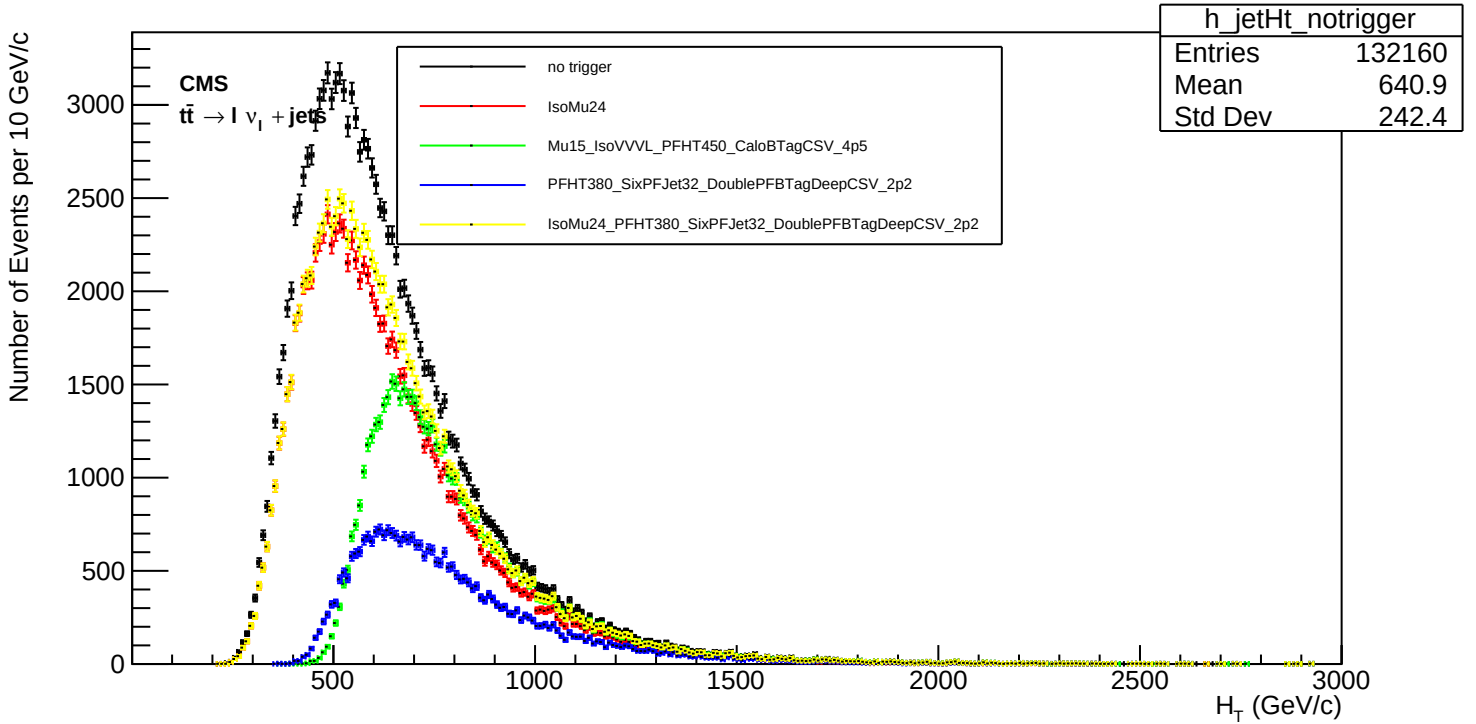
On-line (pre-)selection Requisites for:

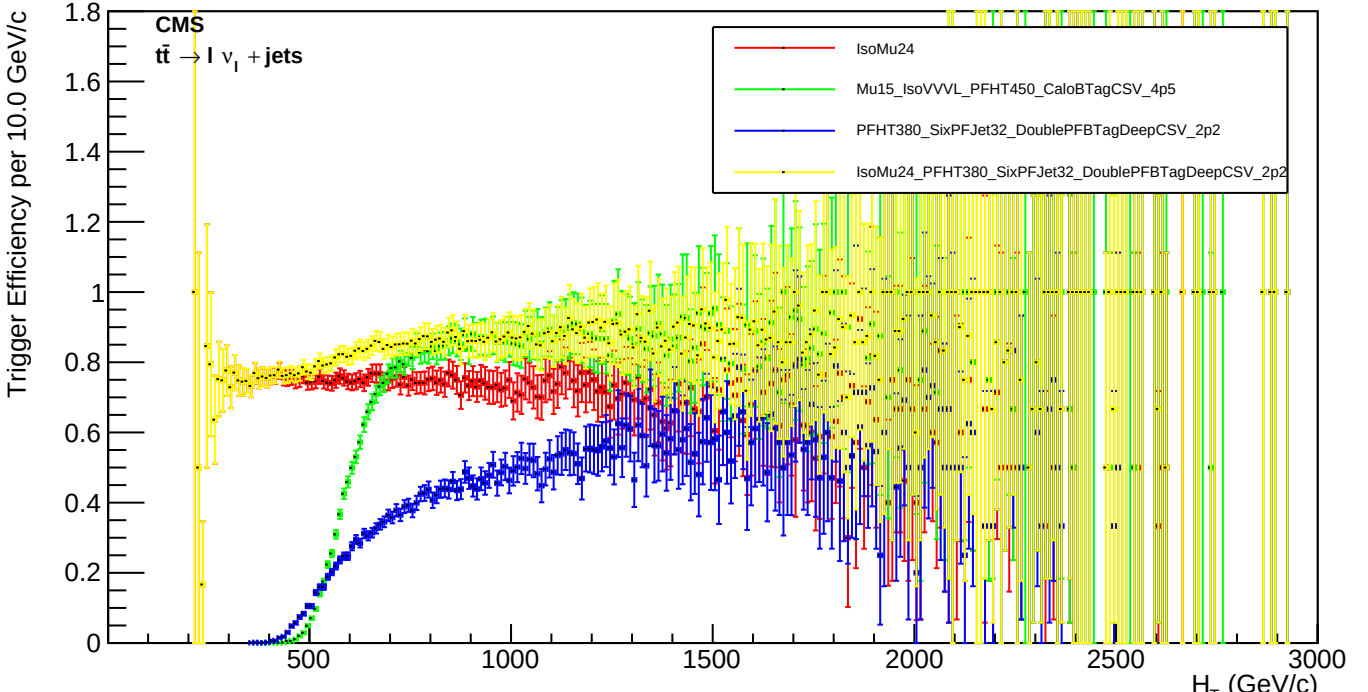
- **Jets:** number > 5
- **Muons:** number >0
- **Electrons:** number >0

Event Limit: None (see last page)

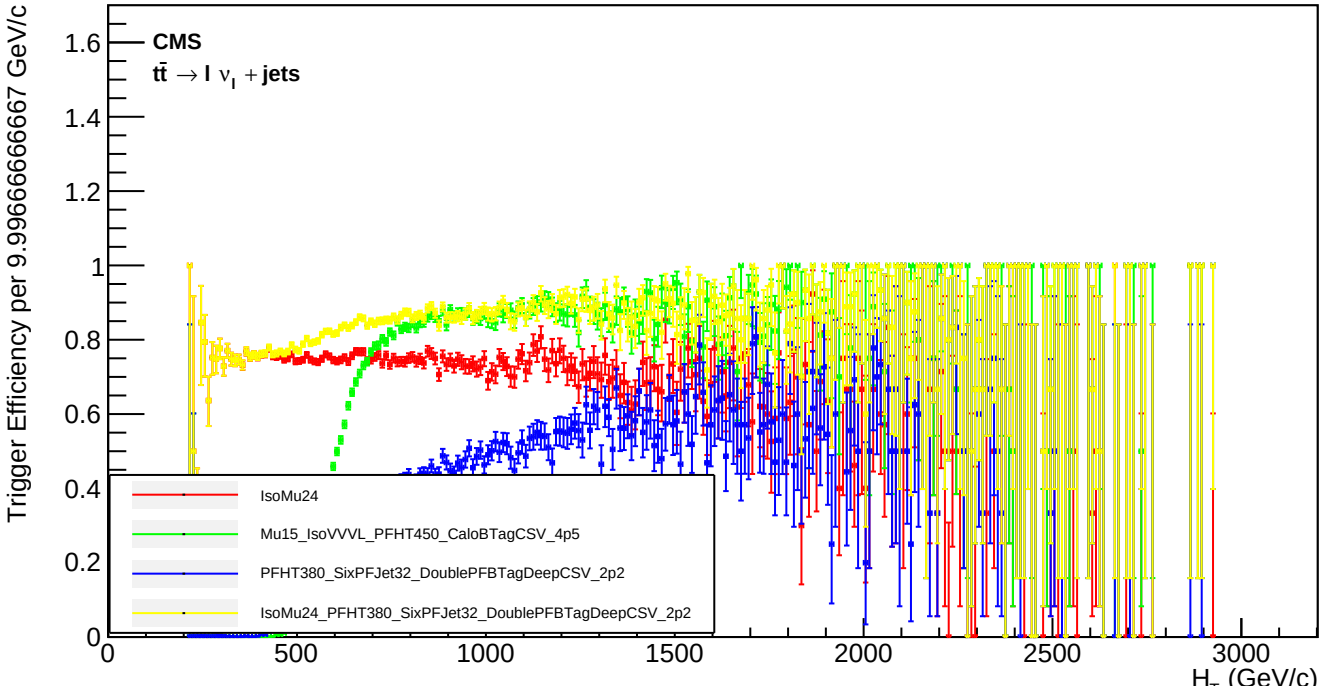
Off-line (post-)selection Requisites for:

