|A^+ = A^-) = 0.003$

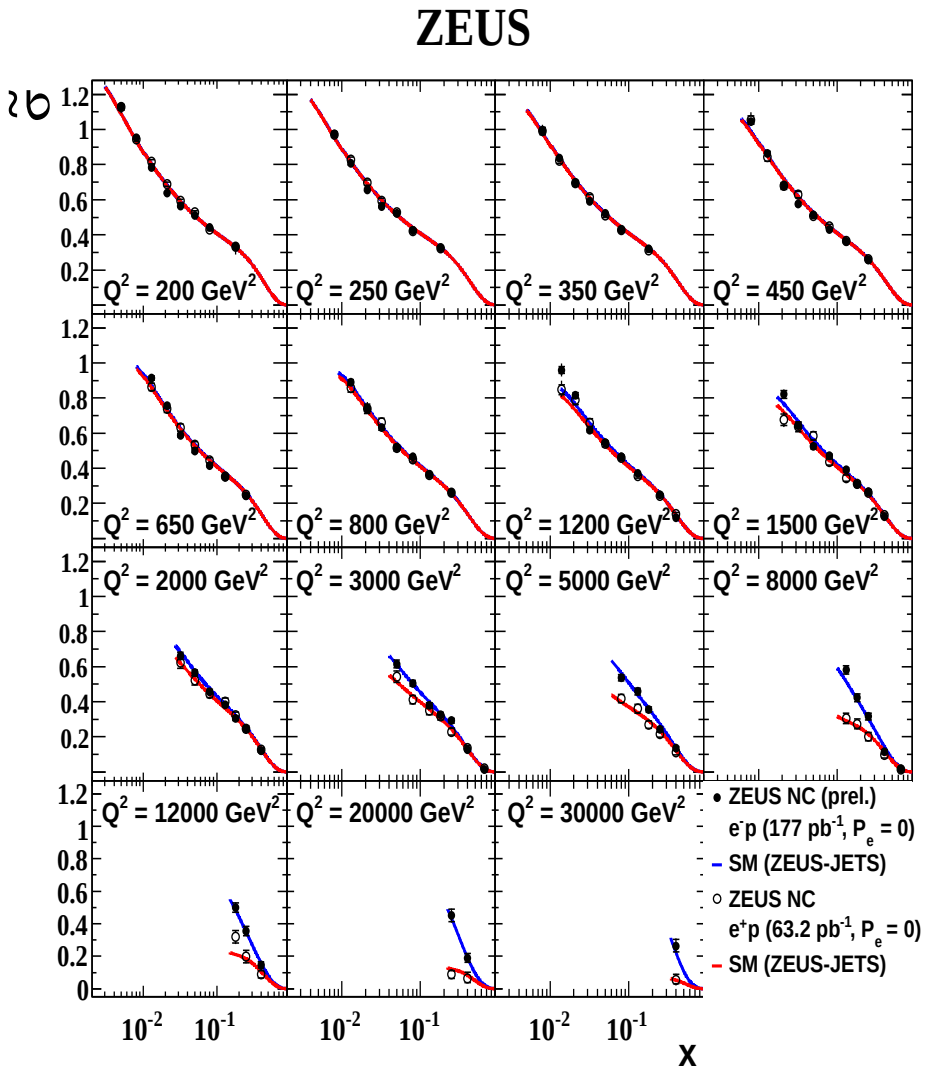


Neutral Currents e^-p vs e^+p, F_3

$$\tilde{\sigma}(e^+p) - \tilde{\sigma}(e^-p) = 2\frac{Y^-}{Y^+}xF_3$$

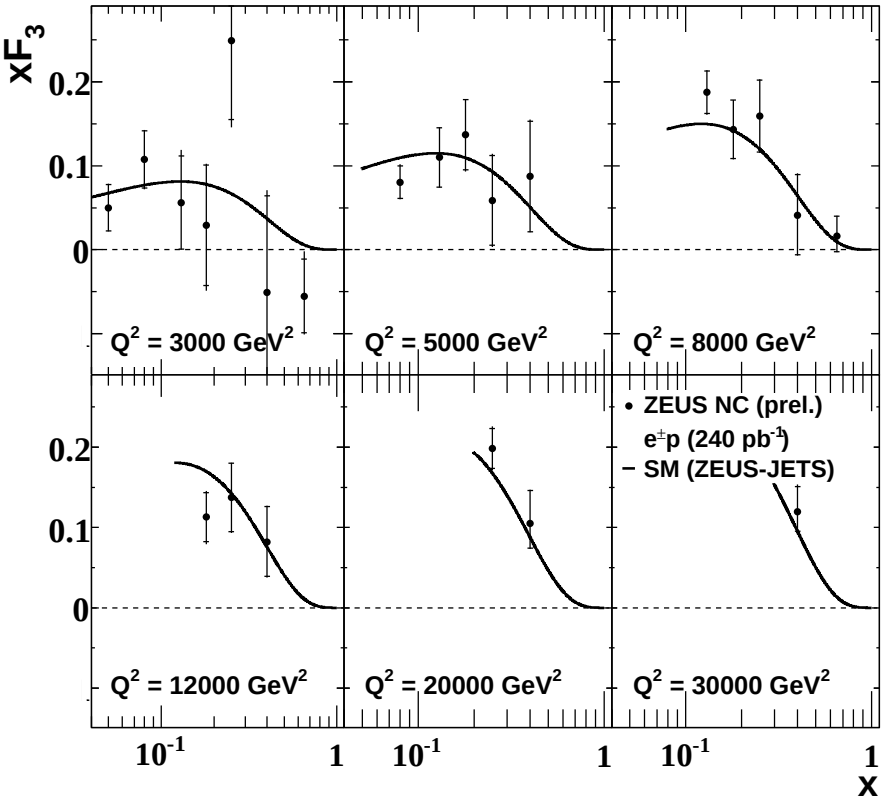
$$\simeq 2\frac{Y^-}{Y^+}\sum(q-\bar{q})2e_q a_q a_e \chi_Z$$

sensitivity to axial coupling of u, d to Z^0



e$^-$p,corrected to $\mathcal{P}_e \sim 0$

e$^+$p unpolarised from HERA-I



Valence distribution from pure p target

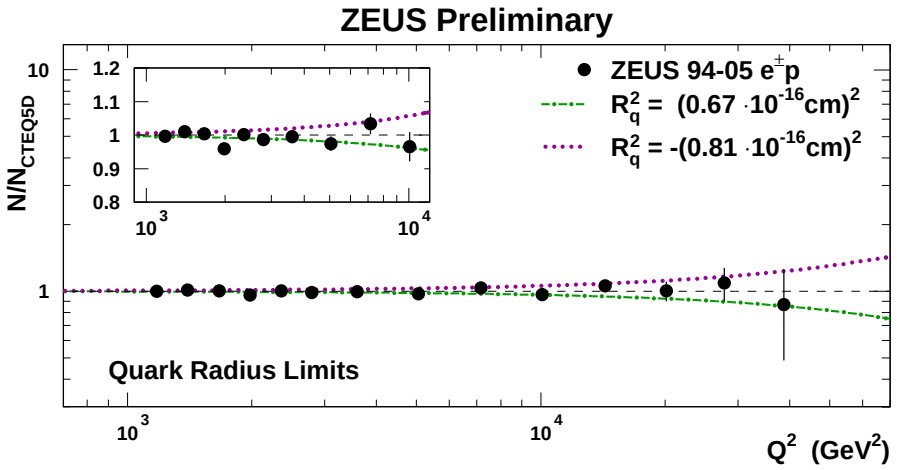
Limits on new physics

Compare NC DIS with SM to search for new contributions to the $eq \to eq$ amplitude:
Contact Interactions, Large Extra Dimensions, quark substructure

Combined HERA-I and HERA-II-pol.
L= 274 pb^{-1}

Quark radius

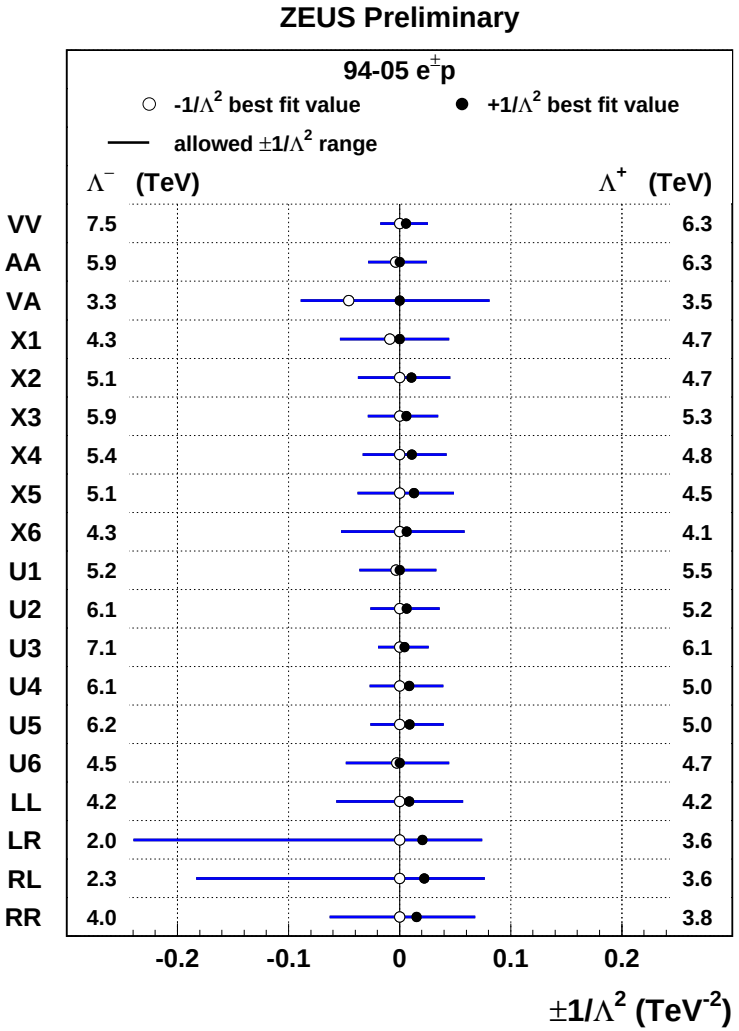
$$\frac{d\sigma}{dQ^2} = \left(\frac{d\sigma}{dQ^2}\right)_{SM} \left(1 - \frac{1}{6} R_q^2 Q^2\right)^2$$



EW Quark radius (RMS)
$R_q < 0.67 \times 10^{-3}$ fm (prel.)

