

Extraction of PDFs from DIS and DY data

(S.Alekhin, Protvino, Russia)

What do we know from the charged-leptons DIS?

- Gluons and sea at $x = 10^{-5} \div 0.2$ (**HERA+NMC**)
- Valence quarks at $x < 0.8$ (**SLAC+BCDMS**)

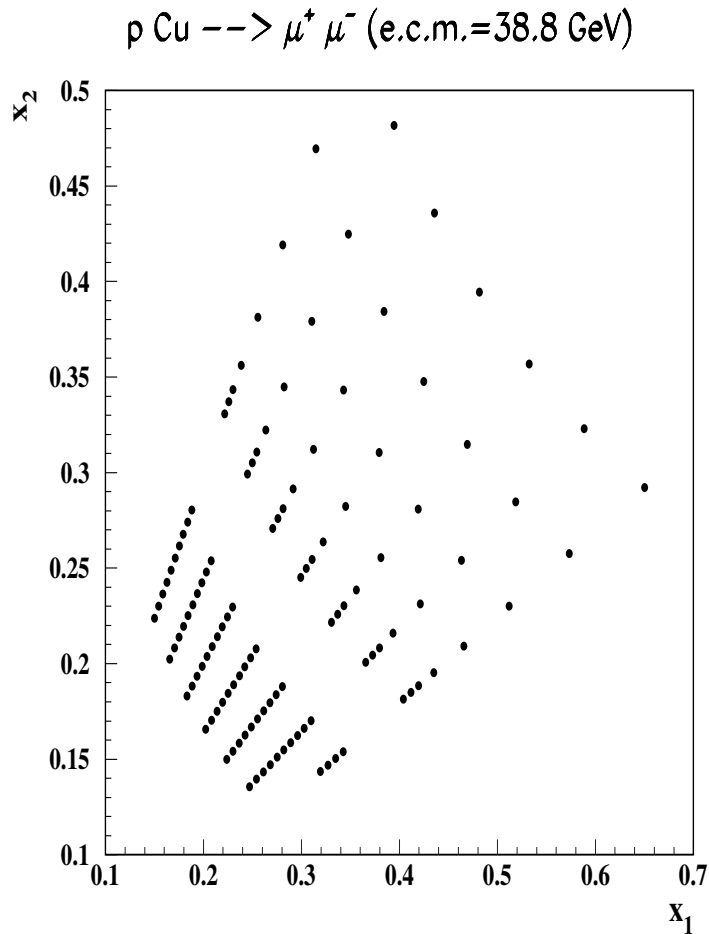
What we do not know from the charged-leptons DIS?

- Gluons at $x > 0.2$ (**jets: CDF/D0/H1/ZEUS**)
- Sea at $x > 0.2$ including $\bar{d} - \bar{u}$ (**Drell-Yan: E605/E866**)
- Strange sea (νN : **NuTeV/CHORUS/NOMAD**)

Addressed issues

- What is impact of the existing Drell-Yan data? (qualitative estimate and low limit on the errors in PDFs after new data will be added)
- Are the existing Drell-Yan data consistent with the DIS ones? (what is relevant value of $\Delta\chi^2$)
- Result of combination of the Drell-Yan and DIS data

