New developments in QCD analysis of F2D

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Plan

Note: for clarity of the presentation we focus the discussion of 'QCD analysis' to 'QCD fits' (with NLO DGLAP evolution equations) and then to diffractive PDFs (DPDFs)

** QCD fits on F2D and diffractive PDFs (DPDFs):
Discussion of the DPDFs w.r.t. Data sets (F2D)
Results of the fits on all ZEUS versus all H1 data
FLD predictions
Discussion of the uncertainties…

** Applications to Tevatron and perspectives @ LHC

Data sets: inclusive diffraction

Pre-2008 data samples (published):

1. H1 LRG (M_Y<1.6 GeV)
2. H1 FPS (M_Y=Mp)
3. ZEUS FPC-I (M_Y<2.3 GeV)
4. ZEUS LPS (M_Y=Mp)
5. ZEUS FPC-II (M_Y<2.3 GeV)

Post-2008 (published):

6. ZEUS-LRG new (M_Y<2.3 GeV) (arXiv:0812.2003)
7. ZEUS-LPS new (M_Y=Mp) (arXiv:0812.2003)

Preliminary:

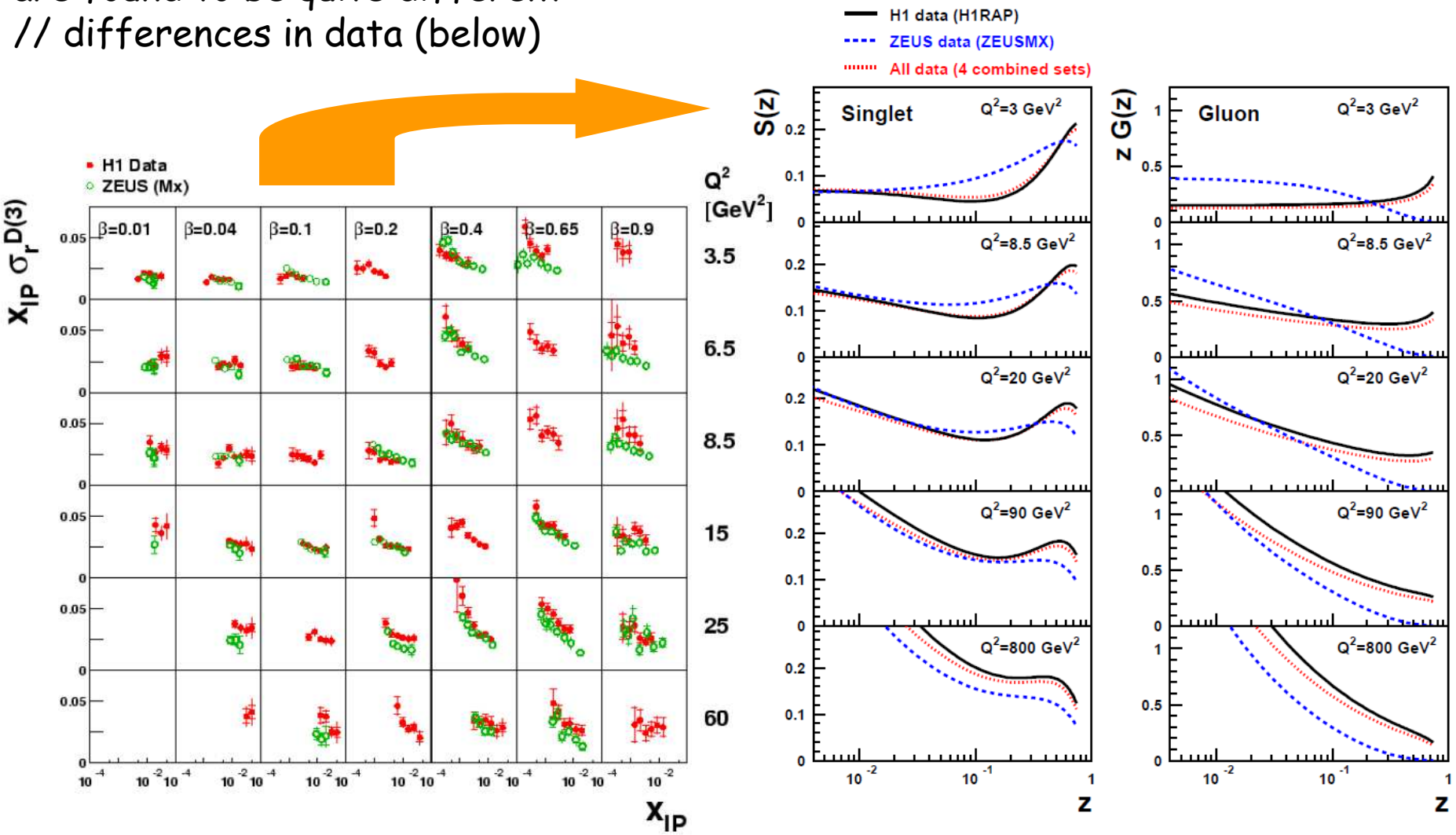
8. H1-LRG new 99-04 (M_Y<1.6 GeV) (preliminary)

-- THEN: QCD fits of (part of) these data sets
Method already explained by Marta Rupsa (previous talk)
-- **DPDFs of this talk based on:**
C. Royon, L. S. et al. Nucl.Phys.B781:1-31,2007; Nucl.Phys.B746:15-28,2006

Fits on H1 (LRG) and ZEUS (Mx)

