PDF fitting with decorrelated LHeC data in xFitter

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Gavin Pownall [1] Francesco Giuli [3] Claire Gwenlan [1]
Max Klein [2]

[1]University of Oxford

[2]University of Liverpool

[3]INFN and University of Tor Vergata

Context

For NNPDF pseudodata fits, systematic errors are uncorrelated[1] and used as follows:

$$\delta^{\text{exp}}_{\text{tot},i} \equiv ((\delta^{\text{exp}}_{\text{stat},i})^2 + (f_{\text{corr}} \times f_{\text{red}} \times \delta^{\text{exp}}_{\text{syst},i})^2)^{1/2} \quad (1)$$

f_{red} is a reduction factor accounting for better knowledge in future - relevant for HL-LHC, not LHeC
f_{corr} is a scale factor accounting for the fact that these systematics are correlated.
In previous NNPDF-style studies, $f_{\text{red}} = f_{\text{corr}} = 1$

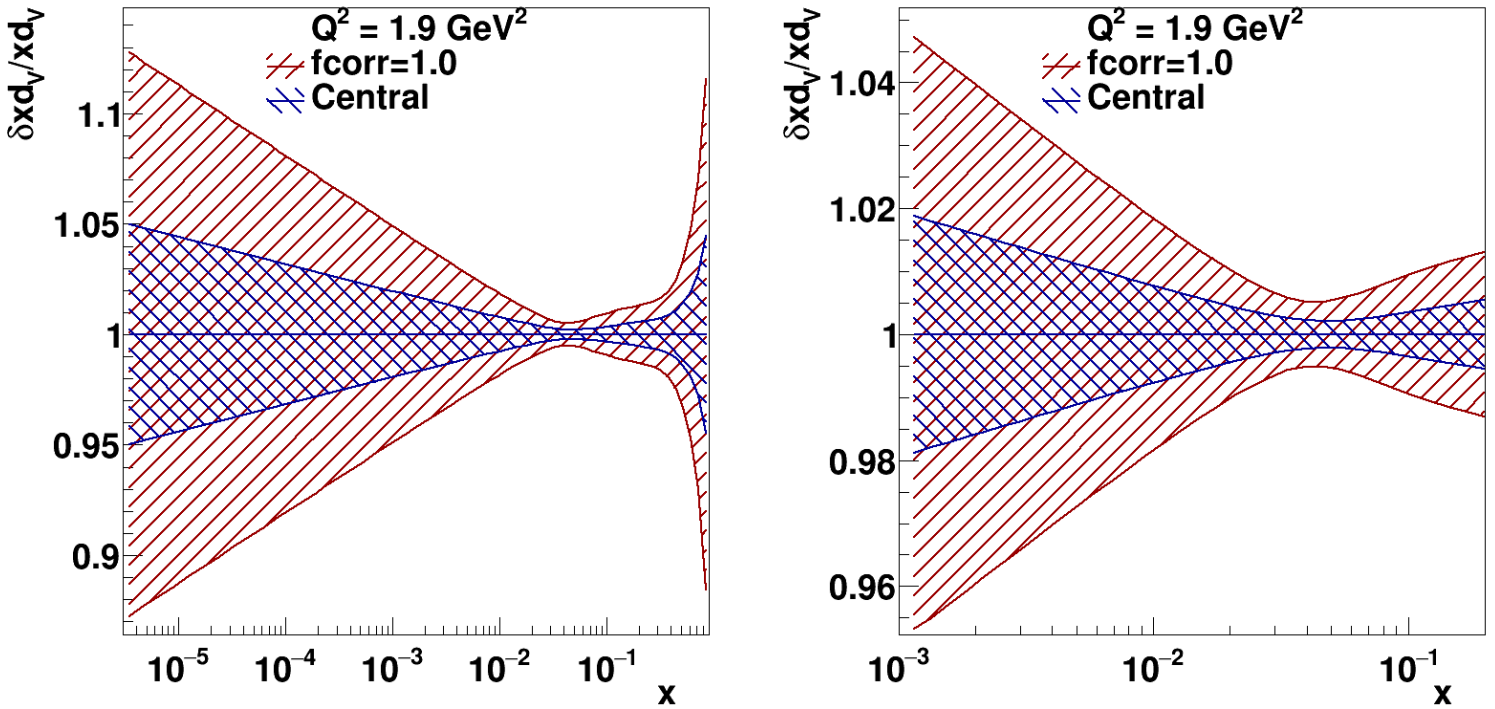
[1] Except for luminosity, which is correlated across all bins and all datasets.

