

# Outlook and Action Items

MC generators and future challenges

- a joint ATLAS/CMS/CERN LPCC workshop

ATLAS: A. Buckley and T. Kuhl

CMS: P. Lenzi and S. Padhi

LPCC: M. Mangano

Many thanks to the speakers for extremely nice talks!!

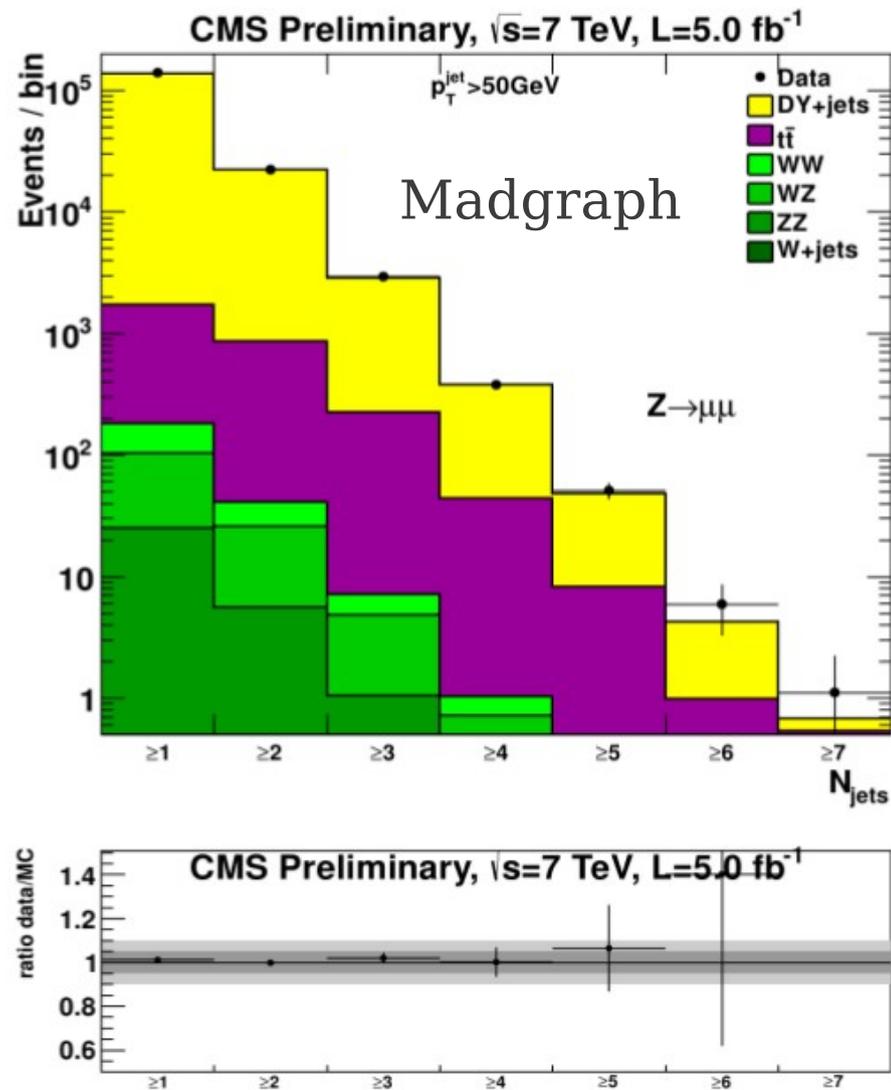
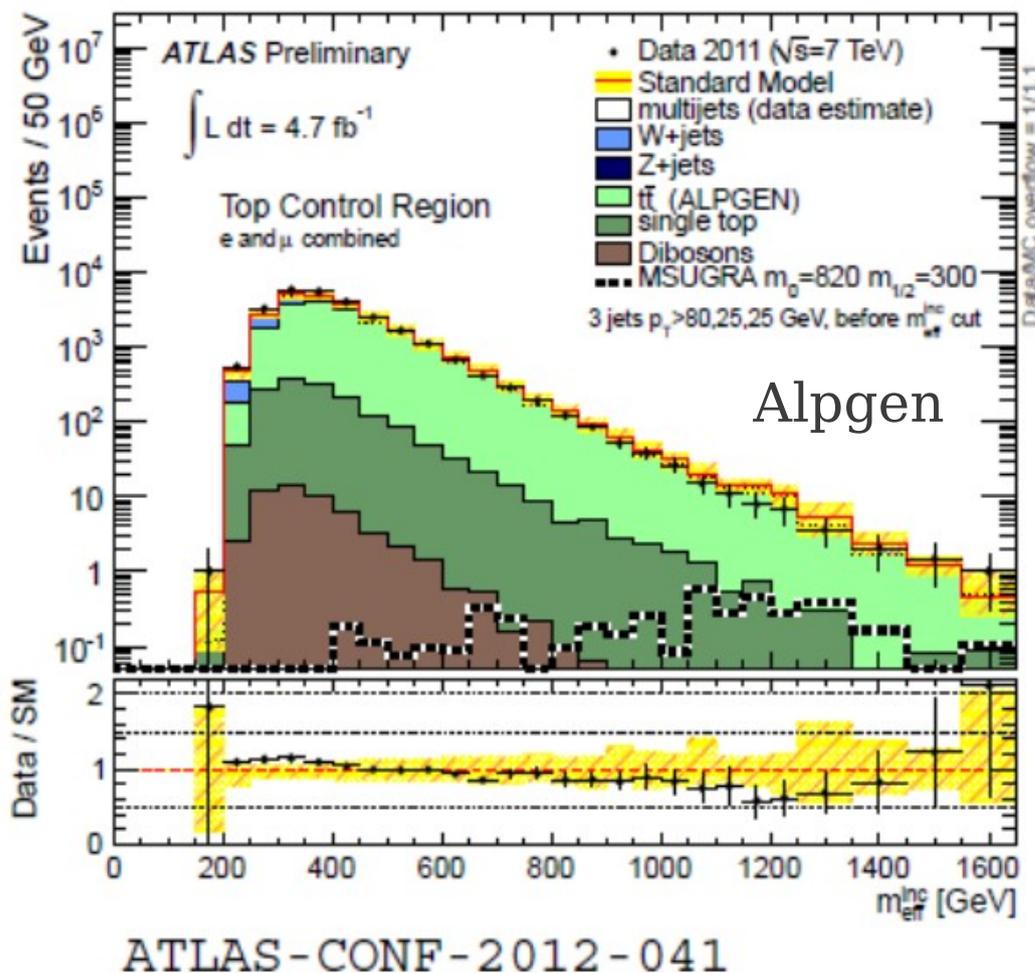
- Special thanks to the audience for valueable comments/suggestions

