Diffractive Dijet & *charm* Production at H1 and ZEUS

Roger Wolf,

University of Heidelberg
for the H1 Collaboration

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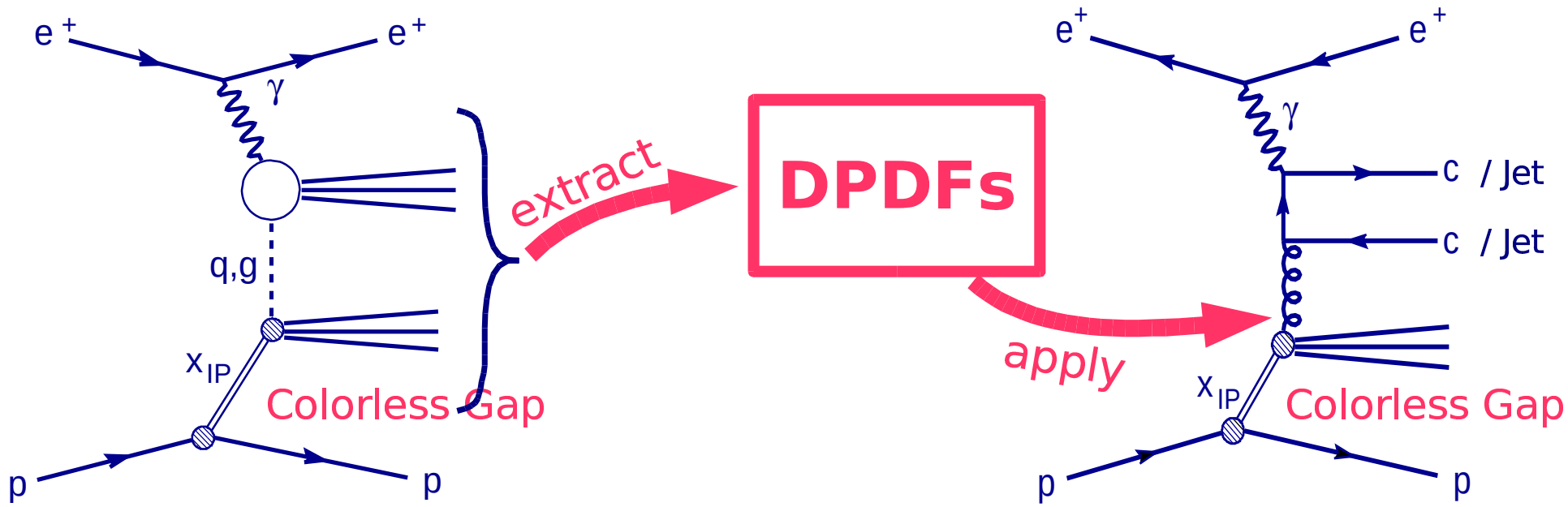
QCD Factorization in Diffraction

$$\sigma_{meas} = (\textbf{universal}\ \text{DPDFs}) \otimes (\text{Hard}\ \textbf{ME})$$

Inclusive Final States **Exclusive Final States**



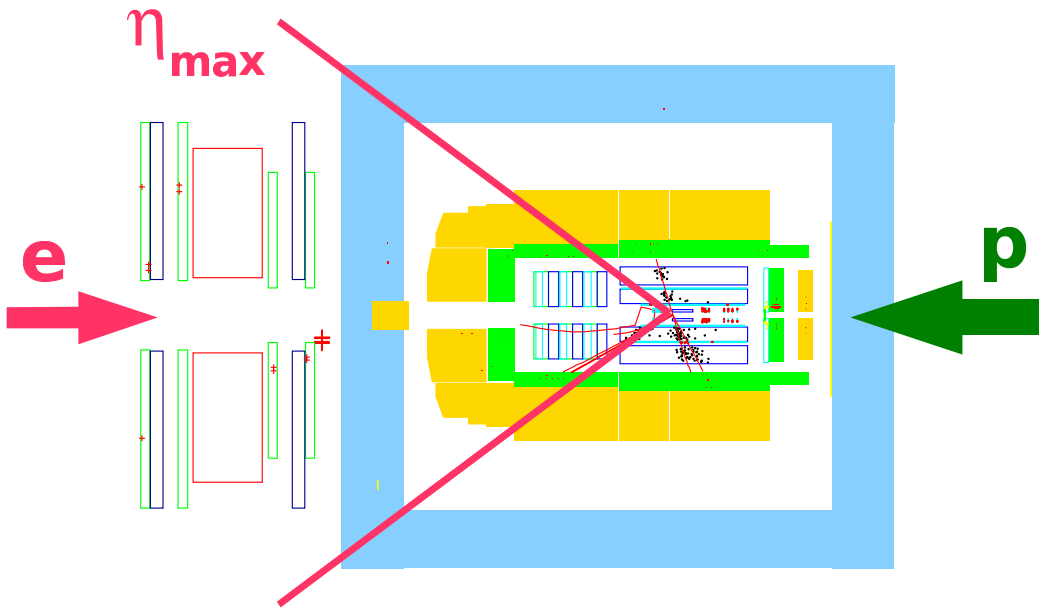
- **Non-Trivial** statement
- **Solid Proof** that it is fulfilled in QCD for ep (in DIS) at 'sufficiently' large Q^2

Diffractive Event Selection

Diffractive Selection: **No activity** in the forward direction of H1 (or ZEUS) above noise thresholds (η_{max})

$x_{IP} < 0.04$; $M_Y < 1.6$ GeV, $|t| < 1\text{GeV}^2$

$x_{IP} < 0.03$; (16±4% correction to proton elastic cross section)

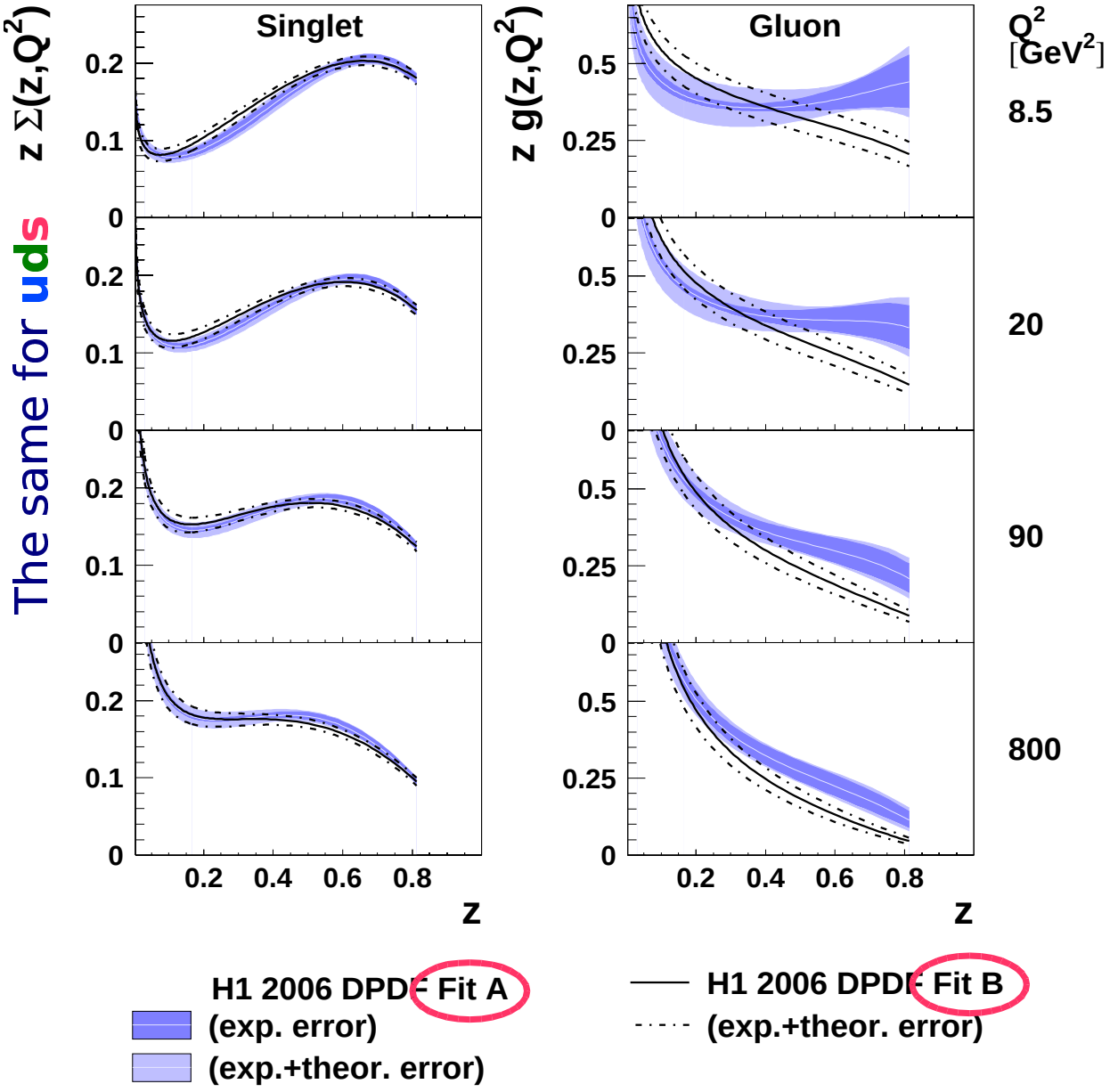


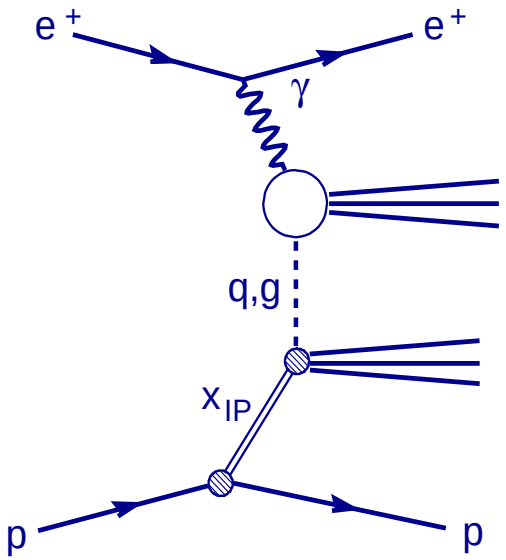
DIS Selection: Scattered lepton in backward calorimeter

