

# A common $t\bar{t}$ Monte-Carlo sample will facilitate top physics combinations and comparisons for CMS and ATLAS.

## Towards Common $t\bar{t}$ Monte-Carlo Settings for ATLAS and CMS

### INTRO

- Presenting the improved **Powheg+Pythia8** sample (v2): more physical settings.
- Introducing the first common **Sherpa** sample (v1).
- Comparison with unfolded CMS and ATLAS data is performed (Rivet).

### The common sample enables:

- the calculation of **correlations** between experiments correctly;
- the identification of **differences** in ATLAS and CMS measurements;
- the use of the sample as a **baseline prediction**;
- **resource sharing** for event generation.

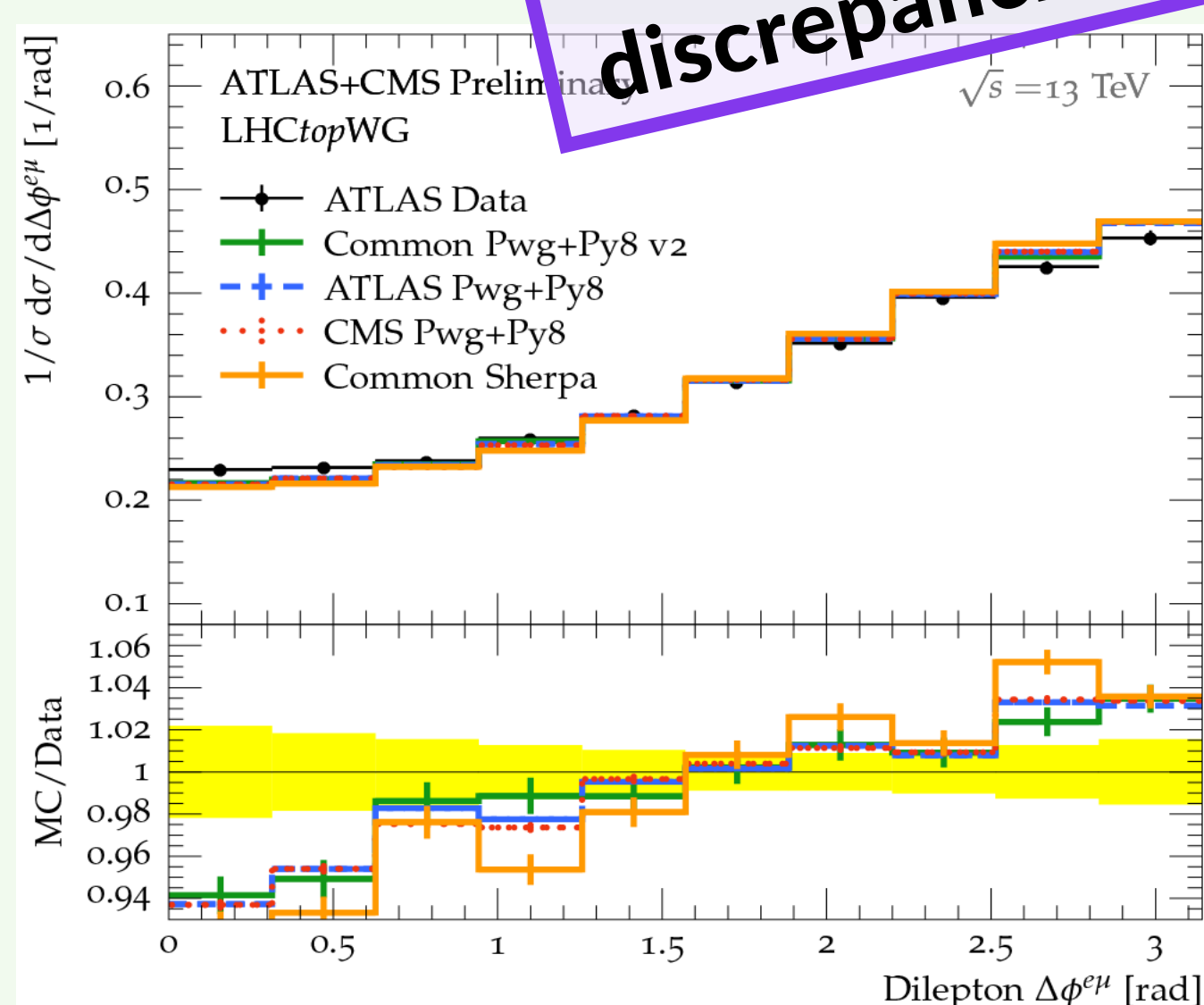
### The common settings:

- **Pow+Pyt**: based on Monash-CMW tune with  $\alpha_s = 0.118$ ;
- chosen to improve the agreement with data;
- **Sherpa**: ATLAS default settings.

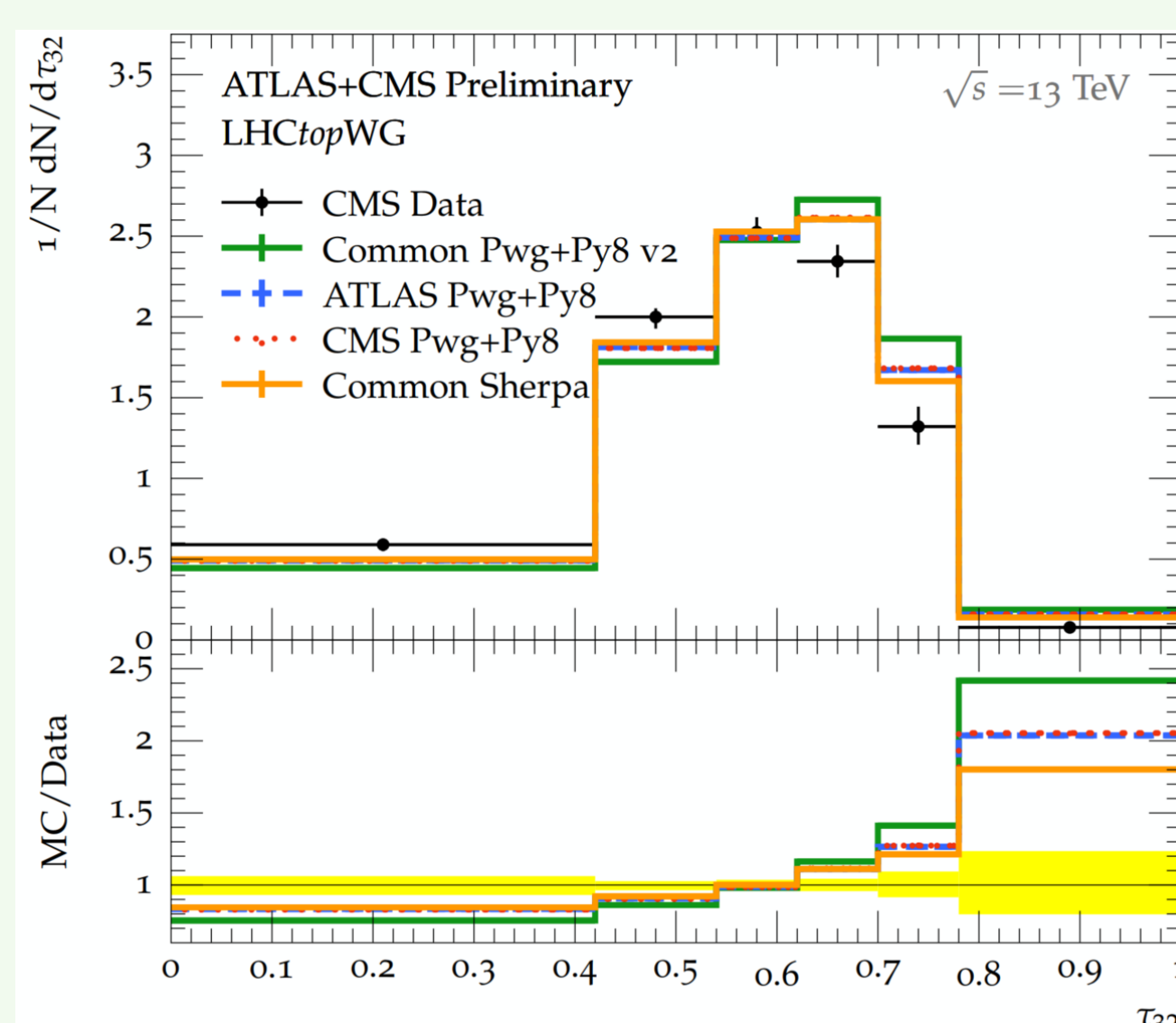
## RESULTS

$\Delta\phi$  angle between the leptons in the  $t\bar{t}$  dilepton channel is sensitive to top spin correlations.