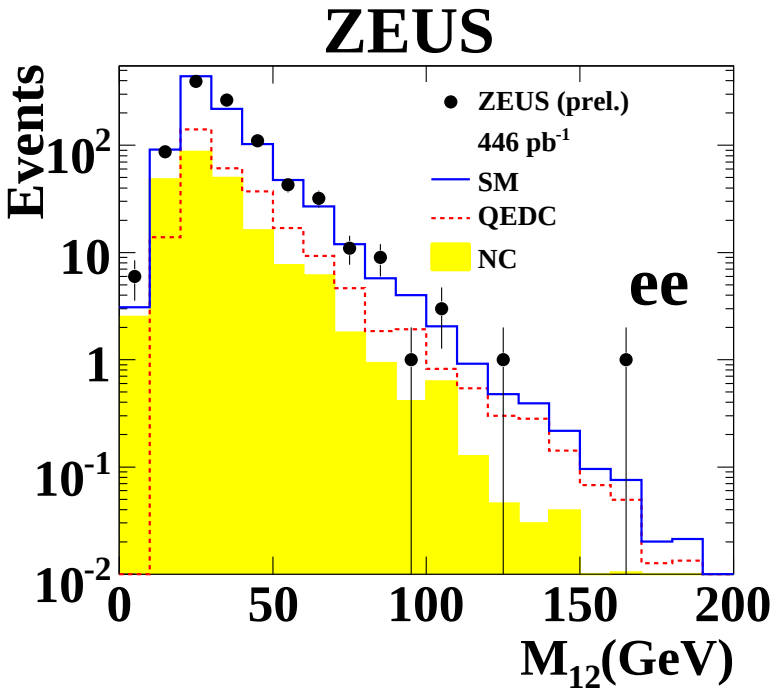
Contact Interactions

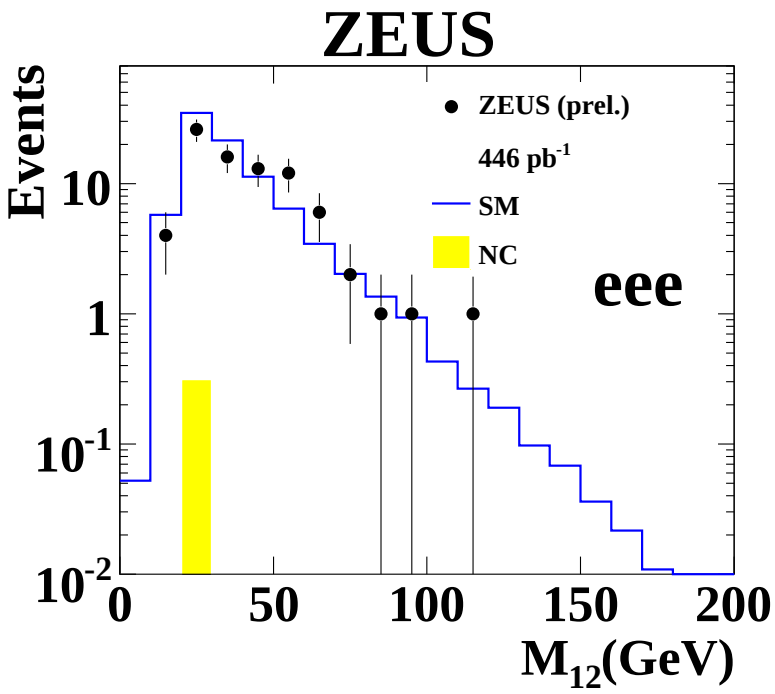
$$\mathcal{L}_{CI} = \frac{2\pi}{\Lambda} \sum_{\alpha,\beta=L,R} (q_\alpha \gamma^\mu q_\alpha)(e_\beta \gamma^\mu e_\beta)$$



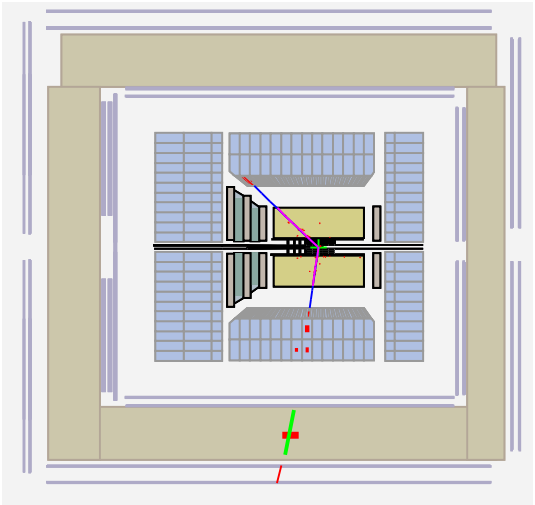
Limits on Λ for VV,AA ∼ 6-7.5 TeV

Multileptons



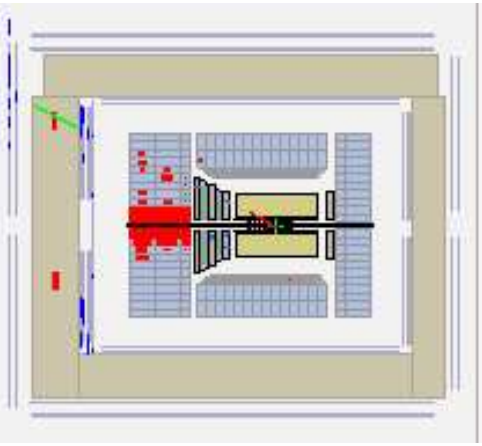


Multielectron analysis $\Uparrow$:
ee: 2 central e with $P_T^{1,2} > 10,5$ GeV
eee: an additional e with $E > 10$GeV (5 in rear)
almost full luminosity (446 pb^{-1})
good agreement with SM



electron+muon analysis (135 pb^{-1})$\Longrightarrow$:
3 events, in agreement with 2 expected from τ τ

Isolated leptons and P_T^{miss}

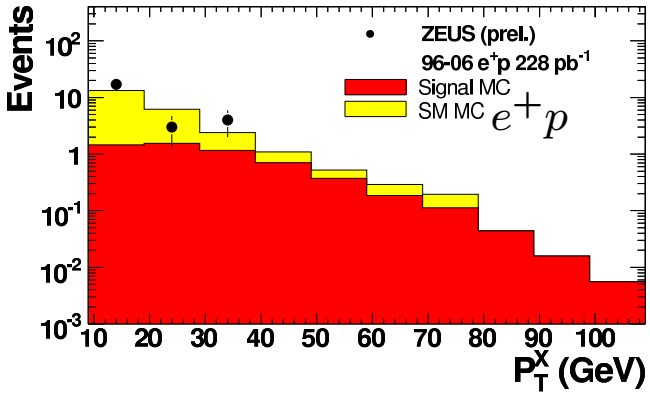


Analysis of e^+p data up to 2006 (228 pb^{-1})

All e^-p 98-06 (204 pb^{-1})

All in good agreement with SM

muon-channel

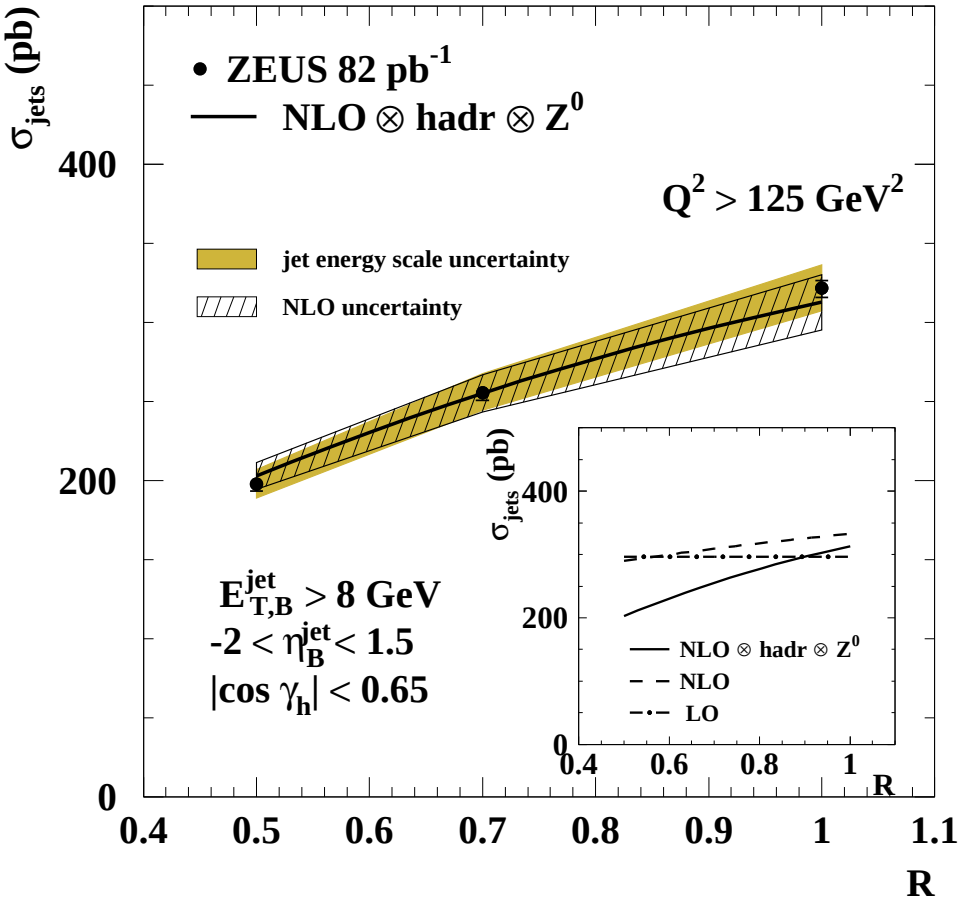


	12 $<P_T^X<$25 GeV Data/SM (W)	$P_T^X >$ 25 GeV Data/SM (W)
e 98-06 e^-p (204 pb^{-1})	$6/2.9 \pm 0.5$ (56%)	$5/3.8 \pm 0.6$ (55%)
e 96-06 e^+p (228 pb^{-1})	$4/2.8 \pm 0.5$ (63%)	$1/3.2 \pm 0.4$ (75%)
e 96-06 $e^\pm p$ (432 pb^{-1})	$10/5.7 \pm 0.7$ (60%)	$6/7.0 \pm 0.7$ (64%)
μ 98-06 e^-p (204 pb^{-1})	$2/2.2 \pm 0.3$ (68%)	$2/2.2 \pm 0.3$ (86%)
μ 96-06 e^+p (228 pb^{-1})	$3/2.6 \pm 0.5$ (68%)	$3/3.1 \pm 0.5$ (80%)
μ 96-06 $e^\pm p$ (432 pb^{-1})	$5/4.8 \pm 0.5$ (68%)	$5/5.3 \pm 0.6$ (82%)

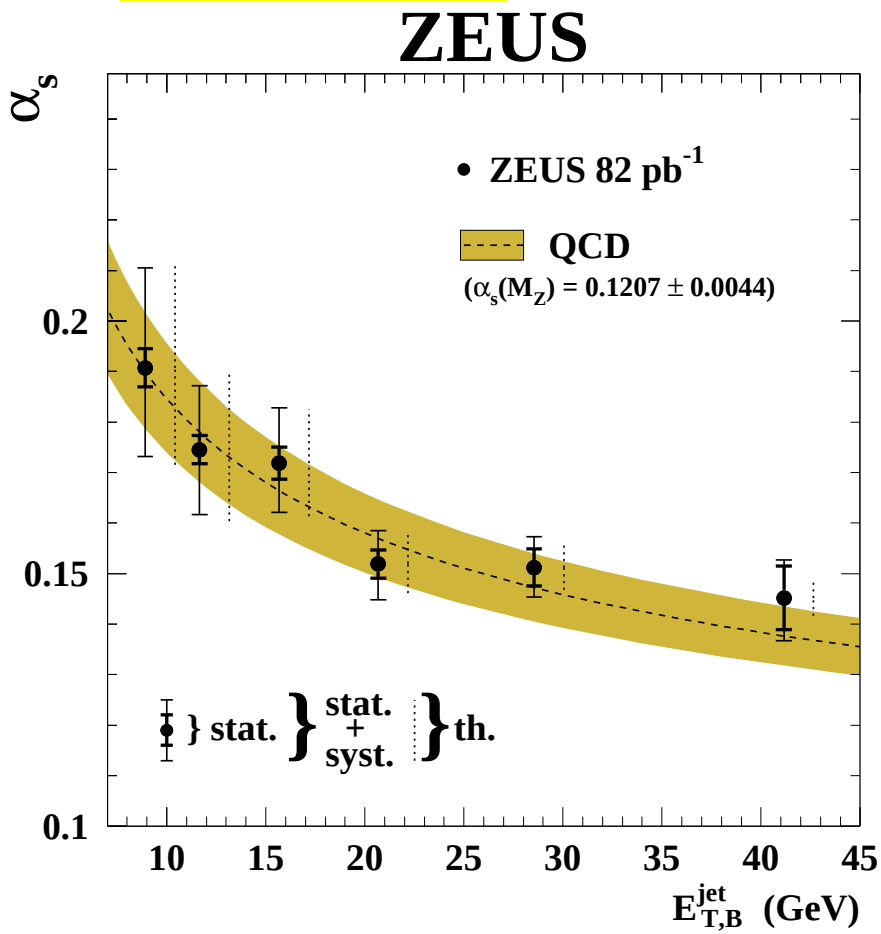
Inclusive Jets in Breit frame in DIS

- Inclusive jets in Breit frame directly sensitive to α_s and $g(x)$
Small theor. uncertainty ($\sim 5\%$) at high E_T and Q^2
- all HERA-I data published, good agreement with NLO QCD

