ZEUS Results

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Outline

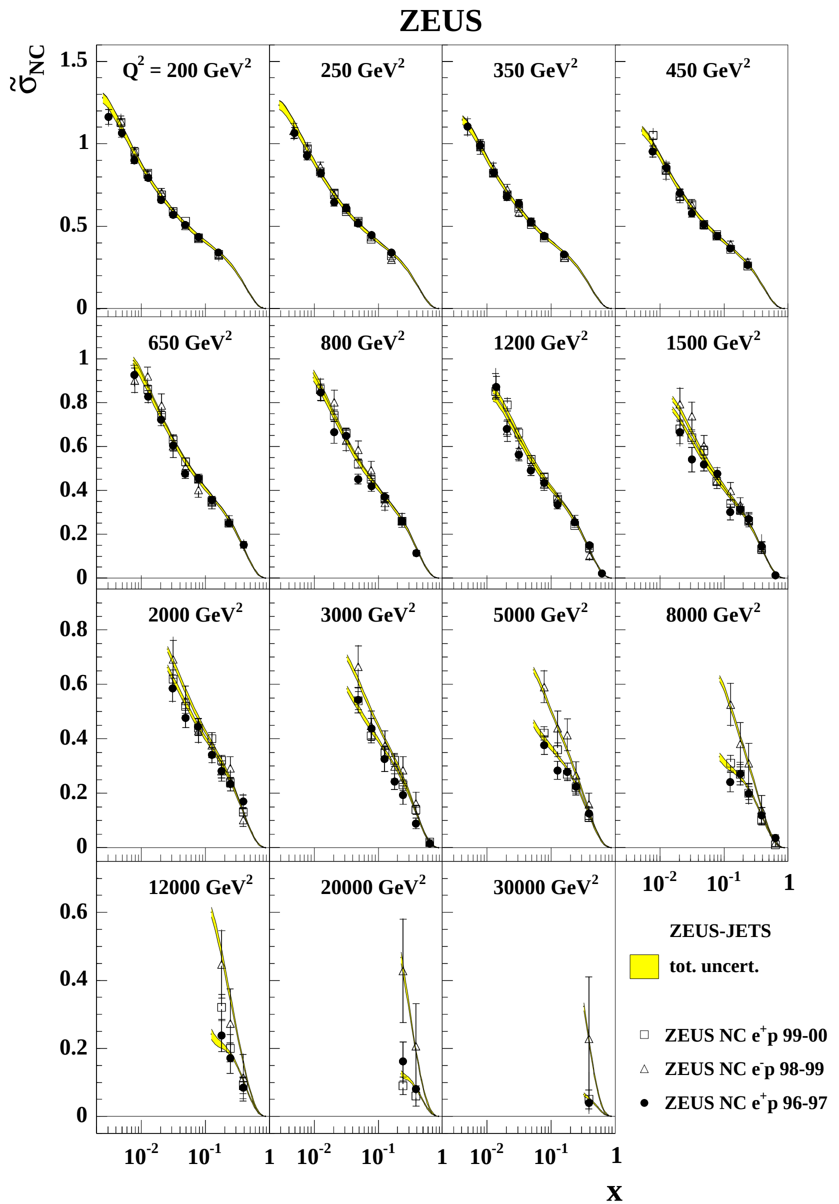
- QCD fits to structure functions and jet data
- α_S and jets at ZEUS
- Diffractive structure functions and final states
- Final states: strange and pentaquark states
- SUSY searches
- Heavy Flavours
- HERA II: first look at heavy flavour
- HERA II: CC and NC polarized cross-sections

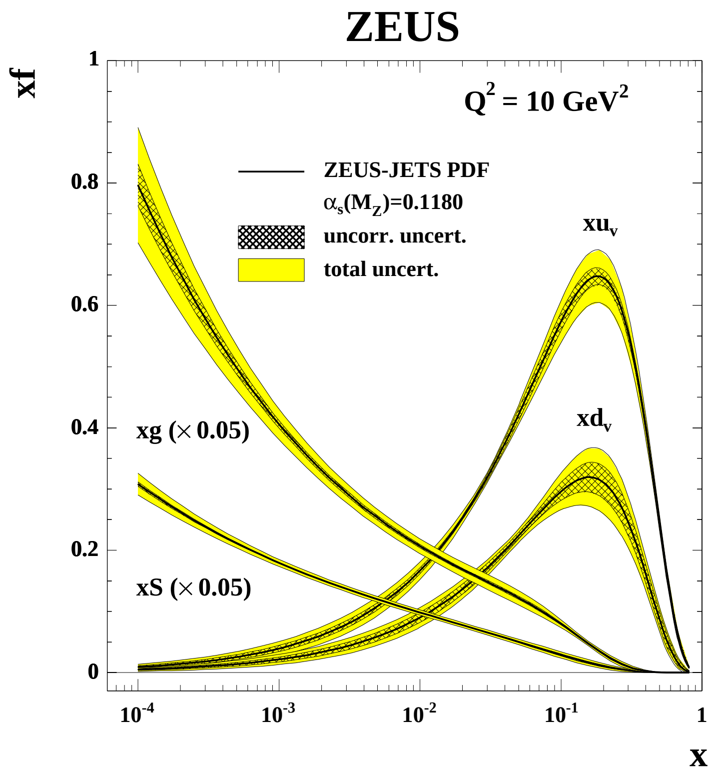
Results based on 130 pb^{-1} of $e^{\pm}p$ at HERA I
and on 45 pb^{-1} of $e^{+}p$ and 33 pb^{-1} of $e^{-}p$ at HERA II.

NLO QCD fits

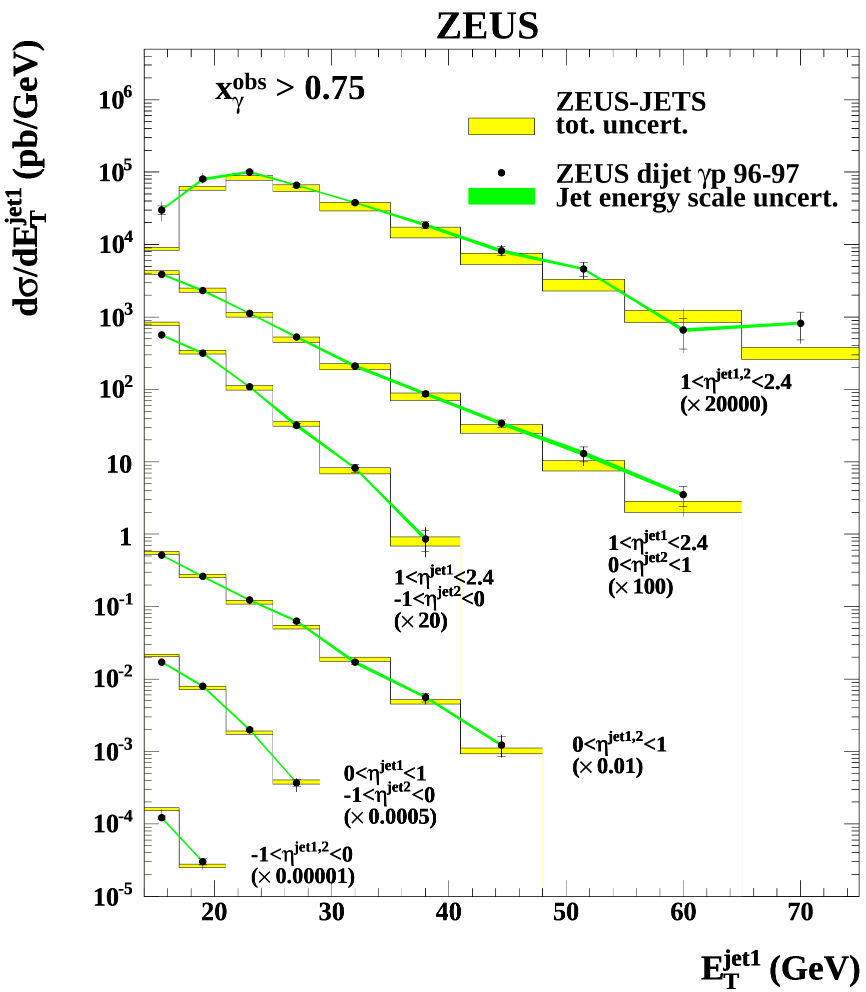
ZEUS-JETS: NLO QCD DGLAP analysis on ZEUS (HERA I) data alone

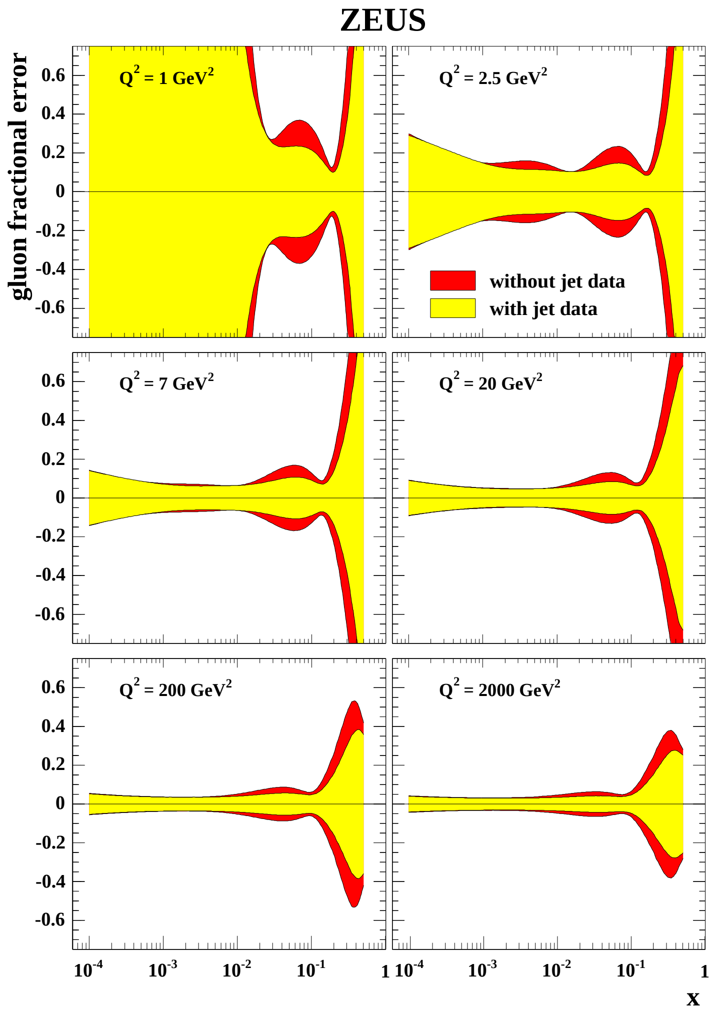
- low Q^2 NC $\longrightarrow$ sea and gluon at low x
- high Q^2 NC/CC $\longrightarrow$ valence at high x
- Direct γp and DIS jets data from 96-97 included in the fit in a rigourous way $\longrightarrow$ constrain the gluon at mid-to-high–x.





NLO QCD fits





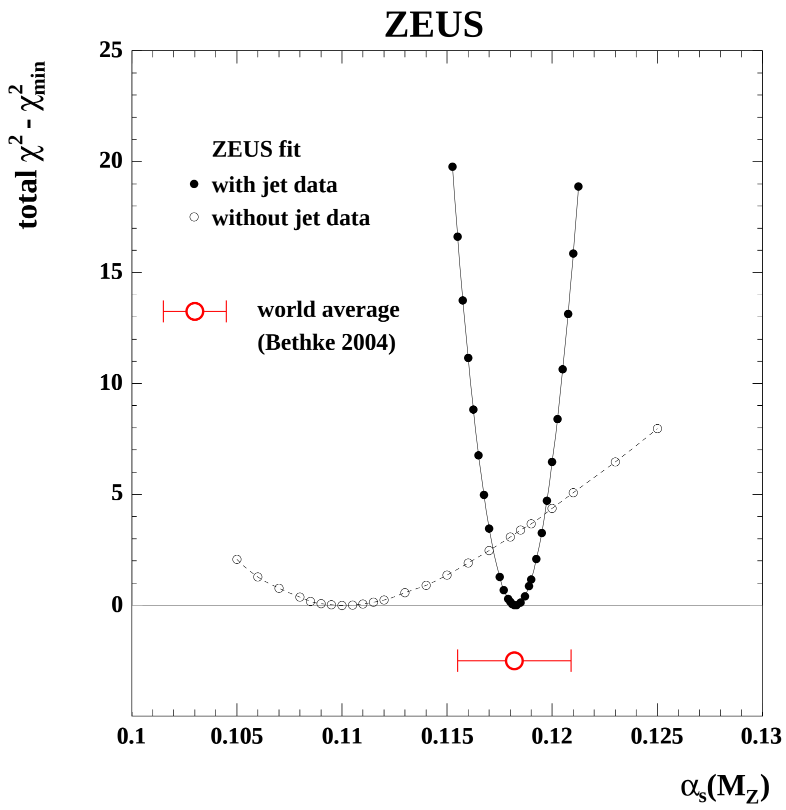
Energy scale uncertainty very small

Error on the jets cross-sections of the order of 5%

Improved gluon precision at middle-x
i.e. $Q^2 = 7\ GeV^2, x = 0.06$
from 17% to 10%