Impact of the E605 data on PDFs



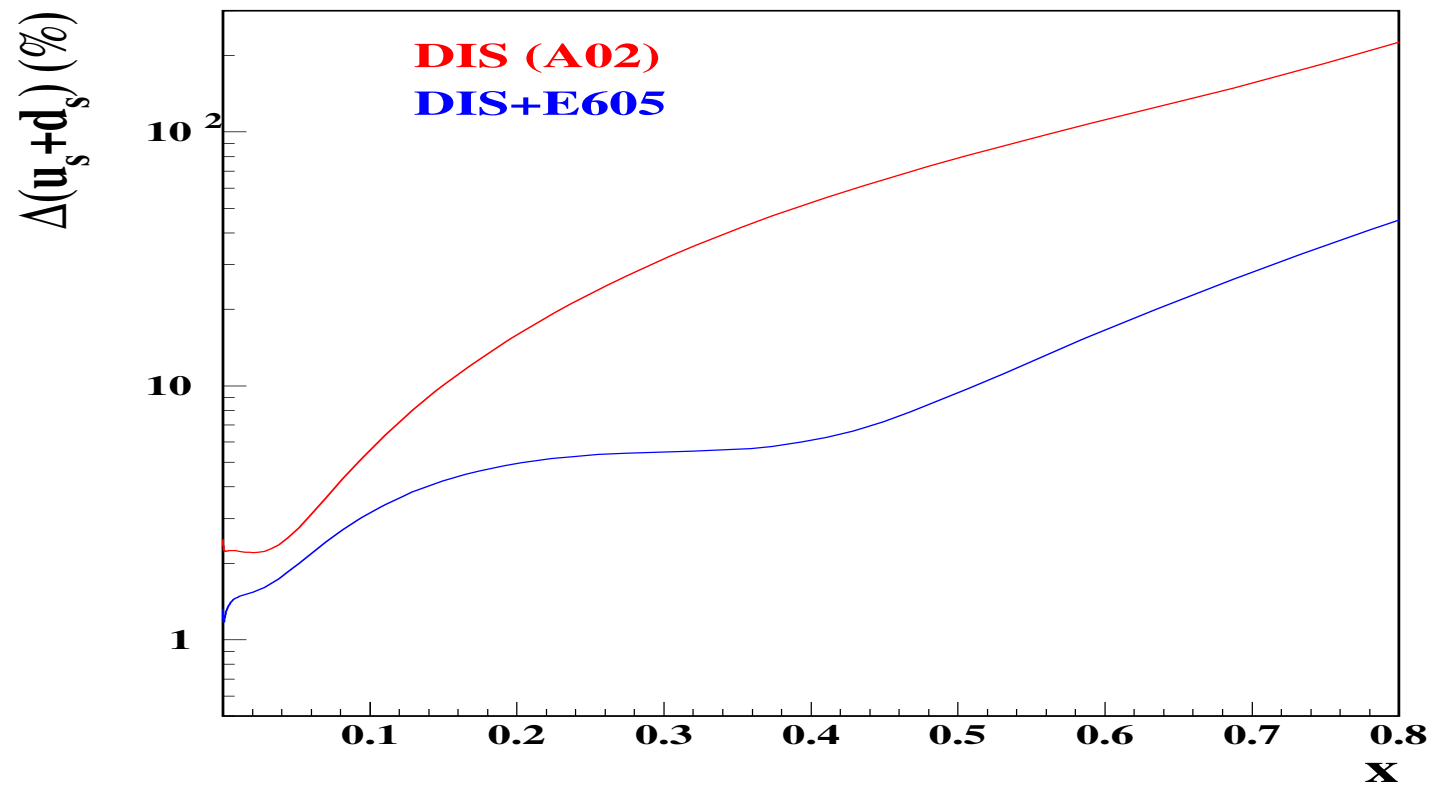
$$\sigma_{\text{DY}} \sim q(x_1)\bar{q}(x_2) + q(x_2)\bar{q}(x_1)$$

From the DY data $\Delta\sigma_{\text{DY}} \lesssim 20\%$

From the DIS fit $\Delta q \sim O(1\%)$

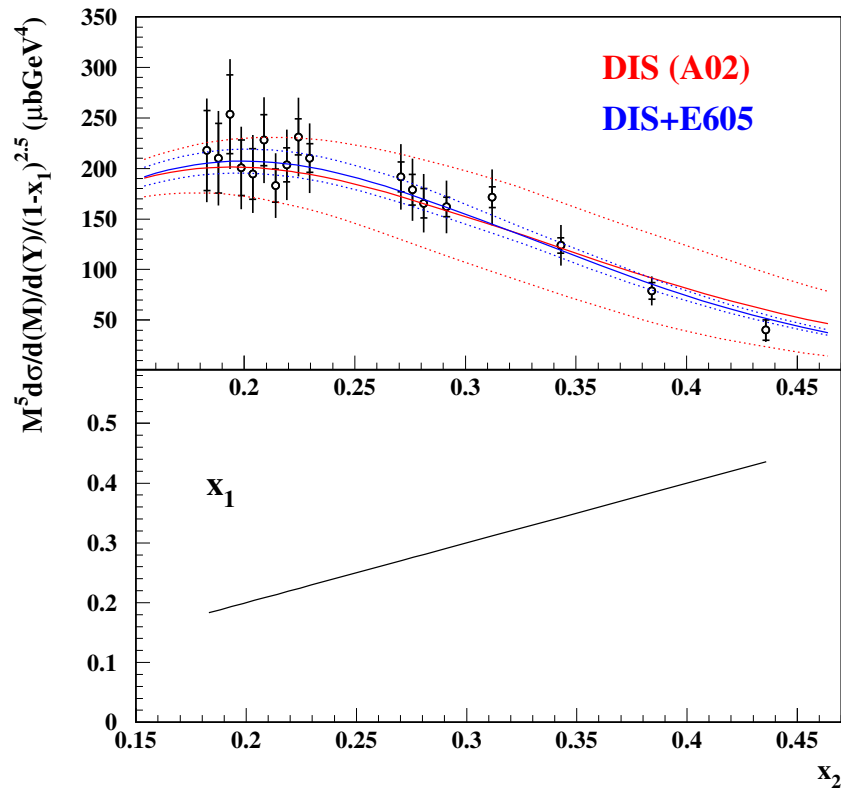
From the DIS+DY combination
 $\Delta\bar{q} \lesssim 20\%$ at $x \lesssim 0.6$

