

Les **H**ouches **A**ccord **PDF**

Status Report and Future Plans

PDF4LHC Workshop
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Outline

- Introduction & recap - what is LHAPDF.
- Installation of LHAPDF – changes in download & install
- Using LHAPDF
 - Initialization routines
 - PDF calculating routines
 - PDF sets included in LHAPDF
- Extras:
 - Multiset initialization
 - Adding a User's own PDF set
 - C++ wrapper
 - Short tour of the web site
- Summary – including Future Plans.

Introduction & Recap

the beginning

The story so far.....

- 2001 Les Houches meeting – LHAPDF interface was conceived to enable the usage of PDF sets with uncertainties in a uniform manner.
- It was also to be viewed as a successor to PDFLIB.
- 2002 Walter Giele (Fermilab) produced the first LHAPDF version with very elegant (Fortran) code:-
 - Utilised on-the-fly evolution to higher Q scales starting from the parameterized fits at the fitting scale Q_0 .
 - A PDF sets could contain multiple members (eg error sets)
 - Very compact and easily updated – just add new parameters.
 - Incorporated 2 evolution codes QCDNUM and CTEQ's own.

Introduction & Recap

some problems and their solution

(big) BUT

in order to have a usable PDFLIB replacement there were problems.

- The parameterizations were not always available for all sets.
- The specific evolution code used by the authors was not always available.
- It was slow in some circumstances – especially the initialization phase.

so (in 2003*)

A hybrid was developed which incorporated:

- using the interpolation grids and codes given by the PDF authors (.LHgrid)
- plus Walter's elegant on-the-fly evolution method. (.LHpdf)

(*This is when I joined and eventually took on the project)

Introduction & Recap

making a complete solution

ALSO

In order to have a comprehensive PDFLIB replacement there were other features needed:-

- To enable easy incorporation into existing programs: an (alternative) interface which looked like PDFLIB (ie PDFSET, STRUCTM, etc..)
- Availability of other key PDF sets, eg. photons and pions.
- Availability of some older nucleon PDF sets for comparisons.
- Ability to calculate Nuclear PDFs.
- Ability to add a user's own PDF set.
- Ability to use more than one PDF set in the same programme without having to re-initialize each time.

Over the intervening time all the above have been added in various stages.

Timeline of the development of LHAPDF

2002	V1	original implementation by WG
2003	V2	PDF grid interpolation method + single compilation
2004	V3	PDFLIB-like LHAglue wrapper + numbering scheme
2005	V4	Pion/Photons + changed file structure
<hr style="border-top: 1px dashed black;"/>		
	V4.1 V4.2	Moved into hepforge + gnu auto-tools Makefile generation
2006	V5.0 V5.1 V5.2 V5.2.1 V5.2.2 V5.2.3	Multi-PDFset initialization + Bug fixes + libtools library building + New PDF sets
2007	V5.3.0 V5.3.1	+ Nuclear PDFs + User PDFs etc...
2008	V5.4.0	very soon

Downloading and Installing LHAPDF

- Since V4.1 LHAPDF has been hosted by [hepforge](#)*
 - We do not provide precompiled system specific libraries.
 - Use the gnu build system, [autotools](#) to construct a [configure](#) script capable of constructing a [Makefile](#) to build LHAPDF on the specific system. Then use gnu [libtool](#) to build both the static and dynamic shared libraries [libLHAPDF.a](#) and [libLHAPDF.so](#) which can be used in linking to a user's programme.
 - There is the option of installing either to a standard location `/usr/local` or to a location of the user's choice (`--prefix` option).
 - Tested on a variety of systems and compilers including:
f77, g77, gfortran, f95, ifort - SL4, fedora 5, ubuntu, mac OS X, solaris, amd64
- * [hepforge](#) is a part of the CEDAR project providing a development environment for hep projects (see next slide).

Hepforge

hosts ~45 projects



CEDAR HEPDATA JETW

- Home
- About
- Register
- Projects
- Downloads
- Documentation
- Mailing lists

HepForge

HepForge is a development environment for high energy physics software development projects. Some of the benefits offered by HepForge are:

- Unrestricted shell account
- Web page hosting
- Public Subversion hosting
- Mailing lists
- Bug tracker and wiki system

If you are a researcher in a high energy physics group and you would like to start a HepForge project, please see our [registration page](#).

Hosted projects

You can browse the list of projects using HepForge from our [projects page](#).



Last updated: Thu

HepForge projects

Here is the current list of projects using HepForge to do their development. (We will be introducing keyword sorting of projects in time.)

- **AGILE** : C++ MC generator interface library
- **Cadabra**
- **CASCADE** : MC hadron level event generator for ep and pp using uPDFs
- **CEDAR**
- **DataHarvester** : library for reading from/writing to various file formats
- **ETMAC** : Fitting program for lattice QCD based on R
- **EUDAQ** : A portable desktop DAQ system written in C++
- **ExHuME** : C++ generator of central Exclusive Hadronic Monte-carlo Events
- **FastNLO**
- **FeynML**
- **Fortran Herwig** : Fortran-based Monte Carlo event generator with parton shower
- **HepData** : HepData database and Web interface development project
- **HepForge** : Project to build and maintain the HepForge system!
- **HepJet** : A common C++ implementation of various jet algorithms
- **HepMCVisual** : An interactive Browser for HepMC events
- **HepML** : Proposed interchange formats for MC parameters and HepData records
- **HepTeX** : Collection of HEP-specific TeX/LaTeX packages
- **Herwig++**
- **HOPPET** : Higher Order Perturbative Parton Evolution Toolkit
- **HZSteer** : IO and steering utilities for HZTool.
- **HZTool** : Data-MC comparison histogramming
- **JetWeb** : Web-based system for MC event generator validation
- **jHepWork** : a general-purpose data-analysis framework based on JAIDA
- **Jimmy** : Multiple interactions implementation for Herwig
- **JMinHEP** : a framework for clustering analysis in JAVA
- **KtJet** : C++ implementation of the kt jet clustering algorithm
- **LHAPDF** : Les Houches Accord PDF library and interface

Andy Buckley in Durham is the main author and maintainer of Hepforge

Downloading and Installing LHAPDF

where to find the code

LHAPDF the Les Houches Accord PDF Interface

Home

- LHAPDF Home
- Publications
- Installation
- PDF sets
- Downloads**
- User manual
- Theory review
- C++ wrapper
- .LHpdf files
- Mailing list

LHAPDF provides a unified and easy to use interface to modern PDF sets. It is designed to work not only with individual PDF sets but also with the more recent multiple "error" sets. It can be viewed as the successor to PDFLIB, incorporating many of the older sets found in the latter, including pion and photon PDFs. In LHAPDF the computer code and input parameters/grids are separated thus allowing more easy updating and no limit to the expansion possibilities. The code and data sets can be downloaded together or individually as desired. From version 4.1 onwards a configuration script facilitates the installation of LHAPDF.

