

Refine Cut Strategy

- **HTCondor scripts for VLQ analysis is available**
 - Do not need to download datasets manually
 - Scripts are for Fermilab server (Need to be modified a bit for lxplus)
- Focus on 1 signal process for now
 - $T' \rightarrow tH$; $t \rightarrow Wb \rightarrow qq\bar{b}$; $H \rightarrow WW \rightarrow m+m-\nu\nu$ (1 lepton pair, 3 jets and at least 1 b jet)
- Basic cuts
 - Cuts for muons
 - Tight ID cut: Muon_tightId
 - $Pt(\mu) > 20\text{GeV}$
 - $|\eta| < 2.4$
 - Tight isolation cut: goodMuons_miniPFRelIso_all < 0.05
 - Cuts for jets
 - Tight jet ID cut: Jet_jetId: 6
 - $Pt(\text{jet}) > 30\text{GeV}$
 - $|\eta| < 2.5$
 - Cuts for events
 - 1 OS muon pair (2 muons)
 - At least 3 jets
 - At least 1 b jet
 - Loose b-tag jet: goodJets_btagDeepFlavB > 0.049

Apply GEN cuts to Signal MC

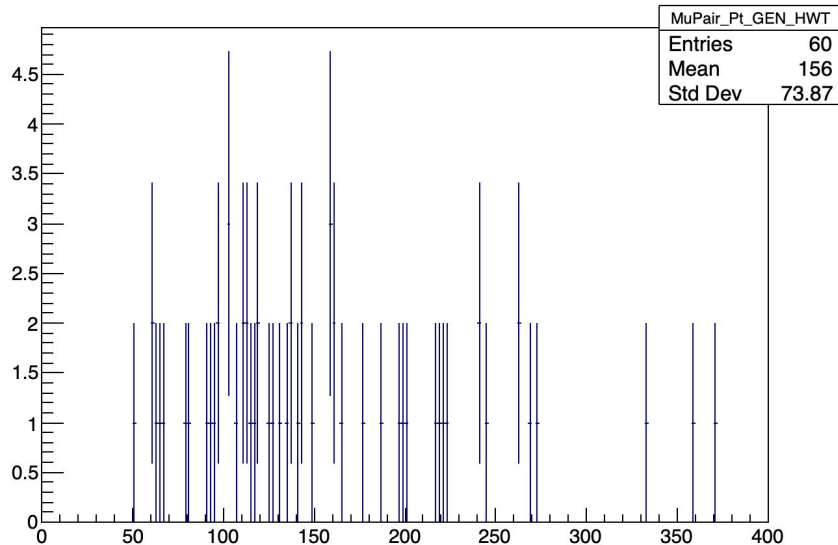
- Require full-chain decay for muons: $T' \rightarrow H \rightarrow W \rightarrow \mu$
 - **basic cuts && GEN selection** are applied
 - find 2.05 events (cross-section 89fb)
 - 2.4 events if we use $H \rightarrow W \rightarrow \mu$ as GEN selection

Cuts	N_signal (89fb)	N_TTbar (87315fb)	N_TTZ (770 fb)	N_WW&WZ (12178 fb)	N_TTW (610.5 fb)
Basic cuts	10.79	36893.02	374	2.37 (just ignore them)	210.98
Basic cuts && GEN selection ($T' \rightarrow H \rightarrow W \rightarrow \mu$)	2.05	-	-	-	-

