Pomeron structure and diffractive parton distributions

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with

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- Experimental data
- Regge factorization test
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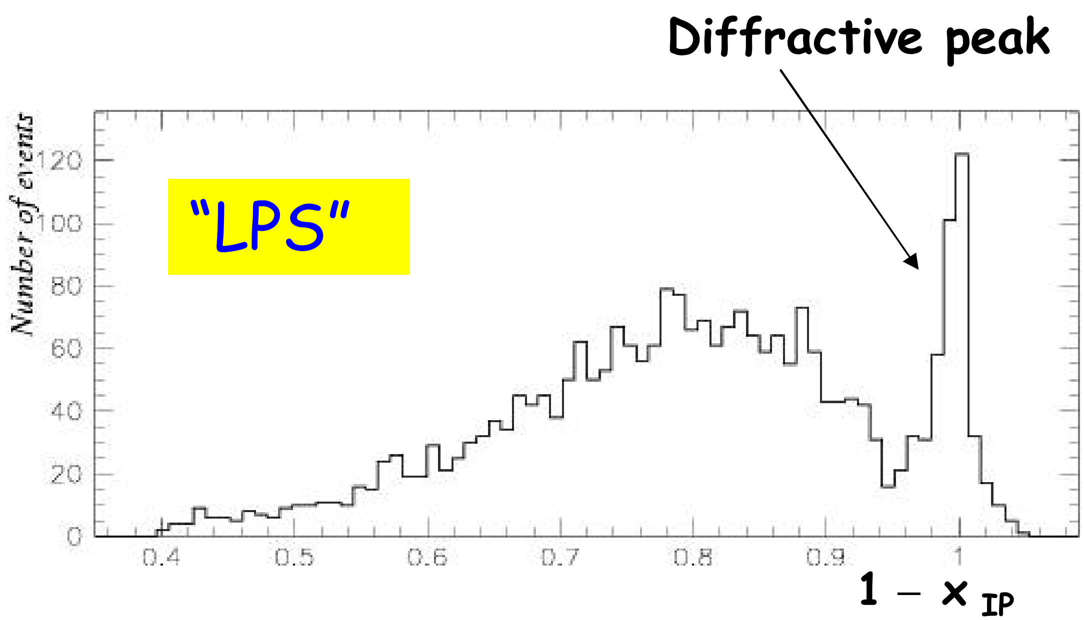
Theoretical framework

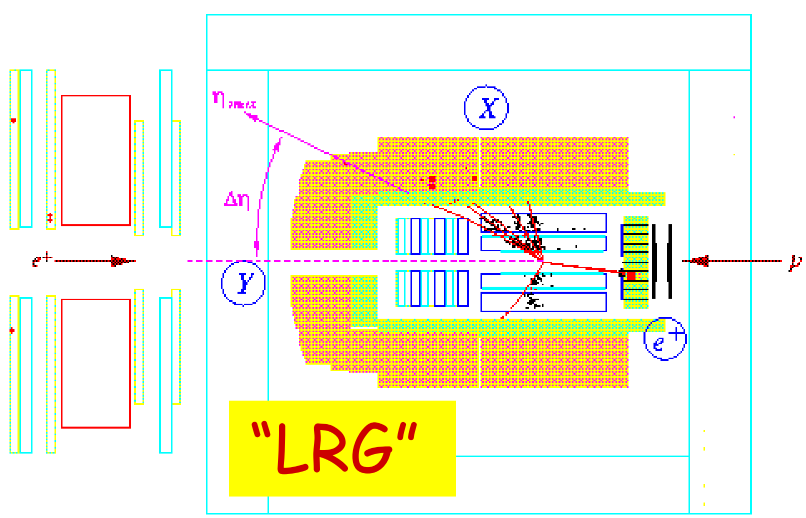
- Structure function data interpreted as

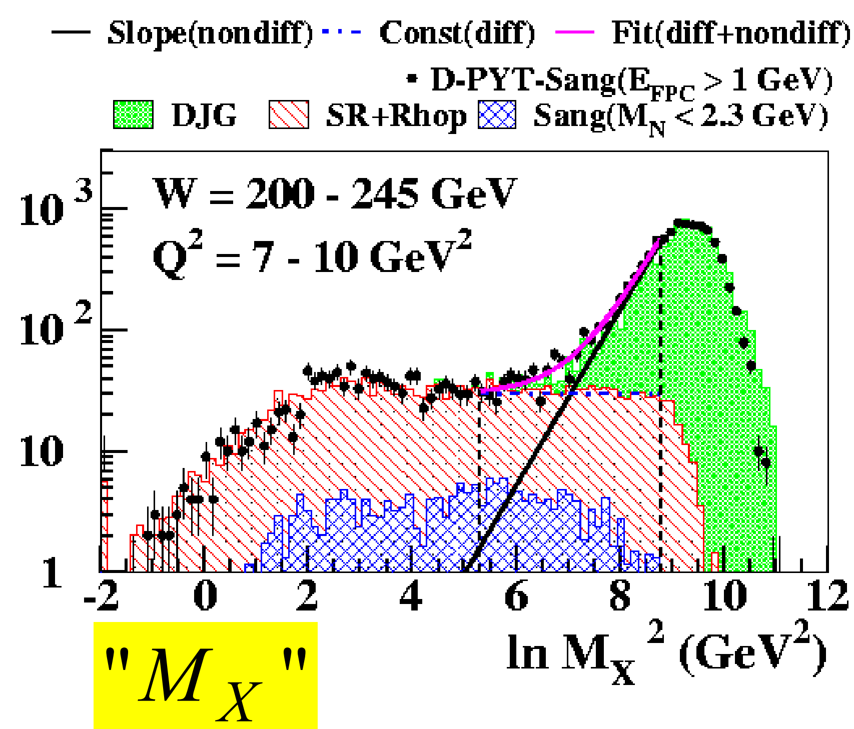
$$x_{IP}\sigma_r^{D(3)} = x_{IP}F_2^{D(3)} - \frac{y^2}{1+(1-y)^2} x_{IP}F_L^{D(3)}$$

- Use Regge factorization
- In the NLO QCD calculations, include also F_L.

Diffractive event selection







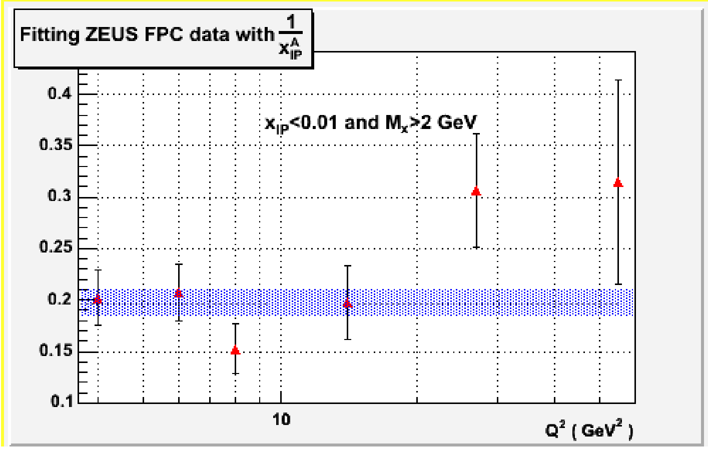
Regge factorization test

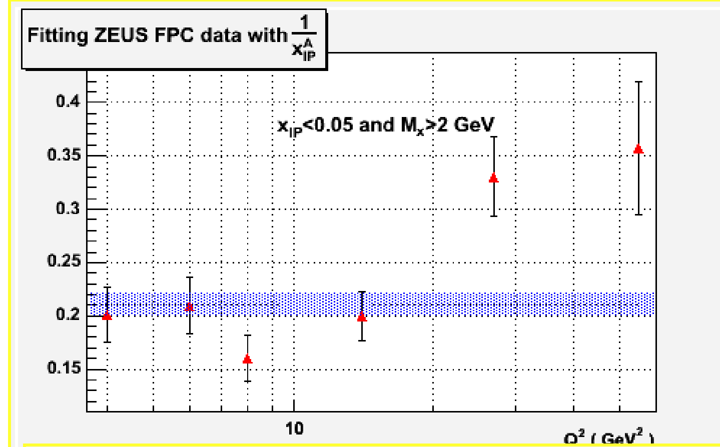
$$F_2^{D(3)}(Q^2, x_{IP}, \beta) = Flux(x_{IP}) \times F_2^{IP}(Q^2, \beta)$$

