

MC kick-off

Jonas M. Lindert



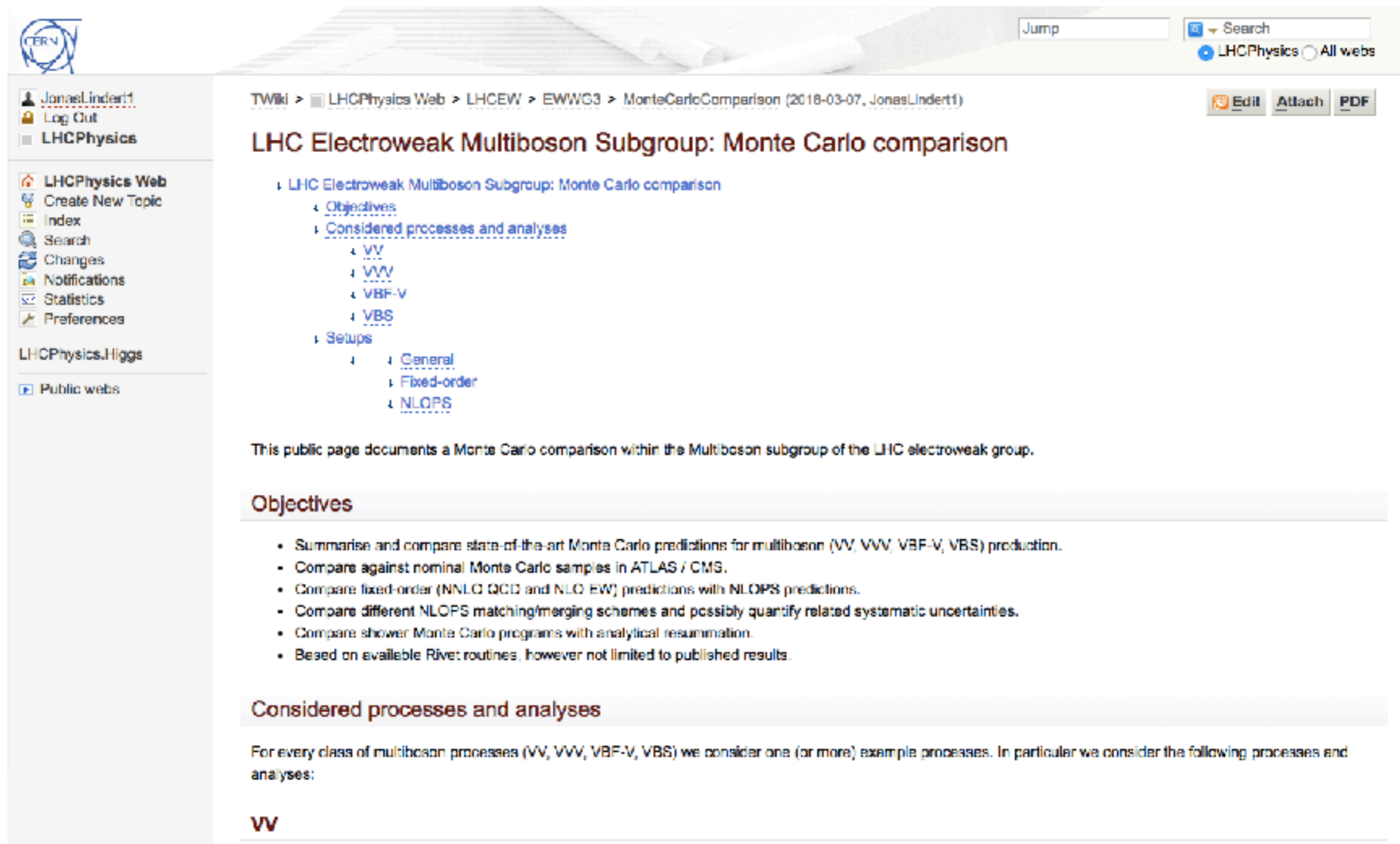
07. March 2018

Objectives

- Summarise and compare state-of-the-art Monte Carlo predictions for multiboson production: **VV, VVV, VBF-V, VBS** (**7 representative signatures**)
 - Compare against nominal Monte Carlo samples in ATLAS / CMS.
 - Compare fixed-order (NNLO QCD and NLO EW) predictions with NLOPS predictions.
 - Compare different NLOPS matching/merging schemes. However, not a tuned technical comparison, i.e. individual scale setting.
 - Compare shower Monte Carlo programs with pT / jet-veto resummation.
 - Based on available Rivet routines. However not limited to published results.
- ➔ Prepare LHC EW WG Yellow Report

Details: Twiki-page

<https://twiki.cern.ch/twiki/bin/view/LHCPhysics/MonteCarloComparison>



The screenshot shows a Twiki page interface. At the top left is the CERN logo. Below it, the user 'JonasLindert1' is logged in, with options to 'Log Out' and 'LHCPhysics'. A search bar is located at the top right, with a 'Jump' field and a search button. The page title is 'LHC Electroweak Multiboson Subgroup: Monte Carlo comparison'. The breadcrumb trail is 'TWiki > LHCPhysics Web > LHCEW > EWWG3 > MonteCarloComparison (2018-03-07, JonasLindert1)'. The page content includes a table of contents with sections: 'Objectives', 'Considered processes and analyses' (subdivided into VV, VVV, VBF-V, VBS), and 'Setups' (subdivided into General, Fixed-order, NLOPS). A paragraph states: 'This public page documents a Monte Carlo comparison within the Multiboson subgroup of the LHC electroweak group.' Below this are sections for 'Objectives' and 'Considered processes and analyses'. The 'Objectives' section lists six bullet points. The 'Considered processes and analyses' section begins with the text: 'For every class of multiboson processes (VV, VVV, VBF-V, VBS) we consider one (or more) example processes. In particular we consider the following processes and analyses:'.

Objectives

- Summarise and compare state-of-the-art Monte Carlo predictions for multiboson (VV, VVV, VBF-V, VBS) production.
- Compare against nominal Monte Carlo samples in ATLAS / CMS.
- Compare fixed-order (NNLO QCD and NLO EW) predictions with NLOPS predictions.
- Compare different NLOPS matching/merging schemes and possibly quantify related systematic uncertainties.
- Compare shower Monte Carlo programs with analytical resummation.
- Based on available Rivet routines, however not limited to published results.

Considered processes and analyses

For every class of multiboson processes (VV, VVV, VBF-V, VBS) we consider one (or more) example processes. In particular we consider the following processes and analyses:

VV

WW

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

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

Desired accuracy:

1) fixed order: NNLO QCD + NLO EW

MATRIX

MG5_aMC@NLO
Sherpa+Recola/OpenLoops

...

