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PDFLIB: Nucleon, Pion and Photon Parton Density Functions and alpha(s) Calculations

User's Manual

Version 7.09

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A complete manual in PostScript format exists on a separate file
Requests can be addressed to the CERN Program Library Office

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Abstract

This document describes an integrated package of Parton Density Functions called PDFLIB which has been added to the CERN Program Library Pool W999 and is labelled as W5051. In this package all the different sets of parton density functions of the NUCLEON, the PION and the PHOTON which are available today (about 100 different sets) have been put together. All these sets have been combined in a consistent way such that they all have similar calling sequences and no external data files have to be read in anymore. A default set has been prepared, although those prefering their own set or wanting to test a new one may do so within the package. The selection mode, the program parameters as well as the possibilities to modify the defaults and to control errors occured during execution are described.

The package offers as well a program to calculate the strong coupling constant alpha(s) to first or second order (default). The correct Lambda(QCD) associated to the selected set of structure functions and the number of allowed flavours with respect to the given Q**2 is automatically used in the caculation. For those structure functions where the evolution has been performed to leading order only, an alpha(s) value fixed to first order is returned.

The package is written in standard FORTRAN-77 and is available on all CERN system areas.

Submitter: H. Plothow-Besch/CERN-PPE
Language: FORTRAN 77
Library: PDFLIB

PDFLIB - User's Manual

CERN Computer Program Library entry W5051

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PROGRAM SUMMARY

Titel of Program : PDFLIB, version 7.09

Catalogue number : W5051 in the CERN Computer Program Library

Program obtainable from : CERN Computer Program Library Office

Computer for which the program is designed and others on which it has been tested:
Computer : IBM 3090, VAX, IBM-RISC, DECS, SUN, APOLLO, HP-UX, Silicon Graphics, NEXT, CDC, CRAY, IBM-PC

Operating systems : VM/CMS, VAX/VMS, Unix, Windows NT

Programming language used : FORTRAN 77, program is available in the CVS format

Number of lines in distributed progam, including test data, etc : 192 000

Memory required, including testprograms and some documentation : 25 Mbytes
(Source code: 10 Mbytes, Library: 10 Mbytes)

No. of bits in a word : 64

Peripherals used : line printer (optional)

Keywords : parton density functions, structure functions, W5051, nucleon-, proton-, pion-, photon density parametrisations, Altarelli-Parisi equation, strong coupling constant alpha(s)

Nature of physical problem :
All theoretical calculations of cross sections involving the hadronic structure of the incoming particles, i.e. protons, pions or photons, use the parton density at a given longitudinal momentum X of the parton and at a given momentum transfer Q**2. There is a variety of parametrisations available, but each of them has its own structure for input and/or output.

Method of solution :
Collection of all available parton density parametrisations and application in an identical format for all of them, regardless of the author's convention or of the particle type.