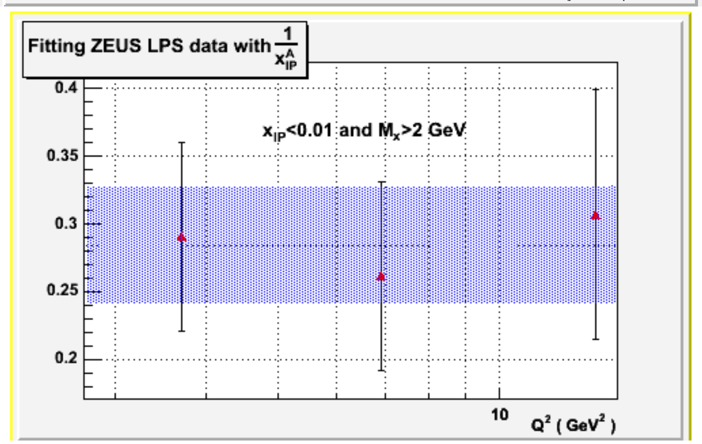
Assume form of flux is $\propto x_{IP}^{-A}$

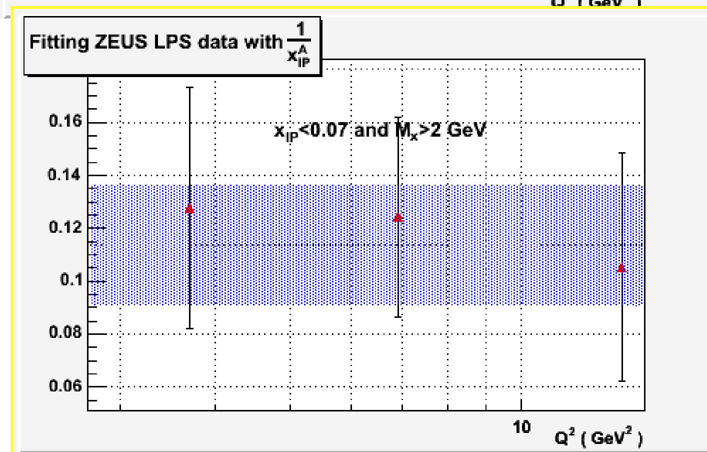
Test if A is function of Q^2 or of β

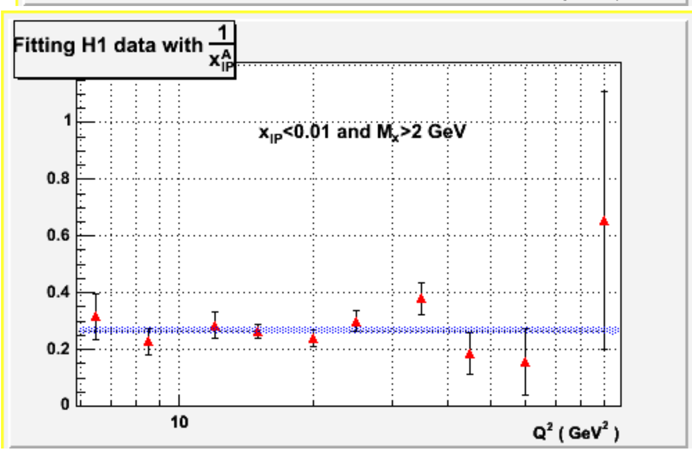
Testing Regge factorization: Q^2 dependence











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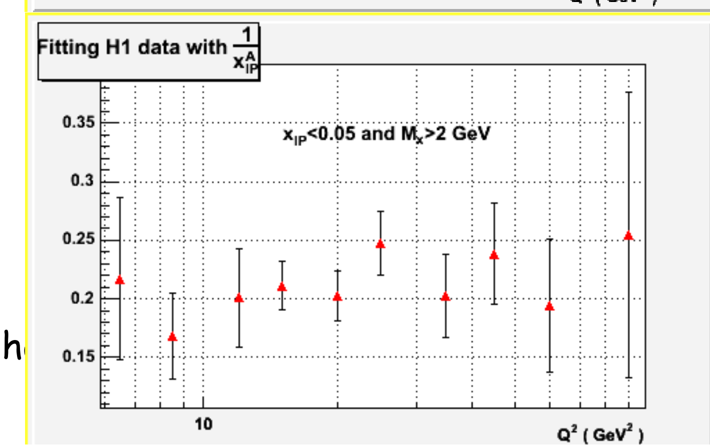
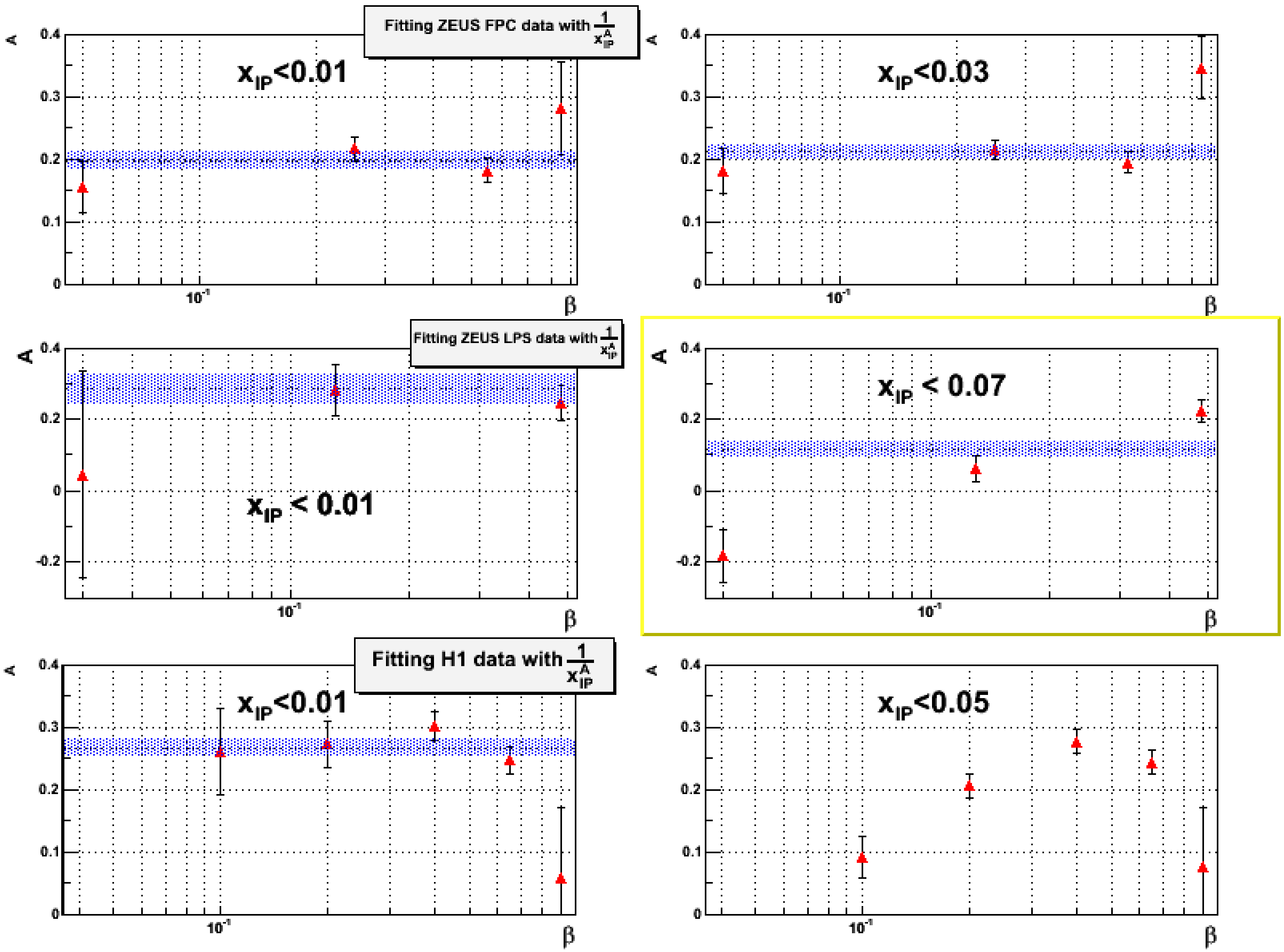