PhP Selection:

- Absence of scattered lepton (*untagged*)
- Scattered lepton at low angle (*tagged*)

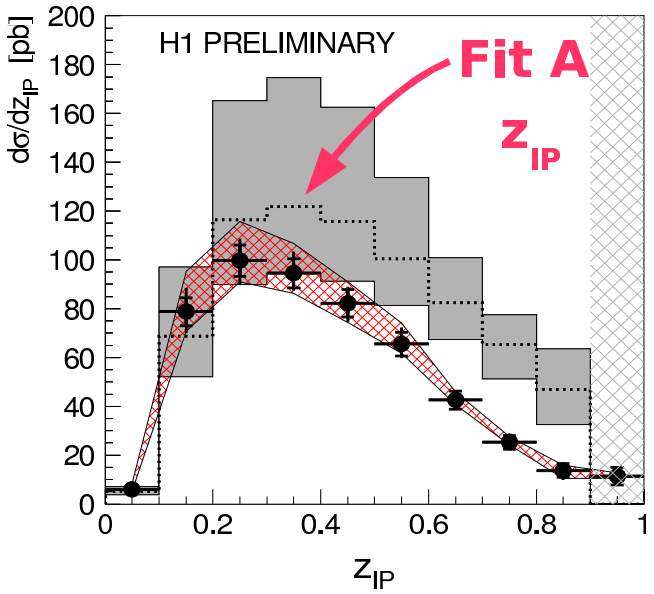
Diffractive Parton Density Functions

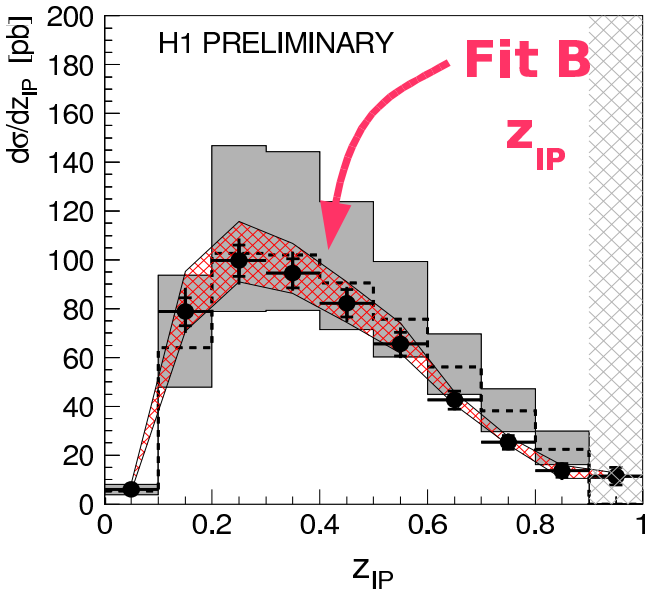


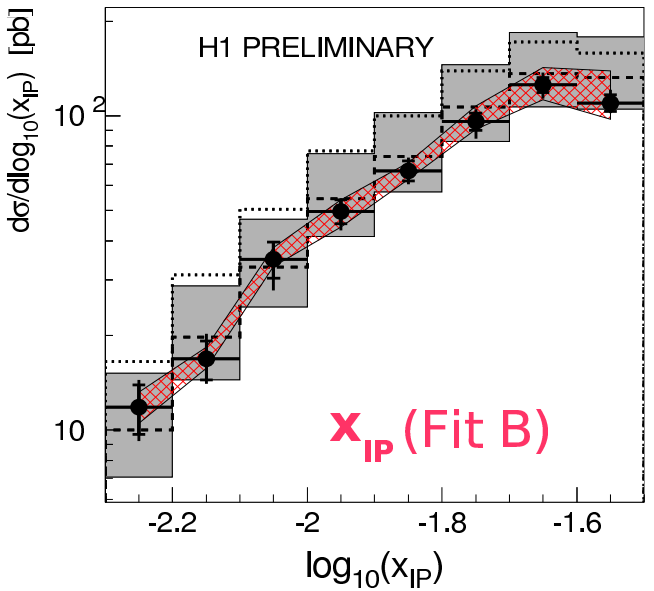


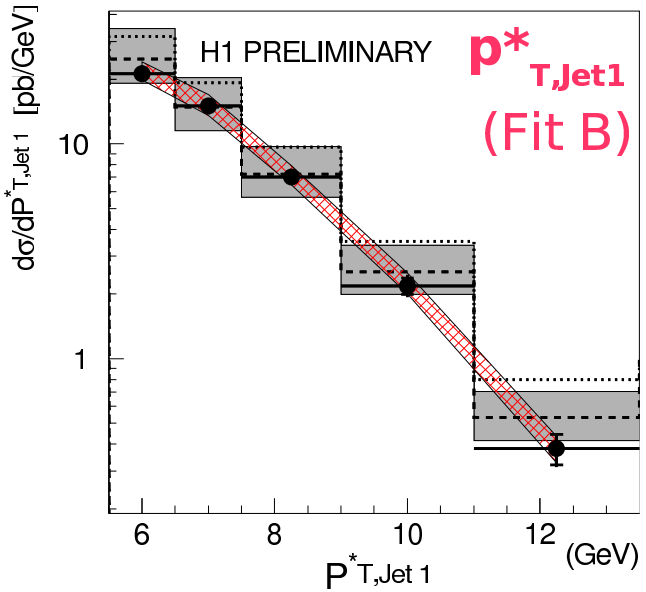
- **H1 2006 DPDF** Fit A & B
- Well constrained **singlet**
- Weakly constrained **gluon** (esp. at high values of z)

Diffractive **Dijet** Production **(DIS)**









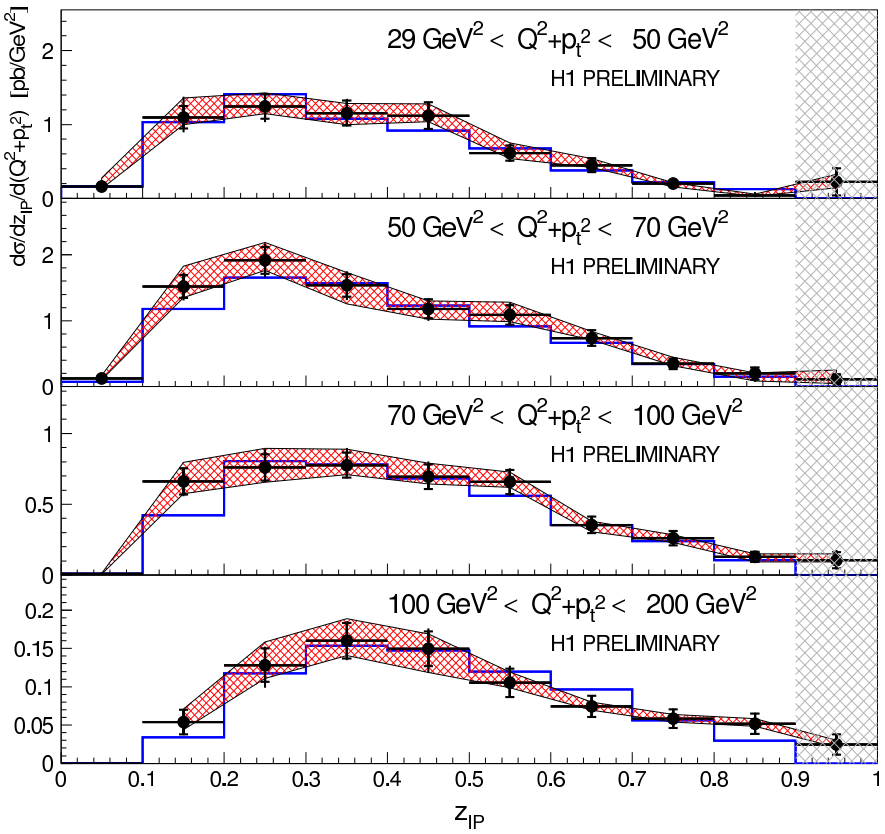
Dijet Selection

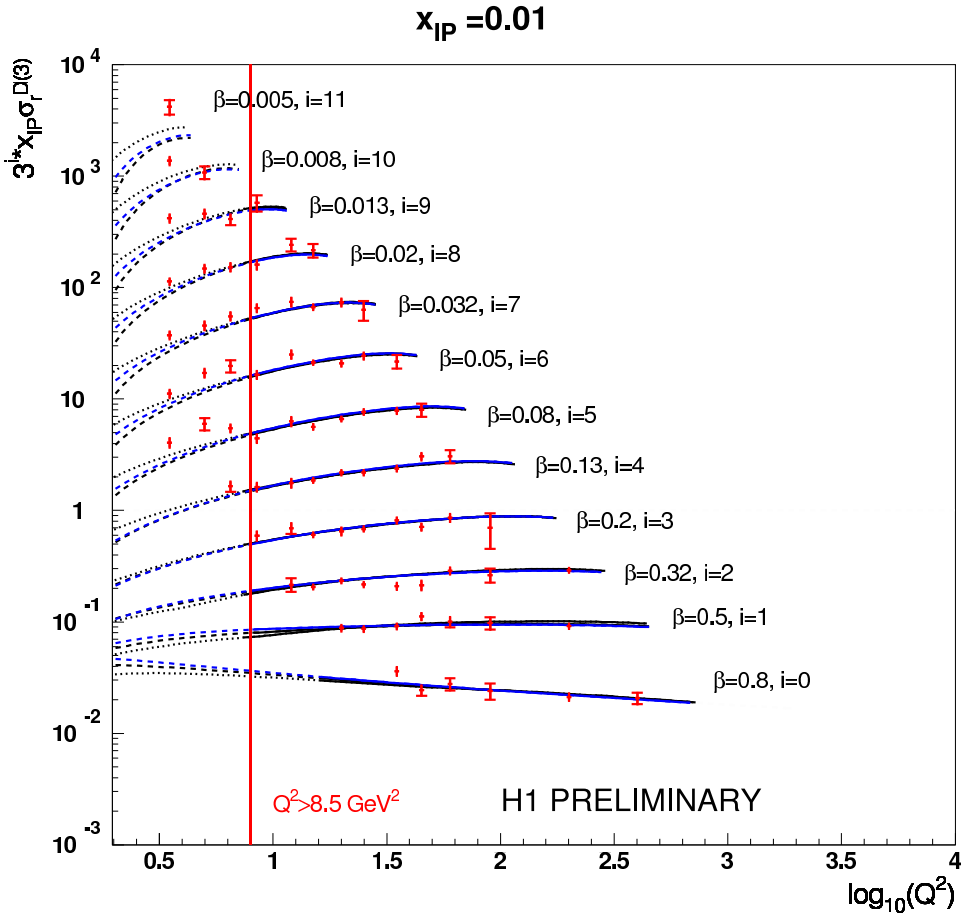
(Prel 2006)

