AB(K)M news

S.Alekhin (*IHEP, Protvino & DESY, Zeuthen)*

- New H1 data for the NC charm SFs
- CC inclusive data in the 3-flavor FFN scheme
- New H1 data from the low-energy run
- Jet data from Tevatron and LHC.
- Value of α_s

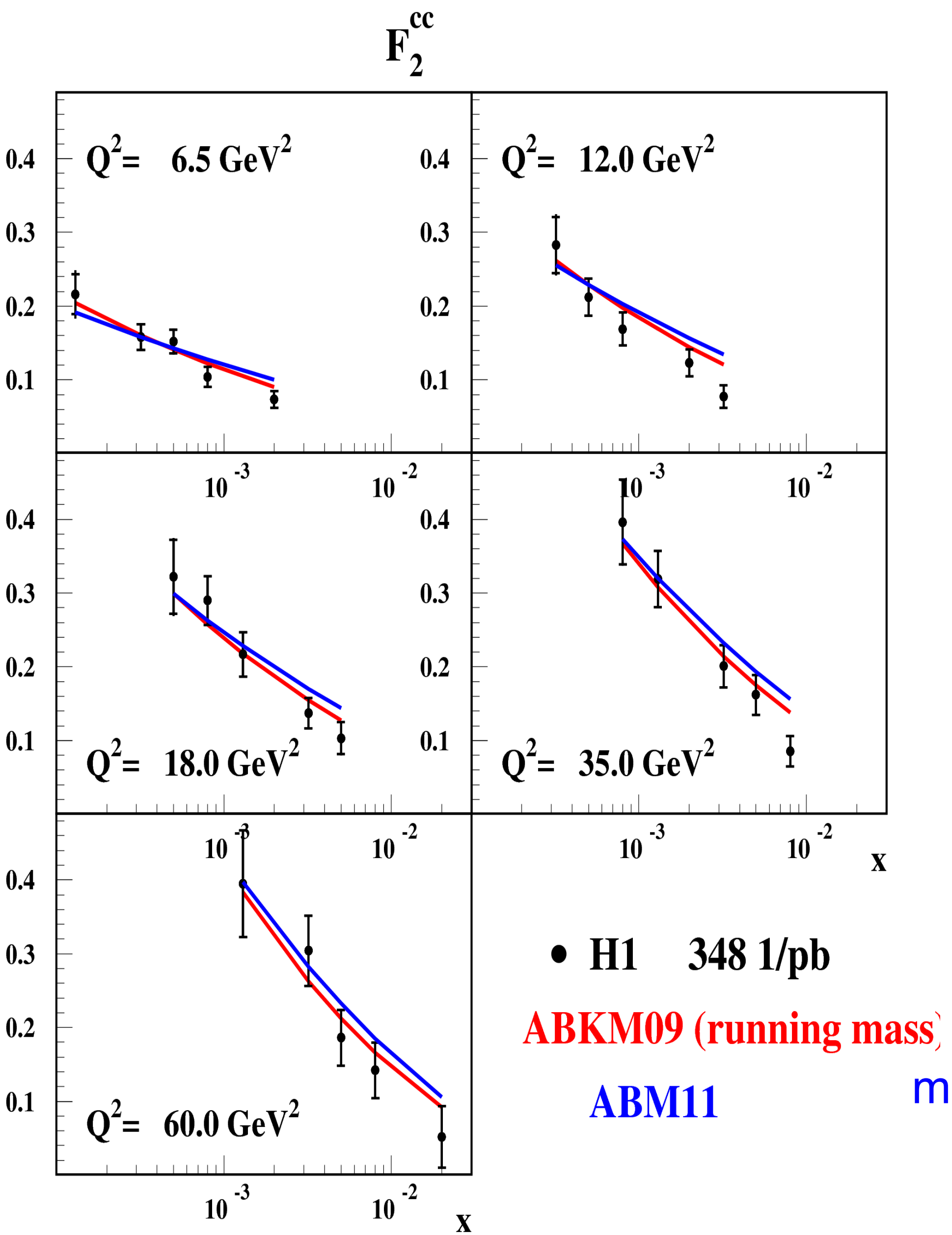
sa, Blümlein, Moch [hep-ph 1105.5349]

sa, Moch [hep-ph 1107.xxxx]

Hamburg, 4 July 2011

New H1 data on F_2^{cc} and running-mass scheme

H1 Collaboration [hep-ex 1106.1028]



The choice of $\mu_R = m_h$ is close to the data kinematic $\rightarrow$ better perturbative convergence and reduced scale dependence

Laengenfeld, Moch, Uwer PRD 80, 054009 (2009)

The heavy-quark electroproductoin in the approximate NNLO (full NLO + NNLO threshold resummation)

sa, Moch PLB 699, 345 (2011)

ABKM09 (running mass):

$m_c(m_c)$=1.18±0.06 GeV (incl.F_2 +PDG)

ABM11: (prel.)

$m_c(m_c)$=1.10±0.04 GeV (incl.F_2 + F_2^{cc})

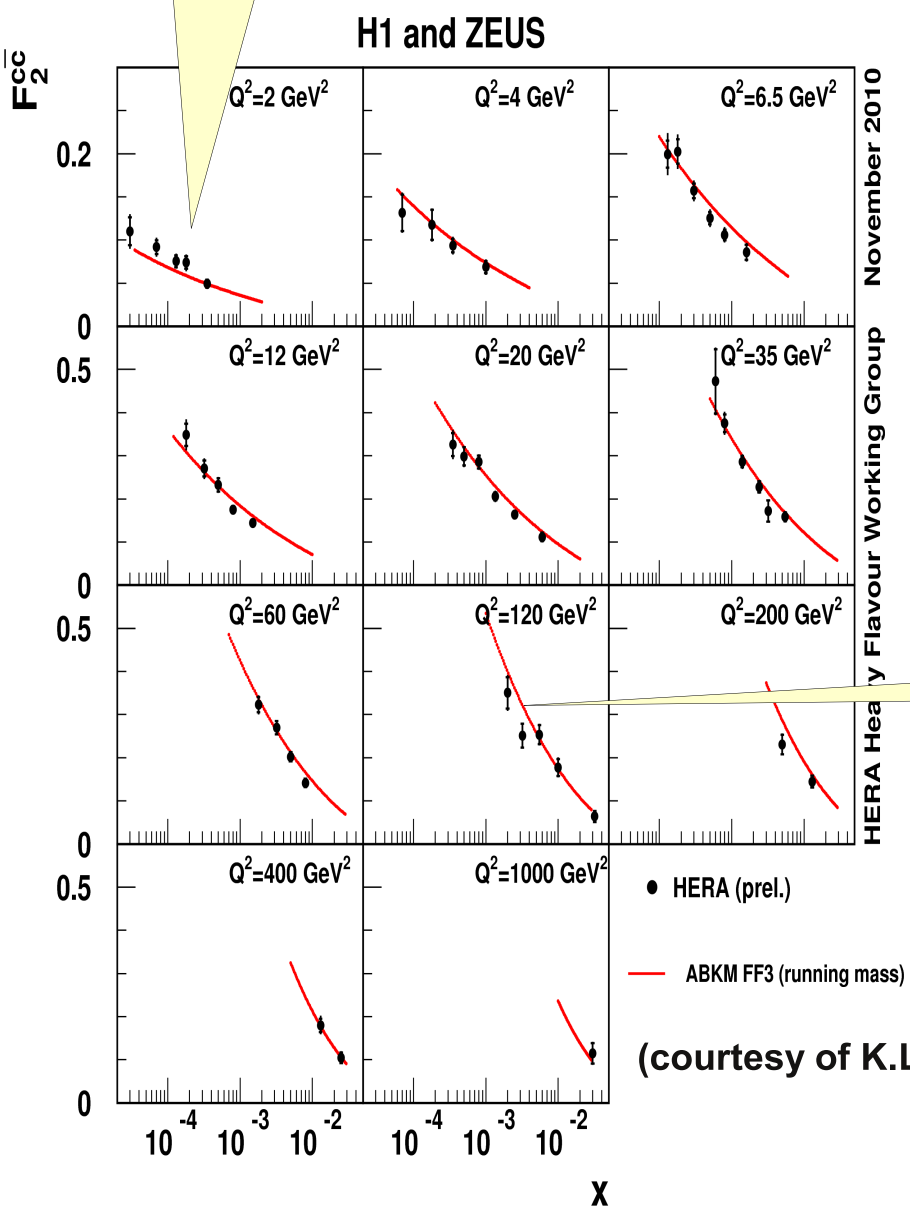
$m_c(m_c)$=1.14±0.04 GeV (incl.F_2 + F_2^{cc} + PDG)

$m_c(m_c)$=1.27±0.08 GeV (PDG '10)

Combined NC HERA on c-quark production

The NNLO(approx.) FFNS ABM ***predictions*** based on the running mass definition are
In nice agreement with the combined HERA data

N^3LO corrections?