References :
[1] H. Plothow-Besch, 'PDFLIB: Structure Functions and alpha(s) Calculations', User's Manual - Version 1.00, W5051 PDFLIB, 1991.03.21, CERN-PPE.
[2] H. Plothow-Besch, 'PDFLIB: a library of all available parton density functions of the nucleon, the pion and the photon and the corresponding alpha(s) calculations', Comp. Phys. Comm. 75 (1993) 396-416.
[3] H. Plothow-Besch, 'The Parton Distribution Function Library', Int. J. Mod. Phys. A10 (1995) 2901-2910.

```
1*********************************************************************
 *                                                                   *
 *  0.  Major Differences compared to earlier Versions               *
 *                                                                   *
 *                                                                   *
 *  0.1  The actual Version 7.09 wrt Version 6.00:                   *
 *                                                                   *
 *                                                                   *
 *     The following major changes compared to version 6.00 of PDFLIB *
 *  have been implemented:                                           *
 *                                                                   *
 *  Several NUCLEON structure function sets have been added:         *
 *                                                                   *
 *    - the NLL sets A of Martin Roberts and Stirling (MRS-A lQ) for *
 *      low Q**2 of May 1995 in the DIS and the MS_bar renormalisation *
 *      schemes, as well as the NLL sets A' for 6 different values of *
 *      alpha_s (MRS-Ap-150, MRS-Ap-201, MRS-Ap-266, MRS-Ap-344,     *
 *      MRS-Ap-435, MRS-Ap-542), the J and J' sets (MRS-J and MRS-Jp) *
 *      of May 1996 which include the high p_T-jet data of the TEVA- *
 *      TRON, and the latest MRS sets R1 to R4 (MRS-R1, MRS-R2,      *
 *      MRS-R3, MRS-R4) of May 1996 with grid data as well as in its *
 *      parametrized form (MRS-R1-F) and (MRS-R2-F);                 *
 *    - version 4 of the CTEQ group of June 1996 as NLL parametrisa- *
 *      tion in the $\overline{MS}$ as well as in the DIS renormalisa- *
 *      tion scheme and as LO (CTEQ4M, CTEQ4D, CTEQ4L), the CTEQ4M set *
 *      for 5 different values of alpha_s (CTEQ4A1, CTEQ4A2, CTEQ4A3, *
 *      CTEQ4A4, CTEQ4A5), a set which includes the high $p_T$-jet   *
 *      data of the TEVATRON (CTEQ4HJ), and a set for low Q**2       *
 *      (CTEQ4lQ);                                                   *
 *    - the new sets of Gl"uck, Reya, Stratmann and Vogelsang as LO  *
 *      and of August 1995 as NLL in the MS_bar renormalisation scheme *
 *      of polarized parton distributions in a 'standard' and a      *
 *      'valence' fit version (GRSVpolS, GRSVpolV). A special COMMON *
 *      block (COMMON /GRSVA1/ A1P, A1N, A1D) transmits directly the *
 *      spin asymmetries of the proton, the neutron and the deuteron. *
 *                                                                   *
 *  A NEW GROUP of authors of PHOTON structure function sets has been *
 *  added:                                                           *
 *                                                                   *
 *    - the 4 old LO sets of Schuler and Sjostrand of March 1995, as *
 *      well as the 4 LO sets of their revised version of May 1996   *
 *      (SaS-G-1D, SaS-G-1M, SaS-G-2D, SaS-G-2MD).                   *
 *                                                                   *
 *  Several new PHOTON structure function sets have been added:      *
 *                                                                   *
 *    - the recent LO set of Gl"uck, Reya and Stratmann of February  *
 *      1996 (GRS-G);                                                *
 *    - the recent LO and HO sets of Gordon and Storrow of August 1996 *
 *      (GS-G-LO, GS-G-HO).                                          *
 *                                                                   *
 *  To take into account the need for more input parameters for parton *
 *  densities of the photon a NEW SUBROUTINE STRUCTP has been added  *
 *  which should be called instead of STRUCTM in case of applications *
 *  of the photon.                                                   *
 *                                                                   *
 *  Several CORRECTIONS to existing structure function sets have been *
 *  performed:                                                       *
 *                                                                   *
 *    - to account for heavy quark contributions (c and b) in the    *
 *      nucleon parton densities of Gl"uck, Reya and Vogt (GRV94),   *
 *      now automatically the OLD GRV parton densities of 1992 are   *
 *      called for c and b quarks as advised in their paper;         *
 *    - corrections for LINNUX-systems suggested by V. Balashov have *
 *      been taken into account.                                     *
 *                                                                   *
 *  A BUG in the data tables for the parton densities of the photon of *
 *  the set of Aurenche, Fontannaz and Guillet (AFG-G) has been fixed. *
 *                                                                   *
 ******************************** - 4 - ***************************
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1*********************************************************************
 *                                                                   *
 *    More details can be found on the next pages of this updated    *
 *  User's Manual.                                                   *
 *                                                                   *
 *    The response from the Physics community has been very satis-   *
 *  factory, which is encouraging us to keep up-to-date with the     *
 *  latest developments in this area. The author will be pleased to  *
 *  learn about new parton density functions, as well as to receive  *
 *  suggestions to improve both, the usage and the documentation.    *
 *  Please send your comments to plothow@mail.cern.ch.               *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *  0.2  Version 6.00 wrt Version 5.00:                              *
 *                                                                   *
 *                                                                   *
 *     The following major changes compared to version 5.00 of PDFLIB *
 *  have been implemented:                                           *
 *                                                                   *
 *  Several NUCLEON structure function sets have been added:         *
 *                                                                   *
 *    - the NLL sets A' and G of Martin, Roberts and Stirling (MRS-Ap) *
 *      and (MRS-G) of February 1995 with grid data as well as in its *
 *      parametrized version (MRS-Ap-F) and (MRS-G-Fit),             *
 *    - the version 3 of the CTEQ group of October 1994 as NLL parame- *
 *      trisation in the MS_bar as well as in the DIS renormalisation *
 *      scheme and as LO (CTEQ3M, CTEQ3D, CTEQ3L),                   *
 *    - the new sets of GRV of November 1994 as NLL in the MS_bar as *
 *      well as in the DIS renormalisation scheme and as LO GRV      *
 *      (GRV94-MS, GRV94DI, GRV94-LO).                               *
 *                                                                   *
 *  A NEW group of PHOTON structure function sets have been added:   *
 *                                                                   *
 *    - the six NLL sets of the WHIT group (WHIT1-G to WHIT6-G).     *
 *                                                                   *
 *  Please note that as new the default set the MRS set (G) has been *
 *  chosen (NPTYPE = 1, NGROUP = 3, NSET = 41).                      *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *  0.3  Version 5.00 wrt Version 4.00:                              *
 *                                                                   *
 *                                                                   *
 *     The following major changes compared to version 4.00 of PDFLIB *
 *  have been implemented:                                           *
 *                                                                   *
 *  NUCLEON structure function sets have been added:                 *
 *                                                                   *
 *    - the NLL set A of Martin, Roberts and Stirling (MRS-A) and the *
 *      parametrized version (MRS-A-Fit)                             *
 *  PHOTON structure function sets have been added:                  *
 *    - the NLL set of Aurenche, Fontannaz and Guillet (AFG-G).      *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *  0.4  Version 4.00 wrt Version 3.00:                              *
 *                                                                   *
 *                                                                   *
 *     The following major changes compared to version 3.00 of PDFLIB *
 *  have been implemented:                                           *
 *                                                                   *
 *  NUCLEON structure function sets have been updated or added:      *
 *                                                                   *
 *                                                                   *
 ******************************** - 5 - ***************************
```

```
1**********************************************************************
 *                                                                    *
 *    - the updated NLL sets of Martin, Roberts and Stirling (MRS) of *
 *      November 1992, the sets S0', D0' and D-' in the MSbar as well *
 *      as the sets S0', D0' and D-' in the DIS renormalisation       *
 *      scheme. Please note that the previous S0, D0 and D- sets have *
 *      been retracted by the authors. The new MRS(H) set in both     *
 *      schemes have also been added,                                 *
 *    - the NLL and LO sets of the CTEQ collaboration (CTEQ) in its   *
 *      parametrised form of January 1993. These are the sets 1M, 1MS *
 *      and 1ML in the MSbar, the set 1D in the DIS renormalisation   *
 *      scheme and the LO set 1L,                                     *
 *    - the new NLL sets A and B of Berger and Meng (BM) of           *
 *      February 1993 with special gluon distributions, and finally   *
 *    - the new NLL and LO sets of the CTEQ collaboration (CTEQ) in   *
 *      its parametrised form of August 1993. These are the sets 2M,  *
 *      2MS, 2MF and 2ML in the MSbar, the set 2D in the DIS renorma- *
 *      lisation scheme and the LO set 2L. The revised CTEQ2 version, *
 *      CTEQ2p, of November 1993 is recommended by the authors.       *
 *                                                                    *
 *  Please note that the default set has been put to the GRV set HO   *
 *  (NPTYPE = 1, NGROUP = 5, NSET = 3 / former MODE = 72).            *
 *                                                                    *
 *  The MOST DRASTICAL change of the package has been, however, the   *
 *  NEW FORMAT of PARAMETER SETTINGS. Instead of using only ONE para- *
 *  meter (MODE) to select a set of parton density functions (PDF),   *
 *  each PDF set is now identified by THREE parameters. These are     *
 *  NPTYPE, NGROUP and NSET, for PARTICLE TYPE (Nucleons, Pions or    *
 *  Photons) AUTHOR GROUP (f.ex. MRS, CTEQ, GRV, etc) and the PARAME- *
 *  TRISATION SET within the group. Therefore the user should provide *
 *  THREE parameters (NPTYPE, NGROUP, NSET) to the subroutine PDFSET, *
 *  each time a PDF set shall be selected. But to make life nice and  *
 *  easy, it is also possible to select a PDF set by transferring only*
 *  ONE parameter to PDFSET as before: this parameter should then     *
 *  identify the NAME of the author group in an unequivocal way; the  *
 *  selection of the PDF set within the author group is made by the   *
 *  corresponding VALUE value (f.ex. PARM(1) = 'MRS' with VALUE(1) =  *
 *  29.0D0 would select the 29th set of the Nucleon PDFs of MRS, and  *
 *  f.ex. PARM(1) = 'GRVph' with VALUE(1) = 1.0D0 would select the    *
 *  first set of the Photon PDFs of GRV). As a suggestion, the NAME for*
 *  each PDF set can be found in the NEW COMMON block /W505110/SFNAME, *
 *  where SFNAME is a CHARACTER*8 array with dimension SFNAME(NPTYMX, *
 *  NGRMAX,NSETMX), and NPTYMX, NGRMAX, NSETMX are defined by the     *
 *  parameter sequence, +SEQ, W5051P2. In case the user wants to se-  *
 *  lect the DEFAULT, it is sufficient to transfer as the ONLY parame-*
 *  ter PARM(1) = 'Nset' with VALUE(1) = 0.0D0. This change of format *
 *  had been necessary to take into account the inflationary growing  *
 *  number of PDFs until now and to foresee already the possibility of*
 *  adding new PDFs in a more flexible way. Please note that in case  *
 *  of any INCONSISTANCY of parameter settings, the DEFAULT setting is*
 *  always chosen.                                                    *
 *                                                                    *
 *  WARNING : Please also note that the internal COMMON block /W50511/*
 *  has been modified to /W50511/ NPTYPE,NGROUP,NSET,MODE,NFL,LO,TMAS.*
 *                                                                    *
 *  A new feature, PDFLIB in quiet mode, has been implemented. If the *
 *  user does not want to see any output from PDFLIB, not even the    *
 *  version number, he/she must set the parameter PARM(1)='first' with*
 *  value VAL(1)=0.D0. Under this condition any output is suppressed. *
 *                                                                    *
 *  Full backward compatibility with previous versions is ensured !!  *
 *  This means that old programs using PDF sets up to version 3.00 of *
 *  PDFLIB should run without ANY change. To ensure this, four new    *
 *  COMMON blocks have been added:                                    *
 *                                                                    *
 *    - /W50519/ NEWVER :  to flag the NEW/OLD version with the       *
 *      LOGICAL variable NEWVER,                                      *
 *                                                                    *
 ********************************** - 6 - ***************************
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1**********************************************************************
 *                                                                    *
 *    - /W505120/ NPGSMX(NPTYMX,NGRMAX),NSETFL(NPTYMX,NGRMAX,NSETMX) : *
 *      to provide the actual maximum number of parametrisation sets  *
 *      per particle type and author group, and to flag the retracted *
 *      PDF sets (NSETFL(I,J,K) = 0),                                 *
 *    - /W505121/ NPTYCR(MODEMX),NGROMX(MODEMX),NSETCR(MODEMAX) :     *
 *      to provide the cross reference to the NPTYPE, NGROUP and NSET *
 *      value (NEW format) for a given MODE value (OLD format),       *
 *    and                                                             *
 *    - /W505122/ MODECR(NPTYMX,NGRMAX,NSETMX) :  to provide the      *
 *      cross reference to the MODE value (OLD version) for a given   *
 *      NPTYPE, NGROUP and NSET value (NEW format). In case of the    *
 *      above added PDF sets NO MODE value is available; in that case *
 *      MODECR(I,J,K) = -1 is returned.                               *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *  0.5  Version 3.00 wrt Version 2.00                                *
 *                                                                    *
 *                                                                    *
 *     The following major changes compared to version 2.00 of PDFLIB *
 *  had been implemented:                                             *
 *                                                                    *
 *  NUCLEON structure function sets had been updated or added:        *
 *                                                                    *
 *    - the NLL set of Aurenche et al. (ABFOW),                       *
 *    - the updated NLL set of Kwiecinski, Martin, Roberts and        *
 *      Stirling (KMRS) set B0 with u_bar not equal to d_bar          *
 *      of April 1992,                                                *
 *    - the new NLL sets of Martin, Roberts and Stirling (MRS)        *
 *      set S0, D0 and D- with u_bar not equal to d_bar of April 1992.*
 *                                                                    *
 *  Please note that the default set had been put to the MRS set S0   *
 *  (MODE = 45).                                                      *
 *                                                                    *
 *  PION structure function sets had been added:                      *
 *                                                                    *
 *    - the new LO and NLL sets of Gl"uck, Reya and Vogt (GRV-P)      *
 *      of August 1991,                                               *
 *    - the new sets 2 and 3 of Aurenche et al. (ABFKW-P).            *
 *                                                                    *
 *  Please also note that the ABFKW set had changed MODE number from  *
 *  110 -> 180, as well as the SMRS sets from 120ff -> 130ff, and     *
 *  that earlier inconsistencies in the parton density definitions    *
 *  had been corrected.                                               *
 *                                                                    *
 *  For the first time also PHOTON structure function sets had been   *
 *  added to the package. These sets were the following:              *
 *                                                                    *
 *    - the old Duke and Owens (DO-G) LO and NLL sets,                *
 *    - the old LO sets 1 to 4 of Drees and Grassie (DG-G),           *
 *    - the new LO sets 1 to 3 of Abramowicz, Charchula and Levy      *
 *      (LAC-G),                                                      *
 *    - the new LO sets 1 and 2 and the NLL set of Gordon and Storrow *
 *      (GS-G) of July 1991,                                          *
 *    - the new LO and NLL sets, as well as the leading term of the   *
 *      NLL calculation of Gl"uck, Reya and Vogt (GRV-G)              *
 *      of December 1991,                                             *
 *    - the new NLL sets of Aurenche et al. (ACFGP-G) of April 1992.  *
 *                                                                    *
 *  Some improvements in the usage of the package had been made:      *
 *                                                                    *
 *    - more protections had been implemented and inconsistencies     *
 *      had been corrected to make the package more robust and        *
 *      available on ALL system areas, and finally                    *
 *                                                                    *
 ********************************** - 7 - ***************************
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- the subroutine STRUCTM had been added. STRUCTM is basically the same routine as the old steering subroutine STRUCTF apart from ONE additional parameter in the argument list which had been added to transfer separately the parton densities for u_bar and d_bar. The argument list of the subroutine STRUCTF was as before; in case of STRUCTF sea = (u_bar + d_bar)/2 is transferred. The subroutine PFTOPDG, which is the sterring routine in PDG format, was unchanged; this routine always transferred u_bar and d_bar separately.

0.6 Version 2.00 wrt Version 1.00

The following major changes compared to version 1.00 of PDFLIB had been implemented:

New parton density functions of the NUCLEON had been added:

- the old LO set of Buras and Gaemers of 1978 (BEBC) for completeness,
- all the LO sets of Diemoz, Ferroni, Longo and Martinelli (DFLM) including their parametrisation for the NLL average fit,
- the new LO set 1.1 of Owens (DO 1.1) of June 1991,

and finally

- the new LO and NLL sets of Gl"uck, Reya and Vogt (GRV) of May 1991.

PION structure function sets had been added to the package:

- the old Owens (OW-P) sets 1 and 2,
- the newer Aurenche et al. (ABFKW-P) set and
- the new Sutton, Martin, Roberts and Stirling (SMRS-P) sets 1, 2 and 3.

Some improvements in the usage of the package had been made:

- COMMON block names had been changed to avoid interference to those defined by the user (/IMODE/ -> /W50511/, /ALAMB/ -> /W50512/),
- three new COMMON blocks had been added:
  a) /W50513/ XMIN,XMAX,Q2MIN,Q2MAX : to provide the minimum and maximum values of X and Q**2 for each set of structure functions,
  b) /W50510/ IFLPRT : to provide a print flag at different levels to print
     b.1) the variables of the three COMMON blocks /W50511/, /W50512/ and /W50513/ at job initialisation
     b.2) error messages during job execution
  c) /W50514W/ PDFWGT : to take into account the event weight for error counting
- a subroutine PDFSTA had been added to allow at job termination for a summary how often X and Q**2 limits have been exceeded,
- the MODE number of some structure functions had been changed to keep consistensy,
- the number of parameters which can be set through the subroutine PDFSET had been extended to 20,
- more protections had been implemented and inconsistencies had been corrected to make the package more robust,

and finally

- a subroutine PFTOPDG had been provided as an interface for those users who prefer the flavour code convention of the PDG instead of the PDFLIB format.

1. The Library of Parton Densities: PDFLIB

1.1. Introduction

Perturbative QCD describes the Q^2 dependence of the parton densities through the solution of the Altarelli-Parisi equations. Its predictive power is given by the universality of these densities. Usually these densities are extracted from precision measurements in fixed-target experiments of a given process at some scale - recently they have also been extracted from the HERA ep-collision experiments -, and then used to perform calculations for different reactions in an extrapolated range of Q^2 provided that the elementary cross sections at the parton level are known. To be able to predict cross sections for a wide range of hard scattering processes, it is of fundamental importance to have a reliable and precise set of parton density distributions, together with a precise value of the strong coupling constant alpha_s. Therefore the momentum distributions of quarks and gluons are key ingredients for the lepton-lepton, lepton-hadron and hadron-hadron collider phenomenology, whenever the hadronic structure of nucleons, pions or photons is involved. Apart from the obvious applications mentioned above, the study of parton distributions provides also information about flavour dependence, isospin symmetry, partons in nuclei, sum rules, polarized parton distibutions, etc.. For any application the parton densities should therefore be sufficiently well known, and the different sets should be easily accessible.

1.2. Structure Functions of the Nucleon

The number of sets of parton density functions of the NUCLEON available today is about 70 and is still growing. The older sets are leading order (LO) evolutions of the Altarelli-Parisi equations only, like

- Buras and Gaemers (BEBC) [1],
- Owens and Reya (OR) [2],
- Baier, Engels and Petersson (BEP) [3],
- Gl"uck, Hoffmann and Reya (GHR) [4],
- Duke and Owens (DO) sets 1 and 2 [5],
- Eichten, Hinchliffe, Lane and Quigg (EHLQ) sets 1 and 2 [6],
- Diemoz, Ferroni, Longo and Martinelli (DFLM) [7] with Lambda_4(QCD) = 200 MeV for soft and hard valence quark and soft and hard gluon distributions],

and

- the set 1.1 of Owens (DO 1.1) [8], replacing the DO [5] sets 1 and 2.

Most of the sets, essentially the more recent ones, are next-to-leading order evolutions, like

- Diemoz, Ferroni, Longo and Martinelli (DFLM) with Lambda_4(QCD) = 160, 260, 360 MeV [7],
- Martin, Roberts and Stirling (MRS) sets 1 to 3, sets E and B and sets E' and B' [9],
- Harriman, Martin, Roberts and Stirling (HMRS) sets E, E+, E- and B [10],

- Kwiecinski, Martin, Roberts and Stirling (KMRS) [11] sets B0 and B-, and for the B- set with different radii for shadowing,
- Martin, Roberts and Stirling (MRS-B Lambda) [11] for the B0 set also with different values of Lambda_4(QCD) = 135, 160, 200 and 235 MeV,
- Martin, Roberts and Stirling (MRS) [12] sets S0, D0 and D- as well as the upgraded KMRS set B0, all having u_bar not equal to d_bar,
- Morfin and Tung (MT) sets 1 to 6 [13],
- Gl"uck, Reya and Vogt (GRV) [14] including their new parametrisation from August 1991,
- the set of Aurenche et al. (ABFOW) [15],
- the upgraded Martin, Roberts and Stirling (MRS) [16] sets S0', D0' and D-' as well as the more recent MRS(H) set, all in both, the MS_bar and the DIS renormalisation schemes,
- the upgraded Martin, Roberts and Stirling (MRS) [17] sets S0', D0' and D-' in the DIS renormalisation scheme and MRS(H),
- the Berger and Meng (BM) [17] sets 1 and 2 with special gluon distributions,
- the two first versions of the CTEQ collaboration (CTEQ1 and CTEQ2) [18],
- the set of Martin, Roberts and Stirling (MRS-A) [19] in form of a grid and in form of a parametrisation,
- the two sets of Martin, Roberts and Stirling (MRS-A' and MRS-G) [20] in form of a grid and in form of a parametrisation,
- the third versions of the CTEQ collaboration (CTEQ3) [21],
- the 1994 set of Gl\"{u}ck, Reya and Vogt (GRV) [22],
- the recent sets of Martin, Roberts and Stirling for low Q^2 (MRS-A lQ) [23] and the MRS-A' sets for 6 different values of alpha_s (MRS-Ap-150 to MRS-Ap-542) [24],
- the more recent sets of Martin, Roberts and Stirling (MRS-J and MRS-Jp) [25] and the latest sets R1 to R4 (MRS-R1 to MRS-R4) [26] in form of a grid and in form of a parametrisation,
- the fourth versions of the CTEQ collaboration (CTEQ4) [27],

and finally

- the LO and NLL sets of Gl\"{u}ck, Reya, Stratmann and Vogelsang (GRSV) [28] of polarized parton densities,

The different NLL sets use either the DIS [44] or the MS_bar renormalisation scheme. Some of the sets are available in both renormalisation schemes. All sets are made using four flavours in the initial state (NF = 4). The value of the QCD scale factor, Lambda_4(QCD), ranges from 45 to 500 MeV.

A summary of all parton density functions of the NUCLEON available in the package can be found in Table 1.

1.3. Structure Functions of the Pion

There is also a limited number of parton density functions of the PION available. These are the old set to leading order evolution of

- Owens (OW-P) [29], sets 1 and 2,

and the next-to-leading order evolutions of

- Aurenche et al. (ABFKW-P) [30], sets 1, 2 and 3,
- Sutton, Martin, Roberts and Stirling (SMRS-P) [31], sets 1, 2 and 3 and
- Gl"uck, Reya and Vogt (GRV-P) [32], the LO and NLL sets.

A summary of all parton density functions of the PION availble in the package can be found in Table 2.

1.4. Structure Functions of the Photon

In addition there are also a few parton density functions of the PHOTON available. These are the old sets to leading order evolution of

- Duke and Owens (DO-G) (and the NLL) [33] using an asymptotic solution of the Altarelli-Parisi equation,
- Drees and Grassie (DG-G) sets 1 to 4 [34] using a full solution of the Altarelli-Parisi equation,
- Abramowicz, Charchula and Levy (LAC-G) [35] sets 1 to 3 using a full solution of the Altarelli-Parisi equation,

and of

- Watanabe, Hagiwara, Izubuchi and Tanaka (WHIT1 to WHIT6) [36],

and the next-to-leading order evolution of

- Gordon and Storrow (GS-G) [37], the LO sets 1 and 2 and the NLL set,
- Gl"uck, Reya and Vogt (GRV-G) [38], the LO, NLL and the leading term of the NLL sets,
- Aurenche et al. (ACFGP-G) [39] sets 1 and 2, without and with massive charm,

and finally

- _ the LO and NLL sets of Aurenche, Fontannaz and Guillet, (AFG-G) [40].

Recently new sets of of the parton densities of the photon have been come out:

- Schuler and Sjostrand (SaS-G) [41],
- the new sets of Gl"uck, Reya and Stratmann (GRG-G) [42], and
- the new sets LO and NLL of Gordon and Storrow (GS-G) [43].

A summary of all parton density functions of the PHOTON available in the package can be found in Table 3.

1.5 The Library PDFLIB

We have put together all these different sets of parton density functions in ONE SINGLE PACKAGE [45]. This library PDFLIB can be found in and obtained from the CERN Computer Program Library under the registration number W5051.

Please notice that the use of the PDFLIB library does not prevent to consult the publications of the different authers, which can be found in the bibliography of this manual, for details about each parton density function.

We have modified the sets such that NO external data files for the grids have to be read in anymore. All these structure function sets have been combined in a consistent way such that they all appear in an IDENTICAL STRUCTURE to the user. The selection is made via THREE parameters, NPTYPE, NGROUP and NSET, which identify a PDF set by its PARTICLE TYPE (Nucleon: NPTYPE = 1, Pion: NPTYPE = 2, Photon: NPTYPE = 3), its AUTHOR GROUP (f.ex. MRS: NGROUP = 3, CTEQ: NGROUP = 4, GRV: NGROUP = 5) and its PDF SET WITHIN THE GROUP (NSET = 1,2,3 etc.). These parameters should be set with a call to subroutine PDFSET at the initialization phase. A simple SUBROUTINE call, which is IDENTICAL for all applications (nucleons, pions, photons) returns the parton densities for all partons (u, d, s, c, b, t, gluon and their antiquarks) at a given X value (where X is the fraction of the longitudinal momentum carried by the parton) and the Q-scale SCALE (in GeV). A DEFAULT set has been prepared, although those preferring their OWN PRIVATE set or wanting to test a NEW one may do so within the package. Error control can be obtained by setting a print flag to obtain output either during execution and/or as a summary at job termination via a call to the subroutine PDFSTA.

The source code of the different parton density sets has been modified in such a way that the library can be used on all the different computer systems known today. Full backward compatibility will always be assured. PDFLIB has been run under different operating systems like VM/CMS, VAX/VMS and ULTRIX without problems. The library has been tested on the different system areas to ensure identical results within the given machine precision. The program has been run and tested on the following computers: IBM 3090, VAX, IBM-RISC, DECS, SUN, APOLLO, HP-UX, Silicon Graphics, CDC, CRAY, IBM-PC. The programming language is FORTRAN 77. The actual source code manager system used is CVS. The required memory storage including testprograms and some documentation is about 25 Mbytes. The latest edition (July 1997) is version 7.09 and can be requested from the CERN Computer Program Library. To run PDFLIB a link to the CERN library (PACKLIB, MATHLIB and KERNLIB) is required.

1.6. Calculation of the Stroing Coupling constant alpha(s)

Within the SAME package a program is also provided to calculate the strong coupling constant alpha(s) to second order (default) or to first order (by user's choice). The correct Lambda(QCD) associated to the selected set of structure functions and the number of allowed flavours with respect to the given Q**2 is automatically used in the calculation. For those structure functions where the evolution has been performed to leading order only, the alpha(s) value to first order is returned.

2. Application of the Parton Density Package PDFLIB

In the following the use of and the access to the PDFLIB package is described.

2.1 Parameter Setting and Selection of Sets

To access his/her preferred set of structure functions the user must define the THREE parameters, NPTYPE, NGROUP and NSET, which identify each set of parton density functions via a call to the subroutine