Testing Regge factorization: β dependence

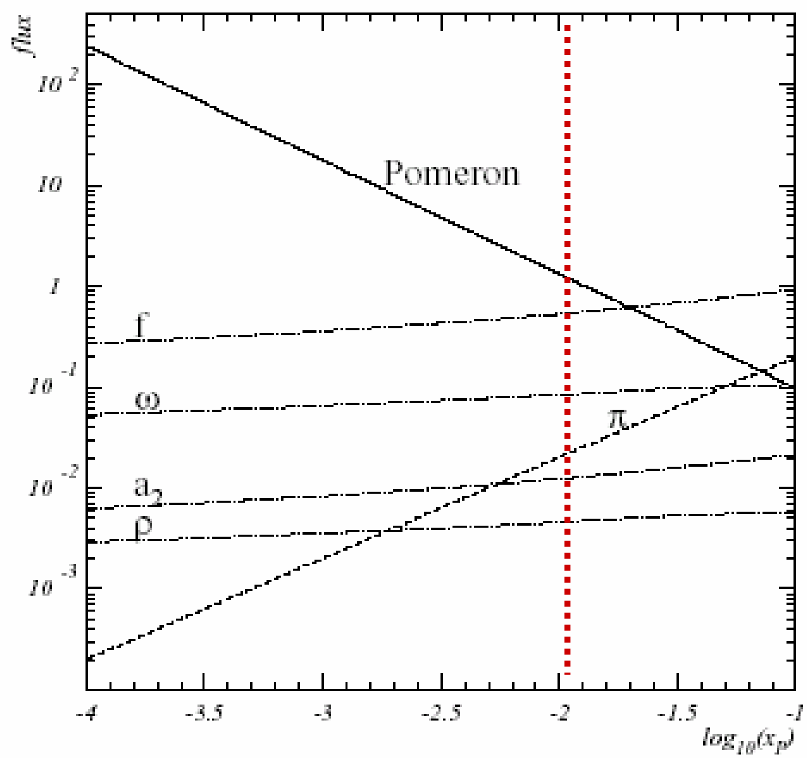


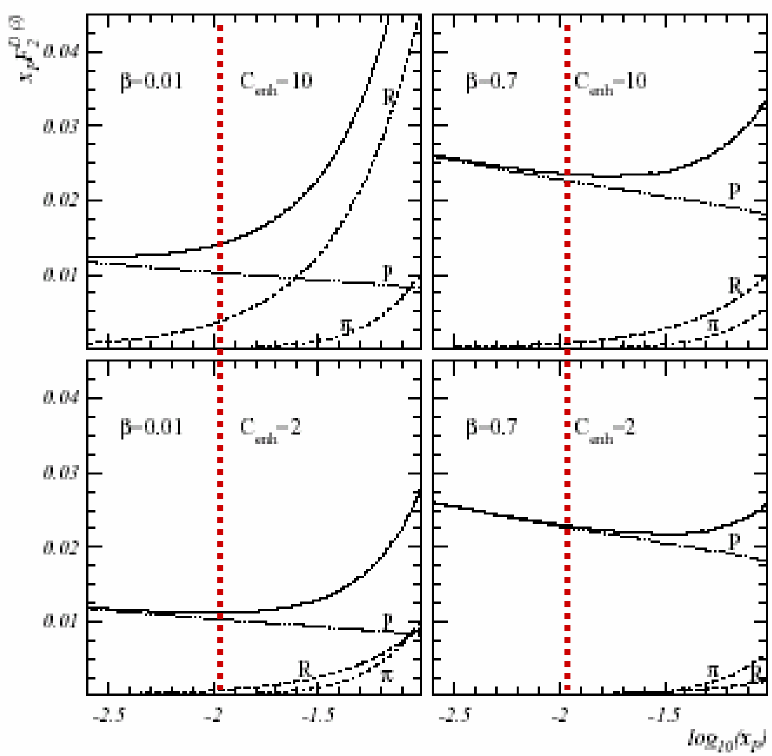
Testing Regge factorization

For $x_{IP} < 0.01$, flux seems indeed independent of Q^2 and of β.

Reggeon and pion contributions in diffractive processes

K. Golec-Biernat, J. Kwiecinski and A. Szczurek, Phys. Rev. **D56** (1997) 3955.





Data selection

For QCD analysis

$$x_{IP} < 0.01$$

$$Q^2 > 3\,GeV^2$$

$$M_X > 2\,GeV$$

Fits to ZEUS FPC, ZEUS LPS and H1 data were performed (see tables 2, 3 and 4 respectively). Data were selected according to the cut: $Q^2 > 3\,\mathrm{GeV}^2$, $x_{I\!P} < 0.01$ and $M_X > 2\,\mathrm{GeV}$.

Results of NLO QCD fits

In table 1 values of the parameters, as obtained from the fits for different data sets, are shown. General fit information including probability and χ^2, is also provided.

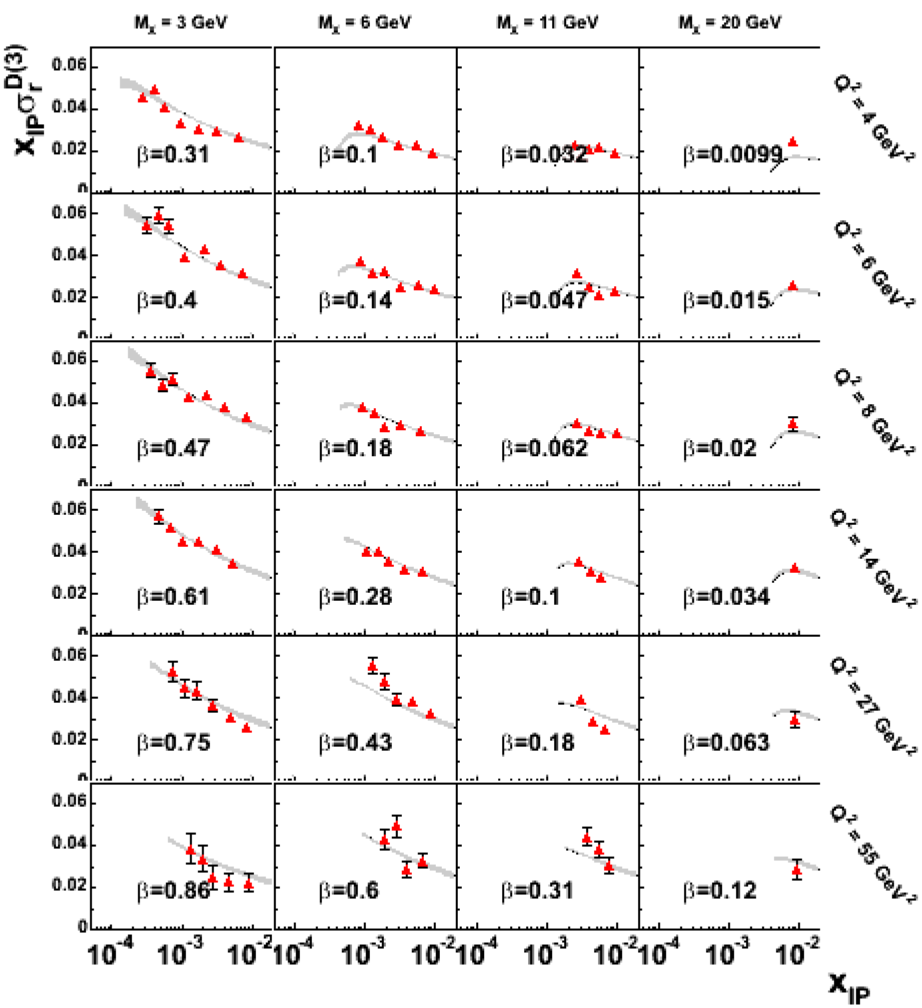
Table 1: Fit results for different data sets

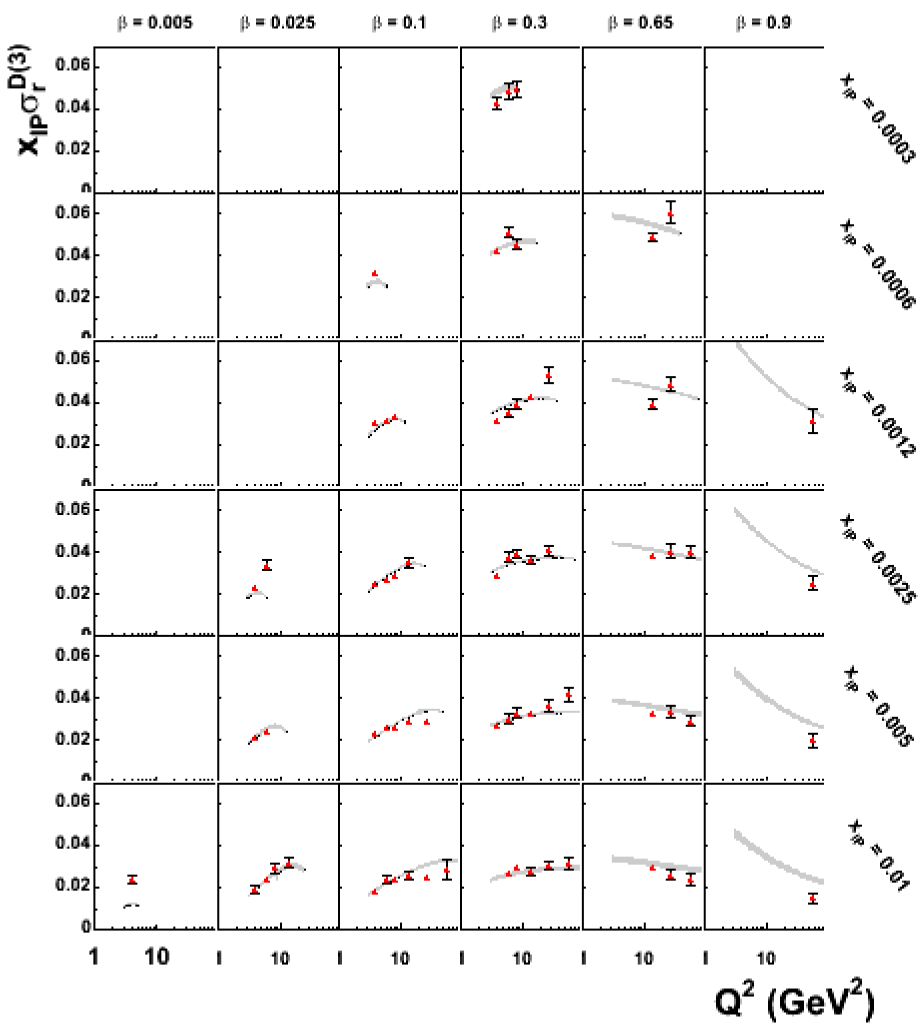
Name	ZEUS FPC	ZEUS LPS	H1
$\alpha_{I\!P}(0)$	1.138 ± 0.011	1.189 ± 0.020	1.178 ± 0.007
A_q	0.107 ± 0.016	0.025 ± 0.007	0.092 ± 0.017
α_q	0.405 ± 0.021	0.19 ± 0.07	1.28 ± 0.07
β_q	0.103 ± 0.004	-0.396 ± 0.002	0.29 ± 0.03
A_g	6.09 ± 0.77	47 ± 27	0.191 ± 0.013
α_g	0.524 ± 0.036	1.23 ± 0.16	-0.639 ± 0.002
β_g	4.51 ± 0.07	12.8 ± 4.3	-0.87 ± 0.03
N_{points}	98	27	182
N_{params}	7	7	7
χ^2	90.7	10.1	189
$\chi^2/d.o.f.$	0.995	0.5	1.0
$Probability$	49%	96%	48%

