The combined H1 and ZEUS data in the NNLO PDF fit

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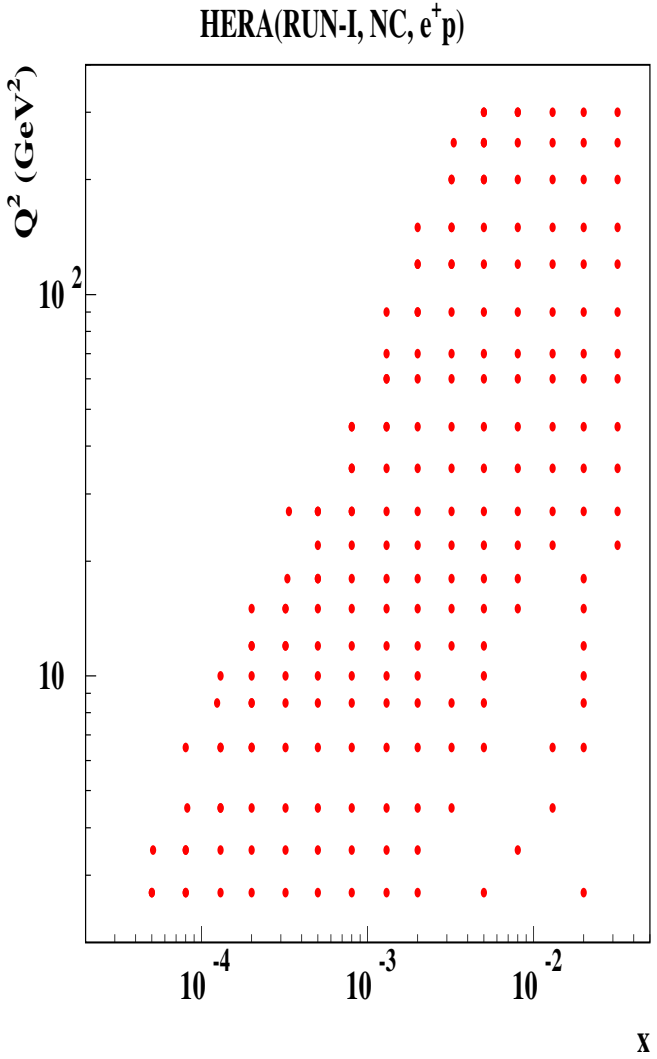
(sa-Blümlein-Klein-Moch 10)

We perform analysis of

- the inclusive DIS data with the transferred momentum $Q^2 > 2.5$ GeV^2 (SLAC-BCDMS-NMC-H1-ZEUS).
- the fixed target Drell-Yan data by FNAL-E-605 (p Cu) and FNAL-E-866 (pp/pD).
- data on dimuon production in the νN interactions by the CCFR and NuTeV collaborations