Contents:

Installing LHAPDF.
List of all available PDF sets.

Patches: patches to 5.3.1

Downloads:

Latest released version (16/11/2007):
5.3.1 (full): lhapdf-5.3.1.tar.gz
5.3.1 (no pdf files): lhapdf-5.3.1-nopdf.tar.gz

Old versions:
5.3.0 (full): lhapdf-5.3.0.tar.gz(patches)
5.2.3 (full): lhapdf-5.2.3.tar.gz
5.2.2 (full): lhapdf-5.2.2.tar.gz
5.2.1 (full): lhapdf-5.2.1.tar.gz
5.2 (full): lhapdf-5.2.tar.gz
5.1 (full): lhapdf-5.1.tar.gz
5.0.0 (full): lhapdf-5.0.0.tar.gz
4.2 (full): lhapdf-4.2.tar.gz
4.1.1 (full): lhapdf-4.1.1.tar.gz
4.0 (full): lhapdf-4.0.tar.gz
3.0 (full): lhapdf-3.0.tar.gz
2.0 (full): lhapdf-2.0.tar.gz

HepForge downloads

Back to project list...

LHAPDF project:

Name	Version	Filename
lhapdf	5.3.1 nopdf	lhapdf-5.3.1-nopdf.tar.gz (703k)
	5.3.1	lhapdf-5.3.1.tar.gz (38M)
	5.3.0 nopdf	lhapdf-5.3.0-nopdf.tar.gz (703k)
	5.3.0	lhapdf-5.3.0.tar.gz (38M)
	5.2.3 nopdf	lhapdf-5.2.3-nopdf.tar.gz (684k)
	5.2.3	lhapdf-5.2.3.tar.gz (32M)
	5.2.2 nopdf	lhapdf-5.2.2-nopdf.tar.gz (684k)
	5.2.2	lhapdf-5.2.2.tar.gz (32M)
	5.2.1 nopdf	lhapdf-5.2.1-nopdf.tar.gz (684k)

Can download with or without the PDFsets directory – but be careful if using old PDFsets with newer code!

Patches: patches to 5.3.1

Downloads:

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Old versions:
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5.2.3 (full): lhapdf-5.2.3.tar.gz
5.2.2 (full): lhapdf-5.2.2.tar.gz
5.2.1 (full): lhapdf-5.2.1.tar.gz

Can also download from GENSER

Downloading and Installing LHAPDF

installation instructions are on-line

The screenshot shows the LHAPDF website interface. On the left is a navigation menu with links like 'LHAPDF Home', 'Publications', 'Installation', 'PDF sets', 'Downloads', 'User manual', 'Theory review', 'C++ wrapper', '.LHpdf files', 'Mailing list', 'ChangeLog', 'Contact', and 'hepforge'. The main content area is titled 'Home' and contains a paragraph about LHAPDF's purpose. Below this is a 'Contents:' section with a list of links. One link, 'Installing LHAPDF', is highlighted with a red box and an arrow pointing to the right. On the right side of the page, there is a section titled 'Installation (4.1 onwards)' which provides step-by-step instructions for downloading and installing LHAPDF. The instructions include commands for downloading a tar file, unpacking it, changing the directory, and running the configuration script. A note specifies that the configuration should be run in a different directory than the source files. The page footer contains contact information for Mike Whalley at Durham University.

Installation (4.1 onwards)

First download the required gzipped tar file (eg `lhpdf-v.r.p.tar.gz`) from the downloads section (either with or without the PDFsets as required). Then do the following:-

```
tar -xvzf lhpdf-v.r.p.tar.gz
```

to unpack this into the directory `lhpdf-v.r.p`.

```
cd lhpdf-v.r.p
```

to change directory (`v.r.p` = version.revision.patch, eg 5.3.1).

If you have root privilege and want the installed files to go by default into `/usr/local` then do:

```
./configure
```

If you do not have root privilege and/or want the files installed into a different directory then do:

```
./configure --prefix=/path/to/directory
```

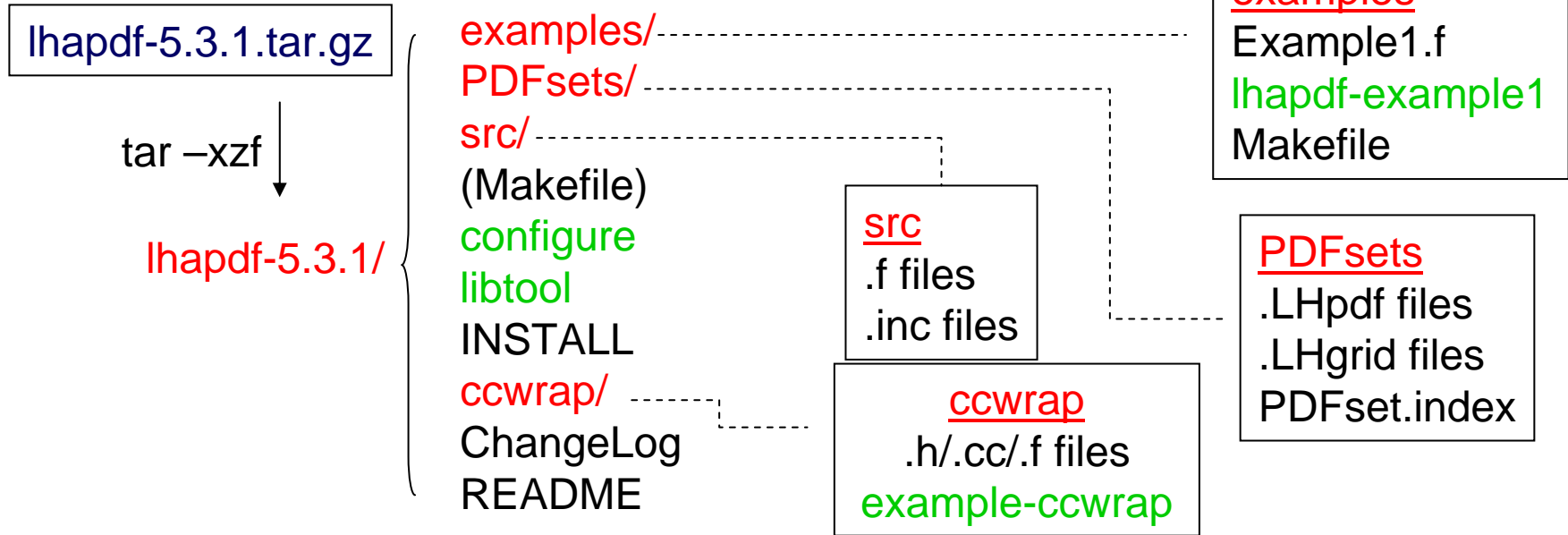
note: this should be a different directory to the `'lhpdf-v.r.p'` directory, otherwise the install step will not work.

