

New Studies

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based on Max's new simulations

Outline:

- ➊ Status of xFitter releases
- ➋ Highlights of the recent results using xFitter
- ➌ Analyses by xFitter developers:
 - ➍ determination of the photon PDF

New Files from Max

Overview on simulations for FCC M.Klein 17.3.2017

Calculations are done of the uncertainties of the NC and CC inclusive cross sections as can be expected for the FCC-ep.

The following sets are provided:

| NC/CC Name | Ee[GeV] | Ep[TeV] | P(e) | Charge | Lum[ab-1] |
|--|---------|---------|------|--------|-----------|
| nominal, high luminosity data, negative polarisation | | | | | |
| NC datfcc5060ncem | 60 | 50 | -0.8 | -1 | 1 |
| CC datfcc5060ccem | 60 | 50 | -0.8 | -1 | 1 |
| nominal, high luminosity data, opposite polarisation | | | | | |
| NC datfcc5060ncep | 60 | 50 | 0.8 | -1 | 0.3 |
| CC datfcc5060ccep | 60 | 50 | 0.8 | -1 | 0.3 |
| positron data, unpolarised | | | | | |
| NC datfcc5060ncepp | 60 | 50 | 0 | +1 | 0.1 |
| CC datfcc5060ccepp | 60 | 50 | 0 | +1 | 0.1 |
| low energy data, unpolarised | | | | | |
| NC datfcc720ncem | 20 | 7 | 0 | -1 | 0.1 |
| CC datfcc720ccem | 20 | 7 | 0 | -1 | 0.1 |

each file has a header which should make the meaning of the numbers clear.

In the LHeC Note 2013-002 PHY these simulations are described (for the LHeC case)

<http://cds.cern.ch/record/1564929/files/maxvoiSMnote.pdf>

For the FCC the following cuts were applied:

eta_max=5, .95 < y < 0.001

Error assumptions

energy scales: e: 0.1%, h=0.5%
this is the D/MC scale difference

Radcor 0.3% Photoproduction at high y: 1%
uncorrelated extra efficiency 0.5%

The luminosity error is kept aside, one may assume 0.5-1%.

in xfitter the files are:

lhc/lhec/

datfcc5060ccepp.dat
datfcc5060ncepp.dat
datfcc5060ccep.dat
datfcc5060ncep.dat
datfcc5060ccem.dat
datfcc5060ncem.dat

