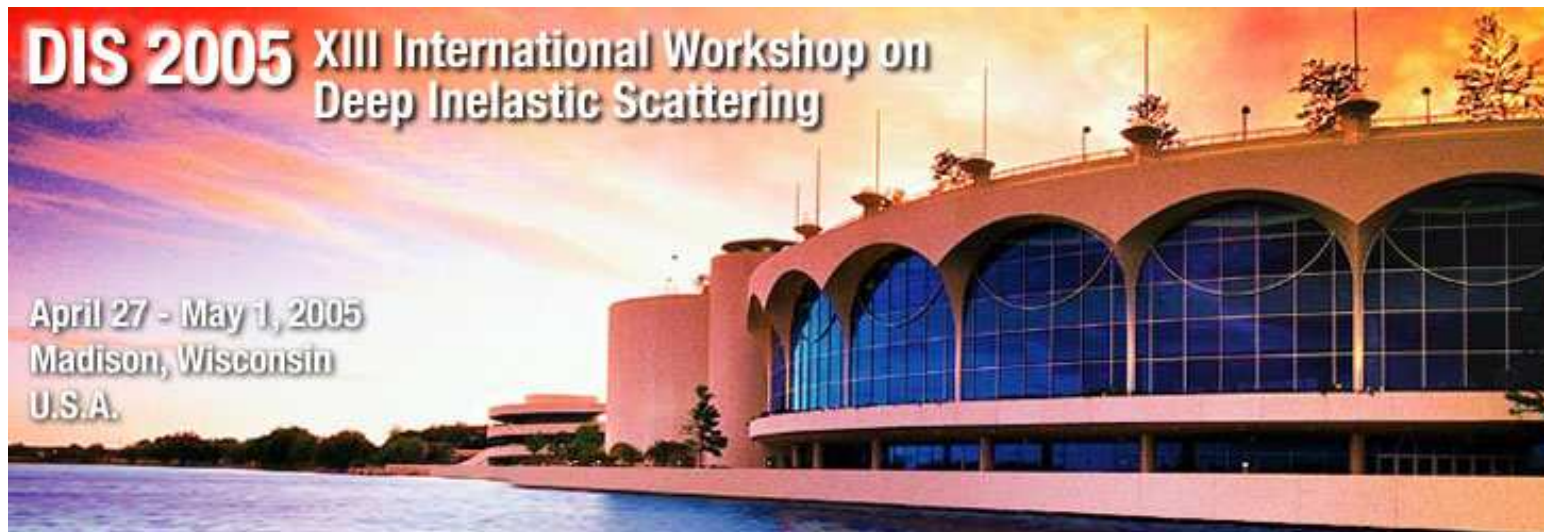


ZEUS Results

Elisabetta Gallo
INFN Firenze, Italy



Madison, 27/4/05

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

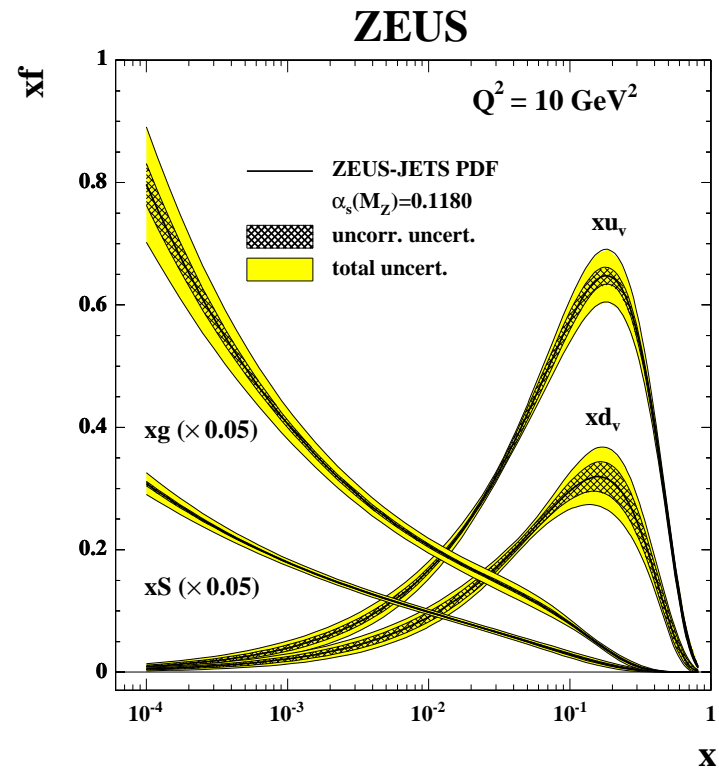
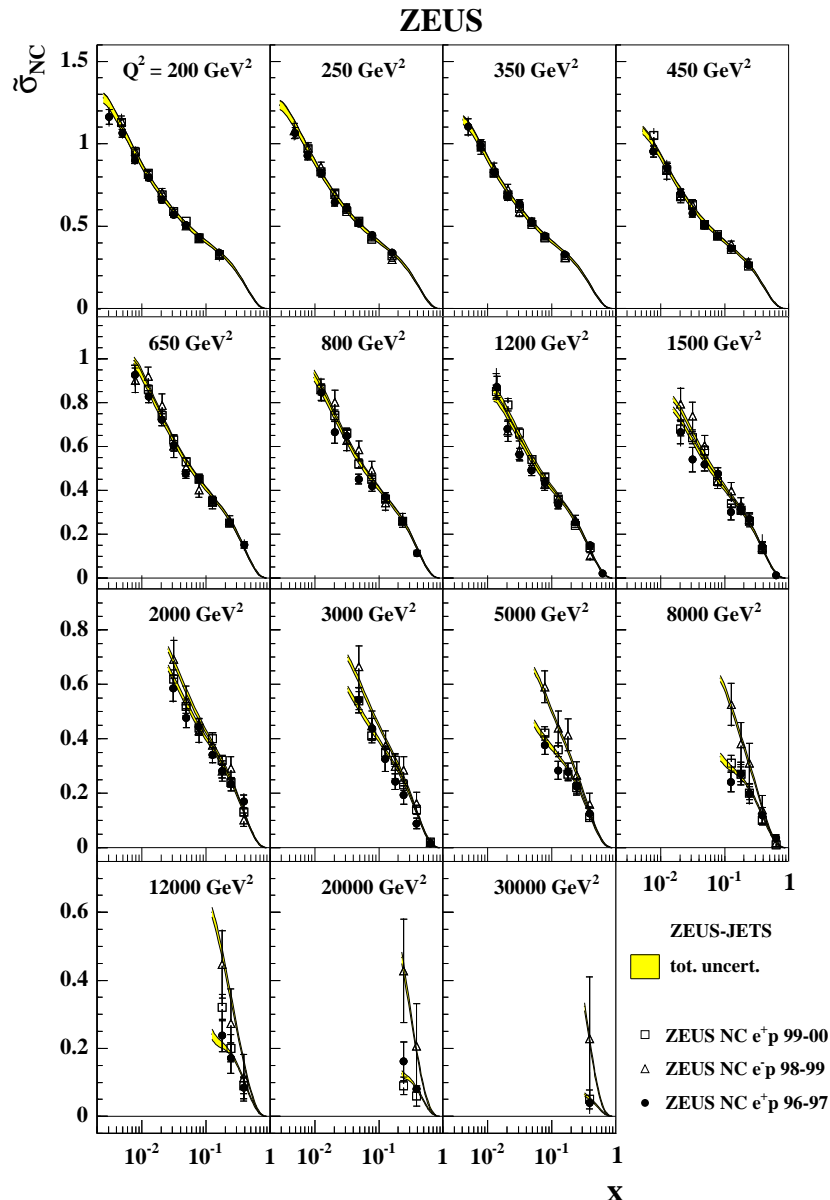
Results based on 130 pb^{-1} of $e^\pm p$ at HERA I
and on 45 pb^{-1} of $e^+ p$ and 33 pb^{-1} of $e^- p$ at HERA II.



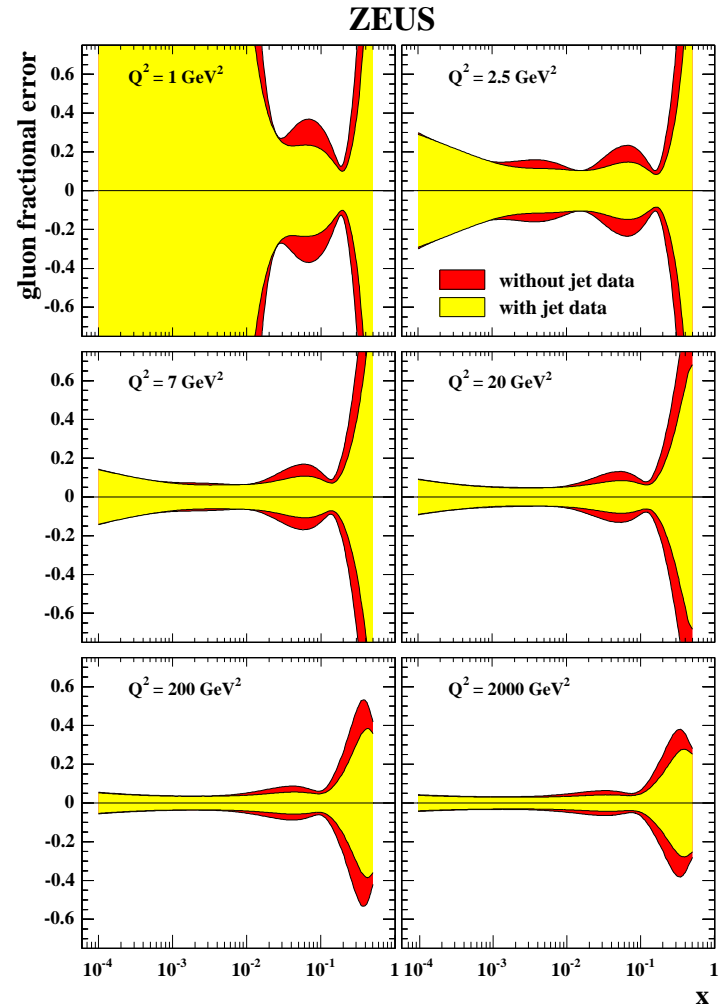
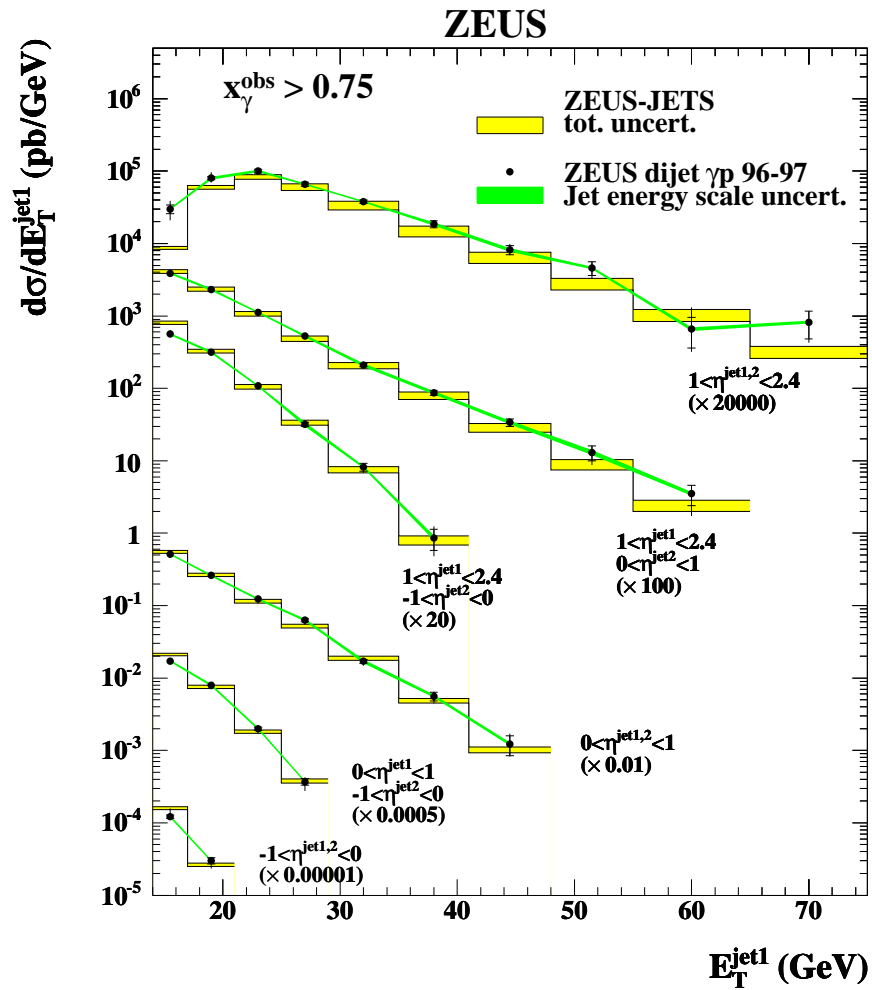
NLO QCD fits