Then do:

```
make  
make install
```

Downloading and installing LHAPDF

installation schematic



`configure --prefix=$home/local/ → make → make install → make clean`

Note also:

`configure -h`
`configure --disable-ccwrap ---`
`configure --disable-lhaglu ---`

Do not install in the build directory

`$home/local/ bin/ lhapdf-config`
`lib/ libLHAPDF.a`
`libLHAPDF.so`
`libLHAPDFWrap.a`
`libLHAPDFWrap.so`
`share/ lhapdf/PDFsets/.....LHpdf`
`/.....LHgrid`
`/PDFsets.index`

Downloading and Installing LHAPDF

what about patches?

LHAPDF the Les Houches Accord PDF Interface

Home

LHAPDF provides a unified and easy to use interface to modern PDF sets. It is designed to work not only with individual PDF sets but also with the more recent multiple "error" sets. It can be viewed as the successor to PDFLIB, incorporating many of the older sets found in the latter, including pion and photon PDFs. In LHAPDF the computer code and input parameters/grids are separated thus allowing more easy updating and no limit to the expansion possibilities. The code and data sets can be downloaded together or individually as desired. From version 4.1 onwards a configuration script facilitates the installation of LHAPDF.

Contents:

- Installing LHAPDF.
- List of all available PDF sets.
- On-line user manual.
- PDF set numbers
- A wrapper for C++.
- A little bit of theory.
- Description of the .LHpdf files
- PDFsets index

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- 5.3.1 (no pdf files): lhpdf-5.3.1-nopdf.tar.gz

Old versions:

- 5.3.0 (full): lhpdf-5.3.0.tar.gz(patches)
- 5.2.3 (full): lhpdf-5.2.3.tar.gz

Patches: patches to 5.3.1

The following patches to version (5.3.1) are available:

Date	New file	Description	Dependencies
19/11/2007	src/LHpdflib.f	Corrects error in displaying the version number.	-
19/11/2007	src/EVLCTEQ.f src/wrapcteq6.f src/wrapcteq65.f	Limits the excessive number of 'outside Q2/X range' errors reported by cteq6 routines	-
13/12/2007	src/wrapsmrspi.f	Fixes problem of incorrect values returned when using > 1 member in this set (SMRS - 231-233)	-
12/12/2007	src/wrapowspi.f	Fixes problem of EXTRAPOLATE pdfs beyond limits not working	-

To apply the patches please replace the file in the relevant directory (normally src) and make/make install again.

Last updated: Wed Dec 5 22:29:50 2007

Patches which correct bugs, not just improvements for the next release

Using LHAPDF

PDF set initialization

The location of the PDFsets files have to be specified either:

in the argument of **InitPDFset('fully-qualified-name')**

or, in this order of precedence:

- **call SetPDFPath('/path/to/PDFsets')**
- Environmental variable **\$LHAPATH**
- **Determines itself** using 'lhpdf-config' or binreloc (5.4.0 onwards)

Selecting which PDFset to use:

call **InitPDFset('fully-qualified-name')**

call **InitPDFsetByName('name')**

Which PDFset member to use:

call **InitPDF(member)**

Standard LHAPDF

parm(1)='DEFAULT'

value(1)=lhaglu number

parm(1)='PYTHIA'

parm(1)='HERWIG'

{ Input lhaglu
number through
specific parameters

call **PDFSET(parm,value)**

LHAGlu/PDFLIB-like

Using LHAPDF

routines to evaluate PDFs

call evolvePDF(x, q, f)

call evolvePDFp($x, q, p2, ip2, f$)

call evolvePDFa(x, q, a, f)

call evolvePDFphoton($x, q, f, photon$)
(*mrst2004qed set only*)

Standard LHAPDF

	0=gluon
	(-)1=(anti)down
	(-)2=(anti)up
f(-6,6)	(-)3=(anti)strange
	(-)4=(anti)charm
	(-)5=(anti)bottom
	(-)6=(anti)top

call STRUCTM($x, q, upv, dnv, usea, dsea, str, chm, bot, glu$)

call STRUCTP($x, q2, p2, ip2, upv, dnv, \dots$)

call STRUCTA(x, q, a, upv, dnv, \dots)

LHAGlue/PDFLIB-like

upv – up valence
dnv – down valence
dsea – up sea
dsea – down sea
etc...

beware the $q2$ here!

all are x^*pdf

Using LHAPDF

other routines

Obtain alphas for current set

alphasPDF(*q*)

Get various parameters

call getLam4(*member, qcdl4*)
call getLam5(*member, qcdl5*)
call getXmin(*member, xmin*)
call getXmax(*member, xmax*)
call getQ2min(*member, q2min*)
call getQ2max(*member, q2max*)

Get number of members in set

call numberPDF(Nmem)

Print out description of set

call getDesc()

Controlling statistics collection

call SetLHAPARM('NOSTAT')
call SetLHAPARM('16')
Call PDFSTA()

Controlling what happens at limits

Call SetLHAPARM('EXTRAPOLATE')
Call SetLHAPARM('18')

Controlling amount of output

Call SetLHAPARM('SILENT')
Call SetLHAPARM('LOWKEY')
Call SetLHAPARM('19')

PDFsets included 5.3.1 (5.4.0)

- 10000 -> CTEQ
(cteq65s), cteq65c, cteq6AB, cteq65 cteq61, cteq6,
cteq5, cteq4
- 20000 -> MRST
mrst2006nnl o, mrst2004qed, mrst2004FF, mrst2004,
mrst2003c, mrst2002, mrst2001, mrst98
- 30000 -> Fermi
Fermi_100/1000
- 40000 -> Alekhin
Alekhin_100/1000, Alekhin2002
- 50000 -> Botje
Botje_100/1000
- 60000 -> ZEUS
zeus2005, zeus2002
- 70000 -> H1
H12000
- 80000 -> GRV
GRV98
- 90000 -> spare

xxxx = .LHpdf
xxxx = .LHgrid
xxxx = both

Plus pdfs for
300 - photon
200 - pion
as in PDFLIB

PDFsets numbers for lhaglu

http://projects.hepforge.org/lhapdf/

LHAPDF the Les Houches Accord PDF Interface

- LHAPDF Home
- Publications
- Installation
- PDF sets
- Downloads
- User manual
- Theory review
- C++ wrapper
- .LHpdf files
- Mailing list
- ChangeLog
- Contact

Home

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Contents:

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- On-line user manual
- PDF set numbers**
- A wrapper for C++.
- A little bit of theory.
- Description of the .LHpdf files
- PDFsets.index
- How to join the mailing list.
- View the Subversion repository.
- Tracker/Wiki
- ChangeLog.