. Jet radius dependence



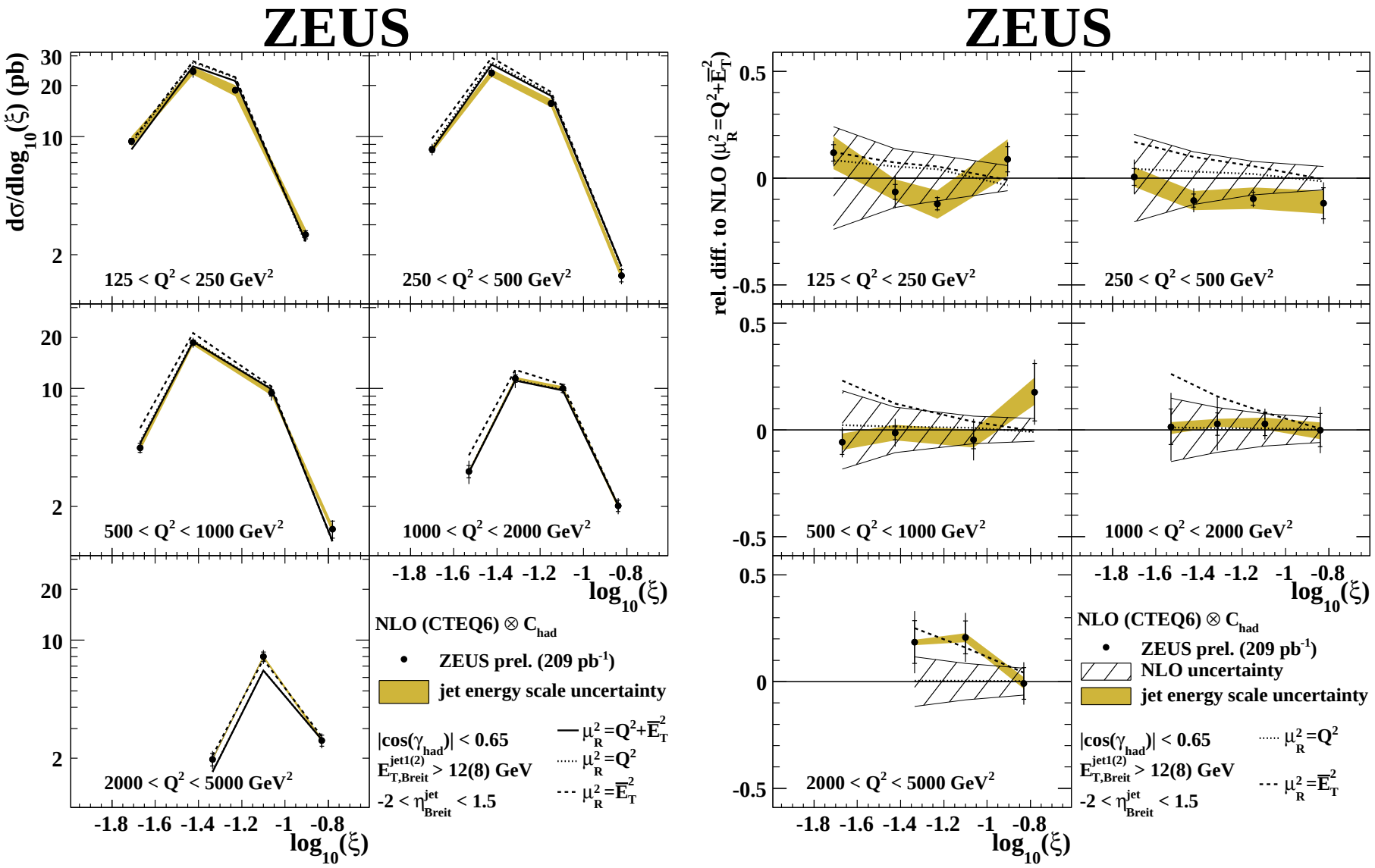
extraction of α_S



$$\alpha_S(M_Z) = 0.1207 \pm 0.0014(\text{stat.}) \pm 0.0035(\text{syst.}) \pm 0.0023(\text{theo.})$$

Dijets in DIS

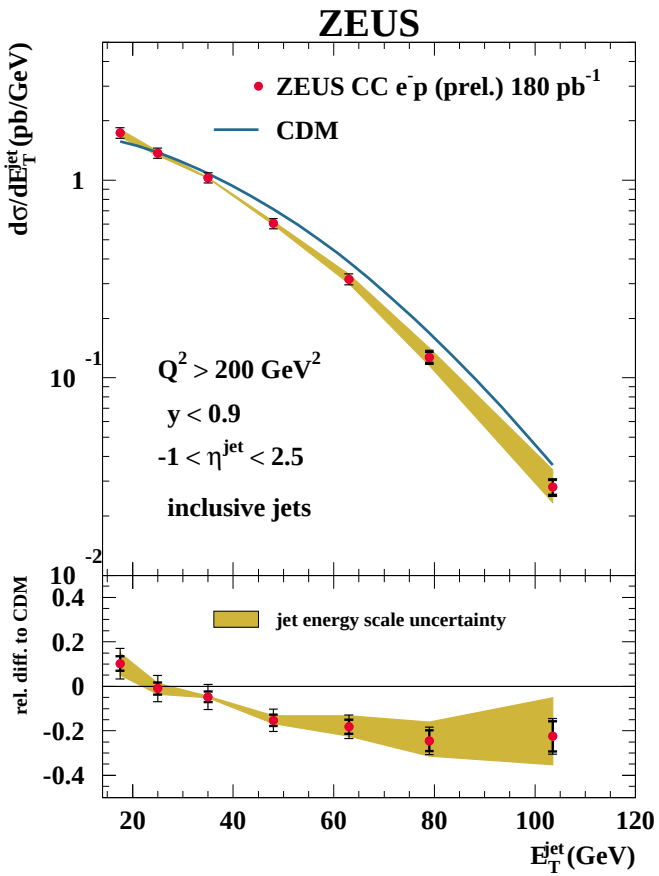
- HERA-I data published, extended to HERA-II 04-05 (209 pb^{-1})
- Sensitivity to $g(x)$ at large ξ