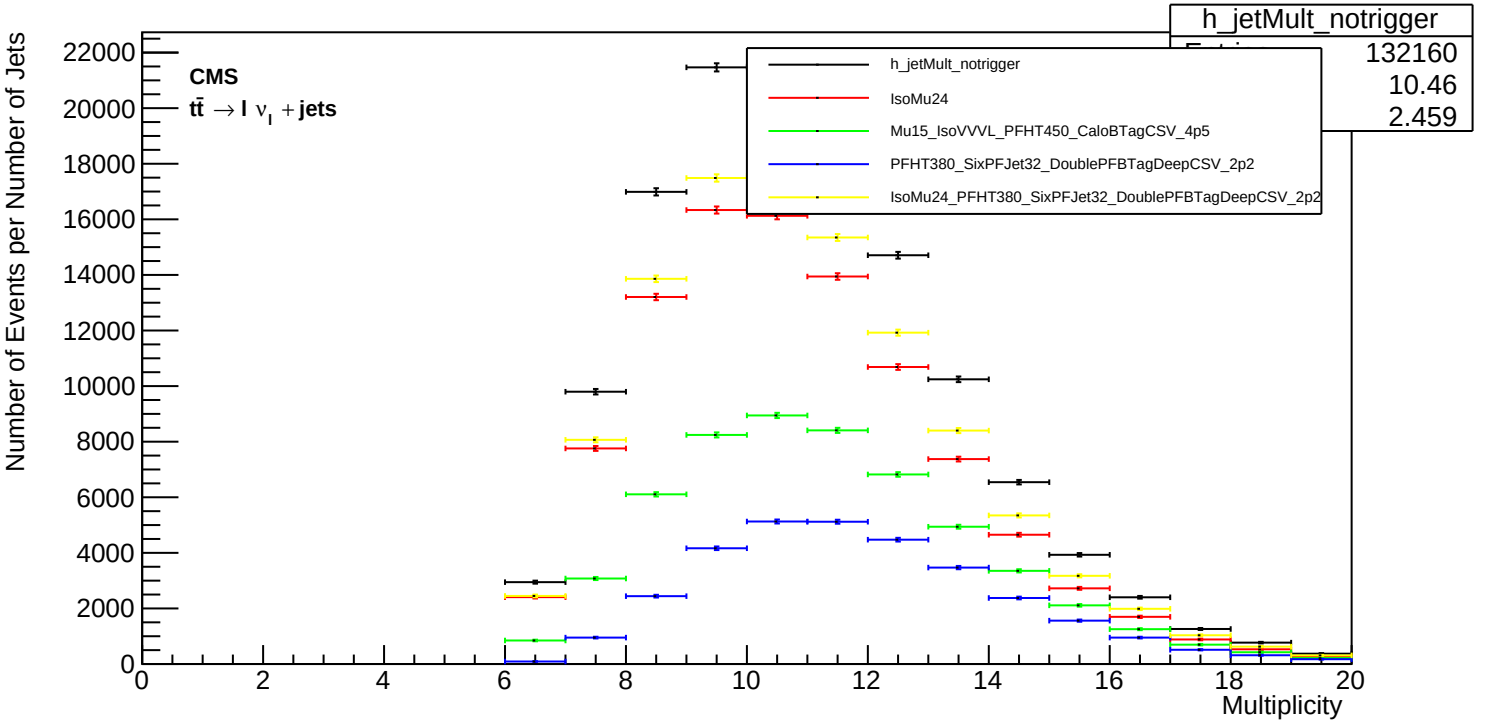
- **Jets:** jetId > 2 , p_T > 30 and |η|<2.4 (for at least 6)
  btagDeepFlavB > 0.7489 (for at least one jet)
- **Muons:** has tightId, |η|<2.4 and miniPFRelIso_all<0.15 (for at least 1)

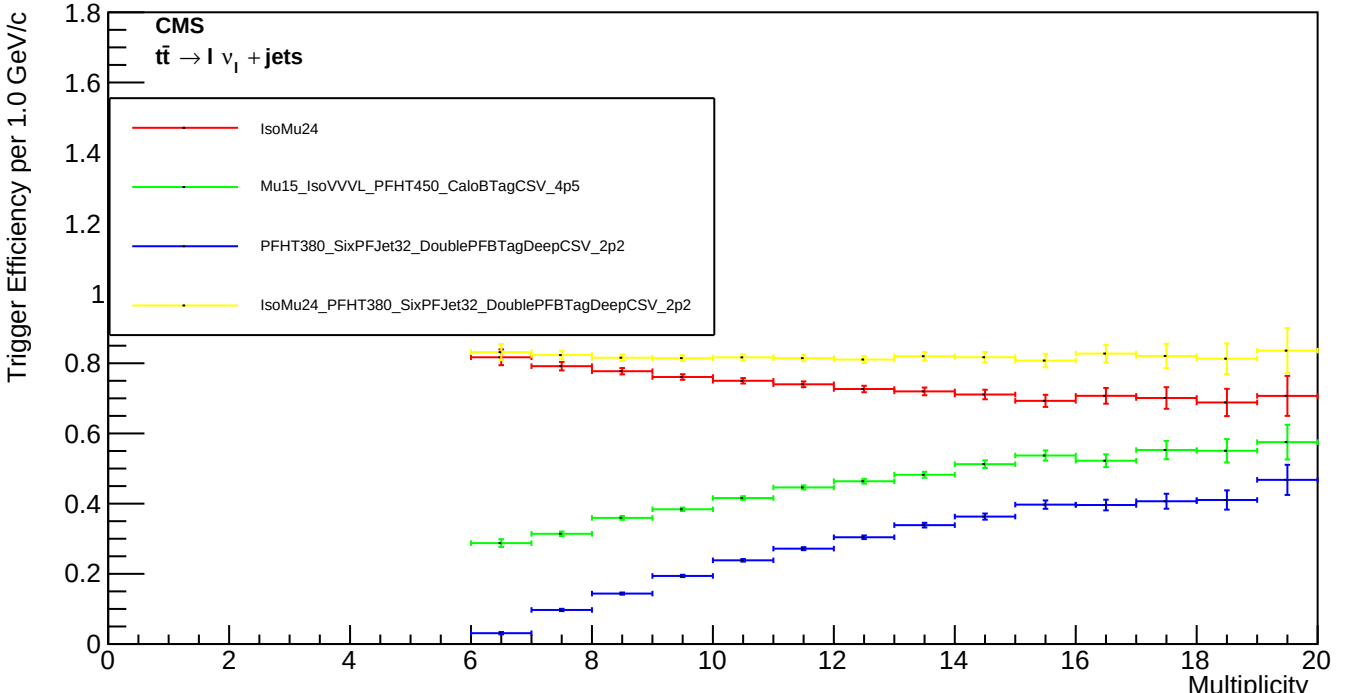

no trigger
h_jetHt_notrigger
Entries 132160
Mean 640.9
Std Dev 242.4
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
no trigger
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Number of Events per 10 GeV/c
0
500
1000
1500
2000
2500
3000
H_T (GeV/c)