Publications/LHAPDF reference

User supplied Tips & Tricks:

- 1) Importing lhpdf-wrapper into ROOT

NOTE: Details of the changes in the different versions

LHAPDF is maintained by Mike Whalley at Durham University (UK)
 email:m.r.whalley@durham.ac.uk phone:+44-191-334-3807 fax:+44-191-334-3658

A PDF set numbers and names

Notes:

- When using the LHAGLUE initialization method:

- The columns headed .LHpdf and .LHgrid give the set numbers to use with LHAGLUE

- When Using the direct LHAPDF initialization routines:

- The .LHpdf and .LHgrid columns show the availability of the respective files
- The File Name and Member columns give the names to use in the direct LHAPDF initialization routines.
- .LHpdf or .LHgrid has to be appended to the File Name depending the availability of that file (as indicated in the table) and wishes of the user.

Proton PDFs

>

PDF set	.LHpdf	.LHgrid	File Name	Member	Xmin	Xmax	Q2min GeV ²	Q2max GeV ²
CTEQ6m (central value)	10000	10050	cteq6m	0	10 ⁻⁶	1	1.69	10 ⁸
CTEQ6 (40 error sets)	10001-10040	10051-10090	cteq6 cteq6mE	1-40	10 ⁻⁶	1	1.69	10 ⁸
CTEQ6l (LO fit/NLO alphas)	10041	-	cteq6l	0/1	10 ⁻⁶	1	1.69	10 ⁸
CTEQ6ll (LO fit/LO alphas)	10042	-	cteq6ll	0/1	10 ⁻⁶	1	1.69	10 ⁸
CTEQ61 (central value)	10100	10150	cteq61	0	10 ⁻⁶	1	1.69	10 ⁸
CTEQ61 (40 error sets)	10101-10140	10151-10190	cteq61	1-40	10 ⁻⁶	1	1.69	10 ⁸
CTEQ6AB (20 sets, variable alphas)	-	10250-10269	cteq6AB	0-19	10 ⁻⁶	1	1.69	10 ⁸

ASCII readable
flat text file

PDFsets.index file

Installed into the
share/lhapdf
directory

The screenshot shows the Lhapdf website interface. On the left is a navigation menu with items like 'LHAPDF Home', 'Publications', 'Installation', 'PDF sets', 'Downloads', 'User manual', 'Theory review', 'C++ wrapper', '.LHpdf files', 'Mailing list', 'ChangeLog', 'Contact', and 'hepforge'. The main content area includes a 'Home' section with a description of Lhapdf and a 'Contents' section listing various resources. A large window displays the content of the 'PDFsets.index' file, which is a text file with columns for LHnumber, NType, Ngroup, Nset, LHname, LHmember, q2min, q2max, xmin, xmax, and comment. A legend below the window explains the columns, with a bracket under 'old PDFLIB numbers' covering LHnumber, NType, Ngroup, and Nset. An arrow points from the 'PDFsets.index' link in the contents to the displayed file content.

```

19060 1 4 47 cteq5d.LHgrid 1 1. 100000000. 1.E-05 1. CTEQ5d(Standard_DIS)
19070 1 4 46 cteq5l.LHgrid 1 1. 100000000. 1.E-05 1. CTEQ5l(Leading_Order)
19150 1 4 34 cteq4m.LHgrid 1 2.56 100000000. 1.E-05 1. CTEQ4m(Standard_MSbar)
19160 1 4 33 cteq4d.LHgrid 1 2.56 100000000. 1.E-05 1. CTEQ4d(Standard_DIS)
19170 1 4 32 cteq4l.LHgrid 1 2.56 100000000. 1.E-05 1. CTEQ4l(Leading_Order)
20001 1 0 0 MRST2001nlo.LHpdf 1 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20002 1 0 0 MRST2001nlo.LHpdf 2 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20003 1 0 0 MRST2001nlo.LHpdf 3 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20004 1 0 0 MRST2001nlo.LHpdf 4 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20051 1 0 0 MRST2001nlo.LHgrid 1 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20052 1 0 0 MRST2001nlo.LHgrid 2 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20053 1 0 0 MRST2001nlo.LHgrid 3 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20054 1 0 0 MRST2001nlo.LHgrid 4 1.25 10000000. 1.E-05 1. MRST2001(NLO)
20060 1 0 0 MRST2001lo.LHgrid 1 1.25 10000000. 1.E-05 1. MRST2001(LO)
20070 1 0 0 MRST2001nnlo.LHgrid 1 1.25 10000000. 1.E-05 1. MRST2001(NNLO)
  
```

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Old versions:
5.3.0 (full): lhpdf-5.3.0.tar.gz (patches)
5.2.3 (full): lhpdf-5.2.3.tar.gz
5.2.2 (full): lhpdf-5.2.2.tar.gz
5.2.1 (full): lhpdf-5.2.1.tar.gz
5.2 (full): lhpdf-5.2.tar.gz
5.1 (full): lhpdf-5.1.tar.gz

LHnumber NType Ngroup Nset LHname LHmember q2min q2max xmin xmax comment
old PDFLIB numbers

LHAPDF is maintained by Mike Whalley at Durham University (UK)
email:m.r.whalley@durham.ac.uk phone:+44-191-334-3807 fax:+44-191-334-3658

Last updated: Wed Dec 5 22:29:50 2007

Multi-PDFset Initialisation introduced from V5

Essential if more than one PDF set is to be used in a single programme (re-initialisation is far too slow). For example a nucleon, a pion, and a photon set in a MC.

V5 onwards allows this to happen.

In the standard LHAPDF there are equivalent routines with the letter 'M' appended to the routine names and an extra first parameter for the set Sequence number , 'nset'

eg. call InitPDFSetByNameM(*nset*, '*name*')
 call evolvePDFM(*nset*, *x*, *q*, *f*)
 etc...

In the LHAGlue PDFLIB-like wrapper this is all taken care of invisibly to the user. (Will cycle if > the default 3 PDF sets are used)

The maximum number is defined in the include file `src/parmsetup.inc` (nmxset) with a default of 3.

User's own PDF sets

wrapper routine

Within LHAPDF there is a dummy wrapper routine which a user can use as a basis to construct their own PDF sets and run within the LHAPDF framework.

This is wrapUSER.f and is called from the wrapevolve.f routine.

