

# To dos and future combinations

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on behalf of the TOPLHCWG

What we are doing  
What we know we should do soon  
What we might do in future  
Discussion...

# What we are doing

- “Urgent” combinations are already being addressed (talks today)
  - Top mass
  - Cross sections: single top and top pair
- Our focus in the next months is to bring to successful completion the current combinations
- The top physics program at the LHC is very rich. We should get prepared to combine other measurements. Some of these require prior agreements among Collaborations and a strict contact with the TH community
  - Experimental “acceptances”
  - Differential cross sections
  - Extraction of mass from the total cross section
  - Constraints to the  $Wtb$  vertex
  - ...

**What we know we should be doing soon**

# Total cross section and detector “acceptances”

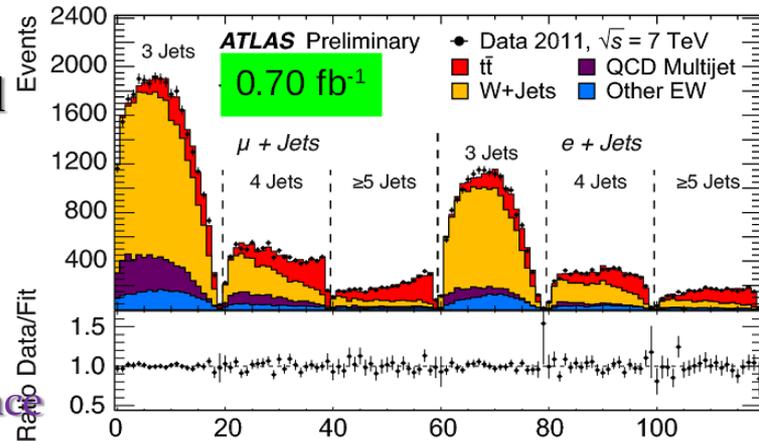
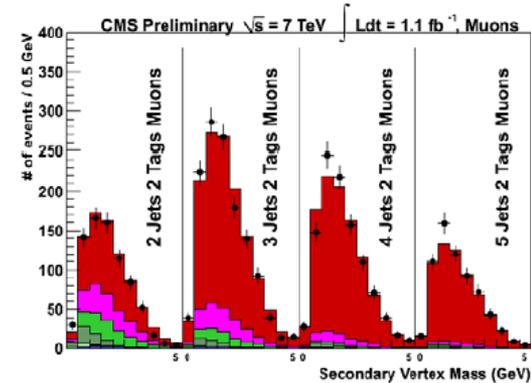
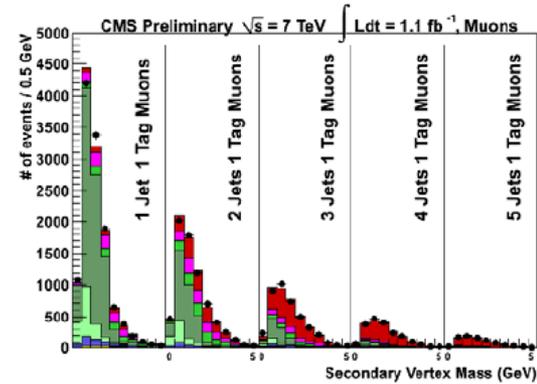
- Recurrent request from TH: just provide a cross section in your detector “acceptance”
  - Acceptances are well defined quantities only for “cut’n’count” analyses

- Most analyses extract the signal cross section in (multi-D) likelihood fits

- Background regions (typically  $W+1-2-3$  jets) may be part of the fit to the  $t\bar{t}$  cross-section
- Some systematic effects are also fit. Others are integrated out as nuisance parameters

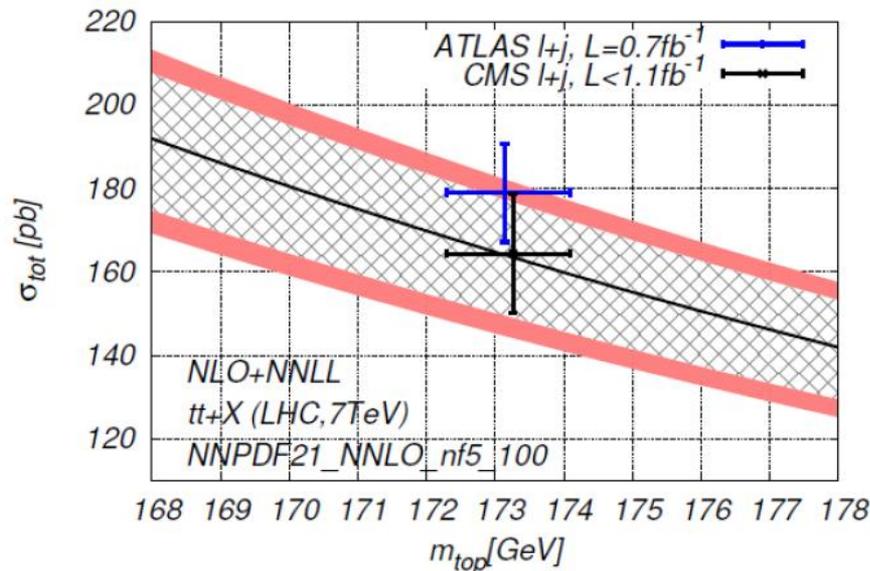
- Can we also provide a measurement in a restricted region of phase space?