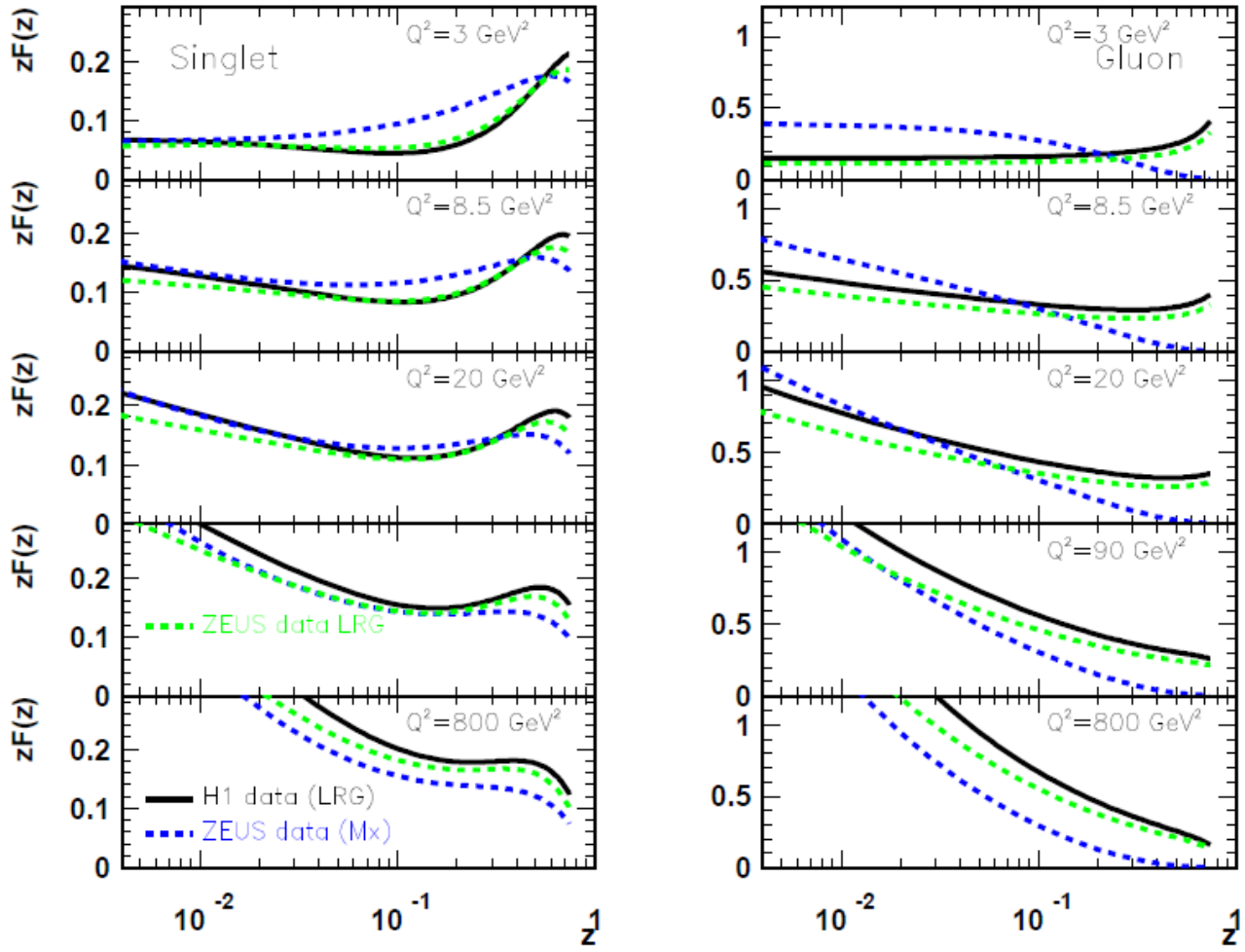
ZEUS Mx and H1 LRG DPDFs are found to be quite different // differences in data (below)

C. Royon, L. S. et al. Nucl.Phys.B781:1-31,2007



Update with last ZEUS LRG data

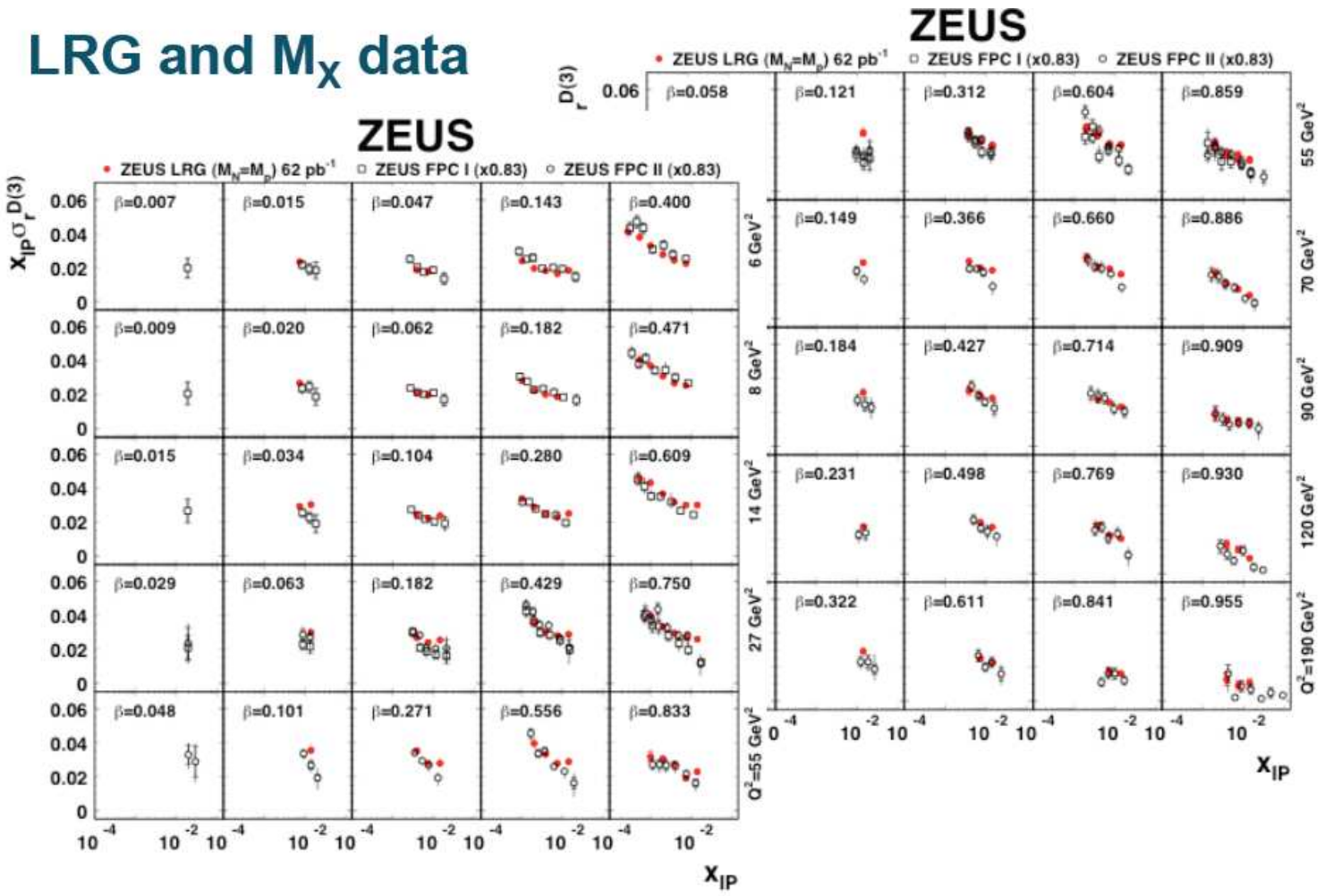
QCD Fit result is found to be very close to H1 LRG…
Normalisation of ~10% difference between H1/ZEUS derived from the fit
ZEUS Mx and ZEUS LRG DPDFs are found to be quite different!