↓

```
subroutine USERevolve(x,Q,f)
...code to calculate xfx()

entry USERread(nset)
...code to read in and set up grid files

entry USERalfa(alfas,Q)
...code to return alphas

entry USERinit()
...initialization code for whole set

entry USERpdf()
...initialization code for member

end
```

↓

```
subroutine evolvePDFM(nset,x,Q,f)
....
if(name(nset).eq.'USER') call USERevolve(x,Q,f)

entry readevolve(nset)
....
if|(name(nset).eq.'USER') call USERread(nset)
....

etc...
```

Recognises the name USER in the 'evolution:' section of the input .LHgrid or .LHpdf file

User's own PDF sets

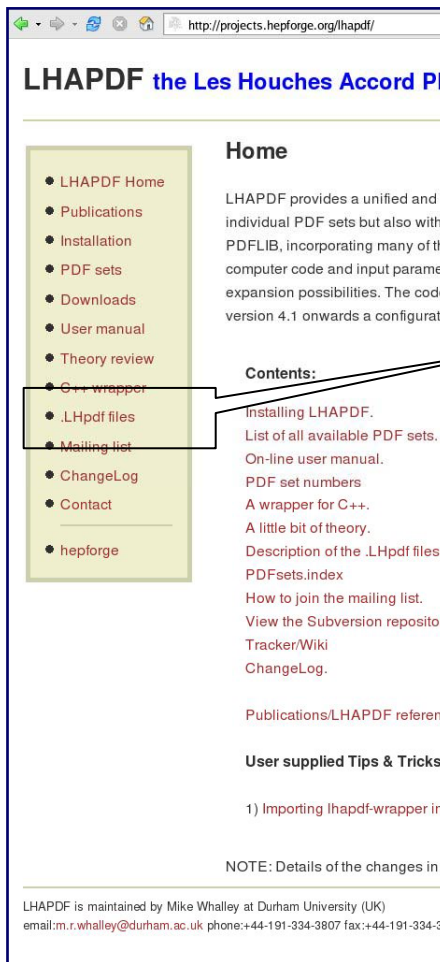
.LHpdf and .LHgrid files

This must be constructed for the particular circumstance of the PDF depending of the method used and details of the parameters or grid.

Details based on examples are given on the web site, but generally the following sections are present:

'Version' '5.3' <- always the first line
'Description:' <- following lines describe the PDFs
'Alphas:'
'Evolution:' ← Input information about the evolution and
'QCDParams:' for .LHgrid the grid files themselves
'MinMax:'
'Parametrization:' ← For .LHpdf type details of the
'Parameterlist:' parameterization
'End:'

LHAPDF – .LHpdf files



The screenshot shows the LHAPDF website interface. A callout box highlights the '.LHpdf files' link in the left-hand navigation menu. The main content area includes a 'Home' section with a description of LHAPDF, a 'Contents' section with a list of links, and a footer with contact information.

Description of .LHpdf files

All text strings must be enclosed in single quotation marks.

The example shown here is from the MRST2002nlo.LHpdf file

The first line declares the earliest version of LHAPDF with which the files works, in the following way:

```
'Version' '5.0'
```

Next follows a section giving a description of the PDF set. It starts with the line 'Description:' followed by an arbitrary (max 20) number of lines. This is the text that is printed out with the call `description()` command.

```
'Description:'  
'MRST fit: hep-ph/0211080'  
'This set has 1 member PDFs. '  
' mem=1 --> MRST2002nlo: Best fit (alpha_S=0.119) '  
'Note that the best fit (mem=0) has been set equal '  
'to MRST2002nlo'
```

Next is a section, starting with the line 'Evolution', which defines the evolution method to be used. It is followed by a number of other lines. The first of these lines has three parameters. (1) the order of the evolution, (2) the Q^2 of the PDF fit and (3) the renormalization factor, which for all the sets so far is 1.0. The next line declares the evolution code to be used, in this case `QCDNUM_MRST`. Other options are `QCDNUM`, `QCDNUM_ZEUS_TR`, `QCDNUM_ZEUS_ZM` and `EVLCTEQ`. For the varieties of `QCDNUM` evolution there is a final line in this section which defines the `QCDNUM` grid parameters, as file name, number of x bins, xmin, xmax, number of Q^2 bins, `Q2min` and `Q2max`.

```
'Evolution:'  
'nlo', 1.0, 1.0  
'QCDNUM_MRST'  
'MRST.large.grid', 400, 1d-6, 1d0, 112, 1.d0, 1d10
```

C++ wrapper (ccwrap)

Initially provided by Stefan Gieseke for V2 and updated through to V5. Recently (V5,4) revamped by Andy Buckley to make more implementation independent.

It consists of:

LHAPDFWrap.cc

LHAPDFWrap.h

LHAPDFfw.f

FortranWrappers.h

test-lhapdf-ccwrap.cc ← test example programme

The standard LHAPDF installation procedure builds the libLHAPDFWrap static (.a) and dynamic libraries (.so), installing them into the standard /lib directory along with the Fortran libraries.

Can be disabled with `configure --disable-ccwrap`

C++ wrapper (ccwrap)

selecting the pdf set and member

To use, first create instance of LHAPDFWrap using one of:

```
LHAPDFWrap pdf = LHAPDFWrap(string name, int member);  
LHAPDFWrap pdf = LHAPDFWrap(string name);  
LHAPDFWrap pdf = LHAPDFWrap();
```

plus if needed:

```
pdf.initPDFSet(string fully-qualified-name);  
pdf.initPDFSetByName(string name);  
pdf.initPDF(int member);
```


C++ wrapper (ccwrap)

evaluating the pdfs

(vector) pdf.xfx(*double x, double q*);

(double) pdf.xfx(*double x, double q, int fl*);

(vector) pdf.xfxp(*double x, double q, double p2, int ip2*);

(double) pdf.xfxp(*double x, double q, double p2, int p2, int fl*);

etc... xfxa(...

xfxphoton(...

Plus a complete set with 'M' at the end of the method name and an extra 'int nset' as the first argument for the set number.

eg: pdf.xfxM(*int nset, double x, double q*);

'*int fl*' is the parton flavour (0 =gluon etc..) and these methods return a single double for that flavour, otherwise a vector is returned.

C++ wrapper (ccwrap)

other methods

Include:

(int) pdf.numberPDF(); ← returns number of PDF members in set

(void) pdf.getDescription(); ← prints the PDF description

(double) pdf.alphasPDF(*double q*); ← returns alphas for the PDF set

(double) pdf.getLam4();

(double) pdf.getLam5();

(double) pdf.getXmin(*int member*);

(double) pdf.getXmax(*int member*);

(double) pdf.getQ2min(*int member*);

(double) pdf.getQ2max(*int member*);

} returns the various parameters

Plus the usual set with suffix 'M' and extra first argument 'int nset' for multiset use.

Short tour of the LHAPDF web site

mailing list - subscribing

The screenshot shows the LHAPDF website interface. On the left, a navigation menu lists various sections, with 'Mailing list' highlighted. A callout box on the right provides a detailed view of the 'Email the developers' page, which includes sections for 'About lhapdf', 'Using lhapdf', and 'Subscribing to lhapdf'. The 'Subscribing to lhapdf' section contains a form with input fields for 'Your email address', 'Your name (optional)', and 'Pick a password', along with a 'Subscribe' button. The form also includes a section for entering a privacy password and a 'Reenter password to confirm' field.

LHAPDF — Email the developers (subscription not required)

About lhapdf

This list is an email alias to reach the developers.

