



# PDF4MC

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# PDF4MC approach

Can a PDF obtained by a MC fit and what is the influence of parton showers to a fit?

- parametrized PDFs @ starting  $Q_0^2$  evolved in LHAPDF for MC generator, e.g.

$$xf(Q_0^2, x) = P_1 x^{P_2} (1-x)^{P_3} e^{xP_4} (1 + e^{P_5 x})^{P_6}$$

- MC generator makes predictions for e.g. x-section,  $F_2$
- fit these MC predictions to data by changing parameters of starting PDFs
- including parton showers

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## PDF4MC approach

- use of *RAPGAP* and *PYTHIA 6.418* running at  $10^6$  events to produce MC predictions

- fit these MC predictions to 104 experimental data points of dataset:

*H1 Collaboration, EPJC 21 (2001) 33*

(measurement of inclusive DIS  $\sigma$ -section at  $\sqrt{s}=300.9$  GeV)

- kinematic range

$$3 \cdot 10^{-5} \leq x \leq 0.2$$

$$5 \text{ GeV}^2 \leq Q^2 \leq 150 \text{ GeV}^2$$



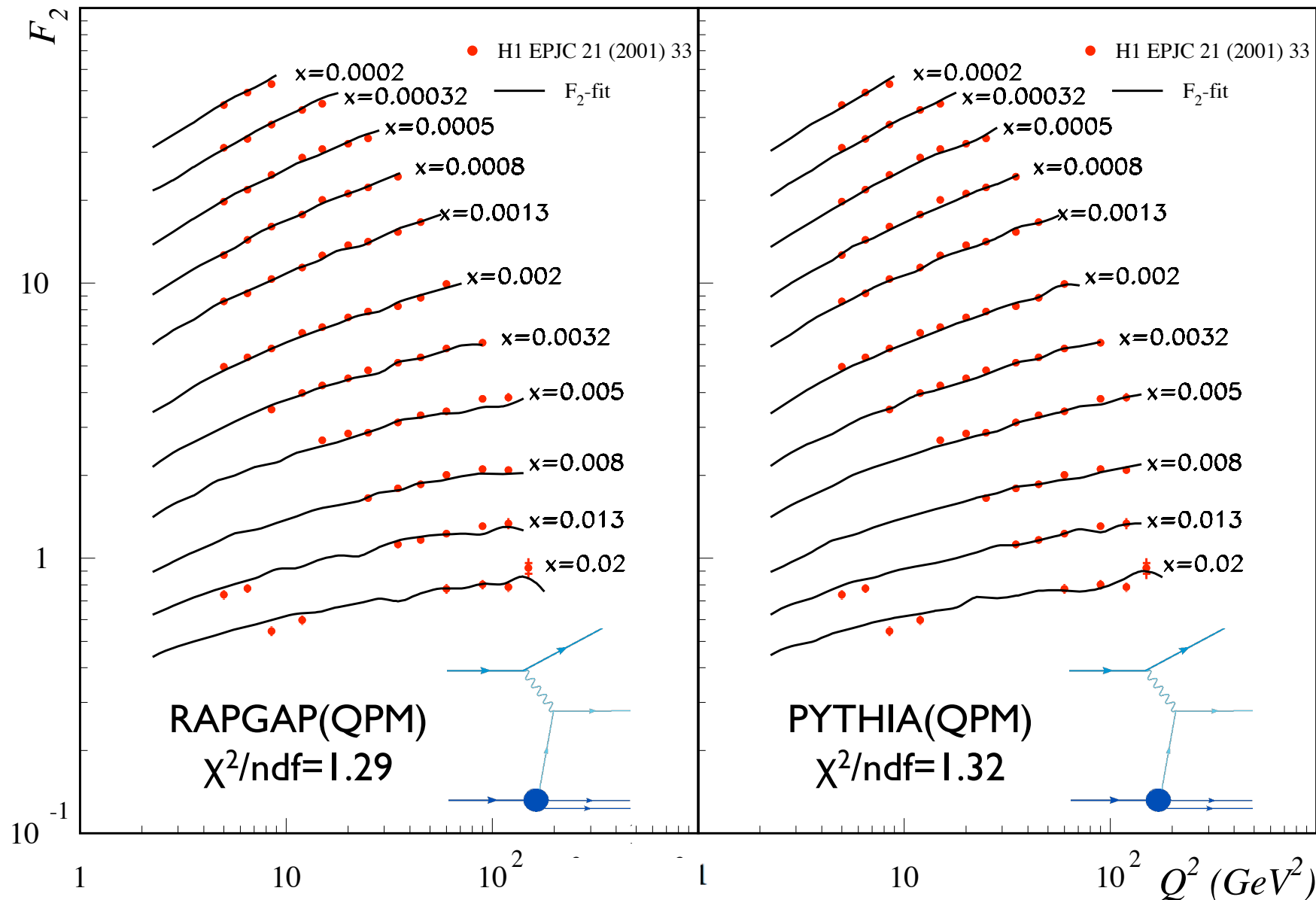
# PDF4MC approach

- fitting of gluon and seaquark-densityfunctions  
(weak sensitivity to valencequark-densityfunctions)
- in both cases the cteq-logpade parametrization is used:

$$xf(Q_0^2, x) = P_1 x^{P_2} (1-x)^{P_3} e^{xP_4} (1 + e^{P_5} x)^{P_6}$$

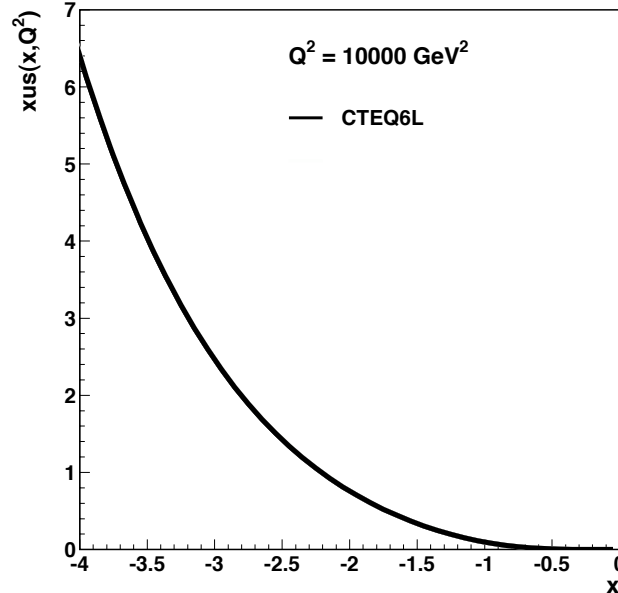
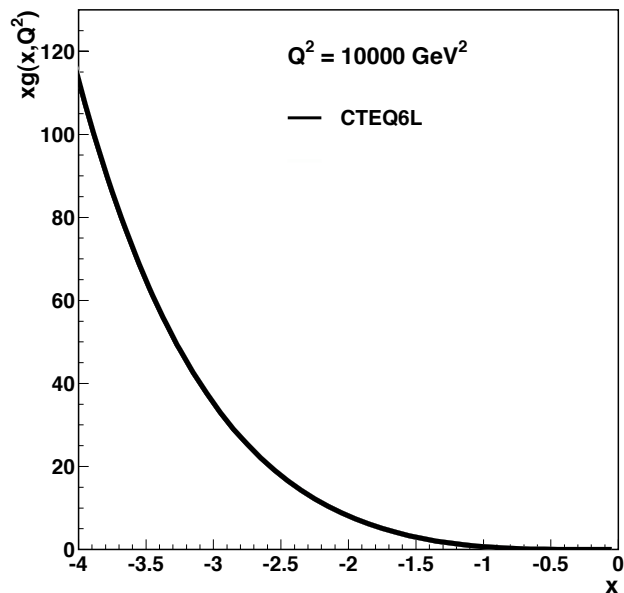
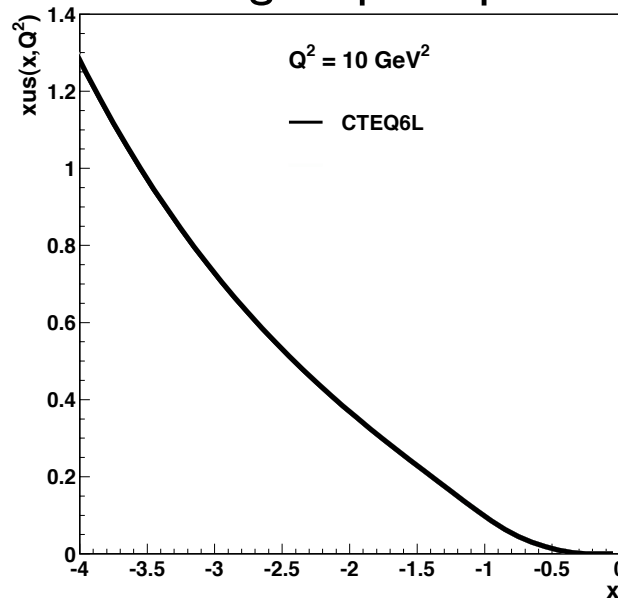
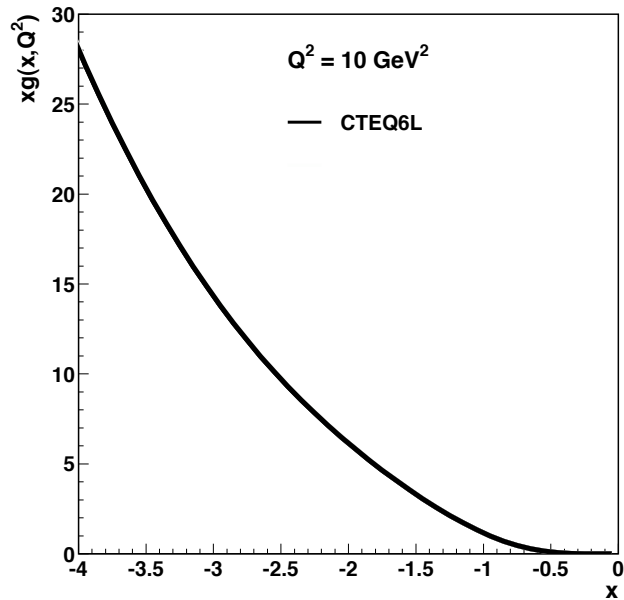
- fitting of 12 parameters

