xFitter examples

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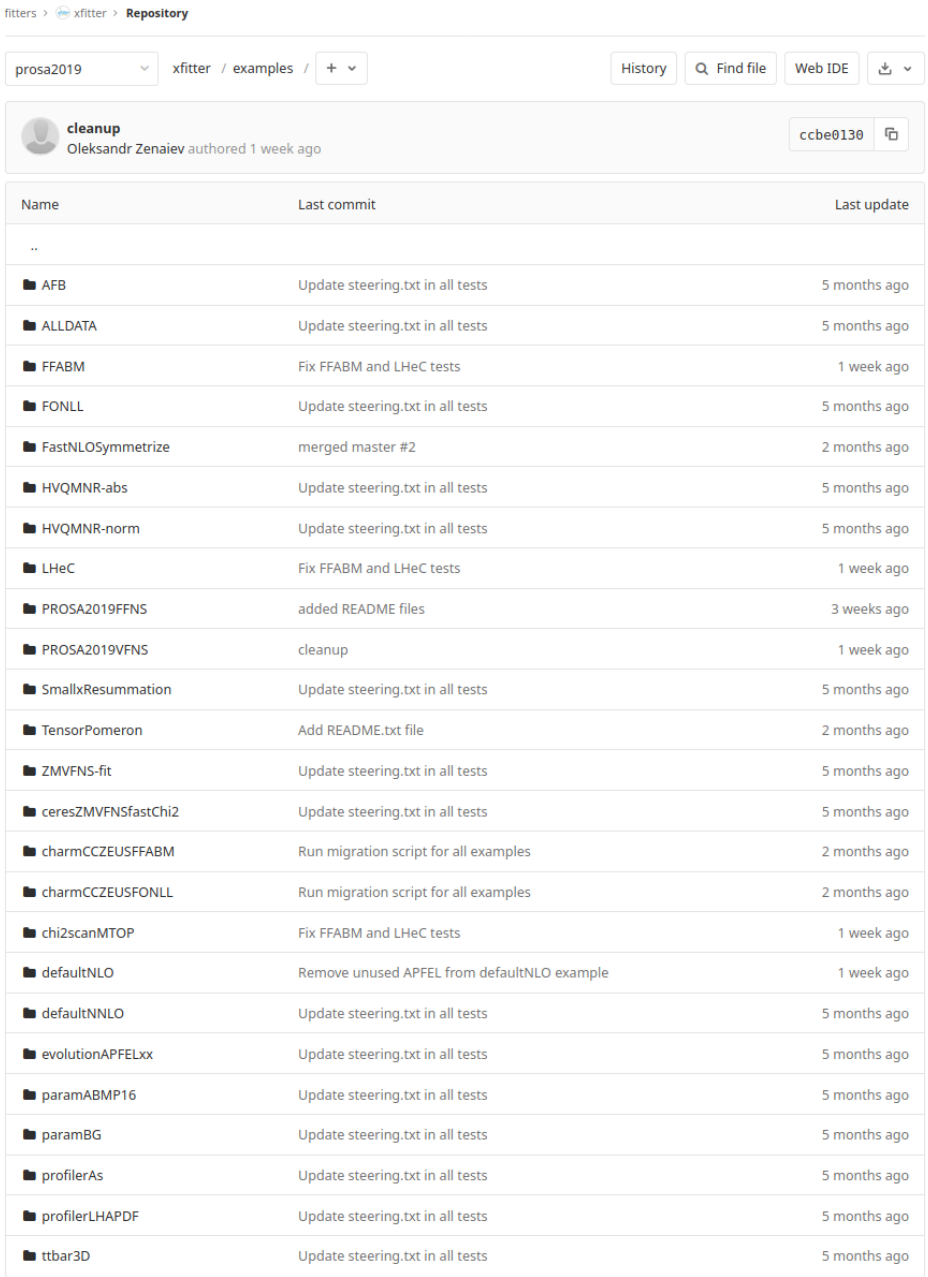
xFitter workshop, DESY Hamburg
26 Feb 2020

xFitter examples (tests)



fitters › xfitter › Repository

prosa2019 | xfitter / examples / | History | Find file | Web IDE

cleanup
Oleksandr Zenaiev authored 1 week ago — ccbe0130

Name	Last commit	Last update
..		
AFB	Update steering.txt in all tests	5 months ago
ALLDATA	Update steering.txt in all tests	5 months ago
FFABM	Fix FFABM and LHeC tests	1 week ago
FONLL	Update steering.txt in all tests	5 months ago
FastNLOSymmetrize	merged master #2	2 months ago
HVQMNR-abs	Update steering.txt in all tests	5 months ago
HVQMNR-norm	Update steering.txt in all tests	5 months ago
LHeC	Fix FFABM and LHeC tests	1 week ago
PROSA2019FFNS	added README files	3 weeks ago
PROSA2019VFNS	cleanup	1 week ago
SmallxResummation	Update steering.txt in all tests	5 months ago
TensorPomeron	Add README.txt file	2 months ago
ZMVFNS-fit	Update steering.txt in all tests	5 months ago
ceresZMVFNSfastChi2	Update steering.txt in all tests	5 months ago
charmCCZEUSFFABM	Run migration script for all examples	2 months ago
charmCCZEUSFONLL	Run migration script for all examples	2 months ago
chi2scanMTOP	Fix FFABM and LHeC tests	1 week ago
defaultNLO	Remove unused APFEL from defaultNLO example	1 week ago
defaultNNLO	Update steering.txt in all tests	5 months ago
evolutionAPFELxx	Update steering.txt in all tests	5 months ago
paramABMP16	Update steering.txt in all tests	5 months ago
paramBG	Update steering.txt in all tests	5 months ago
profilerAs	Update steering.txt in all tests	5 months ago
profilerLHAPDF	Update steering.txt in all tests	5 months ago
ttbar3D	Update steering.txt in all tests	5 months ago

- Initially, we wanted to have ‘unit tests’
- . . . or at least some kind of check whether anything is broken
- Implemented a set of ‘examples’:
  - e.g. 1st example was HERAPDF2.0 NNLO χ^2 iteration (`bin/xfitter`)
  - each example contains all input files (`steering.txt, parameters.yaml, constants.yaml`) to run xfitter (typically one χ^2 iteration)
  - . . . and README!
  - it contains also expected output directory (`output`)

  → check if we get identical output
- this appears to be useful also as:
  - examples for new users
  - . . . or for old users not yet familiar with new approaches to reactions, evolutions, parametrisations etc.: we do not have documentation yet, but we have examples!
  - way to share/preserve xfitter analyses

How to run xFitter examples

How to run them:

`./tools.sh`

(run all tests, ∼30 min), or

`./tools/test.sh <NAME1> <NAME2> ...`

`NAME` is any directory name from `examples` (`ls examples`)

```
zenaiev@lhcbzenaiev ~/xfitter/master-240120 $time ./tools/test.sh
Testing AFB ... PASS [details in temp/AFB/test.log]
Testing ALLDATA ... FAIL [details in temp/ALLDATA/test.log]
Testing charmCCZEUSFFABM ... PASS [details in temp/charmCCZEUSFFABM/test.log]
Testing charmCCZEUSFONLL ... PASS [details in temp/charmCCZEUSFONLL/test.log]
Testing chi2scanMTOP ... FAIL [details in temp/chi2scanMTOP/test.log]
Testing defaultNLO ... FAIL [details in temp/defaultNLO/test.log]
Testing defaultNNLO ... FAIL [details in temp/defaultNNLO/test.log]
Testing evolutionAPFELxx ... FAIL [details in temp/evolutionAPFELxx/test.log]
Testing FastNLOSymmetrize ... PASS [details in temp/FastNLOSymmetrize/test.log]
Testing FFABM ... PASS [details in temp/FFABM/test.log]
Testing FONLL ... FAIL [details in temp/FONLL/test.log]
Testing HVQMNR-abs ... PASS [details in temp/HVQMNR-abs/test.log]
Testing HVQMNR-norm ... PASS [details in temp/HVQMNR-norm/test.log]
Testing LHeC ... PASS [details in temp/LHeC/test.log]
Testing paramABMP16 ... PASS [details in temp/paramABMP16/test.log]
Testing paramBG ... FAIL [details in temp/paramBG/test.log]
Testing profilerAs ... PASS [details in temp/profilerAs/test.log]
Testing profilerLHAPDF ... FAIL [details in temp/profilerLHAPDF/test.log]
Testing PROSA2019FFNS ... PASS [details in temp/PROSA2019FFNS/test.log]
Testing PROSA2019VFNS ... PASS [details in temp/PROSA2019VFNS/test.log]
Testing SmallxResummation ... FAIL [details in temp/SmallxResummation/test.log]
Testing TensorPomeron ... PASS [details in temp/TensorPomeron/test.log]
Testing ttbar3D ... PASS [details in temp/ttbar3D/test.log]
Testing ZMVFNS-fit ... FAIL [details in temp/ZMVFNS-fit/test.log]
-> 14 test(s) PASS
-> 10 test(s) FAIL

real    26m1.522s
user    25m51.960s
sys     0m7.892s
```

(status of master branch on 25 Feb 2020 9:00 CET)

How to run xFitter examples

After one has run a test, one can go to `temp/<NAME>` working directory:

```
zenaiev@lhcbzenaiev ~/xfitter/master-240120 $cd temp/FFABM/
zenaiev@lhcbzenaiev ~/xfitter/master-240120/temp/FFABM $ls
constants.yaml  datafiles  output  parameters.yaml  steering.txt  test.log  unpolarised.wgt  xfitter.log
```

From here one can continue work on this example, e.g. change steering files and run xfitter again etc.