Using lhapdf

To post a message to all the list members, send email to lhapdf@projects.hepforge.org.

You can subscribe to the list, or change your existing subscription, in the sections below.

Subscribing to lhapdf

Subscribe to lhapdf by filling out the following form.

This is a closed list, which means your subscription will be held for approval. You will be notified of the list moderator's decision by email. This is also a private list, which means that the list of members is not available to non-members.

Your email address:

Your name (optional):

You may enter a privacy password below. This provides only mild security, but should prevent others from messing with your subscription. **Do not use a valuable password** as it will occasionally be emailed back to you in cleartext.

If you choose not to enter a password, one will be automatically generated for you, and it will be sent to you once you've confirmed your subscription. You can always request a mail-back of your password when you edit your personal options.

Pick a password:

Reenter password to confirm:

Subscribe

Short tour of the LHAPDF web site on-line user manual

The image shows a screenshot of a web browser displaying the LHAPDF website. The browser's address bar shows the URL <http://projects.hepforge.org/lhapdf/>. The page title is "LHAPDF the Les Houches Accord PDF Interface".

The main content area is titled "Home" and contains a paragraph: "LHAPDF provides a unified and easy to use interface to modify individual PDF sets but also with the more recent multiple 'e' PDFLIB, incorporating many of the older sets found in the late computer code and input parameters/grids are separated through expansion possibilities. The code and data sets can be downloaded from version 4.1 onwards a configuration script facilitates the installation".

On the left side, there is a navigation menu with the following items: LHAPDF Home, Publications, Installation, PDF sets, Downloads, User manual, Theory review, C++ wrapper, .LHpdf files, Mailing list, ChangeLog, Contact, and hepforge. The "User manual" item is highlighted with a box, and a line points from this box to the "Contents" section of the manual shown in the right-hand panel.

The right-hand panel, titled "LHAPDF manual", shows the "LHAPDF version 5 User Guide" and a "Contents" section. The contents are listed as follows:

- 1 Introduction
- 2 Installing LHAPDF
 - 2.1 Version 4.1 onwards
 - 2.1 Version 4.0 and earlier
- 3 Interfacing LHAPDF with a Code
 - 3.1 Using the LHAPDF routines directly
 - 3.2 Using the LHAGLUE interface
 - 3.3 Whether to use .LHpdf or .LHgrid files?
- 4 Multiset Initialization with Version 5
 - 4.1 How many sets can be initialised
 - 4.2 Using multiset initialization with LHAGlue
 - 4.3 Using multiset initialization with native LHAPDF routines
- 5 C++ wrapper
 - 5.1 Description

Below the contents, there is a section titled "Appendices" with the following items:

- A PDF set numbers and names
- B Examples
 - B.1 Example 1: A PDF table

At the bottom of the page, there is a footer: "LHAPDF is maintained by Mike Whalley at Durham University (UK) email:m.r.whalley@durham.ac.uk phone:+44-191-334-3807 fax:+44-191-334-3658".

Short tour of the LHAPDF web site

ChangeLog

ChangeLog for LHAPDF

v5r3p1 - 16/11/07

- * STRUCTM/STRUCTP now allow constants in calling argument string.
- * New MRST 2001/2204 code for better extrapolation, which also fixes the bug which caused failure of these on extrapolation.
- * Fixes VZERO name conflict with (for example) CERNLIB
- * Corrects error in MRST2006 code causing PDFs to be frozen at $Q=1.43$ when called with Q between 1.43 and 4.3.

v5r3 - 28/06/2007

- * addition of the following new PDFsets:
 - mrst2004qed
 - mrst2006nnlo
 - cteq65
 - cteq65c
 - cteq5f3
 - cteq5f4
- * GetNf() now returns '-1' for the .LHgrid files - it only returns the correct number of Flavours if evolution is done in the PHAPDF program -ie .LHpdf files
- * C++ wrapper library (LHAPDFWrap.a and .so) is now built automatically in the make/make install procedure and placed in the standard LHAPDF library directory.
- * New Fortran routines and C++ methods to extract the max and min X and Q^{*2} values in the raw LHAPDF code.
- * 'extrapolate' the PDFs beyond the max/min x/Q^2 now works with the raw LHAPDF code.
- * Addition of wrapUSER.f routine to allow a hook for user written PDF sets to be added.
- * Finding PDF sets with lhapdf-config now writes into \$HOME/.lhapdf/, rather than /tmp. This avoids write permission conflicts between users.
- * Added PDFsets.index file
- * Distributions are now built in a more standard way with "make dist" and the dist-hook mechanism

v5r2p3 - 6/11/2006

- * fixed error causing anti-b in zeus2002 to be zero.
- * for consistency the argument lists in a02init,a02munit and grxlim corrected.

v5r2p2 - 19/7/2006

- * Fixed error in print statement in Example5.f
- * Removed reference to the HL2000lo2 sets in lhaglu.f
- * Added common LUDAT1 to lhaglu.f to allow working with older Pythia versions
- * Fixed problems with 's in descriptions causing errors with gfortran compiler
- * Fixed problem causing QCDNUM (in MRST and ZEUS) to work slowly with V5.

v5r2p1 - 21/6/2006

LHAPDF is maintained by Mike Whalley at Durham University (UK)
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Short tour of the LHAPDF web site available PDFsets

The screenshot shows the LHAPDF website interface. On the left is a navigation menu with items like 'LHAPDF Home', 'Publications', 'Installation', 'PDF sets', 'Downloads', 'User manual', 'Theory review', 'C++ wrapper', '.LHpdf files', 'Mailing list', 'ChangeLog', 'Contact', and 'hepforge'. The main content area is titled 'Available PDF sets' and contains a table of PDF sets. A callout box points to the 'PDF sets' menu item and the table.