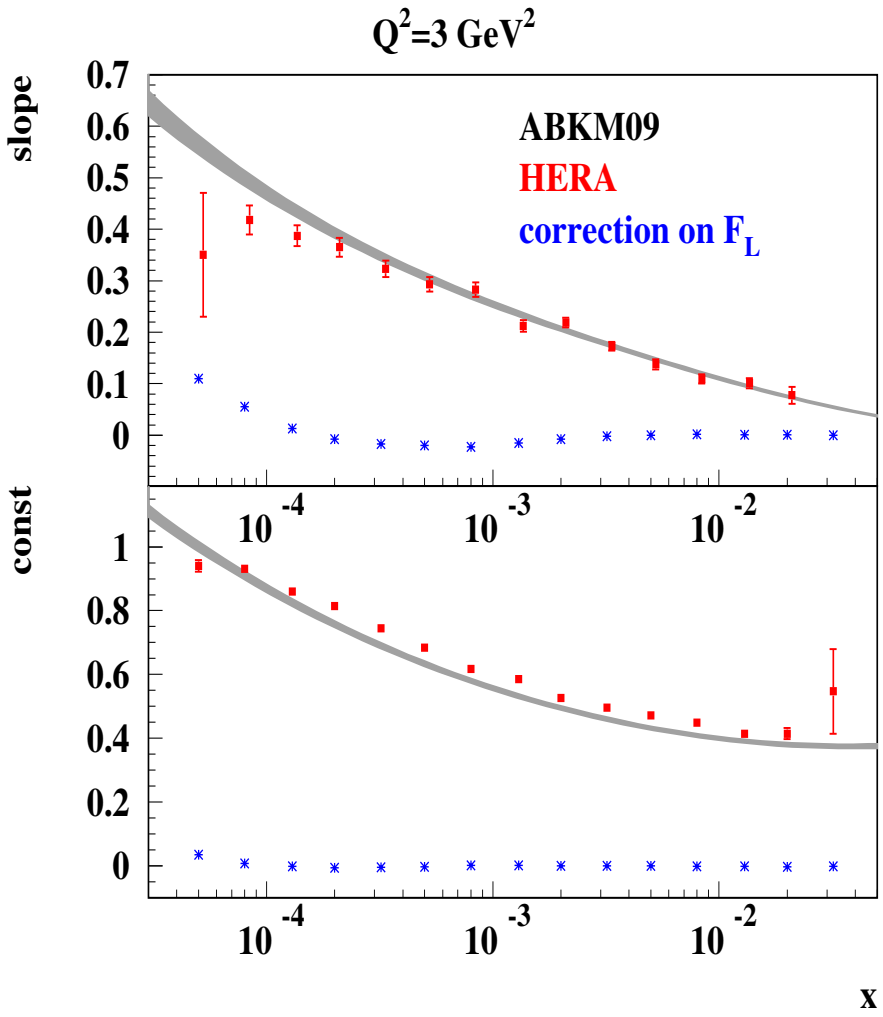
in the NNLO approximation for the PDFs evolution and the light-parton coefficient functions. The heavy quark contribution to the charged-lepton DIS is calculated in the 3-flavour scheme with account of the corrections up to $O(\alpha_s^2)$ (NLO).



- The data on F_2 can be described by a simple model-independent form

$$F_2^i = a_i + b_i \ln(Q^2) + c_i \ln^2(Q^2)$$

- With account of the correlated uncertainties (114 sources) for the most precise part of the NC positron data the value of χ^2/NDF=153/134=1.14 (45 parameters).
- Without account of the correlations χ^2/NDF=123/134=0.9



- The Q-slope of the combined data on F_2 is very well reproduced by the ABKM09 PDFs
- The constant term is systematically lower, except of the lowest-x region

The general functional form of the PDFs employed in the QCD fit

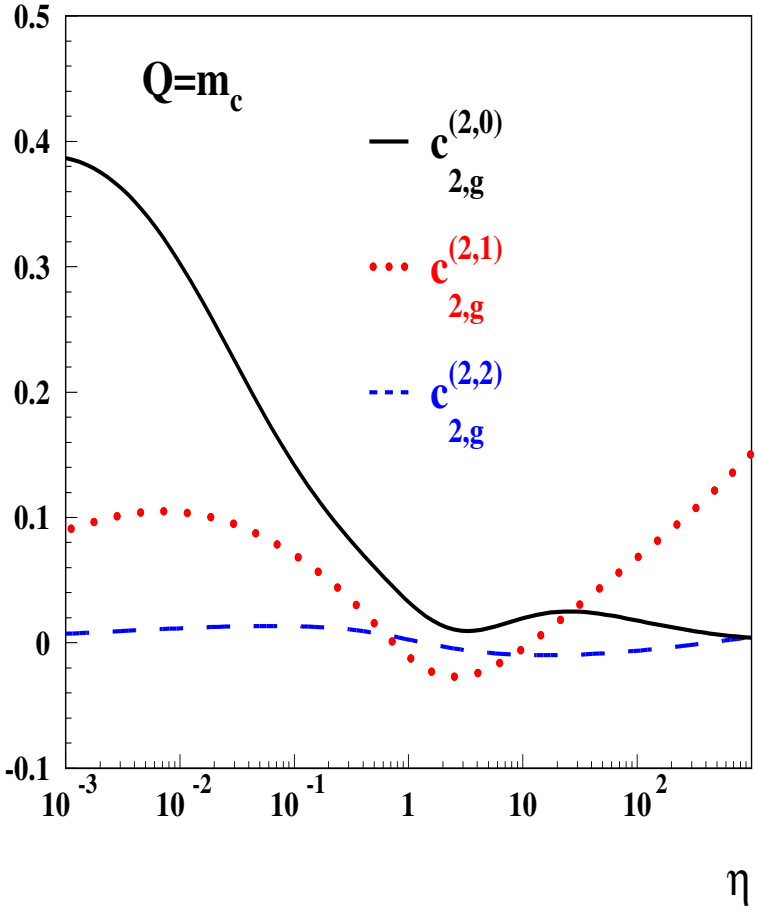
$$q(x) = exp\left[a \ln x(1 + \beta \ln x)(1 + \gamma_1 x + \gamma_2 x^2 + \gamma_3 x^3)\right](1 - x)^b.$$