To check why a test failed:

```
zenaiev@lhcbzenaiev ~/xfitter/master-240120 $cat temp/ALLDATA/test.log
========================================
Running check: ALLDATA
========================================
This is validation test:
OK if code runs properly
FAILED if code fails to reproduce expected results
========================================
Running in temp/ALLDATA
Log file stored in temp/ALLDATA/xfitter.log
Using input files from examples/ALLDATA
========================================
After minimisation    5349.35  3024     1.769

+++  Files "temp/out.txt" and "temp/def.txt" are equal
========================================
Check of chi^2 is PASSED
========================================
Checking all output files ...
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_06.txt examples/ALLDATA/output/pdfs_q2val_06.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/proton/proton.info examples/ALLDATA/output/proton/proton.info ... FAILED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/proton/proton_0000.dat examples/ALLDATA/output/proton/proton_0000.dat ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/Status.out examples/ALLDATA/output/Status.out ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/lhapdf.block.txt examples/ALLDATA/output/lhapdf.block.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_08.txt examples/ALLDATA/output/pdfs_q2val_08.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/parsout_0 examples/ALLDATA/output/parsout_0 ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/parsout_1 examples/ALLDATA/output/parsout_1 ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/fittedresults.txt examples/ALLDATA/output/fittedresults.txt ... FAILED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_02.txt examples/ALLDATA/output/pdfs_q2val_02.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/minuit.out.txt examples/ALLDATA/output/minuit.out.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_03.txt examples/ALLDATA/output/pdfs_q2val_03.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_05.txt examples/ALLDATA/output/pdfs_q2val_05.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/Results.txt examples/ALLDATA/output/Results.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pulls.last.txt examples/ALLDATA/output/pulls.last.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_04.txt examples/ALLDATA/output/pdfs_q2val_04.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/minuit.save.txt examples/ALLDATA/output/minuit.save.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_07.txt examples/ALLDATA/output/pdfs_q2val_07.txt ... PASSED
numdiff -a 1e-4 -r 1e-4 temp/ALLDATA/output/pdfs_q2val_01.txt examples/ALLDATA/output/pdfs_q2val_01.txt ... PASSED
========================================
Something FAILED: see above for details
========================================
```

AFB

- AFB
- ALLDATA
- FFABM
- FONLL
- FastNLOSymmetrize
- HVQMNR-abs
- HVQMNR-norm
- LHeC
- PROSA2019FFNS
- PROSA2019VFNS
- SmallxResummation
- TensorPomeron
- ZMVFNS-fit
- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
- chi2scanMTOP
- defaultNLO
- defaultNNLO
- evolutionAPFELxx
- paramABMP16
- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 324 Bytes

```
One chi2 iteration for AFB pseudodata, checks AFB (LO) and APPLgrid (NLO) reactions

Exemplary input files for AFB analysis:
(1) LO should produce chi2 = 0 (input PDFs and all parameters are set appropriately;
    use HERAPDF20_NNLO_EIG to get chi2 = 0 at LO)
(2) NLO should produce chi2 != 0 because pseudodata are from LO
```

- Example from xfitter paper by J. Fiaschi et al. JHEP 1910 (2019) 176
  “PDF Profiling Using the Forward-Backward Asymmetry in Neutral Current DY Production”
- uses dedicated pseudodata
  `datafiles/lhc/pseudo-AFB/AFB_LO-thexp.dat`,
  `datafiles/lhc/pseudo-AFB/AFB_NLO-thexp.dat`
- demonstrates how to use ‘AFB’ reaction (implemented by J. Fiaschi): LO calculation of forward-backward Drell-Yan asymmetry

parameters.yaml 473 Bytes

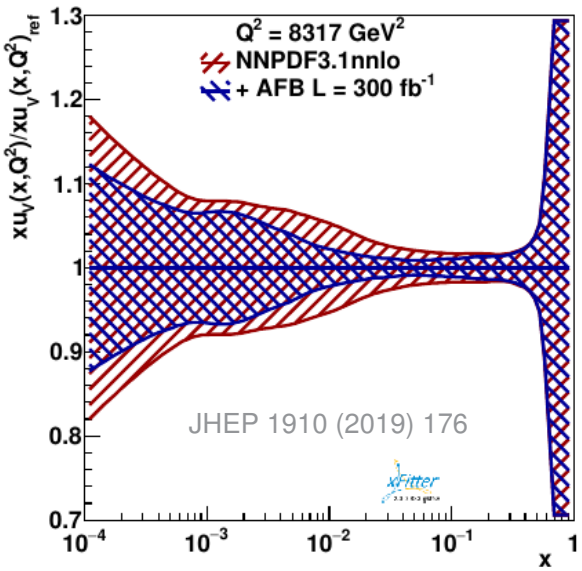
```yaml
Minimizer: MINUIT # CERES
MINUIT:
  Commands: |
    set str 2
    call fcn 3
#    call fcn 1
#    migrad
#    hesse
#    call fcn 3
#  doErrors :  Hesse # None

DefaultEvolution: proton-LHAPDF

Evolutions:
  proton-LHAPDF:
    class: LHAPDF
#    set: "HERAPDF20_NNLO_EIG" # activate this to get chi2=0 at LO
#    set: "CT14nnlo"
    set: "NNPDF30_nlo_as_0118"
    member: 0

? !include constants.yaml

byReaction:
  # AFB settings:
  AFB:
    ? !include reactions/AFB.yaml
```



ALLDATA

- AFB
- ALLDATA
- FFABM
- FONLL
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- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
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- defaultNNLO
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- paramBG
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- profilerLHAPDF
- ttbar3D

README.txt 1.11 KB

Edit | Web IDE | Replace

```
One chi2 iteration for ALL data using NLO RTOPT LHAPDF=NNPDF30_nlo_as_0118
it tests also FlipCharge and FlipUD evolutions
it tests also storing PDF from LHAPDF evolution in LHAPDF6 format

This tests aims to enable all data available in xFitter datafiles.
As of 2.07.2019 only these datasets are not covered by this test:

datafiles/hera/zeus/diffractiveDis/0812.2003: not supported in xfitter-2.2, use xfitter-2.0.1
datafiles/hera/h1/jets/0904.3870: not supported in xfitter-2.1 and xfitter-2.2 (normalised jet cross sections), use xfitter-2.0.1
datafiles/hera/h1/jets/1406.4709: not supported in xfitter-2.1 and xfitter-2.2 (normalised jet cross sections), use xfitter-2.0.1
datafiles/lhc/atlas/topProduction/1407.0371: not supported in xfitter-2.1 and xfitter-2.2 (DiffTop & fastNLO), use xfitter-2.0.1
datafiles/lhc/cms/topProduction/1211.2220: not supported in xfitter-2.1 and xfitter-2.2 (DiffTop & fastNLO), use xfitter-2.0.1
LHeC: pseudodata covered in dedicated test (LHeC)
AFB: pseudodata covered in dedicated test (AFB)

Some other data sets which are superseeded are explicitly listed and commented out in steering.txt.
```

- (almost) all data available in xFitter: 85 data files ($> 3K$ data points)
- sorted by experiments and reaction
- compared to NLO predictions using NNPDF3.1: χ^2 should not be taken as something really meaningful as there are many parameters to set

