Status of xFitter
Open Source QCD Fit framework

Voica Radescu (CERN/Oxford)/ Ringaile Placakyte (Uni Hamburg)

xFitter Meeting in Oxford, UK

19 - 22 March 2017
St Hilda's College, Oxford, UK

Overview of xFitter developments/new features since last meeting

Status of xFitter

Welcome to xFitter (former HERAFitter)

Proton parton distribution functions (PDFs) are essential for precision physics at the LHC and other hadron colliders. The determination of the PDFs is a complex endeavor involving several physics process. The main process is the lepton proton deep-inelastic scattering (DIS), with data collected by the HERA ep collider covering a large kinematic phase space needed to extract PDFs. Further processes (fixed target DIS, ppbar collisions etc.) provide additional constraining powers for flavour separation. In particular, the precise measurements obtained or to come from LHC will continue to improve the knowledge of the PDF.

The xFitter project is an open source QCD fit framework ready to extract PDFs and assess the impact of new data. The framework includes modules allowing for a various theoretical and methodological options, capable to fit a large number of relevant data sets from HERA, Tevatron and LHC. This framework is already used in many analyses at the LHC.

Downloads of xFitter software package

💡 **xFitter-2.0.0 release is publicly available.**
All the xFitter releases can be accessed HERE.
All the former (HERAFitter) releases can be accessed 🌐 HERE.
Description: 🌐 http://arxiv.org/abs/1410.4412

—>this talk (for future plans, see Sasha's talk)

xFitter Meetings

💡 🌐 xFitter Meeting in Oxford 20-22 March 2017

- User's Meetings: meetings to enhance communication between users and developers (open access)
- Developer's Meeting: technical weekly meetings to ensure communication among developers (restricted access)
- Steering Group's Meeting (restricted access)

xFitter representation

- List of results
- List of collected talks

—> see Kristin's talk for overview of results, and LHC talks for performance

To Be Updated

Developers Info (restricted to developers)

- Internal Developments

Organisation

Steering Group is composed of:
- **Conveners:** Voica Radescu, Ringaile Placakyte, Amanda Cooper-Sarkar
- **Release coordinator/Librarian** (revision of the release candidates): Sasha Glazov
- **Contact Persons:** Cristi Diaconu (H1),Klaus Rabbertz (CMS), Bogdan Malaescu (ATLAS), Olaf Behnke (ZEUS), Ronan McNulty (LHCb), Gavin Salam (theory)
- **DESY IT Contact:** Yves Kemp

Hayk and Andrey moved on to other projects

Getting help

Send email to ✉ xfitter-help@desy.de

Status of xFitter releases

- installation scripts
- get data script

- new stable release

  - svn —> git

Thanks to Hayk
for his contributions
as librarian
(svn releases)

xFitter / DownloadPage

Releases of the xFitter QCD analysis package

- Versioning convention: **i.j.k** with
  - **i** - stable release
  - **j** - beta release
  - **k** - bug fixes.
- The release notes can be found in this attachment: 📎xFitter_release_notes.pdf .
- Installation script for xFitter together with QCDNUM, APFEL, APPLGRID, LHAPDF 📎install-xfitter
- The script to download coupled data and theory files 📎xfitter-getdata.sh.
- Data and theory files are also stored in 🌐 hepforge and can be accessed from there ("List of Data Files").

Date	Version	Files	Remarks
03/2017	**2.0.0 FrozenFrog**	📎xfitter-2.0.0.tgz	stable release with decoupled data and theory files
07/2016	**1.2.2**	📎xfitter-1.2.2.tgz	release with decoupled data and theory files
05/2016	**1.2.1**	📎xfitter-1.2.1.tgz	release with decoupled data and theory files
02/2016	**1.2.0**	📎xfitter-1.2.0.tgz	release with decoupled data and theory files

Documentation

- Manual (under continuous improvement) can be accessed 📎here.
- The **README** file (accessible via the package) gives an explanation for a quick start.
- The **INSTALLATION** file (accessible via the package) provides information for package installation and usage instructions.
- The package is licensed under GNU GPL, please see **LICENCE** for mode details (accessible via the package).

Web access to GIT

- The master version can be viewed and downloaded from 🌐 https://gitlab.cern.ch/fitters/xfitter.git

Links to external packages

External packages that could be run with xFitter via configuration flags can be accessed for convenience HERE .

HERAverager data combination package

Information can be accessed here 🌐 https://wiki-zeuthen.desy.de/HERAverager.