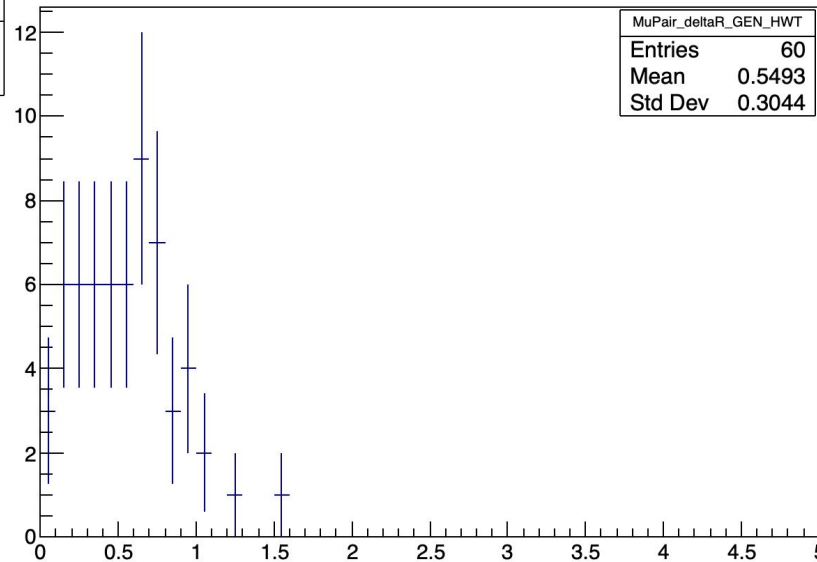
Apply GEN cuts to Signal MC

- **Require full-chain decay for muons: $T' \rightarrow H \rightarrow W \rightarrow \mu$**
 - **basic cuts && GEN selection are applied**
 - **Need more statistics!**
 - **Found some T' MC samples on DAS website (Should we use them?)**