&
DPDFs
ZEUS LRG
close to
H1 LRG

Are ZEUS LRG and ZEUS Mx so different?

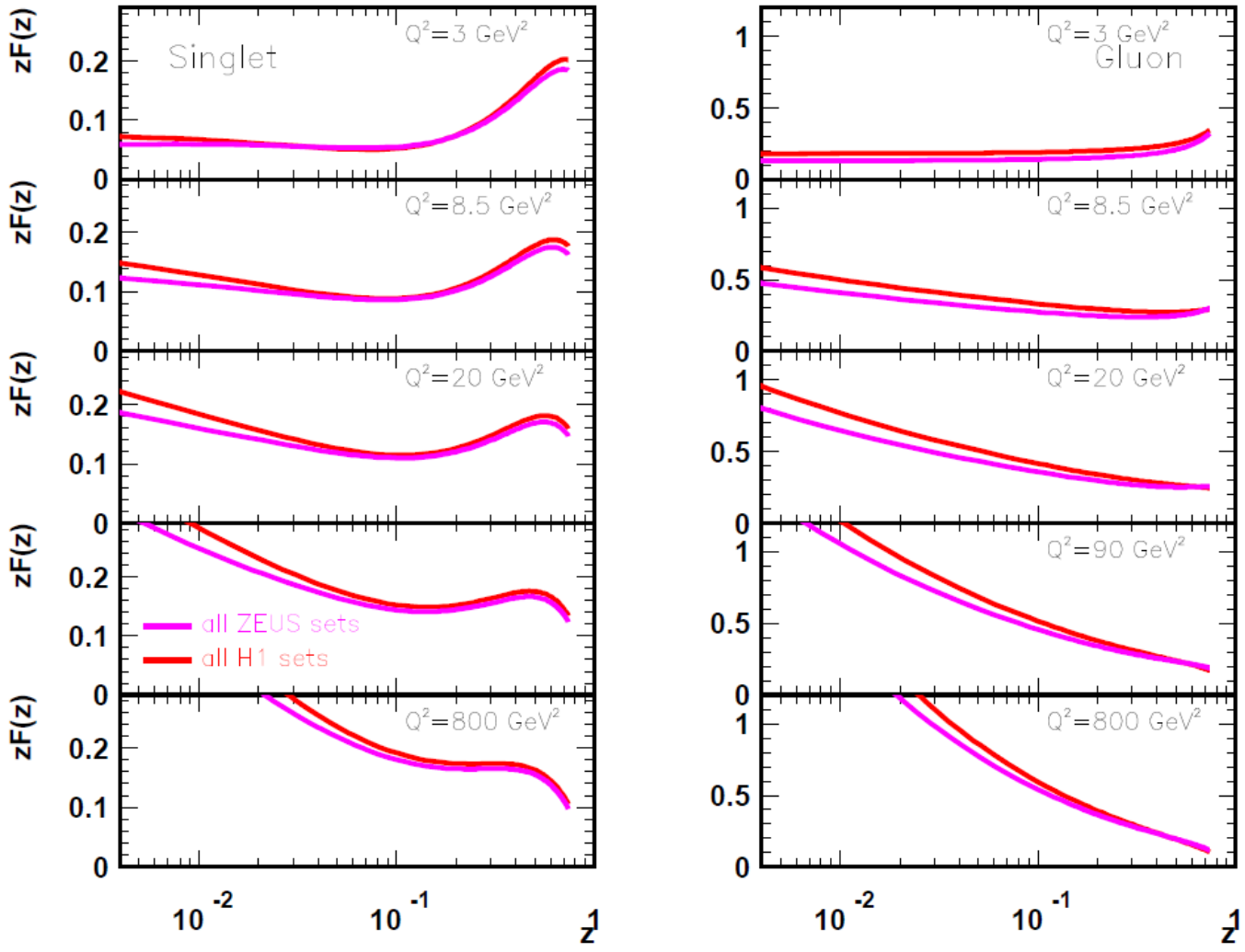
ZEUS LRG and Mx cross sections are quite close for most bins…
=> High sensitivity of the QCD fit technique… (too high?!)



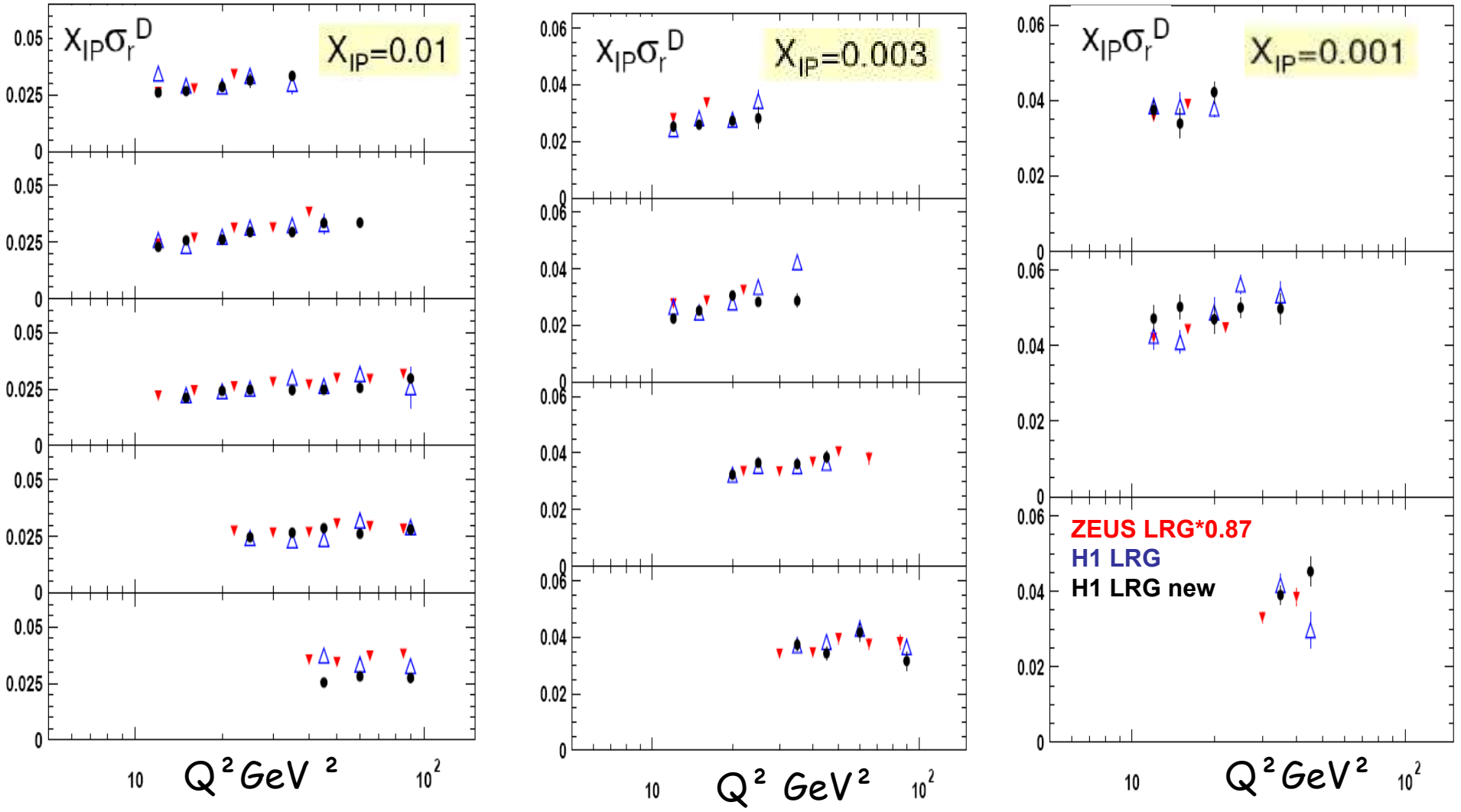
Summary: H1 versus ZEUS DPDFs (last data)

