



NEW MATCHING UNCERTAINTY PRESCRIPTION IN TOP QUARK PROCESSES FOR ATLAS

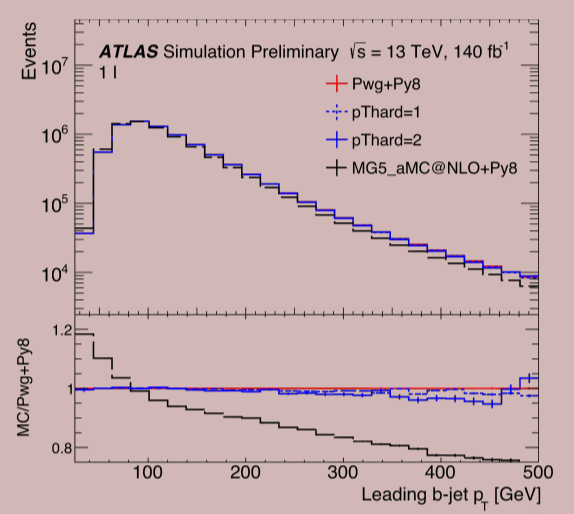
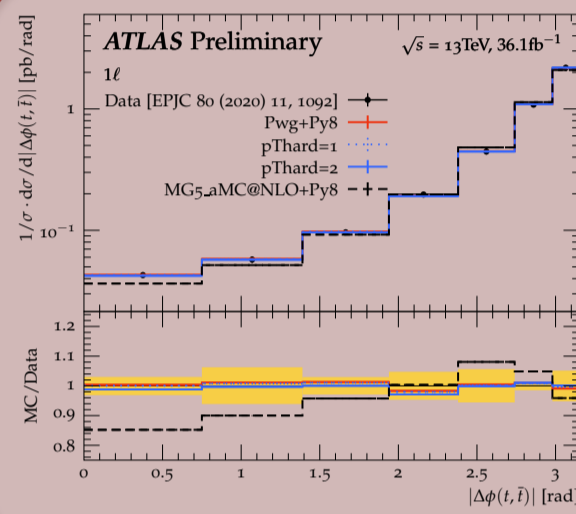
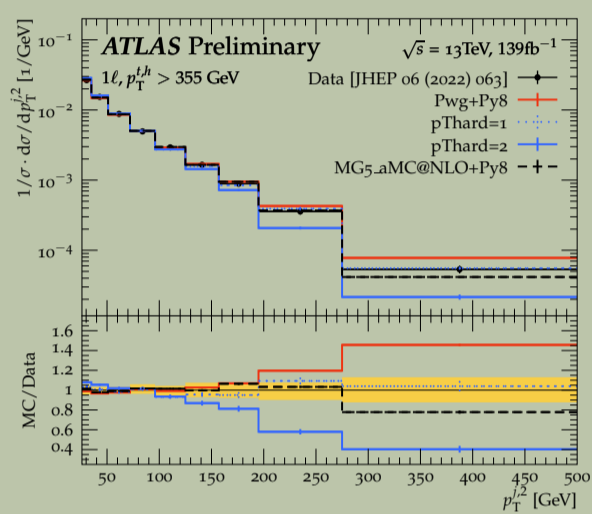
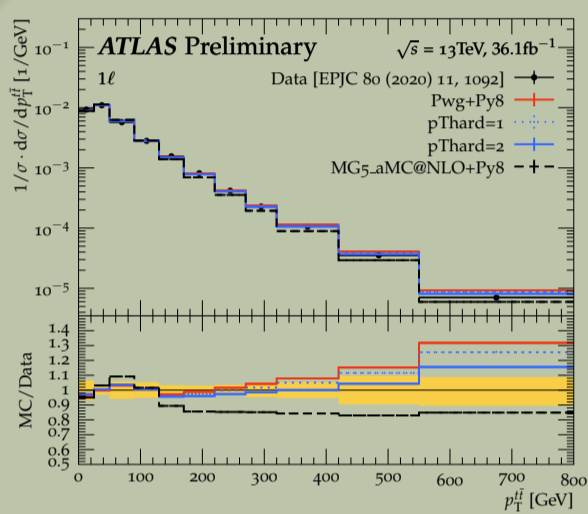
LHCC Poster Session, November 27th, 2023

Previous matching uncertainty recipe in ATLAS of comparing PP8 and aMC+P8 convolutes multiple modelling differences
Need for a dedicated matching uncertainty

What is the matching uncertainty?