datfcc720ccep.dat
datfcc720ncep.dat

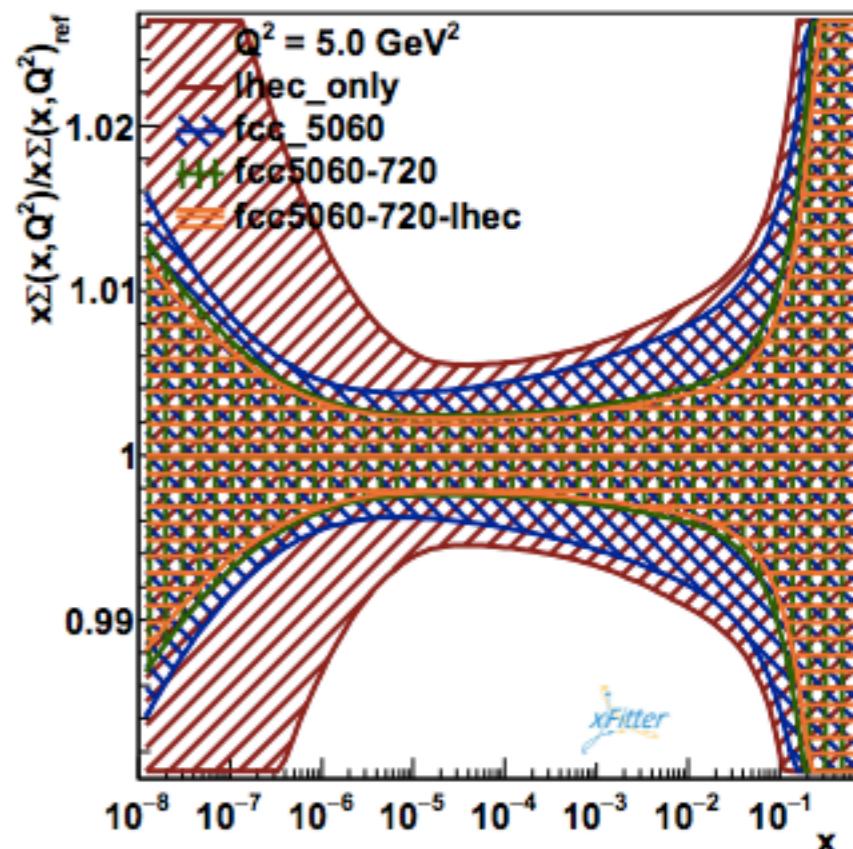
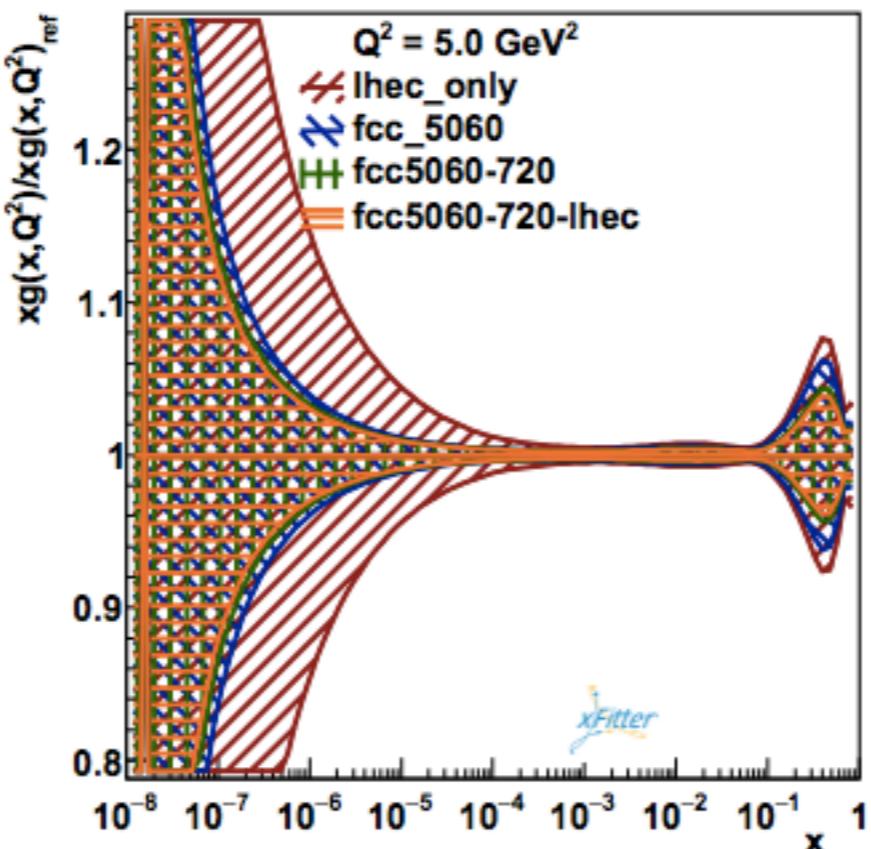
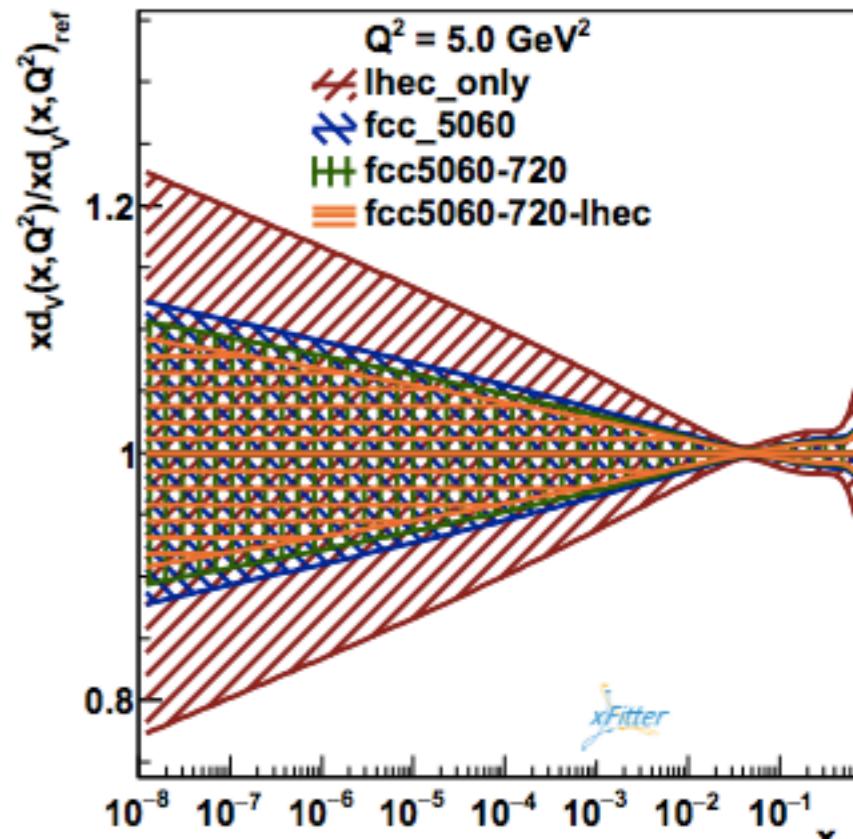
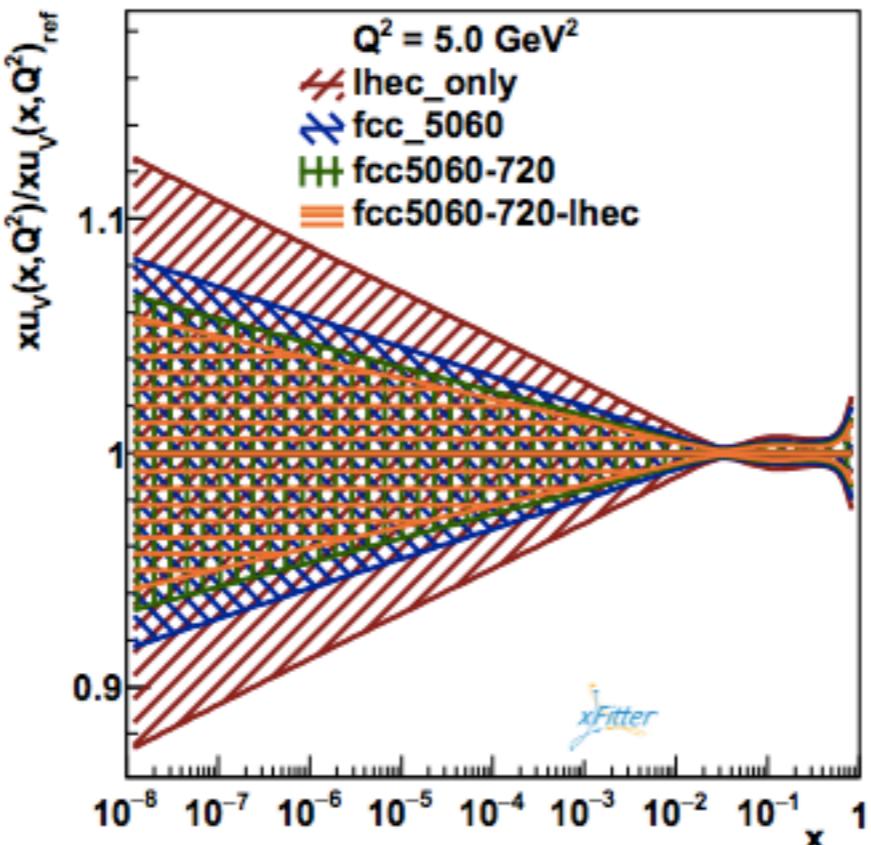
PDFs using standard HERA parametrisation

- Using current HERAPDF parametrisation:

$$\begin{aligned}
 xg(x) &= A_g x^{B_g} (1-x)^{C_g} - A'_g x^{B'_g} (1-x)^{C'_g}, \\
 xu_v(x) &= A_{u_v} x^{B_{u_v}} (1-x)^{C_{u_v}} (1+E_{u_v} x^2), \\
 xd_v(x) &= A_{d_v} x^{B_{d_v}} (1-x)^{C_{d_v}}, \\
 x\bar{U}(x) &= A_{\bar{U}} x^{B_{\bar{U}}} (1-x)^{C_{\bar{U}}} (1+D_{\bar{U}} x), \\
 x\bar{D}(x) &= A_{\bar{D}} x^{B_{\bar{D}}} (1-x)^{C_{\bar{D}}}.
 \end{aligned}$$

