H1 F2D and Diffractive Charged Current Results

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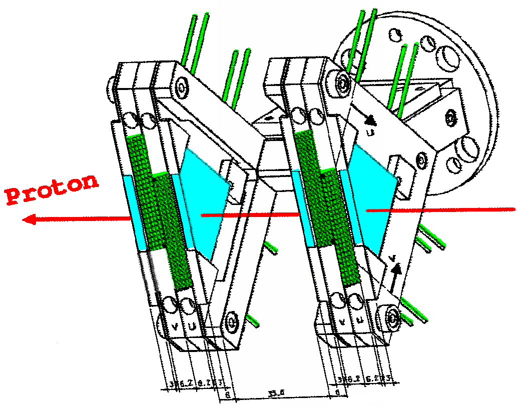
Diffraction and Vector Mesons Working Group

Diffraction at H1 $ep \to eXp$

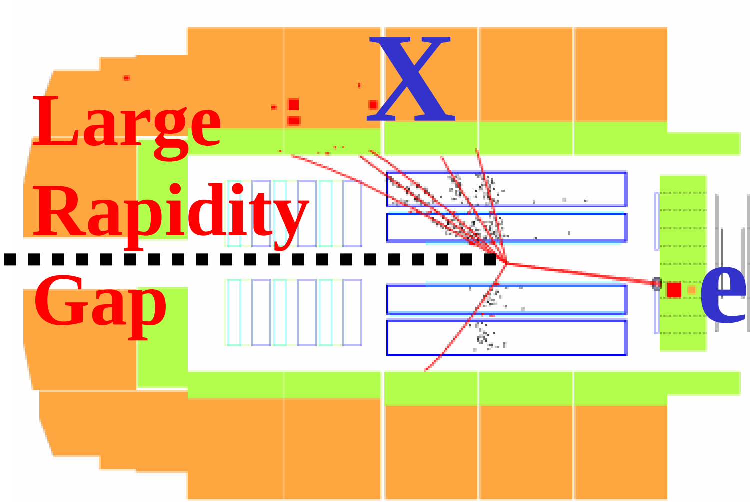
Forward Proton Spectrometer



$z = 64, z = 80m$

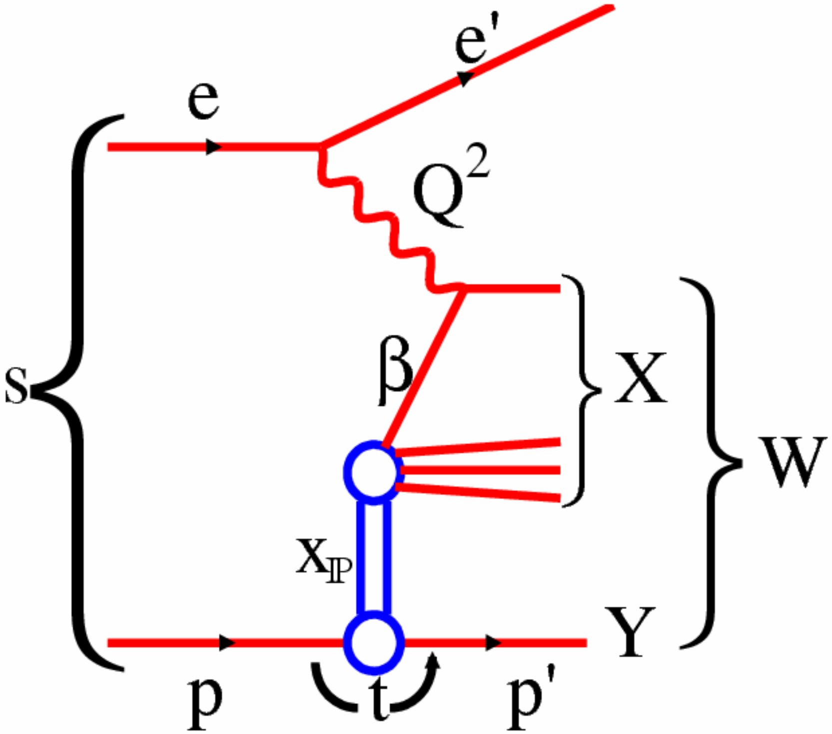
p

Large Rapidity Gap in H1



Measure Leading Proton	Require Large Rapidity Gap
No proton dissociation	Kinematics measured from X system
Measure the t dependence	Integrate over t and M_Y
Low detector acceptance	High detector acceptance $\to$ precision

Diffractive kinematics



Q^2 = Virtuality of photon

= momentum transfer at e vertex

β = fractional momentum of struck parton relative to diffractive exchange

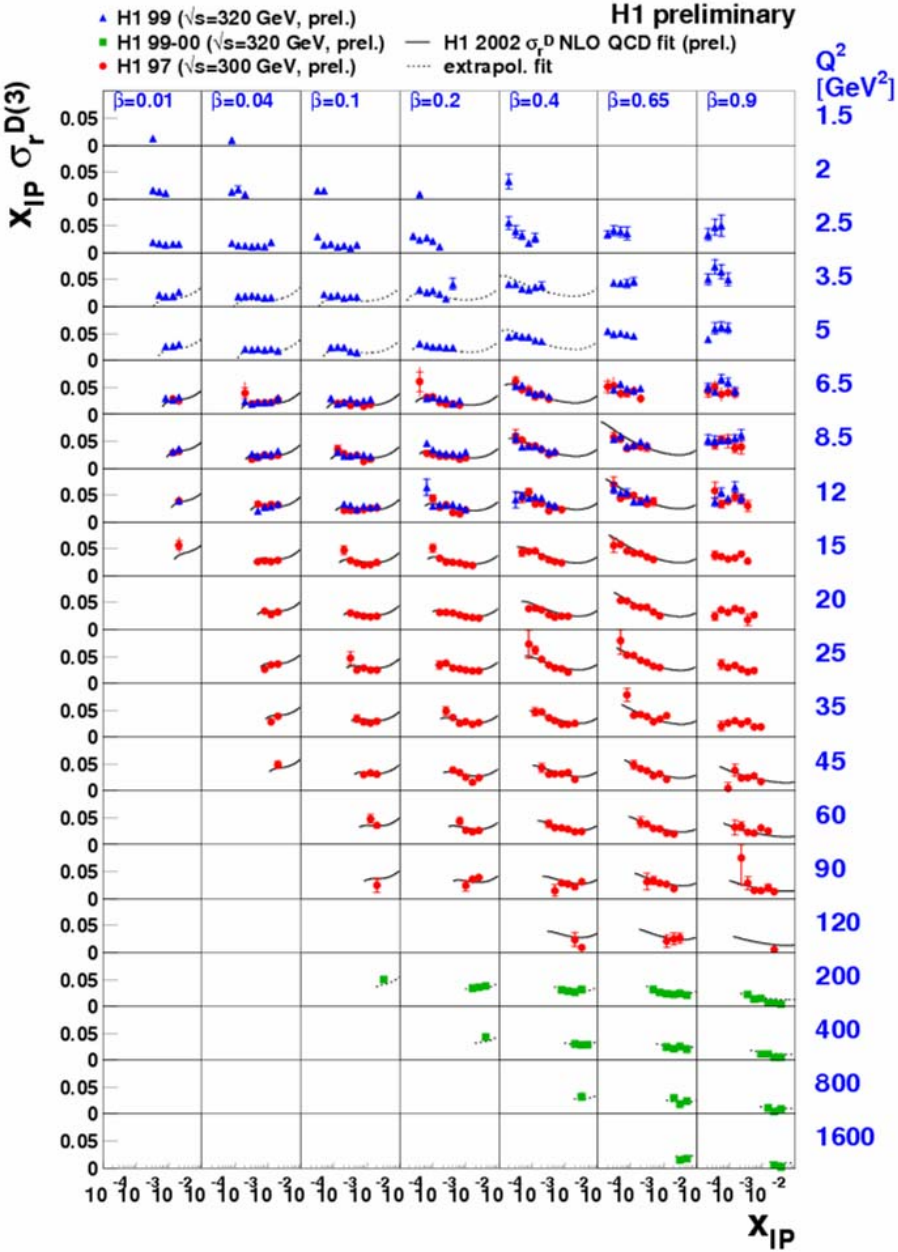
x_{IP} = fractional momentum of the diffractive exchange relative to the proton