(courtesy of K.Lipka)

$m_c(m_c)$=1.18±0.06 GeV

The combined HERA data prefer $m_c(m_c)$ closer to the PDG value

Improved accuracy due to correlation between quark and gluon PDFs must be reduced

No need of the resummation

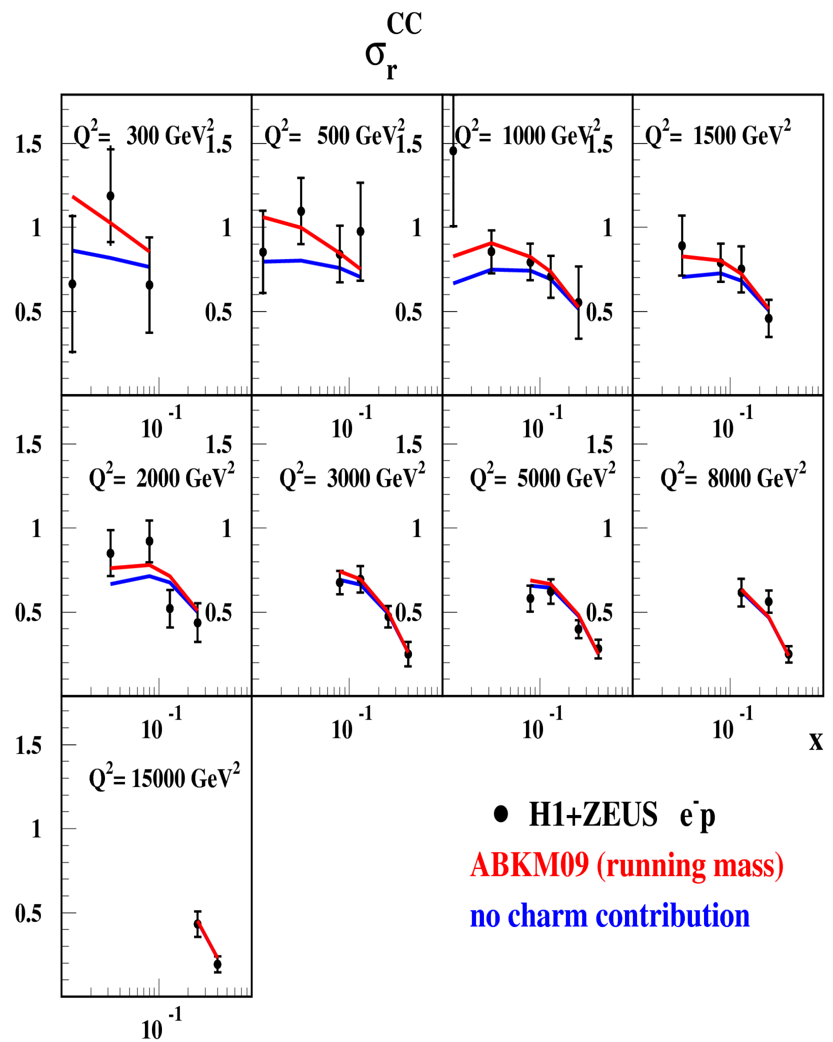
At $Q >> m_c$ first Mellin NNLO moments are known

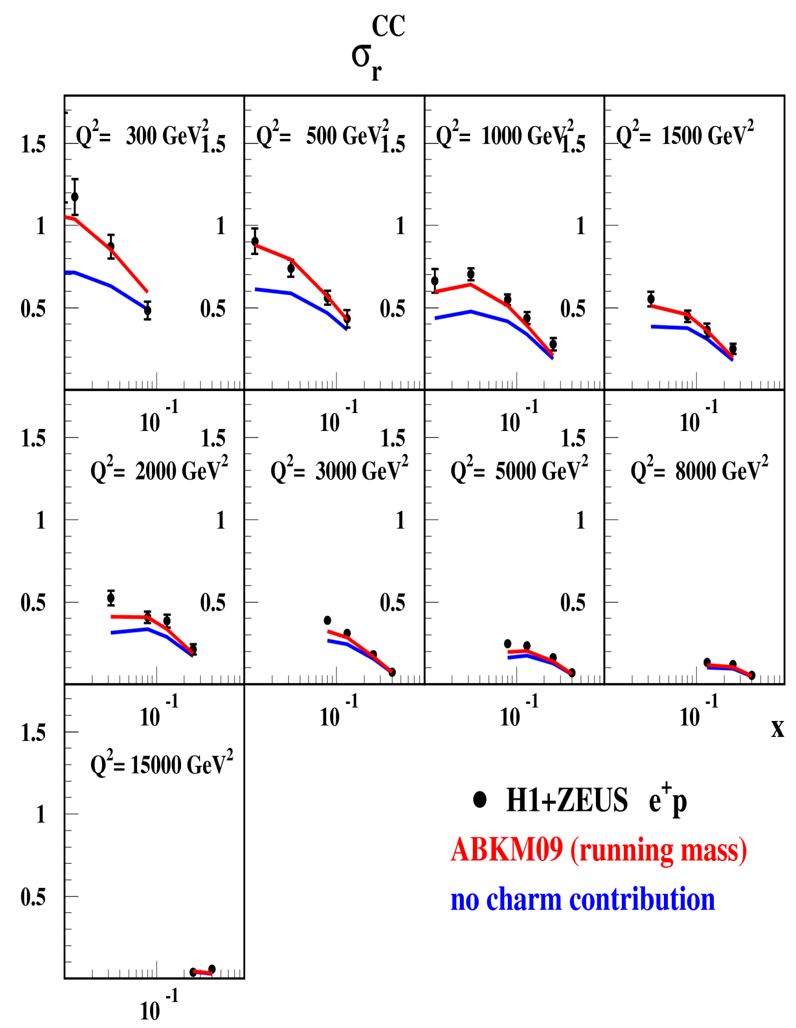
Ablinger at al. NPB 844, 26 (2011)

Bierenbaum, Blümlein, Klein NPB 829, 417 (2009)

CC inclusive data and running-mass scheme

H1 and ZEUS Collaborations JHEP 1001, 109 (2010)