2) NLOPS (0,1j merged) at particle-level

MG5_aMC@NLO
POWHEG-BOX+MiNLO
Sherpa
HW7

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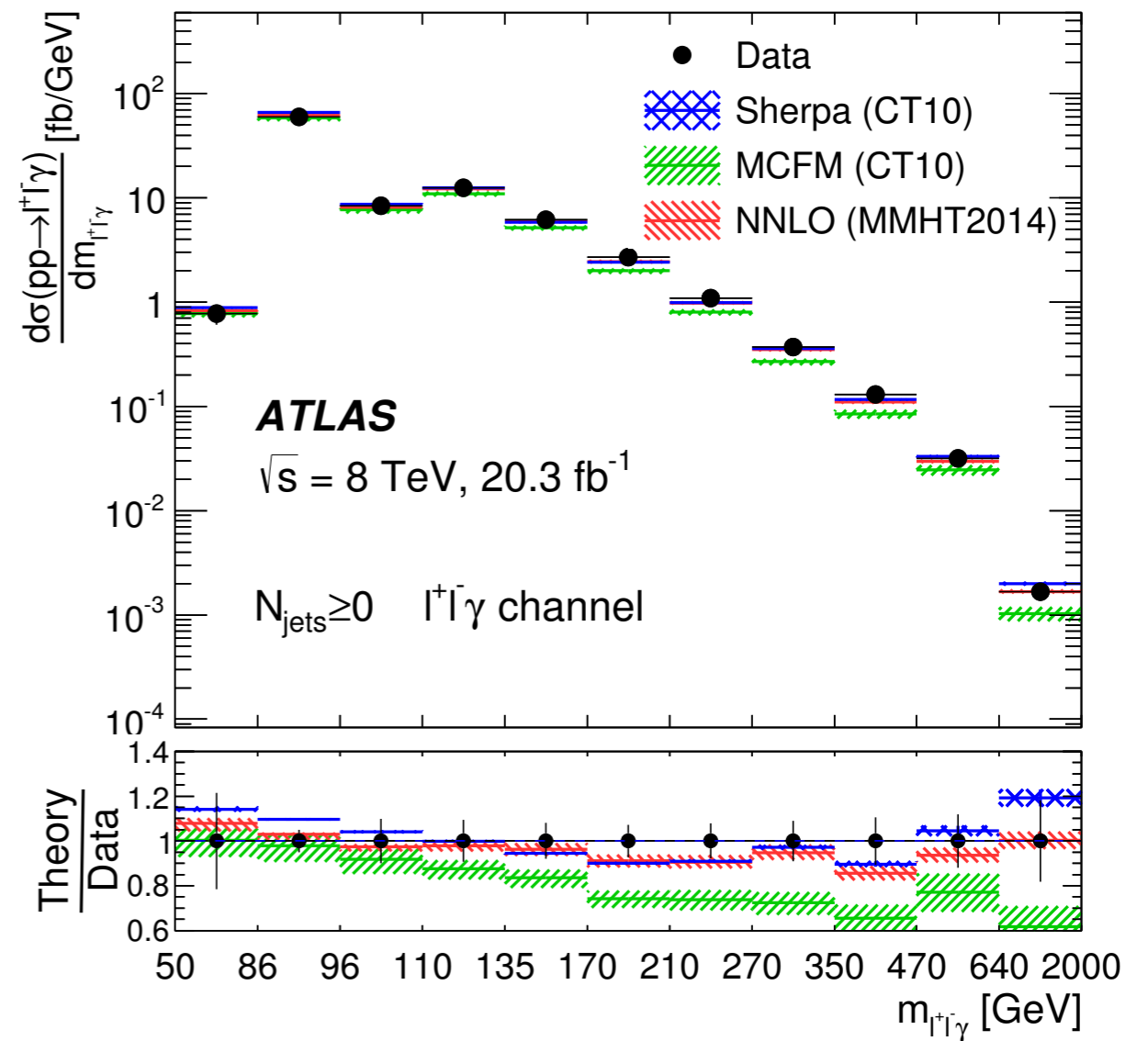
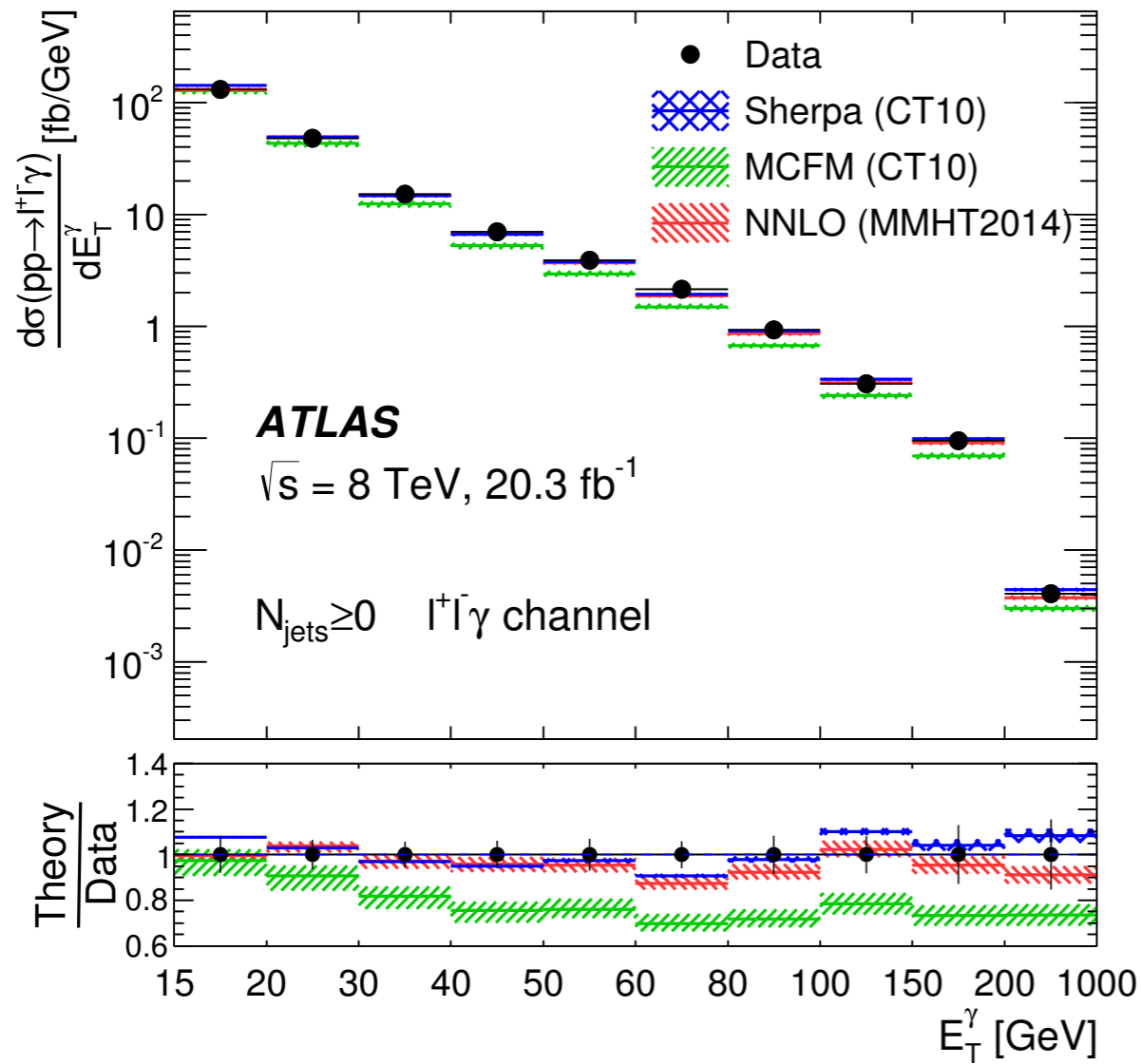
3) NLOPS for loop-induced gg (ZZ,WW)