We need to move forward with the key items we learnt during the workshop ..

# Key Highlights

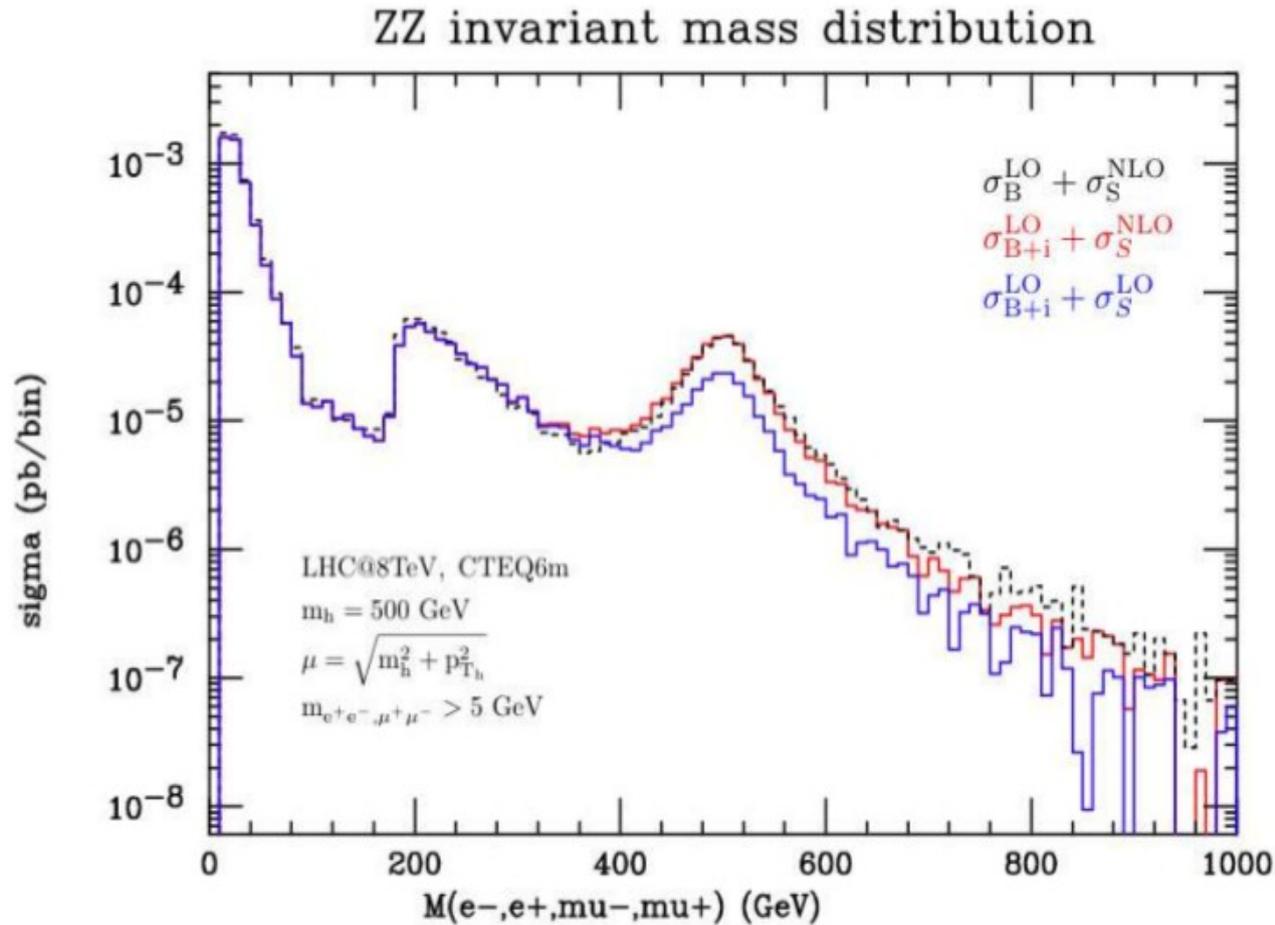
One of the major success of the current multi-leg matched MC generators

- it describes extremely well in bulk as well as shapes for most regions



# Brand new NLO + multiparton generators

aMC@NLO : <http://amcatnlo.cern.ch>



Similarly:

Sherpa+NLO

# Brand new NLO + multiparton generators

We should define a few key processes, which can be pushed through using aMC@NLO/Sherpa+NLO with ATLAS/CMS simulations for comparison/validation/predictions

- $Wbb + \text{Jets}$
- $Zbb + \text{Jets}$
- $t\bar{t}b\gamma$ ,  $t\bar{t}bW$ ,  $t\bar{t}bZ$ ,  $WW\gamma$ ,  $WWW$  etc

Validation is the key to gain the trust:

- Sherpa with Openloops, GoSam or BlackHat

**Action item: Integrate them into our experimental infrastructure**

# Shower developments with multi-leg matching

Remarkable developments in the shower profiles

- See Pythia (Leif Lonnblad) and Herwig (Simon Plaetzer) talks

Experiments are currently moving into fully C++ era

- Need it for multi-threading/parallel processing .. etc
- Alpgen/Madgraph with Pythia8 (or Herwig++) are the next steps
- Use 4-flavour shower scheme.

Pythia8:

- Can we declare “no need” for power shower ?

# Experimental needs

Experiments need clear guidance from MC authors on best shower configs to use with:

- Pythia8 CKKW-L will reweight  $\alpha_s$  mismatches
  - UMEPS, UNLOPS ... as the next step
  - more shower freedom
- Alpgen+PYTHIA ~requires consistent  $\alpha_s$
- Sherpa internally forces consistency of PDF/ME/PS  $\alpha_s$ !
  - Choice of PDF defines jet shapes?!
- Building systematics from 2/3/4 scale variations
  - use of weight vectors in **rivet**

# Experimental needs

Impact of soft QCD tuning on NLO matching?

- Colour reconnection in ttbar etc.?
- Studies in collaboration with authors will help us a lot.