- Yes, need to provide a second result per channel
  - Motivate this in publications
  - The result cannot be competitive with reference analyses
- Need sync between experiments
  - Agree on the definition of the common acceptance

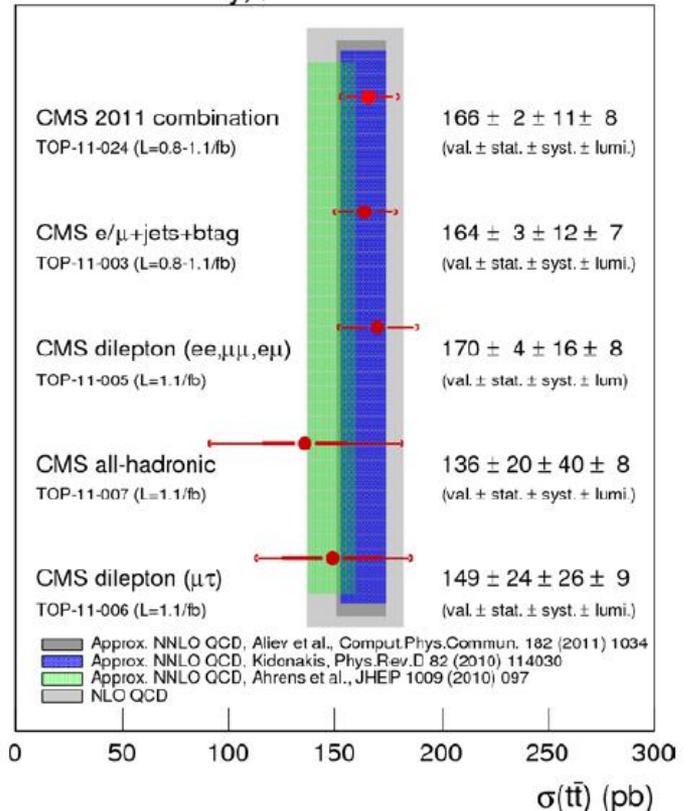


# The way we provide our cross sections

- The dependence of the cross-section on mass can introduce ambiguities when presenting our results
  - Current EXP results presented at a common conventional top mass of 172.5 GeV: not the current world average (agreement may change)
- Should present combined plots consistently at the PDG top mass
  - Need to extrapolate the experimental measurements to the right top mass
  - Need to be able to evaluate TH predictions at that mass