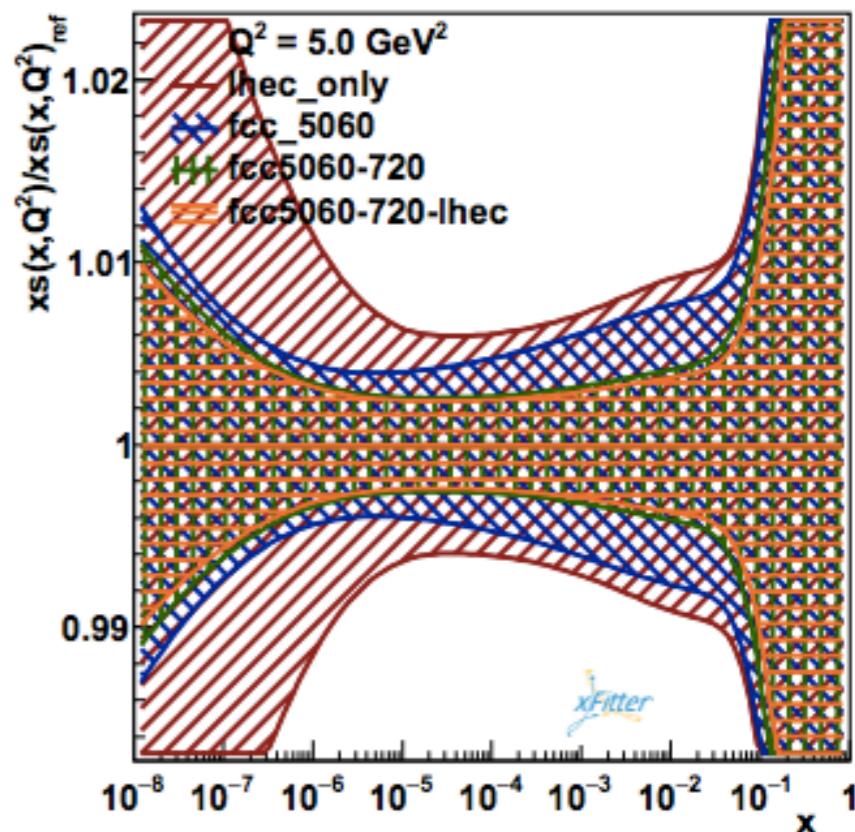
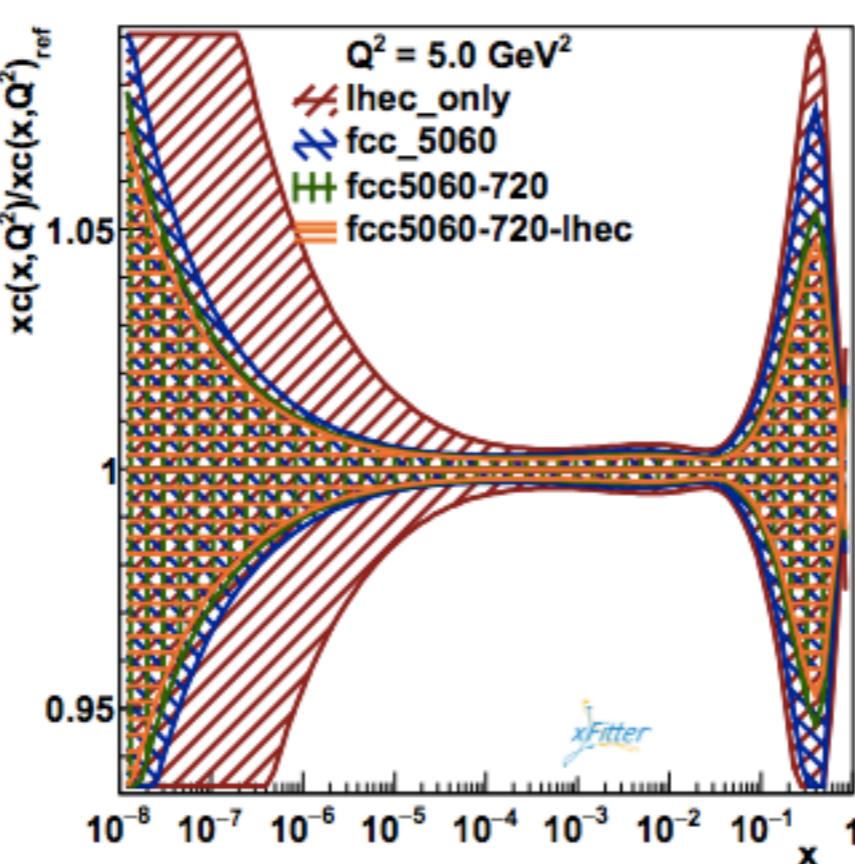
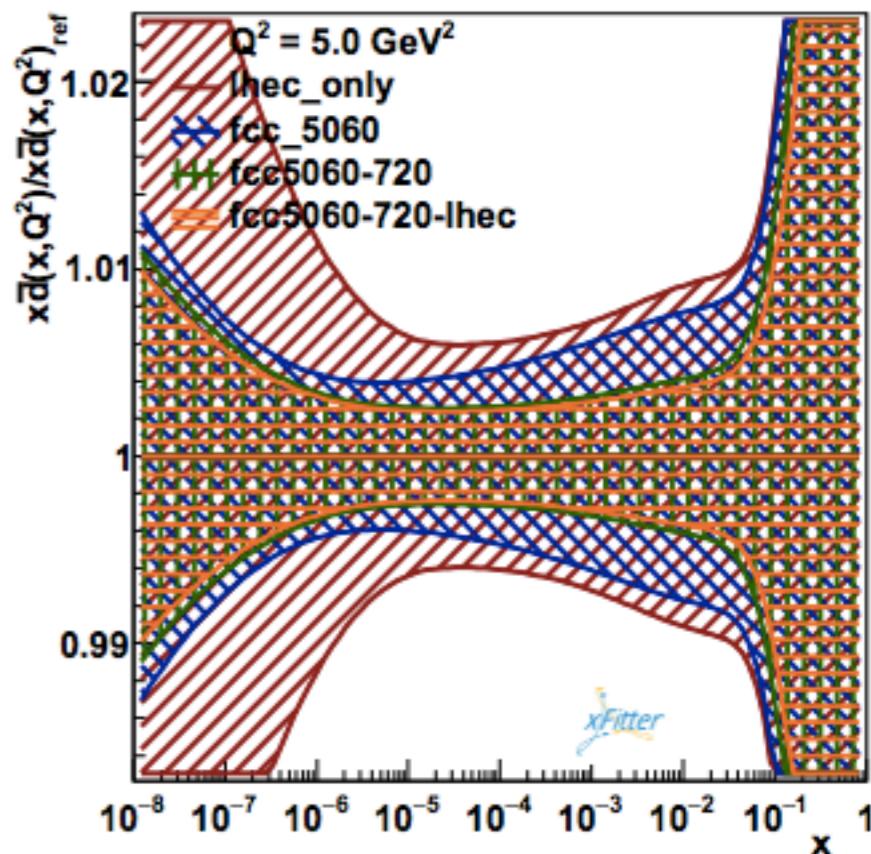
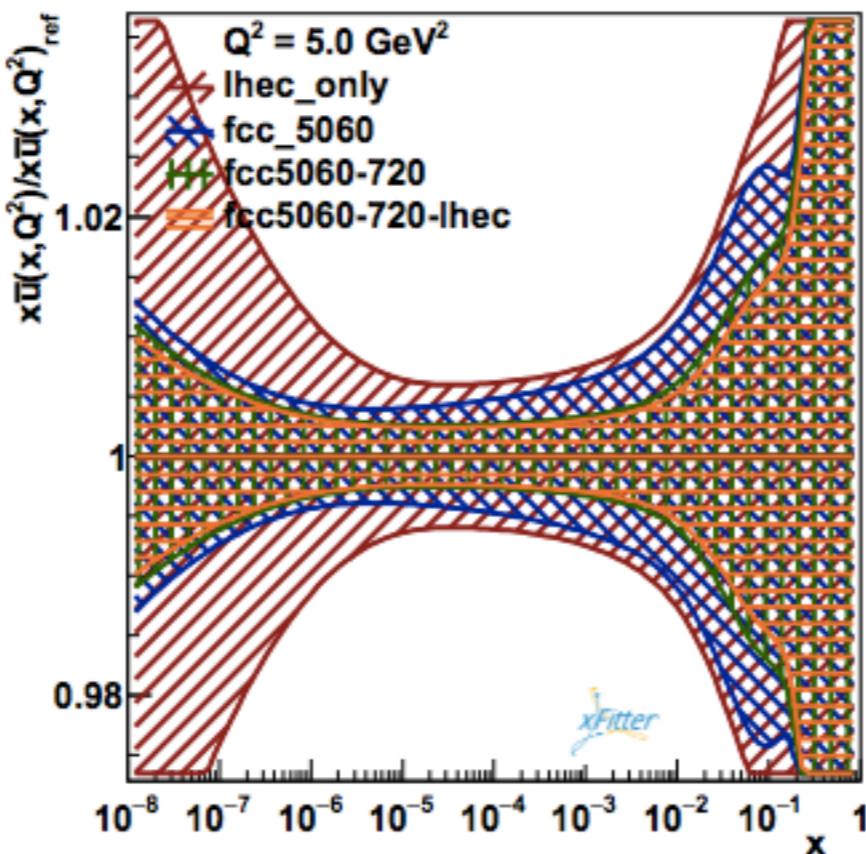
- 14 free parameters
- Note, in the past we used: 12 free parameters (pos gluon, less for sea)

