Software Review: Update

24 June 2022

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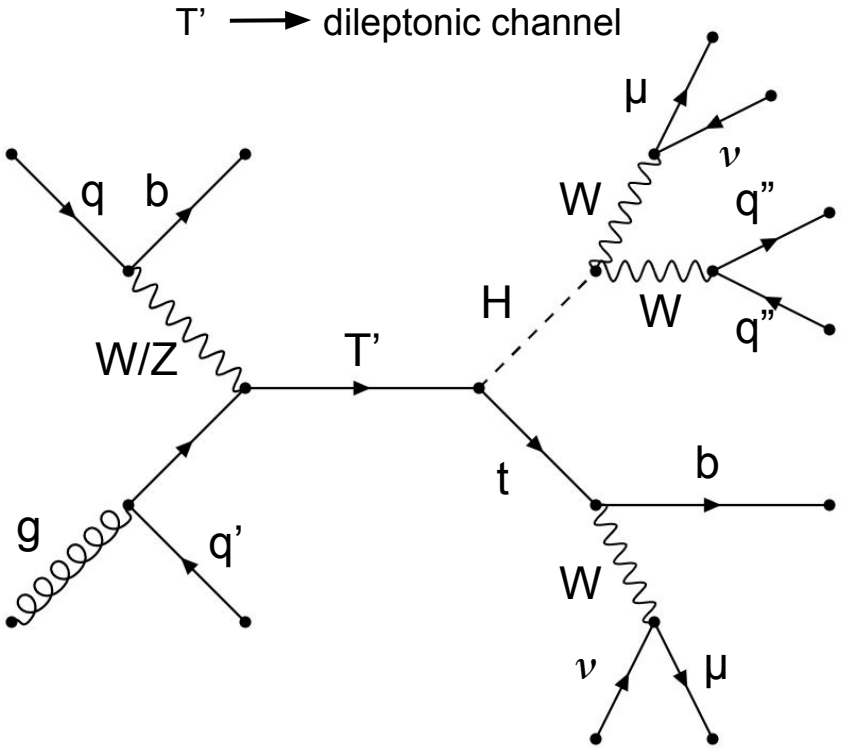


Basic selection: 2 tight SS Muons with Pt > 20 GeV, |η| < 2.4 and tight isolation.

Reminder (two strategies):

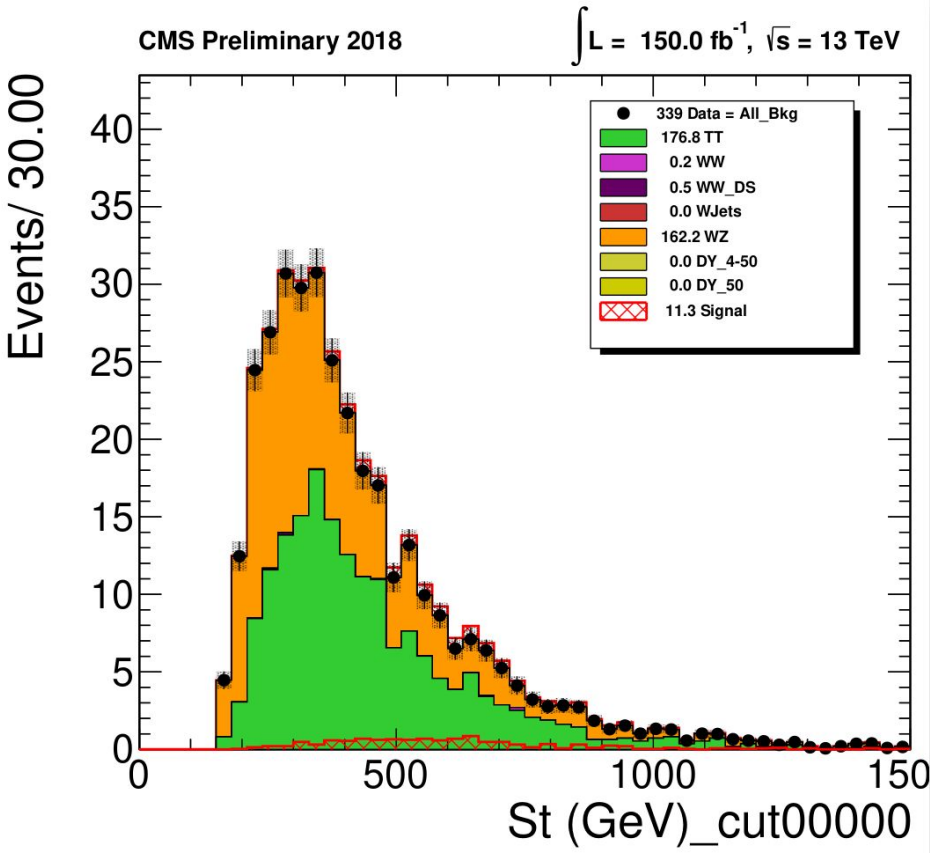
Strategy 1: Cut 1: Pt of the leading muon > 80 GeV.
Cut 2: Pt of the subleading muon > 40 GeV.
Cut 3: ΔR > 1.8.
Cut 4: at least one b-jet (b-tag loose).