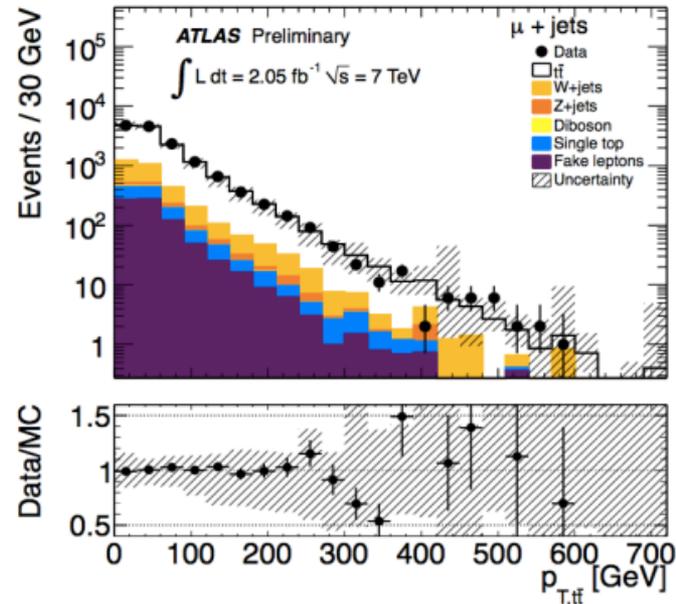
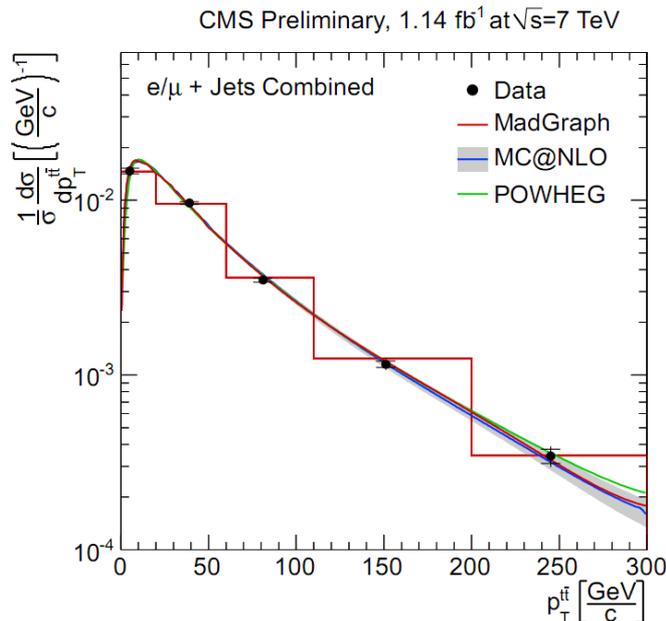
CMS Preliminary,  $\sqrt{s}=7$  TeV



**What we might be doing in the (near) future**

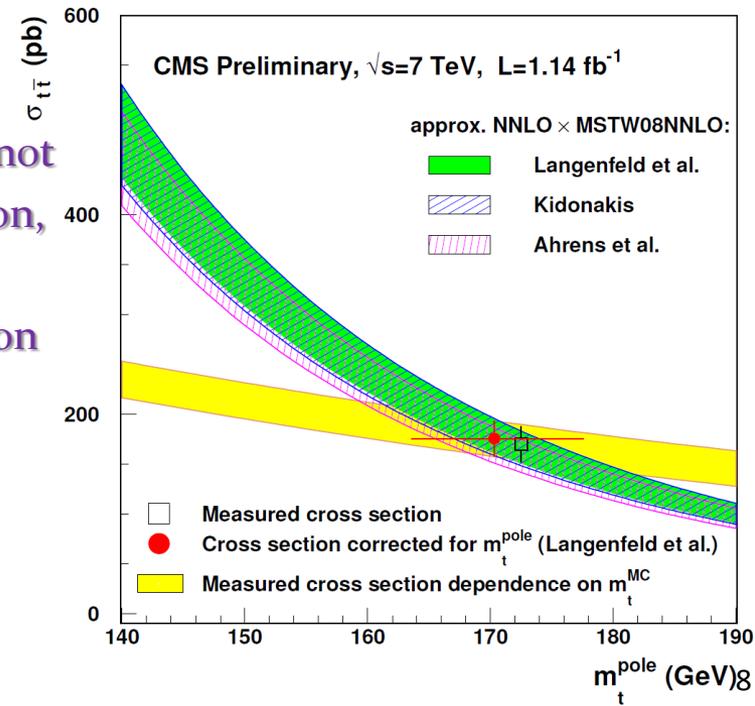
# Combining differential distributions: issues

- Experiments (will) provide particle-level unfolded differential distributions
  - Very valuable to combine experiments
- Combination may be difficult unless we agree on (in order of importance)
  - Operative definition of a top quark at particle level for top related quantities
    - see William's talk
  - Definition of observables to combine ( $p_{T,S}$ ,  $\eta$ s of leptons, jets, tt system, t/tbar,...)
    - Notice that charge asymmetry/spin correlations may be very interesting particular cases
  - Binning and (minimal) acceptance