# Results



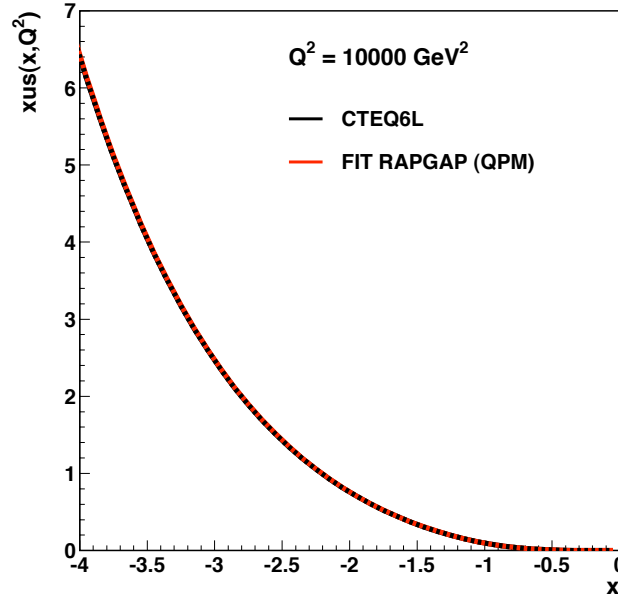
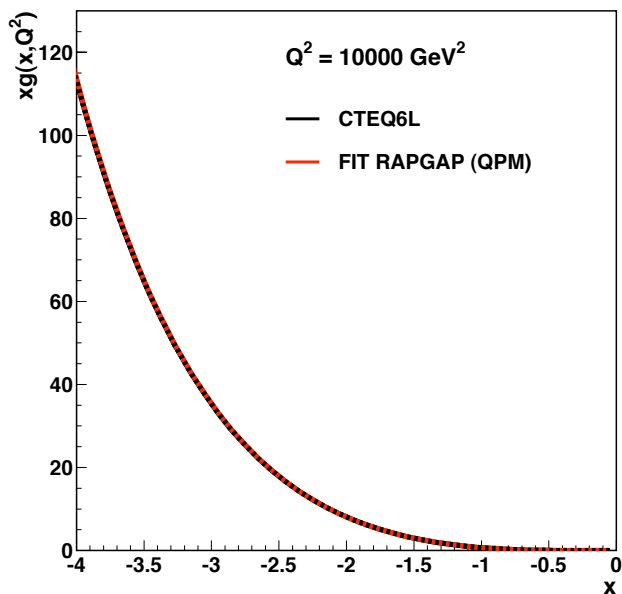
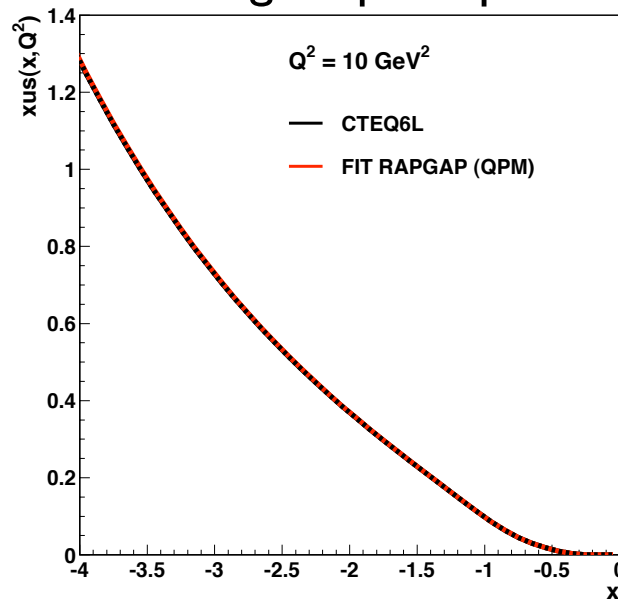
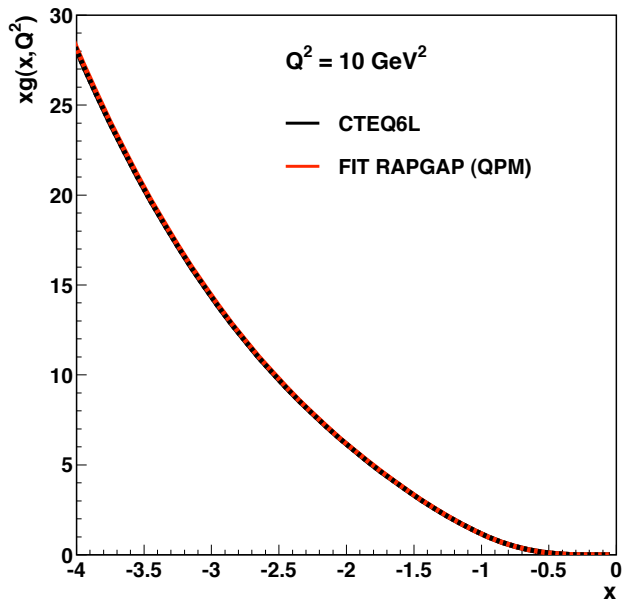
# Results

fit: *RAPGAP* running in quark parton model (QPM)



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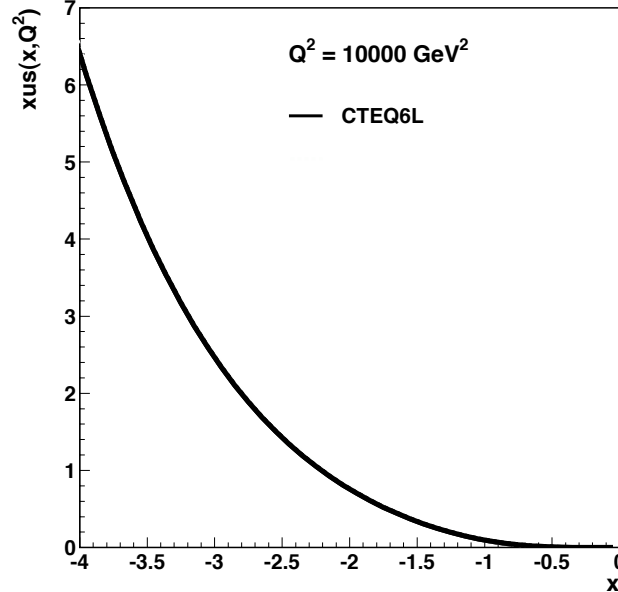
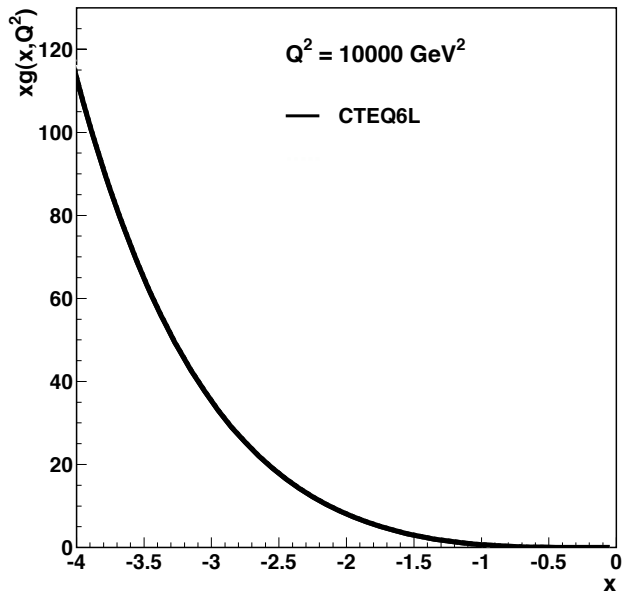
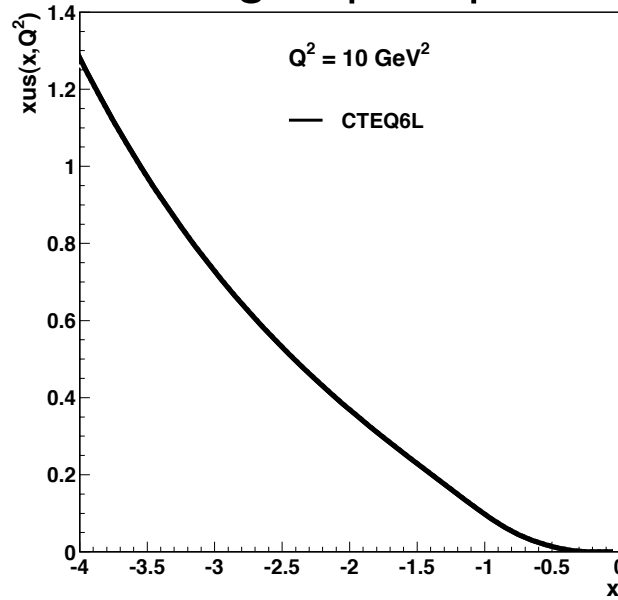
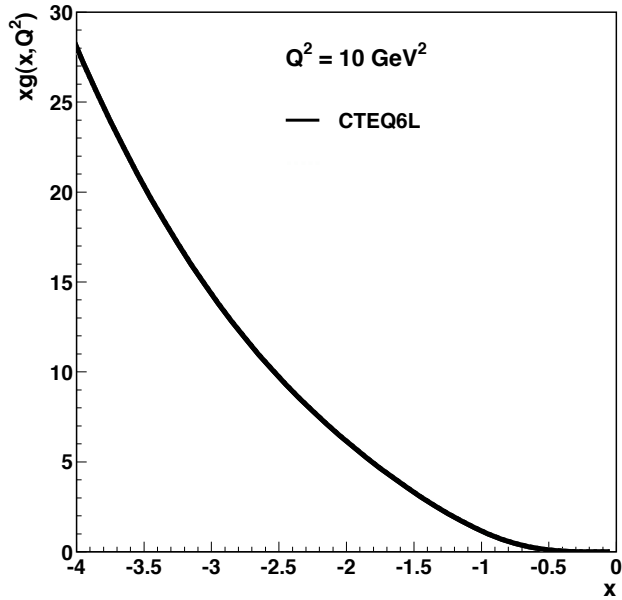