Selection	Signal	All Background	S/B
Basic selection	25.1	24268.9	0.10%
Cut 4: At least one b-jet	11.3	340.5	3.32%

Strategy 2: Cut 1: Pt of the sum of the two muons > 160 GeV.
Cut 2: ΔR > 1.8.
Cut 3: at least one b-jet (b-tag loose).

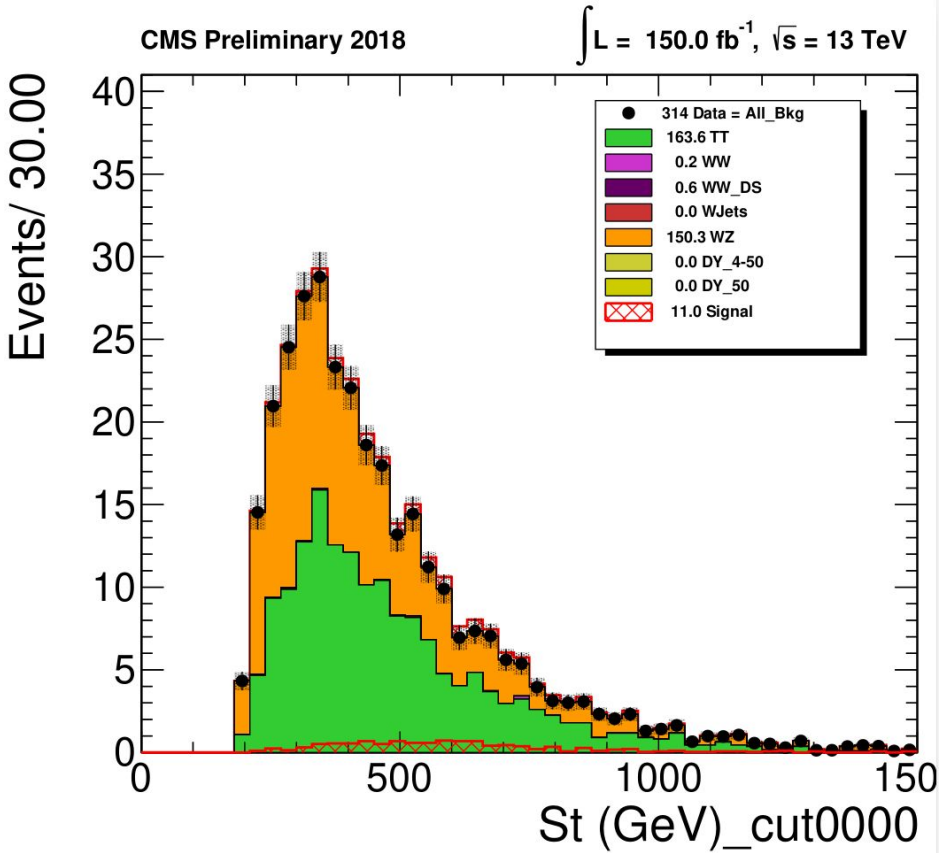
Selection	Signal	All Background	S/B
Basic selection	25.1	24268.9	0.10%
Cut 3: At least one b-jet	11.0	315.5	3.49%