7.2 Fit presentation

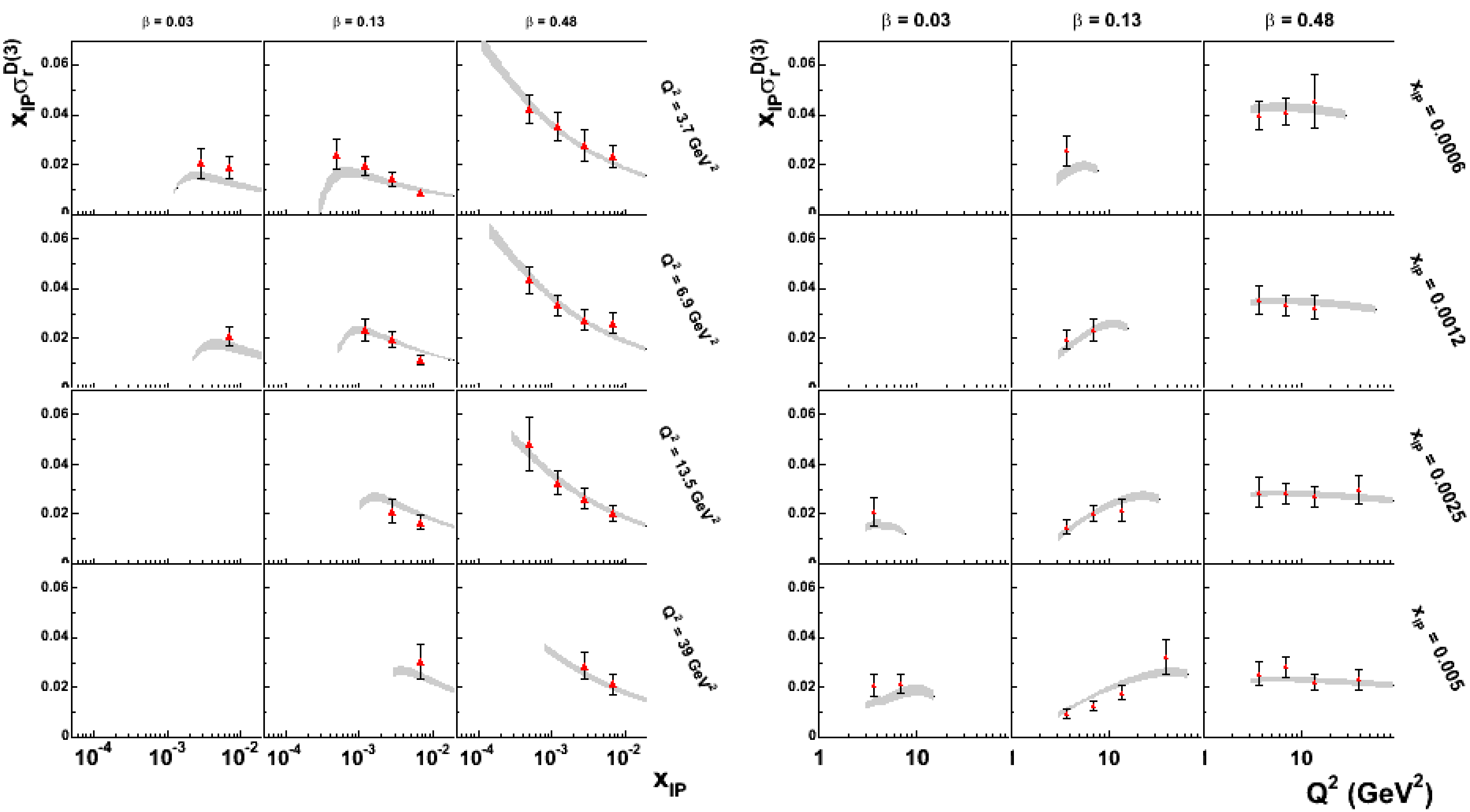
The results of the fits (Table 1) are presented in the figs.23 - 30.