α_S at ZEUS

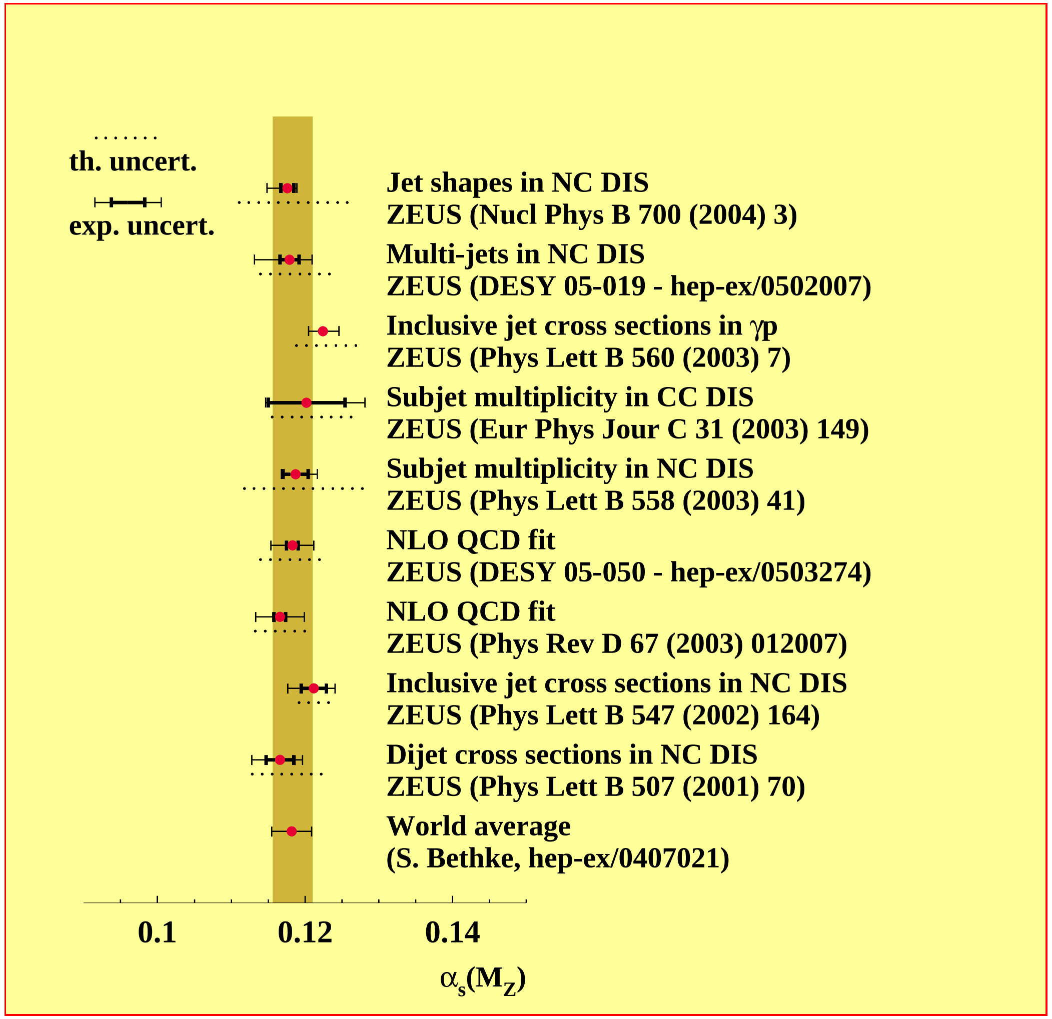
ZEUS-JETS-α_S fit:



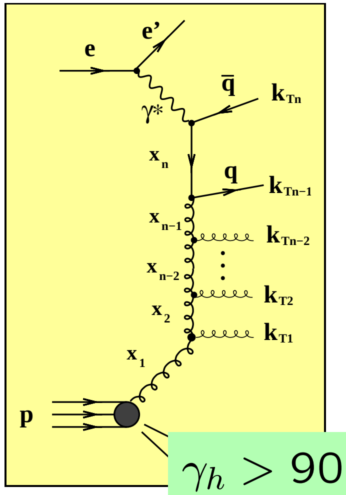
dijets and str. funct. data depend differently on α_S and $xg(x)$
$\rightarrow \alpha_S = 0.1183 \pm\ 0.0028(exp.)$
$\pm\ 0.0008(model) \pm\ 0.005(scale)$

First extraction of α_S from HERA data alone

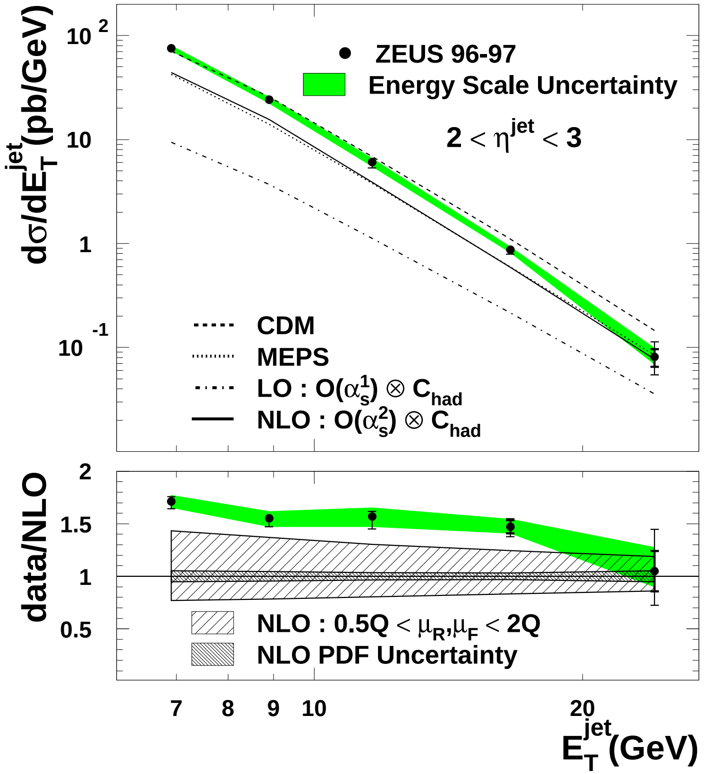
Summary of α_S at ZEUS:

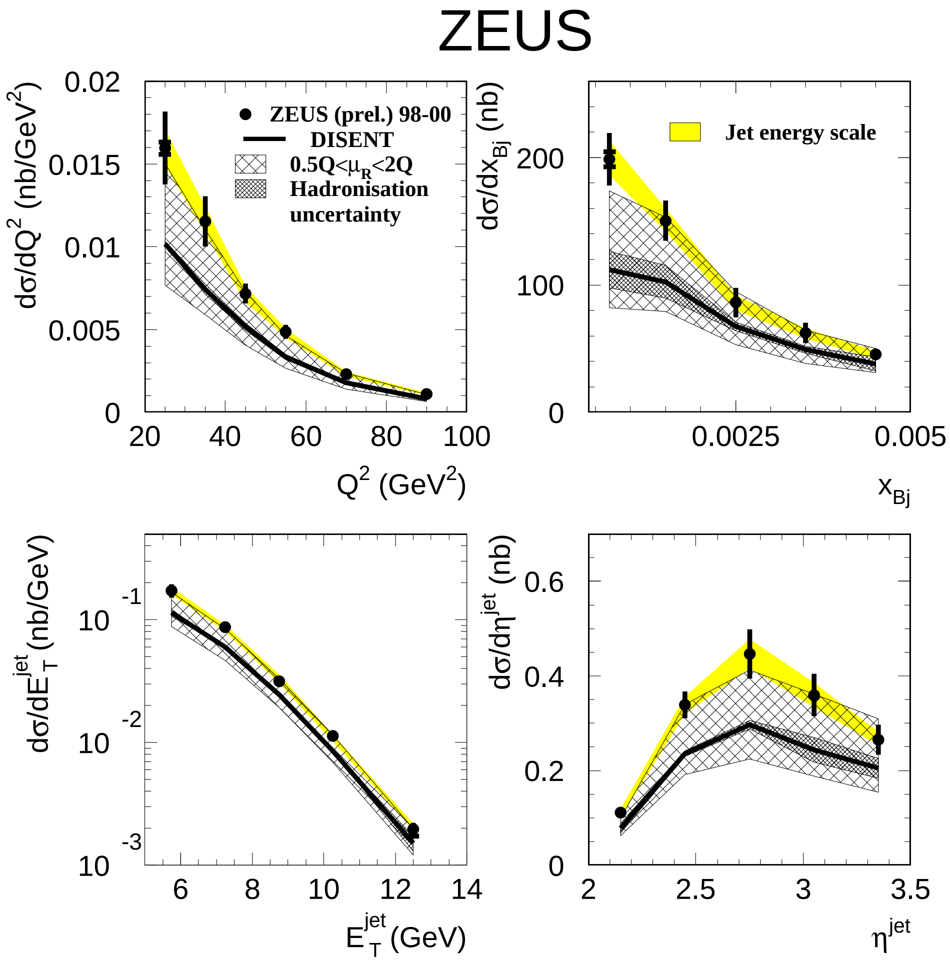


BFKL-DGLAP in low-x forward jets



$\gamma_h > 90^\circ, E^2_{T,\text{jet}} \simeq Q^2, 2 < \eta_{\text{jet}} < 3$

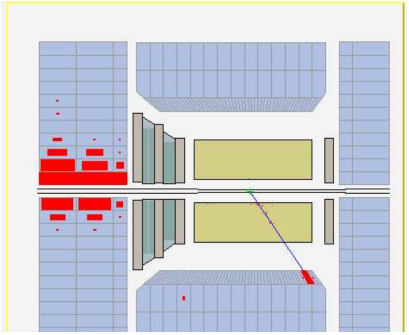




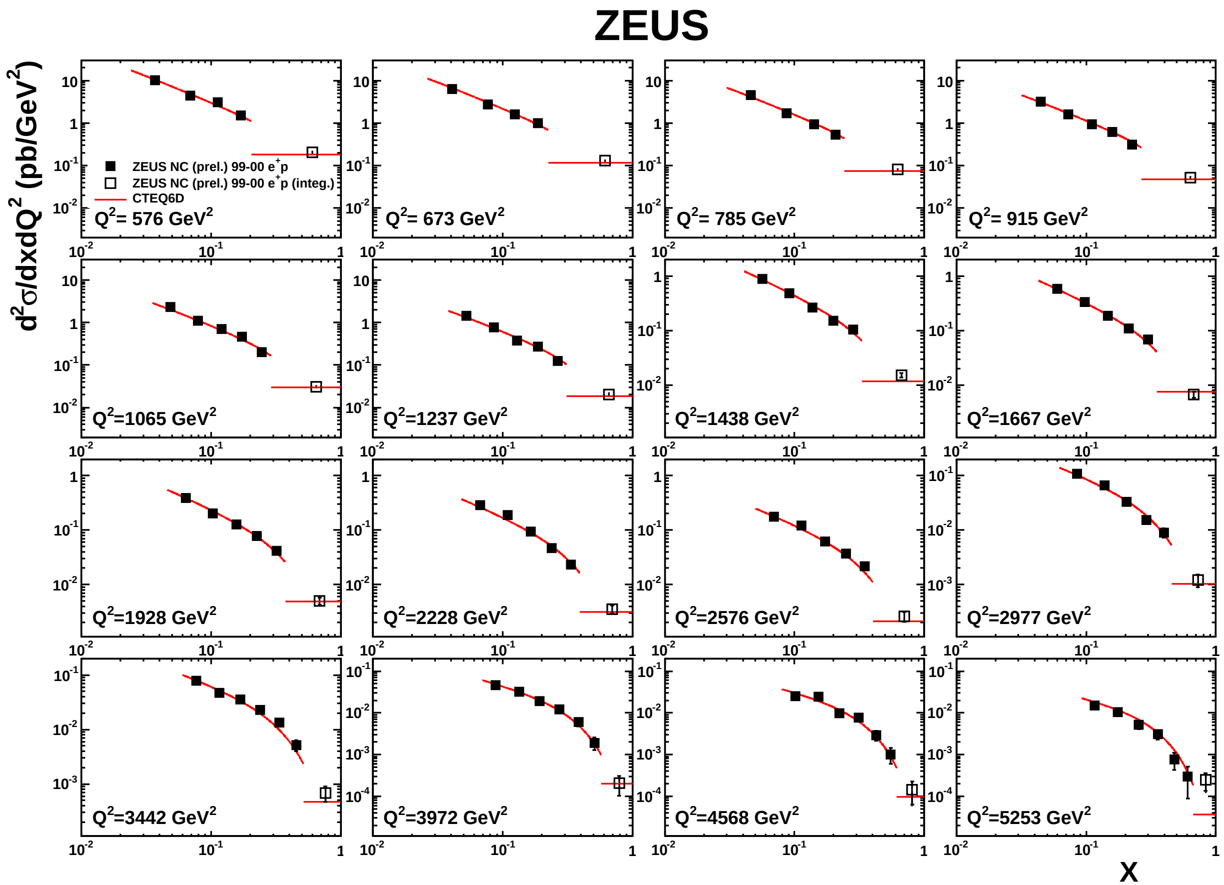
$E^2_{T,\text{jet}} \simeq Q^2, x_{\text{jet}} >> x, 2 < \eta_{\text{jet}} < 3.5$ (FPC)

Data slightly above NLO (DISENT) at low x, theoretical uncertainties are still large.

