



HERAFitter User's Meeting status report

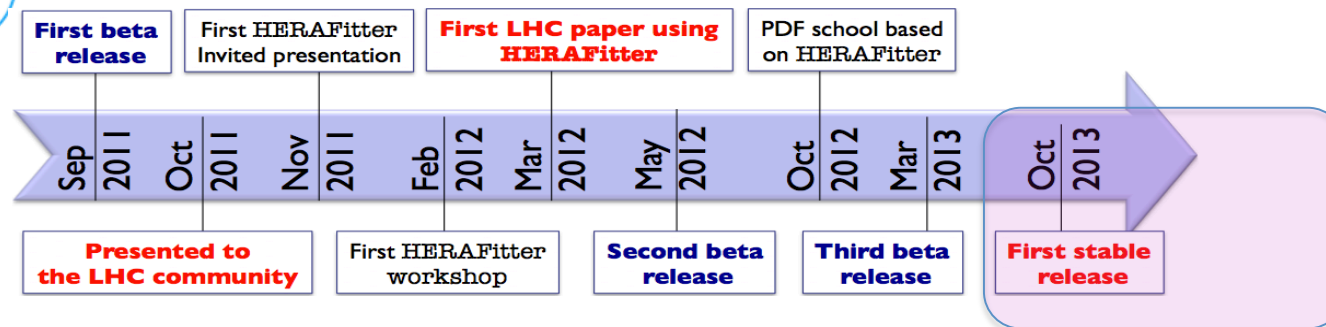


Announcements:

- Next meeting – proposal 14-18.10 – doodle:
<http://doodle.com/fygtcqk6fydkz3zm>
- Conferences and Workshops:
 - QCD@LHC
 - ICNFP → **winning POSTER!**
 - ISMD (15-20 Sept 2013)
 - TOP2013 (14-19 Sept 2013)
 - ATLAS SM Workshop (19-21 Sept 2013)
 - HADRON (4-8 Nov) ?
 - QCD Tools for LHC Physics: from 8 to 14 TeV (14-15 Nov)
 - PRC DESY (24-25 October)



HERAFitter time scale



Current releases: A bug Fix release 0.3.1 is available for download:

Next release will contain more features and better documentation

- Improved quantitative comparison with predictions:
 - Including PDF uncertainties
 - Possibility to compare with external predictions
- Possibility to use asymmetric uncertainties
- Added more options for chisquare representation
- Bug fix in reweighting code based on Hessian PDF sets
- Enabled LO PDF fits
- improved uPDF interface (tbc)
- Large improvements in the drawing tools
 - Multiple overlay option for individual PDF
 - data vs prediction, pull plots
- Multi-processor performance using OpenMP
- Generalised APPLGRID interface (tbc)
- Generalised minimisation (tbc)
- Possibility to fit Lead PDF (tbc)
- Possibility to fit QED PDF (generalised QCDNUM package, tbc)
- Improved Parametrisation style (tbc)



New developments for next release

- ◆ Quantitative comparison of data and theory predictions including PDF uncertainties
 - ▶ using LHAPDF

$$\chi^2 = \sum_i \left(\frac{\mu_i - m_i \left[1 + \sum_j b_j^{\text{exp}} \gamma_{ji}^{\text{exp}} + \sum_j b_j^{\text{theo}} \gamma_{ji}^{\text{theo}} \right]}{\Delta_i} \right)^2 + \sum_j (b_j^{\text{exp}})^2 + \sum_j (b_j^{\text{theo}})^2$$

Now extended for ABM set too

Since **r1106** this extension is introduced to HERAFITTER. The computations are enabled by LHAPDFERRORS flag. Optional new flag SCALE68 can be used to scale the PDF uncertainties from 90% to 68% level.

Fit 30 data points at NNLO, using CT10, MSTW08 and HERAPDF1.5 set (EIG-only):

PDF set	Central PDF	With PDF uncertainties
CT10	34.1	32.0
MSTW08	72.0	49.7
HERAPDF1.5eig	43.1	39.2

→ for the ATLAS measurements, the conclusions do not change dramatically for the fit including uncertainties.