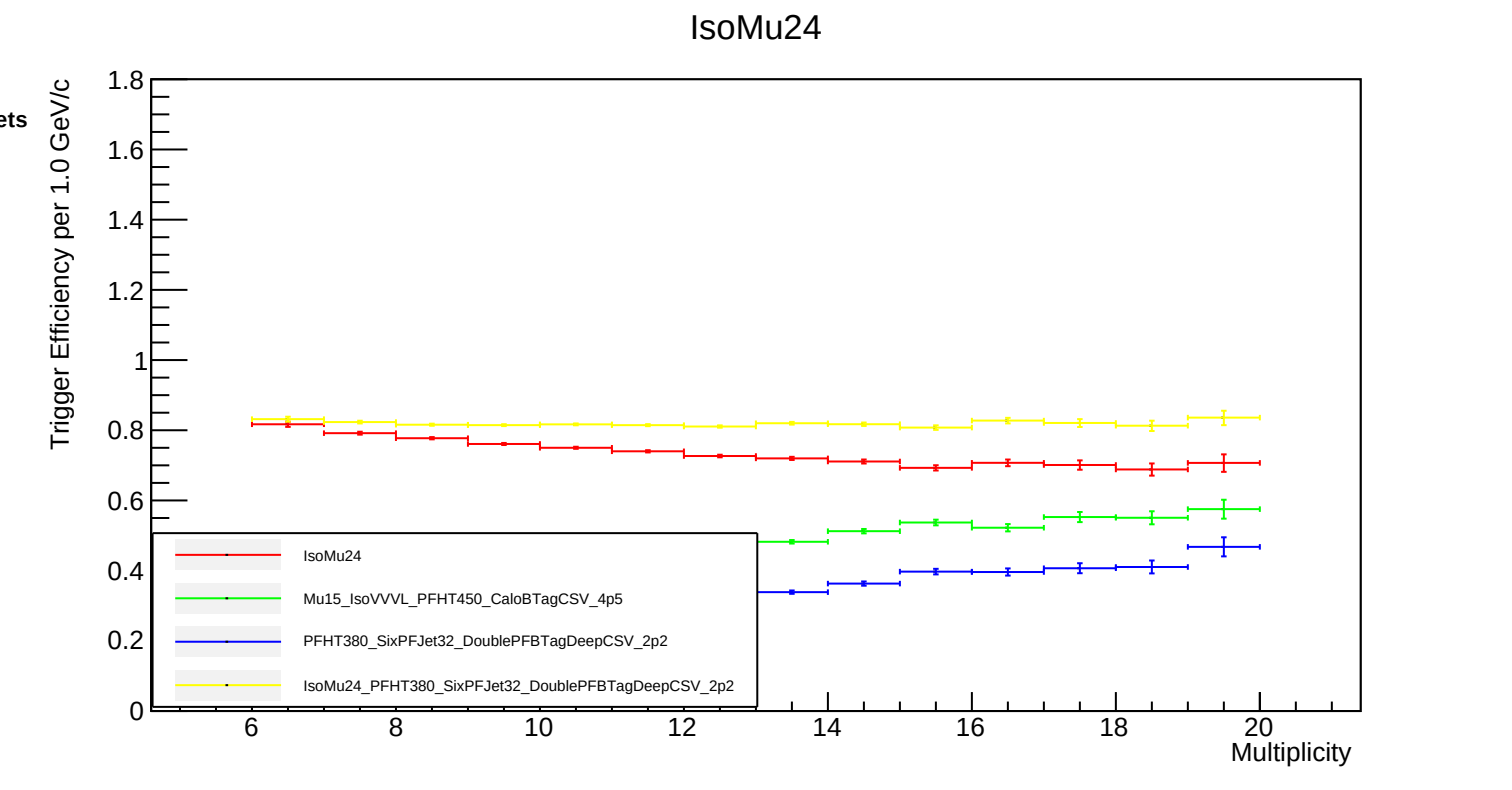

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 10.0 GeV/c
H_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
500
1000
1500
2000
2500
3000

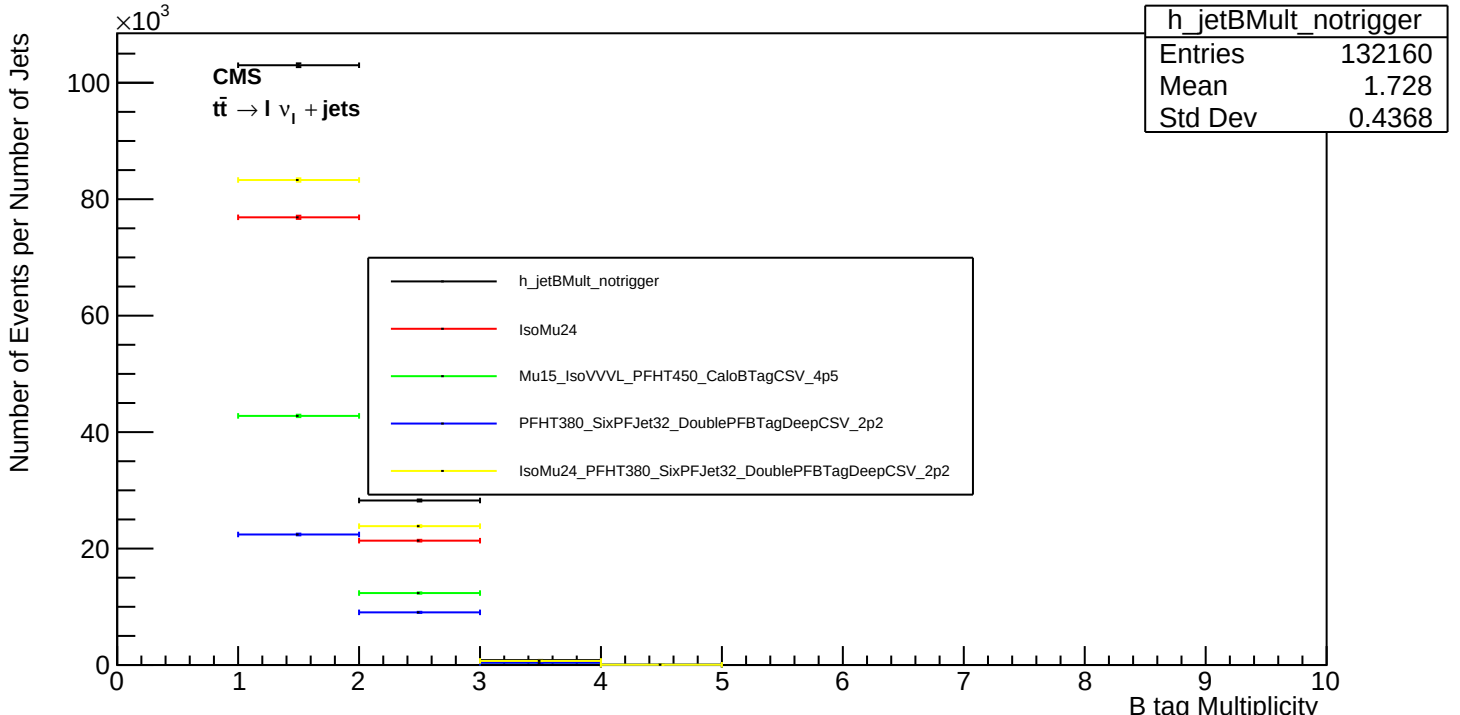
IsoMu24

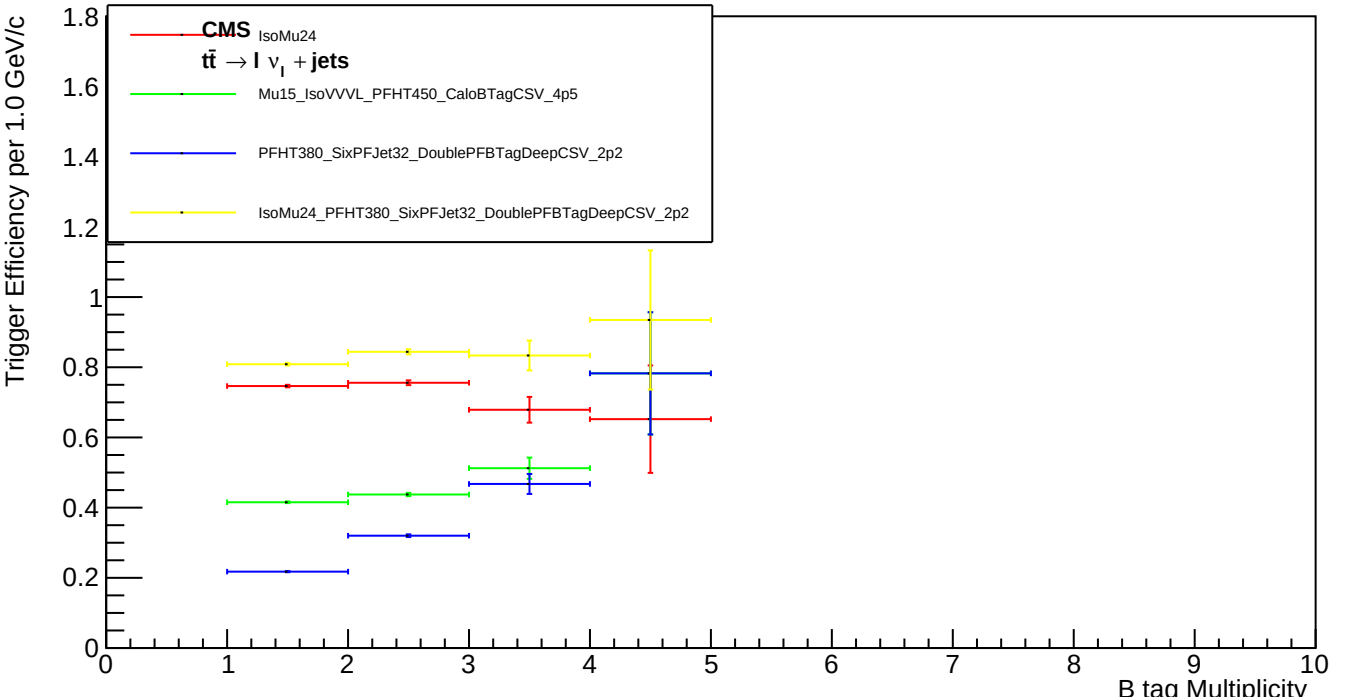

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 9.9966666667 GeV/c
H_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
0
500
1000
1500
2000
2500
3000
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2


h_jetMult_notrigger
132160
10.46
2.459
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
h_jetMult_notrigger
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Number of Events per Number of Jets
Multiplicity
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
0
2
4
6
8
10
12
14
16
18
20