POWHEG BOX+ggvvamp

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Zgamma

ATLAS_2016_I1448301

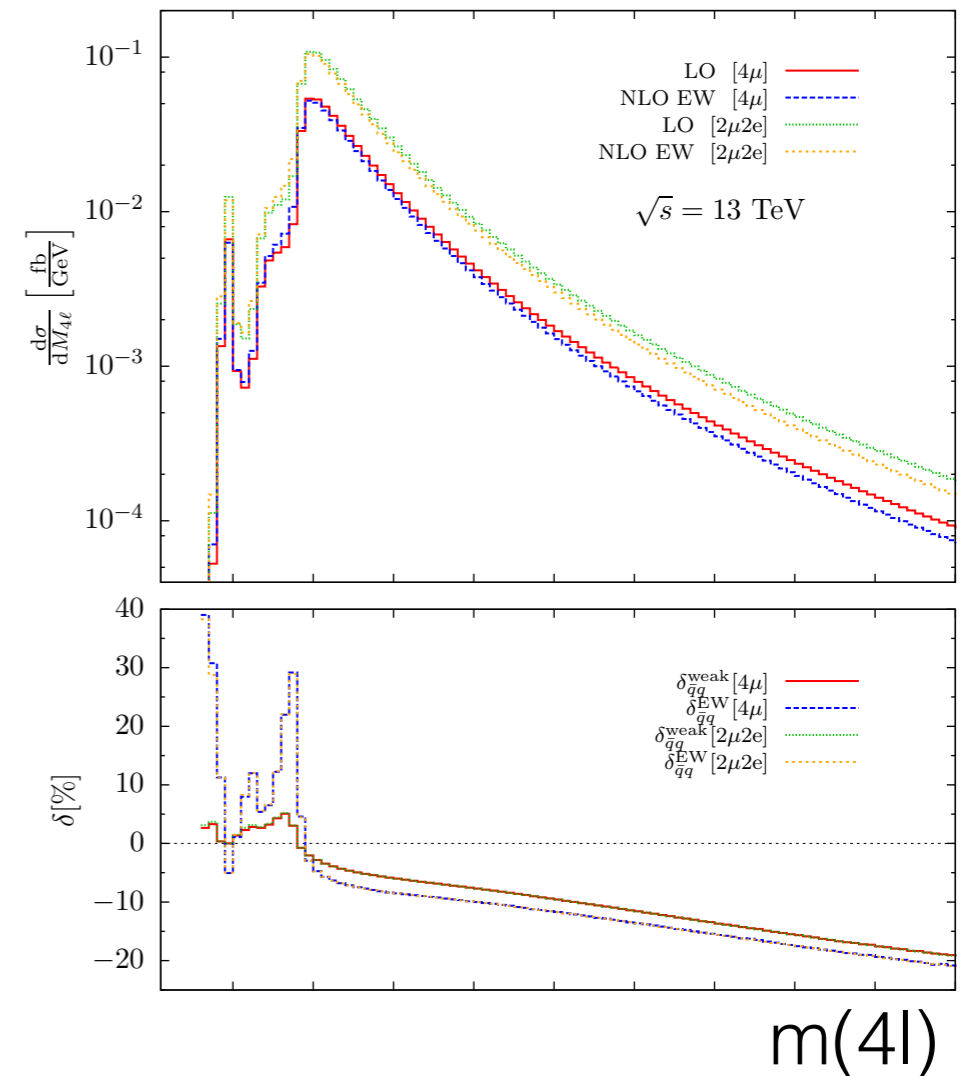
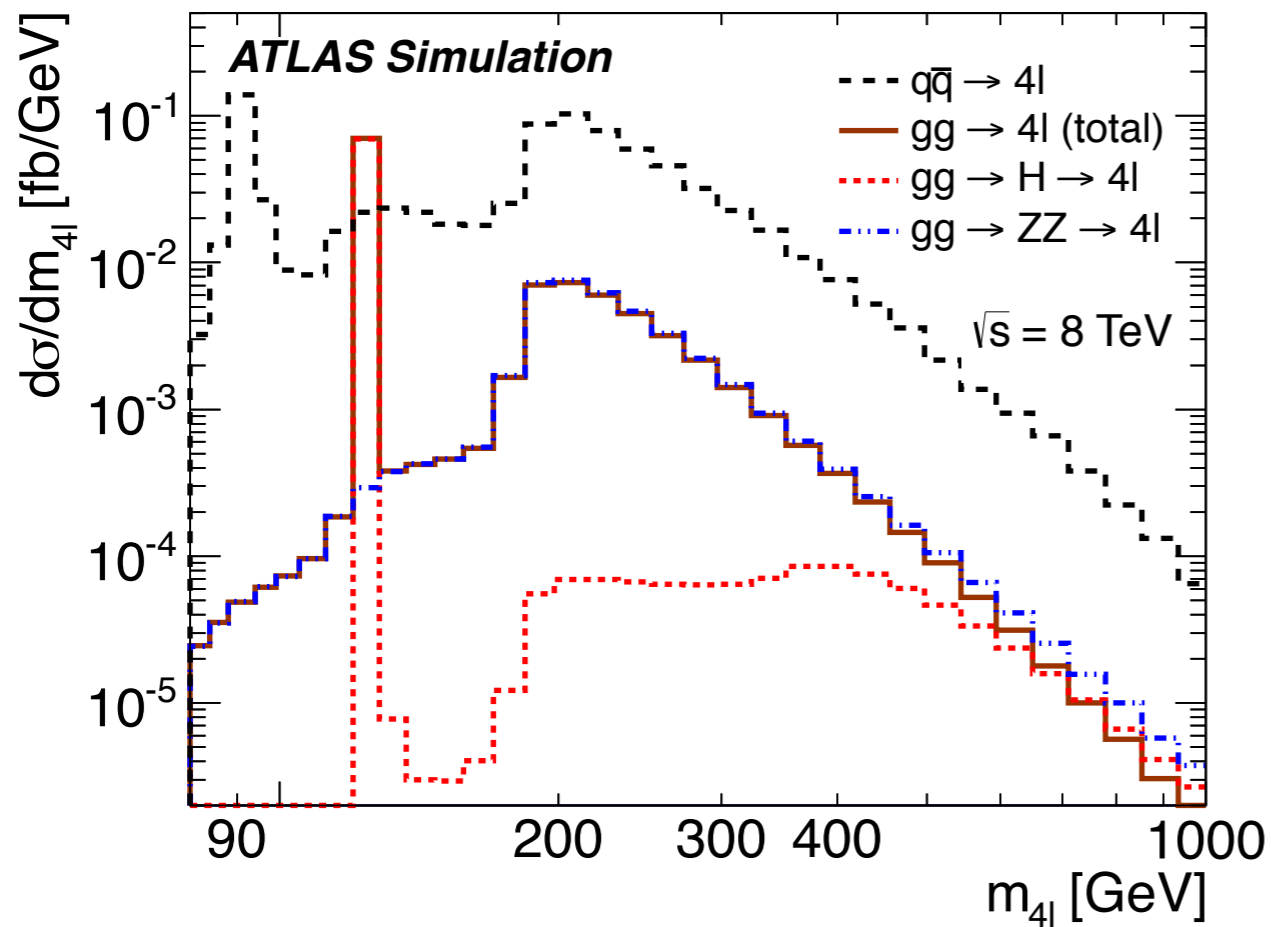


Observables: E_T^γ , $m(l\bar{l}\gamma)$ + m_{ll} , p_{Tll} , $dR(l\bar{l},\gamma)$
(with and without jet veto)

ZZ: line-shape & pT(ZZ)

