Powheg PDF reqweighting checks

Jan Kretzschmar

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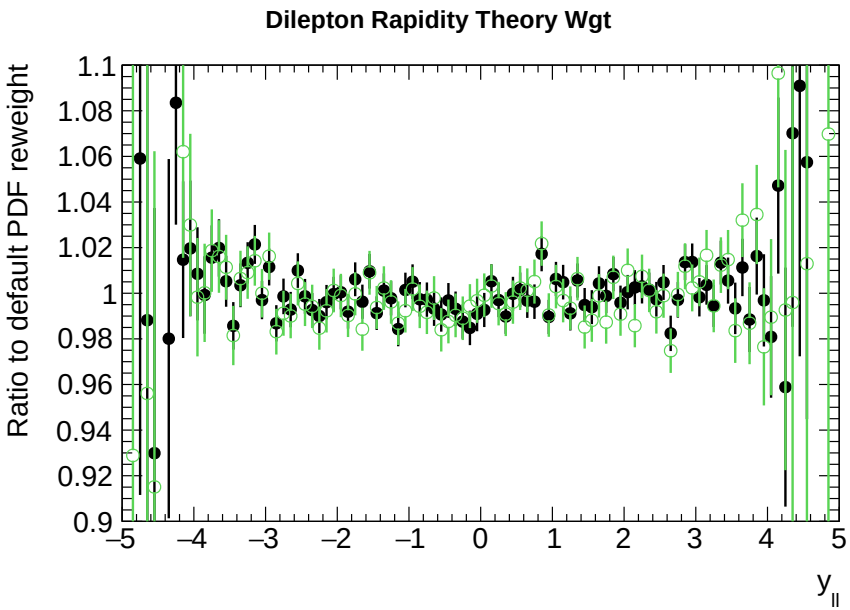
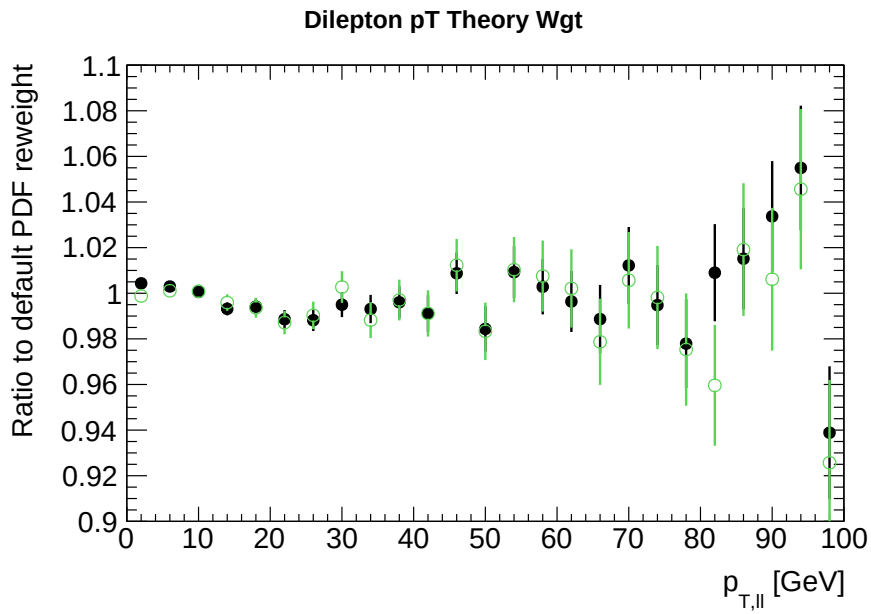
Introduction

- As we learned about last week, the PDF reweighting we use in Powheg is not really complete:
  - We reweight the matrix element calculation part
  - We do NOT reweight the Sudakov part
- The so-called "full reweighting" is implemented in Powheg since a while, but not widely used: slow, sometimes large weights etc.
- Run a quick check if this matters!
- Timing to generate and compute about 400 PDF weights for 10k events, just to get a feeling:
  - Initial event generation: $\sim$ 10s
  - Standard PDF weight computation: $\sim$ 10min
  - "Full" PDF weight computation, "exact": $\sim$ 10hours (!)
  - "Full" PDF weight computation, "Sjostrand approx": $\sim$ 5hours
- So full reweighting is prohibitively slow, basically slower than generating events from scratch ... anyway, I started jobs of 2M events at each of $\{1.96$ TeV $p\bar{p}$, 7 TeV $pp\}$ $\times$ $\{W^+, W^-, Z\}$
- Showing some "quick" plots from the 7 TeV pp W^+ run in full phase space – note was done a bit manual, maybe a few plots not quite right