Results.txt 79.6 KB

```
After minimisation    5349.35  3024     1.769

  Partial chi2s
Dataset    1    549.44   377  HERA1+2 NCep 920
Dataset    2     83.44    70  HERA1+2 NCep 820
Dataset    3    247.94   254  HERA1+2 NCep 575
Dataset    4    229.15   204  HERA1+2 NCep 460
Dataset    5    236.74   159  HERA1+2 NCem
Dataset    6     43.00    39  HERA1+2 CCep
Dataset    7     65.77    42  HERA1+2 CCem
Dataset    8     12.10    24  H1 inclusive jet 99-00 data
Dataset    9     17.66    28  H1 low Q2 inclusive jet 99-00 data
Dataset   10     30.34    30  ZEUS inclusive jet 96-97 data
Dataset   11     27.05    30  ZEUS inclusive jet 98-00 data
Dataset   12     14.76    22  ZEUS inclusive dijet 98-00/04-07 data
Dataset   13     37.88    47  HERA c
Dataset   14     17.41    27  HERA b
Dataset   15    106.83    83  BCDMS F2p 100GeV
Dataset   16     86.52    91  BCDMS F2p 120GeV
Dataset   17    114.22    79  BCDMS F2p 200GeV
```

FFABM

README.txt 71 Bytes

```
One chi2 iteration NLO FFABM QCDNUM [HERAPDF-HVQMASS arXiv:1804.01019]
```

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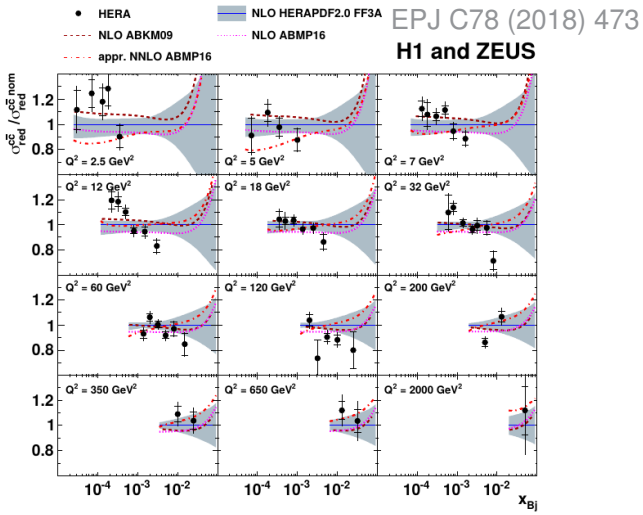
- Example from H1ZEUS paper EPJ C78 (2018) 473 “Combination and QCD analysis of charm and beauty production cross-section measurements in deep inelastic ep scattering at HERA”
- Uses NLO FFABM scheme with $n_f = 3$
- Demonstrate how to make free charm and beauty quark masses

```
# Specify HF scheme used for DIS NC processes:
hf_scheme_DISNC :
#  defaultValue : 'RT_DISNC'        # global specification
#  defaultValue : 'BaseDISNC'       # global specification
#  defaultValue : 'FONLL_DISNC'     # global specification
  defaultValue : 'FFABM_DISNC'
#  'HERA1+2 NCep 920' : 'BaseDISNC' # datafile specific (based on name)
#  1 : BaseDISNC
#  'HERA1+2 NCep 920' : 'Fractal_DISNC'  # Fractal model. Add parameters file if you want to try it (see above)

# Specify HF scheme used for DIS CC processes:
hf_scheme_DISCC :
#  defaultValue : 'BaseDISCC'       # global specification
#  defaultValue : 'FONLL_DISCC'     # global specification
  defaultValue : 'FFABM_DISCC'     # global specification
```




```
Parameters:
  Ag   :  DEPENDENT
  Bg   : [ -0.198201, 0.27 ]
  Cg   : [  8.142429,  0.32 ]
  Agp  : [ 0.495745, 0.01 ]  # negative gluon ....
  Bgp  : [ -0.273, 0.01 ]
  Cgp  : [ 25.0, 0.]  # fix C of negative gluon
  Auv  :  DEPENDENT
  Buv  : [ 0.678261, 0.016 ]
  Cuv  : [ 4.872811, 0.06 ]
  Duv  : [    0     ]
  Euv  : [ 14.650936, 0.8 ]
  Adv  :  DEPENDENT
  Bdv  : [ 0.820427, 0.06 ]
  Cdv  : [ 4.266412, 0.3 ]
  Aubar: [ 0.0, 0.0 ] # not used (Aubar=Adbar)
  Bubar: [ 0.0, 0.0  ] # not used (Bubar=Bdbar)
  Cubar: [ 8.268980, 0.8 ]
  Dubar: [ 13.944063, 1.0 ]
  Adbar: [ 0.1016922, 0.01 ]
  Bdbar: [ -0.172385, 0.004  ]
  Cdbar: # another example of providing value, step etc.
    value: 5.825632
    step: 1.2345
    #min
    #max
    #pr_mean
    #pr_sigma
  ZERO : [ 0. ]          # zero
  fs : [ 0.4, 0.0 ]
  mch : [ 1.290, 0.001 ]
  mbt : [ 4.049, 0.001 ]
```

FONLL

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README.txt 96 Bytes

```
One chi2 iteration FONLL APFEL
It tests also storing PDF from APFEL evolution in LHAPDF6 format
```

```
DefaultEvolution: proton-APFELff
#DefaultEvolution: proton-QCDNUM

Evolutions:
  proton-APFELff:
    ? !include evolutions/APFEL.yaml
    decomposition: proton
    kmc : 2.0 # ratio between charm quark threshold and mass
    kmb : 1.5 # ratio between bottom quark threshold and mass
```

```
# Specify HF scheme used for DIS NC processes:
hf_scheme_DISNC :
#  defaultValue : 'RT_DISNC'        # global specification
#  defaultValue : 'BaseDISNC'       # global specification
  defaultValue : 'FONLL_DISNC'     # global specification
#  defaultValue : 'FFABM_DISNC'
#  'HERA1+2 NCep 920' : 'BaseDISNC' # datafile specific (based on name)
#  1 : BaseDISNC
#  'HERA1+2 NCep 920' : 'Fractal_DISNC'  # Fractal model. Add parameters file if you want to try it (see above)

# Specify HF scheme used for DIS CC processes:
hf_scheme_DISCC :
#  defaultValue : 'BaseDISCC'       # global specification
  defaultValue : 'FONLL_DISCC'     # global specification
#  defaultValue : 'FFABM_DISCC'     # global specification
```

```
WriteLHAPDF6:
  name: "proton"
  description: "..."
  authors: "..."
  reference: "..."
    # use DefaultEvolution
  #evolution: proton-QCDNUM
    # take internal grid
  preferInternalGrid:
    # or define grid
  #Xrange: [1e-4, 1]
  #Qrange: [1,1000]
  #Xnpoints: 200
  #Qnpoints: 120
```

FastNLOSymmetrize

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- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 124 Bytes

```
1
2  Test of FastNLO and its Symmetrise option using tables from
3  http://www.precision.hep.phy.cam.ac.uk/results/ttbar-fastnlo/
4
```

```
TermName   = 'R'
TermSource = 'fastNLO'
TermInfo   = 'Filename=datafiles/lhc/pseudo-ttbar/LHC13-Ytt-HT4-173_3-bin1.tab:Symmetrise=1'
TheorExpr  = 'R'
```

```
*-2.4 -1.8 0.43997E+02 1. 100.
*-1.8 -1.6 0.91239E+02 1. 100.
*-1.6 -1.4 0.12115E+03 1. 100.
*-1.4 -1.0 0.15318E+03 1. 100.
*-1.2 -1.0 0.18547E+03 1. 100.
*-1.0 -0.8 0.21613E+03 1. 100.
*-0.8 -0.6 0.24274E+03 1. 100.
*-0.6 -0.4 0.26483E+03 1. 100.
*-0.4 -0.2 0.28126E+03 1. 100.
*-0.2  0.0 0.28824E+03 1. 100.
 0.0  0.2 0.28824E+03 1. 100.
 0.2  0.4 0.28126E+03 1. 100.
 0.4  0.6 0.26483E+03 1. 100.
 0.6  0.8 0.24274E+03 1. 100.
 0.8  1.0 0.21613E+03 1. 100.
 1.0  1.2 0.18547E+03 1. 100.
 1.2  1.4 0.15318E+03 1. 100.
 1.4  1.6 0.12115E+03 1. 100.
 1.6  1.8 0.91239E+02 1. 100.
 1.8  2.4 0.43997E+02 1. 100.
```

