ZEUS Status Report

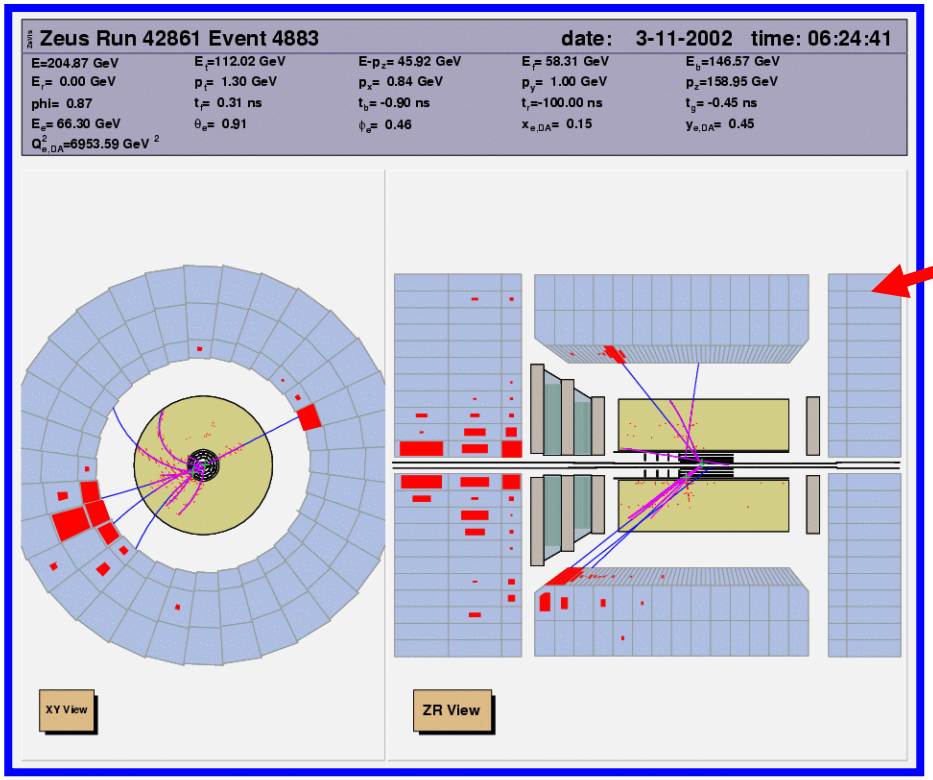
- 2002-2003 Running Period
  - Detector Progress
  - Data Analysis
- Background Studies
- Physics Results Highlights
- Physics Outlook and Goals

Stathes Paganis
Columbia University
On behalf of the ZEUS Collaboration
PRC Meeting May 2003

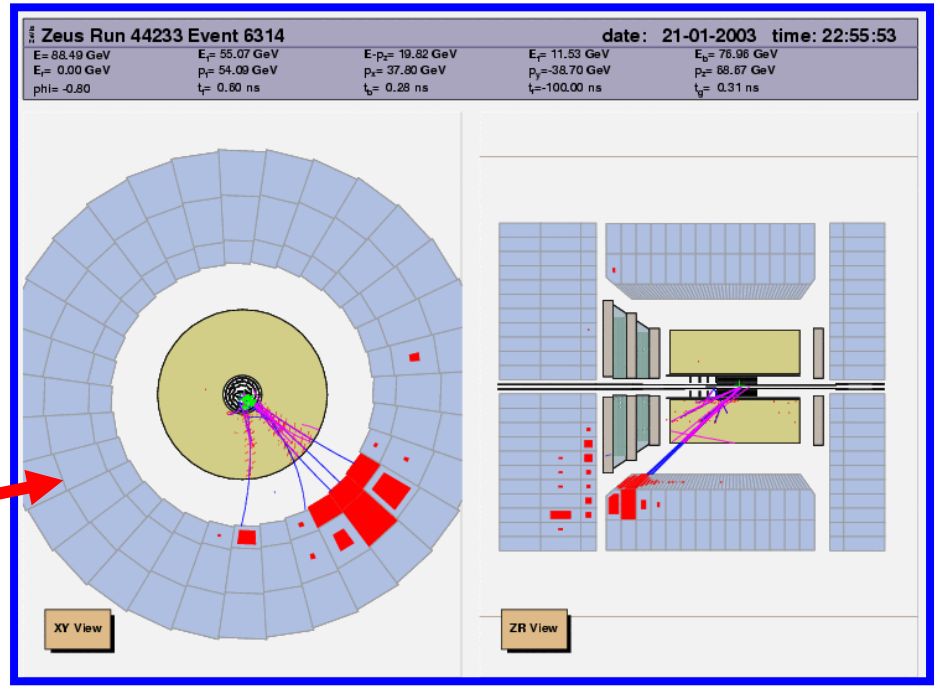
2002-2003 Running Period:

Data Collected: 2000 ($L=45.8pb^{-1}$) and 2002/2003 ($L=1.55pb^{-1}$)

CTD at 95%HV



Neutral Current Event



Charged Current Event

Microstrip-Vertex-Detector (MVD)

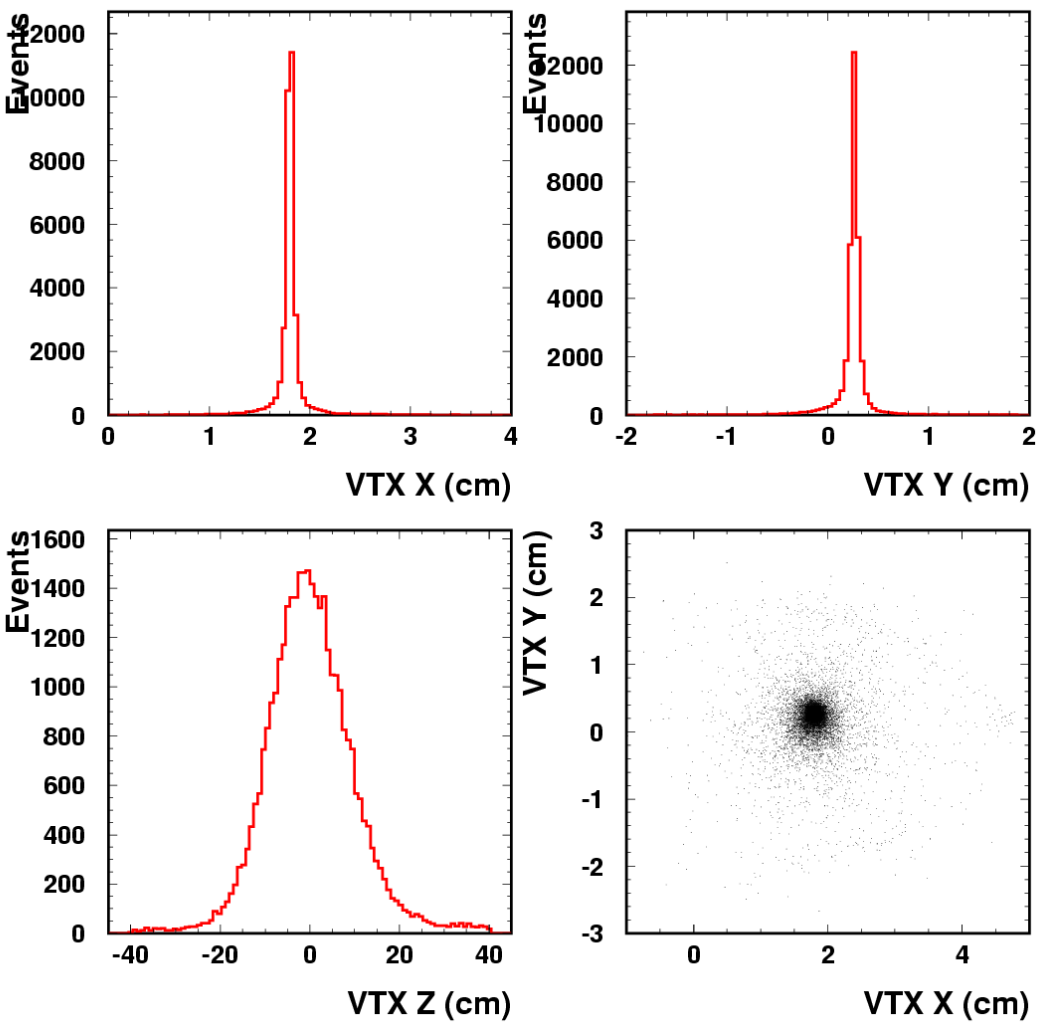
- 267 runs with 3.1Mio events recorded between 10/31/02 and 02/18/03 with MVD on and DQM (> 676 nb^{-1})
- DAQ reliable and conforms to the ZEUS specifications