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xFitter / DownloadPage

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≡ fitters / xfitter   This project Search 🔍   **Sign in**

Project Activity Repository Pipelines Registry Graphs Issues Merge Requests 0 Wiki Snippets

Thanks to Andrey
for the major effort to move
to GIT/JIRA

xfitter

★ Star 5   HTTPS ▾ https://gitlab.cern.ch/fitt(📋

SSH ▾ ssh://git@gitlab.cern.ch:7999/ 📋

KRB5 ▾ https://:@gitlab.cern.ch:844; 📋

Voica (CERN/Oxford) & Ringaile (Uni Hamburg)

What's in the new release (I)

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:** • 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

= Ongoing xFitter study
= Markov Chain analysis
(to be discussed on
Wednesday)

=feature used for Photon
PDF xFitter paper
- see Francesco's talk

arXiv:1701.18553

=feature used for Dipole Fits
- see Agnieszka's talk

arXiv:1611.10100

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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.

Voica (CERN/Oxford) & Ringaile (Uni Hamburg)

What's in the new release (II)

—> see Michiel's talk

this is new script:
./xfitter-getdata.sh - - help

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)

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this is new script:
tools/xfitter-getdata.sh - - help

xFitter **http://xfitter.hepforge.org/data.html**

This page contains the list of publicly available experimental data sets (with corresponding theory grids if available) in the xFitter package.
To download data set please click on the arXiv link (and open/save tar.gz file).

```
xfitter-getdata.sh script allows to download public data
sets from the xFitter package (from hepforge)

For the list of available data sets please check:
  http://xfitter.hepforge.org/data.html

or input_steering/steering.txt.ALLdata in xFitter package

To download all available data sets do:
 ./xfitter-getdata.sh ALL

To download a specific data set do:
 ./xfitter-getdata.sh arXivNumber(reportNumber)

this will download the indicated dataset with the directory
structure ready to be used in xFitter
(dirCollider/dirExperiment/dirReactionType/dirArxivNumber)

Note, that related theory or correlation files (if any)
will be downloaded together with the specified data file

===> to see available data sets to download type:
 ./xfitter-getdata.sh --print (or -p)
```

No	Collider	Experiment	Reaction	arXiv	Readme
1	fixedTarget	bcdms	inclusiveDis	cern-ep-89-06	README
2	hera	h1	beautyProduction	0907.2643	
3	hera	h1	inclusiveDis	1012.4355	
4	hera	h1	jets	0706.3722	README
5	hera	h1	jets	0707.4057	README
6	hera	h1	jets	0904.3870	README
7	hera	h1	jets	0911.5678	README
8	hera	h1	jets	1406.4709	README
9	hera	h1zeusCombined	charmProduction	1211.1182	
10	hera	h1zeusCombined	inclusiveDis	0911.0884	
11	hera	h1zeusCombined	inclusiveDis	1506.06042	
12	hera	zeus	beautyProduction	1405.6915	
13	hera	zeus	diffractiveDis	0812.2003	
14	hera	zeus	jets	0208037	
15	hera	zeus	jets	0608048	
16	hera	zeus	jets	1010.6167	
17	lhc	atlas	drellYan	1305.4192	
18	lhc	atlas	drellYan	1404.1212	
19	lhc	atlas	jets	1112.6297	
20	lhc	atlas	jets	1304.4739	
21	lhc	atlas	topProduction	1406.5375	
22	lhc	atlas	topProduction	1407.0371	

[discussions with Graeme]

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—> see Michiel's talk

this is new script:
xfitter-getdata.sh - - help
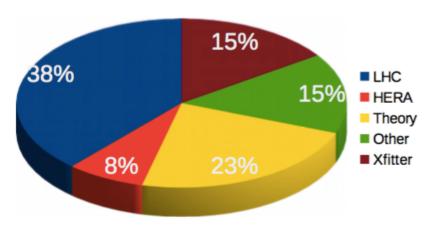
new release based on it

improvements in the drawing tools:

9

Analyses using xFitter since Dubna

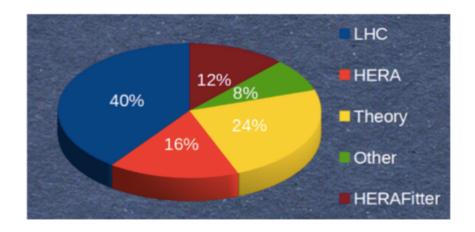More than 4**0 public results** obtained using xFitter from the beginning of the project (2011)

https://www.x tter.org/xFitter/xFitter/results

> 2017: Oxford

[see Kristin's talk]

2 new xFitter developers' team results, 2 more on the pipe line before next release

High demand of xFitter at the conferences:

> 2016: Dubna

22-27.05.2017	PHOTON 2017	V. Bertone	xFitter talk	invited talk
15-20.05.2017	LHCP 2017	A. Glazov	xFitter talk	abstract accepted
03-07.04.2017	DIS 2017	F. Olness	xFitter talk	invited talk
03-07.04.2017	DIS 2017	F. Giuli	xFitter talk	invited talk
25.03-01.04.2017	Moriond QCD	V. Bertone	xFitter talk	talk accepted
19-22.03.2017	xFitter workshop Oxford	users and developers	xFitter talks/discussions	
7.03.2017	PDF4LHC	V. Radescu	xFitter talk	invited talk

2016

Date	Conference/Workshop	Presenter	Link
14-18.11.2016	POETIC16	A. Glazov	talk using xFitter
14-18.11.2016	POETIC16	F. Olness	xFitter talk
7-10.11.2016	REF2016	V. Radescu	xFitter for TMDs talk
7-10.11.2016	REF2016	R. Placakyte	xFitter talk
25.09-1.10.2016	Vietnam 2016	S. Glazov	xFitter talk
13.09.2016	PDF4LHC	R. Placakyte	xFitter talk
2.09-8.09.2016	Diffraction 2016	A. Sarkar-Cooper	xFitter talk
22.08-26.08.2016	QCD@LHC2016	V. Radescu	xFitter talk
06-16.07.2016	CTEQ and MCnet school	R. Placakyte, S. Camarda	PDF lecture, xFitter tutorial
|11-15.07.2016	QCD-N'16	V.Bertone	xFitter talk
6.06-10.06.2016	Low X 2016	A. Sarkar-Cooper	xFitter talk
29.05-4.06.2016	Quarks-2016	A. Sapronov	xFitter talk
27.04-1.05.2016	DIS 2016	O. Zenaev	xFitter talk
27.04-1.05.2016	DIS 2016	V. Bertone	APFEL & xFitter analysis
19-26.03.2016	Moriond QCD		
14.03.2016	PDF4LHC	V.Radescu/ A. Cooper-Sarkar	xFitter talks: release and summary of Dubna Workshop
18-20.02.2016	xFitter workshop Dubna	users and developers	xFitter talks/discussions

Summary and Outlook

- xFitter (former HERAFitter) project is based on a multi-functional open source QCD software package that provides a framework for scrupulous interpretations of the QCD analyses with its main application at the LHC program
  - www.xfitter.org
  - new release: **Frozen Frog** is out:
    - first stable release since herafitter-1.0.0
    - first release based on git
- More results are in pipeline related to threshold displacement application, FL structure Functions, iTMD developments, PDF+PS, resummed calculations, etc..

- Preparations for new release are ongoing which would have major structural improvements

–> see Sasha's talk

Thank you for your interest in xFitter and for your participation to the Oxford workshop
we welcome your feedback and your input!

Agenda for the xFitter meeting in Oxford

- Meeting will take place within the St. Hilda College grounds 19-22.03
  - Arrival and welcome drinks on Sunday, 19.03, 19:00-21:00
  - Every day 2 coffee breaks: 10:45-11:15, 16:00-16:30
  - Lunch breaks 12:30 - 14:00
  - Dinner Event - Tuesday, 19:30 - 21:30
  - Monday and 1/2 Tuesday - Users Discussions
  - 1/2 Tuesday and 1/2 Wednesday - Developers

20th of March:

On Monday 17:30 PM GMT
Satellite Meeting
LHeC PDFs and low x

Report from LHC exp.

Next interests in tool develop

Future experiments studies

PDF groups (part I)