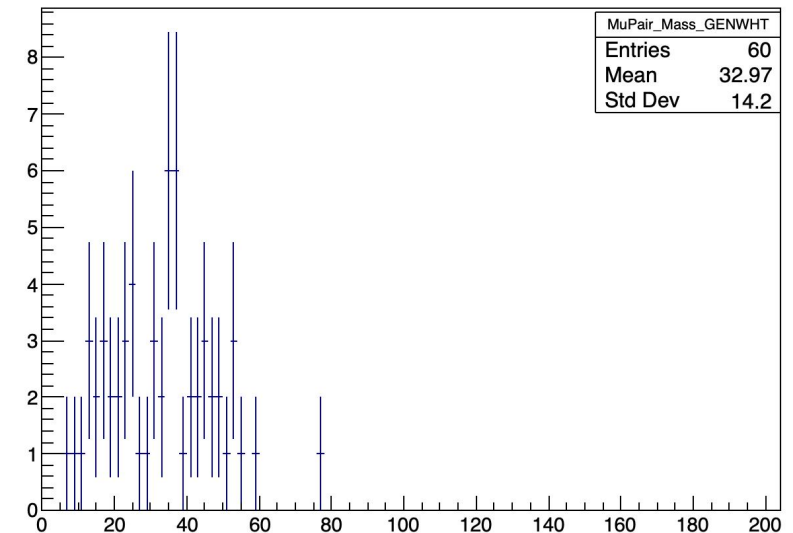
MuPair_Pt_GEN_HWT



MuPair_deltaR_GEN_HWT

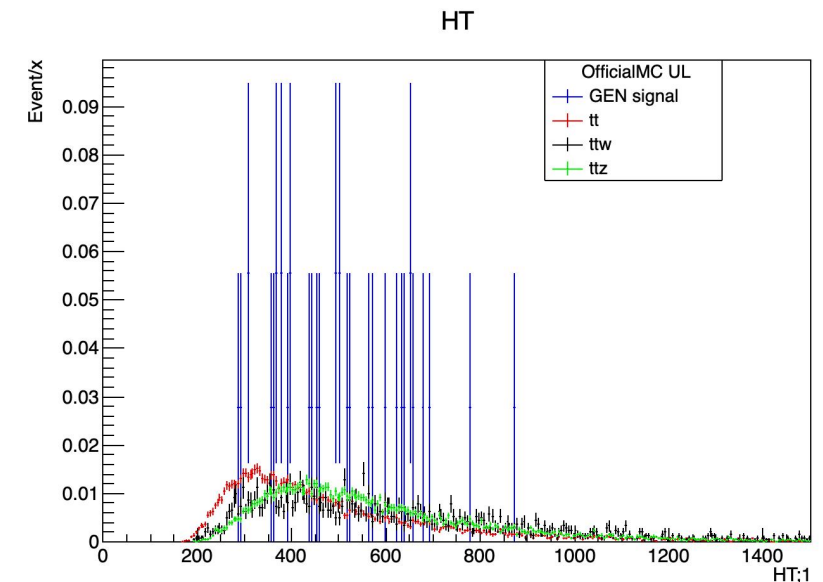
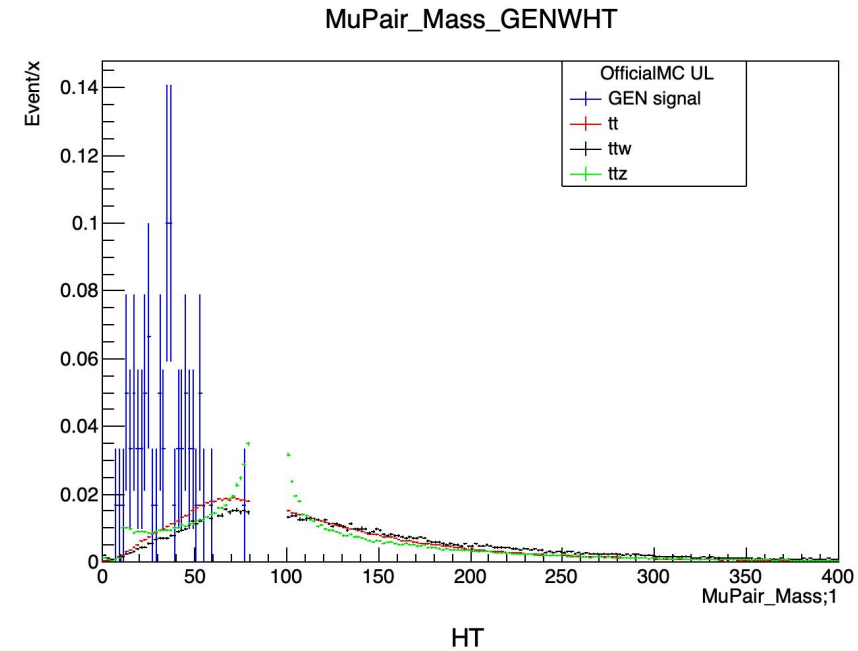
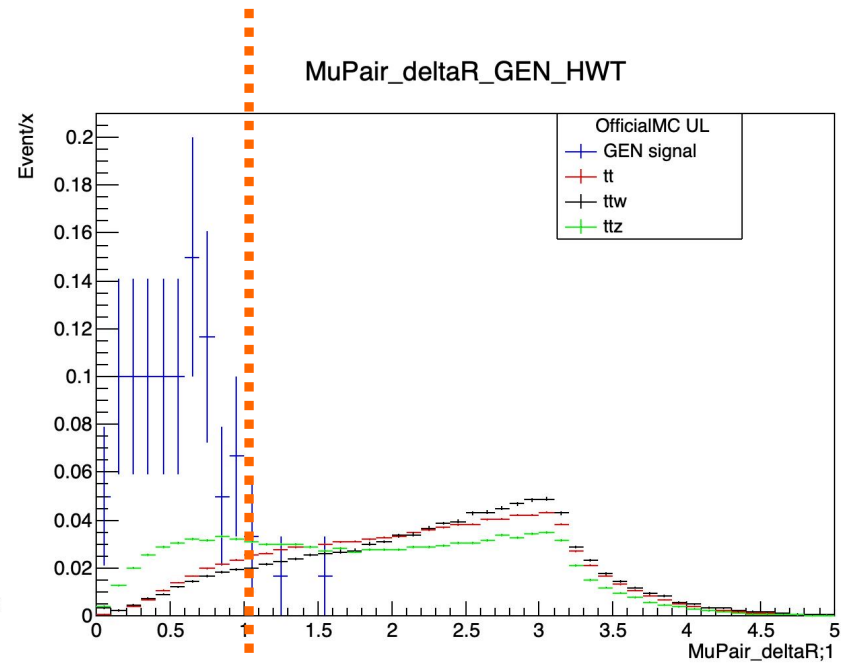
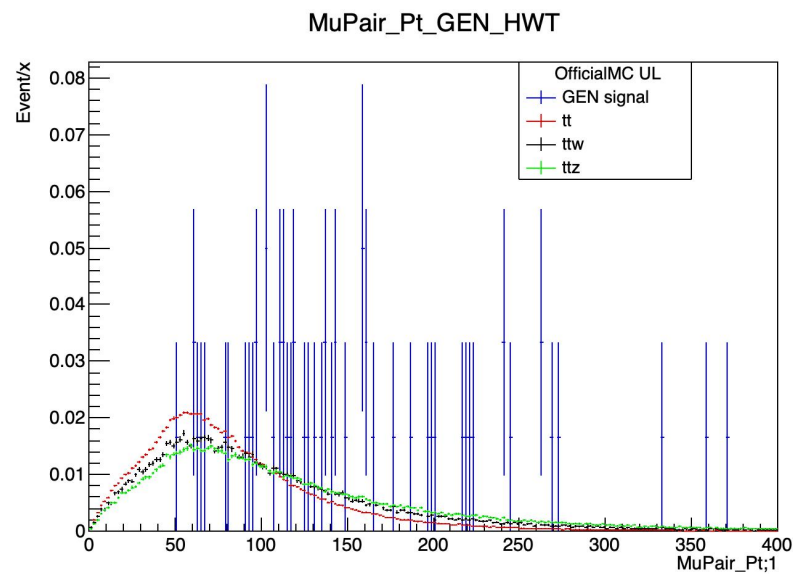