Very high-x in NC



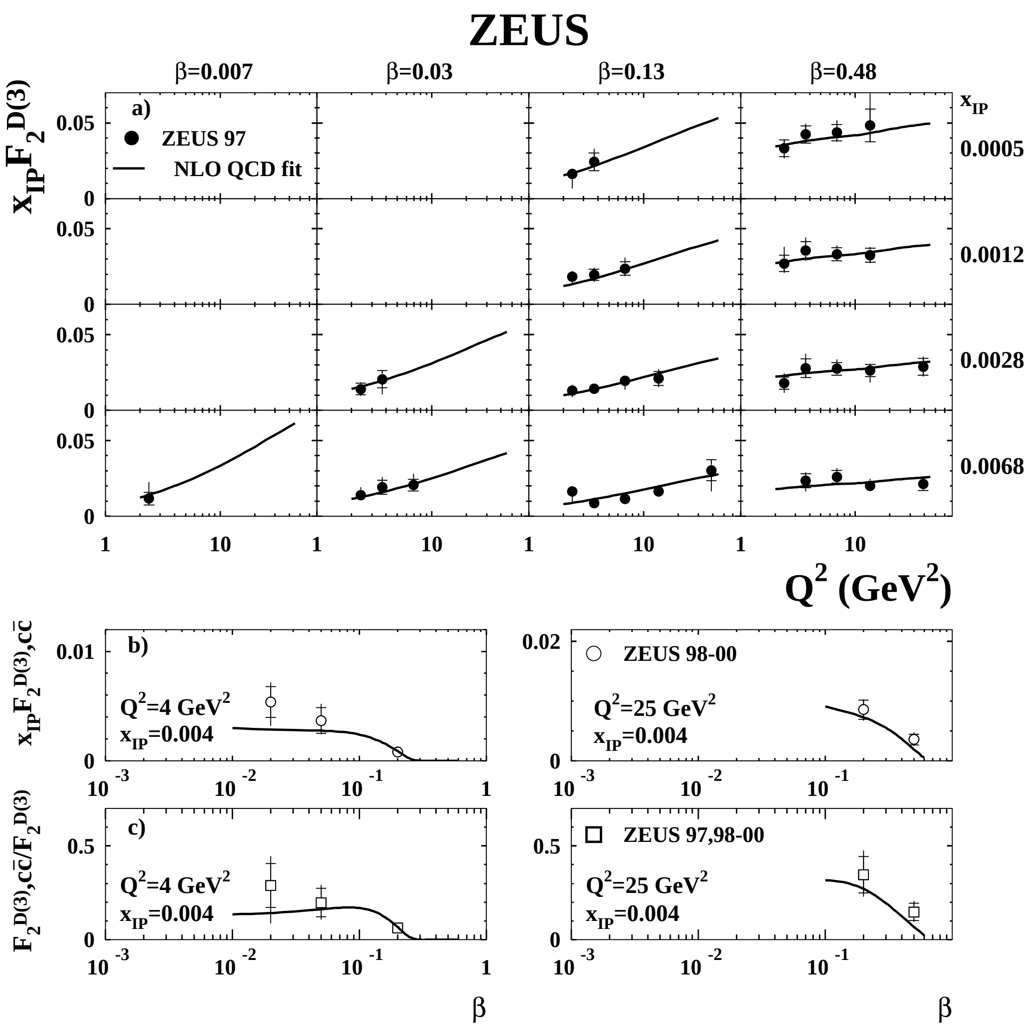
- Q^2 reconstructed from electron
- If jet inside detector, x from E_{jet}, θ_{jet}
- If jet outside, take integral $x_{\text{limit}} < x < 1$ (last bin)
- Extend to $x > \simeq 0.4$

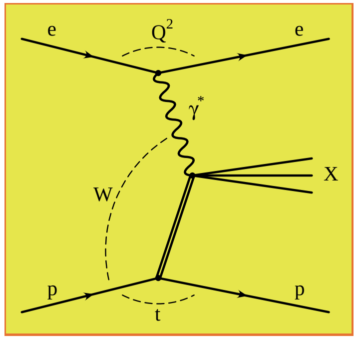


First measurement of very high-x at HERA, important for valence quarks

Uncertainties at very high-x are similar to the other regions

Diffractive structure functions

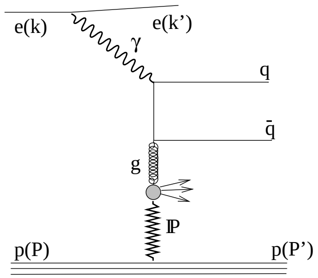




NLO QCD fi t for $Q^2 > 2\ GeV^2, x_P < 0.01$

- 10% of DIS events are diffractive, LPS data, NLO QCD fit to extract the diffractive pdfs $F_2^D(3) = f_{IP}(x_{IP})F_{IP}^2(\beta, Q^2)$
- charm data essential to constrain gluon. Gluon contribution $= 82 \pm 8^{+5}_{-16}\%$ at $Q^2 = 2\ GeV^2$.
- QCD fit describes $F_2^D(3)$ and $F_2^{D(3)cc} \longrightarrow$ diffractive hard scattering factorization
- Can diffractive pdfs describe djet-production?

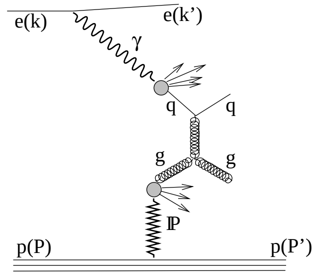
Diffractive γp dijets



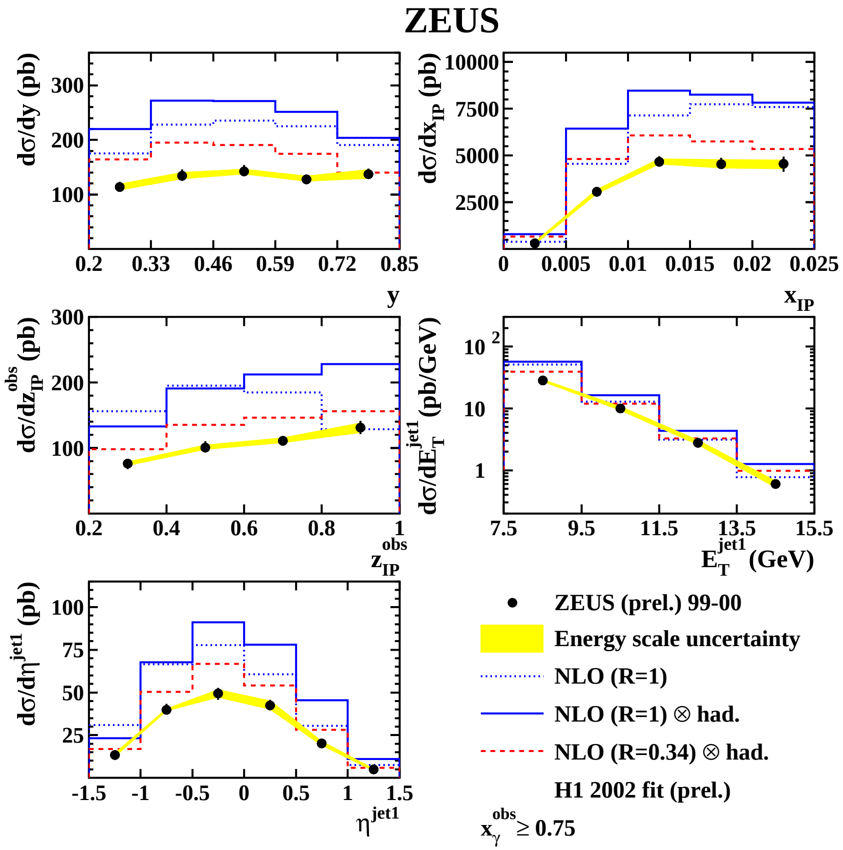
(a)

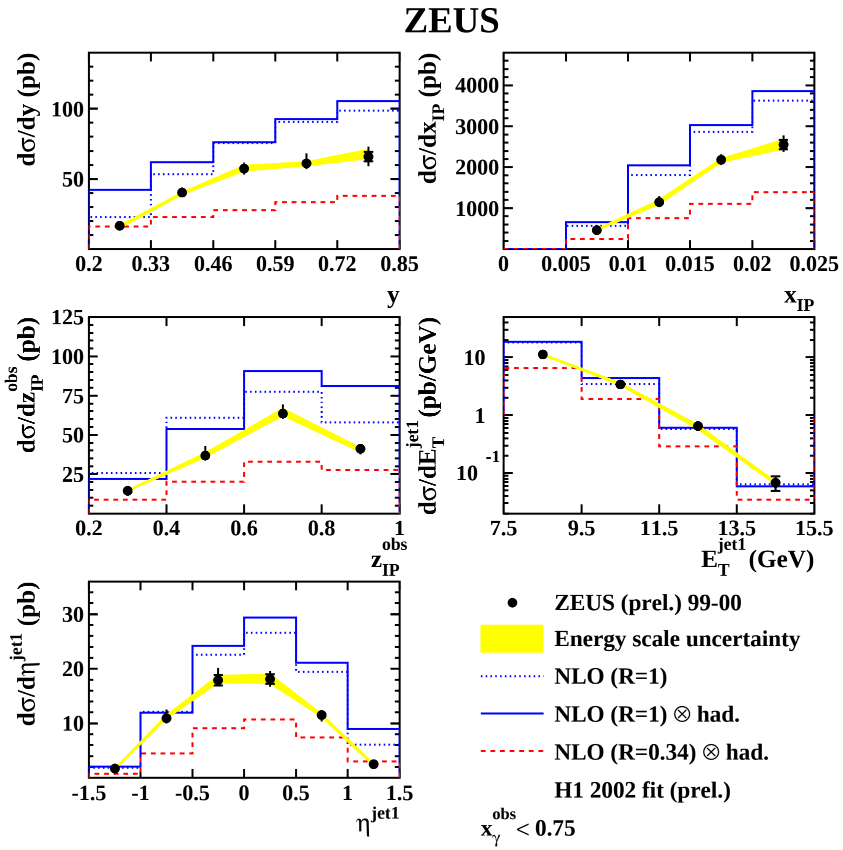
$x_\gamma > 0.75$

$x_\gamma < 0.75$



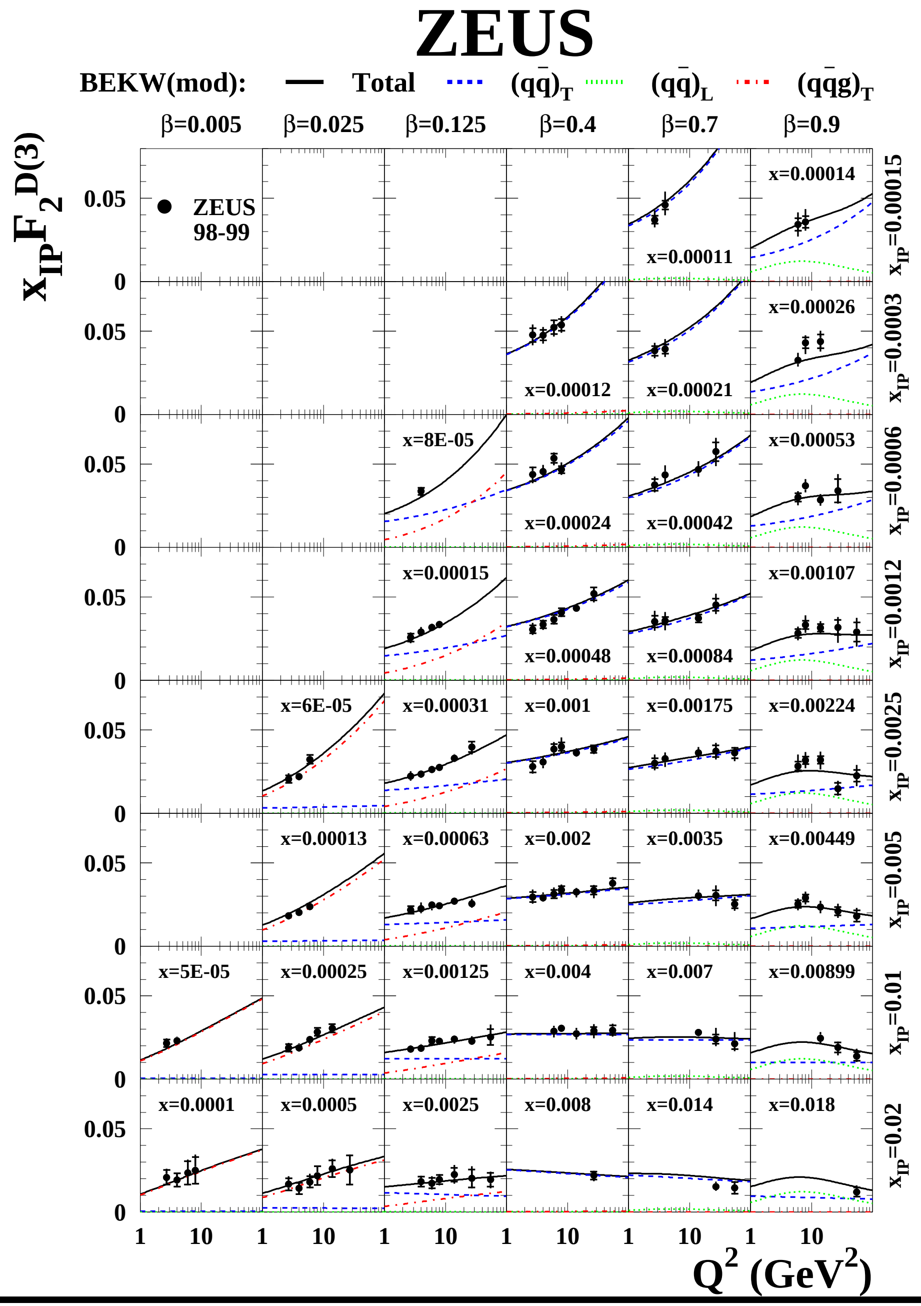
(b)





