PROGRESS REPORT ON BENCHMARK COMPARISONS

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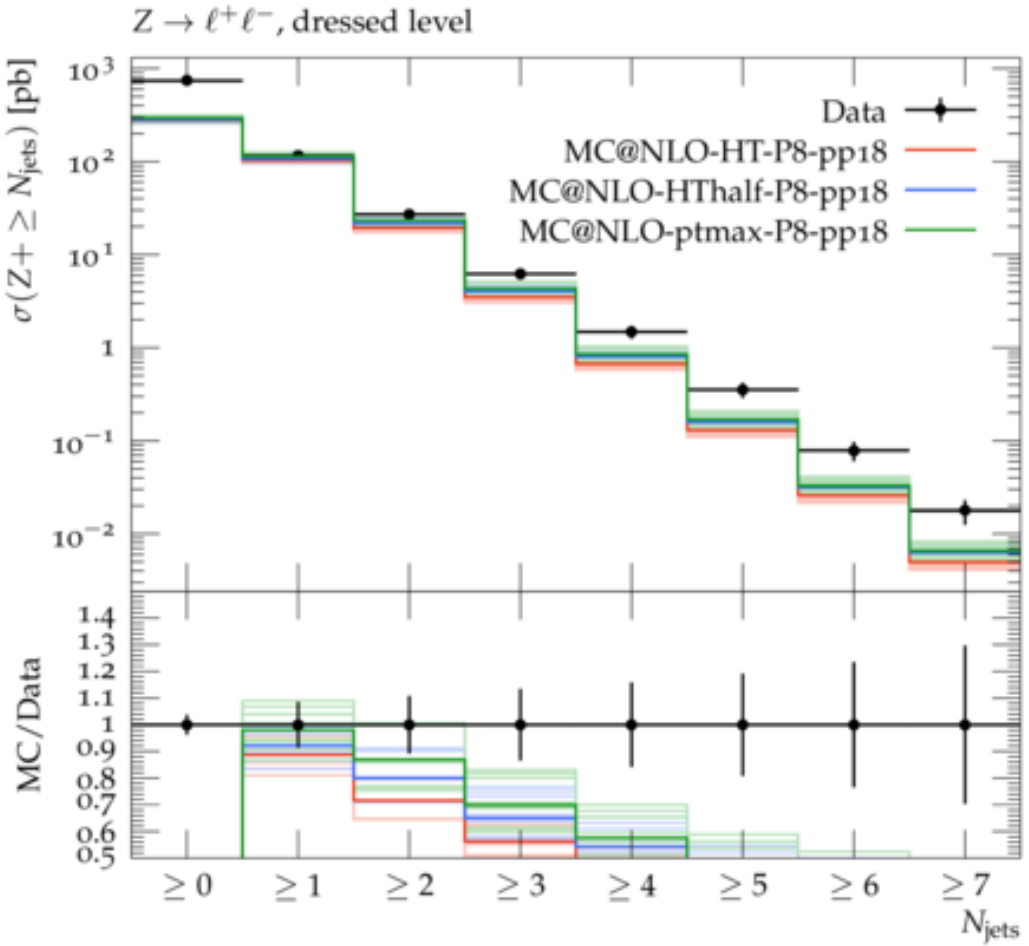
Introduction

- Performing V+Jets benchmark comparisons
  - I run parton shower with Pythia8 or Cascade and use Rivet to compare simulated results with available data
  - Matrix elements are generated with aMC@NLO centrally
    - PDF set for Pythia8: NNPDF30NNLO (lhaid=261000)
    - PDF set for Parton Branching (Cascade): TMDset2 (lhaid=1102200)
- Currently focusing on scale choice dependence
  - A deep investigation for the case of inclusive jets was made by Currie et al. (https://arxiv.org/abs/1807.03692)
  - Process under investigation: Z+Jets, $\sqrt{s} = 13\ \mathrm{TeV}$
  - 2 rivet plugins: ATLAS_2017_I151425, CMS_2018_I1667854 (ATLAS_2020_I1788444 to be included soon)
  - 3 different scale choices: H_T, $\frac{H_T}{2}$, p_T^{max}

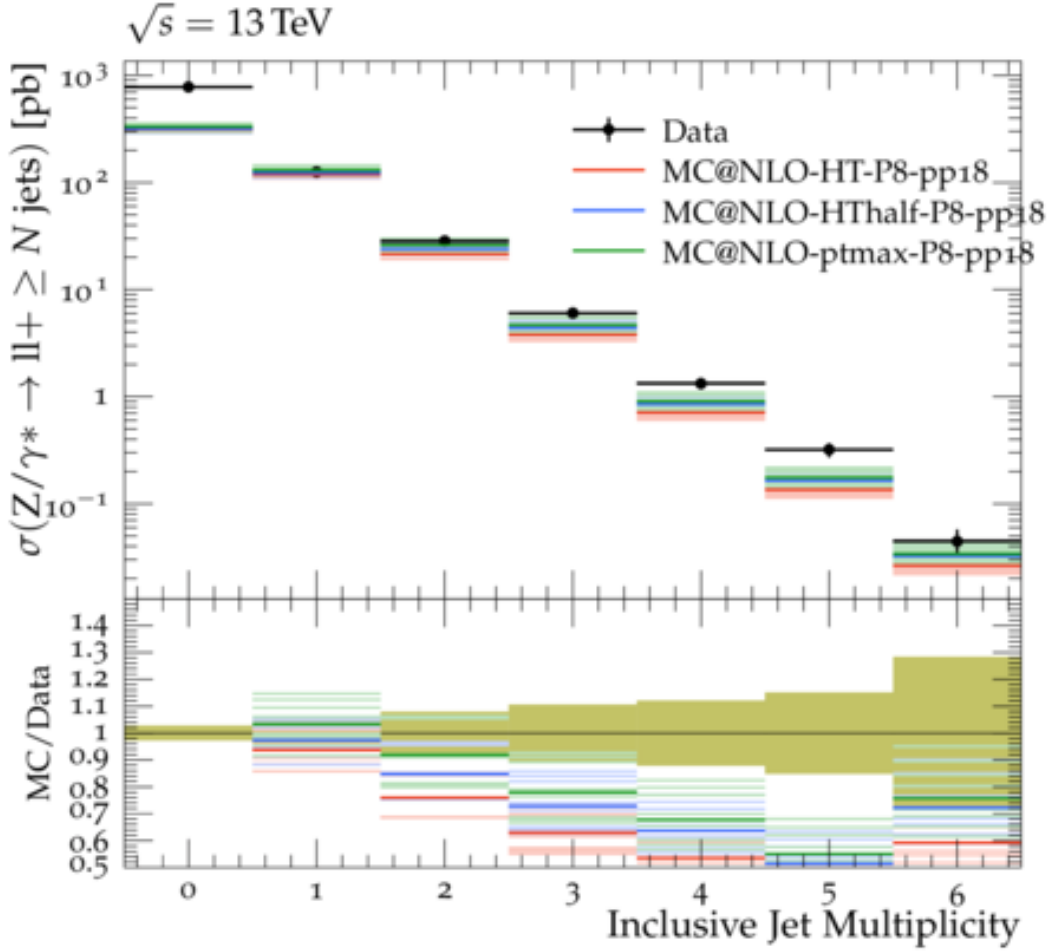
Number of jets (Pythia8)