Fit results for ZEUS FPC data

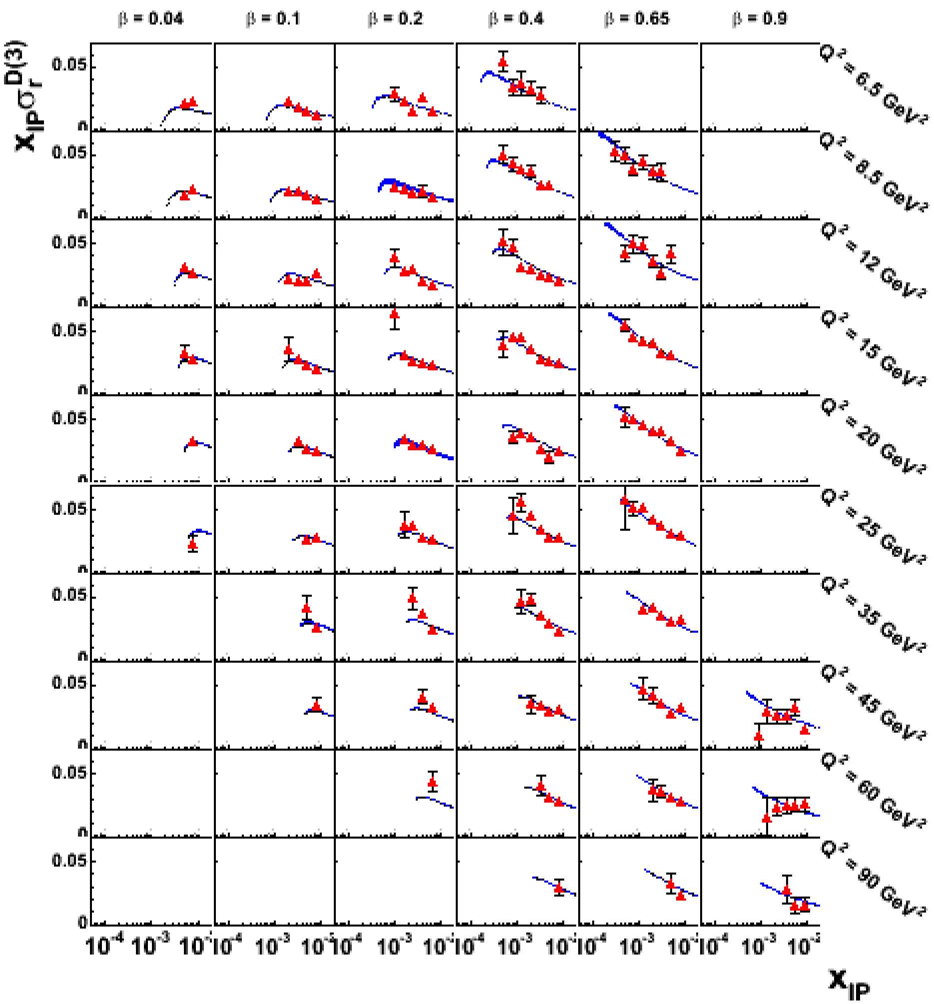


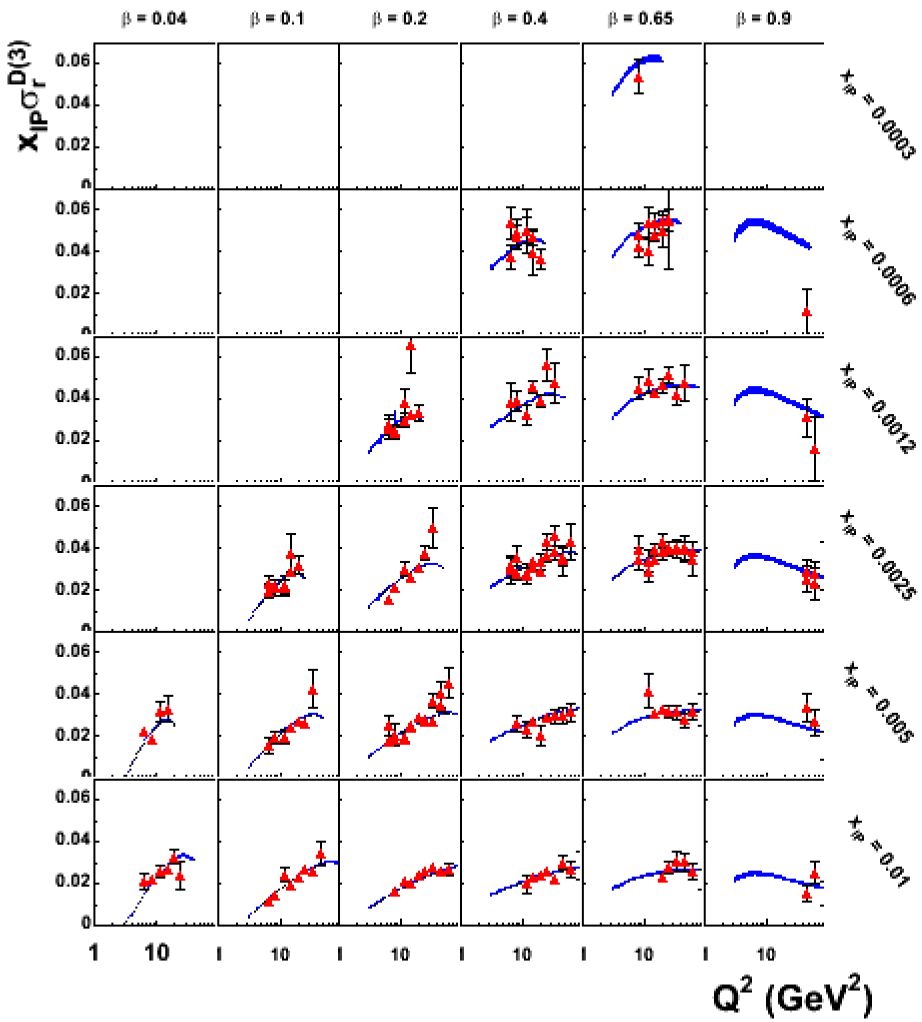


Fit results for ZEUS LPS data

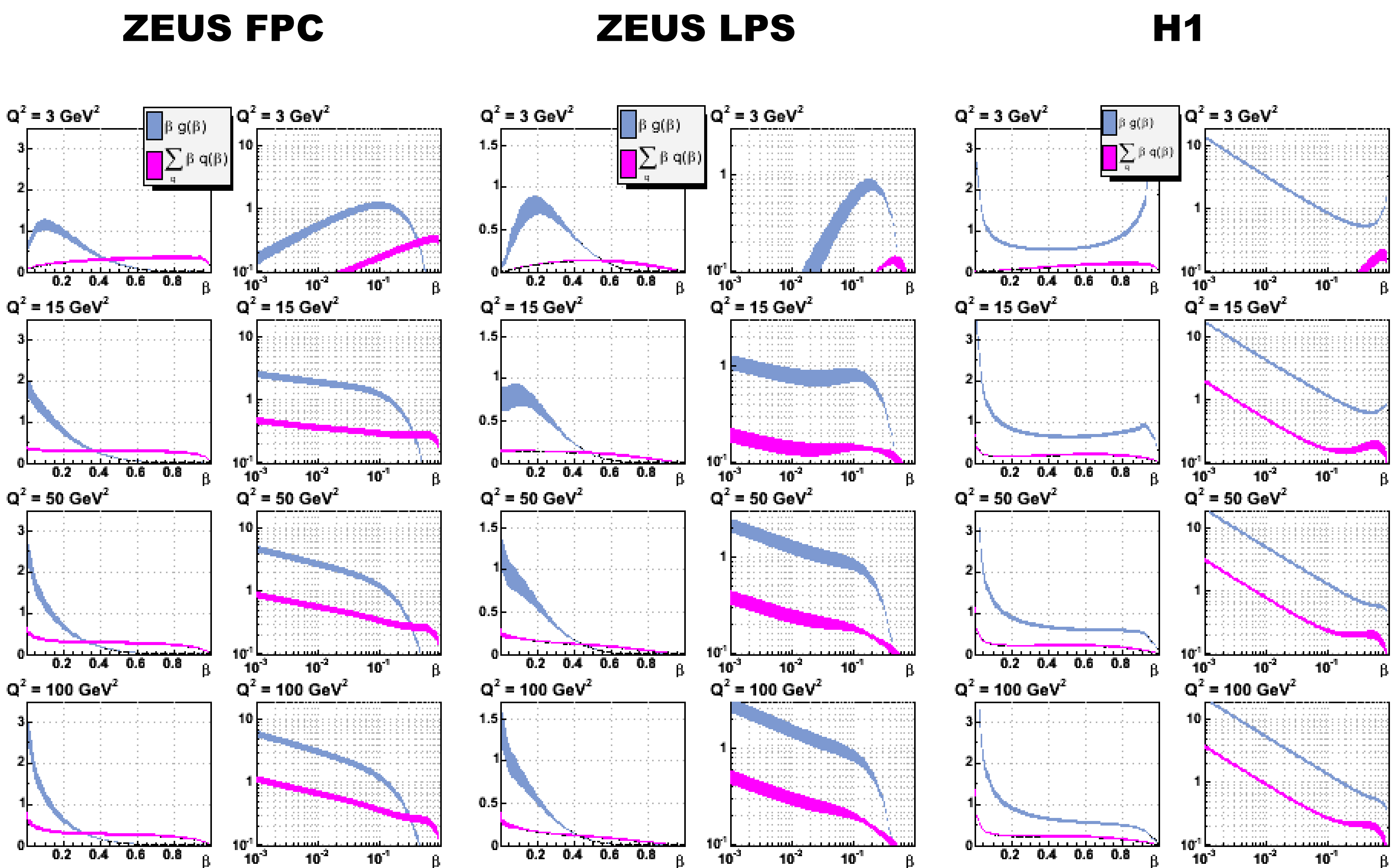


Fit results for H1 data



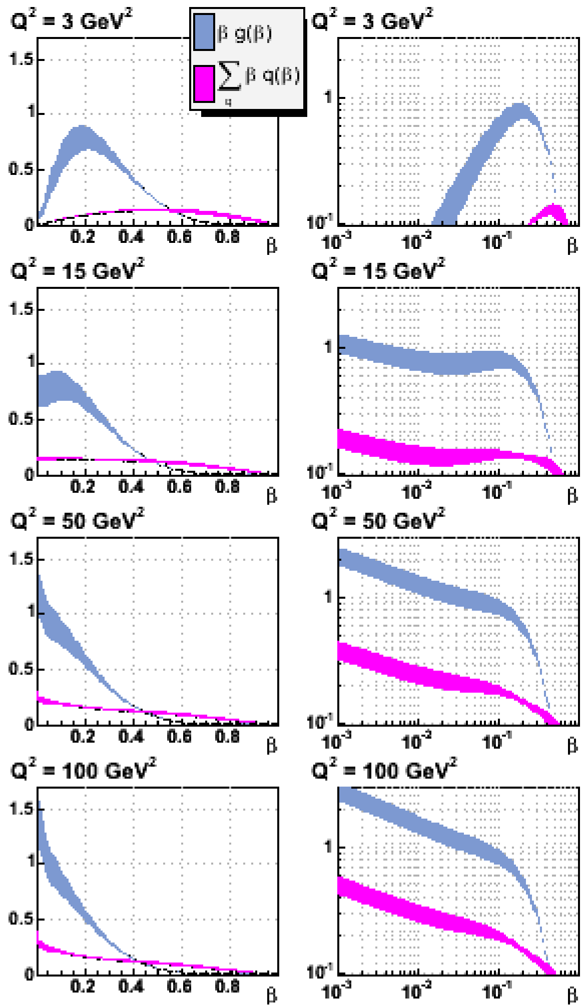


Parton Distribution functions

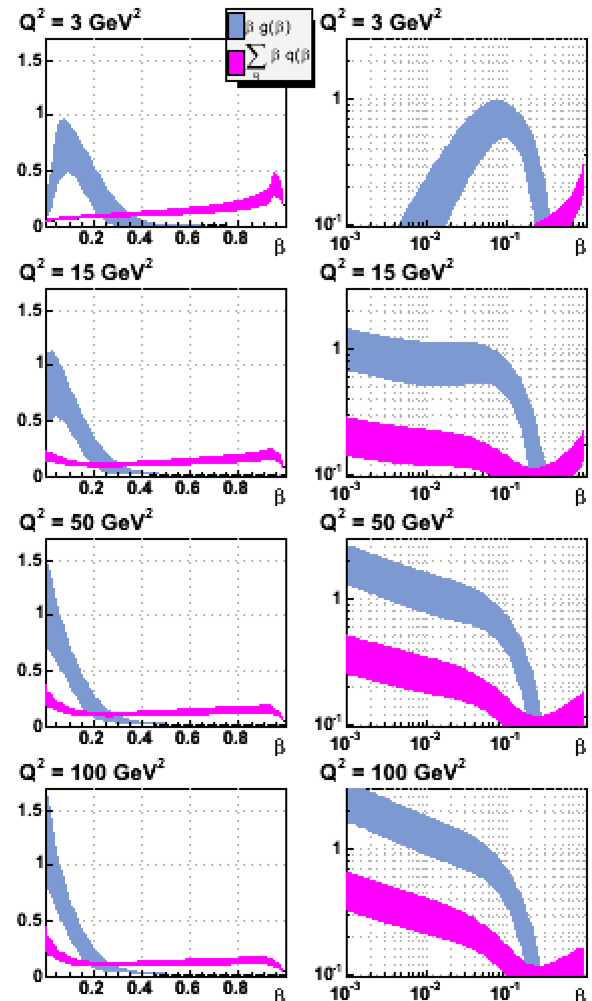