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

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



NLO QCD fits

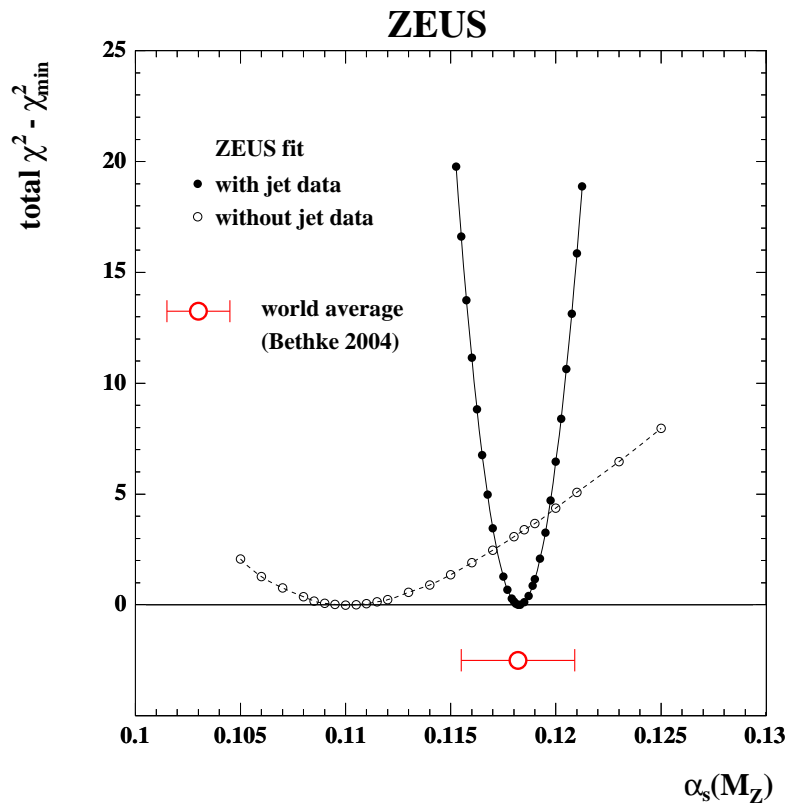


Energy scale uncertainty very small
Error on the jets cross-sections of the order of 5%

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



ZEUS-JETS- α_S fit:

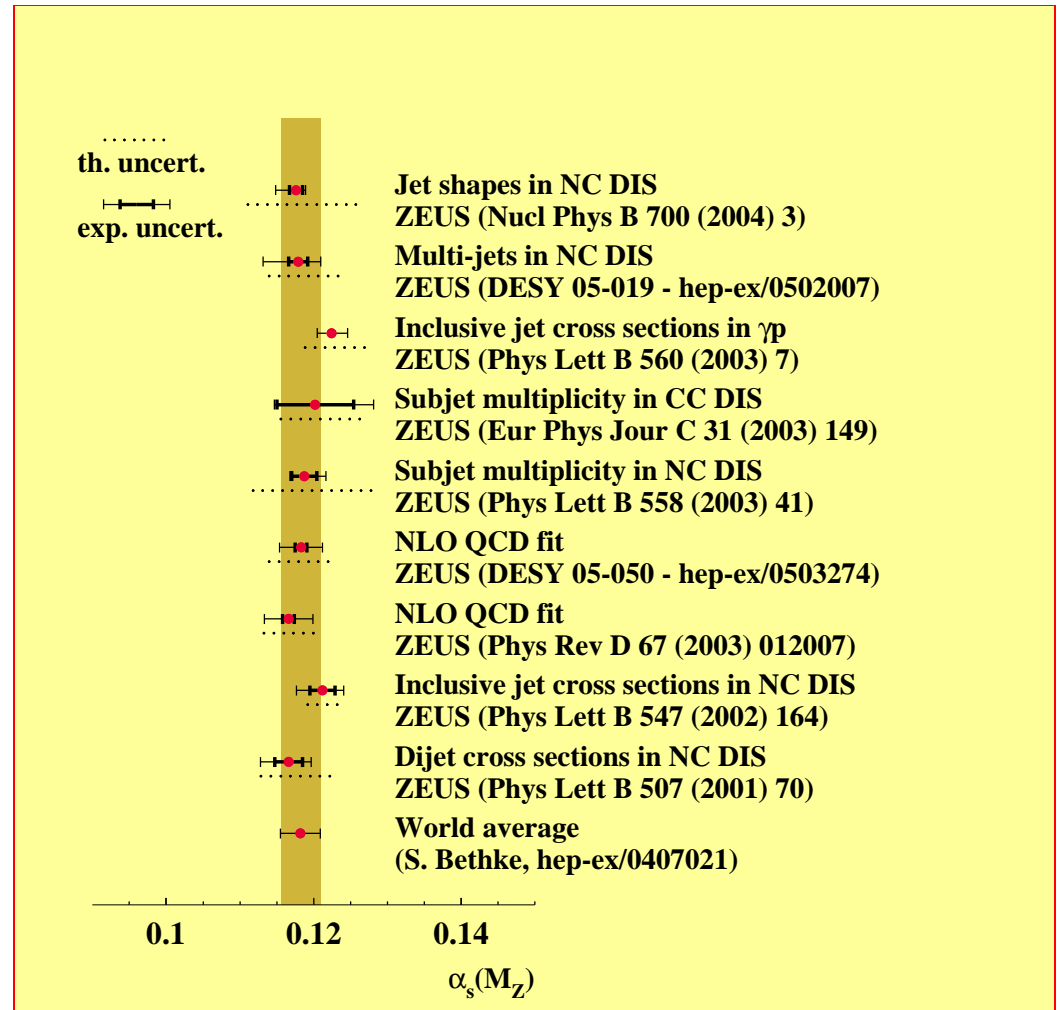


dijets and str. funct. data depend differently on α_S and $xg(x)$

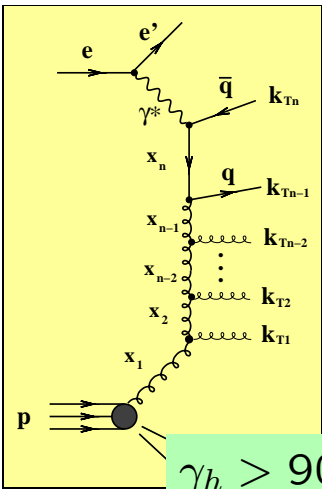
$$\rightarrow \alpha_S = 0.1183 \pm 0.0028(\text{exp.}) \pm 0.0008(\text{model}) \pm 0.005(\text{scale})$$

First extraction of α_S from HERA data alone

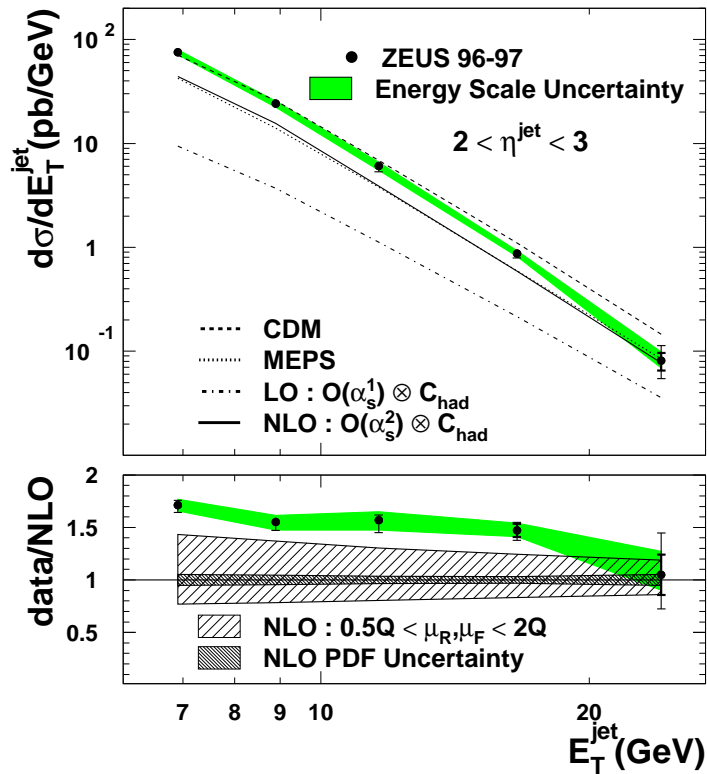
Summary of α_S at ZEUS:



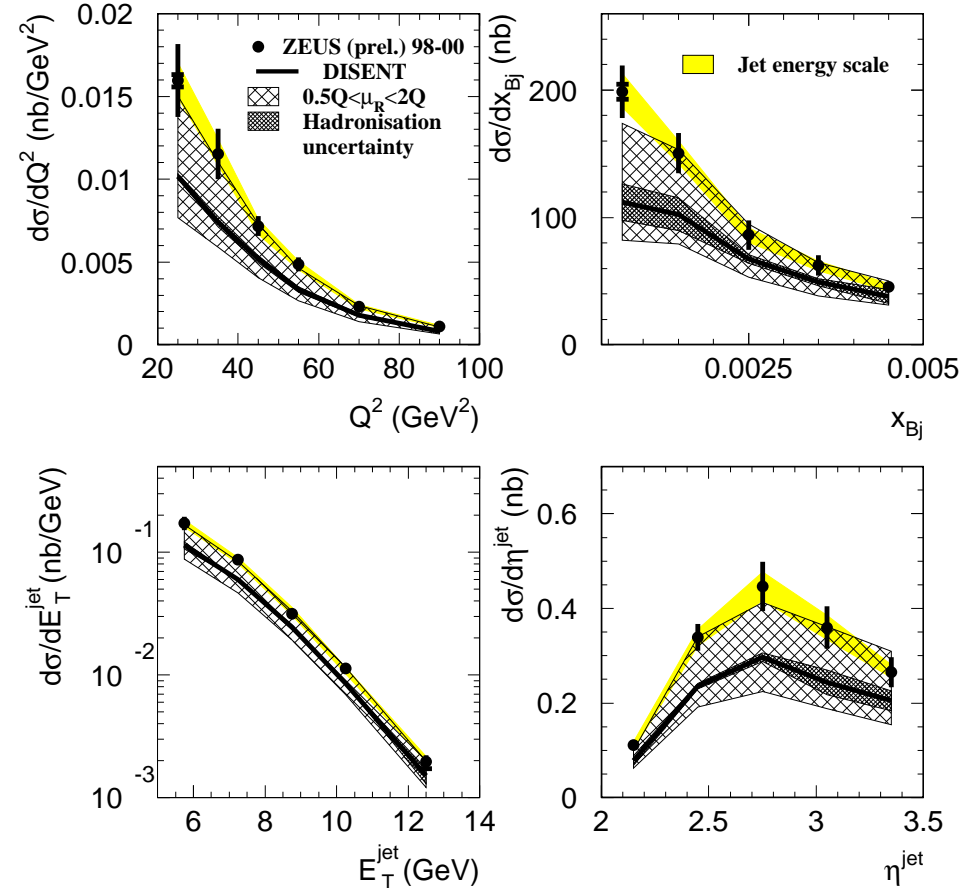
BFKL-DGLAP in low- x forward jets



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



ZEUS

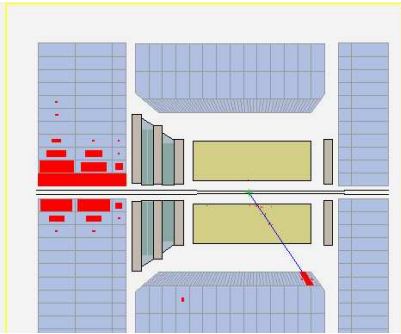


$$E_{T,\text{jet}}^2 \simeq Q^2, x_{\text{jet}} \gg x, 2 < \eta_{\text{jet}} < 3.5 \text{ (FPC)}$$