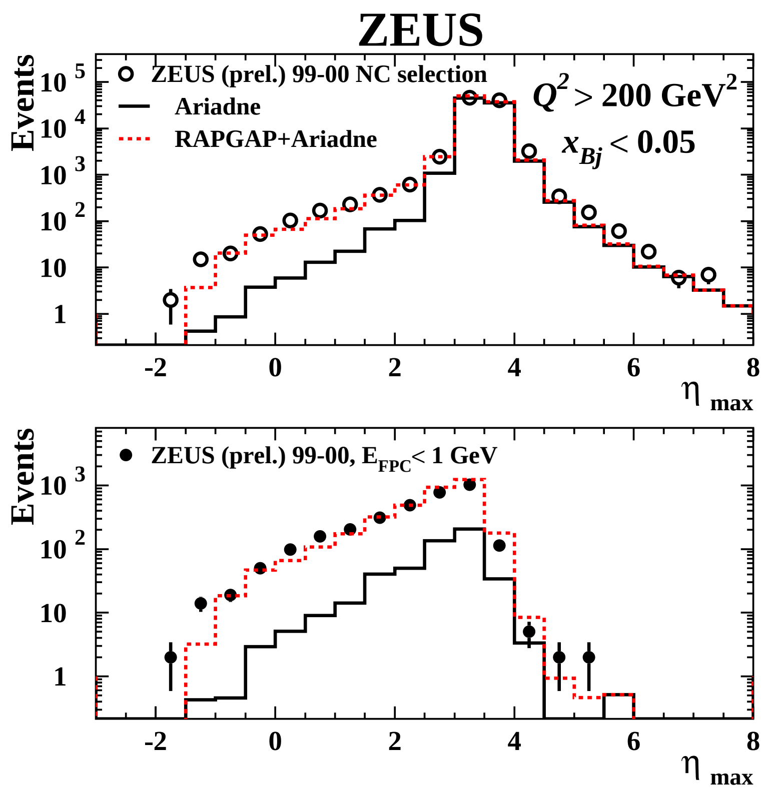
NLO QCD predictions (KlKr+H1 2002 fit) describe shape, but overall suppression factor of $R \simeq 0.5$ is needed, for resolved (close to pp collisions) but also for direct.

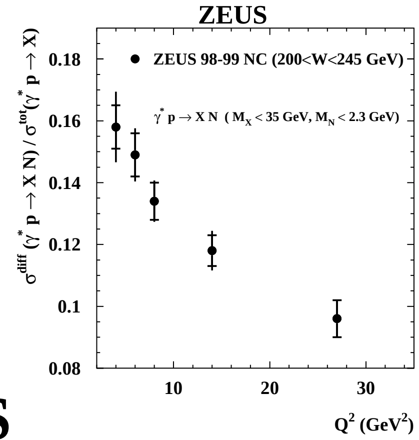
Diffractive structure functions

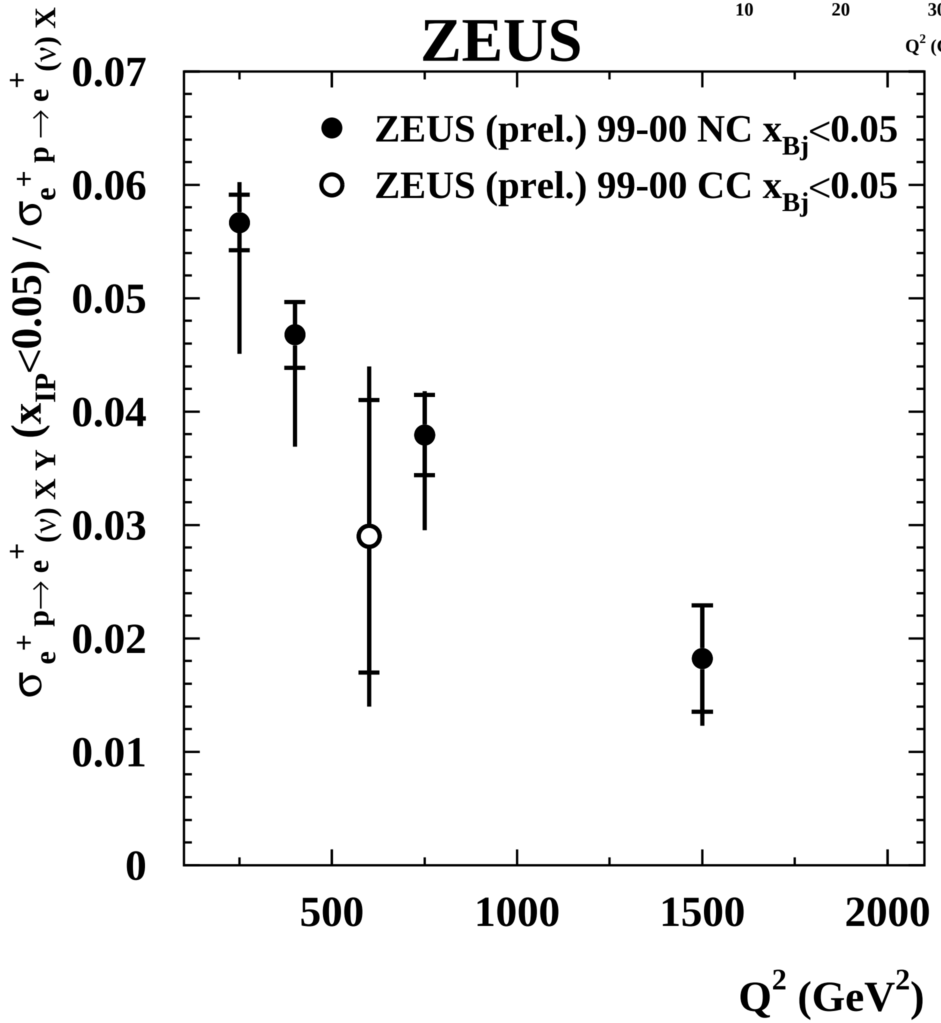


- $F_2^D(3)$ determined with the ln M_x method, larger kinematic range, lower $Q^2(> 2\ GeV^2)$, higher M_X up to 35 GeV (extension in η due to the FPC $5 < \eta < 4$), high statistics
- Positive scaling violations $\longrightarrow$ confirm perturbative effects
- At fixed β, $x_{I\!P}F_2^D(3)$ changes with Q^2 differently for different $x_{I\!P}$ bins $\longrightarrow$ observation of breaking of Regge factorization

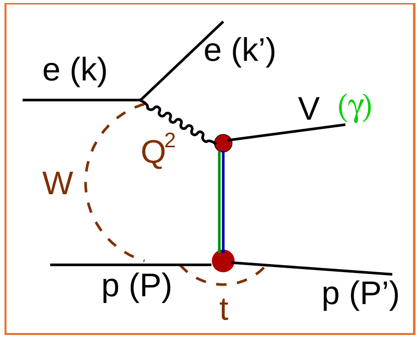
Diffraction at High Q^2



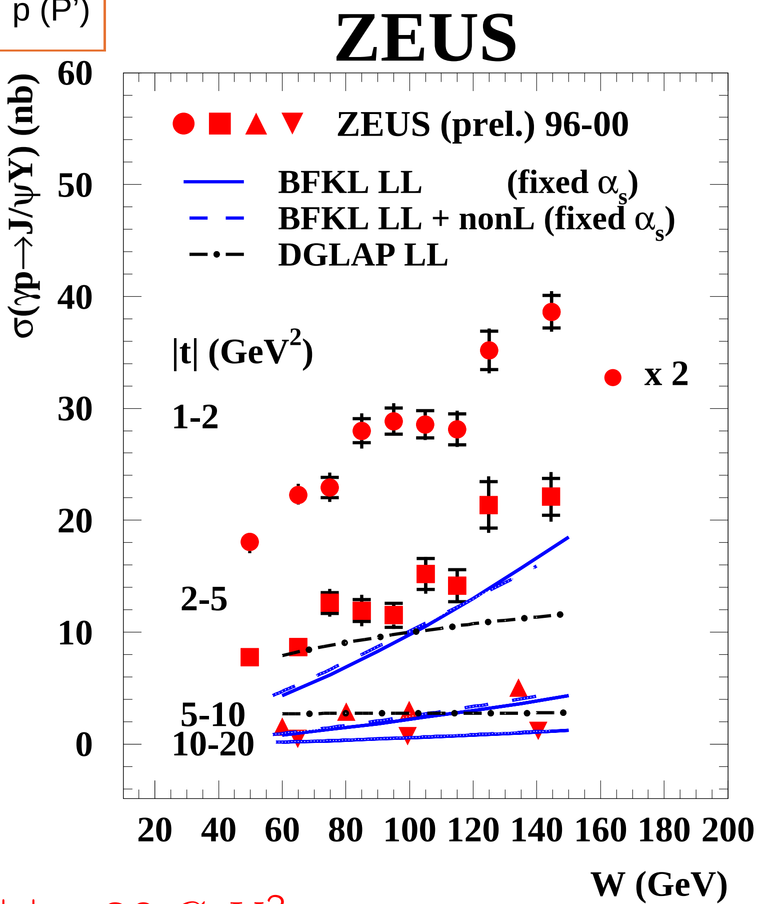


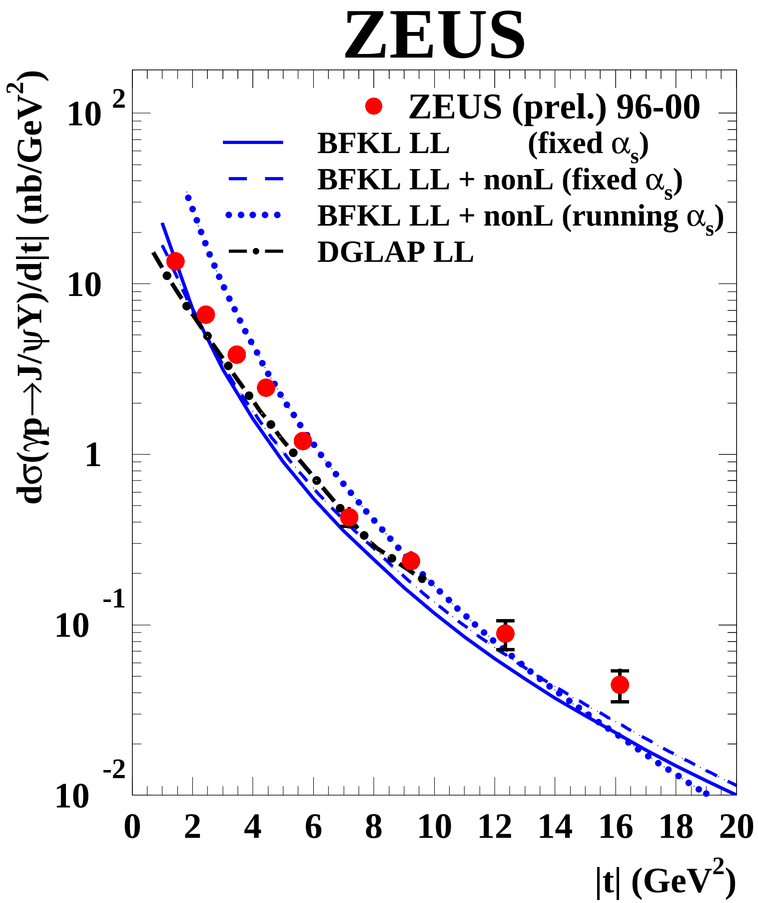


$\sigma_{diff}/\sigma_{tot}$ measured for NC $Q^2 > 200\ GeV^2$,
$\sigma_{diff}/\sigma_{tot} = 2.9 \pm 1.2(stat.) \pm 0.8(syst)\%$ for CC