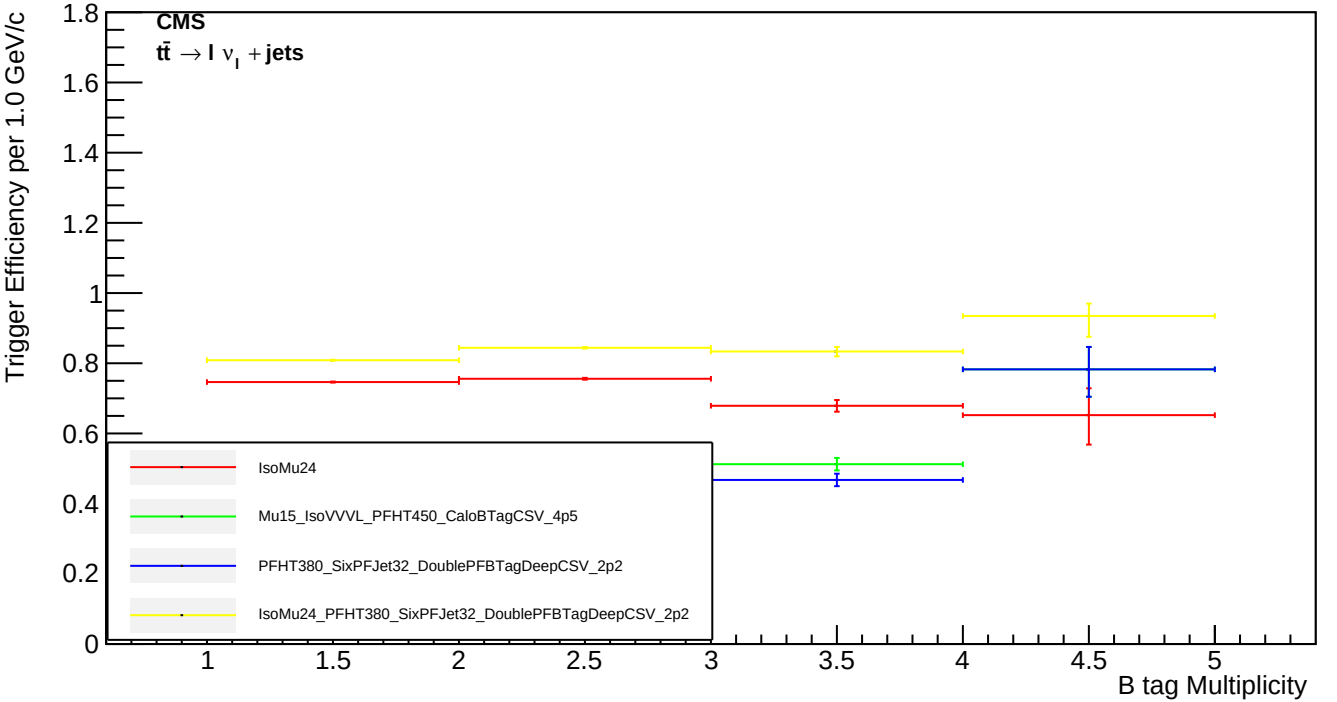

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 1.0 GeV/c
Multiplicity
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
2
4
6
8
10
12
14
16
18
20

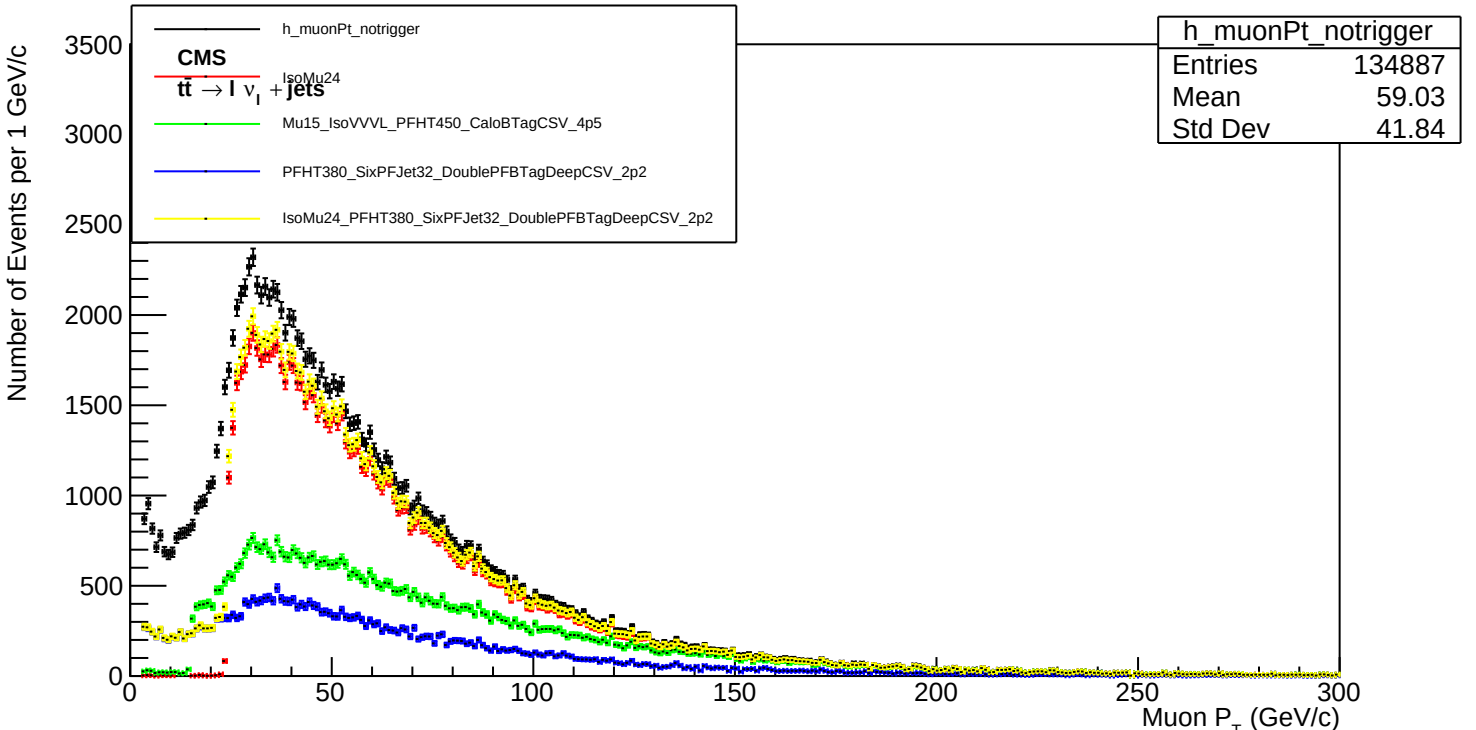

IsoMu24
Trigger Efficiency per 1.0 GeV/c
Multiplicity
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2

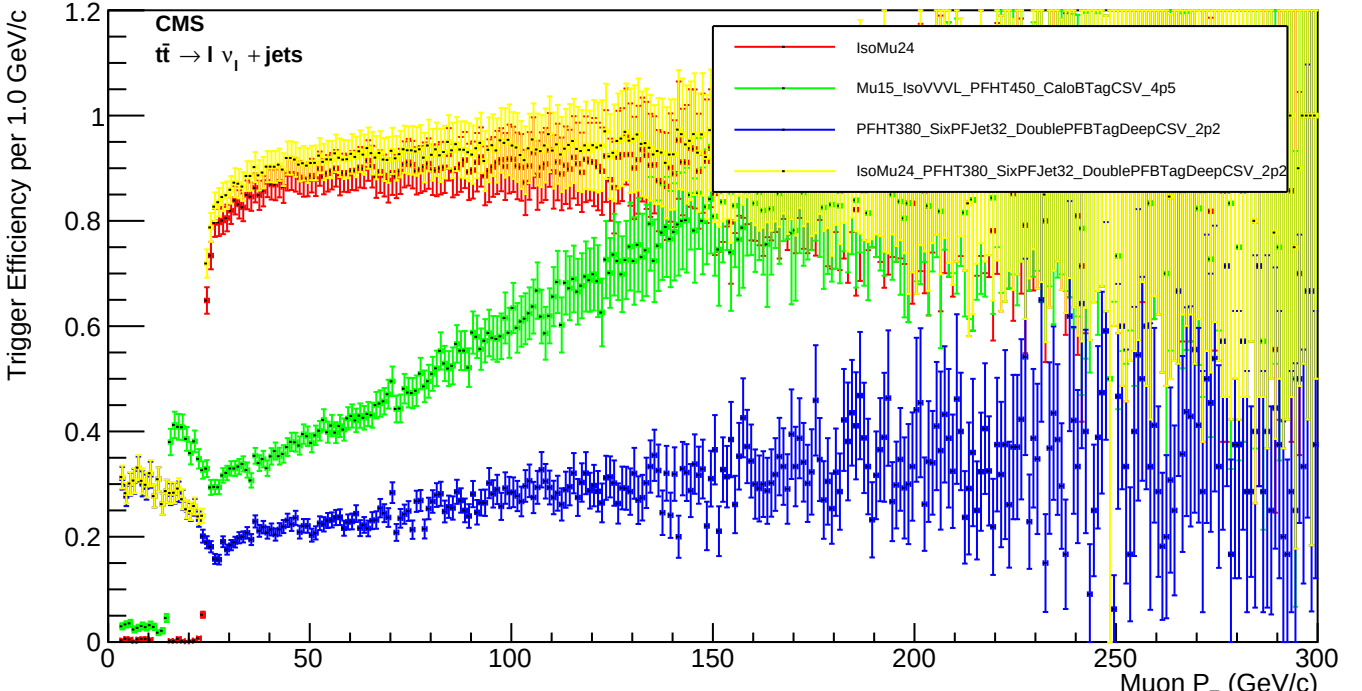

h_jetBMult_notrigger
Entries 132160
Mean 1.728
Std Dev 0.4368
CMS
$t\bar{t} \rightarrow l\ \nu_l$ + jets
h_jetBMult_notrigger
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
×10^3
Number of Events per Number of Jets
B tag Multiplicity
0
20
40
60
80
100
0
1
2
3
4
5
6
7
8
9
10