ATLAS 2015 I1394865, MC ZZINC, CMS 2012 I1298807

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

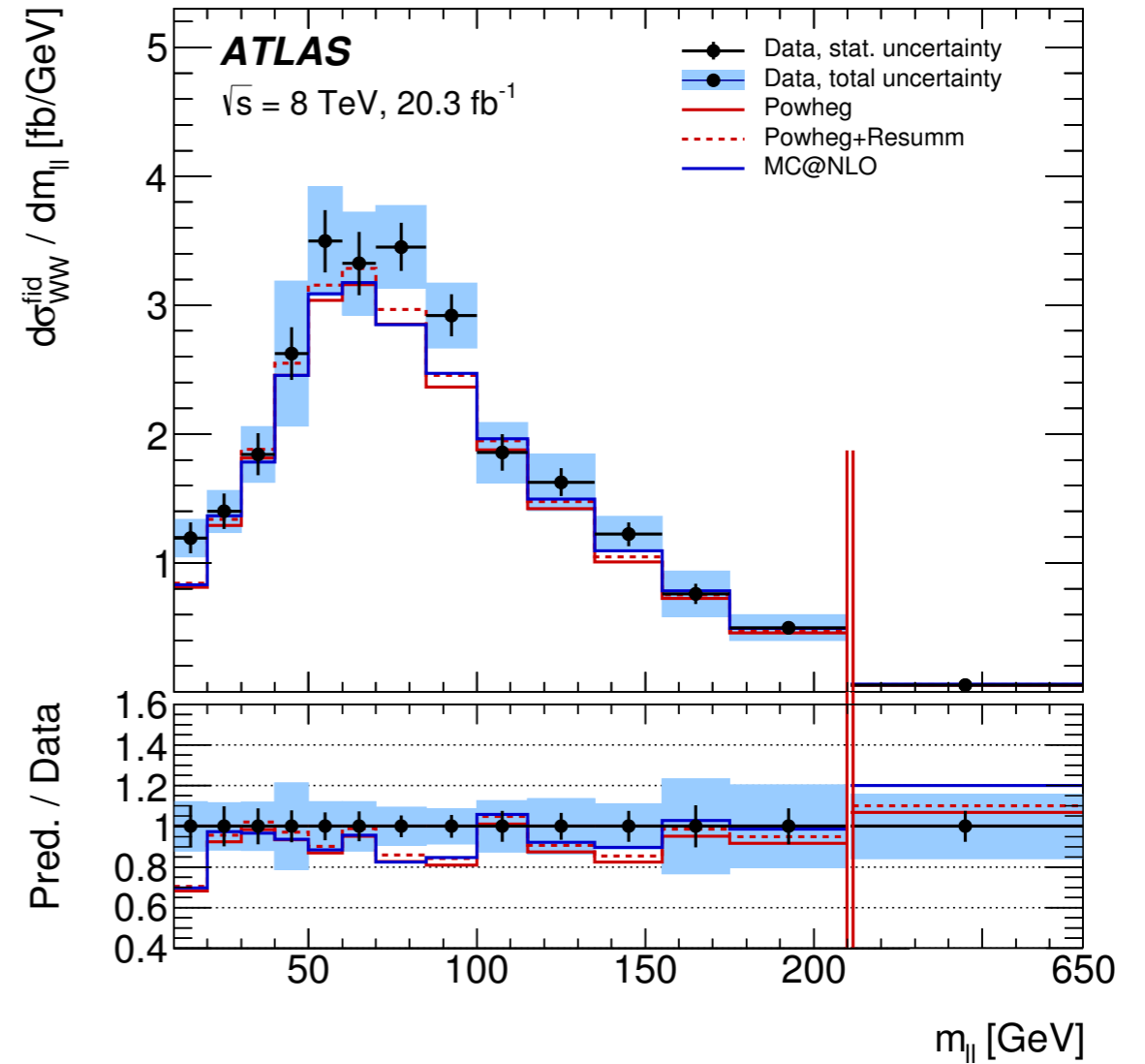
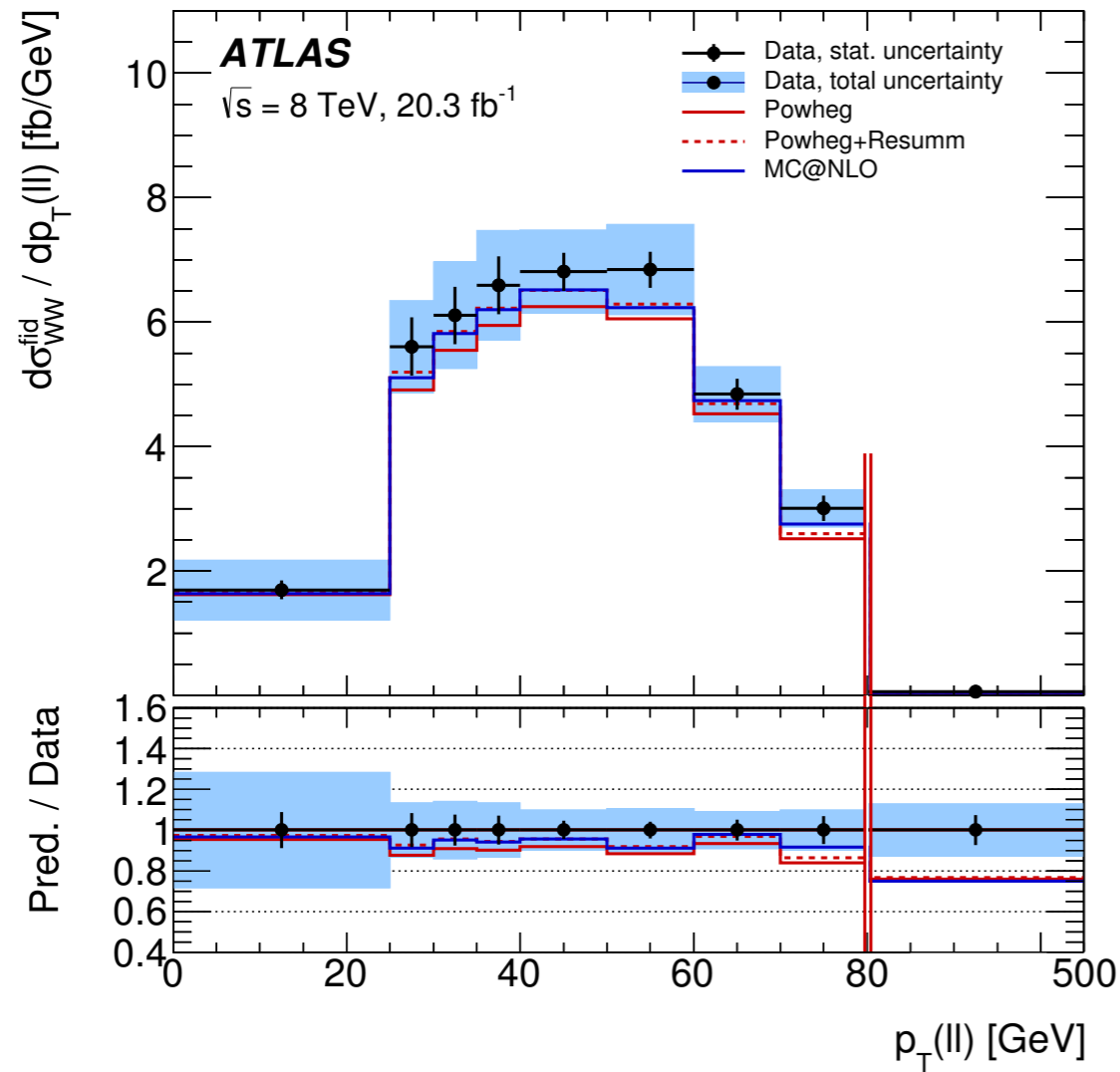


Observables: m_{4l} , p_{TZZ} , p_{TZ1} , p_{TZ1} , p_{TZ1} , $d\Phi(Z1,Z2)$, $d\Phi(l+,l-), \dots$