Run selection criteria were

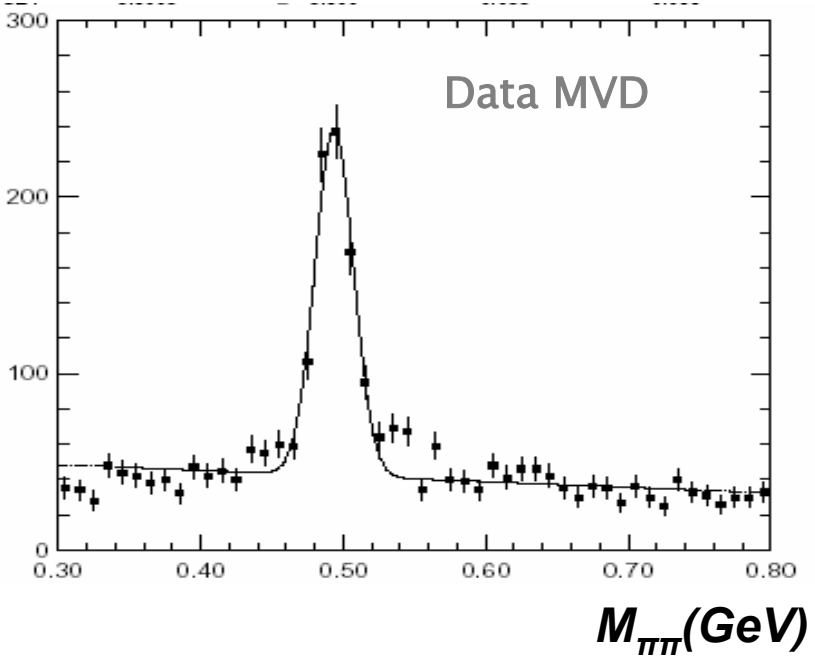
- ep run
- more than 2k events
- CTD on (95% voltage)
- MVD on and DQM-checked ok

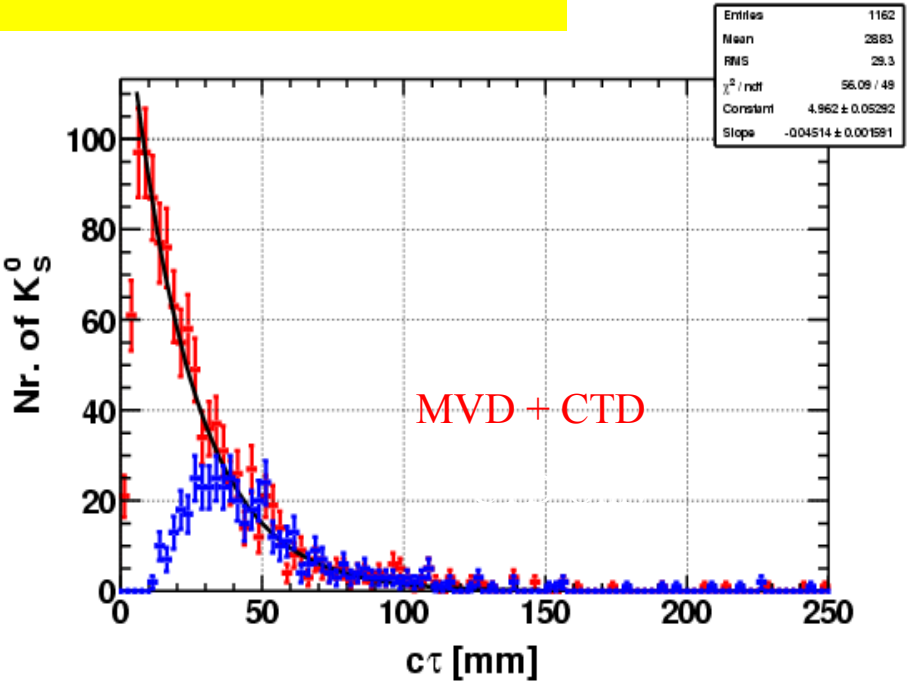
Event selection:

- E-Pz > 10
- abs(VtxZ)<40
- More than 2 vertex tracks
- Less than 25 vertex tracks.
- electron energy > 10 GeV



K^0_S with MVD





- MVD had a successful commissioning period.
- The detector is running well
- Radiation dosage is monitored
- Alignment, Tracking and Vertexing are coming along nicely.

Straw Tube Tracker (STT)

Detector installed into ZEUS in April 2001

After installation a few H/W problems were identified which prevented effective data taking

A committee reviewed repair plans; February 18, 2003 final go-ahead for the STT repairs

March/3 – present: STT removed and repairs have been succesfully completed

STT now installed back in ZEUS and all channels are working as expected

STT dismounted for repairs

STT remounted after repairs

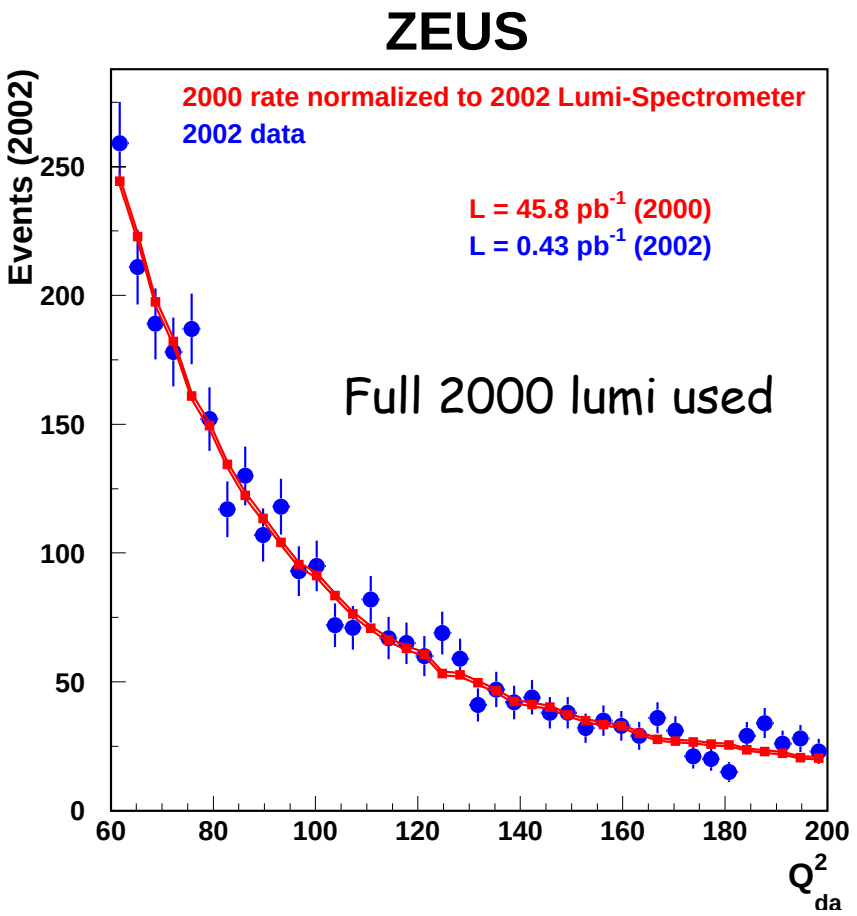
Luminosity Monitors and Measurement

ZEUS has two luminosity monitors: photon calorimeter and spectrometer

Detectors (calorimeter, spectrometer), FEE and digital electronics commissioned and operational.