► Result of RAPGAP-fit consistent with CTEQ6L



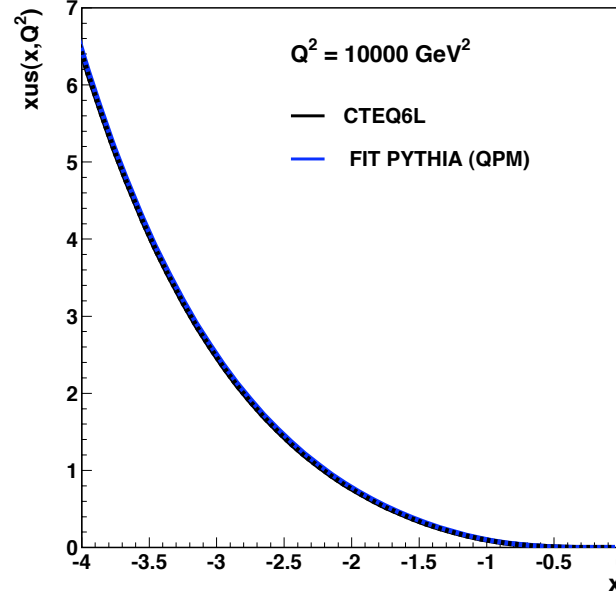
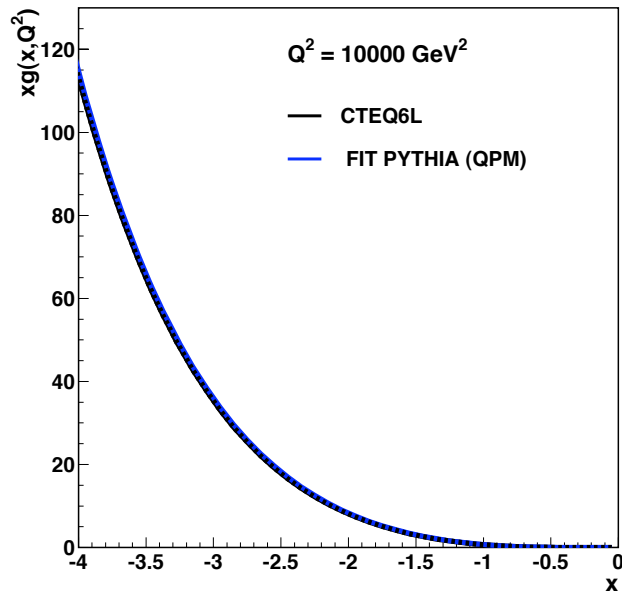
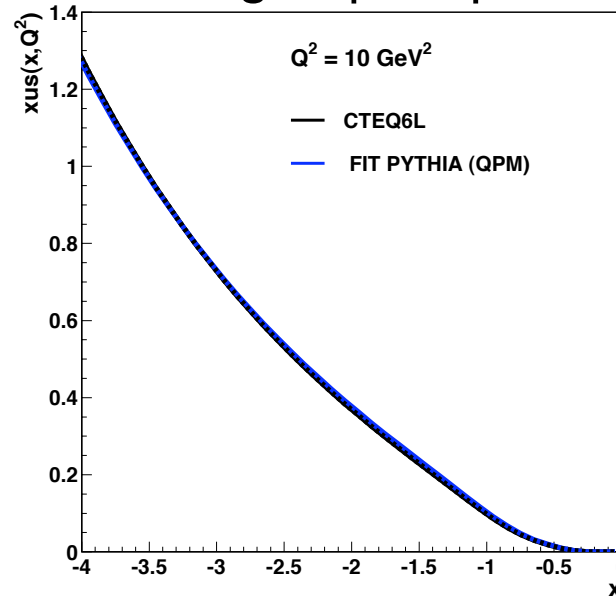
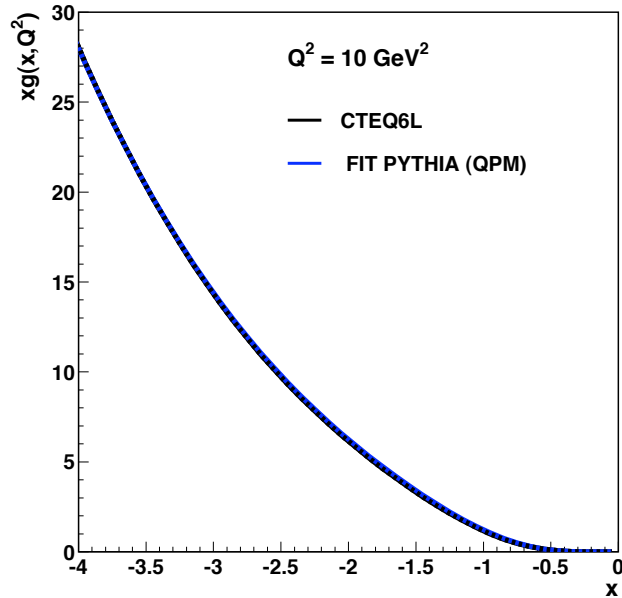
# Results

fit: *PYTHIA* running in quark parton model (QPM)



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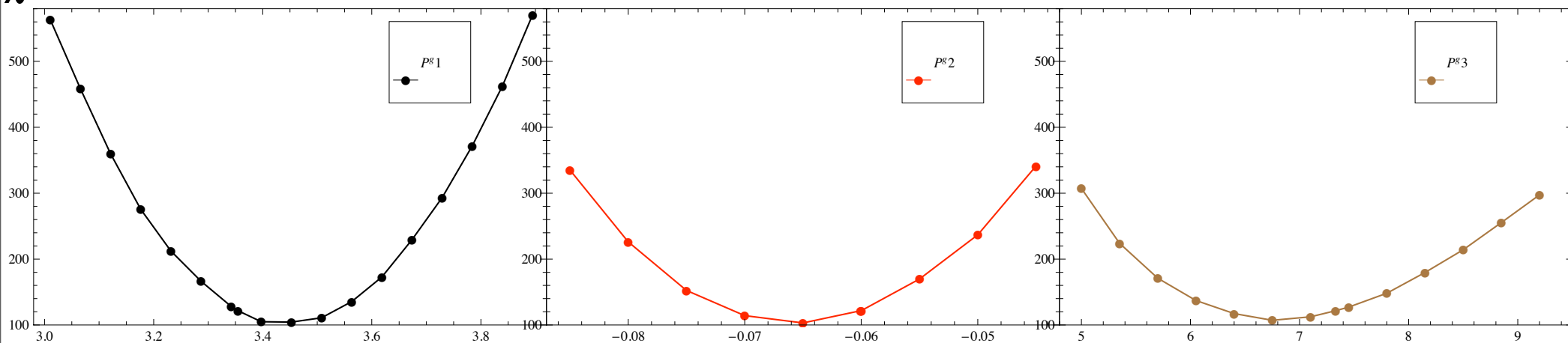


► Result of PYTHIA-fit  
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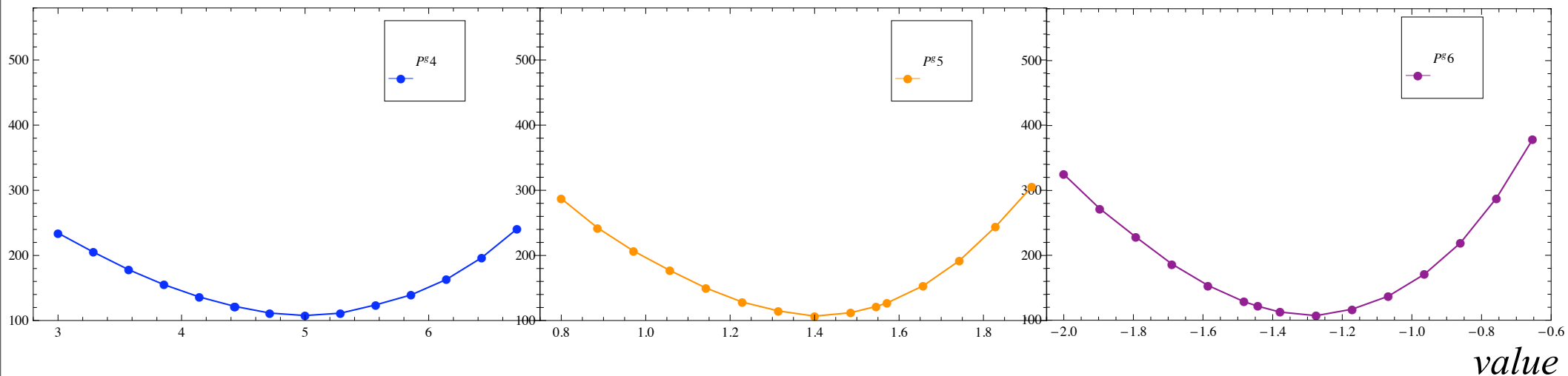
# Results

scans of gluondensity parameters (*PYTHIA*, *QPM*)

$\chi^2$

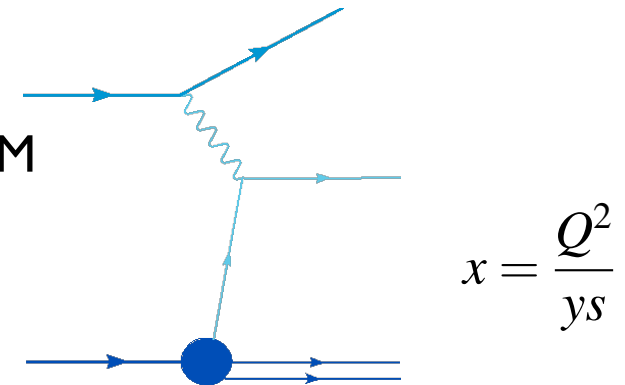


$$xg(Q_0^2, x) = \textcircled{P_1} x^{\textcircled{P_2}} (1-x)^{\textcircled{P_3}} e^{x^{\textcircled{P_4}}} (1 + e^{\textcircled{P_5}} x)^{\textcircled{P_6}}$$

