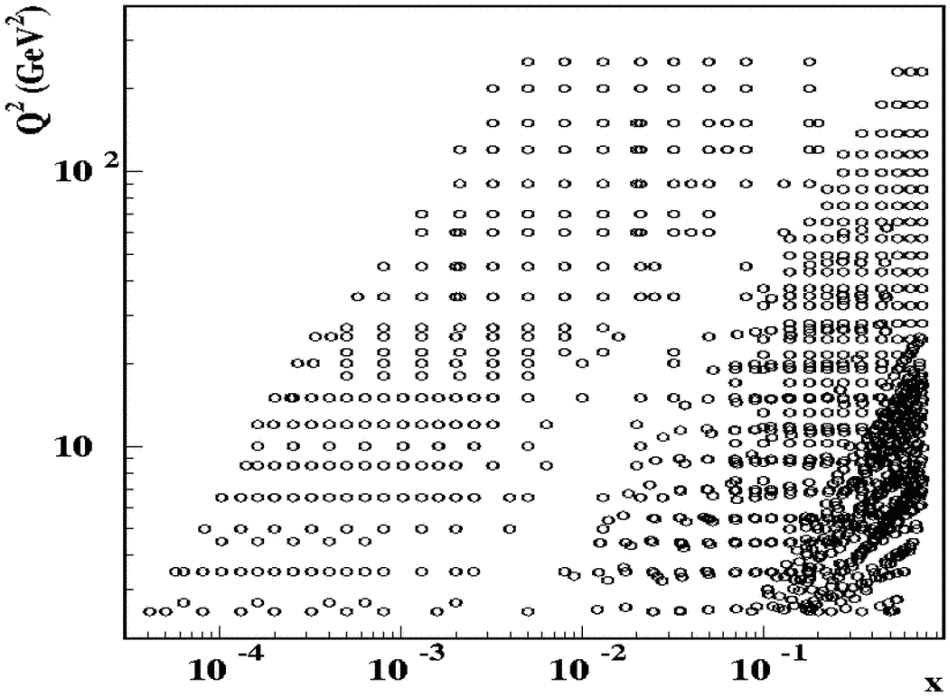
PDFs from the DIS data

- DIS is clean process (the high order QCD corrections are relatively small, other theoretical errors are under control)
- experimental errors in existing data are well studied and supplied by the complete description of the experimental errors including correlations (comprehensive propagation of the errors in PDFs)
- it allows to check the universality of PDFs confronting to data for other processes (in particular, for the searches of new physics)

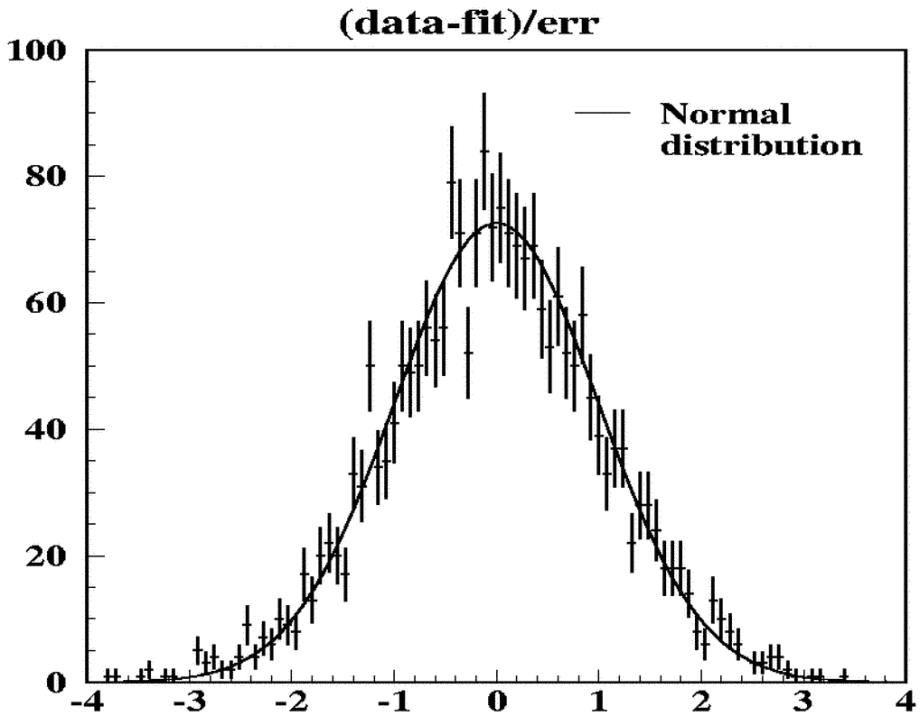
Kinematics

(SLAC-BCDMS-NMC-H1-ZEUS)



