Cut Strategy

- ➢ Study case 1 first (maybe study case3 at the same time)
  - case1: T'->tH; t->Wb->qqb; H->WW->l+l-**νν**   (1 lepton pair, 3 jets and at least 1 b jet)
  - case2: T' -> tH; t->Wb->blν; H->WW->qql   (1 lepton pair, 3 jets and at least 1 b jet)
  - case3: T' -> tH; t->Wb->qqb; H->ZZ->l+l-qq   (1 lepton pair, 3 jets and at least 1 b jet)

- ➢ Basic cuts:
  - Cuts for muons
    - Tight ID cut: Muon_tightId
    - Pt(mu) > 20GeV
    - |eta| < 2.4
    - Tight isolation cut: goodMuons_miniPFRelIso_all < 0.05
  - Cuts for jets
    - Tight jet ID cut: Jet_jetId: 6
    - Pt(jet) > 30GeV
    - |eta| < 2.5
  - Cuts for events
    - 1 OS muon pair
    - At least 3 jets
    - At least 1 b jet
      - Medium b-tag jet: goodJets_btagDeepFlavB>0.2783
- ➢ Study 2 more cuts
  - HT, ST and muon pair Pt
    - ST/ HT/ HT+Muon Pair Pt
  - Reconstruct W/ top
    - Find a W peak and a top bump
 - DeltaR(muon, b jet)

Jet pT cuts study

➢ Cut on one of the Pt variables
- ▪ HT: sum of all jets
- ▪ ST: sum of all muons and jets
- ▪ Muon pair Pt: sum of muons pt
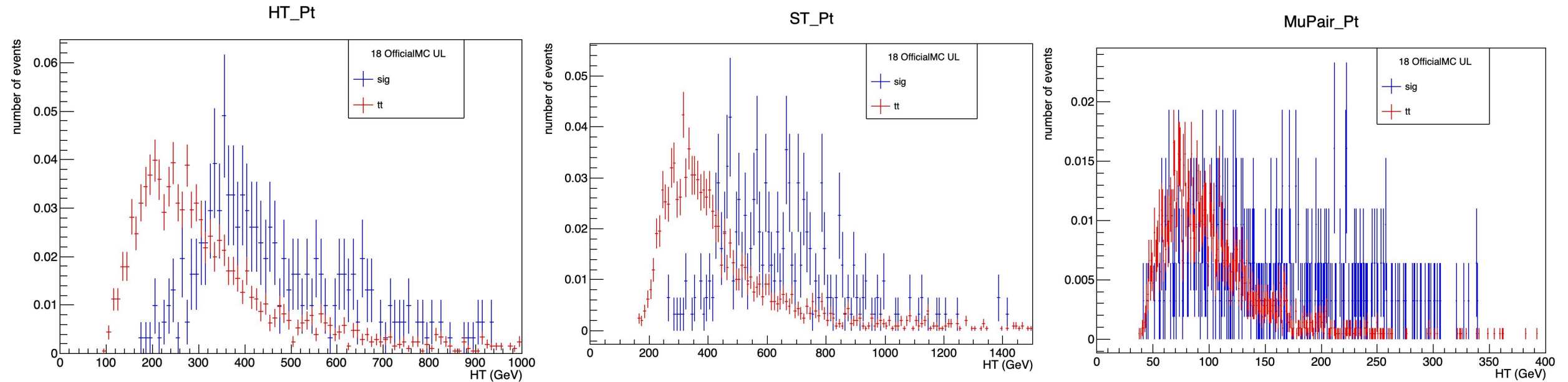
Jet pT cuts study

