Update from Last Meeting

➢ **Add T T->lepton+jet background MC sample**
  ▪ **cross section: 364351 fb-1**
  ▪ **Most are removed by basic cuts**
  ▪ **14.7 events left after all cuts**

➢ **Remove overlap jets**
  ▪ **Remove these jets: min(dR(jet, mu)) < 0.4**

➢ **Check analysis code and found a typo**
  ▪ **Related to T' transverse mass calculation**
  ▪ **Keep checking**

➢ **Trying to find a good main variable**
  ▪ **Stacked plots are on the way...**
  ▪ **Thinking about loosen the pt cut a little bit**

The following cuts are basic cuts:
- For Muons
  - Two opposite sign muons
  - Pt > 20GeV
  - |eta| < 2.4
  - Tight Muon ID: Muon_tightId
  - Tight isolation: goodMuons_miniPFRelIso_all < 0.05
  - Significance cut: Muon_sip3d < 3
- For jets
  - Tight jet ID: Jet_jetId= 6
  - Pt > 30GeV
  - |eta| < 2.5
  - At least 3 good jets
  - At least 1 Loose B jet(goodJets_btagDeepFlavB>0.049)

- Cut0: Mu pair mass < 60GeV
- Cut1: Top reconstruction is valid
- Cut2: Mu pair Pt + top pt > 350 GeV
- Cut3: Minimal delta R (mu, b jet from top) > 2
- Cut4: delta R (b jet from top, W from top) < 2.5

Remove overlapped jets

- ➢ **Remove overlapped jets**
  - ▪ **Overlapped jets: min(dR(jet, mu)) < 0.4**
  - ▪ **Function is added at the beginning of the analysis code**
- ➢ **Jets number in each process decrease**
- ➢ **Events number in each process decrease then increase**
  - ▪ **decrease before cut1: the number of jets is reduced**
  - ▪ **increase after cut1: Removing overlap jets increase the quality of top reconstruction**

$$\frac{N_{jets}(removeoverlap) - N_{jets}(withoverlap)}{N_{jets}(withoverlap)}$$

Cuts	N(jets)_Signal	N(jets)_TT	N(jets)_TTJetLepton	N(jets)_TTW	N(jets)_TTZ	N(jets)_TTH
Basic cuts	-6.6%	-6.2%	-17.0%	-5.9%	-5.1%	-7.3%
Basic cuts&& Cuts01234	-3.0%	-5.6%	-10.7%	-5.3%	-3.85%	-5.2%

Cuts	N_Signal	N_GENSignal	N_TT	N_TTJetLepton	N_TTW	N_TTZ	N_TTH
Basic cuts	-10%	-5.75%	-20.0%	-33.17			
Basic cuts&& Cuts01	+1.3%	+0.9%	-4.54%	-2.4%			
Basic cuts&& Cuts01234	+3.4%	+1.3%	+9.8%	+0.8%			

$$\frac{N_{events}(removeoverlap) - N_{events}(withoverlap)}{N_{events}(withoverlap)}$$
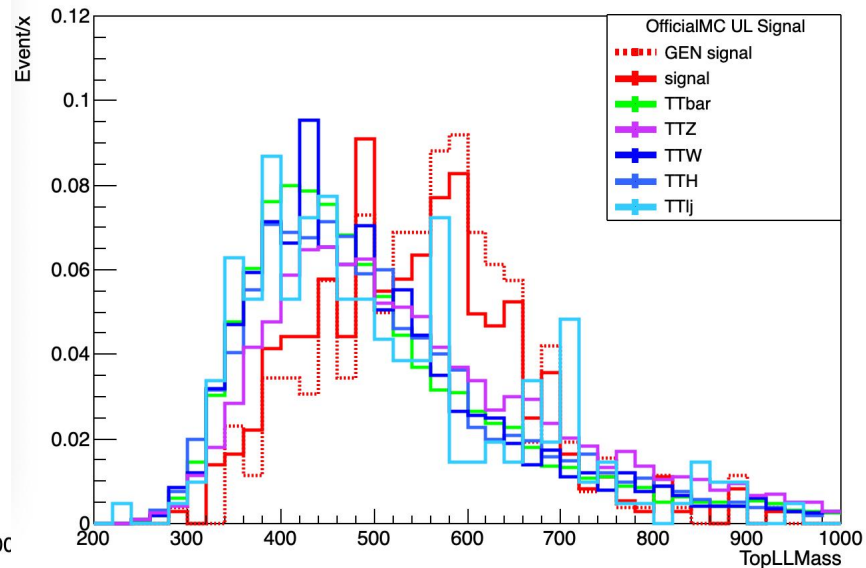
"Remove" Main Pt cut