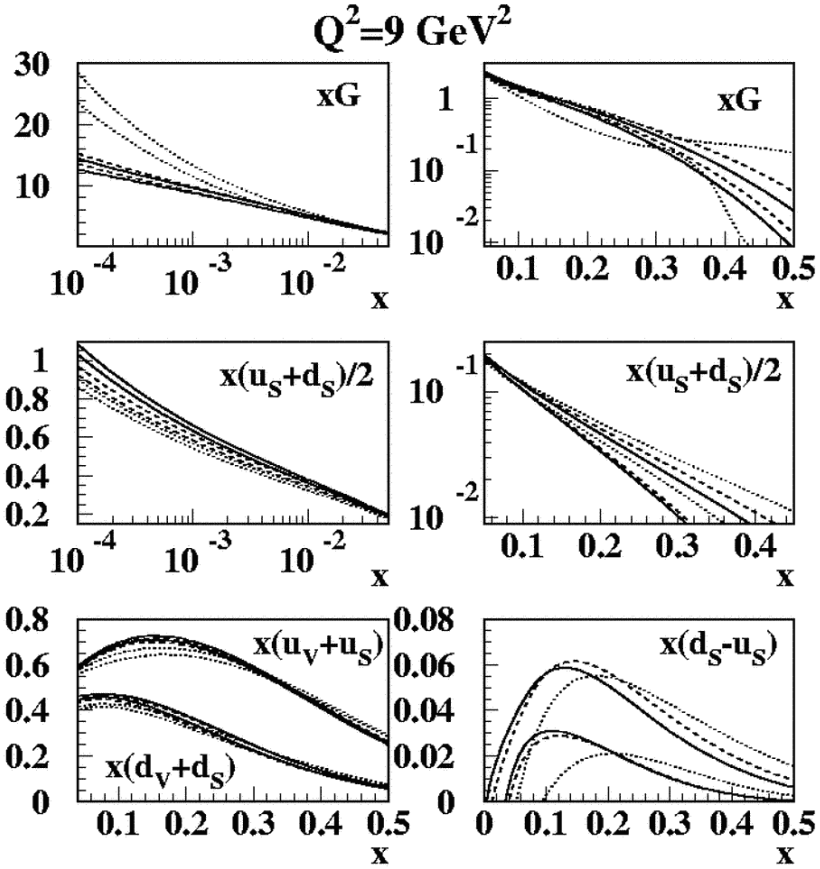
Account of the target mass correction and dynamical high-twist terms allows to include data with low W; account of the Fermi motion correction allows to add deuteron data.

Quality of the fit



Good χ^2 allows rigorous estimation of the confidence levels ($\Delta\chi^2 = 1$).