Former source of discrepancies

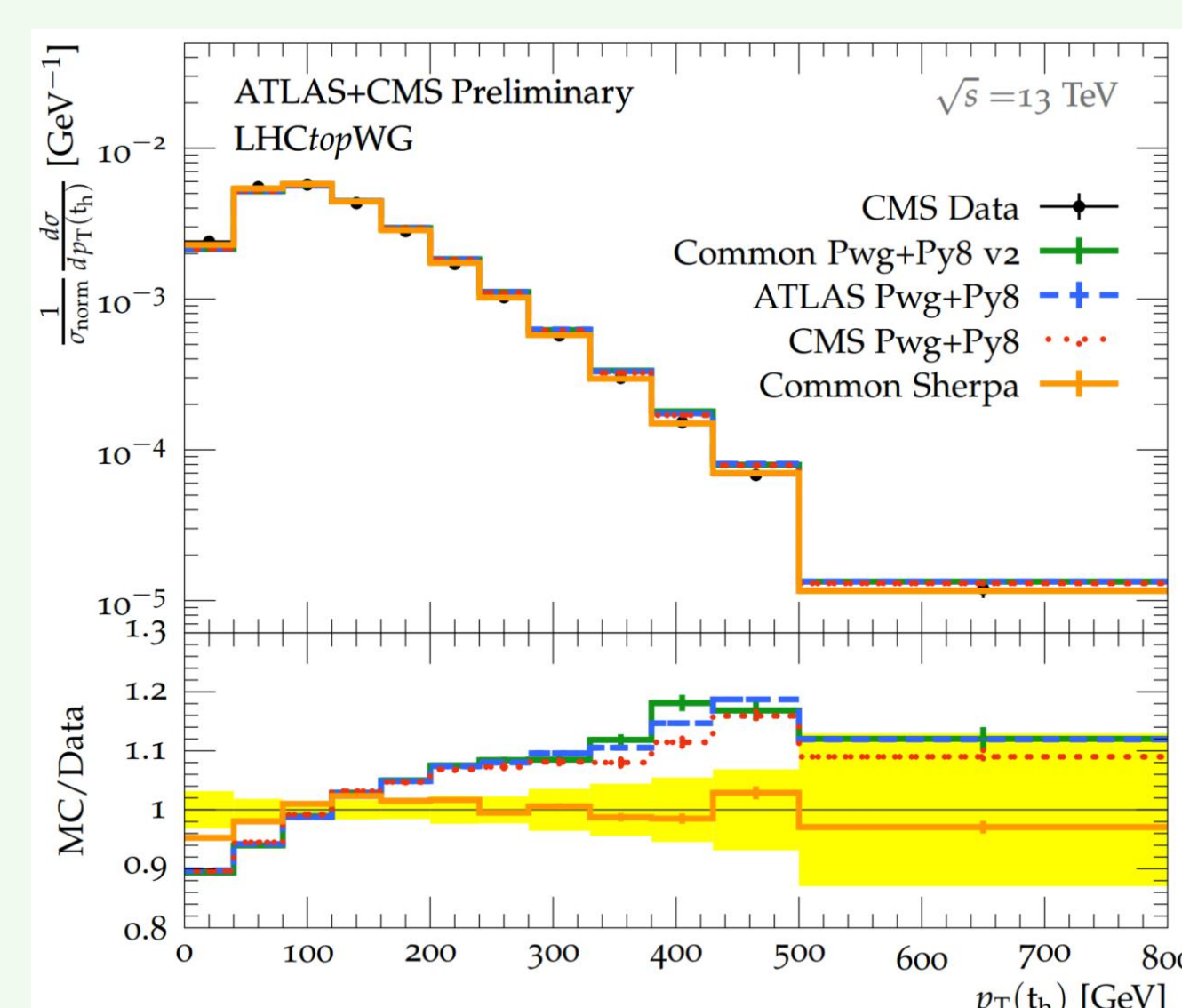


**N-subjettiness ratio  $\tau_{32}$**  in jet substructure is particularly sensitive to final-state radiation. Shape differences observed between data and all generators.