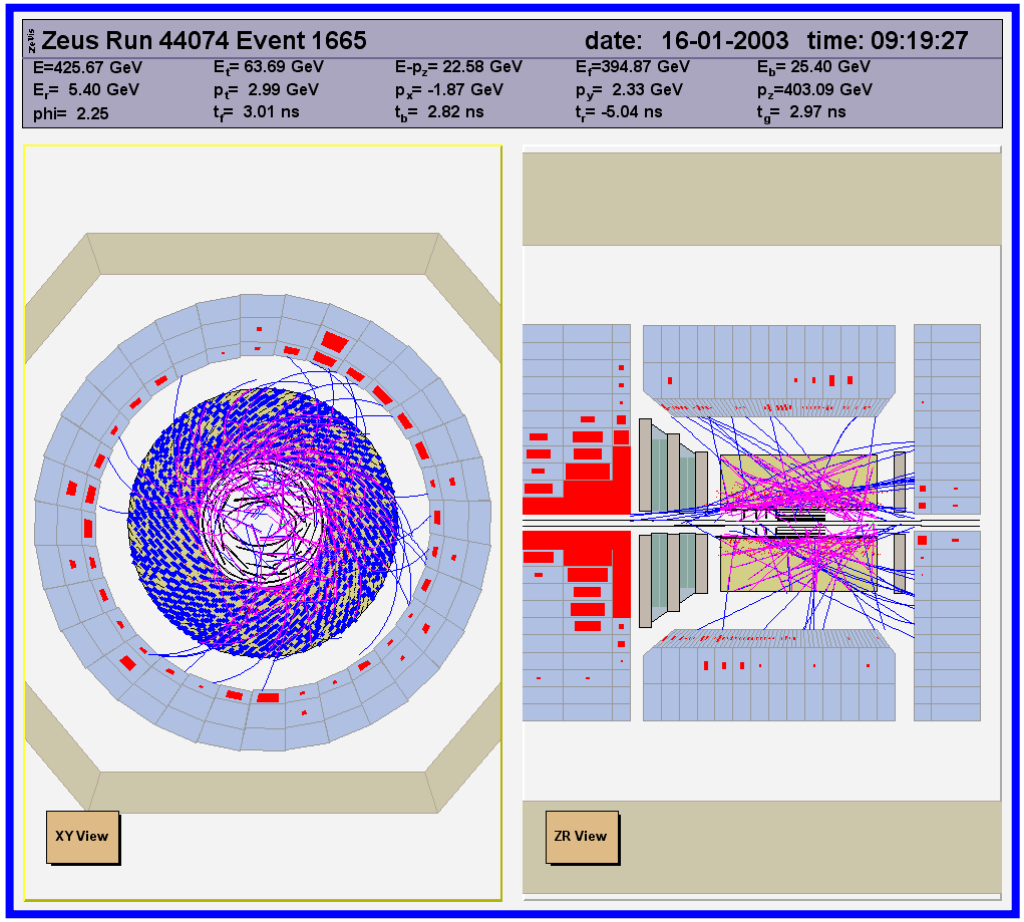
Both systems report lumi and beam profiles on-line to HERA via the ZEUS lumi-monitor.

The measured Luminosity was used by several 2002-2003 studies by all physics groups. Very important for example in studies of background effects on physics.



Neutral Current event rates from 2002 compared to 2000 rates normalized by the luminosity, are in very good agreement

Background at ZEUS IP



SUMMARY

- Understanding of background conditions has been very challenging.

  Effort of many people.
- Quantitative understanding of background achieved
- Modifications to IP area planned and reviewed:
  - Significant improvement of synchrotron radiation background x10
  - Positron background improvement factor of ≥2
  - Several measures to improve proton beam-gas background.
- After the modifications we expect that ZEUS will be able to run at the highest luminosity
- Shutdown to effect these changes are on schedule

Physics Highlights

ZEUS: 8 papers since last PRC, 50 abstracts submitted to EPS

High E_T and high Q^2 physics:

- Extraction of a_s from PhP

Diffraction and low x:

- Inclusive diffraction with FPC
- First measurement of F_L

Hadronic Final States:

- KsKs final state in DIS

Searches for new physics:

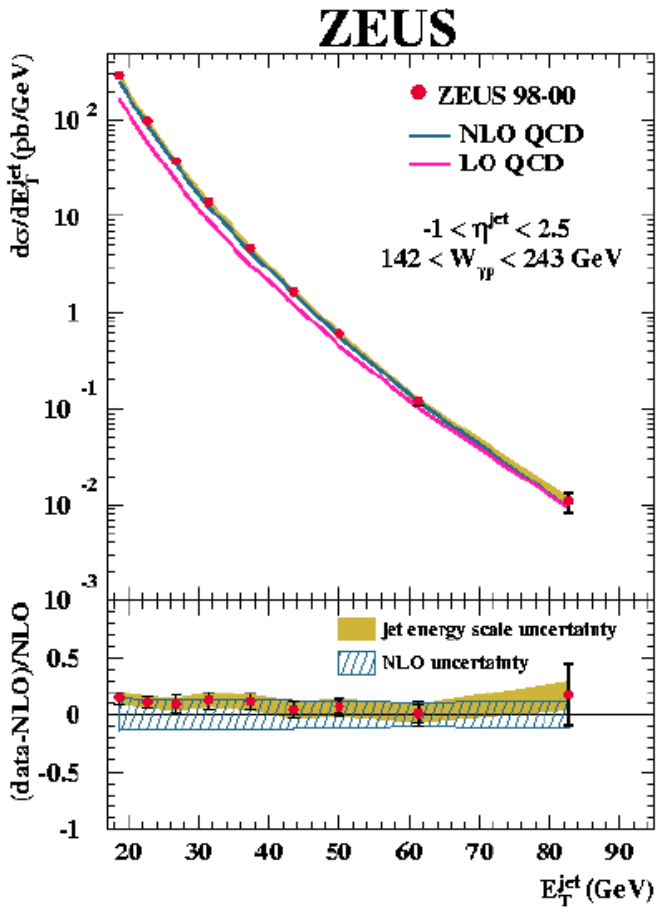
- Lepto-quarks and single top

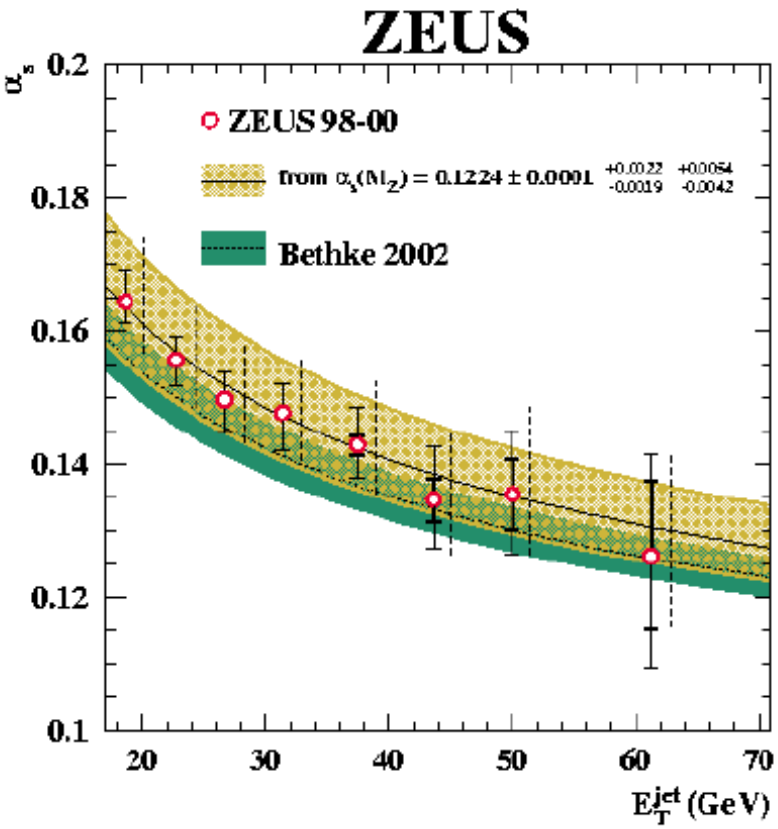
Heavy Flavour Physics:

- Charm fragmentation fractions
- Charm content of the photon in charm photoproduction

High E_T jet cross section in γp

Inclusive jet cross section in γp has been measured with high precision, allowing for small exp. error a_s determination

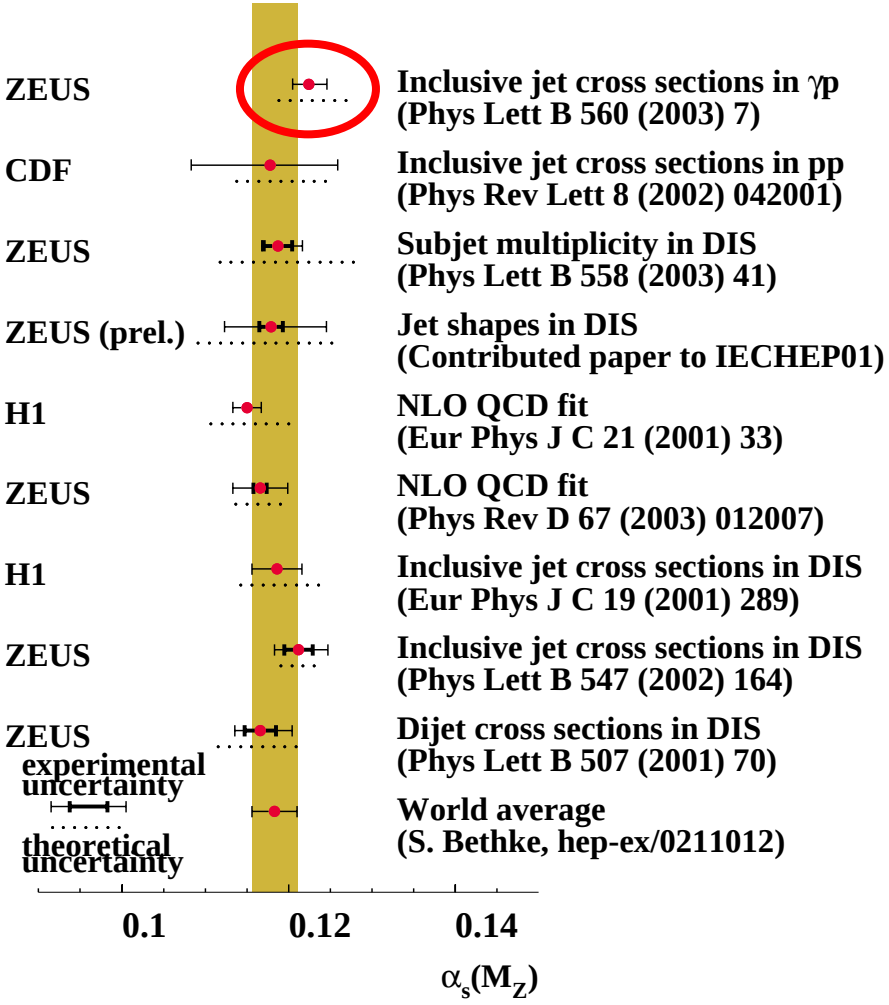


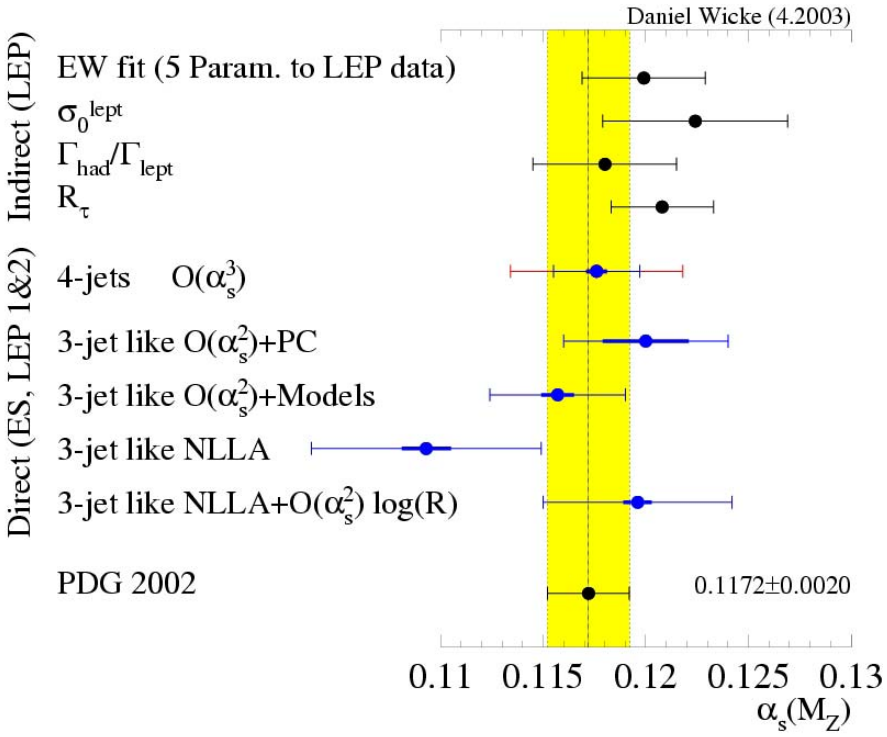


a_s is determined at different bins of E_T: a_s running is observed in a single measurement