- **Incl k_t in γp cms (y=1)**
- E_t^{*Jet1}>5GeV, E_t^{*Jet2}>4GeV
- **$4<Q^2<80$ GeV^2**
- **$0.1<y<0.7$**

- **NLO**: Nagy et al.
- **DPDFs**: H1 2006 DPDF Fit A & B
- $\mu^2 = (p_t^2+Q^2)$
- **Problems** esp. with z_{IP}
- BUT **Fit B does better** than Fit A

Combined Fit (Dijet + Incl) (DIS)

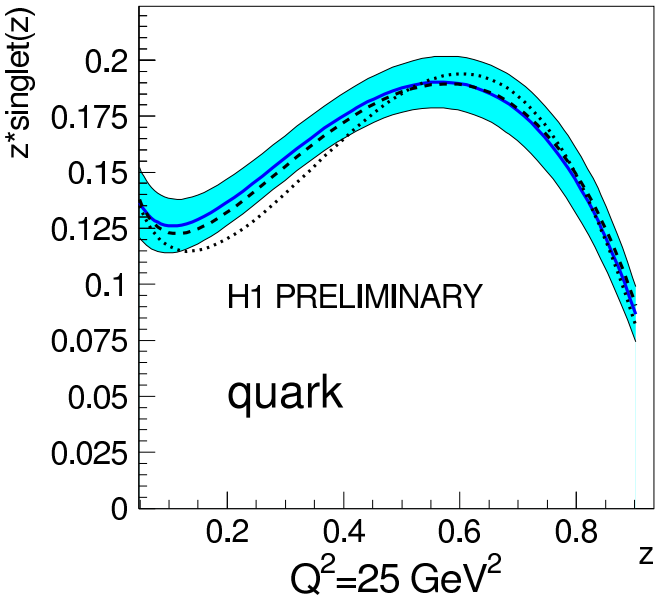


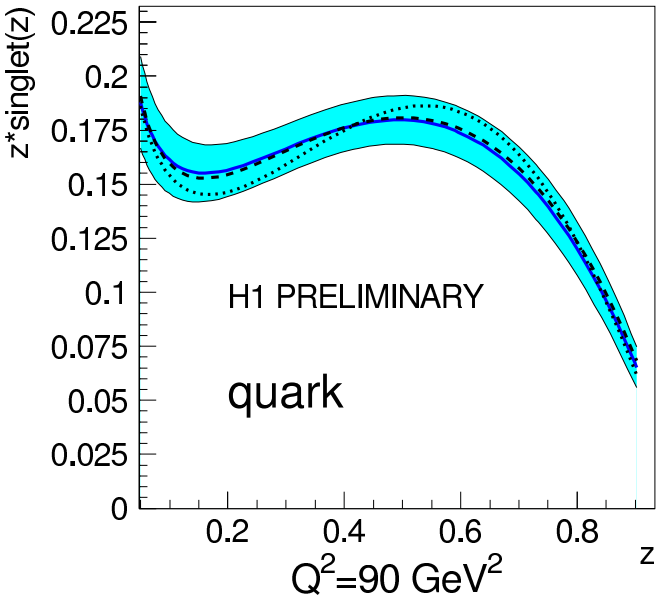


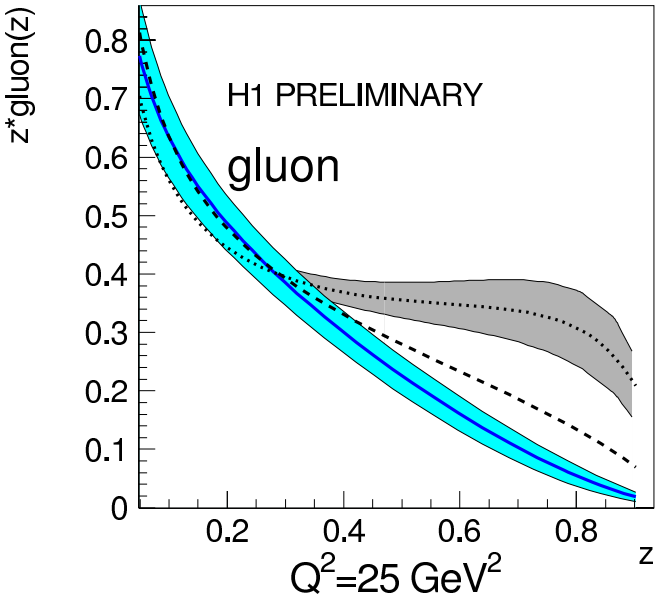
- **Very good** Fit Results
- χ^2/ndf **= 0.89** (27/36 Dijet + 169/190 Incl)

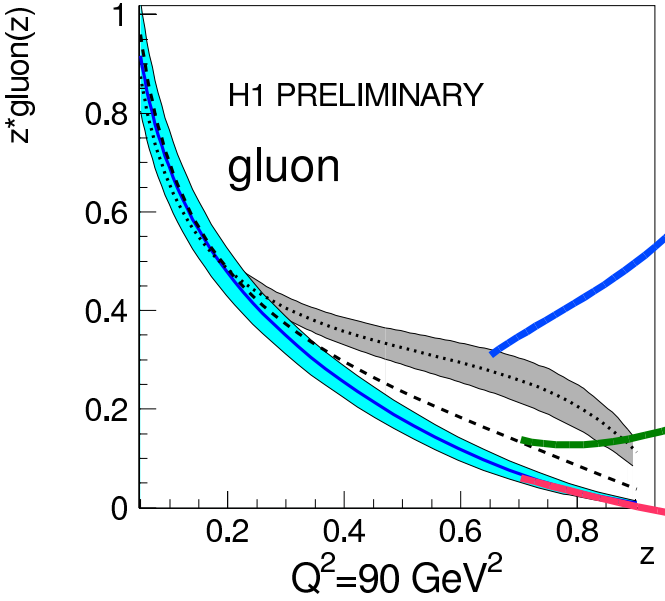
- Hardly any pull to the incl. data (**complementary** datasets)
- **Less sensitive** to the choice of parametrisation

Combined Fit Results (DIS)









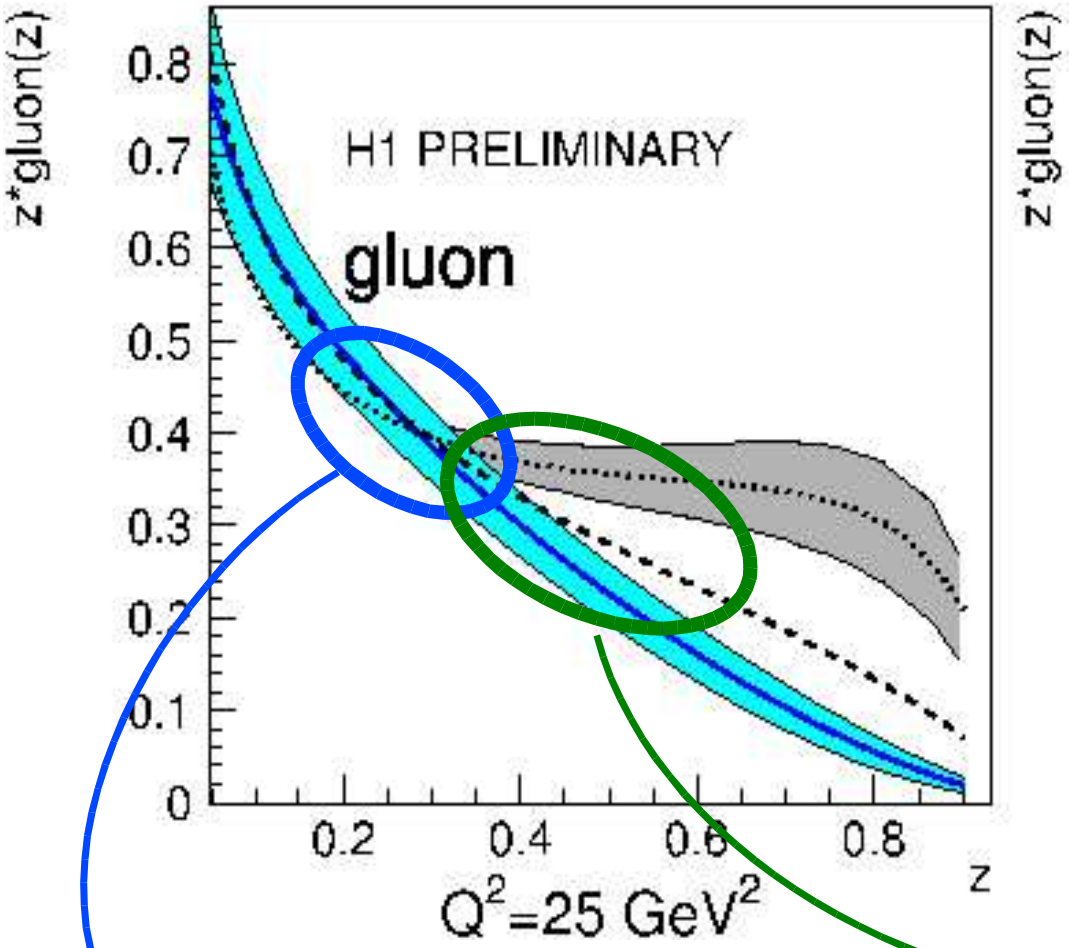
- **Improves** incl. fit at high z
- **Constraines** quark+gluon over a wide range $(0.05<z_{IP}<0.9)$

