# NNLO PDFs from HERA to LHC

(S.Alekhin, Protvino, Russia)

The NNLO PDFs are necessary for

- the precise studies at the LHC
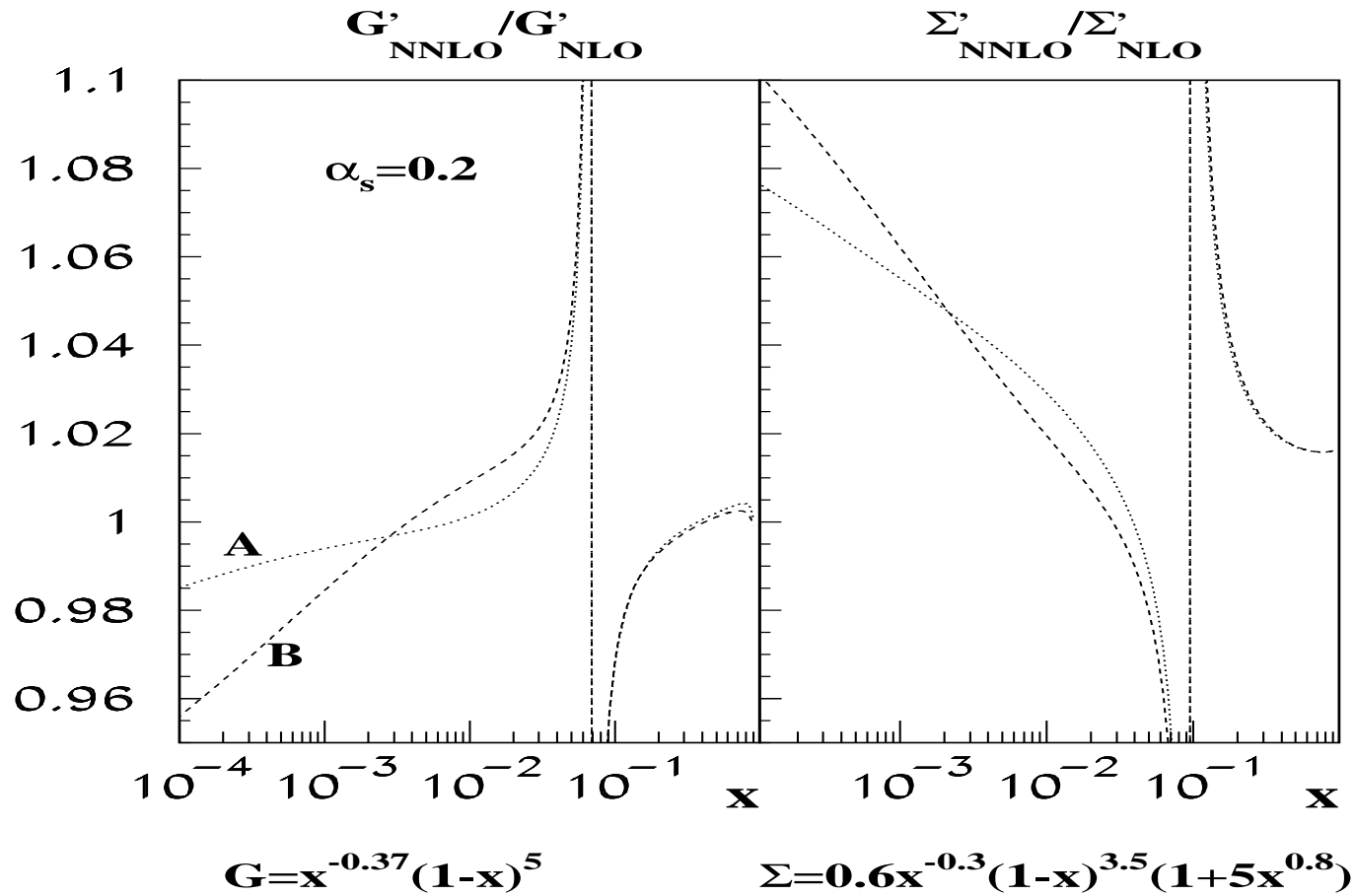
- the estimation of the soft background

Two NNLO PDFs sets are available

- MRST (from the global fit with account of the NNLO corrections to the DIS coefficient functions)

- S.A. (from the fit to the global DIS data)