(Reminder) Strategy 1: St after Cut 4 (separated background)



The main backgrounds are TTbar and WZ (~50%/50%). ⟶ The WZ could be removed!

(Reminder) Strategy 2: St after Cut 3 (separated background)



Same conclusion.

Application of an additional criterion at basic selection to veto a third muon:
Basic selection: 2 tight SS Muons with Pt > 20 GeV, |η| < 2.4 and tight isolation.

↓

Basic selection: 2 loose Muons with Pt > 10 GeV, |η| < 2.4 and loose isolation +
2 tight SS Muons with Pt > 20 GeV, |η| < 2.4 and tight isolation.

Application of an additional criterion at basic selection with the impact parameter to remove the events with muons coming from taus:
Basic selection: 2 loose Muons with Pt > 10 GeV, |η| < 2.4 and loose isolation +
2 tight SS Muons with Pt > 20 GeV, |η| < 2.4 and tight isolation.

↓

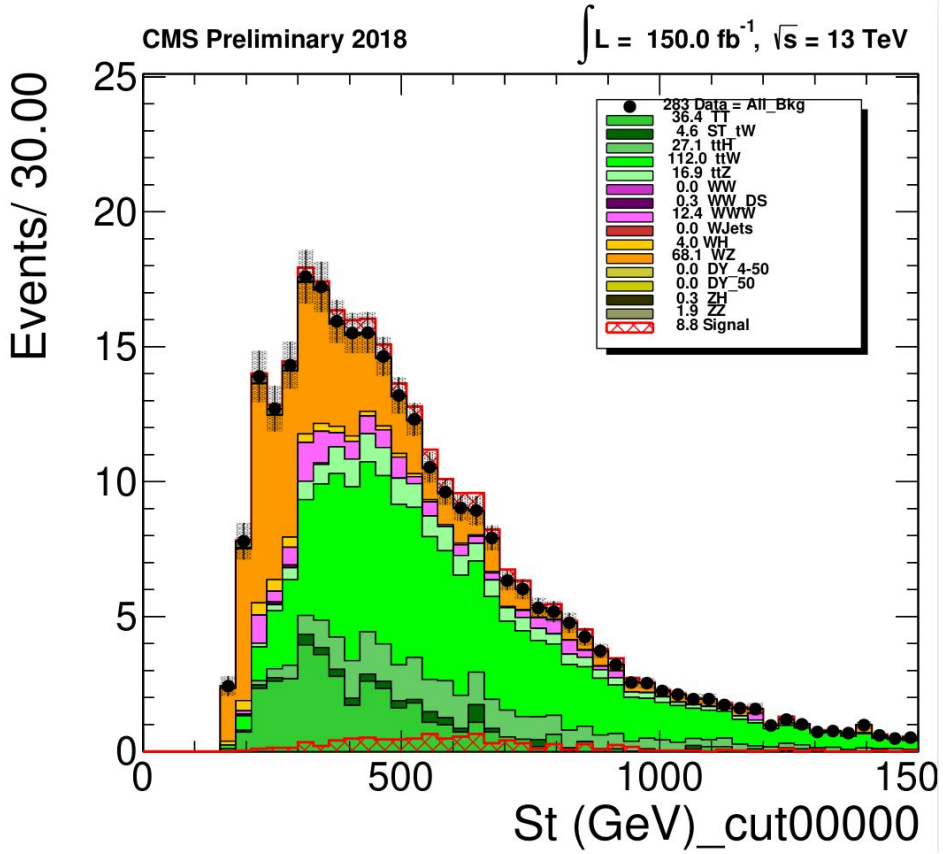
Basic selection: 2 loose Muons with Pt > 10 GeV, |η| < 2.4 and loose isolation +
2 tight SS Muons with Pt > 20 GeV, |η| < 2.4, tight isolation and sip_3d < 3 (sip = impact parameter significance).