At $\beta = \gamma = 0$ it reproduces a conventional shape $q(x) = x^a(1 - x)^b$. The coefficients γ allow additional flexibility at $x \gtrsim 0.1$ and the coefficients β – at $x \lesssim 0.1$.

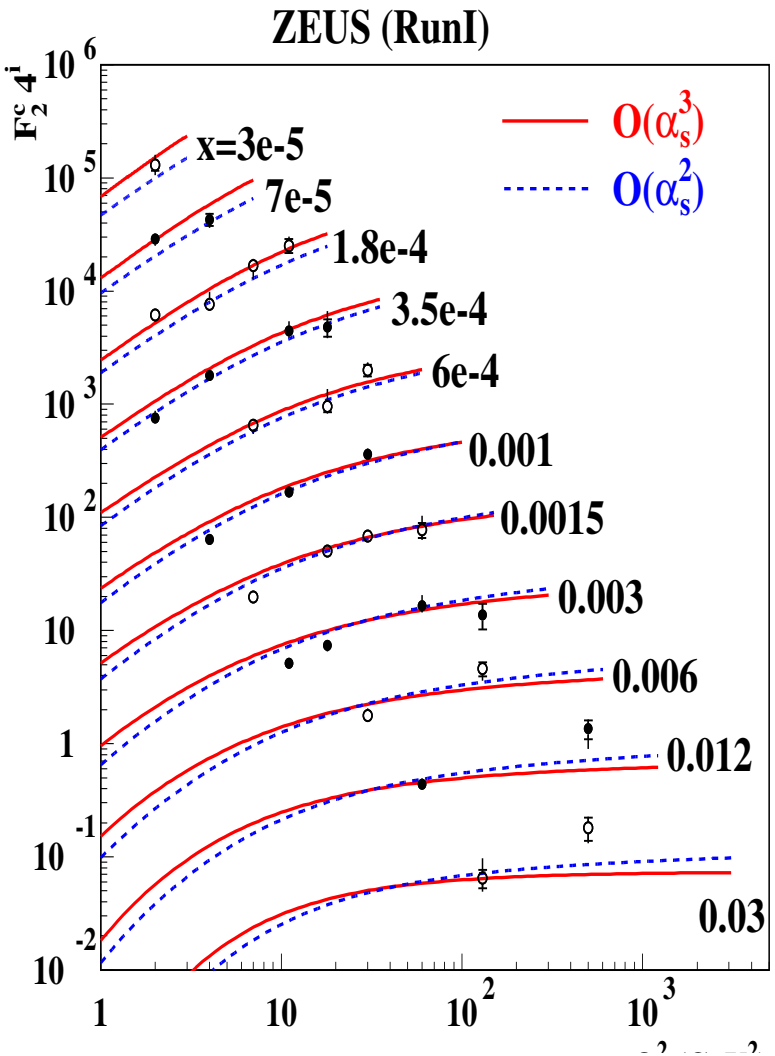
In the version of fit, which include the combined HERA data, we add coefficients γ_3 for the valence quarks and the coefficient β to the sea distribution. We also tried the coefficient β for gluons, it turned out unnecessary.