t = momentum transfer at p vertex

$$\sigma_r^{D(3)}(\beta, Q^2, x_{IP}) = \frac{\beta Q^4}{4\pi\alpha^2(1-y+y^2/2)} \cdot \frac{d\sigma^D{}_{ep\to e'Xp'}}{d\beta dQ^2 dx_{IP}}$$

$$\boldsymbol{= F_2^{D(3)} \text{ if } F_L^{D(3)} = 0}$$

Rapidity Gap data



$$\sigma_r^{D(3)}(\beta, Q^2, x_{IP}) = \frac{\beta Q^4}{4\pi\alpha^2(1-y+y^2/2)} \cdot \frac{d\sigma^D{}_{ep\to e'Xp'}}{d\beta dQ^2 dx_{IP}}$$

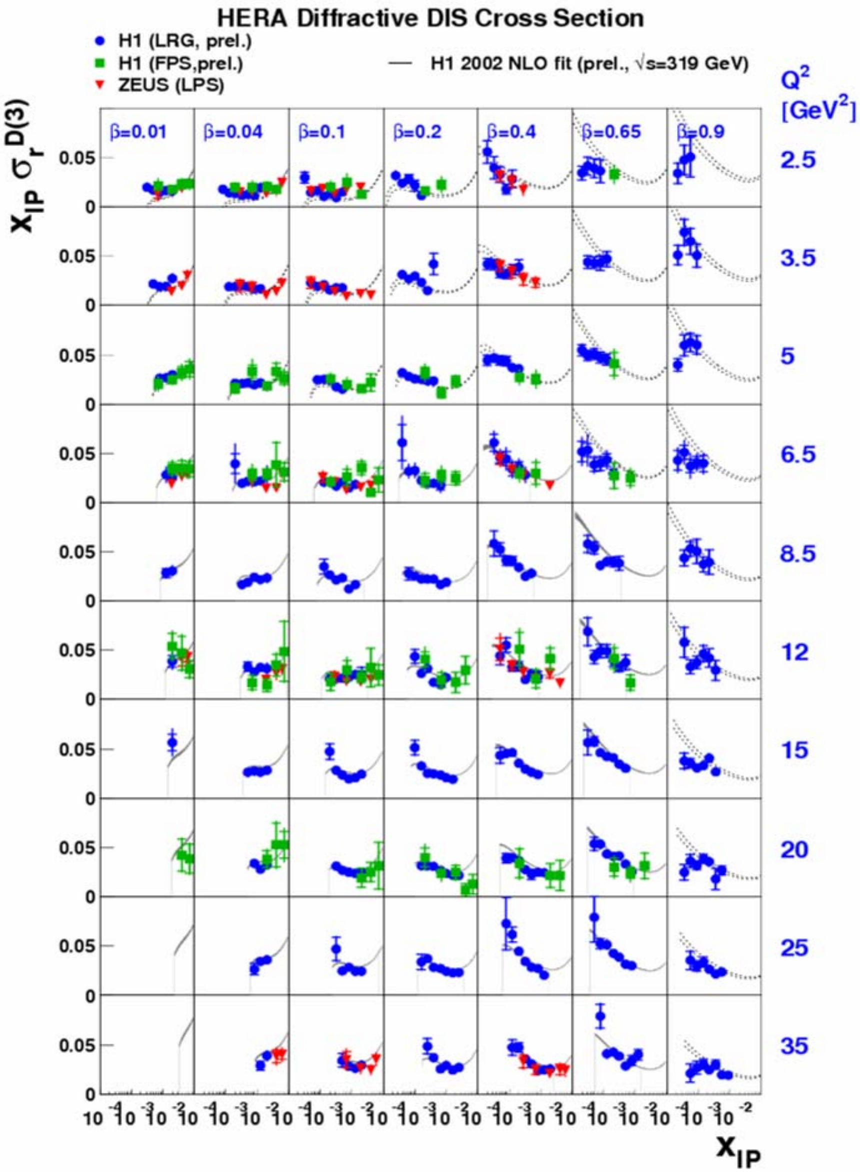
Cross-section defined for:

$M_Y < 1.6\ GeV,\ |t|^2 < 1.0\ GeV^2$

Large data sample consisting of three datasets covering the accessible kinematic plane with high precision

Also shown is the NLO QCD fit to the data which describes the data well, more on that later…

Leading Proton compared with Rapidity Gap selection



For comparison a factor of 1.1 is applied to correct from

$M_Y=M_p \rightarrow M_Y<1.6\ GeV$

Measurements obtained using the two independent experimental techniques agree well; find equally good agreement with ZEUS leading proton data

Possibility of providing constraints on the proton dissociation correction

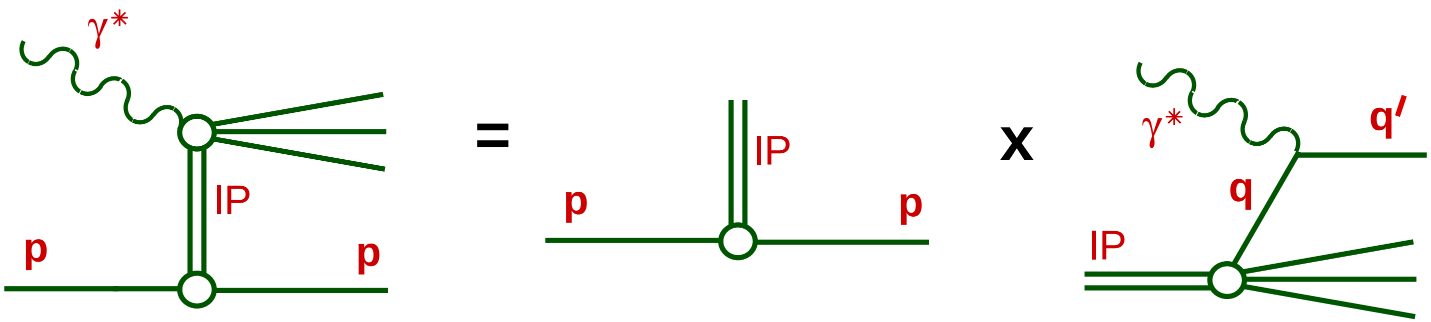
Factorisation and Diffraction

- **QCD Hard Scattering factorisation (Collins factorisation)**

$$\sigma(\gamma^* p \rightarrow Xp) \approx p_{q/p}(x_{IP}, t; x, Q^2) \otimes \hat{\sigma}_{\gamma^* p}(x, Q^2)$$