J/Ψ production at high t



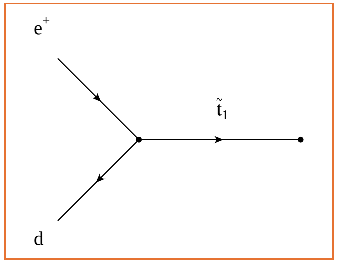


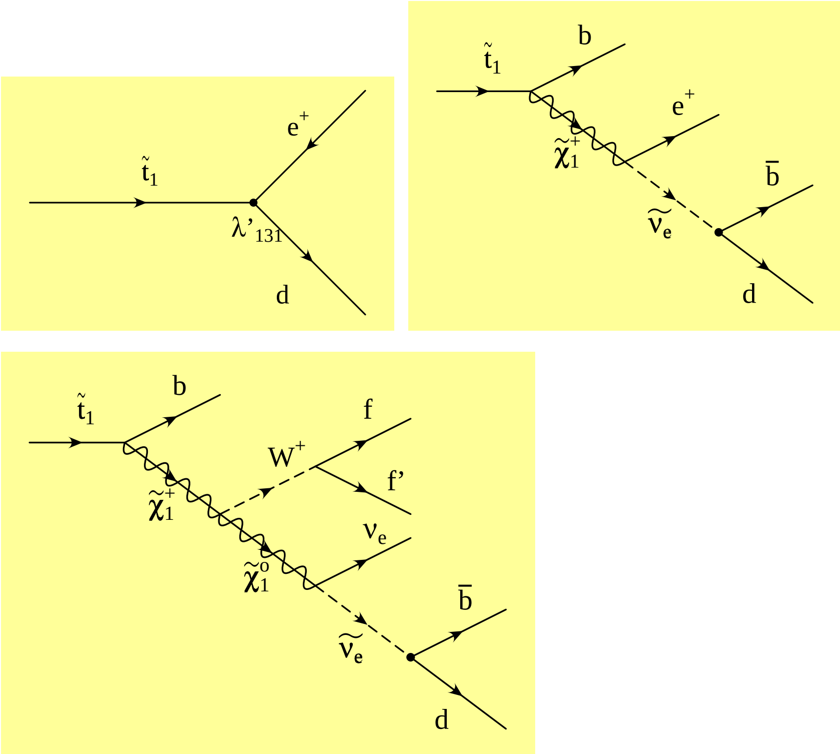
J/Ψ in γp at $1 < |t| < 20\ GeV^2$

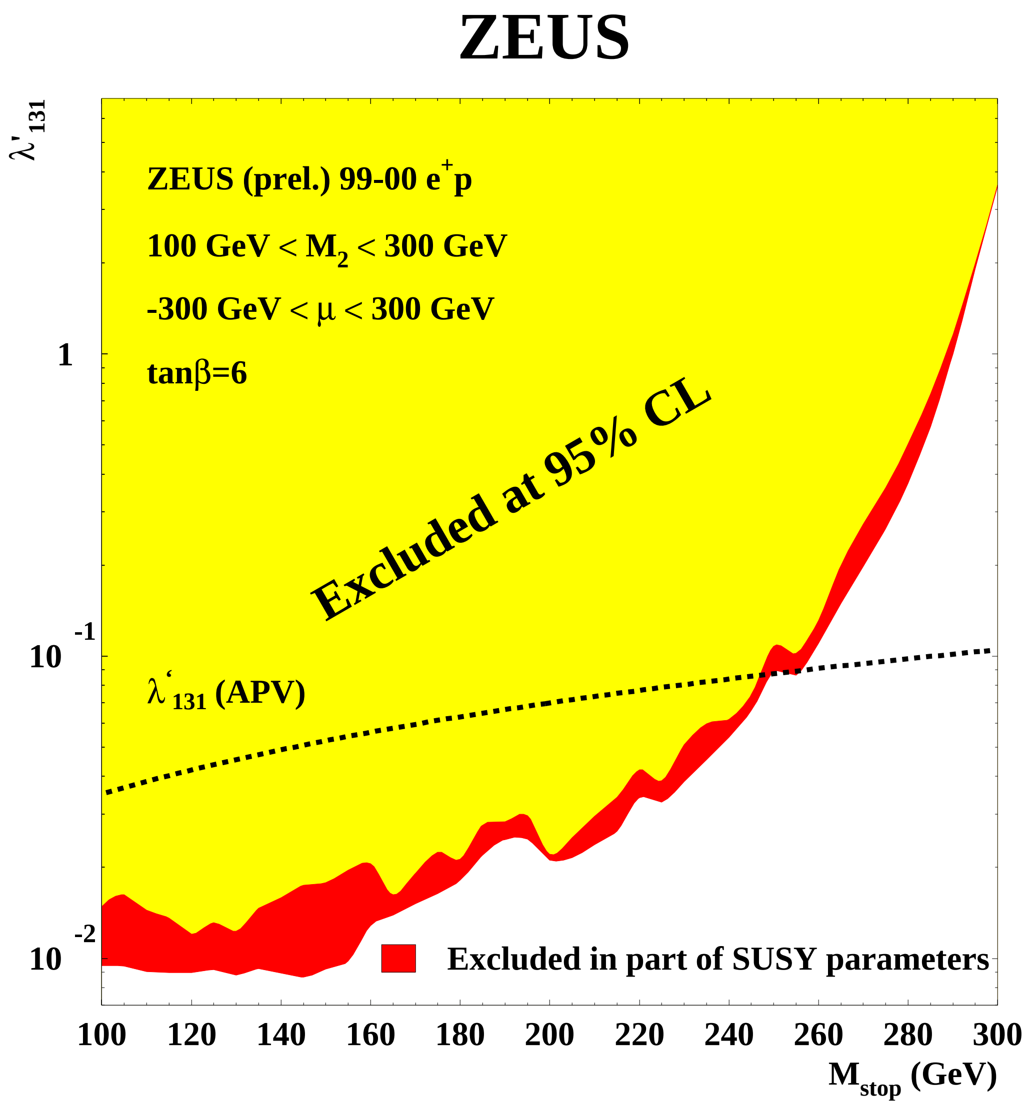
$50 < W < 150\ GeV, z > 0.95$

BFKL gives reasonable description
DGLAP does not describe rise with W

Search for R_p-violating SUSY-I





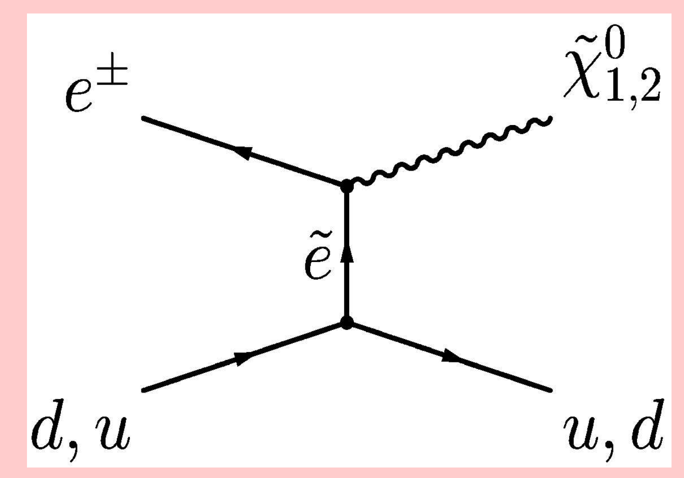


All topologies e-J, e-MJ, ν-MJ searched for

No evidence found, limit on stop

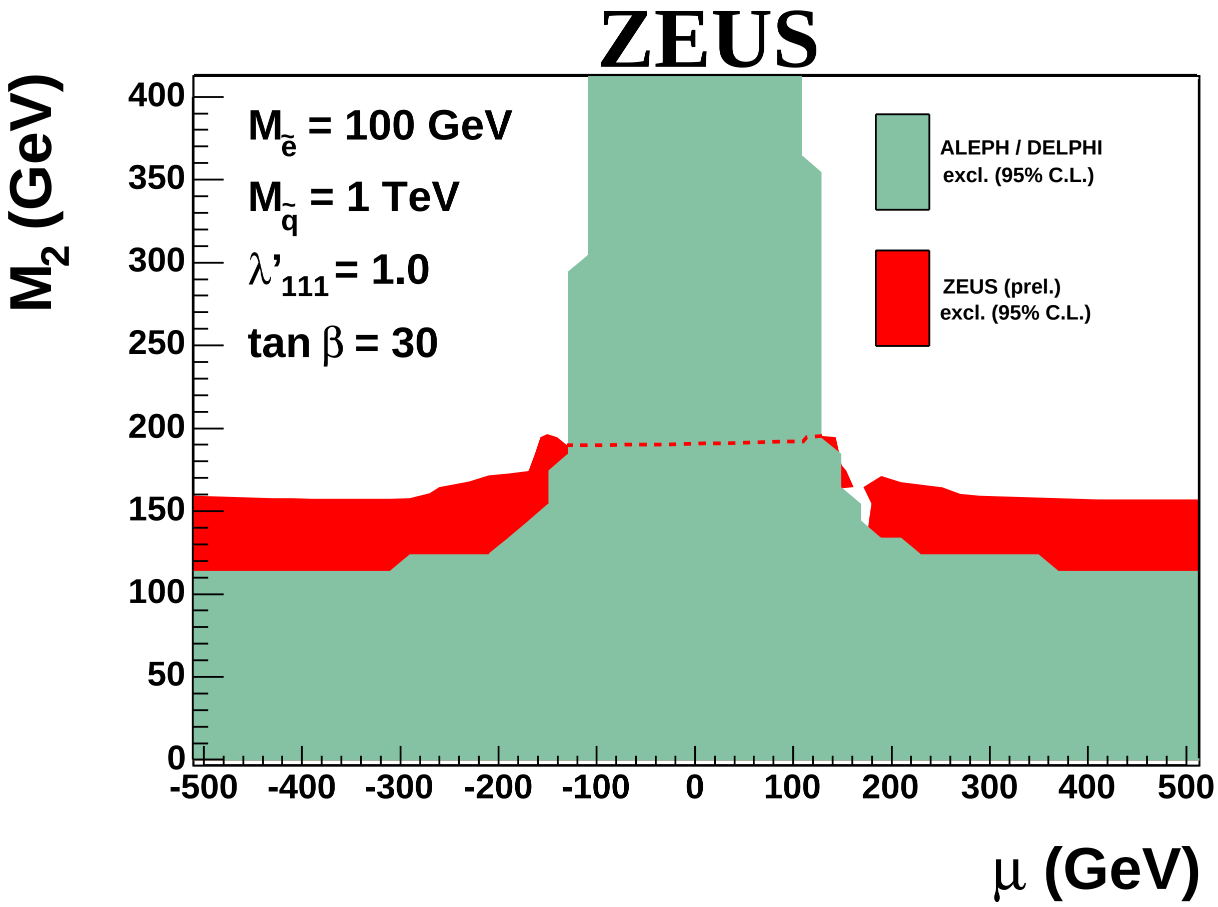
Search for R_p-violating SUSY-II

Assume selectron-exchange dominant with λ'_{111}



Discriminant method to distinguish from DIS background, requiring at least 2 high-E_T jets.

No evidence found $\rightarrow$ Limit on gaugino production



LEP2 excluded area from a scan in SUSY space obtained requiring $M(\chi^{\pm}) > 103\ GeV$.

Strange production: BE correlations in $K^{\pm}$

BE effect: enhancement in the production of identical bosons with similar momenta

$R(p_1 \cdot p_2) = \rho(p_1 \cdot p_2)/\rho(p_1)\rho(p_2)$

ρ particle density distribution functions for identical bosons, $Q_{12}^2 = -(p_1 - p_2)^2$

Double ratio: Ref sample=mixed sample with pairs of kaons (no BEC)

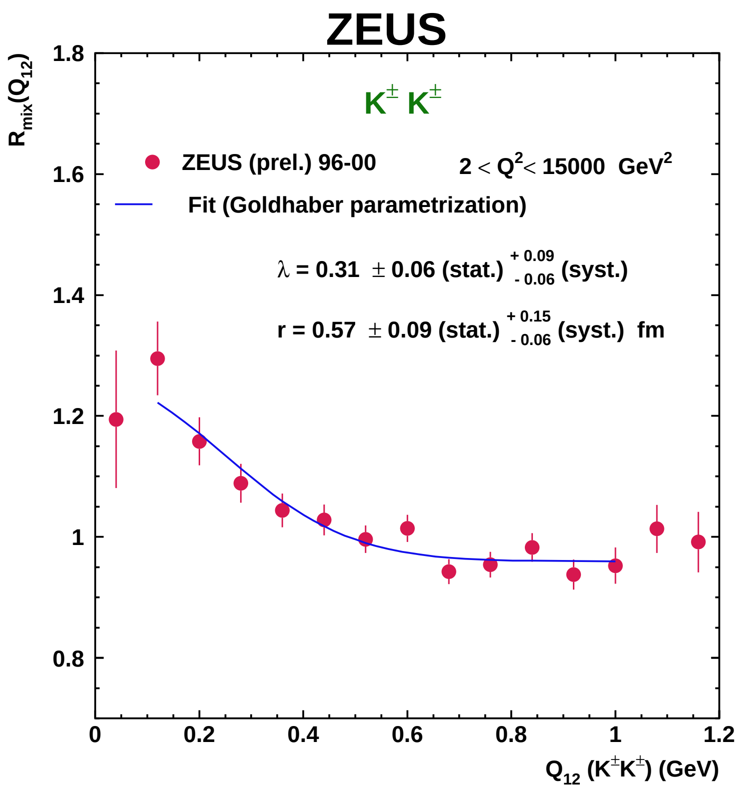
$R \propto (1 + \lambda exp(-r^2 Q_{12}^2))$