Comparisons at different values of f_{corr}

All of these comparisons are done using 5+1 PDFs.
Only a baseline is used (A,B and C parameters in all PDFs only)[2].
Study done to NLO in QCD. Similar studies done by Francesco at NNLO, with similar results.
In the "central" fit, NC cross-sections are correlated to NC and CC correlated to CC. Systematics are combined in to one, or a select few - the precise effect of this on the results is unknown.
Luminosity correlated across all datasets.

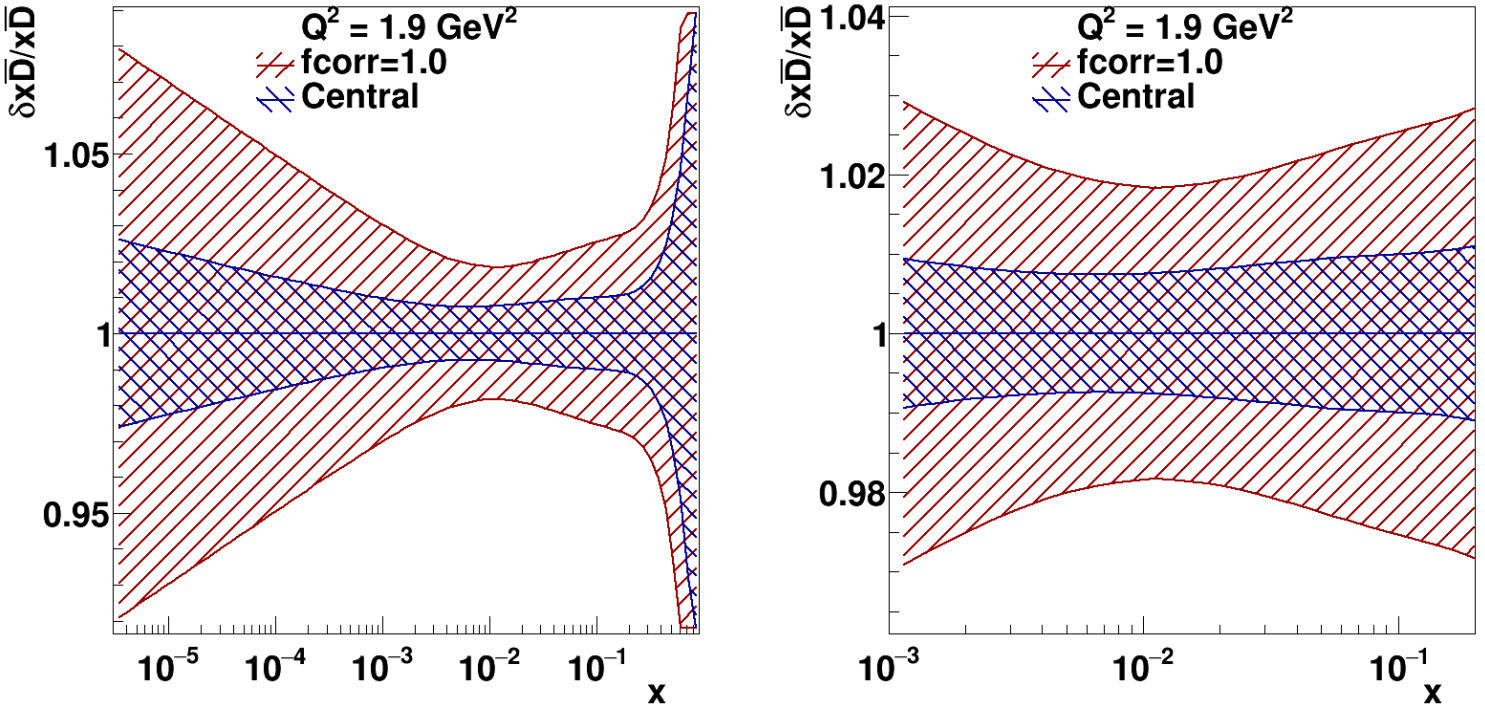
[2] Usual constraints on A_{u_v}, A_{d_v} and A_g from number and momentum sum rules.