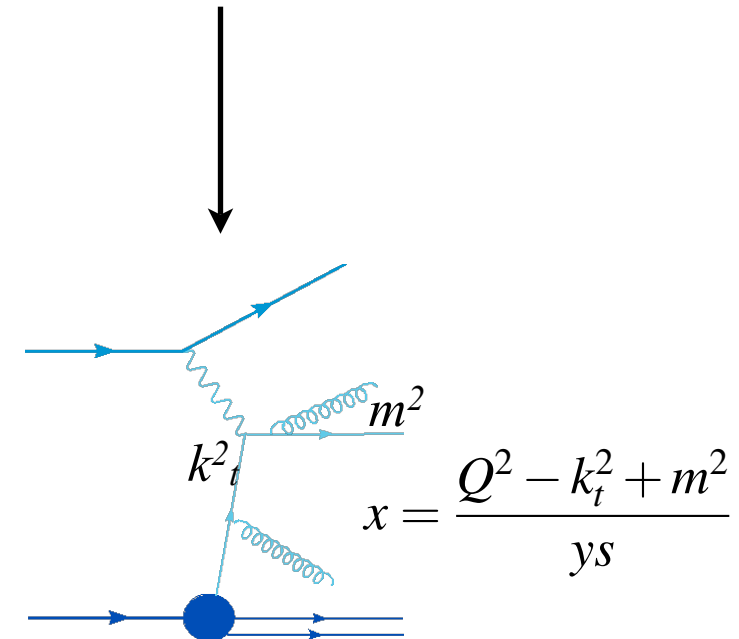


# PDF4MC approach

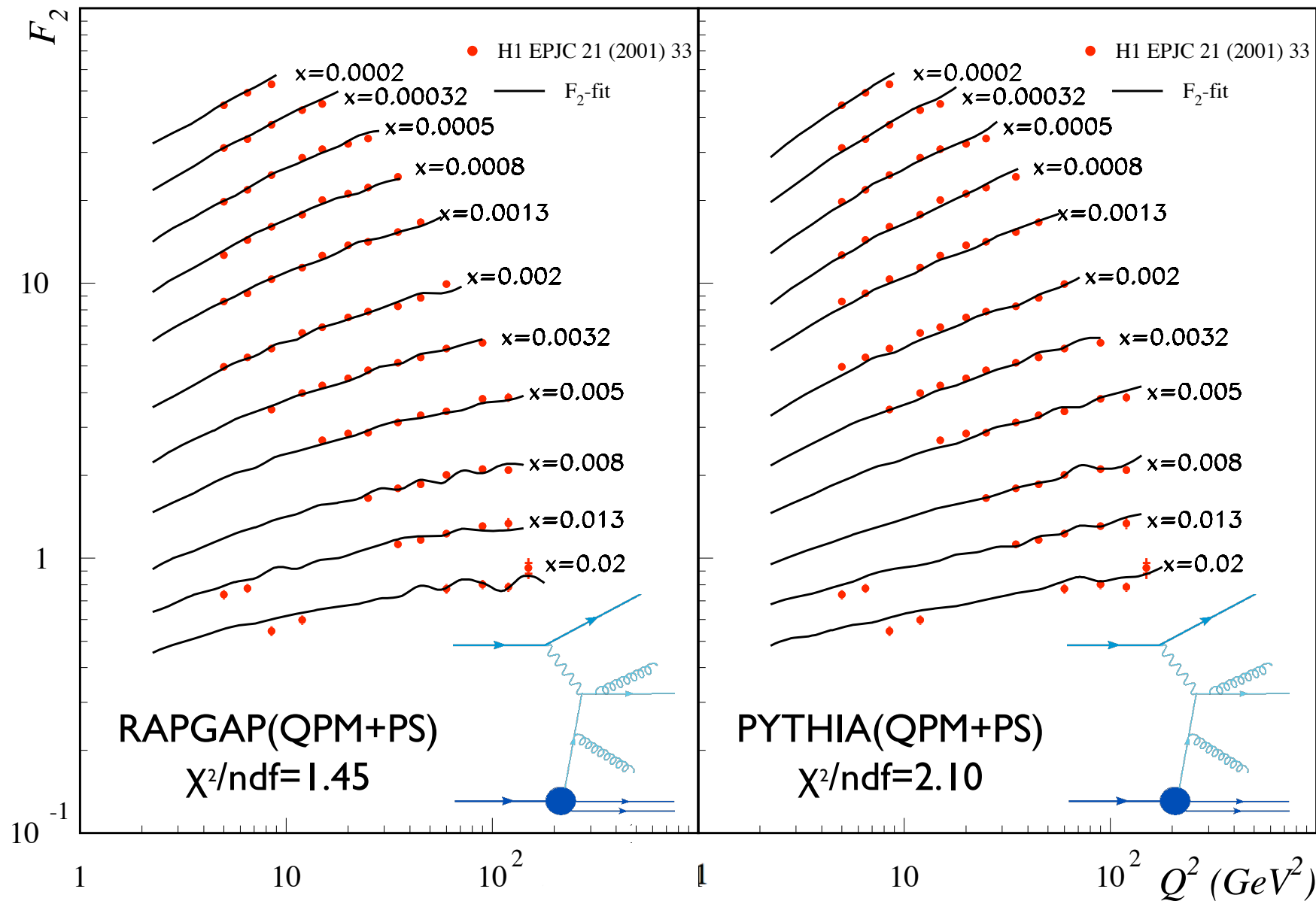
- *RAPGAP* and *PYTHIA* yield consistent results in QPM



- What happens if parton showers are included?

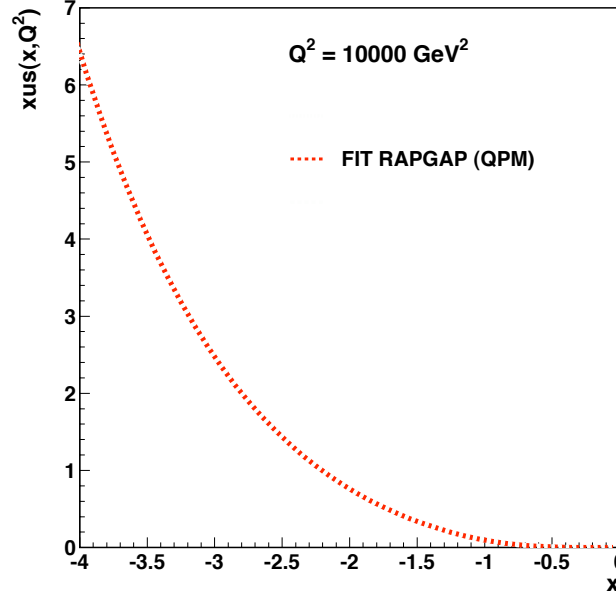
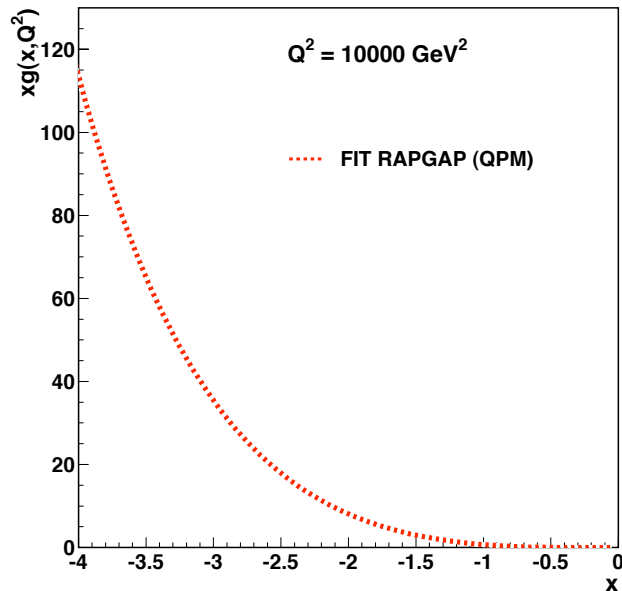
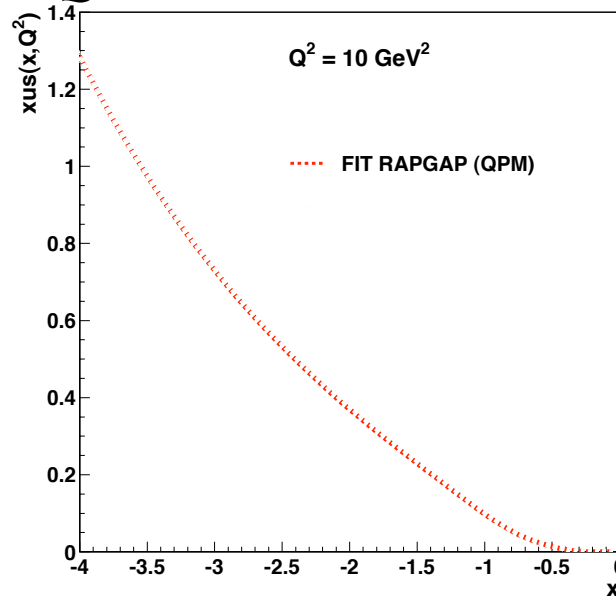
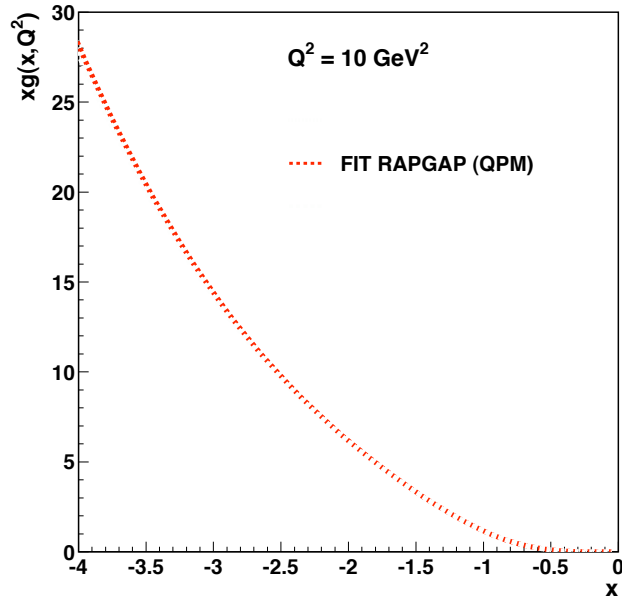