Objectives include: compare NLO EW with QED-PS



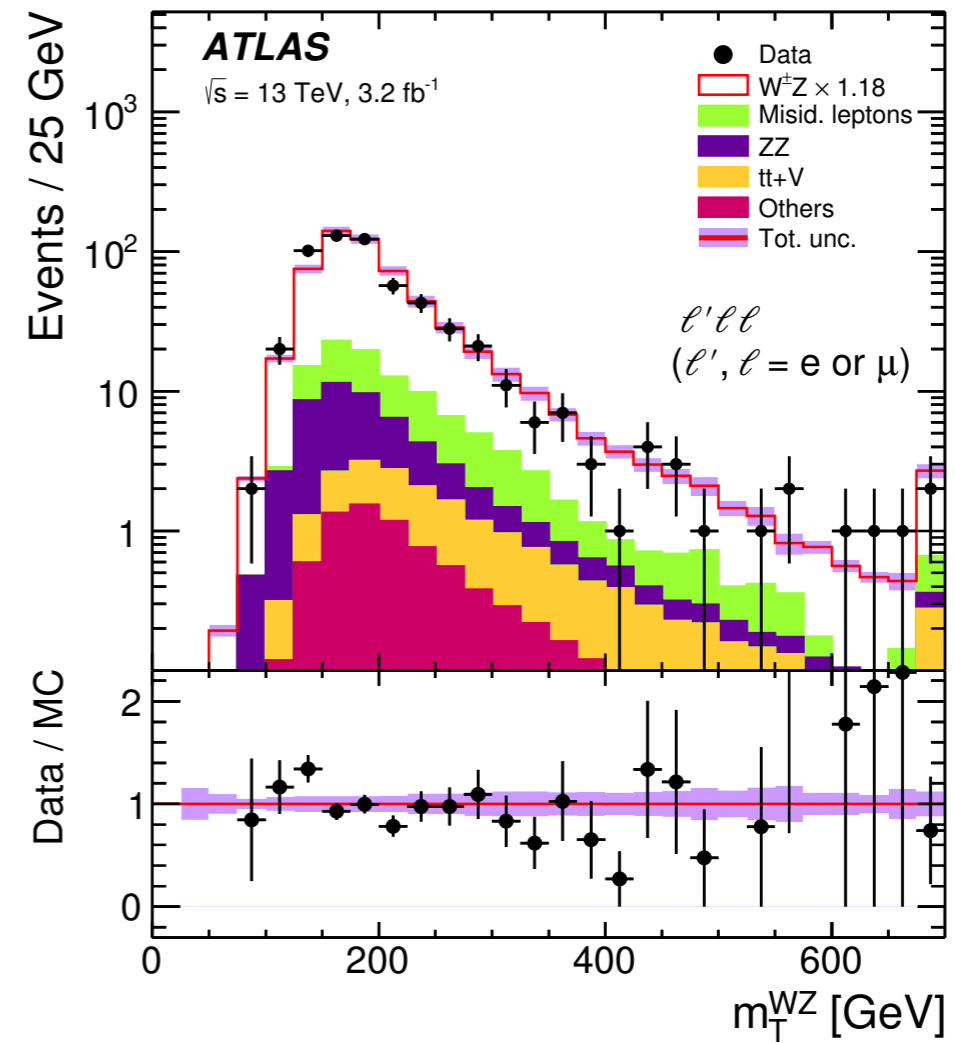
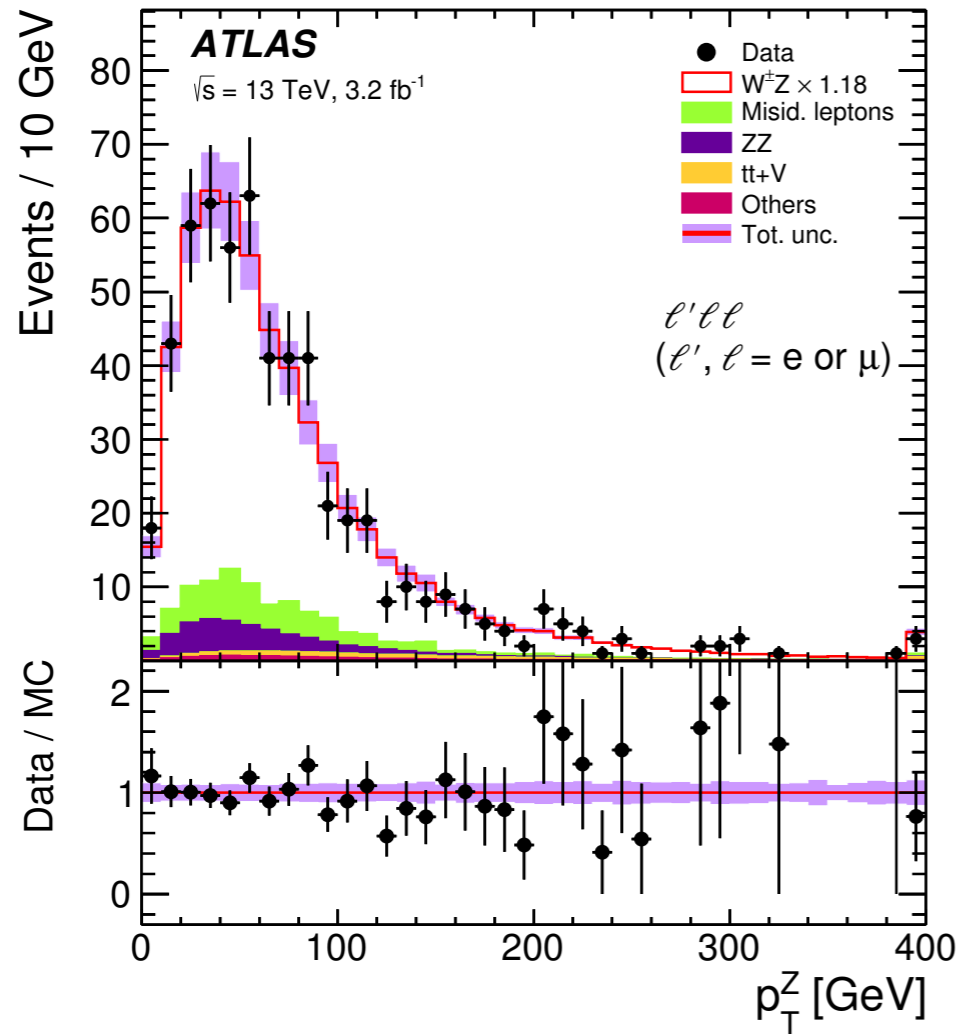
ATLAS_2016_II426515 & MC_WWINC & MC_WWJETS



Observables: $p_T(\text{II})$, $m(\text{II})$, $d\Phi(\text{I},\text{I})$, $p_{T1} + \text{MET}$, high- m_{II}
WW-jet correlations: $d\text{Eta}(\text{WW},j1)$, $dR(\text{WW},j1)$, ...

WZ

ATLAS_2016_I1469071



Observables: p_T^Z , m_T^W , m_T^{WZ} , $m(\text{III})$, p_T^I

WW

Process	Mode	based on	contributing groups
WWW	$W(\rightarrow e^+\nu)W(\rightarrow e^-\bar{\nu})W(\rightarrow e^\pm\nu)$	ATLAS 2016 I1492320 31	
$W^+W^-\gamma$?		

Desired accuracy:

1) fixed order: NLO QCD + NLO EW (on-shell)