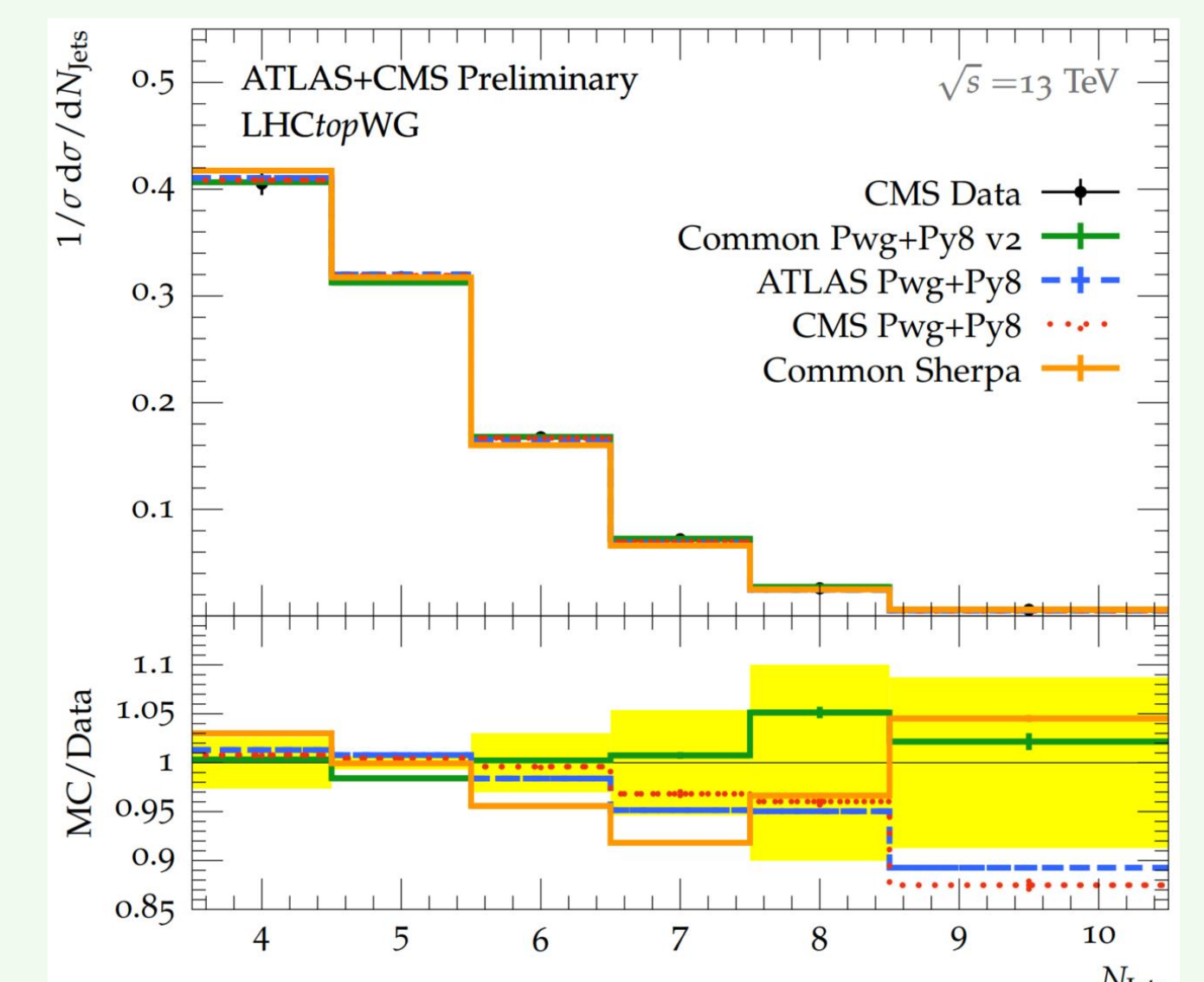


$p_T$  of the **hadronically decaying top** in the lepton+jets channel. **Pow+Pyt** predicts a too hard top spectrum.

Known Pow+Pyt NLO issue



**Common Pow+Pyt** reproduces  $N_{\text{jets}}$  in the lepton+jets channel best. Difficult to tune right; a trade-off with  $H_T$  and top  $p_T$ .



### CONCLUSIONS

The common sample:

- shows a good agreement with the ATLAS and CMS nominal samples and data.
- is ready to be used in analyses (LHE files available).

### A comparison of the main settings for Powheg+Pythia8 and Sherpa

#### Main Powheg+Pythia8 settings

Setting name	Setting description	CMS default	ATLAS default	Common Powg+Py8 v0.1	Common Powg+Py8 v2
<b>POWHEG</b>					
qmass	top-quark mass [GeV]	172.5	172.5	172.5	172.5
twidth	top-quark width [GeV]	1.31	1.32	1.315	1.311
hdamp	first emission damping parameter [GeV]	237.8775	258.75	250	250