```
      CALL PDFSET(PARM,VALUE)
```

at the initialization phase of his/her MAIN program, or use the package as a 'black box' with the default values (see below). An example of the application of PDFLIB is given in the appendix. The arguments PARM and VALUE are VECTORS of DIMENSION 20 and have the following meaning

```
      PARM(I)  = character*20 variable, which defines in any order
                 the variables
                 'NPTYPE', 'NGROUP', 'NSET', 'MODE', 'INIT0',
                 'NFL', 'LO', 'TMAS', 'QCDL4', 'QCDL5' and
                 'XMIN', 'XMAX', 'Q2MIN', 'Q2MAX'
      VALUE(I) = the corresponding numerical value of the variable
                 PARM(I)
                 (TMAS, QCDL4, QCDL5, XMIN, XMAX, Q2MIN and Q2MAX
                 are DOUBLE PRECISION variables),
```

where

```
      NPTYPE = number of particle type ranging from 1 to 3
               (Nucleons: NPTYPE = 1, Pions: NPTYPE = 2 and
                Photons: NPTYPE = 3)
               (Default: NPTYPE = 1)
      NGROUP = number of author group ranging from 1 to 9
               (Default: NGROUP = 3)
      NSET   = number of a selected structure function set within
               the author group ranging from 1 to 58
               (Default: NSET = 41)
     (MODE   = number of a selected structure function set ranging
               from 0 to 281 - OLD format !!)
               (Default: MODE = 45)
      INIT0  = in case of PARM(1) = 'INIT0' PDFSET fills as the
               only action the COMMON blocks /W505110/, /W505120/
               /W505121/ and /W505122/
      NFL    = desired number of flavours in the alpha(s) calcula-
               tion ranging from 3 to 6
               (Default: NFL = 5)
      LO     = order of alpha(s) calculation; if LO = 1, alpha(s)
               to first order only
               (Default: LO = 2)
      TMAS   = the user defined value of the top-quark mass in
               GeV/c**2 (optional)
               (Default: TMAS = 180.0D0)
      QCDL4  = QCD scale, Lambda_4(QCD), in GeV for four flavours
      QCDL5  = QCD scale, Lambda_5(QCD), in GeV for five flavours
               corresponding to QCDL4
```

and

```
1*********************************************************************
 *                                                                   *
 *       XMIN   = minimum allowed X value                            *
 *       XMAX   = maximum allowed X value                            *
 *       Q2MIN  = minimum allowed Q**2 value (in (GeV/c)**2)         *
 *       Q2MAX  = maximum allowed Q**2 value (in (GeV/c)**2)         *
 *                                                                   *
 *  for each set of structure functions.                             *
 *                                                                   *
 *     Please also note that PDFSET can be called as often as the user *
 *  likes. In order to redefine the parameters to select other sets of *
 *  structure functions which the user wants to investigate, it might  *
 *  be necessary to call PDFSET in an alternating way, but it is al-   *
 *  ways mandatory to transfer either the THREE parameters, NPTYPE,    *
 *  NGROUP, NSET, or the 'NAME' of the author group with their corres- *
 *  ponding VALUE values. The subroutine PDFSET fills the internal     *
 *  COMMON blocks                                                    *
 *                                                                   *
 *       COMMON/W50511/ NPTYPE,NGROUP,NSET,MODE,NFL,LO,TMAS          *
 *       COMMON/W50512/ QCDL4,QCDL5                                  *
 *       COMMON/W50513/ XMIN,XMAX,Q2MIN,Q2MAX                        *
 *                                                                   *
 *  at the time the routine is called. Please note that in case of a   *
 *  multiple call to PDFSET with fewer parameters redefined than in a  *
 *  preceeding call, always the last parameters are kept in memory.    *
 *  All variables of the three COMMON blocks can be automatically      *
 *  printed at job initialisation by setting the print flag IFLPRT in  *
 *  the COMMON block                                                 *
 *                                                                   *
 *       COMMON/W50510/ IFLPRT                                       *
 *                                                                   *
 *  to IFLPRT = 2.                                                   *
 *                                                                   *
 *     The program is protected against calculations of Q^2 values     *
 *  below Q2MIN (in this case Q^2 = Q2MIN) and of X values in unphysi- *
 *  cal regions (X < 0 or X > 1). The execution of the program is      *
 *  stopped in the later case. To control how often the X or Q^2 ran-  *
 *  ges have been exceeded during execution of the user's program a    *
 *  call to the subroutine                                           *
 *                                                                   *
 *       CALL PDFSTA                                                 *
 *                                                                   *
 *  at the termination phase of his/her MAIN program allows to print a *
 *  summary of these errors. The print flag in the COMMON/W50510/IFLPRT*
 *  may be set to IFLPRT = 3 to print an error message EACH TIME a     *
 *  limit has been exceeded during job execution. Please note that     *
 *  this may produce an ENORMOUS AMOUNT OF OUTPUT !                  *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *  2.2  The Calling Sequence: PDFLIB Format                         *
 *                                                                   *
 *                                                                   *
 *     The main steering routine for a set of structure functions is   *
 *  accessed as follows:                                             *
 *                                                                   *
 *       CALL STRUCTM(X,SCALE,UPV,DNV,USEA,DSEA,STR,CHM,BOT,TOP,GL)  *
 *                                                                   *
 *     Please note that all variables are defined as DOUBLE PRECISION. *
 *  The user has to provide the following INPUTs:                    *
 *                                                                   *
 *       X      = X value of parton                                  *
 *       SCALE  = QCD scale in GeV                                   *
 *                                                                   *
 *     The subroutine STRUCTM returns the following OUTPUT:          *
 *                                                                   *
 ******************************* - 14 - ******************************
```



```
1*********************************************************************
 *                                                                   *
 *       UPV    = up valence quark                                   *
 *       DNV    = down valence quark                                 *
 *       USEA   = sea (up_bar)                                       *
 *       DSEA   = sea (down_bar)                                     *
 *       STR    = strange quark                                      *
 *       CHM    = charm quark                                        *
 *       BOT    = bottom quark                                       *
 *       TOP    = top quark                                          *
 *       GL     = gluon                                              *
 *                                                                   *
 *     In case up_bar is not given separately from down_bar it is set  *
 *  USEA = DSEA.                                                     *
 *                                                                   *
 *     The recommended set of structure functions from the different   *
 *  authors is put in bold characters. If NSET is set to zero (or if   *
 *  any of the parameters, NPTYPE, NGROUP or NSET, is undefined) ONE   *
 *  DEFAULT SET is selected which is always the Nucleon parton densi-  *
 *  ties, the set of MRS set G (NPTYPE = 1, NGROUP = 3, NSET = 41),    *
 *  also in case of NPTYPE = Pion or Photon.                         *
 *                                                                   *
 *     Please note that in any of the calling sequences for the        *
 *  nucleon, the pion and the photon it is always returned           *
 *  X * parton distribution function !                               *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *  2.3  The Calling Sequence: PDG Format                            *
 *                                                                   *
 *                                                                   *
 *     To allow the use of the package with the flavour code conven-   *
 *  tion of the Particle Data Group (PDG) an interface has been writ-  *
 *  ten which translates the PDFLIB format (see Section 2.2) into the  *
 *  PDG format. Instead of calling the subroutine STRUCTM the user     *
 *  preferring the flavour code convention of the PDG accesses the     *
 *  package via a call to the subroutine                             *
 *                                                                   *
 *       CALL PFTOPDG(X,SCALE,DXPDF).                                *
 *                                                                   *
 *     All variables are defined as DOUBLE PRECISION as before, and    *
 *  X and SCALE are INPUTs provided by the user having the same      *
 *  meaning as before.                                               *
 *                                                                   *
 *     The subroutine PFTOPDG outputs a vector DXPDF(-6:6) of which    *
 *  its variables have the following meaning:                        *
 *                                                                   *
 *       DXPDF(0)   = gluon                                          *
 *       DXPDF(1)   = sum of down valence + down_bar quark           *
 *       DXPDF(2)   = sum of up valence + up_bar quark               *
 *       DXPDF(3)   = strange quark                                  *
 *       DXPDF(4)   = charm quark                                    *
 *       DXPDF(5)   = bottom quark                                   *
 *       DXPDF(6)   = top quark                                      *
 *  and  DXPDF(-1) to DXPDF(-6) are the corresponding antiquarks.    *
 *                                                                   *
 *     DXPDF(-1) = DXPDF(-2) stands for down_bar = up_bar or         *
 *  (down_bar + up_bar)/2 in almost all parametrisations. In case    *
 *  where u_bar is not equal to d_bar DXPDF(-1) = d_bar and          *
 *  DXPDF(-2) = u_bar. In all sets is DXPDF(3) = DXPDF(-3),          *
 *  DXPDF(4) = DXPDF(-4), DXPDF(5) = DXPDF(-5) and                   *
 *  DXPDF(6) = DXPDF(-6) so far.                                     *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 *                                                                   *
 ******************************* - 15 - ******************************
```