(sa-Moch 09)

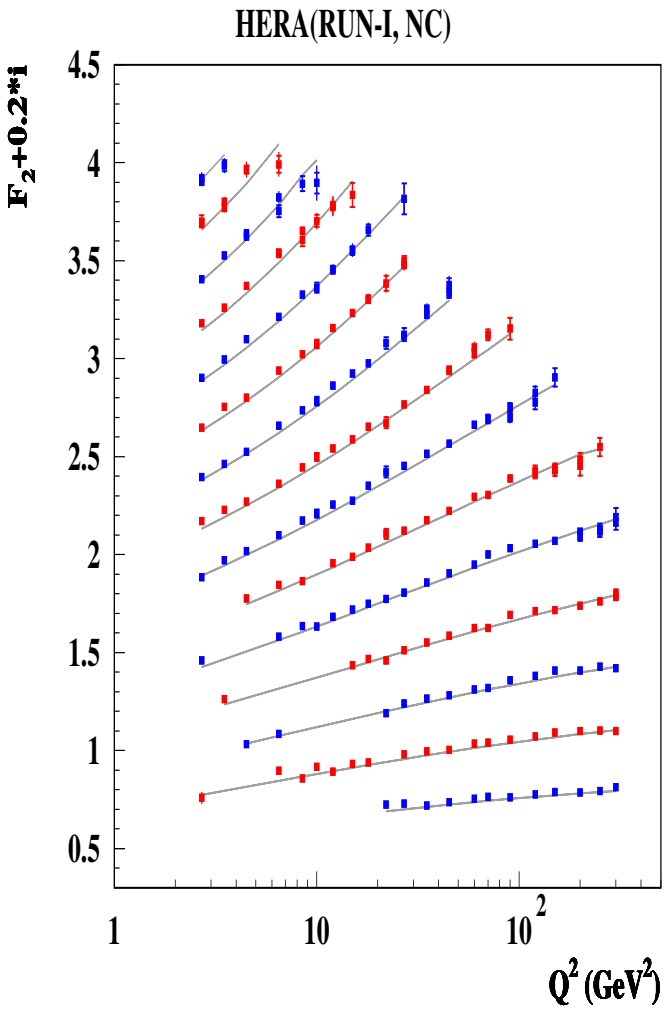
$$C_{2,g}^{\rm NNLO} = c_{2,g}^{(2,0)} + c_{2,g}^{(2,1)} \ln(\mu^2/m_c^2) + c_{2,g}^{(2,2)} \ln^2(\mu^2/m_c^2)$$