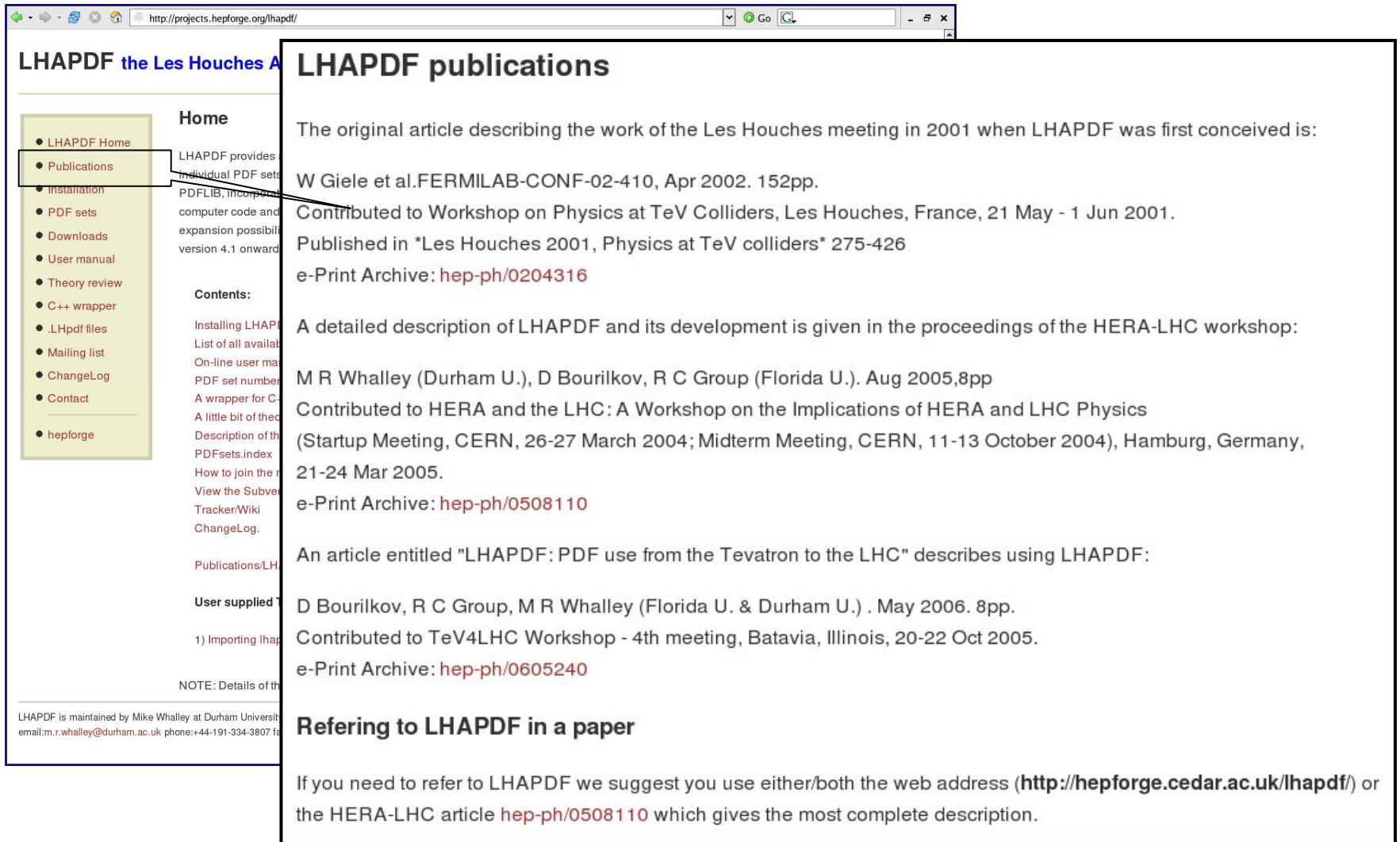
Can download the individual PDF files from here. (latest version only)

Available PDF sets

Individual files can be downloaded from the right hand two columns

Nucleon PDF Set Summary			
PDF set	Members	.LHpdf File	.LHgrid File
Alekhin02 LO	15	-	a02m_lo.LHgrid
Alekhin02 NLO	15	-	a02m_nlo.LHgrid
Alekhin02 NNLO	15	-	a02m_nnlo.LHgrid
Alekhin00	100	Alekhin_100.LHpdf	-
Alekhin00	1000	Alekhin_1000.LHpdf	-
Botje99	100	Botje_100.LHpdf	-
Botje99	1000	Botje_1000.LHpdf	-
CTEQ65c (cteq65c)	7	-	cteq65c.LHgrid
CTEQ65 (cteq65)	40	-	cteq65.LHgrid
CTEQ6AB (cteq6AB - variable alphas)	20	-	cteq6AB.LHgrid
CTEQ61 (cteq61m + errors)	41	cteq61.LHpdf	cteq61.LHgrid
CTEQ6	41	cteq6.LHpdf	cteq6mE.LHgrid
CTEQ6 Standard MSbar	1	cteq6m.LHpdf	-
CTEQ6 LO fit, with NLOOrder alpha_S	1	cteq6l.LHpdf	-
CTEQ6 LO fit, with LOOrder alpha_S	1	cteq6ll.LHpdf	-
CTEQ5m Standard MSbar	1	-	cteq5m.LHgrid
CTEQ5m1 updated CTEQ5m	1	-	cteq5m1.LHgrid

Short tour of the LHAPDF web site referencing LHAPDF



The screenshot shows the LHAPDF website at <http://projects.hepforge.org/lhapdf/>. The navigation menu on the left includes links for Home, Publications, Installation, PDF sets, Downloads, User manual, Theory review, C++ wrapper, .LHpdf files, Mailing list, ChangeLog, Contact, and hepforge. The main content area is titled "LHAPDF publications" and contains several entries. A callout box highlights the "Publications" link in the navigation menu and the "LHAPDF publications" section of the page content.

LHAPDF publications

The original article describing the work of the Les Houches meeting in 2001 when LHAPDF was first conceived is:
W Giele et al.FERMILAB-CONF-02-410, Apr 2002. 152pp.
Contributed to Workshop on Physics at TeV Colliders, Les Houches, France, 21 May - 1 Jun 2001.
Published in *Les Houches 2001, Physics at TeV colliders* 275-426
e-Print Archive: hep-ph/0204316

A detailed description of LHAPDF and its development is given in the proceedings of the HERA-LHC workshop:
M R Whalley (Durham U.), D Bourilkov, R C Group (Florida U.). Aug 2005,8pp
Contributed to HERA and the LHC: A Workshop on the Implications of HERA and LHC Physics
(Startup Meeting, CERN, 26-27 March 2004; Midterm Meeting, CERN, 11-13 October 2004), Hamburg, Germany,
21-24 Mar 2005.
e-Print Archive: hep-ph/0508110

An article entitled "LHAPDF: PDF use from the Tevatron to the LHC" describes using LHAPDF:
D Bourilkov, R C Group, M R Whalley (Florida U. & Durham U.) . May 2006. 8pp.
Contributed to TeV4LHC Workshop - 4th meeting, Batavia, Illinois, 20-22 Oct 2005.
e-Print Archive: hep-ph/0605240

Referring to LHAPDF in a paper

If you need to refer to LHAPDF we suggest you use either/both the web address (<http://hepforge.cedar.ac.uk/lhapdf/>) or the HERA-LHC article hep-ph/0508110 which gives the most complete description.

Future Plans

- Next release 5.4.0 will be out very soon
- Continue to support the maintenance and development of LHAPDF
- Respond to users questions and suggestions for new features and improvements, incorporating them if feasible.
- Add new sets as and when they are made available

Credits

Walter Giele (Fermilab)– original idea and code

Dimitri Bourilkov (Florida) – LHagLue wrapper

Andy Buckley (Durham) – Installation/hepforge/C++ code

David Grellscheid (Durham) – C++ code improvements

Stefan Gieseke(Karlsruhe) original C++ wrapper code

+ MRW

+ those authors who have supplied their PDF sets

+ many others ...