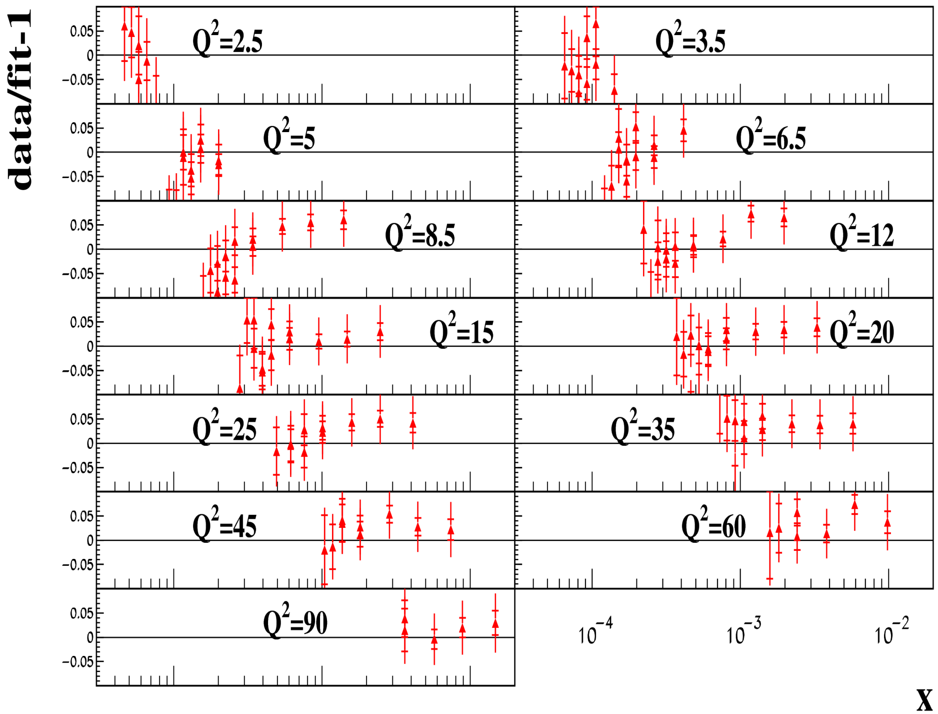


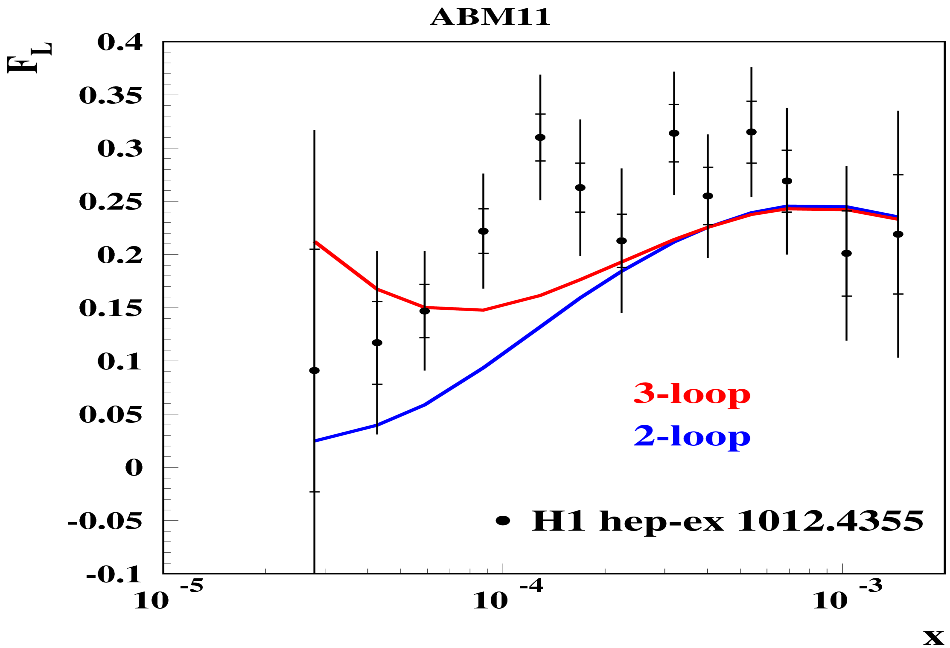


Existing NC and CC DIS data do not ask the large-log resummation

Glück, Reya, Stratmann NPB 422, 37 (1994)

F_L at small x





The data prefer quite big 3-loop corrections to F_L at small x

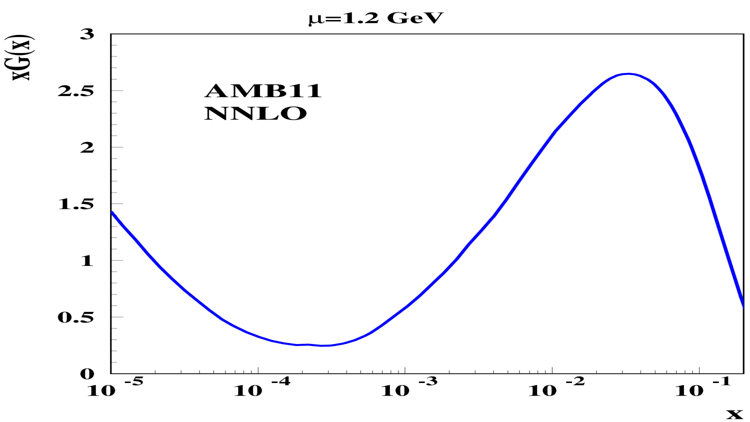
Moch, Vermaseren, Vogt PLB 606, 123 (2005)

- The low-energy H1 data are quite sensitive to F_L at small x and Q

  H1 Collaboration [hep-ex 1012.4355]

- The data can be easily accommodated in the fit: the value of χ^2/NDP=1.05; no clear sign of the collinear evolution violation

- Positive small-x gluons are preferred by the data at low scale



Impact of the jet data on gluons

- The NNLO corrections to jet production are cumbersome (non-trivial subtraction of the IR singularities), only the e+e- case has been solved recently.

Gehrmann-De Ridder, Gehrmann, Glower, Heinrich, Weinzierl

NLO evolution + NLO coefs
- consistent fit
- QCD evolution is inaccurate

NNLO evolution + NLO coefs
- the PDF evolution more accurate
- the PDFs ready for the HO calculations

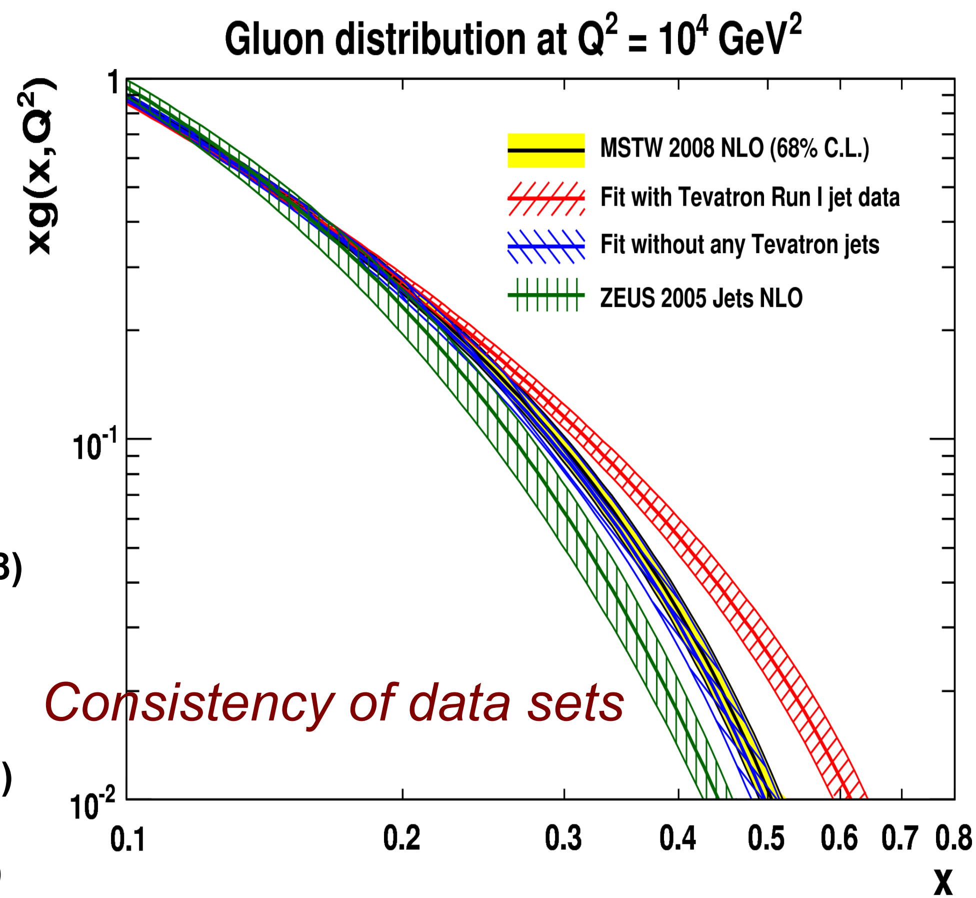
RunII Tevatron data checked wrt ABKM09:

D0 midpoint inclusive (R=0.7)
PRL101, 062001 (2008)

D0 midpoint di-jet (R=0.7)
PLB 693, 531 (2010)

CDF K_T inclusive (D=0.7)
PRD 75, 092006 (2007)

CDF midpoint inclusive (R=0.7)
PRD 78, 052006 (2008)

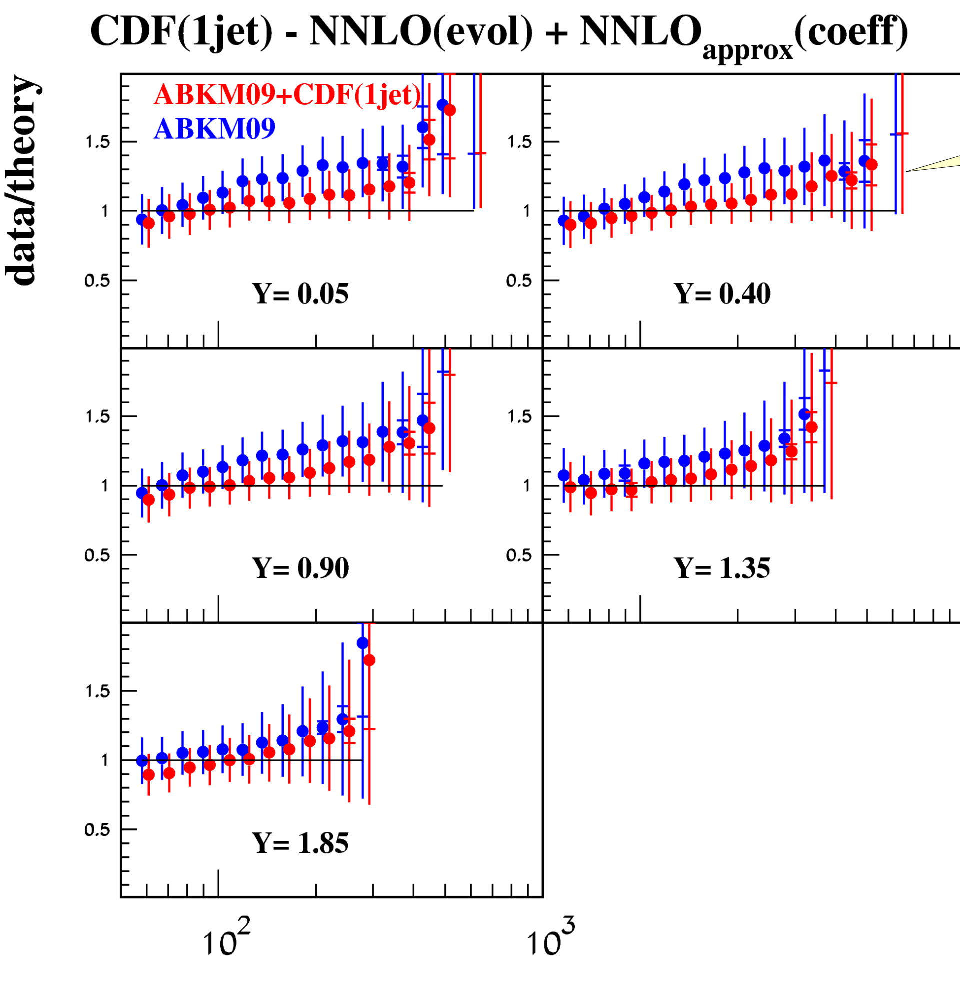


MSTW Collaboration EPJC 63, 189 (2009)