➢ Choose HT > 300 && mu pair Pt > 140

	Number of TT events (after scaling)	Number of Signal events (after scaling)	Ratio S/B_tt
Basic cuts&& deltaR (mu+, mu-) < 1	17621.0	12.6	0.0715%
Basic cuts&& deltaR (mu+, mu-) < 1 && mu pair pt > 140	2681.3	7.4	0.276%
Basic cuts&& deltaR (mu+, mu-) <1 && ST > 400	6661.5	11.8	0.177%
Basic cuts&& deltaR (mu+, mu-) <1 && HT > 300	6577.9	10.8	0.165%
Basic cuts&& deltaR (mu+, mu-) <1 && HT > 300 && mu pair pt > 140	1912.1	6.4	0.332%
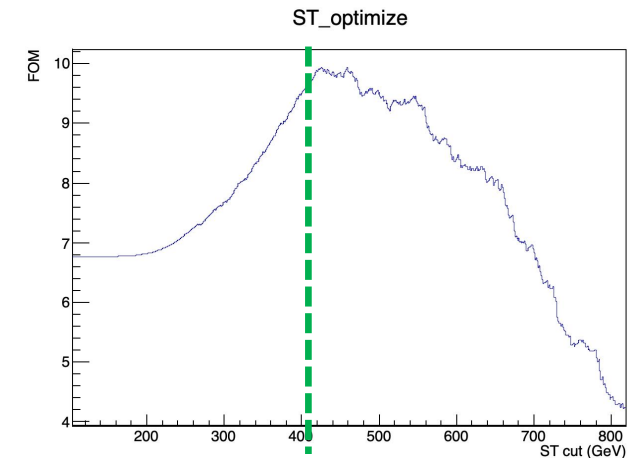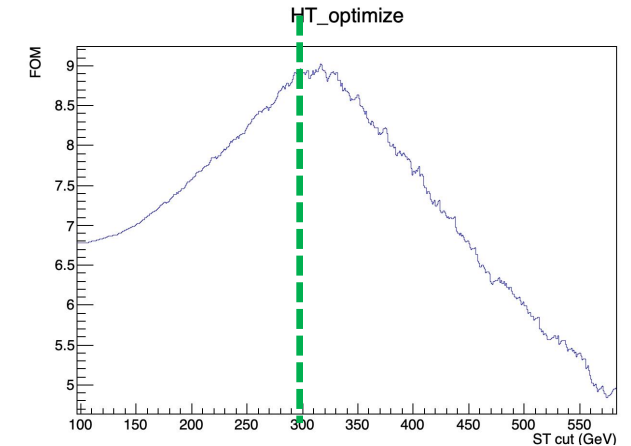
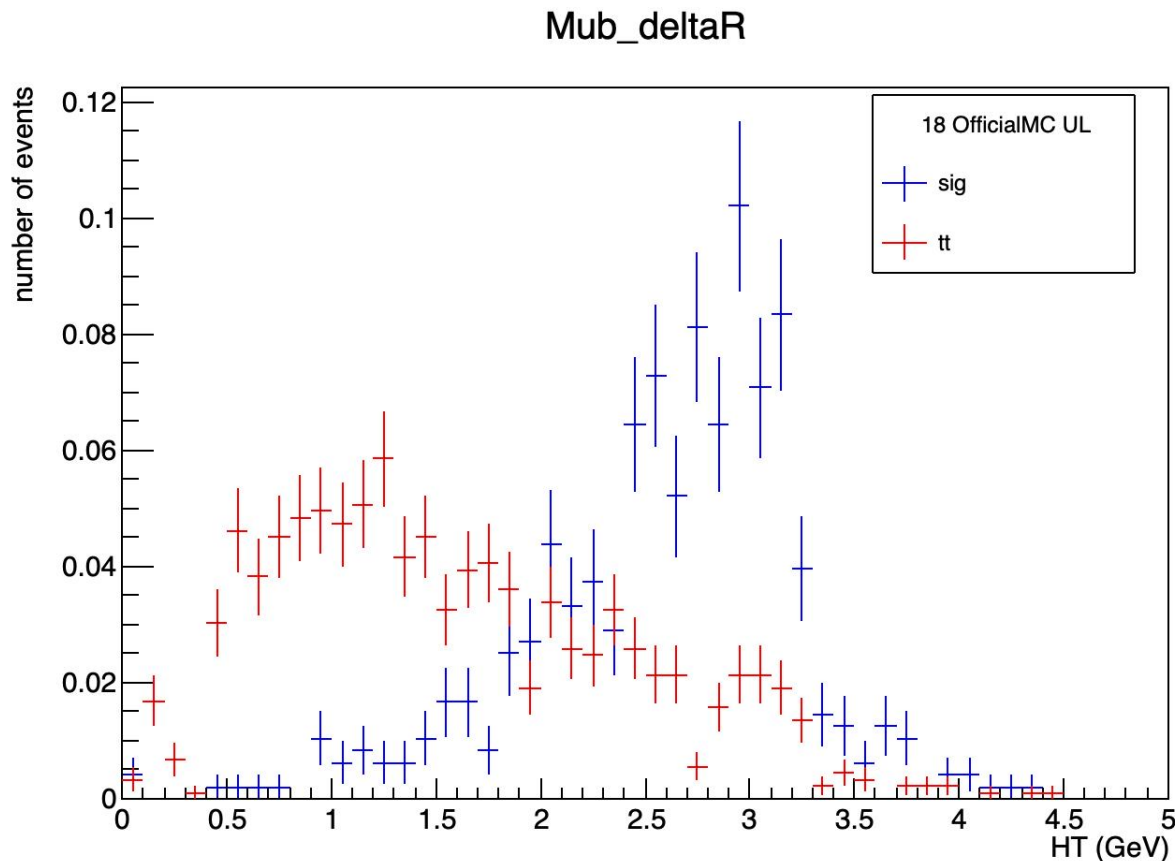# case3 issue