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

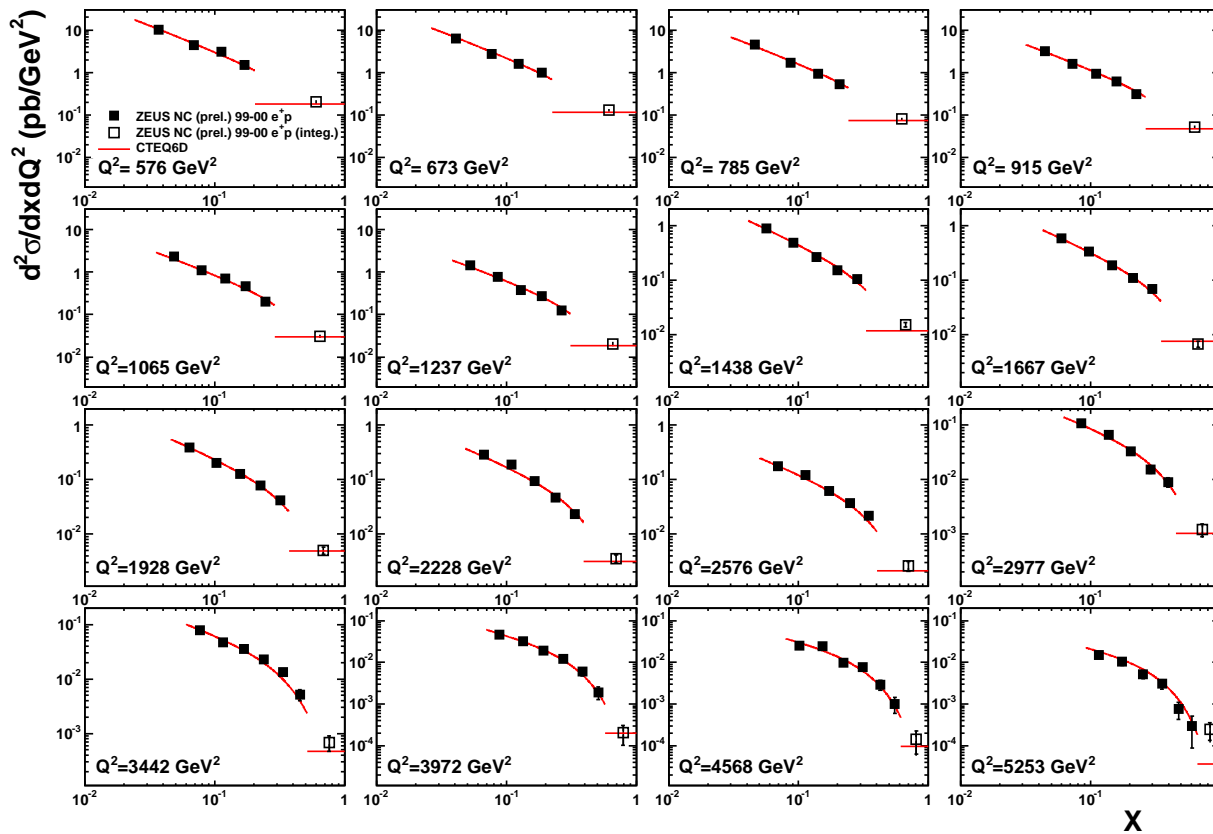


Very high- x in NC



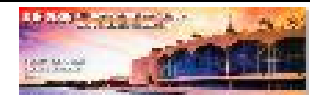
- Q^2 reconstructed from electron
- If jet inside detector, x from E_{jet}, θ_{jet}
- If jet outside, take integral $x_{limit} < x < 1$ (last bin)
- Extend to $x > \simeq 0.4$

ZEUS

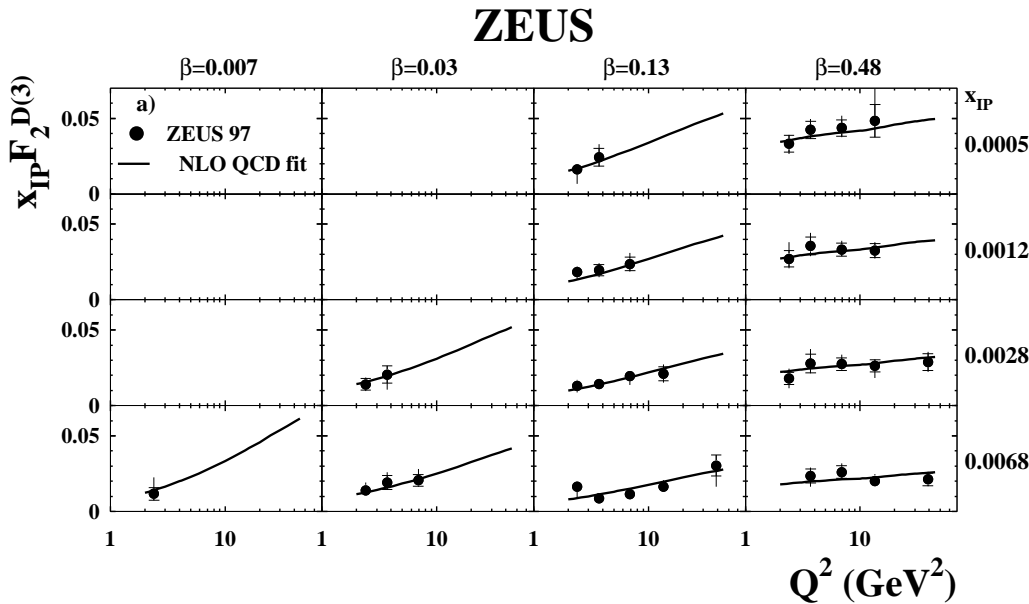
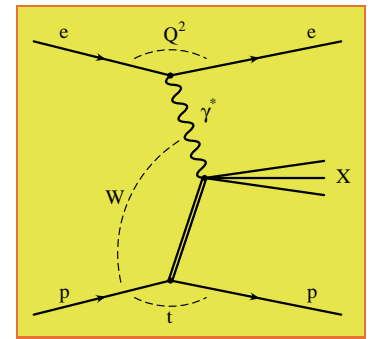


First measurement of very high- x at HERA, important for valence quarks

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



Diffractive structure functions



- 10% of DIS events are diffractive, LPS data, NLO QCD fit to extract the diffractive pdfs

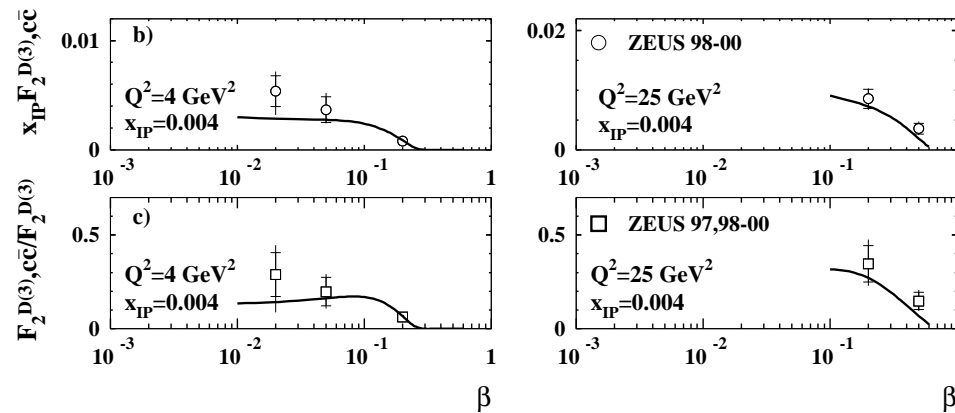
$$F_2^D(3) = f_{IP}(x_{IP}) F_{IP}^2(\beta, Q^2)$$

- charm data essential to constrain gluon. Gluon contribution

$$= 82 \pm 8_{-16}^{+5} \% \text{ at } Q^2 = 2 \text{ GeV}^2.$$

- QCD fit describes $F_2^D(3)$ and $F_2^{D(3)cc}$ \rightarrow diffractive hard scattering factorization

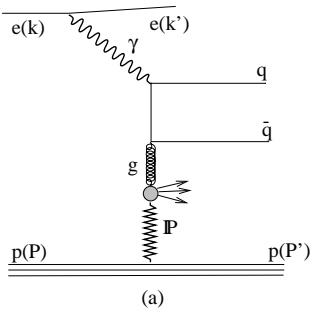
- Can diffractive pdfs describe djet-production?



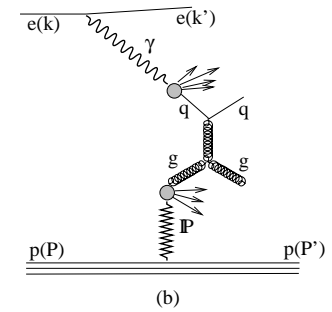
NLO QCD fit for $Q^2 > 2 \text{ GeV}^2, x_p < 0.01$



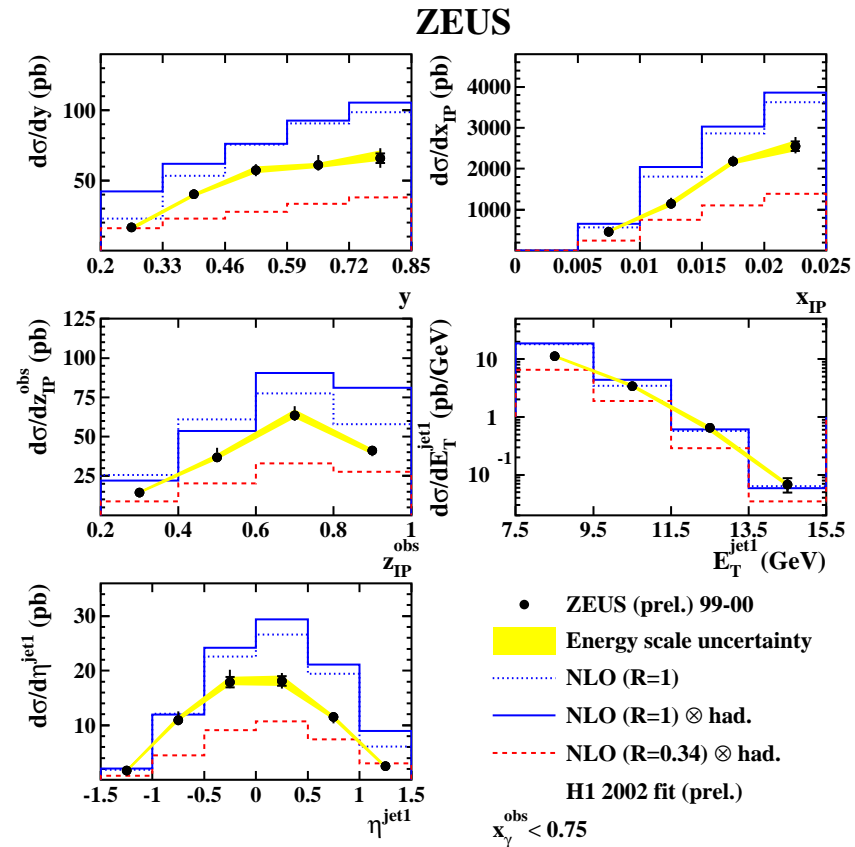
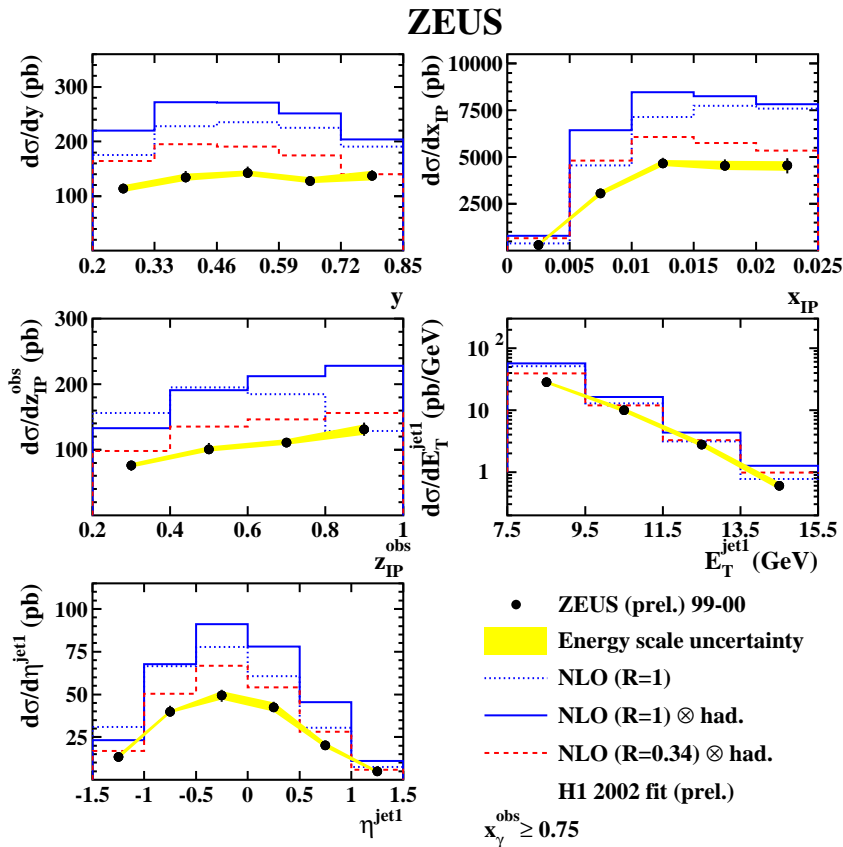
Diffractive γp dijets