High E_T jet cross section in γp

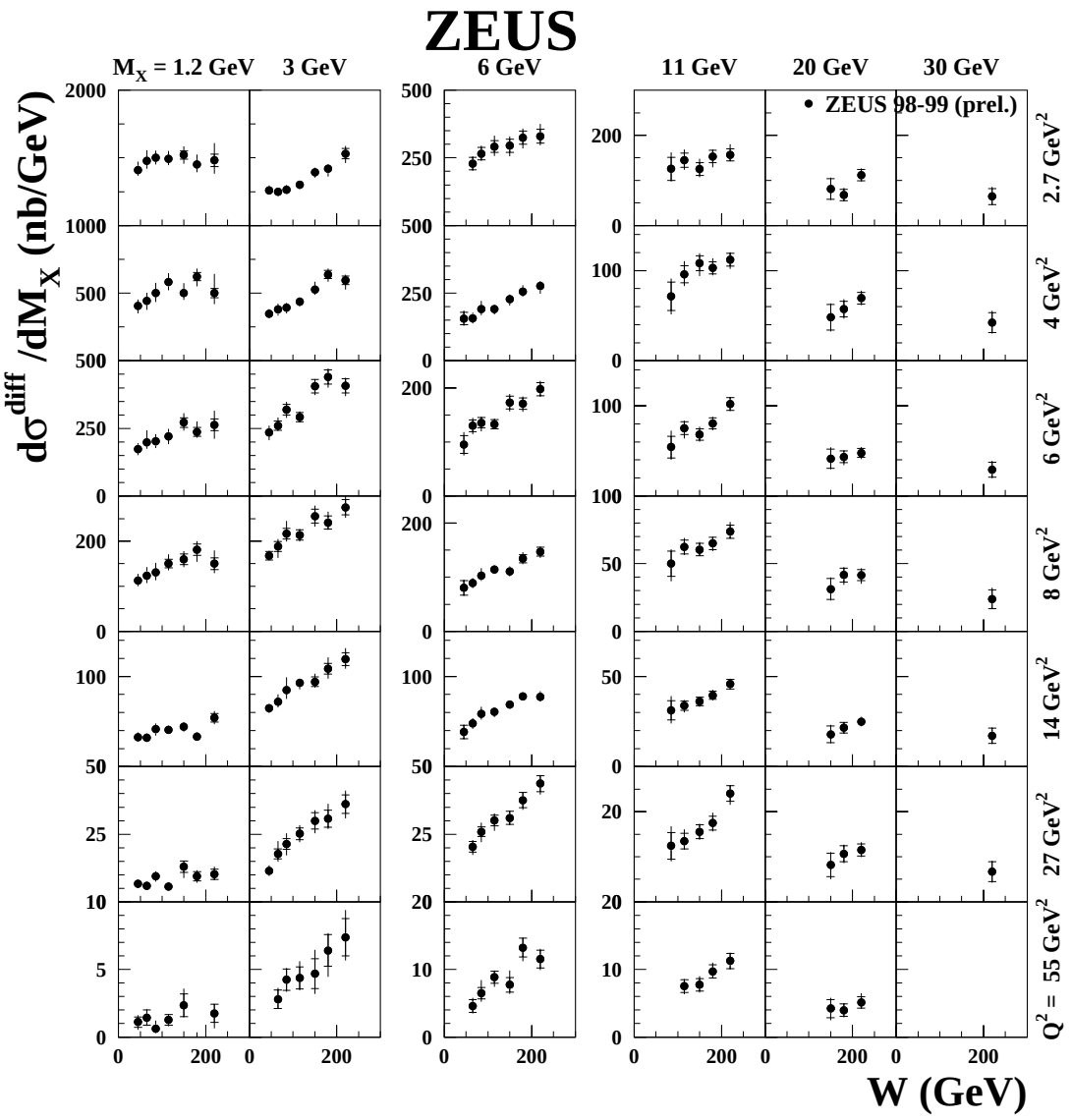
a_s determination from incl. jet cross sections in γp and comparison with other measurements.





- a_s measurement consistent with all recent measurements
- Small experimental uncertainties: competitive with LEP
- Theoretical uncertainty larger than the experimental error

Inclusive Diffraction with FPC



$$\frac{d\sigma^{diff}}{dM_X} \sim \left(W^2\right)^{2(\alpha_{IP}^{diff}(0)-1)}$$

α^{diff} determined by fitting $d\sigma/dM_x$

$$\sigma_{tot}(\gamma^* p) = \frac{4\pi^2\alpha}{Q^2(1-x)} F_2(x,Q^2) \sim W^{2\lambda}$$

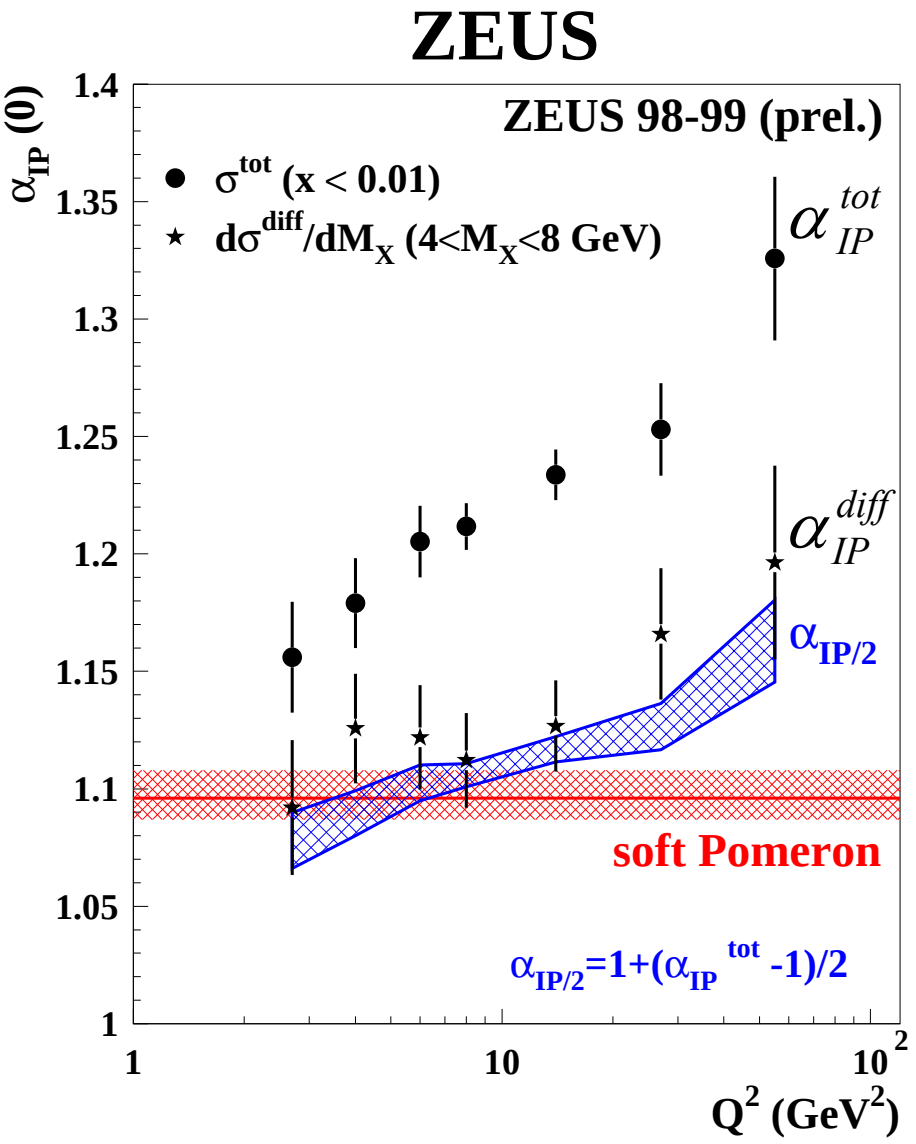
$$F_2 \sim x^{-\lambda}$$

$$W^2 \approx Q^2(1-x)/x$$

$$\lambda = \alpha_{IP}^{tot}(0) - 1$$

α^{tot} determined by fitting the F_2 x distributions

Inclusive Diffraction with FPC



$$\sigma^{tot}_{\gamma^* p} \sim \left(W^2\right)^{\alpha^{tot}_{IP}(0)-1}$$

$$\frac{d\sigma^{diff}}{dM_X} \sim \left(W^2\right)^{2\left(\alpha^{diff}_{IP}(0)-1\right)}$$

Data (4<Mx<8 GeV) show:

$$\alpha^{diff}_{IP} \approx 1+\left(\alpha^{tot}_{IP}-1\right)/2$$

- For Q^2>10GeV^2 $\alpha_{IP}^{diff}(0)$ lies above soft pomeron and its Q^2 dependence is clearly visible.
- $\alpha_{IP}^{diff}(0)$ is half that expected from inclusive DIS $\alpha_{IP}^{tot}(0)$.