# Results



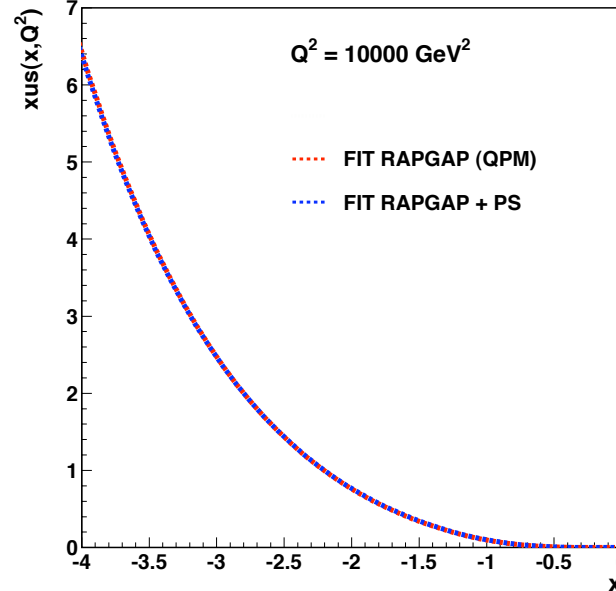
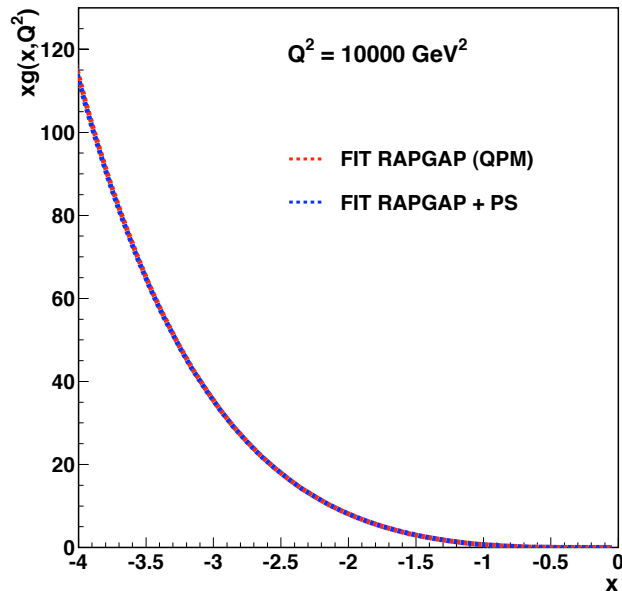
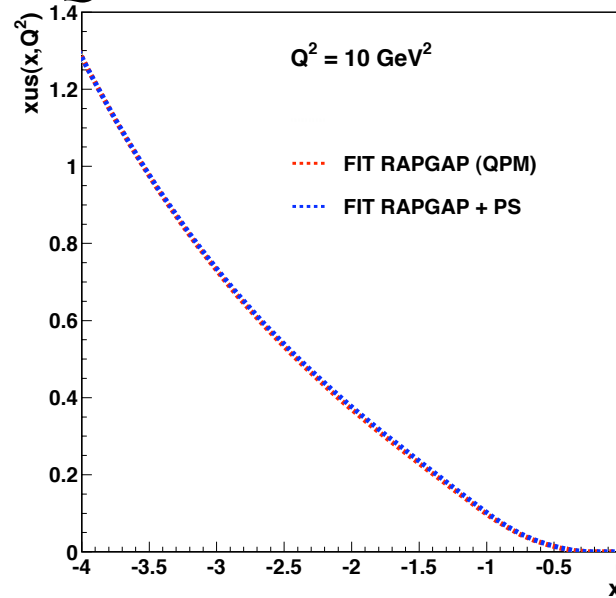
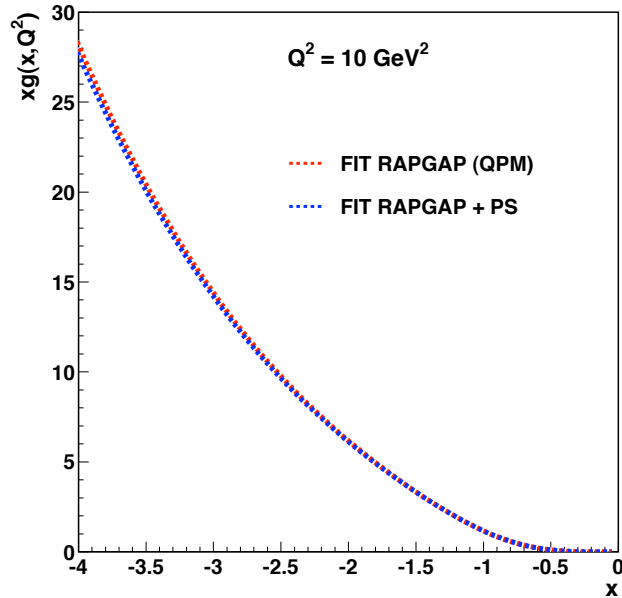
# Results

fit: RAPGAP with  $Q^2$ -ordered, initial and final state parton shower



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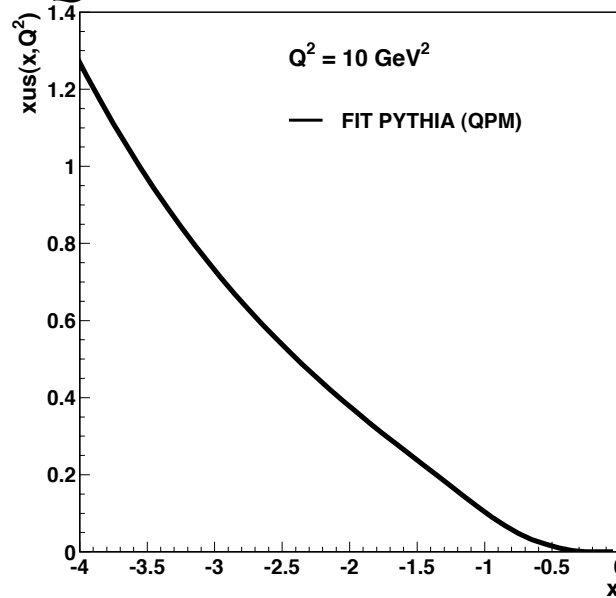
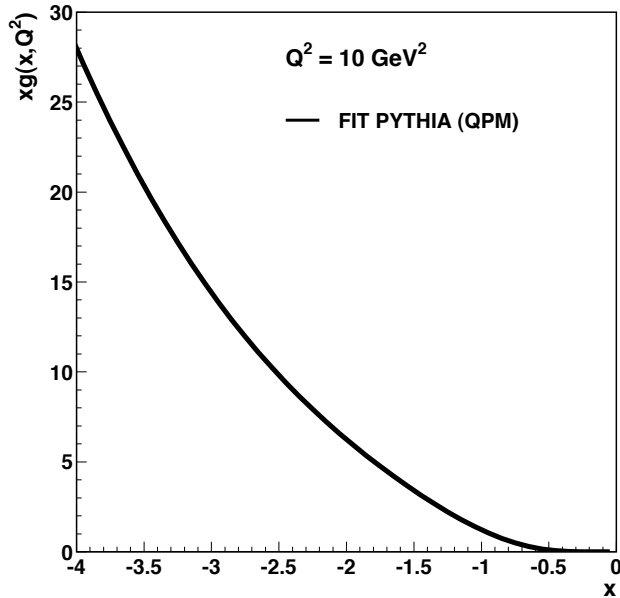
► RAPGAP yields  $Q^2$  and  $x$  independent of parton shower s.f.

QCD Effects On The Event Structure In Leptoproduction

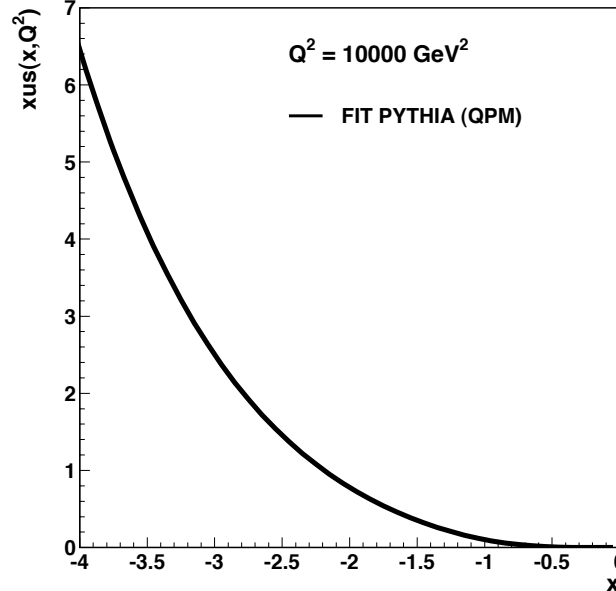
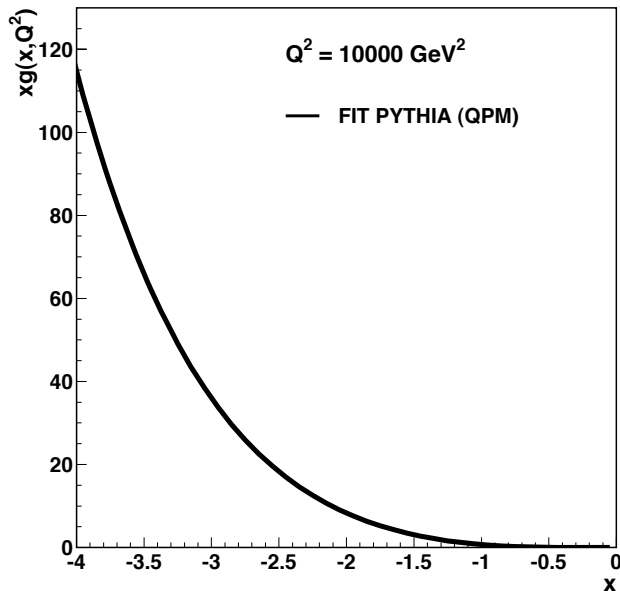
M. Bengtsson, T. Sjostrand  
(Lund U., Dept. Theor. Phys.) ,  
G. Ingelman (DESY) .  
DESY 87/097, LU TP-87-11, Aug 1987.  
28pp.  
Published in Nucl.Phys.B301:554,1988.

