



CC DIS at α_s^3 in Mellin- N and Bjorken- x spaces

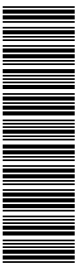
M. Rogal*

*Deutsches Elektronensynchrotron DESY
Platanenallee 6, D-15738 Zeuthen, Germany
E-mail: Mikhail.Rogal@desy.de*

Third-order results for the structure functions of charged-current deep-inelastic scattering are discussed. New results for 11'th Mellin moment for $F_{2,L}^{vp-\bar{v}p}$ structure functions and 12'th moment for $F_3^{vp-\bar{v}p}$ are presented as well as corresponding higher Mellin moments of differences between the respective crossing-even and -odd coefficient functions. Approximations in Bjorken- x space for these differences obtained with lowest five moments as well as consistency of new results with these approximations are discussed. The $1/N_c$ suppression of the differences is shown and the correction to the Paschos-Wolfenstein relation is discussed.

*8th International Symposium on Radiative Corrections (RADCOR)
October 1-5 2007
Florence, Italy*

*Speaker.



1. Introduction

Structure functions in deep-inelastic scattering (DIS) are among the most extensively measured observables. Today the combined data from fixed-target experiments and the HERA collider spans about four orders of magnitude in both Bjorken- x and the scale $Q^2 = -q^2$ given by the momentum q of the exchanged electroweak gauge boson [1]. In this report I focus on the W -exchange charged-current (CC) case, see Refs. [2, 3, 4] for recent measurements in neutrino DIS and at HERA. I present new Mellin moments for coefficient functions in combination $\nu p - \bar{\nu} p$ and discuss the results for differences between the corresponding crossing-even and -odd coefficient functions. I show suppression of such differences in large $1/N_c$ limit and discuss α_s^3 correction to the Paschos-Wolfenstein relation [5].

2. Results for the CC coefficient functions and their applications

Recently the first five odd-integer moments have been computed of the third-order coefficient functions for $F_{2,L}^{\nu p - \bar{\nu} p}$ in charged-current DIS, together with the corresponding moments $N = 2, \dots, 10$ for $F_3^{\nu p - \bar{\nu} p}$ [6]. Meanwhile calculation of new results for 11'th moment for the first and 12'th moment for the latter case has been finished. We use scale choice $\mu = \mu_f = Q$ and standard QCD colour factors $C_A = 3$ and $C_F = 4/3$ throughout this paper and denote the Mellin- N moments of corresponding coefficient functions as $C_{a,N}^{\text{ns}}$, $a = 2, 3, L$. Following the formalism outlined in [6] we find the following numerical results

$$\begin{aligned}
C_{2,11}^{\text{ns}} &= 1 + 21.01295976 a_s + a_s^2 (722.3767644 - 51.01867375 n_f) \\
&\quad + a_s^3 (29020.51723 - 4259.717409 n_f + 89.53420655 n_f^2), \\
C_{L,11}^{\text{ns}} &= 0.4444444444 a_s + a_s^2 (30.42631299 - 1.781422693 n_f) \\
&\quad + a_s^3 (2021.685213 - 266.3750306 n_f + 7.082458684 n_f^2), \\
C_{3,12}^{\text{ns}} &= 1 + 22.20106054 a_s + a_s^2 (774.6238566 - 53.26617873 n_f) \\
&\quad + a_s^3 (31152.95983 - 4483.444700 n_f + 91.41515482 n_f^2), \tag{2.1}
\end{aligned}$$

where the normalized coupling constant $a_s = \alpha_s/(4\pi)$ and n_f denotes the number of effectively massless quark flavours. The results in analytical form can be found in App. A.

Unlike fixed- N calculations for the combination $\nu p - \bar{\nu} p$, the complete three-loop results for $F_{2,L}^{\nu p + \bar{\nu} p}$ [7, 8] (the α_s^3 coefficient functions for this process are those of photon-exchange DIS, but without the contributions of the f_{l_1} flavour classes) and $F_3^{\nu p + \bar{\nu} p}$ [9] facilitate analytic continuations to these values of N . This continuation has been performed using the x -space expressions and the Mellin transformation package provided with version 3 of FORM [10]. Thus we are in a position to derive the respective moments of the hitherto unknown third-order contributions to the even-odd differences which are defined as

$$\delta C_{2,L} = C_{2,L}^{\nu p + \bar{\nu} p} - C_{2,L}^{\nu p - \bar{\nu} p}, \quad \delta C_3 = C_3^{\nu p - \bar{\nu} p} - C_3^{\nu p + \bar{\nu} p}. \tag{2.2}$$

The signs are chosen such that the differences are always ‘even – odd’ in the moments N accessible by the OPE, and it is understood that the $d^{abc} d_{abc}$ part of $C_3^{\nu p + \bar{\nu} p}$ [11, 9] is removed before the