$$x_\gamma > 0.75$$



$$x_\gamma < 0.75$$

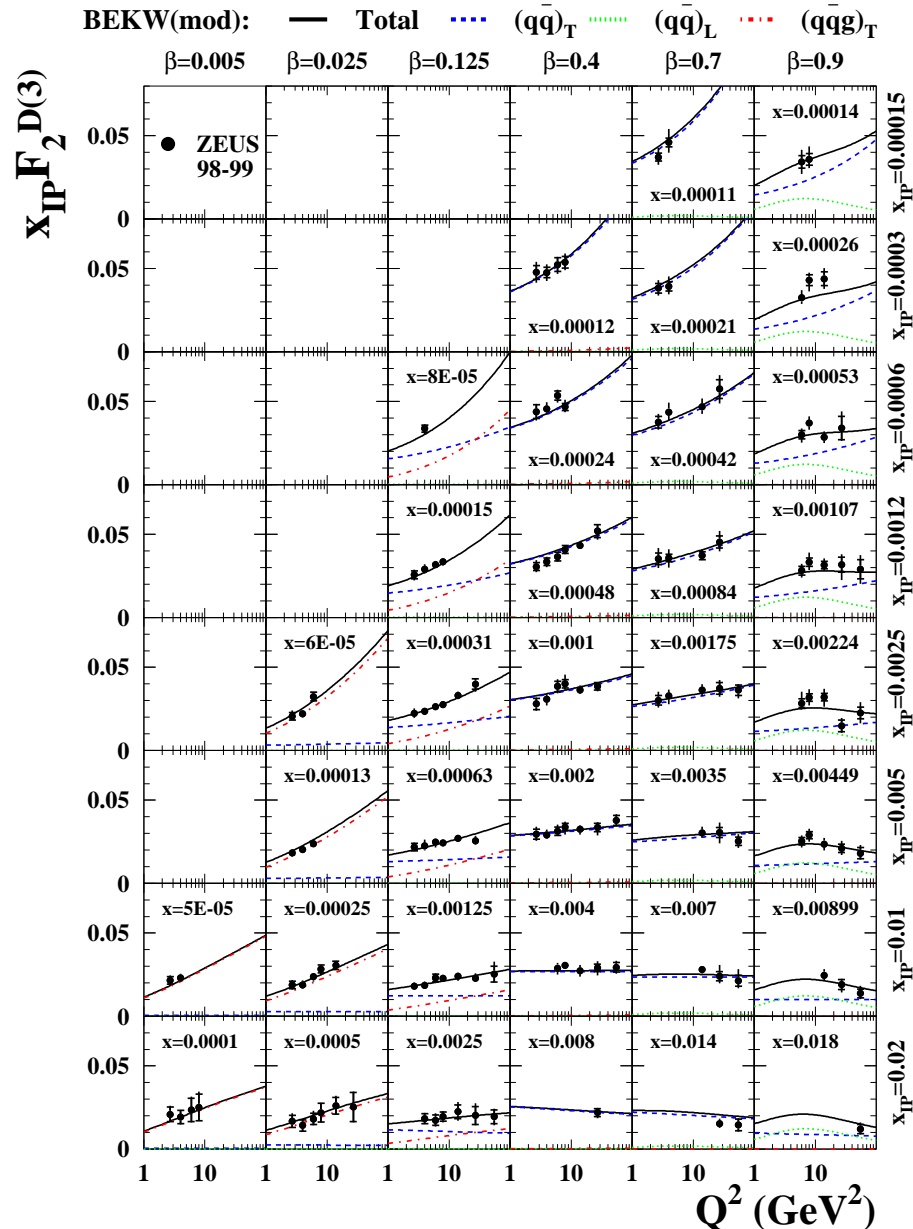


NLO QCD predictions (KIKr+H1 2002 fit) describe shape, but overall suppression factor of $R \simeq 0.5$ is needed, for resolved (close to pp collisions) but also for direct.



Diffractive structure functions

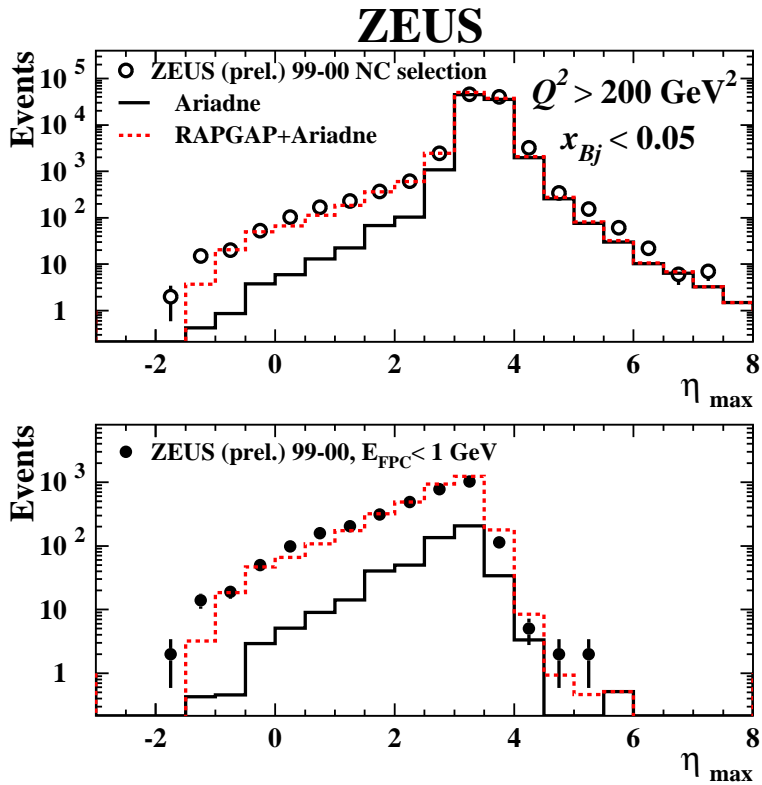
ZEUS



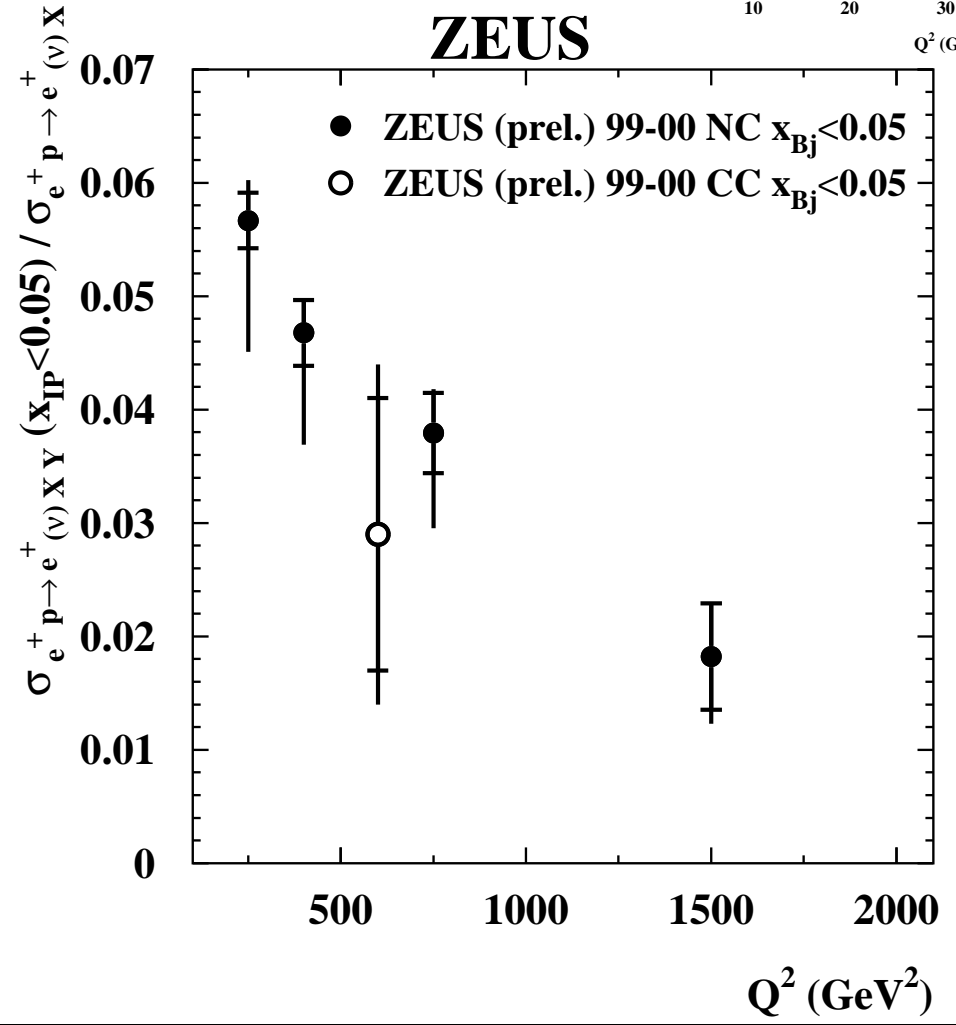
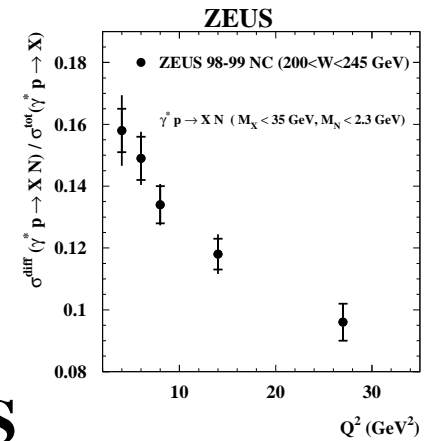
- $F_2^D(3)$ determined with the $\ln M_x$ method, larger kinematic range, lower $Q^2 (> 2 \text{ GeV}^2)$, higher M_X up to 35 GeV (extension in η due to the FPC $5 < \eta < 4$), high statistics
- Positive scaling violations \longrightarrow confirm perturbative effects
- At fixed β , $x_{IP} F_2^D(3)$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



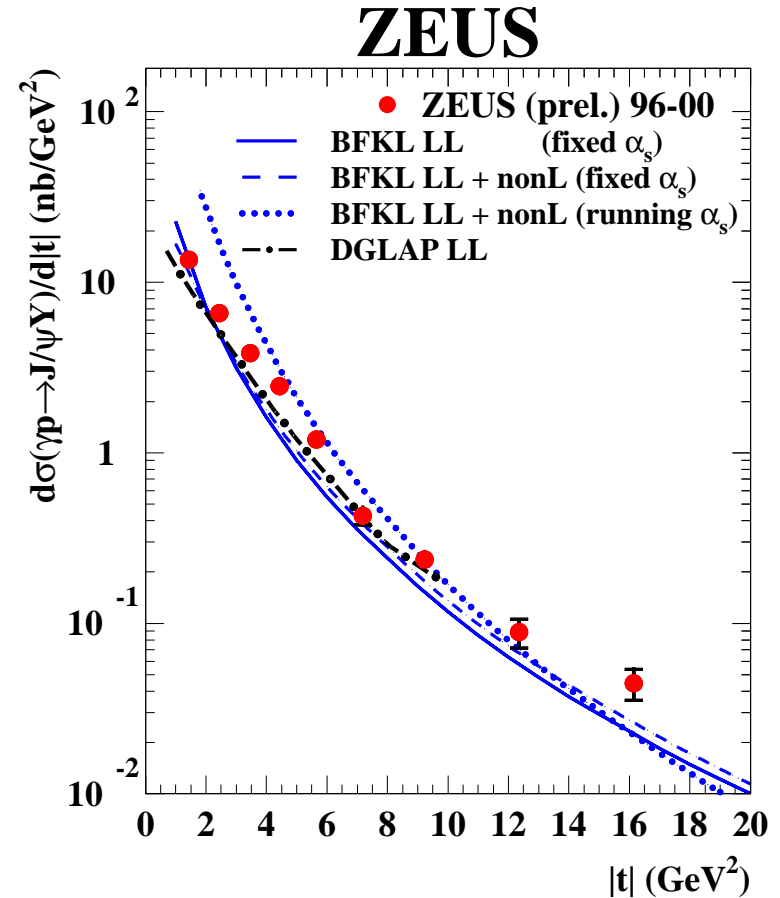
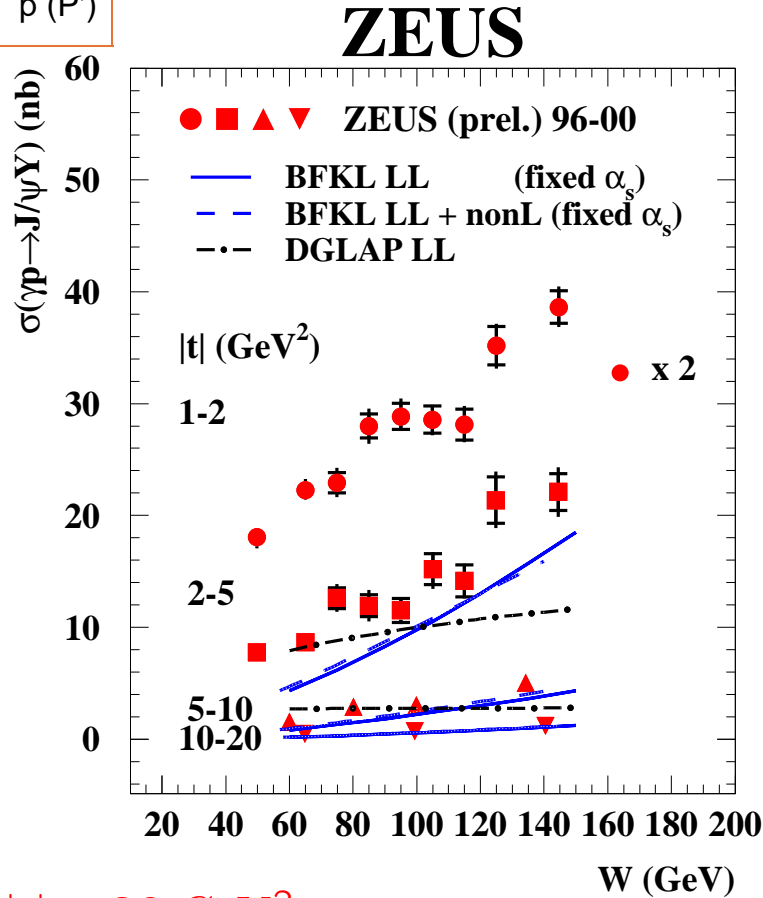
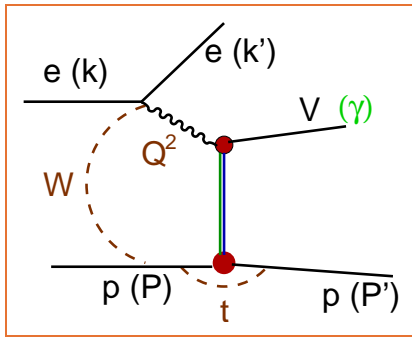
Diffraction at High Q^2