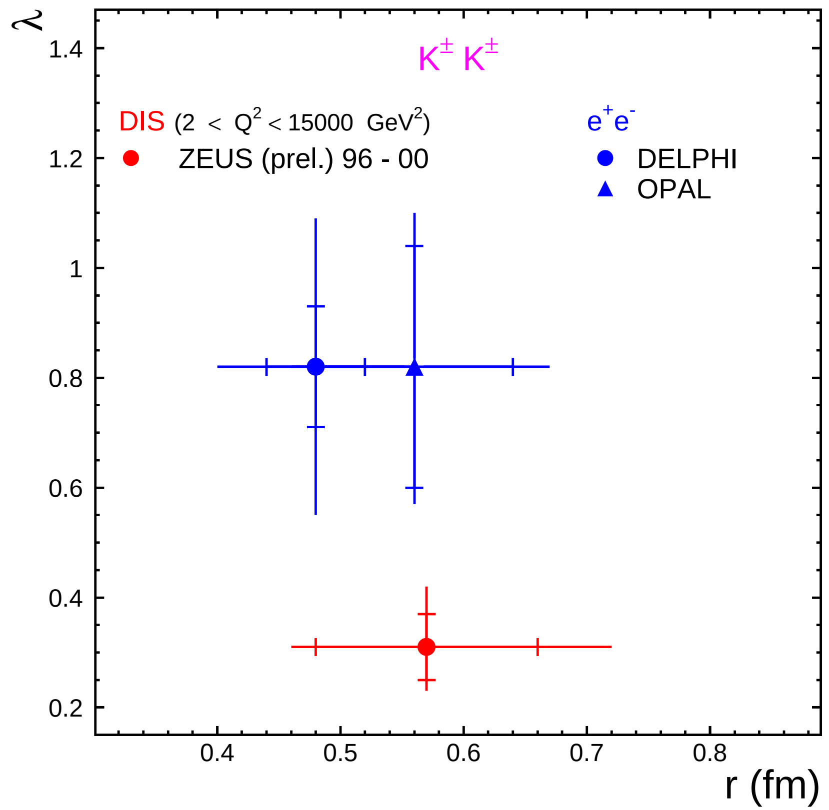
λ measure of the coherence

r radius of emitting source

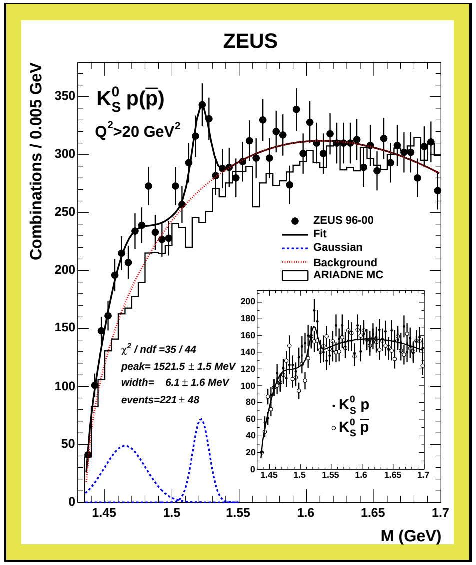
Comparison to e^+e^- shows different $\lambda \rightarrow$

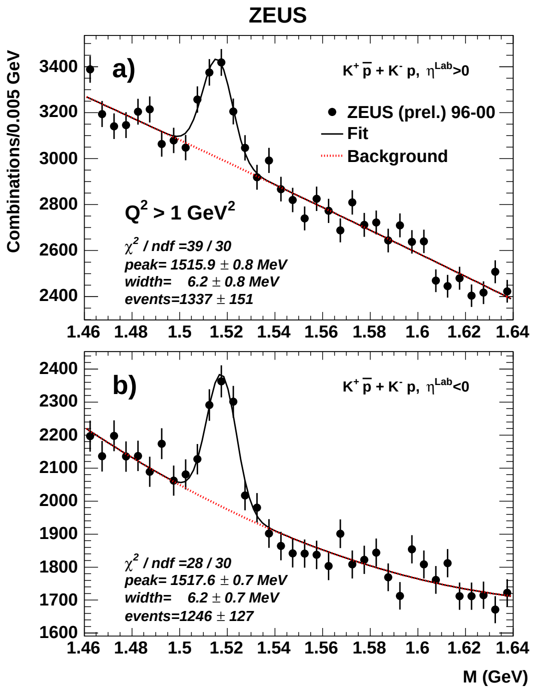
ZEUS mainly target region

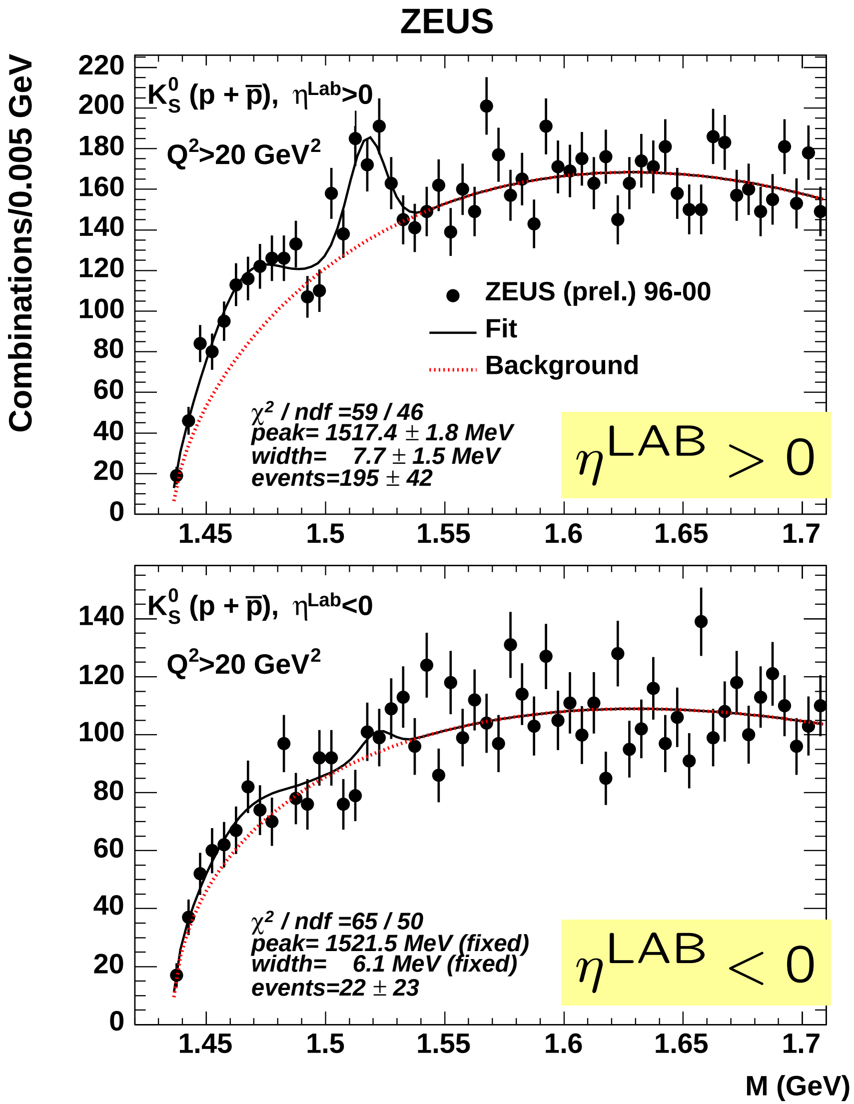




Strange production: $K^0_S p(\bar{p})$ resonance





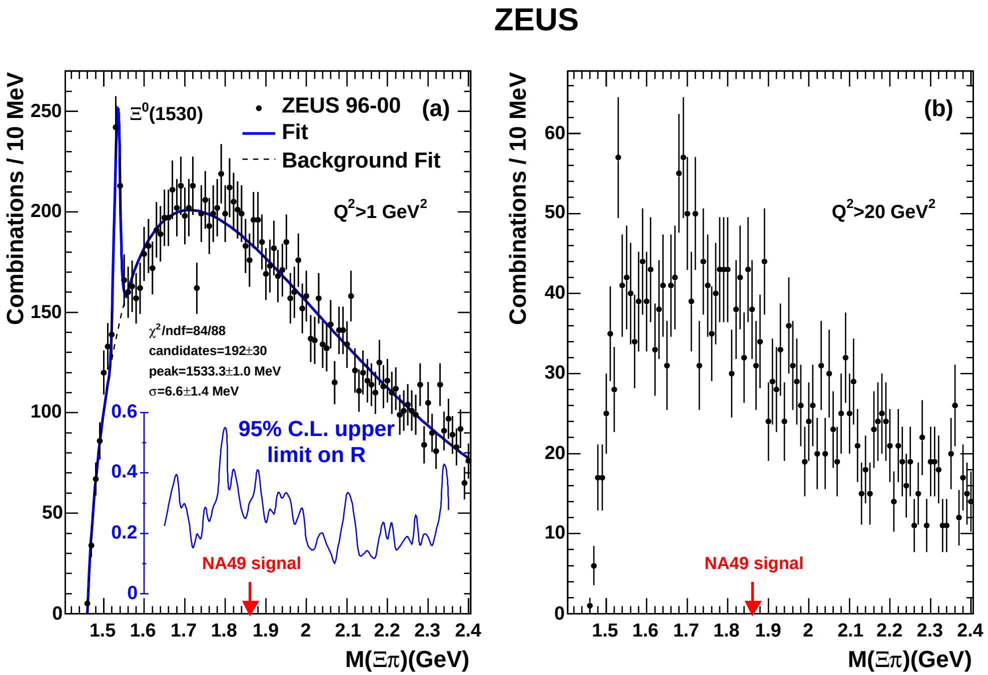


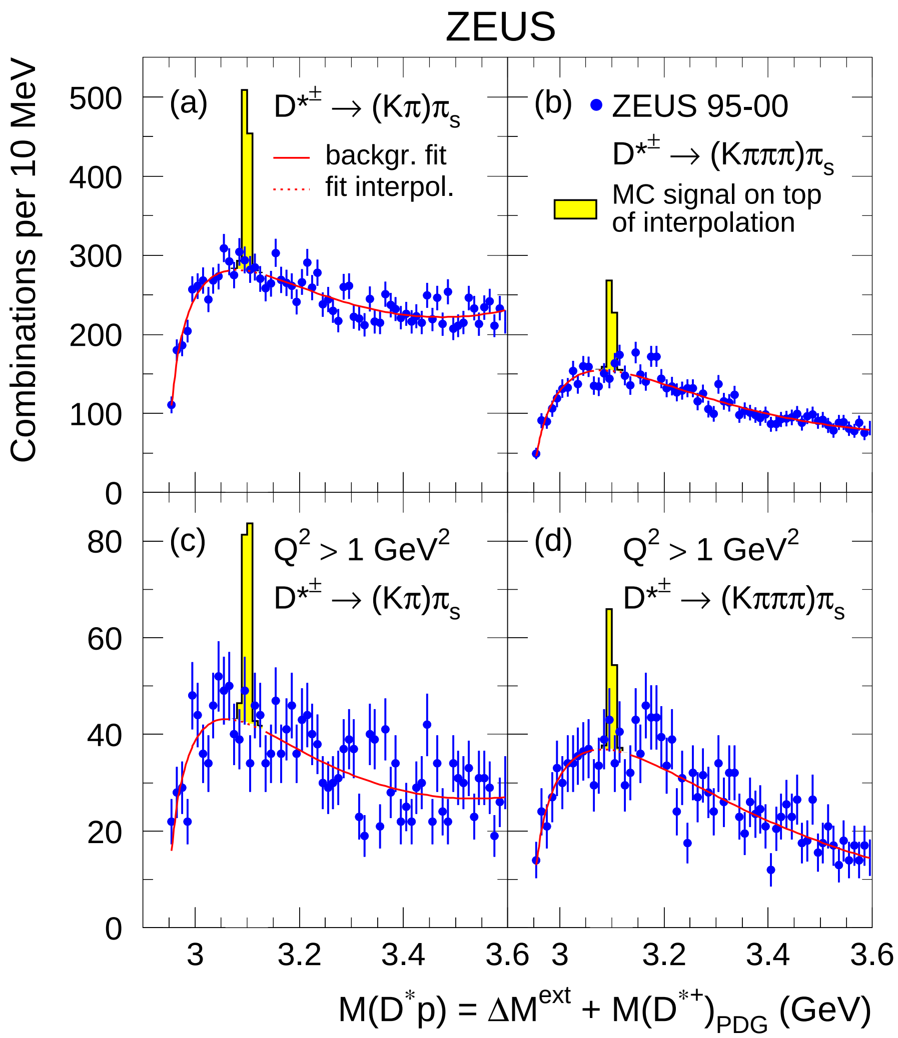
Resonance in $K^0_S p(\bar{p})$ observed consistent with the Θ^+ observed by low-energy experiments

Trying to understand production mechanism

Production rate is higher in the forward region
($> 3\ \sigma$ in number of events)
(not for the $\Lambda(1520)$)

Other pentaquark searches at ZEUS





No evidence for NA49 pentaquark $\to \Xi\pi$

Upper limit R=

$[\Xi^{--}_{3/2}(\Xi^-\pi^-)$ or $\Xi^0_{3/2}(\Xi^-\pi^+)]/\Xi^0(1530)$

$<$ 0.29 at 95% CL around 1860 GeV.

