

# Outlook

Markus, Michelangelo, Roberto

TOPLHCWG open session, 28<sup>th</sup>-29<sup>th</sup> November 2013

# Activities

- The work of the TOPLHWG is already very diversified:
  - Combination activities
    - Five main axes providing results or being worked on ( $m_t$ ,  $\sigma_t$ ,  $\sigma_{tt}$ , W helicity, asymmetries)
  - Comparison of results/agreement on conventions
    - When combining existing measurements, new common conventions are agreed and will be followed for future measurements at ATLAS and CMS
    - Define together acceptance and particle level quantities
  - Critical review of combination tools
    - BLUE, new ideas and tool standardization
    - Started discussions about tools beyond linear approximation
  - Harmonization of our dominant systematic errors
    - Experimental: JES, b-tagging
    - Theory: Radiation, generator difference, b-fragmentation
  - Forum for TH-EXP discussions
    - Best tools for our predictions for single top and top pair
    - How to present results and best predictions to compare to
    - Attack in time potential systematic effects (ex: top mass, b-fragmentation)
- In this outlook
  - Ideas about what we would like to see done by this WG in the next year

# Harmonization of systematic errors

- Radiation: we should make sure to understand the different sensitivities w.r.t. our conventions.
  - Ongoing studies in ATLAS re-calculating radiation systematic errors using the ALPGEN samples with modified scales ('a la CMS').
  - Possibly CMS tries ATLAS' large/low IFSR settings
    - benchmark analysis could be the di-lepton cross section @7 TeV
  - Constrain radiation parameters with data and come to a closer set-up for the 13TeV run
- Comparison of generators:
  - decide whether (and when) the comparison of the central predictions of two calculations should also be quoted as an extra systematic error.
    - Example: POWHEG vs MC@NLO – see yesterday's discussion
- b hadronization treatment:
  - Test the assumptions about their inclusion in JES, try and avoid double countings.
  - ATLAS is working on the jet re-calibration for this purpose.
- Grouping of (other) experimental systematic errors.
  - Bring to completion the harmonization of b-tag systematic errors and JES (also versus Tevatron).

# Common acceptance and differential distributions

- We should critically review the guidelines for defining a common acceptance for quoting our cross sections, and for the definition of pseudo top quarks.
  - In their last form, they are documented in the last talk at the open session:  
<https://indico.cern.ch/getFile.py/access?contribId=1&sessionId=0&resId=0&materialId=slides&confId=245769>
  - We should make sure they will be implemented in the next set of papers, either as references or as secondary results, by both Collaborations
- We should understand our DT/MC (dis)agreements on differential distributions in the light of what presented at TOP2013 (and yesterday here).
  - Work started for this workshop should be completed
- In the longer run we should agree on the steps for performing a combination of differential distributions
  - Agree to produce background-subtracted distributions unfolded to stable particles level (and implicitly we must use the same definition of variables at particle level, see above link).

# Theory

- Our common playground is given by the dominant TH systematic sources
  - hard radiation, treatment of (b-)fragmentation, CR effects
- Tuning/constraining Monte Carlos
  - Techniques for constraining radiation in top pair and single top
  - Techniques for studying b-fragmentation at the LHC
  - UE and CR in top pair events
- The issue of the mass of an unstable, coloured, non-hadronizing particle.
  - Desirable to have conclusive discussions on this in the near future and mostly driven by TH (hope for a session at the next open meeting in Spring?)
  - Discuss about the strategy for the incoming mass combinations versus the increasing number of indirect extractions (for instance the di-lepton endpoint analysis).
- Keep regular reports and discussions on tools/computations/MCs
  - Always keep the state-of-the-art comparison between measurements and predictions
  - Understand (suspicious) differences in Monte Carlos(e.g.  $p_T(t)$ )/drive new developments
  - Important for giving guidelines in time on new measurements/combinations, and to strengthen links between TH and EXP.

# Future combinations (I)

- The scope of the WG in terms of combination of measurements will naturally extend in the long run.
- This comprise the inclusion of more combinations for which both collaborations produce combinable<sup>(\*)</sup> results...