MuPair_Mass_GENWHT



Mu Pair Distribution

- Compare GEN signal distribution with background distribution
 - Signal: basic cuts & GEN selection
 - Background: basic cuts
 - Add DelataR cut: $\Delta R(\mu^+, \mu^-) < 1$
 - Will add cut on mu pair pt & HT
 - To be optimized



Mu Pair Distribution

Cuts	N_signal (89fb)	N_TTbar (87315fb)	N_TTZ (770 fb)	N_WW&WZ (12178 fb)	N_TTW (610.5 fb)	S/B
Basic cuts	10.79	36893.02	374	2.37 (just ignore them)	210.98	
Basic cuts && GEN selection (T'->H->W->mu)	2.05	-	-	-	-	0.00547%
Basic cuts && GEN selection for signal (T'->H->W->mu) && dR(m+,m-) < 1	1.92	4385.0	93.54	-	22.53	0.043%
Basic cuts && GEN selection for signal (T'->H->W->mu) && dR(m+,m-) < 1 && X_min < 18	1.44	1523.19	52.12		9.52	0.091%

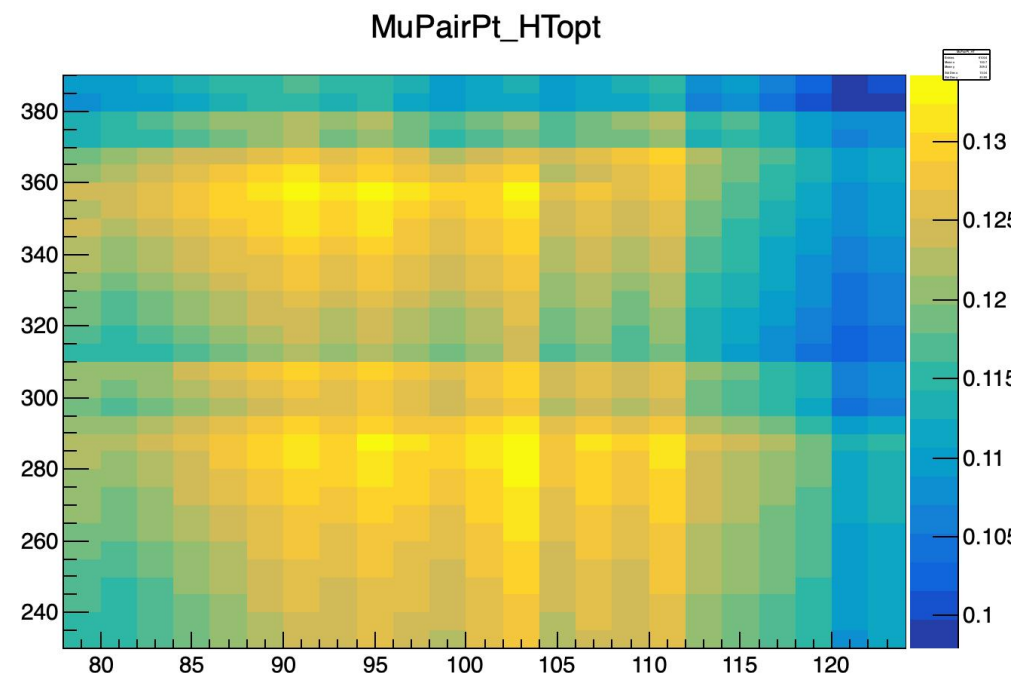
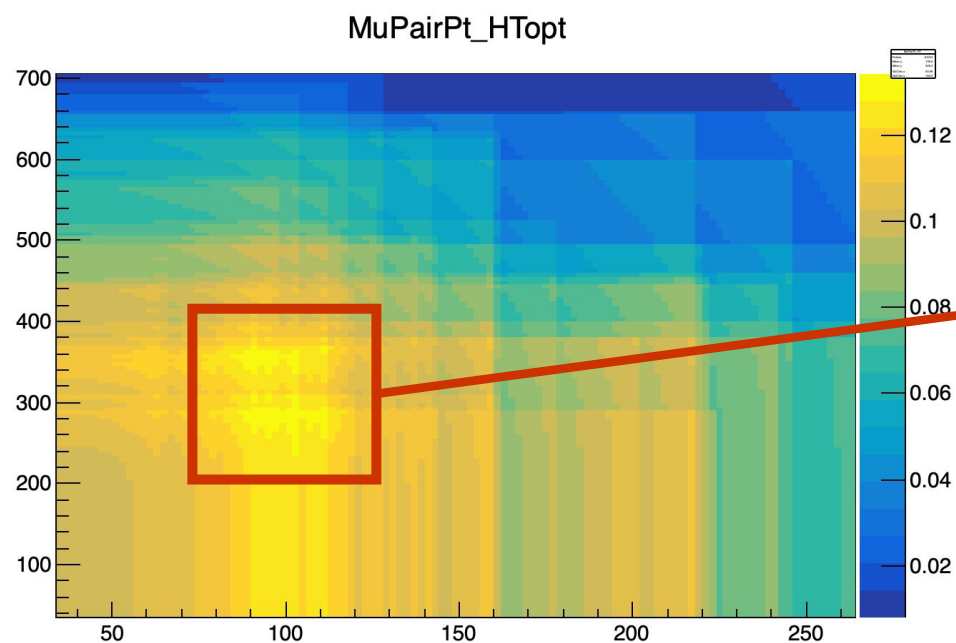
X_min cut is from jet reconstruction (Chi2 sorting algorithm)