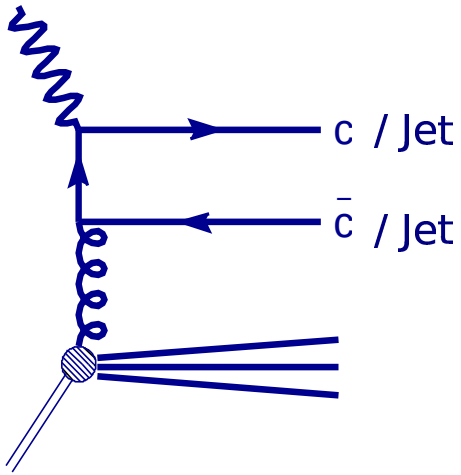
Fit A

Fit B

Cmb Fit

Complementarity of ***charm*** & **Dijets**





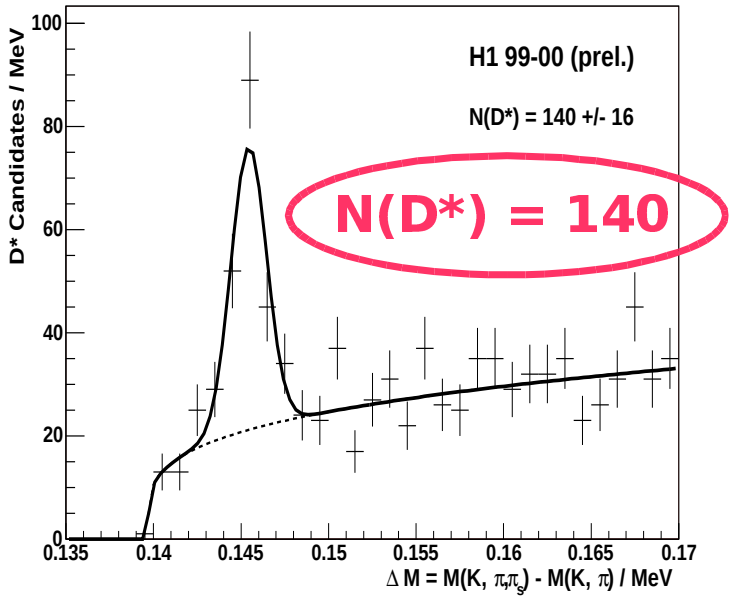
Probed by **Dijet** measurement
$\langle\mu^2\rangle$ = 30-40 GeV^2

Probed by ***charm*** measurement
$\langle\mu^2\rangle$ = 11-16 GeV^2

Diffractive *charm* Production (DIS)

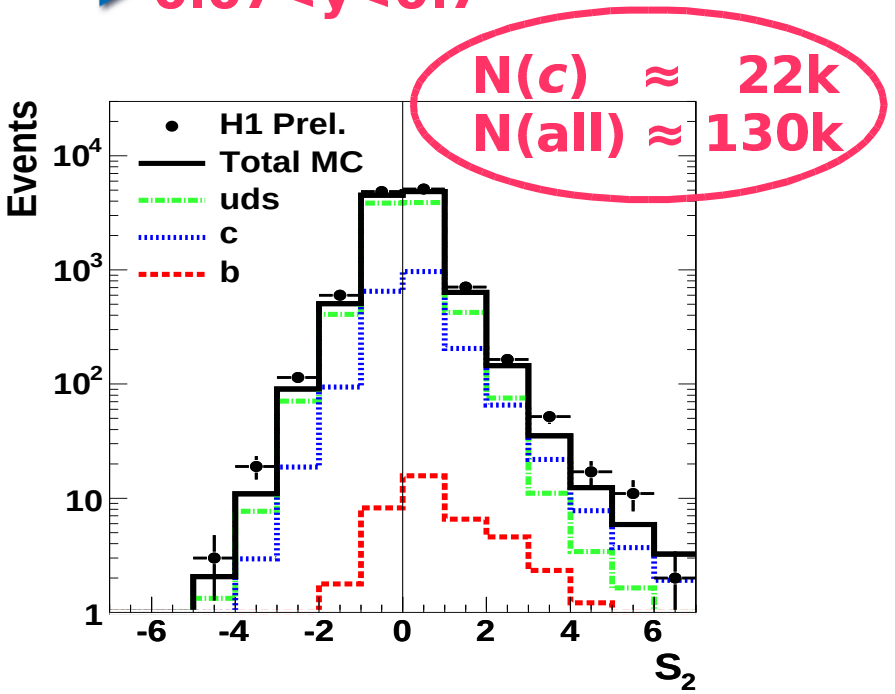
*D** Selection (H1 Prel 2004):

- $D^* \rightarrow K \pi \pi_s$
- $2<Q^2<100$ GeV^2
- $0.05<y<0.7$

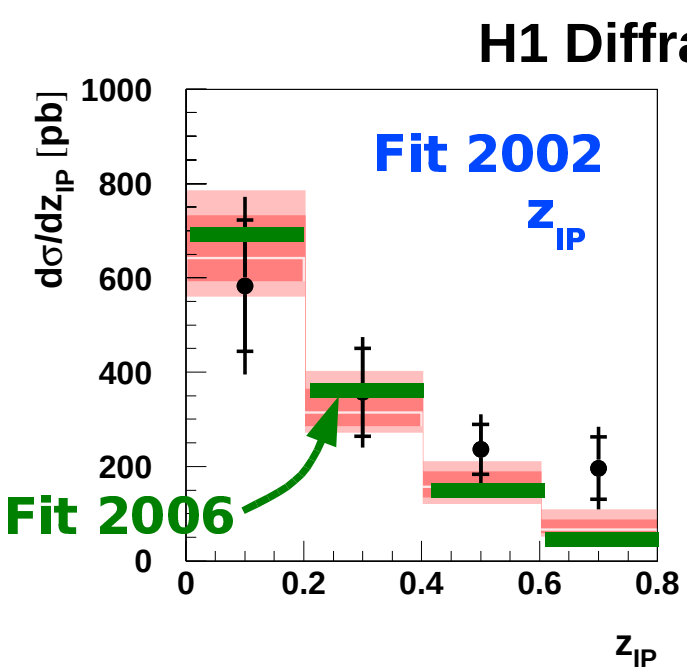


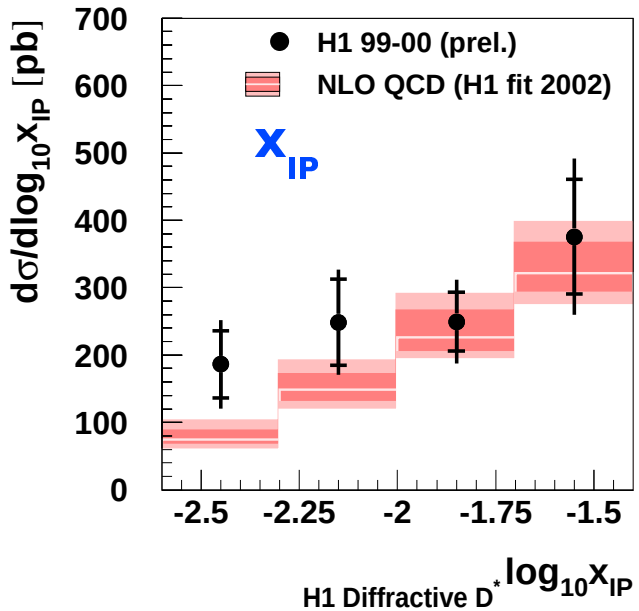
Displ. Track Selection (H1 Prel 2006):

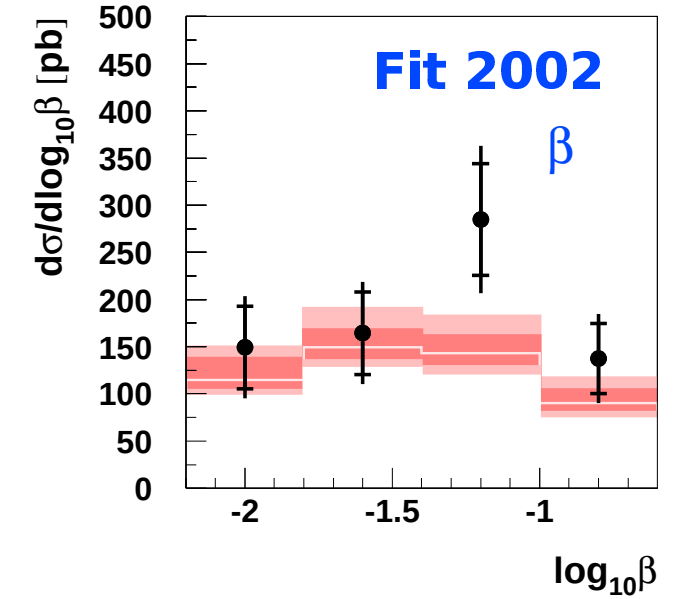
- Tracks displ. from primary vertex
- $15<Q^2<100$ GeV^2
- $0.07<y<0.7$

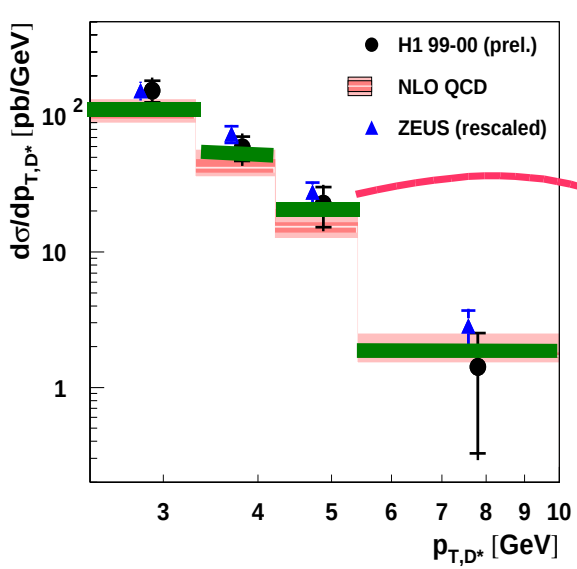


Comp. with NLO: *D** Selection (DIS)