$f_{\text{corr}} = 1$



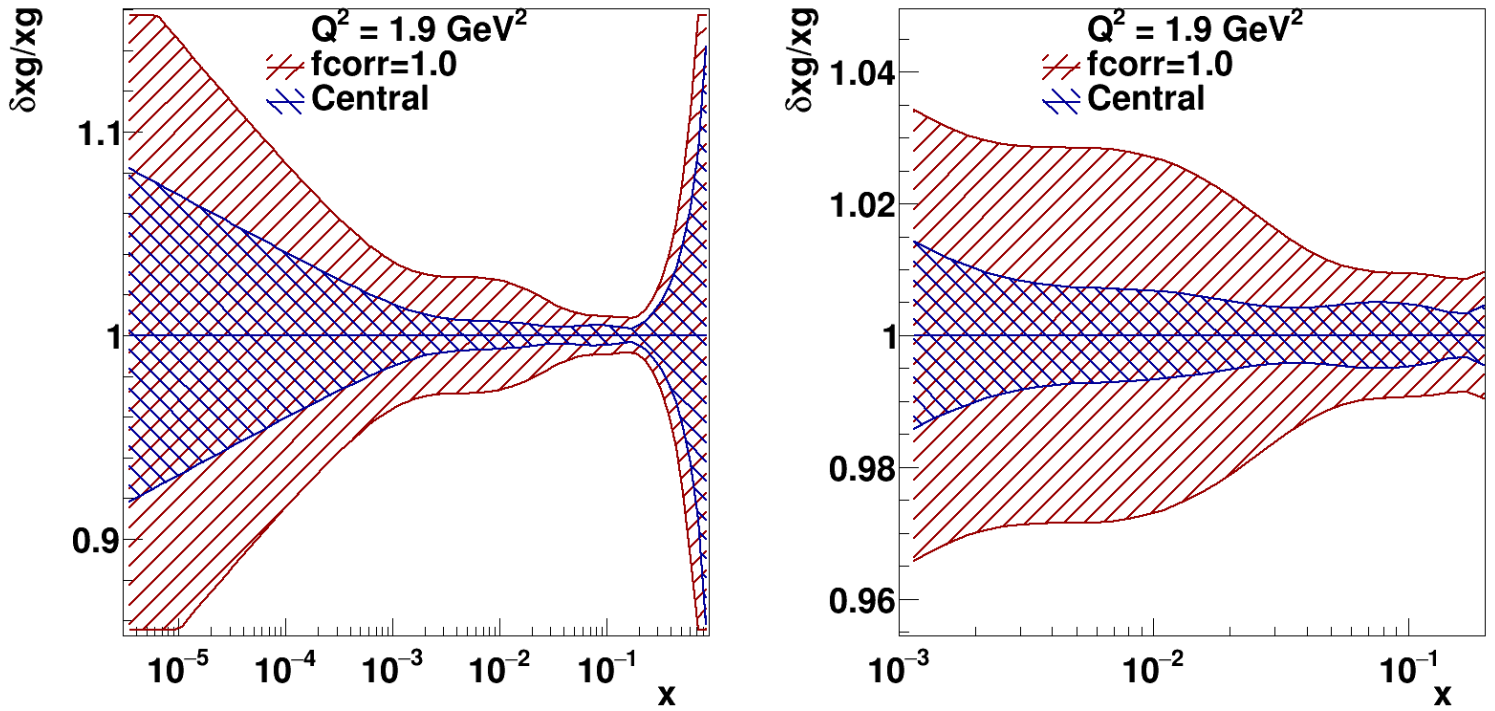
Left: d_v ratio at full x range. **Right:** d_v ratio at mid x range. Similar results for u_v.