```
1**********************************************************************
 *                                                                    *
 *  2.4  Error Handling                                               *
 *                                                                    *
 *                                                                    *
 *     A note of caution should be addressed here. All structure      *
 *  functions are limited in X and Q**2 which range for most of the   *
 *  sets from                                                         *
 *                                                                    *
 *       4 - 10            < Q**2 < 10**6 - 10**8 (GeV/c)**2          *
 *       10**{-5} - 10**{-4} < X < 1.                                 *
 *                                                                    *
 *     If the user wants to extend the X or Q**2 ranges, it is pos-   *
 *  sible for some of the structure function sets, but the result     *
 *  should be looked at with great caution. If in doubt, please check *
 *  with the authors of the structure function set. The program is    *
 *  protected against calculations of Q**2 values below Q2MIN (in this *
 *  case Q**2 = Q2MIN) and of X values in unphysical regions (X < 0 or *
 *  X > 1). The execution of the program is stopped in the later case. *
 *                                                                    *
 *     A COMMON block can be accessed                                 *
 *                                                                    *
 *       COMMON/W50513/ XMIN,XMAX,Q2MIN,Q2MAX                         *
 *                                                                    *
 *  where                                                             *
 *                                                                    *
 *       XMIN   = minimum allowed X value                             *
 *       XMAX   = maximum allowed X value                             *
 *       Q2MIN  = minimum allowed Q**2 value (in (GeV/c)**2)          *
 *       Q2MAX  = maximum allowed Q**2 value (in (GeV/c)**2)          *
 *                                                                    *
 *  is given for each set of structure functions. To control how often *
 *  the X or Q**2 ranges have been exceeded during execution of the   *
 *  user's program a call to the subroutine                           *
 *                                                                    *
 *       CALL PDFSTA                                                  *
 *                                                                    *
 *  at the termination phase of his/her MAIN program allows to print  *
 *  a summary of these errors. If the COMMON block                    *
 *                                                                    *
 *       COMMON/W50514W/ PDFWGT                                       *
 *                                                                    *
 *  where                                                             *
 *                                                                    *
 *       PDFWGT = weight                                              *
 *                                                                    *
 *  is filled by the user on an event-to-event basis the statistics   *
 *  in the error summary takes into account this weight.              *
 *                                                                    *
 *     The print flag in the COMMON/W50510/IFLPRT may be set to       *
 *  IFLPRT = 3 to print an error message EACH TIME a limit is exeeded *
 *  during job execution. Please note that setting this flag may pro- *
 *  duce an ENORMOUS AMOUNT of output!                                *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *  2.5  Features                                                     *
 *                                                                    *
 *                                                                    *
 *     If NPTYPE = 1, NGROUP = 1 and NSET = 1, the user has the possi- *
 *  bility to use his/her own private set of structure functions      *
 *  (i.e. CDHS effective structure functions could be inseted here,   *
 *  or the user could implement a new set of structure functions for  *
 *  testing purposes). To insert the private set the DUMMY subroutine *
 *                                                                    *
 *    SUBROUTINE STRPRIV(X,SCALE,UPV,DNV,USEA,DSEA,STR,CHM,BOT,TOP,GL) *
 *                                                                    *
 ****************************** - 16 - ********************************
```



```
1**********************************************************************
 *                                                                    *
 *  should be activated by the user. All variables have to be defined *
 *  as DOUBLE PRECISION. The variables have the same meaning as des-  *
 *  cribed for the subroutine STRUCTM in Section 2.2 (for explanations *
 *  see there).                                                       *
 *                                                                    *
 *     For the calculation of the strong coupling constant alpha(s)   *
 *  (see Section 3) with the user's private set of structure functions *
 *  the user should provide a value for the variables QCDL4 and QCDL5 *
 *  via the subroutine PDFSET at the initialization phase. In fact,   *
 *  because only the parameter QCDL5 is used in the alpha(s) calcul-  *
 *  ation, only this definition is mandatory.                         *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *                                                                    *
 *  2.6. How to find PDFLIB                                           *
 *                                                                    *
 *                                                                    *
 *     At CERN the PDFLIB library and corresponding documentation are *
 *  available on all systems in the standard areas.                   *
 *                                                                    *
 *       System            Library                                    *
 *                                                                    *
 *       VXCERN            CERN:[NEW.LIB]PDFLIB.OLB                   *
 *       Unix systems      /cern/new/lib/libpdflib.a                  *
 *                                                                    *
 *                                                                    *
 *     At CERN on Unix systems the package may be accessed via the    *
 *  'cernlib' command:                                                *
 *                                                                    *
 *    \ 'cernlib pdflib packlib mathlib kernlib' \                    *
 *                                                                    *
 *     All necessary information about PDFLIB can also be found on the *
 *  World Wide Web via the path 'CERN.Computing.CERNLIB.documentation' *
 *  or directly as                                                    *
 *                                                                    *
 *   for the flat version :                                           *
 *               http://wwwcn.cern.ch/asdoc/pdflib/pdflib.html        *
 *   or for the PostScript version :                                  *
 *               http://wwwcn.cern.ch/asdoc/psdir/pdflib.ps.gz        *
 *                                                                    *
 *     The source code of PDFLIB may be obtained from asisftp.cern.ch *
 *  via anonymous ftp with:                                           *
 *                                                                    *
 *    get   /cernlib/share/new/src/mclibs/pdf         or              *
 *    get   /cernlib/share/new/src/mclibs/pdf.tar     or              *
 *    get   /cernlib/share/new/src/mclibs/pdf.tar.gz                  *
 *                                                                    *
 *  even, if the last two files are not visible via the command 'ls'. *
 *                                                                    *
 *                                                                    *
 *     Whenever you use this program, please give reference to the    *
 *  following papers:                                                 *
 *                                                                    *
 *     H. Plothow-Besch, 'The Parton Distribution Function Library',  *
 *     Int. J. Mod. Phys. A10 (1995) 2901-2920.                       *
 *                                                                    *
 *  and/or                                                            *
 *                                                                    *
 *     H. Plothow-Besch, 'PDFLIB: A Library of all available Parton   *
 *     Density Functions of the Nucleon, the Pion and the Photon and  *
 *     the corresponding alpha_s Calculations',                       *
 *     Comp. Phys. Comm. 75 (1993) 396-416.                           *
 *                                                                    *
 *  and/or                                                            *
 *                                                                    *
 ****************************** - 17 - ********************************
```

```
1*************************************************************************
 *                                                                       *
 *     H. Plothow-Besch, 'PDFLIB: Structure Functions and alpha_s        *
 *     Calculations',                                                    *
 *     User's Manual - Version 1.00, W5051 PDFLIB,                       *
 *     1991.03.21, CERN-PPE.                                             *
 *                                                                       *
 *  and/or                                                               *
 *                                                                       *
 *     H. Plothow-Besch, 'PDFLIB: Nucleon, Pion and Photon Parton        *
 *     Density Functions and alpha_s Calculations',                      *
 *     Users's Manual - Version 7.09, W5051 PDFLIB,                      *
 *     1997.07.02, CERN-PPE.                                             *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *  3.  PION and PHOTON Parton Densities                                 *
 *                                                                       *
 *                                                                       *
 *     The calling sequences to the PION and the PHOTON sets of parton   *
 *  densities is kept identical to those described in Sections 2.2 and   *
 *  2.3 for the nucleon structure functions.                             *
 *                                                                       *
 *     In case of the PION structure functions it is set and returned    *
 *  UPV = DNV, SEA = STR (USEA = DSEA = STR) and TOP = 0                 *
 *  (DXPDF(1) = DXPDF(2), DXPDF(3) = DXPDF(-1) = DXPDF(-2) and           *
 *  DXPDF(6) = 0).                                                       *
 *                                                                       *
 *     In case of the PHOTON structure functions it is set and           *
 *  returned UPV = USEA, DNV = DSEA and TOP = 0                          *
 *  (DXPDF(1) = 2 * DXPDF(-1), DXPDF(2) = 2 * DXPDF(-2), as a result     *
 *  of the definitions - see Section 2.3 -, and DXPDF(6) = 0), while     *
 *  all the other quarks are set identical to their antiquark densi-     *
 *  ties. Note that the alpha_(QED) has to be taken care of by the       *
 *  user !                                                               *
 *                                                                       *
 *     To take into account the need for more input parameters for       *
 *  parton densities of the photon a NEW SUBROUTINE STRUCTP has been     *
 *  added which should be called instead of STRUCTM in case of appli-    *
 *  cations of the photon. Therefore, the main steering routine for a    *
 *  set of structure functions of the photon should now be accessed      *
 *  as follows:                                                          *
 *                                                                       *
 *    CALL STRUCTP(X,Q2,P2,IP2,UPV,DNV,USEA,DSEA,STR,CHM,BOT,TOP,GL)     *
 *                                                                       *
 *  Please note that all variables (INPUT and OUTPUT) are defined as     *
 *  DOUBLE PRECISION. The user has now to provide the following          *
 *  INPUTs:                                                              *
 *                                                                       *
 *     X    =  x value of parton                                         *
 *     Q2   =  QCD scale in GeV**2                                       *
 *     P2   =  virtuality of the photon in GeV**2,                       *
 *             should be = 0 for an on-shell photon                      *
 *     IP2  =  parameter to evaluate off-shell anomalous component       *
 *                                                                       *
 *     The OUTPUT parameters are defined as for STRUCTM (see             *
 *  Section 2.2).                                                        *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 ******************************** - 18 - *********************************
```