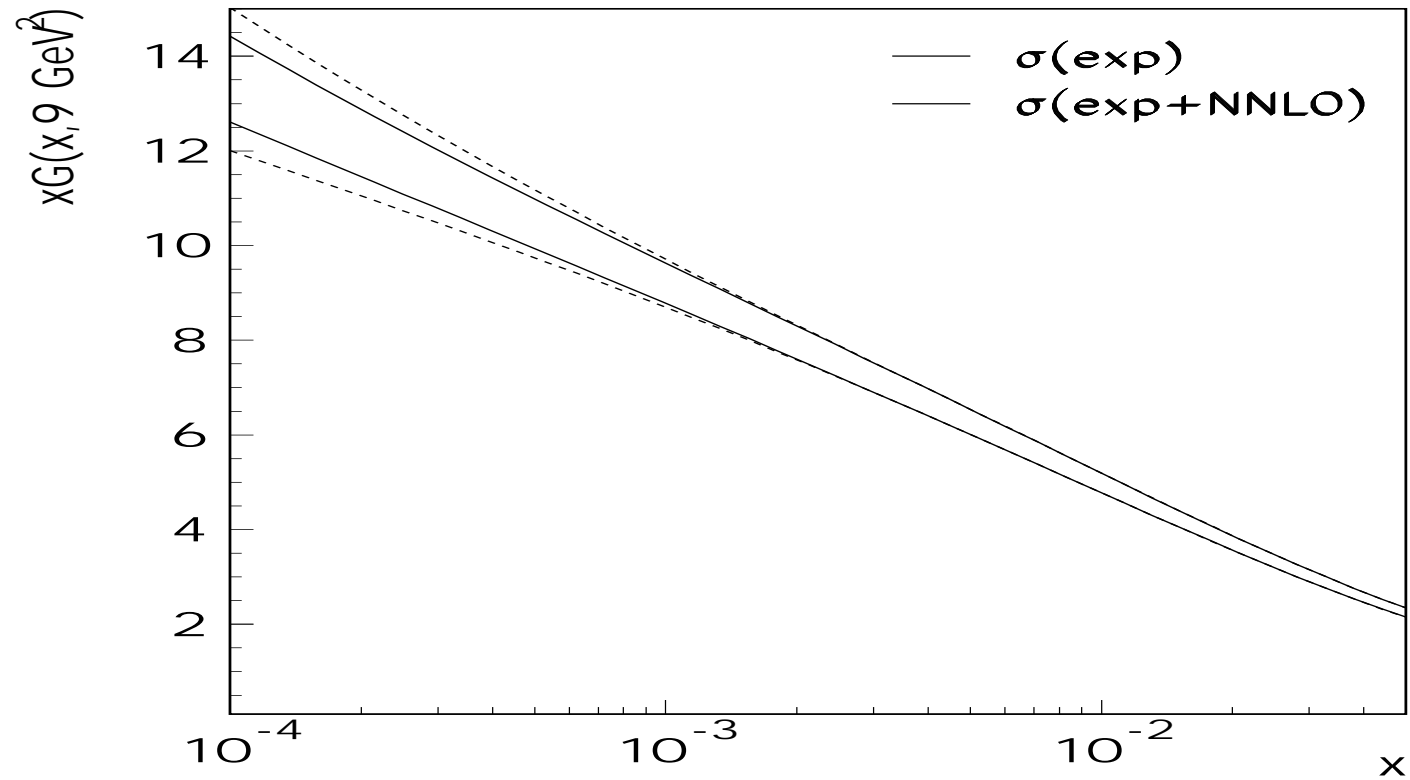Both sets obtained with the approximate NNLO evolution