Collaborative work should be possible/encouraged

(worked well with ATLAS involvement in Alpgen+Pythia8)

Communication is the key (Inter-experiment as well as with the authors)

In particular experiments should talk more with MC authors directly

(within constraints of data security and via designated contacts).

Pure MC studies should not be controversial, and we only hurt ourselves by trying to handle everything internally.

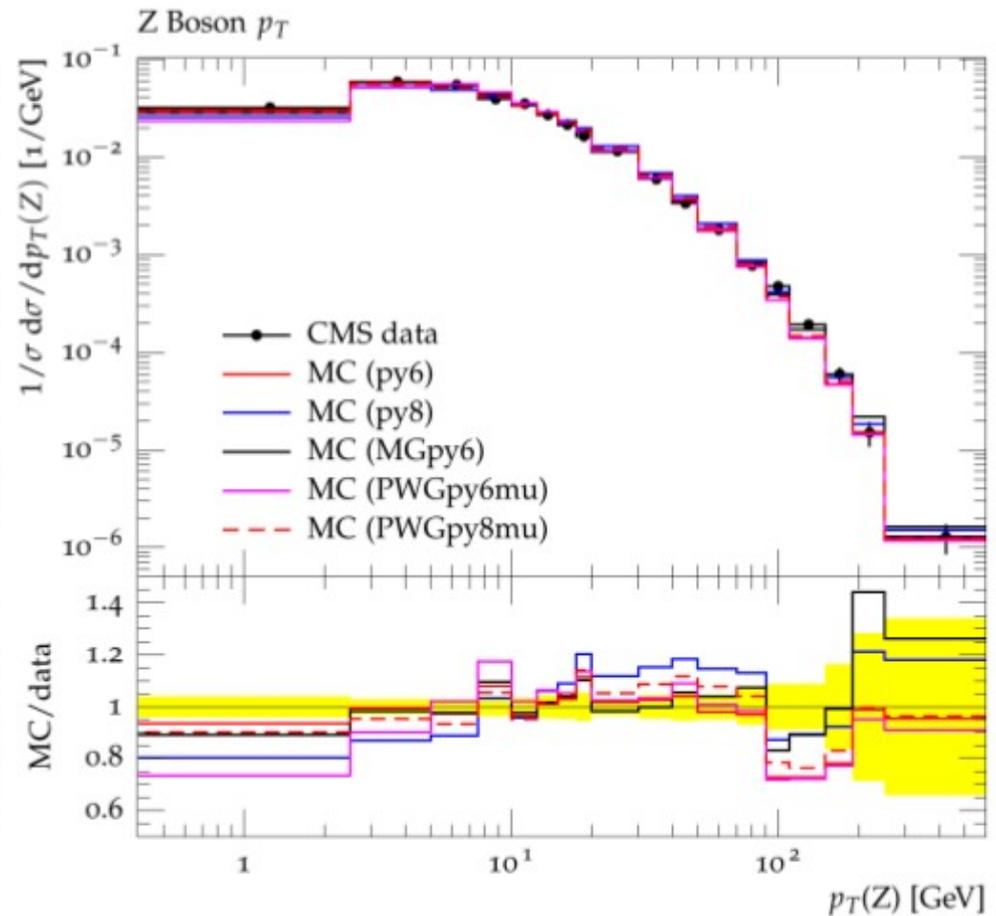
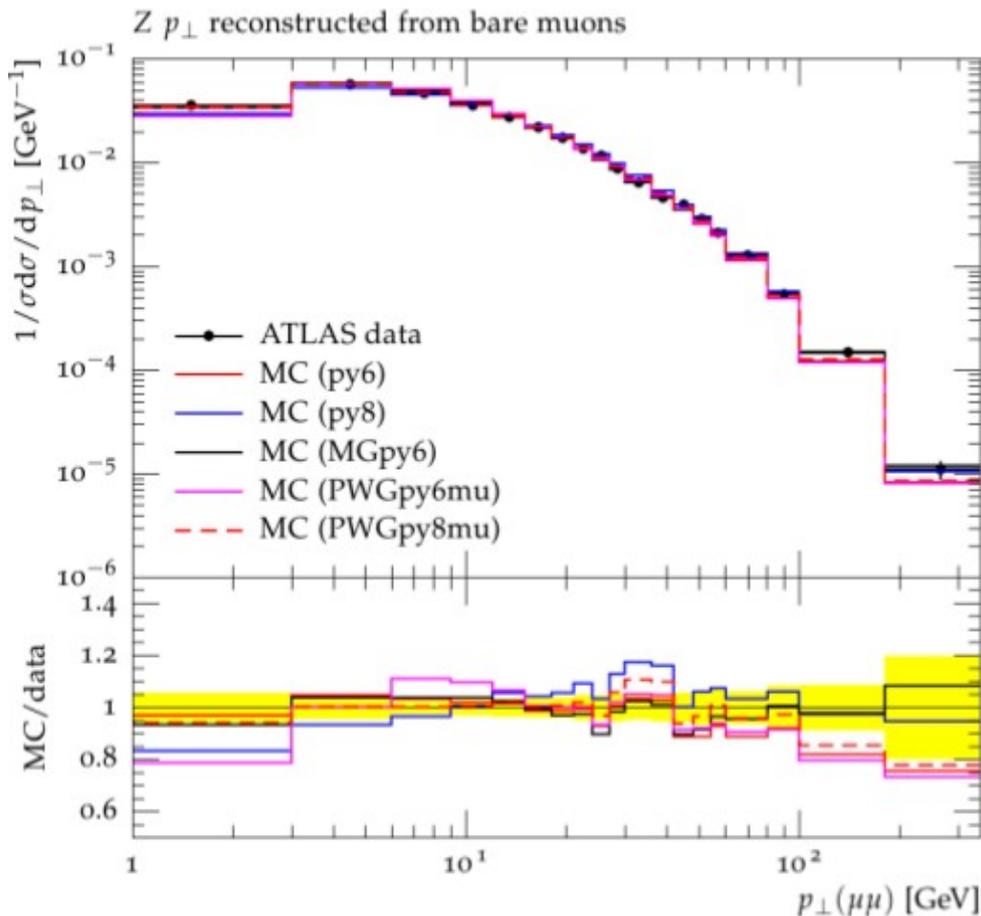
We need versioning - in particular for POWHEG