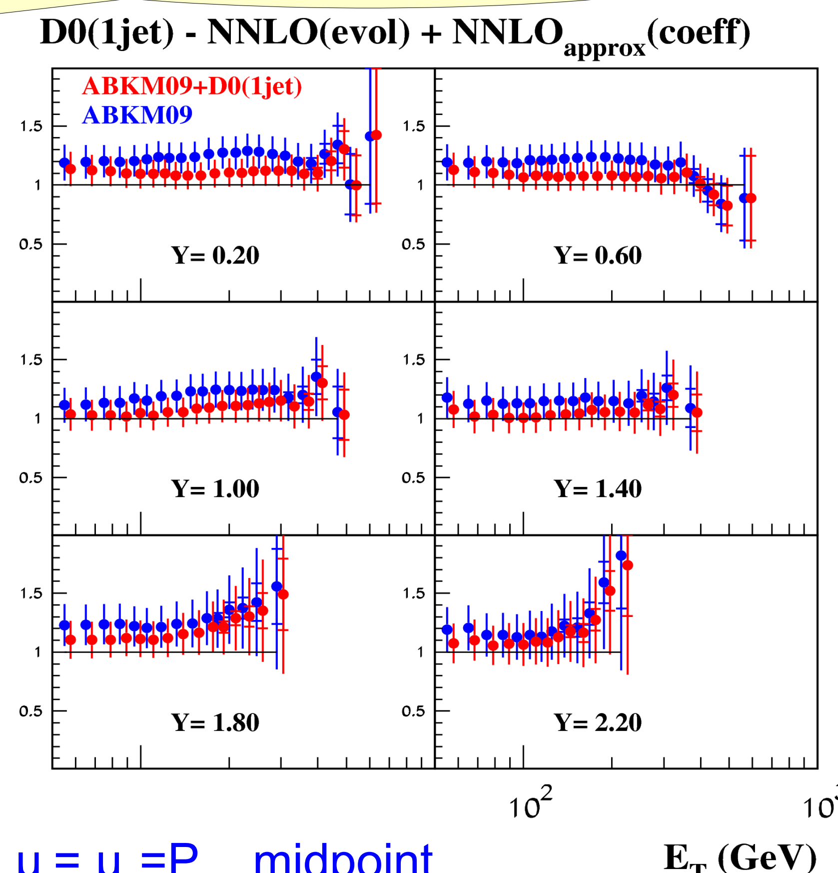
FastNLO is used to employ NLO corrections.

Kluge, Rabberitz, Wobbisch [hep-ph 0609285]