# Uncertainty in the NNLO kernel
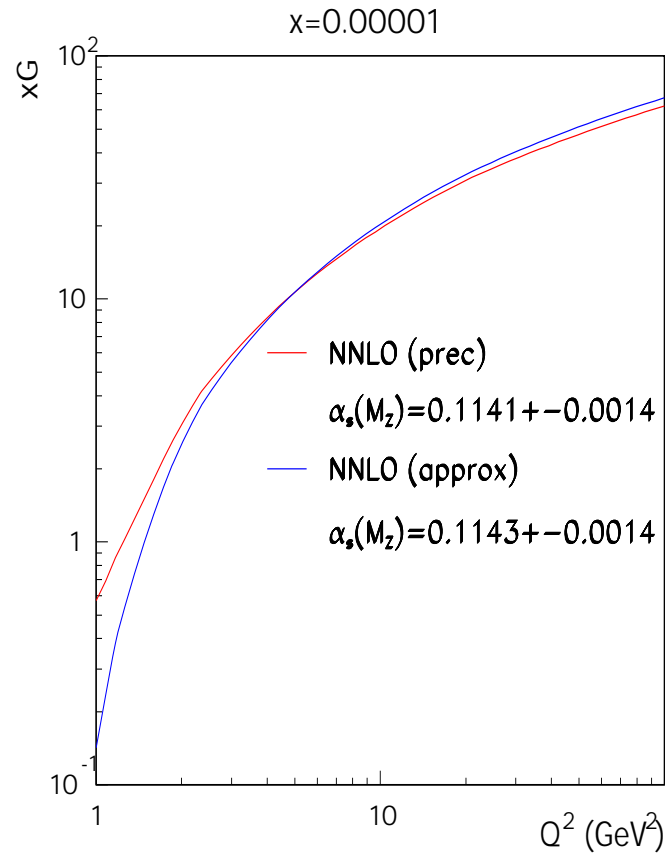
(van Neerven-Vogt 00)



$G'_{NNLO}/G'_{NLO}$

$\Sigma'_{NNLO}/\Sigma'_{NLO}$

$\alpha_s = 0.2$

A

B

$G = x^{-0.37}(1-x)^5$

$\Sigma = 0.6 x^{-0.3}(1-x)^{3.5}(1+5x^{0.8})$

# Uncertainty in the PDFs due to uncertainty in the NNLO kernel

# PDFs with the precise NNLO kernel

(Moch-Vermasseren-Vogt 04)



