MC/theory comparisons

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Objectives

- Summarise and compare state-of-the-art predictions for multiboson production: **7 representative signatures**
- Compare against nominal Monte Carlo samples in ATLAS / CMS.
- Compare fixed-order (NNLO QCD and NLO EW) predictions with (N)NLOPS predictions (QCD and QED shower modelling).
- Compare different NLOPS matching/merging schemes. However, not a tuned technical comparison, i.e. individual scale settings.
- Compare shower Monte Carlo programs with pT / jet-veto resummation.
- Based on modified Rivet routines of prior analyses (available in EWWG git).

Note: ongoing!

Signatures

VV

Process	Mode	based on
$Z\gamma$	$Z(\to e^+e^-)\gamma$	ATLAS_2016_I1448301
ZZ	$Z(\to \ell^+\ell^-)Z(\to \ell'^+\ell'^-)$	ATLAS_2015_I1394865 (line-shape) & CMS_2012_I1298807 (pTZZ) & MC_ZZINC
WW	$W(\to e^+\nu)W(\to e^-\bar{\nu})$	ATLAS_2016_I1426515 & MC_WWINC & MC_WWJETS
WZ	$W(\to \mu^+\nu_\mu)Z(\to e^+e^-)$	ATLAS_2016_I1469071 &ATLAS_2016_I1492320_3

VVV

Process	Mode	based on
WWW	$W(\to e^+\nu)W(\to e^-\bar{\nu})W(\to e^\pm\nu)$	ATLAS_2016_I1492320_3l

VBF-V

Process	Mode	based on	contributing groups
$Z+2j$	$Z(\to e^+e^-)+2j$	ATLAS_2014_I1279489	

VBS

Process	Mode	based on
$WW+2j$	W^+W^++2j	ATLAS_2014_I1298023 & MC_WWJETS

→VBSCan

see 1803.07943

VV

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All sqrt(S)=13 TeV -> not necessarily compared against data

Considered predictions:

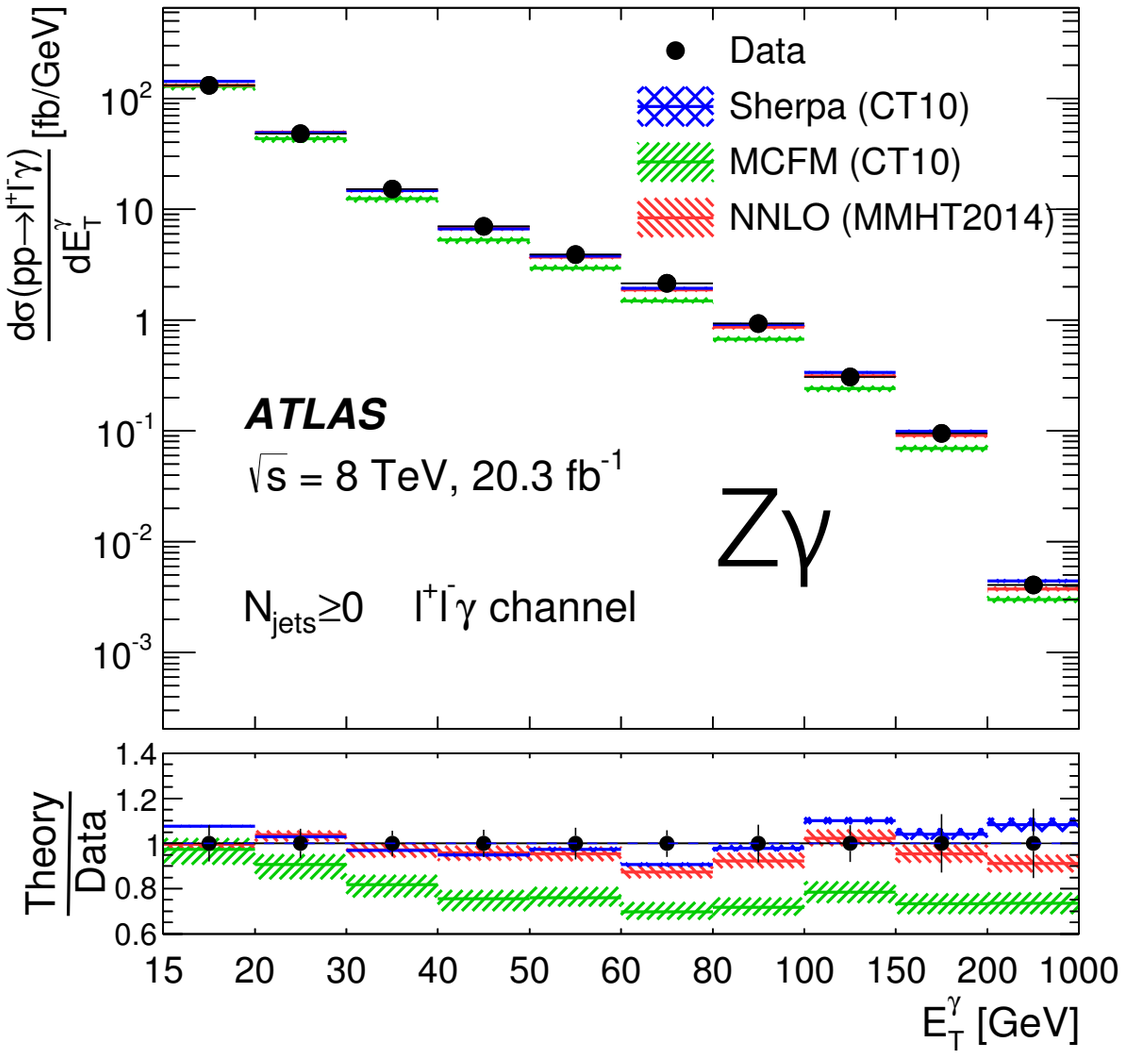
1) fixed order: NNLO QCD + NLO EW → MATRIX