CTEQ6.6

- Denominator: sample reweighted to CTEQ6.6 via "standard" PDF reweighting
- Numerator 1: sample reweighted to CTEQ6.6 via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to CTEQ6.6 via "full, approx" PDF reweighting

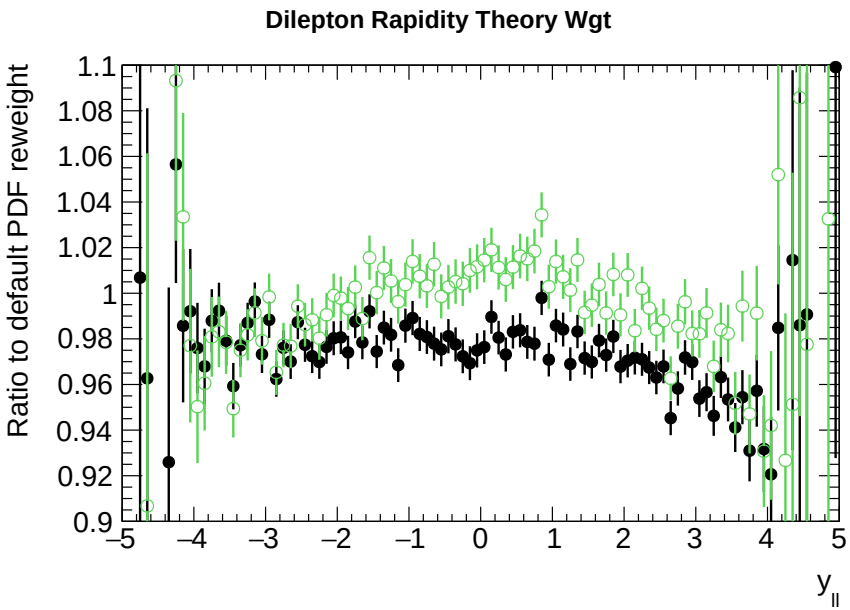


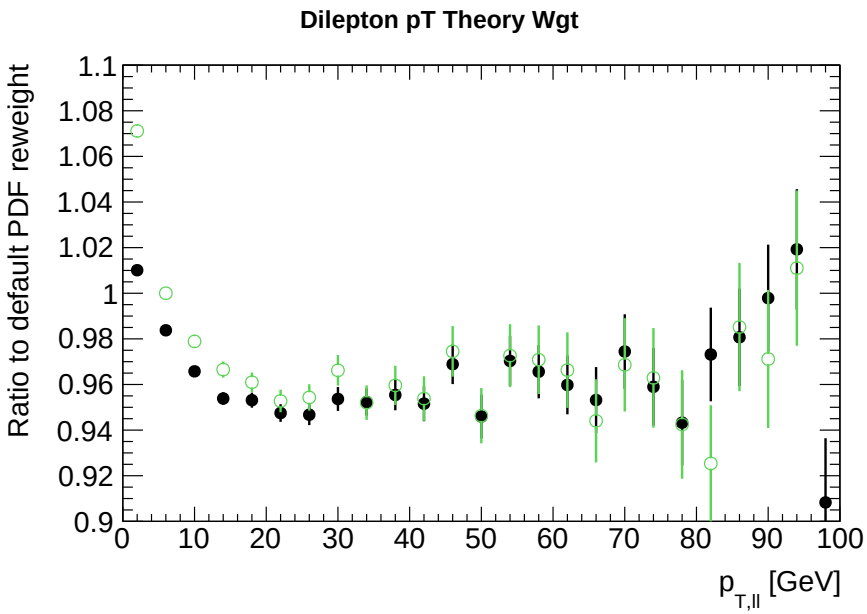


- Small effect here, both "full" options very close

CT10nnlo

- Denominator: sample reweighted to CT10nnlo via "standard" PDF reweighting
- Numerator 1: sample reweighted to CT10nnlo via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to CT10nnlo via "full, approx" PDF reweighting