- There is a slight difference between different scale choices
- $\mu = p_T^{max}$ gives the best agreement and $\mu = H_T$ the worst (same for both analyses)

ATLAS_2017_I151425



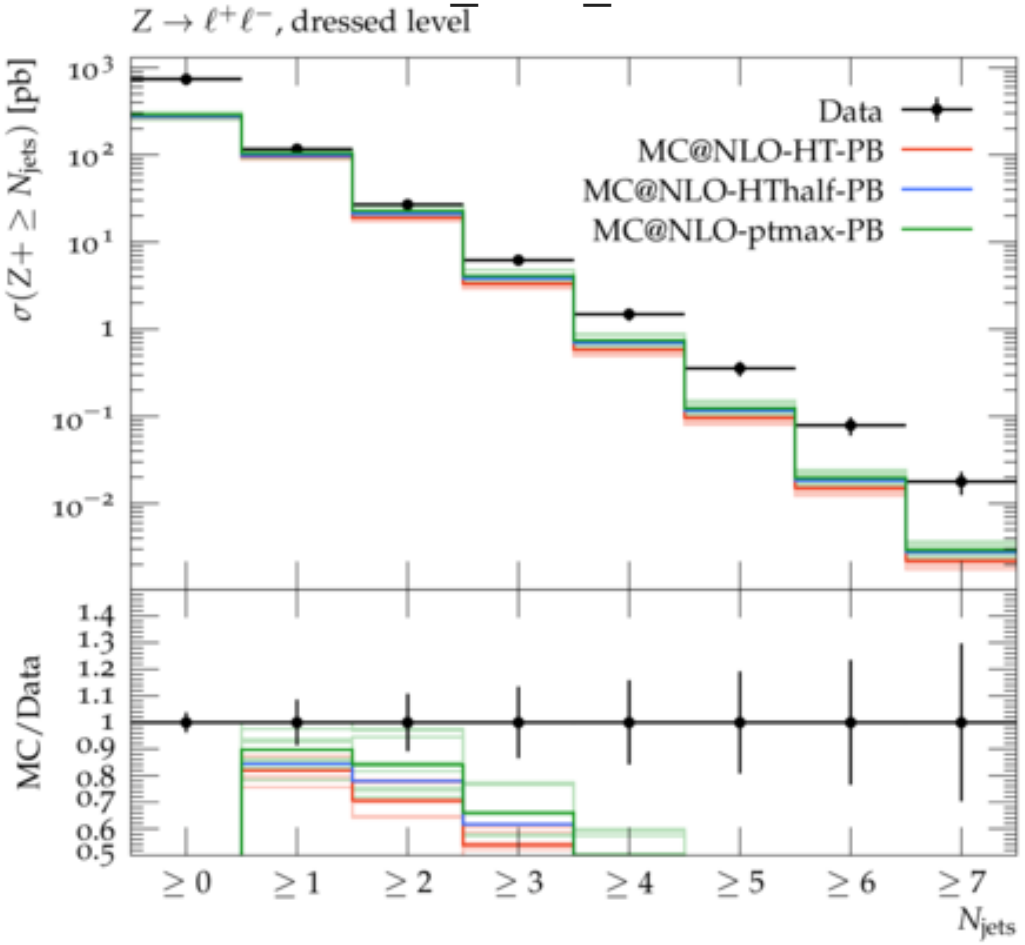
CMS_2018_I1667854



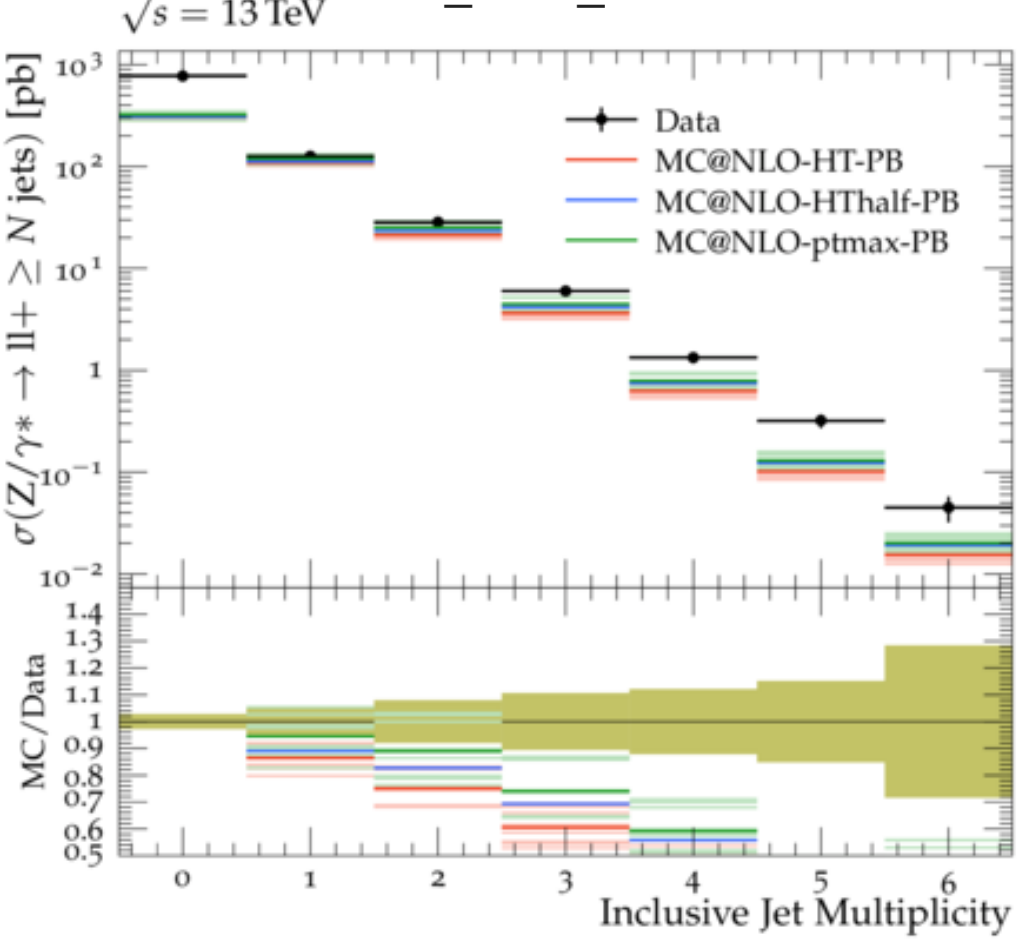
Number of jets (Parton Branching)

- Worse agreement than Pythia overall
- There is a slight difference between different scale choices
- $\mu = p_T^{max}$ gives the best agreement and $\mu = H_T$ the worst (same for both analyses)