$Q^2=9 \text{ GeV}^2$



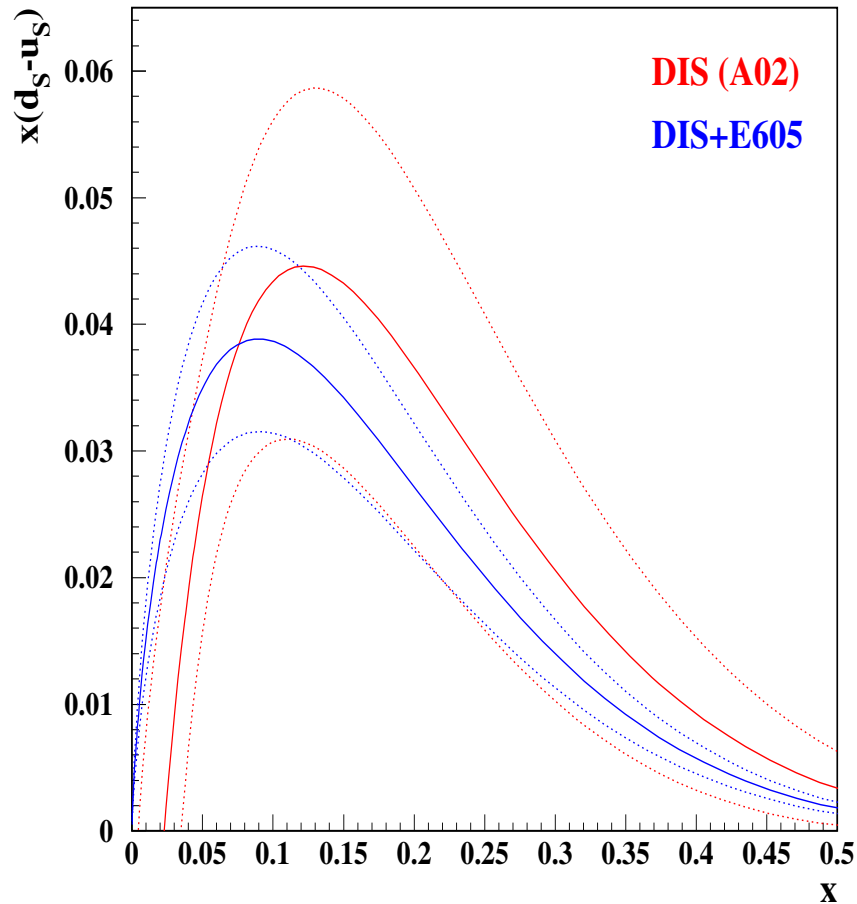
We do observe suppression of the error in sea up to 20% at $x \sim 0.6$

E-605 (Y=0.0)



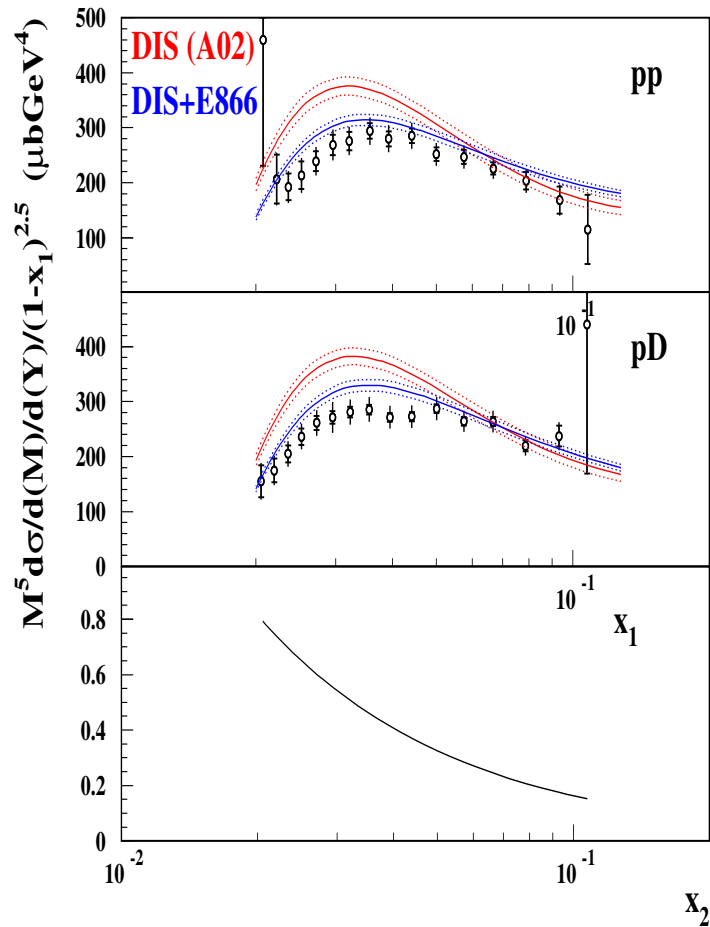
The overall consistency of the E605 and DIS data is good: The DY data are well within the bands of the DIS fit.