$B_g, C_g, D_g, B_{uv}, C_{uv}, E_{uv}, B_{dv}, C_{dv}, C_{\bar{U}}, A_{\bar{D}}, B_{\bar{D}}, C_{\bar{D}}$



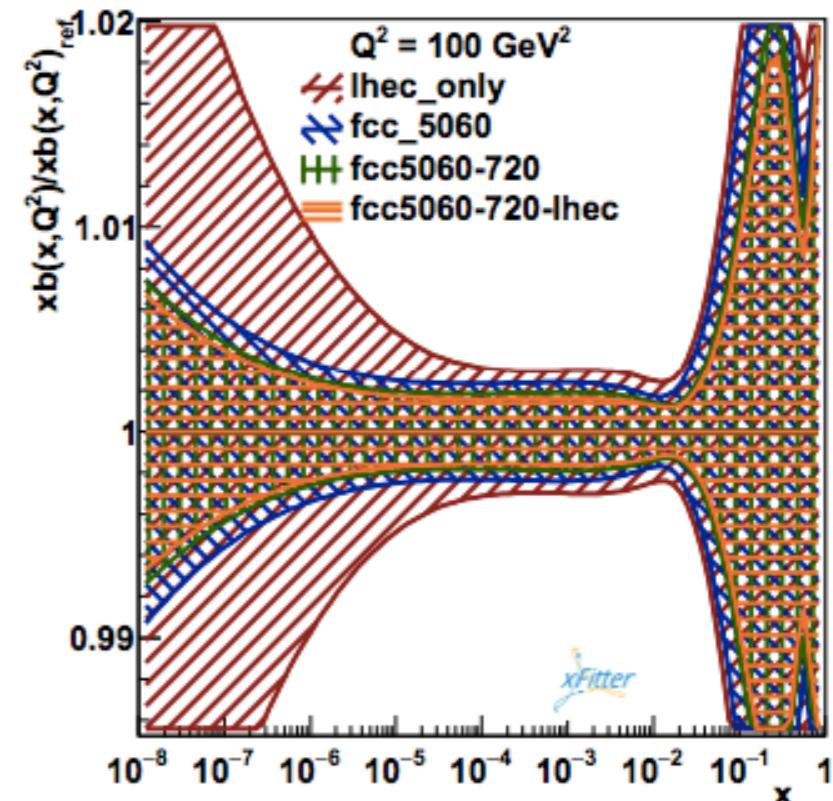
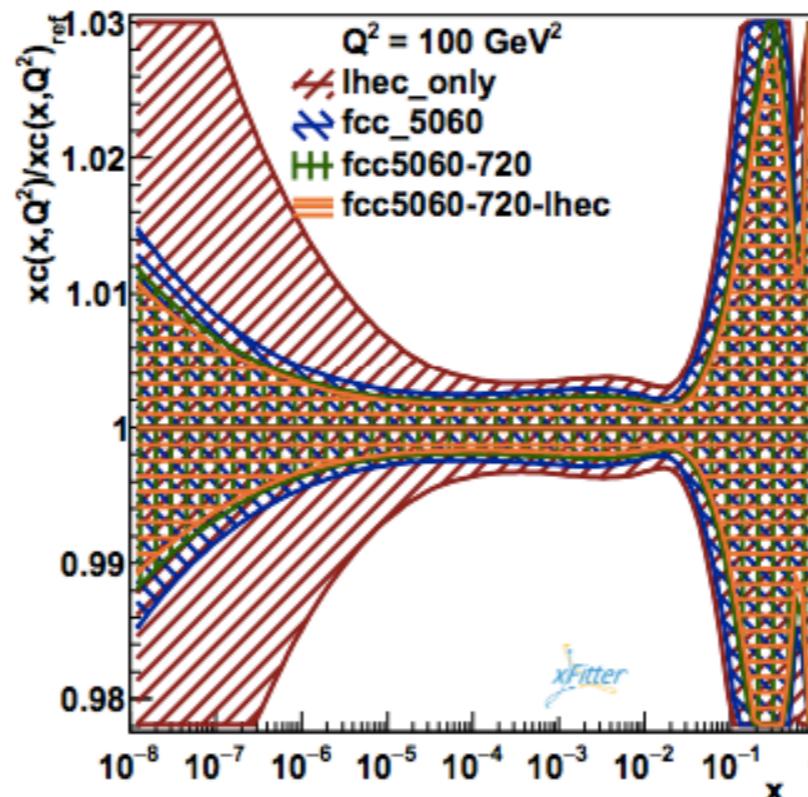
PDFs using standard parametrisation

- above charm threshold:



PDFs using standard parametrisation

- above bottom threshold:



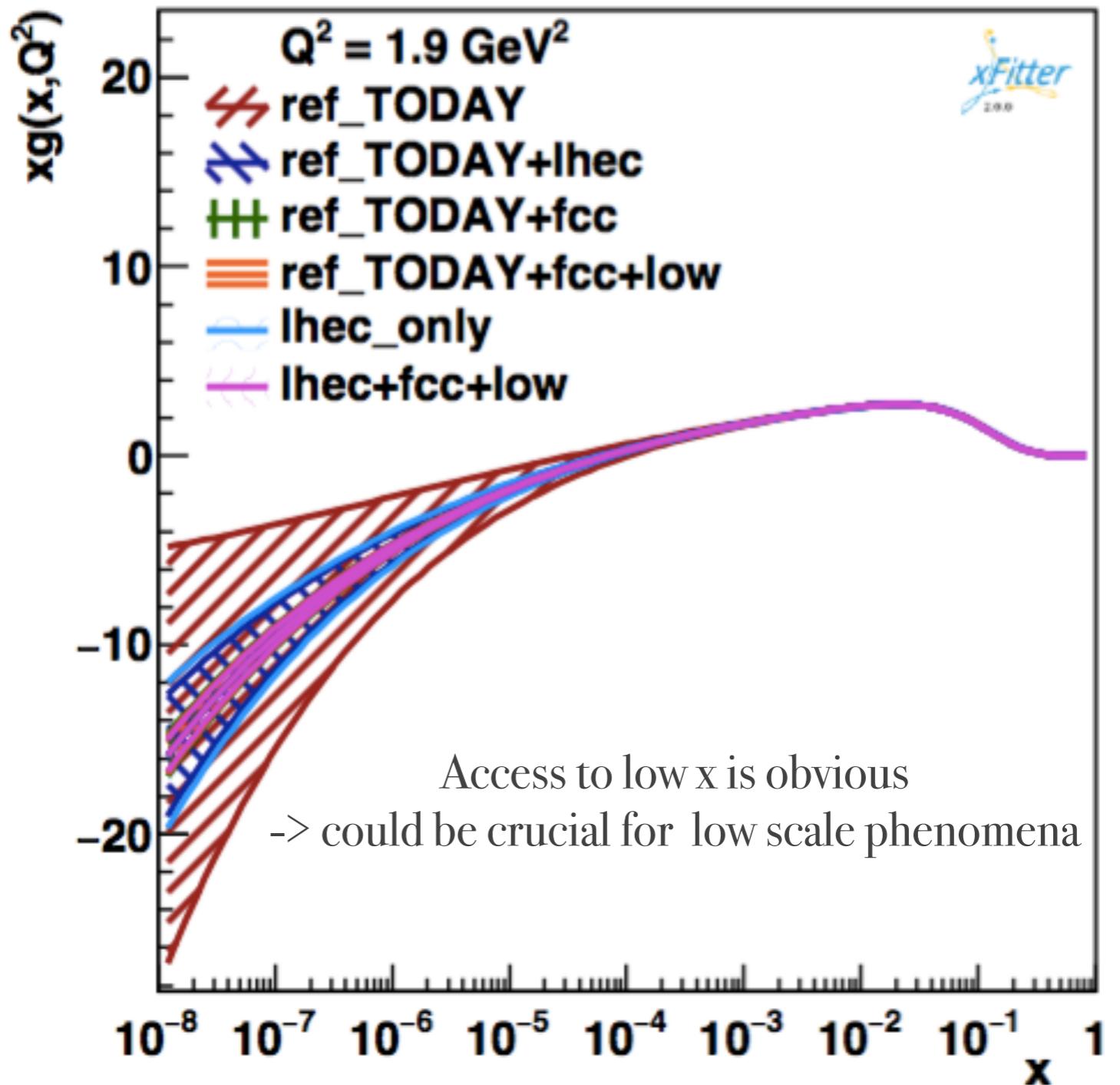
| Parameter | lhec only | fcc 5060 | fcc5060-720 | fcc5060-720-lhec |
|-----------|------------------|------------------|------------------|--------------------|
| 'Bg' | -0.015 ± 0.024 | -0.015 ± 0.010 | -0.0148 ± 0.0094 | -0.0148 ± 0.0085 |
| 'Cg' | 9.11 ± 0.35 | 9.11 ± 0.26 | 9.11 ± 0.18 | 9.11 ± 0.16 |
| 'Aprig' | 1.04 ± 0.13 | 1.044 ± 0.096 | 1.044 ± 0.094 | 1.044 ± 0.090 |
| 'Bprig' | -0.166 ± 0.013 | -0.1664 ± 0.0058 | -0.1664 ± 0.0044 | -0.1664 ± 0.0040 |
| 'Cprig' | 25.00 | 25.00 | 25.00 | 25.00 |
| 'Buv' | 0.7135 ± 0.0099 | 0.7135 ± 0.0065 | 0.7135 ± 0.0054 | 0.7135 ± 0.0046 |
| 'Cuv' | 4.841 ± 0.021 | 4.841 ± 0.017 | 4.841 ± 0.012 | 4.841 ± 0.011 |
| 'Euv' | 13.41 ± 0.45 | 13.41 ± 0.35 | 13.41 ± 0.25 | 13.41 ± 0.22 |
| 'Bdv' | 0.806 ± 0.021 | 0.806 ± 0.011 | 0.8058 ± 0.0097 | 0.8058 ± 0.0084 |
| 'Cdv' | 4.080 ± 0.086 | 4.080 ± 0.032 | 4.080 ± 0.030 | 4.080 ± 0.027 |
| 'Cubar' | 8.06 ± 0.43 | 8.06 ± 0.33 | 8.06 ± 0.25 | 8.06 ± 0.21 |
| 'DUbar' | 11.9 ± 1.4 | 11.9 ± 1.2 | 11.90 ± 0.92 | 11.90 ± 0.76 |
| 'ADbar' | 0.1756 ± 0.0042 | 0.1756 ± 0.0031 | 0.1756 ± 0.0019 | 0.1756 ± 0.0017 |
| 'BDbar' | -0.1724 ± 0.0025 | -0.1724 ± 0.0014 | -0.1724 ± 0.0010 | -0.17236 ± 0.00094 |
| 'CDbar' | 4.89 ± 0.23 | 4.89 ± 0.20 | 4.89 ± 0.16 | 4.89 ± 0.13 |
| 'alphas' | 0.1180 | 0.1180 | 0.1180 | 0.1180 |
| 'rs' | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