Two solutions of ZEUS LPS data

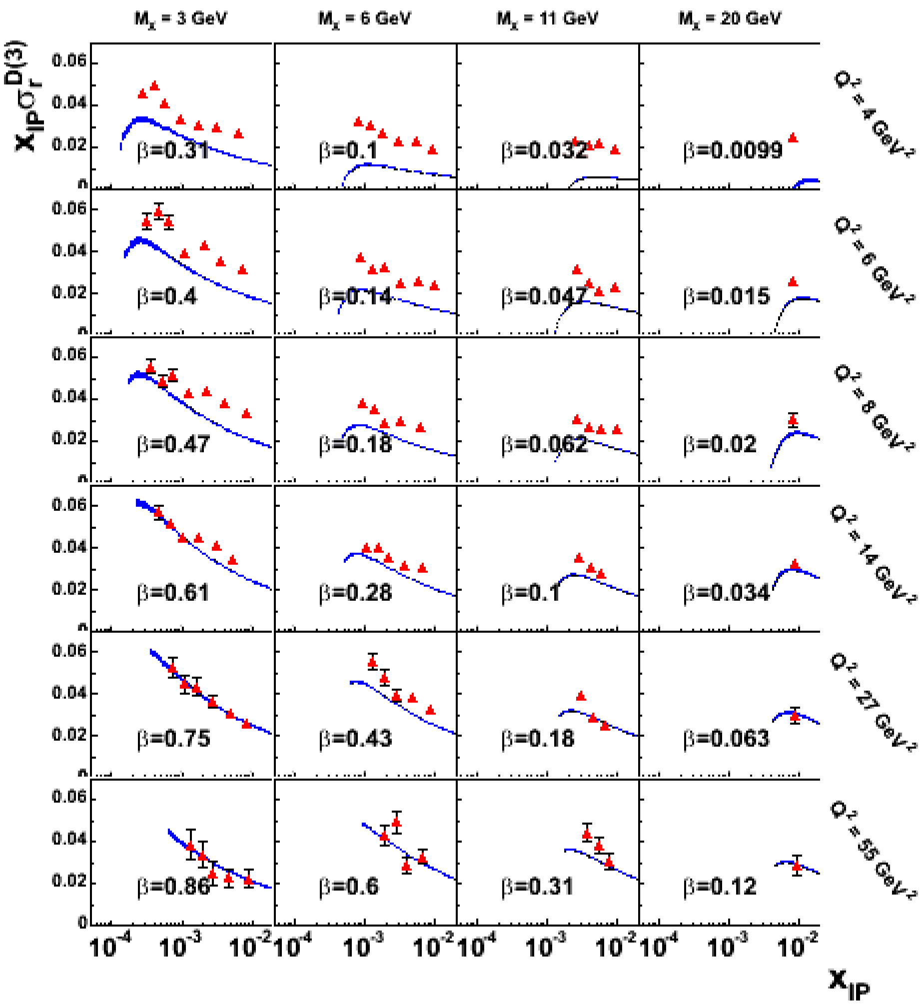
gluons >> quarks

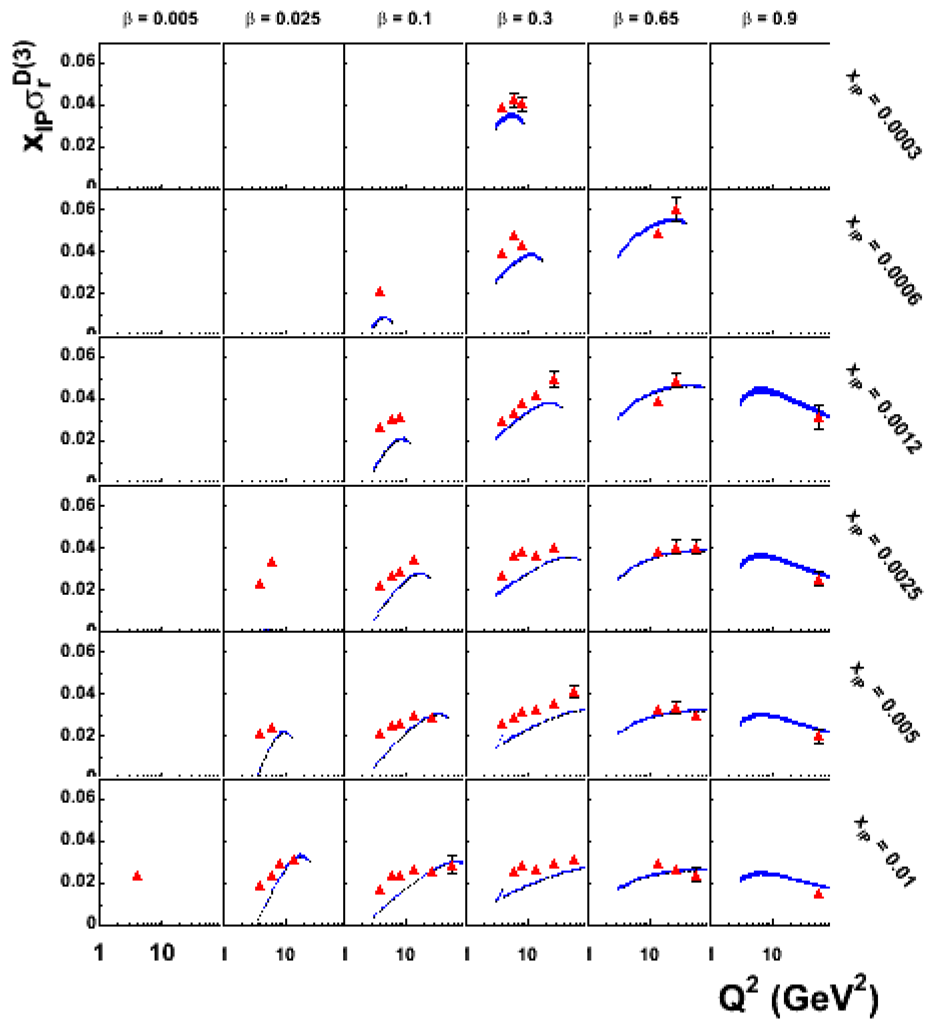


gluons ≈ quarks

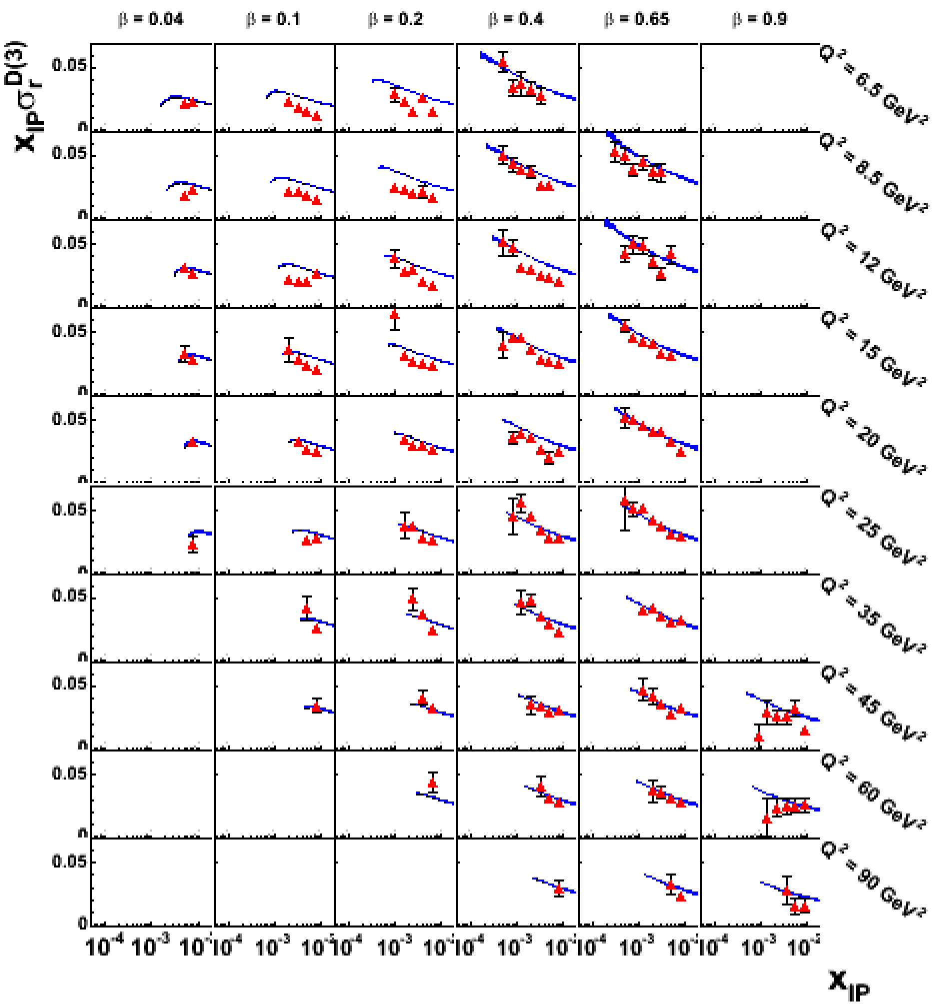


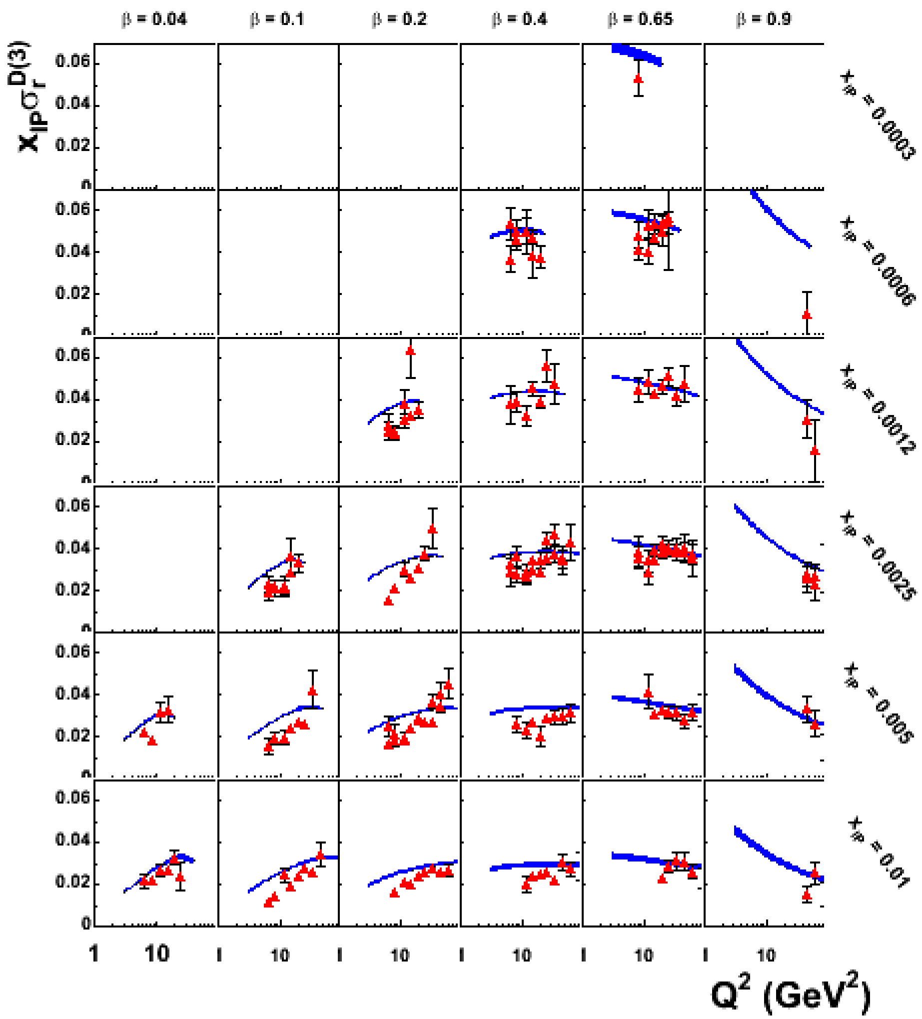
ZEUS FPC data vs H1 fit



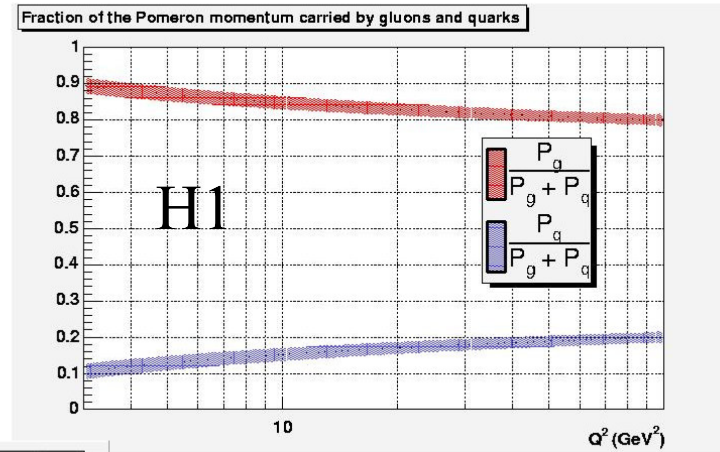


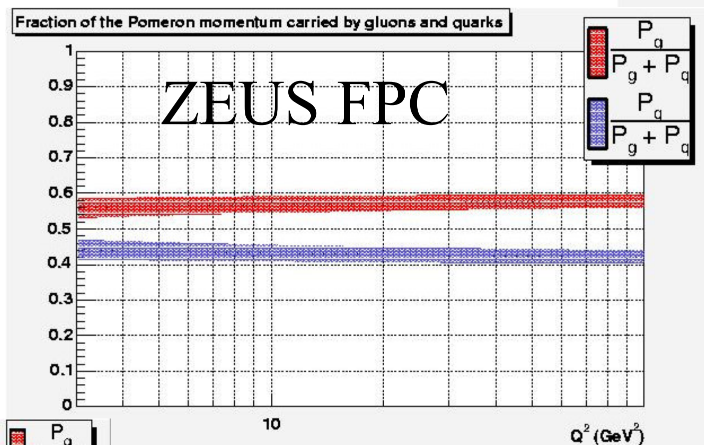
