Overview of the Top FC Analysis

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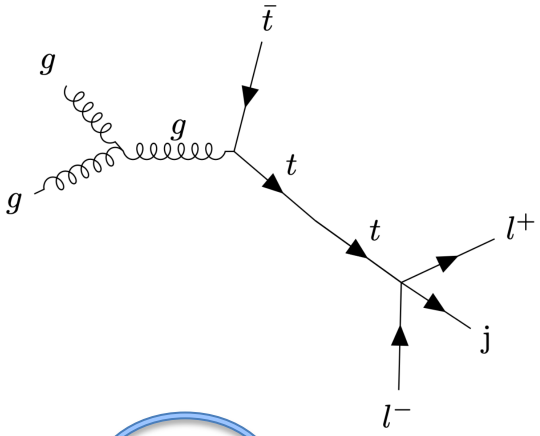
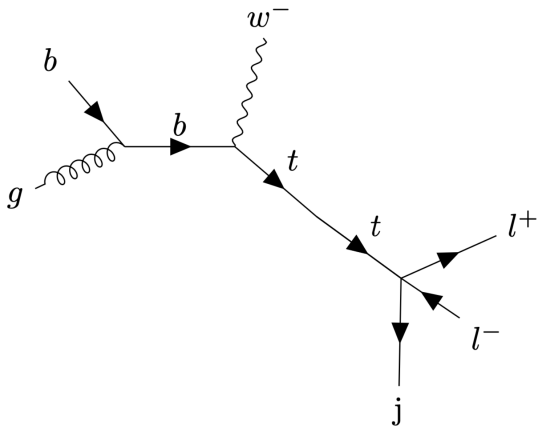
Flavor Changing in Top sector

In this analysis we looking for FC ($t \to u$ or $t \to c$) in top sector as the heaviest quark which may be an indicator of new flavor physics.



ttbar



tW

- Starting with **ttbar**, targeting **final states** with three leptons (a pair of OP) and a b-tagged jet (one of the tops decays leptonically via w $\to l\ \nu_l$)
- There are **at least** two jets – other jets might come from showering
- Presence of several charged leptons allows an efficient lepton trigger
- The leading potential backgrounds are $tZ, t\bar{t}W, t\bar{t}Z, t\bar{t}t\bar{t}, WZ, ZZ, t\bar{t}$

Signal and background generation

- Signal and background events are generated with MG5 (for ME) + PYTHIA (for PS and HAD) + Delphes (for HLLHC card detection). almost 3M events for both charm and up signals and 2M events for each background.

- Weights look fine (<1) for all signal and background events except for $t\bar{t}$. The $t\bar{t}$ background has really high xsec so to get weight<1, almost extra 5M events is needed (the third lepton in $t\bar{t}$ should be fake btw).

- Here is the weight summary for all analysis processes:

weights = {'ttbarZ': 0.00431, 'tZ': 0.00375, 'tttt': 2.79520e-05, 'ZZ': 0.67125, 'ttbar': 8.53651, 'ttbarW': 0.00015, 'WZ': 0.13575,'signal_charm': 0.01376, 'signal_up': 0.01376}

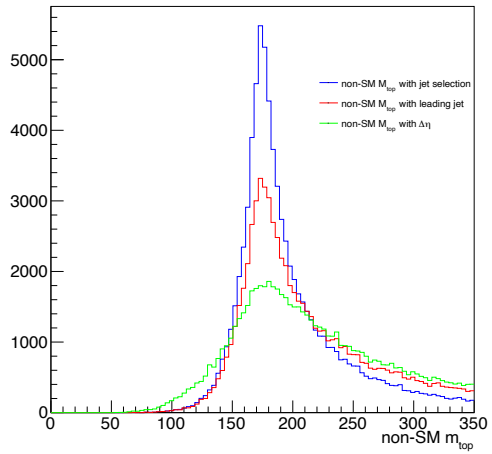
Preselections

- The preselections applied:
  1. exactly 3 leptons (for now just electrons) with one pair of OS
  2. At least 2-jets with one b-tagged jet
  3. no minimum cuts on jet's P_T or lepton's P_T. Might be useful to have it!
  4. no lepton trigger at this level