Perfectly compatible with errors…

δ = **5%-10% for zS and 10%-25% for zG [25% for zG at large z]**



Note: H1preliminary versus other data sets



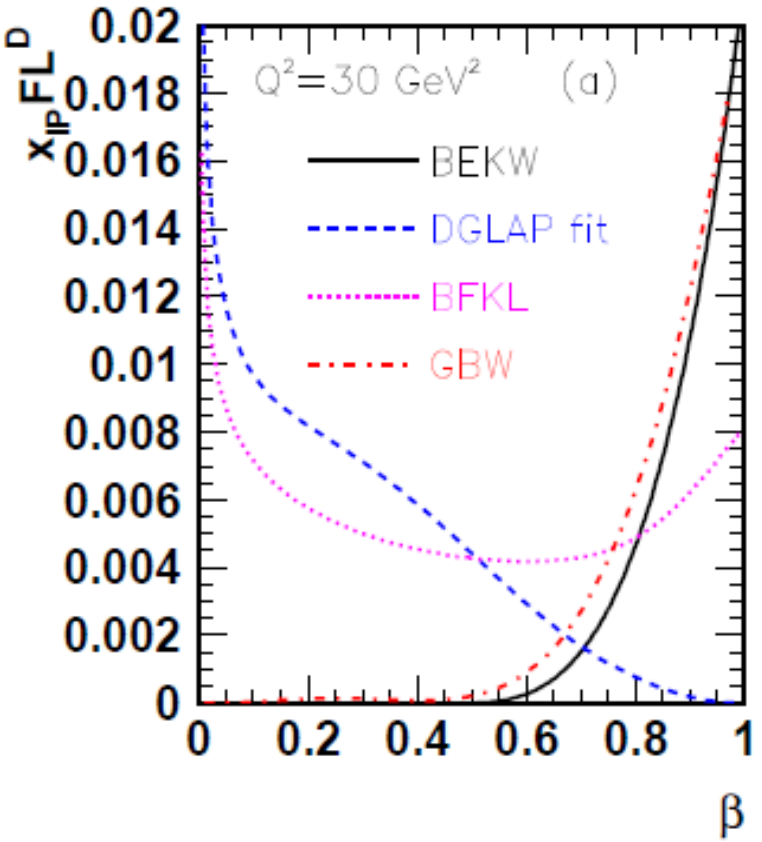
good agreement of all data sets… (with H1/ZEUS ~0.9 -global-)
=> Will provide high precision (high constraints) on DPDFs!

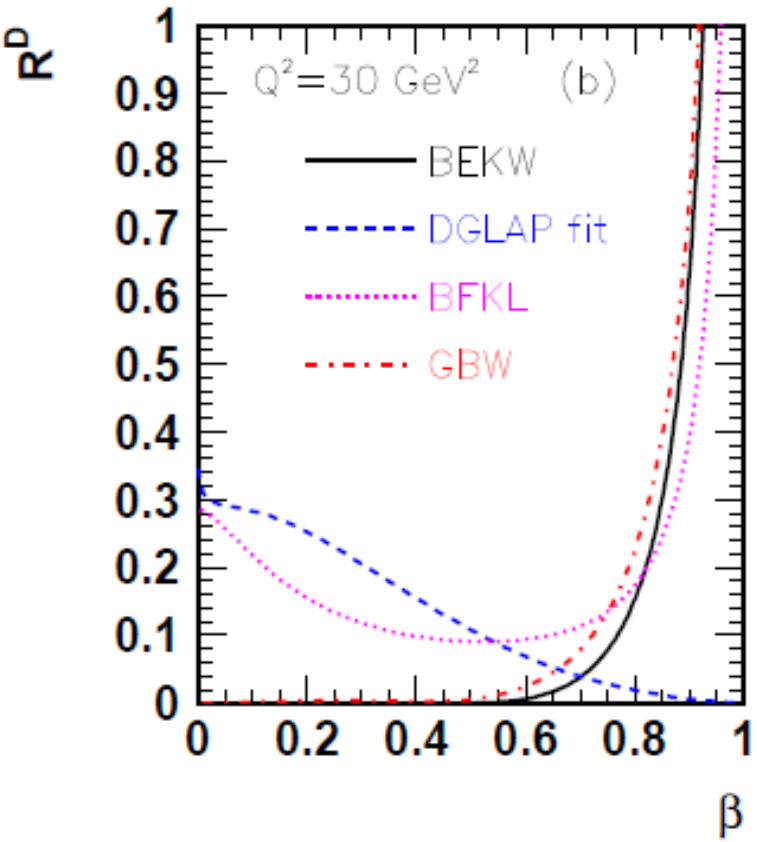
FL^D and $R^D=FL^D/(F2^D-FL^D)$

For $x_{IP} = 10^{-3}$

– – – – Result of the Global QCD fit to F2D data

Oter curves: dipole-like models…





Uncertainty on the gluon @ large z

Method developped in:
C. Royon, L. S. et al. Nucl.Phys.B781:1-31,2007

If we shift the high z behaviour of the
Gluon density by $zG \rightarrow zG * (1-z)^{\Delta\nu}$

