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# PDF order and Pythia8 tunes in CMS

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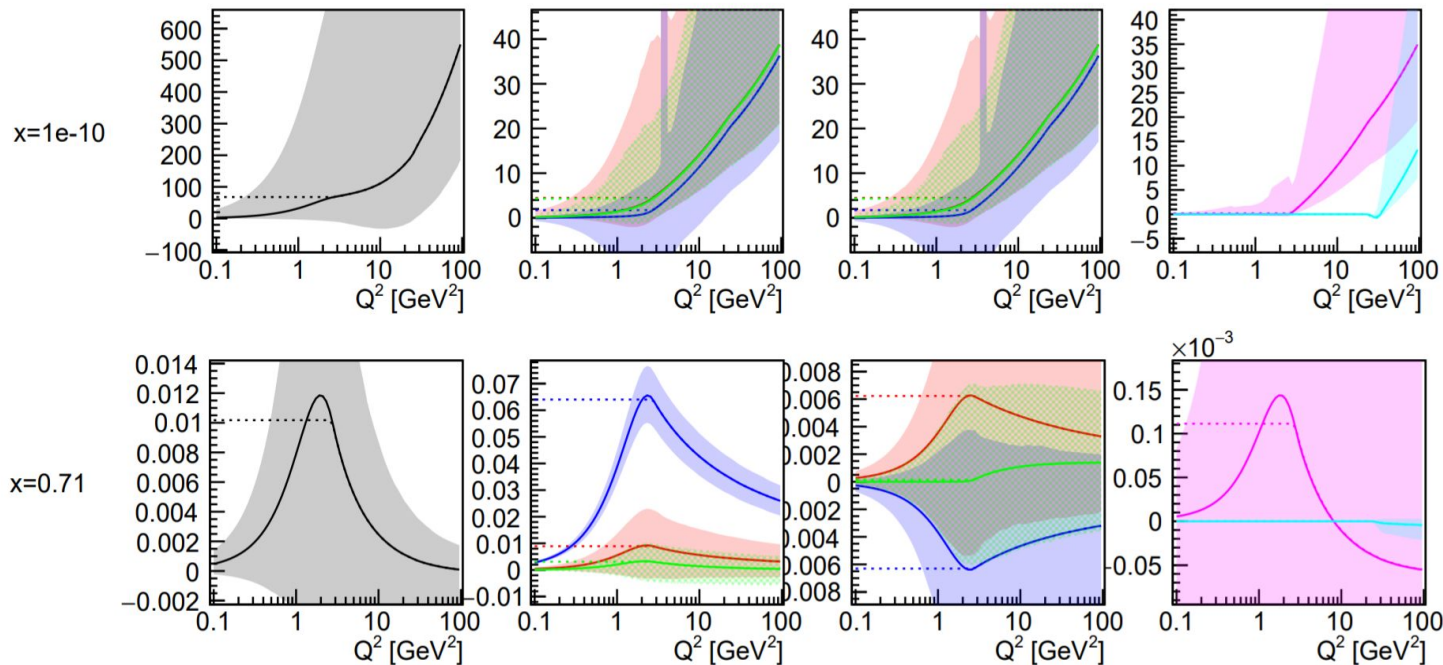
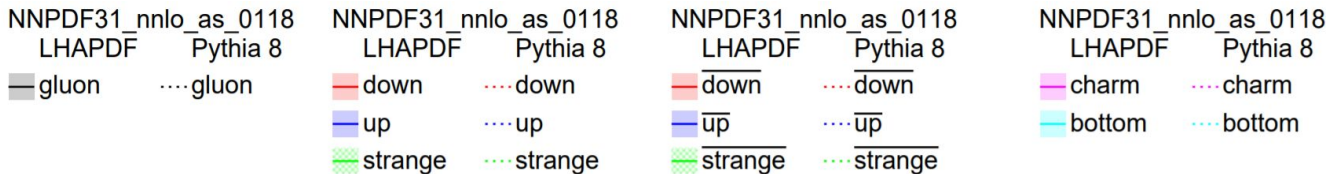
6 September 2017  
PDF4LHC Meeting

# PDF choices for the tunes

- Recent discussions on the order of PDF sets in parton showers (cfr. last LHC and the Standard Model: Physics and Tools Meeting [presentations](#))
- We would like to match the PDF in PS and in the ME, and to have LO PDF for MPI to make sure small x-gluon is physical.
- We test the effect of using different PDF orders of NNPDF sets in Pythia8 among other parameter variations
  - CP1: NNPDF3.1 LO ( $\alpha_s$  0.130)
  - CP2: NNPDF3.1 LO ( $\alpha_s$  0.130)
  - CP3: NNPDF3.1 NLO ( $\alpha_s$  0.118)
  - CP4: NNPDF3.1 NLO ( $\alpha_s$  0.118)
  - CP5: NNPDF3.1 NNLO ( $\alpha_s$  0.118)

