We performed the combine fits of SLAC, BCDMS and NMC data at NLO level. The data are fitted very well with the both: renormalon-type and non-renormalon type parametrizations of higher twist contributions. The renormalon-type parametrizations lead to the large values of QCD parameter $\Lambda_{\overline{MS}}^{\frac{\alpha_s}{2}} \sim 370 \pm 16$ MeV (or $\alpha_s(M_Z^2) \sim 0.1187 \pm 0.0013$).

The accuracy of the present data for deep inelastic (DIS) structure functions (SF) has been reached the level at which the $Q^2$-dependence of logarithmic QCD-motivated and power-like ones may be divided and studied (see, for example, the recent reviews and them references). In the present letter we analyse at NLO order of perturbative QCD the most known DIS SF $F_2(x, Q^2)$ taking into account SLAC, BCDMS and NMC experimental data. We stress our opinion to the power-like effects, so-called twist-4 (i.e. $\sim 1/Q^2$) and twist-6 (i.e. $\sim 1/Q^4$) contributions. To our purposes we represent the SF $F_2(x, Q^2)$ as the contribution of the part $F_2^{QCD}(x, Q^2)$ (including target mass corrections (TMC)) described by perturbative QCD and the nonperturbative part:

$$F_2(x, Q^2) = F_2^{QCD}(x, Q^2) + \frac{h_4(x)}{Q^2} + \frac{h_6(x)}{Q^4}$$

To contrary to standard fits (see, for example) when the direct numerical calculations based on DGLAP equation are used to evaluate of SF, we use the exact solution of DGLAP equation for the Mellin moments of $F_2^{QCD}(x, Q^2)$ and the subsequent reproduction of $F_2(x, Q^2)$ at some $Q^2$-value with help of the Jacobi Polynomial expansion method:

$$F_2^{N_{max}}(x, Q^2) = x^\alpha(1-x)^\beta \sum_{n=0}^{N_{max}} \Theta_n^{\alpha,\beta}(x) \sum_{j=0}^{n} c_j^{(n)}(\alpha, \beta)M_{j+2}(Q^2),$$

where $\Theta_n^{\alpha,\beta}$ are the Jacobi polynomials and $\alpha, \beta$ are their parameters, fixed by the condition of the requirement of the minimization of the error of the reconstruction of the structure functions.
For $ n $-space the eq. (1) transforms to
\[ M_n(Q^2) = M_n^{PQCD}(Q^2) + \left[ \frac{C_4(n)}{Q^2} + \frac{C_6(n)}{Q^4} \right] \cdot M_n^{NS}(Q^2), \tag{3} \]
where (hereafter $(a = 4, 6)$) $ C_a(n) = \int_0^1 x^{n-2} h_a(x) dx / M_n^{NS}(Q^2) $. The $ Q^2 $-evolution of the moments $ M_n^{NS}(Q^2) $ is given by the well known perturbation QCD formulae (see [5]). The moments $ M_n^{PQCD}(Q^2) $ is distinct from $ M_n^{NS}(Q^2) $ by including TMC. The moment $ M_n^{NS}(Q_0^2) $ is theoretical input of our analysis and its parameters should be found together with $ h_4(x) $, $ h_6(x) $ and QCD parameter $ \Lambda $ by the fits of experimental data.

The shapes $ h_a(x) $ of the higher twist (HT) corrections are primary consideration in our analysis. They are chosen in the several different forms.

- The twist-4 and twist-6 terms are fixed in agreement with the infrared renormalon model (see [2] and them references). The values of HT coefficient functions $ C_4(n) $ and $ C_6(n) $ are given (see [4]) in the form $ \frac{A_{\text{ren}}^a}{A_{\text{ren}}^a} \cdot \int_0^1 x^{n-2} h_a(x) dx / M_n^{NS}(Q^2) $. The values of $ A_{\text{ren}}^a $ have been estimated (in [4]) as $ A_{\text{ren}}^4 = 0.2 \text{ GeV}^2 $ and $ A_{\text{ren}}^6 = (A_{\text{ren}}^4)^2 = 0.04 \text{ GeV}^4 $. We use them here as free parameters.

- The twist-4 term in the form $ h_4(x) \sim \frac{d}{dx} \ln F_N^2(x, Q^2) \sim 1/(1 - x) $. This behaviour matches the fact that higher twist effects are usually important only at higher $ x $. The twist-4 coefficient function has the form $ C_4^{\text{der}}(n) = (n - 1) A_4^{\text{der}} $.

- HT terms are considered as free parameters at every $ x_i $ bin. They have the form $ h_a^{\text{free}}(x) = \sum_{i=1}^I h_a(x_i) $, where $ I $ is the number of bins. The constants $ h_a(x_i) $ (one per $ x $-bin) parametrize $ x $-dependence of $ h_a^{\text{free}}(x) $.

To clear up the importance of HT terms we fit SLAC, BCDMS and NMC ($ H_2 $ and $ D_2 $) data [6] (including the systematical errors), keeping identical form of perturbative part. We choose hereafter $ Q_0^2 = 5 \text{ GeV}^2 $, $ N_{\text{max}} = 6 $, $ 0.3 \leq x \leq 0.9 $ and $ I = 6 $. Basic characteristics of the quality of the fits are $ \chi^2/\text{DOF} $ for SF $ F_2 $ and for its slope $ d\ln F_2/d\ln Q^2 $, which has very sensitive perturbative properties (see [2]). We use MINUIT program for minimization of two $ \chi^2 $ values:

\[ \chi^2(F_2) = \left| \frac{F_2^{\text{exp}} - F_2^{\text{cor}}}{\Delta F_2^{\text{exp}}} \right|^2 \quad \text{and} \quad \chi^2(\text{slope}) = \left| \frac{b^{\text{exp}} - b^{\text{cor}}}{\Delta b^{\text{exp}}} \right|^2, \quad (b = \frac{d\ln F_2}{d\ln Q^2}) \]

We obtain the following results.
Let us now present the main results.