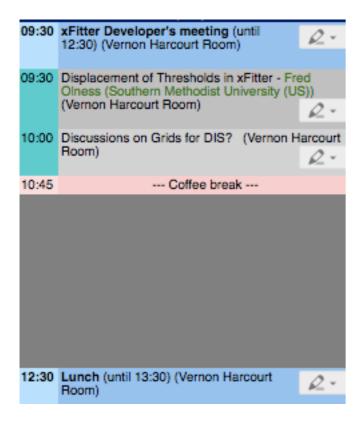*xFitter results from 2017*

20 Mar 2017	
09:30	xFitter User's meeting (until 12:30) (Vernon Harcourt Room)
09:30	Welcome - Amanda Sarkar (University of Oxford (GB)) (Vernon Harcourt Room)
	central_ox_map.pdf Info-on-Oxford.docx Info-on-Oxford.pdf
09:45	Overview of xFitter developments/new features since last meeting - Ringaile Placakyte (Deutsches Elektronen-Synchrotron (DE)) Voica Ana Maria Radescu (Deutsches Elektronen-Synchrotron (DE)) (Vernon Harcourt Room)
10:15	Overview of results obtained with xFitter - Kristin Lohwasser (University of Sheffield (GB)) (Vernon Harcourt Room)
10:45	--- Coffee break ---
11:15	xFitter performance: ATLAS report and wishes - Valerie Lang (Ruprecht-Karls-Universitaet Heidelberg (DE)) (Vernon Harcourt Room)
11:40	xFitter performance: CMS report and wishes - Oleksandr Zenaiev (Vernon Harcourt Room)
12:05	LHCb report and wishes - Stephen Farry (University of Liverpool (GB)) (Vernon Harcourt R...
12:30	Lunch (until 13:30) (Vernon Harcourt Room)
13:30	xFitter User's meeting (until 17:30) (Vernon Harcourt Room)
14:00	PDFs+ EW and + PS - Jan Kretzschmar (University of Liverpool (GB)) (Vernon Harcourt R...
14:30	Future experiments (LHeC+FCC-eh) studies using xFitter - Max Klein (Vernon Harcourt R...
15:00	MMHT and connection to xFitter - Robert Samuel Thorne (University College London (UK)) (Vernon Harcourt Room)
15:30	CT and CTEQ PDFs and connection to xFitter - Pavel Nadolsky (Southern Methodist Unive... (Vernon Harcourt Room)
16:00	--- Coffee break ---
16:30	The photon PDF from high-mass Drell Yan data at the LHC - Mr. Francesco Giuli (Universit... Oxford (GB)) (Vernon Harcourt Room)
16:50	Dipole Models in xFitter - Agnieszka Luszczak (Vernon Harcourt Room)
17:10	Discussions (Vernon Harcourt Room)
17:30	Satellite meeting: LHeC PDF and low x meeting (until 19:00) (Vernon Harcourt Room)

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  - Monday and 1/2 Tuesday - Users Discussions
  - 1/2 Tuesday and 1/2 Wednesday - Developers

hands on 22nd of March   **21st of March:**

new release

News from fast grids

Updates from modules

activities related to PDFs

09:30 xFitter Users meeting (until 12:30) (Vernon Harcourt Room)

09:30 xFitter release plans - Alexander Glazov (Deutsches Elektronen-Synchrotron (DE)) (Vernon Harcourt Room)

10:00 News from APFEL (NLO QED corrections, HQ thresholds) - Valerio Bertone (University of Oxford (GB)) (Vernon Harcourt Room)

10:20 Updates in QCDNUM - Michiel Botje (NIKHEF (NL)) (Vernon Harcourt

10:45 --- Coffee break ---

11:15 ABMP and connection to xFitter - Ringaile Placakyte (Deutsches Elektronen Synchrotron (DE)) (Vernon Harcourt Room)

11:45 NNPDFs and connection to xFitter - Maria Ubiali (University of Cambridge (GB)) (Vernon Harcourt Room)

12:15 Discussions (Vernon Harcourt Room)

12:30 Lunch (until 13:30) (Vernon Harcourt Room)

13:30 xFitter Developer's meeting (until 18:10) (Vernon Harcourt Room)

14:00 News from APPLgrid and NNLO-Bridge - Mark Sutton (University of Su (GB)) Mark Sutton (Vernon Harcourt Room)

14:30 Updates to HVQMNR module - Oleksandr Zenaiev (DESY) (Vernon H Room)

14:55 Top++ and Hathor interface - Artur Trofymov (Deutsches Elektronen-Synchrotron (DE)) James Edward Ferrando (Deutsches Elektronen-Synchrotron (DE)) (Vernon Harcourt Room)

15:20 Nuclear PDFs - Aleksander Kusina (LPSC Grenoble) Fred Olness (Sou Methodist University (US)) (Vernon Harcourt Room)

15:45 Discussions (Vernon Harcourt Room)

16:00 --- Coffee break ---

16:30 Fragmentation functions - Valerio Bertone (University of Oxford (GB)) R Placakyte (Deutsches Elektronen-Synchrotron (DE)) (Vernon Harcourt

16:50 TMDs via xFitter - Hannes Jung (Deutsches Elektronen-Synchrotron (D (Vernon Harcourt Room)

17:20 Discussions (Vernon Harcourt Room)

19:30 Dinner at the College (until 21:30) (College)

09:30 xFitter Developer's meeting (until 12:30) (Vernon Harcourt Room)

09:30 Displacement of Thresholds in xFitter - Fred Olness (Southern Methodist University (US)) (Vernon Harcourt Room)

10:00 Discussions on Grids for DIS? (Vernon Harcourt Room)

10:45 --- Coffee break ---

12:30 Lunch (until 13:30) (Vernon Harcourt Room)