$f_{\text{corr}} = 1$



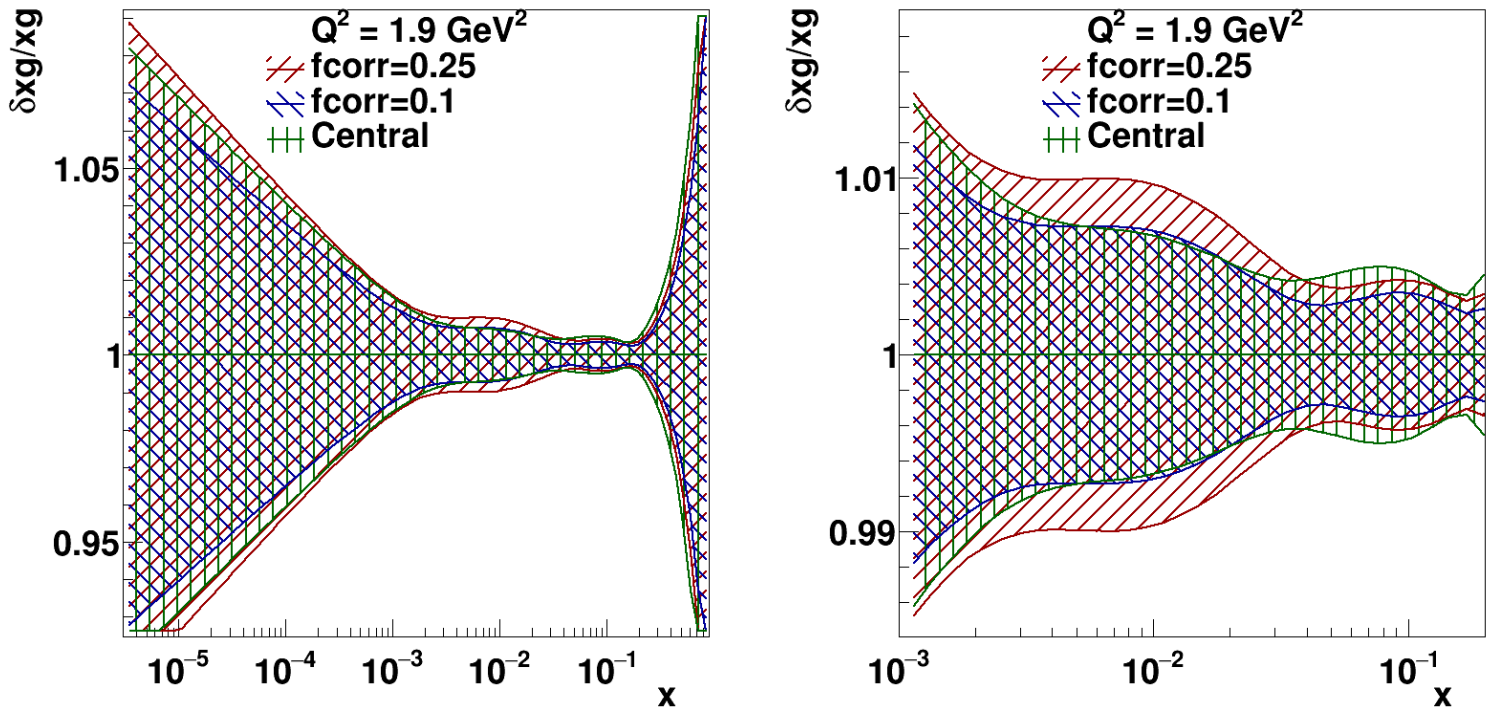
Left: $\bar{D}$ ratio at full x range. **Right:** $\bar{D}$ ratio at mid x range. Similar results for D, U, $\bar{U}$ and individual quarks.