$Q^2=9 \text{ GeV}^2$



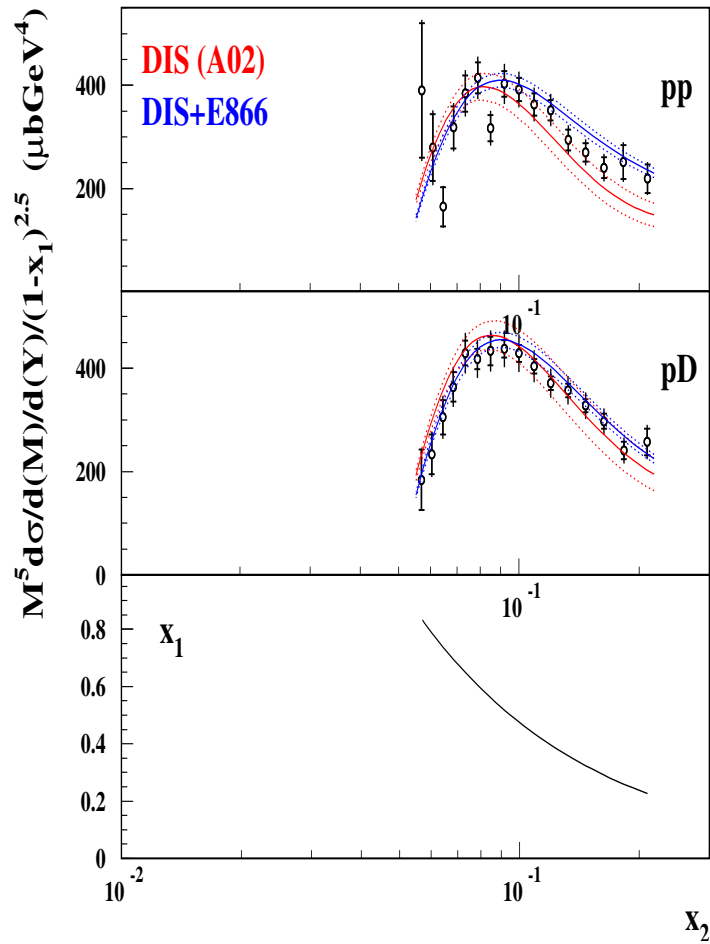
In the DIS+E605 fit the error in isospin asymmetry is improved marginally due to the E605 target is nearly isoscalar. The proton-proton DY data are necessary to constraint $(\bar{d} - \bar{u})$.

E866 (M= 4.95 GeV)