One can see the level of improvement on the parameters at the asymptotic limit

How about vs today's data

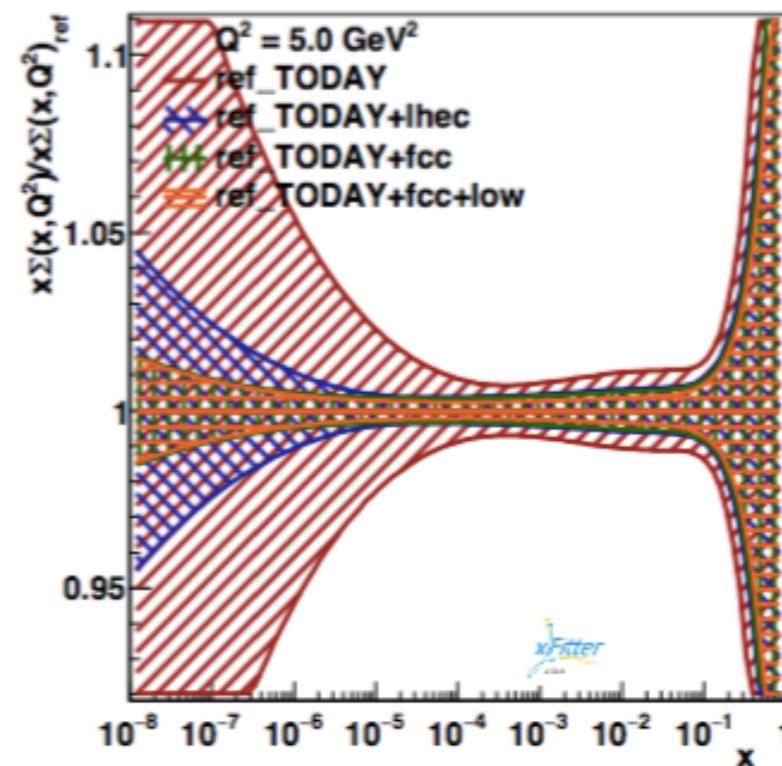
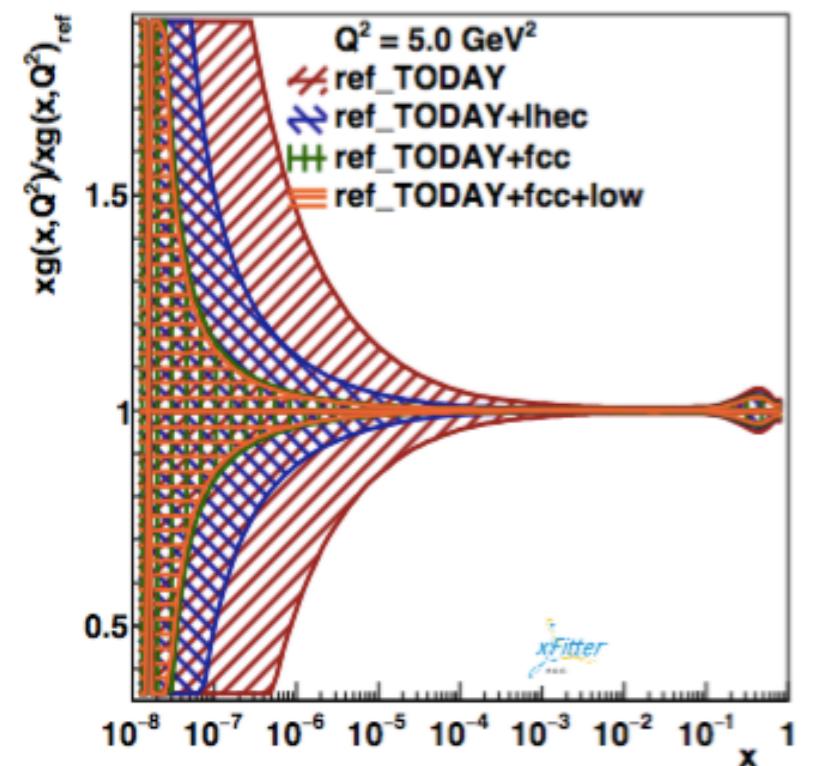
- Using 50 data sets from: fixed target to colliders using ep, pp, ppbar, and from DIS to jets, DY

| |
|---|
| LHEC NC ele neg pol cross section |
| LHEC NC ele pos pol cross section |
| LHEC CC pos unpol cross section |
| LHEC NC pos unpol cross section |
| LHEC CC ele neg pol cross section |
| LHEC CC ele pos pol cross section |
| FCC NC low energy ele 0 Pol cross section |
| FCC CC low energy ele 0 Pol cross section |
| FCC NC 50TeV - 60GeV ele -0.8 Pol cross section |
| FCC CC 50 TeV 60 GeV pos -0.8 Pol cross section |
| FCC CC 50TeV 60 GeV ele -0.8 Pol cross section |
| FCC CC 50 TeV 60 GeV pos 0.8 Pol cross section |
| FCC NC 50TeV - 60GeV pos 0.8 Pol cross section |
| ATLAS Jet data 0 $ y < 0.3$ R=0.6 |
| ATLAS Jet data 0.3 $ y < 0.8$ R=0.6 |
| ATLAS Jet data 0.8 $ y < 1.2$ R=0.6 |
| ATLAS Jet data 1.2 $ y < 2.1$ R=0.6 |
| ATLAS Jet data 2.1 $ y < 2.8$ R=0.6 |
| ATLAS Jet data 2.8 $ y < 3.6$ R=0.6 |
| ATLAS Jet data 3.6 $ y < 4.4$ R=0.6 |
| ZEUS inclusive jet 98-00 data |
| ZEUS inclusive dijet 98-00/04-07 data |
| H1 inclusive jet 99-00 data |
| H1 low Q2 inclusive jet 99-00 data |
| ZEUS inclusive jet 96-97 data |
| CDF inclusive jets |
| CDF Z rapidity 2010 |
| D0 pp jets |
| D0 Z rapidity 2007 |
| D0 W asymmetry 2013 |
| D0 W-μnu lepton asymmetry pt > 35 GeV |
| CDF W asymmetry 2009 |
| BCDMS F2p 100GeV |
| ATLAS high mass DY mass 2011 |
| BCDMS F2p 200GeV |
| BCDMS F2p 280GeV |
| HERA1+2 CCep |
| HERA1+2 CCem |
| HERA1+2 NCem |
| HERA1+2 NCep 820 |
| HERA1+2 NCep 920 |
| HERA1+2 NCep 460 |
| HERA1+2 NCep 575 |
| ATLAS low mass DY 2011 |
| ATLAS DY mass 2010 extended data |
| CMS inclusive jets 2011 |
| CMS Norm. differential ttbar vs pt 7 TeV |
| ATLAS Norm. differential ttbar vs pT 7 TeV |
| CMS total ttbar 7TeV mt=173.3 GeV |
| ATLAS total ttbar 7TeV mt=173.3 GeV |
| CMS electron Asymmetry rapidity |
| CMS Boson rapidity |
| CMS W muon asymmetry |
| H1 normalised inclusive jets with unfolding |
| H1 normalised dijets with unfolding |
| H1 normalised trijets with unfolding |
| ATLAS low mass Z rapidity 2011 |
| ATLAS peak CC Z rapidity 2011 |
| ATLAS peak CF Z rapidity 2011 |
| ATLAS high mass CC Z rapidity 2011 |
| ATLAS high mass CF Z rapidity 2011 |
| ATLAS W- lepton rapidity 2011 |
| ATLAS W+ lepton rapidity 2011 |



