From the ZEUS-LPS $F_2^{D(3)}$ to the Tevatron

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Introduction

- **QCD factorisation theorem holds for diffractive DIS: can extract diffractive PDFs (dPDFs) from inclusive diffraction and use them to calculate cross sections of other diffractive processes (eg charm or jet production)**

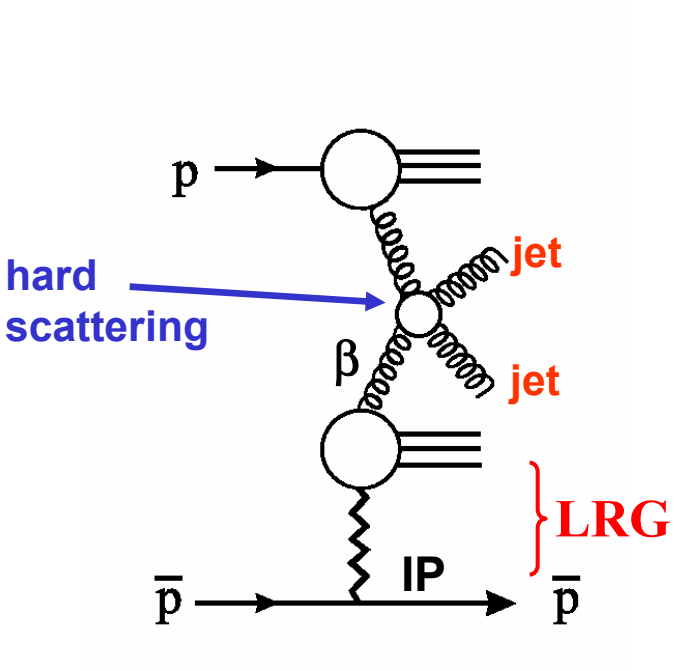
- **However, dPDFs extracted in DIS do not work in diffractive hadron-hadron collisions (cf CDF dijets vs H1 dPDFs)**

- **Probably due to rescattering between spectator partons**

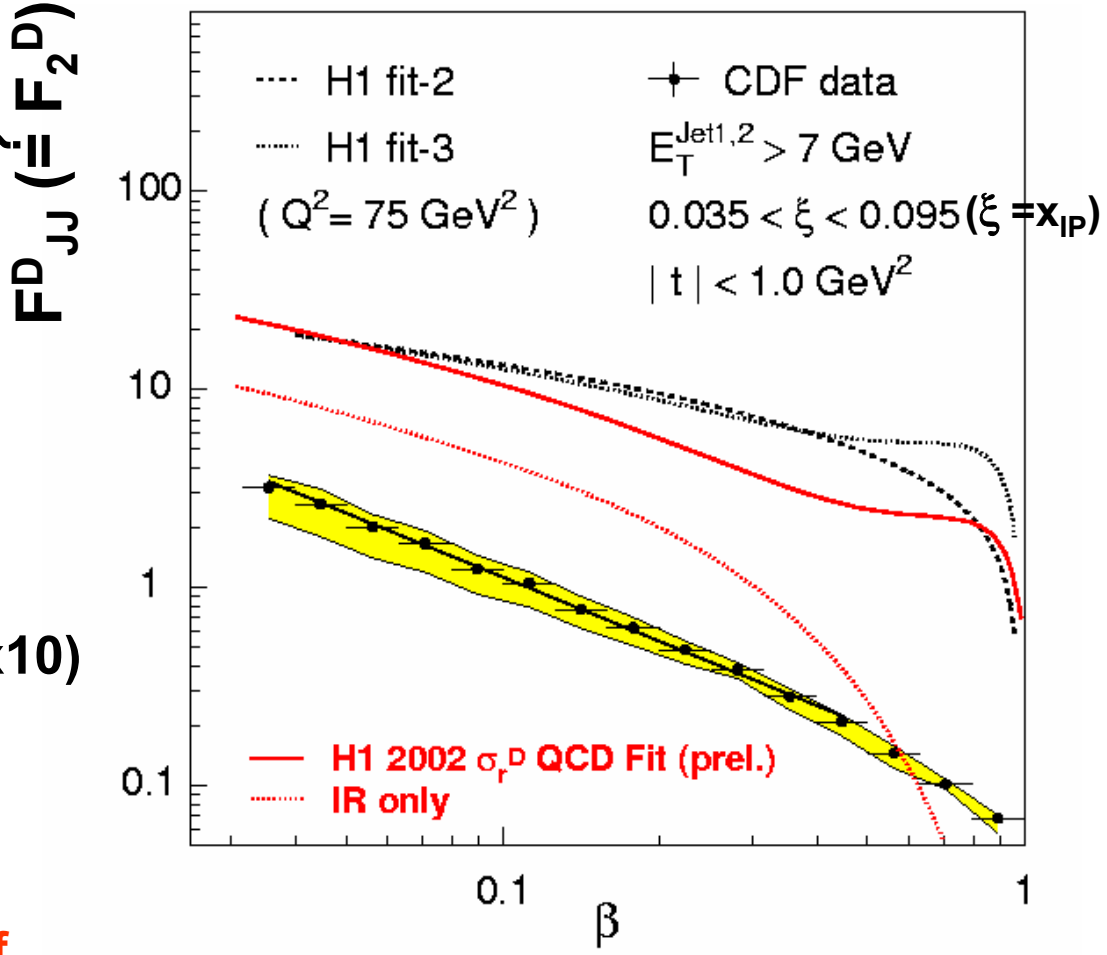
- **Important to understand violation quantitatively: ingredient for calculating diffractive Higgs cross section**