x=0.00001

NNLO (prec)
$\alpha_s(M_z)$=0.1141+−0.0014

NNLO (approx)
$\alpha_s(M_z)$=0.1143+−0.0014

xG axis, $Q^2$ (GeV$^2$) axis
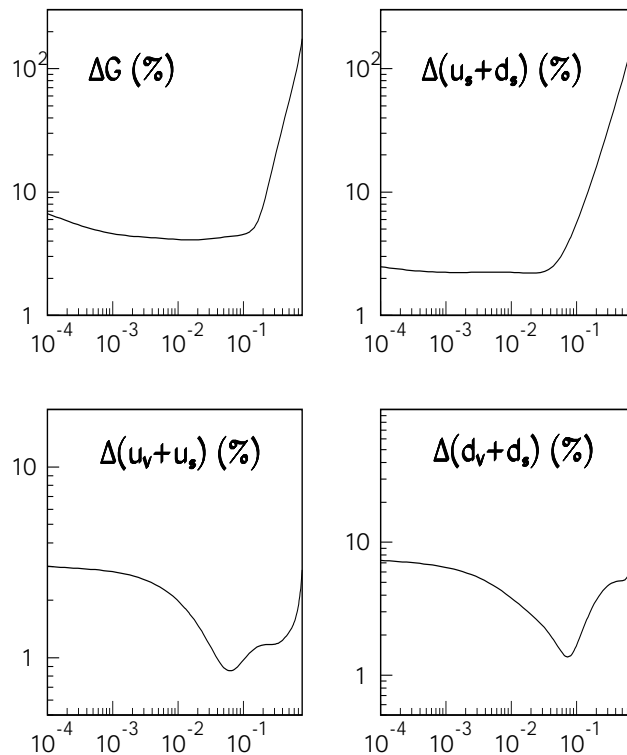
With the precise NNLO kernel gluon distribution increases