```
1*************************************************************************
 *                                                                       *
 *  4.  alpha(s) Calculation                                             *
 *                                                                       *
 *                                                                       *
 *     Within the same package a program is provided to calculate the    *
 *  strong coupling constant alpha(s) to second order as a function      *
 *  of Lambda(QCD) of five flavours and the desired number of fla-       *
 *  vours (NFL) for the selected set of structure functions, which       *
 *  fixes Lambda(QCD). The formula on which the calculations are         *
 *  based upon can be found in Ref. [46]. The same three parameters,     *
 *  NPTYPE, NGROUP and NSET, which select a structure function set,      *
 *  is used to steer the calculation of the alpha(s) value at a given    *
 *  scale from the Lambda(QCD) defined in the selected structure         *
 *  function.                                                            *
 *                                                                       *
 *      The value of alpha(s) is matched at the thresholds q = m_q.      *
 *  When invoked with NFL < 0, it chooses NFL as the number of fla-      *
 *  vours for which the masses are less then q. For the quark masses     *
 *  where thresholds are changed the following values have been used:    *
 *       m_charm = 1.5 GeV/c**2, m_bottom = 4.75 GeV/c**2 and            *
 *       m_top = 180 GeV/c**2.                                           *
 *                                                                       *
 *     The alpha(s) value can be obtained via a call to:                 *
 *       FUNCTION ALPHAS2(SCALE)                                         *
 *                                                                       *
 *     The user has to provide the following INPUT:                      *
 *                                                                       *
 *       SCALE  =  QCD scale in GeV                                      *
 *                                                                       *
 *     The function ALPHAS2 returns the following OUTPUT:                *
 *                                                                       *
 *       ALPHAS2 =  alpha strong to second order,                        *
 *                                                                       *
 *  if LO not equal to one. For those structure functions, for which     *
 *  the evolution is done to leading order only, alpha(s) to first       *
 *  order is returned.                                                   *
 *                                                                       *
 *     The same subroutine                                               *
 *                                                                       *
 *       SUBROUTINE PDFSET(PARM,VALUE)                                   *
 *                                                                       *
 *  as described in Section 2.1 should be used to change the default     *
 *  values of the variables NPTYPE, NGROUP, NSET, NFL, LO, TMAS,         *
 *  QCDL4, QCDL5, XMIN, XMAX, Q2MIN and Q2MAX.                           *
 *                                                                       *
 *     The internal COMMON block                                         *
 *                                                                       *
 *       COMMON/W50512/ QCDL4,QCDL5                                      *
 *                                                                       *
 *  where                                                                *
 *                                                                       *
 *       QCDL4  = QCD scale, Lambda_4(QCD), in GeV for four flavours     *
 *       QCDL5  = QCD scale, Lambda_5(QCD), in GeV for five flavours     *
 *                corresponding to QCDL4                                 *
 *                                                                       *
 *  provides the actual value of Lambda_4(QCD) and Lambda_5(QCD) used    *
 *  in the alpha(s) calculation for four and five flavours, respectiv-   *
 *  ly, for each set of structure functions.                             *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 *                                                                       *
 ******************************** - 19 - *********************************
```

5. Conclusions

In the Long Write-up as an example, the NUCLEON structure function distributions at the scale Q**2 = m_W**2 for up valence lence quark is shown in Figs. 1 as a function of the parton X. The average X values for CERN and FNAL as well as for LHC and SSC energies at that scale are indicated. It can be seen from that figures that there is a large spread in shape for the different sets leading to different results in a cross section calculation. It should be pointed out that the spread from the different parametrisations in the SAME renormalisation scheme is MUCH LARGER than the spread of parametrisations in different renormalisation schemes. This is valid for ALL parton densities, and in particular at small X values !

A comparison to recent data is shown in Fig. 2, where the ratio F_2(n)/F_2(p) at Q**2 = m_W**2 is displayed. Note that the older sets of structure functions, namely the set of Owens and Reya [2] and the set of Baier et al. [3] have only been implemented for completeness. These sets should not be used for cross section calculations of any hard processes at high energies anymore. From Fig. 2 we conclude that also the other older sets of structure functions, namely the two sets of Duke and Owens [5] and the two sets of Eichten et al. [6] should be used with some care, because they do not fit the recent low energy deep-inelastic lepton-nucleon data from NMC and BCDMS [47]. This is not surprising because these data were not available when the sets have been made. The new set of DO 1.1 superseeds the old DO sets 1 and 2 but still gives very limited results in the low X region, even though data are available there. We conclude that the recent sets of parton densities could be preferred for all theoretical predictions involving structure functions, because they fit the present nucleon data best.

In Fig. 3 the F_2(p) distribution of the recent data from Ref. [48] at Q**2 = 5 GeV**2, together with the recent data at Q**2 = 15 GeV**2 from the H1 and the ZEUS experiments [49] at the ep-collider HERA is shown as a function of X. Overlayed on the same Figure are a few theoretical predictions of more recent parton parametrisations [12-16] at Q**2 = 15 GeV**2. Please note that most of these parametrisations are NOT TRUE predictions because the data are fully or partially used in the fits. From Figs. 2 and 3 we conclude that the recent sets of parton densities, namely the GRV set HO [14], but also the old MT set B2 [13] - both sets are true predictions -, and the updated MRS set (H) [16], could be preferred for all theoretical predictions involving structure functions, because they fit the present data best which, at the moment,are still suffering from large uncertainties.

Figure 4 shows a comparison of F_2(\gamma)/alpha_(QED) at Q**2 = 100 GeV**2 of the different PHOTON structure function sets as a function of X. The charm quark density has been taken into account. The theoretical predictions are compared with experimental data from the JADE experiment [50] at the same Q**2 value. Because of large experimental uncertainties no distinction between the different parton density sets can be made yet.

The response from the Physics community has been very satisfactory, which is encouraging us to keep up-to-date with the latest developments in this area. Therefore, please CONTINUE SENDING YOUR FEEDBACK ON THE USAGE AND POSSIBLE IMPROVEMENTS TO US. Coming new sets of structure functions should be easily implemented in the package. Authors of {\bf new sets} are kindly asked to PROVIDE US with the RELEVANT INFORMATION. PLEASE RETURN ANY PROBLEMS, QUES-

TIONS, SUGGESTIONS FOR IMPROVEMENTS TO THE AUTHOR OF THE PACKAGE (e-mail address: plothow@mail.cern.ch).

5. Acknowledgements

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 *                                                                   *
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 *      R. Brun, O. Couet, C. Vandoni and P Zanarini;                *
 *      see also to References therein.                              *
 *                                                                   *
 *                                                                   *
 *                                                                   
```

```
Example of Fig. 1, cont'd

1000     FORMAT(/,'  X= ',F6.4,'  Q= ',F6.3,'  UPV= ',8.4)
         CALL HF1(ID+NHB,X,UPV)
10    CONTINUE
C get alpha(s) for selected set of SF at Q = SCALE
      ALF = ALPHAS2(DSCALE)
      WRITE(6,4000) NPTYPE,IGR,ISET,SFNAME(NPTYPE,IGR,ISET),
     +                MODECR(NPTYPE,IGR,ISET),NSF
      WRITE(6,4001) DSCALE,ALF
4000  FORMAT(/,'  Nptype = ',I1,'  Ngroup = ',I1,'  Nset = ',I2,
     +         '  Name = "'A8,'"  CrMode = ',I3,'  HBId = ',I3)
4001  FORMAT(1H ,' SCALE  = ',F8.4,'   alpha(s) = ',F6.4)
C get error summary for each set of SF
      CALL PDFSTA
   ENDDO
20 CONTINUE
C
   STOP
   END




   This code will produce the following output:


       1. HBOOK Output :

   one histogram for each set of structure functions. The histo-
gram output has then been accessed, and each histogram has been
superimposed on one single frame using the PAW package [51] to
obtain Fig. 1 of the Long Write-up.


       2. Print Output (Example is given for NPTYPE = 1,
NGROUP = 3, NSET = 41 only :

 1*****  PDFLIB Version:  7.09  Released on  970702  at  16.05  in
 the CERN Computer Program Library  W5051  *****
  *****  Library compiled on  970702  at  16.05   *****

 Nucleon PDFs:  Ngroup = 3,  Nset = 41,  for MRS Set (G) Structure
                                                        Functions

 X= 0.5000  Q= 80.140  UPV=   0.1176

 Nptype = 1  Ngroup = 3  Nset = 41 Name = "MRS-G   "  CrMode =  -1  HBId = 60
 Scale  =  80.1400  alpha(s) =  0.1154

 PDFLIB : Summary from PDFSTA
 Nptype = 1  Ngroup = 3  Nset = 41  Name = "MRS-G   "  CrMode =  -1
 Nfl    = -5  LO = 2  Tmas = 180.00 GeV/c**2
 QCDL4  = 0.2550 GeV,  QCDL5 =   0.1708 GeV
 Xmin   = 0.10E-04,  Xmax =  0.99999E+00,  Q2min =  5.000 (GeV/c)**2,
   Q2max =  0.27E+10 (GeV/c)**2

 PDFSTA:    NO errors occured
```



```
Appendix B


   A list of subroutines, functions, COMMON blocks and parameters
of RELEVANCE to the user which are used in PDFLIB is given below:


   List of relevant subprograms and COMMON blocks in PDFLIB:

  (S = Subroutine, F = Function, C = COMMON, P = Parameter)
 ------------------------------------------------------------

  S  PDFSET   : to set all parameters for PDFLIB
  S  STRUCTF  : to access PDFLIB with output in PDFLIB format
  S  STRUCTM  : to access PDFLIB with output in PDFLIB format
                (with u_bar not equal to d_bar)
  S  STRUCTP  : to access PDFLIB with output in PDFLIB format
                for PHOTON structure functions
  S  PFTOPDG  : to access PDFLIB with output in PDG format
  S  PDFSTA   : to print summary of parameters and error statistics
  F  ALPHAS2  : to calculate alpha(s) to second order QCD

  C  W50510   : IFLPRT - to set print flag
  C  W50511   : NPTYPE,NGROUP,NSET,MODE,NFL,LO,TMAS
                - to select a structure function set, to
                define number of flavours, flag for leading
                order and value for the mass of the top quark
  C  W50512   : QCDL4,QCDL5 - contains Lambda_4(QCD) and
                Lambda_5(QCD) (in GeV)
  C  W50513   : XMIN,XMAX,Q2MIN,Q2MAX - contains minimum and
                maximum values of X and Q**2
  C  W50516   : FIRST - to force printing name of structure
                function set in case of multiple choices
  C  W50519   : NEWVER - flags NEW/OLD version of PDFLIB format
  C  W505110  : SFNAME - contains NAME (CHARACTER*8 array with
                dimension SFNAME(NPTYMX,NGRMAX,NSETMX)) for
                each set of PDFs
  C  W505120  : NPGSMX(NPTYMX,NGRMAX),NSETFL(NPTYMX,NGRMAX,NSETMX)
                - contains maximum number of stucture functions
                per particle type and author group, and FLAG
                for retracted PDF set (NSETFL(I,J,K) = 0),
  C  W505121  : NPTYCR(MODEMX),NGROCR(MODEMX),NSETCR(MODEMX)
                - cross reference to the NPTYPE, NGROUP and
                NSET value (NEW format) for a given MODE
                value (OLD format)
  C  W505122  : MODECR(NPTYMX,NGRMAX,NSETMX) - cross reference
                to the MODE value (OLD format) for a given
                NPTYPE, NGROUP and NSET value (NEW format)
  P  W5051P2  : MODEMX - maximum number of structure function
                sets in the OLD PDFLIB format
              : NPTYMX,NGRMAX,NSETMX - maximum number of
                structure function sets in the NEW PDFLIB
                format for particle type, author group number
                and number of sets within an author group
  P  W5051P7  : L6 - to define logical print unit number
 ------------------------------------------------------------
```

Appendix C

A complete list of subroutines, functions, COMMON blocks and parameters which are used in PDFLIB is given below:

Complete list of subprograms and COMMON blocks in PDFLIB:
(in alphabetical order)

(S = Subroutine, F = Function, C = COMMON, P = Parameter)

- S ABFKW1 : ABFKW SF set 1 in the pion (NP=2,NG=6,NS=1)
- S ABFKW2 : ABFKW SF set 2 in the pion (NP=2,NG=6,NS=2)
- S ABFKW3 : ABFKW SF set 3 in the pion (NP=2,NG=6,NS=3)
- S ACFGP1 : ACFGP SF set 1 in the photon (NP=3,NG=6,NS=1)
- S ACFGP2 : ACFGP SF set 1 in the photon (mc) (NP=3,NG=6,NS=2)
- F AFCPLU : to get PD with massive charm for ACFGP
- F AFGETFV : to interpolate PDs in grid for ACFGP
- F AFGIN2 : to interpolate PDs in grid for ACFGP
- F AFGINT : to interpolate PDs in grid for ACFGP
- F AFPOLIN : to interpolate PDs in grid for ACFGP
- F AFRATIN : to interpolate PDs in grid for ACFGP
- F ALPHAS2 : to calculate alpha(s) to second order QCD
- F AUGETFV : to interpolate logarithmically PDs in grid
- S AURGAM : to get the PDs in the photon for ACFGP-G
- S AURPI1 : to get the PDs in the pion for ABFKW-P set 1
- S AURPI2 : to get the PDs in the pion for ABFKW-P set 2
- S AURPI3 : to get the PDs in the pion for ABFKW-P set 3
- S AURPR : to get the PDs in the nucleon for ABFOW
- F BBETA : DOUBLE PRECISION beta function using DGAMMA
- F BETA : SINGLE PRECISION beta function using GAMMA
- S BXF3 : BEP SF set for up and down valence quarks
- S BXGLUE : BEP SF set for gluons
- S BXQBAR : BEP SF set for antiquarks
- F CTQ1OPD : CTEQ SF sets 1M, 1MS, 1ML, 1D and 1L
- F CTQ1OPF : Description of CTEQ sets 1M, 1MS, 1ML, 1D, 1L
- F CTQ1PD : CTEQ SF sets 1M, 1MS, 1ML, 1D and 1L
- F CTQ1PF : Description of CTEQ sets 1M, 1MS, 1ML, 1D, 1L
- F CTQ2OPD : CTEQ SF sets 2M, 2MS, 2ML, 2D and 2L
- F CTQ2OPF : Description of CTEQ sets 2M, 2MS, 2ML, 2D, 2L
- S CTQ2OPS : CTEQ SF sets 2M, 2MS, 2ML, 2D and 2L
- F CTQ2PPD : CTEQ SF sets 2pM, 2pMS, 2pML, 2pD and 2pL
- F CTQ2PPF : Description of CTEQ sets 2pM, 2pMS, 2pML, 2pD, 2pL
- S CTQ2PPS : CTEQ SF sets 2pM, 2pMS, 2pML, 2pD and 2pL
- F CTQ3PD : CTEQ SF sets 3L, 3M and 3D
- S CTQ3PDS : CTEQ SF sets 3L, 3M and 3D
- F CTQ3PF : Description of CTEQ sets 3L, 3M and 3D
- F CTQ4Fn : Description of CTEQ sets 4L, 4D, 4A1-A5, 4HJ and 4lQ
- F CTQ4PnX : CTEQ SF sets 4L, 4D, 4A1-A5, 4HJ and 4lQ
- S CTQ4RA1 : Parameters of CTEQ set 4 A1
- S CTQ4RA2 : Parameters of CTEQ set 4 A2
- S CTQ4RA4 : Parameters of CTEQ set 4 A4
- S CTQ4RA5 : Parameters of CTEQ set 4 A5
- S CTQ4RD : Parameters of CTEQ set 4 D
- S CTQ4RHJ : Parameters of CTEQ set 4 HJ
- S CTQ4RL : Parameters of CTEQ set 4 L
- S CTQ4RM : Parameters of CTEQ set 4 M
- S CTQ4RlQ : Parameters of CTEQ set 4 lQ
- F DBFINT : to interpolate linearly PDs in grid (double precision)
- S DFLM1 : interface to DFLM 160 (NP=1,NG=2,NS=7)