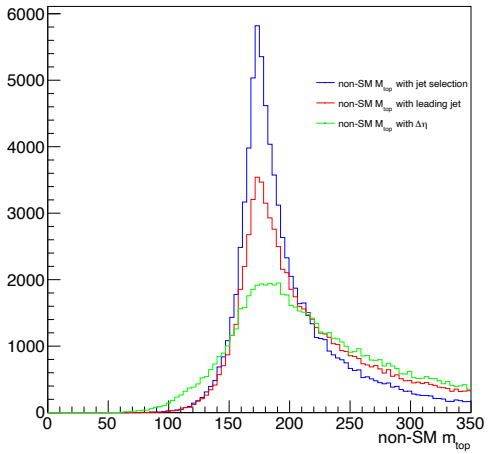
Non-SM top mass reconstruction

- Three algorithms used to reconstruct non-SM top mass:
  1. the min $\Delta\eta$ between electrons is used to select OP electrons and subsequently non-SM top mass reconstruction (green)
  2. the leading non-btagged jet and the 3 electrons are the inputs for $\min(|m_{llq} - m_{top}|)$ to choose the best selection for OS electrons (red)
  3. Loop over all the electrons and jets to get $\min(|m_{llq} - m_{top}|)$. The combination will be used to indicate OS leptons (blue)