fittedresults.txt 1.79 KB

```
1            1
2          501
3   Pseudo-data for ttbar production at LHC 13 TeV
4  Plot1@Experiment:PseudoLHC13TeV; @Ylog
5   Ymin        Ymax        dummy          data      +- uncor     +- tot      th orig
6   0.00000E+00 0.20000E+00 0.00000E+00 0.28824E+03 0.40763E+01 0.28825E+03 0.57648E+03
7   0.20000E+00 0.40000E+00 0.00000E+00 0.28126E+03 0.39776E+01 0.28127E+03 0.56252E+03
8   0.40000E+00 0.60000E+00 0.00000E+00 0.26483E+03 0.37453E+01 0.26484E+03 0.52966E+03
9   0.60000E+00 0.80000E+00 0.00000E+00 0.24274E+03 0.34329E+01 0.24275E+03 0.48548E+03
10  0.80000E+00 0.10000E+01 0.00000E+00 0.21613E+03 0.30565E+01 0.21614E+03 0.43225E+03
11  0.10000E+01 0.12000E+01 0.00000E+00 0.18547E+03 0.26229E+01 0.18548E+03 0.37094E+03
12  0.12000E+01 0.14000E+01 0.00000E+00 0.15318E+03 0.21663E+01 0.15319E+03 0.30636E+03
13  0.14000E+01 0.16000E+01 0.00000E+00 0.12115E+03 0.17133E+01 0.12116E+03 0.24231E+03
14  0.16000E+01 0.18000E+01 0.00000E+00 0.91239E+02 0.12903E+01 0.91244E+02 0.18248E+03
15  0.18000E+01 0.24000E+01 0.00000E+00 0.43997E+02 0.62221E+00 0.43999E+02 0.87995E+02
```

HVQMNR-abs, HVQMNR-norm

- AFB
- ALLDATA
- FFABM
- FONLL
- FastNLOSymmetrize
- HVQMNR-abs
- HVQMNR-norm
- LHeC
- PROSA2019FFNS
- PROSA2019VFNS
- SmallxResummation
- TensorPomeron
- ZMVFNS-fit
- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
- chi2scanMTOP
- defaultNLO
- defaultNNLO
- evolutionAPFELxx
- paramABMP16
- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 147 Bytes

```
One chi2 iteration for PROSA analysis 1503.04581 (absolute variant)

Chi2 from 1503.04581 cannot be reproduced exactly because of software changes
```

README.txt 149 Bytes

```
One chi2 iteration for PROSA analysis 1503.04581 (normalised variant)

Chi2 from 1503.04581 cannot be reproduced exactly because of software changes
```

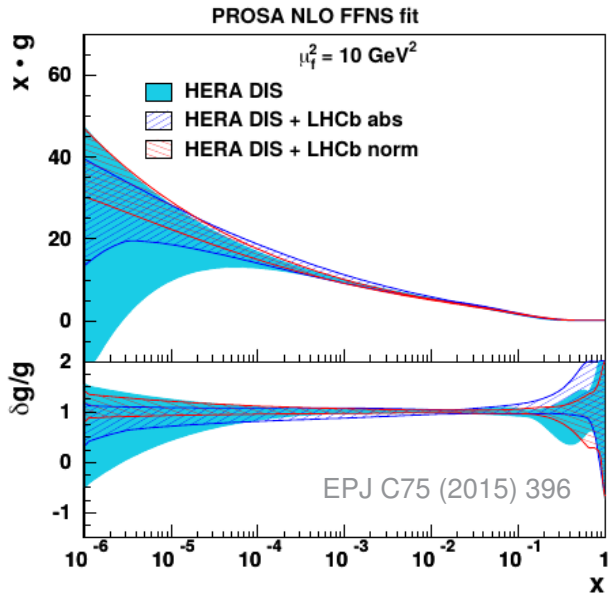
- Example from PROSA 2015 paper (EPJ C75 (2015) 396): HERA DIS + LHC forward charm and beauty production using NLO FF scheme
- NB: implementation of calculations for charm and beauty in pp in `HVQMNR_LHCb_7TeV_charm`, `HVQMNR_LHCb_7TeV_beauty` reactions is customised for particular data sets and not recommended in general anymore → use `cbdiff` reaction instead

steering.txt 11.4 KB

```
*  Namelist to control input data
*

&InFiles
  ! Number of intput files
    NInputFiles = 14

   InputFileNames =
    'datafiles/hera/h1zeusCombined/inclusiveDis/0911.0884/H1ZEUS_CC_e-p_HERA1.0-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/0911.0884/H1ZEUS_CC_e+p_HERA1.0-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/0911.0884/H1ZEUS_NC_e-p_HERA1.0-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/0911.0884/H1ZEUS_NC_e+p_HERA1.0-thexp.dat',
    'datafiles/hera/h1zeusCombined/charmProduction/1211.1182/H1ZEUS_Charm_combined-thexp.dat',
    'datafiles/hera/zeus/beautyProduction/1405.6915/ZEUS_Beauty_vertex-thexp.dat',
    'datafiles/lhc/lhcb/charmProduction/1302.2864/LHCb_7TeV_Charm_Dzero_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/charmProduction/1302.2864/LHCb_7TeV_Charm_Dch_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/charmProduction/1302.2864/LHCb_7TeV_Charm_Dstar_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/charmProduction/1302.2864/LHCb_7TeV_Charm_Ds_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/charmProduction/1302.2864/LHCb_7TeV_Charm_Lambdac_y_Normy-thexp.dat',
    'datafiles/lhc/lhcb/beautyProduction/1306.3663/LHCb_7TeV_Beauty_Bch_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/beautyProduction/1306.3663/LHCb_7TeV_Beauty_Bzero_pty_Normy-thexp.dat',
    'datafiles/lhc/lhcb/beautyProduction/1306.3663/LHCb_7TeV_Beauty_Bs_pty_Normy-thexp.dat',
&End
```



LHeC

- AFB
- ALLDATA
- FFABM
- FONLL
- FastNLOSymmetrize
- HVQMNR-abs
- HVQMNR-norm
- LHeC
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- PROSA2019VFNS
- SmallxResummation
- TensorPomeron
- ZMVFNS-fit
- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
- chi2scanMTOP
- defaultNLO
- defaultNNLO
- evolutionAPFELxx
- paramABMP16
- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 175 Bytes

```
One chi2 iteration for LHeC pseudodata

These are just examplary files to test that LHeC data files can be used in xFitter: input parameters, output etc. could be meaningless
```

- Just an example how to use LHeC data files from
- χ^2 is probably meaningless

steering.txt 11.2 KB

```
*  Namelist to control input data
*

&InFiles
  ! Number of intput files
    NInputFiles = 16

   InputFileNames =
    'datafiles/lhec/1206.2913/fccCC-thexp.dat',
    'datafiles/lhec/1206.2913/fccNC-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.deut.CC-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.deut.NC-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.ele.pmCC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.ele.pmNC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.ele.ppCC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.ele.ppNC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.pos.pmCC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.pos.pmNC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.pos.ppCC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/lhec.pos.ppNC.mc14-thexp.dat',
    'datafiles/lhec/1206.2913/omimiCC.mc1.47.nlo-thexp.dat',
    'datafiles/lhec/1206.2913/omimiNC.mc1.47.nlo-thexp.dat',
    'datafiles/lhec/1206.2913/omiplCC.mc1.47.nlo-thexp.dat',
    'datafiles/lhec/1206.2913/omiplNC.mc1.47.nlo-thexp.dat',
    'datafiles/lhec/1206.2913/oplnuCC.mc1.47.nlo-thexp.dat',
    'datafiles/lhec/1206.2913/oplnuNC.mc1.47.nlo-thexp.dat',
```

Results.txt 2.25 KB

```
After minimisation 2453975.95  1620  1514.800

  Partial chi2s
Dataset    11345069.36    49  Fcc CC ele neg pol cross section
Dataset    2 532015.05    81  Fcc NC ele neg pol cross section
Dataset    3  64252.46    82  LHEC CC DEUT cross section
Dataset    4  43647.14   114  LHEC CC DEUT cross section
Dataset    5  18859.35    90  LHEC CC ele pm cross section
Dataset    6  15156.85   135  LHEC NC ele pm cross section
Dataset    7  15695.07    89  LHEC CC ele pp cross section
Dataset    8  15654.47   135  LHEC NC ele pp cross section
Dataset    9  15647.38    86  LHEC CC pos pm cross section
Dataset   10  16181.98   135  LHEC NC pos pm cross section
Dataset   11  18765.81    86  LHEC CC pos pp cross section
Dataset   12  15096.29   135  LHEC NC pos pp cross section
Dataset   13 126777.11    88  LHEC CC ele neg pol cross section
Dataset   14  66286.23   124  LHEC NC ele neg pol cross section
Dataset   15  71070.65    84  LHEC CC ele pos pol cross section
Dataset   16  61888.93   121  LHEC NC ele pos pol cross section
```