Complete list of subprograms, cont'd

- S DFLM2 : interface to DFLM 260 (NP=1,NG=2,NS=8)
- S DFLM3 : interface to DFLM 360 (NP=1,NG=2,NS=9)
- S DFLM4 : interface to DFLM soft valence quarks (NP=1,NG=2,NS=1)
- S DFLM5 : interface to DFLM hard valence quarks (NP=1,NG=2,NS=2)
- S DFLM6 : interface to DFLM soft gluons (NP=1,NG=2,NS=3)
- S DFLM7 : interface to DFLM hard gluons (NP=1,NG=2,NS=4)
- S DFLM8 : interface to DFLM LO average fit (NP=1,NG=2,NS=5)
- S DFLM9 : interface to DFLM NLL average fit (NP=1,NG=2,NS=6)
- S DGPHO1 : DG SF set 1 in the photon (NP=3,NG=2,NS=1)
- S DGPHO2 : DG SF set 2 in the photon (NP=3,NG=2,NS=2)
- S DGPHO3 : DG SF set 3 in the photon (NP=3,NG=2,NS=3)
- S DGPHO4 : DG SF set 4 in the photon (NP=3,NG=2,NS=4)
- S DOPHO1 : DO SF set 1 in the photon (NP=3,NG=1,NS=1)
- S DOPHO2 : DO SF set 2 in the photon (NP=3,NG=1,NS=2)
- F DPOLIN : to interpolate PDs in grid (DOUBLE PRECISION)
- S FXAVER : DFLM SF set of LO central average fit
- S FXG160 : DFLM SF set of NLL with QCDL4 = 160
- S FXG260 : DFLM SF set of NLL with QCDL4 = 260
- S FXG360 : DFLM SF set of NLL with QCDL4 = 360
- S FXGHAR : DFLM SF set of LO hard gluon
- S FXGSOF : DFLM SF set of LO soft gluon
- S FXNLLA : DFLM SF set of NLL central average fit
- S FXVHAR : DFLM SF set of LO hard valence
- S FXVSOF : DFLM SF set of LO soft valence
- F GAMFUN : to calculate GAMMA funct. in either SP or DP prec.
- F GAMMADO : to calculate GAMMA funct. in SP (Hastings)
- F GHRDV : GHR SF set for down quarks
- F GHRGL : GHR SF set for gluons
- F GHRUV : GHR SF set for up quarks
- F GHRXI : GHR SF set for antiquarks
- F GHRXS : GHR SF set for strange quarks
- F GR94FV : GRV94 SF set for up + down valence quarks + gluons
- F GR94FW : GRV94 SF set for antiquarks
- F GR94FWS : GRV94 SF set for strange quarks
- F GRSF1 : GRS SF set part1 in the photon
- F GRSF2 : GRS SF set part2 in the photon
- S GRSGALO : GRS SF set of LO in the photon (NP=3,NG=5,NS=4)
- S GRSVH1 : GRSV SF set of pol. NLL standard (NP=1,NG=5,NS=10)
- S GRSVH2 : GRSV SF set of pol. NLL valence (NP=1,NG=5,NS=11)
- S GRSVL1 : GRSV SF set of pol. LO standard (NP=1,NG=5,NS=8)
- S GRSVL2 : GRSV SF set of pol. LO valence (NP=1,NG=5,NS=9)
- S GRV94DI : GRV94 SF set of DIS in the nucleon (NP=1,NG=5,NS=7)
- S GRV94HO : GRV94 SF set of MS_bar in the nucleon (NP=1,NG=5,NS=6)
- S GRV94LO : GRV94 SF set of LO in the nucleon (NP=1,NG=5,NS=5)
- F GRVFGP : GRV SF set for gluons in the pion
- F GRVFQBP : GRV SF set for s, c and b quarks in the pion
- F GRVFV : GRV SF set for up + down valence quarks
- F GRVFVP : GRV SF set for valence quarks in the pion
- F GRVFW : GRV SF set for antiquarks and gluons
- F GRVFWS : GRV SF set for strange, charm and bottom quarks
- S GRVGAH0 : GRV SF set lead. terms of NLL in the photon (NP=3,NG=5,NS=1
- S GRVGAHO : GRV SF set of NLL in the photon (NP=3,NG=5,NS=2)
- S GRVGALO : GRV SF set of LO in the photon (NP=3,NG=5,NS=3)
- F GRVGF : GRV SF set for u and d quarks and gluons in the photon
- F GRVGFS : GRV SF set for s, c and b quarks in the photon
- S GRVHO : GRV SF set of NLL (NP=1,NG=5,NS=3)
- S GRVLO : GRV SF set of LO (NP=1,NG=5,NS=4)
- S GRVPIHO : GRV SF set of NLL in the pion (NP=2,NG=5,NS=1)
- S GRVPILO : GRV SF set of LO in the pion (NP=2,NG=5,NS=2)
- S GSXCOR : to get X coordinates for SFGSHO + LO sets 1, 2
- S GS2XCOR : to get X coordinates for SFGSHO + LO 96
- S GS96HO : GS-96 SF set of HO in the photon (NP=3,NG=4,NS=4)
- S GS96LO : GS-96 SF set of LO in the photon (NP=3,NG=4,NS=5)

Complete list of subprograms, cont'd

S	HMRS1EB	: Description of HMRS sets E, B (1.90-retracted)
S	HMRS2EB	: Description of HMRS sets E, B (3.90)
S	HMRS3EB	: Description of HMRS sets E, B (4.90)
S	HMRSGEB	: Description of HMRS sets E, E+, E- and B
S	KMRSEB	: Description of KMRS sets E and B
S	KMRSGEB	: Description of KMRS B0 with L=135,160,200,235
S	MRSDSHD	: Description of MRS sets D0', S0', D-', (H) in DIS
S	MRSDSHP	: Description of MRS sets D0', S0', D-', (H)
S	MRSEB	: Description of MRS sets E and B
S	MRSEBP	: Description of MRS sets E' and B'
S	NEWDO1	: DO SF set 1.1 (NP=1,NG=1,NS=10)
S	PDFSET	: to set all parameters for PDFLIB
S	PDFSTA	: to print summary of param. and error statistics
S	PDFVERS	: to get date and time of PDFLIB Library release
F	PDXMT	: Description of MT sets 1 to 11
S	PDZXMT	: MT SF sets 1 to 11
S	PFTOPDG	: to access PDFLIB with output in PDG format
S	PHLAC1	: interface to LAC-G set 1 in the photon
S	PHLAC2	: interface to LAC-G set 2 in the photon
S	PHLAC3	: interface to LAC-G set 3 in the photon
S	RXDV	: OR SF set for down valence quarks
S	RXGLUE	: OR SF set for gluons
S	RXQBAR	: OR SF set for antiquarks
S	RXUD	: OR SF set for the sum of up + down quarks
S	SASAN1	:
S	SASANO	:
S	SASBEH	:
S	SASDIR	:
S	SASGAM1	:
S	SASGAM2	:
S	SASVM1	:
S	SASVMD	:
S	SEADIS	: BEBC SF set for antiquarks
S	SFABFOW	: ABFOW SF set (NP=1,NG=6,NS=1)
S	SFAFG1	: AFG SF set of NLL for Photons (NP=3,NG=6,NS=3)
S	SFBMA	: BM SF set A (NP=1,NG=7,NS=1)
S	SFBMB	: BM SF set B (NP=1,NG=7,NS=2)
S	SFCTQ11	: CTEQ SF set 1L (LO) (NP=1,NG=4,NS=12)
S	SFCTQ12	: CTEQ SF set 1M (NP=1,NG=4,NS=13)
S	SFCTQ13	: CTEQ SF set 1MS (NP=1,NG=4,NS=14)
S	SFCTQ14	: CTEQ SF set 1ML (NP=1,NG=4,NS=15)
S	SFCTQ15	: CTEQ SF set 1D (NP=1,NG=4,NS=16)
S	SFCTQ21	: CTEQ SF set 2L (LO) (NP=1,NG=4,NS=17)
S	SFCTQ22	: CTEQ SF set 2M (NP=1,NG=4,NS=18)
S	SFCTQ23	: CTEQ SF set 2MS (NP=1,NG=4,NS=19)
S	SFCTQ24	: CTEQ SF set 2MF (NP=1,NG=4,NS=20)
S	SFCTQ25	: CTEQ SF set 2ML (NP=1,NG=4,NS=21)
S	SFCTQ26	: CTEQ SF set 2D (NP=1,NG=4,NS=22)
S	SFCTQ31	: CTEQ SF set 3L (LO) (NP=1,NG=4,NS=29)
S	SFCTQ32	: CTEQ SF set 3M (NP=1,NG=4,NS=30)
S	SFCTQ33	: CTEQ SF set 3D (NP=1,NG=4,NS=31)
S	SFCTQ41	: CTEQ SF set 4L (LO) (NP=1,NG=4,NS=32)
S	SFCTQ42	: CTEQ SF set 4D (NP=1,NG=4,NS=33)
S	SFCTQ43	: CTEQ SF set 4M (NP=1,NG=4,NS=34)
S	SFCTQ44	: CTEQ SF set 4A1 (NP=1,NG=4,NS=35)
S	SFCTQ45	: CTEQ SF set 4A2 (NP=1,NG=4,NS=36)
S	SFCTQ46	: CTEQ SF set 4A4 (NP=1,NG=4,NS=38)
S	SFCTQ47	: CTEQ SF set 4A5 (NP=1,NG=4,NS=39)
S	SFCTQ48	: CTEQ SF set 4HJ (NP=1,NG=4,NS=40)
S	SFCTQ49	: CTEQ SF set 41Q (NP=1,NG=4,NS=41)
S	SFDISA	: MRS SF set A (DIS) (NP=1,NG=3,NS=44)
S	SFDISD0	: MRS SF set D0' (DIS) (NP=1,NG=3,NS=33)
S	SFDISDM	: MRS SF set D-' (DIS) (NP=1,NG=3,NS=34)

Complete list of subprograms, cont'd

S	SFDISH	: MRS SF set (H) (NP=1,NG=3,NS=36)
S	SFDISS0	: MRS SF set S0' (DIS) (NP=1,NG=3,NS=32)
S	SFDSQA	: MRS SF set A (DIS) low Q**2 (NP=1,NG=3,NS=44)
S	SFEHLQ1	: EHLQ SF set 1 (NP=1,NG=1,NS=8)
S	SFEHLQ2	: EHLQ SF set 2 (NP=1,NG=1,NS=9)
S	SFGRVH	: old GRV SF set of NLL (NP=1,NG=5,NS=1)
S	SFGRVL	: old GRV SF set of LO (NP=1,NG=5,NS=2)
S	SFGSHO	: GS SF set of NLL in the photon (NP=3,NG=4,NS=1)
S	SFGSLO1	: GS SF set 1 of LO in the photon (NP=3,NG=4,NS=2)
S	SFGSLO2	: GS SF set 2 of LO in the photon (NP=3,NG=4,NS=3)
S	SFKBMR2	: KMRS SF set B- with R2 shadowing (NP=1,NG=3,NS=19)
S	SFKBMR5	: KMRS SF set B- with R5 shadowing (NP=1,NG=3,NS=20)
S	SFLACG1	: LAC SF set 1 in the photon (NP=3,NG=3,NS=1)
S	SFLACG2	: LAC SF set 2 in the photon (NP=3,NG=3,NS=2)
S	SFLACG3	: LAC SF set 3 in the photon (NP=3,NG=3,NS=3)
S	SFMFAP	: MRS SF set Ap parametrisation (NP=1,NG=3,NS=40)
S	SFMFR1	: MRS SF set R1 parametrisation (NP=1,NG=3,NS=57)
S	SFMFR2	: MRS SF set R2 parametrisation (NP=1,NG=3,NS=58)
S	SFMRSD0	: MRS SF set D0 (NP=1,NG=3,NS=27)
S	SFMRSDM	: MRS SF set D- (NP=1,NG=3,NS=28)
S	SFMRSG	: MRS SF set G (NP=1,NG=3,NS=41)
S	SFMRSJ	: MRS SF set J (NP=1,NG=3,NS=51)
S	SFMRSS0	: MRS SF set S0 (NP=1,NG=3,NS=26)
S	SFMS105	: MRS SF set Ap (150) (NP=1,NG=3,NS=45)
S	SFMS110	: MRS SF set Ap (201) (NP=1,NG=3,NS=46)
S	SFMS115	: MRS SF set Ap (266) (NP=1,NG=3,NS=47)
S	SFMS120	: MRS SF set Ap (344) (NP=1,NG=3,NS=48)
S	SFMS125	: MRS SF set Ap (435) (NP=1,NG=3,NS=49)
S	SFMS130	: MRS SF set Ap (542) (NP=1,NG=3,NS=50)
S	SFMSAP	: MRS SF set Ap (NP=1,NG=3,NS=39)
S	SFMSBA	: MRS SF set A (NP=1,NG=3,NS=37)
S	SFMSBB0	: MRS SF set B0' (NP=1,NG=3,NS=
S	SFMSBD0	: MRS SF set D0' (NP=1,NG=3.NS=30)
S	SFMSBDM	: MRS SF set D-' (NP=1,NG=3,NS=31)
S	SFMSBH	: MRS SF set (H) (NP=1,NG=3,NS=35)
S	SFMSBS0	: MRS SF set S0' (NP=1,NG=3,NS=29)
S	SFMSFA	: MRS SF set A parametrisation (NP=1,NG=3,NS=38)
S	SFMSFG	: MRS SF set G parametrisation (NP=1,NG=3,NS=42)
S	SFMSJP	: MRS SF set Jp (NP=1,NG=3,NS=52)
S	SFMSQA	: MRS SF set A low Q**2 (NP=1,NG=3,NS=43)
S	SFMSR1	: MRS SF set R1 (NP=1,NG=3,NS=53)
S	SFMSR2	: MRS SF set R2 (NP=1,NG=3,NS=54)
S	SFMSR3	: MRS SF set R3 (NP=1,NG=3,NS=55)
S	SFMSR4	: MRS SF set R4 (NP=1,NG=3,NS=56)
S	SFMT10	: interface to MT set 6 (MS_bar)
S	SFMT11	: interface to MT set LO
S	SFMTU1	: interface to MT set S1 (DIS)
S	SFMTU2	: interface to MT set B1 (DIS)
S	SFMTU3	: interface to MT set B2 (DIS)
S	SFMTU4	: interface to MT set E1 (DIS)
S	SFMTU5	: interface to MT set 6 (u_bar + d_bar)/2 (DIS)
S	SFMTU6	: interface to MT set S1 (MS_bar)
S	SFMTU7	: interface to MT set B1 (MS_bar)
S	SFMTU8	: interface to MT set B2 (MS_bar)
S	SFMTU9	: interface to MT set E1 (MS_bar)
S	SFSAS11	: SaS SF set 1D (V1) (NP=3,NG=9,NS=1)
S	SFSAS12	: SaS SF set 1M (V1) (NP=3,NG=9,NS=2)
S	SFSAS13	: SaS SF set 2D (V1) (NP=3,NG=9,NS=3)
S	SFSAS14	: SaS SF set 2M (V1) (NP=3,NG=9,NS=4)
S	SFSAS21	: SaS SF set 1D (V2) (NP=3,NG=9,NS=5)
S	SFSAS22	: SaS SF set 1M (V2) (NP=3,NG=9,NS=6)
S	SFSAS23	: SaS SF set 2D (V2) (NP=3,NG=9,NS=7)
S	SFSAS24	: SaS SF set 2M (V2) (NP=3,NG=9,NS=8)