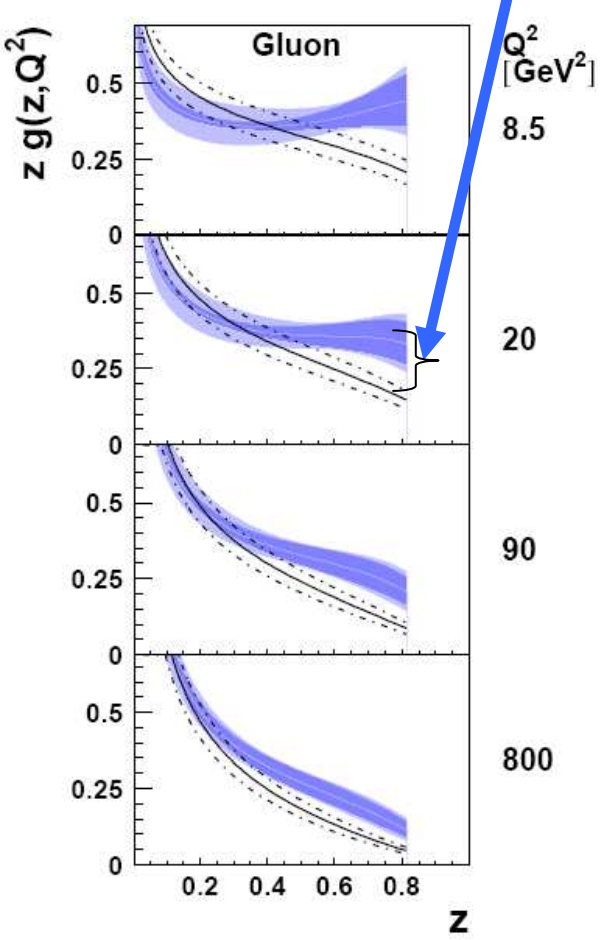
THEN: $\Delta\nu$ is (approx.) conserved during the QCD evolution

Efficient method to quantify the large z uncertainty
Including experimental and param. (functionnal) aspects…

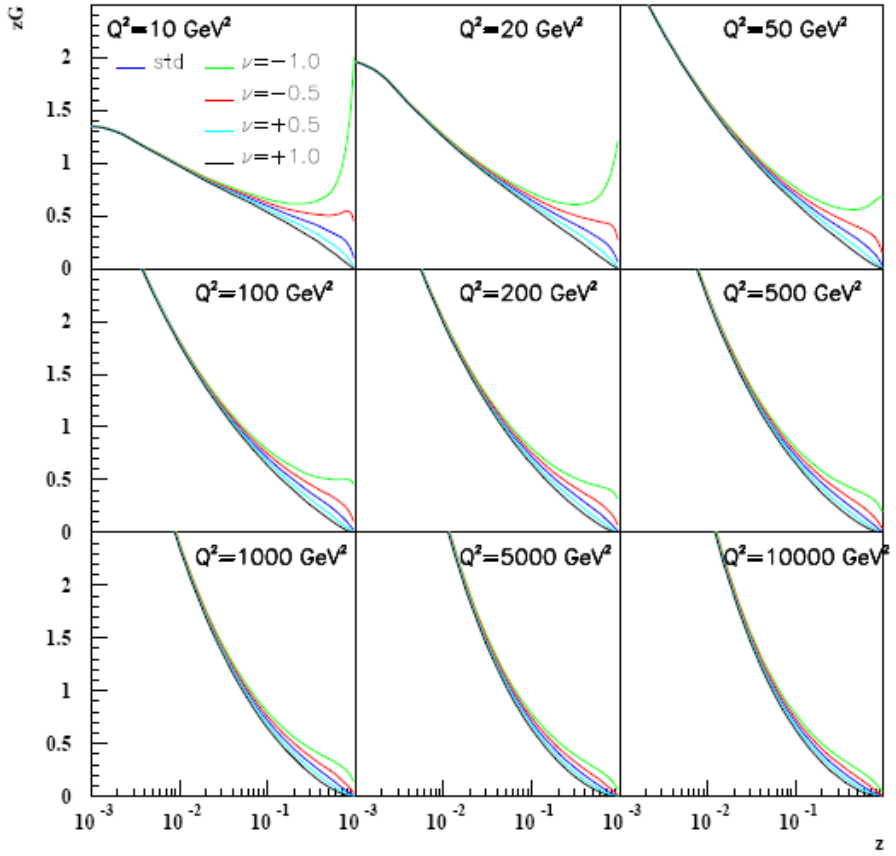
Check the impact of this error on Tevtatron/LHC observables
(following of the talk)

Uncertainty on the gluon @ large z

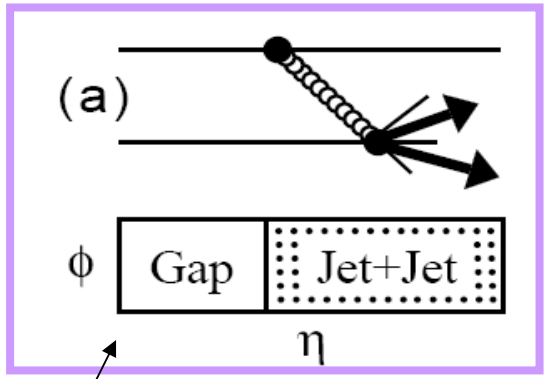
From a fit to H1/ZEUS data
ν = 0.0 +/- 0.5

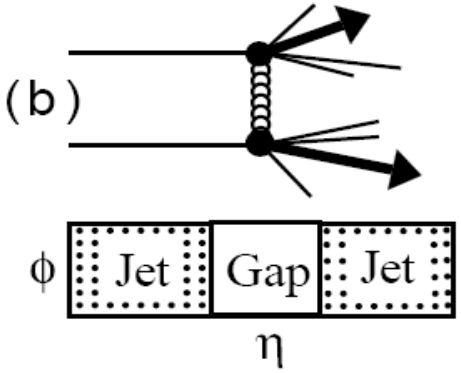


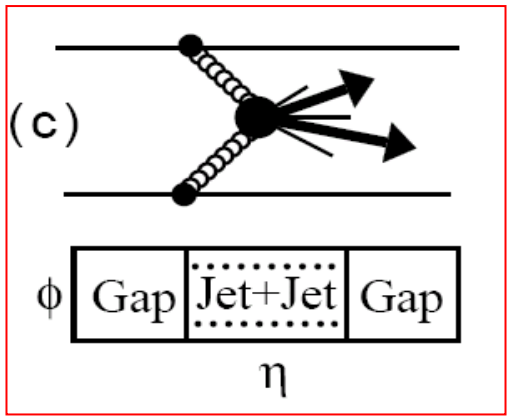
Gluon density
With 1 and 2 'sigmas' variations