at small $x/Q$; impact of the precise NNLO PDFs on the Higgs production c.s. is within few percent
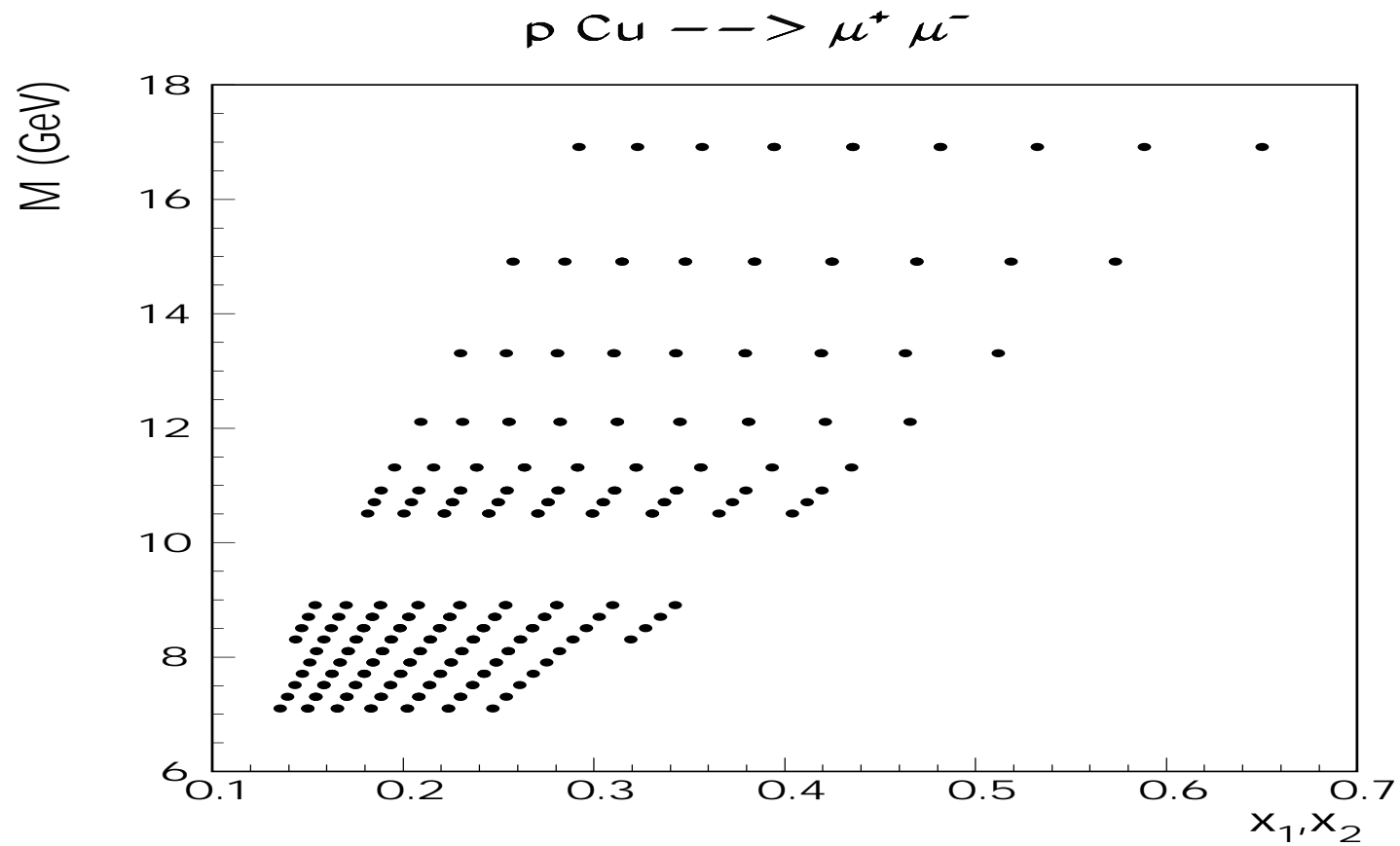
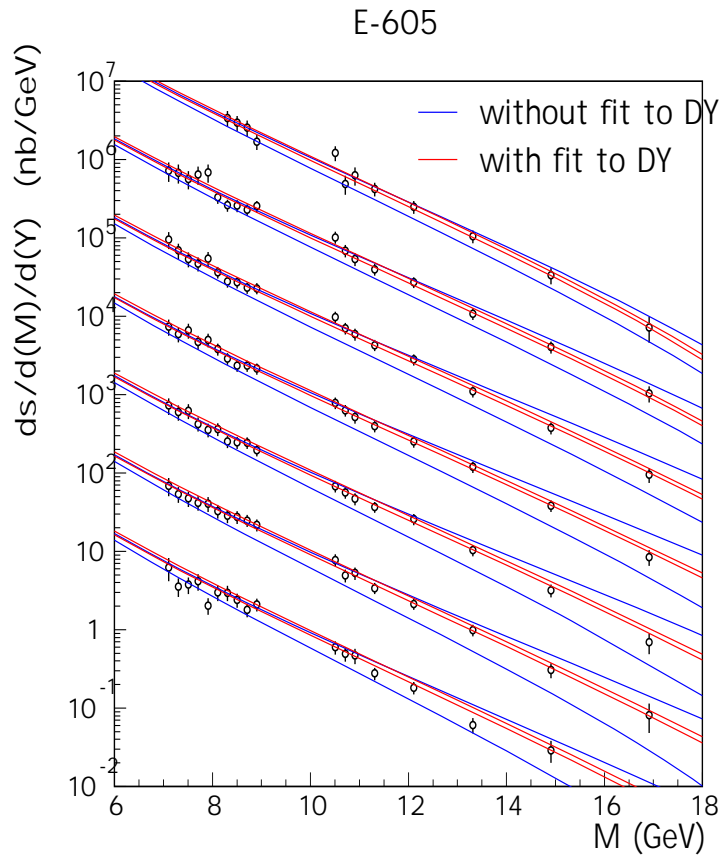# Errors in PDFs due to uncertainties in the data