PROSA2019FFNS, PROSA2019VFNS

README.txt 47 Bytes

```
1  FFNS fit from PROSA2019 paper arXiv:1911.13164
```

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- charmCCZEUSFONLL
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- paramBG
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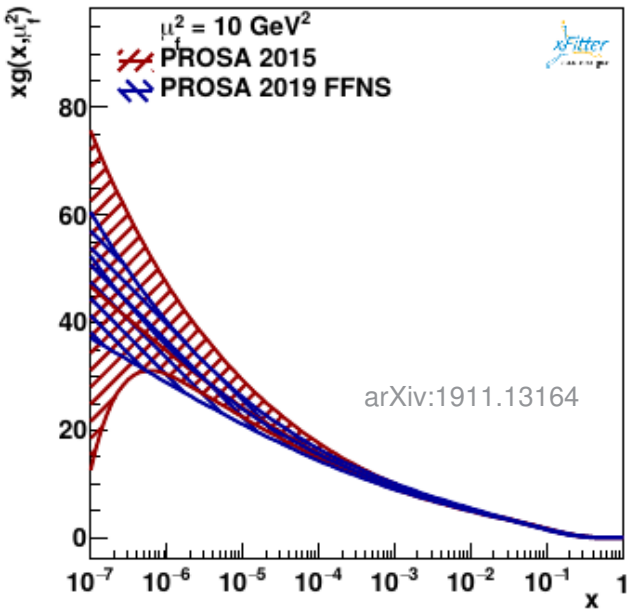
- profilerLHAPDF
- ttbar3D

- Demonstrate how to apply cuts based on dataset id, also flexible PDF parametrisation, tuning of QCDNUM grid parameters, manipulation with bins (cross section normalisation) etc.: see talk “Prosa analyses”

```
62  Evolutions:
63    proton-QCDNUM:
64      ? !include evolutions/QCDNUM.yaml
65      decomposition: proton #this could be omitted, as the default decomposition is set
66      class: QCDNUM
67      #xGrid    :   [9.9e-7, 0.01, 0.1, 0.4, 0.7]
68      xGrid    :   [9.9e-9, 0.01, 0.1, 0.4, 0.7]
69      xGridW   :   [1,       2,     4,   8,  16]
70      Q2Grid   :   [1.,  2.05e8 ]
71      Q2GridW  :   [1.,     1.]
72      NQ2bins  :   120
73      NXbins   :   200
74      Read_QCDNUM_Tables : 1
75      SplineOrder : 2
76      ICheck   :   0                # do or not check of the grid boundaries,
```




```
223   !--------------------- pp charm ----------------
224
225    ProcessName(11)     = 'DUMMY'
226    Dataset( 1,11)      = 420
227    Dataset( 2,11)      = 421
228    Dataset( 3,11)      = 422
229    Dataset( 4,11)      = 423
230    Dataset( 5,11)      = 510
231    Dataset( 6,11)      = 511
232    Dataset( 7,11)      = 512
233    Dataset( 8,11)      = 513
234    Dataset( 9,11)      = 400
235    Dataset(10,11)      = 401
236    Dataset(11,11)      = 402
237    Dataset(12,11)      = 403
238    Dataset(13,11)      = 500
239    Dataset(14,11)      = 501
240    Dataset(15,11)      = 503
241    Dataset(16,11)      = 430
242    Dataset(17,11)      = 431
243    Dataset(18,11)      = 432
244    Dataset(19,11)      = 433
245    Variable(11)        = 'pTmax'
246    CutValueMin(11)     = 0.0
247    !CutValueMax(11)     = 1.17 ! k = 2.2
248    !CutValueMax(11)     = 3.02 ! k = 3.1
249    CutValueMax(11)     = 5.14 ! k = 4.5
250    !CutValueMax(11)     = 7.20 ! k = 6.0
251    !CutValueMax(11)     = 12.5 ! k = 10.0
252
253   !--------------------- pp beauty ----------------
254
255    ProcessName(12)     = 'DUMMY'
256    Dataset( 1,12)      = 411
257    Dataset( 2,12)      = 412
258    Dataset( 3,12)      = 413
259    Variable(12)        = 'pTmax'
260    CutValueMin(12)     = 0.0
261    !CutValueMax(12)     = 3.83 ! k = 2.2
262    !CutValueMax(12)     = 9.90 ! k = 3.1
263    CutValueMax(12)     = 16.9 ! k = 4.5
264    !CutValueMax(12)     = 23.6 ! k = 6.0
265    !CutValueMax(12)     = 40.9 ! k = 10.0
```

SmallxResummation

- AFB
- ALLDATA
- FFABM
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- charmCCZEUSFFABM
- charmCCZEUSFONLL
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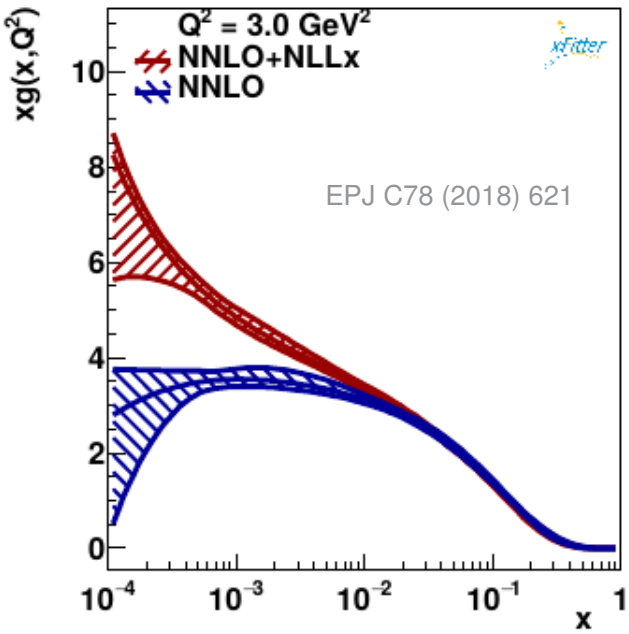
- defaultNNLO
- evolutionAPFELxx
- paramABMP16
- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 150 Bytes

```
1  One chi2 iteration for small x resummation xfitter analysis 1802.00064
2
3  Chi2 and PDFs are no the same as in the paper due to recent software changes
```

- Example from xFitter paper EPJ C78 (2018) 621 “Impact of low-x resummation on QCD analysis of HERA data”
- Demonstrate how to enable NLLx resummation using APFEL

```
72  Evolutions:
73    proton-APFELff:
74      ? !include evolutions/APFEL.yaml
75      decomposition: proton
76      kmc : 1.2 # ratio between charm quark threshold and mass
77      nllxResummation : "On"
```



TensorPomeron

- AFB
- ALLDATA
- FFABM
- FONLL
- FastNLOSymmetrize
- HVQMNR-abs
- HVQMNR-norm
- LHeC
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- charmCCZEUSFFABM
- charmCCZEUSFONLL
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- profilerLHAPDF
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README.txt 158 Bytes

```
Full Tensor Pomeron fit to HERA and fixed target data. Requires complete set of datafiles/
See published paper at https://doi.org/10.1103/PhysRevD.100.114007
```

- See “Tensor pomeron and odderon phenomenology” talk tomorrow

```
&InFiles
  ! Number of intput files
    NInputFiles = 8

  ! Input files:

     InputFileNames =
    'datafiles/hera/h1/inclusiveDis/9509001/h1_gammap.dat',
    'datafiles/hera/zeus/inclusiveDis/0202034/zeus_gammap.dat',
    'datafiles/fixedTarget/slac/inclusiveDis/PRL_40_1978_1222/slac_gammap.dat',
    'datafiles/fixedTarget/baksan/Yad_Fiz_66_2003_591/baksan_gammap.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/1506.06042/HERA1+2_NCep_920-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/1506.06042/HERA1+2_NCep_820-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/1506.06042/HERA1+2_NCep_575-thexp.dat',
    'datafiles/hera/h1zeusCombined/inclusiveDis/1506.06042/HERA1+2_NCep_460-thexp.dat',
&End
```

```
# Specify HF scheme used for DIS NC processes:
hf_scheme_DISNC :
  defaultValue : 'TensorPomeron'
```