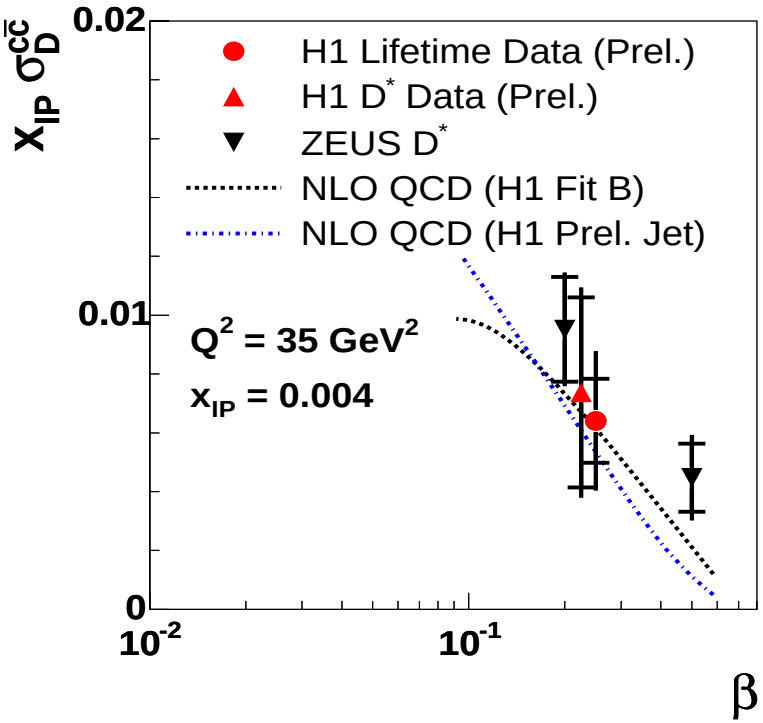


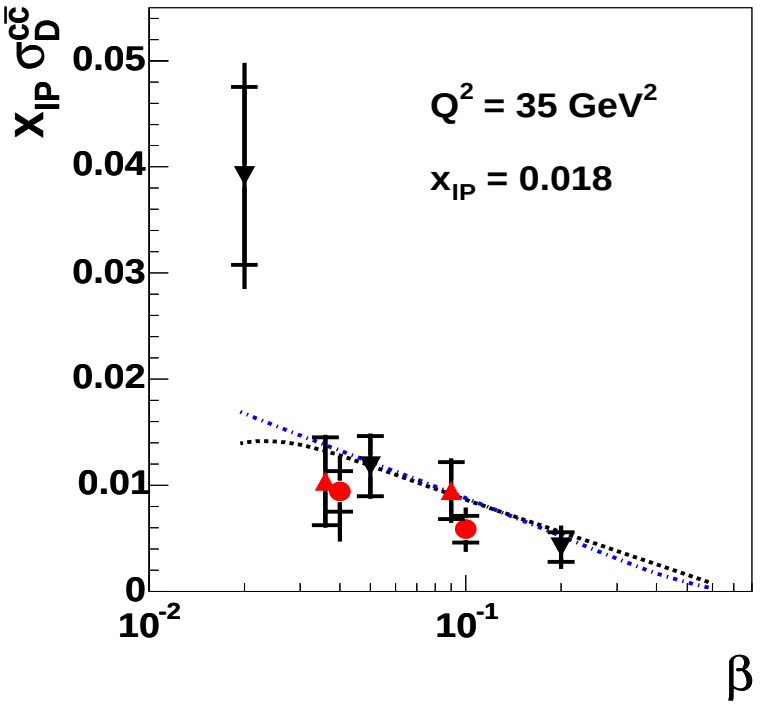
- **NLO**: Collins et al. (*massive scheme*)
- **DPDFs**: H1 fit 2002 (Prel.)
- $\mu^2 = (4m_c^2+Q^2)$
- Overall **good** Description!

Good agreement between H1 and ZEUS data

Comp. with NLO: *displ. Track Selection* (DIS)

charm contribution to F2D:



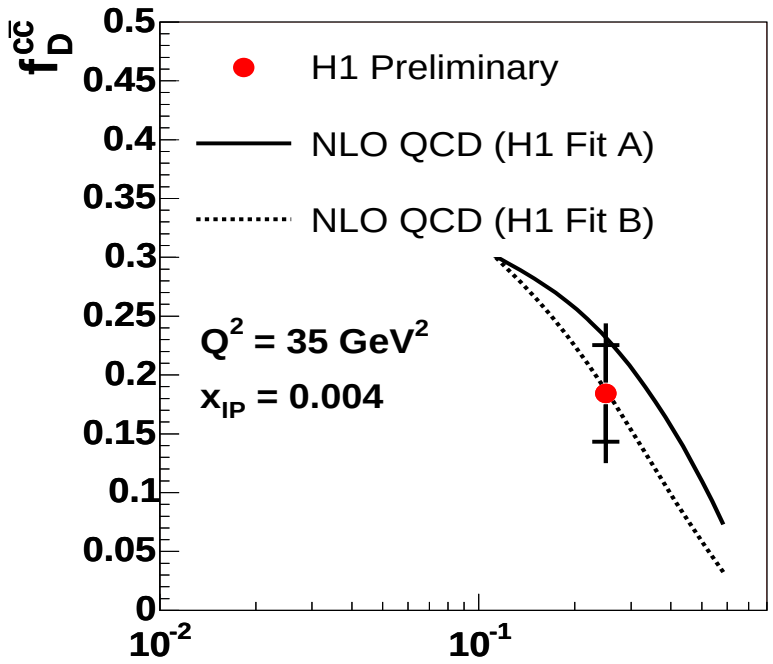


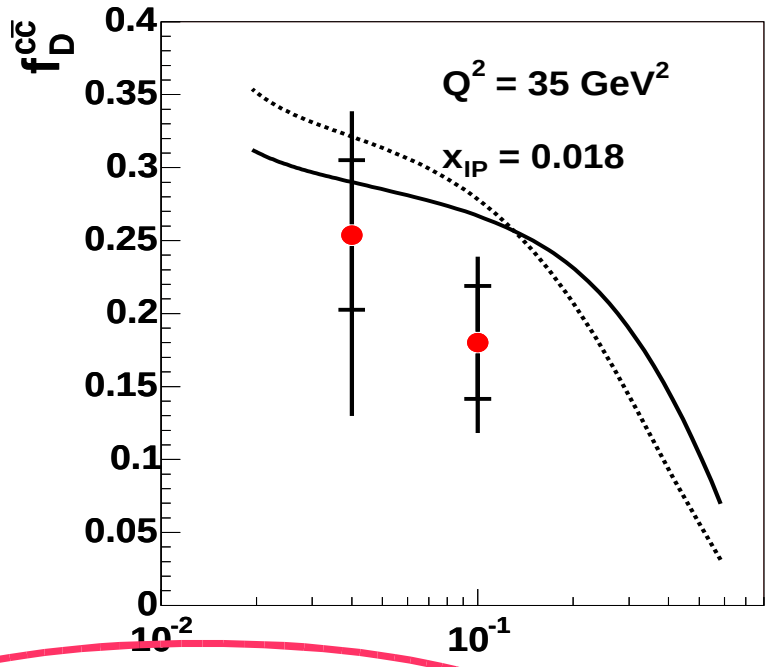
- **NLO**: direct comp. (*massive scheme*)
- **DPDFs**: H1 2006 DPDF Fit A & B

- $\mu^2 = (4m_c^2)$
- $\langle\mu^2\rangle$ = **5.6 GeV²**
- Overall **good** Description!

Comp. with NLO: *displ. Track Selection* (DIS)

charm contribution to F2D:



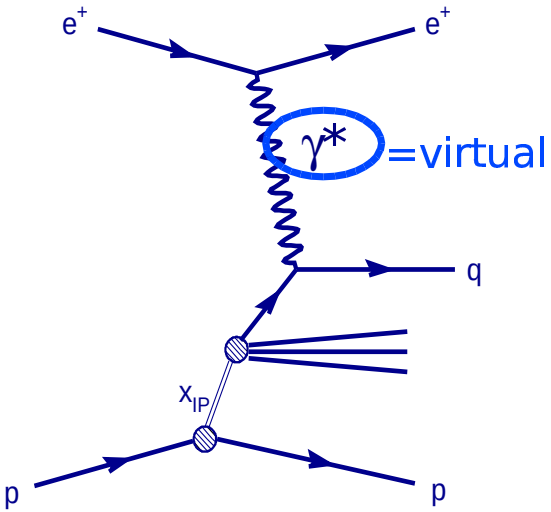


Simillar charm fraction as for incl scattering

Factorization is experimentally verified in DIS!

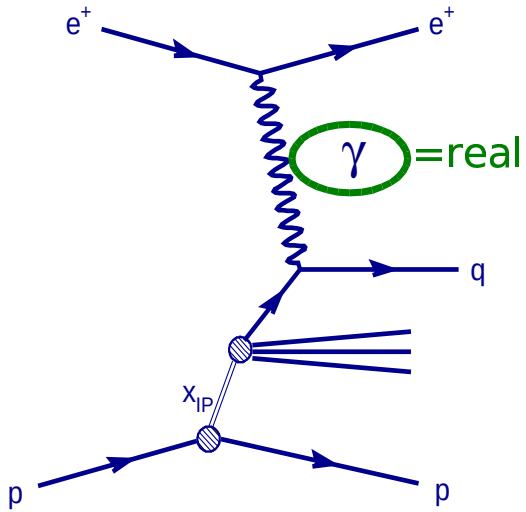
Transition from **ep** to **Hadron-Hadron**

DIS

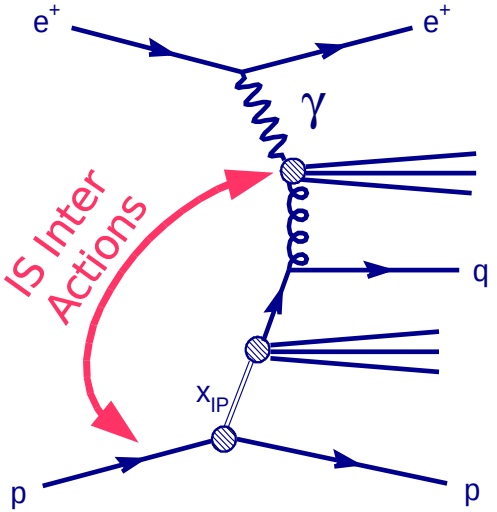


Lepton-Hadron

Photoproduction (γp)