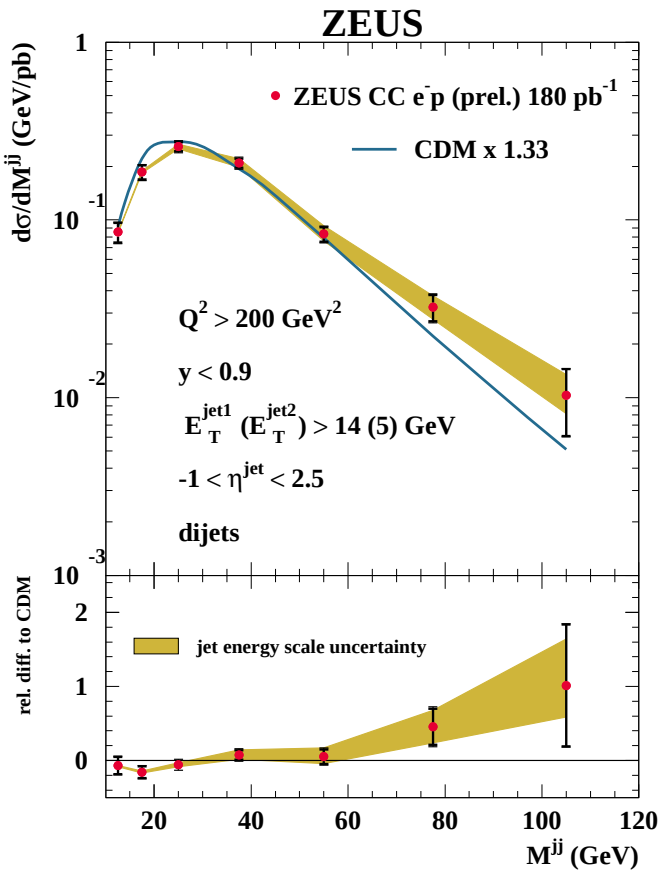
Jet in Charged Current DIS

L=180 pb^{-1} 04-06 e^-p

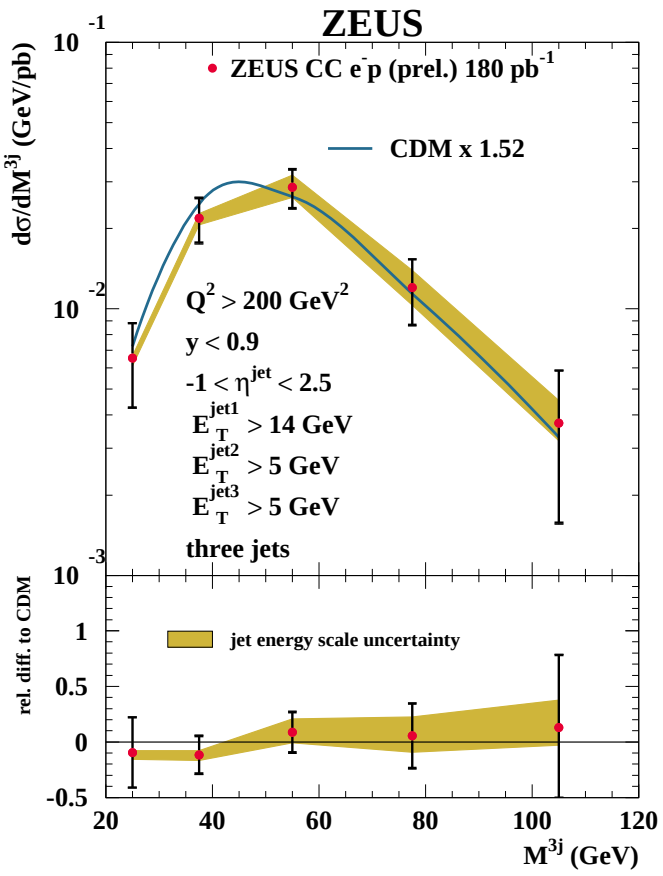
Inclusive jets



Dijets



Trijets



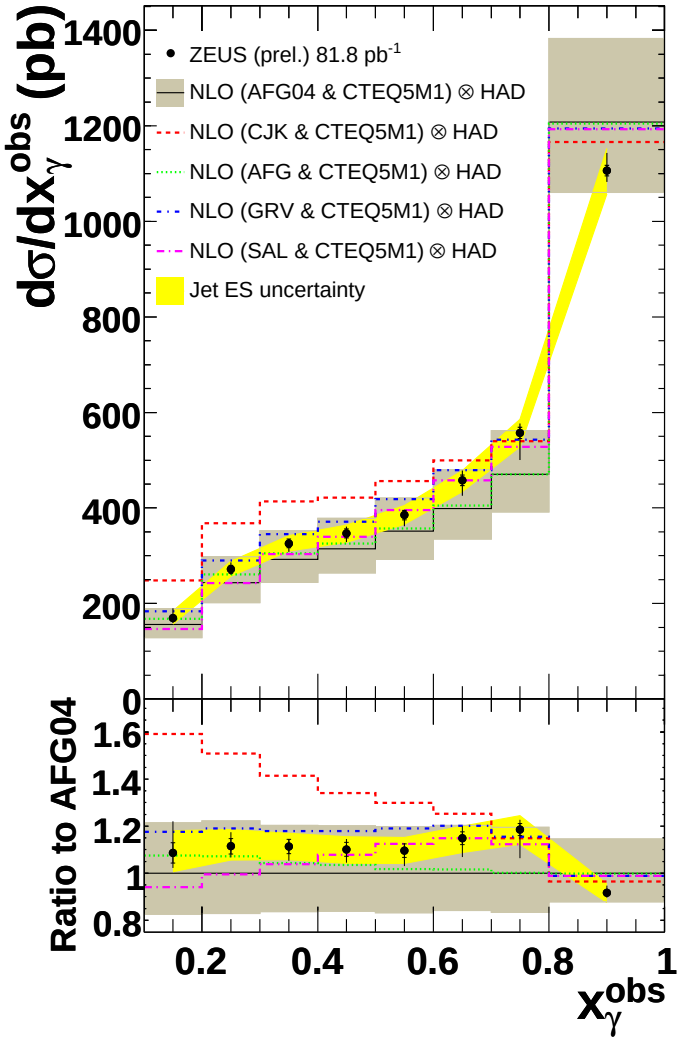
Compared at the moment to MC (Ariadne), NLO coming soon

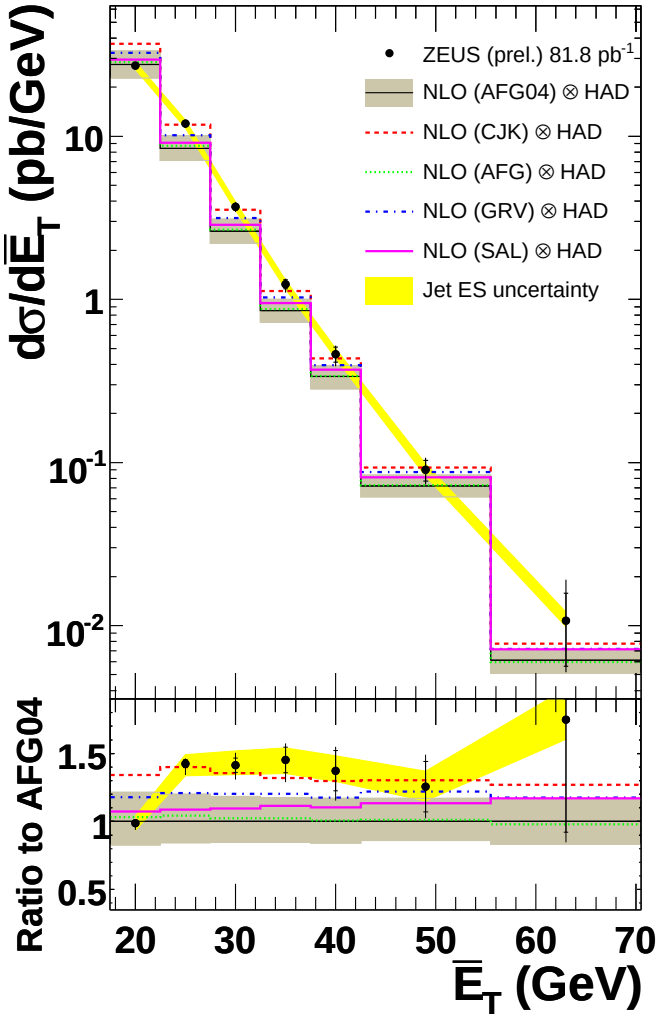
High E_T dijets in photoproduction

$E_T^{j1,j2} > 20, 15$ GeV,
$-1 < \eta^j < 3$
(at least one with $-1 < \eta^j < 2.5$)

well described by NLO QCD

sensitive to $g(x)$ in γ and p

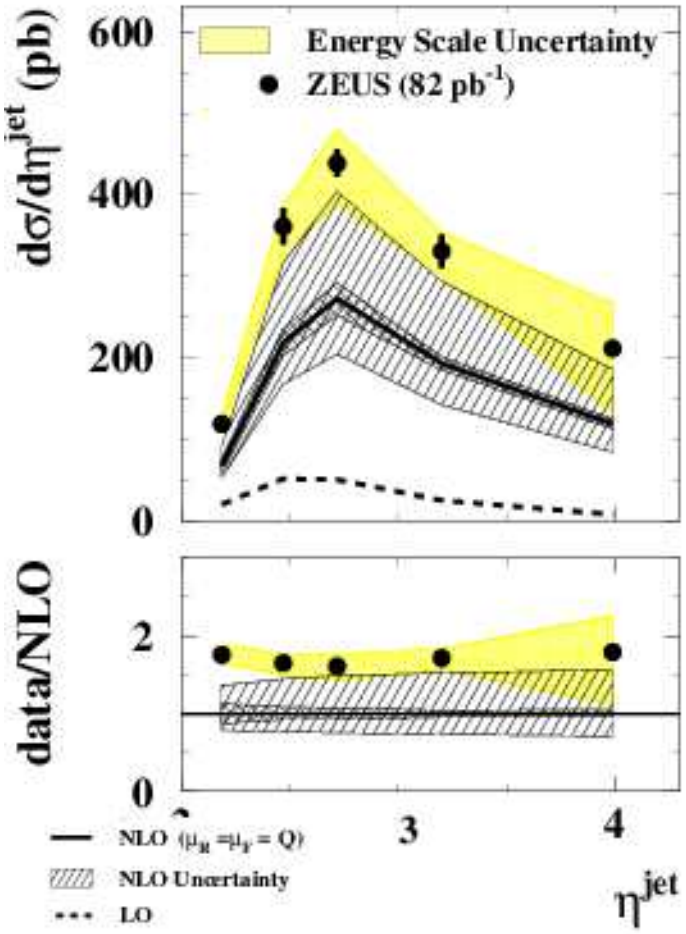




Jets at low-x

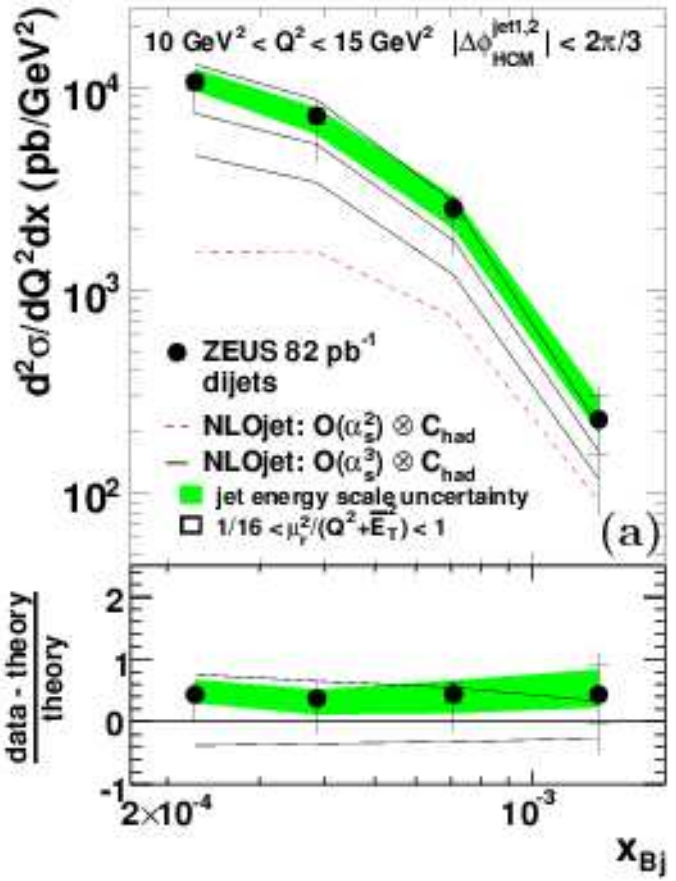
Is standard QCD based on collinear factorization +DGLAP working at low-x for forward and multiple jets?

- Forward jets, range extended to $\eta = 4.3$ agree with fixed-order QCD $O(\alpha_S^2)$



⇑ forward jet cross section for
$E_T^j > 5$GeV; $x^j > 0.036$; $0.5 < (E_T^j)^2/Q^2 < 2$;
$20 < Q^2 < 100\text{GeV}^2$, $4 \times 10^{-4} < x < 5 \times 10^{-2}$

Two and three jets at low-x, agreement with $O(\alpha_S^3)$ calculations



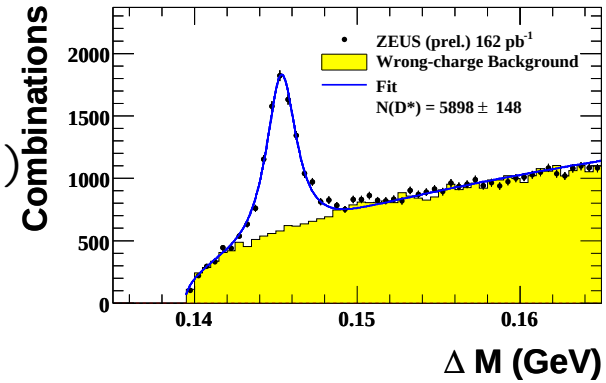
⇑ cross section for unbalanced dijets:
$\Delta\Phi < 120^o$
for $E_{T,HCM}^{j1,2} > 7,5\text{GeV}$, $-1 < \eta_{\text{LAB}} < 2.5$

Charm production in DIS

New measurements of charm in DIS with different techniques:

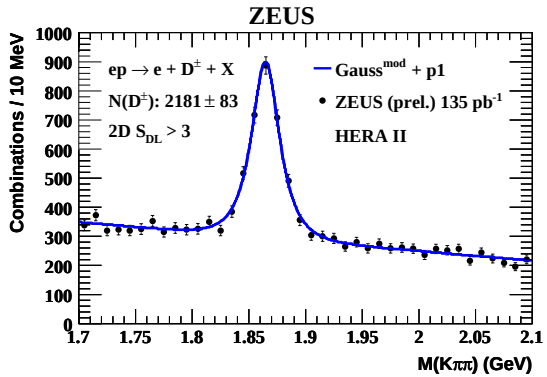
1) combined $D^{\pm}, D^0, D_s$ from HERA-I

2)