➢ After basic cuts && deltaR(mu+, mu-) < 1 && HT > 300 && mu pair Pt > 140
  - There is a clear Z peak in muon pair mass plot
  - A H-> tau tau peak
  - Maybe we can merge case1 nad case3?
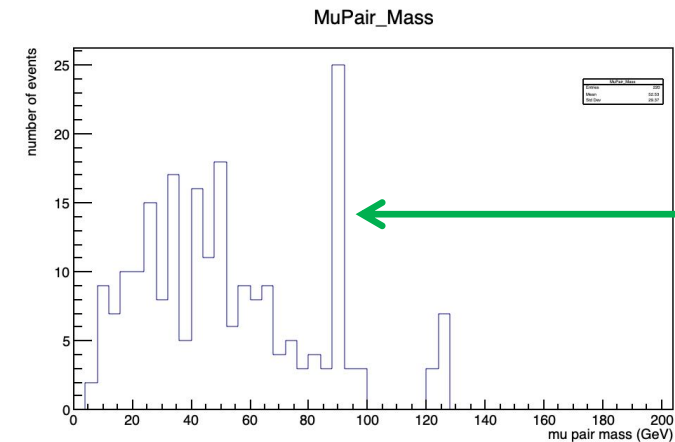

MuPair_Mass
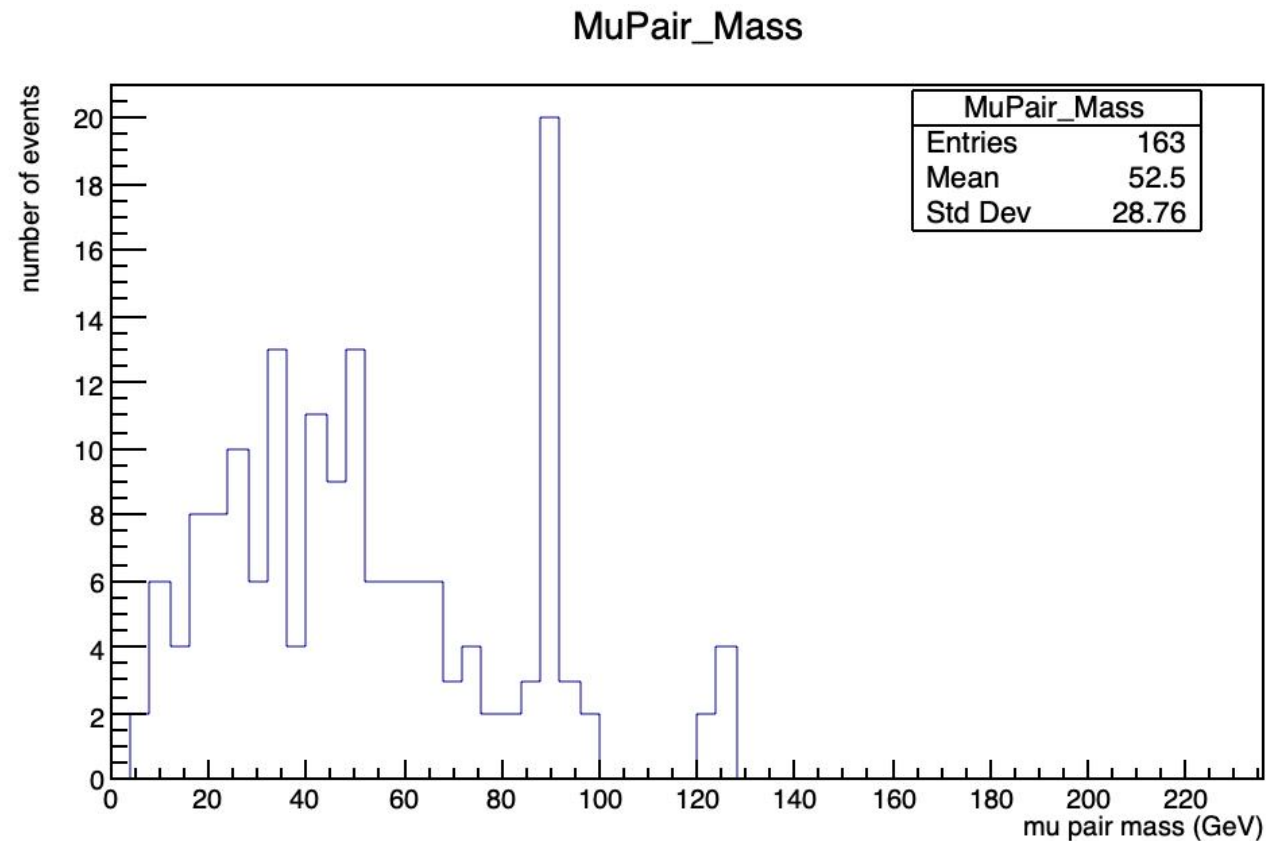
deltaR(b jet, muon)