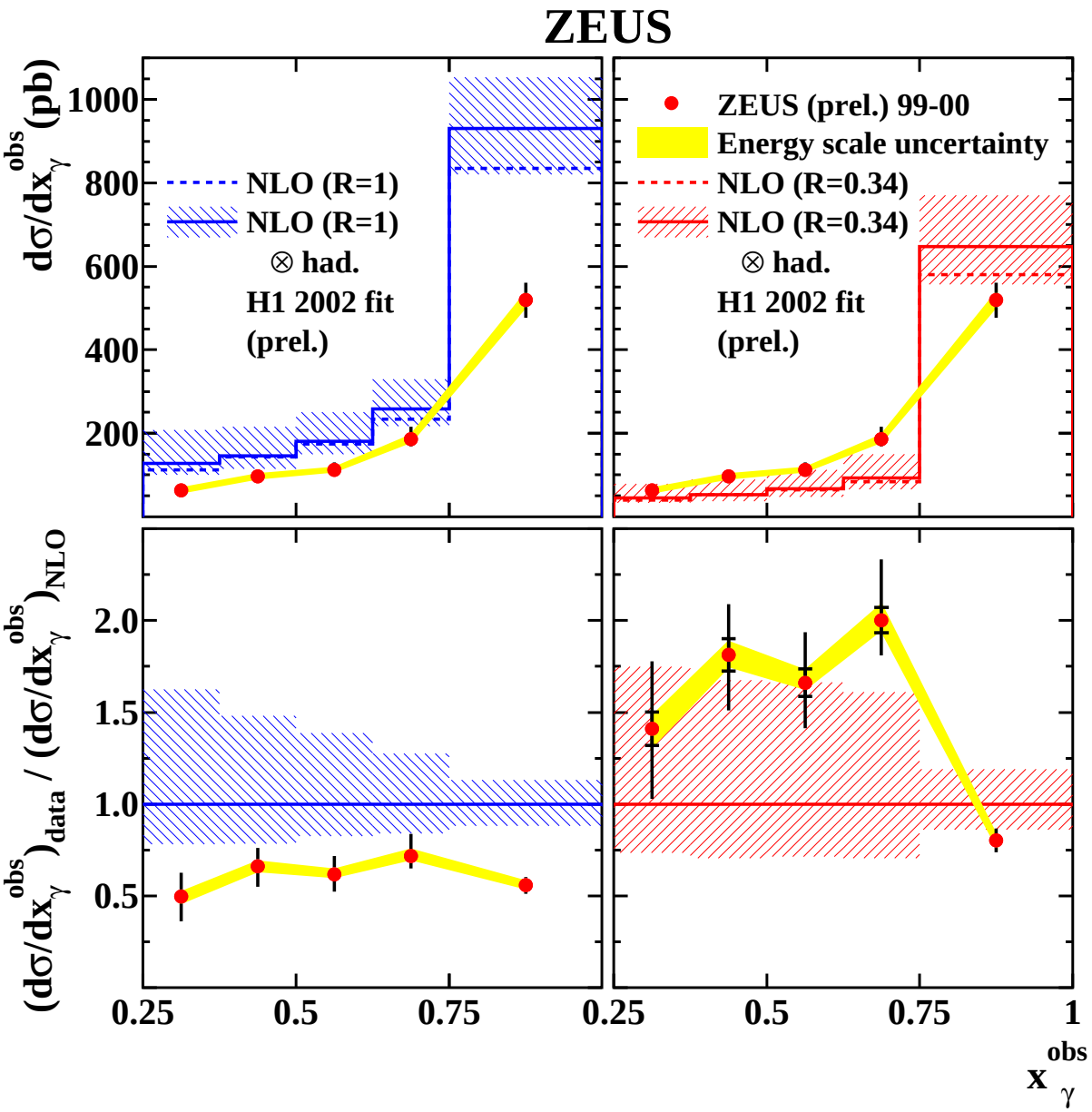


Photon-Hadron



Hadron-Hadron

Diffractive **Dijet** Production (γp)



Dijet Selection

(ZEUS Prel 2005)

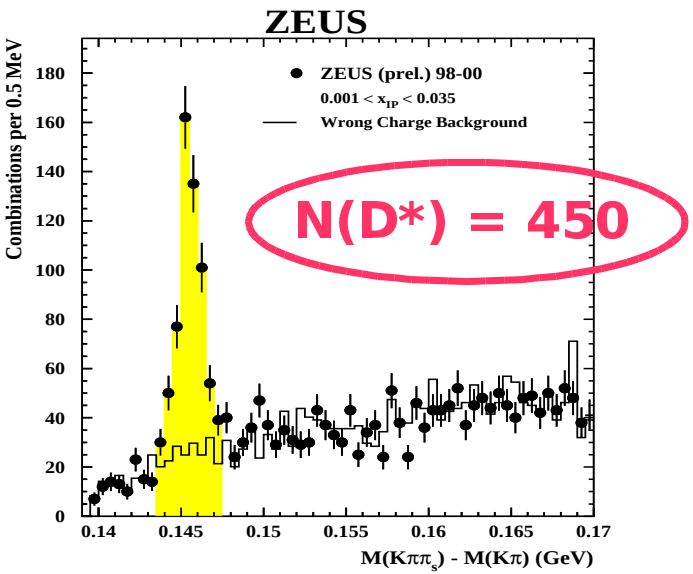
- **Incl k_t in γp cms (y=1)**
- E_t^{*Jet1}>7.5GeV, E_t^{*Jet2}>6.5GeV
- **Q^2<1 GeV^2**
- **0.2<y<0.85**

- **NLO**: Klasen & Kramer
- **DPDFs**: H1 2002 (prel.)
- $\mu^2 = E^{*2}_{t\,Jet1}$
- NLO **overestimates** data by ~2!!!
- Suppression of **resolved & direct** component

Diffractive *charm* Production (γp)

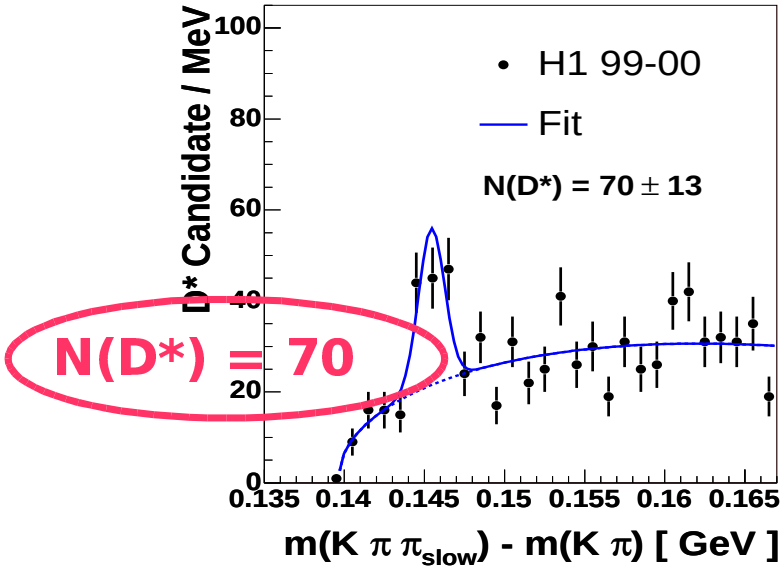
*D** Selection (Prel 2005):

- $D^* \rightarrow K \pi \pi_s$
- $Q^2<1$ GeV^2
- $130<W<300$ GeV

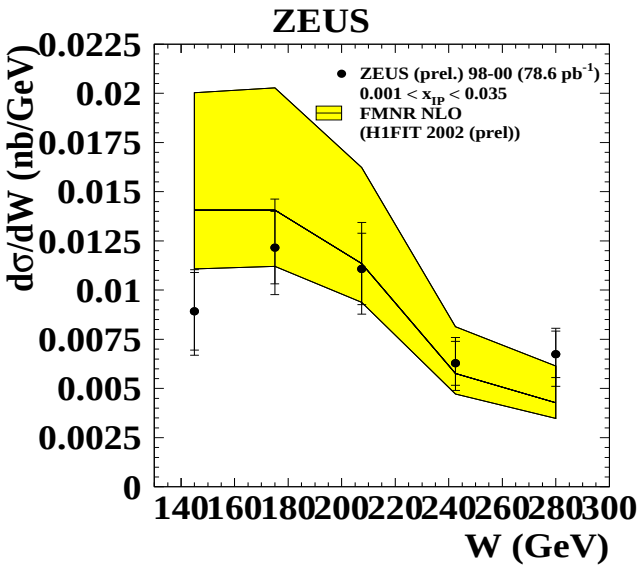


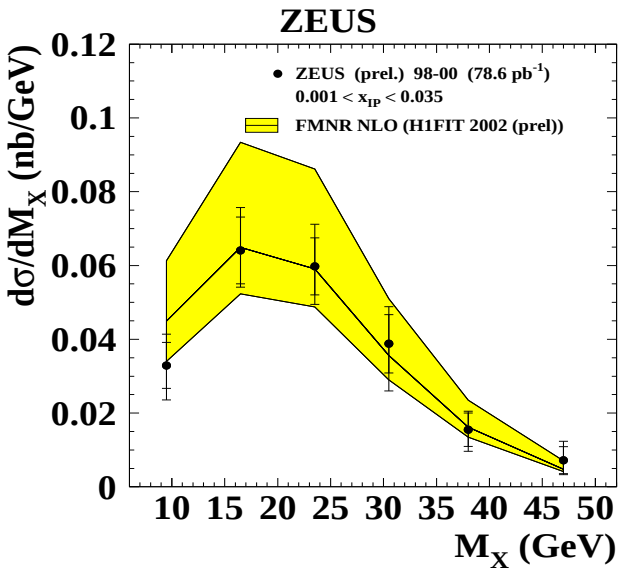
*D** Selection (Prel 2006):

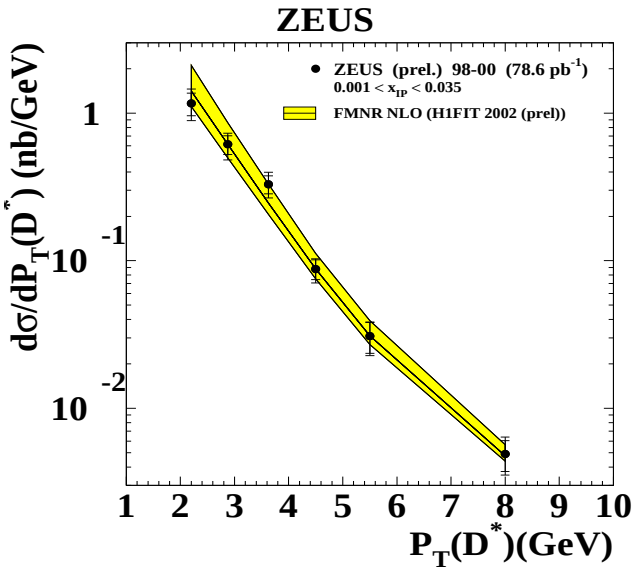
- $D^* \rightarrow K \pi \pi_s$
- $Q^2<0.01$ GeV^2
- $0.3<y<0.65$