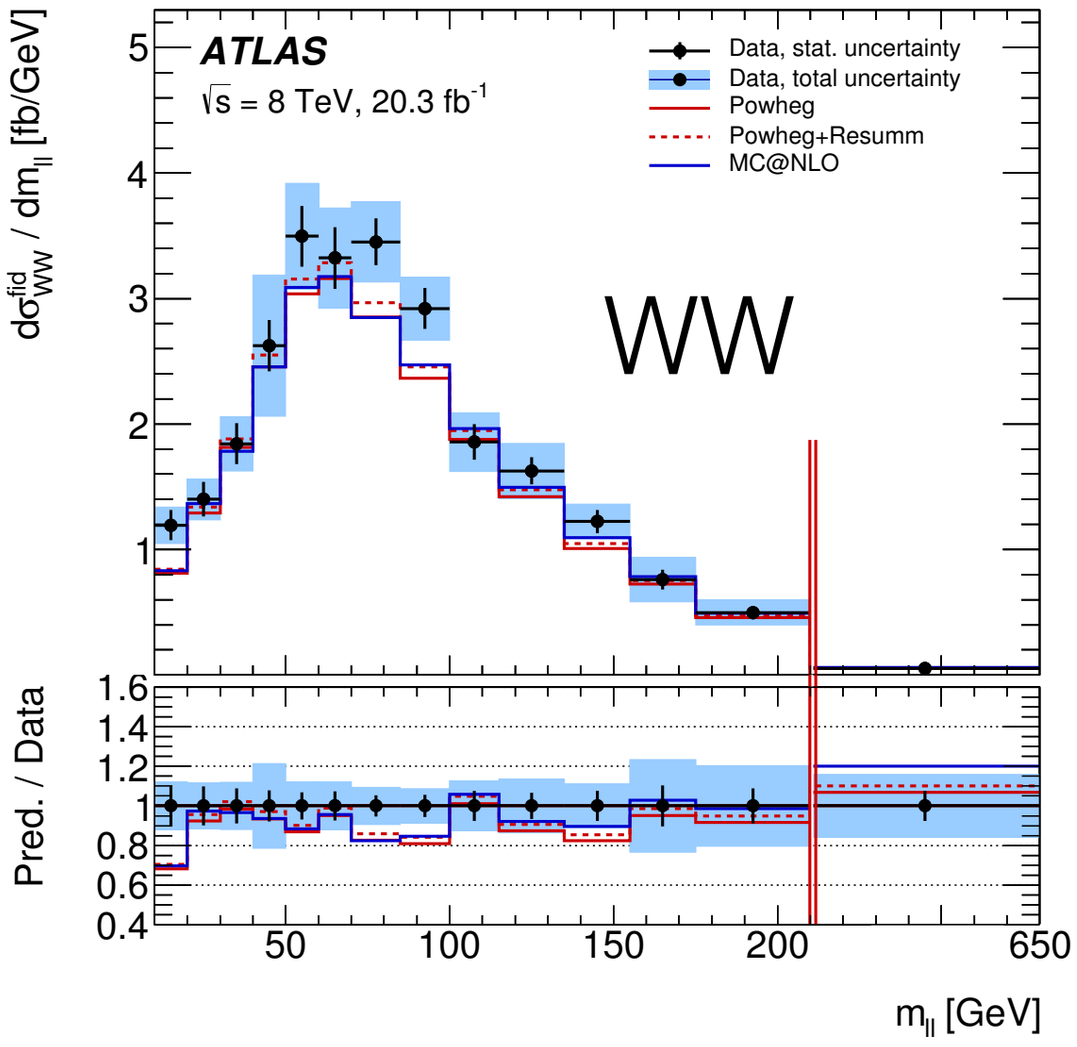
→ MG5_aMC@NLO
Sherpa+Recola/OpenLoops

2) (N)NLOPS (0,1j merged) at particle-level → MG5_aMC@NLO
POWHEG-BOX+MiNLO