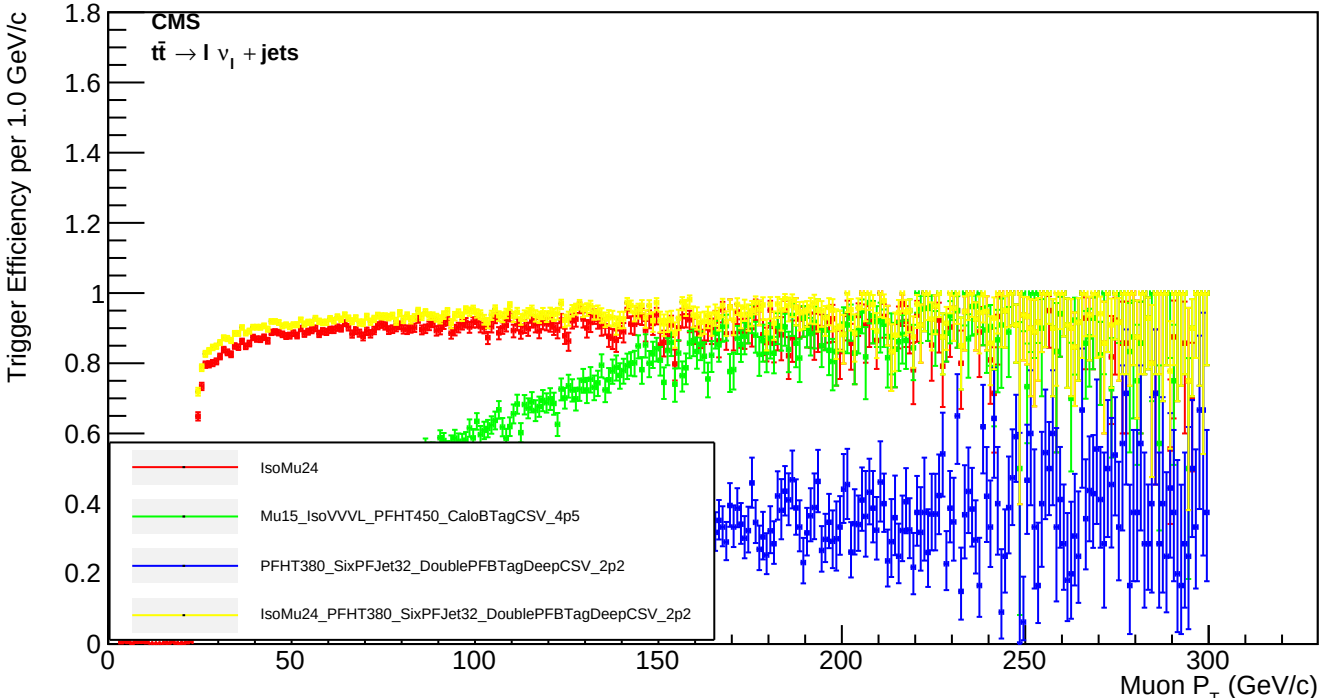

CMS IsoMu24
$t\bar{t} \rightarrow l\ \nu_l + jets$
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 1.0 GeV/c
B tag Multiplicity
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
1
2
3
4
5
6
7
8
9
10

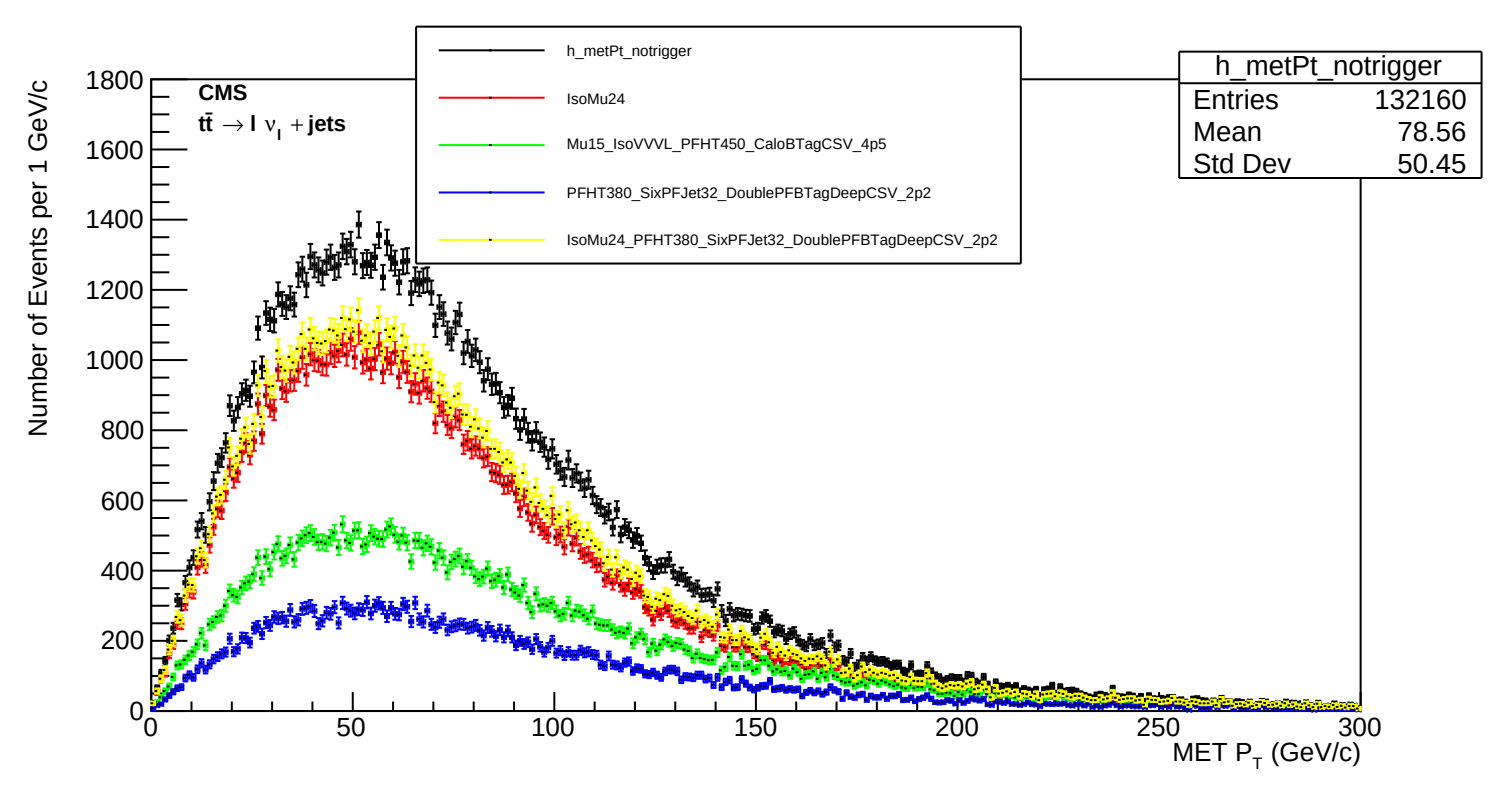
IsoMu24

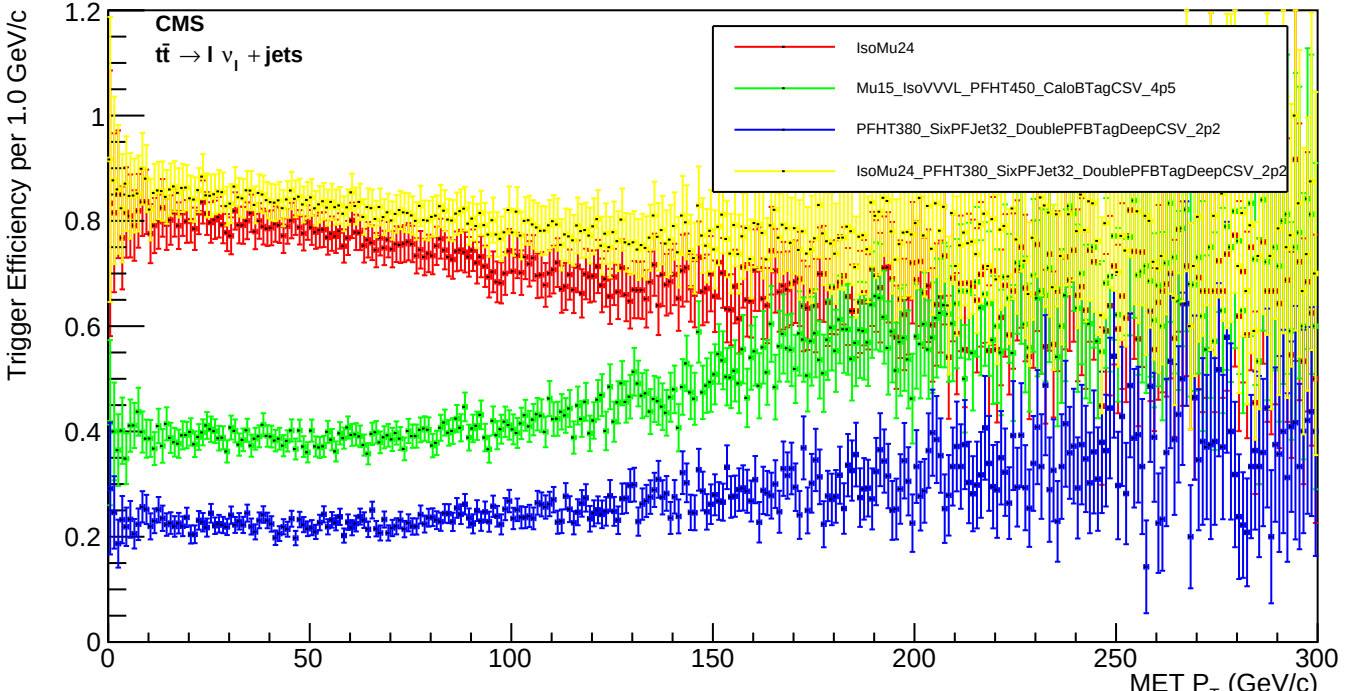

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.0 GeV/c
B tag Multiplicity
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2