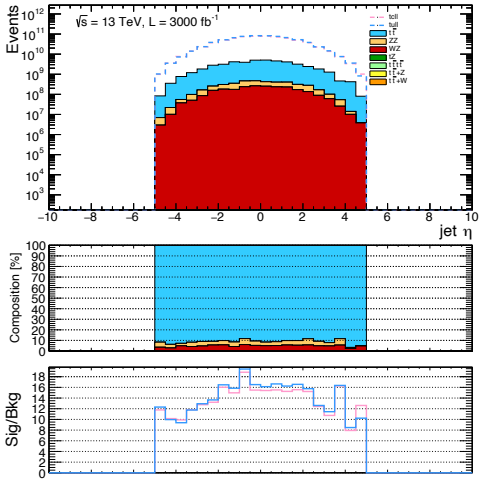
Signal charm

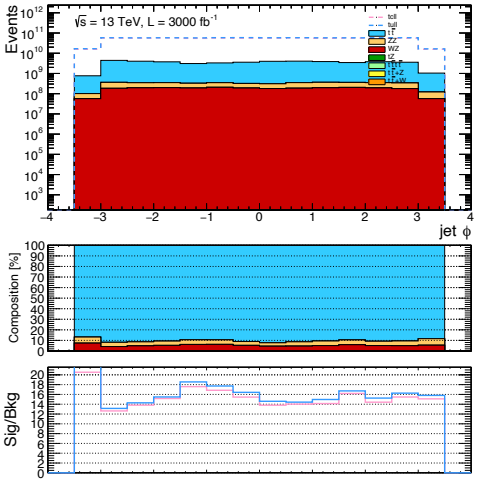


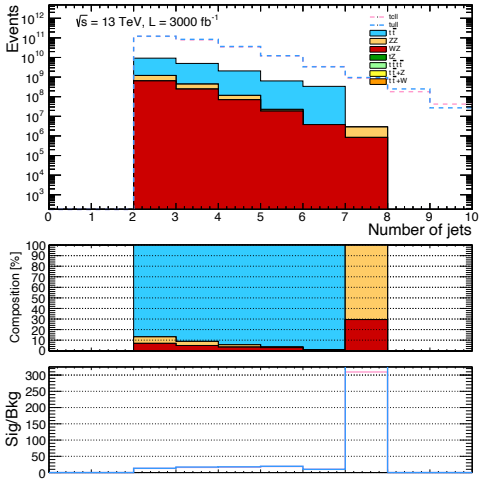
Signal up

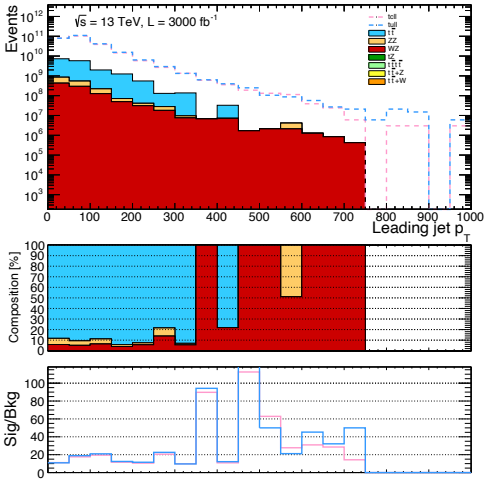


Jet distributions

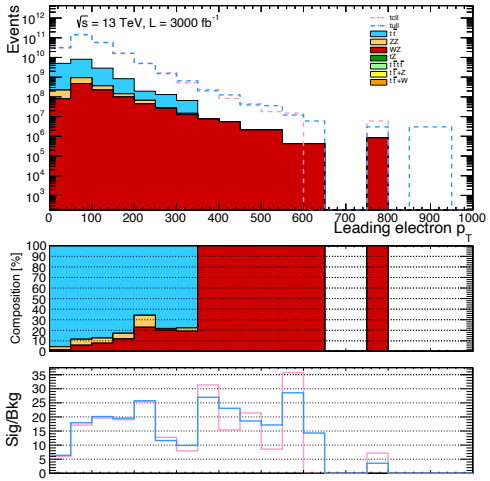


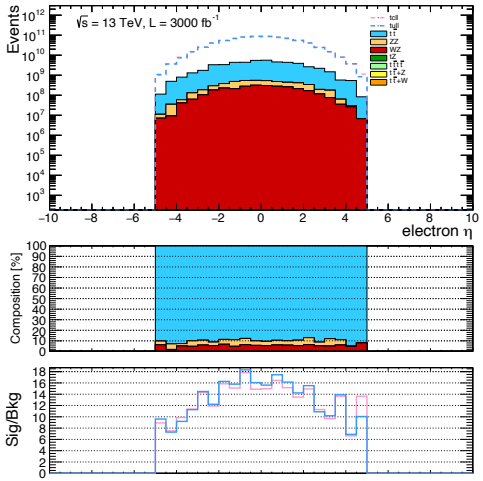


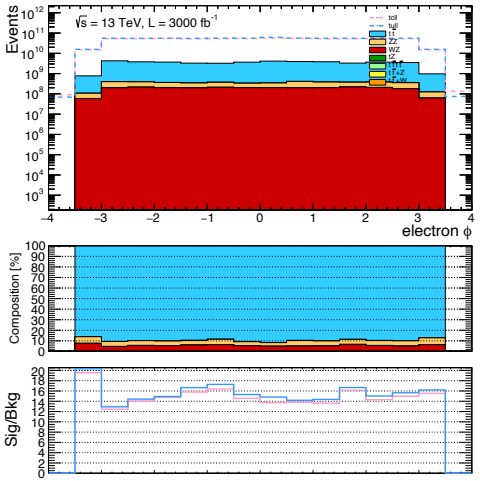




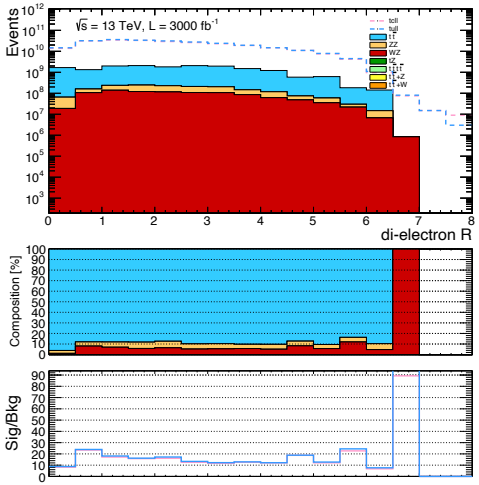
Electron distributions

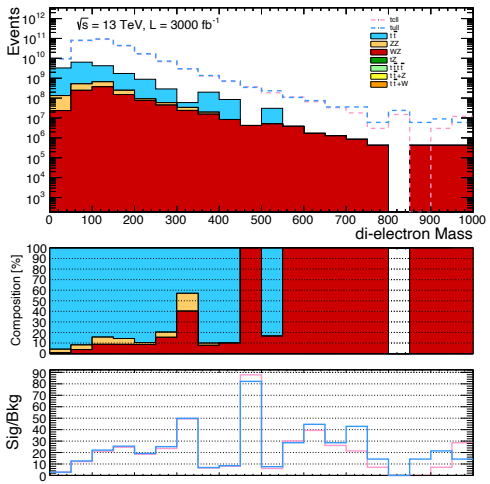


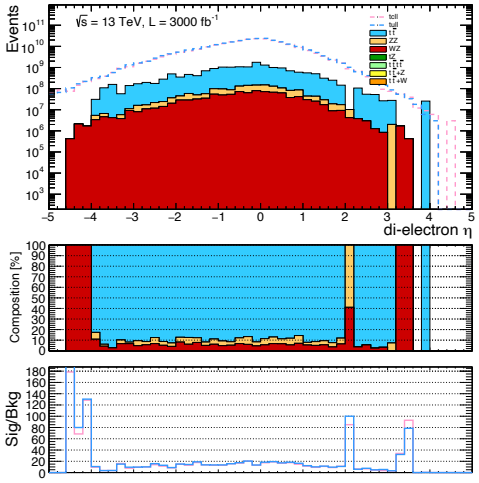


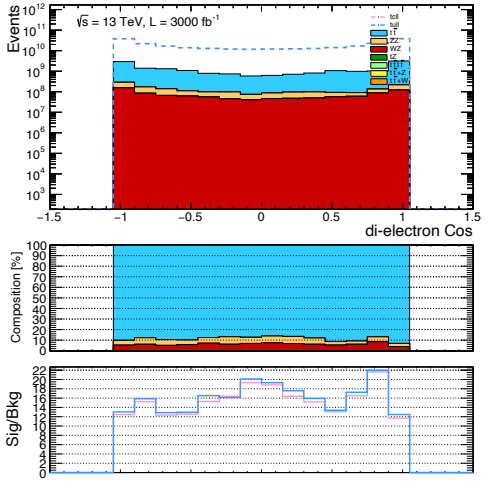


Di-electron distributions

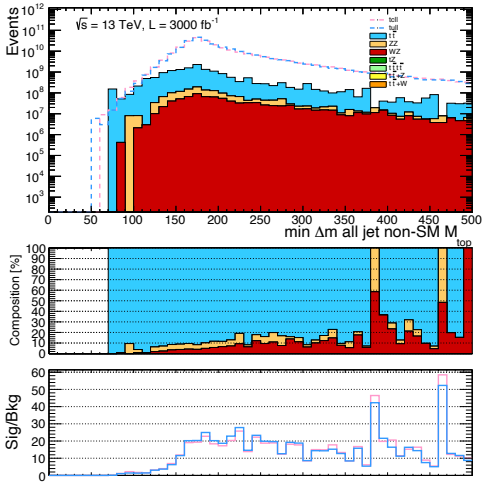


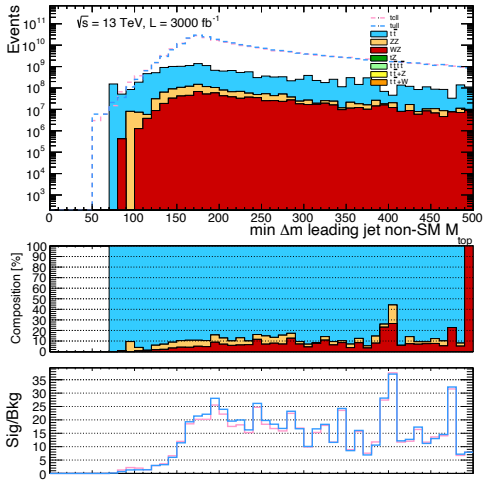


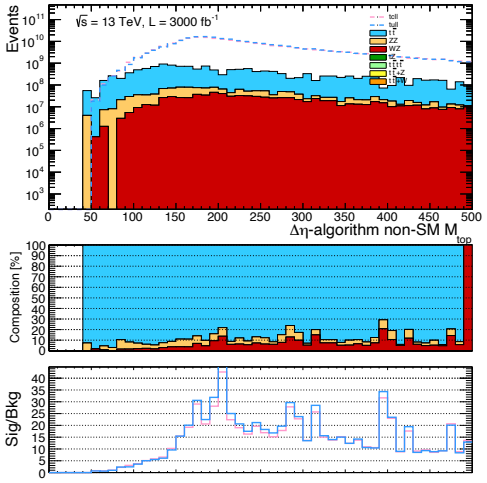


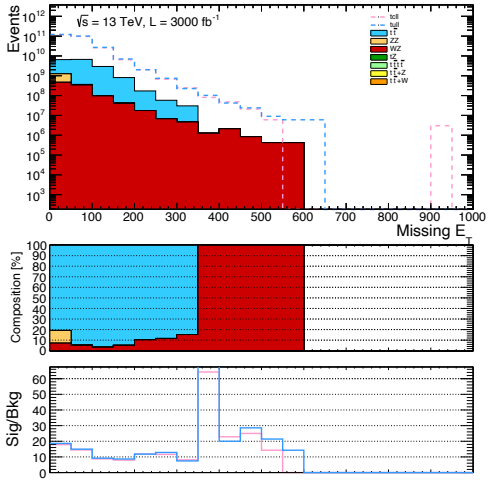


Non-SM Top mass and MET









Few points to double check

- Are we happy with

1. signal and background generation
   - do we need more $t\bar{t}$, as it looks $t\bar{t}$ is an important background?

2. preselections
   - need to apply minimum P_T cut on final objects?
   - what kind of trigger need to be passed?

3. variable distributions
   - m_{top} for new-algorithm looks better but so many events in the tail because of HL. We might to have mass window cut at some point?

Summary & ongoing

- Signal and background events generation is almost done. First round of analysis variables are added to the Git repo but some more optimizations are needed to get better distributions.
- Analysis tree production with important variables and plotting framework are done (tree, plotter).
- Need to think about the right trigger and how to keep it as a separate branch.
- As the next step, we might to think about control/signal region definition.
- Your feedback is welcome and appreciated.

Object mass distributions