

# xFitter: Releases and Updates

March, 2017

**xFitter** versions are labeled as **xfitter-i.j.k** where **i** is the stable release number, **j** is beta release number, and **k** is bug fixes.

Release	Date	Description
<b>xfitter-2.0.0</b> (FrozenFrog)	20.03.2017	<b>Physics related additions:</b> <ul style="list-style-type: none"><li>• Implementation of switching scales for heavy quarks (APFEL)</li><li>• Fast convolution using APFELGRID (fk tables)</li><li>• Write out top LHAPDF if top mass is below kinematic limit (5 and 6 flavour PDFs)</li><li>• Extra PDF parameters of the photon parametrisation</li><li>• Improvements to QED evolution interface (QEDevol)</li><li>• (optionally) Produce symmetric hessian PDF sets using minuit HESSE covariance matrix computation instead of default ITERATE method.</li><li>• Updates to dipole steering files, saturation flag added</li><li>• Extra option to separate statistical uncertainty from total covariance matrix, when it is uncorrelated</li></ul>

## Technical improvements:

- Move to QCDNUM 17-01-13 new PDF interfaces. Make use of fast PDF calls.
- Update fastNLO to latest version. Switch from APPLGRID → FastNLO to native FastNLO.
- `install-xfitter` script uses `cvmfs` (recommended way to install xFitter)
- `xfitter-getdata.sh` script added to download datasets
- Added new datasets from LHC and HERA, and LHeC simulated data.
- Synchronisation of the lhpdf6 output grid with initialisation from QCDNUM
- Restore optional LHAPDFv5 usage
- Possibility to force PDFs to be positive after processing (`xfitter-process` tool)
- Adjustment of internal systematic arrays to to run with all data. Reduction of other internal arrays to keep memory footprint low
- Improvements in configuration and makefiles to work with different compilers and operation systems
- If `OUTPUTDIR` directory exists when running `xfitter`, it will be moved to `OUTPUTDIR_OLD`
- Increased the possible length of the output directory name
- Clean up (removing/renaming functions, suppressing unneeded outputs)
- Updates to README, INSTALLATION, steering files, manual, doxygen config
- Add error message if combine utility is used with LHAPDFv 5.x
- Cleanup of warning messages, better indication of potential problems
- Restore `make dist` functionality
- Added extra automatic checks
- Add feature to draw individual sets by using `set:ID:dir` syntax
- Additional option `--loose-mc-replica-selection`
- Add strict check for second option of MC-replica path matching
- Other small fixes in drawing options (logo, coloured error bands, etc)

## Bug Fixes:

- Fix in the gluon parametrisation (affecting HERAPDF parameterisation sum-rule)
- Enable compilation with LHAPDF6 and without APPLgrid enabled
- Fixes in non-standard parameterisations (e.g. using Chebyshev polynomials )
- Fix few conflicting fortran symbols

Release	Date	Description
<b>xfitter-1.2.2</b>	8.07.2016	<ul style="list-style-type: none"> <li>• Fix in profiling due to multiple sign flips, affects also reweighting.</li> <li>• Fix in the output of PDFs, strange is symetrised to <math>(s + \bar{s})/2</math>.</li> <li>• Fix in calculation of theory error bands for parametrisation uncertainties for the <code>--therr</code> option.</li> <li>• Fix for <code>has_photon</code> LHAPDF variable and protection against LHAPDFQ0 with photon PDFs.</li> <li>• Fixes to dipole steering file in input steering file, updated now to current settings.</li> <li>• Added the H1 beauty data to the list of data files</li> <li>• Fix in the default theoretical parameters for HVQMNR to be used not in Fit mode.</li> <li>• Fix on warning message from Fastnlo.</li> <li>• Added examples in the example directory together with the tutorial slides from CTEQ 2016 school.</li> <li>• Fix in configuratuon for <code>--disable-root</code> option.</li> <li>• Fix in <math>\alpha_s</math> interpolation and protection in overriding the output directories.</li> <li>• Fix in photon PDF sum rules.</li> </ul>