# Results

fit: PYTHIA with  $Q^2$ -ordered, initial and final state parton shower



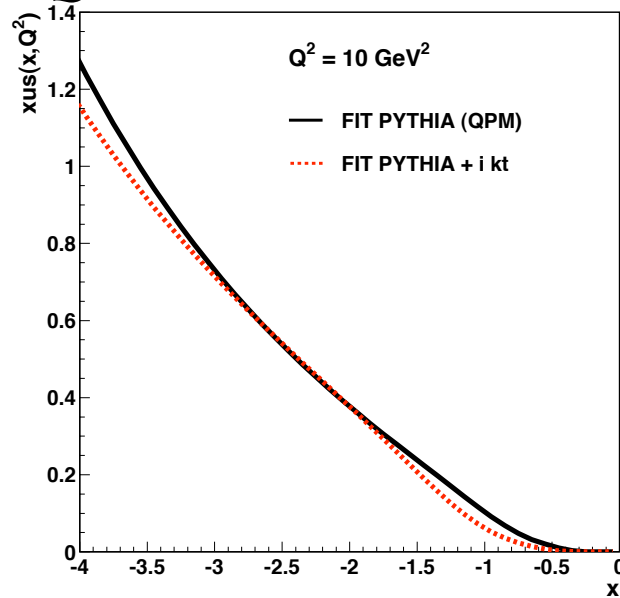
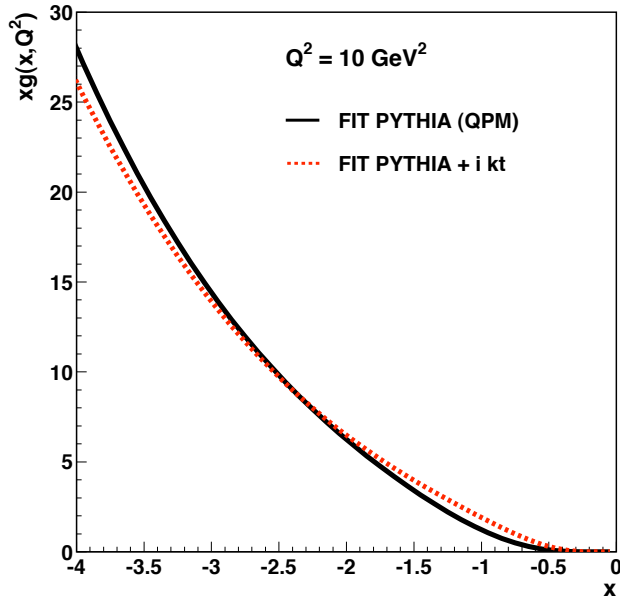
	$\chi^2/\text{ndf}$
QPM	1.32





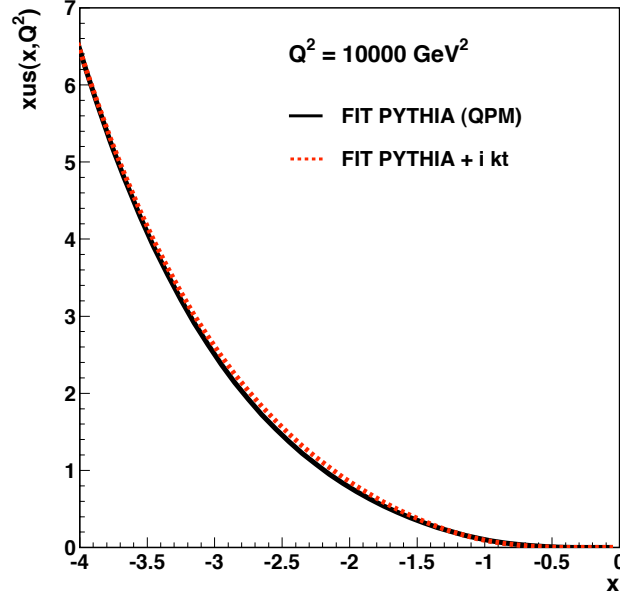
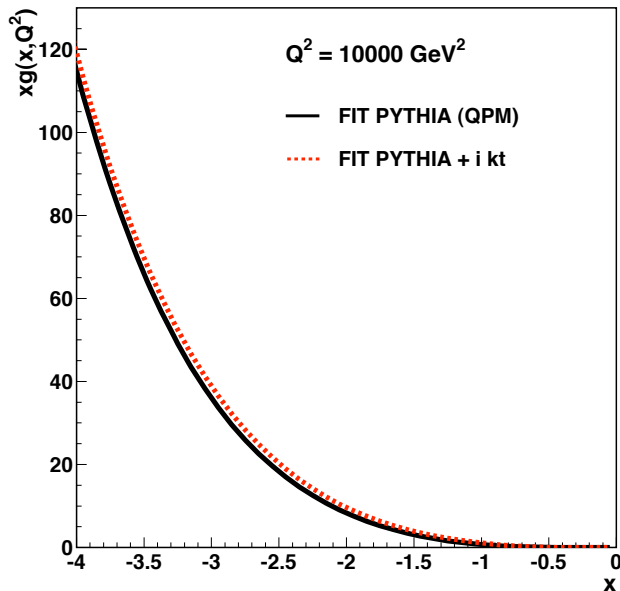
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fit: PYTHIA with  $Q^2$ -ordered, initial and final state parton shower



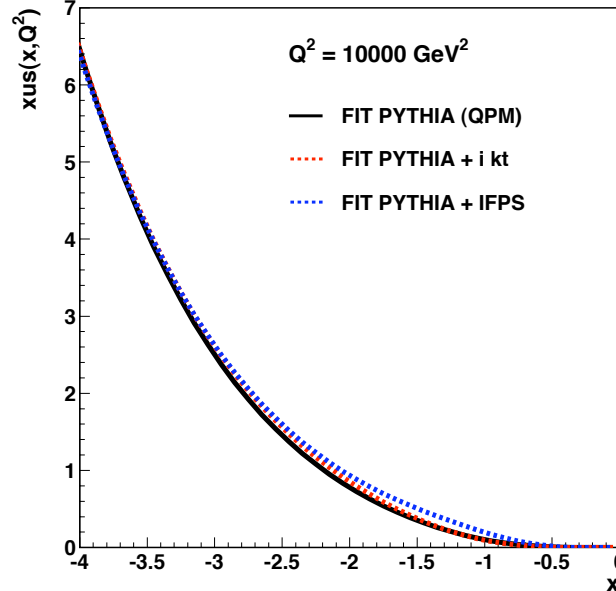
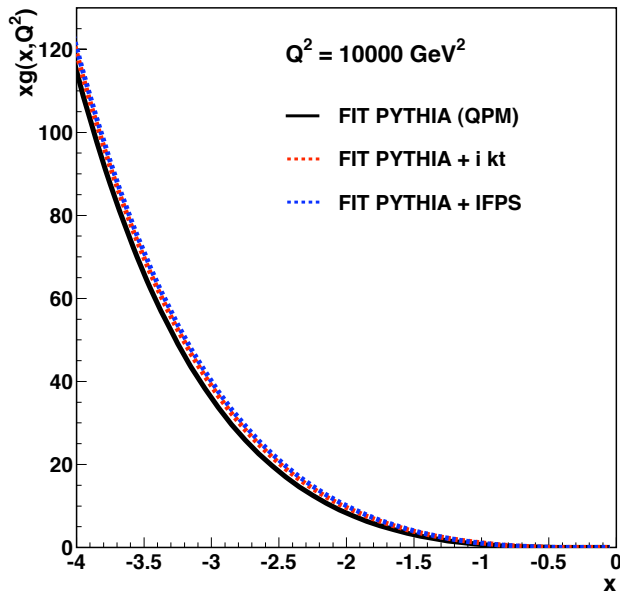
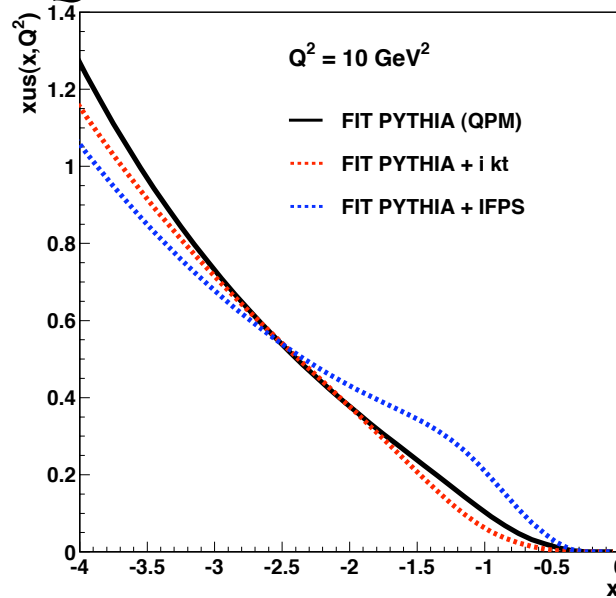
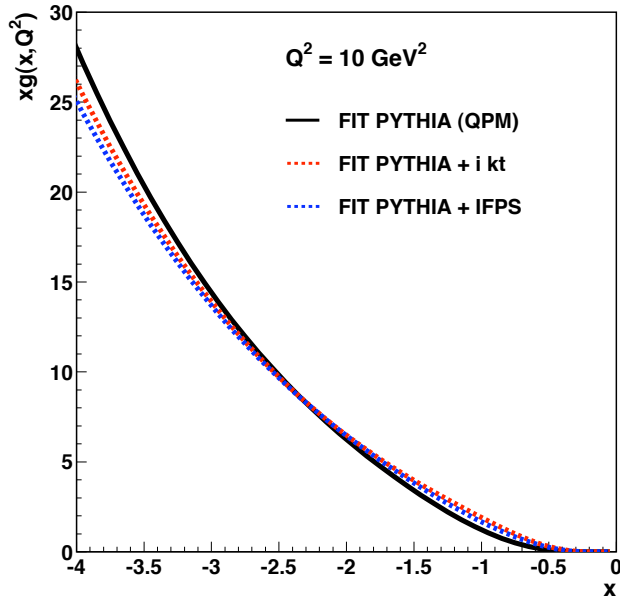
	$\chi^2/ndf$
QPM	1.32
int. $k_t$	1.13

int.  $k_t$ :  $p(k_t) \propto e^{-\frac{(k_t)^2}{\sigma^2}}, \sigma = 2 \text{ GeV}$