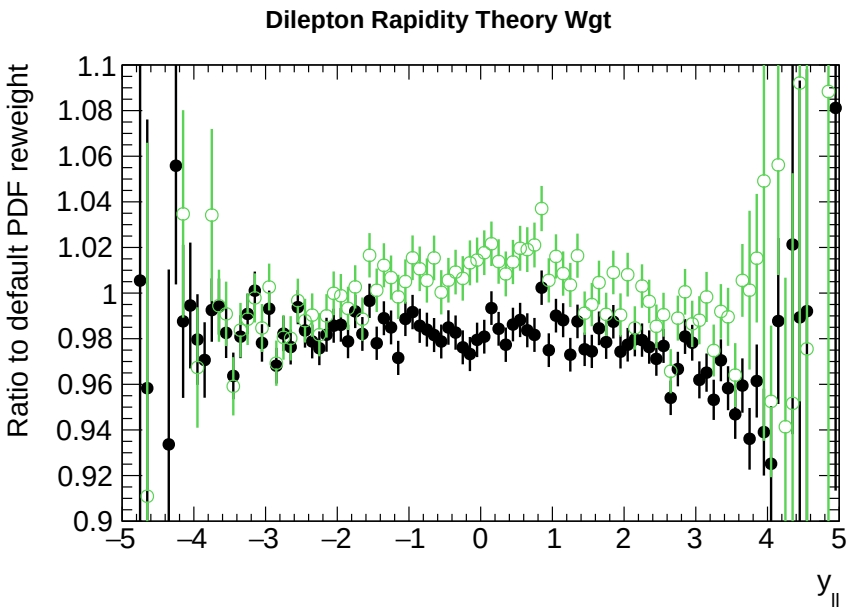


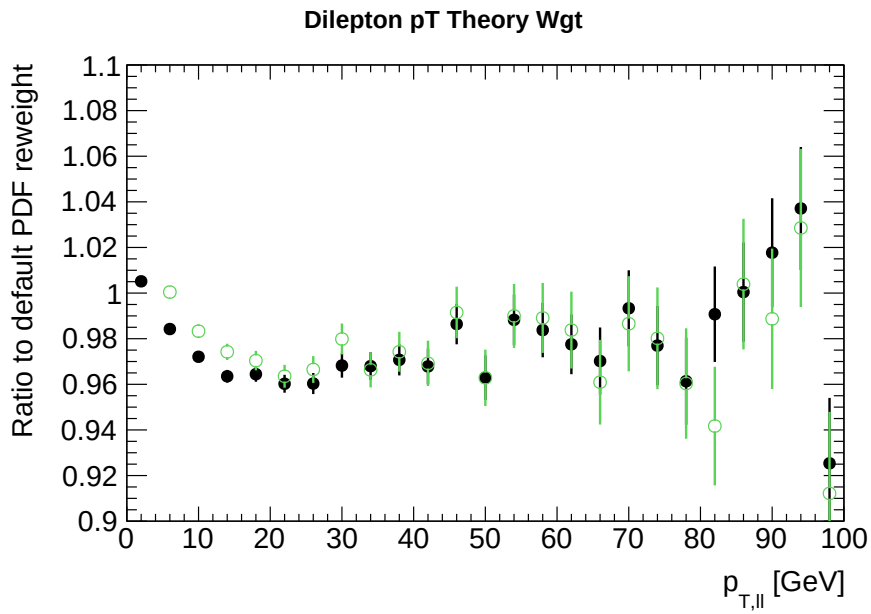


- Large effects here, some asymmetry in y?

CT14nnlo

- Denominator: sample reweighted to CT14nnlo via "standard" PDF reweighting
- Numerator 1: sample reweighted to CT14nnlo via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to CT14nnlo via "full, approx" PDF reweighting