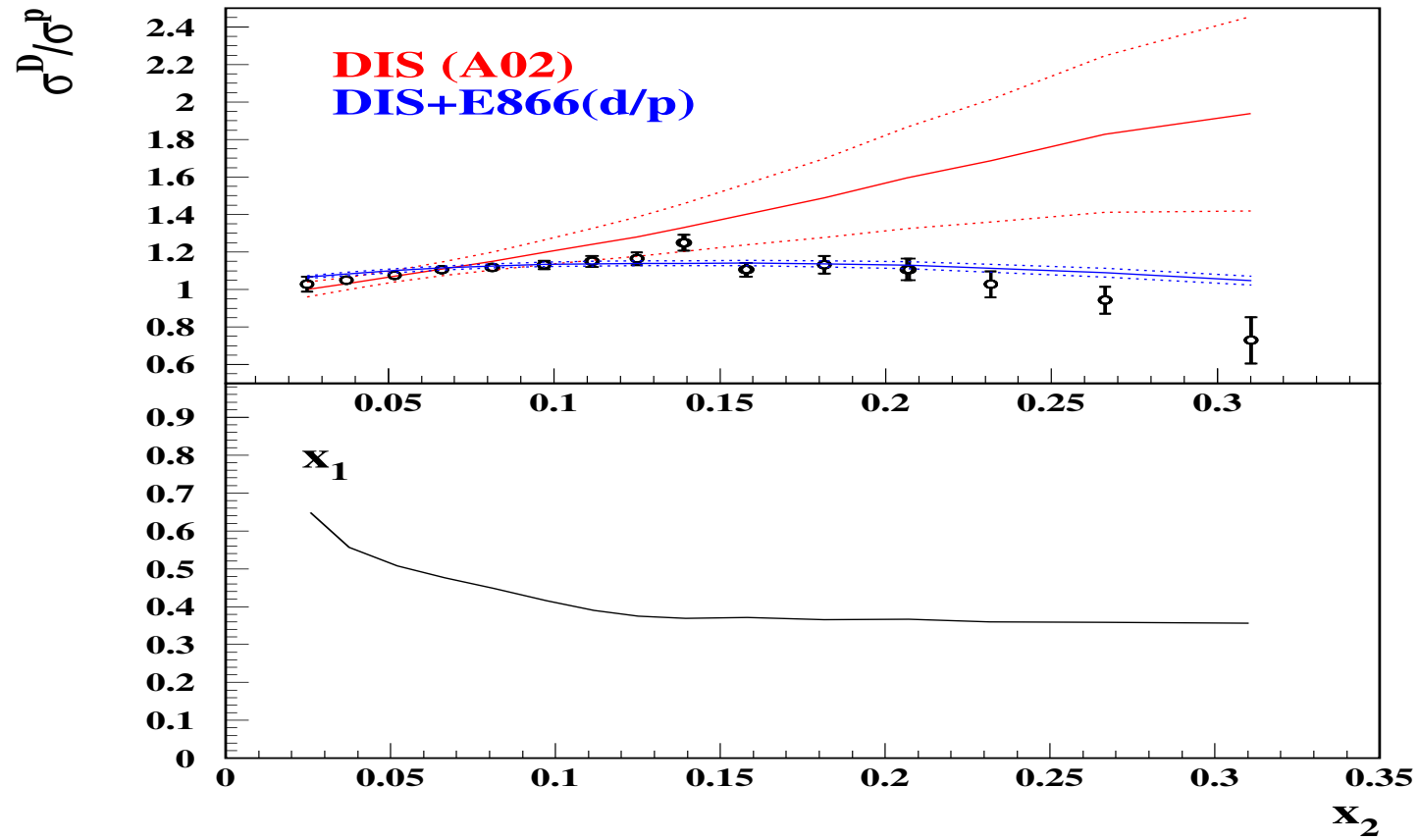
At low-M/high-y the E866 data are in disagreement to the DIS ones; precision of the DIS predictions for the DY cross section is comparable to the precision of the DY data ($\sigma_{\text{DY}} \sim q(x_1)\bar{q}(x_2)$, while $\Delta q(x_1), \Delta \bar{q}(x_2) \sim O(1\%)$ from DIS).

E866 (M= 8.45 GeV)



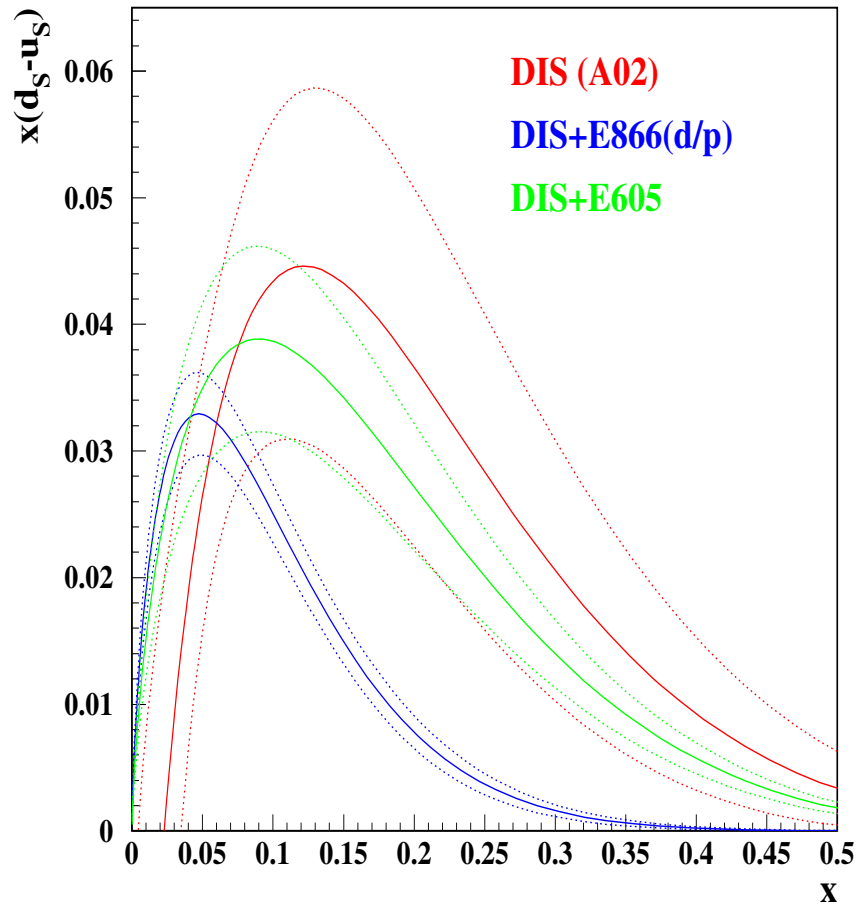
At high-M/high-y the E866 data are in better agreement to the DIS ones.