## Results

fit: PYTHIA with  $Q^2$ -ordered, initial and final state parton shower



	$\chi^2/\text{ndf}$
QPM	1.32
int. $k_t$	1.13
IF PS	2.10

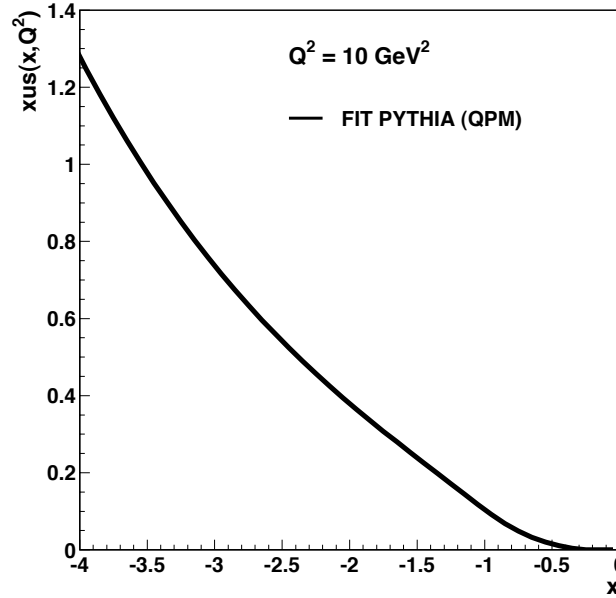
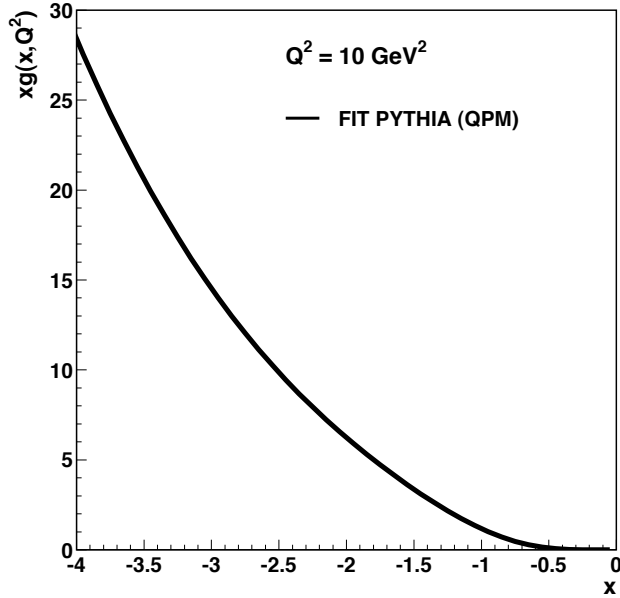
int.  $k_t$ :  $p(k_t) \propto e^{-\frac{(k_t)^2}{\sigma^2}}$ ,  $\sigma = 2 \text{ GeV}$

IF PS:  $x = \frac{Q^2 - k_t^2 + m^2}{ys}$

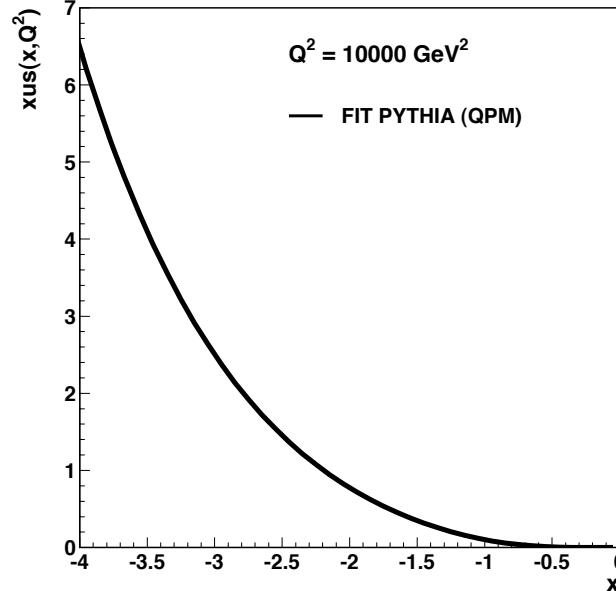
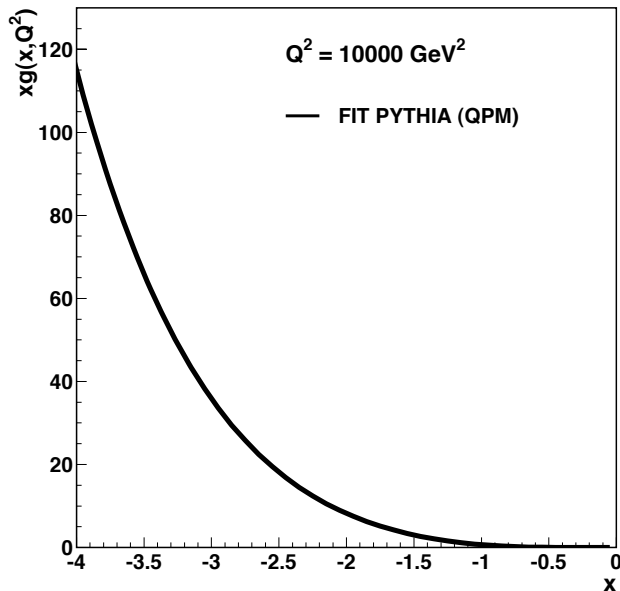
► Including parton showers in fit leads to changes in PDFs

# Results

fit: PYTHIA with  $p_t$ -ordered, initial and final state parton shower,  $P_5$  fixed

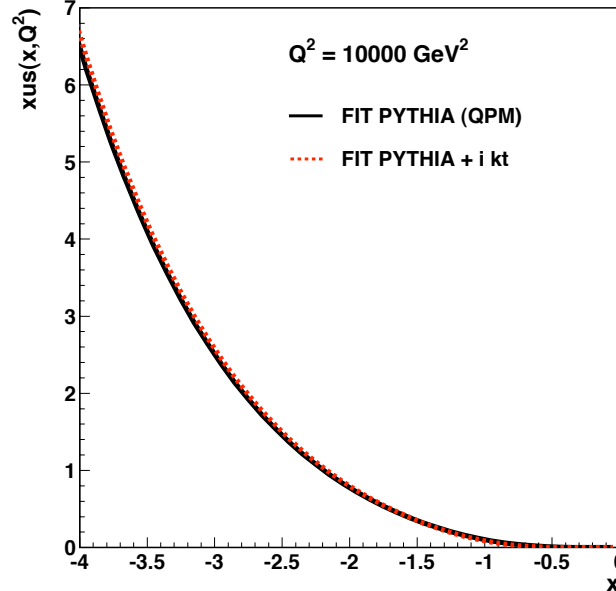
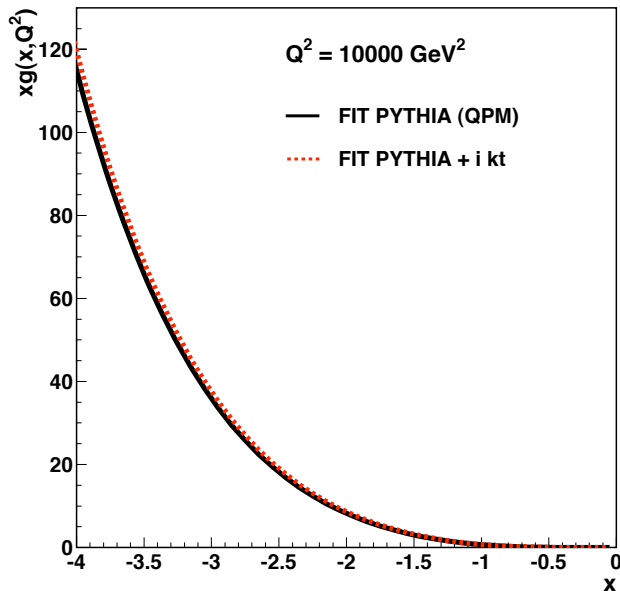
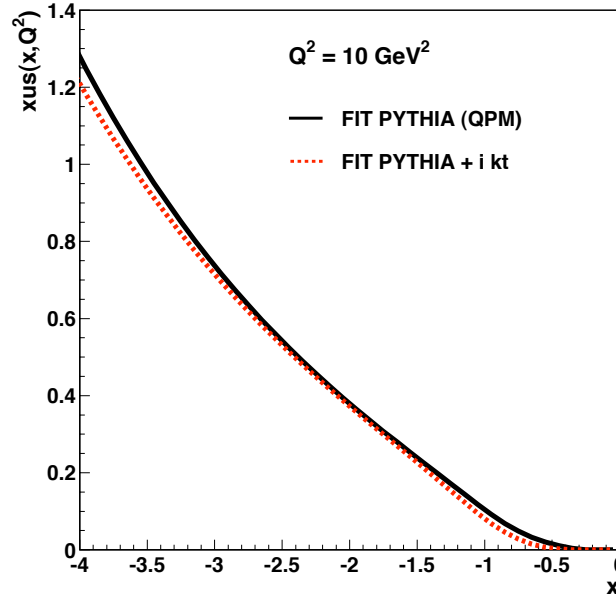
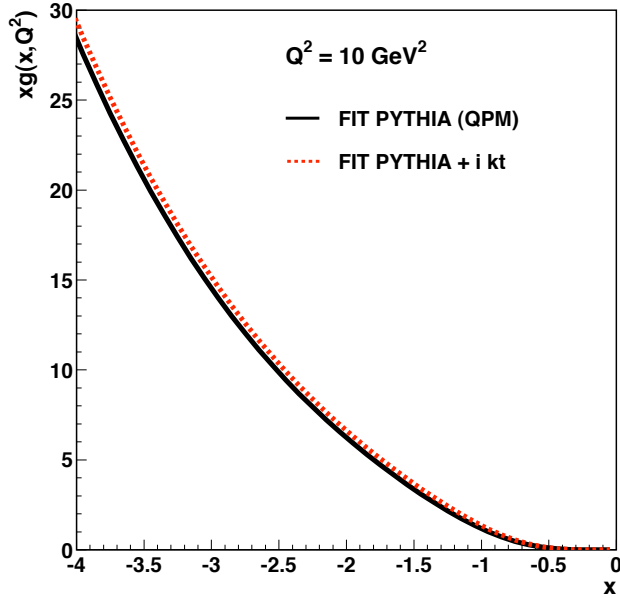