A02



Sea at large x can be improved using the Drell-Yan data and the gluons at large x can be improved using the 2-jet data

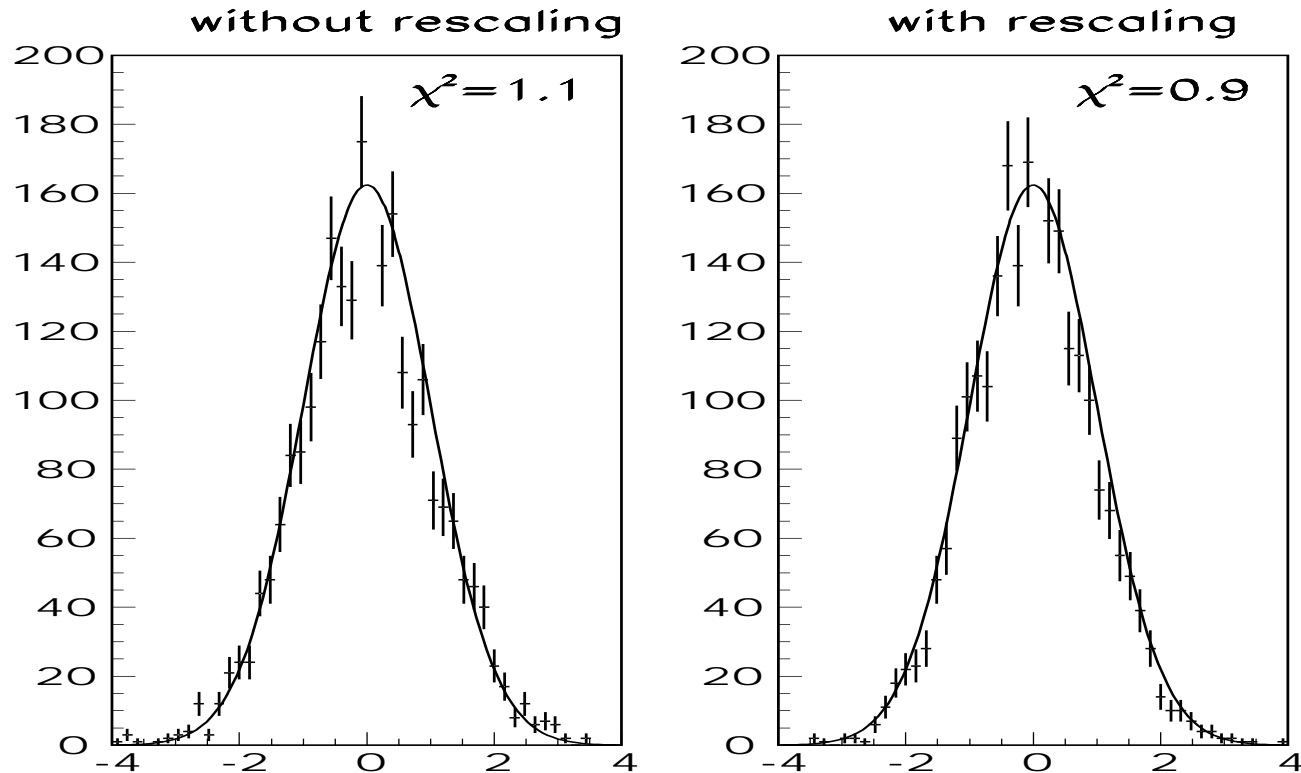# Kinematics of the E-605 experiment



p Cu --> $\mu^+$ $\mu^-$
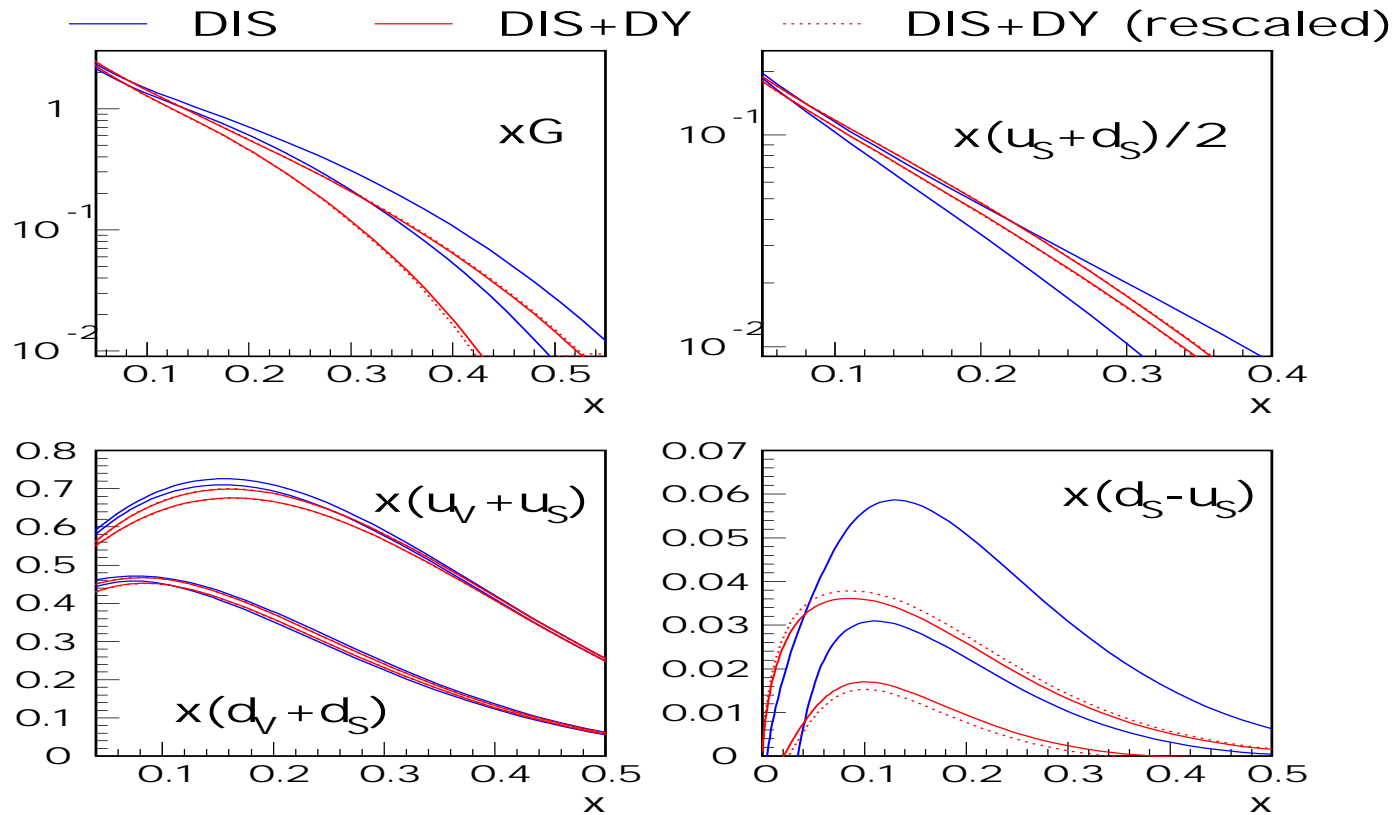
# NNLO fit using a code by Anastasiou-Dixon-Melnikov-Petriello



New fit is within the error bands of the previous fit: determination of the errors is not inconsistent