- ➤ After basic cuts && deltaR(mu+, mu-) < 1 && HT > 300 && mu pair Pt > 140
- ➤ deltaR(b jet, muon) has different behavior for signal and TTbar
  - ▪ A cut could be added
    - ▪ deltaR(mu+, b jet) > 1.5 && deltaR(mu-, b jet) > 1.5

Mub_deltaR

	Number of TT events (after scaling)	Number of Signal events (after scaling)	Ratio S/B_tt
Basic cuts&& deltaR (mu+, mu-) < 1 && HT > 300 && mu pair pt > 140 && deltaR(mu+, b jet) > 1.5 && deltaR(mu-, b jet) > 1.5	813.87	5.46	0.6713%

MuPair_Mass

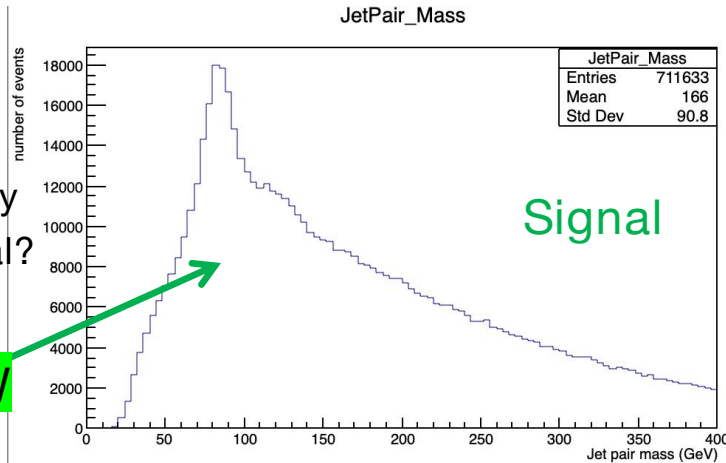Z peak is still there! (make sense)

Jet reconstruction

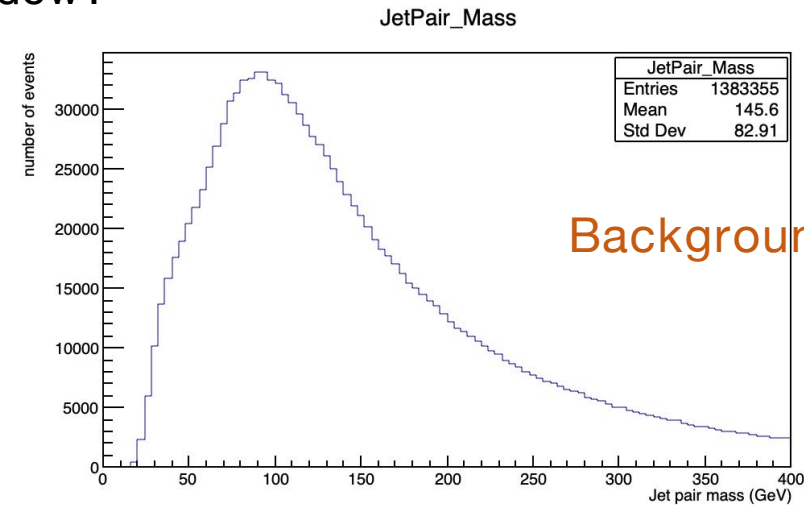➤ Non-b jet pair mass distribution & Triple jets mass distribution
- non-b jet: goodJets_btagDeepFlavB<0.2783
- There is a W bump in signal MC!
- A W mass window cut could be added
  - What's the width of this window?