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



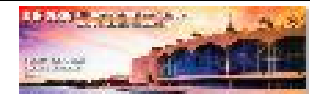
J/ψ production at high t



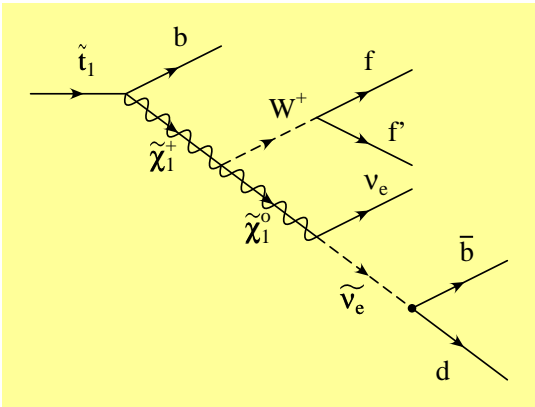
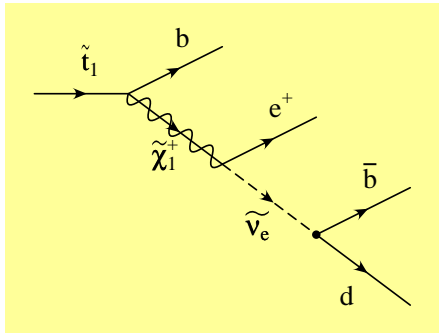
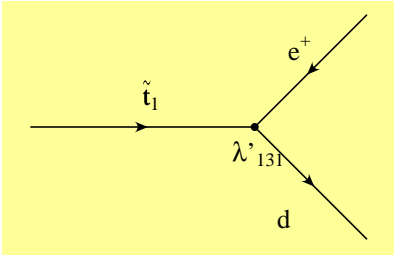
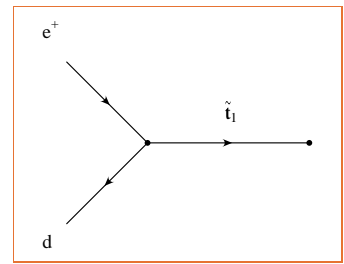
J/ψ in γp at $1 < |t| < 20 \text{ GeV}^2$

$50 < W < 150 \text{ GeV}, z > 0.95$

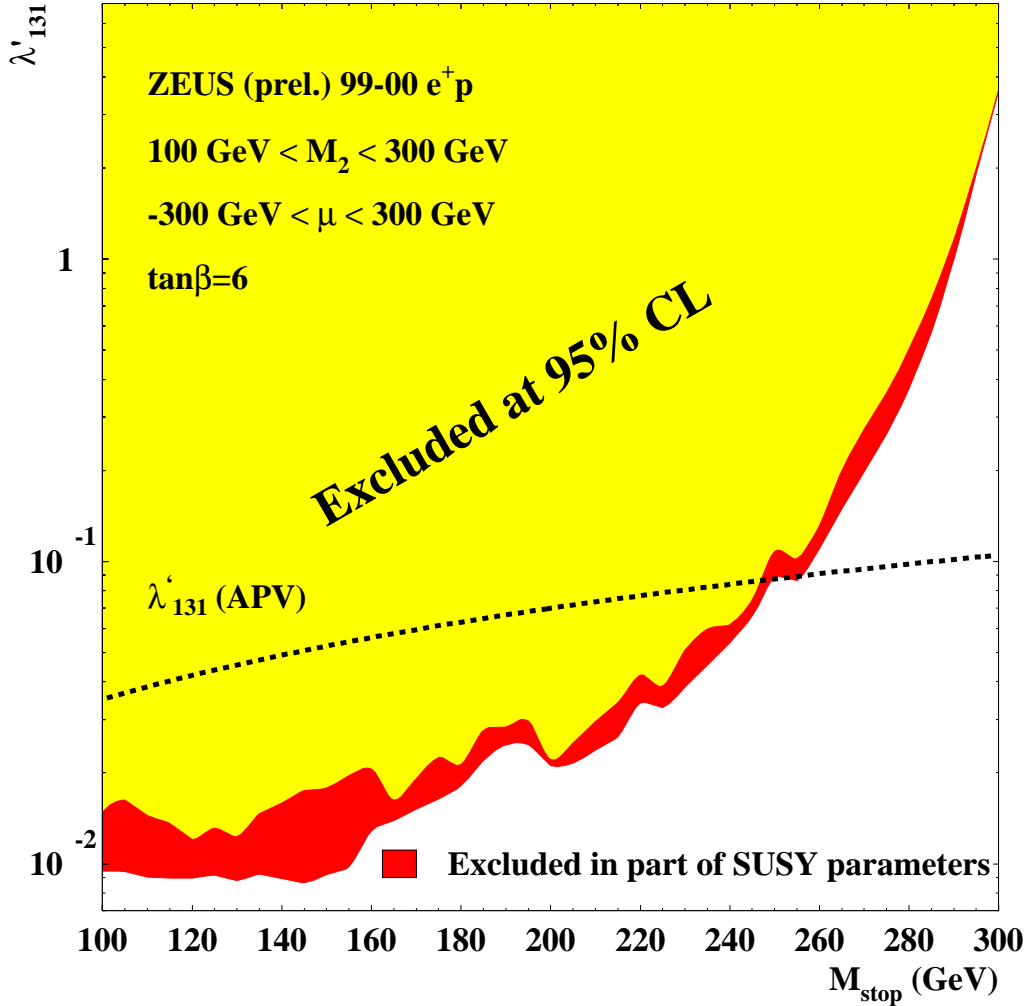
BFKL gives reasonable description
DGLAP does not describe rise with W



Search for R_p -violating SUSY-I



ZEUS

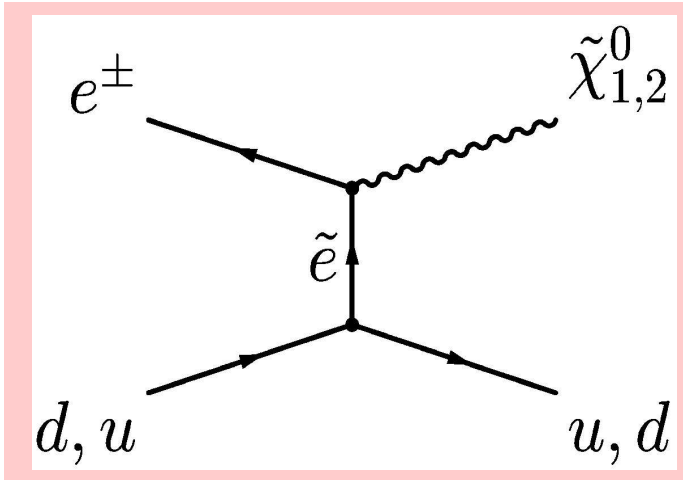


All topologies e-J, e-MJ, ν -MJ
 searched for
 No evidence found, limit on stop



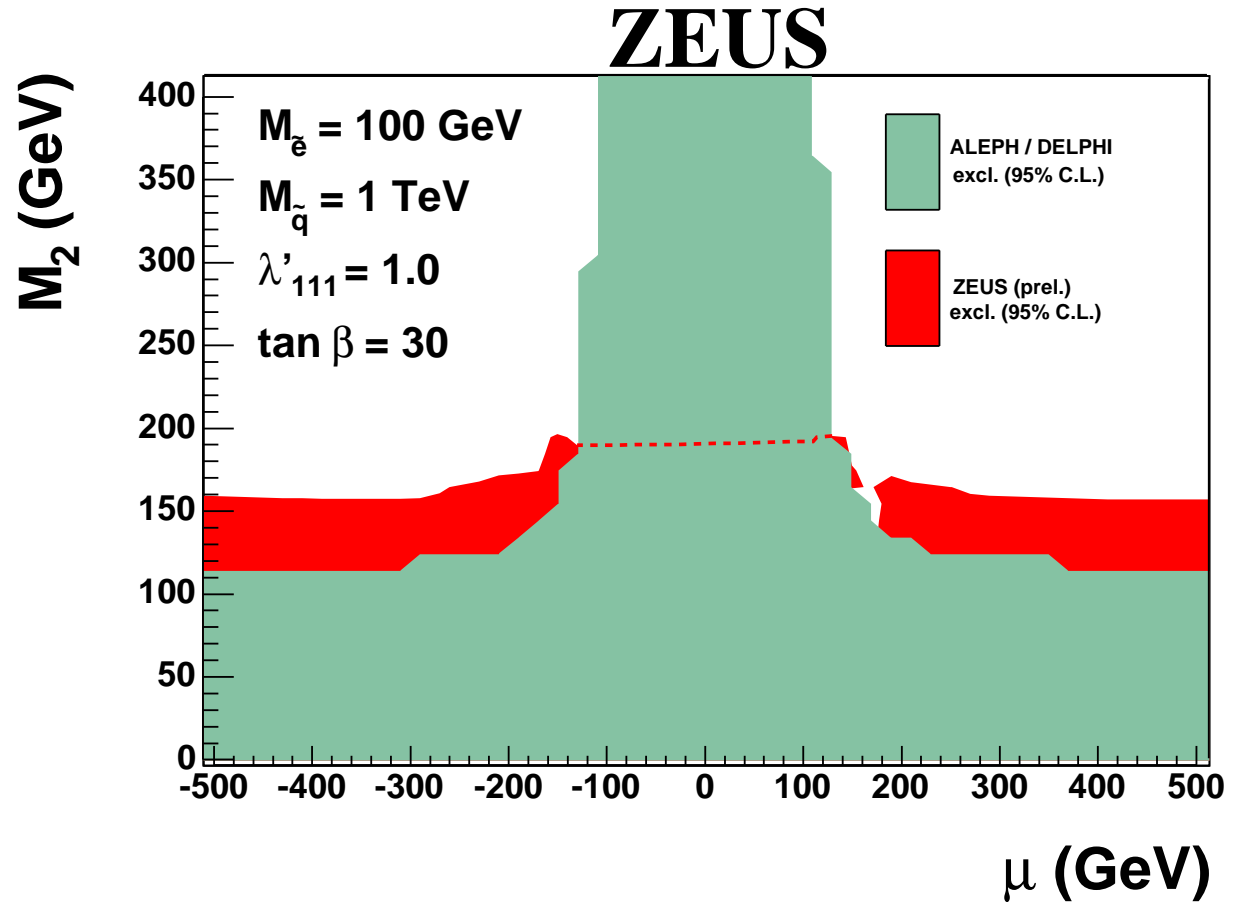
Search for R_p -violating SUSY-II

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 $M(\chi^\pm) > 103 \text{ GeV}$.