Release	Date	Description
<b>xfitter-1.2.1</b>	11.05.2016	<ul style="list-style-type: none"> <li>• Update the EW corrections in CMS 7 TeV jet data, as used for the publication.</li> <li>• Fix in the Hessian error for external codes: FONLL schemes, DGLAP_QED and DGLAP_APFEL_QED were affected.</li> <li>• Fix in <math>\alpha_s</math> for running mass option in FONLL.</li> <li>• Fix in the cached PDFs when using Hessian errors.</li> <li>• Fix in the LHAPDF errors for the MNR code.</li> <li>• Allow the FF scheme for the MNR calculations.</li> <li>• Fix in the handling of the virual grids (hyperbins were not filled).</li> <li>• Improved warning messages in FastNLO from the photon PDF.</li> </ul>

Release	Date	Description
<b>xfitter-1.2.0</b>	15.02.2016	<ul style="list-style-type: none"> <li>• Project renamed from herafitter to xfitter.</li> <li>• Added stand-alone scripts for downloading data/theory files: <b>getter</b> . No need of theory directory anymore, the theory files are now stored under same location with data files.</li> <li>• Change in the executable names: <ul style="list-style-type: none"> <li>– FitPDF → xfitter</li> <li>– DrawPdfs → xfitter-draw</li> <li>– postproc → xfitter-process</li> </ul> </li> <li>• Updated configure.ac to work with latest QCDNUM which is now available with autotools installation (&gt; 17.01.10). <ul style="list-style-type: none"> <li>– new QCDNUM allows possibility to have more than standard PDFs.</li> </ul> </li> <li>• Added QED PDFs via generalised <b>nxn</b> convolution engines of QCDNUM.</li> <li>• Added interface to APFEL which provides access to: <ul style="list-style-type: none"> <li>– evolution code: added DGLAP_APFEL option for standard evolution, or DGLAP_APFEL_QED for QED adjusted evolution.</li> <li>– FONLL heavy flavour schemes with multiple options.</li> </ul> </li> <li>• Added interface to n-space code MELA for Mellin Transformation and it is available via configuration flag.</li> <li>• Added direct access to LHAPDFs avoiding QCDNUM: LHAPDFNATIVE option</li> <li>• Added more data formatted for xfitter: updated Tevatron data, LHCb, HERA)</li> <li>• Added <b>--disable-root</b> option (root is enabled by default).</li> <li>• Default steering updated to HERAI+II data.</li> <li>• Removed DrawResults package, which was redundant, and added and updated drawing options for data files.</li> <li>• Added fixes to DIS electroweak part of the code.</li> <li>• Fixed several fortran warning messages.</li> <li>• Unifying theory interface for expression between FastNLO and APPLGRID usage.</li> </ul>

Release	Date	Description
<b>xfitter-1.2.0</b>	15.02.2016	<ul style="list-style-type: none"> <li>• Updated FastNLO to the latest version</li> <li>• Installation possible with <b>--prefix</b> option, added xfitter-config script.</li> <li>• Added MNR calculation code as used for the LHCb and HERA data analysis [Eur.Phys.J. C75 (2015) 8, 396]</li> <li>• Added new options for the reweighting using Giele-Keller weights. Merged common codes between profiling and reweighting.</li> <li>• Fixing lapack and blas tests to give configure errors and stop</li> <li>• Updated the ABM calculations in sync with OPENQCDRAD 2.0b4</li> <li>• Added possibility to get integrated cross sections for DIS.</li> <li>• Tools/RunJobs and steerings for diffraction adjusted to xFitter.</li> </ul>