wmass	$W^+$ mass [GeV]	80.4	80.3999	80.4	80.4
wwidth	$W^+$ width [GeV]	2.141	2.085	2.11	2.085
bmass	$b$ -quark mass [GeV]	4.8	4.95	4.875	5.06
<b>PYTHIA 8</b>					
	Pythia 8 version	v240	v230	v240 (CMS)	v240 (CMS)
	Tune	CP5	A14	v244 (ATLAS)	Monash-CMW
PDF:pSet	LHAPDF6 parton densities to be used for proton beams	NNPDF31_nlo.as.0118	NNPDF23_lo.as.0130.qed	NNPDF23_lo.as.0130.qed	NNPDF23_lo.as.0130.qed
TimeShower:alphaSvalue	Value of $\alpha_s$ at Z mass scale for Final State Radiation	0.118	0.127	0.1365	0.118
SpaceShower:alphaSvalue	Value of $\alpha_s$ at Z mass scale for Initial State Radiation	0.118	0.127	0.1365	0.118
MPI:alphaSvalue	Value of $\alpha_s$ at Z mass scale for Multi-Parton Interaction	0.118	0.126	0.130	0.130
MPI:pTuref	Reference $p_T$ scale for regularizing soft QCD emissions	1.41	2.09	2.28	2.28
ColourReconnection:range	Parameter controlling colour reconnection probability	5.176	1.71	1.80	1.80