Finally.... to check output numbers

Parton Distributions:

Using the form below you can calculate, in real time, values of $xf(x, Q^2)$ from the groups CTEQ, MRS, GRV, Alekhin, ZEUS and H1. You can compare plots of $xf v x$ at any Q^2 for up to 4 different parton types or PDFs.

xmin = xmax = xinc = $Q^{*2} =$

select lin x or log x

select lin xf or log xf and xfm = and xfmmax =

select either numbers or plot or kumac file

1	<input checked="" type="checkbox"/>	all	CTEQ6.5M	scale-factor	1.0
2	<input type="checkbox"/>	up	MRST2002NLO	scale-factor	1.0
3	<input type="checkbox"/>	up	MRST2002NLO	scale-factor	1.0
4	<input type="checkbox"/>	up	MRST2002NLO	scale-factor	1.0

Parton Distributions, $xf(x)$, from CTEQ6.5M

X	Q^{*2}	up	down	upbar	downbar	strange	charm	bottom	gluon
9.500E-02	1.000E+03	6.221E-01	3.865E-01	9.312E-02	1.259E-01	7.130E-02	3.306E-02	1.582E-02	1.029E+00
1.450E-01	1.000E+03	5.896E-01	3.236E-01	4.989E-02	7.412E-02	3.905E-02	1.610E-02	7.515E-03	5.494E-01
1.950E-01	1.000E+03	5.369E-01	2.614E-01	2.962E-02	4.179E-02	2.230E-02	8.903E-03	4.048E-03	3.239E-01
2.450E-01	1.000E+03	4.702E-01	2.042E-01	1.892E-02	2.182E-02	1.285E-02	5.331E-03	2.347E-03	2.024E-01
2.950E-01	1.000E+03	3.965E-01	1.546E-01	1.234E-02	1.046E-02	7.384E-03	3.367E-03	1.428E-03	1.313E-01
3.450E-01	1.000E+03	3.221E-01	1.136E-01	7.802E-03	4.688E-03	4.223E-03	2.200E-03	8.957E-04	8.741E-02
3.950E-01	1.000E+03	2.521E-01	8.079E-02	4.585E-03	2.137E-03	2.412E-03	1.463E-03	5.707E-04	5.921E-02
4.450E-01	1.000E+03	1.900E-01	5.531E-02	2.477E-03	1.111E-03	1.384E-03	9.751E-04	3.644E-04	4.050E-02
4.950E-01	1.000E+03	1.376E-01	3.616E-02	1.259E-03	6.606E-04	8.002E-04	6.405E-04	2.298E-04	2.777E-02
5.450E-01	1.000E+03	9.545E-02	2.240E-02	6.251E-04	4.093E-04	4.621E-04	4.071E-04	1.408E-04	1.889E-02
5.950E-01	1.000E+03	6.298E-02	1.301E-02	3.098E-04	2.449E-04	2.610E-04	2.447E-04	8.212E-05	1.258E-02
6.450E-01	1.000E+03	3.917E-02	7.000E-03	1.510E-04	1.351E-04	1.391E-04	1.351E-04	4.447E-05	8.054E-03
6.950E-01	1.000E+03	2.266E-02	3.423E-03	6.844E-05	6.543E-05	6.618E-05	6.543E-05	2.156E-05	4.823E-03
7.450E-01	1.000E+03	1.193E-02	1.478E-03	2.618E-05	2.578E-05	2.588E-05	2.578E-05	8.914E-06	2.595E-03
7.950E-01	1.000E+03	5.522E-03	5.373E-04	7.105E-06	7.071E-06	7.080E-06	7.071E-06	2.911E-06	1.174E-03
8.450E-01	1.000E+03	2.104E-03	1.505E-04	9.140E-07	9.127E-07	9.130E-07	9.127E-07	6.831E-07	3.968E-04
8.950E-01	1.000E+03	5.721E-04	2.692E-05	1.205E-07	1.205E-07	1.205E-07	1.205E-07	1.202E-07	7.800E-05
9.450E-01	1.000E+03	7.363E-05	1.205E-07	1.205E-07	1.205E-07	1.205E-07	1.205E-07	1.202E-07	7.800E-05
9.950E-01	1.000E+03	1.260E-06	5.721E-04	1.205E-07	1.205E-07	1.205E-07	1.205E-07	1.202E-07	7.800E-05

HEPDATA

The Durham HEP Databases

from the Durham Database Group, at Durham University(UK).

Comments/Suggestions etc. to: M.R.Whalley@durham.ac.uk

[Registration \(optional\)](#)
[Feedback](#)
[Help/User Guide](#)

HEP DataBase

sections, structure and
 "scattering"
 physics experiments,

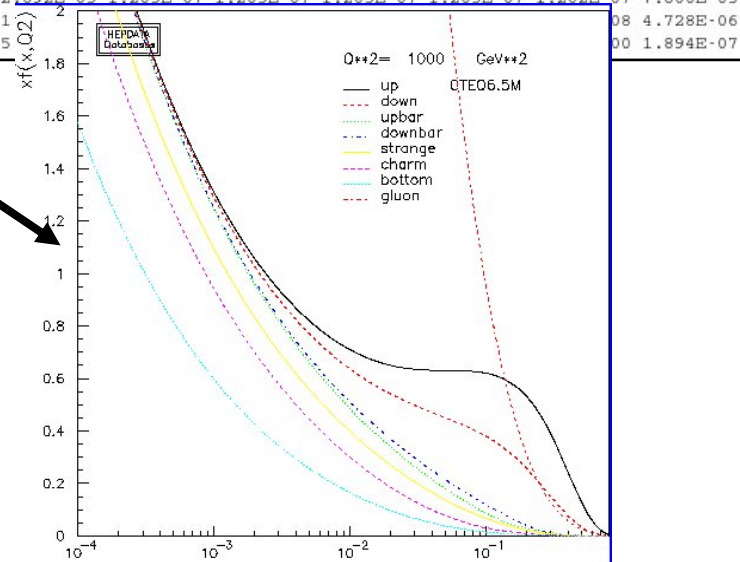
views listed below.

Journal of Physics G -
 ons of the reviews can be

Parton Distribution Function Server

Access the latest parton distribution codes plus [on-line calculation](#)
 and graphical display of the distributions, for the [CTEQ](#), [GRV](#),
[MRST](#) and [Alekhin](#) PDF sets. Includes also [polarized parton](#)
[distributions](#), and also the code for the [ZEUS 2002](#), [ZEUS 2005 jet](#)
[fit](#) and [H1 PDF 2000](#) pdfs.

See also [LHAPDF-5.0.0](#) The Les Houches Accord PDFs (now hosted
 by [CEDAR-hepforge](#))



tus report