Signal and (new!) backgrounds:

Process	Cross-section (fb)
Signal	89
TTbar	87315
Single top	19467
ttH	271
ttW	610.5
ttZ	770
WW	12178
WW (Double Scattering)	169.75

Process	Cross-section (fb)
WWW	208.6
W + Jets	61334900
WH	31.3
WZ	4429.7
Drell-Yan	18610000 (Mass = 4-50 GeV) 6020850 (Mass = 50 GeV)
ZH	185.8
ZZ	1256

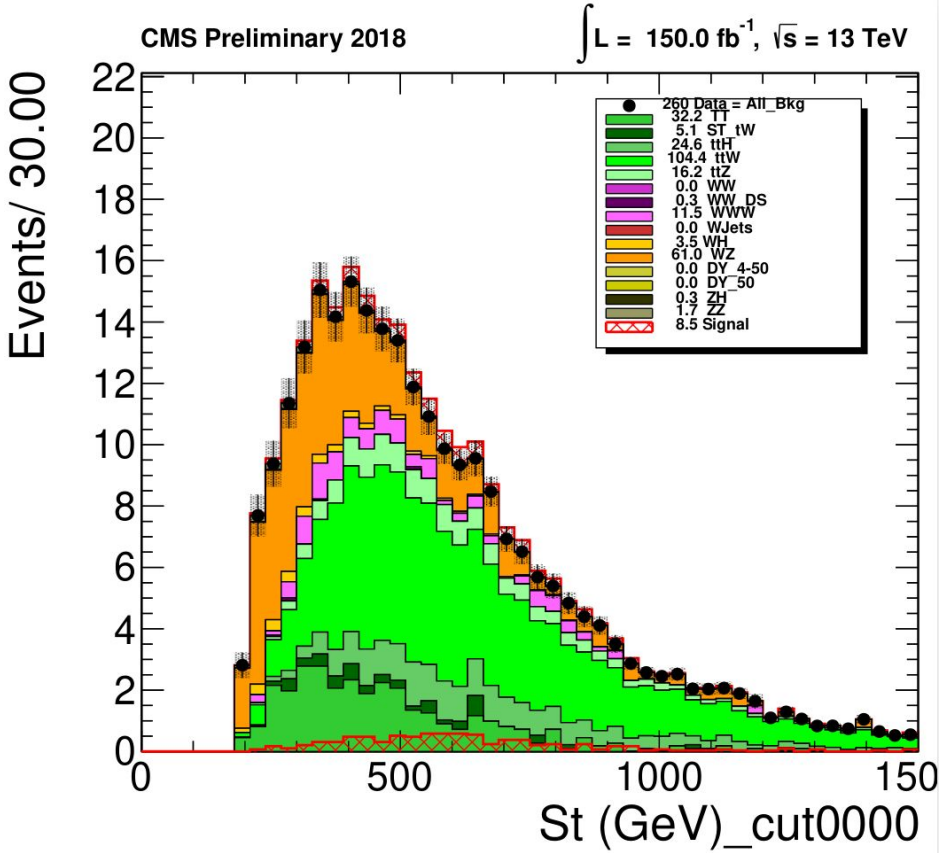
Strategy 1 (updated selection): St after Cut 4 (separated background)



The TTbar and the WZ have been well removed (-80% and -58%) but it could better. On top of that, the main background is now the ttW. The St seems not be the good variable as well as the backgrounds have their maximum for different values. ⟶ Find a new variable!