D0 and CDF inclusive data



dominated by quark-quark scattering



$\mu_r = \mu_F = P_T$ K_T

17 sources of systematics

χ^2/NDP=60/76

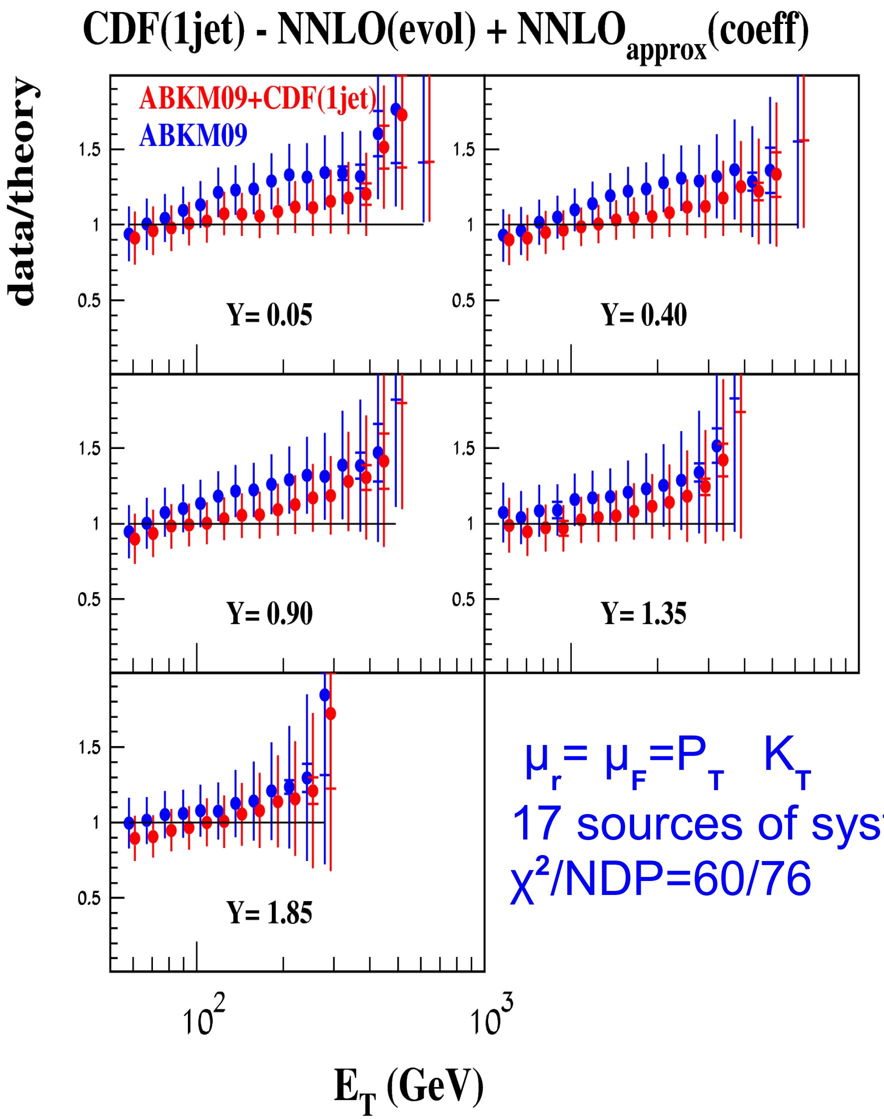
$\mu_r = \mu_F = P_T$ midpoint

24 sources of systematics

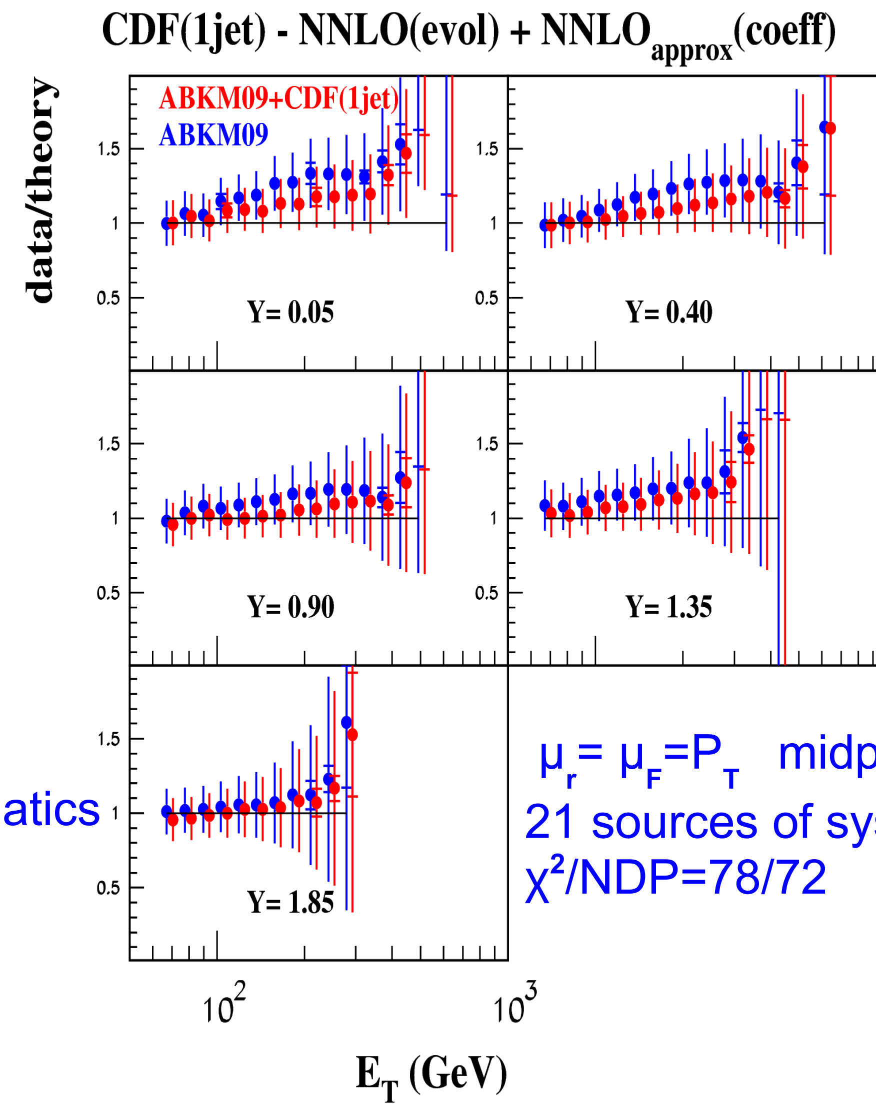
χ^2/NDP=103/110

For the D0 data the discrepancy with the ABKM predictions can be explained by the missing NNLO K-factor of 20-30%. For the CDF data the slope in data is different; the agreement at large E_T can be hardly improved.

CDF: k_T and cone data



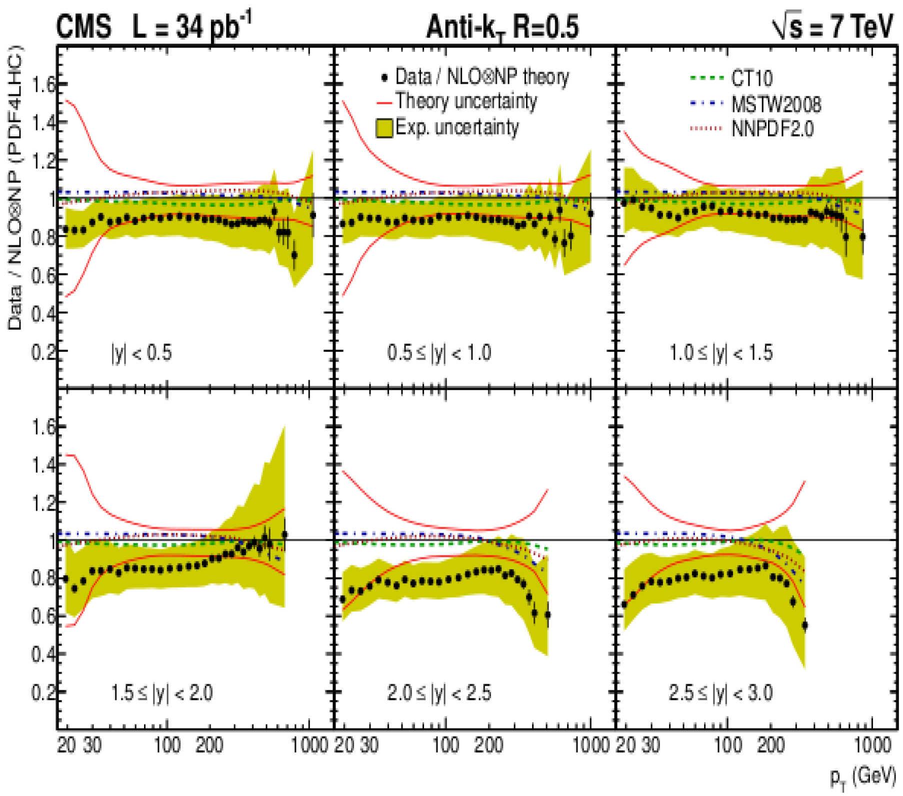
$\mu_r = \mu_F = P_T$ K_T
17 sources of systematics
χ^2/NDP=60/76



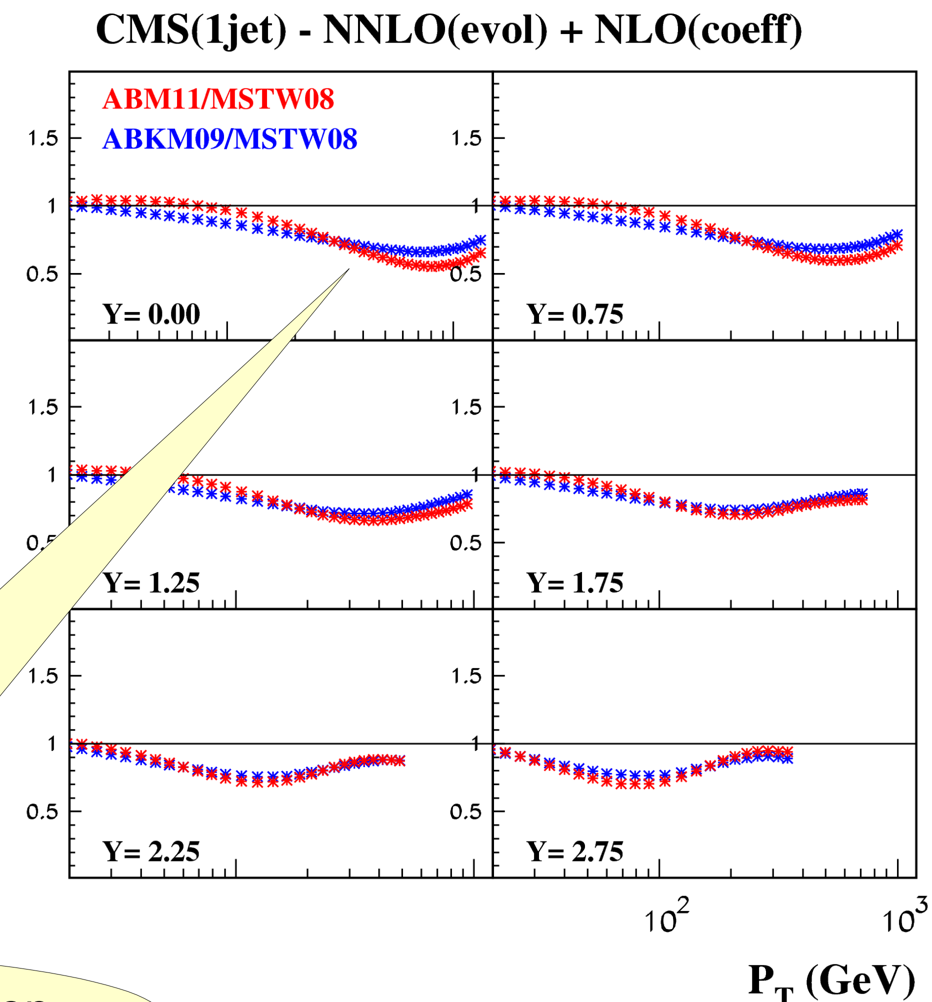
$\mu_r = \mu_F = P_T$ midpoint
21 sources of systematics
χ^2/NDP=78/72

The cone data (predictions) go lower(higher) than the k_T ones → better agreement with the ABKM at low P_T, lower value of α_s is preferred in the combined fit

CMS inclusive jets (7 TeV, 34 1/pb)



CMS Collaboration [hep-ex/1106.0208]