Most top quark processes in ATLAS modelled at NLO+PS accuracy
 → matching is needed to prevent double-counting emission from real matrix element of NLO calculation and emission produced in soft-collinear approximation in PS
 Two different matching approaches in

- POWHEG+PS: POWHEG produces hardest emission (scale = PWHG scale), emission in PS are vetoed if harder than PWHG scale
- aMC@NLO+PS: subtract PS approximation of real ME with aMC@NLO method, attach unrestricted PS afterwards



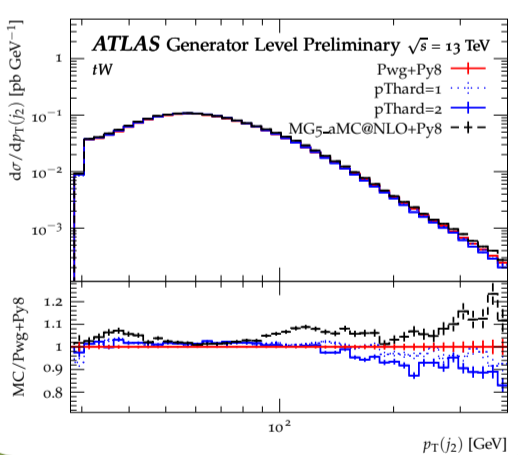
Distributions related to number and energy of emissions **sensitive to matching** and p_T^{hard}

New matching prescription for POWHEG+PYHTIA8 top quark processes

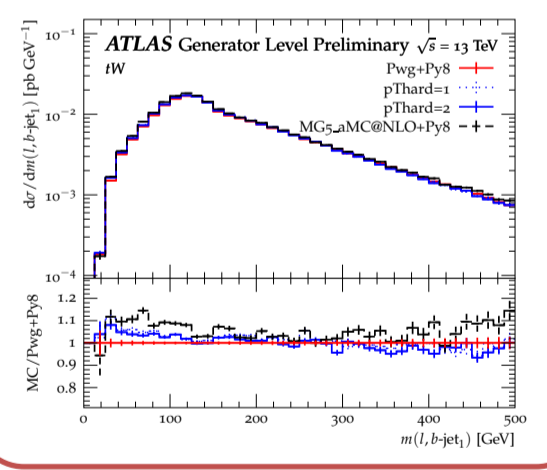
- is to compare $p_T^{\text{hard}} = 0$ and $p_T^{\text{hard}} = 1$ (proposed in [1]), where the PWHG scale is set to:
- $p_T^{\text{hard}} = 0$: SCALUP value of LHE file (default)
 - $p_T^{\text{hard}} = 1$: min. p_T of PWHG emission w.r.t. to beam-axis or other final-state particles
 - $p_T^{\text{hard}} = 2$: min. p_T of all final-state particles w.r.t. beam axis or each other

Distributions **not sensitive to matching**: no variation with p_T^{hard} , differences between PP8 and aMC+P8

Single top: tW



Single top: tW

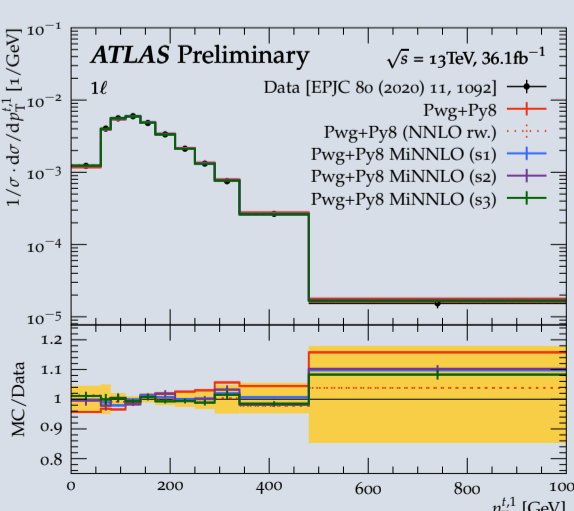
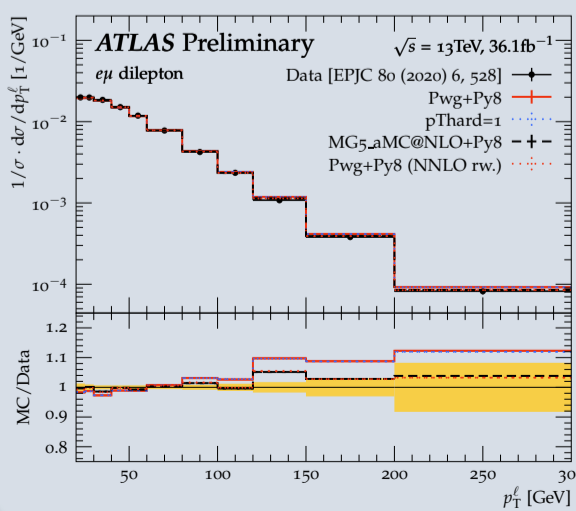


Targeted matching uncertainty, but comparison of PP8 and aMC+P8 accidentally covered two additional effects, which are now added as dedicated uncertainties

top p_T mismodelling

top quark line shape

Apply **NNLO reweighting** to NLO+PS $t\bar{t}$ sample based on $m_{t\bar{t}}$ and $p_T^{t\bar{t}}$ to cover top-quark p_T mismodelling of PP8



Comparing PP8 and **PP8+MadSpin**, which reproduces top line shape of aMC+P8. Needs special treatment due to 4-mom. inconsistencies in 5FS MadSpin+P8