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, $Q_{12}^2 = -(p_1 - p_2)^2$

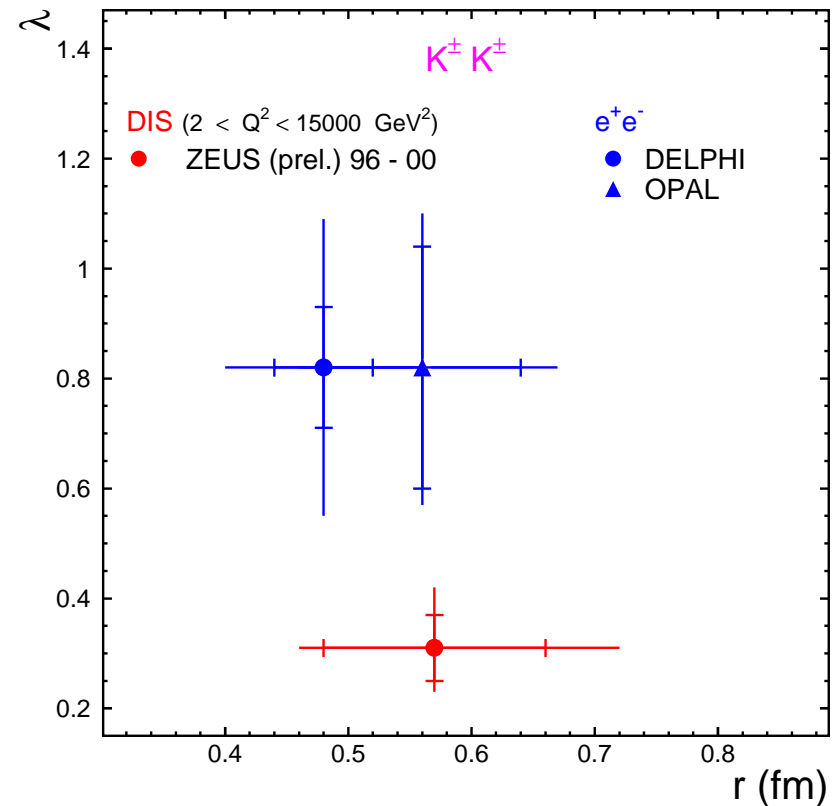
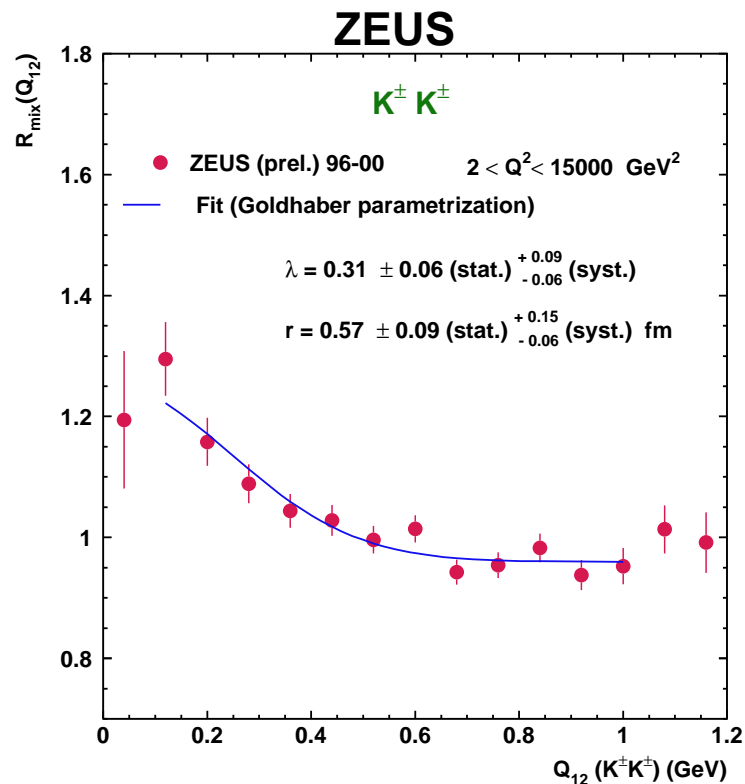
Double ratio: Ref sample=mixed sample with pairs of kaons (no BEC)

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

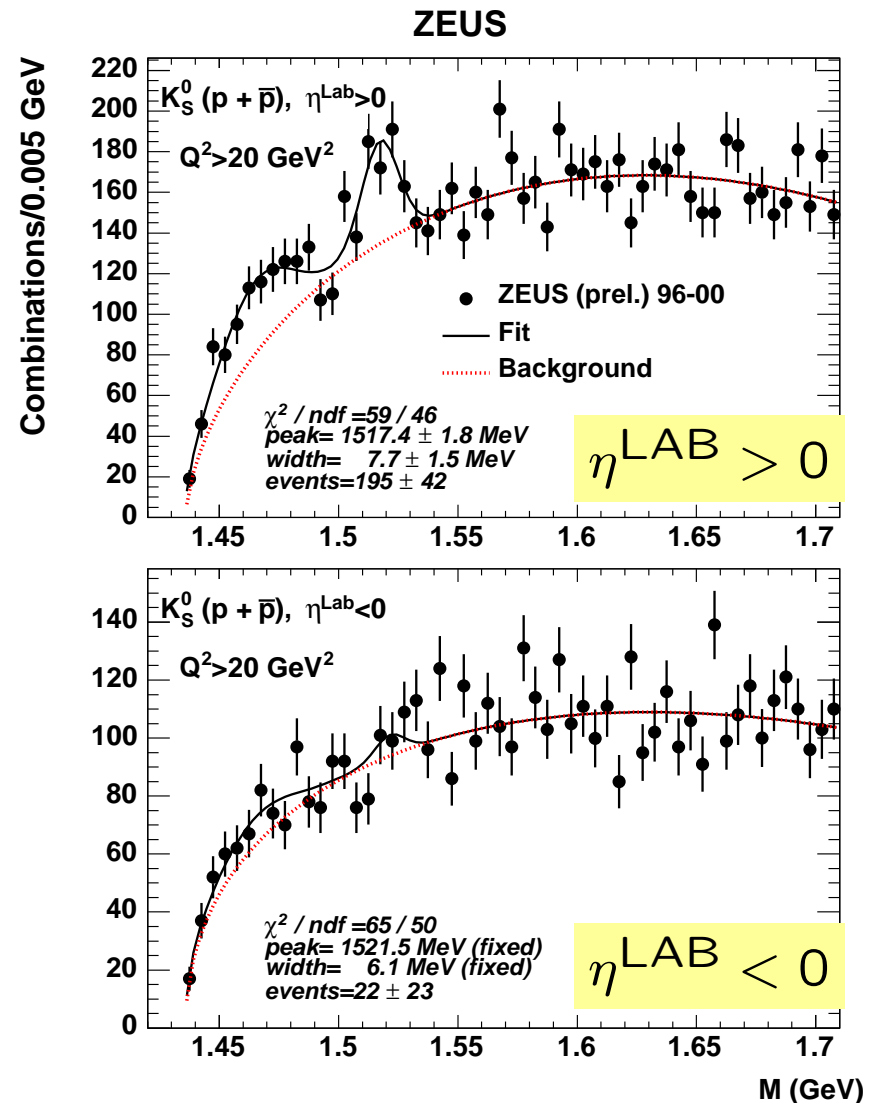
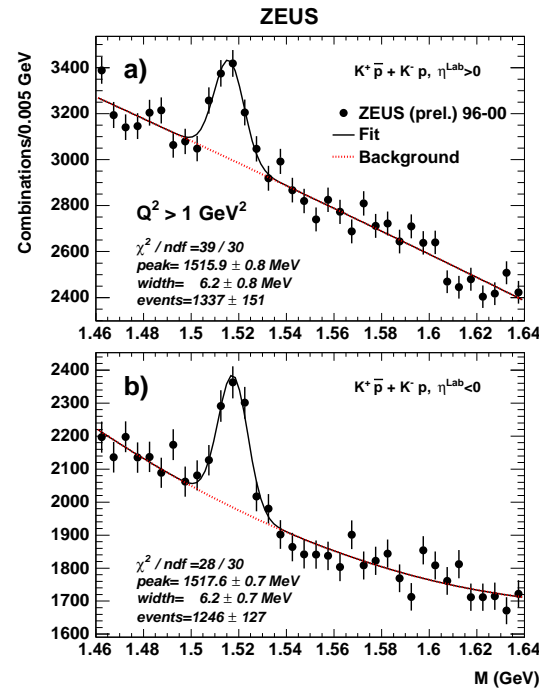
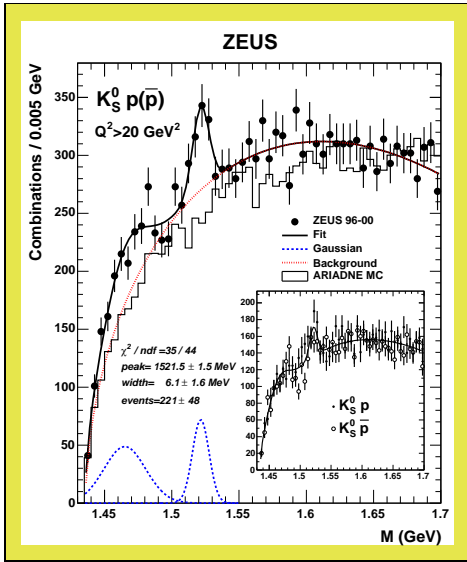
λ measure of the coherence

r radius of emitting source

Comparison to e^+e^- shows different $\lambda \rightarrow$
ZEUS mainly target region



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



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

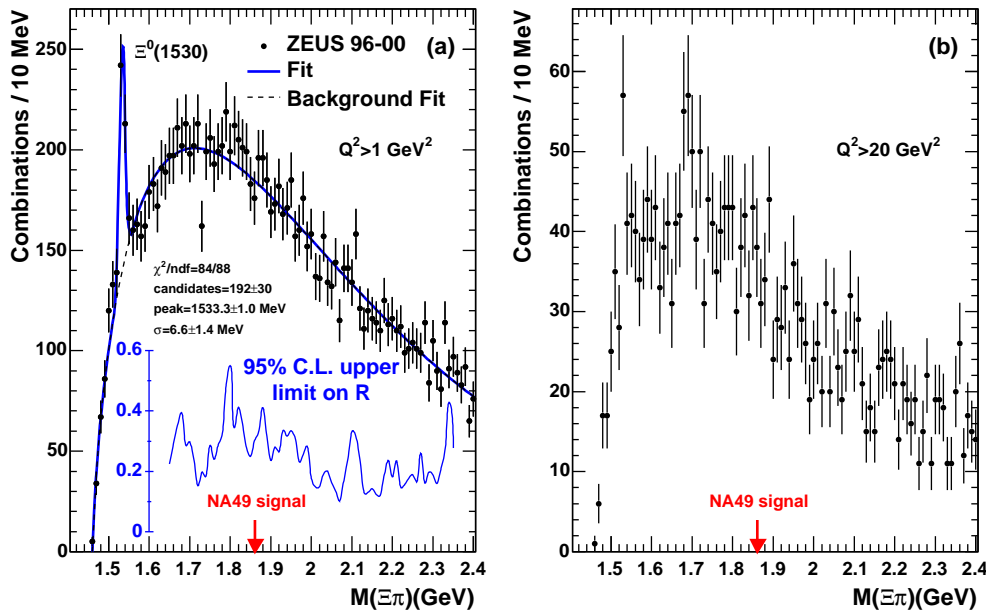
Trying to understand production mechanism

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



Other pentaquark searches at ZEUS

ZEUS



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

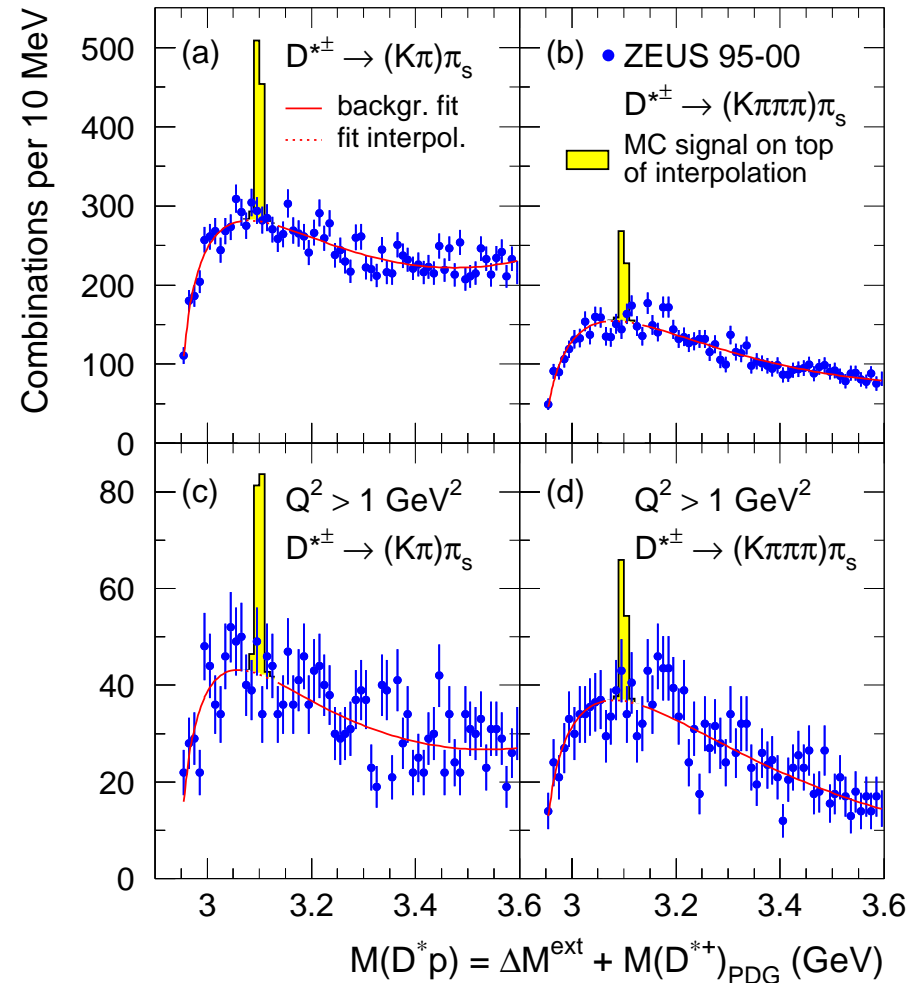
Upper limit R=

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

< 0.29 at 95% CL around 1860 GeV.