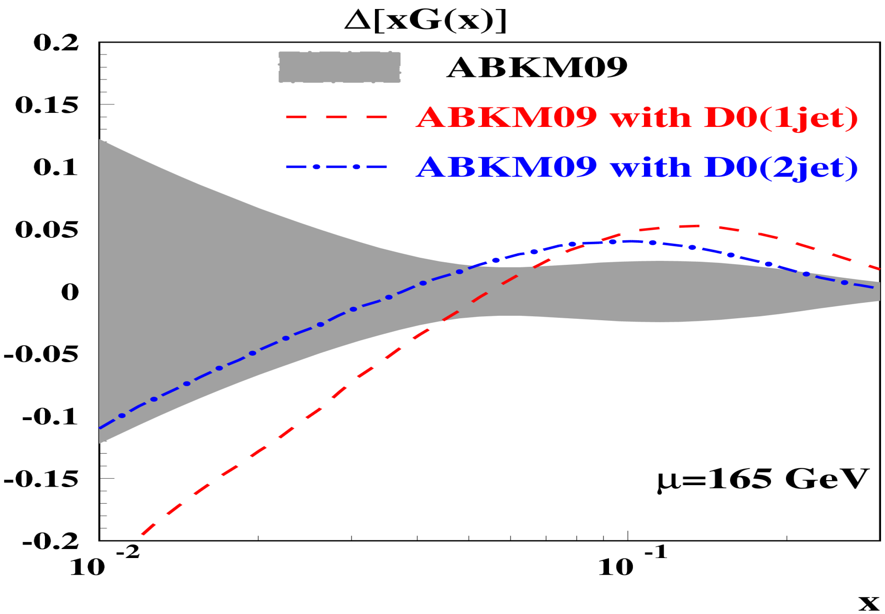


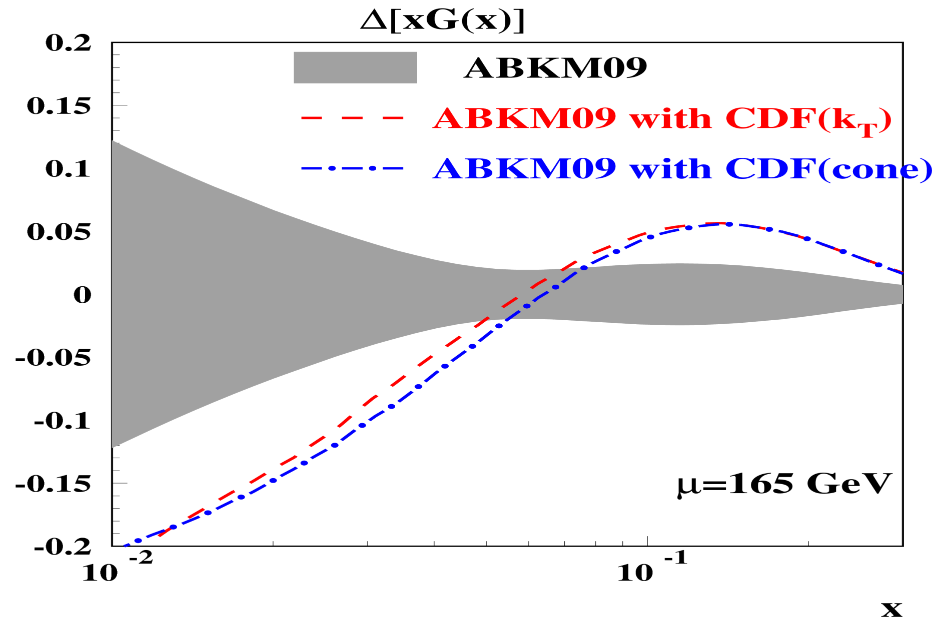
Kinematics for M_H=165 GeV at Tevatron

(FastNLO courtesy of K.Rabberitz)

The CMS data go systematically lower that the predictions based on the PDF fitted to the Tevatron jet data. For the PDF, which do not use the Tevatron jet data, agreement at large P_T is better. At small P_T the PDFs are constrained by the HERA data.

Gluons at small x and Higgs c.s.

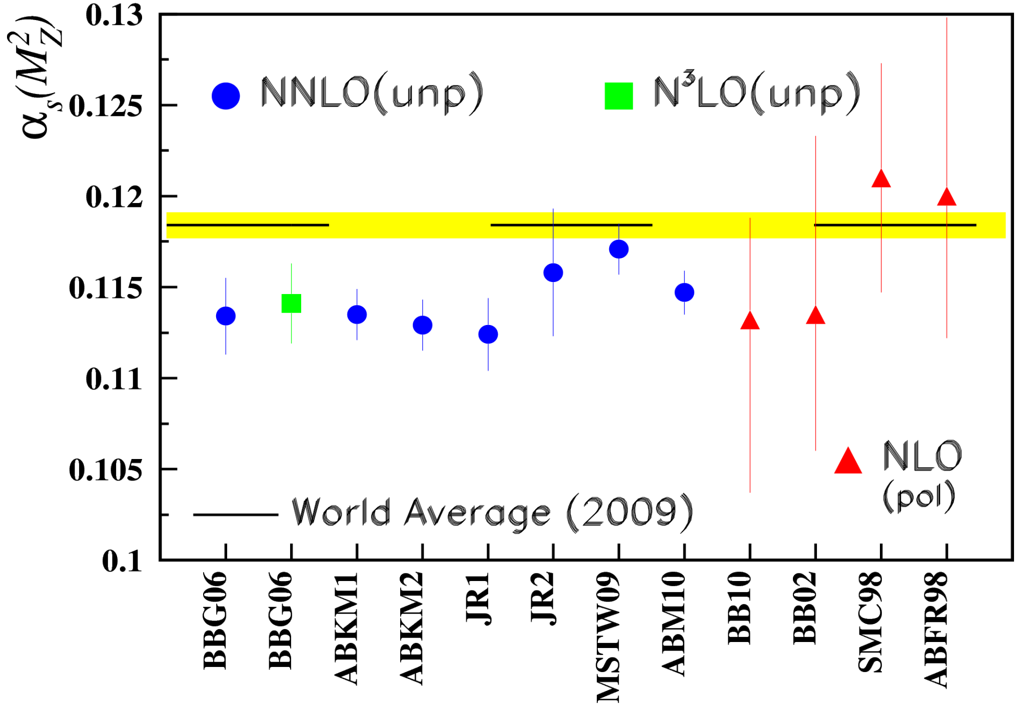




	$\alpha_s(M_Z)$(NNLO)	$\sigma(M_H$=165 GeV) (pb)	
		Tevatron	LHC7
ABKM:	0.1135(14)	0.253(22)	7.05(23)
+ D0(1jet):	0.1149(12)	0.297(12)	7.30(15)
+ D0(2jet):	0.1145(9)	0.281(12)	7.28(14)
+ CDF/k_T	0.1143(9)	0.292(10)	7.18(14)
+ CDF/cone	0.1134(9)	0.283(10)	7.02(14)

- The Tevatron jet data pull the Higgs up by 1-2σ, depending on the data set; the effect must reduce with the NNLO correction to the jet production taken into account
- For the LHC7 relative effect is smaller, than for the Tevatron
- *The value of α_s is still “small”*

PDFs and α_s



Blümlein, Böttcher NPB 841, 205 (2010)

- Many important hadronic processes i.e. Higgs and top-quark production are $\sim\alpha_s^2$.
- The gluon distribution is correlated with α_s $\rightarrow$ effect is accumulated.
- The value of α_s from DIS *(mostly defined by the non-singlet part)* is about 3σ lower than the world average of 2009.

Bethke EPJC 64, 689 (2009)

From the Tevatron jet data

$\alpha_s(M_z)=0.1161\pm0.0045$ (NLO)

D0 Collaboration [hep-ex 1006.2855]

$\alpha_s(M_z)=0.1135\pm0.0014$ (NNLO)

sa, Blümlein, Klein, Moch PRD 81, 014032 (2010)

$\alpha_s(M_z)=0.1171\pm0.0014$ (NNLO)

MSTW Collaboration EPJC 64, 653 (2009)

From the world e+e- data on trust

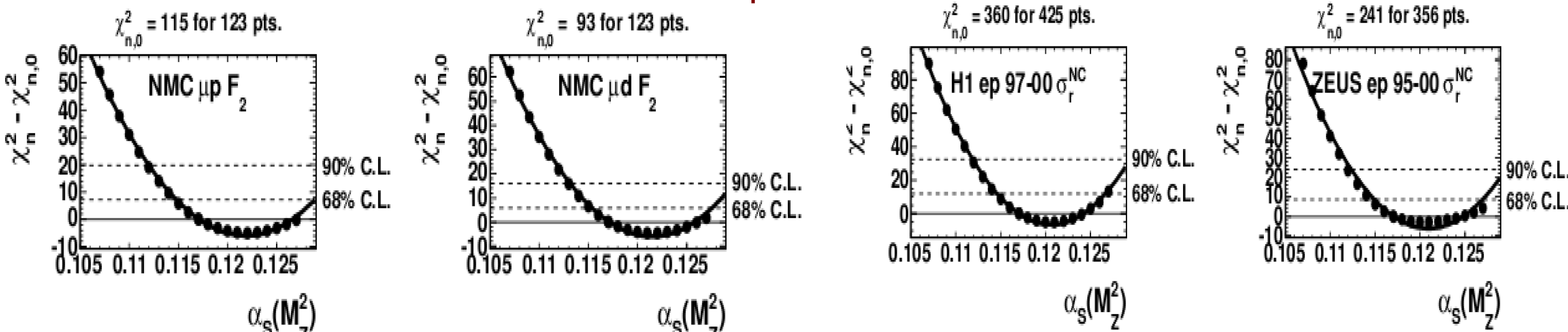
$\alpha_s(M_z)=0.1135\pm0.0002(\text{exp.})\pm0.0005(\text{had.})$
$\pm0.0009(\text{pert..})$ (NNLO)+*power corr.*

Abbate, Fickinger,Hoang, Mateu, Steward [hep-ph 1006.3080]