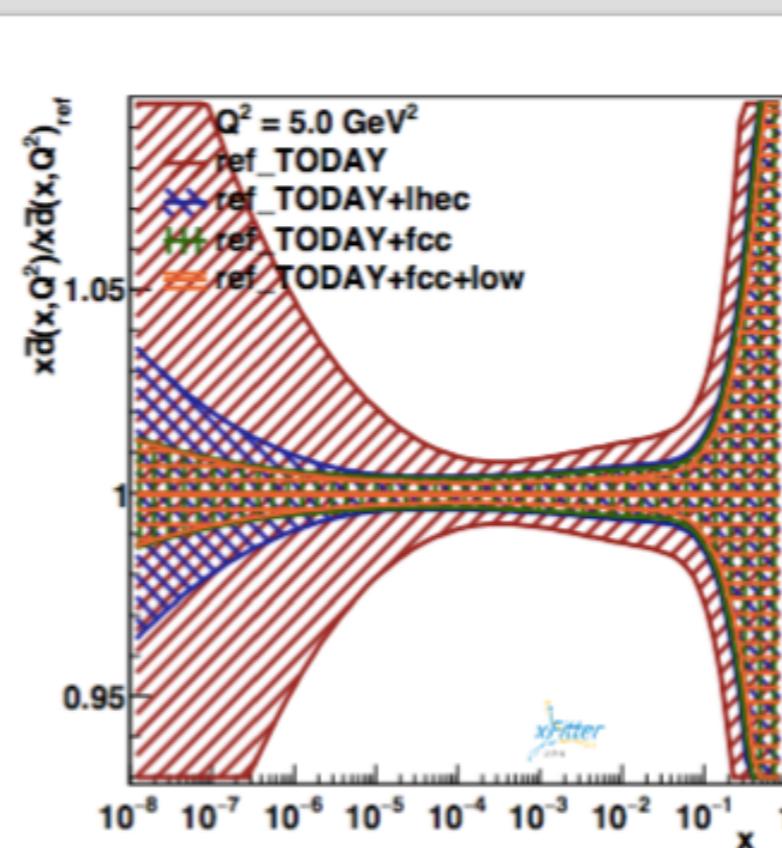
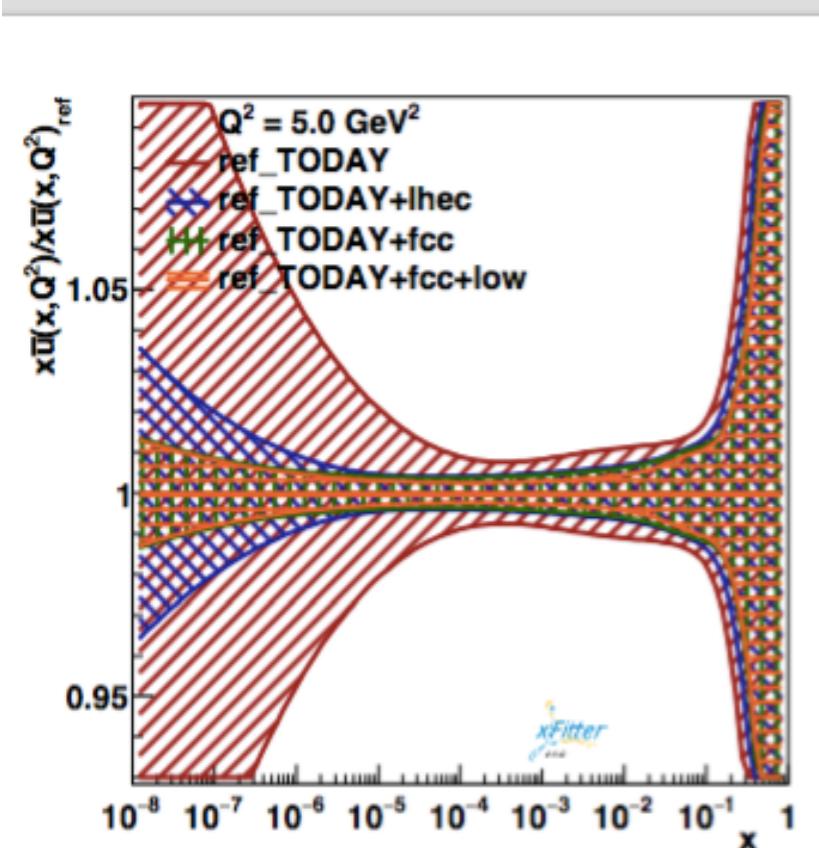
How about vs today's data

- Using 50 data sets from: fixed target to colliders using ep, pp, ppbar, and from DIS to jets, DY



Do we need <10 % precision for PDFs?
and the answer is given by LHC that yes:
PDFs are dominant limiting factor
for SM stress test measurements