ATLAS_2017_I151425



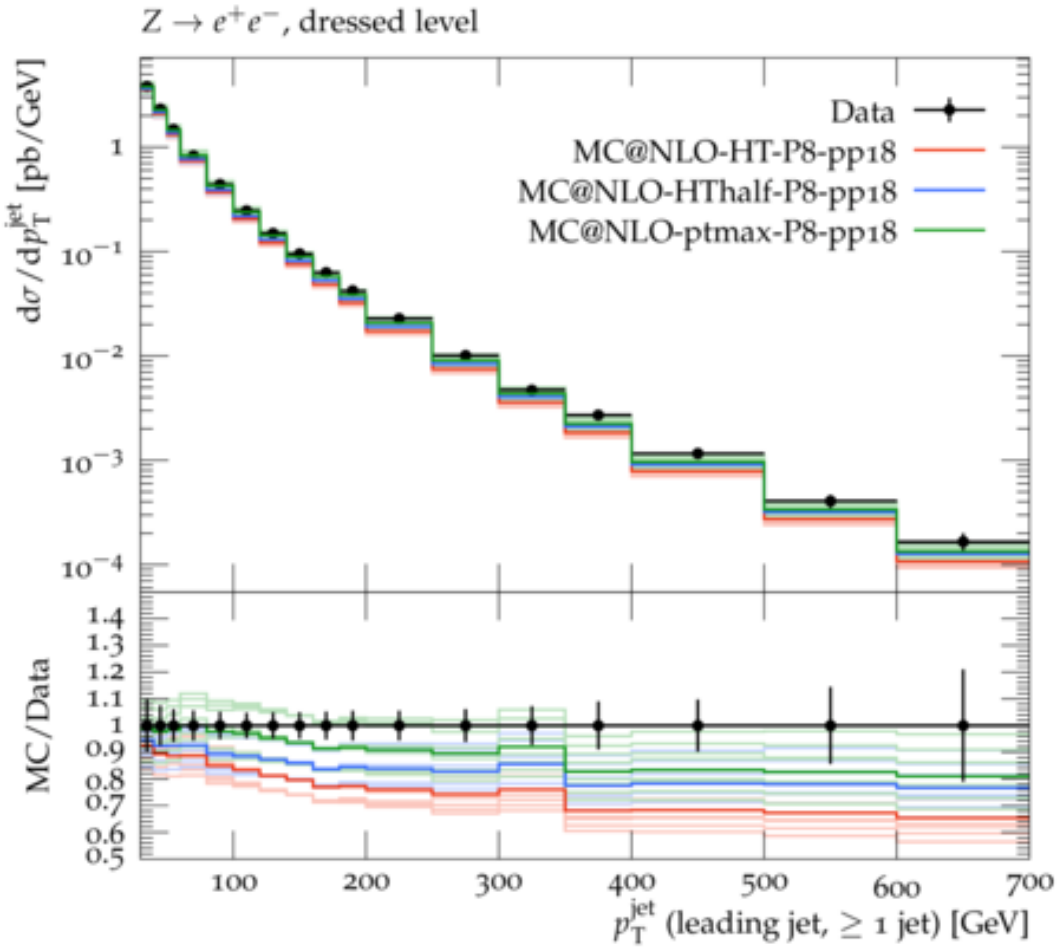
CMS_2018_I1667854



Leading jet p_T (Pythia8)

- Very good agreement for $p_T^{jet} < 100$ GeV for $\mu = p_T^{max}$ case
- Agreement becomes worse for higher p_T^{jet} values in all cases

ATLAS_2017_I151425



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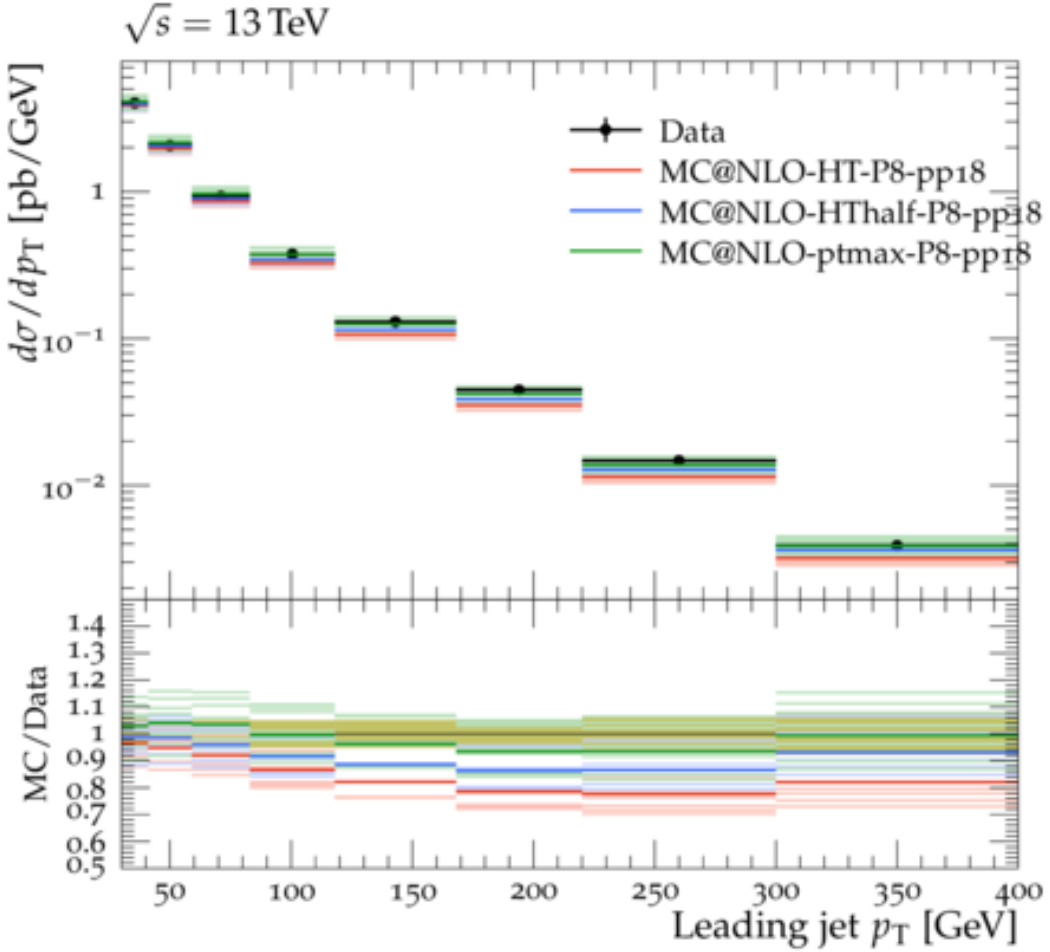
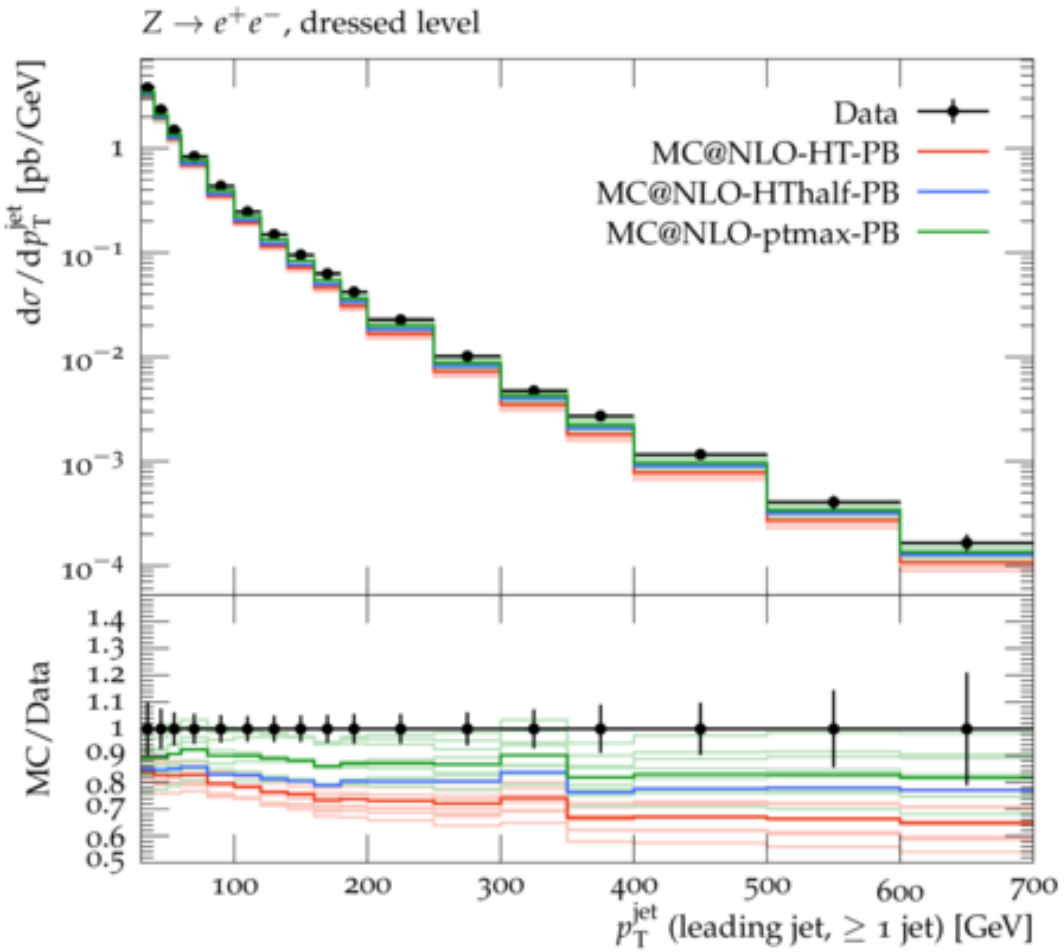