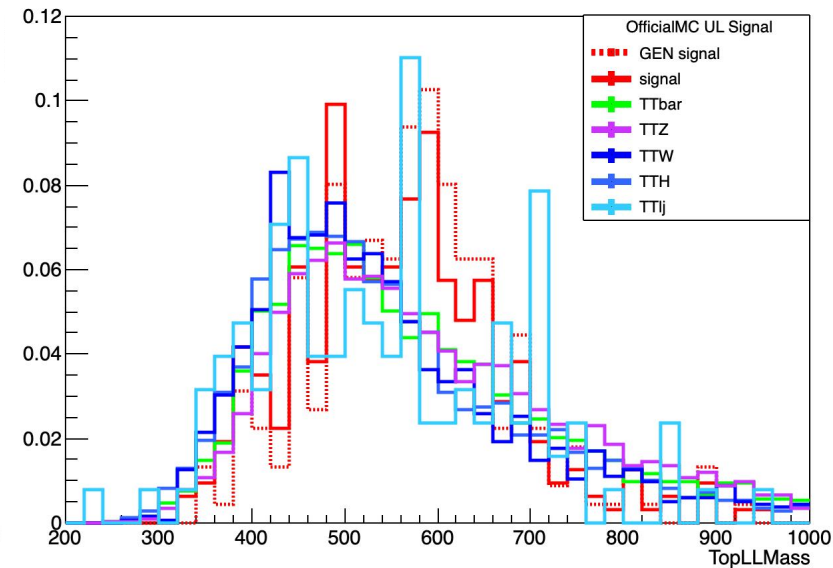> ➤ **After basic cut, cut0, ~~cut1~~, cut2, cut3 &cut4:**
>   - ▪ **(top candidate + lepton pair).M() looks like a good main variable**
>   - ▪ **Maybe need to loosen cut1 (Mu pair Pt + top pt > 350 GeV)**
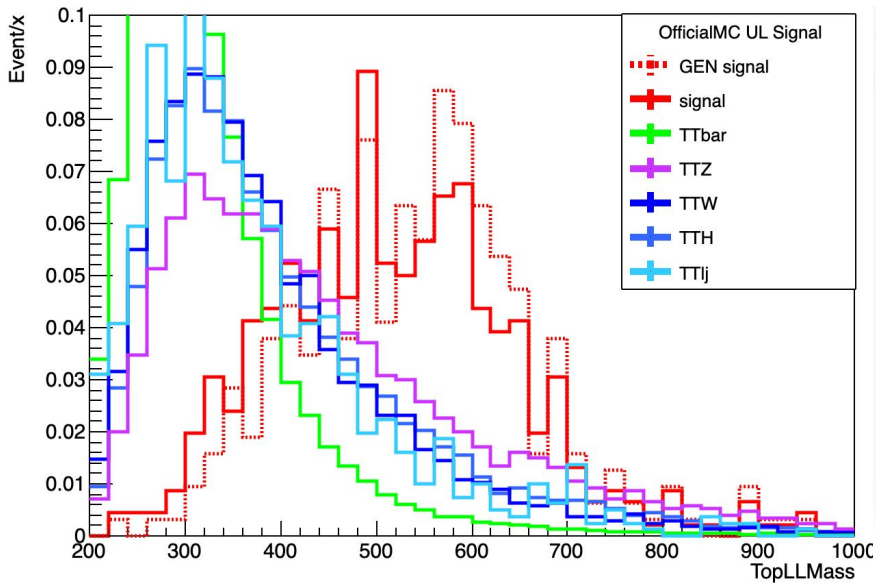
NO Cut1
7255 TTbar events left
5.17 signal events left