New developments for next release

- ▶ Also related to data comparison with predictions (computed elsewhere than HERAFitter):
 - ✧ Can add it as text file in a similar fashion as data
 - ➔ Allows to mix different theoretical sources of uncertainties in a chisquare comparison

&InTheory

! Fixed theory predictions, parallel to data files

```
InputTheoNames(1) = 'theo1.dat'
```

```
InputTheoNames(2) = 'theo2.dat'
```

```
InputTheoNames(3) = 'theo3.dat'
```

&End

- ▶ Chisquare calculation is extended to use parabolic approximation for asymmetric uncertainties.
- ▶ The chisquare code was updated to use covariance (syst or total) and/or correlation matrix (stat or syst)

$$\chi^2 = \sum_{i,j} (D_i - T_i) \text{Cov}_{i,j}^{-1} (D_j - T_j)$$

$$\begin{array}{ccc} \text{statistical} & \text{uncorrelated} & \text{correlated} \\ \downarrow & \downarrow & \downarrow \\ \text{Cov} = C^{stat} + C^{uncor} + C^{corr} \end{array}$$



New developments for next release

→ Implementation:

- Build N_{pdf} random replicas from central prediction and n error sets:

$$F(S_k) = F(S_0) + \sum_{j=1}^n [F(S_j^\pm) - F(S_0)] |R_{jk}| \quad (k = 1, \dots, N_{pdf}),$$

(Difference) check using lhpdf)

- Calculate weights based on chi2 of random predictions and data
- Other stuff, effective number of replicas, rescaling of data uncertainties... → same as for NNPDF
- Output new LHAPDF reweighted PDF set

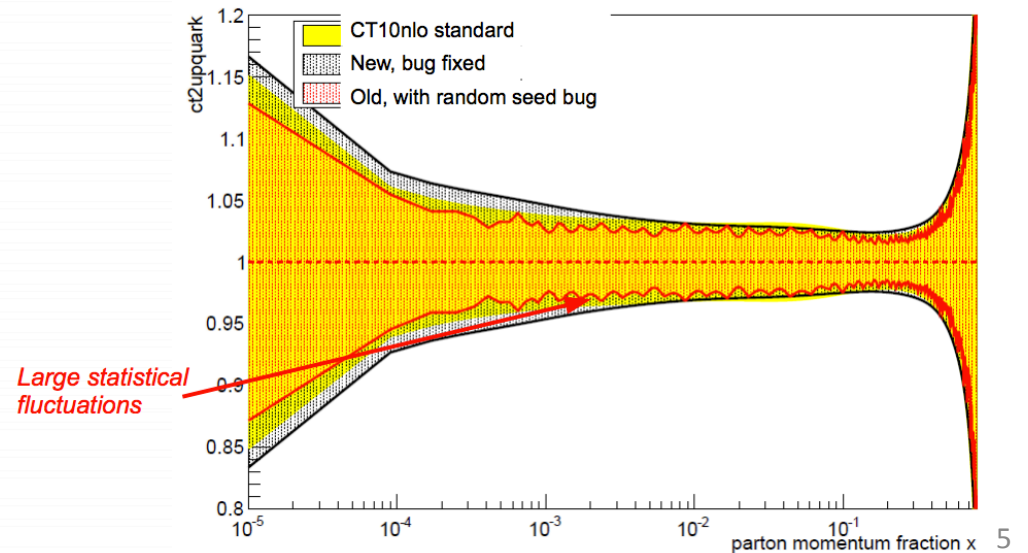
→ Problem in the implementation:

- 1) bug in the cast of bool to determine whether symmetric error → **Fixed!!**
overestimate of errors of random PDFs
- 2) Used different random seed for each eigenvector, PDF set, point in x and Q^2 → quite some fluctuations for created random sets

20.8.2013

NNPDF reweighting and HERA Fitter - Kristin Lohwasser

Works for CT, NNPDF, MSTW sets
To be tested for other PDF sets





New developments already available in the trunk

- ▶ Freedom to change the name of the output directory in steering.txt

```
&OutDir
  ! Name of the directory where output will be stored (max 22 characters)
  OutDirName = 'output'
&End
```

- ▶ Dummy reaction type for testing formats (data central = theory)

```
Reaction = 'Dummy'
```

- ▶ Running with multi processing: openMP (requires a library patch to QCDNUM)
- ▶ Generalised minimisation based on multiple sampling of minuit files (in progress)



Drawing tools

- ◆ Extended the Drawing of the output PDFs and data vs theory comparison:

```
DrawPdfs [options] dir1[:label1] [dir2[:label2]] [...]
```

First directory is used as reference for PDF ratio plots and to display data in data pulls plots.

Directory labels are used in the legends of the plots, to add spaces and special characters to the labels use quotation marks ' (ex. dir:'HERA I'). To specify greek letters and latex commands in the labels use the ROOT notation (#alpha #bar{u}).