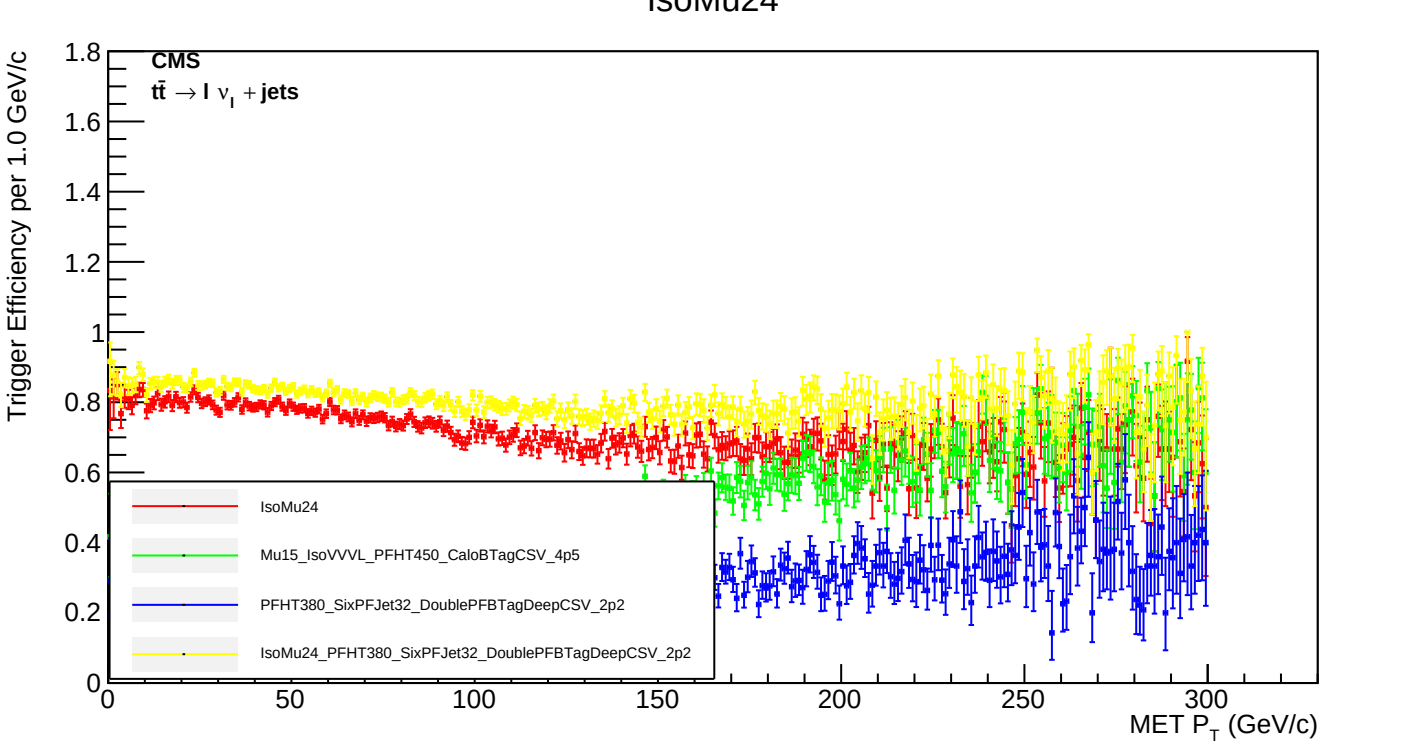

h_muonPt_notrigger
CMS
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
h_muonPt_notrigger
Entries 134887
Mean 59.03
Std Dev 41.84
Number of Events per 1 GeV/c
Muon P_T (GeV/c)
0
500
1000
1500
2000
2500
3000
3500
0
50
100
150
200
250
300

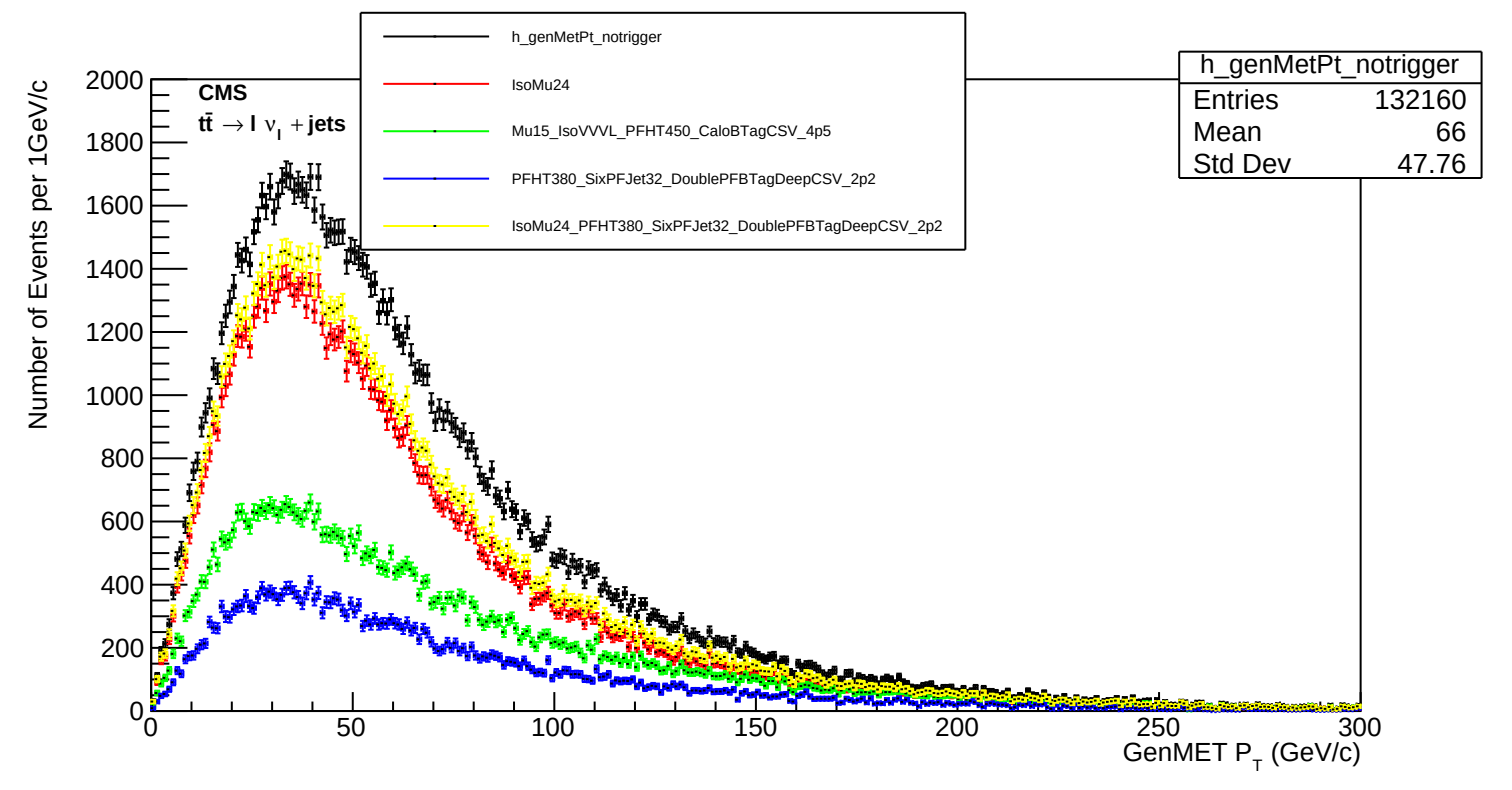

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 1.0 GeV/c
Muon P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
50
100
150
200
250
300