	$\chi^2/\text{ndf}$
QPM	1.13



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fit: PYTHIA with  $p_t$ -ordered, initial and final state parton shower,  $P_5$  fixed

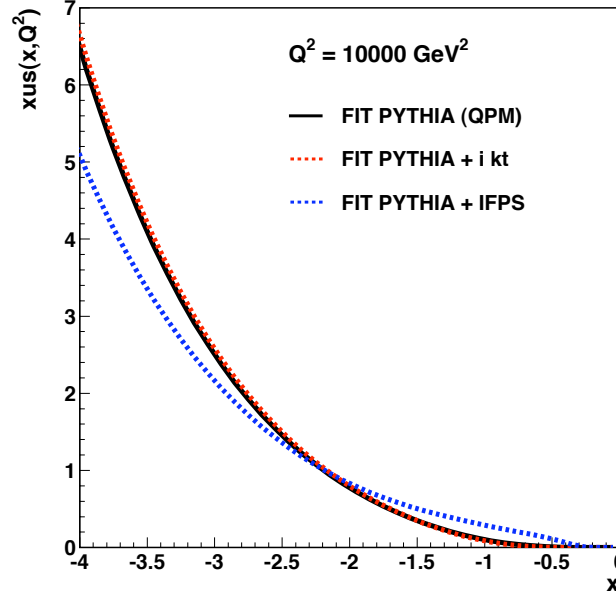
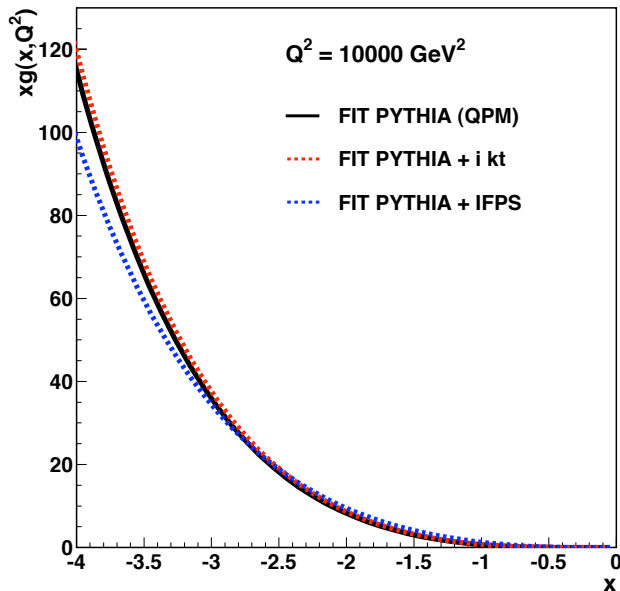
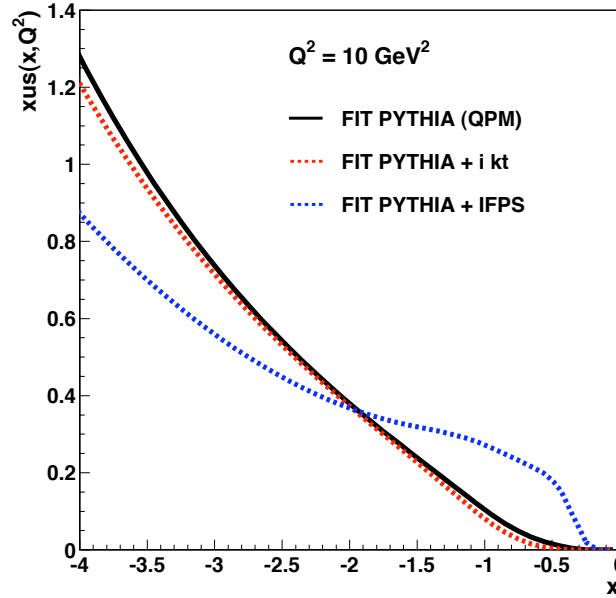
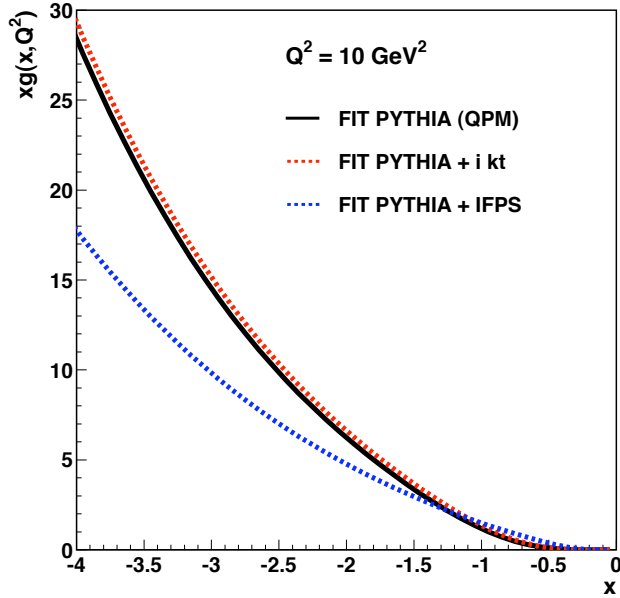


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# Results

fit: PYTHIA with  $p_t$ -ordered, initial and final state parton shower,  $P_5$  fixed



	$\chi^2/\text{ndf}$
QPM	1.13
int. $k_t$	1.40
IF PS	1.81

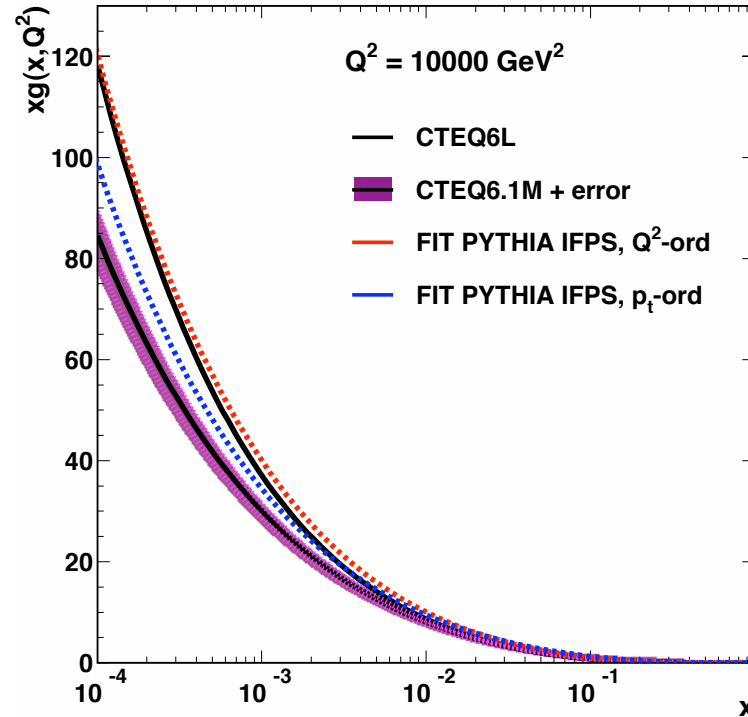
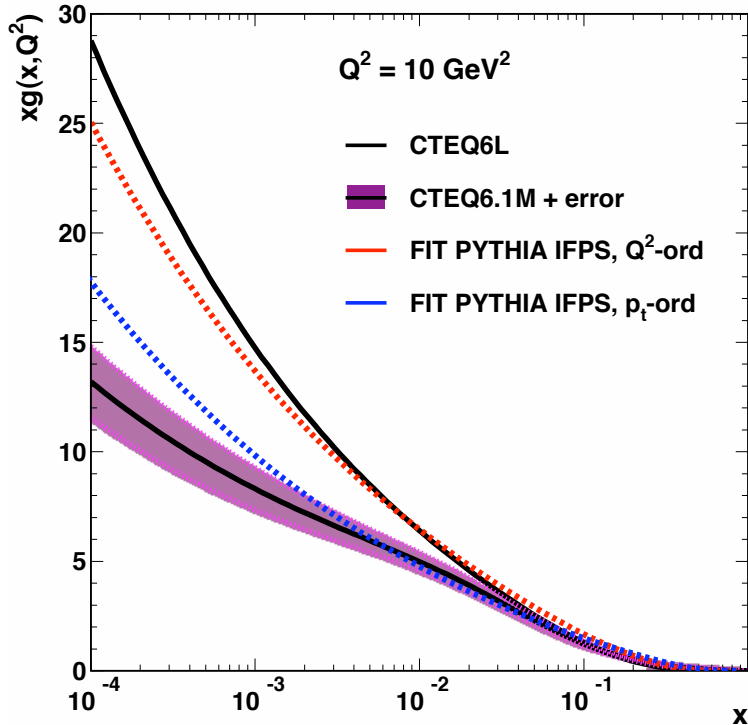
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► Different results for  $Q^2$ -ordered and  $p_t$ -ordered parton showers

# Results

$p_t$ - and  $Q^2$ -ordered p.s. in *PYTHIA* compared to CTEQ6L and 6.1M



► Kinematics push fitresult in direction of NLO PDFs



## Summary

- fitting of *RAPGAP* and *PYTHIA* QPM-predictions to inclusive DIS data leads to a PDF-parametrization consistent with CTEQ6L
- including parton showers in the *RAPGAP*-fit does not change the result
  - shows that  $Q^2$  and  $x$  in *RAPGAP* are indeed independent of parton showers
- including parton showers in the *PYTHIA*-fit leads to changes in PDFs
- different results for different ordering ( $Q^2$  and  $p_t$ ) of parton showers in *PYTHIA*



## Outlook

- including more datapoints, e.g. combined datasets of H1 and ZEUS, in the analysis
- first release of PDF-set in summer 2009 !





Thank you for your attention