Mu Pair Pt & HT Cut Optimization

- 2D optimization FOM: $N_{\text{signal}} / \sqrt{N_{\text{bkg}} + 3/2}$
 - $N_{\text{bkg}} = N_{\text{ttbar}} + N_{\text{ttz}} + N_{\text{ttw}}$ (after scaling)
 - **Mu pair pt > 90 GeV && HT > 360**

Need more signal MC events!

Cuts	N_signal (89fb)	N_TTbar (87315fb)	S/B
Basic cuts && GEN selection for signal && $dR(m^+, m^-) < 1$ && Mu pair pt > 90 && HT > 360	1.165	692.86	0.001681
Basic cuts && GEN selection for signal && $dR(m^+, m^-) < 1$ && Mu pair pt > 100 && HT > 280	1.233	809.26	0.00152



Cut flow table

Cuts	N_signal (89fb)	N_TTbar (87315fb)	N_TTZ (770 fb)	N_TTW (610.5 fb)	S/B
Basic cuts	10.79	36893.02	374	210.98	
Basic cuts && GEN selection ($T' \rightarrow H \rightarrow W \rightarrow \mu$)	2.05	-	-	-	0.00547%
Basic cuts && GEN selection for signal ($T' \rightarrow H \rightarrow W \rightarrow \mu$) && $dR(m+, m-) < 1$	1.92	4385.0	93.54	22.53	0.043%
Basic cuts && GEN selection for signal ($T' \rightarrow H \rightarrow W \rightarrow \mu$) && $dR(m+, m-) < 1$ && $X_{\min} < 18$	1.44	1523.19	52.12	9.52	0.091%
Basic cuts && GEN selection for signal ($T' \rightarrow H \rightarrow W \rightarrow \mu$) && $dR(m+, m-) < 1$ && Muon pair $p_t > 90$ && $HT > 360$ && $X_{\min} < 18$	1.23	809.26	43.66	7.65	0.14%

Cuts	N_signal (89fb)	N_TTbar (87315fb)	N_TTZ (770 fb)	N_TTW (610.5 fb)	S/B
Basic cuts && GEN selection for signal ($T' \rightarrow H \rightarrow W \rightarrow \mu$) && $dR(m^+, m^-) < 1$ && Muon pair $pt > 90$ && $HT > 360$ && $X_{min} < 18$	1.165	692.86	43.66	7.65	0.16%
Basic cuts && GEN selection for signal ($T' \rightarrow H \rightarrow W \rightarrow \mu$) && $dR(m^+, m^-) < 1$ && Muon pair $pt > 140$ && $HT > 300$ && $X_{min} < 18$ && $dR(\mu, bjet) > 1.5$	0.68	308	33	3.6	0.197%

Cuts from last
meeting

too many
signal events
are removed?

Fly with HTCondor!

- **Analysis datasets within fly framework in HTCondor pool**
 - **Scripts are prepared for LPC server**
 - **Big bandwidth & less restrictions**
 - ***No long need to download nanoaod files to local machine!***
 - **Directly read root files from CMS das**
 - **Input: txt files contains nanoaod files name**
 - **VOMS certificate needed**
 - **Collect results at EOS space**
 - **Very effective for big MC samples (TTbar) ! && Save a lot of space!**

```

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```

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TTLOS_TT218_4
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Input: 1 txt file

Output: root files