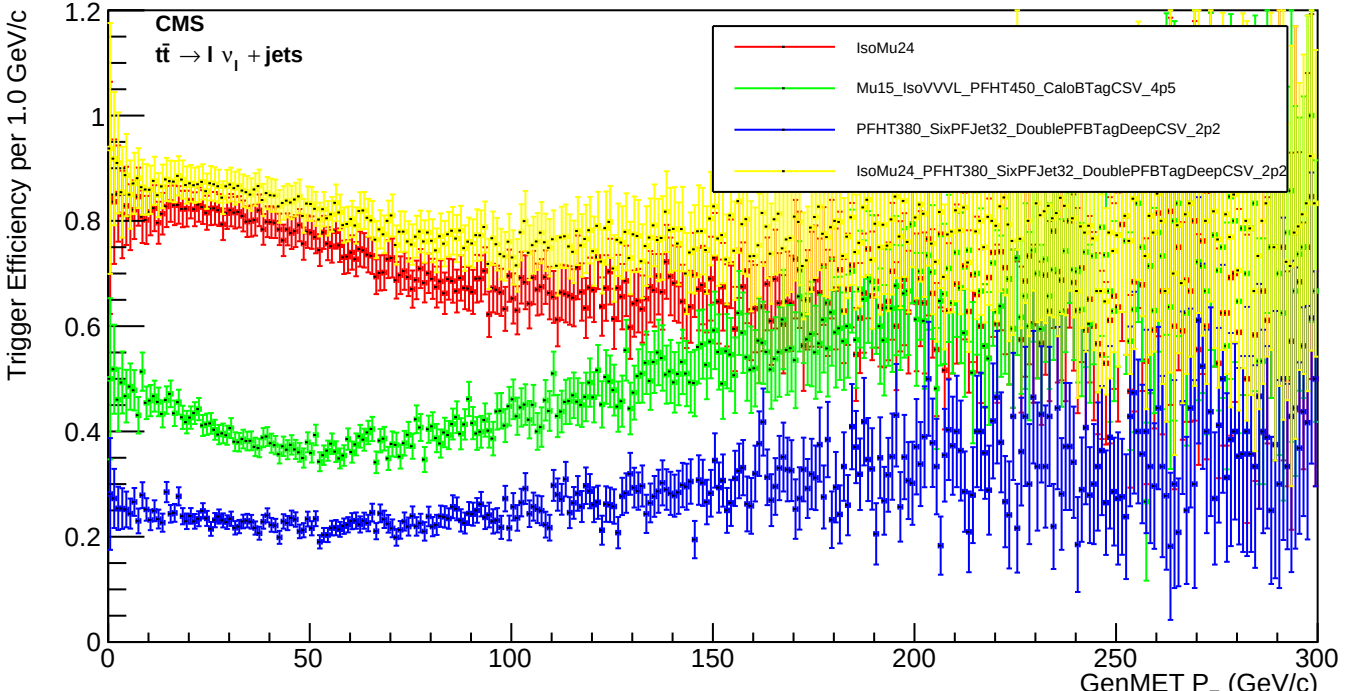

IsoMu24
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.0 GeV/c
Muon P_T (GeV/c)
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2


h_metPt_notrigger
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
h_metPt_notrigger
Entries 132160
Mean 78.56
Std Dev 50.45
CMS
tt̄ → l ν_l + jets
Number of Events per 1 GeV/c
MET P_T (GeV/c)
0
200
400
600
800
1000
1200
1400
1600
1800
0
50
100
150
200
250
300

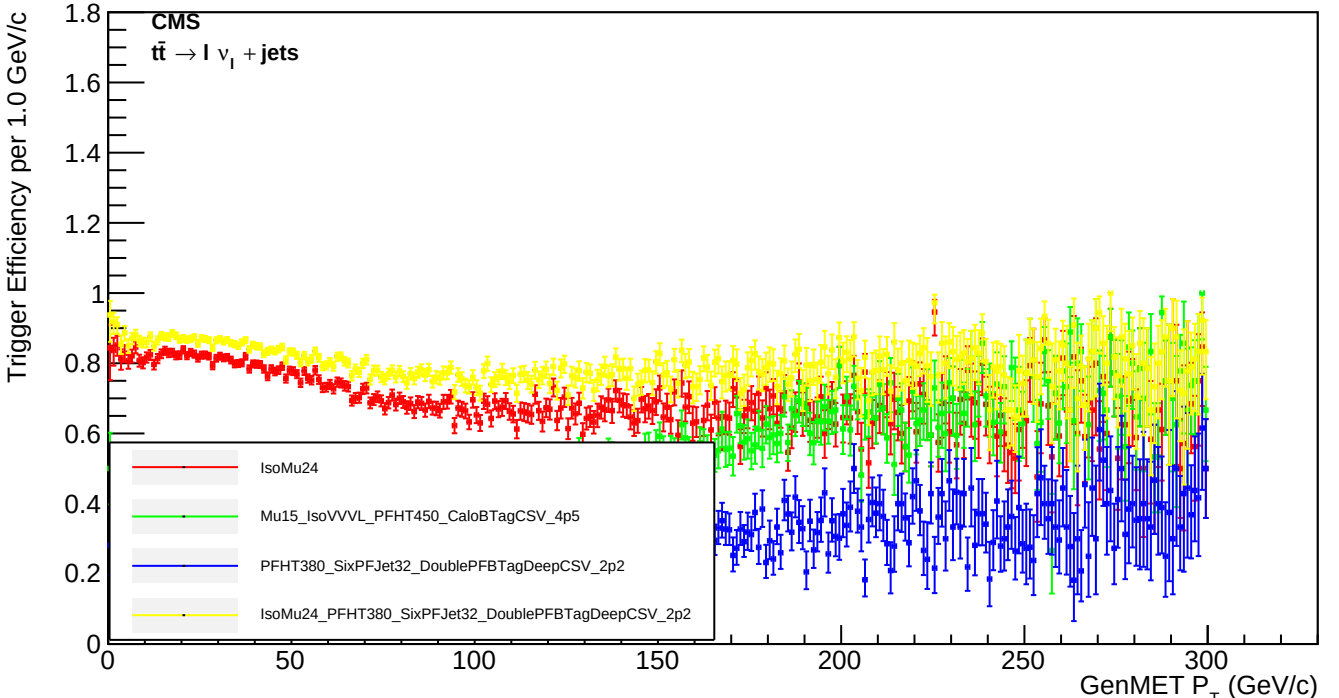

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 1.0 GeV/c
MET P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
50
100
150
200
250
300


IsoMu24
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.0 GeV/c
MET P_T (GeV/c)
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2

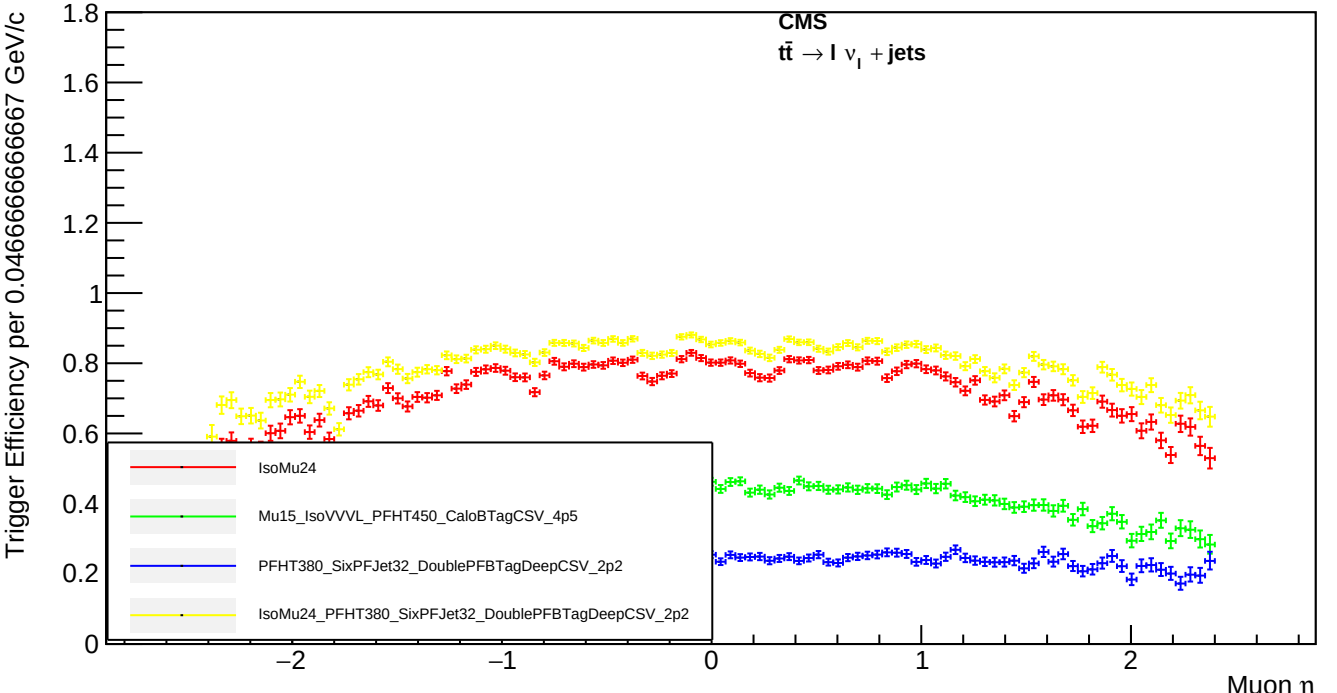

h_genMetPt_notrigger
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
h_genMetPt_notrigger
Entries 132160
Mean 66
Std Dev 47.76
CMS
tt̄ → l ν_l + jets
Number of Events per 1GeV/c
GenMET P_T (GeV/c)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
50
100
150
200
250
300