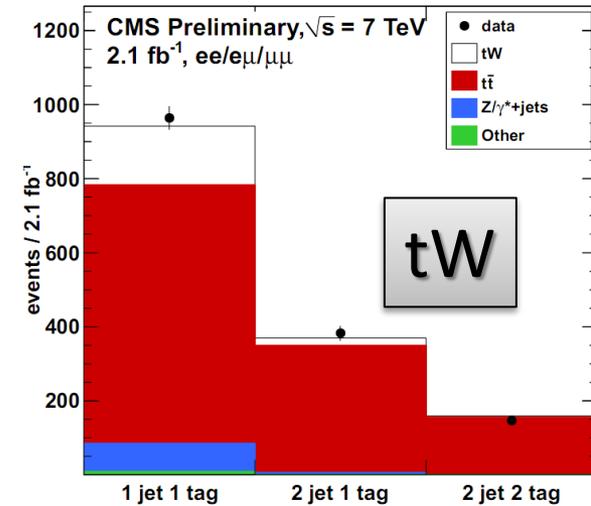
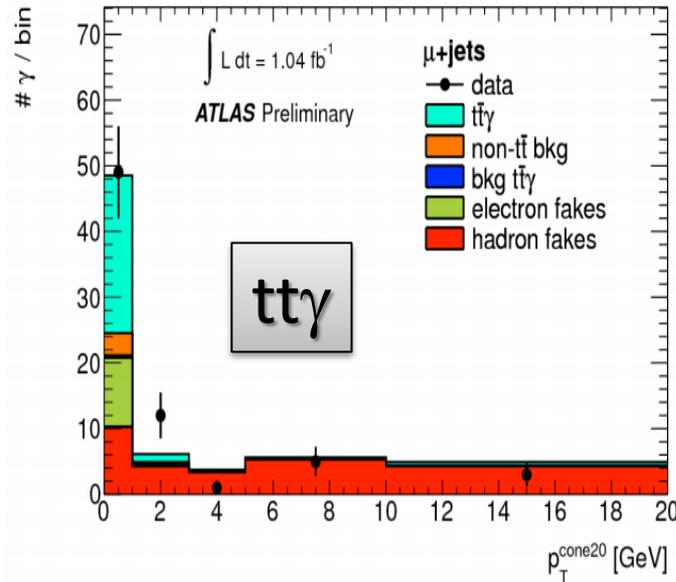
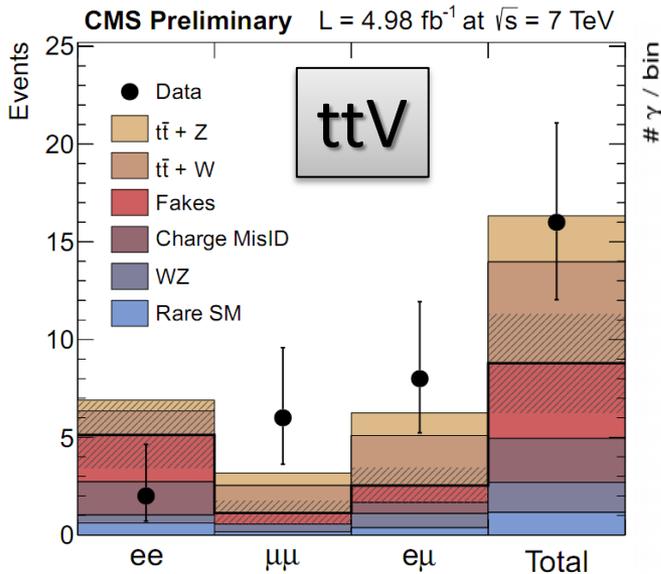
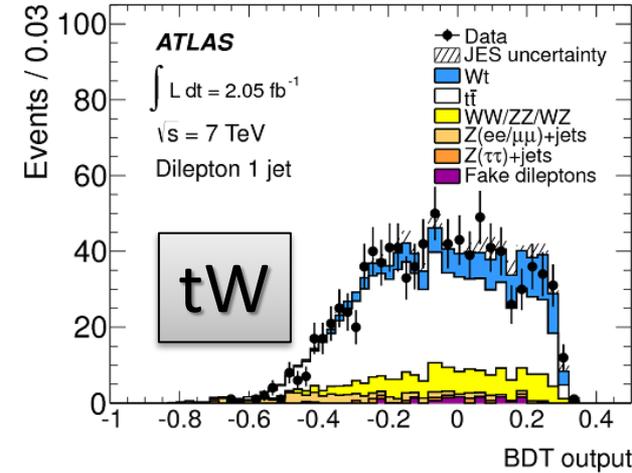
# Top mass from top-pair cross-section

- A relatively straightforward addition to our combination program, whenever agreed on the procedure
- Two ways for performing the combination:
  - Combine only the extracted values of the top mass
    - Need to propagate the cross section systematic breakdown to the extracted mass
    - Need to make sure both experiments use the very same theory predictions
  - Combine the cross section dependence, and “centralize” the extraction
    - Just profit from the cross section combination done at the reference value (172.5)
    - Use the same relative weights, assuming they do not depend on the top mass (first order approximation, associate an error to it?)
    - Both experiments need to provide the cross section as a function of the mass (agree on binning)