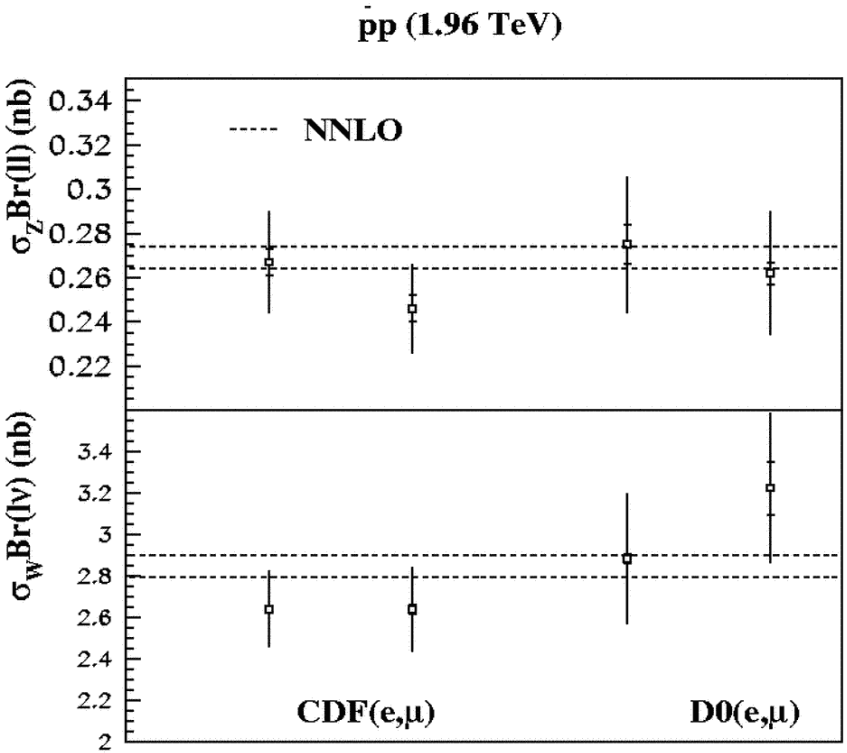
Perturbative stability of PDFs



The change of the PDFs from NLO to NNLO is generally smaller than their experimental errors

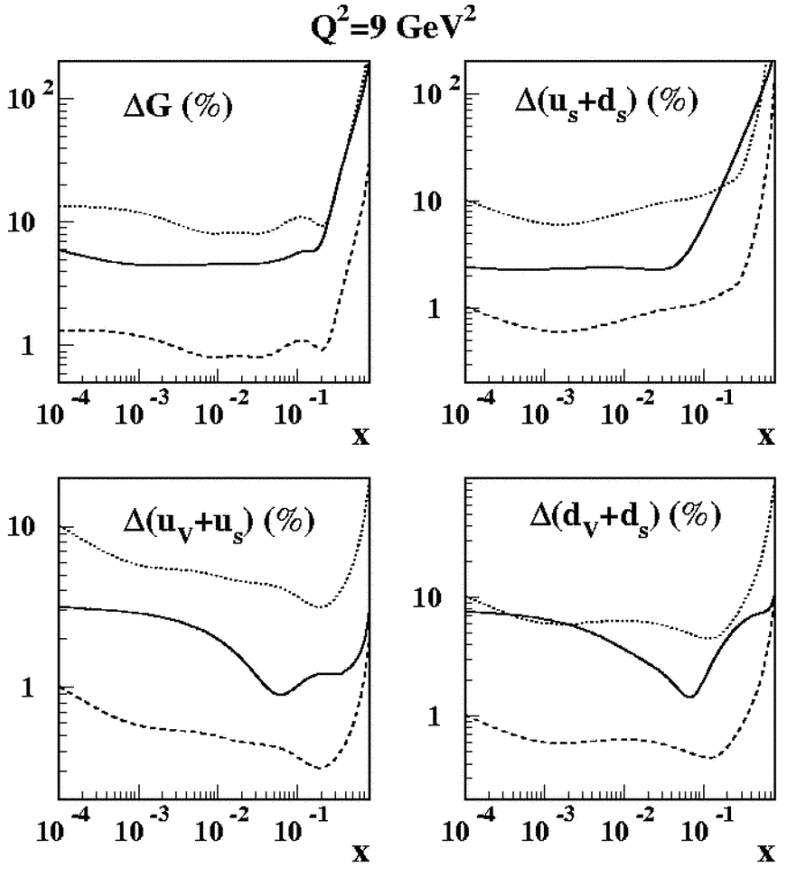
Benchmark of the W/Z rates

(Hamberg-Matsuura-van Neerven 91)
(Harlander-Kilgore 02)



pp (14 TeV)
$\sigma_Z = 60.0 \pm 1.9(\text{PDFs})$ nb
$\sigma_W = 204.6 \pm 6.4(\text{PDFs})$ nb

Comparison to the global fit



Full: A02
Dots: CTEQ6
Dashes: CTEQ6 without tolerance factor (=10)

Two variants of conclusion

- Addition of more data is useless if you do not control additional sources of theoretical errors
- In the CTEQ analysis the errors are underestimated due to omitting of the normalization errors of experiment