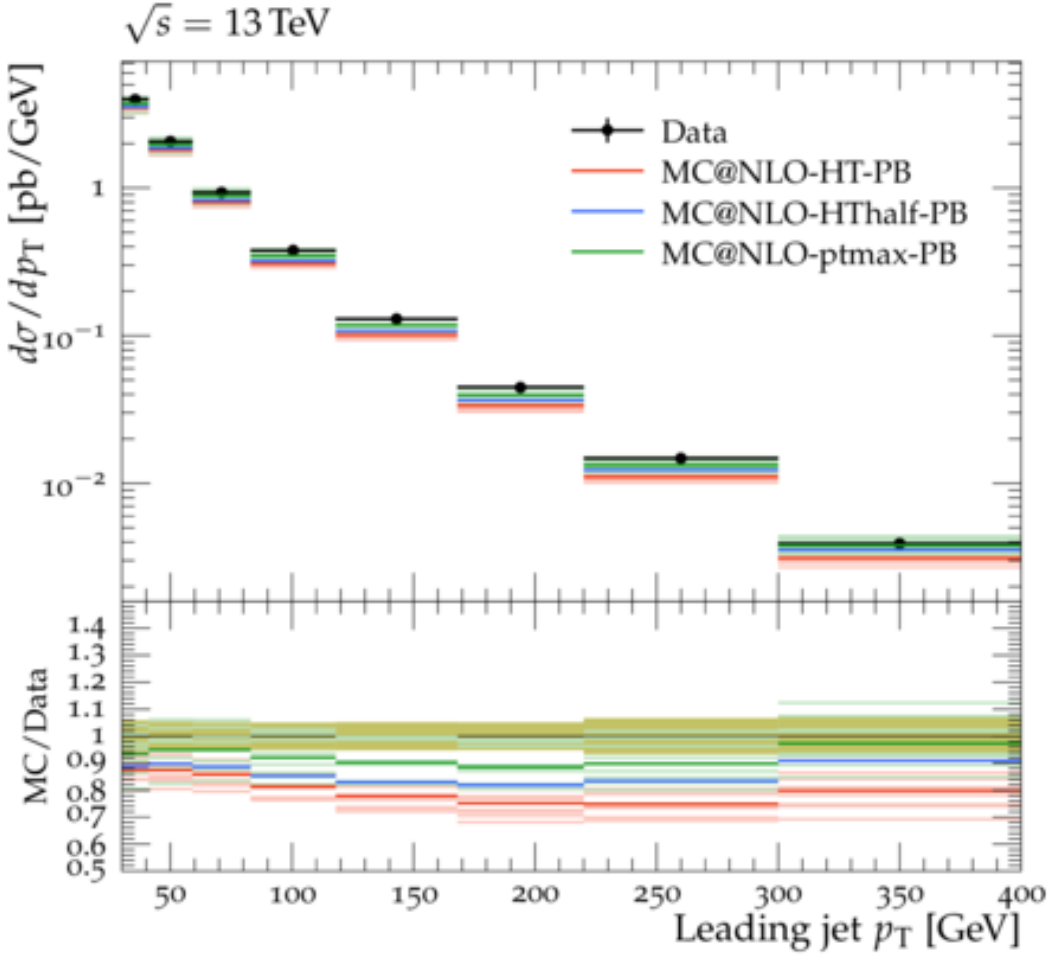
Leading jet p_T (Parton Branching)