• Only perturbative QCD part is included (i.e. $C_a = 0$, $M_{\text{nucl}}^2 = 0$):

$$\chi^2/\text{DOF}(F_2) = \frac{3510}{581}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{1977}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 283 \pm 7 \text{ MeV}$$

• Only TMC are included (i.e. $C_a = 0$):

$$\chi^2/\text{DOF}(F_2) = \frac{1175}{581}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{464}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 254 \pm 7 \text{ MeV}$$

• TMC and $h_i^{free}$ (see Table) are included:

$$\chi^2/\text{DOF}(F_2) = \frac{368}{581}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{15}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 286 \pm 25 \text{ MeV}$$

• TMC, $C_{4}^{\text{der}}$ and $h_i^{free}$ (see Table) are included:

$$\chi^2/\text{DOF}(F_2) = \frac{481}{581}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{70}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 190 \pm 28 \text{ MeV}$$

$$A_{\text{der}}^4(H_2) = 0.175 \pm 0.050 \text{ GeV}^2, \quad A_{\text{der}}^4(D_2) = 0.094 \pm 0.044 \text{ GeV}^2$$

• TMC, $C_{4}^{\text{ren}}$ and $h_i^{free}$ (see Table) are included:

$$\chi^2/\text{DOF}(F_2) = \frac{374}{549}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{13}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 380 \pm 16 \text{ MeV}$$

$$A_{4}^{\text{ren}}(H_2) = 0.160 \pm 0.016 \text{ GeV}^2, \quad A_{4}^{\text{ren}}(D_2) = 0.182 \pm 0.018 \text{ GeV}^2$$

• TMC, $C_{4}^{\text{ren}}$ and $C_{6}^{\text{ren}}$ are included:

$$\chi^2/\text{DOF}(F_2) = \frac{540}{581}, \quad \chi^2/\text{DOF}(\text{slope}) = \frac{15}{7}, \quad \Lambda_{\overline{MS}}^{f=4} = 360 \pm 16 \text{ MeV}$$

$$A_{4}^{\text{ren}}(H_2) = 0.097 \pm 0.011 \text{ GeV}^2, \quad A_{4}^{\text{ren}}(D_2) = 0.060 \pm 0.011 \text{ GeV}^2$$

$$A_{6}^{\text{ren}}(H_2) = 0.0044 \pm 0.0006 \text{ GeV}^4, \quad A_{6}^{\text{ren}}(D_2) = 0.0042 \pm 0.0006 \text{ GeV}^4$$

Let us now present the main results.

• Both renormalon-type and non-renormalon-type HT terms lead to very good fits of SLAC, BCDMS and NMC data. However, the renormalon-type HT terms lead to the large values of QCD parameter $\Lambda_{\overline{MS}}^{f=4} \sim 370 \pm 16 \text{ MeV}$ (or $\alpha_s(M_Z^2) \sim 0.1187 \pm 0.0013$).
• Twist-4 terms are very similar to ones obtained in [4], when we considered
them as free parameters.
• Twist-6 terms are different for proton and deuteron SF that seems indicate
about a nonzero nuclear correlations in deuteron.

Table. The values of the parameters for $h_4^{\text{free}}$ (GeV^2), $h_6^{\text{free}}$ and $T_6^{\text{free}}$ (GeV^4).

| $x_i$  | 0.35 | 0.45 | 0.55 | 0.65 | 0.75 | 0.85 |
|-------|------|------|------|------|------|------|
| $h_4^{\text{free}}(H_2)$ | -0.242 ± 0.021 | -0.172 ± 0.042 | -0.031 ± 0.072 | 0.337 ± 0.124 | 0.762 ± 0.214 | 1.42 ± 0.56 |
| $h_4^{\text{free}}(D_2)$ | -0.202 ± 0.025 | -0.064 ± 0.044 | 0.102 ± 0.072 | 0.271 ± 0.117 | 0.435 ± 0.188 | 1.43 ± 0.54 |
| $h_6^{\text{free}}(H_2)$ | -0.301 ± 0.019 | -0.365 ± 0.056 | -0.394 ± 0.192 | 0.034 ± 0.460 | -0.61 ± 1.20 | -5.48 ± 4.61 |
| $h_6^{\text{free}}(D_2)$ | -0.209 ± 0.026 | -0.064 ± 0.062 | 0.242 ± 0.143 | 0.102 ± 0.441 | 0.38 ± 0.79 | 7.59 ± 4.24 |
| $T_6^{\text{free}}(H_2)$ | -0.179 ± 0.037 | 0.050 ± 0.080 | 0.249 ± 0.137 | 0.518 ± 0.308 | -1.23 ± 0.79 | -10.90 ± 3.86 |
| $T_6^{\text{free}}(D_2)$ | -0.102 ± 0.042 | 0.287 ± 0.086 | 0.704 ± 0.141 | 0.350 ± 0.282 | -2.26 ± 0.59 | -5.77 ± 3.87 |

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