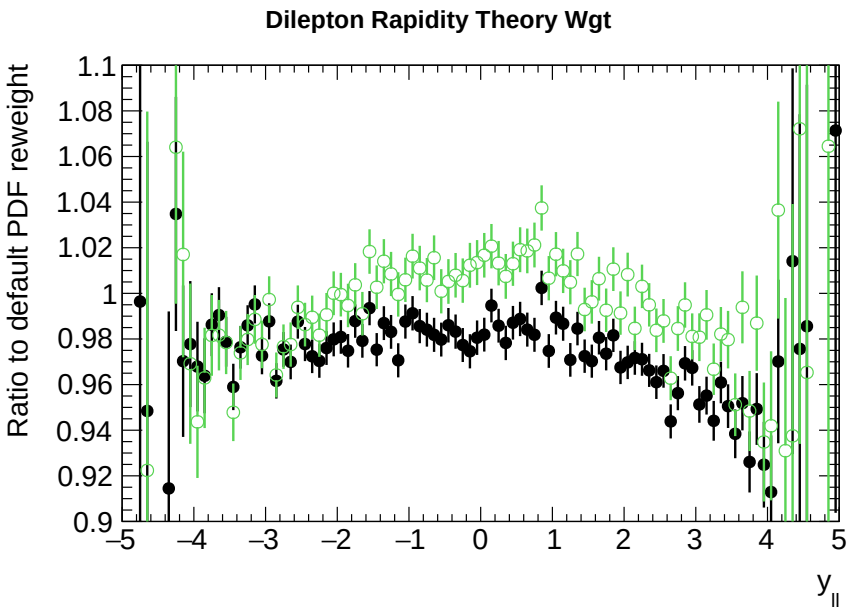


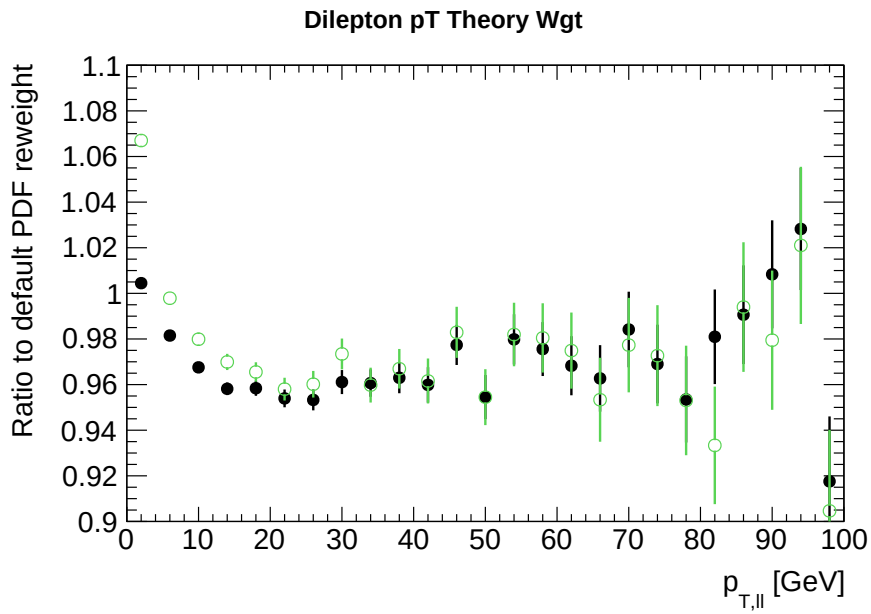


- Large effects here, note one point off-scale (probably need to cut out some events with crazy weight)

MMHT14nnlo

- Denominator: sample reweighted to MMHT14nnlo via "standard" PDF reweighting
- Numerator 1: sample reweighted to MMHT14nnlo via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to MMHT14nnlo via "full, approx" PDF reweighting

