Particle Physics Phenomenology II

FS 11, Series 11

Due date: 16.05.2011, 1 pm

Exercise 1

In the following exercise you will have to download the LHAPDF library. This provides you with an interface for C or Fortran which enables you to access all pdf sets of essentially all providers. To set up the LHAPDF library you should

i) download the package from http://www.hepforge.org/downloads/lhapdf

ii) untar it (`tar -zxvf lhapdf-*.*.*.tar.gz`) and do
```
./configure --prefix=/path/to/LHAPDF/directory --enable-low-memory
make
make install
```
Note that the `path/to/LHAPDF/directory` is an absolute path, not a relative one. See http://projects.hepforge.org/lhapdf/install for more details on how to install the LHAPDF library.

iii) After having installed the library you have to tell the system where to find it, by fixing the LD_LIBARY_PATH
```
UNIX/LINUX :
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/path/to/LHAPDF/directory/lib/.libs
MAC OSX :
export DYLD_LIBRARY_PATH=$DYLD_LIBRARY_PATH:/path/to/LHAPDF/directory/lib/.libs
```

Placing this export command in your .bashrc (unix/linux) or .bash_profile (MAC OSX) will save you having to retype it after every logout.

iii) Next, you have to fetch the actual pdf grids. In the directory of LHAPDF there is a `bin/lhapdf-getdata` executable, which can fetch the pdfs you need and place them in a local directory of your choice. Type

```
./bin/lhapdf-getdata MRST2004 --dest=/path/to/pdfgrids
./bin/lhapdf-getdata MSTW2008 --dest=/path/to/pdfgrids
./bin/lhapdf-getdata cteq6 --dest=/path/to/pdfgrids
```

The full functionality of that script can be seen by
`bin/lhapdf-getdata --help`
See http://projects.hepforge.org/lhapdf/install for more details.

iv) Finally you have to tell the system where to find the grids, by setting the environment variable

`export LHAPATH = /path/to/pdfgrids`

Placing this export command in your .bashrc (unix/linux) or .bash_profile (MAC OSX) will save you having to retype it after every logout.

v) Check whether your installation has been succesful by running one of the example programs. To do this go to /lhapdf*.*.*/examples and type `./lhapdf-cctest1`.

Exercise 2

In this exercise you will use the LHAPDF library to plot the electromagnetic proton structure function

$$F_2(x,Q) = \sum_{i=-6}^{6} q_i^2 x f_i(x,Q).$$

Here q_i denotes the electric charge of parton i, x is the parton momentum fraction of the proton, Q is the factorisation scale and $f_i(x,Q)$ is the parton distribution function of parton i. Note that LHAPDF returns $xf(x,Q)$. Compare your plot with the one in the Deep Inelastic Scattering script, p.19.

If you want to write your program in C, you will need to include the following statement at the beginning of your program

```
#include "LHAPDF/LHAPDF.h"
```

Then use

```
gcc yourprogram.cc -L/path/to/lib/.libs -lLHAPDF -I/path/to/lhapdf/directory/include
```

to compile your program. See the example "CCtest1.cc" for how to use the interface.