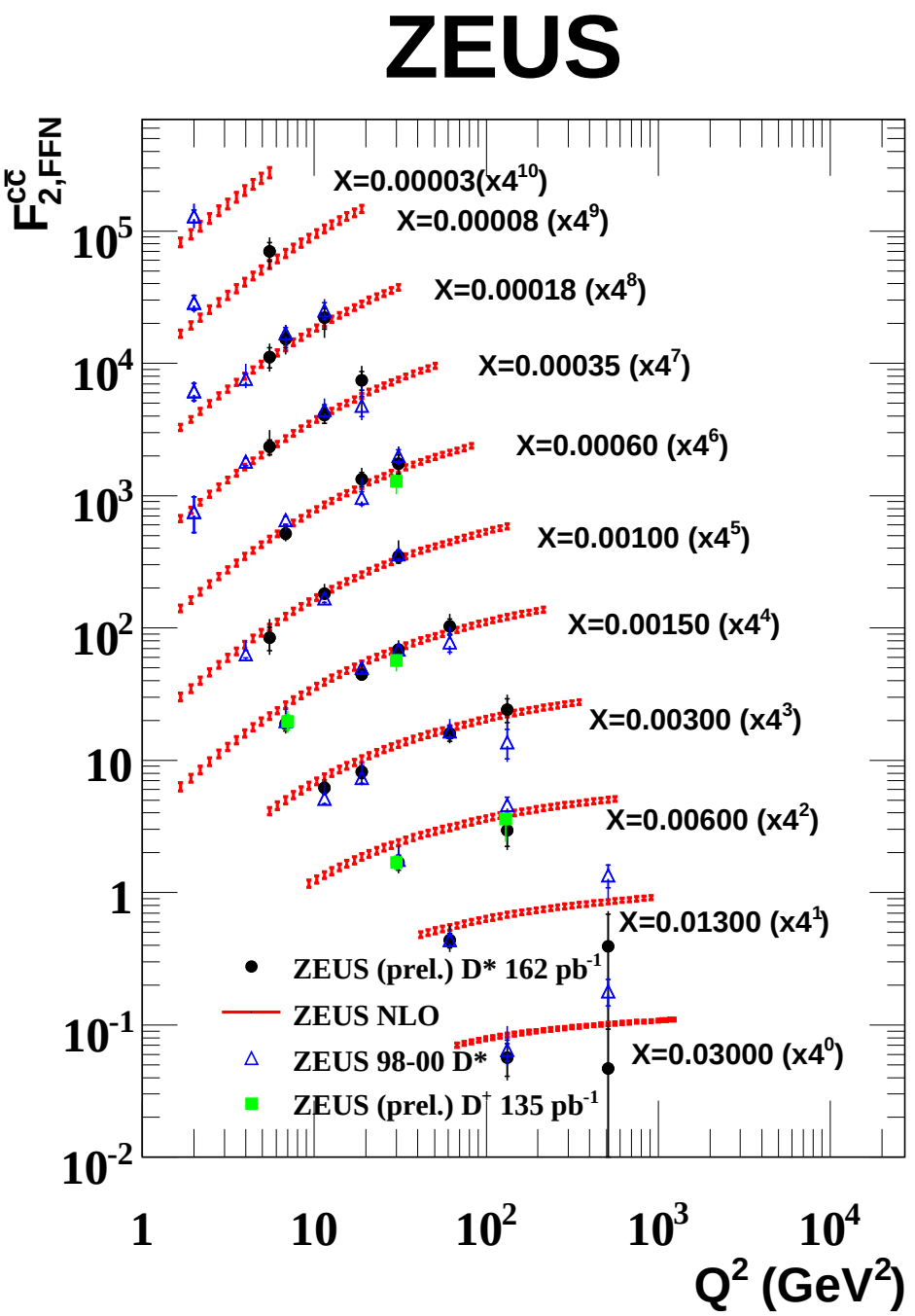
$D^{*\pm}$ (prel.)
162 pb^{-1}
HERA-II

3)



D^+ (prel.)
135 pb^{-1}
HERA-II
lifetime selection
$L_{XY}/\sigma_{L_{XY}} > 3$

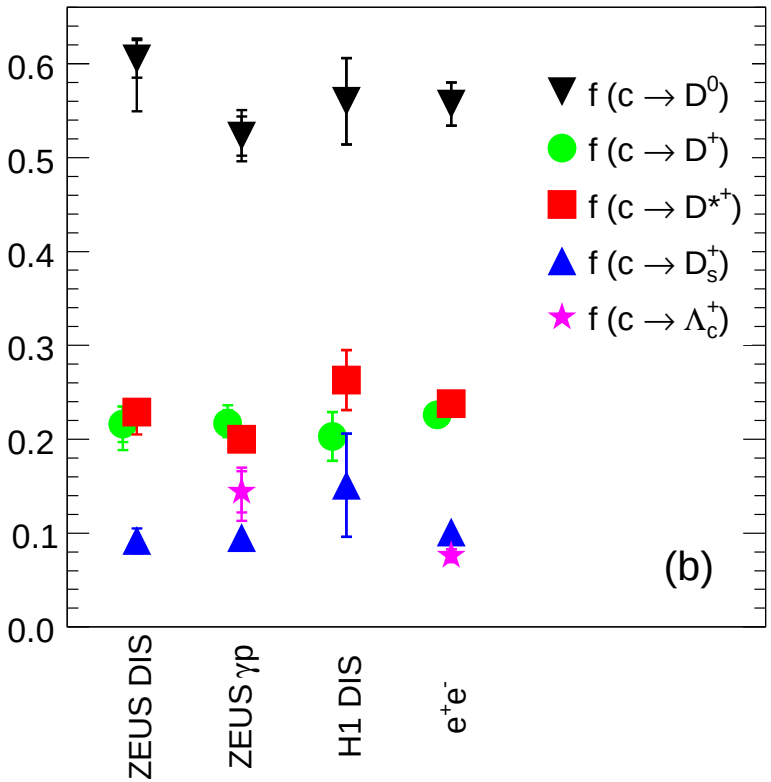
Measured in a given $\eta(D)$, $p_T(D)$ range, extrapolated to inclusive $F_2^{c\bar{c}}$ using FFNS NLO (HVQDIS) $\Longrightarrow$



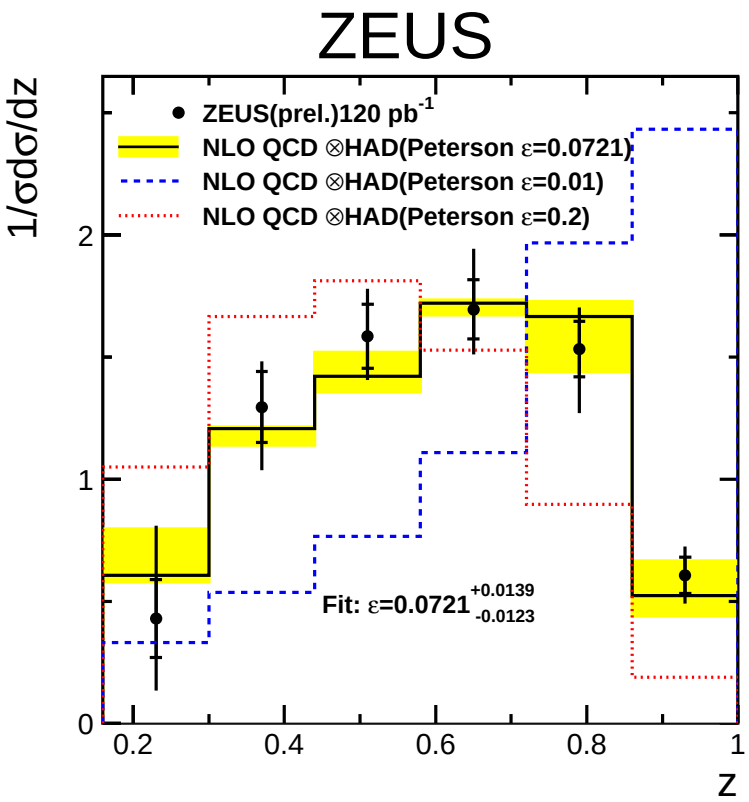
Charm Fragmentation

- heavy quark production is an independent tool to access $g(x)$

- heavy quarks are tagged from heavy mesons, a precise comparison with theory needs knowledge of nonperturbative fragmentation



⇑ new fragmentation fractions in DIS



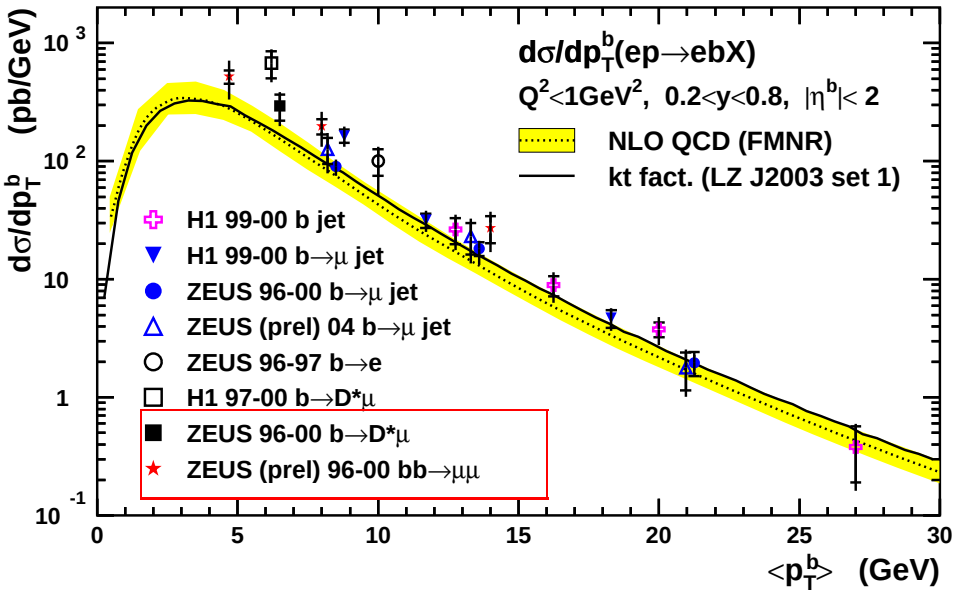
⇑ D^* fragmentation function
$Z = (E + P_{||})_D/(E + P)_{\text{jet}}$, PhP, $E_T^j > 11$GeV
best fit to Peterson ϵ within NLO theory (FMNR): $\epsilon = 0.07$