- Flatter MC/Data ratio than for Pythia
- The overall agreement is worse

ATLAS_2017_I151425



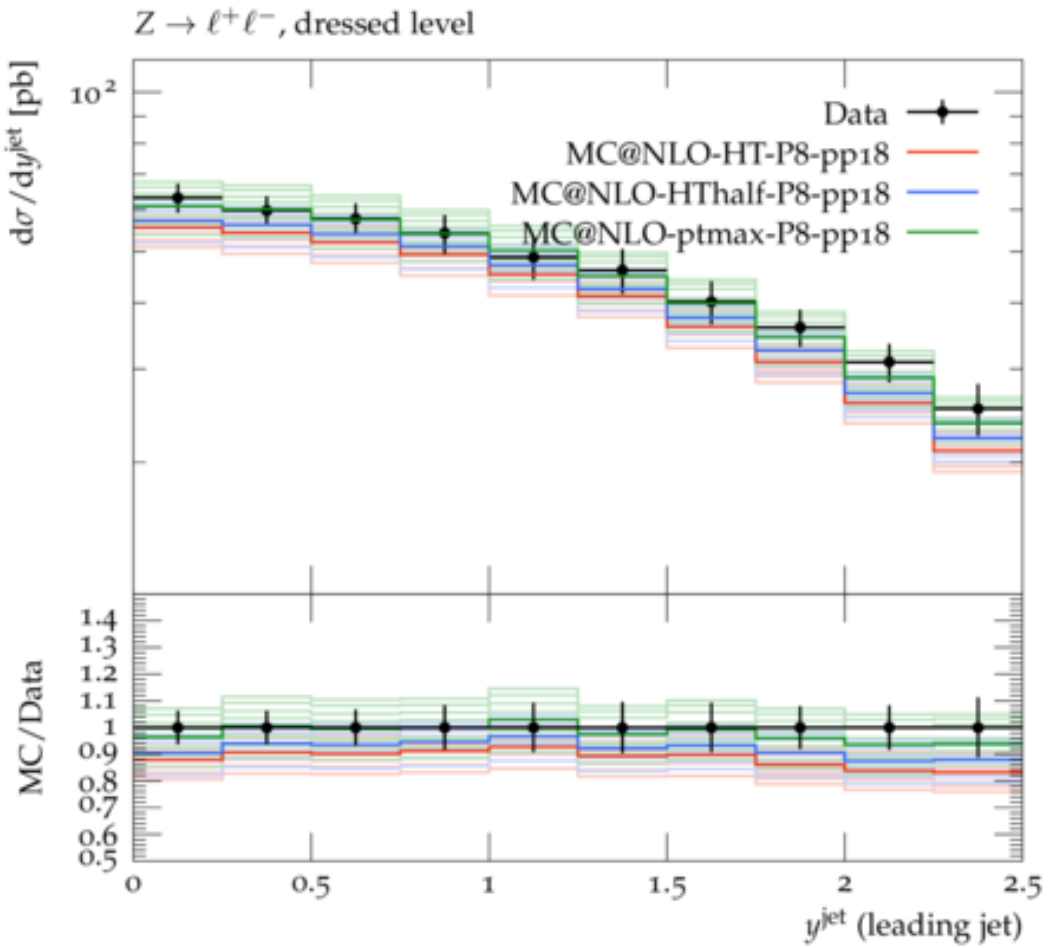
CMS_2018_I1667854



Leading jet rapidity (Pythia8)

- Agreement within 95% for p_T^{max} case
- Agreement within 85-90% for H_T and $\frac{H_T}{2}$ cases

ATLAS_2017_I151425



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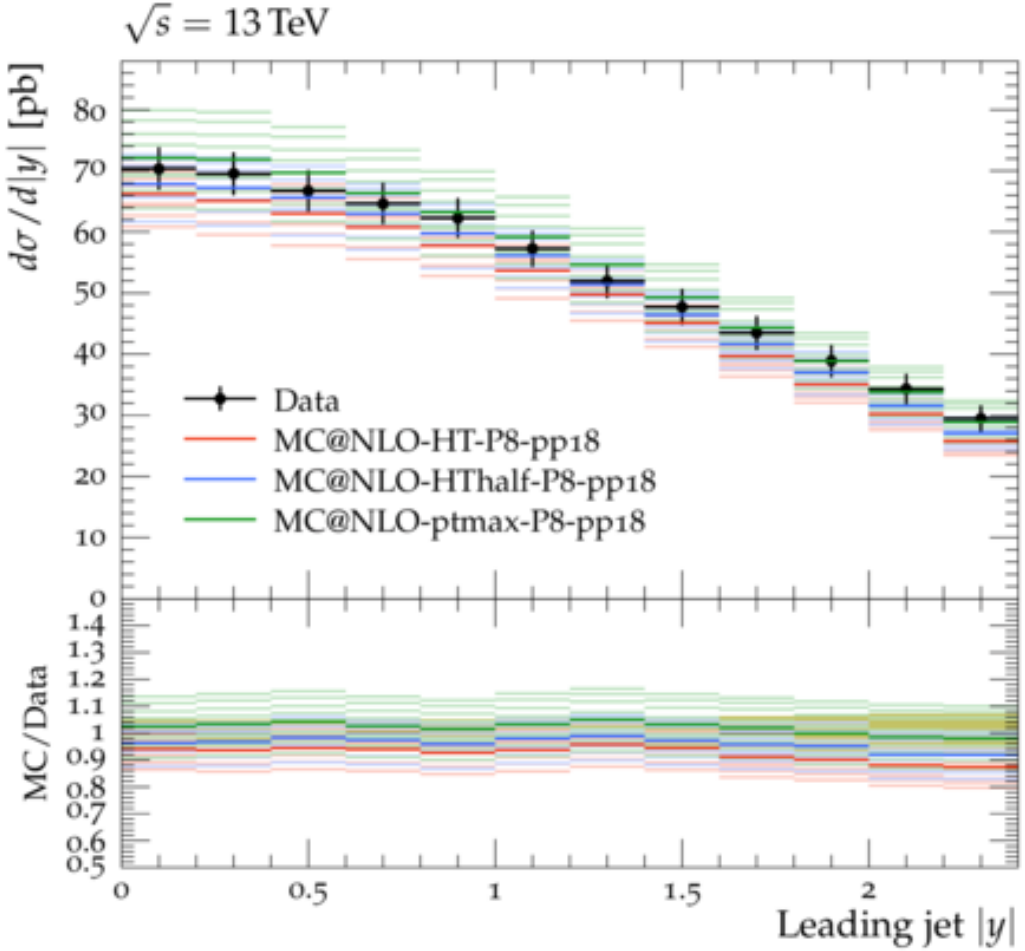
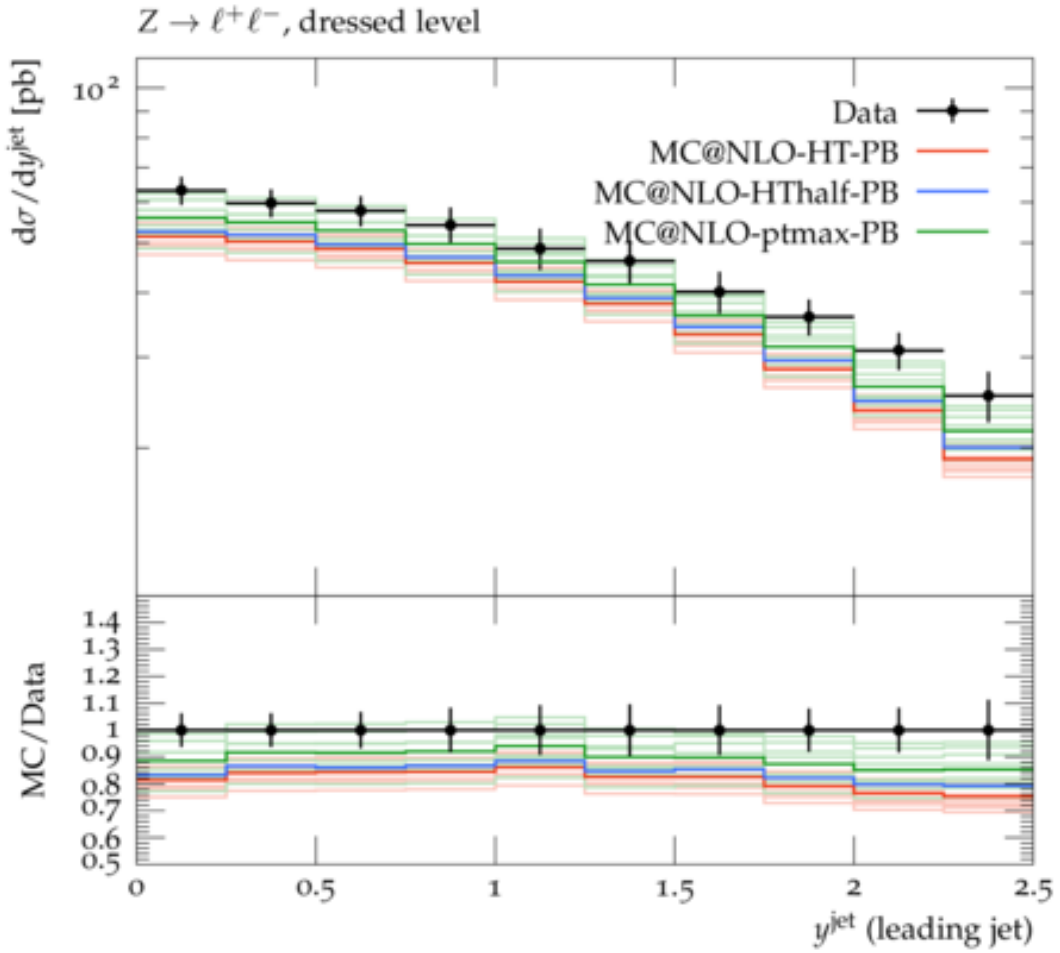