Release	Date	Description
<code>herafitter-1.1.1</code>	3.03.2015	<ul style="list-style-type: none"> <li>• Fix in the reweighting code in the new interface to <code>LHAPDFv6</code> involving the gluon ID (different gluon ID is used between <code>LHAPDFv5</code> and <code>v6</code>)</li> <li>• Fix in TMD code: remove the <code>CERNLIB</code> dependence and update to <code>LHAPDFv6</code> , fix to the treatment of heavy quarks; updated steering files and <code>README</code> .</li> <li>• Fix of the <code>TheoryType</code> expression parsing used in data files</li> <li>• Fix in transformation from a Hessian to MC PDF set to preserve correlations</li> <li>• Fixed/improved the dynamic memory allocation for systematic arrays <code>NSysMax</code> and <code>WORK</code> arrays.</li> <li>• Fix of the warning for treatment of statistical errors (when default treatment changed to poisson errors).</li> <li>• Fix in the <math>\chi^2</math> code using additional rescale of stat. uncertainty to account for systematic shifts</li> <li>• Fixed/added drawing options for Diffractive PDFs.</li> <li>• Added <math>F_2</math> structure function in reaction type instead of cross section.</li> </ul>

Release	Date	Description
<code>herafitter-1.1.0</code>	29.09.2014	<ul style="list-style-type: none"> <li>• Removed dependence on <code>CERNLIB</code> and related libraries.</li> <li>• Added interface to <code>LHAPDFv6</code>.</li> <li>• Added more and improved drawing options for visualisation of results.</li> <li>• Added possibility to deal with multi-dimensional data (virtual grids).</li> <li>• Additional options in parametrisation styles: added mixed forms between HERA style for gluon and sea and CTEQ style for valence.</li> <li>• Added new data from Tevatron, ATLAS and CMS.</li> <li>• Added improvements and more flexibility in the <math>\chi^2</math> and covariance matrix code: possibility to transform into nuisance representation for data with uncertainties given in the covariance form.</li> <li>• Included a new fastNLO version, which was generalised in order to accommodate DiffTop grids.</li> <li>• Added DiffTop grids via fastNLO.</li> </ul>

Release	Date	Description
herafitter-1.0.0	10.12.2013	<ul style="list-style-type: none"> <li>• Added possibility to change the name of the output directory in <code>steering.txt</code></li> <li>• Added a dummy reaction type for testing data formats.</li> <li>• Centralised implementation of the scale variations for the DIS processes.</li> <li>• Enabled possibility to perform LO PDF fits.</li> <li>• Added possibility to determine generalised minima based on multiple sampling of <code>minuit</code> files.</li> <li>• Improved quantitative comparison of data to predictions by adding: <ul style="list-style-type: none"> <li>– Possibility to include PDF uncertainties in the <math>\chi^2</math> evaluation;</li> <li>– Possibility to use external predictions as text les (similar format style as for data) in the <math>\chi^2</math> evaluation;</li> </ul> </li> <li>• Added more options for <math>\chi^2</math> representation: <ul style="list-style-type: none"> <li>– Use of covariance and/or correlation matrix (statistical or systematic);</li> <li>– Use of parabolic approximation for asymmetric uncertainties.</li> </ul> </li> <li>• Considerable improvements in the drawing tools: <ul style="list-style-type: none"> <li>– Added new executable to draw PDFs: <code>DrawPdfs</code>;</li> <li>– Added possibility of multiple overlays, each PDF can be plotted separately;</li> <li>– Possibility to visualise the pulls (only for data sets that provide bin ranges).</li> </ul> </li> <li>• Possibility to fit Lead PDF;</li> <li>• Improved interface to Transverse Momentum Distributions (TMDs): <ul style="list-style-type: none"> <li>– Evolution is fully integrated into <code>HERAFitter</code>;</li> <li>– Evolution of valence quarks is also included;</li> <li>– Calculation of the longitudinal cross-section is also included;</li> </ul> </li> <li>• Simplified interface to the parametrisation style;</li> <li>• Fixes to the LHAPDF reweighted PDFs due to random seed generator causing large fluctuations.</li> <li>• New generalised <code>APPLGRID</code> interface: <ul style="list-style-type: none"> <li>– Added parser to identify theory expressions;</li> <li>– Added possibility to select the values for the CKM matrix elements from <code>APPLGRID</code> or <code>HERAFitter</code> .</li> <li>– Added possibility to flag a data bin to be excluded from the fit.</li> </ul> </li> <li>• Tool to convert covariance matrix to nuisance parameter representation.</li> </ul>