- **Will present comparison of CDF diffractive dijets results with extrapolation of recent ZEUS measurement of F_2^D**

The CDF vs H1 comparison



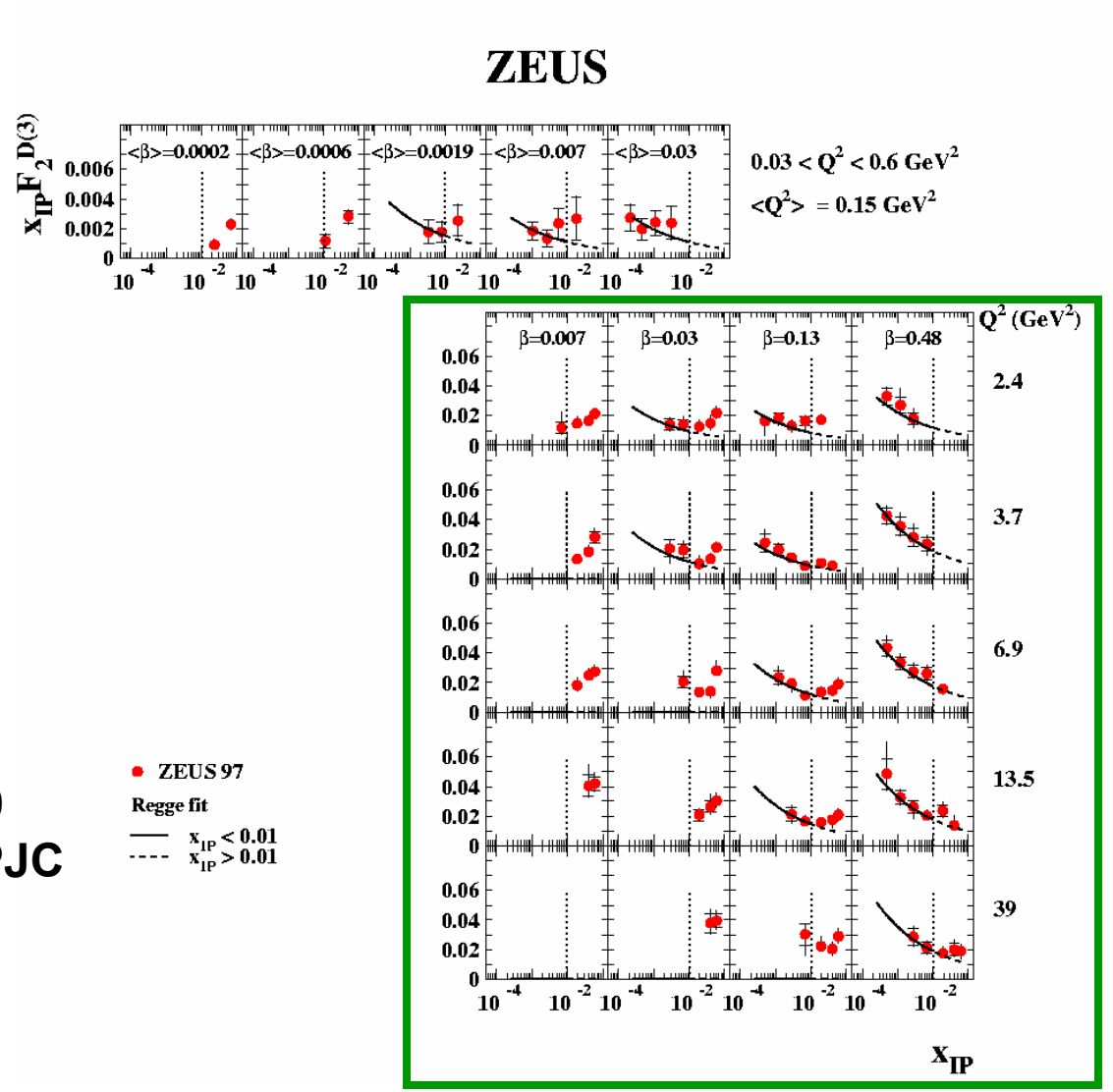
Normalisation discrepancy (x10)