Leading jet rapidity (Parton Branching)

- Agreement within 85-95% for p_T^{max} case
- Agreement within 75-90% for H_T and $\frac{H_T}{2}$ cases

ATLAS_2017_I151425



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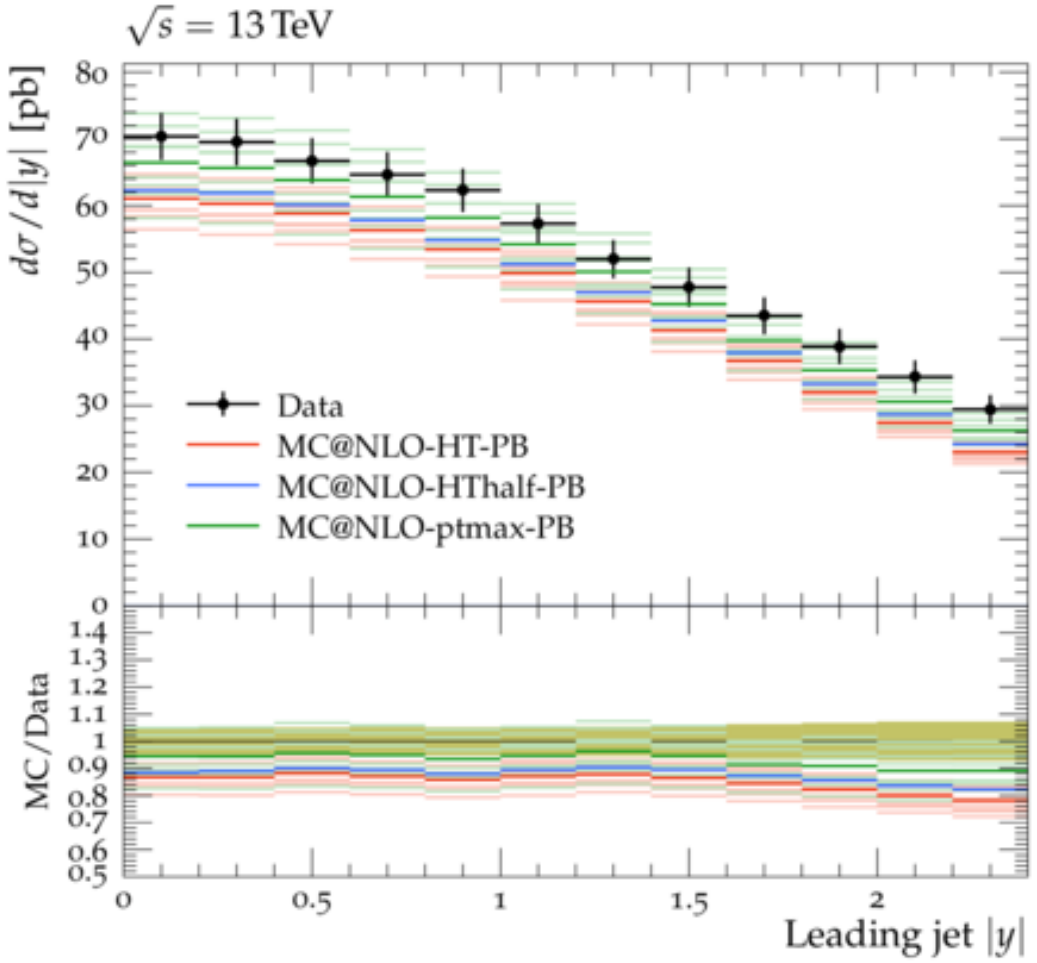
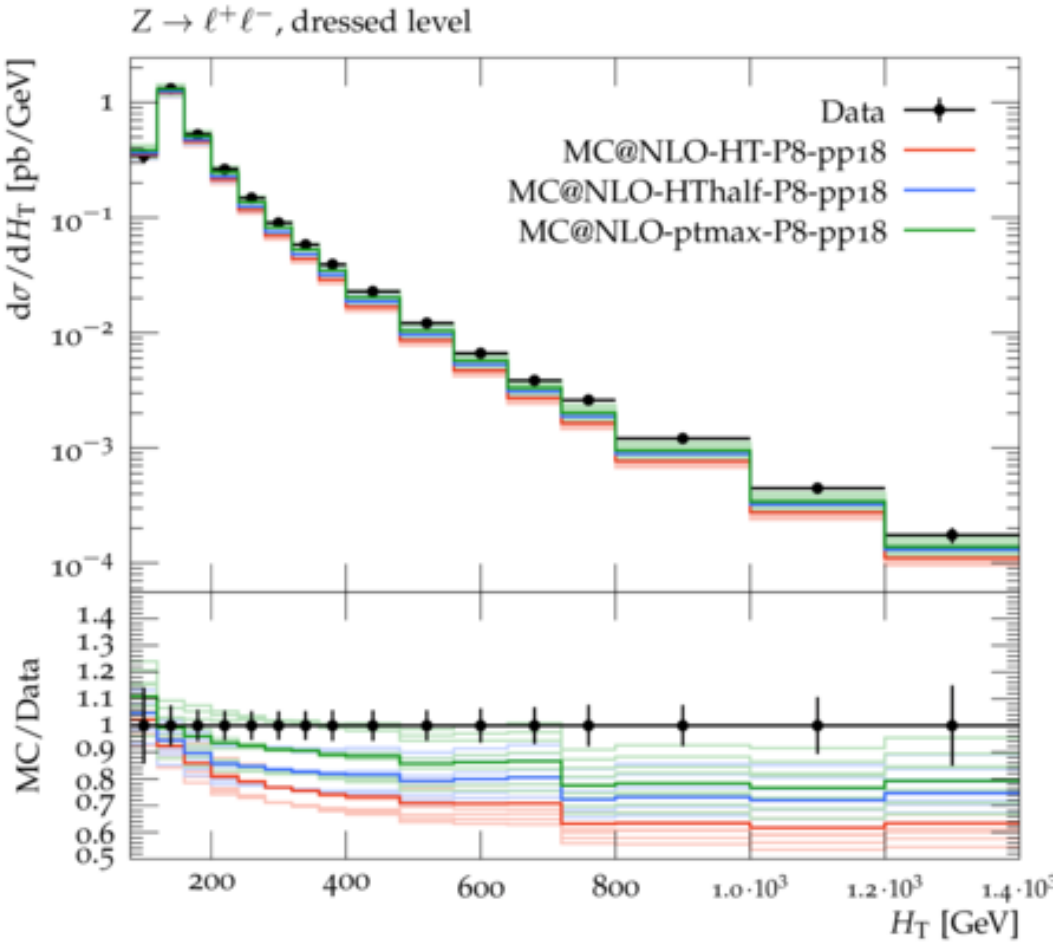