Selection	Signal	All Background	S/B
Basic selection	18.1	10263.2	0.18%
Cut 4: At least one b-jet	8.8	293.9	3.10%

Strategy 2 (updated selection): St after Cut 3 (separated background)



Same conclusion.

Selection	Signal	All Background	S/B
Basic selection	18.1	10263.2	0.18%
Cut 3: At least one b-jet	8.5	260.8	3.26%

Strategy 1:

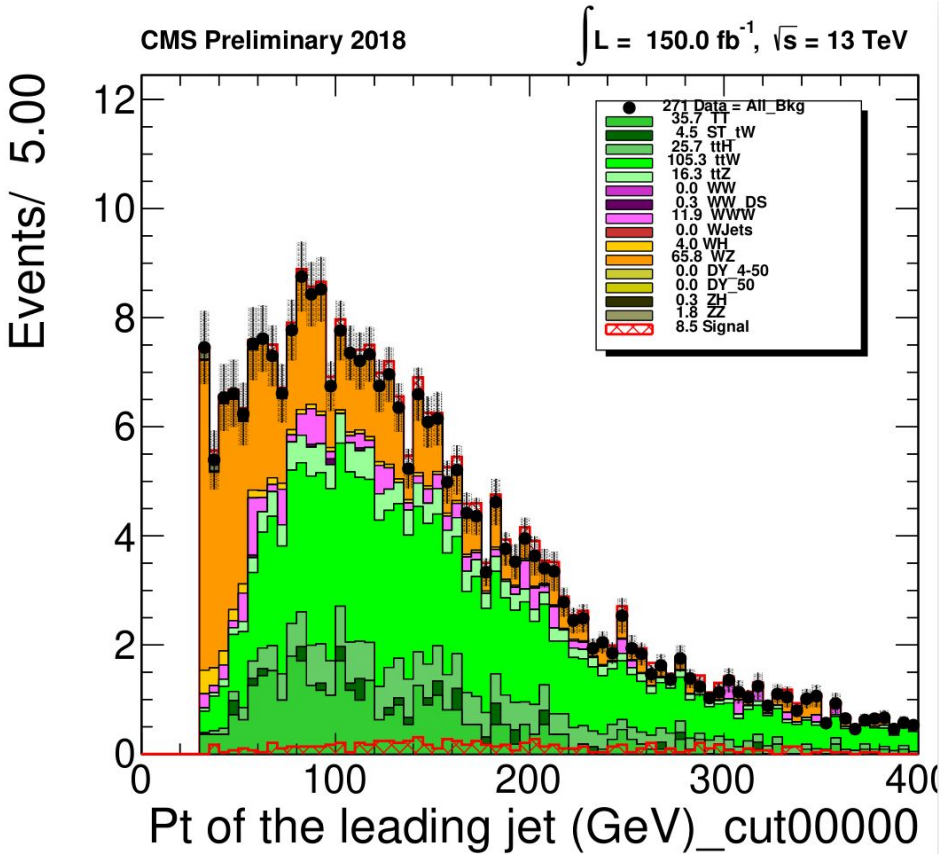
Selection	Percentage of correct identification
Basic selection	70.7%
Cut 1: Pt first muon > 80 GeV	73.3%
Cut 2: Pt second muon > 40 GeV	77.2%
Cut 3: $\Delta R > 1.8$	77.4%
Cut 4: At least one b-jet	76.7%