At fixed x_{IP} and t diffractive Parton Densities evolve according to DGLAP

- **Regge factorisation - “Resolved Pomeron model”:**



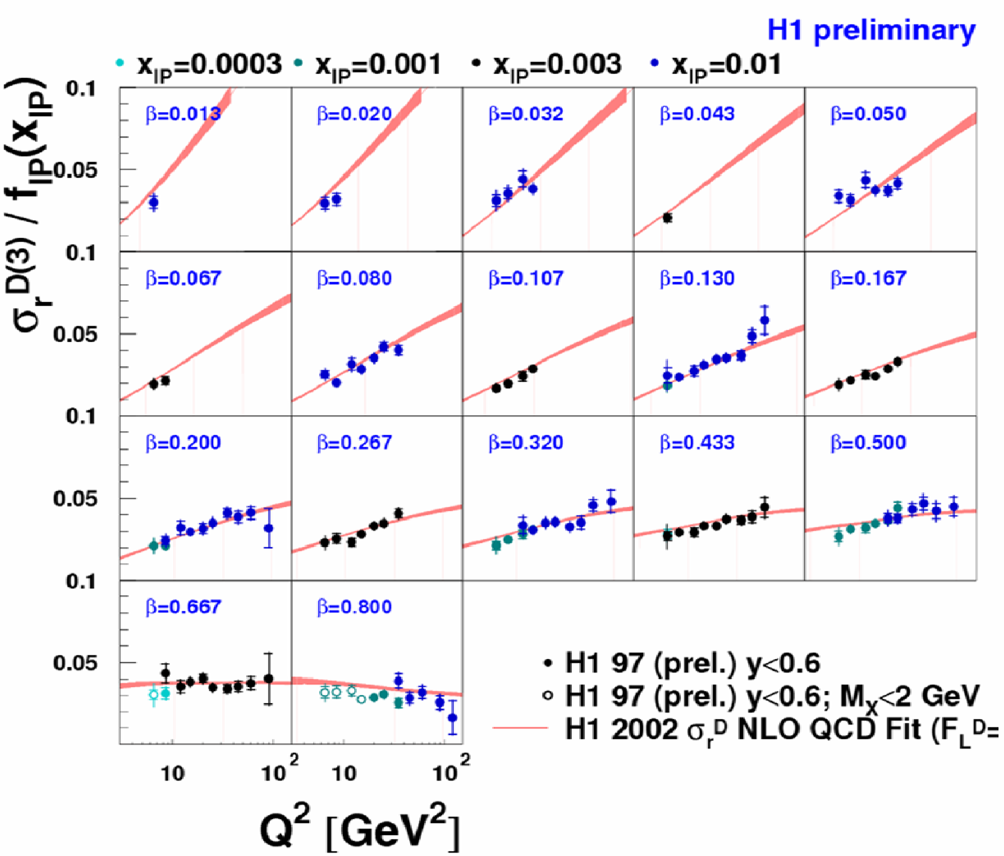
$$\sigma(\gamma^* p \rightarrow Xp) \approx f_{IP/p}(x_{IP}, t) \otimes p_{q/p}(\beta, Q^2) \otimes \hat{\sigma}_{\gamma^* p}(\beta, Q^2)$$