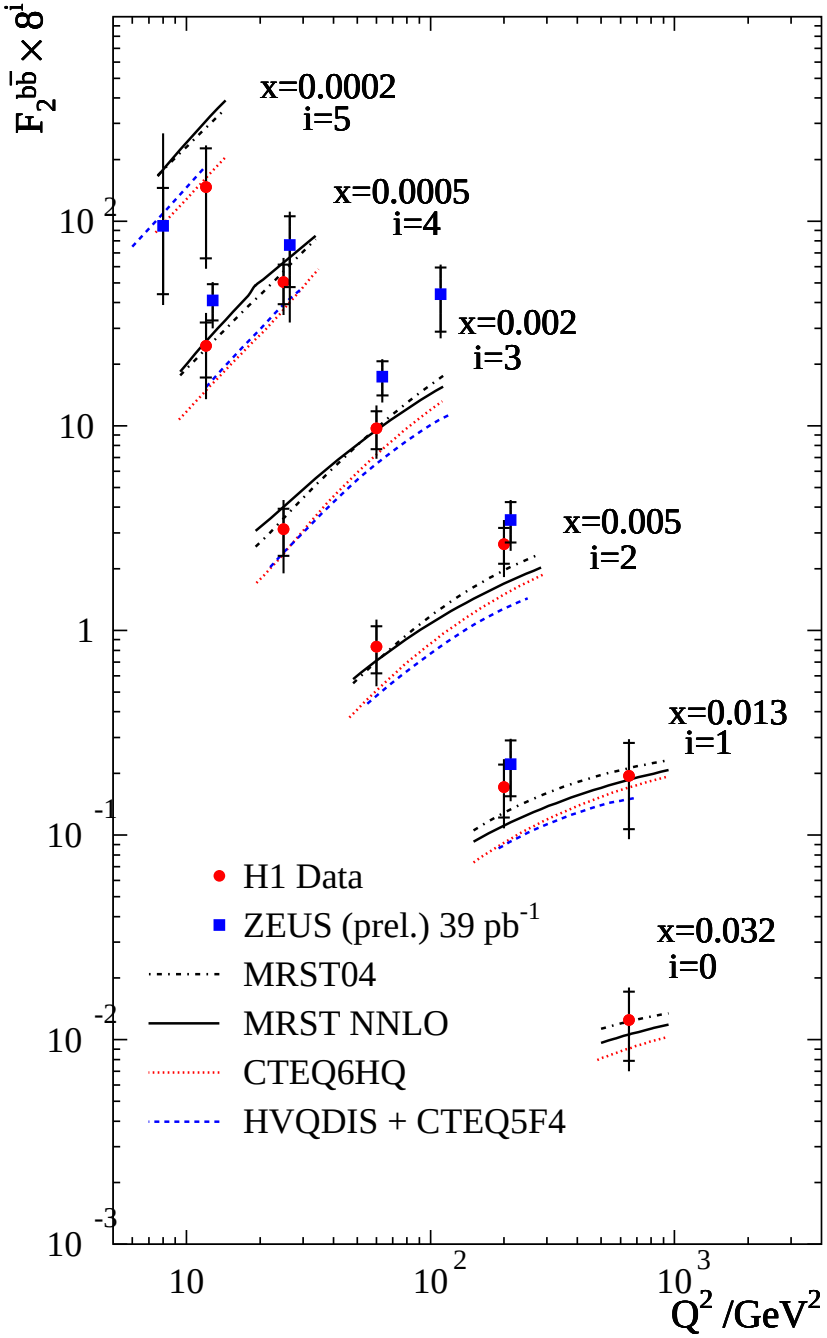
Beauty production

- DIS: $F_2^{b\bar{b}}$ (prel.) from μ+jet ($p_T^{\rm rel}$) $\Longrightarrow$
39 pb^{-1} 03-04 data,
room for improvement

- Photoproduction: measurements
from μ+jets, $\mu\mu$, $D^*\mu$
tendency to be above theory at low p_T^b? $\Downarrow$

HERA





Scaled charged track momentum distributions

New prel. results based on full HERA luminosity (475 pb^{-1})

Extend previous data to
$Q^2 = 40000\text{GeV}^2$

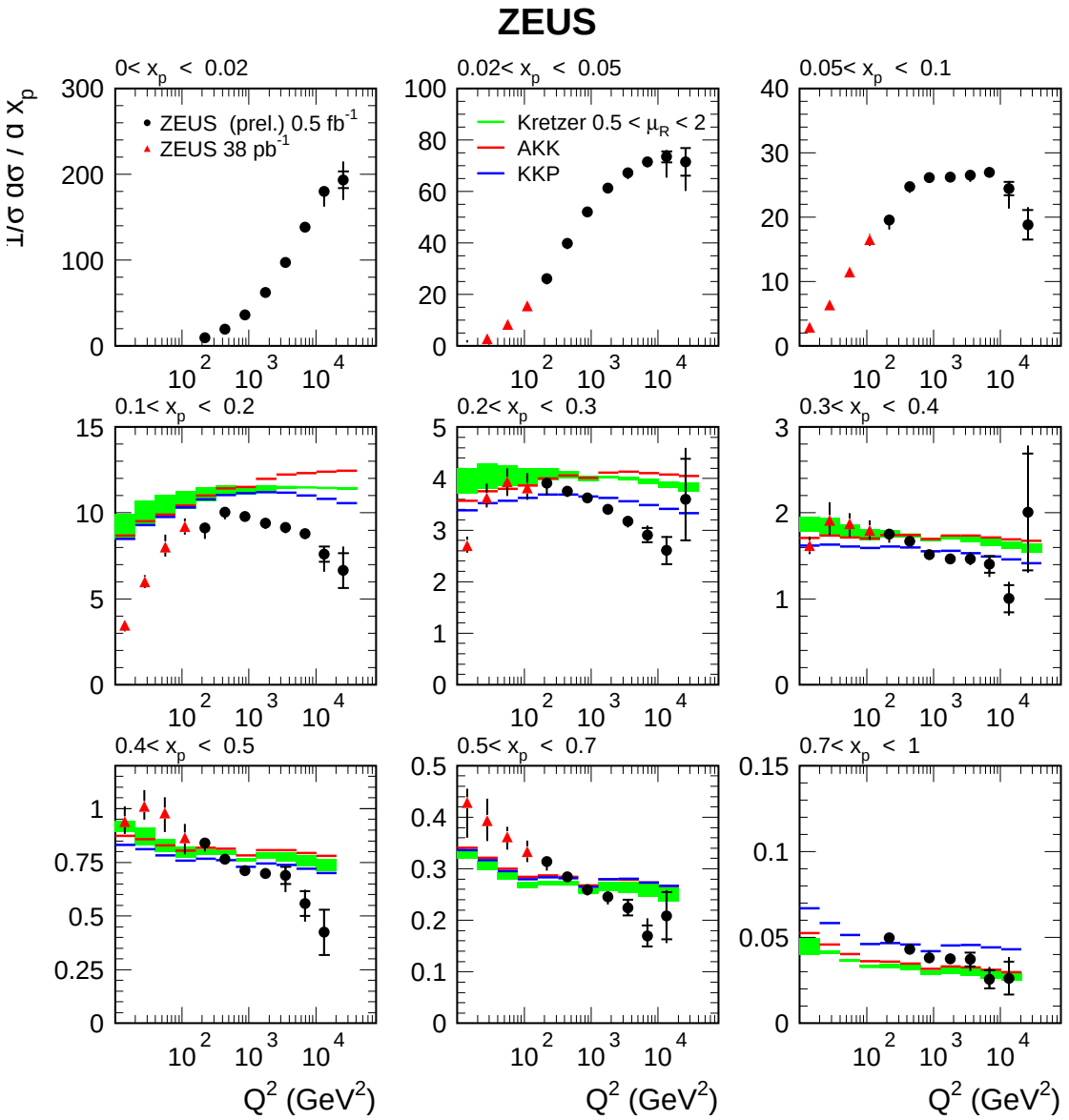
$x_p = p(\text{track})/(\text{Q}/2)$
current region of Breit frame

Clear scaling violation observed

Compared to NLO with
frag. functions from e^+e^-

Agreement not so good

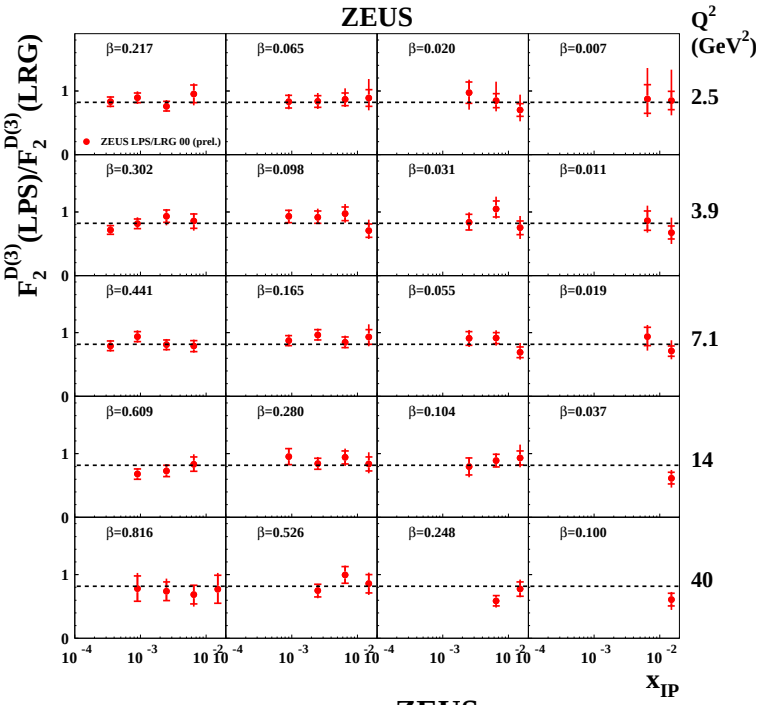
(similarly for MC and MLLA)



Inclusive diffraction

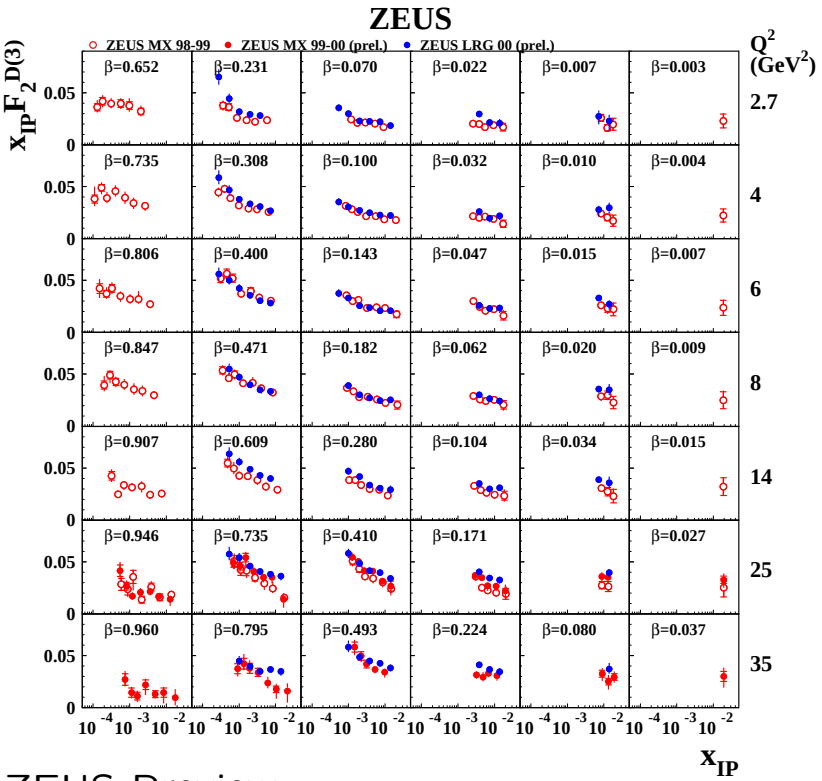
Diffraction selected with three methods:
small mass of the hadronic system (M_X)
large rapidity gap (LRG)
leading proton (LPS)

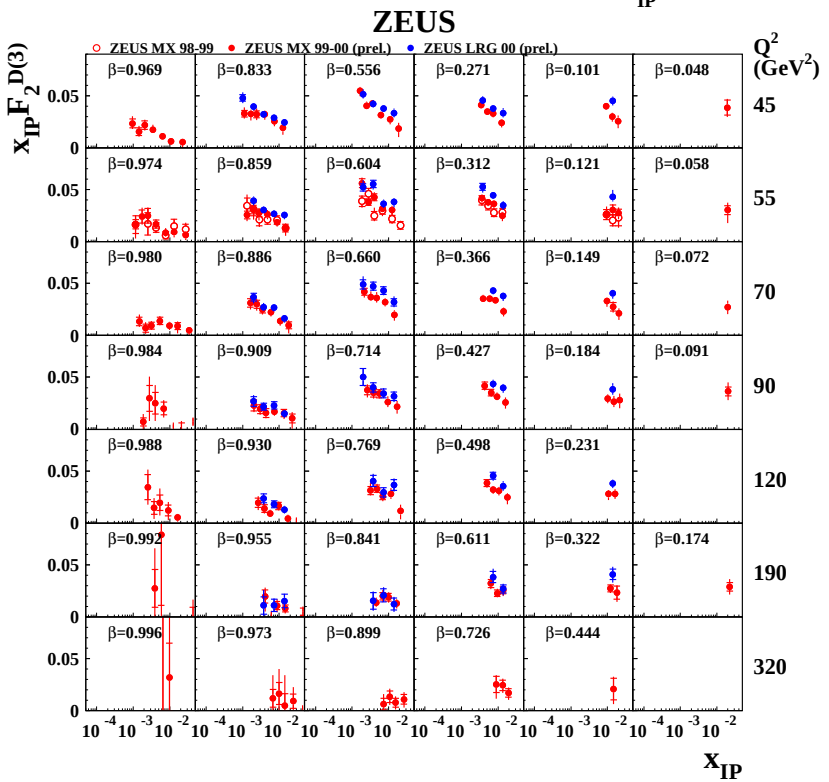
Ratio LPS/LRG 2000 (prel.) $\Longrightarrow$



