$H \to WW^{(*)}$ Update: FEHiP (N)NLO Studies

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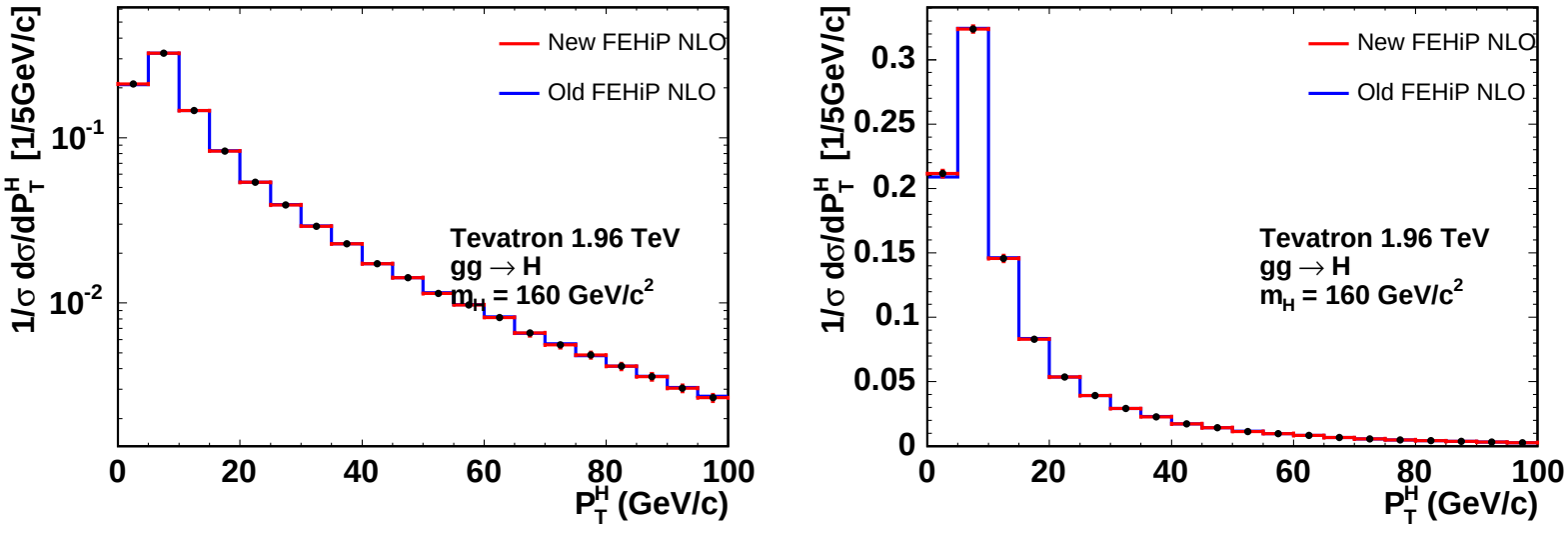
Review:

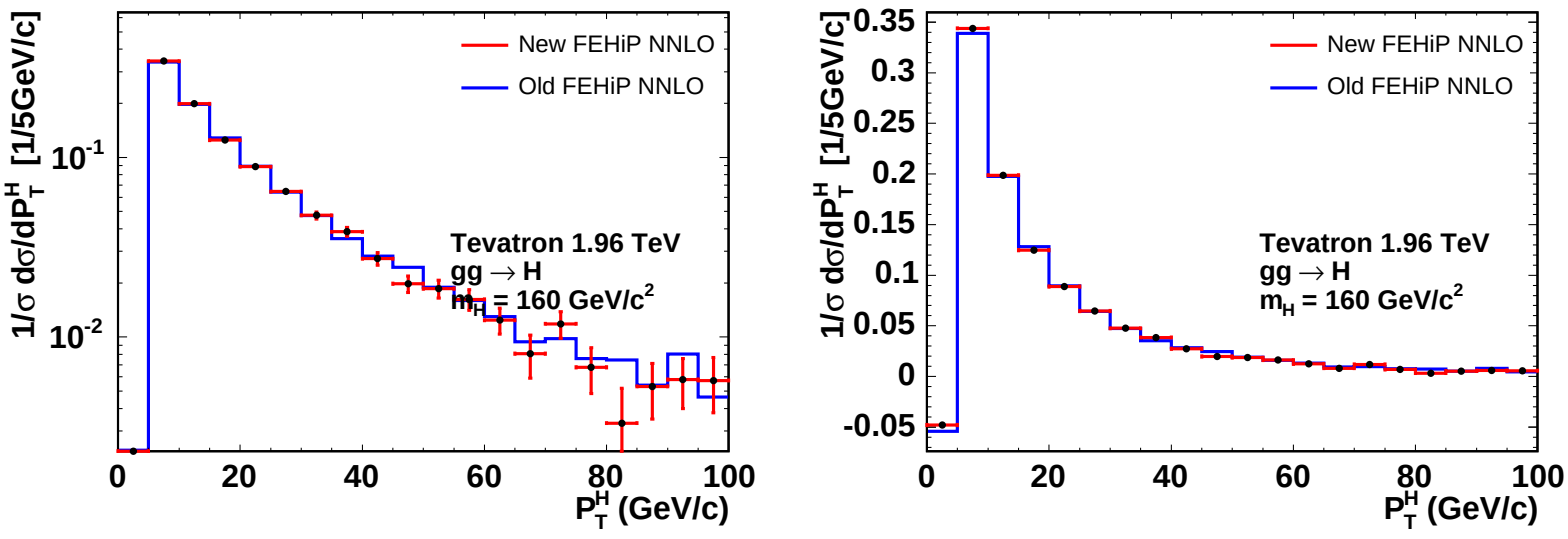
- Two weeks ago showed Elliot's FEHiP (N)NLO histograms
  - NNLO cross sections for Higgs $p_T < 45$ GeV were incorrect (were actually the NLO cross sections)
  - Reran those NNLO cross sections
  - Jobs for $p_T < 15$ GeV timed out, but were "close enough" to convergence to use the cross section
- Other small issues with old FEHiP calculations:
  - Tevatron energy set to 1980 GeV instead of 1960
  - New version of Cuba available, much faster!
- Recompiled FEHiP, recalculated (N)NLO cross sections

Compare new and old FEHiP NLO histograms



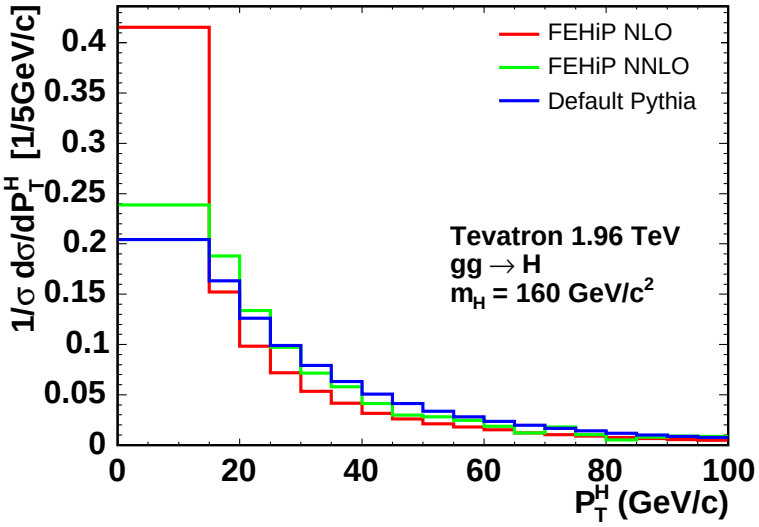
- Left: log scale, Right: non-log scale
- FEHiP errors shown for new cross sections
- NLO cross sections essentially unchanged
  - Reducing Tev energy reduces cross section slightly
  - New Cuba integration changes results slightly