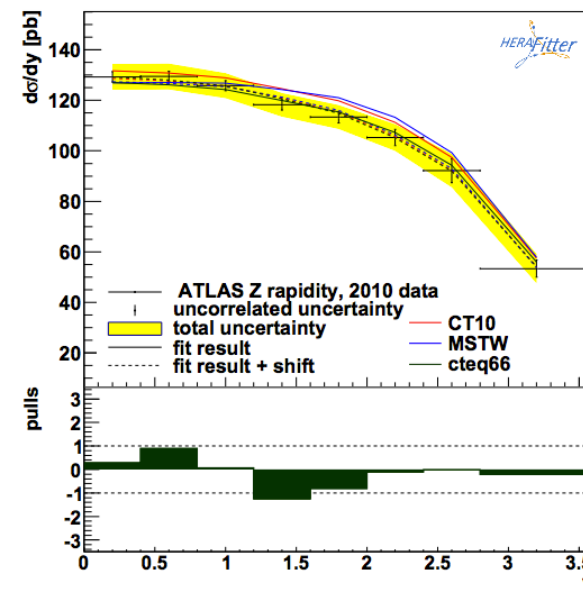
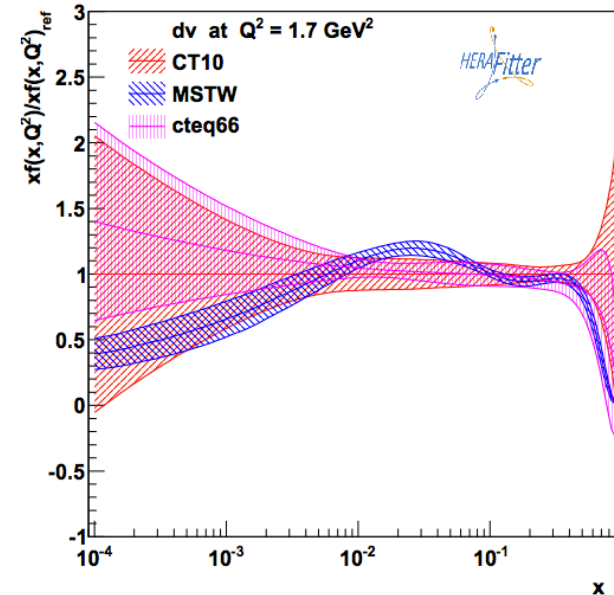
It is possible to specify up to 6 directories, you need to specify at least one

general options:

- help Show this help
- pdf (require ps2pdf) Produce and addition plot file in pdf format
- colorpattern <1-3> Select among 3 additional color patterns

options for pdf plots:

- bands Draw PDF uncertainty band
- outdir <output directory> Specify output directory
- splitplots Produce also additional eps files for each plot
- filledbands Filled uncertainty bands, usefull for sensitivity studies
- ratorange <min:max> Specify y axis range in PDF ratio plots





HERAFitter developments perspectives

A list of planned developments:

◆ Theory (short and long terms):

- ▶ ACOT NNLO.
- ▶ More on Nuclear PDFs.
- ▶ ACOT in QCDNUM, using fast convolution engine.
- ▶ Improvements in ttbar cross-section calculation for fits, top studies
- ▶ Intrinsic charm
- ▶ EW corrections
- ▶ low x models:
 - ✧ dipole/saturation
 - ✧ resummation
 - ✧ kt-factorisation
- ▶ DNNLO in APPLGRID. → indirectly related but would facilitate NNLO fits (Pavel)
- ▶ Different evolution schemes:
 - ✧ e.g. matched to MC showering, mixed Dipole-DGLAP fits.

◆ Data treatments:

- ▶ Additional tools to transform covariance matrix to nuisance parameter representation
- ▶ Alternative to MINUIT minimization package
- ▶ HERAverager: alpha version available: <https://wiki-zeuthen.desy.de/HERAverager>



Today's Agenda

Monday, 9 September 2013

- 14:00 - 14:20 **Status 20'**
Speakers: Voica Ana Maria Radescu (Deutsches Elektronen-Synchrotron (DE)), Ringaile Placakyte (Deutsches Elektronen-Synchrotron (DE))
- 14:20 - 14:40 **QED PDF in HERAFitter 20'**
Speaker: Renat Sadykov (Joint Inst. for Nuclear Research (RU))
- 14:40 - 15:00 **lead PDF status 20'**
Speakers: Prof. Fred Olness (Southern Methodist University), Fred Olness (Southern Methodist University (US)), Dr. Aleksander Kusina (Southern Methodist University)
- 15:00 - 15:20 **Report from Users 20'**