Possible reason: rescattering of spectator partons in p,$\bar{p}$ (Khoze et al)

Phys Rev Lett 84 (2000) 5043

The recent ZEUS F_2^D measurement with the Leading Proton Spectrometer (LPS)



Data used for LO fit

DESY-04-131
hep-ex/0408009
accepted by EPJC

LO QCD fit to the LPS data

- Assume Regge factorisation: $F_2^{D(3)} = f_{IP} F_2^{IP} + f_{IR} F_2^{IR}$

- Pomeron and Reggeon fluxes as in H1 fit: $f_i(x_{IP},t) = \exp(b_i t) \cdot 1/x_{IP}^{2\alpha_i(t)-1}$
  $\alpha_{IP}(t) = 1.17 + 0.26t$, $\alpha_{IR}(t) = 0.5 + 0.9t$
  $b_{IP} = 4.6\ \text{GeV}^{-2}$, $b_{IR} = 2.0\ \text{GeV}^{-2}$

- Parameterise F_2^{IP} in terms of diffractive PDFs:

  assume $u=d=s=\bar{u}=\bar{d}=\bar{s}$

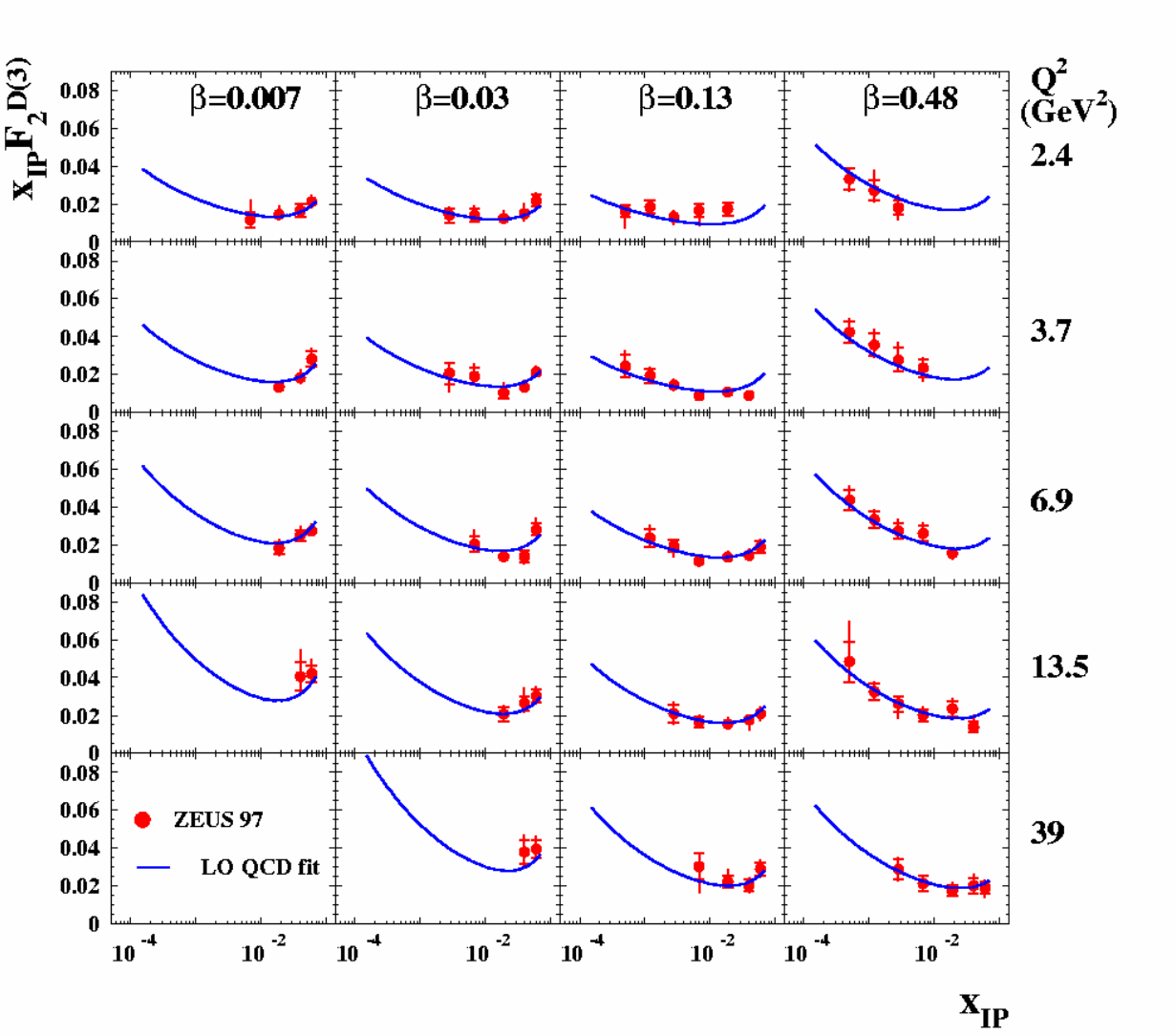
  $zf(z) = (a_1 + a_2 z + a_3 z^2)(1-z)^{a4}$

- Assume F_2^{IR} is proportional to pion structure function: $F_2^{Reg} = \text{cost} \times F_2^{\pi}$
  F_2^{π} from GRV
  [H1 used parameterisation by Owens et al, available only for $Q^2 > 4\ \text{GeV}^2$]

- Evolution with QCDNUM, initial scale= $2\ \text{GeV}^2$, $\alpha_s(M_Z) = 0.118$

- Charm treated in FFN scheme, $m_c = 1.5$ GeV (for 1.4-1.6 GeV results do not change)

