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
xfitter-2.0.0 (FrozenFrog)	20.03.2017	**Physics related additions:**

Physics related additions:

- Implementation of switching scales for heavy quarks (APFEL)
- Fast convolution using APFELGRID ("fk" tables)
- Write out top LHAPDF if top mass is below kinematic limit (5 and 6 flavour PDFs)
- Extra PDF parameters of the photon parametrisation
- Improvements to QED evolution interface (QEDevol)
- (optionally) Produce symmetric hessian PDF sets using minuit HESSE covariance matrix computation instead of default ITERATE method.
- Updates to dipole steering files, saturation flag added
- Extra option to separate statistical uncertainty from total covariance matrix, when it is uncorrelated

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 lhapdf6 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
- Fixes in non-standard parameterisations (e.g. using Chebyshev polynomials)
- Fix few conflicting fortran symbols.

Release	Date	Description
xfitter-1.2.2	8.07.2016	• Fix in profiling due to multiple sign flips, affects also reweighting. • Fix in the output of PDFs, strange is symetrised to $(s + \bar{s})/2$. • Fix in calculation of theory error bands for parametrisation uncertainties for the `--therr` option. • Fix for `has_photon` LHAPDF variable and protection against LHAPDFQ0 with photon PDFs. • Fixes to dipole steering file in input steering file, updated now to current settings. • Added the H1 beauty data to the list of data files • Fix in the default theoretical parameters for HVQMNR to be used not in Fit mode. • Fix on warning message from Fastnlo. • Added examples in the example directory together with the tutorial slides from CTEQ 2016 school. • Fix in configuratuon for `--disable-root` option. • Fix in α_s interpolation and protection in overriding the output directories. • Fix in photon PDF sum rules.

Release	Date	Description
xfitter-1.2.1	11.05.2016	• Update the EW corrections in CMS 7 TeV jet data, as used for the publication. • Fix in the Hessian error for external codes: FONLL schemes, DGLAP_QED and DGLAP_APFEL_QED were affected. • Fix in α_s for running mass option in FONLL. • Fix in the cached PDFs when using Hessian errors. • Fix in the LHAPDF errors for the MNR code. • Allow the FF scheme for the MNR calculations. • Fix in the handling of the virual grids (hyperbins were not filled). • Improved warning messages in FastNLO from the photon PDF.

Release	Date	Description

`xfitter-1.2.0`	15.02.2016	• Project renamed from herafitter to xfitter.
		• Added stand-alone scripts for downloading data/theory files: `getter` . No need of theory directory anylonger, the theory files are now stored under same location with data files.
		• Change in the executable names:
		  – FitPDF → xfitter
		  – DrawPdfs → xfitter-draw
		  – postproc → xfitter-process
		
		• Updated configure.ac to work with latest QCDNUM which is now available with autotools installation ($> 17.01.10$).
		  – new QCDNUM allows possibility to have more than standard PDFs.
		
		• Added QED PDFs via generalised `nxn` convolution engines of QCDNUM.
		• Added interface to APFEL which provides access to:
		  – evolution code: added DGLAP_APFEL option for standard evolution, or DGLAP_APFEL_QED for QED adjusted evolution.
		  – FONLL heavy flavour schemes with multiple options.
		
		• Added interface to n-space code MELA for Mellin Transformation and it is available via configuration flag.
		• Added direct access to LHAPDFs avoiding QCDNUM: LHAPDFNATIVE option
		• Added more data formatted for xfitter: updated Tevatron data, LHCb, HERA)
		
		• Added `--disable-root` option (root is enabled by default).
		• Default steering updated to HERAI+II data.
		• Removed DrawResults package, which was redundant, and added and updated drawing options for data files.
		• Added fixes to DIS electroweak part of the code.
		• Fixed several fortran warning messages.
		• Unifying theory interface for expression between FastNLO and APPLGRID usage.

Release	Date	Description
`xfitter-1.2.0`	15.02.2016	• Updated FastNLO to the latest version • Installation possible with `--prefix` option, added xfitter-config script. • Added MNR calculation code as used for the LHCb and HERA data analysis [Eur.Phys.J. C75 (2015) 8, 396] • Added new options for the reweighting using Giele-Keller weights. Merged common codes between profiling and reweighting. • Fixing lapack and blas tests to give configure errors and stop • Updated the ABM calculations in sync with OPENQCDRAD 2.0b4 • Added possibility to get integrated cross sections for DIS. • Tools/RunJobs and steerings for diffraction adjusted to xFitter.

Release	Date	Description
`herafitter-1.1.1`	3.03.2015	• Fix in the reweighting code in the new interface to `LHAPDFv6` involving the gluon ID (different gluon ID is used between `LHAPDFv5` and `v6`) • Fix in TMD code: remove the `CERNLIB` dependence and update to `LHAPDFv6`, fix to the treatment of heavy quarks; updated steering files and `README`. • Fix of the `TheoryType` expression parsing used in data files • Fix in transformation from a Hessian to MC PDF set to preserve correlations • Fixed/improved the dynamic memory allocation for systematic arrays `NSysMax` and `WORK` arrays. • Fix of the warning for treatment of statistical errors (when default treatment changed to poisson errors). • Fix in the χ^2 code using additional rescale of stat. uncertainty to account for systematic shifts • Fixed/added drawing options for Diffractive PDFs. • Added F_2 structure function in reaction type instead of cross section.