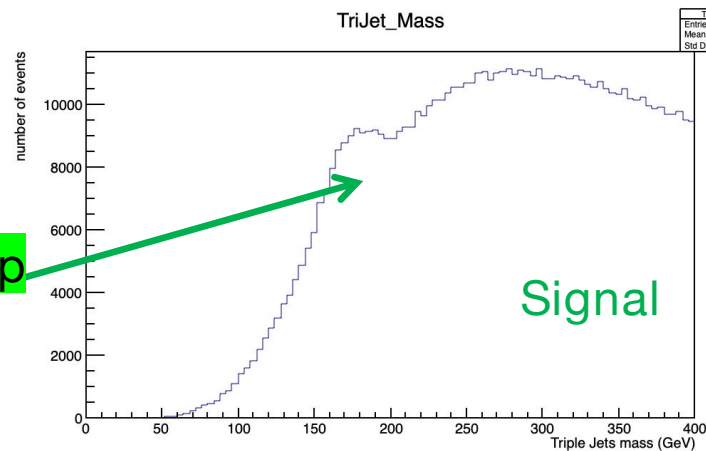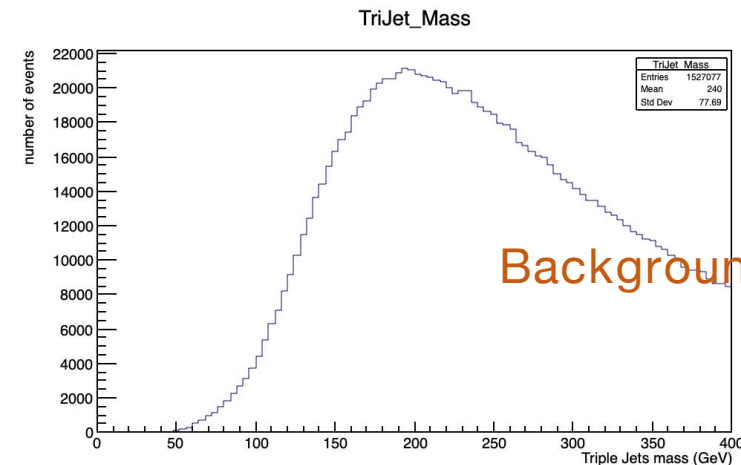The "peak" is pretty wide, is that normal?

qq->W

Signal

bqq->top
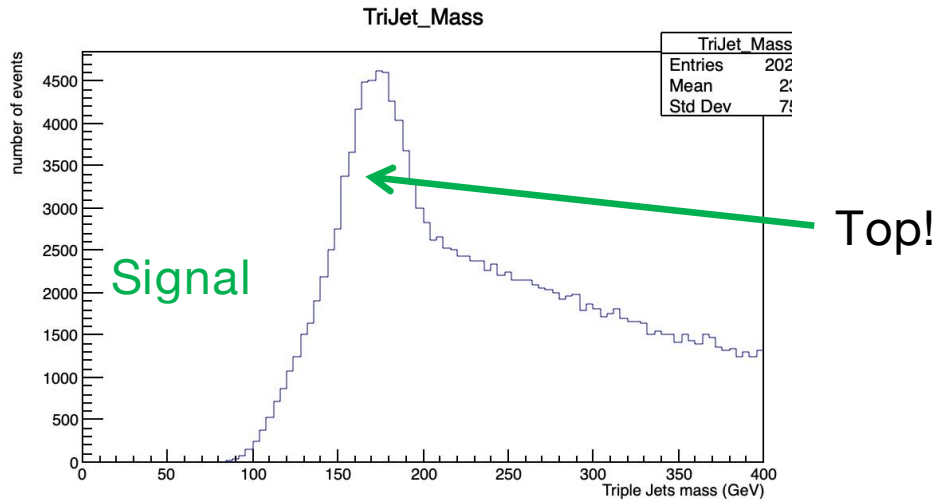
Signal

Background

These plots are after basic cuts

Background

Jet reconstruction

➤ Add a very inappropriate W mass window cut: 70 GeV < non-b jet pair mass < 100 GeV

Top!

Signal

	Number of TT events (after scaling)	Number of Signal events (after scaling)	Ratio S/B_tt
Basic cuts&& deltaR (mu+, mu-) < 1 && HT > 300 && mu pair pt > 140 && deltaR(mu+, b jet) > 1.5 && deltaR(mu-, b jet) > 1.5 && 70 < non-b jet pair mass < 100	206.25	2.46	1.19%

Background

Signal

Signal

Z peak is still there! (That's why I want to merge case1 and case 3)