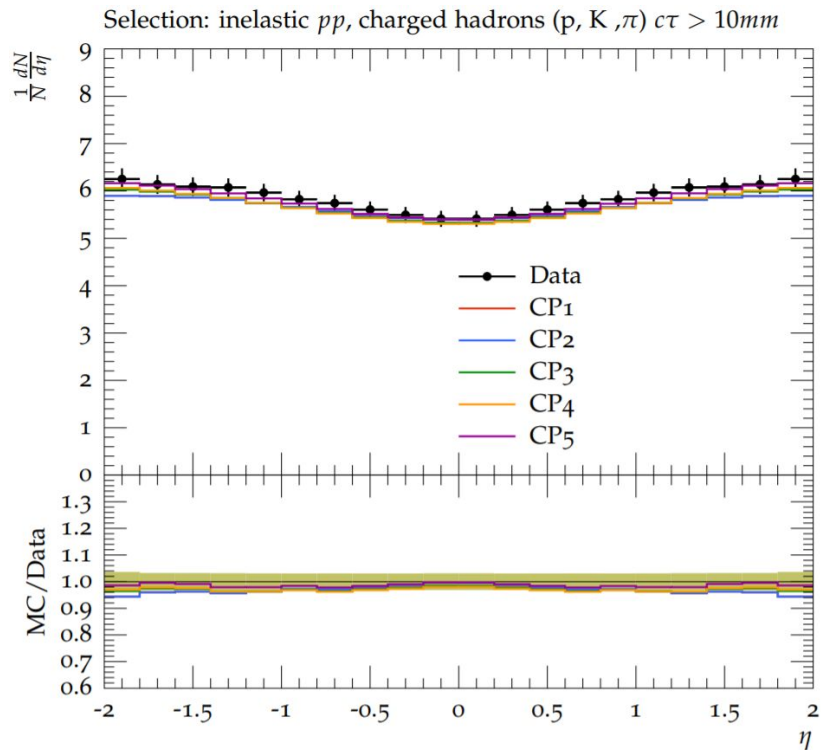
} Currently not possible to set different PDFs in MPI and PS in Pythia.

# Test of higher order PDF positiveness



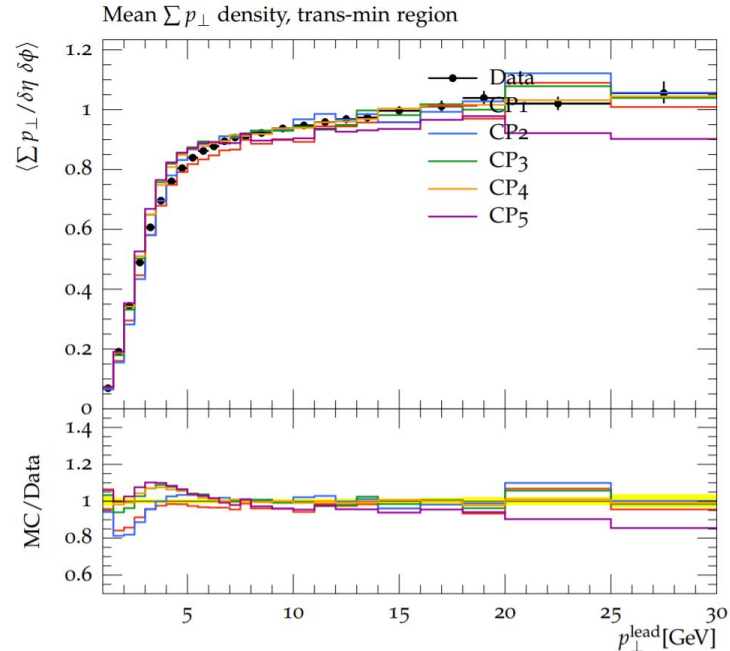
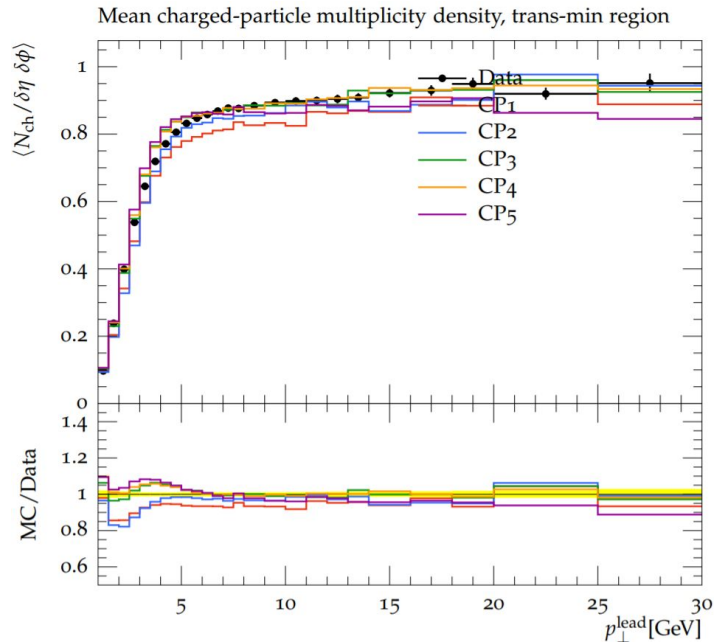
# Minimum Bias

- Rivet: CMS\_2015\_I1384119, 0 Tesla,  $\sqrt{s} = 13$  TeV,  $|\eta| < 2$



# Underlying Event

- Rivet: ATLAS\_2017\_I1509919,  $\sqrt{s} = 13$  TeV,  $|\eta| < 2.5$ ,  $p_T > 0.5$  GeV with at least one of the charged particles  $p_T > 1$  GeV
- Distributions most sensitive to MPI (where we might expect to have the biggest problems not using a leading order PDF)



# Conclusion

- UE/Min-Bias data are described at the same level by tunes with LO, NLO, and NNLO PDF NNPDF3.1 sets.
- It would still be good if Pythia8 allows setting different PDFs for PS and MPI (as e.g. in Herwig7)

Special thanks to the Sherpa, Herwig and MG5\_aMC@NLO collaborations for fruitful discussions