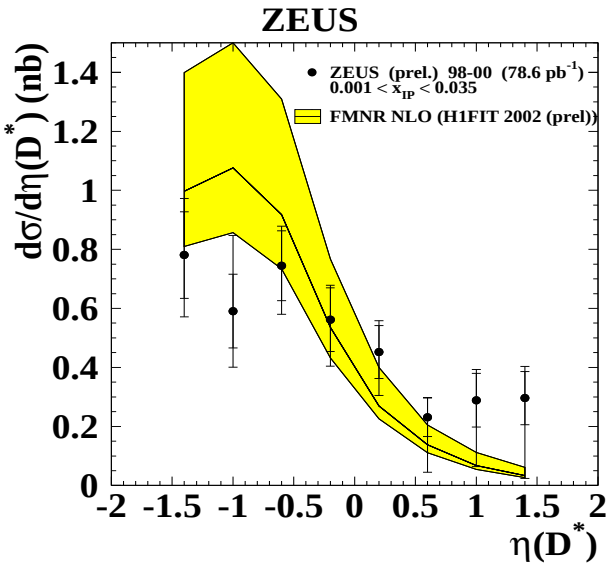


Comparison with NLO: *charm* (γp)



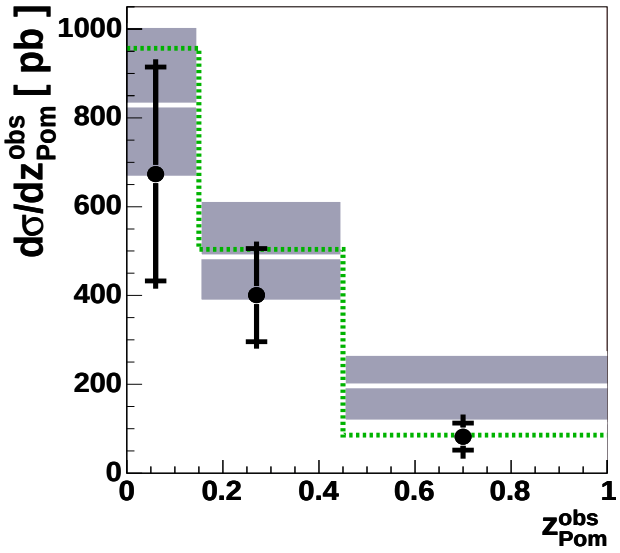


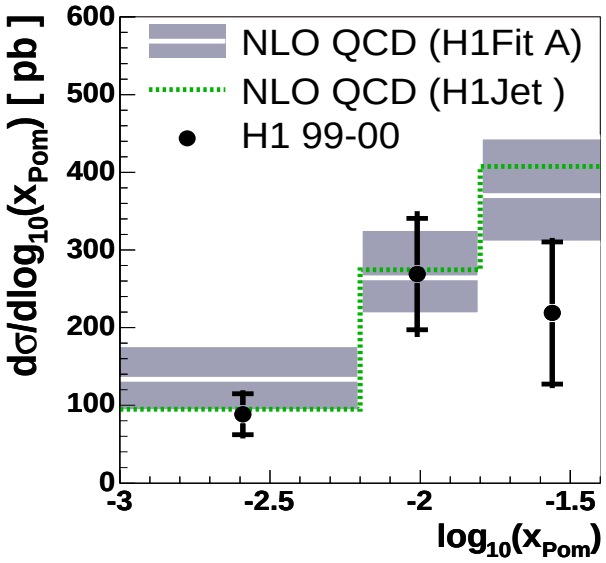


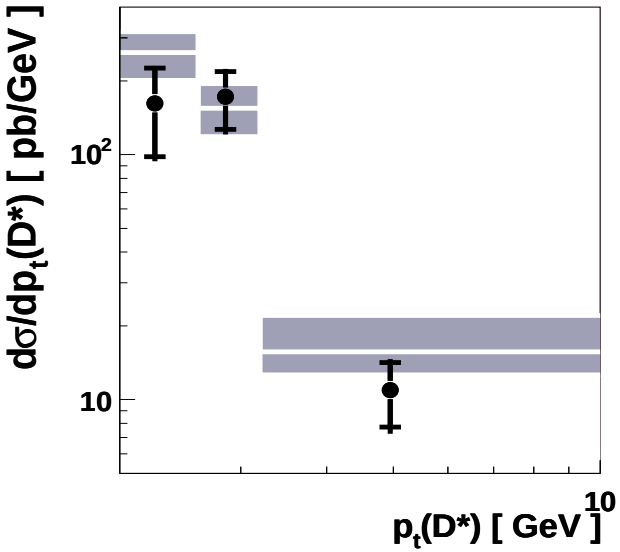


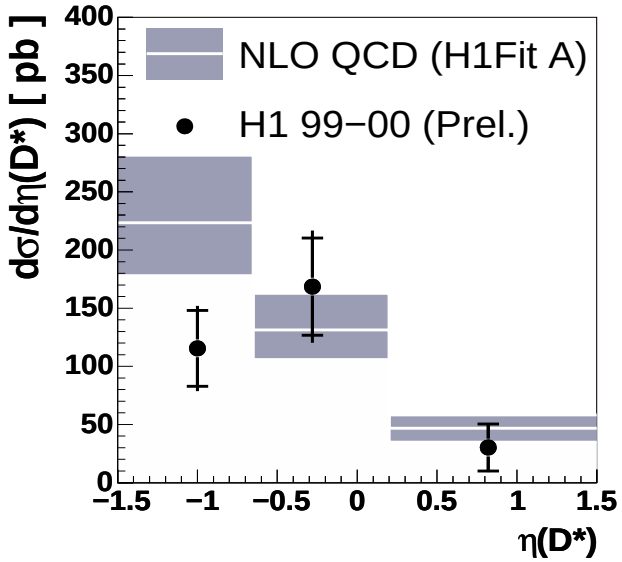
- **NLO**: Frixione et al. (*massive scheme*)
- **DPDFs**: H1 2002 (prel.)
- $\mu^2 = (m_c^2 + p_t^2)$
- **Good description!**

Comparison with NLO: *charm* (γp)









- **NLO**: Frixione et al. (*massive scheme*)
- **DPDFs**: H1 2006 DPDF Fit A & B
- $\mu^2 = (4m_c^2+p_t^2)$
- **Good description!**

Factorization seems to be fullfilled for *charm* in γp

BUT: large theory uncertainties

Summary

- **New DPDFs** available to test QCD Factorization
- **New**  measurement of diffractive Dijets **constrains diffractive gluon** in wide z range
- **New**  measurements of diffractive *charm* in DIS shows that there is a **large *charm* fraction** in the incl cross section
- **New**  & 

measurements of diffractive charm in γp exist

Summary

QCD Factorization:

	DIS	γp
charm	+	+
Dijets	+	−

Low statistics + large NLO uncert.'s at low scales

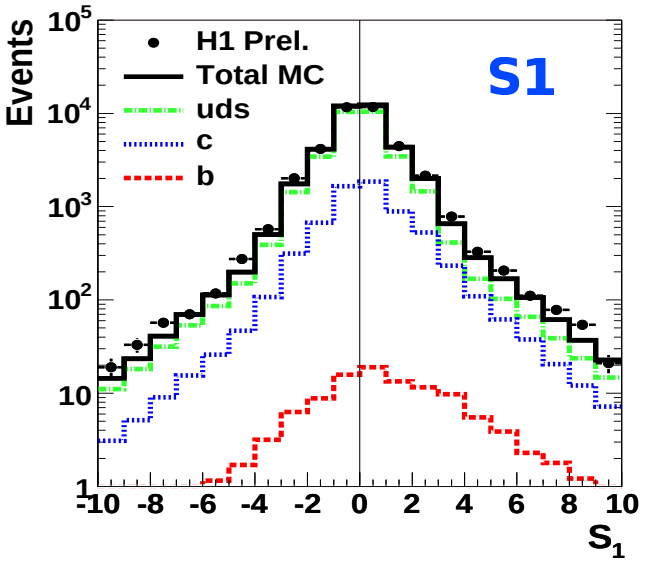
Dijets provide **BIG improvement** of DPDFs for gluon at high z

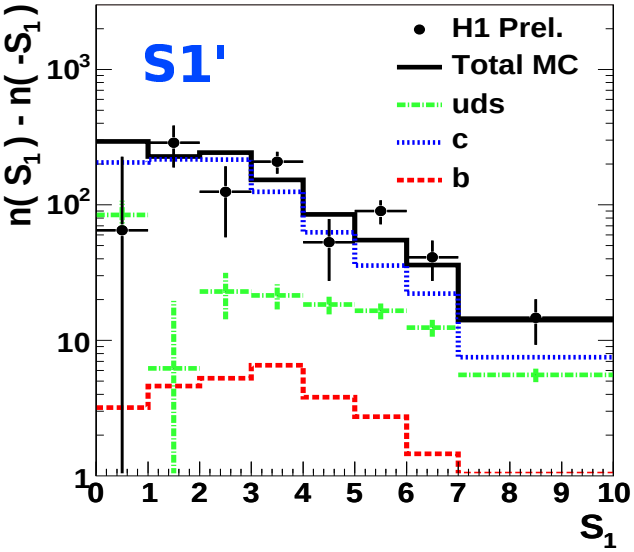
Breakdown of factorisation both in **direct** & **resolved** γp