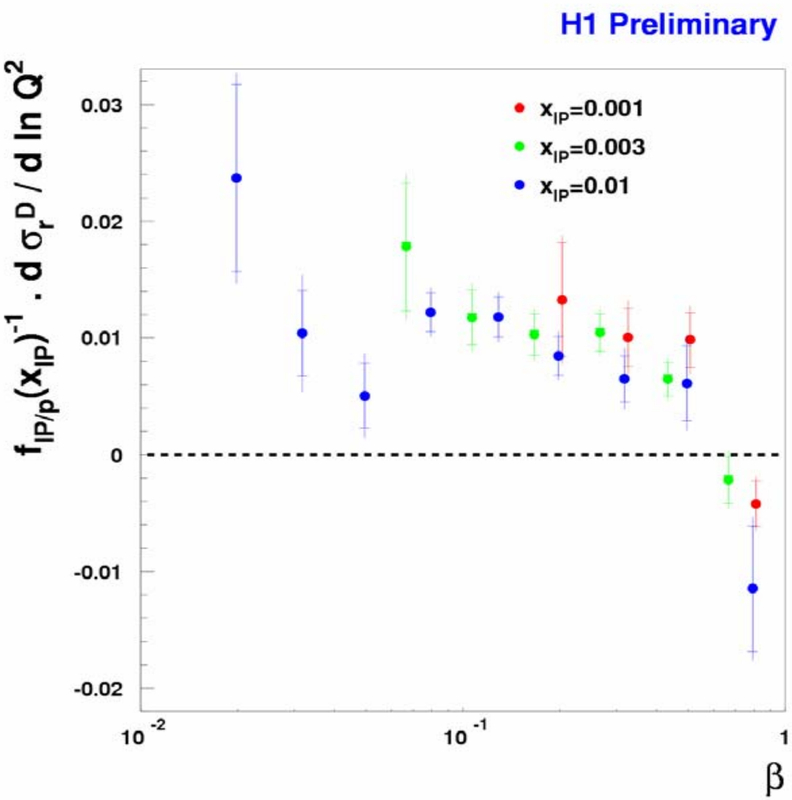
Regge motivated pomeron flux

$$f_{IP/p}(x_{IP}, t) = \frac{e^{Bt}}{x_{IP}^{2\alpha(t)-1}}$$

Shape of diffractive pdfs independent of x_{IP} and t

Q^2 dependence of the data in x_{IP} bins

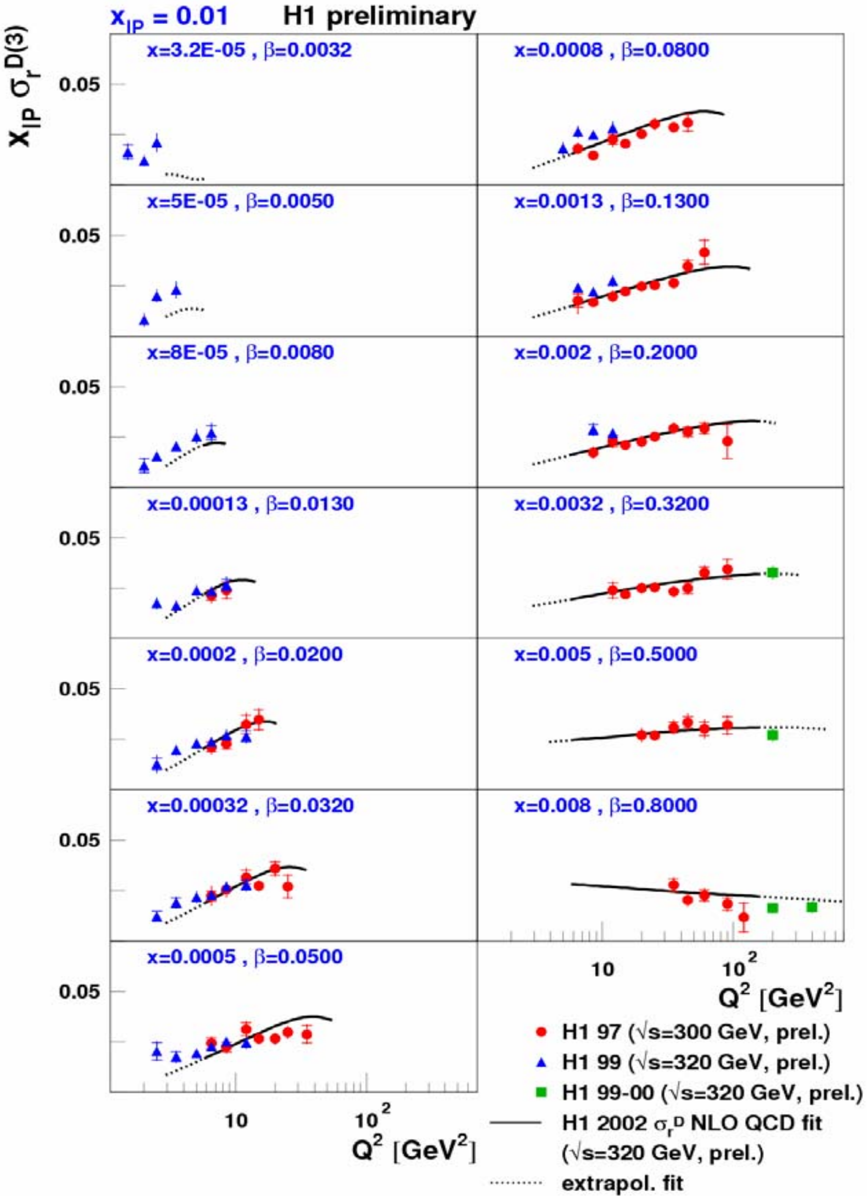


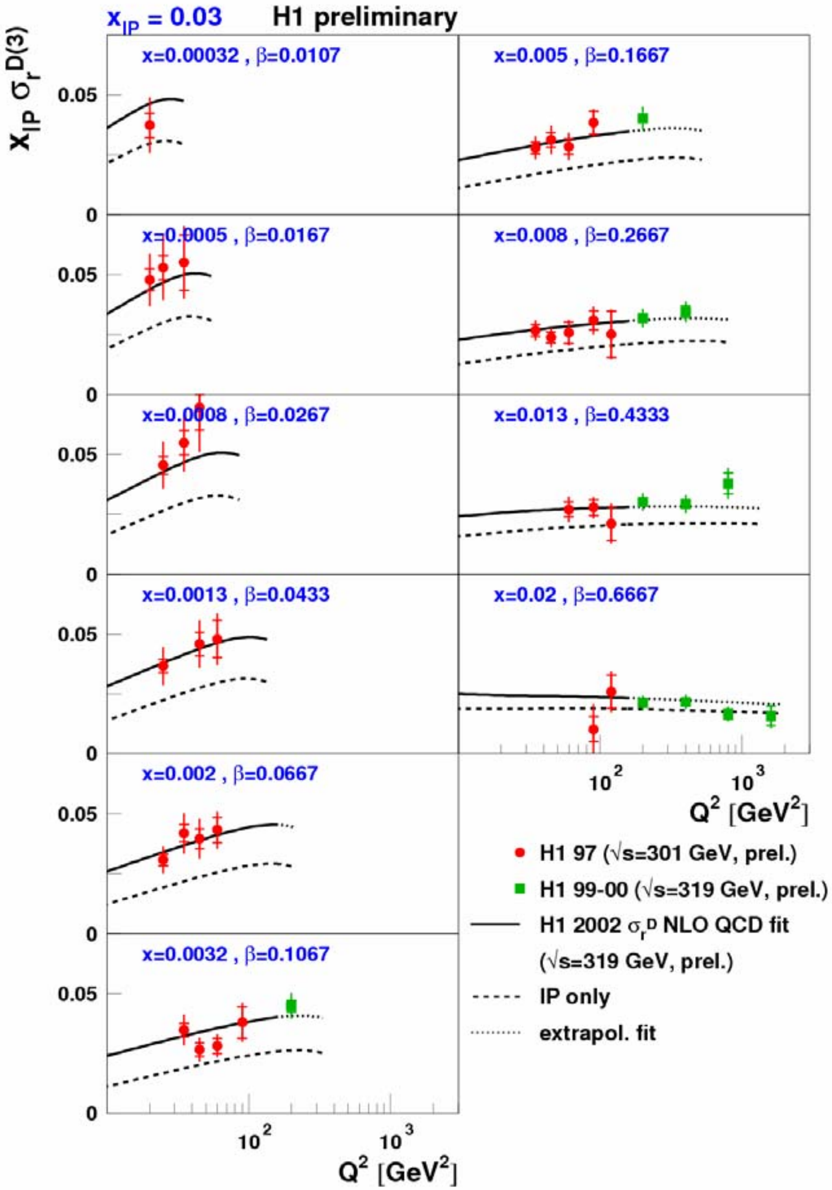


x_{IP} dependence removed by dividing $\sigma_r^{D(3)}$ by flux factor $f_{IP}(x_{IP})$

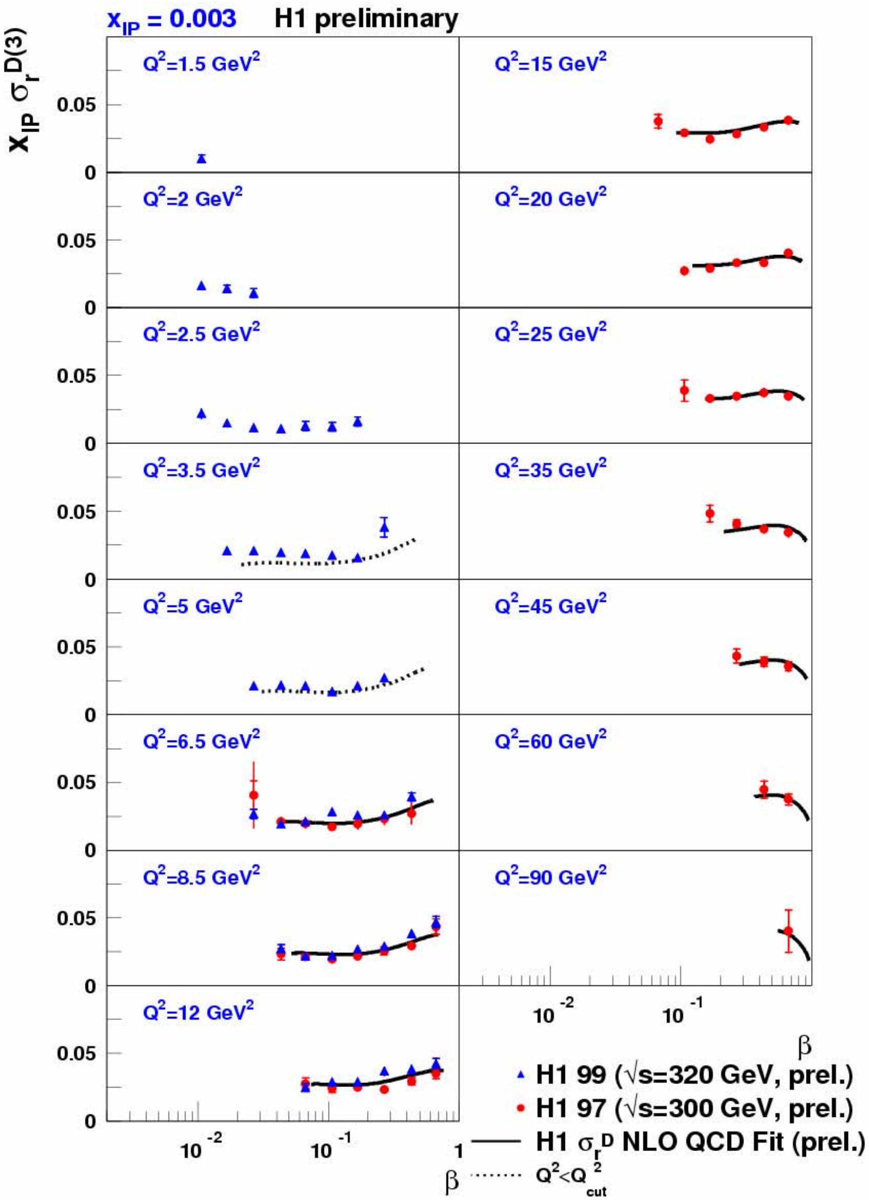
Different x_{IP} bins agree on Q^2 dependence across the whole β range