Scalar H_T (Pythia8)

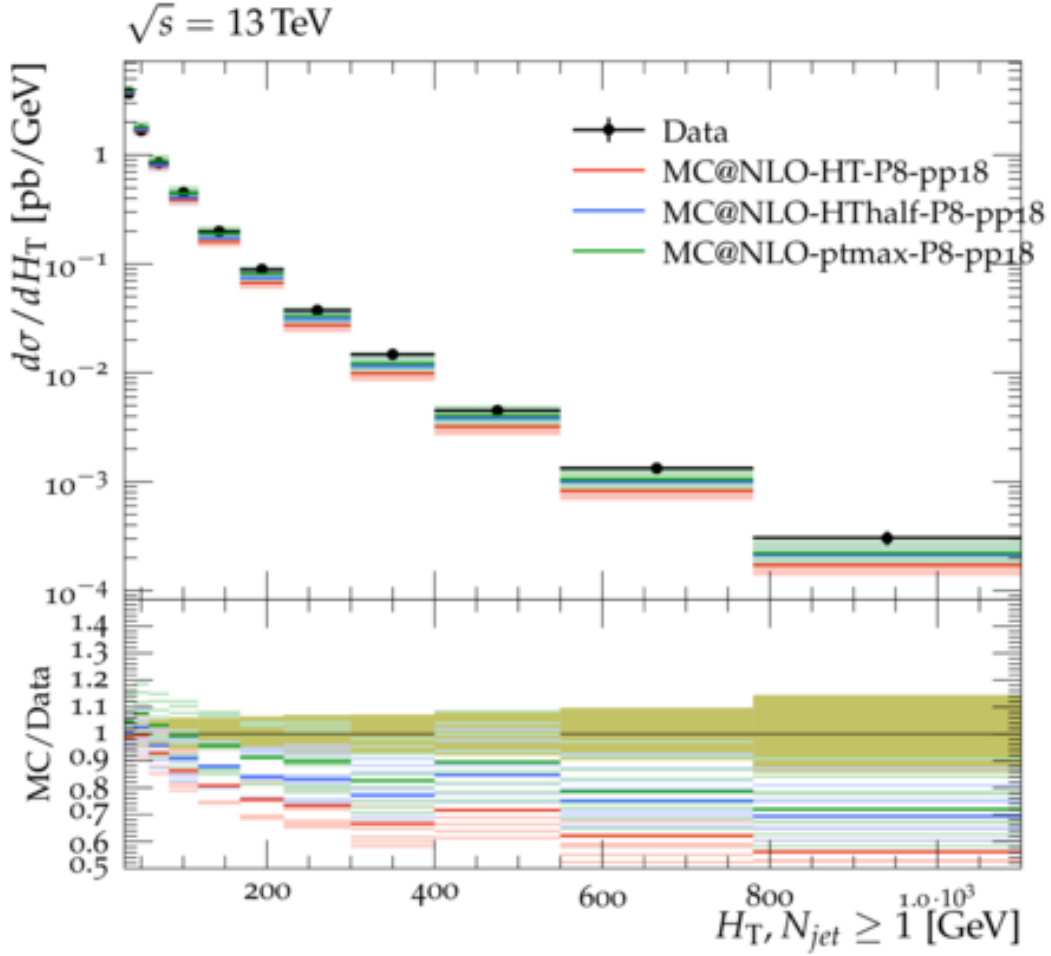
- p_T^{max} case has the highest cross section
- All the cases have a sharper fall than data, making the agreement best for H_T case in bin 1 and for p_T^{max} case in every other bin

ATLAS_2017_I151425



Not directly comparable!
ATLAS includes lepton p_T in H_T calculation while CMS does not.