ZMVFNS-fit

- AFB
- ALLDATA
- FFABM
- FONLL
- FastNLOSymmetrize
- HVQMNR-abs
- HVQMNR-norm
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- PROSA2019VFNS
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- TensorPomeron
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- charmCCZEUSFFABM
- charmCCZEUSFONLL
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README.txt 134 Bytes

```
Full fit (PDF+alpha_s) ZMVFNS NNLO QCDNUM, with error bands (takes ~ 10 min)
It tests also storing PDF eigenvectors in LHAPDF6 format
```

- The only test which performs MINUIT minimisation (often fails because of small numeric differences)

parameters.yaml 4.52 KB

```yaml
Minimizer: MINUIT # CERES
MINUIT:
  Commands: |
    set str 2
    call fcn 1
    migrad
    hesse
    call fcn 3

  doErrors :  Hesse # None
```

ceresZMVFNSfastChi2

- AFB
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- charmCCZEUSFONLL
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- defaultNNLO
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- paramBG
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- profilerLHAPDF
- ttbar3D

README.txt 141 Bytes

Edit | Web IDE | Replace | Delete

```
1
2  Full minimization of the HERA data using ceres minimizer, QCDNUM and ZMVFNS. In addition, fast version of chi2 is tested with BLAS enabled.
```

- Requires Ceres to be installed (this test is skipped by default)
- The only example which demonstrates how to setup another minimiser

parameters.yaml 5.17 KB

```
1  Minimizer: CERES
2  MINUIT:
3    Commands: |
4      set str 2
5      call fcn 3
```

charmCCZEUSFFABM, charmCCZEUSFONLL

- AFB
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- PROSA2019VFNS
- SmallxResummation
- TensorPomeron
- ZMVFNS-fit
- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
- chi2scanMTOP
- defaultNLO
- defaultNNLO
- evolutionAPFELxx
- paramABMP16
- paramBG
- profilerAs
- profilerLHAPDF
- ttbar3D

README.txt 84 Bytes

```
1  One chi2 iteration charm production in CC NLO FFABM [arXiv:1904.03261, see Table 4]
```

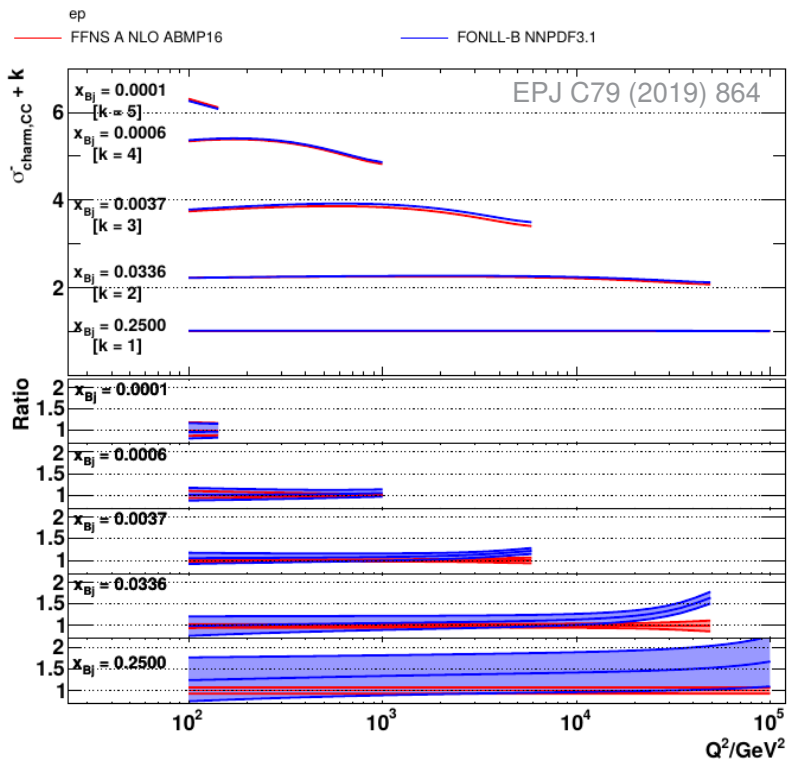
README.txt 84 Bytes

```
1  One chi2 iteration charm production in CC NLO FONLL [arXiv:1904.03261, see Table 4]
```

- Example from xFitter paper EPJ C79 (2019) 864 “Probing the strange content of the proton with charm production in charged current at LHeC”

```
65  Evolutions:
66    proton-APFELff:
67      ? !include evolutions/APFEL.yaml
68      FONLLVariant : 'B'
69      decomposition: proton
70  DefaultEvolution: proton-APFELff
```

```
78  byReaction:
79    FONLL_DISNC:
80      ? !include reactions/FONLL_DISNC.yaml
81    FONLL_DISCC:
82      ? !include reactions/FONLL_DISCC.yaml
83      FONLLVariant : 'B'
84      MassScheme   : 'MSbar'
85      Running      : 1
86
87  # Specify HF scheme used for DIS CC processes:
88  hf_scheme_DISCC :
89    defaultValue : 'FONLL_DISCC'
```



chi2scanMTOP

- AFB
- ALLDATA
- FFABM
- FONLL
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- HVQMNR-norm
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README.txt 141 Bytes Edit | Web IDE | Replace | Delete

```
This example shows the extraction of the top mass in the MSbar scheme mt(mt) from the inclusive ttbar cross section using Hathor predictions
```

```
# Profiler allows to add variations of parameters and PDF eigenvectors as additional nuisance parameters
#
Profiler:
  Parameters:
    alphas: [ 0.118, 0.119, 0.117 ]  # central, up, (down) variation. If down is not given, uses symmetrizes Up variation
  #Evolutions:
  #  proton-LHAPDF:
  #    sets:    [CT10]
  #    members: [[0,1,end]]
  Status: "Off"               # "Off" to turn off profiler
  WriteTheo: "Off"            # Can be "Off", "On" or "Asymmetric" (to store asymmetric variations)
  getChi2: "Off"              # determine and report chi2 for each variation
```

chi2scan.txt 591 Bytes Edit | Web IDE | Replace | Delete

```
m_{t} [GeV]
163.1959868643716       1.461475956232212       -0.2836150642547916
ax^2+bx+c       0.4681721370978568      -152.8074968008872      12468.490549423
163.1958466939107       0       3.288201071427466e-07   -0.2838757797835569
ax^3+bx^2+cx+d  0       0.4681721370978568      -152.8074968008872      12468.490549423
163.3078339941645       1.518309008666847       1.569411844103087       -0.00215532961738063
ax^4+bx^3+cx^2+dx+e     5.594337063555465e-05   -0.02754154031501438    4.96136652868047        -391.5142939621641      11782.67980960892
160     4.275045958982793
162     0.6936252842034929
164     0.2036711280226615
166     3.222397859114234
168     10.19893499259951
170     21.61843296848564
```

defaultNLO, defaultNNLO

- AFB
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README.txt 136 Bytes

```
One chi2 iteration NLO RTOPT QCDNUM [HERAPDF2.0 arXiv:1506.06042]
It tests also storing NLO PDF from QCDNUM evolution in LHAPDF6 format
```

README.txt 149 Bytes

```
One chi2 iteration NNLO RTOPT QCDNUM (default) [HERAPDF2.0 arXiv:1506.06042 ]
It tests also storing NNLO PDF from QCDNUM evolution in LHAPDF6 format
```

```
WriteLHAPDF6:
  name: "proton"
  description: "..."
  authors: "..."
  reference: "..."
    # use DefaultEvolution
  #evolution: proton-QCDNUM
    # take internal grid
  preferInternalGrid:
    # or define grid
  #Xrange: [1e-4, 1]
  #Qrange: [1,1000]
  #Xnpoints: 200
  #Qnpoints: 120
```

Results.txt 14.4 KB

```
After minimisation    1363.40  1131     1.205

  Partial chi2s
Dataset    1    442.52( +7.94)   377  HERA1+2 NCep 920
Dataset    2     66.14( +0.02)    70  HERA1+2 NCep 820
Dataset    3    219.14( +1.06)   254  HERA1+2 NCep 575
Dataset    4    217.70( -0.88)   204  HERA1+2 NCep 460
Dataset    5    219.32( -0.22)   159  HERA1+2 NCem
Dataset    6     44.90( +0.38)    39  HERA1+2 CCep
Dataset    7     55.98( -2.14)    42  HERA1+2 CCem

 Correlated Chi2    91.547021663724067
 Log penalty Chi2    6.1545474513137997
 Systematic shifts          169
```

evolutionAPFELxx

- AFB
- ALLDATA
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- FONLL
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- HVQMNR-abs
- HVQMNR-norm
- LHeC
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- PROSA2019VFNS
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- TensorPomeron
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- ceresZMVFNSfastChi2
- charmCCZEUSFFABM
- charmCCZEUSFONLL
- chi2scanMTOP
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```
1
2  Use APFEL++ evolution and compare HERA-pdf central fit to the ATLAS 7 TeV Z-cross section data.
```

- Demonstrates how to setup PDF evolution using APFEL++