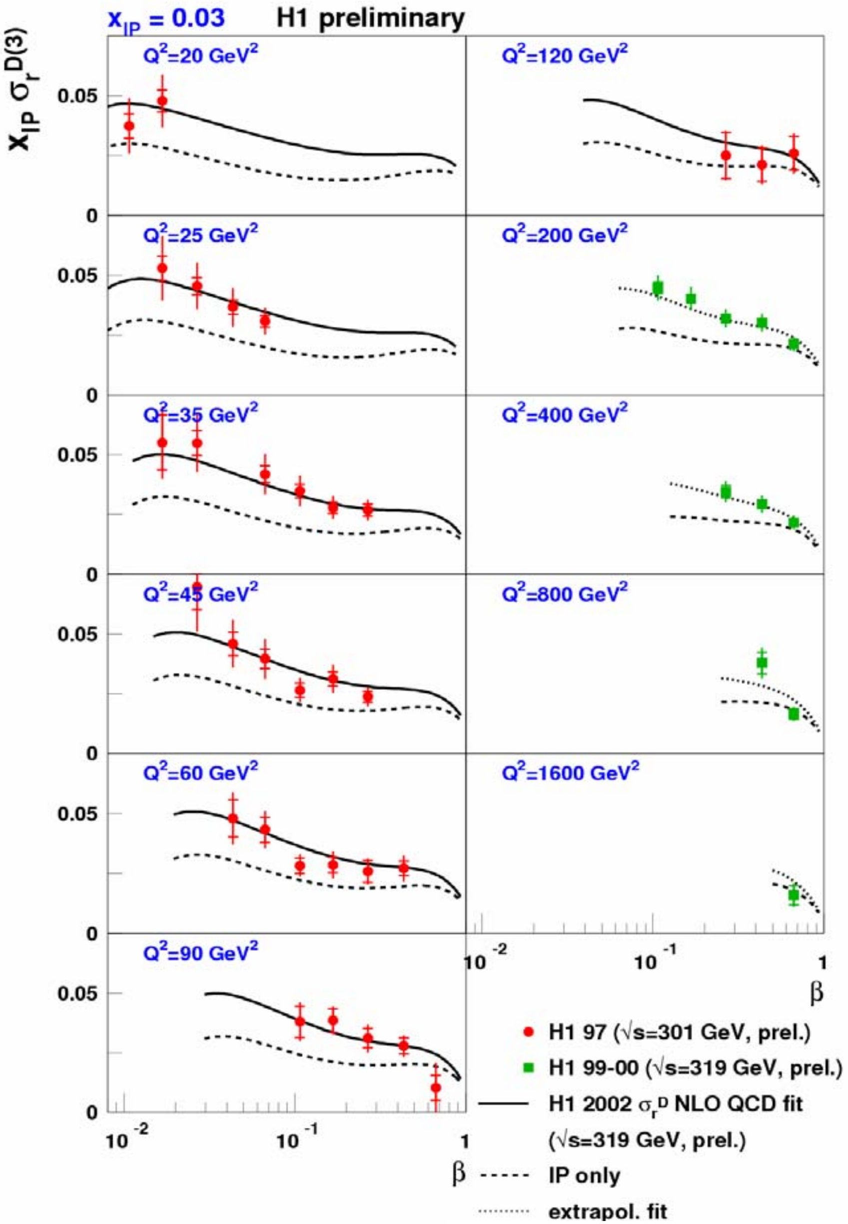
Q^2 dependence of the data at fixed x_{IP}



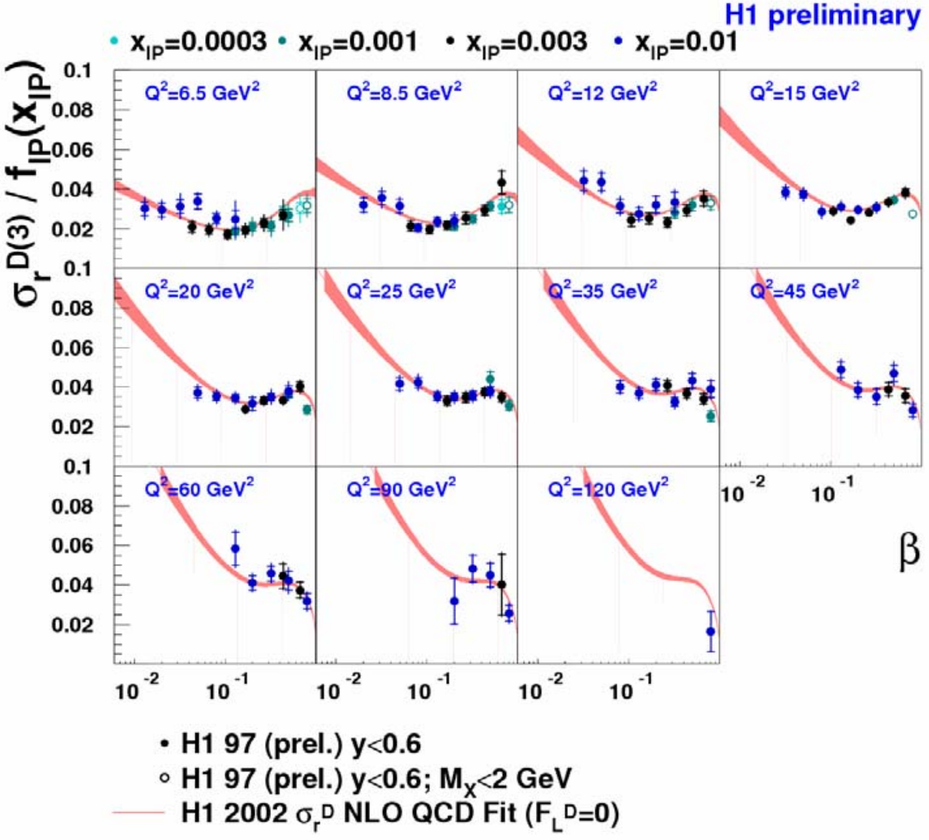


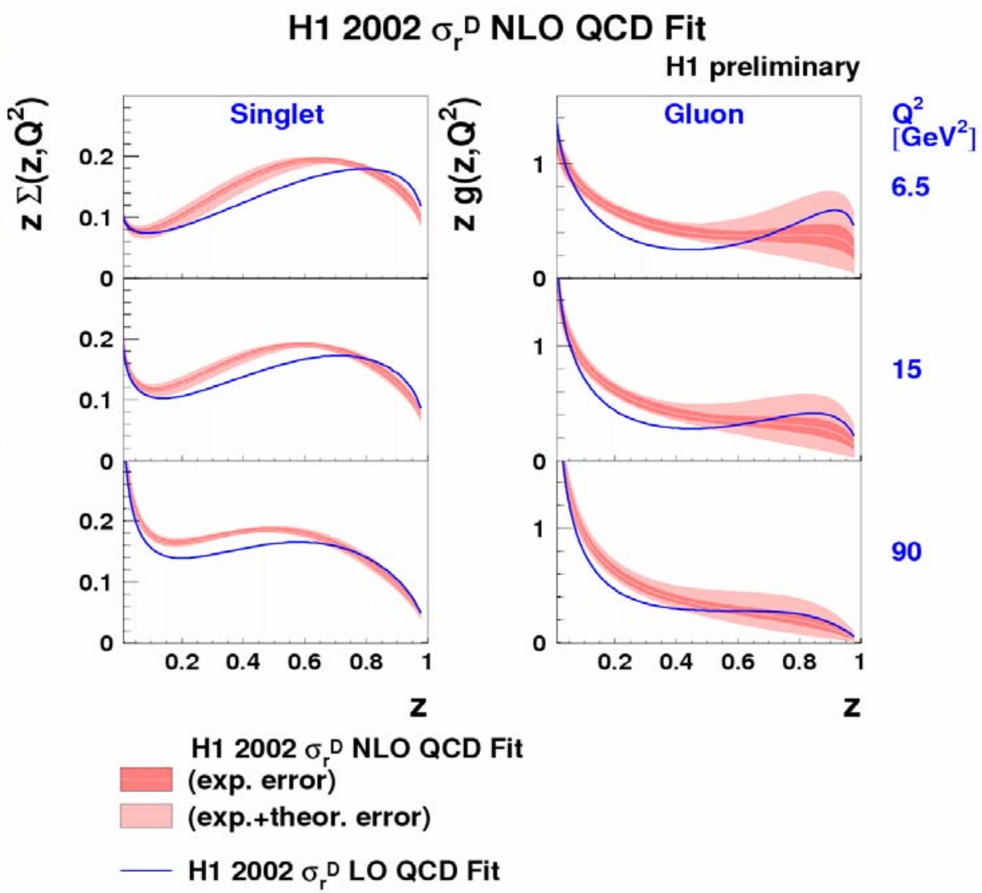
β dependence of the data at fixed x_{IP}