Release	Date	Description
`herafitter-1.1.0`	29.09.2014	• Removed dependence on CERNLIB and related libraries. • Added interface to `LHAPDFv6`. • Added more and improved drawing options for visualisation of results. • Added possibility to deal with multi-dimensional data (virtual grids). • Additional options in parametrisation styles: added mixed forms between HERA style for gluon and sea and CTEQ style for valence. • Added new data from Tevatron, ATLAS and CMS. • Added improvements and more flexibility in the χ^2 and covariance matrix code: possibility to transform into nuisance representation for data with uncertainties given in the covariance form. • Included a new fastNLO version, which was generalised in order to accommodate DiffTop grids. • Added DiffTop grids via fastNLO.

Release	Date	Description
`herafitter-1.0.0`	10.12.2013	- Added possibility to change the name of the output directory in `steering.txt` - Added a dummy reaction type for testing data formats. - Centralised implementation of the scale variations for the DIS processes. - Enabled possibility to perform LO PDF fits. - Added possibility to determine generalised minima based on multiple sampling of `minuit` files. - Improved quantitative comparison of data to predictions by adding: - Possibility to include PDF uncertainties in the χ^2 evaluation; - Possibility to use external predictions as text les (similar format style as for data) in the χ^2 evaluation; - Added more options for χ^2 representation: - Use of covariance and/or correlation matrix (statistical or systematic); - Use of parabolic approximation for asymmetric uncertainties. - Considerable improvements in the drawing tools: - Added new executable to draw PDFs: `DrawPdfs`; - Added possibility of multiple overlays, each PDF can be plotted separately; - Possibility to visualise the pulls (only for data sets that provide bin ranges). - Possibility to fit Lead PDF; - Improved interface to Transverse Momentum Distributions (TMDs): - Evolution is fully integrated into `HERAFitter`; - Evolution of valence quarks is also included; - Calculation of the longitudinal cross-section is also included; - Simplified interface to the parametrisation style; - Fixes to the LHAPDF reweighted PDFs due to random seed generator causing large fluctuations. - New generalised `APPLGRID` interface: - Added parser to identify theory expressions; - Added possibility to select the values for the CKM matrix elements from `APPLGRID` or `HERAFitter` . - Added possibility to flag a data bin to be excluded from the fit. - Tool to convert covariance matrix to nuisance parameter representation.

Release	Date	Description
`herafitter-0.3.1`	11.06.2013	• Fixing interface with LHAPDF when fitting only α_S • Fixing the floating point error for negative predictions in χ^2 calculation • Fixing the treatment of the statistical correlations • Fixing treatment for asymmetric uncertainties
`herafitter-0.3.0`	26.03.2013	• The `theoryfiles` directory is detached from the release (to be downloaded separately) • Added via automake tools a `make check` to test sanity of the codes. • Added a User Example directory for reference outputs. • Inclusion of more data sets (like CMS, Tevatron). • Implemented a treatment for asymmetric systematic uncertainties. • Added updates to ACOT code which include higher order contributions for F_2 and F_L. • Added new dipole models. • Implementation of treatment for the unintegrated PDFs (or TMDs). • Reorganisation of the χ^2 module, the old style is preserved and it should be used for the offset method and covariance matrix for chisquare representation. • Implementation of PDF reweighting based on eigenvectors. • Added new parametrisation styles and regularisation techniques. • A New FastNLO format was introduced.

Release	Date	Description
`herafitter-0.2.1`	13.07.2012	• Fixing the RT Fast scheme: the k-factors were determined for single point instead for each data point which is now fixed.
`herafitter-0.2.0`	9.05.2012	• New implementation of RT scheme (VFNS): Standard and Optimal NLO and NNLO. • 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. • New module for heavy flavour treatment using FFNS ABM scheme. • New module for DIPOLE models (GBW, IIM). • New Hathor module for $t\bar{t}$ cross section calculation - optional via configure flag. • New Diffractive module for fits to diffractive data. • New data sets from HERA, Fixed target experiments, Tevatron and LHC. • New interface to LHAPDF to access external PDFs for prediction estimation - optional via configure flag. • New module for NNPDF reweighting tool - optional via configure flag. • New addition for error handling providing a summary of errors. • Improved interface to FASTNLO module via FASTNLOREADER. • Improved intefaces between QCDNUM and cross-section calculation codes. PDF caching mechanisms for faster computations. • Improved modularity of the structure by separating the chisquare definition from minimisation routine. • New common interfaces to access PDFs and alphas, in interface/src . • Improved handling of PDF parametrisation, in src/pdf_param.f . • Centralised passing of the constants to EW module via ewparam.txt card. • New implementation for scale variation for APPLGRID and FASTNLO via steering.txt card
`herafitter-0.1.0`	15.09.2011	• Initial release