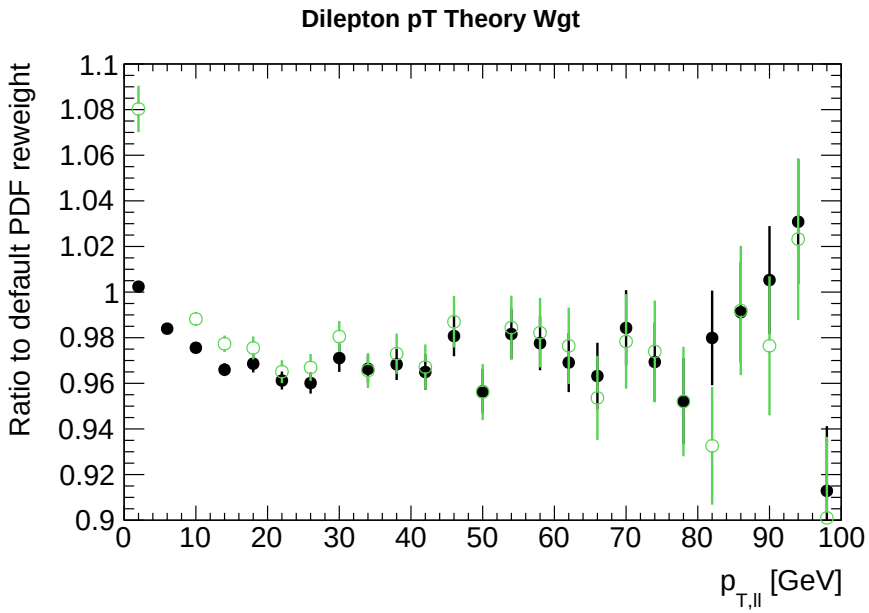




- Large effect here

NNPDF3.1NNLO

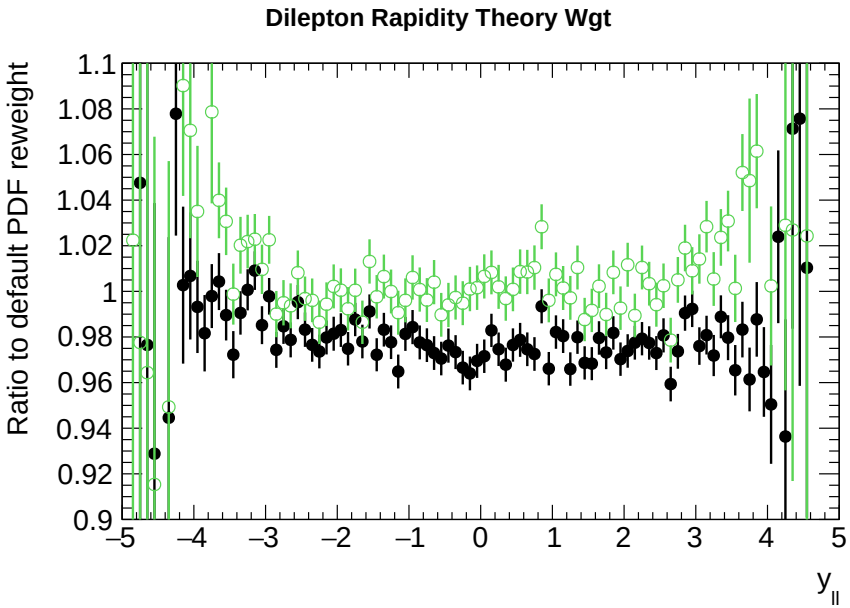
- Denominator: sample reweighted to NNPDF3.1nnlo via "standard" PDF reweighting
- Numerator 1: sample reweighted to NNPDF3.1nnlo via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to NNPDF3.1nnlo via "full, approx" PDF reweighting

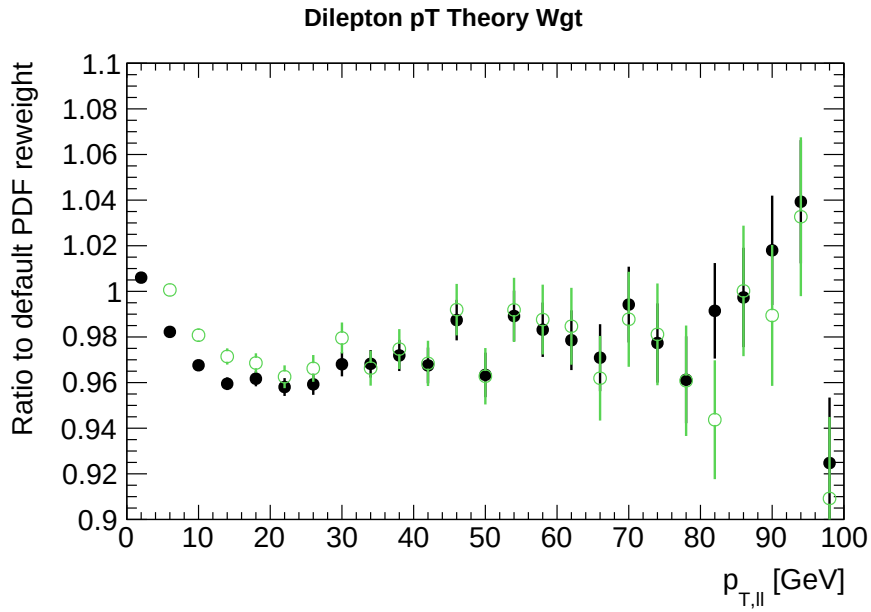


- Large effects here, note one point off-scale (probably need to cut out some events with crazy weight)
- Missed to save one plot...

ABMP16

- Denominator: sample reweighted to ABMP16nnlo via "standard" PDF reweighting
- Numerator 1: sample reweighted to ABMP16nnlo via "full, exact" PDF reweighting
- Numerator 2: sample reweighted to ABMP16nnlo via "full, approx" PDF reweighting





- Medium-sized effects here, note one point off-scale

Conclusion

- "Full PDF reweighting" options checked: on first look differences seem large
- Whole procedure is very, very computing intensive; the "approximation" tested is far away from the "exact" option
- In a few days I can have 2M events at each of $\{1.96$ TeV $p\bar{p}$, 7 TeV $pp\} \times \{W^+, W^-, Z\}$ with "approximate" and "exact" reweighting options ready, so we can test the effects; hard/impossible to extend this to 10M per sample at this stage
- When running over these samples, one should probably "regularise" the weights, i.e. restrict the maximum allowed weight to sth. like < 10