Diffractive pdfs



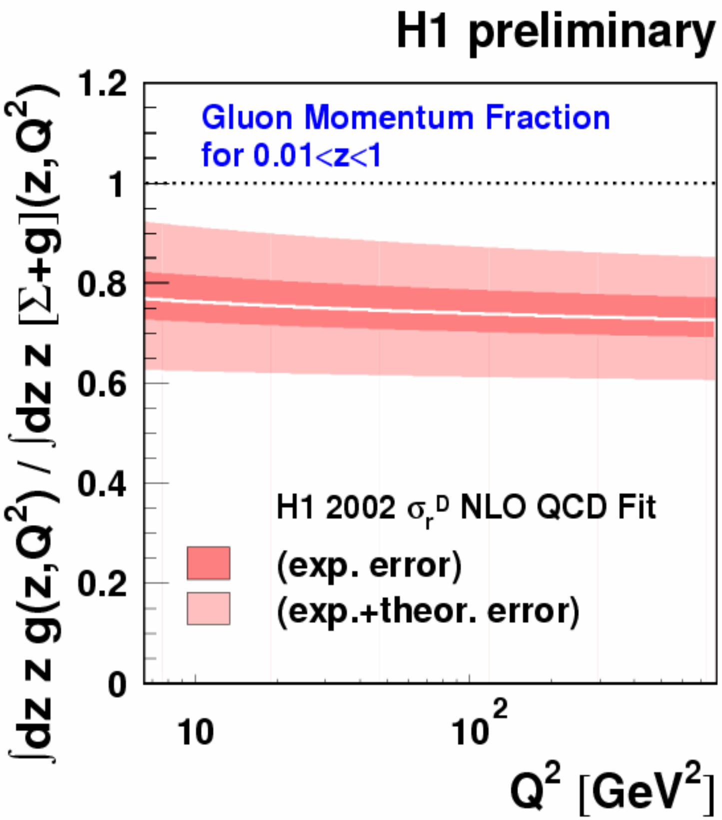


Fit assumes x_{IP} factorisation including sub-leading trajectory

Fit singlet and gluon components at starting scale of $Q^2_{min} = 3$ GeV^2

Singlet well constrained, gluon dominated but large uncertainty at high z

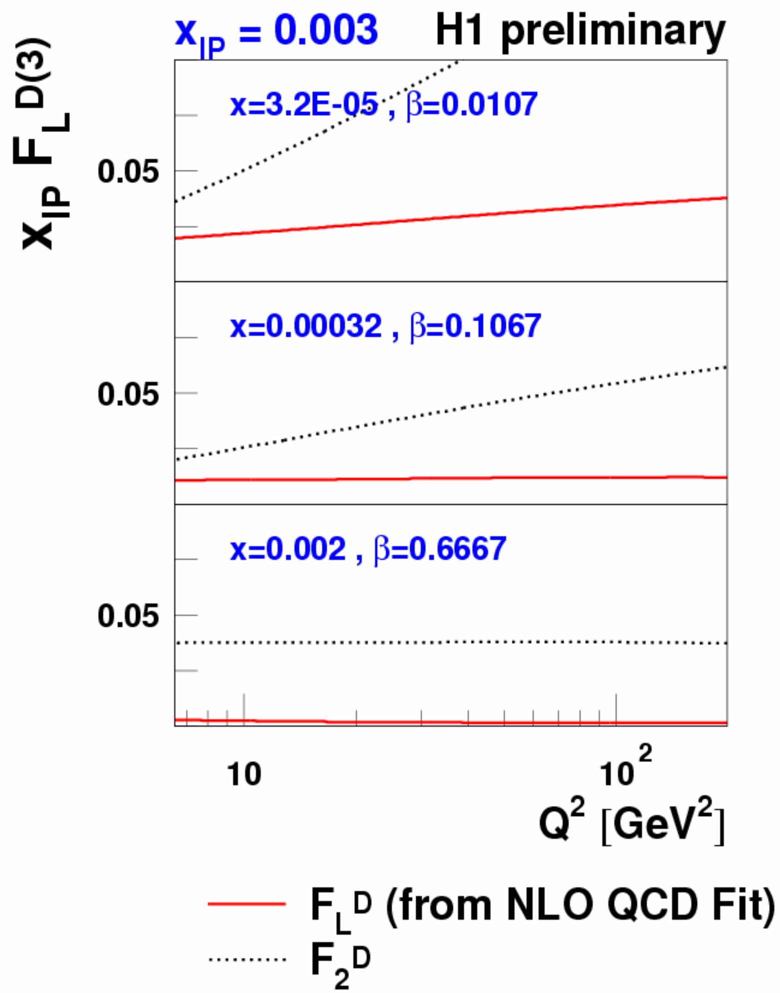
Gluon fraction and F_L at leading twist



Gluon-dominated exchange

→ 75 ± 15%

F_L large at low Q^2 and low β

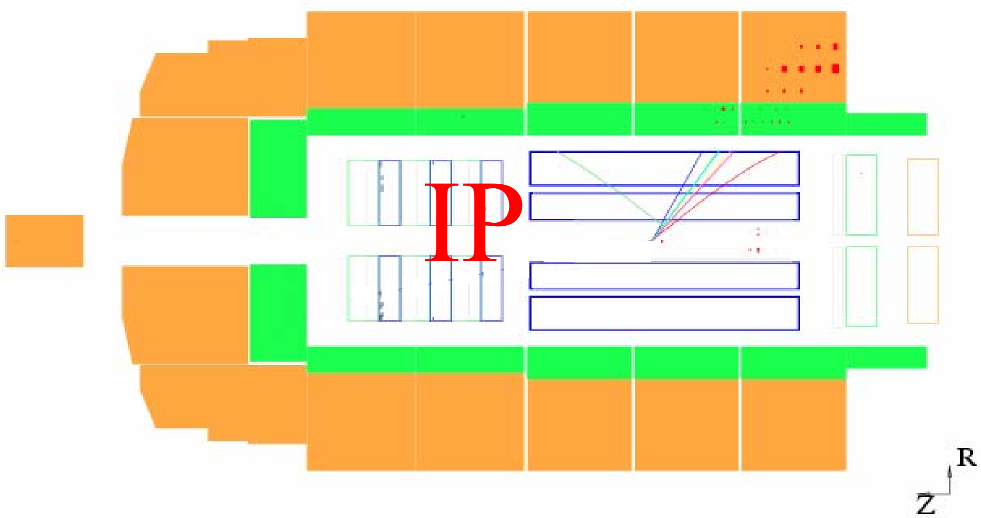


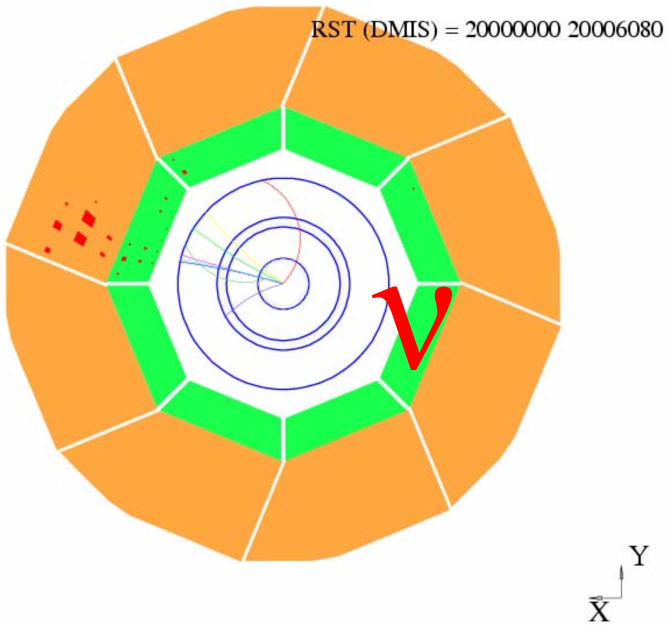
A self-consistent picture of diffractive DIS at H1

- Use these diffractive pdfs as input to Monte Carlo to predict exclusive processes
  - *See talk on DDIS Dijets by Mozer*
  - *See talk on DDIS D* by Beckingham*
- Already saw self consistency in inclusive NC analyses (fit to medium Q^2 data describes lower and higher Q^2 sets well)
- How about charged current?