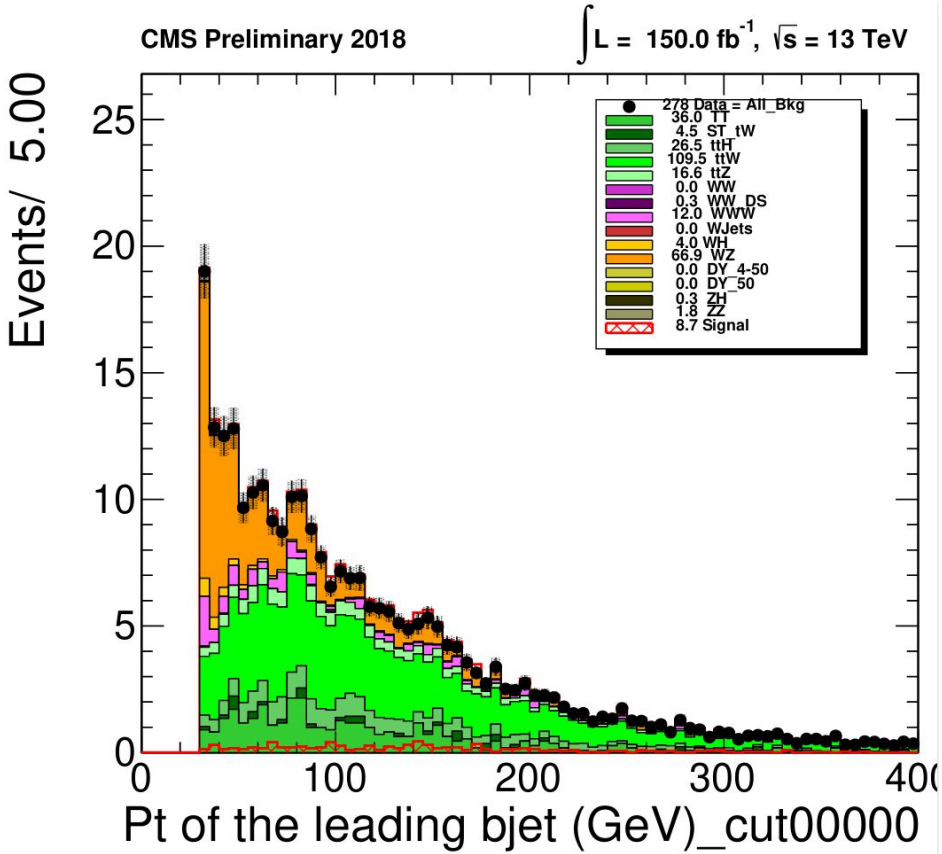
Strategy 2:

Selection	Percentage of correct identification
Basic selection	70.7%
Cut 1: Sum Pt two muons > 160 GeV	75.6%
Cut 2: $\Delta R > 1.8$	75.9%
Cut 3: At least one b-jet	75.0%

The signal correct identification wrt Generator information has been increased by 13%. ⟶ Good (Still polluted by taus for ~22% and by Z for ~2%).

Strategy 1: Pt of the leading jet and b-jet after Cut 4 (separated background)