```yaml
DefaultEvolution: proton-APFEL

Evolutions:
  proton-APFELff:
    ? !include evolutions/APFEL.yaml
    decomposition: proton
  proton-QCDNUM:
    ? !include evolutions/QCDNUM.yaml
    decomposition: proton #this could be omitted, as the default decomposition is set
    # The following allows QCDNUM to read PDFs from other evolutions:
    #EvolutionCopy: "proton-LHAPDF"
  proton-LHAPDF:
    class: LHAPDF
    set: "NNPDF30_nlo_as_0118"
    #set: "CT10nlo"
    member: 0
  proton-APFEL:
    ? !include evolutions/APFELxx.yaml
    decomposition: proton
```

paramABMP16

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```
One chi2 iteration with PDF parametrisation from ABMP16 analysis [Phys.Rev. D96 (2017) no.1, 014011] and HERA data.
Note that theory predictions do not reproduce ABMP16 analysis, only PDF at the starting scale (Q = 3 GeV) are the same.
Tests PDF parametrisation classes ABMPvalence, ABMPvalence, ABMPsea, ABMPgluon.
```

- Example with ABMP16 PDF parametrisation (note that chi^2 is quite different)
- ABMP16 PDF parametrisation was implemented using dedicated classes in `pdfparams`, however now it is easier to implement a new PDF parametrisation using flexible PDF paramtrisation (formulas)

```
Parameterisations:
  par_uv:
    class: ABMPvalence
    parameters: [ABMP_uv_A, ABMP_uv_a, ABMP_uv_b, ZERO, ABMP_uv_g1, ABMP_uv_g2, ABMP_uv_g3]
  par_dv:
    class: ABMPvalence
    parameters: [ABMP_dv_A, ABMP_dv_a, ABMP_dv_b, ZERO, ABMP_dv_g1, ABMP_dv_g2, ABMP_dv_g3]
  par_ubar:
    class: ABMPsea
    parameters: [ABMP_us_A, ABMP_us_a, ABMP_us_b, ABMP_us_gm1, ABMP_us_g1, ZERO, ZERO]
  par_dbar:
    class: ABMPsea
    parameters: [ABMP_ds_A, ABMP_ds_a, ABMP_ds_b, ZERO, ABMP_ds_g1, ZERO, ZERO]
  par_s:
    class: ABMPsea
    parameters: [ABMP_ss_A, ABMP_ss_a, ABMP_ss_b, ZERO, ZERO, ZERO, ZERO]
  par_sbar:
    class: ABMPsea
    parameters: [ABMP_ss_A, ABMP_ss_a, ABMP_ss_b, ZERO, ZERO, ZERO, ZERO]
    #class: ABMPPdfParam
    #parameters: [ABMP_ssbar_A, ABMP_ssbar_a, ABMP_ssbar_b, ZERO, ZERO, ZERO, ZERO]
  par_g:
    class: ABMPgluon
    parameters: [ABMP_g_A, ABMP_g_a, ABMP_g_b, ZERO, ABMP_g_g1, ZERO, ZERO]
```

```
Parameters:
  ZERO : [ 0. ]          # zero
  # u valence
  ABMP_uv_A   : DEPENDENT
  ABMP_uv_a   : [  0.613, 0.033 ]
  ABMP_uv_b   : [  3.443, 0.064 ]
  ABMP_uv_g1  : [  -0.22, 0.33  ]
  ABMP_uv_g2  : [  -2.88, 0.46  ]
  ABMP_uv_g3  : [   2.67, 0.80  ]
  # d valence
  ABMP_dv_A   : DEPENDENT
  ABMP_dv_a   : [  0.372, 0.068 ]
  ABMP_dv_b   : [   4.47, 0.55  ]
  ABMP_dv_g1  : [  -3.20, 0.77  ]
  ABMP_dv_g2  : [  -0.61, 1.96  ]
  ABMP_dv_g3  : [    0.0, 0.001 ]
  # u sea
  ABMP_us_A   : [ 0.0703, 0.0081]
  ABMP_us_a   : [-0.4155, 0.031 ]
  ABMP_us_b   : [   7.75, 0.39  ]
  ABMP_us_gm1 : [ 0.0373, 0.0032]
  ABMP_us_g1  : [   4.44, 0.95  ]
  # d sea
  ABMP_ds_A   : [ 0.1408, 0.0076]
  ABMP_ds_a   : [-0.1731, 0.011 ]
  ABMP_ds_b   : [   8.41, 0.34  ]
  ABMP_ds_g1  : [   13.3, 1.7   ]
  # strange sea
  ABMP_ss_A   : [ 0.0594, 0.0042]
  ABMP_ss_a   : [-0.3445, 0.019 ]
  ABMP_ss_b   : [   6.52, 0.27  ]
  # antistrange sea: uncomment these p
  #ABMP_ssbar_A: [ 0.0594, 0.0042]
  #ABMP_ssbar_a: [-0.3445, 0.019 ]
  #ABMP_ss_bbar: [   6.52, 0.27  ]
  # gluon
  ABMP_g_A    : DEPENDENT
  ABMP_g_a    : [-0.1534, 0.0094]
  ABMP_g_b    : [   6.42, 0.83  ]
  ABMP_g_g1   : [  -11.8, 3.7   ]
```

paramBG

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```
One chi2 iteration for HERA data using PDF parametrisation from arXiv:1902.11125

PDF parametrisation from paper:
Marco Bonvini, Francesco Giuli, "A new simple PDF parametrization: improved description of the HERA data", arXiv:1902.11125

The chi2 iteration reproduces values from Table 4 of the paper (within ~ 1 unit).
```

```
Parameterisations:
  par_uv:
    class: Expression
    expression: "Auv*(x^Buv*(1-x)^Cuv)*(1+Euv*x^2+Fuv*ln(x)+Guv*ln(x)^2)"
  par_dv:
    class: Expression
    expression: "Adv*(x^Bdv*(1-x)^Cdv)"
  par_ubar:
    class: Expression
    expression: "Adbar*(x^Bdbar*(1-x)^Cubar)*(1+Dubar*x+Fdbar*ln(x))"
  par_dbar:
    class: Expression
    expression: "Adbar*(x^Bdbar*(1-x)^Cdbar)*(1+Ddbar*x+Fdbar*ln(x))"
  par_s:
    class: Expression
    expression: "Adbar*fs/(1-fs)*(x^Bdbar*(1-x)^Cdbar)*(1+Ddbar*x+Fdbar*ln(x))"
  par_g:
    class: Expression
    expression: "Ag*(x^Bg*(1-x)^Cg)*(1+Fg*ln(x)+Gg*ln(x)^2)"
```

```
Parameters:
  Ag   :  DEPENDENT
  Bg   : [ -0.5009,   0.0060 ]
  Cg   : [  4.4885,   0.1944 ]
  Fg   : [  0.2156,   0.0005 ]
  Gg   : [  0.0119,   0.0010 ]
  Auv  :  DEPENDENT
  Buv  : [  0.7392,   0.0021 ]
  Cuv  : [  4.5845,   0.0170 ]
  Euv  : [  2.7839,   0.0633 ]
  Fuv  : [  0.3416,   0.0027 ]
  Guv  : [  0.0470,   0.0040 ]
  Adv  :  DEPENDENT
  Bdv  : [  0.9882,   0.0108 ]
  Cdv  : [  4.6983,   0.0742 ]
  Cubar: [ 10.9607,   0.2749 ]
  Dubar: [ 17.2935,   0.2808 ]
  Adbar: [  0.0854,   0.0241 ]
  Bdbar: [ -0.3354,   0.0031 ]
  Cdbar: [ 23.8266,   0.9917 ]
  Ddbar: [ 35.0368,   4.5302 ]
  Fdbar: [  0.0744,   0.0011 ]
  ZERO : 0
  fs : [ 0.4, 0.0 ]
```

profilerAs

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```
1  Profiler alpha_s: computes theory prediction and chi2 for HERA data and three values of alpha_s
```