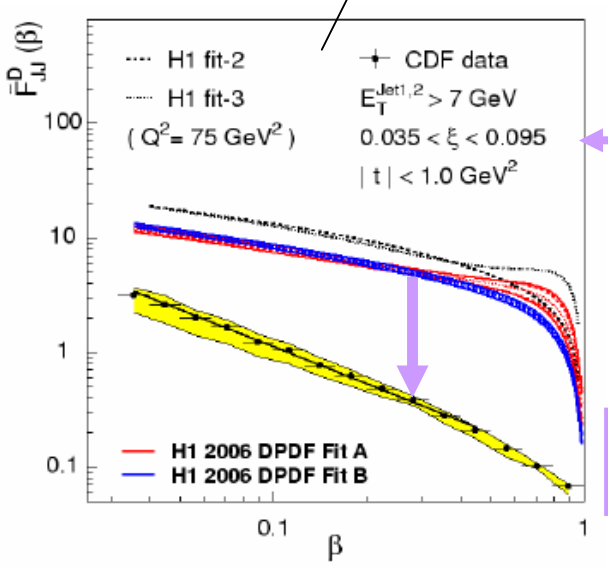


Moving to Tevatron : a brief reminder









(a) Single Diffraction ← QCD factorisation breaking

(b) Large Angle Diffraction

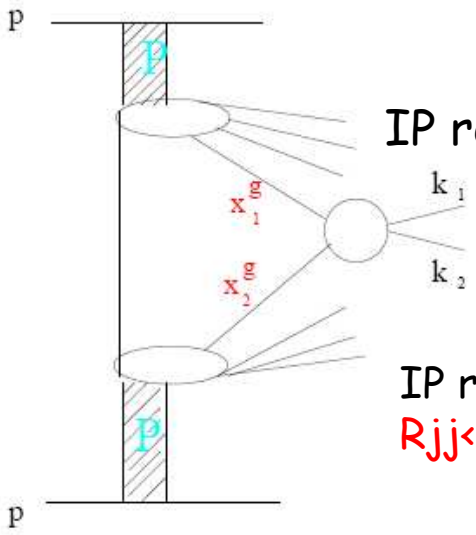
(c) Double Diffraction

$$\tilde{F}_{JJ}^{D}(\beta) = \frac{1}{\xi_{\max} - \xi_{\min}} \int_{\xi_{\min}}^{\xi_{\max}} d\xi \left[\beta g^{D}(\xi, \beta, Q^2) + \frac{4}{9} \beta \Sigma^{D}(\xi, \beta, Q^2) \right]$$

We focus on double diffraction [Double Pomeron Exchange –case (c)-]
and the impact of the gluon density uncertainty on predictions for this process

Hypothesis : we can use the dPDFs extracted @ HERA [at the end the calculations is multiply by the « constant » survival gap probability]

Interest of DPE : Production of heavy states



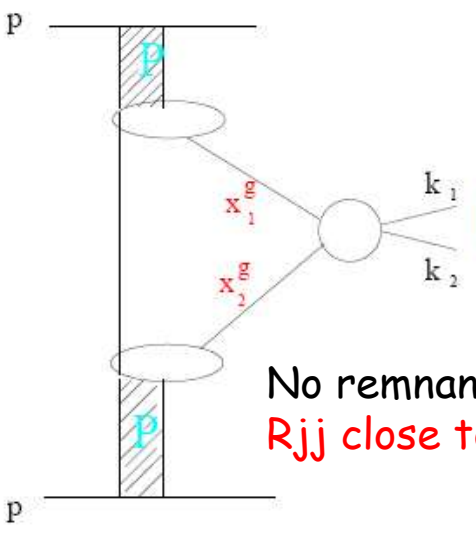
IP remnant

$H, Q\bar{Q}, \gamma\gamma$

IP remnant
Rjj<1

"Inclusive"

$M_X^2 = s\,\xi_1\xi_2$



$H, Q\bar{Q}, \gamma\gamma$

No remnant
Rjj close to 1

"Exclusive "

- Pb : Does Double Pomeron Exchange (DPE) exists in the exclusive mode ?

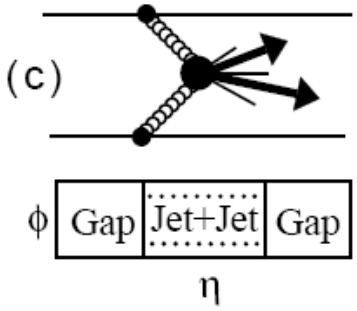
- **We can check if excl. evts exist @ TeV ?!**
  (if not covered by DPDF error)

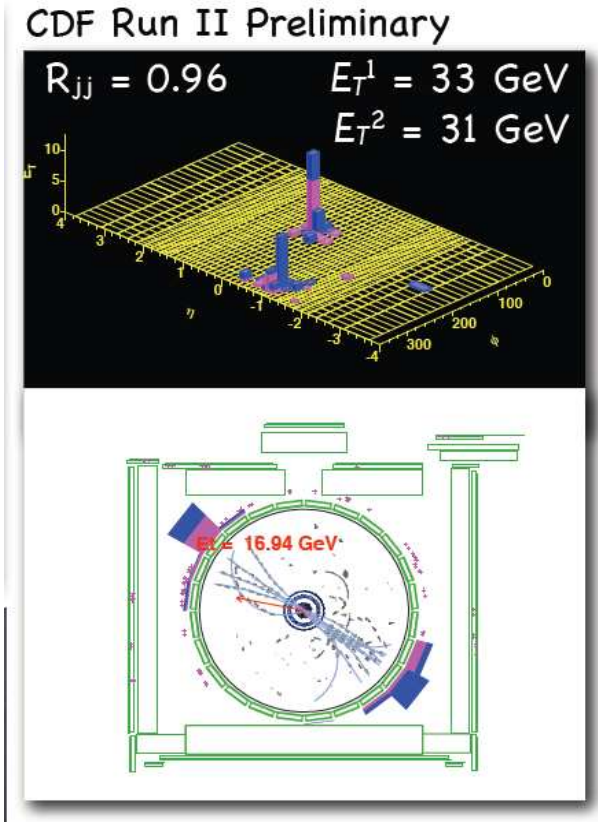
Measurement of the Dijet Mass Fraction @ TeV
See also talk of Olda Kepka