Covariance matrix estimator:

$$y_i = (t_i + \mu_i\sigma_i)(1 + \lambda\eta_i) \approx t_i + \mu_i\sigma_i + \lambda\eta_i t_i$$

$$\chi^2(\theta) = \sum_{i,j=1}^{N} (f_i(\theta) - y_i)C_{ij}^{-1}(f_j(\theta) - y_j)$$

$$C_{ij} = \eta_i\eta_j t_i t_j + \delta_{ij}\sigma_i\sigma_j$$

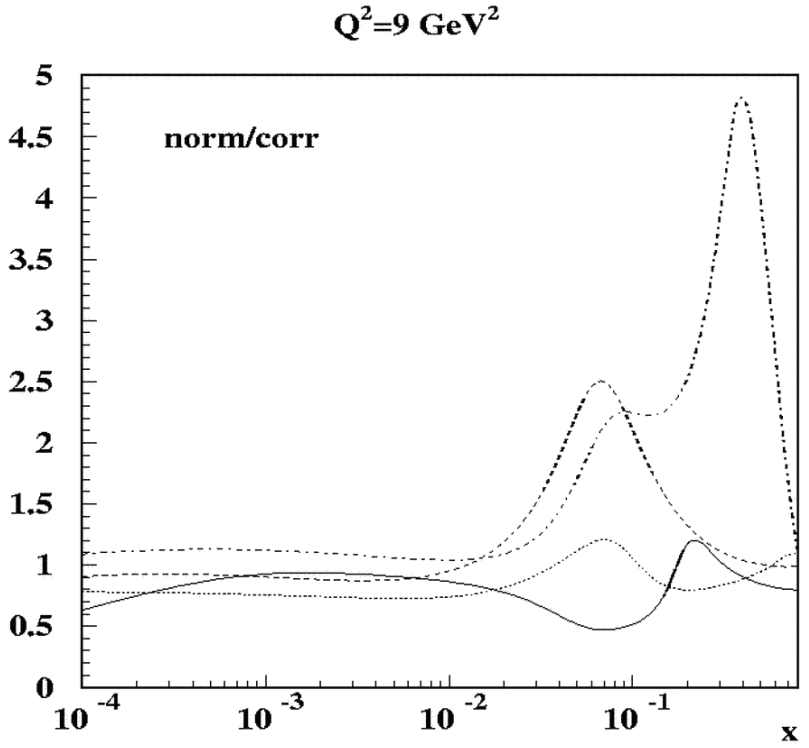
The dispersion of average residual

$$R = \frac{1}{N}\sum_{i=1}^{N} \frac{f_i - y_i}{\sqrt{\sigma_i^2 + s_i^2}}.$$

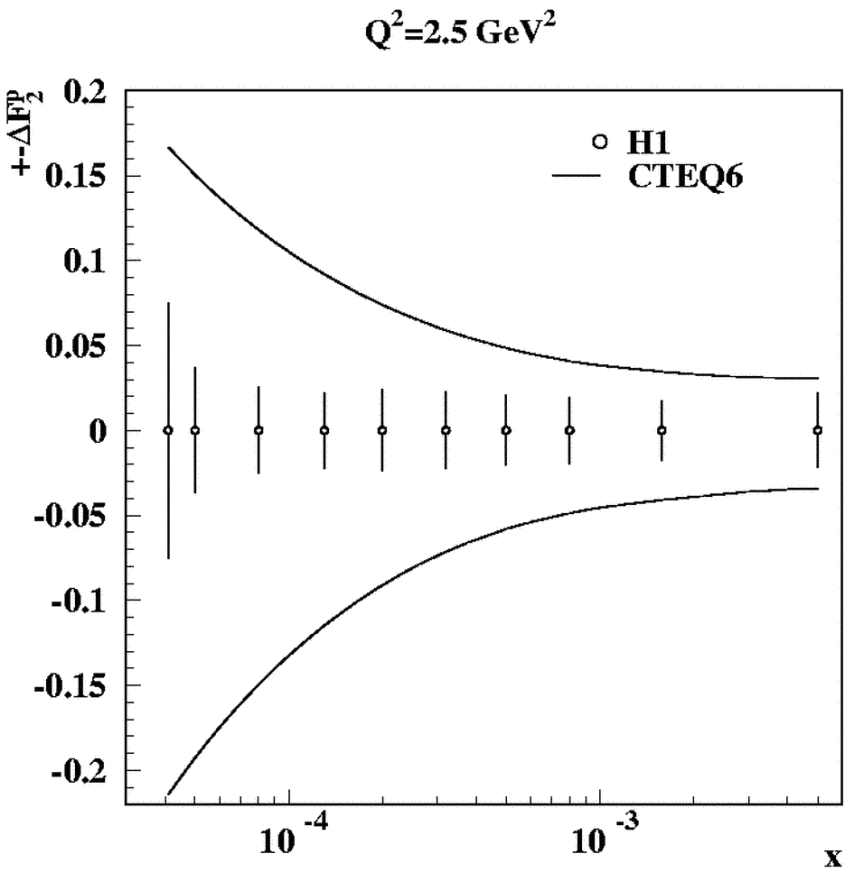
is $\sim 1/N$ for the uncorrelated measurements and 1 for the perfectly correlated ones.