H1 data vs ZEUS FPC fit

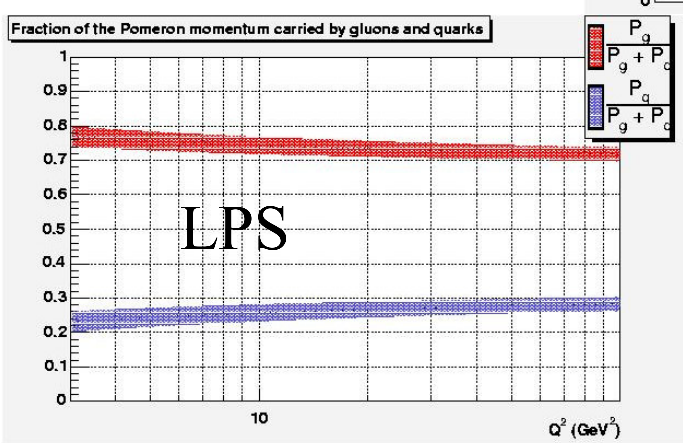




Fraction of Pomeron momentum carried by quarks/gluons







Probability of diffraction

(see L. Frankfurt and M. Strikman, hep-ex/9907221)

$$P_i^D(x,Q^2) = \frac{\int f_i^{(D)}(\beta,Q^2,x_{IP},t)\delta(x - x_{IP}\beta)dtdx_{IP}d\beta}{f_i(x,Q^2)}$$