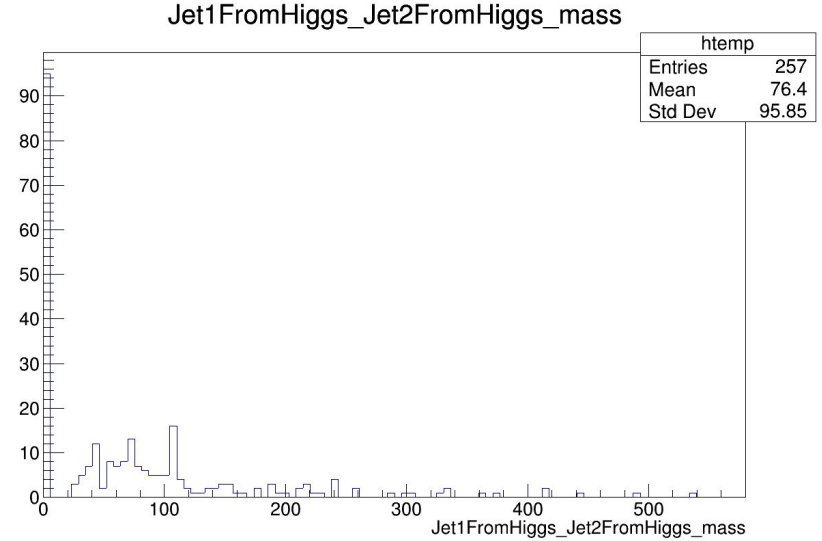


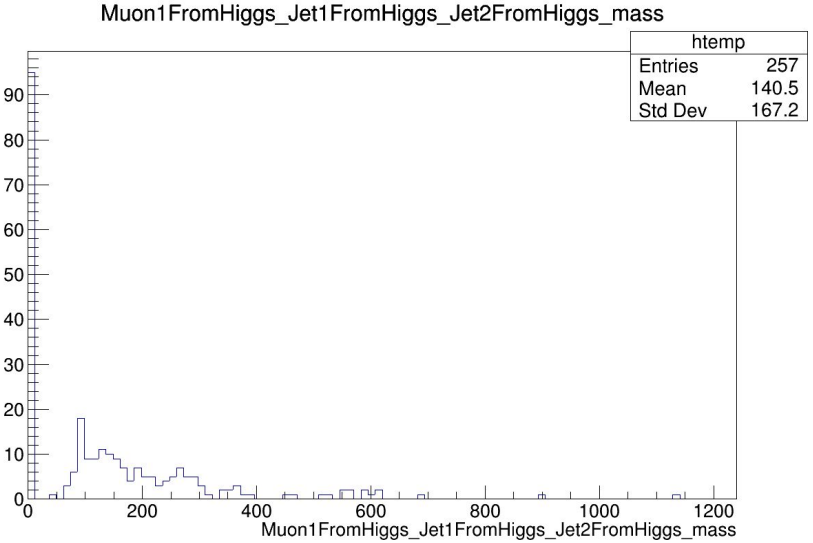
The WZ is the main background at low Pt. ⟶ New update?

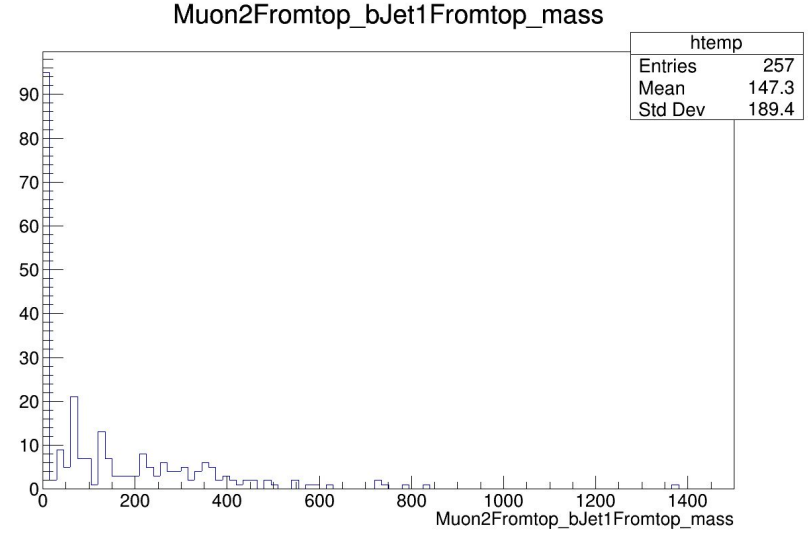
An additional selection on the Pt of the jets seems to remove a lot of WZ but the ttW is barely removed. ~~→~~ ONGOING.

Other updates: - reject events if one invariant dimuon mass among all the muons (loose muons only?) in the events is equal to the Z boson mass (80 GeV - 100 GeV mass window).
→ -2% for the signal, -10% for the WZ. → Need to be applied for all backgrounds (ONGOING).

- check the invariant masses of the two jets (W boson), the muon+two jets (H boson) and the other muon+b-jet (top quark) among the selected muons and jets (> 3 jets with 1 b-jet).







It is not very useful because of the lack of statistics in the signal.

→ Use jets and muons with a loose selection? Apply the MET?