# Few items to follow up

- Similar conclusions for ATLAS and CMS:

P. Lenzi

- powheg+pythia6 Z2\* and pythia8 4C are quite far from the data
  - Why?
- MG+Pythia6, pythia6 and powheg+pythia8 similar

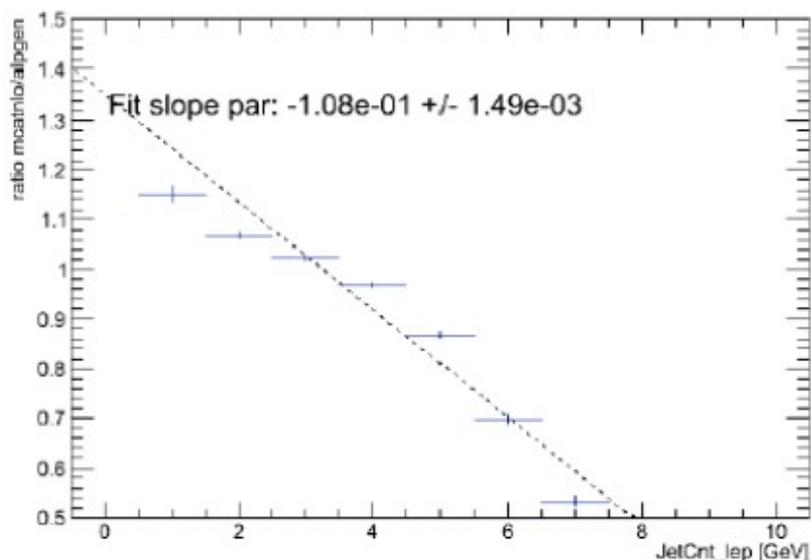


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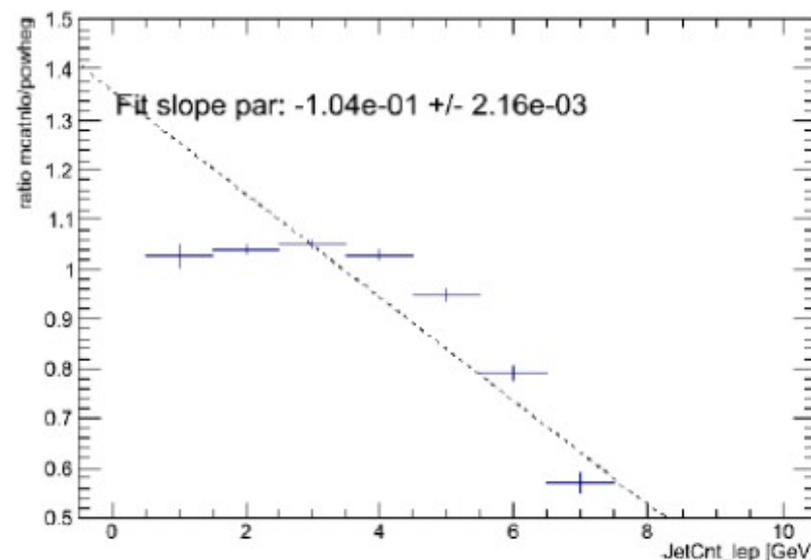
Thorsten Kuhl

Number of jets with  $p_T > 25$  GeV

MC@NLO / Alpgen



MC@NLO / Powheg



\* Powheg describes data really very good, but why does it behave like a “Multi Leg generator” and not drops off after 4 jets?