Impact of the normalization errors

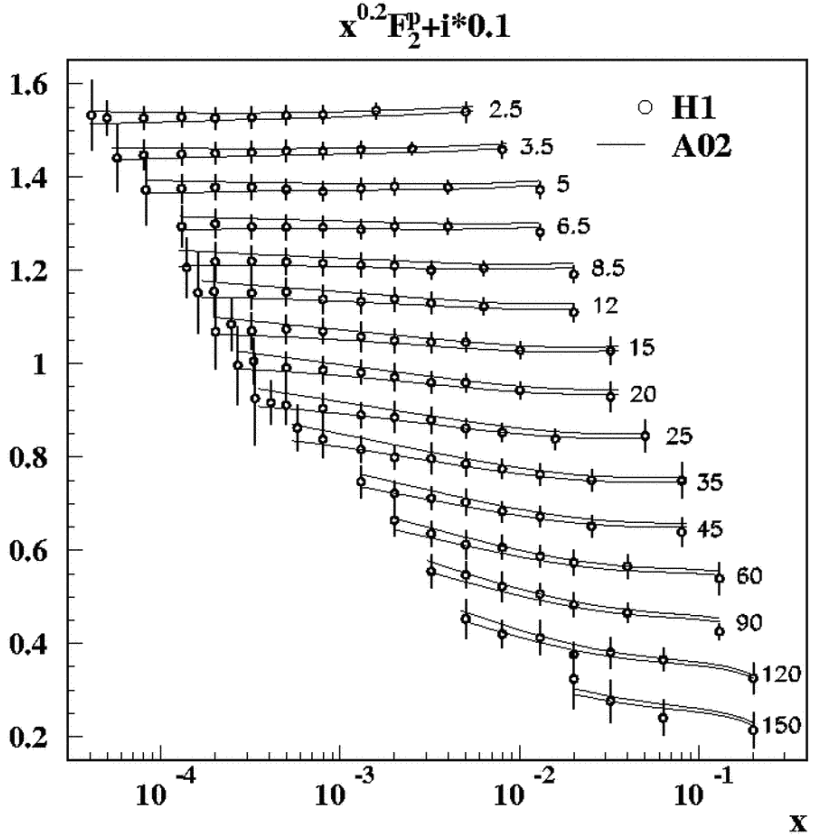
Experiment	NDP	ΔR with norm. err.	ΔR with
SLAC-E-140	26	0.86	
BCDMS	605	0.68	
H1(96-97)	135	0.55	
ZEUS(96-97)	161	0.64	



Efficiency of the estimator



Tolerance factor makes the estimator inefficient



Outlook

- The thorough benchmark of the various codes. This work was initiated at Les Houches workshop 2001, but was not accomplished. Hopefully this workshop can continue this task.
- Quantification/suppression of the errors due to higher-order corrections to the hadron-hadron processes (DY is ready, jets will require NNLO calculations).
- Constraint PDFs with the precision of O(1%) up to large x, better separation of the flavors (LHC, νFactory).