LO QCD fit to the LPS data



χ^2/ndf=69.4/73

From dPDFs to F^D_{jj}

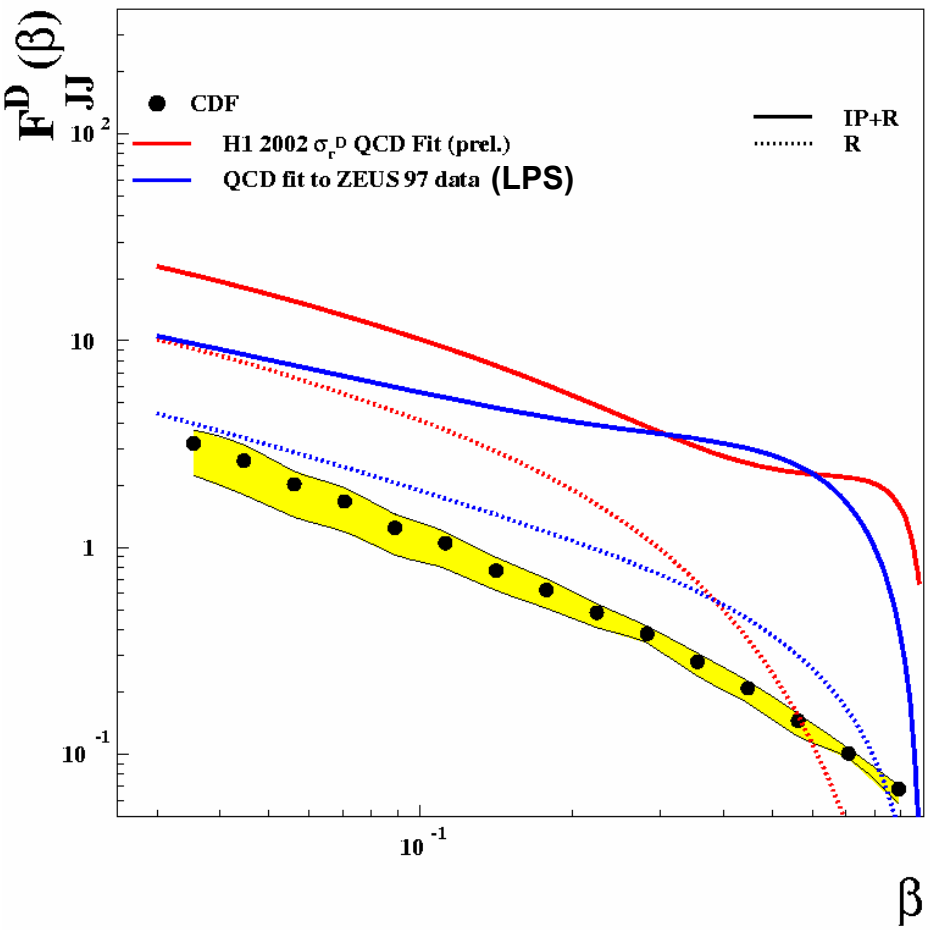
$$F_{jj}^{D} = \frac{1}{0.095-0.035}\sum_{i=IP,IR}\int_{t=-1\,\mathrm{GeV}^2}^{t_{min}}\int_{x_{IP}=0.035}^{x_{IP}=0.095} C_i \cdot f_i(x_{IP},t)\cdot F_{jj}^{i}(\beta)\,dx_{IP}\,dt$$

IP and IR fluxes: $f_i(x_{IP},t)=\exp(b_i t)\cdot 1/x_{IP}^{\,2\alpha_i(t)-1}$

$$F_{jj}^{i}(\beta) = \beta[g(\beta)+\frac{4}{9}q(\beta)]$$

From the LO fit for IP
From F_2^{π} for IR

Comparison with CDF



- No estimate of uncertainties yet:
  large at high β (no coverage !)
  result stable at low β