DIS at low x: first measurement of FL

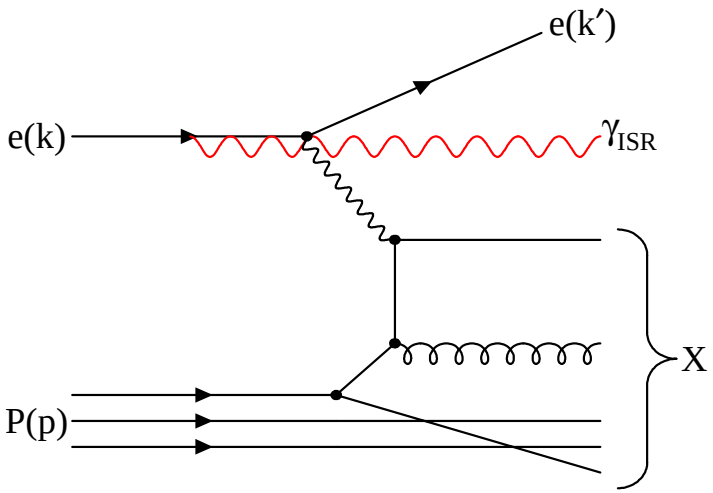
$$\frac{d^2\sigma}{dxdQ^2} = \frac{2\pi a^2}{Q^4 x}\left[\left(1+(1-y)^2\right)F_2(x,Q^2) - y^2 F_L(x,Q^2)\right]$$

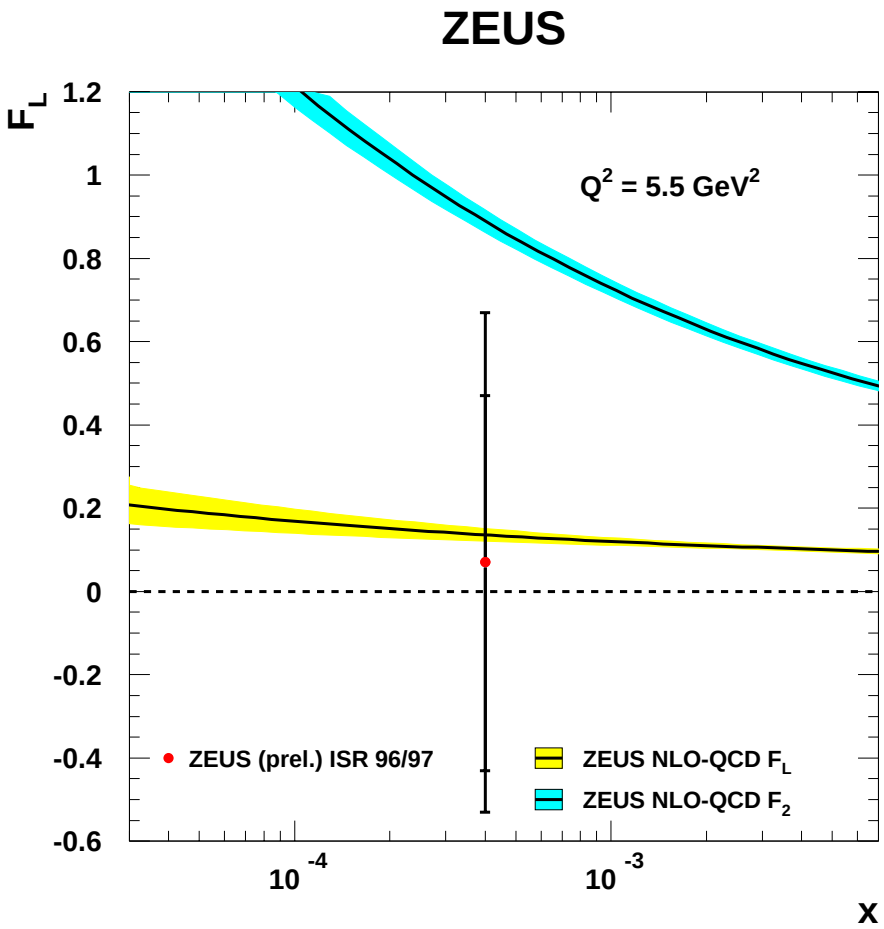
$$y = \frac{Q^2}{sx}$$

F_2, F_L functions of (x,Q^2) only, but cross section also depends on $s=E^2$

➡ Measure it at different energies

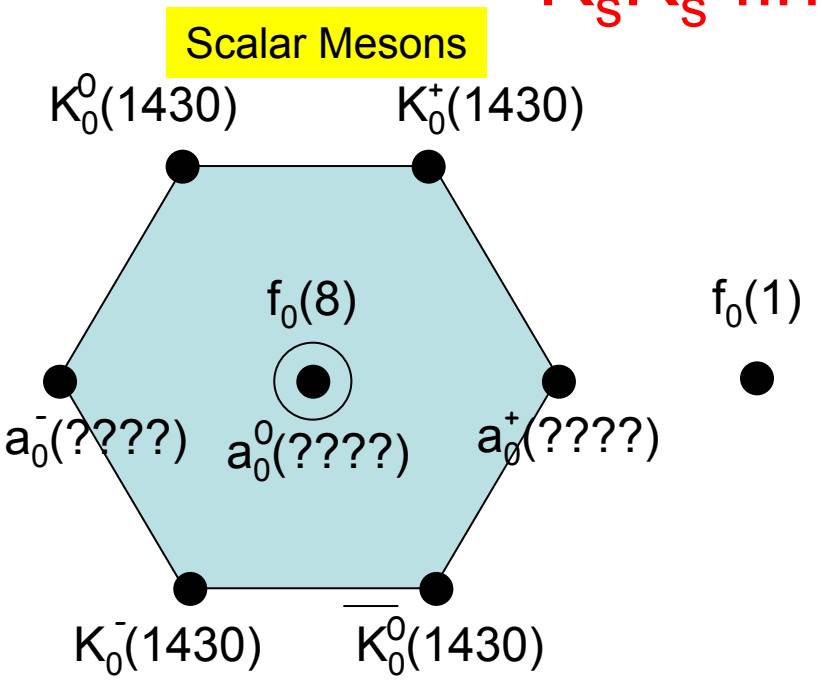
OR exploit events with hard ISR photons radiated from the lepton