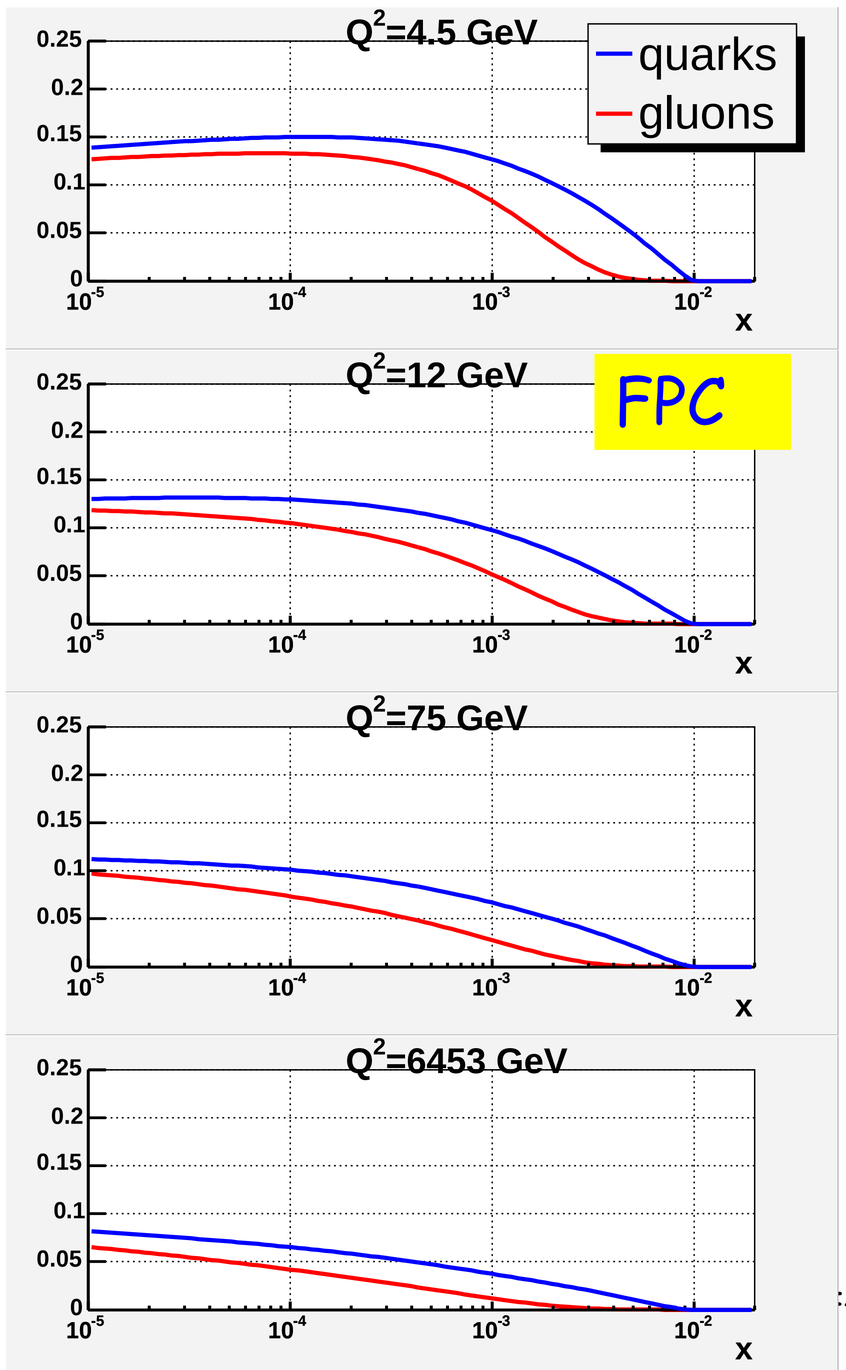
$$= \frac{\int \frac{1}{x_{IP}} f_i^{(D)}\left(\frac{x}{x_{IP}},Q^2,x_{IP},t\right)dtdx_{IP}}{f_i(x,Q^2)}$$

$$= \frac{\int \frac{1}{\beta} f_i^{(D)}\left(\beta,Q^2,\frac{x}{\beta},t\right)dtd\beta}{f_i(x,Q^2)}$$

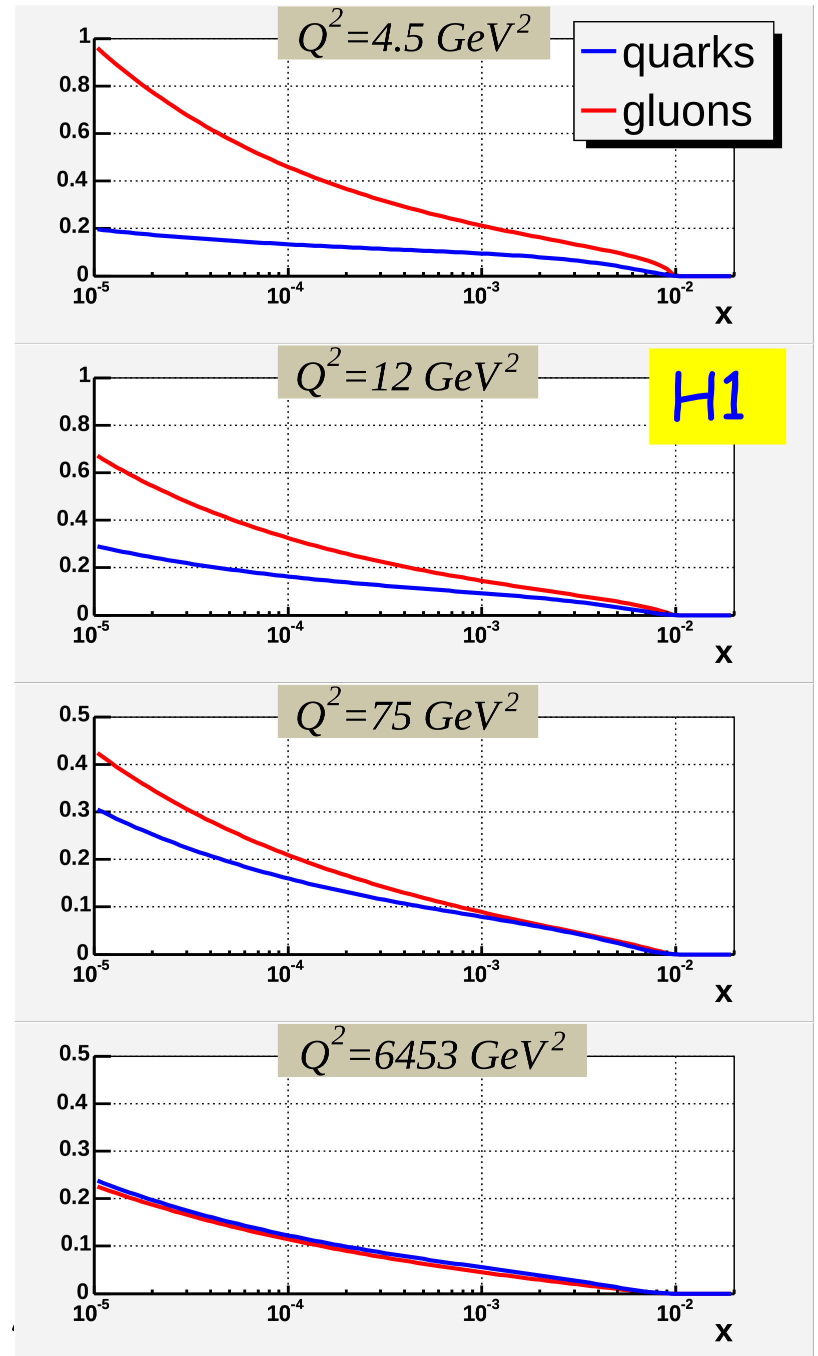
Probability of diffraction (2)

$$P_g^D = \frac{\int_{x/0.01}^{1} d\beta \, \frac{1}{\beta} f_{IP/p}\left(\frac{x}{\beta}\right) g^{IP}(\beta, Q^2)}{g^p(x, Q^2)}$$

$$P_q^D = \frac{\sum_i \int_{x/0.01}^{1} d\beta \, \frac{1}{\beta} f_{IP/p}\left(\frac{x}{\beta}\right) q_i^{IP}(\beta, Q^2)}{\sum_i q_i^p(x, Q^2)}$$


Q^2=4.5 GeV
Q^2=12 GeV
Q^2=75 GeV
Q^2=6453 GeV
quarks
gluons
FPC
x

f. WG,


$Q^2=4.5\ GeV^2$
$Q^2=12\ GeV^2$
$Q^2=75\ GeV^2$
$Q^2=6453\ GeV^2$
quarks
gluons
H1
x

Summary and conclusions

- Regge factorization consistent with available data in the kinematic range: $x_{IP}<0.01$, $Q^2>3GeV^2$, $M_X>2GeV$.
- NLO DGLAP fits done to data, contribution of F_L included in the fit.

$$\alpha_{IP}(0) = 1.138 \pm 0.011 \quad (FPC)$$

$$\alpha_{IP}(0) = 1.189 \pm 0.020 \quad (LPS)$$

$$\alpha_{IP}(0) = 1.178 \pm 0.007 \quad (H1)$$

Summary and conclusions (2)

- FPC and H1 data are incompatible in some of the kinematic regions studied.
- Fraction of the Pomeron momentum carried by gluons:

  H1 and LPS: 70-90%

  FPC: 55-65%
- Probability for diffraction: H1 results for $x<10^{-4}$ are unphysical. Gluon saturation?