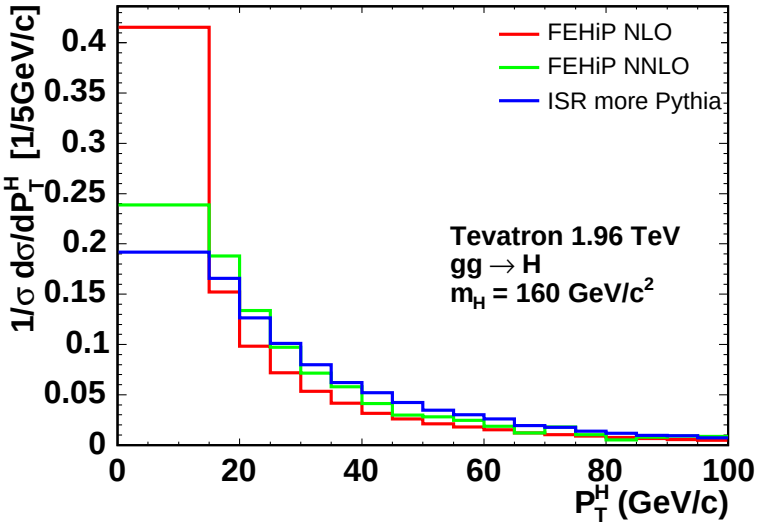
Compare new and old FEHiP NNLO histograms

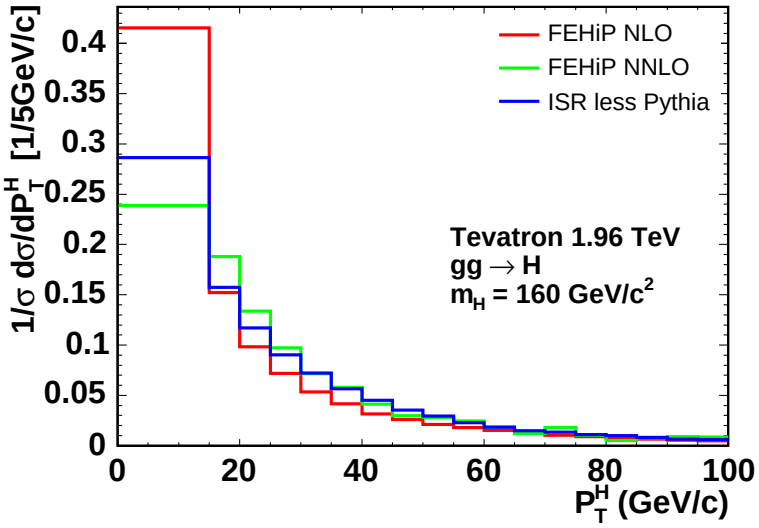


- Left: log scale, Right: non-log scale
- FEHiP errors shown for new cross sections
- More discrepancy for NNLO cross sections
  - NNLO cross sections jump around more at high p_T
  - New & old agree within uncertainties