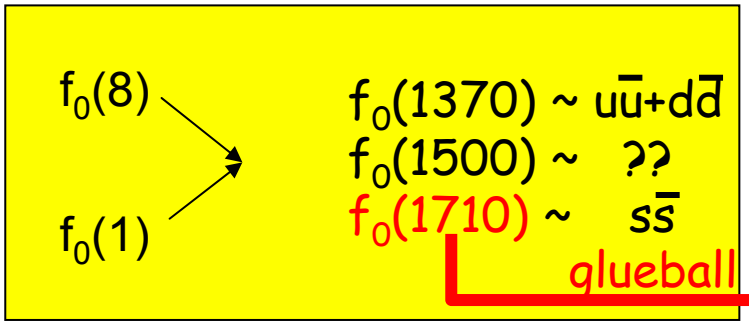


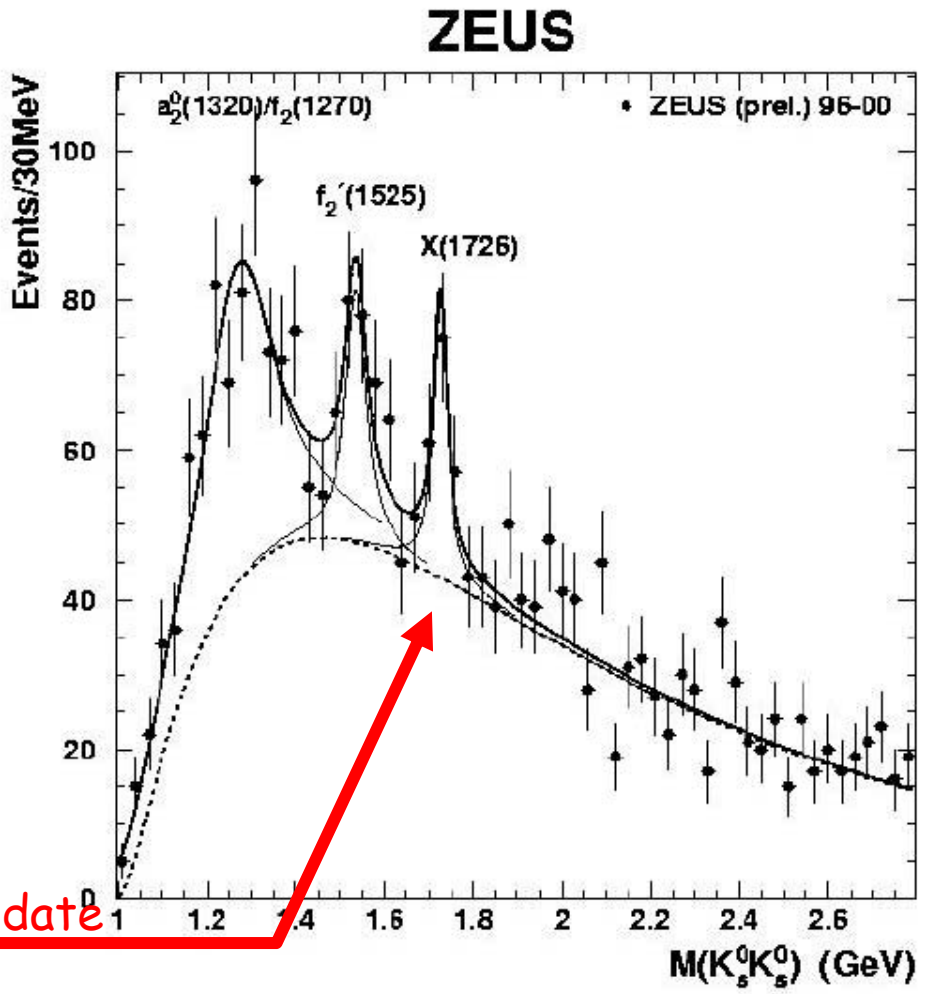


ZEUS Report, PRC May 2003

K_sK_s final state in DIS

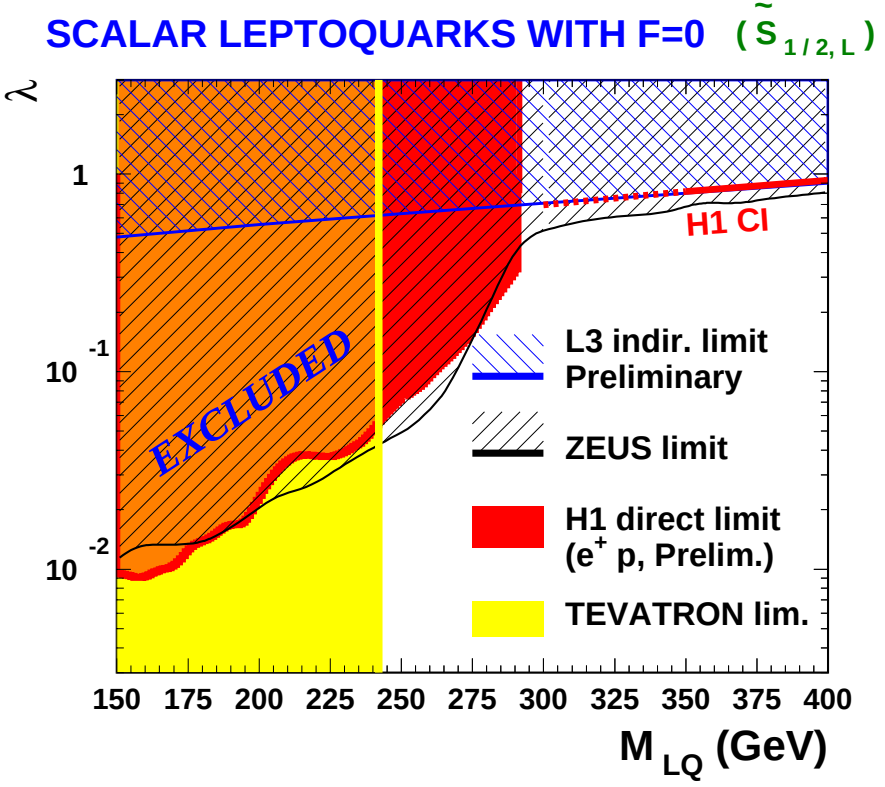




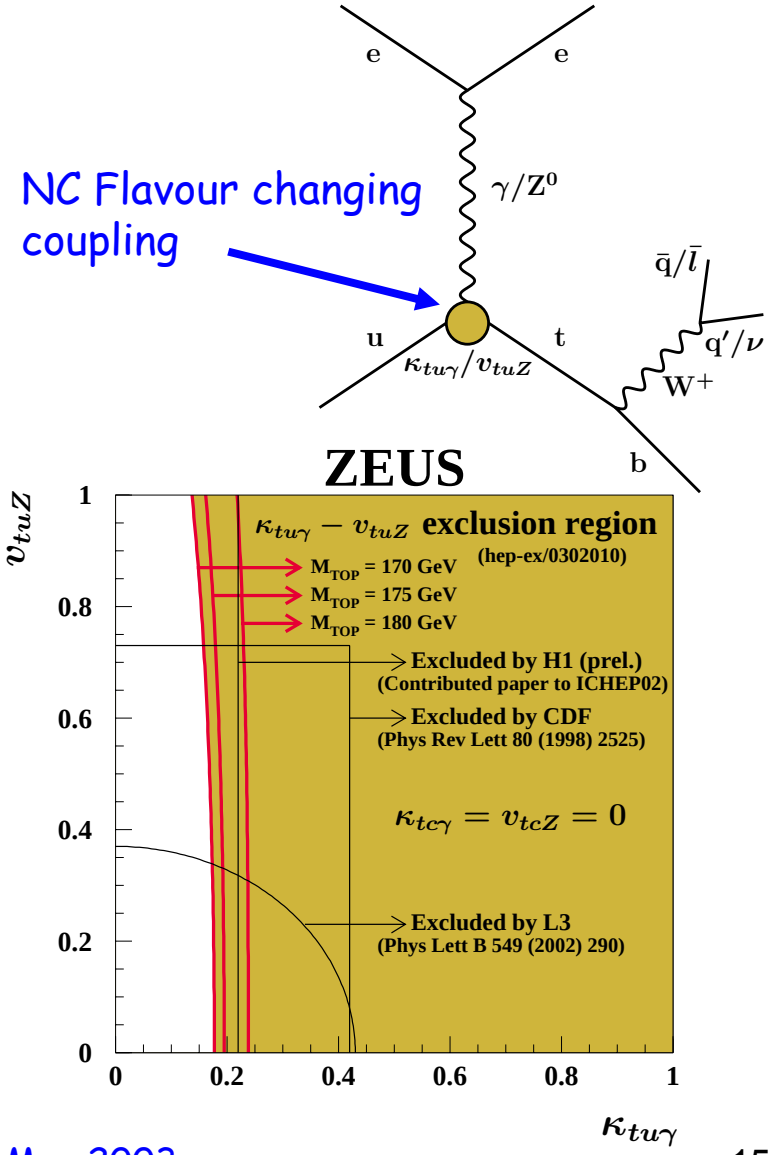


First observation of $J^{CP}=(even)^{++}$ in DIS: two states are observed: a state consistent with $f_2'(1525)$ and $f_0(1710)$