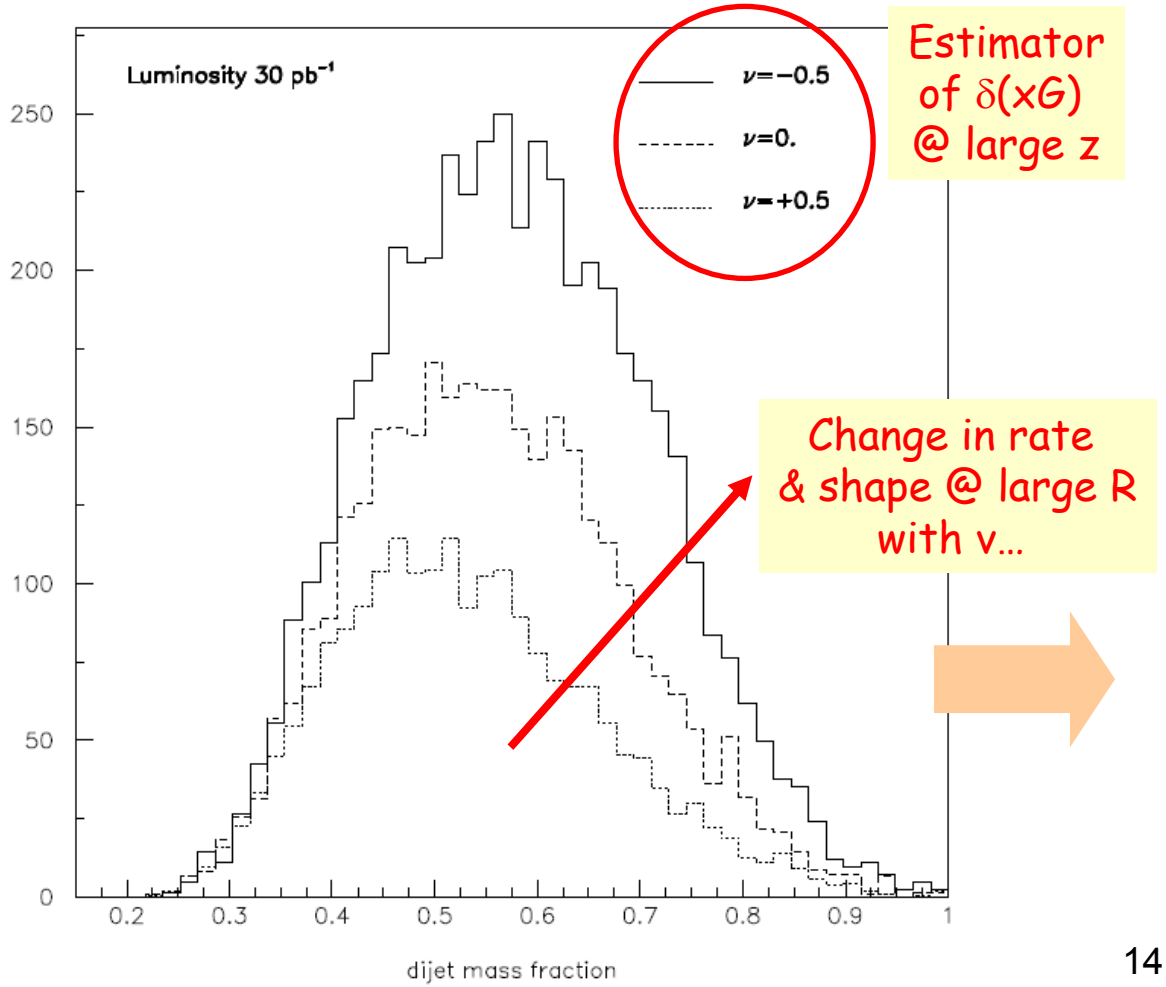
$$R_{jj} = \frac{M_{jj}}{M_X}$$

Gluon density and dijet mass fraction

Possible measurement of the dijet mass fraction at the Tevatron sensitive to gluon density







Estimator of $\delta(xG)$ @ large z

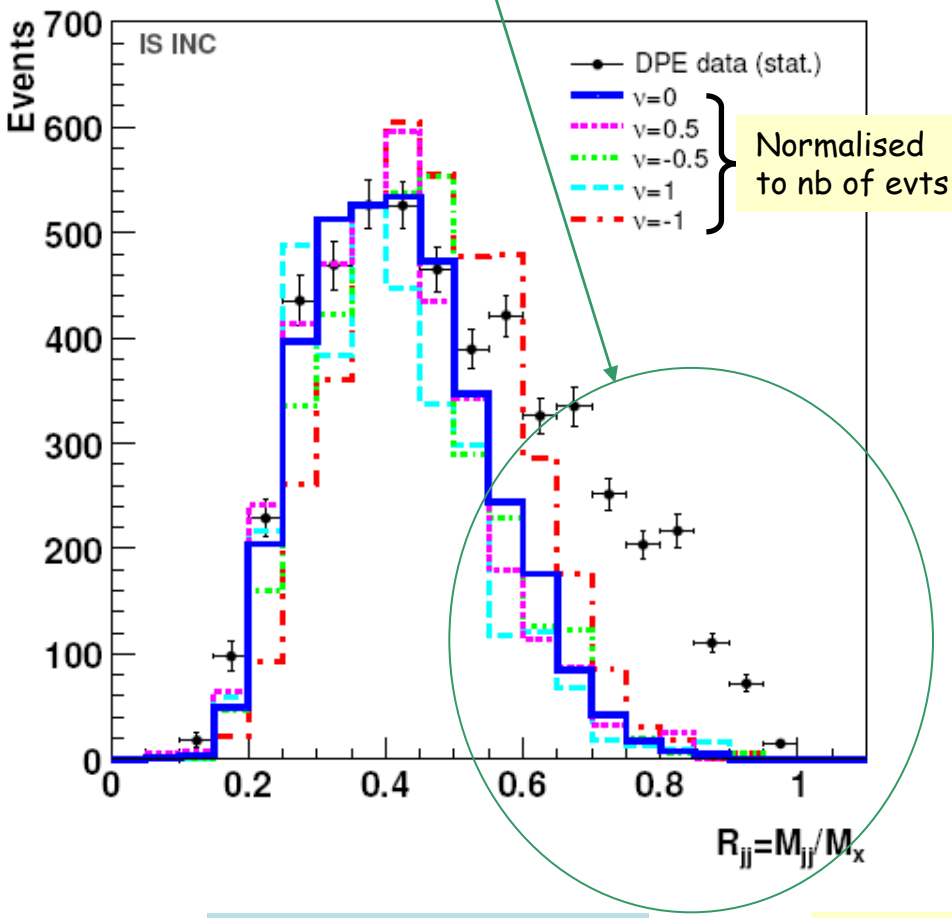
Change in rate & shape @ large R with ν...