Cut1: Mu pair Pt + top pt > 300 GeV
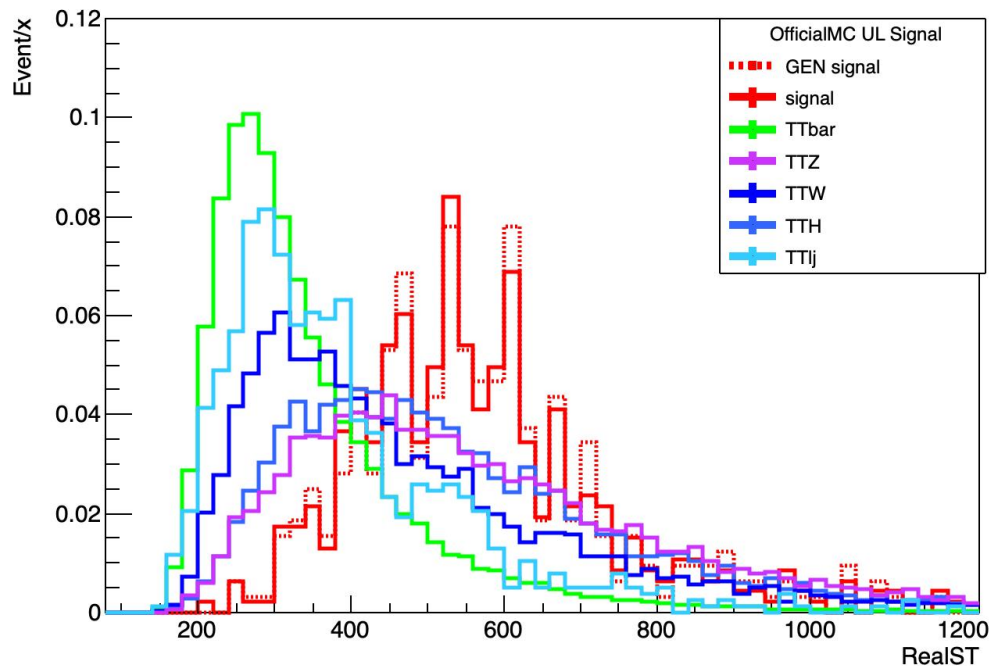 **630 TTbar events left**
4.13 signal events left

Cut1: Mu pair Pt + top pt > 350 GeV
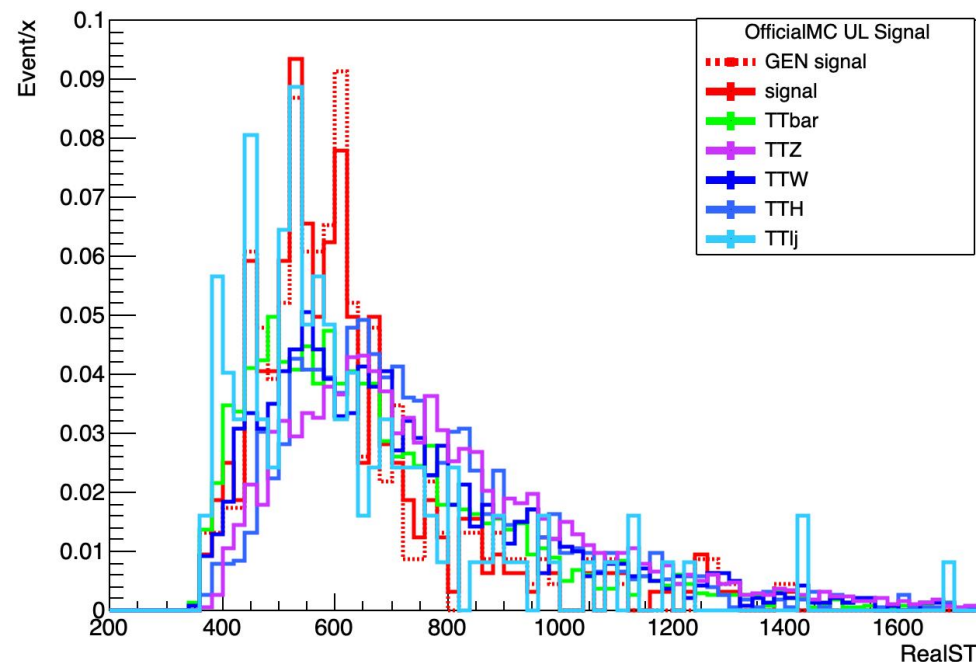 **308 TTbar events left**
3.58 signal events left

Best main variable so far

"Remove" Main Pt cut

➤ **After basic cut, cut0, ~~cut1~~, cut2, cut3 &cut4:**
- **ST is scalar sum of all jets and muons in 1 event**
- **worse than (top+ll).M()**