Recent results are in nice agreement with the DIS values

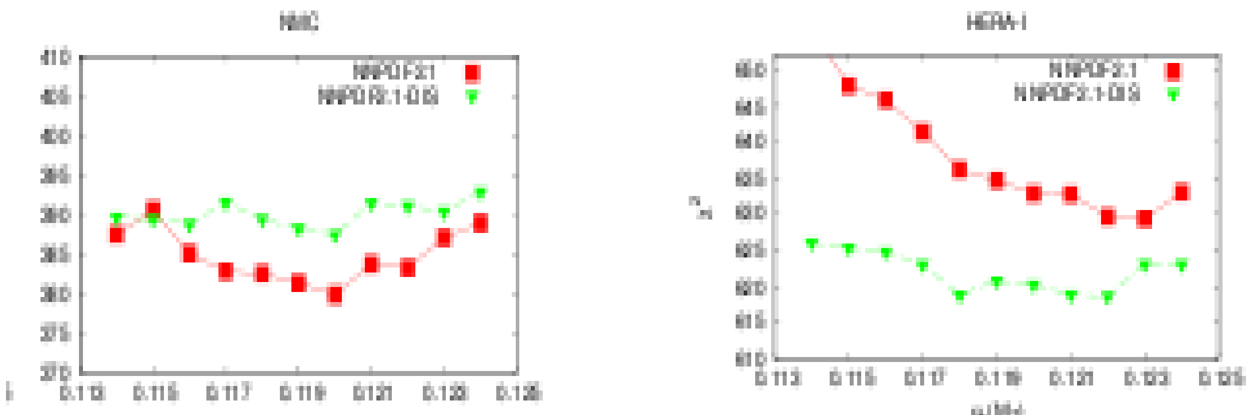
The difference in α_s makes difference of 30-40% in the Higgs c.s. at Tevatron

The HERA and NMC errors are combined in quadrature



MSTW Collaboration EPJC 64, 653 (2009)

The error correlations are taken into account



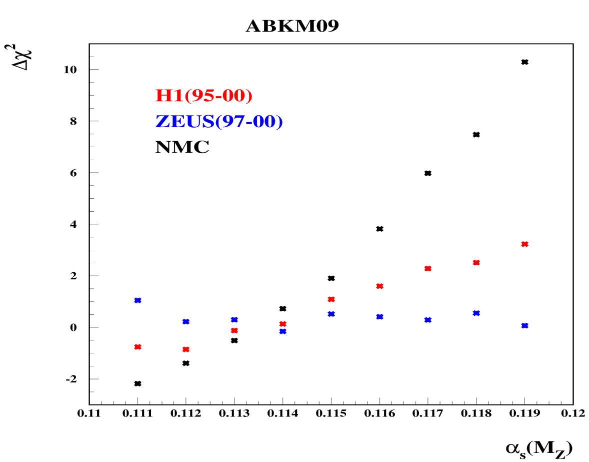
NNPDF Collaboration hep-ph/1103.2369

NNPDF:

$\alpha_s(M_z)$ = 0.1177(9) DIS / NLO

ABKM09: 0.1179(16) NLO

The error correlations are taken into account



With the errors combined in quadrature the HERA and NMC data prefer bigger value of α_s:

ABKM: $\alpha_s(M_z)$ 0.1135 → 0.1163 NNLO

The MSTW value of α_s is pushed up by the DIS data?

Further cross-checks are desirable

Summary

- With improved treatment of the heavy-quark contribution:both NC and CC DIS data can be well described within the 3-flavor scheme → solid theoretical treatment, remaining uncertainties only due to the heavy quark masses

  (*the consistent treatment of the DIS data is important*)

- The “small” value of the α_s is confirmed in the approximate NNLO fit with the Tevatron jet data included:

  $\alpha_s(M_z)$=0.1135(14) → 0.1134 – 0.1149 (NNLO)

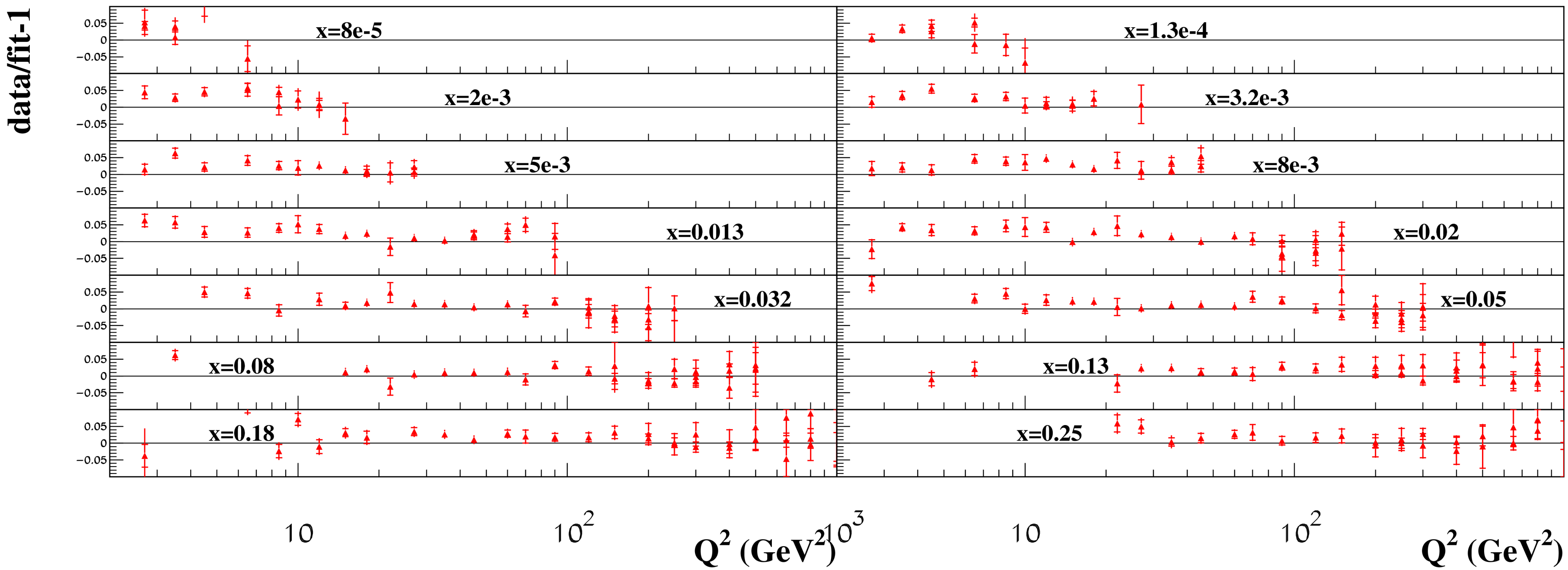
  depending on the data set used

  The Higgs cross section can go up by ~1-2σ

  – *scale sensitivity?* → no NNLO corrections

Combined RunI HERA data

H1 and ZEUS Collaborations JHEP 1001, 109 (2010)



- The PDF shape was modified to accommodate new data

$$xS(x) = exp\left[a \ln x(1 + \beta \ln x)(1 + \gamma_1 x)\right](1-x)^b$$

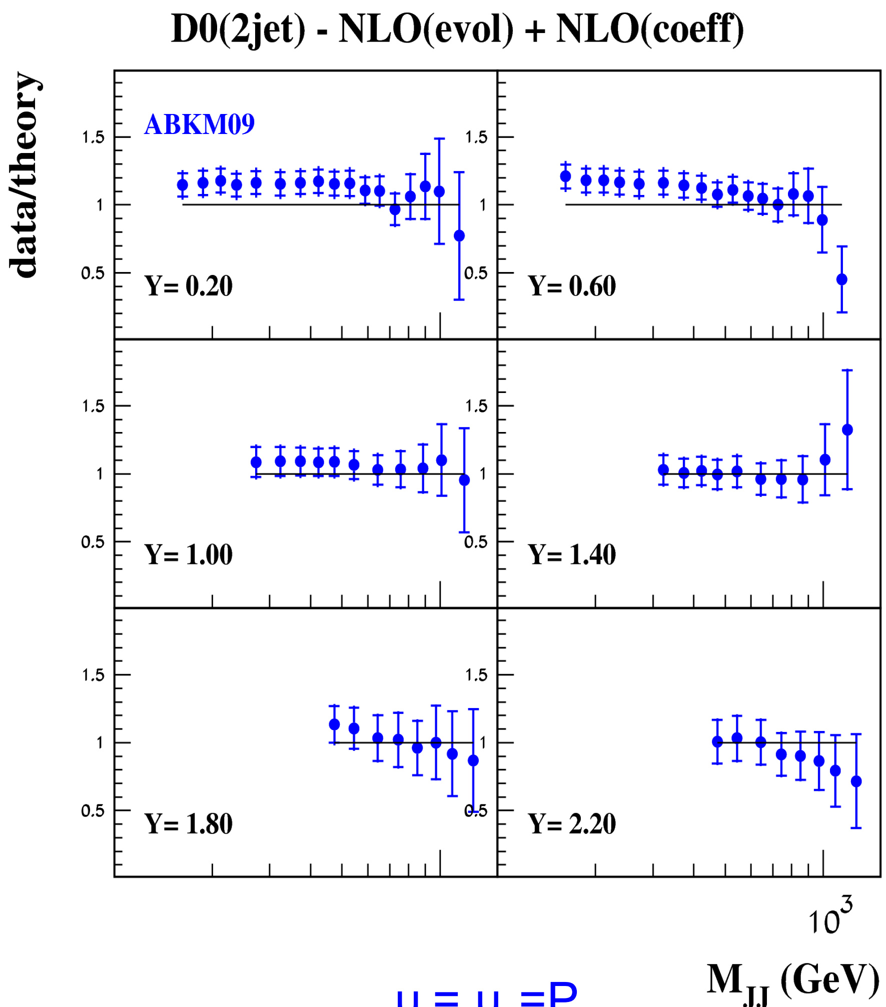
$$xu_V(x) = exp\left[a \ln x(1 + \gamma_1 x + \gamma_2 x^2 + \gamma_3 x^3)\right](1-x)^b$$