E866 (2001)



For the deuteron/proton ratio disagreement at large y vanishes

$Q^2=9 \text{ GeV}^2$



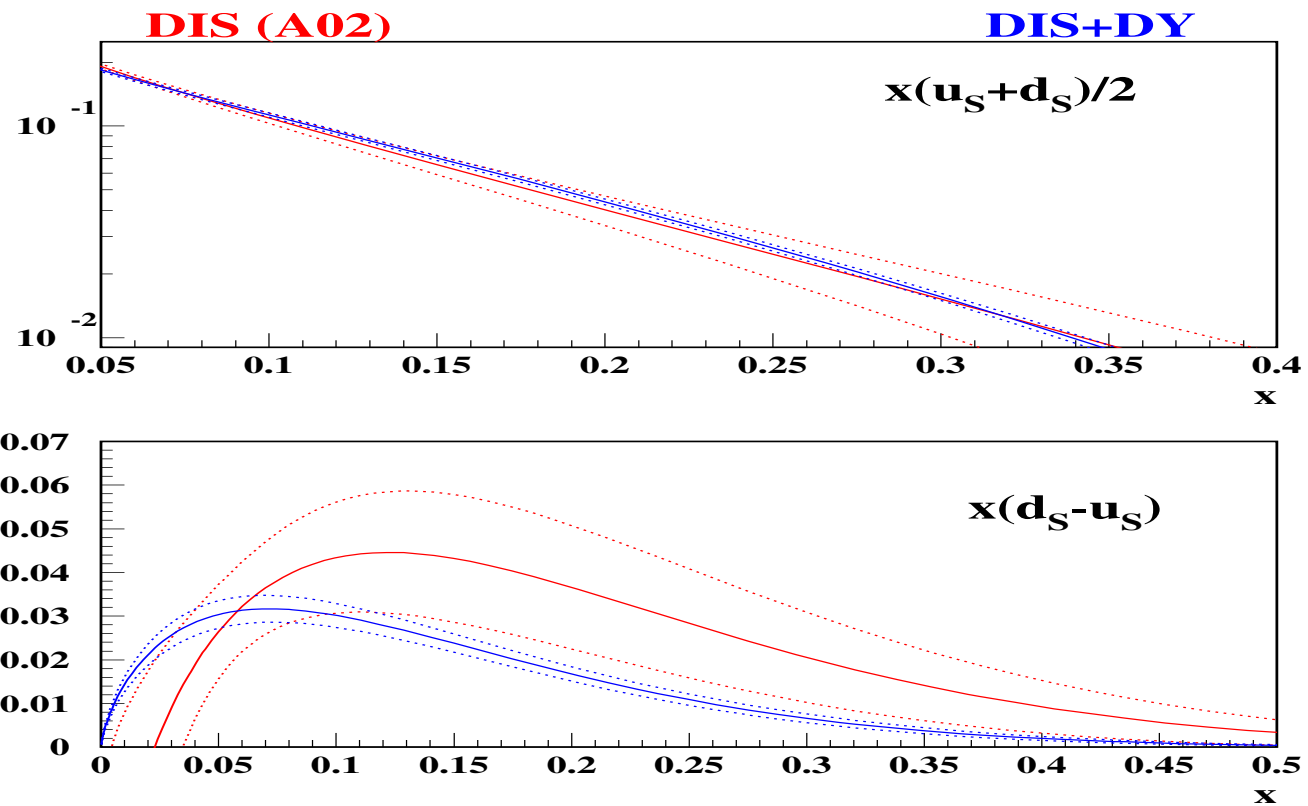
The remaining disagreement between the DIS, E605, and E866(d/p) data is not dramatic, at the level of $\sim 2\sigma$.