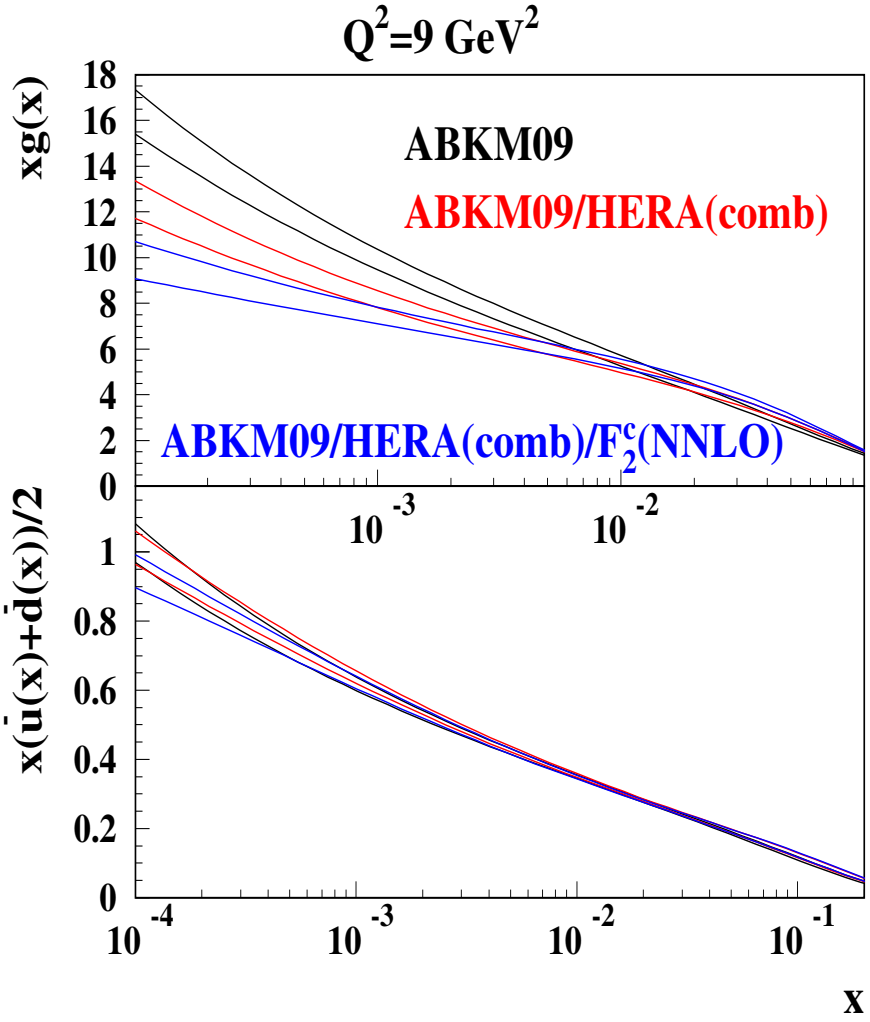
- The coefficients $c_{2,g}^{(2,1)}$ and $c_{2,g}^{(2,2)}$ are known exactly.
- The coefficient $c_{2,g}^{(2,0)}$ can be estimated from the soft-gluon threshold resummation (Laenen-Moch 99). At $\eta = \hat{s}/4m_c^2 - 1 > 1$ this approximation is out of control and are suppressed by factor of $1/\sqrt{1+\eta}$.



The $O(\alpha_s^3)$ corrections improve agreement to the data at small x therefore they were included into the fit. At large Q^2 the full NNLO calculations are necessary, this might lead to further improvement.



The value of χ^2/NDP for the NC HERA data with $Q^2 < 300$ GeV^2 included into the NNLO QCD fit is 355/303=1.19, close to the value of the model independent fit. The fit goes some lower than the data. The average pull of the fit with respect to the data is -0.7. This is not statistically significant in view the errors are dominated by systematic uncertainties, however it means the fit prefers lower normalization of the HERA data if it is free.



- The gluon distribution at small x goes lower than for the ABKM09 set, however it remains positive down to $\mu^2 = 2$ GeV^2.
- The value of $\alpha_s(5, M_Z) = 0.1147(12)$. This is somewhat bigger than the value for the ABKM09 fit $\alpha_s(5, M_Z) = 0.1135(14)$. The difference is within 1σ, however it signals about some tension.

Discussion

- In the QCD fit the combined RUN-I HERA data are in reasonable agreement to other DIS and Drell-Yan data. The value of χ^2/NDP is not perfect, however it happens rather due to fluctuations in the data than due to general trend.
- The modifications of the PDFs, which are necessary to accommodate the combined HERA data include release of the valence quarks shape and modification of the sea asymptotic at small x.
- The HERA data go slightly above than the combined fit. The discrepancy is within the uncertainties (dominated by systematics), however anyway the smaller absolute normalization is more preferable for the fit consistency.