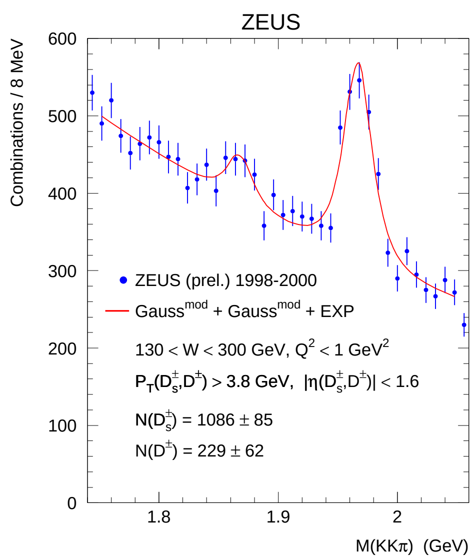
but fragmentation region, does not contradict NA49

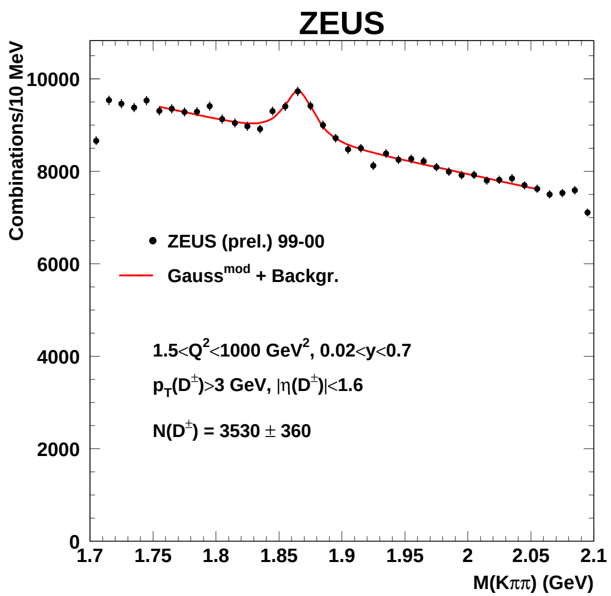
No evidence for Θ_c in $>$ $60000 D^*$ candidates

Charm fragmentation fractions

	ZEUS (DIS) prel.	ZEUS (γp) prel.	H1 (DIS)	Combined e^+e^- data
$f(c \to D^{\pm})$	$0.194 \pm 0.020^{+0.023}_{-0.011}$	$0.249 \pm 0.014^{+0.004}_{-0.008}$	0.203 ± 0.025	0.232 ± 0.025
$f(c \to D^{0})$	$0.584 \pm 0.039^{+0.024}_{-0.050}$	$0.557 \pm 0.019^{+0.005}_{-0.013}$	0.560 ± 0.071	0.232 ± 0.025
$f(c \to D_s^{\pm})$	$0.103 \pm 0.013^{+0.012}_{-0.017}$	$0.107 \pm 0.009^{+0.005}_{-0.005}$	0.151 ± 0.019	0.101 ± 0.019
$f(c \to \Lambda_c^{\pm})$	$0.104 \pm 0.048^{+0.018}_{-0.010}$	$0.076 \pm 0.020^{+0.017}_{-0.001}$		0.076 ± 0.007
$f(c \to D^{*\pm})$	$0.190 \pm 0.014^{+0.023}_{-0.009}$	$0.223 \pm 0.009^{+0.003}_{-0.005}$	0.263 ± 0.032	0.235 ± 0.007

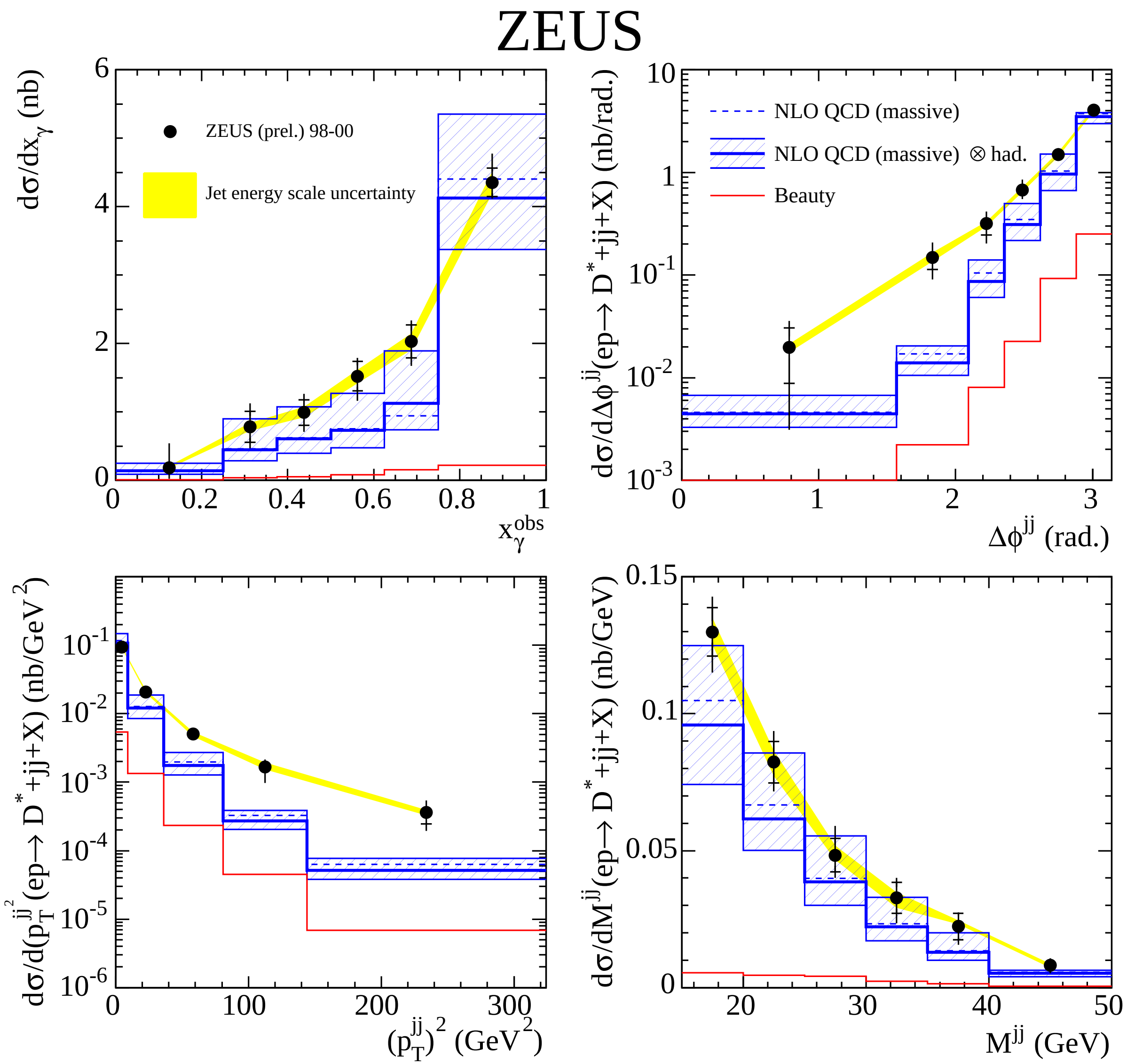
In agreement with universal charm fragmentation fractions



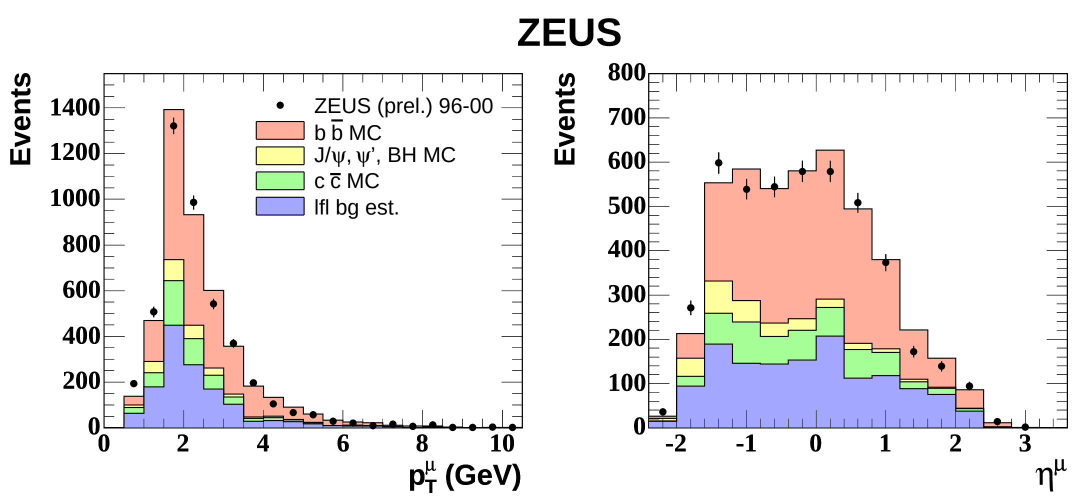


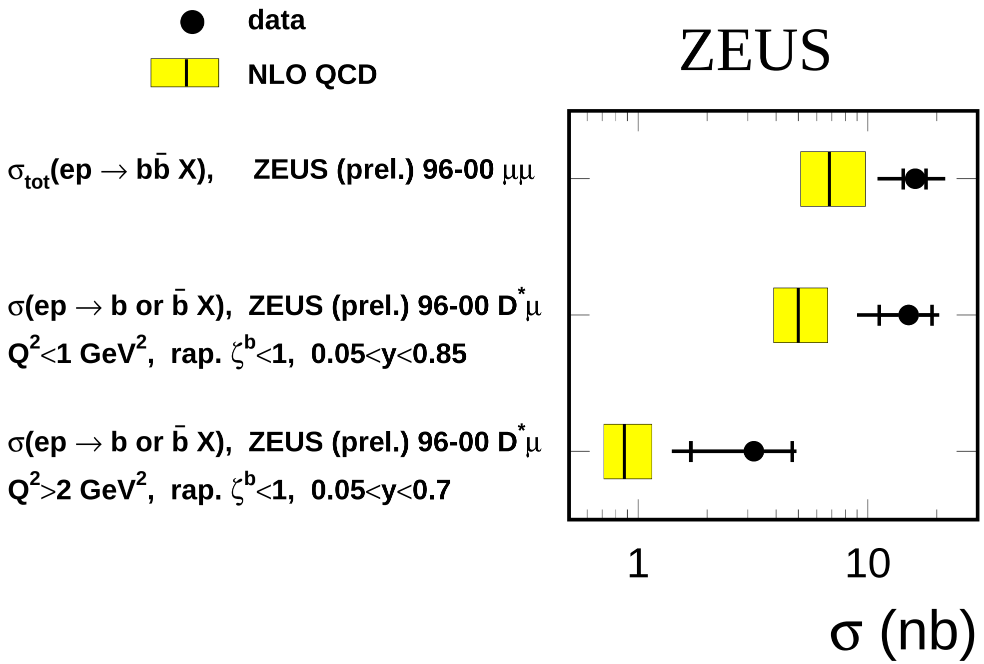
Charm jets in γp

- m_c, p_T^{jet} provide the hard scales, hadronization effects are reduced using jets. Dijets sensitive to higher order effects.
- Comparison of NLO massive calculations (FMNR) to the data shows deviation of $d\sigma/d\Delta\phi^{jj}$ and $d\sigma/dp_T^{jj}$ at low $\Delta\phi^{jj}$ and high p_T^{jj}, especially for resolved-enriched.
- additional Parton Shower in NLO needed or NNLO.



Beauty production in dimuon



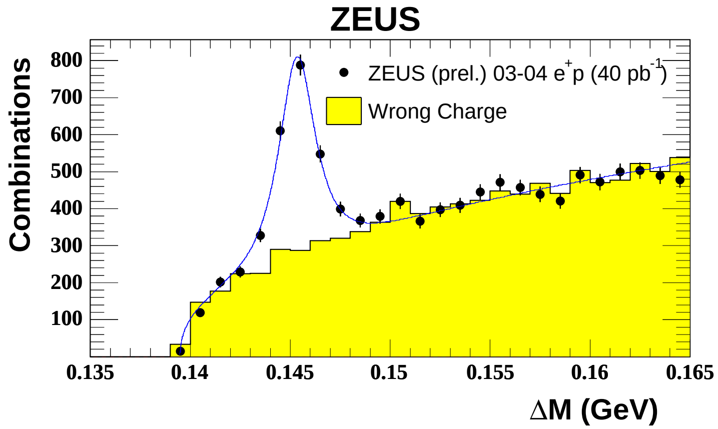


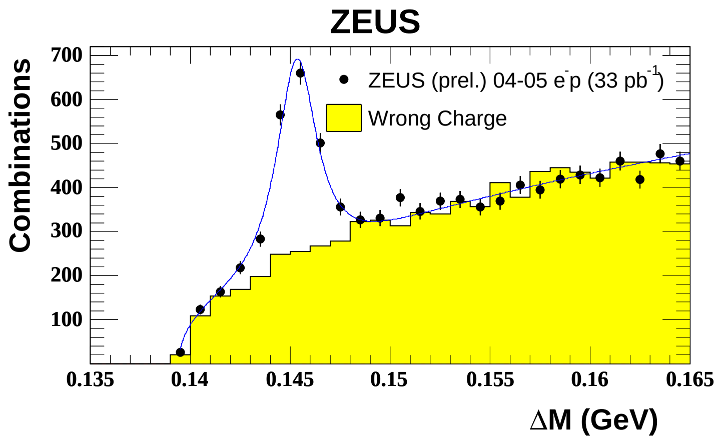
- Both b,$\bar{b}$ required to decay to muons, tagging dimuon suppresses background due to charm and light flavour production
- $\rightarrow$ can move to lower p_T^μ, i.e. low p_T^b.
- σ_{tot}^b above NLO prediction

$\sigma_{tot}^b(ep \rightarrow b\bar{b}X)[318\ GeV] =$
$16.1 \pm 1.8(stat.)^{+5.3}_{-4.8}(syst.)$ nb