Sherpa
HW7
.

3) NLOPS for loop-induced gg (ZZ,WW) → POWHEG BOX+ggvvamp
.

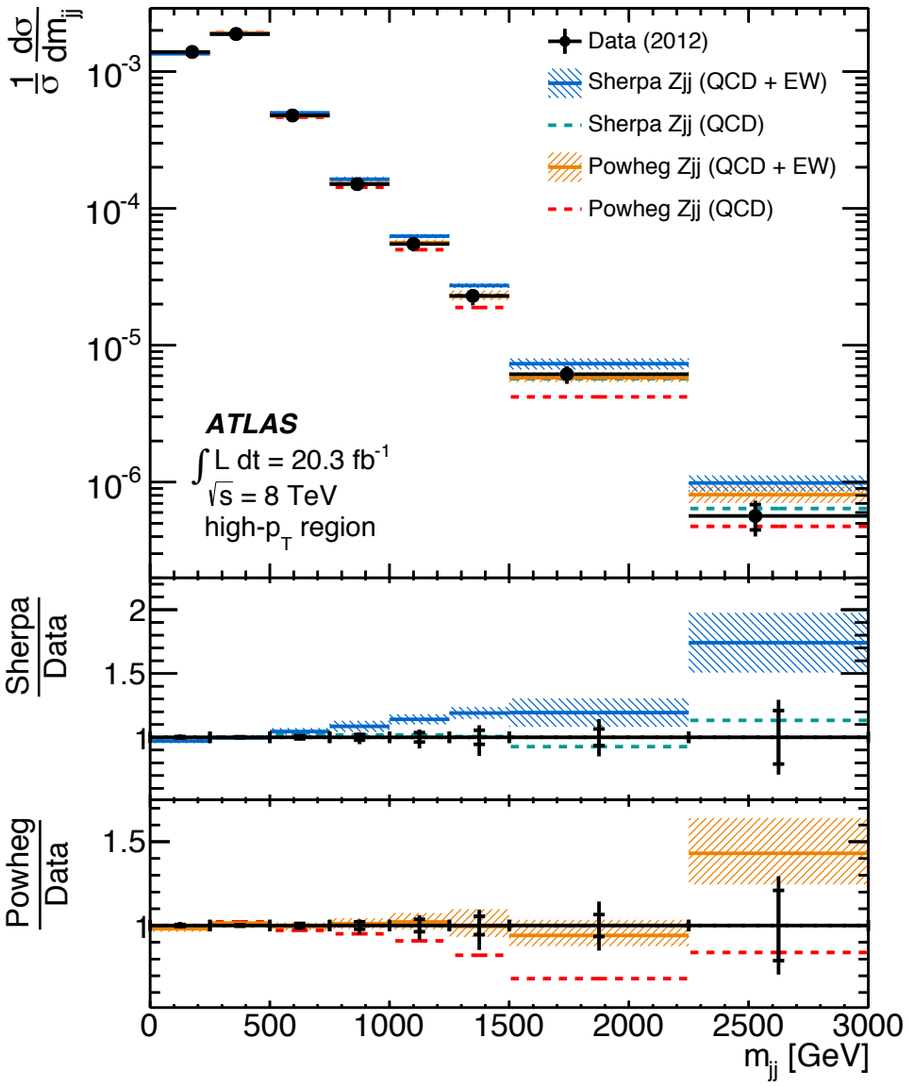
Objectives I: NNLO QCD vs. multi-jet merged