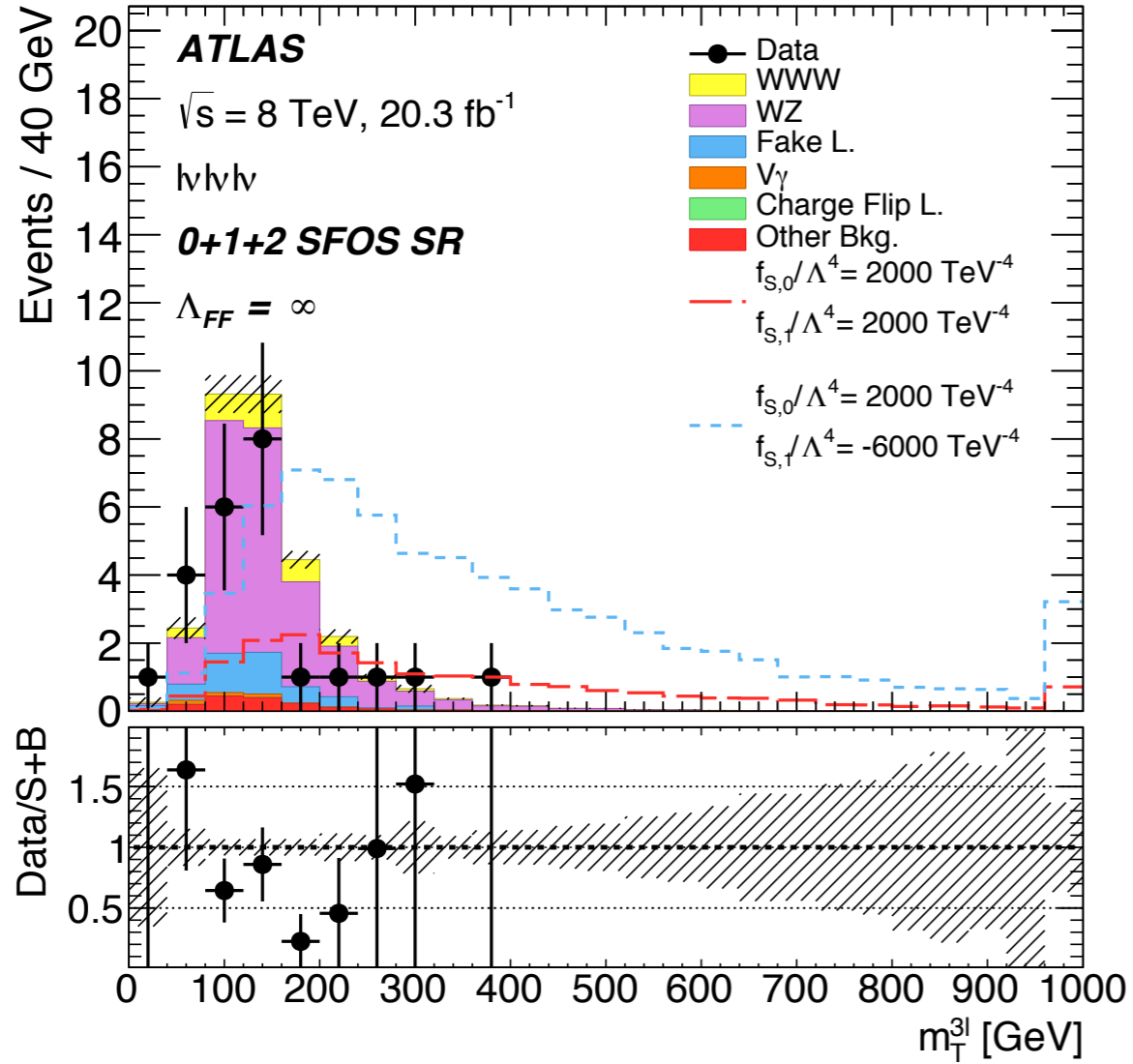
Dittmaier-Huss-Knippen '17
MG5_aMC@NLO
Sherpa+Recola/OpenLoops

2) NLOPS at particle-level

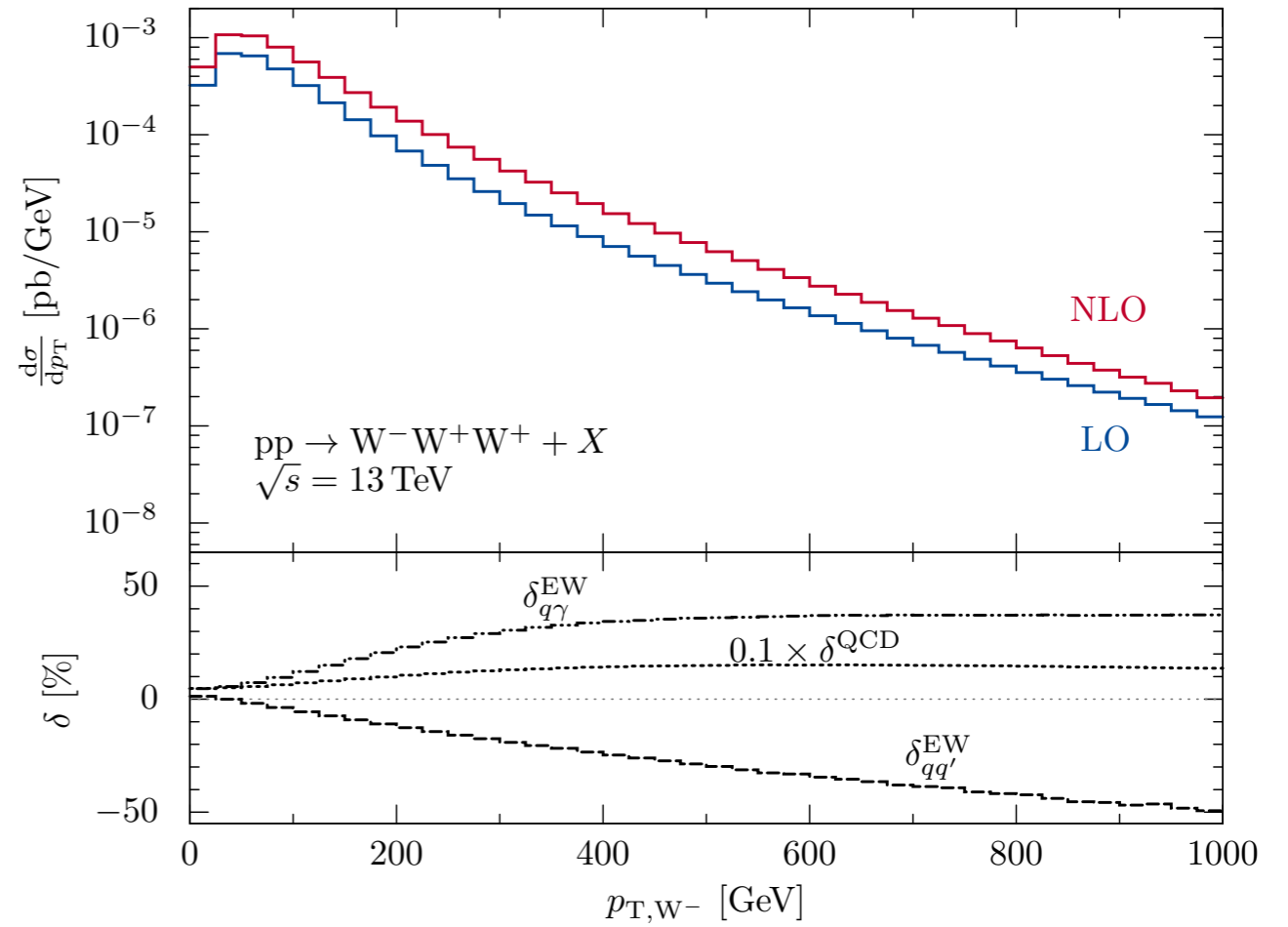
MG5_aMC@NLO
Sherpa
HW7
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WW

ATLAS 2016 I1492320 3I



[Dittmaier, Huss, Knippen '17]



Observables: $m(III)$, p_{TW1} , p_{TW2} , p_{TW3} , MET

VBF-V

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

I) NLOPS at particle-level:

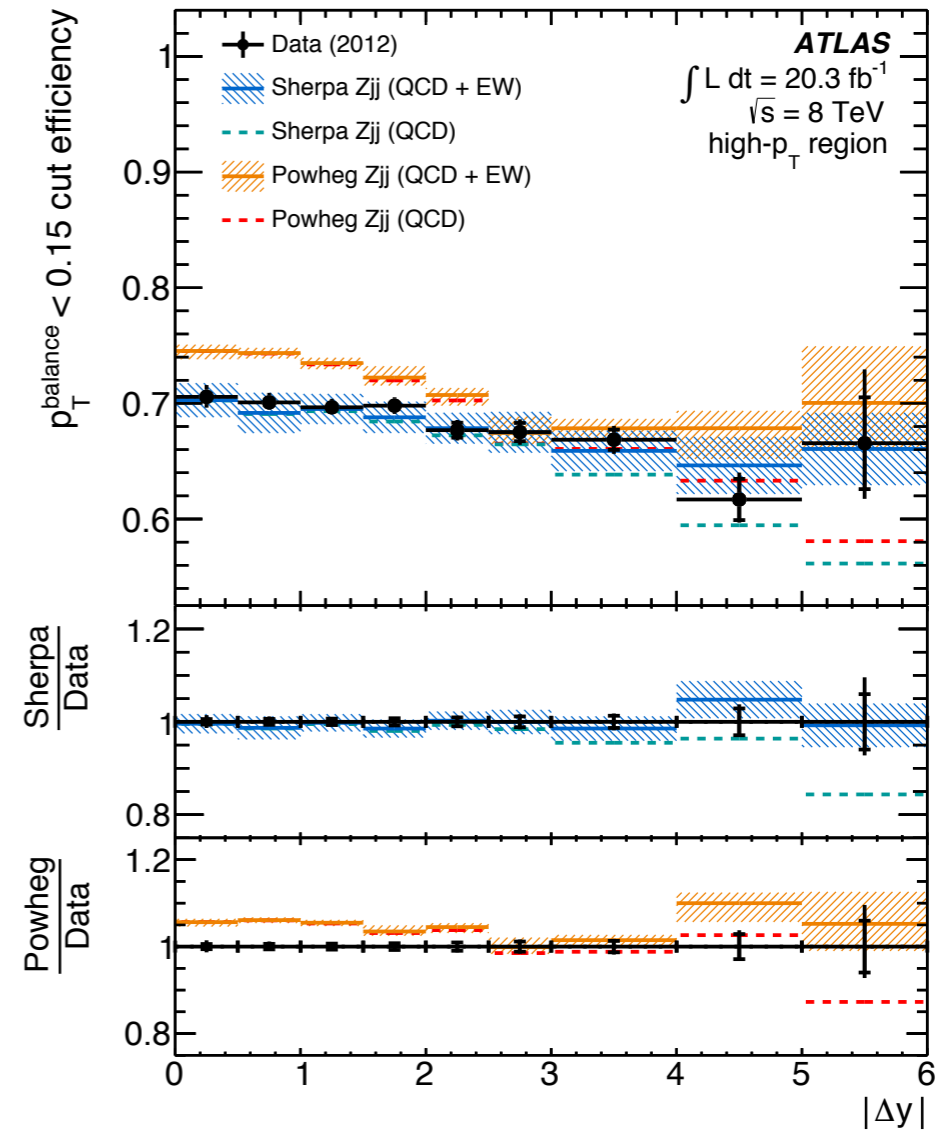
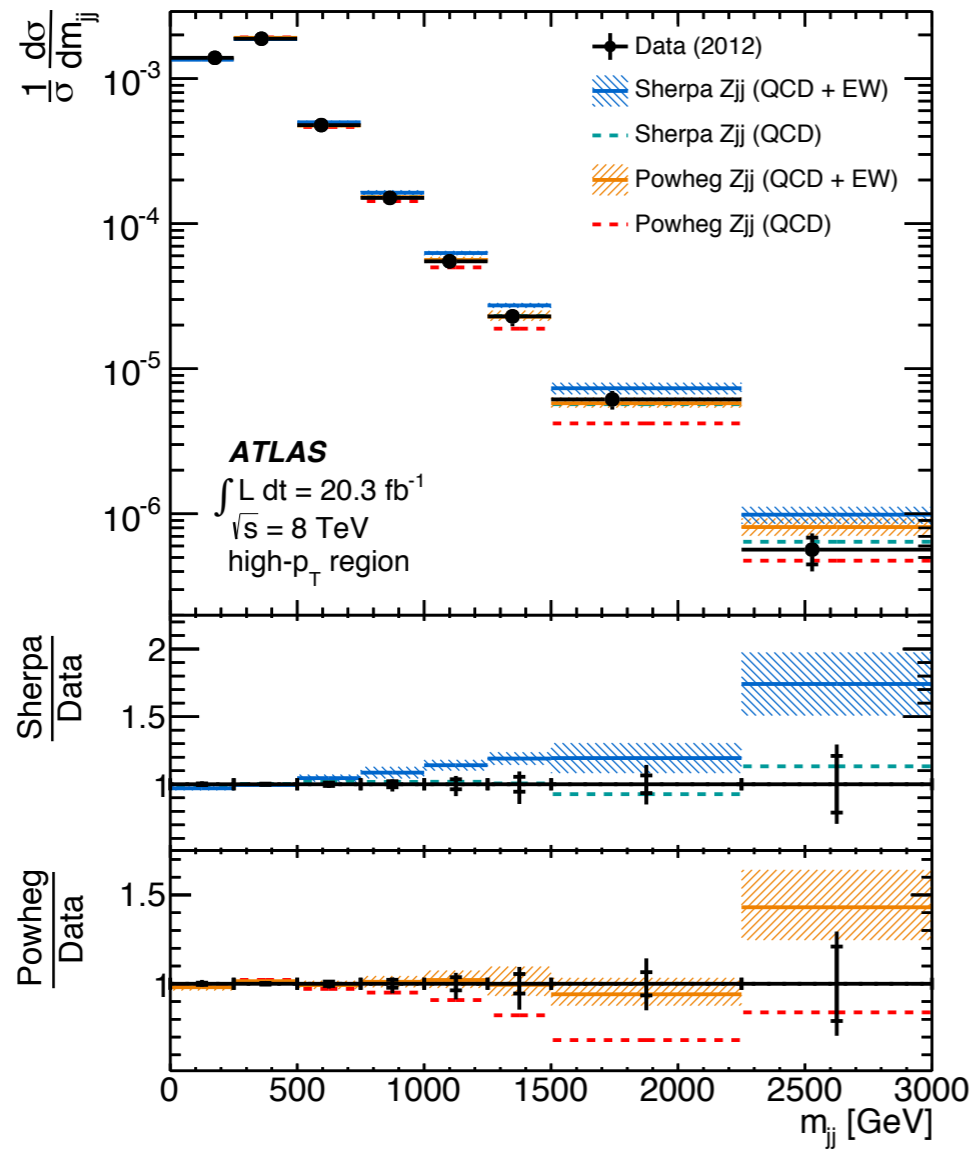
- 1) QCD-prod
- 2) EW-prod (in VBF approximation or LOPS)



MG5_aMC@NLO
POWHEG-BOX
Sherpa
HW7
....

VBF-V

ATLAS 2014 I1279489



Observables: $m(jj)$, $dy(jj)$ + p_{Tj1} , p_{Tj2} , p_{TZ}

VBS

Process	Mode	based on	contributing groups
VBS-WW-ss	$W^+W^+ + 2j$	ATLAS_2014_I1298023 & MC_WWJETS	

Desired accuracy:

1) fixed order: full SM NLO (QCD + EW)



MoCaNLO+Recola

2) NLOPS at particle-level:

1) QCD-prod

2) EW-prod (in VBF approximation or LOPS)