LHeC could be the solution

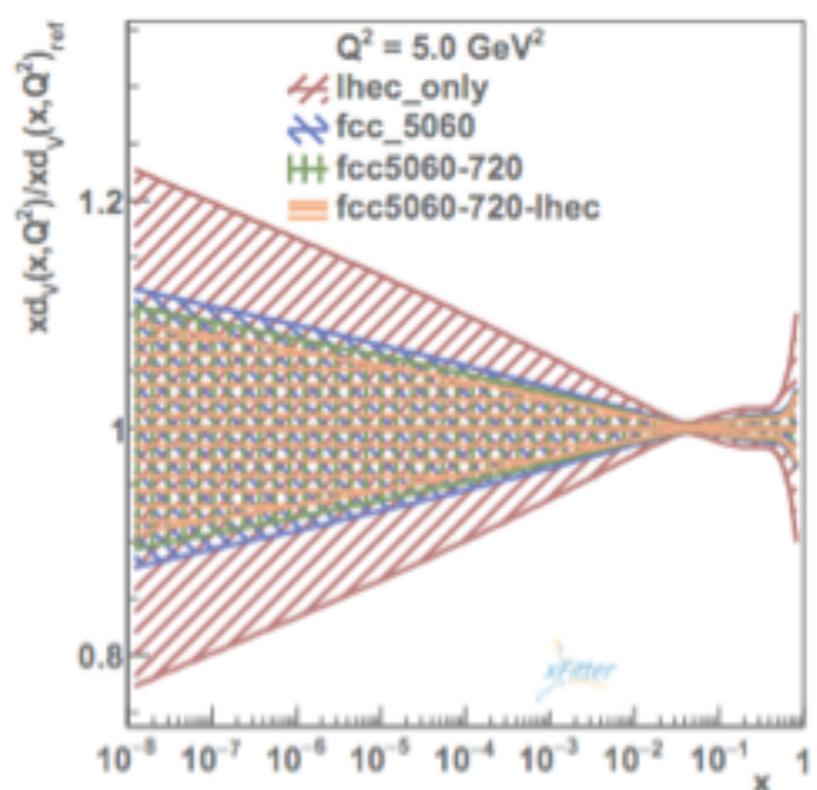
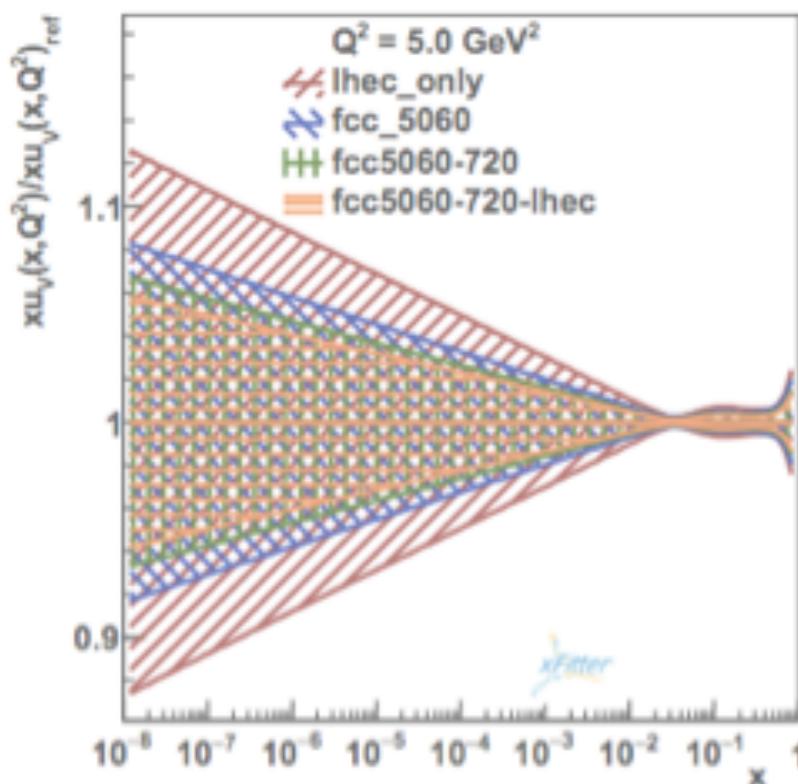
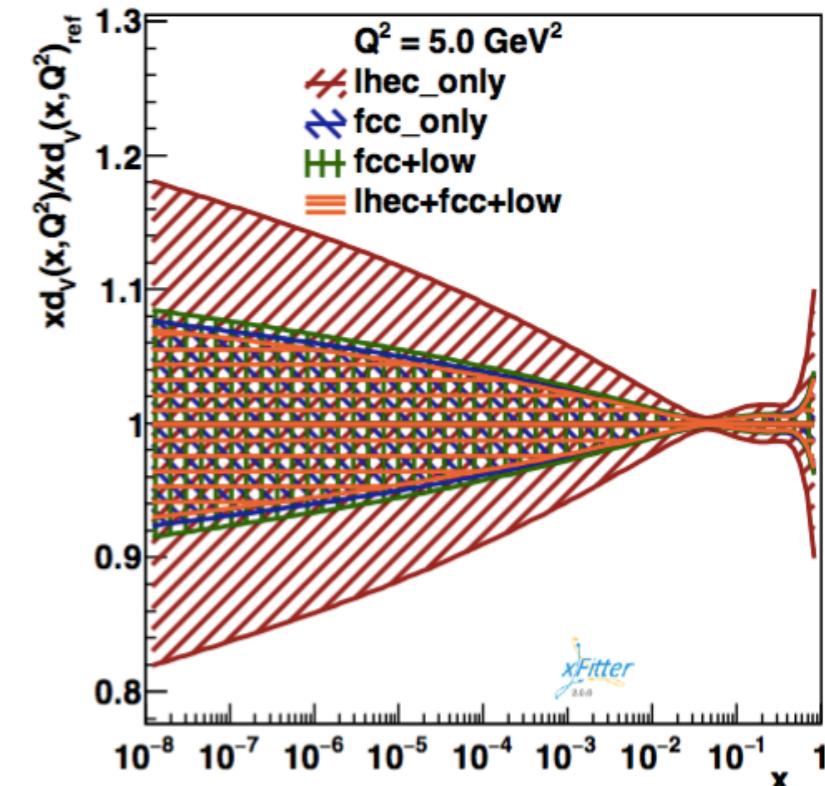
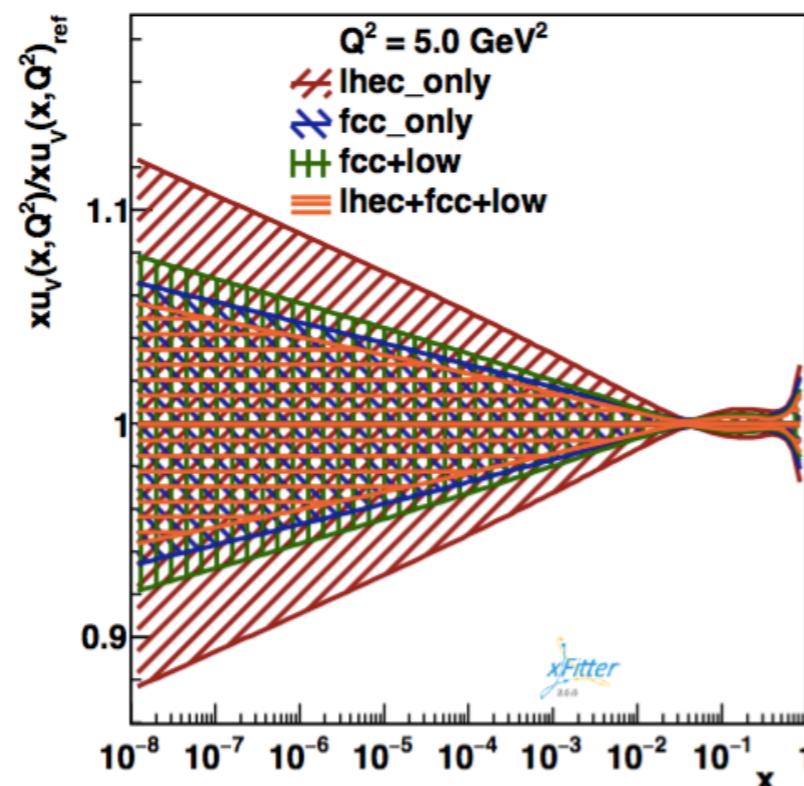


→ important for DY process @ LHC

PDFs using flexible parametrisation

- using hybrid CTEQHERA parametrisation

$$\begin{aligned}
 xg(x) &= A_g x^{B_g} (1-x)^{C_g} (1+D_g x); \\
 xu_v(x) &= A_{u_v} x^{B_{u_v}} (1-x)^{C_{u_v}} e^{F_{u_v} x}; \\
 xd_v(x) &= A_{d_v} x^{B_{d_v}} (1-x)^{C_{d_v}} e^{F_{d_v} x}; \\
 x\bar{u}(x) &= A_{\bar{u}} x^{B_{\bar{u}}} (1-x)^{C_{\bar{u}}} (1+D_{\bar{u}} x); \\
 x\bar{d}(x) &= A_{\bar{d}} x^{B_{\bar{d}}} (1-x)^{C_{\bar{d}}} (1+D_{\bar{d}} x).
 \end{aligned}$$



similar features and level of uncertainties as before

new LHAPDF set

- PDF4LHC

today's data+LHeC