Searches: Leptoquark and single top limits



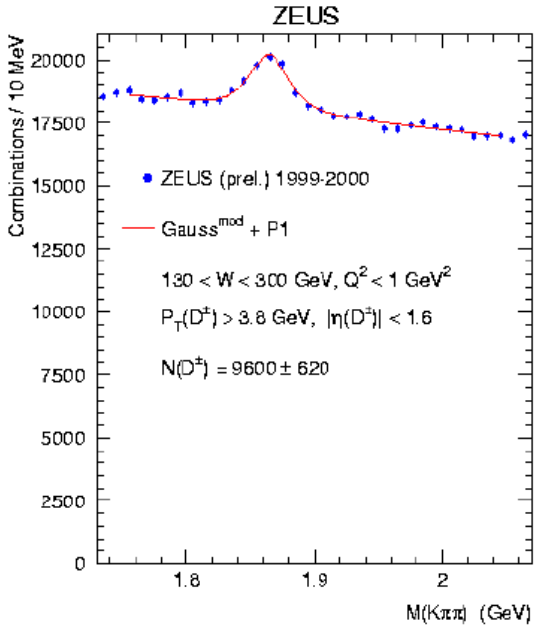
HERA-I limits competitive with LEP, LEP-II and Tevatron Run I



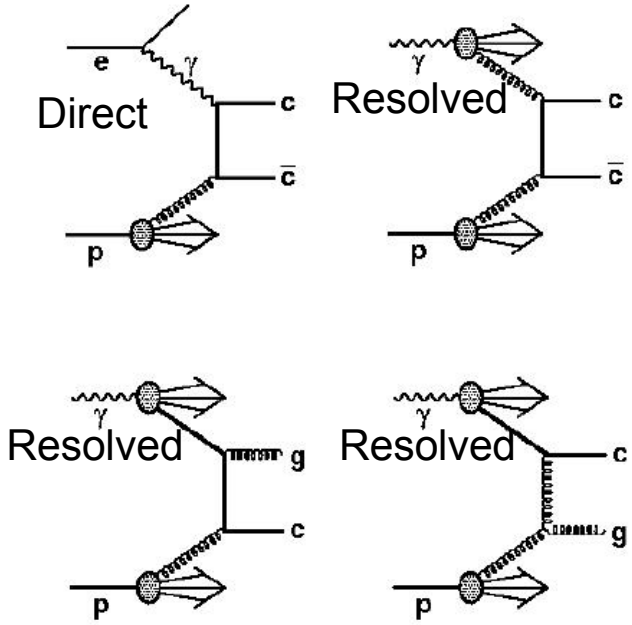
Heavy Flavours: charm fragm. fractions

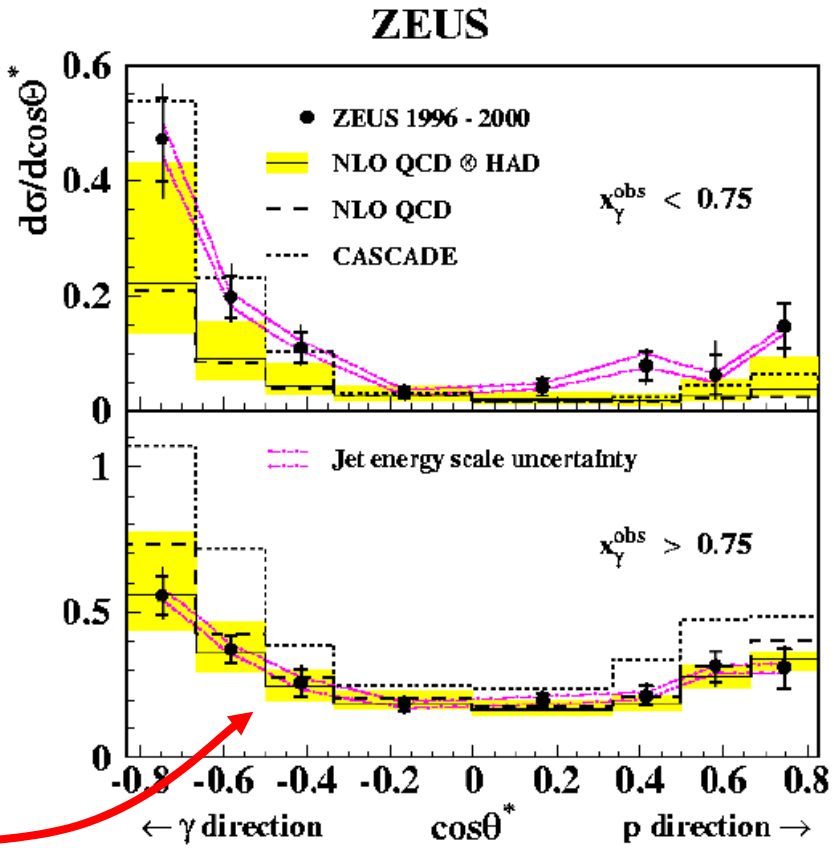
Fragmentation fractions first shown in DIS03	Combined e^+e^-	H1 prelim.
$f(c \to D^+) = 0.249 \pm 0.014(stat)^{+0.004}_{-0.008}(syst)$	0.232 ± 0.010	$0.202 \pm 0.02^{+0.045}_{-0.033}$
$f(c \to D^0) = 0.557 \pm 0.019(stat)^{+0.005}_{-0.013}(syst)$	0.549 ± 0.023	$0.658 \pm 0.054^{+0.117}_{-0.142}$
$f(c \to D_s^+) = 0.107 \pm 0.009(stat)^{+0.005}_{-0.005}(syst)$	0.101 ± 0.009	$0.156 \pm 0.043^{+0.036}_{-0.035}$
$f(c \to \Lambda_c^+) = 0.076 \pm 0.020(stat)^{+0.017}_{-0.001}(syst)$	0.076 ± 0.007	
$f(c \to D^{*+}) = 0.223 \pm 0.009(stat)^{+0.003}_{-0.005}(syst)$	0.235 ± 0.007	$0.263 \pm 0.019^{+0.056}_{-0.042}$

Charm fragmentation fractions are universal



Heavy Flavour Physics: dijet angular distributions





- Dijet angular distributions in photoproduction of charm depend on the spin of the exchanged particle
- For quark exchange a symmetric distribution in $\cos\theta^*$ is expected
- For resolved processes we observe a steep rise of the $\cos\theta^*$ closer to the photon, a characteristic of a gluon exchange: most of the resolved γ contribution in charm production comes from charm from the photon

charm in the photon

Physics Outlook and Goals

ZEUS HERA-I results close to completion: Ready for HERA-II

DIS and high E_T jet cross sections:

- HERA-I: Finalize Incl. DIS and high ET jet production in DIS and PhP
- HERA-II: Polarization, electron running, increase high x PDF accuracy

Diffraction:

- HERA-I: Finalize incl. diffraction and LPS 97-00 analysis, VM diffractive production (php+DIS)
- HERA-II: High Q^2 inclusive, hadr. final states, VM, D*, very high t VM, heavy VM (Υ), DVCS

Searches for new physics (substructure, CI, LQ, ...)

- HERA-I: Use final NC data to complete the contact interaction paper
- HERA-II: Use polarization, CC, and e^- to extend CI searches.

Heavy Flavour Physics:

- HERA-I: Finalize remaining charm and first beauty measurements
- HERA-II: The addition of the MVD upgrade opens the beauty sector to ZEUS.