Comparisons to Pythia when reweighting ISR

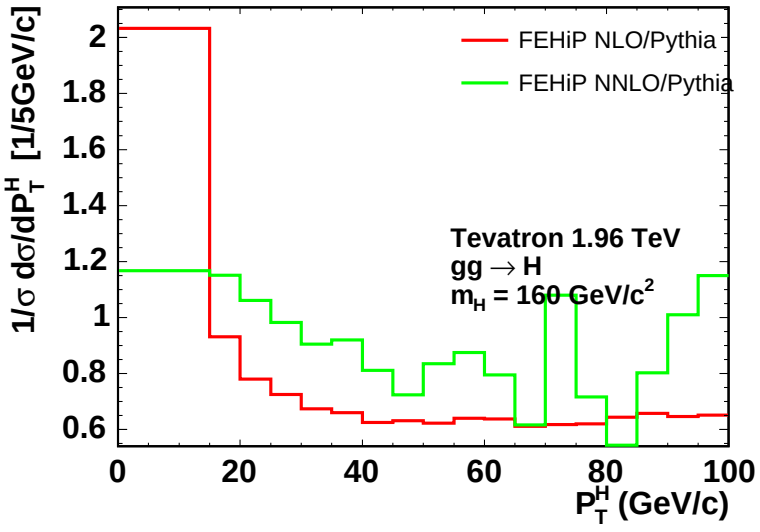


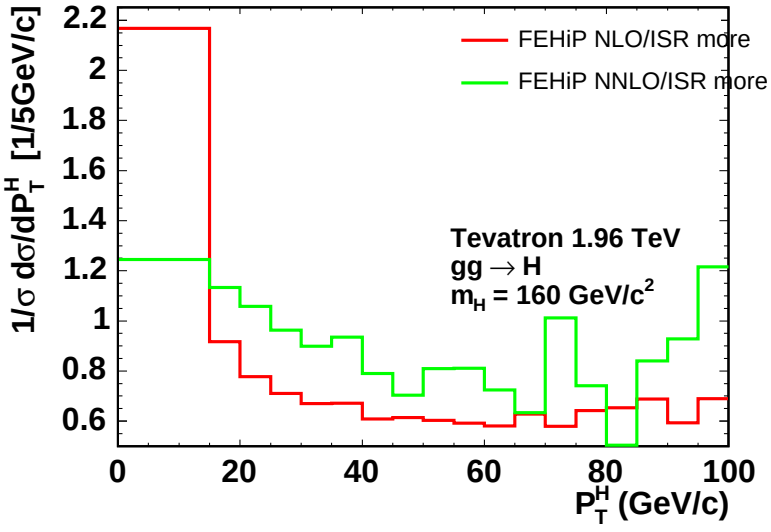


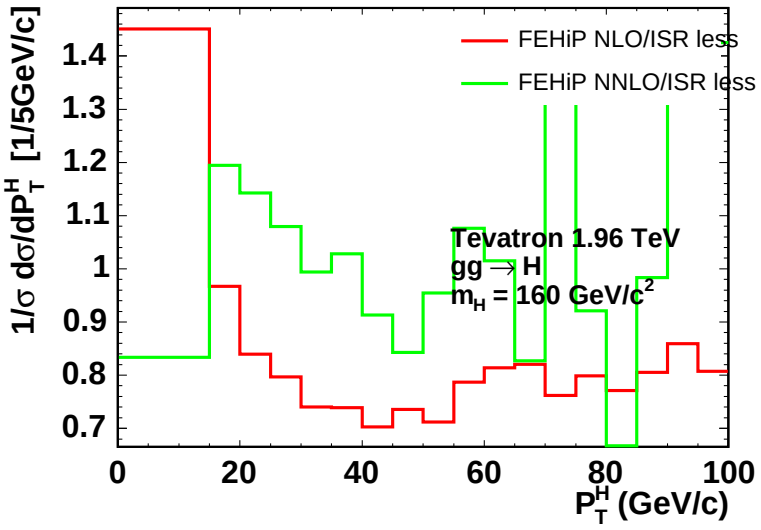


First bin (0-15) is divided by 3

Ratio of (N)NLO and Pythia histograms







Conclusions

- Now have correct FEHiP (N)NLO histograms
  - Comparisons made with first bin of 0-15 GeV
- Compared Pythia samples at generator level
  - More/less ISR samples bracket FEHiP NNLO prediction at low Higgs p_T $\rightarrow$ should be a good systematic
- Pythia angular distributions still an issue:
  - Try training a NN w/o angular distributions and see the impact on sensitivity, or
  - Run FEHiP for different bins of jet angle vs. Higgs direction, compare to Pythia

ISR comparisons (log scale)