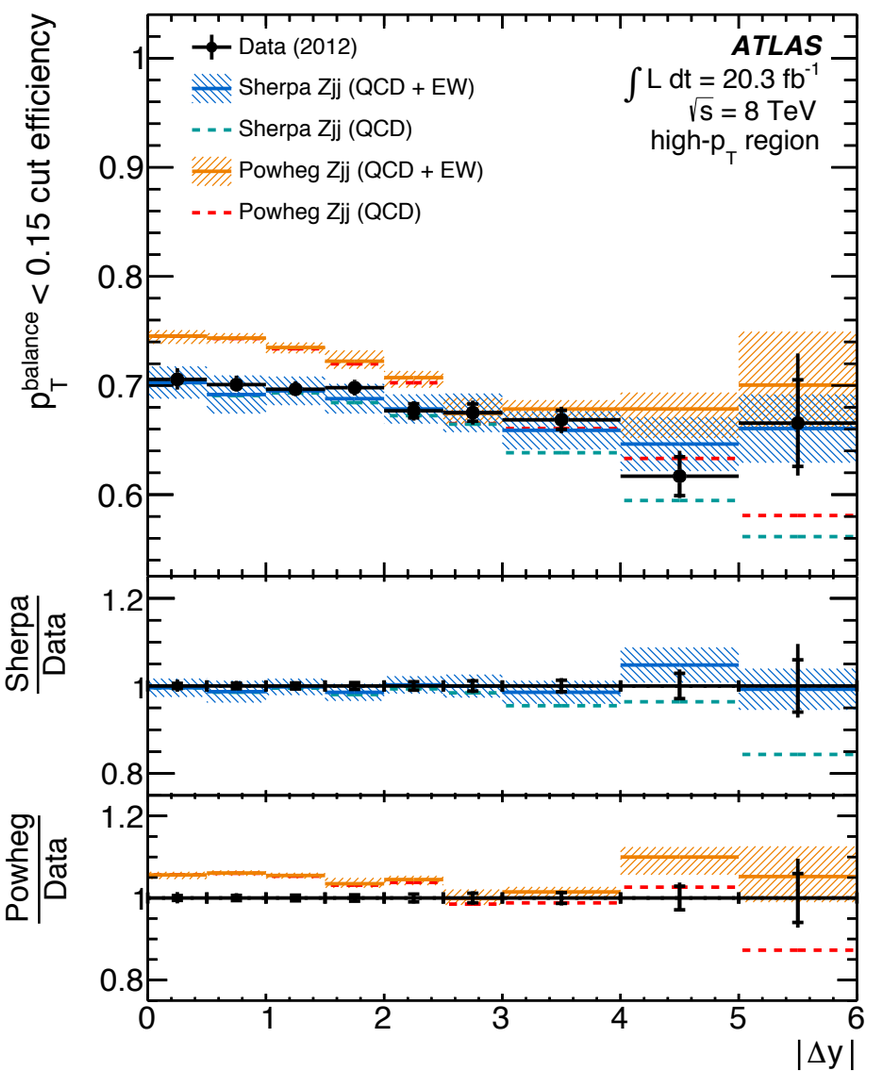




Objectives II: matching systematics

Objectives III: VBF/VBS modelling

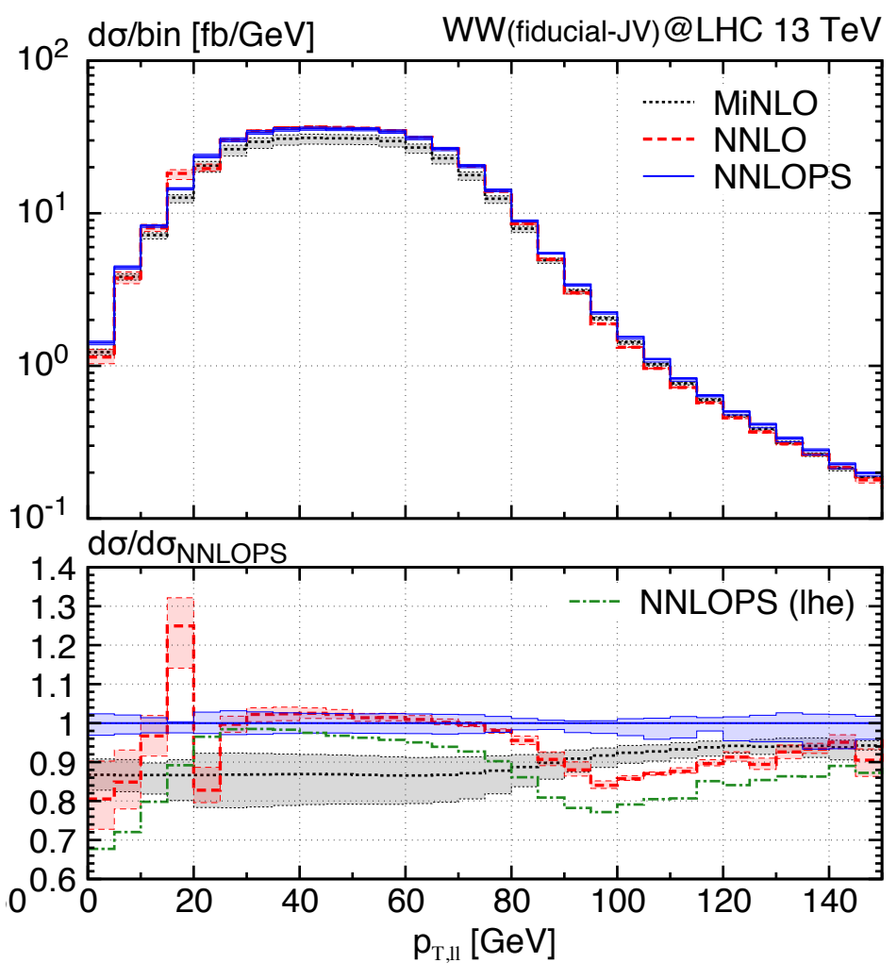


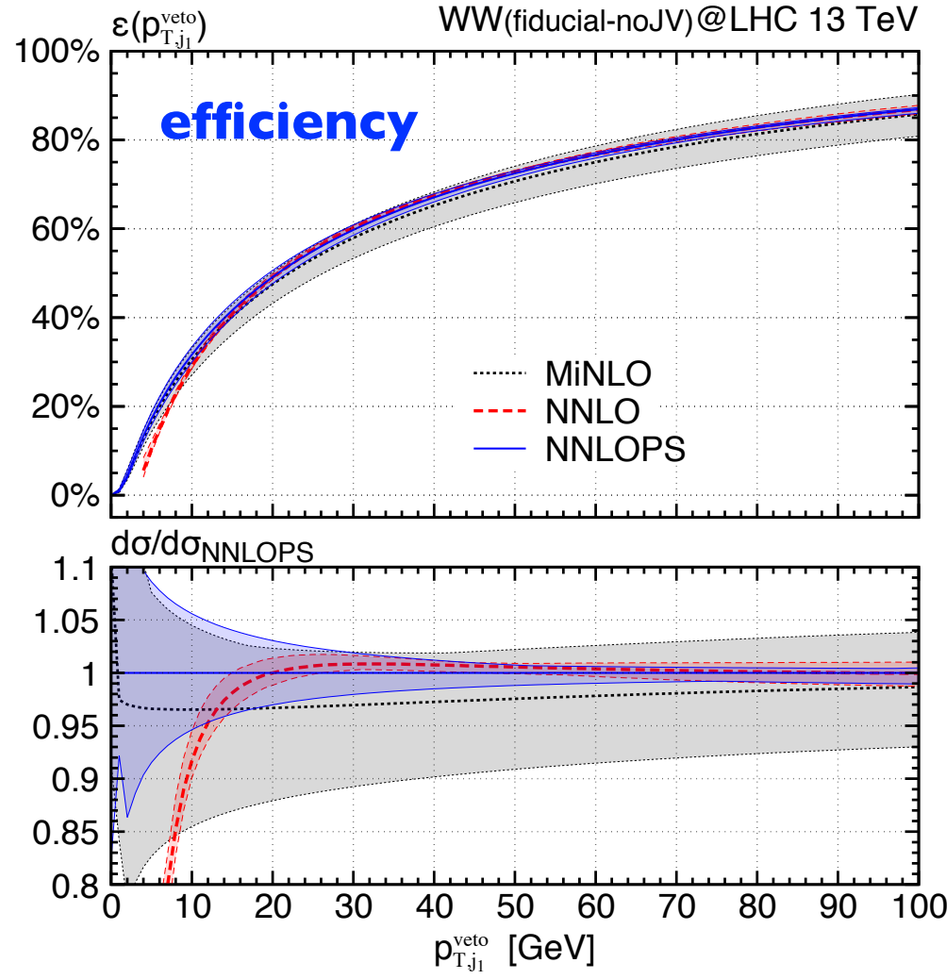


- Recommendations for treatment of central jet veto

Objectives IV: NNLOPS QCD

- for WW production an NNLOPS generator has been presented recently: Re, Wiesemann, Zanderighi, 1805.09857
- based on POWHEG+MiNLO reweighed to NNLO from MATRIX