Agreement at $\sim 10\%$, differences under investigation $\Downarrow$

$F_2^{D(3)}$ from
M_X 98-99
M_X 99-00(prel.)
LRG 00 (prel.)
$\Longrightarrow$



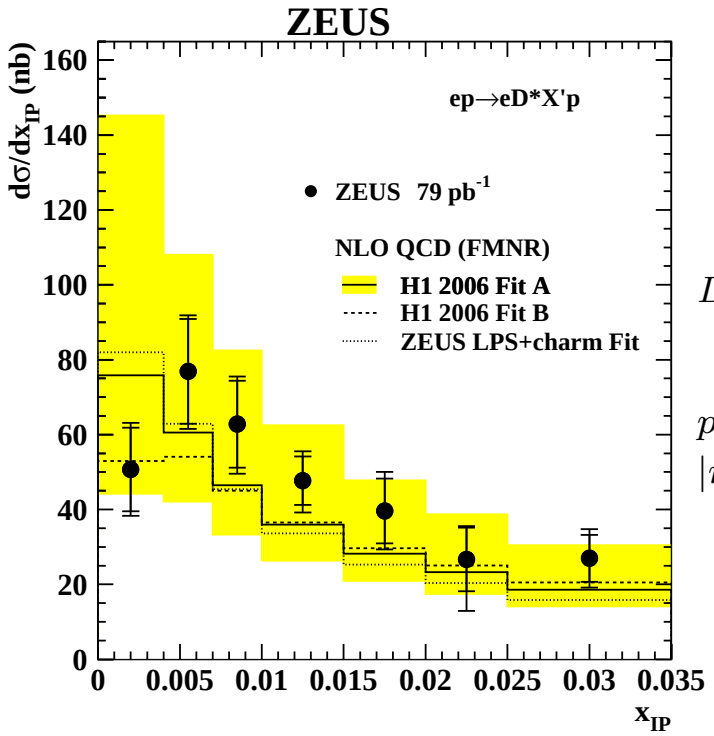


Hard diffraction in photoproduction

Do dPDFs extracted from inclusive DIS describe hard processes in photoprodution ?

HERA-I data

Diffractive D^* photoproduction

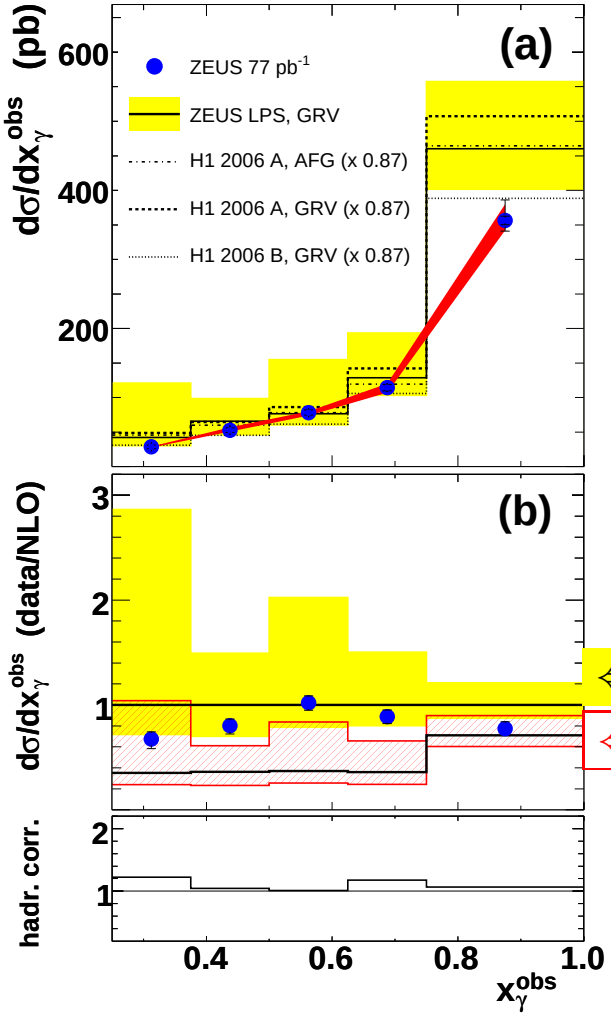


D^* PhP

$p_T > 2$GeV
$|\eta| < 1.5$

Agreement with diff. QCD factorization

Diffractive dijets



Dijet PhP

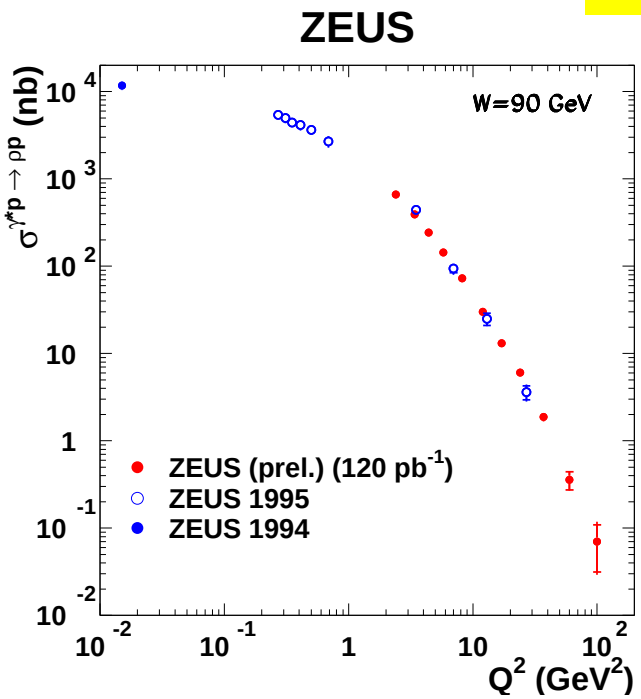
$E_T^{j1,2} > 7.5, 5.5$GeV
$|\eta^j| < 1.5$
$x_{IP} < 0.025$

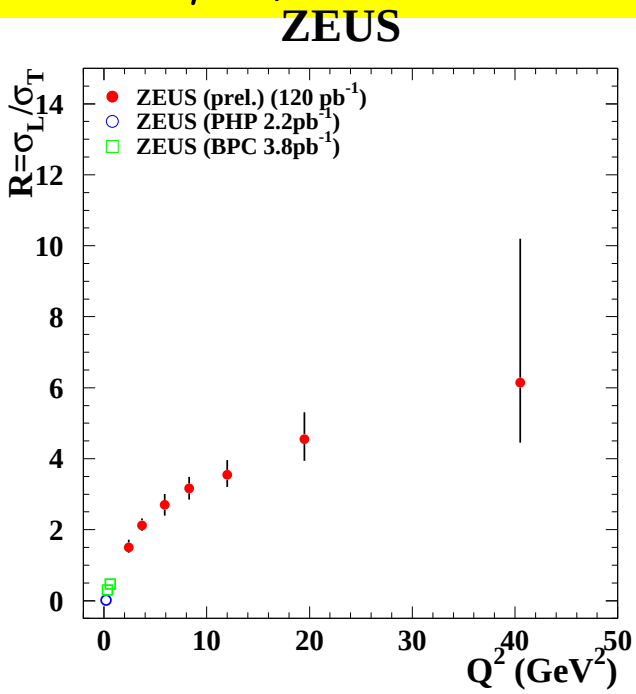
⇐ NLO uncertainty

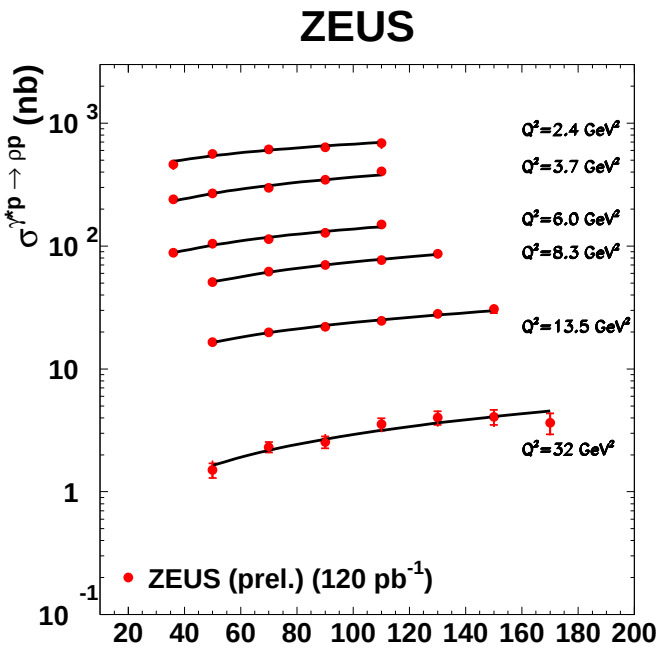
⇐ with Resolved ×0.36

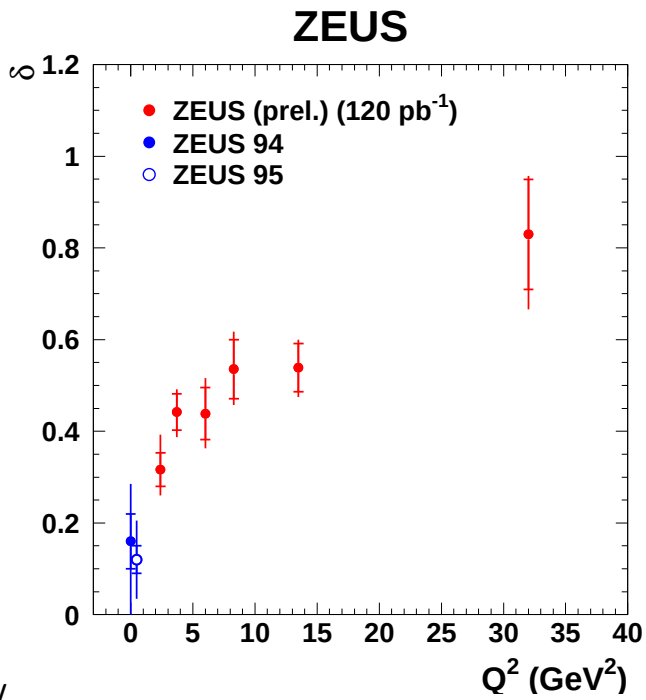
- data final, theory (KK) being checked
- no evidence for factorisation breaking

Exclusive ρ^0 production in DIS









Full HERA-I data (prel.)