# Few items to follow up

Zbb angular correlations:

S. de Visscher

## Phase-space definition

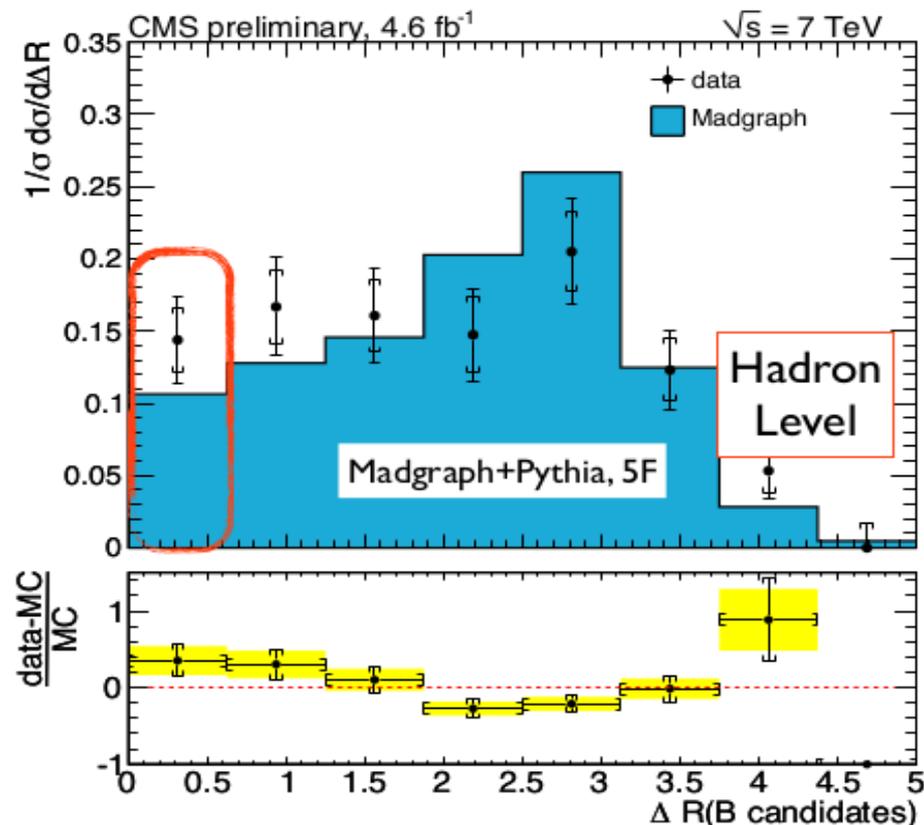
$P_t(l) > 20 \text{ GeV}$ ,  $|\eta| < 2.4$ .

$60 < M(l^+l^-) < 120 \text{ GeV}$

$P_t(\text{B-hadron}) > 15 \text{ GeV}$ ,  $|\eta| < 2.0$

Very collinear region ( $\Delta R < 0.6$ ) probed for the first time with unfolding from detector effect

Data exhibits a flatter shape than Madgraph 5F.