but fragmentation region, does not contradict NA49

ZEUS



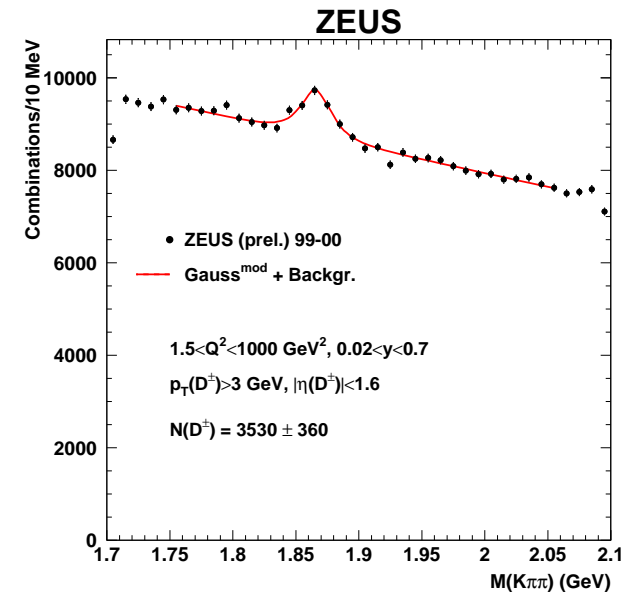
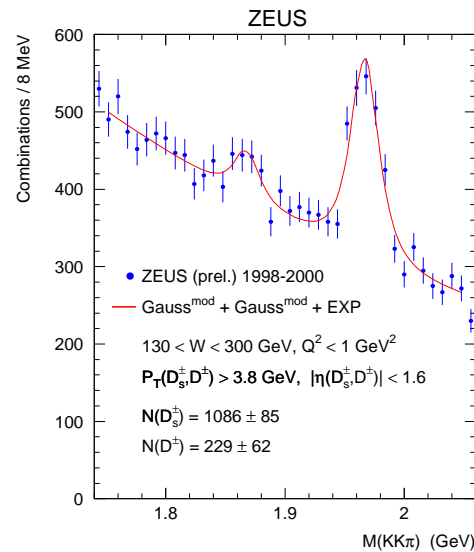
No evidence for Θ_c in $> 60000 D^*$ candidates



Charm fragmentation fractions

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

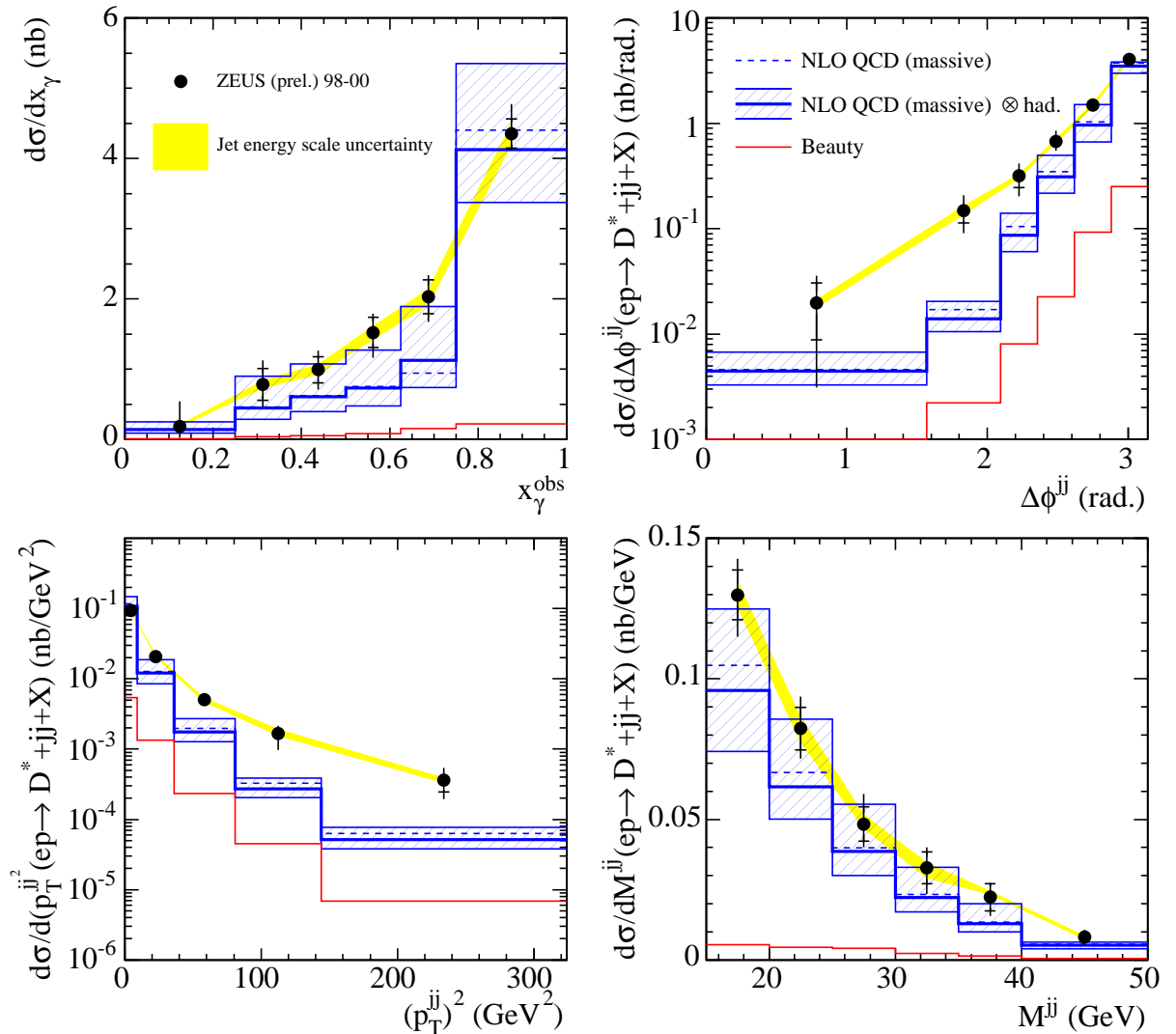
In agreement with universal charm fragmentation fractions



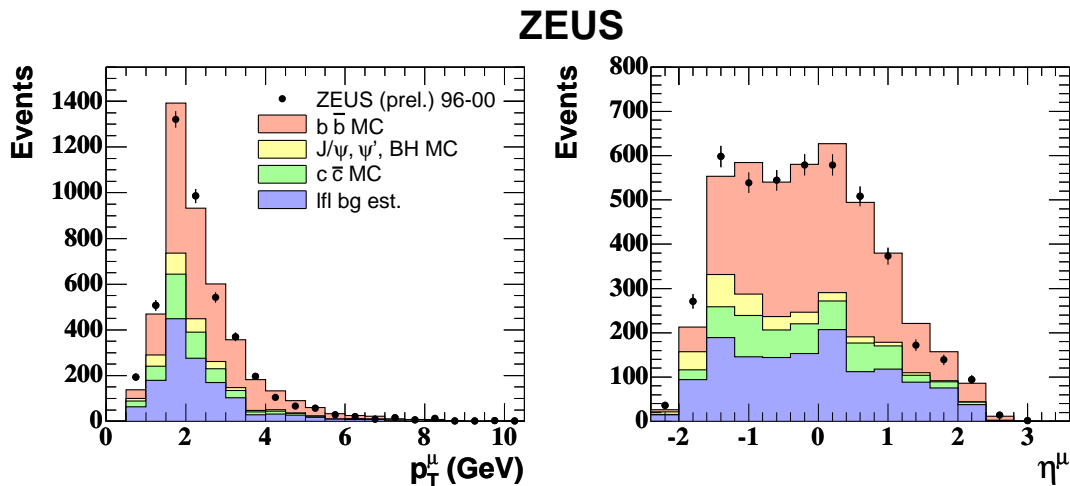
Charm jets in γp

- 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.

ZEUS



Beauty production in dimuon



● data

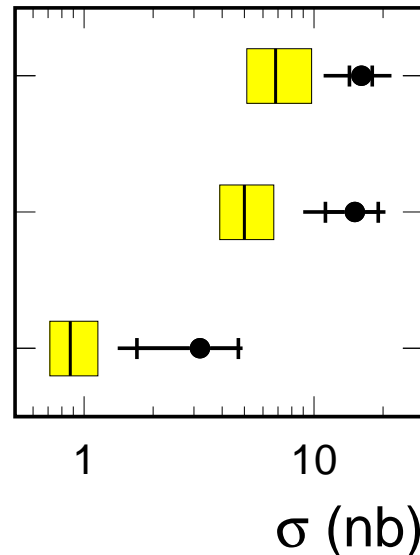
■ NLO QCD

ZEUS

$\sigma_{tot}(ep \rightarrow b\bar{b}X)$, ZEUS (prel.) 96-00 $\mu\mu$

$\sigma(ep \rightarrow b \text{ or } \bar{b} X)$, ZEUS (prel.) 96-00 $D^*\mu$
 $Q^2 < 1 \text{ GeV}^2$, rap. $\zeta^b < 1$, $0.05 < y < 0.85$

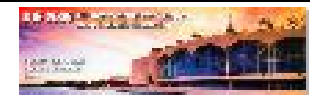
$\sigma(ep \rightarrow b \text{ or } \bar{b} X)$, ZEUS (prel.) 96-00 $D^*\mu$
 $Q^2 > 2 \text{ GeV}^2$, rap. $\zeta^b < 1$, $0.05 < y < 0.7$



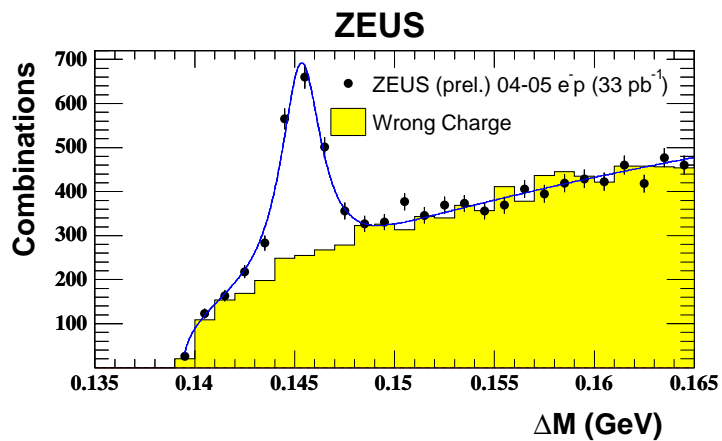
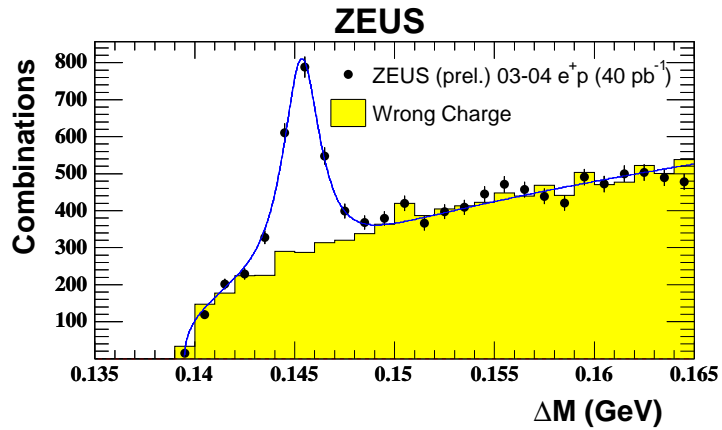
- Both b, \bar{b} required to decay to muons, tagging dimuon suppresses background due to charm and light flavour production
- \rightarrow can move to lower p_T^μ , i.e. low p_T^b .
- σ_{tot}^b above NLO prediction