➤ Examples today (more in next slide):

- Spin correlations in  $t\bar{t}$
- Top polarization in  $t\bar{t}$

ATLAS [ATLAS-CONF-2013-101], 4.6 fb<sup>-1</sup>: precision on  $A(\Delta\Phi) \sim 16\%$   
ATLAS [arXiv:1307.6511], 4.7 fb<sup>-1</sup>: precision on  $\alpha \cdot p \sim 0.040$   
CMS [arXiv:1311.3924], 5.0 fb<sup>-1</sup>: precision on  $A(\Delta\Phi) \sim 15\%$   
precision on  $A_p \sim 0.025$

- ...as well as more “interpretation” tasks:

➤ constraints on  $|V_{tb}|$  and limits on anomalous couplings from single top measurements

- Four individual measurements so far, with different sensitivity. Worth starting a combination after the next updates?
- Tricky year/measurement/experiment correlations to account for

	ATLAS	CMS
t-channel 7 TeV	11.9%	4.8%
tW 7 TeV	17.0%	14.8%
t-channel 8 TeV	10.1%	8.6%
tW 8 TeV	11.2%	12.3%

(\*) consistent measurements, similar sensitivities, common agreements where applicable, same center-of-mass energy where applicable, scientific interest in performing a combination



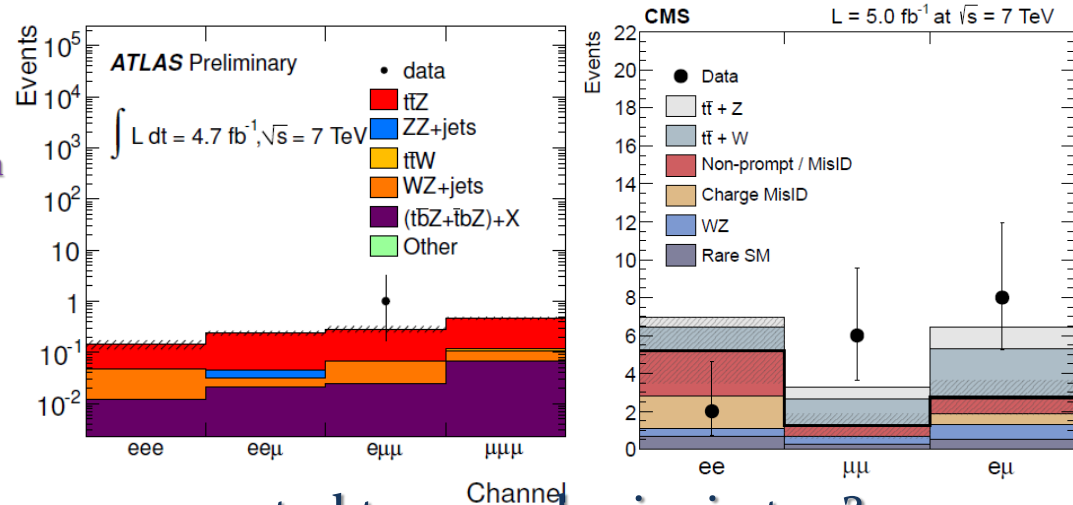
# Future combinations (II)

- ATLAS+CMS combinations will be particularly useful for channels/analyses suffering from low statistics. Next in-line:

## ➤ Single top Wt

Inputs:			
ATLAS [PLB717(2012)330], 2.05 fb <sup>-1</sup> :		24%	CMS [PRL110(2013)022003], 4.9 fb <sup>-1</sup> :
$\sigma_{tW} = 83 \pm 4(\text{stat.})^{+20}_{-19}(\text{syst}) \text{ pb}$			$\sigma_{tW}(7\text{TeV}) = 16^{+5}_{-4} \text{ pb} (4\sigma)$
ATLAS [ATLAS-CONF-2013-100], 20.3 fb <sup>-1</sup> :		21%	CMS [CMS-PAS-TOP-12-040], 12.2 fb <sup>-1</sup> :
$\sigma_{tW}(8\text{TeV}) = 27.2 \pm 5.8 \text{ pb} (4.2\sigma)$			$\sigma_{tW}(8\text{TeV}) = 23.5^{+5.5}_{-5.4} \text{ pb} (6\sigma)$
BDT analysis, e and $\mu$ channels.			BDT analysis, cut-based analysis as cross check. Both e and $\mu$ channels.

- tt+Z/ $\gamma$  (tt+H as part of the Higgs combinations)
  - Expect updates (a tt+Z cross section from ATLAS, tt+ $\gamma$  from CMS)



- Extend discussions to domains more connected to new physics in top?
  - E.g. FCNC, boosted domains,....

# Conclusions...

- Our future work is not a mere continuation of established combinations
  - Harmonization of (TH/EXP) systematic errors – beneficial to all analyses -
  - Understanding our differences (definition of observables/generation setup/...)
  - Interpretation of our measurements ( $|V_{tb}|$ , anomalous couplings)
  - New combinations
- Please contribute your ideas and opinions, do not hesitate and contact us

## ... and announcements

- Markus completed his mandate as ATLAS contact person of the TOPLHCWG
  - Let us thank him for helping to make this WG a reality, and for all the accomplishments of the group so far
- Will be replaced by Maria Costa from 1/12/2013: welcome !
- We are aiming at having the next session in Spring 2014
  - Thanks for participating/contributing