- Demonstrates how to compute predictions for parameter variations and include corresponding uncertainty in χ^2

```
154  #
155  # Profiler allows to add variations of parameters and PDF eigenvectors as additional nuisance parameters
156  #
157  Profiler:
158    Parameters:
159      alphas: [ 0.118, 0.119, 0.117 ]  # central, up, (down) variation. If down is not given, uses symmetrizes Up variation
160    #Evolutions:
161    #  proton-LHAPDF:
162    #    sets:    [NNPDF30_nlo_as_0118]
163    #    members: [[0,1,10]]
164    Status: "On"                # "Off" to turn off profiler
165    WriteTheo: "Asymmetric"             # Can be "Off", "On" or "Asymmetric" (to store asymmetric variations)
166    getChi2: "On"               # determine and report chi2 for each variation
```

Results.txt 14.5 KB

```
1   After minimisation    1363.36  1131     1.205
2
3     Partial chi2s
4   Dataset    1    442.47( +7.94)   377  HERA1+2 NCep 920
5   Dataset    2     66.17( +0.02)    70  HERA1+2 NCep 820
6   Dataset    3    219.14( +1.06)   254  HERA1+2 NCep 575
7   Dataset    4    217.78( -0.88)   204  HERA1+2 NCep 460
8   Dataset    5    219.29( -0.22)   159  HERA1+2 NCem
9   Dataset    6     44.93( +0.38)    39  HERA1+2 CCep
10  Dataset    7     56.03( -2.14)    42  HERA1+2 CCem
11
12   Correlated Chi2    91.400763346124066
13   Log penalty Chi2    6.1545474513137997
14   Systematic shifts          170
15
16                                Name          Shift   +/-    Error          Type
17      1  sysHZComb1001                      0.3179   +/-   0.9327        :N:M:D
18      2  sysHZComb1002                     -0.5146   +/-   0.9365        :N:M:D
```

. . .

```
186   170  alphas                          -0.0195   +/-   0.0952        :N:M:T
```

profilerLHAPDF

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```
Profiler PDF eigenvectors (LHAPDF): computes theory predictions for HERA data nad all PDF eigenvectors
```

- Demonstrates how to compute predictions for parameter variations (can be used later for profiling, eigenvector rotation etc.)

```
#
# Profiler allows to add variations of parameters and PDF eigenvectors as additional nuisance parameters
#
Profiler:
  #Parameters:
  #  alphas: [ 0.118, 0.119, 0.117 ]  # central, up, (down) variation. If down is not given, uses symmetrizes Up variation
  Evolutions:
    proton-LHAPDF:
      sets:    [NNPDF30_nlo_as_0118]
      members: [[0,1,end]]
  Status: "On"                # "Off" to turn off profiler
  WriteTheo: "On"             # Can be "Off", "On" or "Asymmetric" (to store asymmetric variations)
  getChi2: "Off"               # determine and report chi2 for each variation
```

```
* Theory file for HERA1+2 NCep 920
&Data
   Name = "Theory for HERA1+2 NCep 920"
   NData =   377
   NColumn =   104
   ColumnType = 3*"Bin","Theory",100*"Error"
   ColumnName = "Q2","x","y","theory","PDF_nuisance_param_1","PDF_nuisance_param_2","PDF_nuisance_param_3","PDF_nuisance_param_4","PDF_nuisance_param_5","P
   Percent = 100*True
&End
  0.3500E+01  0.4060E-04  0.8518E+00  0.9464E+00 -0.6073E+00 -0.6500E+01  0.2413E+01  0.1628E+01  0.7577E+00 -0.3236E+00 -0.4319E+00 -0.2090E+00 -0.1216E+0
  0.3500E+01  0.4323E-04  0.8000E+00  0.9504E+00 -0.6405E+00 -0.5444E+01  0.1764E+01  0.1079E+01  0.4025E+00 -0.2002E+00 -0.2656E+00 -0.1351E+00 -0.2614E-0
  0.3500E+01  0.4600E-04  0.7519E+00  0.9518E+00 -0.6298E+00 -0.4543E+01  0.1262E+01  0.6361E+00  0.1708E+00 -0.2048E+00 -0.9693E-01 -0.7034E-01  0.5928E-0
  0.3500E+01  0.5124E-04  0.6750E+00  0.9507E+00 -0.6567E+00 -0.3461E+01  0.6564E+00  0.1397E+00 -0.1435E+00 -0.1271E+00  0.2309E-01  0.9977E-02  0.1479E+0
  0.3500E+01  0.5310E-04  0.6513E+00  0.9489E+00 -0.6466E+00 -0.3174E+01  0.5227E+00  0.2750E-01 -0.1931E+00 -0.1610E+00  0.6157E-01  0.3163E-01  0.1729E+0
  0.3500E+01  0.8000E-04  0.4323E+00  0.9174E+00 -0.5616E+00 -0.1038E+01 -0.7314E+00 -0.8890E+00 -0.4154E+00 -0.9517E-01  0.1817E+00  0.2131E+00  0.1809E+0
```

ttbar3d

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```
One chi2 iteration from CMS QCD analysis (simultaneous PDF+alpha_s+m_t^pole fit) of triple-differential ttbar cross sections arXiv:1904.05237
The ttbar data test APPLgrid, KFactor and KMatrix reactions, and spline interpolation in theory expression
```

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- Demonstrates how to use spline in theory expression to interpolate between predictions with different parameter values (kind of alternative to χ scan)
- Demonstrates how to use KFactor and KMatrix for bin manipulation (normalised cross sections, merged bins, bin-by-bin corrections)
- Perhaps longest theory expression ever used in xFitter:

```
TheorExpr     =
'((C.(spline[m1,A1m1,m2,A1m2,m3,A1m3,m4,A1m4,m5,A1m5,PARm]-spline[m1,A2m1,m2,A2m2,m3,A2m3,m4,A2m4,m5,A2m5,PARm]*D))*NP)/sum((C.(spline[m1,A1m1,m2,A1m2,m3,A1m3,m4,A1m4,m5,A1m5,PARm]-spline[m1,A2m1,m2,A2m2,m3,A2m3,m4,A2m4,m5,A2m5,PARm]*D))*NP)'
```

```
TheoryType   = 'expression'
TermName     = 'm1','A1m1','A2m1',
               'm2','A1m2','A2m2',
               'm3','A1m3','A2m3',
               'm4','A1m4','A2m4',
               'm5','A1m5','A2m5',
               'PARm','D','NP','C'
TermType     = 'reaction','reaction','reaction',
               'reaction','reaction','reaction',
               'reaction','reaction','reaction',
               'reaction','reaction','reaction',
               'reaction','reaction','reaction',
               'reaction','reaction','reaction','reaction'
TermSource   = 'KFactor','APPLgrid','APPLgrid',
               'KFactor','APPLgrid','APPLgrid',
               'KFactor','APPLgrid','APPLgrid',
               'KFactor','APPLgrid','APPLgrid',
               'KFactor','APPLgrid','APPLgrid',
               'KFactor','KFactor','KFactor','KMatrix'
TermInfo     =
   'Parameter=m1Value:N=32',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_49.root',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1675/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1675/aMCfast_obs_49.root',
   'Parameter=m2Value:N=32',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_49.root',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1700/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1700/aMCfast_obs_49.root',
   'Parameter=m3Value:N=32',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_49.root',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1725/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1725/aMCfast_obs_49.root',
   'Parameter=m4Value:N=32',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_49.root',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1750/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1750/aMCfast_obs_49.root',
   'Parameter=m5Value:N=32',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_49.root',

   'norm=1:GridName=datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt1j-mt1775/aMCfast_obs_49.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_43.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_45.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_47.root,datafiles/lhc/cms/topProduction/1904.05237/aMCfast-tt0j-mt1775/aMCfast_obs_49.root',
   'Parameter=mtFit:N=32',
   'FileName=datafiles/lhc/cms/topProduction/1904.05237/kf-subtract32.txt:FileLine=1:FileLineFinish=32',
   'FileName=datafiles/lhc/cms/topProduction/1904.05237/CMS_13TeV_ttbar_NjZMttYtt_NPcorr.dat:FileColumn=8',
   'FileName=datafiles/lhc/cms/topProduction/1904.05237/kf-combine-32to24.txt:FileColumnStart=1:FileColumnFinish=32'
```

Summary

- For users: existing xFitter examples give a good overview of current xFitter functionality

  $\rightarrow$ encourage users to check them whenever you have any issues or need something to start with
- For users: we are happy to accommodate your xfitter analyses as new examples

  $\rightarrow$ just send us input files, or create a merge request yourself
- For developers: please always make sure that your changes to the code do not break existing tests
- For experts: we need good solution how to tolerate small numerical differences in output ('diff' does not work always, 'numdiff' is better, but not available on every machine)