Release	Date	Description
<b>herafitter-0.3.1</b>	11.06.2013	<ul style="list-style-type: none"> <li>• Fixing interface with LHAPDF when fitting only <math>\alpha_S</math></li> <li>• Fixing the floating point error for negative predictions in <math>\chi^2</math> calculation</li> <li>• Fixing the treatment of the statistical correlations</li> <li>• Fixing treatment for asymmetric uncertainties</li> </ul>
<b>herafitter-0.3.0</b>	26.03.2013	<ul style="list-style-type: none"> <li>• The <b>theoryfiles</b> directory is detached from the release (to be downloaded separately)</li> <li>• Added via automake tools a <b>make check</b> to test sanity of the codes.</li> <li>• Added a User Example directory for reference outputs.</li> <li>• Inclusion of more data sets (like CMS, Tevatron).</li> <li>• Implemented a treatment for asymmetric systematic uncertainties.</li> <li>• Added updates to ACOT code which include higher order contributions for <math>F_2</math> and <math>F_L</math>.</li> <li>• Added new dipole models.</li> <li>• Implementation of treatment for the unintegrated PDFs (or TMDs).</li> <li>• Reorganisation of the <math>\chi^2</math> module, the old style is preserved and it should be used for the offset method and covariance matrix for chisquare representation.</li> <li>• Implementation of PDF reweighting based on eigenvectors.</li> <li>• Added new parametrisation styles and regularisation techniques.</li> <li>• A New FastNLO format was introduced.</li> </ul>

Release	Date	Description
herafitter-0.2.1	13.07.2012	<ul style="list-style-type: none"> <li>• Fixing the RT Fast scheme: the k-factors were determined for single point instead for each data point which is now fixed.</li> </ul>
herafitter-0.2.0	9.05.2012	<ul style="list-style-type: none"> <li>• New implementation of RT scheme (VFNS): Standard and Optimal NLO and NNLO.</li> <li>• New module for heavy flavour treatment using VFNS ACOT scheme using k-factor technique. Different variants of ACOT scheme available, as well as ZM-VFNS.</li> <li>• New module for heavy flavour treatment using FFNS ABM scheme.</li> <li>• New module for DIPOLE models (GBW, IIM).</li> <li>• New Hathor module for <math>t\bar{t}</math> cross section calculation - optional via configure flag.</li> <li>• New Diffractive module for fits to diffractive data.</li> <li>• New data sets from HERA, Fixed target experiments, Tevatron and LHC.</li> <li>• New interface to LHAPDF to access external PDFs for prediction estimation - optional via configure flag.</li> <li>• New module for NNPDF reweighting tool - optional via configure flag.</li> <li>• New addition for error handling providing a summary of errors.</li> <li>• Improved interface to FASTNLO module via FASTNLOREADER.</li> <li>• Improved interfaces between QCDNUM and cross-section calculation codes. PDF caching mechanisms for faster computations.</li> <li>• Improved modularity of the structure by separating the chisquare definition from minimisation routine.</li> <li>• New common interfaces to access PDFs and alphas, in interface/src .</li> <li>• Improved handling of PDF parametrisation, in src/pdf_param.f .</li> <li>• Centralised passing of the constants to EW module via ewparam.txt card.</li> <li>• New implementation for scale variation for APPLGRID and FASTNLO via steering.txt card</li> </ul>
herafitter-0.1.0	15.09.2011	<ul style="list-style-type: none"> <li>• Initial release</li> </ul>