# Quality of the fit



**without rescaling**

$\chi^2 = 1.1$

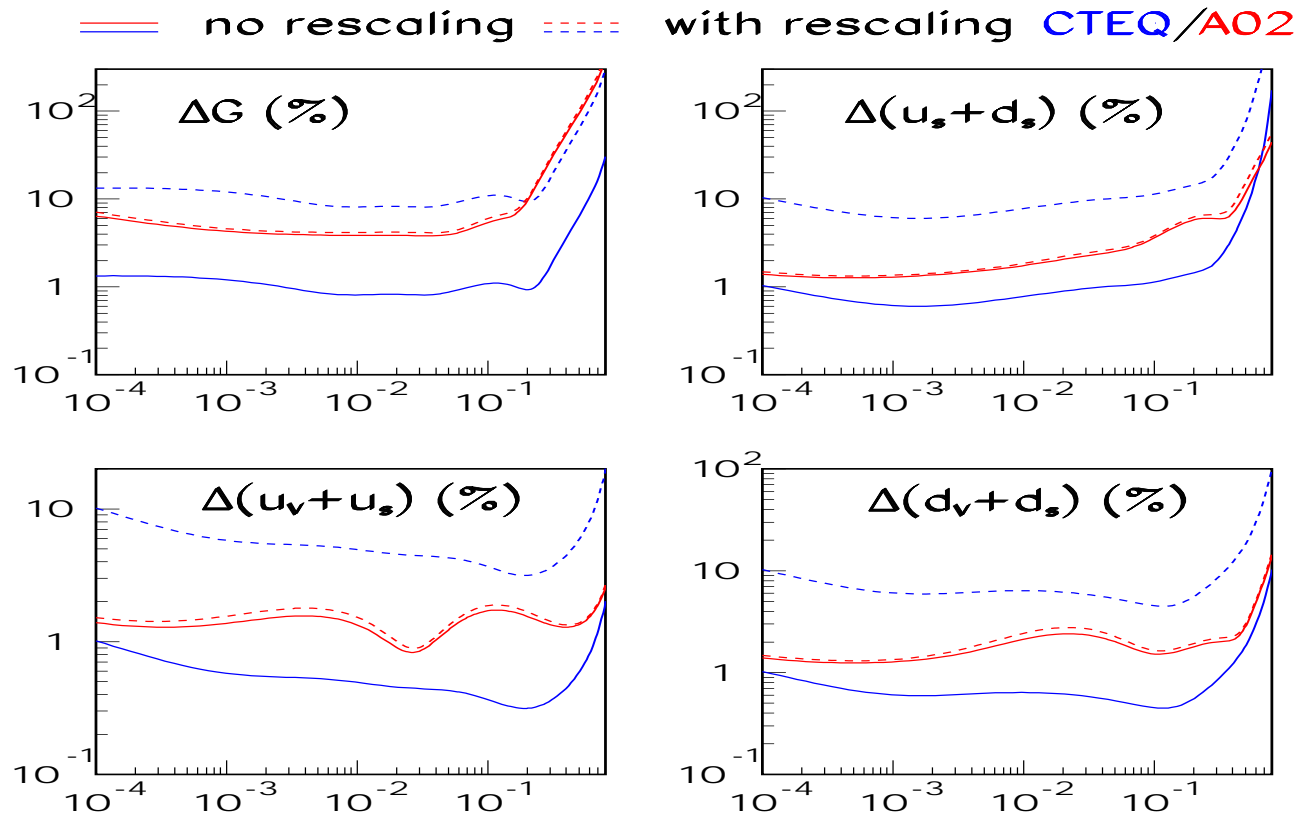**with rescaling**

$\chi^2 = 0.9$

For the experiments with $\chi^2 > 1$ the errors in data were rescaled in order to get $\chi^2 = 1$ (maximal factor is 1.2).

# Impact of the DY data on the PDFs

# Impact of the rescaling on the PDFs errors

# Conclusions&Outlook

- From the E-605 DY data combined with the global DIS data we can gain precision of the the NNLO non-strange sea determination better than 40% up to $x < 0.8$; more input (E-866 data, $W/Z$ distributions) will improve this further.

- The most important "uncertainty" in the PDFs is due to selection the up-value of $\chi^2$ (100 for CTEQ, 50 for MRTS, 1 from the probability theory). Extensive benchmarking of the used procedures is necessary.

- The missing ingredient for the improvement of the gluons at large $x$ are the NNLO corrections to the jet production in hadronic collisions.