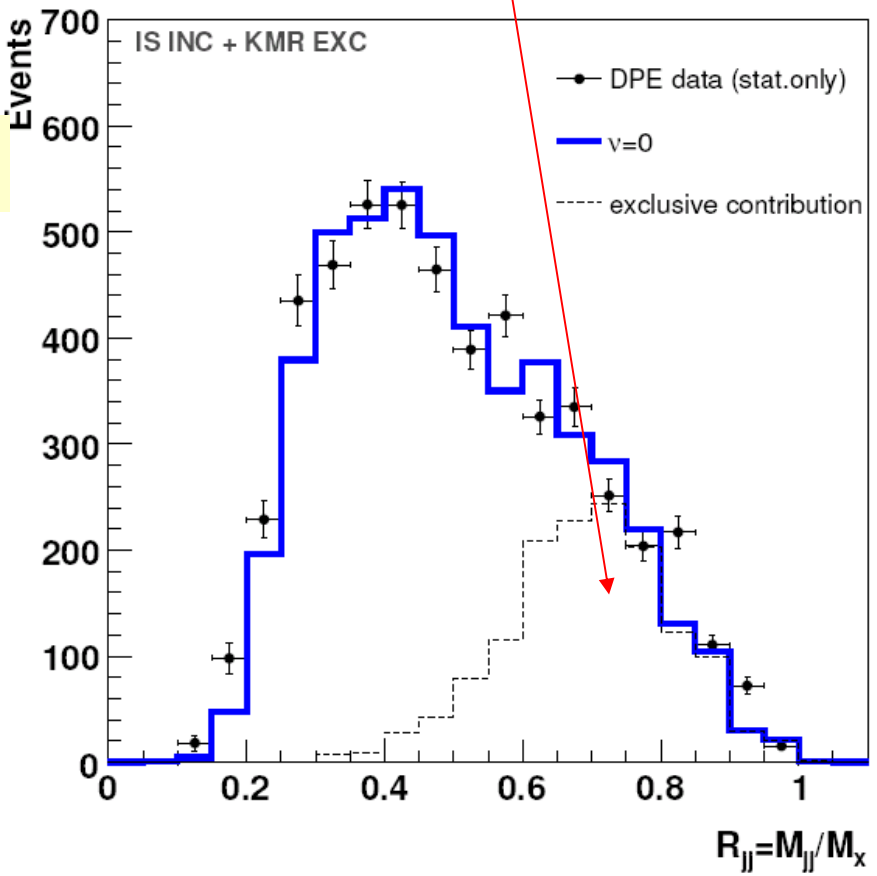
Dijet mass fraction : measurement & predictions

Effect of the gluon uncertainty on the shape :

It does not cover the large R.

predictions with exclusive production



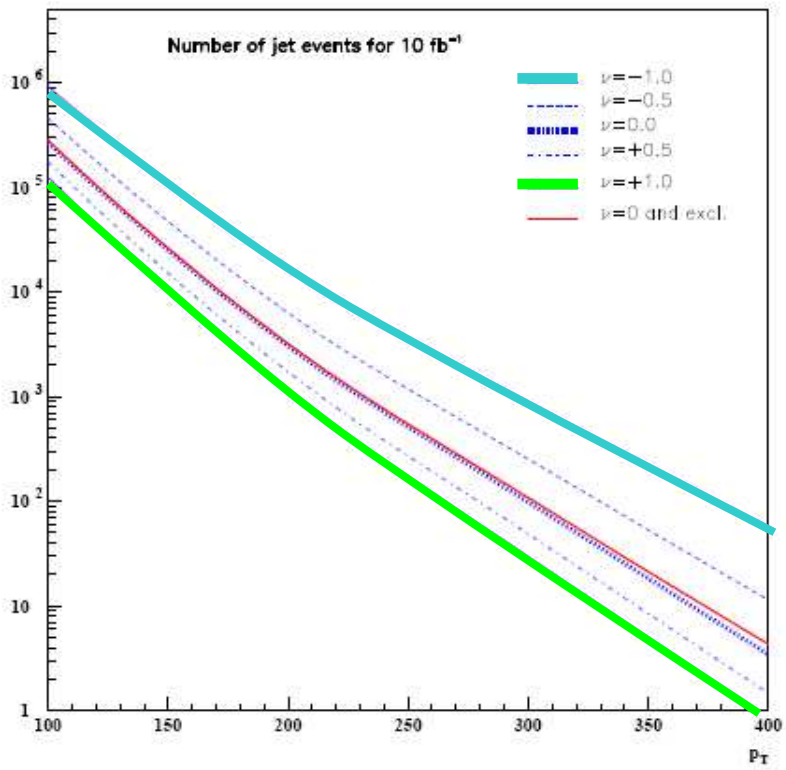


pT (jets) > 10 GeV

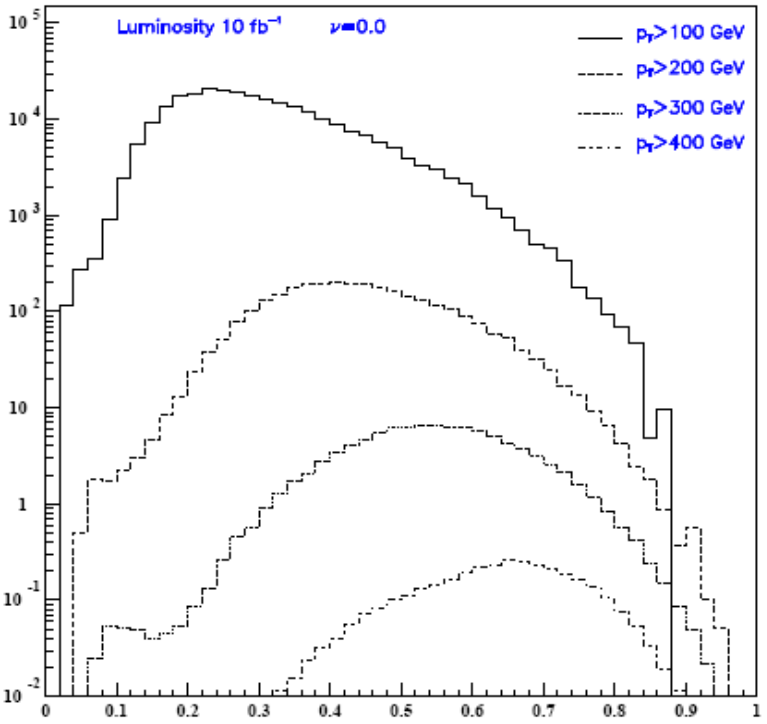
Check the impact on the Gluon @ large z

DPE rate of events @ LHC (simul)

Rate of DPE evenents @ LHC as a function of the transverse momentum (min) of the 2 leading jets <=> **impact of the gluon density (at large z)…**



Rate of events (pt_{min})



Dijet mass fraction

Rjj

Outlook

- Many data sets on F2D (LRG or LPS/FPS)
  => Precise determination of DPFDs
  Once the normalisation difference between data sets H1/ZEUS is treated as free parameters and corrected globaly (10%).
  Is it correct?
  Work needed at the data level to understand this 10%

- DPFDs can be used in other contexts:
  Exclusive dijet events at the Tevatron(/LHC) with/without « Remnants »… Large impact of the large z gluon density!
  But not sufficient to describe the large Rij tail…
  factorisation breaking taking into account as a constant factor
  => Perspectives for LHC (see specific talks @ this workshop)