# Future cross section combinations

- Cross section combinations of low yields processes
  - Single top tW channel (already at 7 TeV)?
  - Longer term combinations
    - single top in s-channel
    - tt in association with bosons
    - tt+bb



# Constraining the $Wtb$ vertex

- Idea on a longer term basis: we ultimately want to combine our experiments to best constrain new physics in the  $Wtb$  vertex

➤ 8 parameters: 
$$\mathcal{L}_{tWb} = -\frac{g}{\sqrt{2}}\bar{b}\left[(V_L P_L + V_R P_R)\gamma^\mu + \frac{i\sigma^{\mu\nu}q_\nu}{m_W}(G_L P_L + G_R P_R)\right]tW_\mu$$

$V_{tb} \sim 1$   
 (SM)

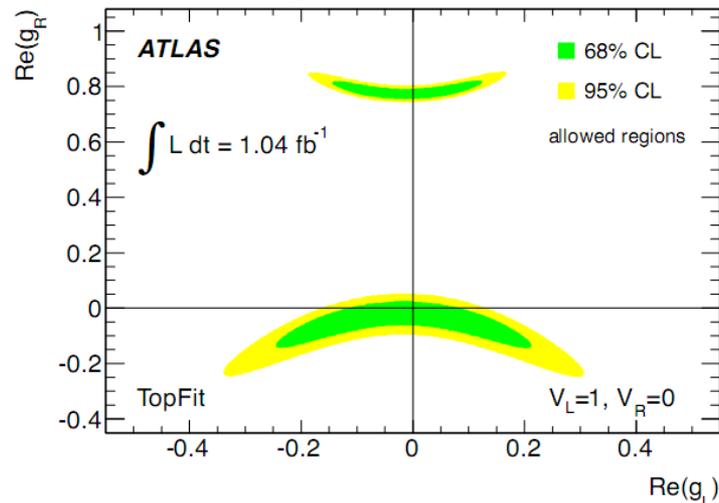
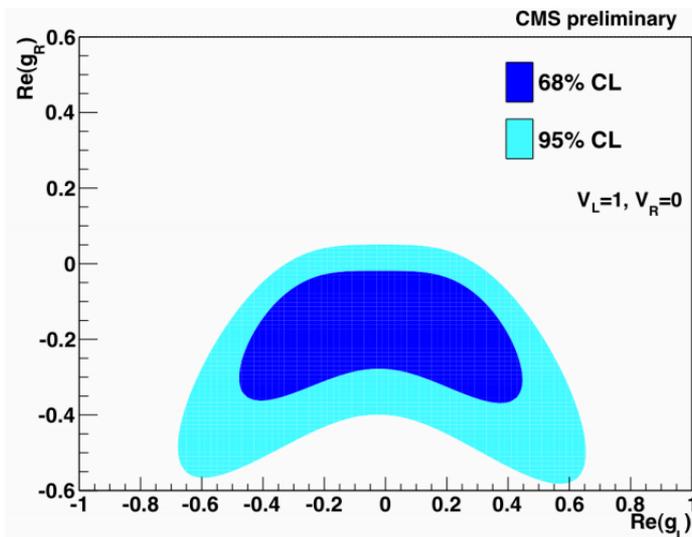
0  
 (SM)

- Different options for the combination?

- Parameters or anomalous couplings
  - I.e. do we make the  $X_L, X_R$  extraction central?
- Find best variables to constrain the  $Wtb$  vertex

analysis for  $L=10 \text{ fb}^{-1}$  (ATLFAST)

	$V_R$ ( $g_L = g_R = 0$ )	$g_L$ ( $V_R = g_R = 0$ )	$g_R$ ( $V_R = g_L = 0$ )
$F_0$	—	[-0.133, 0.102]	[-0.032, 0.022]
$F_L$	[-0.196, 0.186]	[-0.167, 0.136]	[-0.029, 0.021]
$F_R$	[-0.037, 0.107]	[-0.049, 0.017]	—
$\rho_L$	[-0.254, 0.206]	—	[-0.026, 0.023]
$\rho_R$	[-0.028, 0.099]	[-0.046, 0.0129]	—
$A_{FB}$	[-0.118, 0.148]	[-0.090, 0.0585]	[-0.027, 0.023]
$A_+$	[-0.140, 0.146]	[-0.112, 0.0819]	[-0.021, 0.016]
$A_-$	[-0.066, 0.120]	[-0.062, 0.0299]	[-0.017, 0.028]



*Any other idea?*