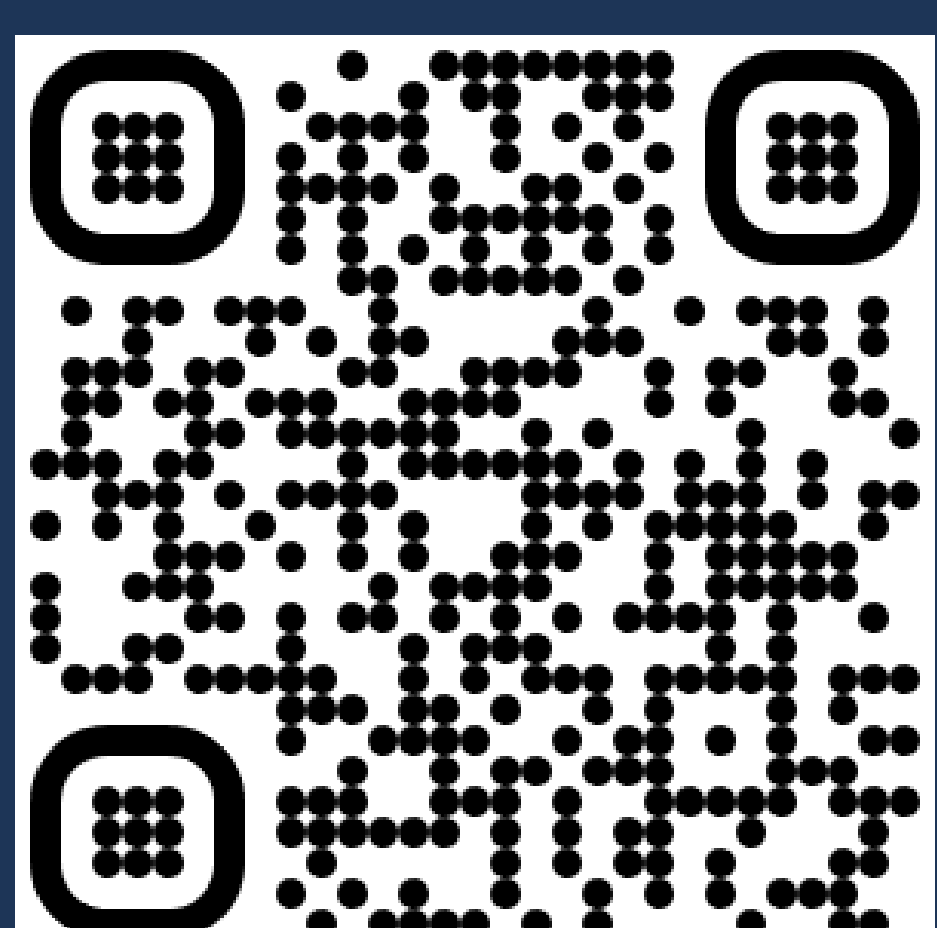
CMS and ATLAS nominal samples:

- CMS: Powheg+Pythia8 (CP5 tune);
- ATLAS: Powheg+Pythia8 (A14 tune) + EvtGen;

#### Main Sherpa 2.2.11 settings used

Setting name	Setting description	Common Sherpa v1
MASS[6]	top-quark mass [GeV]	172.5
HDH_WIDTH	top-quark width [GeV]	1.32
QCUIT	CKKW merging cut [GeV]	30
MASS[24]	$W$ boson mass [GeV]	80.399
WIDTH[24]	$W$ boson width [GeV]	2.085
MASS[5]	$b$ -quark mass [GeV]	4.8
PDF	PDF set to be used for proton beams	NNPDF30_nlo
USE_PDF_ALPHAS	Whether to use the $\alpha_s$ evolution provided in LHAPDF	1
AlphaS	Value of $\alpha_s$	0.118
CSS_EVOLUTION_SCHEME	Choice of evolution variable in the shower	30, modified $p_T$ order incl. $m_{\text{parton}}$ for $g \rightarrow qq$
MePS@NLO	Multijet merging configuration	0.1j@NLO + 2.3,4j@LO

More plots and details in an upcoming ATLAS + CMS note.



ATLAS note found here



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CMS DPS note found here