Intermediate summary

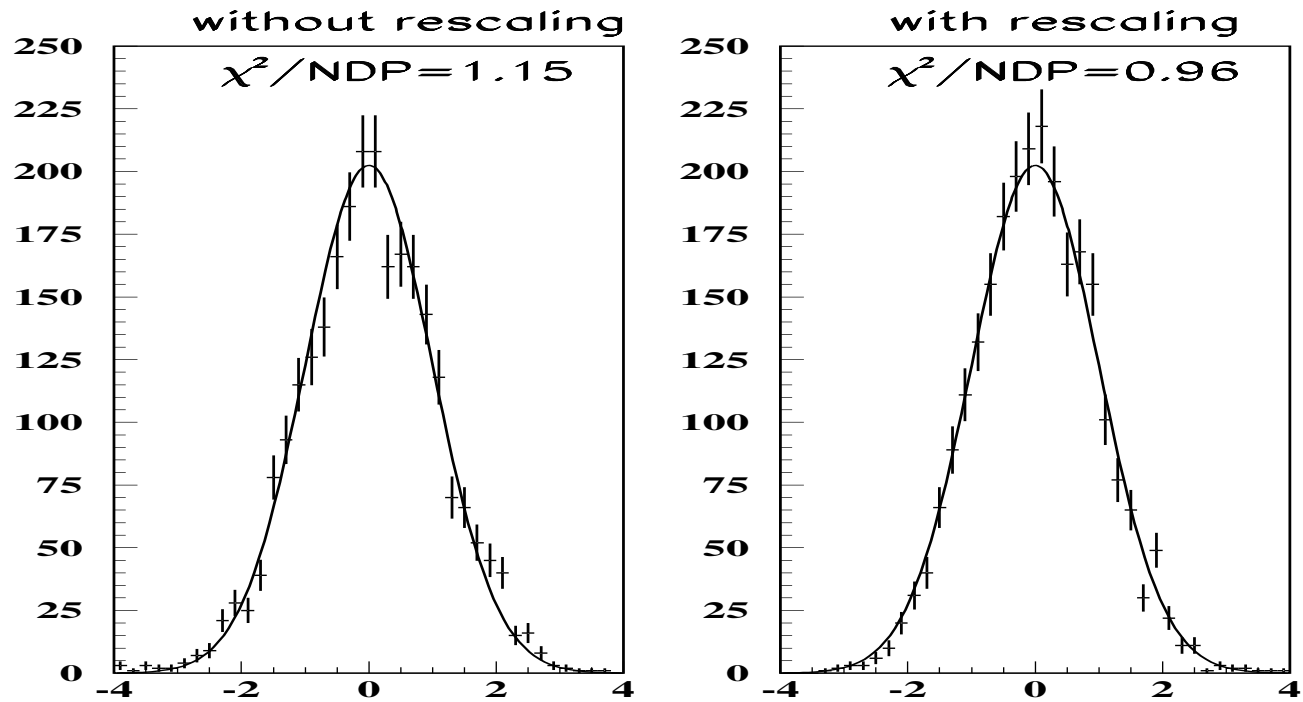
The Drell-Yan data are in certain disagreement with the DIS ones, for now the only possibility to use them in the combined fit is to take the E605 data (isoscalar) and the E866 data for d/p ratio.

Fit of PDFs to the combined DY/DIS data

- World charged leptons proton/deuteron DIS data with $Q^2 = 2.5 \div 300 \text{ GeV}^2$, $x = 10^{-5} \div 0.9$, $W > 1.8 \text{ GeV}$ combined with the E605 and E866(d/p) data
- Full account of the NNLO QCD corrections (exact NNLO evolution kernels by Moch-Vermaseren-Vogt and the DY NNLO coefficient functions by Anastasiou-Dixon-Melnikov-Petriello)
- The FFN scheme with $N_F = 3$ and account of the heavy quarks contributions up to $O(\alpha_s^2)$ by Laenen-Riemersma-Smith-van Neerven