- χ^2/NDP=1.1, with account of the systematic error correlations (114 sources). Slightly worse for the small-Q part, the same observed in the model-independent fit

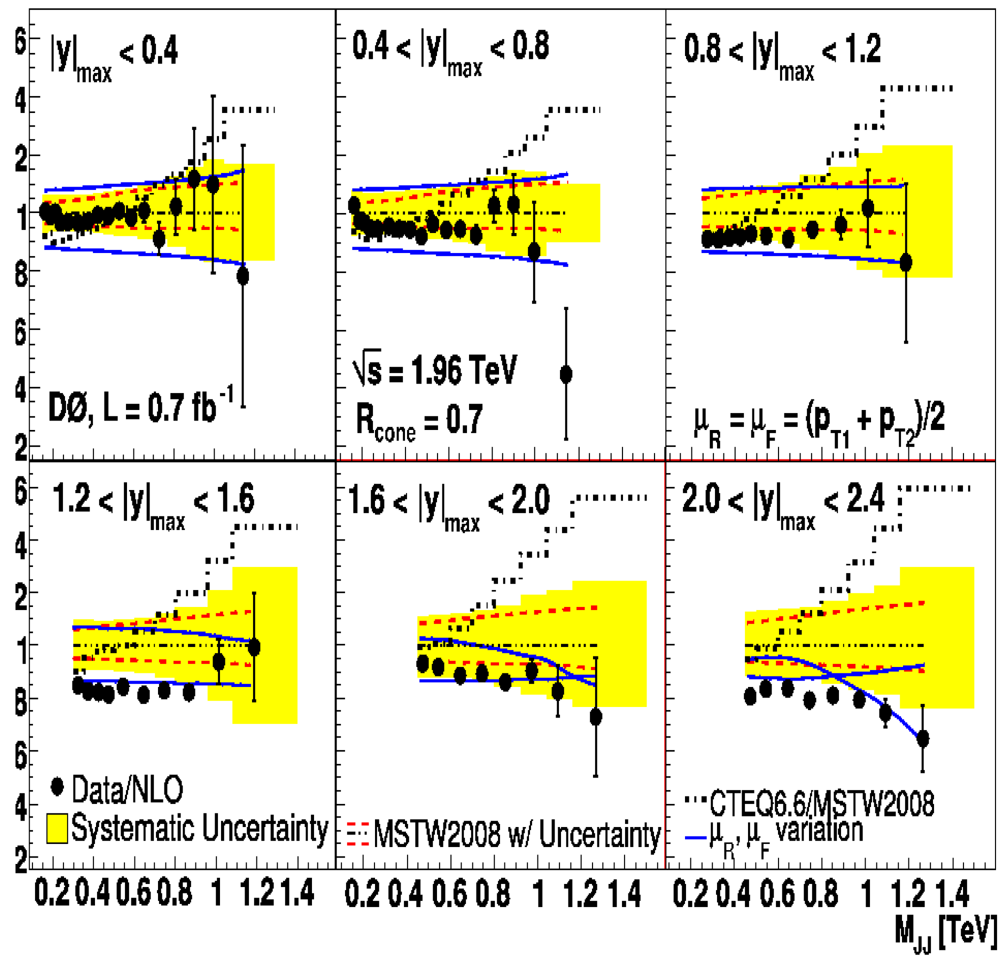
sa, Blümlein, Moch [hep-ph 1007.3657]

$m_c(m_c)$=1.27±0.08 GeV $m_b(m_b)$=4.19±0.13 GeV (PDG '10)

D0 dijet data in the NLO fits



$\mu_r = \mu_F = P_T$

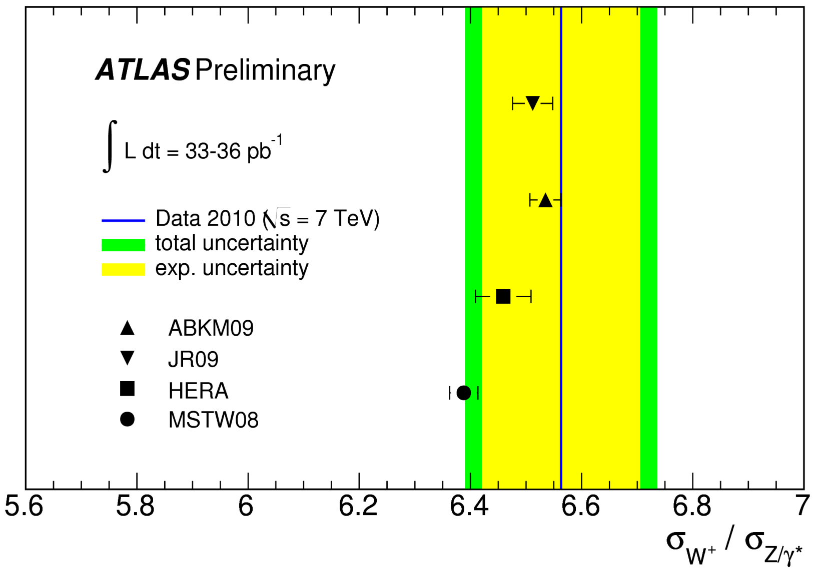


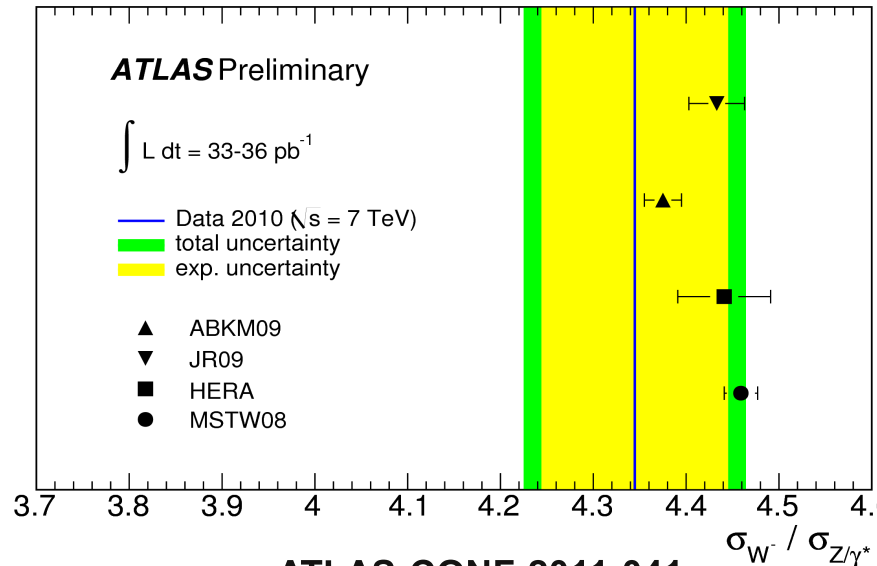
D0 Collaboration PLB 693, 531 (2010)

The NLO ABKM09 **predictions** describes jet data better than the fits based on the Tevatron data? → this is not problem of PDFs, rather problem of the data.

The Tevatron jet data are not completely understood

NNLO benchmarks





ATLAS-CONF-2011-041

The luminosity uncertainty cancels in the ratio

ABKM09 $\alpha_s(M_Z)=0.1135(14)$

	σ(W+) (nb)	σ(W-) (nb)	σ(Z) (nb)	σ(M_H=165 GeV) (pb)
Tevatron	26.1(3)		7.69(8)	0.25(2)
LHC7	58.9(9)	39.4(6)	28.4(5)	7.05(23)

ABM11 = ABKM09 + running mass definition + new HERA data $\alpha_s(M_Z)=0.1134(11)$

	σ(W+) (nb)	σ(W-) (nb)	σ(Z) (nb)	σ(M_H=165 GeV) (pb)
Tevatron	26.41(23)		7.76(7)	0.241(16)
LHC7	58.9(7)	39.6(5)	28.5(3)	7.21(18)

The massive OMEs with the running-mass definition are used to generate 4- and 5-flavor PDFs