Complete list of subprograms, cont'd

```
S  SFWHI1   : WHIT SF set 1 (NP=3,NG=8,NS=1)
S  SFWHI2   : WHIT SF set 2 (NP=3,NG=8,NS=2)
S  SFWHI3   : WHIT SF set 3 (NP=3,NG=8,NS=3)
S  SFWHI4   : WHIT SF set 4 (NP=3,NG=8,NS=4)
S  SFWHI5   : WHIT SF set 5 (NP=3,NG=8,NS=5)
S  SFWHI6   : WHIT SF set 6 (NP=3,NG=8,NS=6)
S  SMRSP31  : SMRS SF set 1 in the pion (NP=2,NG=3,NS=1)
S  SMRSP32  : SMRS SF set 2 in the pion (NP=2,NG=3,NS=2)
S  SMRSP33  : SMRS SF set 3 in the pion (NP=2,NG=3,NS=3)
S  SMRSPI   : Description of SMRS sets 1, 2, 3 in the pion
S  SRCTQ21  : CTEQ SF set 2pL (LO) (NP=1,NG=4,NS=23)
S  SRCTQ22  : CTEQ SF set 2pM (NP=1,NG=4,NS=24)
S  SRCTQ23  : CTEQ SF set 2pMS (NP=1,NG=4,NS=25)
S  SRCTQ24  : CTEQ SF set 2pMF (NP=1,NG=4,NS=26)
S  SRCTQ25  : CTEQ SF set 2pML (NP=1,NG=4,NS=27)
S  SRCTQ26  : CTEQ SF set 2pD (NP=1,NG=4,NS=28)
S  STRBEBC  : BEBC SF set (NP=1,NG=1,NS=2)
S  STRBEP   : BEP SF set (NP=1,NG=1,NS=4)
S  STRCBP   : MRS SF set B' (NP=1,NG=3,NS=7)
S  STRCEP   : MRS SF set E' (NP=1,NG=3,NS=6)
S  STRDO1   : DO SF set 1 (NP=1,NG=1,NS=6)
S  STRDO2   : DO SF set 2 (NP=1,NG=1,NS=7)
S  STRGHR   : GHR SF set (NP=1,NG=1,NS=5)
S  STRH1B   : HMRS SF set B (NP=1,NG=3,NS=9 - retracted)
S  STRH1E   : HMRS SF set E (NP=1,NG=3,NS=8 - retracted)
S  STRH2B   : HMRS SF set B (NP=1,NG=3,NS=11)
S  STRH2E   : HMRS SF set E (NP=1,NG=3,NS=10)
S  STRH3B   : HMRS SF set B (NP=1,NG=3,NS=15)
S  STRH3B1  : HMRS SF set B - L=100 (NP=1,NG=3,NS=16)
S  STRH3B3  : HMRS SF set B - L=300 (NP=1,NG=3,NS=17)
S  STRH3E   : HMRS SF set E (NP=1,NG=3,NS=14)
S  STRH3EM  : HMRS SF set E- (NP=1,NG=3,NS=13)
S  STRH3EP  : HMRS SF set E+ (NP=1,NG=3,NS=12)
S  STRKB0   : KMRS SF set B0 (NP=1,NG=3,NS=21), updated version
S  STRKB02  : KMRS SF set B0 - L=135 (NP=1,NG=3,NS=22)
S  STRKB03  : KMRS SF set B0 - L=160 (NP=1,NG=3,NS=23)
S  STRKB04  : KMRS SF set B0 - L=200 (NP=1,NG=3,NS=24)
S  STRKB05  : KMRS SF set B0 - L=235 (NP=1,NG=3,NS=25)
S  STRKB0O  : KMRS SF set B0 (old version)
S  STRKBM   : KMRS SF set B- (NP=1,NG=3,NS=18)
S  STRMRS1  : MRS SF set 1 (NP=1,NG=3,NS=1)
S  STRMRS2  : MRS SF set 2 (NP=1,NG=3,NS=2)
S  STRMRS3  : MRS SF set 3 (NP=1,NG=3,NS=3)
S  STROWP1  : OW SF set 1 in the pion (NP=2,NG=1,NS=1)
S  STROWP2  : OW SF set 2 in the pion (NP=2,NG=1,NS=2)
S  STRPRIV  : Dummy subroutine for a new set of SF
S  STRUCB   : MRS SF set B (NP=1,NG=3,NS=4)
S  STRUCE   : MRS SF set E (NP=1,NG=3,NS=5)
S  STRUCOR  : OR SF set (NP=1,NG=1,NS=3)
S  STRUCTF  : to access PDFLIB with output in PDFLIB format
S  STRUCTM  : to access PDFLIB with output in PDFLIB format
S  STRUCTP  : to access PDFLIB with output in PDFLIB format for PHOTONS
   TESTGAM  : main program to test PDFLIB for photons
   TESTGAMO : main program to test PDFLIB for photons (OLD)
   TESTPDF  : main program to test PDFLIB in PDFLIB format
   TESTPDFO : main program to test PDFLIB in PDFLIB format (OLD)
   TESTPDG  : main program to test PDFLIB in PDG format
   TESTPDGO : main program to test PDFLIB in PDG format (OLD)
   TMAINUPV : main program to show how to use the package
   TMAINUPVO: main program to show how to use the package (OLD)
F  V3       : BEBC SF set to calculate X * VALDIS
S  VALDIS   : BEBC SF set for up + down valence quarks
S  VLAMBD   : Entry in PDZXMT to get Lambda value for MT sets
```


Complete list of subprograms, cont'd

```
S  WATE32   : defines 32 point Gaussian quadrature routine
S  WHIT1G   : WHIT SF set 1 for gluons
S  WHIT1Q   : WHIT SF set 1 for quarks
S  WHIT2G   : WHIT SF set 2 for gluons
S  WHIT2Q   : WHIT SF set 2 for quarks
S  WHIT3G   : WHIT SF set 3 for gluons
S  WHIT3Q   : WHIT SF set 3 for quarks
S  WHIT4G   : WHIT SF set 4 for gluons
S  WHIT4Q   : WHIT SF set 4 for quarks
S  WHIT5G   : WHIT SF set 5 for gluons
S  WHIT5Q   : WHIT SF set 5 for quarks
S  WHIT6G   : WHIT SF set 6 for gluons
S  WHIT6Q   : WHIT SF set 6 for quarks
```

Complete list of subprograms, cont'd

```
C  W50510   : IFLPRT - to set print flag
C  W50511   : NPTYPE,NGROUP,NSET,MODE,NFL,LO,TMAS -
             to select structure function set, to define
             number of flavours, flag for leading order
             and value for the mass of the top quark
C  W50512   : QCDL4,QCDL5 - contains Lambda_4(QCD) and
             Lambda_5(QCD) (in GeV)
C  W50513   : XMIN,XMAX.Q2MIN,Q2MAX - contains minimum
             and maximum values of X and Q**2
C  W50514   : WXMIN,WXMAX,WQ2MIN,WQ2MAX,WTXMIN,WTXMAX,WQ2MIN,
             WQ2MAX - error counting for fractional and
             total number of X and Q**2
C  W50514W  : PDFWGT - to transmit user filled event weight
C  W50515   : IFLSET,IFLSTA - to transmit flag for call to
             subroutine PDFSET or PDFSTA
C  W50516   : FIRST - to force printing name of structure
             function set in case of multiple choices
C  W50517   : N6 - contains logical print unit number
C  W50518   : save of COMMONs W50510, W50511, W50512, W50513
C  W50519   : NEWVER - to flag NEW or OLD version of PDFLIB
             format
C  W505110  : SFNAME - contains NAME (CHARACTER*8 array with
             dimension SFNAME(NPTYMX,NGRMAX,NSETMX)) for
             each set of PDFs
C  W505120  : NPGSMX(NPTYMX,NGRMAX),NSETFL(NPTYMX,NGRMAX,NSETMX)
             - to provide the actual maximum number of stuc-
             ture function sets per particle type and author
             group, NSETFL(I,J,K) = 0 for retracted PDF set
C  W505121  : NPTYCR(MODEMX),NGROCR(MODEMX),NSETCR(MODEMX)
             - to provide the cross reference to the
             NPTYPE, NGROUP and NSET value (NEW format) for
             a given MODE value (OLD format)
C  W505122  : MODECR(NPTYMX,NGRMAX,NSETMX) - to provide the
             cross reference to the MODE value (OLD format)
             for a given NPTYPE, NGROUP and NSET value
             (NEW format)
P  W5051P0  : LFLPRT - to define print level (D=0)
P  W5051P1  : LPTYPE,LGROUP,LNSET,IFL,LORD,TM - to define
             the defaults for a PDF set given by the
             particle type, author group and number of set
             within an author group, defaults for number of
             flavours, leading order flag and mass of the
             top quark (D=1, 5, 3, 5, 2, 100.D0)
P  W5051P2  : MODEMX - maximum number of structure function
             sets in the OLD PDFLIB format
           : NPTYMX,NGRMAX,NSETMX - maximum number of
             structure function sets in the NEW PDFLIB
             format for particle type, author group number
             and number of sets within an author group
P  W5051P2  : MODEMX - to define maximum number of SF sets
             in PDFLIB (OLD format) (D=281)
P  W5051P7  : L6 - to define logical print unit number (D=6)
P  W5051P7  : L6 - to define logical print unit number
   W50511C  : Comments only - complete list of available SFs
```