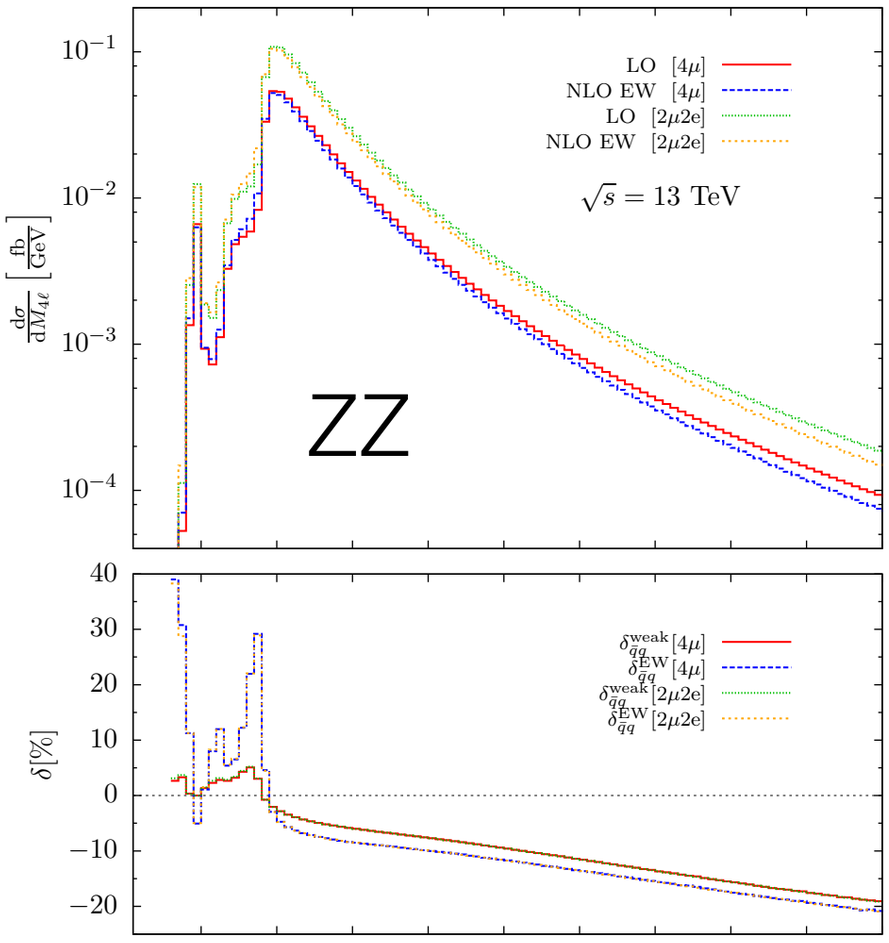




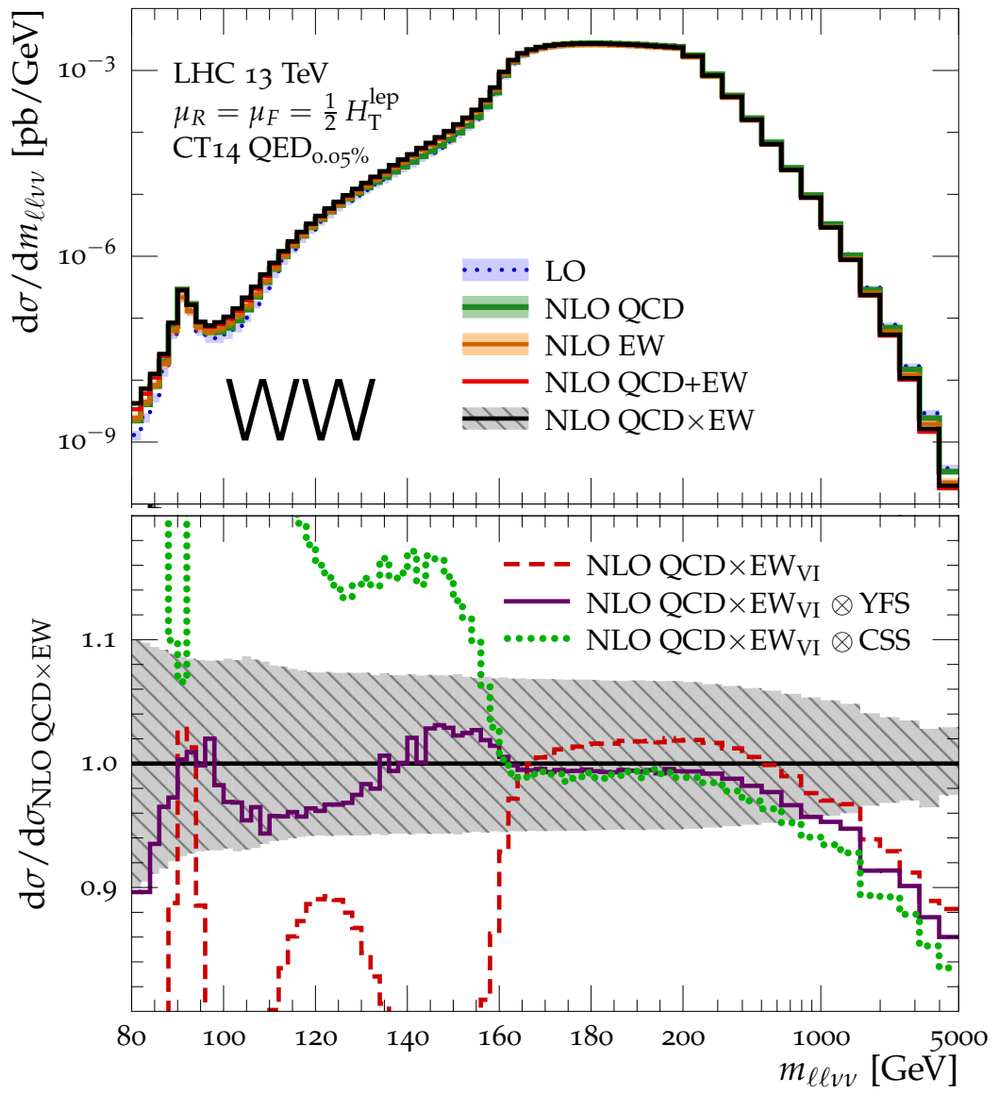
➡compare against nominal ATLAS/CMS predictions

Objectives V: QED modelling

[Biedermann, Denner, Dittmaier, Hofer, Jager, '17]