MG5_aMC@NLO

POWHEG-BOX

Sherpa

HW7

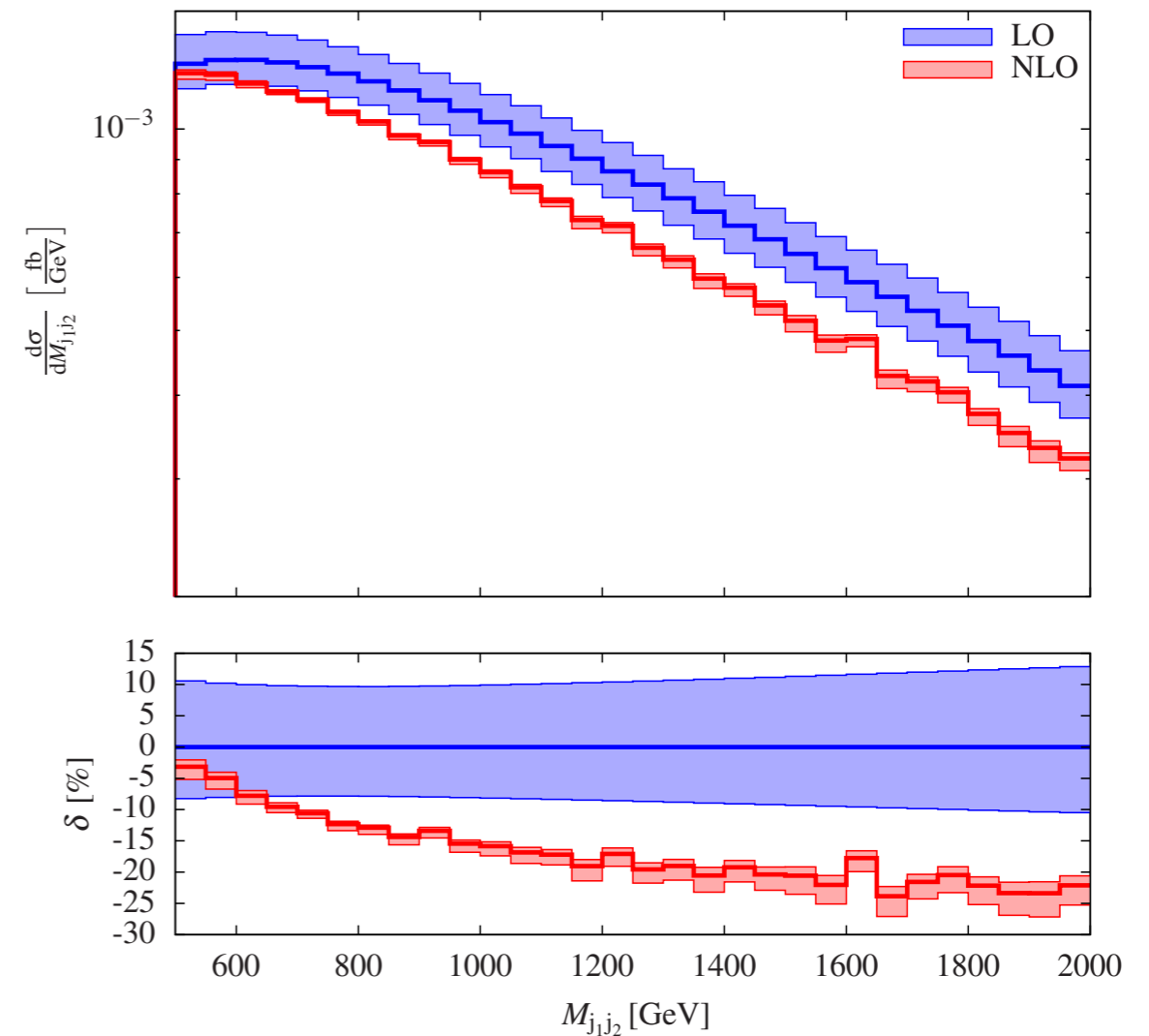
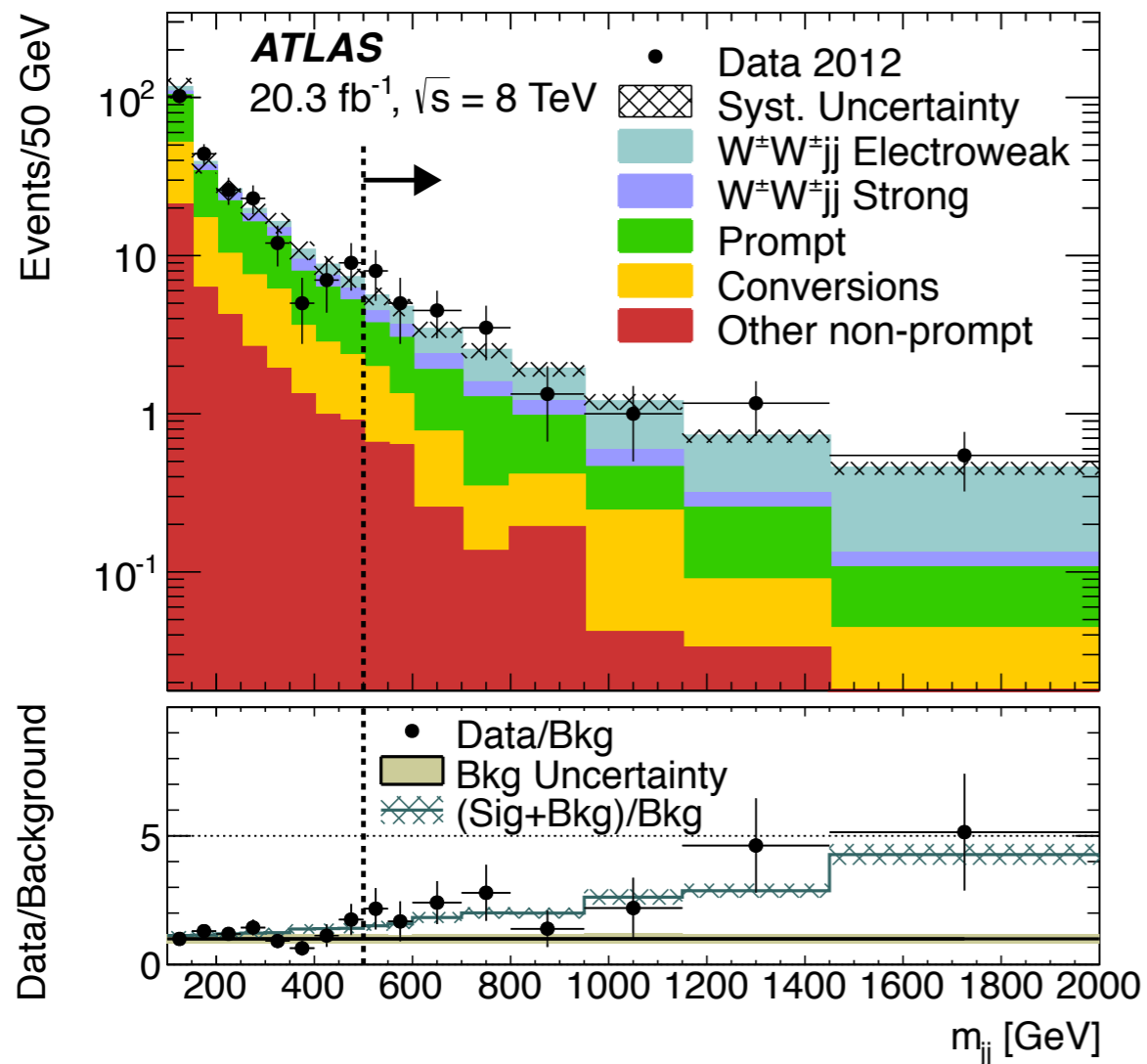
Whizard

....

VBS

ATLAS 2014 I1298023

[Biedermann, Denner, Pellen '17]



Extended by: $m(jj)$, $dy(jj)$, pT_{j1} , pT_{j2} , MET, pT_{l1} , pT_{l2}

-> VBSCan COST network?

(contact: M. Zaro, M. Pellen)

Timeline

MC kick-off - 07.03.18



finalise object definitions and analyses - end of March



first preliminary results - end of April



Initial comparison - mid of June



LHCWG General meeting - 21./22. of June , CERN



Final results - end of Summer

Get involved!

lhc-ewwg-multiboson-admin@cern.ch

already committed groups:

CMS/ATLAS

MATRIX

HW7

Sherpa