NO Cut1
7255 TTbar events left
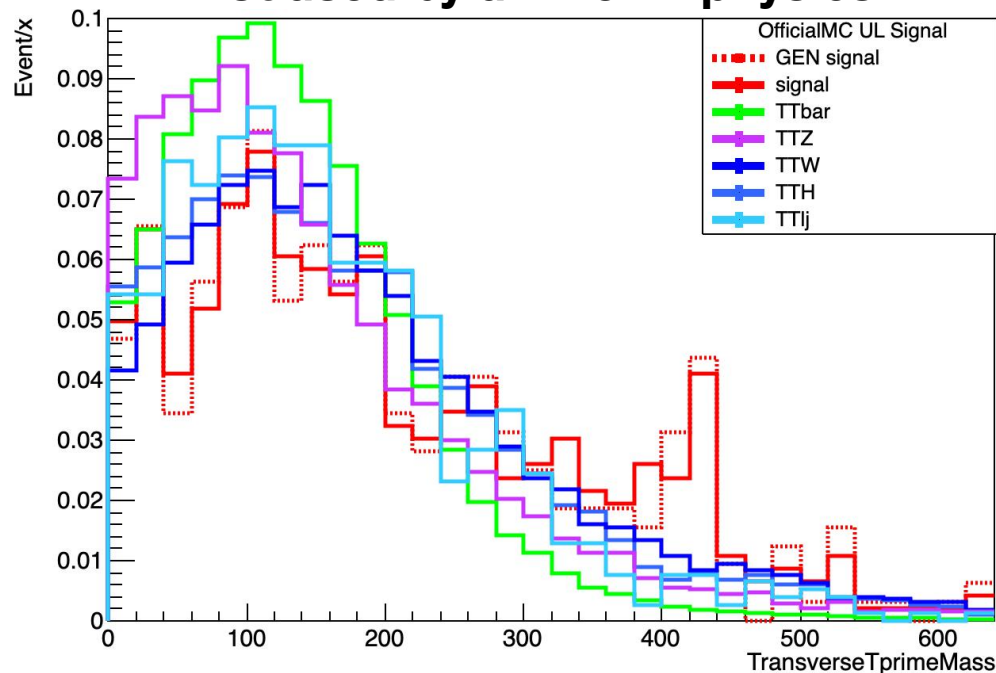**5.17 signal events left**

Cut1: Mu pair Pt + top pt > 350 GeV
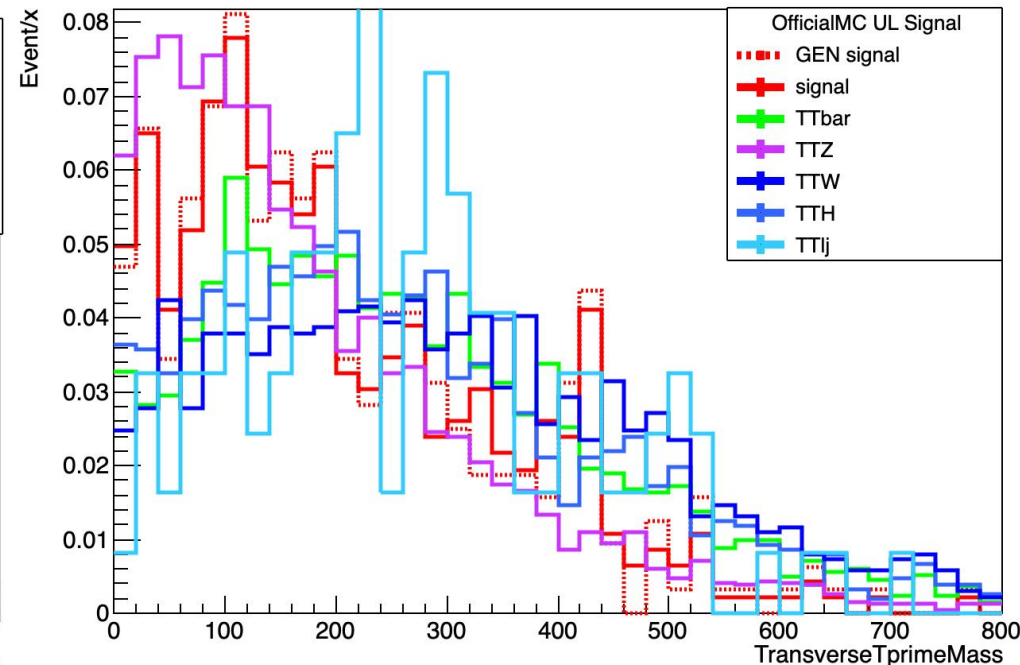**308 TTbar events left**
3.58 signal events left

➢ **After basic cut, cut0, ~~cut1~~, cut2, cut3 &cut4:**
➢ **Still weird**
  ▪ **Other bugs in the code?**
  ▪ **MET_Pt cannot be used directly?**
  ▪ **Caused by unknown physics?**

$$m_T^{T'} = \sqrt{2 * p_T^{ll\&top} * p_T^{MET} * [1 - \cos(\delta\phi(\overrightarrow{p_T^{ll\&top}}, \overrightarrow{p_T^{MET}}))]}$$

NO Cut1
7255 TTbar events left
5.17 signal events left

Cut1: Mu pair Pt + top pt > 350 GeV
 308 TTbar events left
3.58 signal events left

➢ **After basic cut, cut0, ~~cut1~~, cut2, cut3 &cut4:**
  ▪ **Make more sense than transverse T' mass**

$$m_T^H = \sqrt{2 * p_T^{ll} * p_T^{MET} * [1 - \cos(\delta\phi(\overrightarrow{p_T^{ll}}, \overrightarrow{p_T^{MET}}))]}$$