The PDFs from DIS+DY fit are comparable to ones of the DIS fit

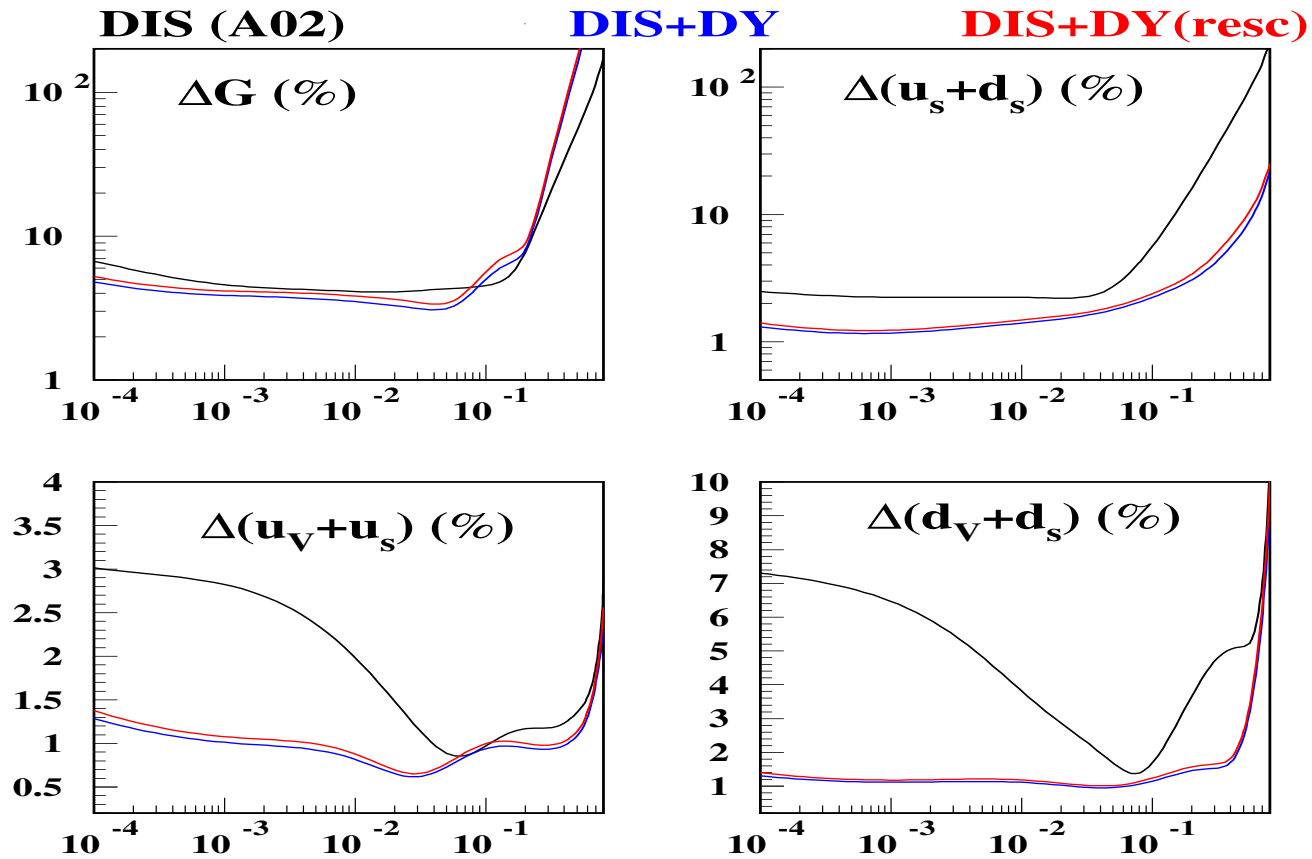


For the experiments with $\chi^2 > 1$ the statistical errors in data were rescaled in order to get $\chi^2 = 1$. This rescaling makes statistical description of the data perfect.

Experiment	NDP	χ^2/NDP	scale factor
SLAC-E-49A	118	0.57	–
SLAC-E-49B	299	1.22	1.10
SLAC-E-87	218	0.95	–
SLAC-E-89A	148	1.38	1.18
SLAC-E-89B	162	0.83	–
SLAC-E-139	26	1.28	1.14
SLAC-E-140	17	0.57	–
BCDMS	605	1.13	1.07
NMC	490	1.24	1.12
H1(96-97)	135	1.18	1.09
ZEUS(96-97)	161	1.28	1.14
E605	119	1.5	1.22
E866	39	1.4	1.19

The scale factors are moderate, within 20%

Experimental errors in PDFs



Impact of the errors rescaling is small

Summary

- Existing Drell-Yan data provide a good constraint on the sea distributions: their errors can be suppressed up to 20% at $x < 0.8$ (*big impact on the searches of new physics at LHC*) . The errors for the valence d-quarks and gluons at small x also decrease after inclusion of the Drell-Yan data.
- There is no need to introduce big scale factor in order to bring the E605 and E866(d/p) data into agreement to the DIS ones, however for the absolute E866 measurements significant disagreement with the DIS data is observed – more thoughtful theoretical studies and/or new DY measurements are necessary.