CC Events with a Rapidity Gap

$ep \rightarrow \nu X p$





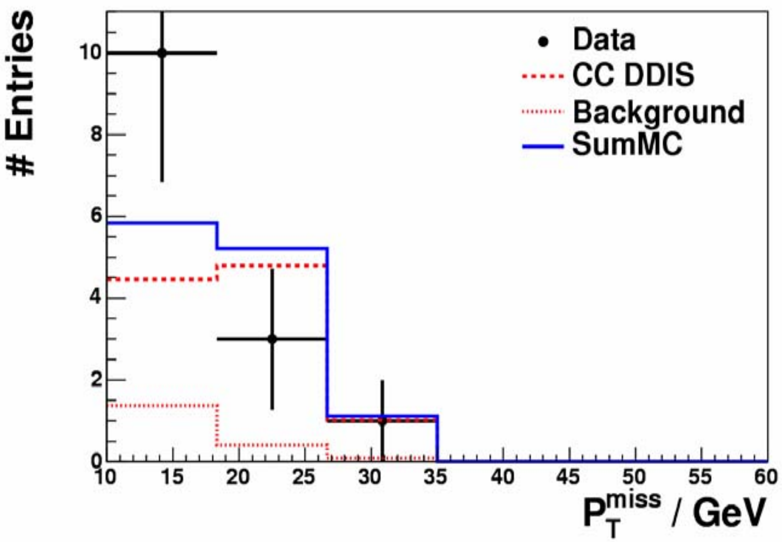
Striking experimental signature:

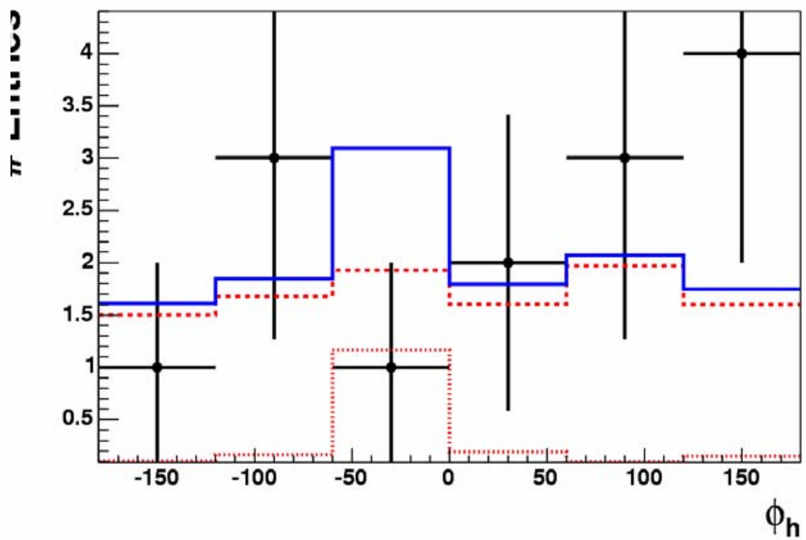
- missing transverse energy (Charged current)
- large gap in rapidity (Diffraction)

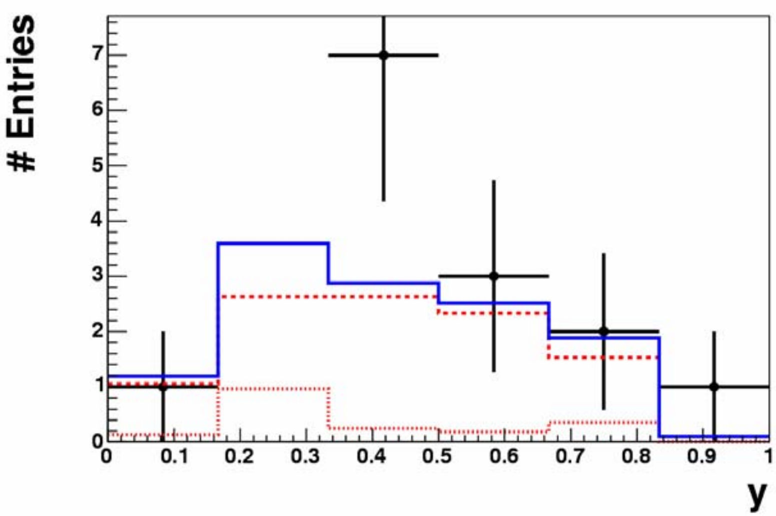
Analysis Technique

- Same 1999/2000 data set used for high Q^2 NC analysis $\rightarrow$ have simultaneous inclusive and diffractive NC and CC analyses
- Use the same forward detector treatment as for the higher statistics NC analysis
- Use similar Monte Carlo treatment as for the NC analysis