MG 5F used by default, need to test this against

-MG4F

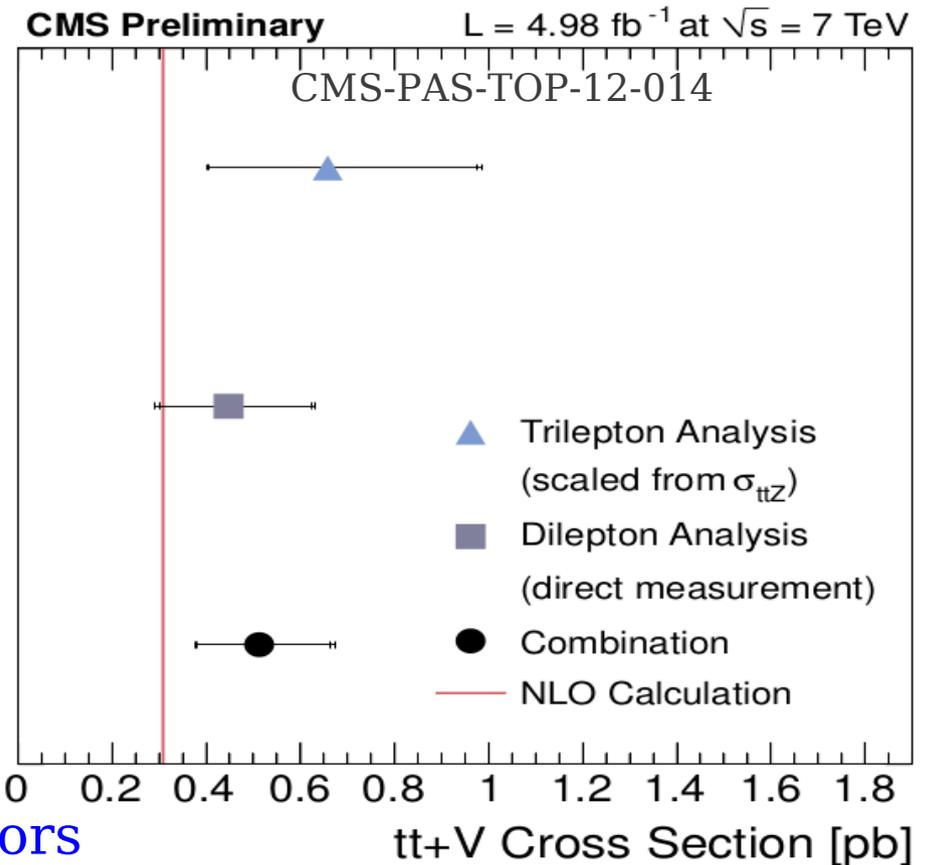
-aMC@NLO

-Sherpa

-ALPGEN 4F

# Finally, we do see rare decays in data

	$\sigma(t\bar{t}Z)$ [pb]	$\sigma(t\bar{t}W)$ [pb]	$\sigma(t\bar{t}V)$ [pb]
Trilepton Analysis	<b>0.30</b> $^{+0.14}_{-0.11}$ $^{+0.04}_{-0.02}$	-	<b>0.66</b> $^{+0.32}_{-0.25}$ $^{+0.09}_{-0.05}$
Dilepton Analysis	-	<b>0.28</b> $^{+0.14}_{-0.12}$ $\pm 0.04$	<b>0.45</b> $^{+0.17}_{-0.15}$ $^{+0.06}_{-0.05}$
Combined	-	-	<b>0.51</b> $^{+0.15}_{-0.13}$ $^{+0.05}_{-0.04}$
NLO Calculation	0.1387	<b>0.169</b> $^{+0.029}_{-0.051}$	<b>0.308</b>



Combined  $t\bar{t}V(W/Z)$  significance

(dileptons+trileptons): - 4.67

Dileptons only: 2.44 ( $t\bar{t}W$ )

Both experiments are actively moving towards rare SM processes.

- We need to use best possible generators

# Future steps

We need to establish a more open forum for discussion of MC-related issues

It is important to have a regular exchange with the authors to follow/fix it

How about a more regular ATLAS/CMS/LPCC MC meetings like this?

- This can be short  $\sim 1/2 - 1$  day
- Discuss in details issues/differences we observe which be followed
- Focused on specific issues like heavy quarks, Tuning, BSM etc.

A big thank you to all of you!

Let us stay in touch as we move forward to the 13 TeV LHC