List of Tables

1 List of available sets of NUCLEON structure functions in PDFLIB version 7.09 36

2 List of available sets of PION structure functions in PDFLIB version 7.09 39

3 List of available sets of PHOTON structure functions in PDFLIB version 7.09 40

Table 1

Available sets of NUCLEON structure functions in PDFLIB

Nptype Ngroup Nset QCDL4	Q**2 min	Name of Set	Scheme	Reference
0 200 0.3		->GRV HO	MS_bar NLL	Default
1 1 1		PRIVATE to user		
1 1 2	45 0.5	BEBC	LO	[Nucl.Phys. B132 (1978) 249]
1 1 3	500 1.8	OR	LO	[Phys.Rev. D17 (1978) 3003]
1 1 4	470 5	BEP	LO	[Z. Phys. C2 (1979) 265]
1 1 5	400 4	GHR	LO	[Z. Phys. C13 (1982) 119]
1 1 6	200 4	DO Set 1	LO	[Phys.Rev. D30 (1984) 49]
1 1 7	400 4	DO Set 2	LO	
1 1 8	200 5	EHLQ Set 1	LO	[Rev.Mod.Phys. 56 (1984) 579;
1 1 9	290 5	EHLQ Set 2	LO	Rev.Mod.Phys. 58 (1985) 1065]
1 1 10	177 4	DO Set 1.1	LO	[Phys.Lett.266B (1991) 3275]
1 2 1	200 10	DFLM soft valence	LO	[Z. Phys. C39 (1988) 21
1 2 2	200 10	DFLM hard valence	LO	
1 2 3	200 10	DFLM soft gluon	LO	
1 2 4	200 10	DFLM hard gluon	LO	
1 2 5	200 10	DFLM central av.	LO	
1 2 6	300 10	DFLM central av.	DIS NLL	
1 2 7	160 10	DFLM 160	DIS NLL	[unpublished]
1 2 8	260 10	->DFLM 260	DIS NLL	
1 2 9	360 10	DFLM 360	DIS NLL	
1 3 1	107 5	MRS 1	MS_bar NLL	[Phys.Rev. D37 (1988) 1181]
1 3 2	250 5	MRS 2	MS_bar NLL	
1 3 3	178 5	MRS 3	MS_bar NLL	
1 3 4	91 5	MRS E	MS_bar NLL	[Phys.Lett. 206B (1988) 327]
1 3 5	228 5	MRS B	MS_bar NLL	
1 3 6	91 5	MRS E’	MS_bar NLL	[Mod.Phys. Lett.A4 (1989) 1135
1 3 7	228 5	MRS B’	MS_bar NLL	
1 3 8	100 5	HMRS E (1.90)	MS_bar NLL	[retracted]
1 3 9	190 5	HMRS B (1.90)	MS_bar NLL	
1 3 10	100 5	HMRS E (3.90)	MS_bar NLL	
1 3 11	190 5	HMRS B (3.90)	MS_bar NLL	
1 3 12	100 5	HMRS E+(4.90)	MS_bar NLL	[Phys.Lett. 243B (1990) 421]
1 3 13	100 5	HMRS E-(4.90)	MS_bar NLL	
1 3 14	100 5	HMRS E (4.90)	MS_bar NLL	[Phys.Rev. D4 (1990) 798]
1 3 15	190 5	HMRS B (4.90)	MS_bar NLL	
1 3 16	100 5	HMRS B (8.90)	MS_bar NLL	[unpublished]
1 3 17	300 5	HMRS B (8.90)	MS_bar NLL	
1 3 18	190 5	KMRS B-(7.90)	MS_bar NLL	[Phys.Rev. D42 (1990) 3645]
1 3 19	190 5	KMRS B-R2 Shadow (7.90)	MS_bar NLL	
1 3 20	190 5	KMRS B-R5 Shadow (7.90)	MS_bar NLL	
1 3 21	190 5	KMRS B0-190 (7.90)	MS_bar NLL	(as updated 4.92)
1 3 22	135 5	MRS B0-135 (10.90)	MS_bar NLL	[Phys.Rev. D43 (1991) 3648]
1 3 23	160 5	MRS B0-160 (10.90)	MS_bar NLL	
1 3 24	200 5	MRS B0-200 (10.90)	MS_bar NLL	
1 3 25	235 5	MRS B0-235 (10.90)	MS_bar NLL	
1 3 26	215 5	MRS S0	(4.92) MS_bar NLL	[retracted]
1 3 27	215 5	MRS D0	(4.92) MS_bar NLL	
1 3 28	215 5	MRS D-	(4.92) MS_bar NLL	
1 3 29	230 5	MRS S0’	(11.92) MS_bar NLL	[Phys.Lett. 306B (1993)145
1 3 30	230 5	MRS D0’	(11.92) MS_bar NLL	

Table 1 (cont’d)

Nptype Ngroup Nset QCDL4	Q**2 min	Name of Set	Scheme	Reference
1 3 31	230 5	MRS D-’	(11.92) MS_bar NLL	
1 3 32	230 5	MRS S0’	(2.93) DIS NLL	[RAL-92-078 (1992)]
1 3 33	230 5	MRS D0’	(2.93) DIS NLL	
1 3 34	230 5	MRS D-’	(2.93) DIS NLL	
1 3 35	230 5	MRS (H)	(11.93) MS_bar NLL	
1 3 36	230 5	MRS (H)	(11.93) DIS NLL	
1 3 37	230 5	MRS (A)	(5.94 MS_bar NLL	[RAL-94-055 (1994)]
1 3 38	230 5	MRS (A) Fit	(5.94) MS_bar NLL	
1 3 39	230 5	MRS (Ap)	(2.95 MS_bar NLL	[RAL-94-104 (1994)]
1 3 40	231 5	MRS (Ap) Fit	(2.95) MS_bar NLL	
1 3 41	255 5	->MRS (G)	(2.95 MS_bar NLL	[RAL-95-021 (1995)]
1 3 42	255 5	MRS (G) Fit	(2.95) MS_bar NLL	
1 3 43	230 .625	MRS Set (A) lowQ^2	MS_bar NLL	[Phys.Rev. D51 (1995)4756]
1 3 44	230 .625	MRS Set (A) lowQ^2	DIS NLL	
1 3 45	150 5	MRS Set (Ap-L150)	MS_bar NLL	[Phys.Lett. 356B (1995)89]
1 3 46	201 5	MRS Set (Ap-L201)	MS_bar NLL	
1 3 47	266 5	MRS Set (Ap-L266)	MS_bar NLL	
1 3 48	344 5	MRS Set (Ap-L344)	MS_bar NLL	
1 3 49	435 5	MRS Set (Ap-L435)	MS_bar NLL	
1 3 50	542 5	MRS Set (Ap-L542)	MS_bar NLL	
1 3 51	344 5	MRS Set (J)	MS_bar NLL	[DTP/96/22 (1996)]
1 3 52	507 5	MRS Set (J’)	MS_bar NLL	
1 3 53	241 5	MRS Set (R1)	MS_bar NLL	[DTP/96/44 (1996)]
1 3 54	344 5	MRS Set (R2)	MS_bar NLL	
1 3 55	241 5	MRS Set (R3)	MS_bar NLL	
1 3 56	344 5	MRS Set (R4)	MS_bar NLL	
1 3 57	241 5	MRS Set (R1)	MS_bar NLL Fit	
1 3 58	344 5	MRS Set (R2)	MS_bar NLL Fit	
1 4 1	212 4	MT S1	DIS NLL	[Z. Phys. C52 (1991) 13]
1 4 2	194 4	MT B1	DIS NLL	
1 4 3	191 4	MT B2	DIS NLL	
1 4 4	155 4	MT E1	DIS NLL	
1 4 5	237 4	MT 6 (1/2s)	DIS NLL	
1 4 6	212 4	MT S1	MS_bar NLL	
1 4 7	194 4	MT B1	MS_bar NLL	
1 4 8	191 4	MT B2	MS_bar NLL	
1 4 9	155 4	MT E1	MS_bar NLL	
1 4 10	237 4	MT 6 (1/2s)	MS_bar NLL	
1 4 11	144 4	MT LO	LO	
1 4 12	168 4	CTEQ 1L	LO	[retracted]
1 4 13	231 4	CTEQ 1M	MS_bar NLL	
1 4 14	231 4	CTEQ 1MS	MS_bar NLL	
1 4 15	322 4	CTEQ 1ML	MS_bar NLL	
1 4 16	247 4	CTEQ 1D	DIS NLL	
1 4 17	190 4	CTEQ 2L	LO	[retracted]
1 4 18	213 4	CTEQ 2M	MS_bar NLL	
1 4 19	208 4	CTEQ 2MS	MS_bar NLL	
1 4 20	208 4	CTEQ 2MF	MS_bar NLL	
1 4 21	322 4	CTEQ 2ML	MS_bar NLL	
1 4 22	235 4	CTEQ 2D	DIS NLL	
1 4 23	190 4	CTEQ 2pL	LO	[to be published]
1 4 24	213 4	CTEQ 2pM	MS_bar NLL	
1 4 25	208 4	CTEQ 2pMS	MS_bar NLL	
1 4 26	208 4	CTEQ 2pMF	MS_bar NLL	

Table 1 (cont'd)

Nptype Ngroup Nset QCDL4	Q**2 min	Name of Set	Scheme	Reference
1 4 27 322 4		CTEQ 2pML	MS_bar NLL	
1 4 28 235 4		CTEQ 2pD	DIS NLL	
1 4 29 177 4		CTEQ 3L	LO	[MSU-HEP/41024]
1 4 30 239 4		->CTEQ 3M	MS_bar NLL	
1 4 31 247 4		CTEQ 3D	DIS NLL	
1 4 32 235	2.56	CTEQ 4LO	LO	[MSUHEP-60426, CTEQ-604]
1 4 33 296	2.56	CTEQ 4D	DIS NLL	
1 4 34 296	2.56	CTEQ 4M	MS_bar NLL	
1 4 35 213	2.56	CTEQ 4A1	MS_bar NLL	
1 4 36 253	2.56	CTEQ 4A2	MS_bar NLL	
1 4 37 296	2.56	CTEQ 4A3	MS_bar NLL	
1 4 38 344	2.56	CTEQ 4A4	MS_bar NLL	
1 4 39 399	2.56	CTEQ 4A5	MS_bar NLL	
1 4 40 302	2.56	CTEQ 4HJ	MS_bar NLL	
1 4 41 259	0.49	CTEQ 41Q	MS_bar NLL	
1 5 1 160	0.2	old GRV HO	MS_bar NLL	[retracted]
1 5 2 220	0.2	old GRV LO	LO	
1 5 3 200	0.3	GRV HO	MS_bar NLL	[Z. Phys. C53 (1992) 127]
1 5 4 200	0.25	GRV LO	LO	
1 5 5 200	0.4	GRV 94 LO	LO	[DO-TH 94/24 (1994)]
1 5 6 200	0.4	->GRV 94 HO	MS_bar NLL	
1 5 7 200	0.4	GRV 94 HO	DIS NLL	
1 5 8 200	0.4	GRSV pol. LO standard	LO	[Phys.Lett. 359B (1995)201
1 5 9 200	0.4	GRSV pol. LO valence	LO	
1 5 10 200	0.4	GRSV pol. HO standard	LO	[Phys.Rev. D53 (1996) 4775
1 5 11 200	0.4	GRSV pol. HO valence	LO	
1 6 1 230	2	ABFOW	MS_bar NLL	[Phys.Rev D39 (1989) 3275]
1 7 1 254	5	BM A	MS_bar NLL	[Phys.Lett. 304B (1993)318
1 7 2 254	5	BM B	MS_bar NLL	

Table 2

Available sets of PION structure functions in PDFLIB

Nptype Ngroup Nset QCDL4	Q**2 min	Name of Set	Scheme	Reference
2 1 1 200	4	OW-P Set 1	LO	[Phys.Rev. D30 (1984) 943]
2 1 2 400	4	OW-P Set 2	LO	
2 3 1 190	5	SMRS-P 1	MS_bar NLL	[Phys.Rev. D45 (1992) 2349]
2 3 2 190	5	->SMRS-P 2	MS_bar NLL	
2 3 3 190	5	SMRS-P 3	MS_bar NLL	
2 5 1 200	0.3	->GRV-P HO	MS_bar NLL	[Z.Phys. C53 (1992) 651]
2 5 2 200	0.25	GRV-P LO	LO	
2 6 1 231	2	->ABFKW-P 1	MS_bar NLL	[Phys.Lett.233B (189) 517]
2 6 2 181	2	ABFKW-P 2	MS_bar NLL	
2 6 3 281	2	ABFKW-P 3	MS_bar NLL	

Table 3

Available sets of PHOTON structure functions in PDFLIB

Nptype	Ngroup	Nset	QCDL4	Q**2 min	Name of Set	Scheme	Reference
3	1	1	380	10	DO-G LO	LO	[Phys.Rev. D26 (1982) 1600]
3	1	2	440	10	->DO-G HO	MS_bar NLL	
3	2	1	400	1	->DG-G Set 1	LO	[Z. Phys. C28 (1985) 451]
3	2	2	400	1	DG-G Set 2	LO	
3	2	3	400	20	DG-G Set 3	LO	
3	2	4	400	200	DG-G Set 4	LO	
3	3	1	200	5	LAC-G 1	LO	[Phys.Lett.269B (1991) 458]
3	3	2	200	5	->LAC-G 2	LO	
3	3	3	200	5	LAC-G 3	LO	
3	4	1	200	5.3	GS-G HO	MS_bar NLL	[Z.Phys. C56 (1992) 307]
3	4	2	200	5.3	GS-G LO set 1	LO	
3	4	3	200	5.3	GS-G LO set 2	LO	
3	4	4	200	5.3	->GS-G-96 HO	MS_bar NLL	[ANL-HEP-PR-96-33]
3	4	5	200	5.3	GS-G-96 LO	LO	
3	5	1	200	0.3	GRV-G LHO	DIS*) NLL	[Phys.Rev. D46 (1992) 1973;
3	5	2	200	0.3	->GRV-G HO	DIS*) NLL	Phys.Rev. D45 (1992) 3986]
3	5	3	200	0.25	GRV-G LO	LO	
3	5	4	200	0.6	GRS-G LO	LO	[Phys. Rev. D51 (1995) 3220
3	6	1	200	2	ACFGP-G HO	MS_bar NLL	[Z.Phys. C56 (1992) 589]
3	6	2	200	2	->ACFGP-G HO-mc	MS_bar NLL	
3	6	3	200	2	->AFG-G HO	MS_bar NLL	
3	8	1	400	4	WHIT-G 1	LO	[KEK preprint 93-160]
3	8	2	400	4	->WHIT-G 2	LO	
3	8	3	400	4	WHIT-G 3	LO	
3	8	4	400	4	WHIT-G 4	LO	
3	8	5	400	4	WHIT-G 5	LO	
3	8	6	400	4	WHIT-G 6	LO	
3	9	1	200	0.36	SAS-G Set 1D (V1)	LO	[Z. Phys. C68 (1995) 607]
3	9	2	200	0.36	SAS-G Set 1M (V1)	LO	
3	9	3	200	4	SAS-G Set 2D (V1)	LO	
3	9	4	200	4	SAS-G Set 2M (V1)	LO	
3	9	5	200	0.36	SAS-G Set 1D (V2)	LO	[CERN-TH/96-04]
3	9	6	200	0.36	SAS-G Set 1M (V2)	LO	
3	9	7	200	4	SAS-G Set 2D (V2)	LO	
3	9	8	200	4	SAS-G Set 2M (V2)	LO	

*) not standard, please consult references.