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

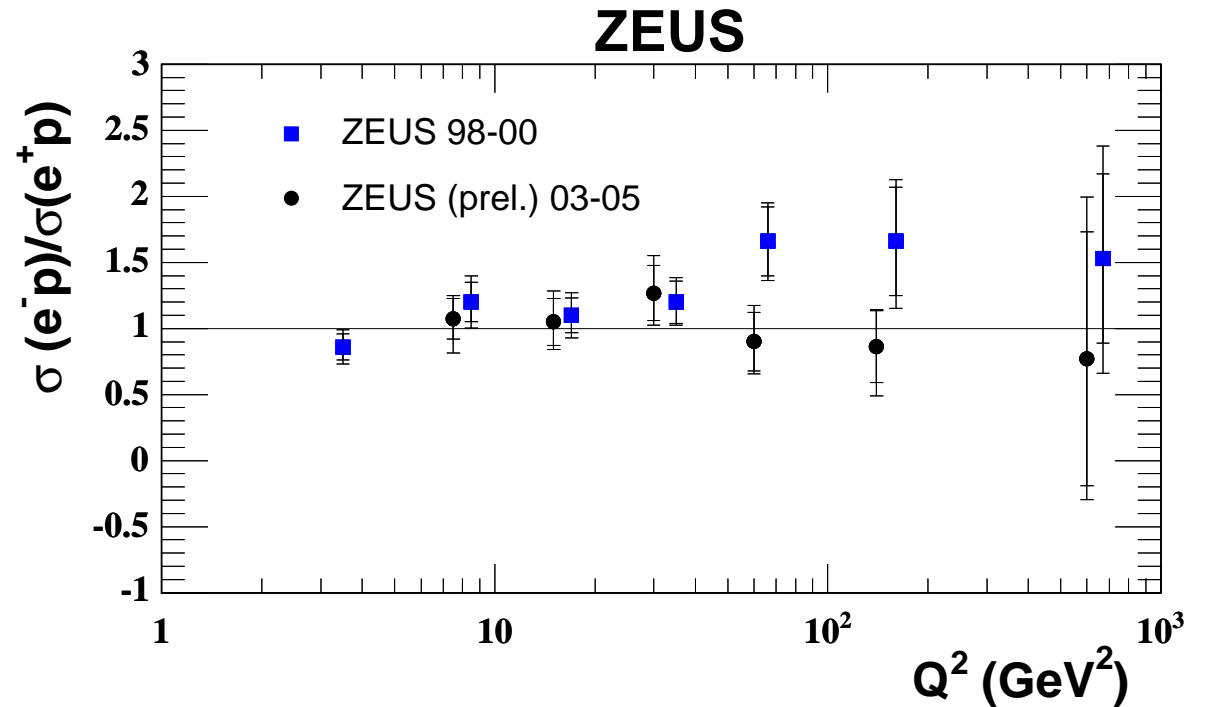
$$\text{NLO (FMNR+HQVDIS)} = 6.9_{(-1.8)}^{(+3.0)} \text{ nb}$$



HERA II: D^* production



Data taken up to few weeks ago

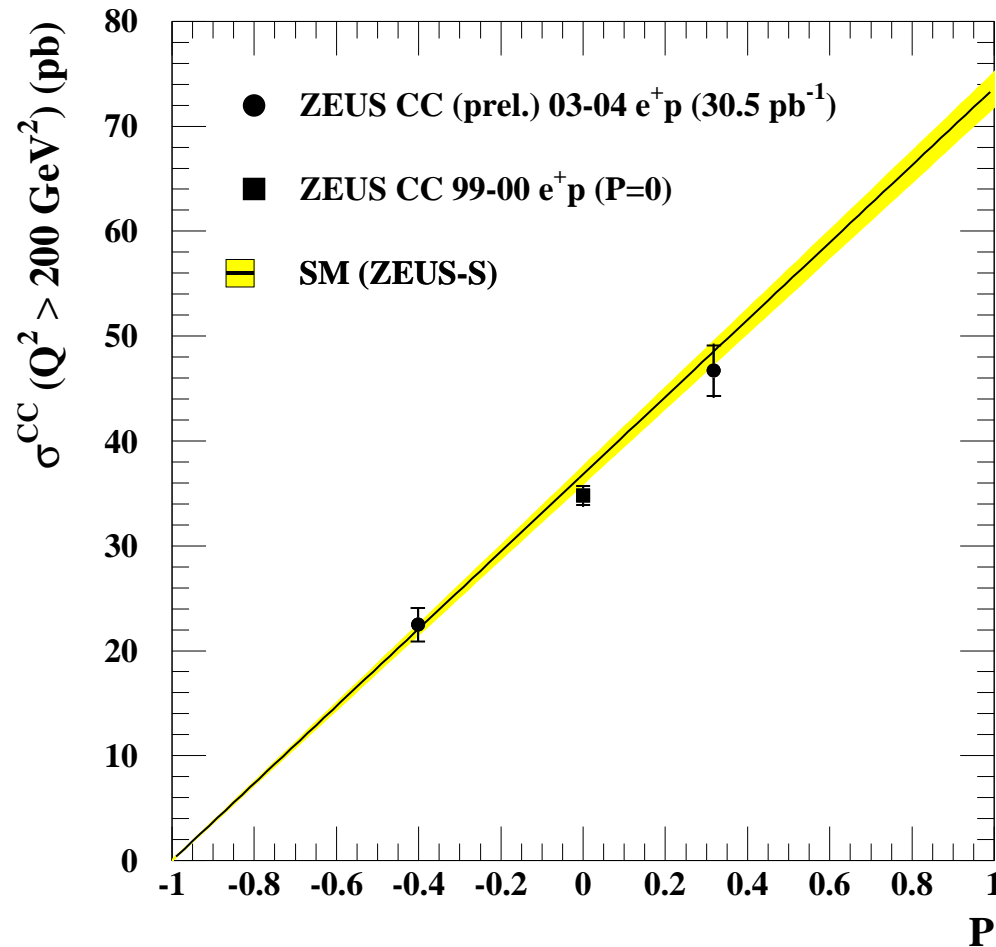


Good agreement between e^+ and e^- for 03/05 data
Excess in 98-00 data not confirmed



HERA II: Charged Current

ZEUS



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

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

$$P = -40\% \quad 16.4 \text{ pb}^{-1}$$

Measurements in agreement with ZEUS-S fit



HERA II : Neutral Current

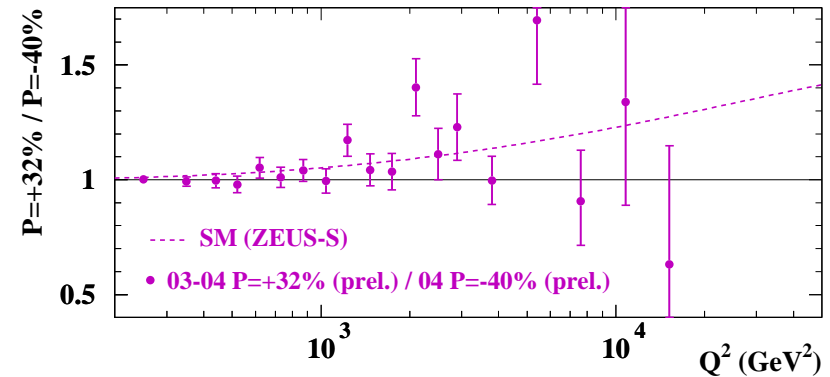
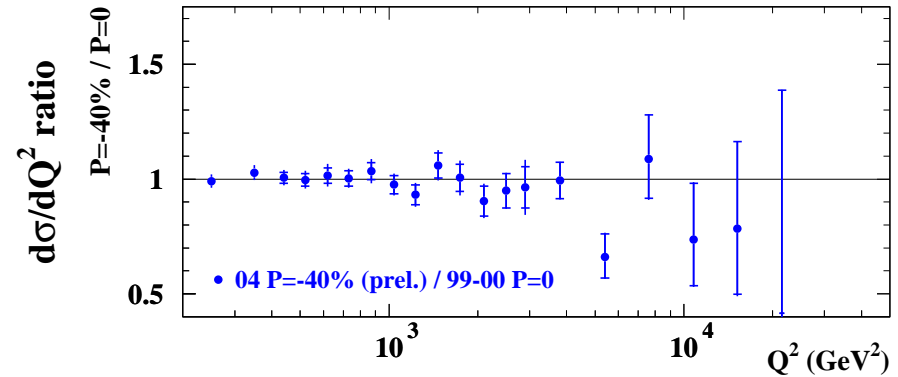
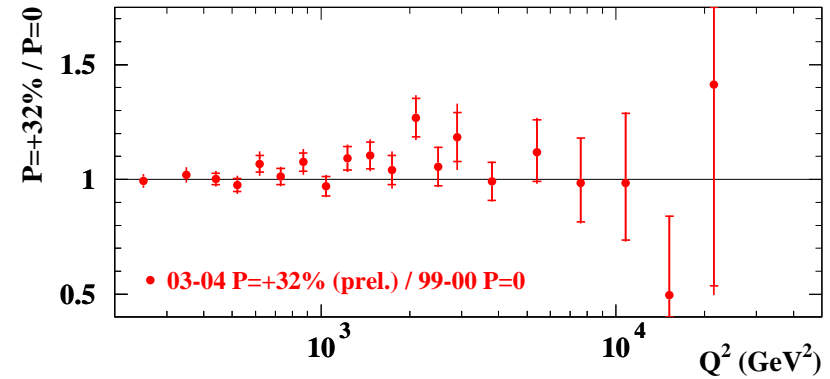
ZEUS

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

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

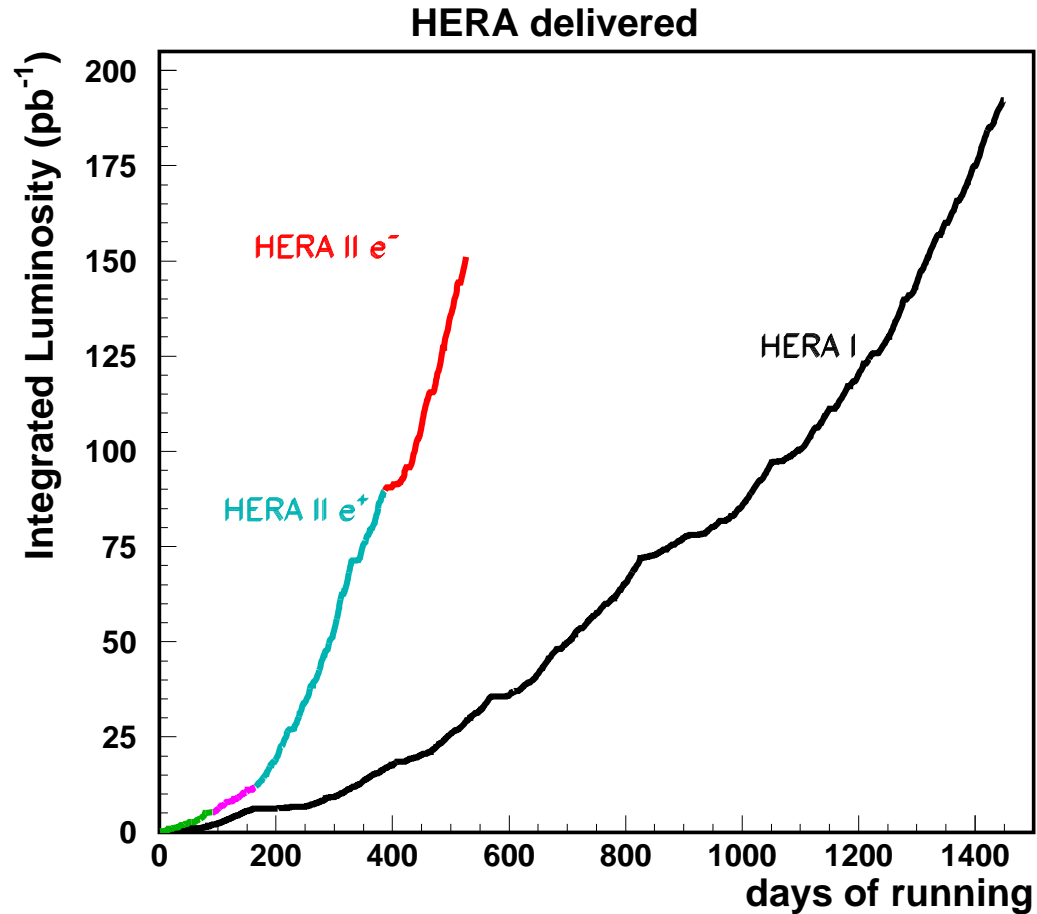
$$\frac{\sigma(P=+32\%)}{\sigma(P=-40\%)} \text{ vs } Q^2$$

Consistent with polarization dependence in NC



Outlook

Many more results and details → see parallel sessions.



More exciting results soon with e^-p data