Precise data up to large Q^2

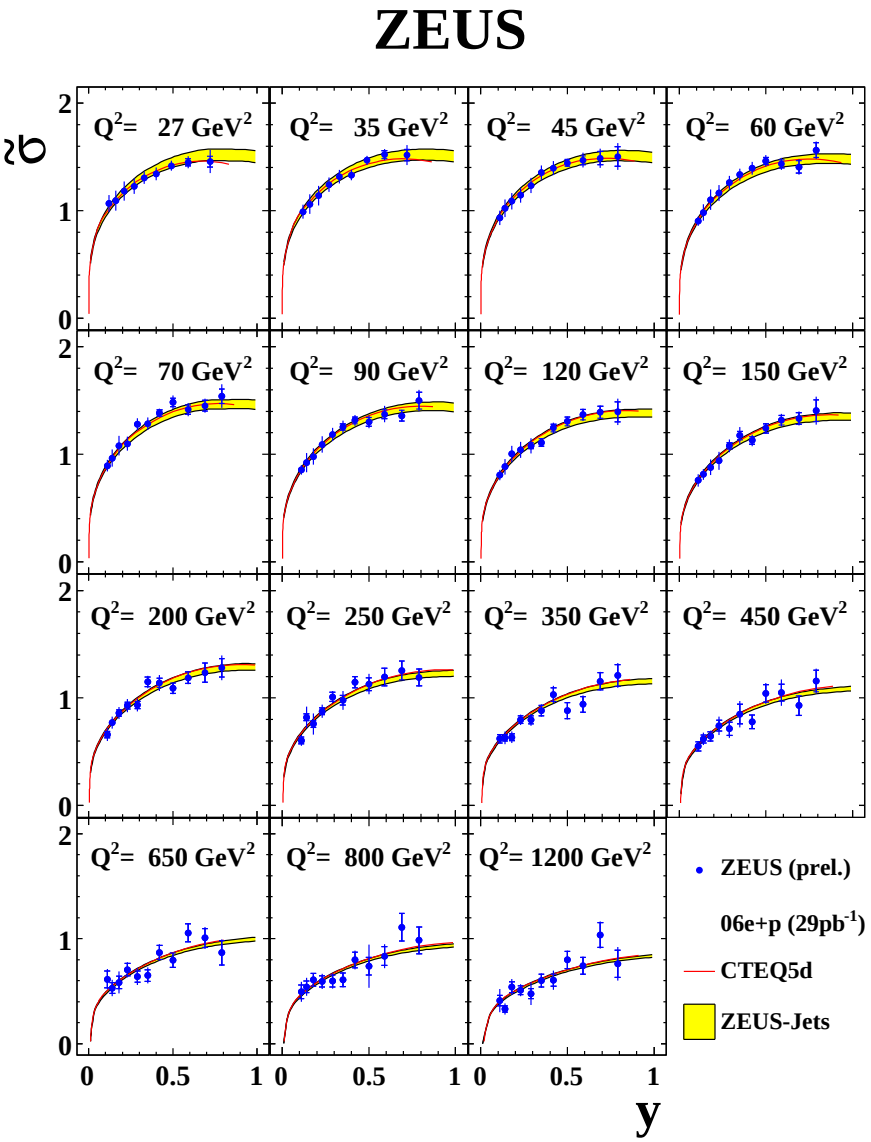
$R = \sigma_L/\sigma_T$ increase with Q^2

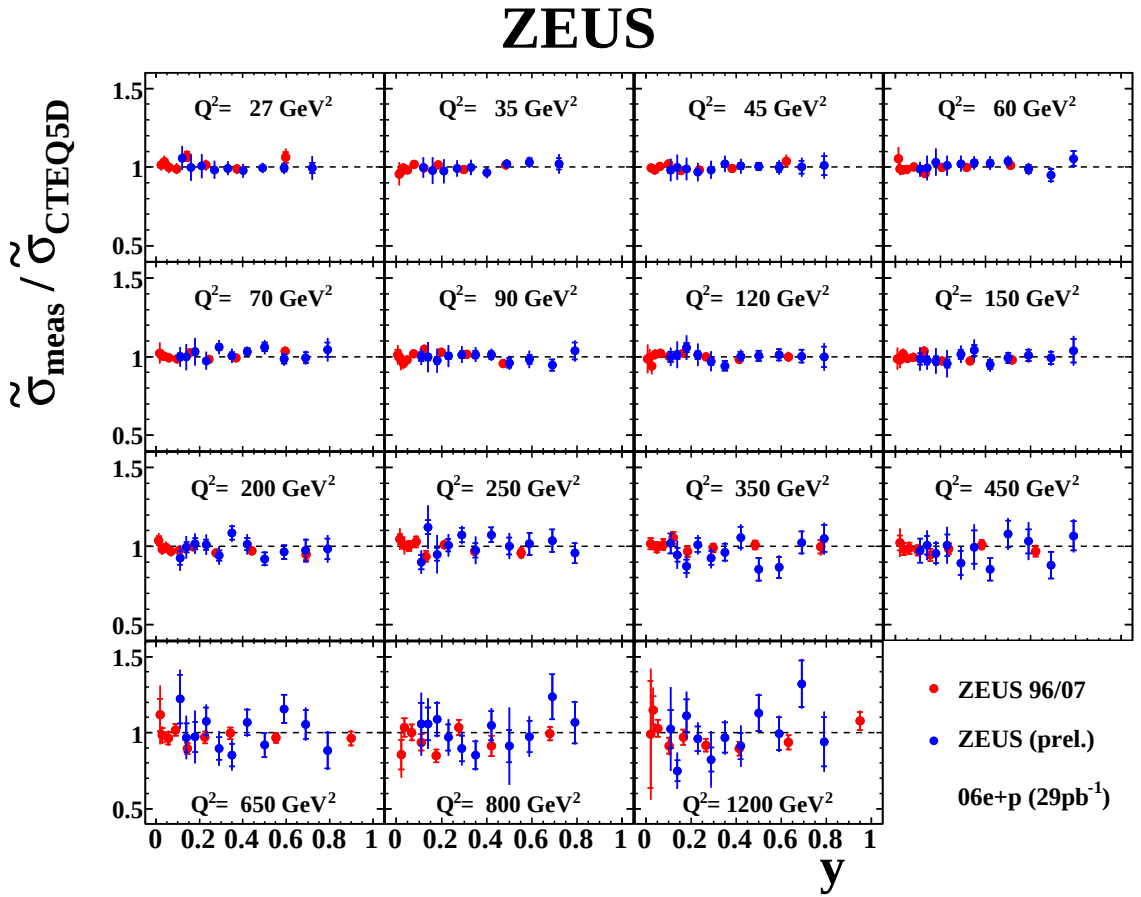
$\sigma(\gamma^* p) \propto W^\delta$

δ strongly increasing with Q^2

DIS at high y

Extending the DIS analysis to high y (low x, low E_e)
Preparation for F_L analysis with low energy data
Special high-y trigger in 2006: 29 pb^{-1} e^+p data (prel.)



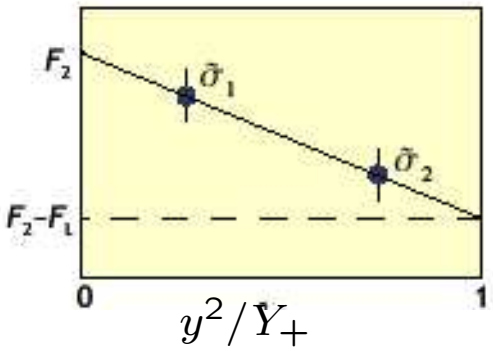


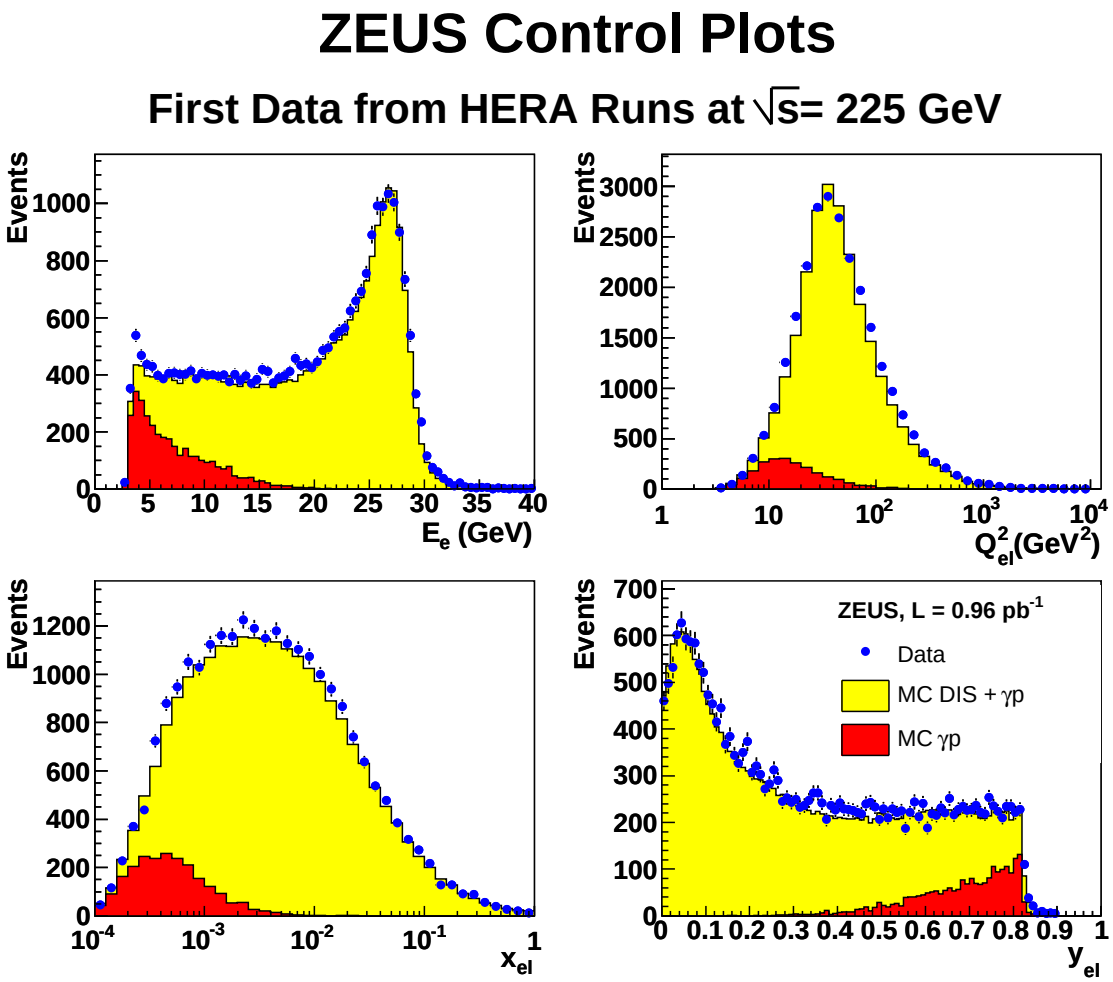
Improves over HERA-I at high-y
for $Q^2 <\sim 100\text{GeV}^2$

First look at Low Energy data

First data collected at reduced proton energy $E_p = 460\text{GeV}$, $E_e = 27.6\text{GeV}$

$$\tilde{\sigma} = F_2(x,Q^2) - \frac{y^2}{Y_+} F_L(x,Q^2)$$





Everything looks as expected

Looking forward for a promising F_L measurement

Conclusions

ZEUS collected 0.50 fb^{-1}, analysis of full luminosity just started

Results on High-Q^2 DIS from full e^-p HERA-II data
will be input to next generation of PDF and EW fits

No deviation from SM seen in NC DIS, multileptons, isolated leptons

New jet data, precision tests of QCD, sensitivity on $g(x)$, α_s

HERA-II measurements of heavy flavours production are coming,
new constraints to $g(x)$?

Finalising HERA-I measurements of diffraction

Low-energy run for the measurement of F_L going well