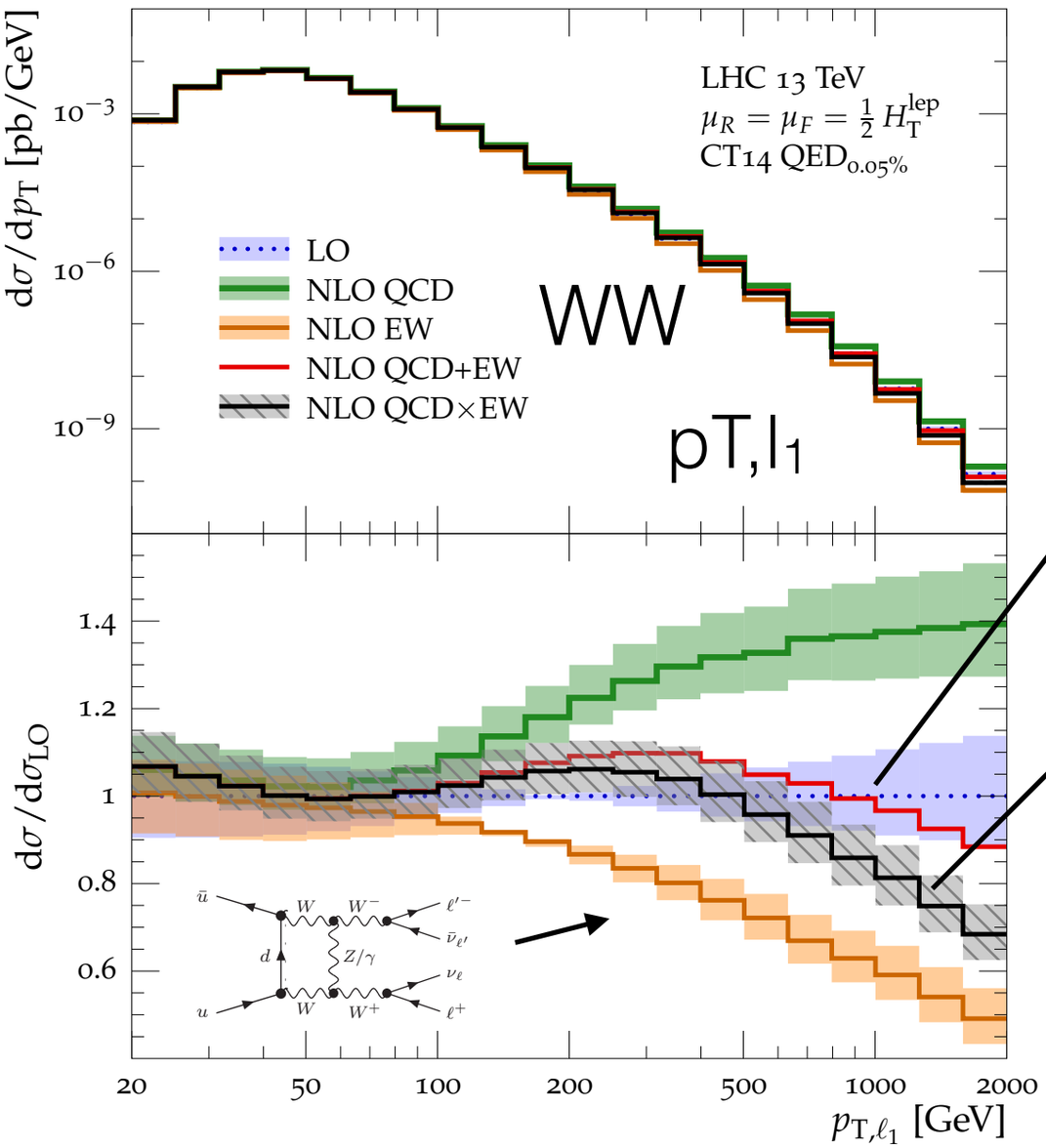
[Kallweit, JML, Pozzorini, Schönherr; '17]



- complicated resonance structures distorted by QED radiation
- compare NLO EW vs. QED parton-shower / YFS …
- in particular relevant for VV as background, e.g. H→VV

Objectives VI: QCD-EW combination

[Kallweit, JML, Pozzorini, Schönherr; '17]



Given QCD and EW corrections are sizeable, also mixed QCD-EW uncertainties of relative have to be considered.

Additive combination

$$\sigma^{\rm NLO}_{\rm QCD+EW} = \sigma^{\rm LO} + \delta\sigma^{\rm NLO}_{\rm QCD} + \delta\sigma^{\rm NLO}_{\rm EW}$$

Multiplicative combination

$$\sigma^{\rm NLO}_{\rm QCD\times EW} = \sigma^{\rm NLO}_{\rm QCD}\left(1 + \frac{\delta\sigma^{\rm NLO}_{\rm EW}}{\sigma^{\rm LO}}\right)$$

(try to capture some $\mathcal{O}(\alpha\alpha_s)$ contributions, e.g. EW Sudakov logs × soft QCD)

Difference between these two approaches indicates size of missing mixed EW-QCD corrections. Here: 10-20% in the tail. Significantly larger e.g. for WZ (large QCD corrections).

- Goal: try to formulate recommendations

Outlook

- ongoing study on MC issues in multiboson processes
- stay tuned! First result soon available…
- Comment welcome!