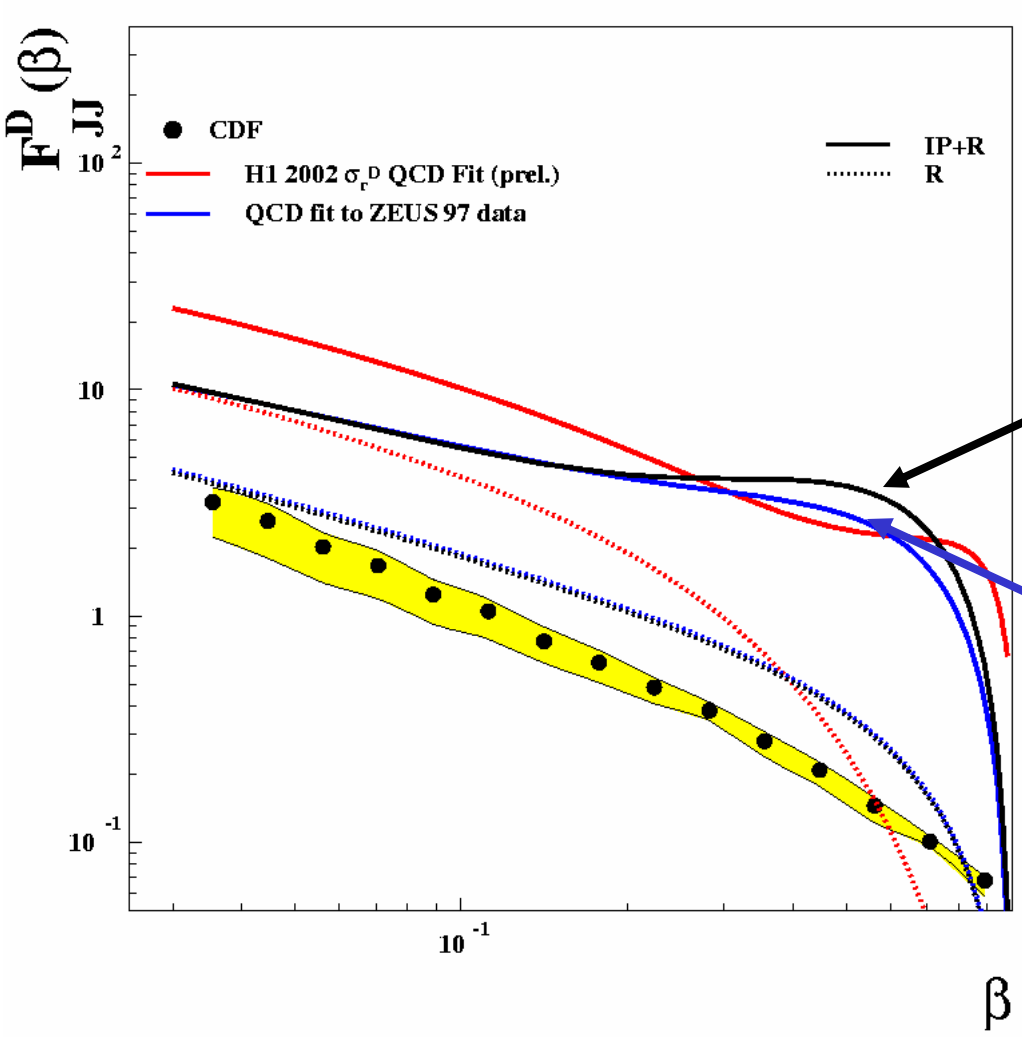
- Smaller discrepancy with respect to CDF than suggested by H1 estimate

- CDF data close to Reggeon contribution –
  does this mean something ?

- Difference with respect to H1:
  - a small contribution (10% ?) possibly due to proton-dissociative background in H1 data.
  - Where does the rest come from ?? (in particular for the Reggeon part)
  - Different x_{IP} coverage (LPS up to x_{IP}=0.07) ?

Comparison with CDF

In order to better constrain the diffractive gluon distribution, repeat fit including both LPS data and ZEUS diffractive charm production (Nucl Phys B (2003) 3).



Fit including diffr charm data

Fit without diffr charm data (previous slide)

No significant effect at low β

Summary

- Used QCD fit to ZEUS LPS data to determine expectation for F^{D}_{JJ} in CDF kinematic range
- LPS data extend to x_{IP}=0.07, largely overlapping the CDF coverage. Limited coverage in β though
- Discrepancy with CDF smaller than suggested by H1 fit, notably at low β – but uncertainties yet to be estimated
- Does this imply smaller rapidity gap suppression probability than previously thought ??
  larger diffractive Higgs cross section ?
- Would be very useful to have Fermilab data at lower values of x_{IP}, relevant for Higgs production
- Need to understand differences with H1