$f_{\text{corr}} = 1$



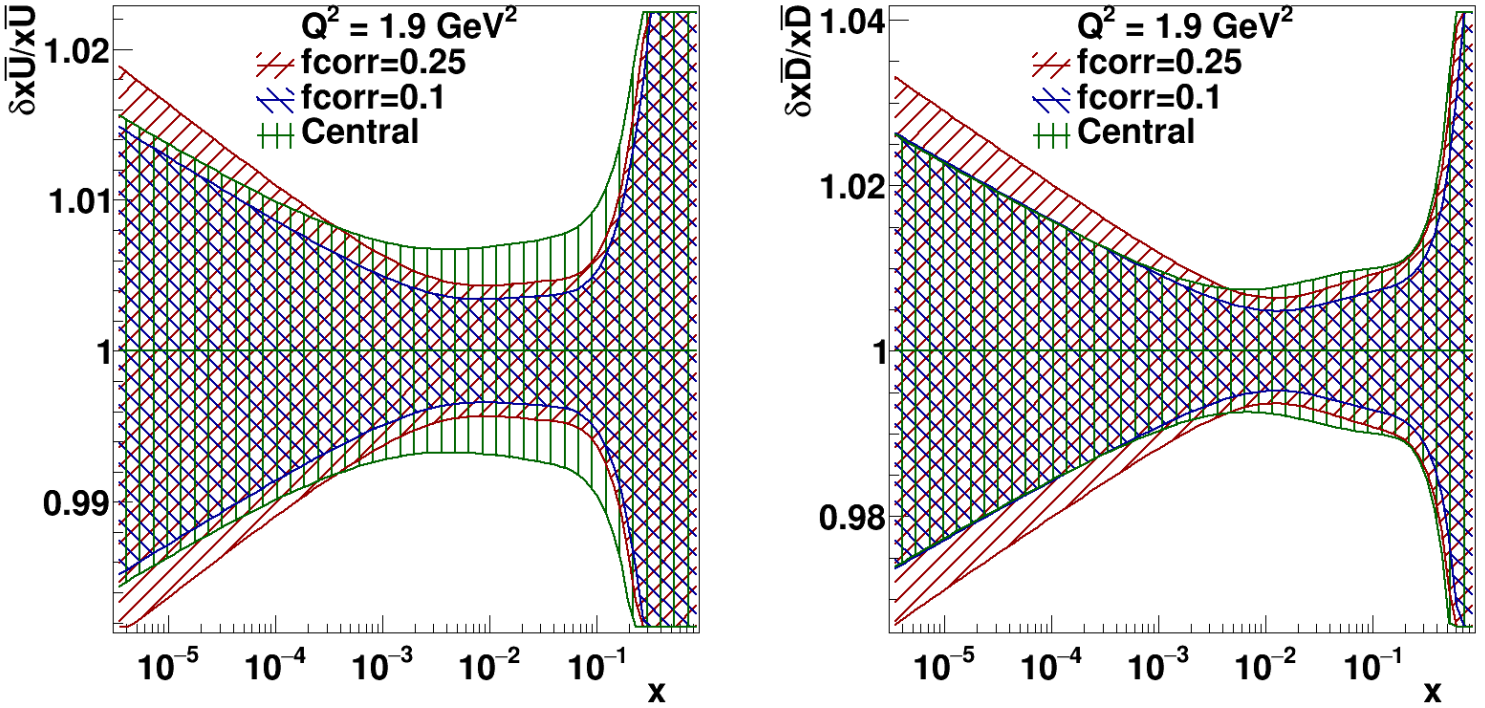
Left: *g* ratio at full x range. **Right:** *g* ratio at mid x range.

More reasonable values of f_{corr}?



Looking at gluon, the correlated results can be reproduced with $f_{corr} \sim 0.25$ - closer to 0.1 in mid region.
Similar results for valence quarks.

More reasonable values of f_{corr}?



Looking at $\bar{U}$ and $\bar{D}$, the closest f_{corr} fit really depends where you look in x. 0.1 at low x, but at mid-high x, 0.25 is clearly optimistic.

Conclusions

Tested the effect of decorrelating and scaling systematics with xFitter:

- $f_{\text{corr}} = 1$ is wildly conservative.
- In some places, a value of 0.1 is reasonable. In others, a value of 0.25 is quite optimistic.

Things we still do not know:

- Does this carry over to NLLx? What about more flexible parameterisations? NNPDF methodology? T=3?

Considering other studies (Fra's studies in flexibility, studies with different tolerance values...), discrepancy might be understood after all.