Diffractive CC Control Plots



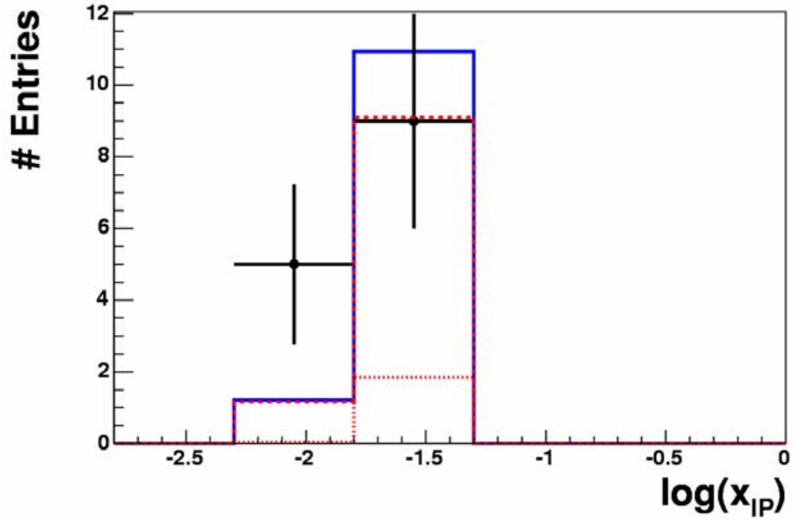


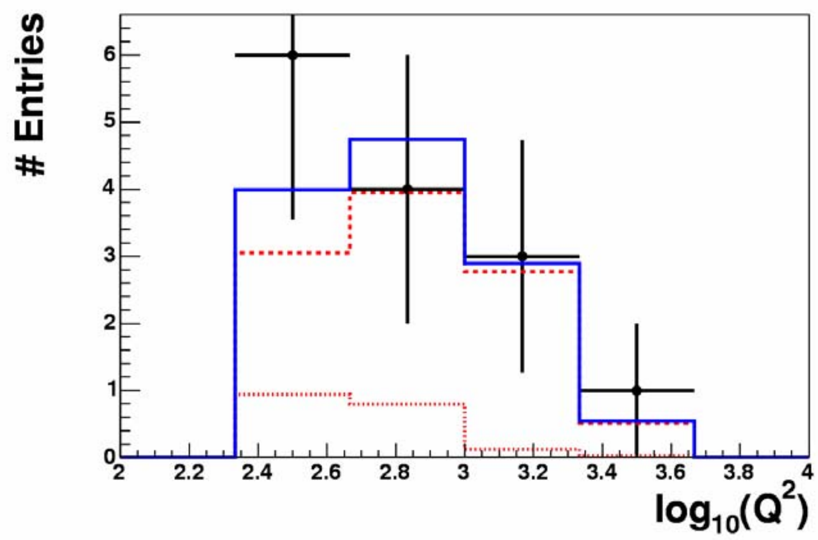


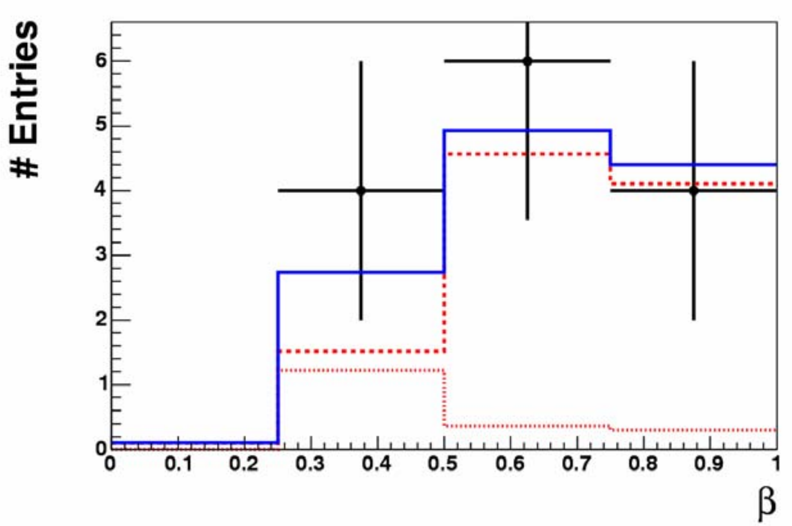
Good description of the data by the RAPGAP simulation (input pdfs are a fit to H1 1994 data)

Main source of contamination is from inclusive CC

Control Plots

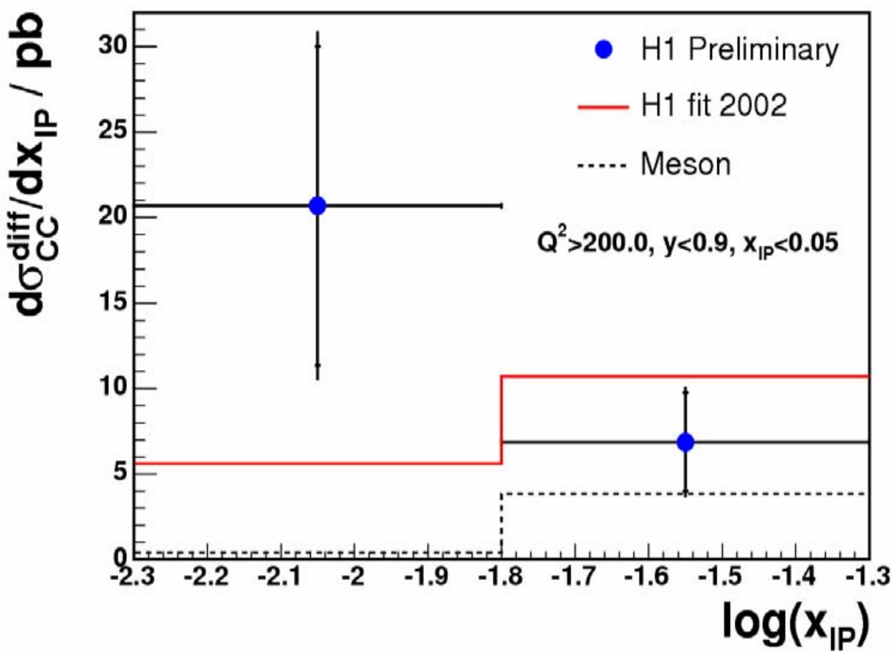


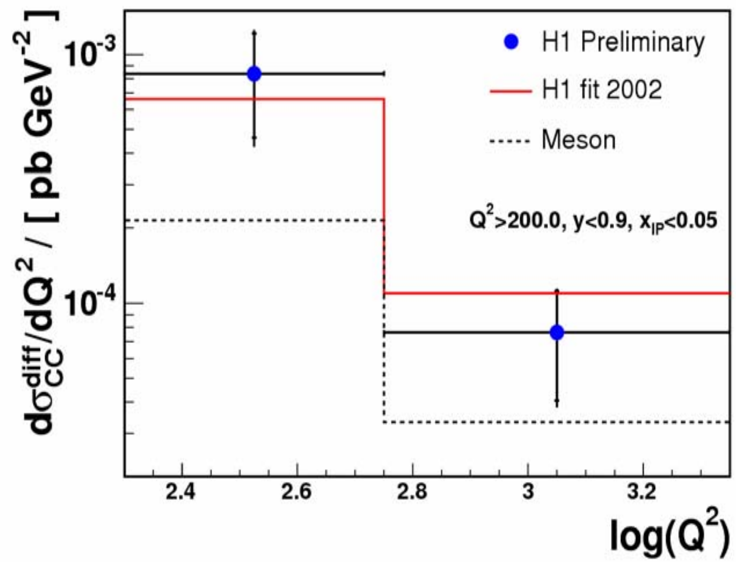


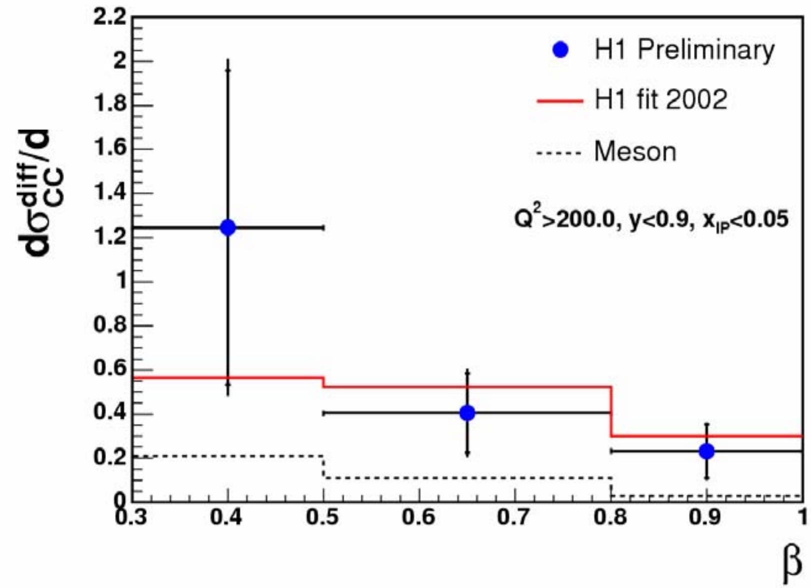


Good description of the kinematic variables → produce single differential cross-sections

Differential diffractive CC cross-sections







Differential cross-sections agree with predictions of NLO QCD fit to the NC data

Total cross-section and ratio to inclusive cross-section

The total CC diffractive cross-section for

$Q^2 > 200$ GeV^2, $y < 0.9$ and $x_{IP} < 0.05$:

$\sigma_{CC}^{diff} = 0.42 \pm 0.13$ (stat.) ± 0.09 (sys.) pb

NLO QCD fit predicts 0.43 ± 0.01 (stat.) pb

Ratio of diffractive to inclusive ($x_{Bj} < 0.05$):

$\sigma_{CC}^{diff} / \sigma_{CC}^{inc} = 2.5 \pm 0.8 \pm 0.6$ %

Summary

- High precision measurements of diffractive DIS analysed using an NLO QCD analysis
- Regge factorisation is a sufficiently good approximation to the data to allow that NLO QCD analysis
- Diffractive pdfs are dominated by the gluon
- Medium Q^2 data fit describes low and high Q^2 NC data well
- Good predictions of measurements of exclusive processes:
  - *See talk on DDIS Dijets by M. Mozer*
  - *See talk on DDIS D* by M. Beckingham*
- Charged current events with large rapidity gaps observed and differential cross-sections extracted
- Predictions of the NLO QCD fit to NC data agree well with differential diffractive CC cross-sections