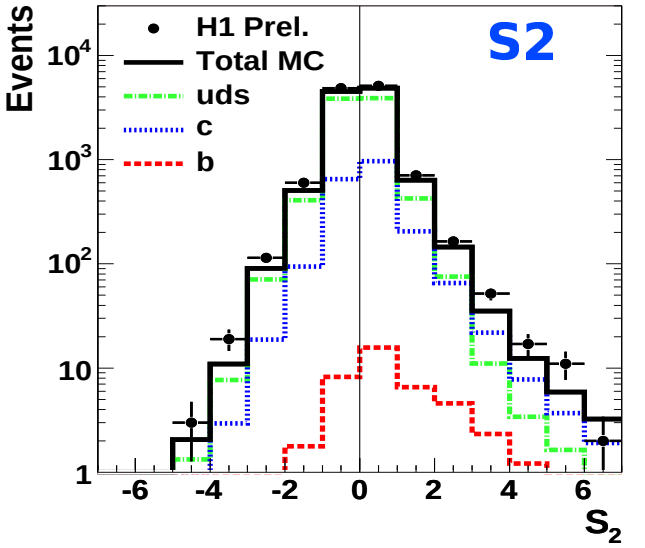
Backup

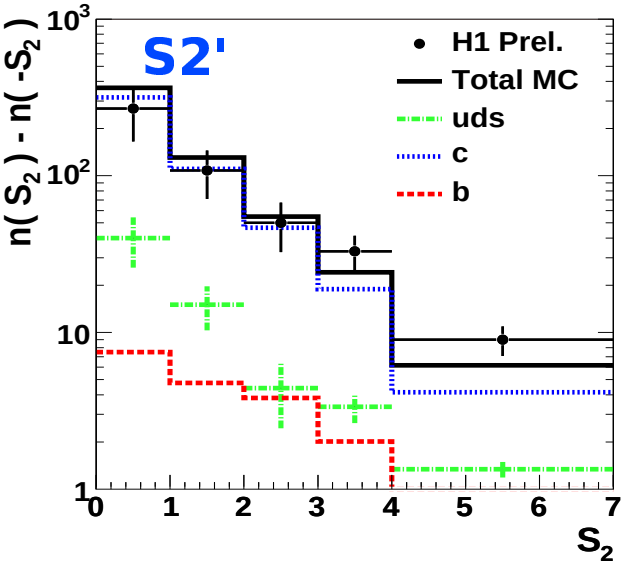
- Reconstruction method for the F2D(charm) measurement by H1
- Comparison of F2D(charm) with 2g model by MRW
- Old Dijet data vs new Dijet data

The **Displ. Trk** method for F2D(charm) **(DIS)**



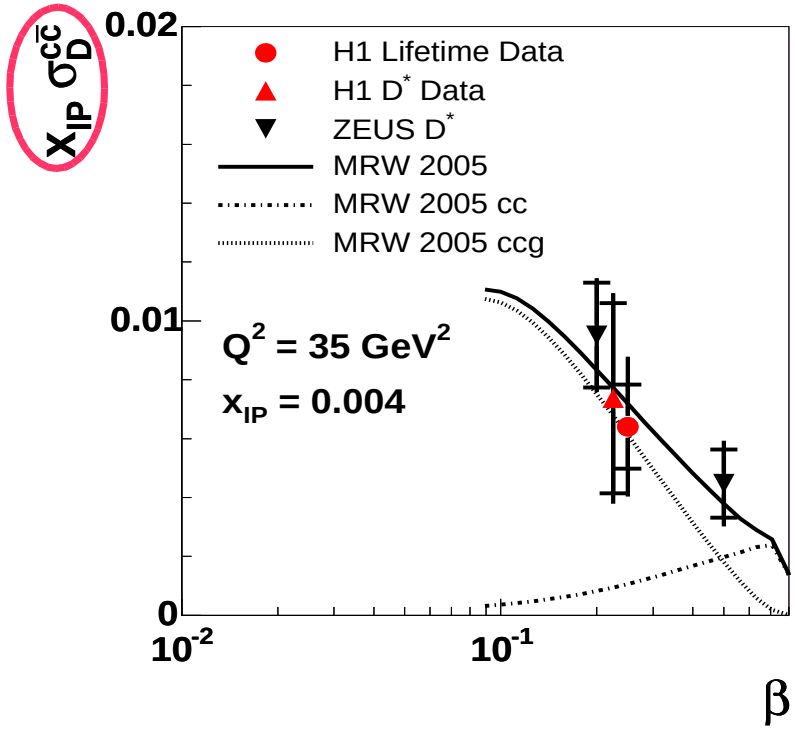


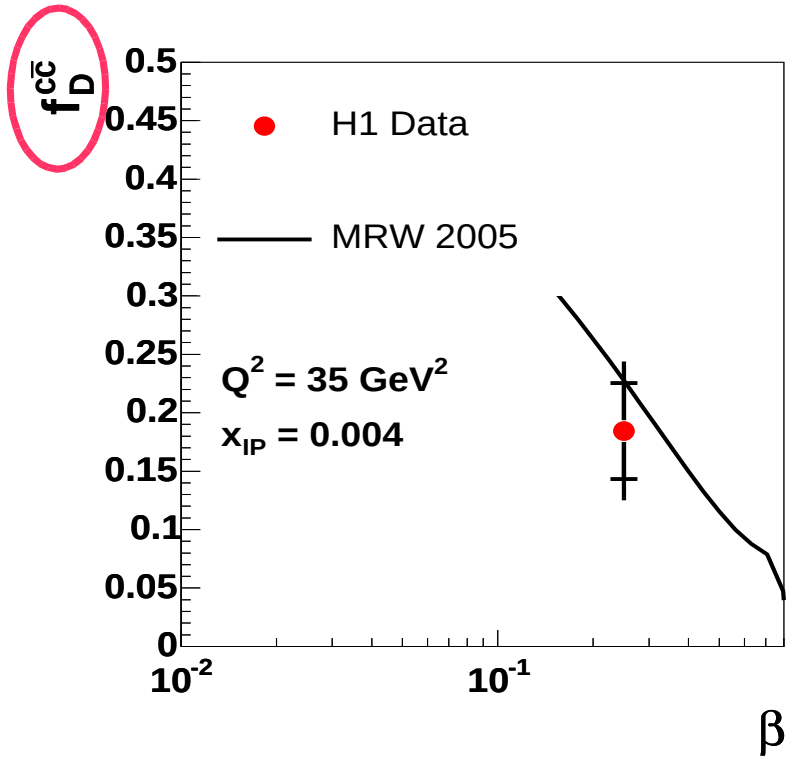




Comparison with **MRW 2g**: ***charm*** **(DIS)**

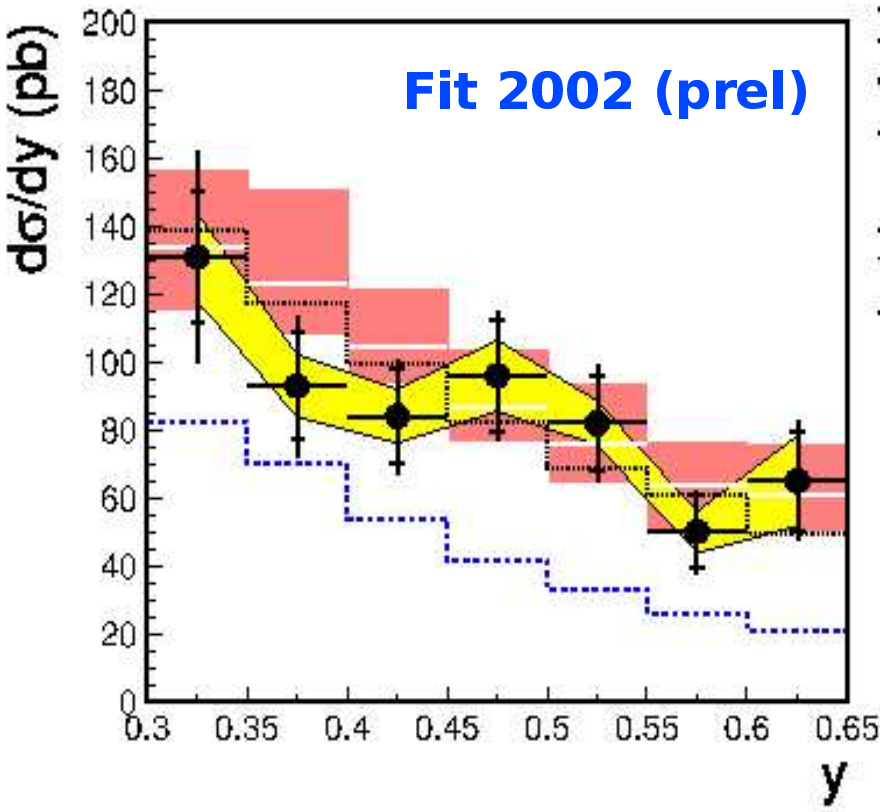
charm **contribution to F2D:**



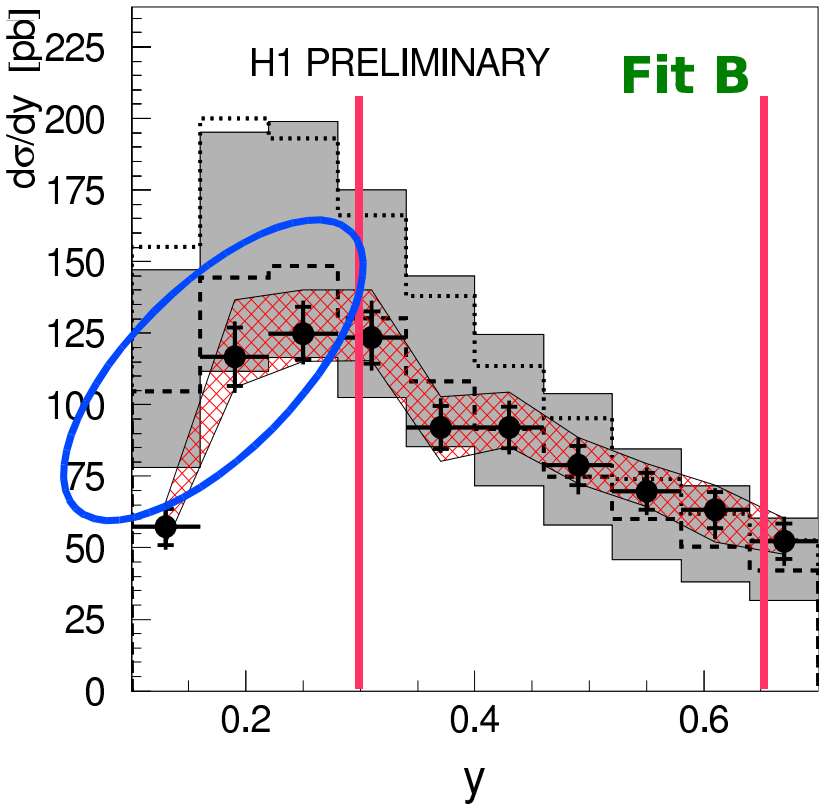


Old Dijet Data vs **new Dijet** Data

Old Dijet Data:



New Dijet Data:



- **Also Problems** with z_{IP} for old data sample
- Problems are **enhanced** by larger y range (0.05<y<0.3)