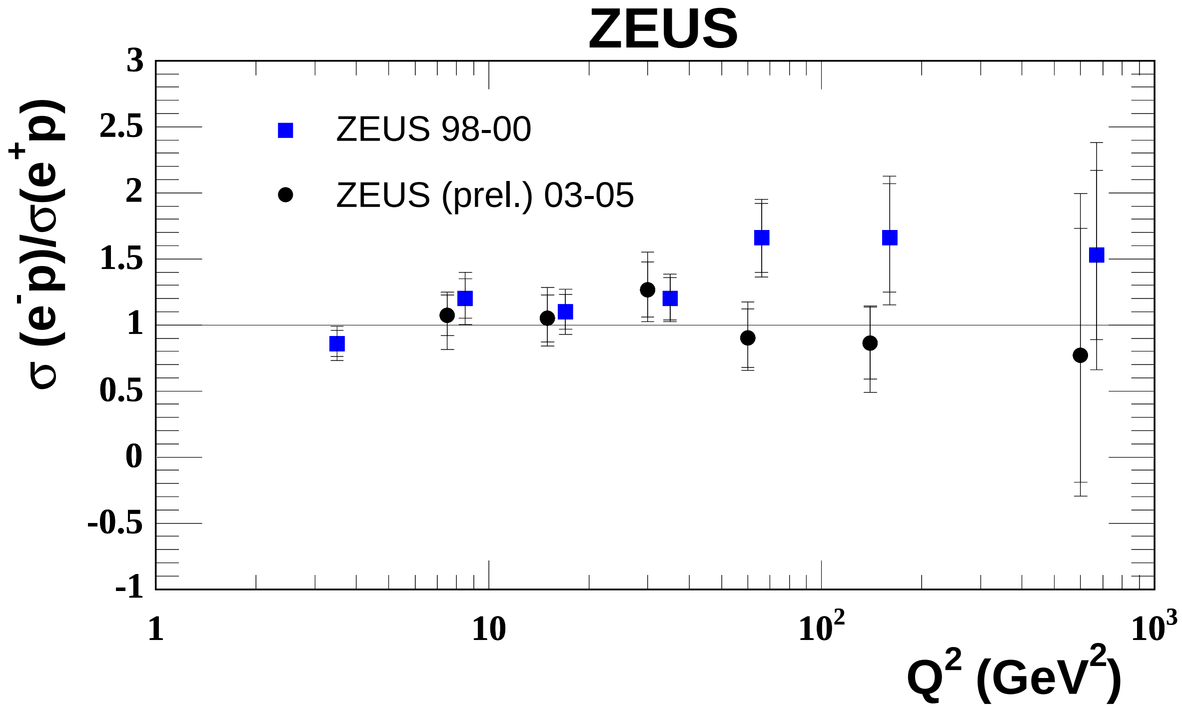
NLO (FMNR+HQVDIS) =
$6.9^{(+3.0)}_{(-1.8)}$ nb

HERA II: D^* production





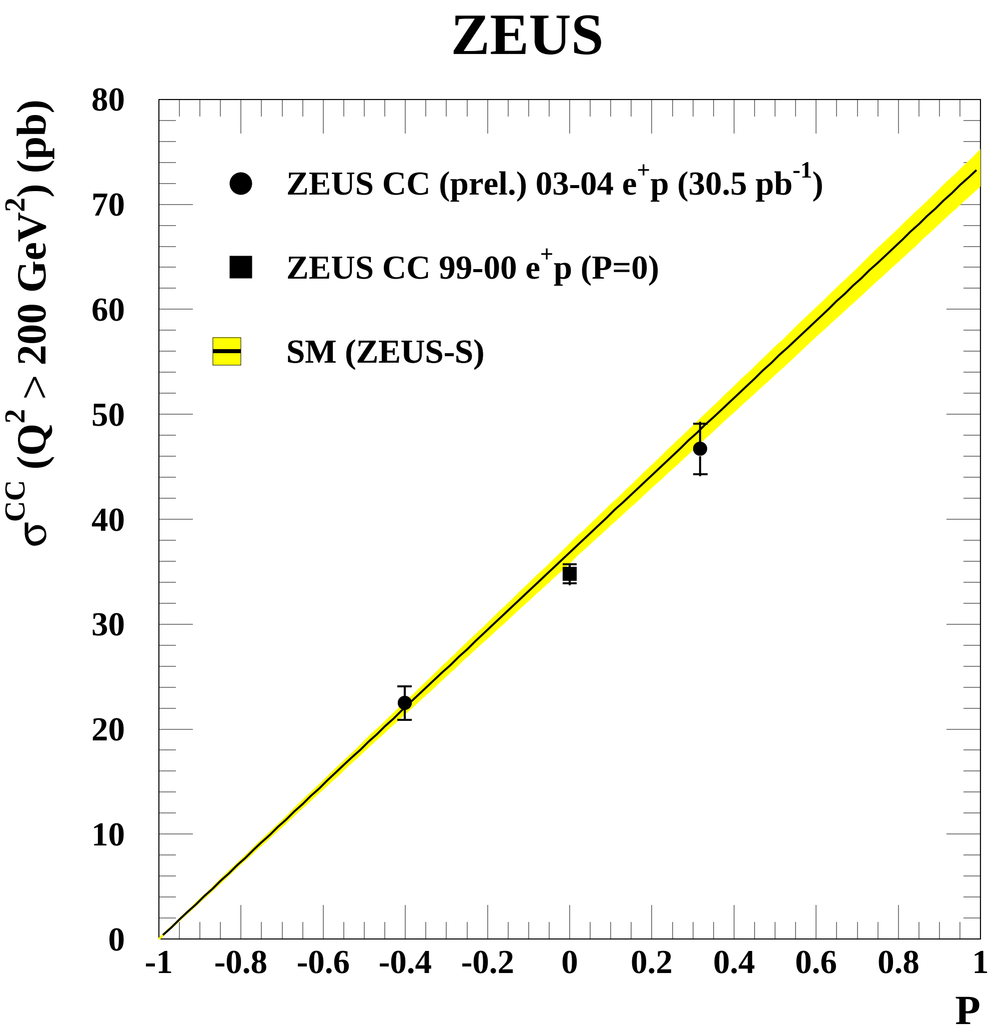
Data taken up to few weeks ago



Good agreement between e^+ and e^- for 03/05 data

Excess in 98-00 data not confirmed

HERA II: Charged Current



In the Standard Model:

$$\sigma^{\pm} = (1 \pm P)\sigma_{CC}(P = 0)$$
$$\sigma^{+}_{CC} \rightarrow 0 \text{ for } (P \rightarrow -1)$$

absence of right-handed W's

$$P = +32\% \quad 14.1\ pb^{-1}$$
$$P = -40\% \quad 16.4\ pb^{-1}$$

Measurements in agreement with ZEUS-S fit

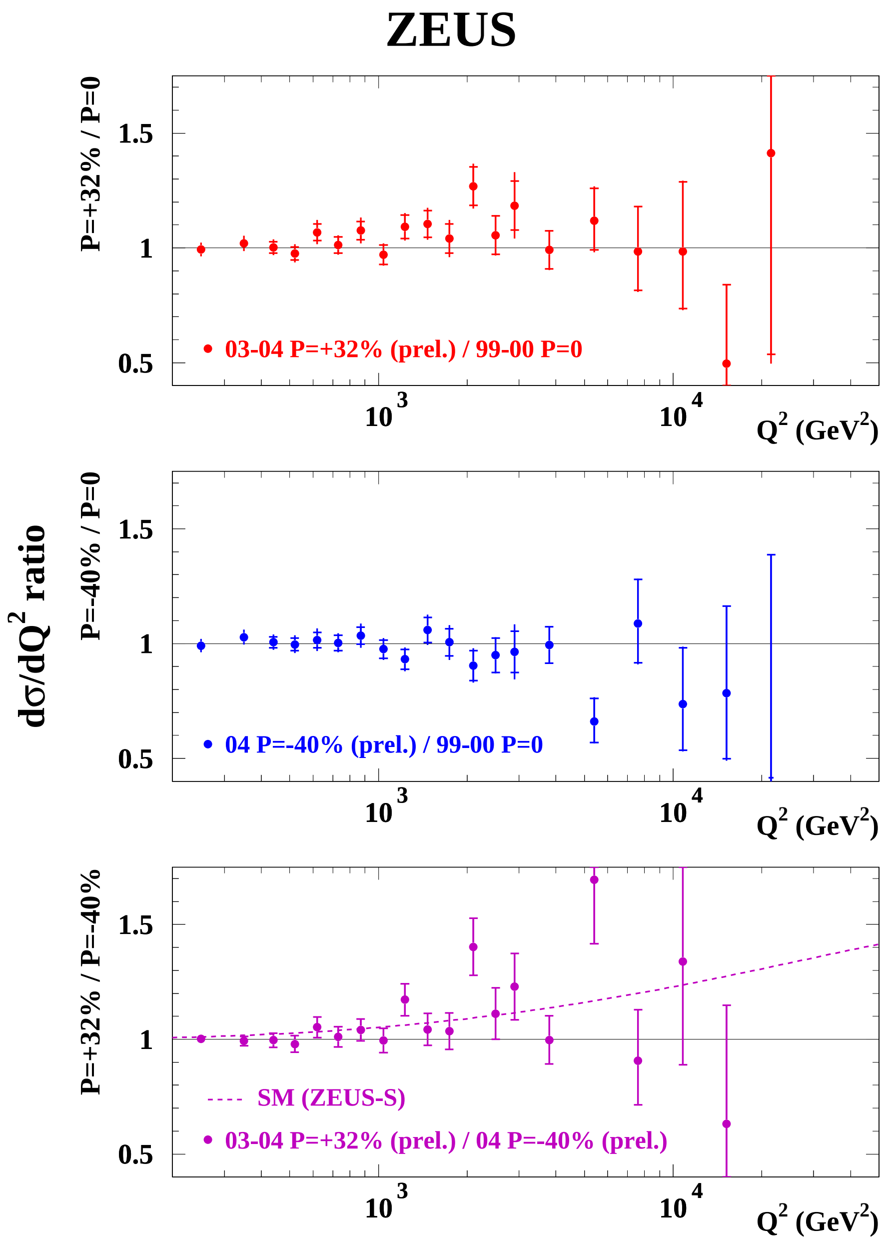
HERA II : Neutral Current

$$\frac{\sigma(P{=}+32\%)}{\sigma(P{=}0)} \text{ vs } Q^2$$

$$\frac{\sigma(P{=}-40\%)}{\sigma(P{=}0)} \text{ vs } Q^2$$

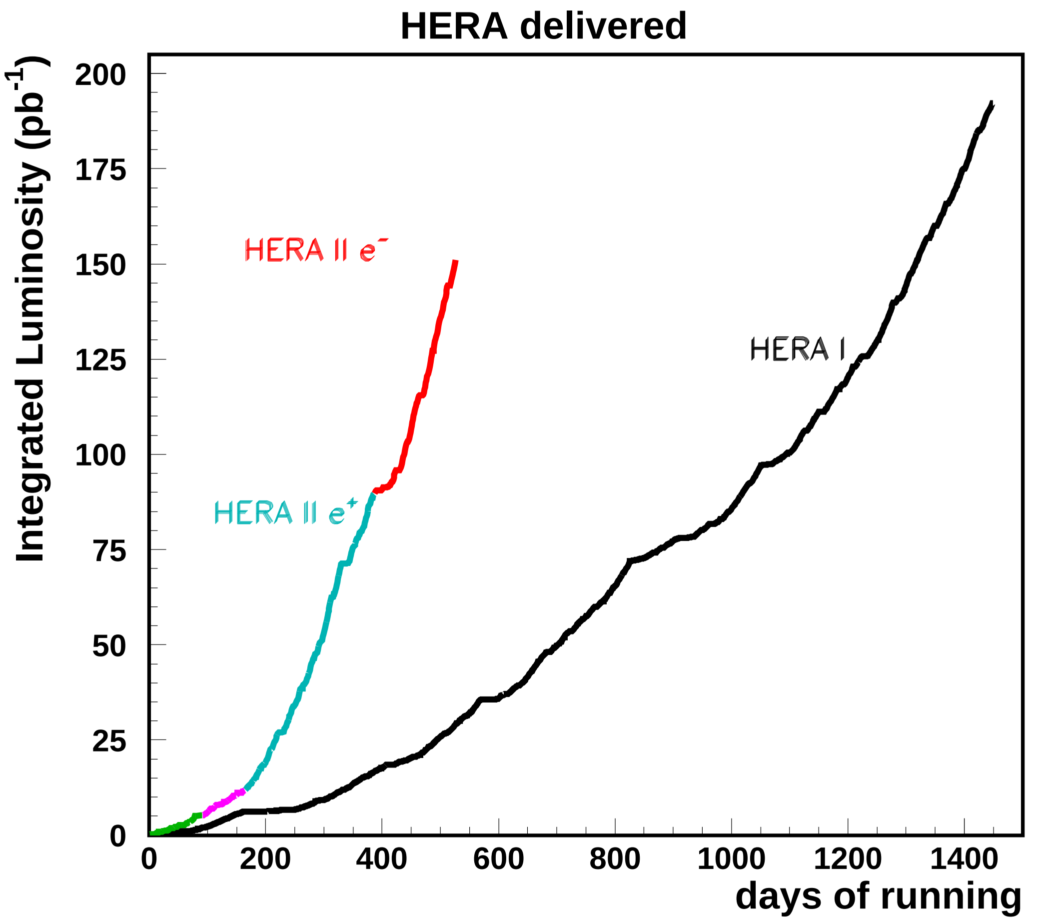
$$\frac{\sigma(P{=}+32\%)}{\sigma(P{=}-40\%)} \text{ vs } Q^2$$

Consistent with polarization dependence in NC



Outlook

Many more results and details $\longrightarrow$ see parallel sessions.



More exciting results soon with $e^- p$ data