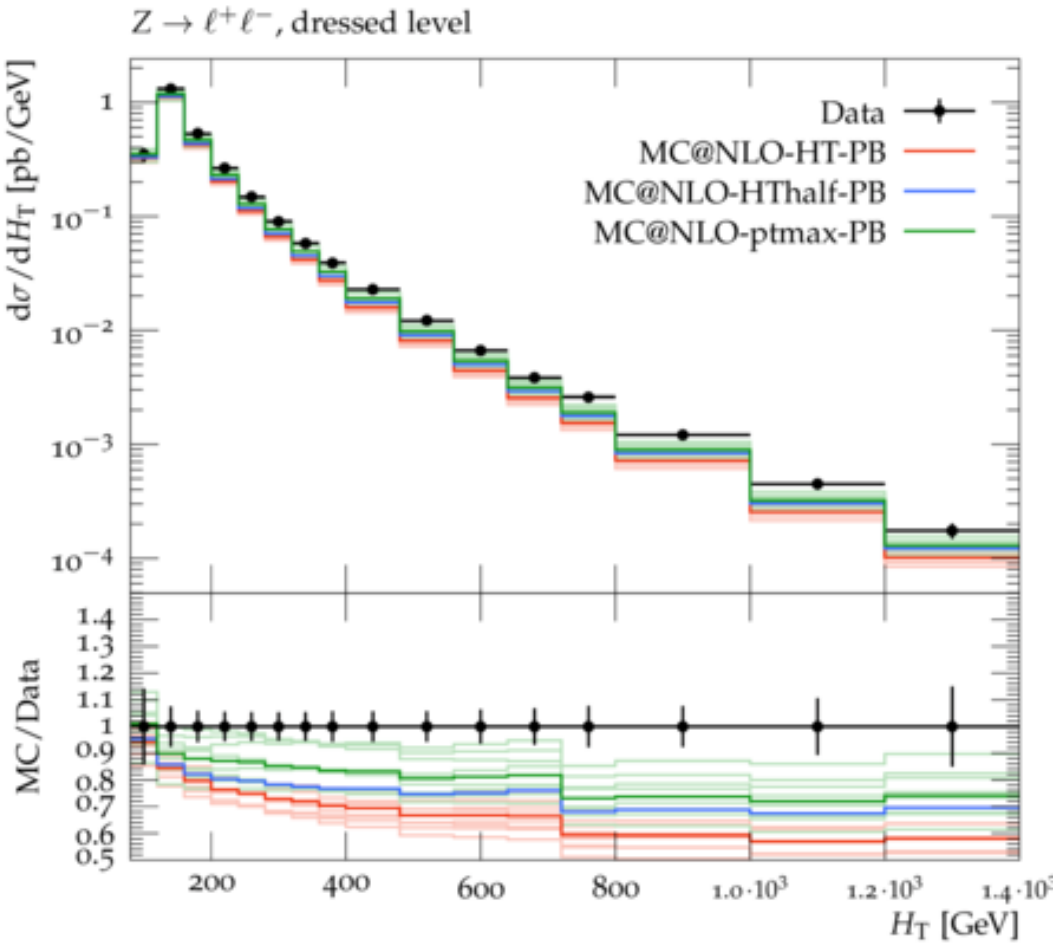
CMS_2018_I1667854



Scalar H_T (Parton Branching)

- p_T^{max} case has best agreement (exact match in the first bin)

ATLAS_2017_I151425



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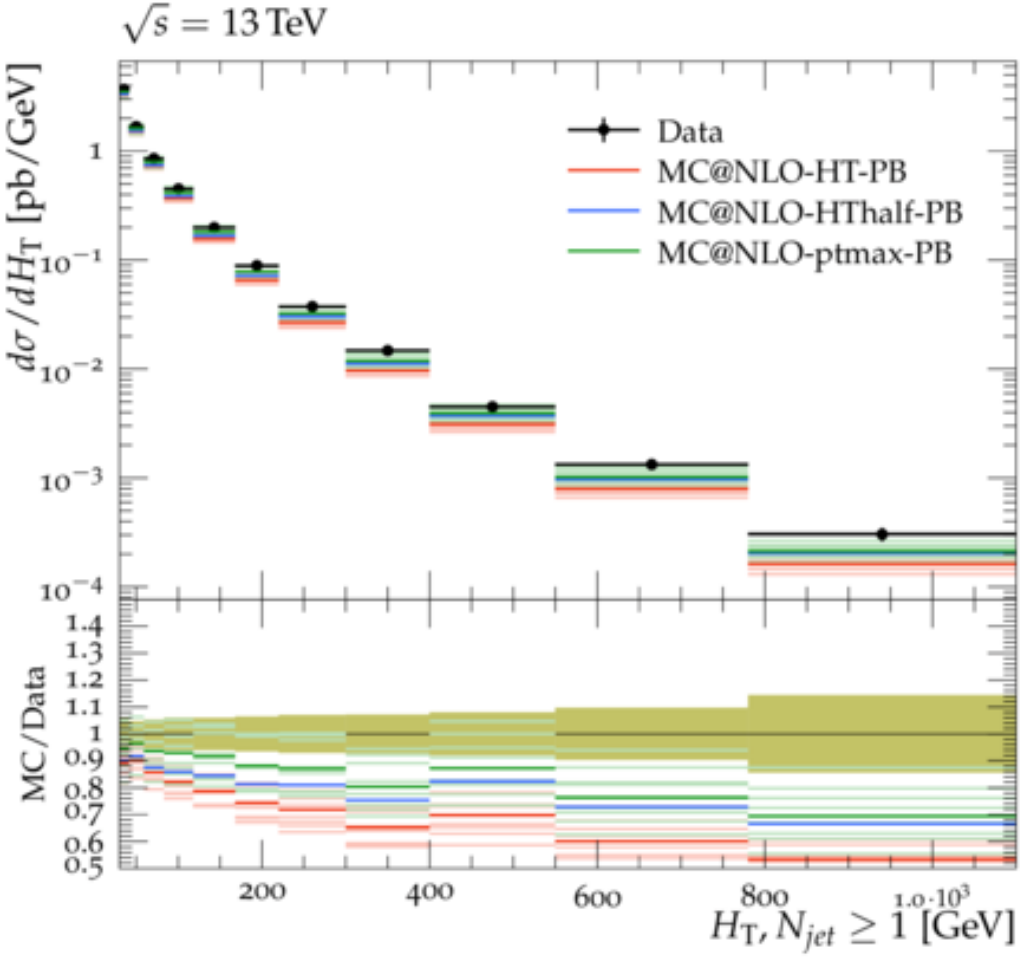

Other cross section comparisons

- Showed only a part of all the cross sections available
- All results can be found on my webpage: https://mambroza.web.cern.ch/mambroza/BenchmarkComparisons/
- I am updating the page as soon as I have more results
- Date of last update can be seen at the bottom of the page

Benchmark comparisons

Created by Marijus Ambrozas

Energy	Process	Comparison	Other parameters	Notes
7 TeV	W+Jets	pp tune comparison	MPI=on, shower=on MPI=off, shower=on MPI=on, shower=off MPI=off, shower=off	Compared 3 pp tunes: pp17 (ATLAS tune AZ), pp18 (CMS Tune MonashStar), pp21 (ATLAS A14 central tune)
		QCD parameter comparison	Tune pp17 Tune pp18 Tune pp21	Compared QCD parameters: MPI = off Parton shower = off Both = off
		QCD evolution technique comparison	–	Compared QCD evolution techniques: Parton shower (Pythia8) Parton branching (Cascade)
		pp tune comparison	MPI=on, shower=on MPI=off, shower=on MPI=on, shower=off MPI=off, shower=off	Compared 3 pp tunes: pp17 (ATLAS tune AZ), pp18 (CMS Tune MonashStar), pp21 (ATLAS A14 central tune)

Summary and outlook

- Producing MC benchmark comparisons for Z+Jets using aMC@NLO and Pythia8/Cascade
  - MC predictions are too small at high jet multiplicities (probably due to aMC@NLO cards)
  - p_T^{max} scale choice gives the highest cross section and the best agreement with data
  - Parton branching provides a smaller cross section than Pythia, making the overall agreement worse
- Planning to include one more rivet plugin (Z+bjet ATLAS_2020_I1788444) and error correlations

Additional slides

Useful links

- All my comparisons can be found here: https://mambroza.web.cern.ch/mambroza/BenchmarkComparisons/
- LHCEW group indico: https://indico.cern.ch/category/3290/
- LHCEW-VJets group twiki: https://twiki.cern.ch/twiki/bin/view/LHCPhysics/EWWG2
- Benchmark comparison tutorial by Hannes Jung: https://gitlab.cern.ch/lhcewkwg/lhcewkwg-vjets/benchmark-comparisons