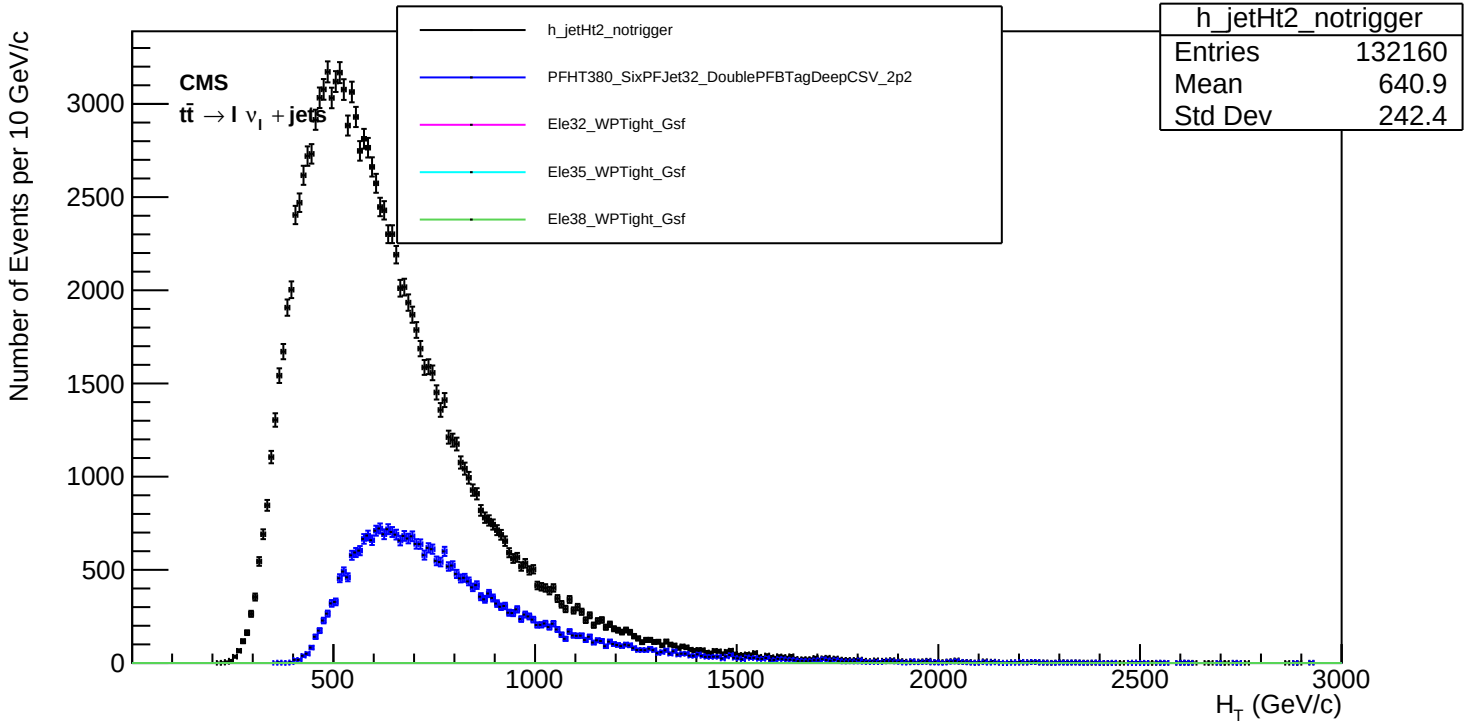

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Trigger Efficiency per 1.0 GeV/c
GenMET P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
50
100
150
200
250
300

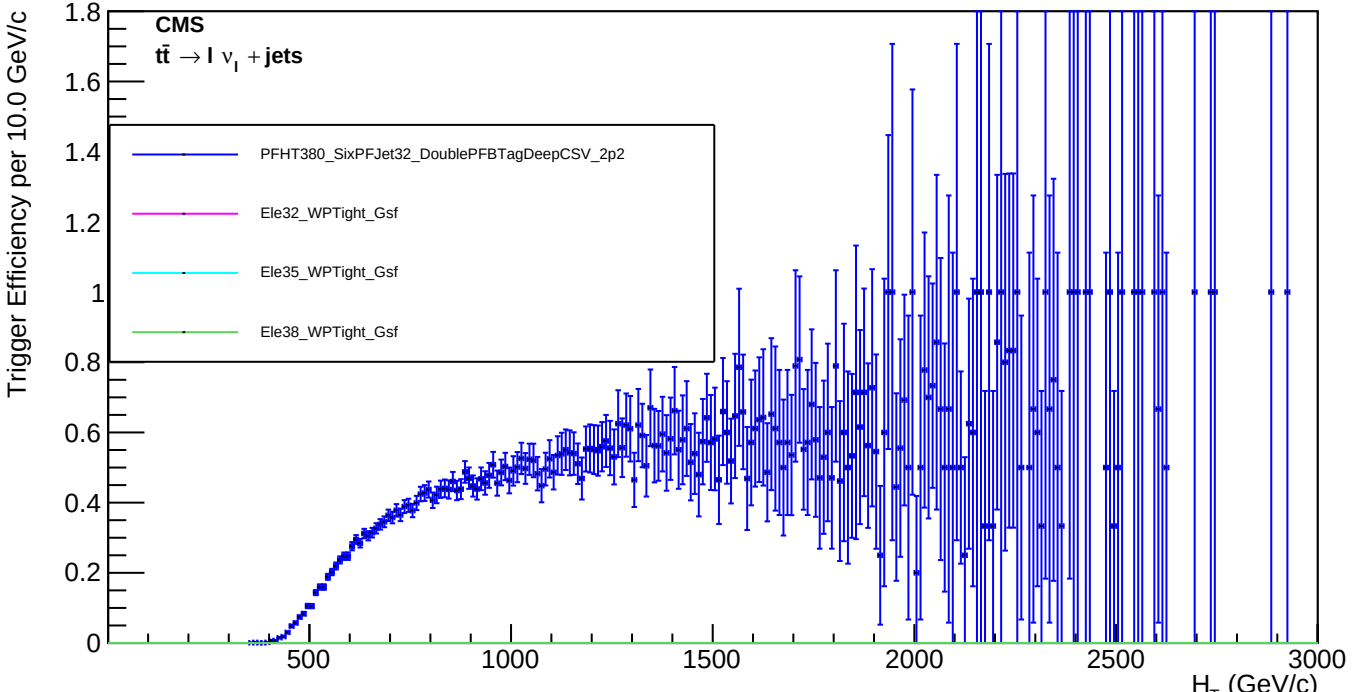
IsoMu24

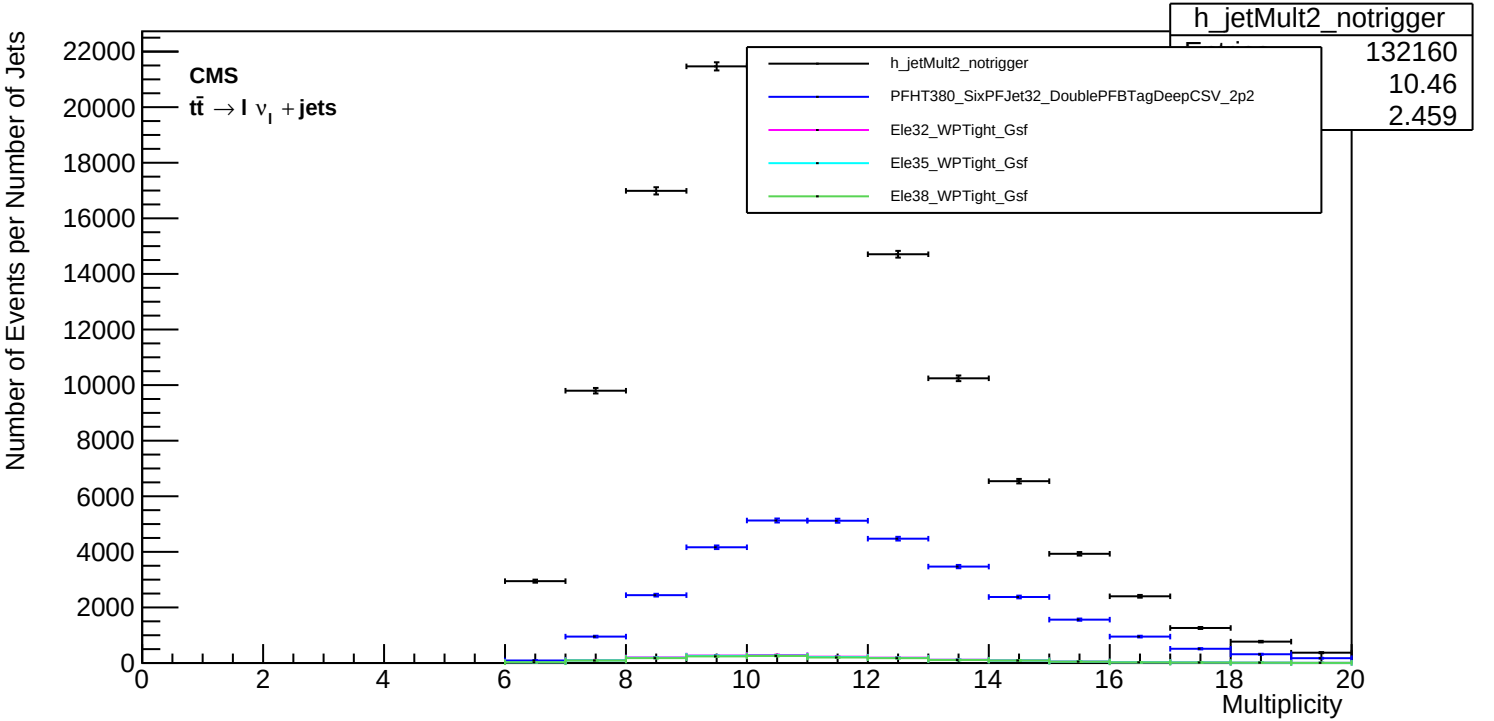

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.0 GeV/c
GenMET P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
50
100
150
200
250
300
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2

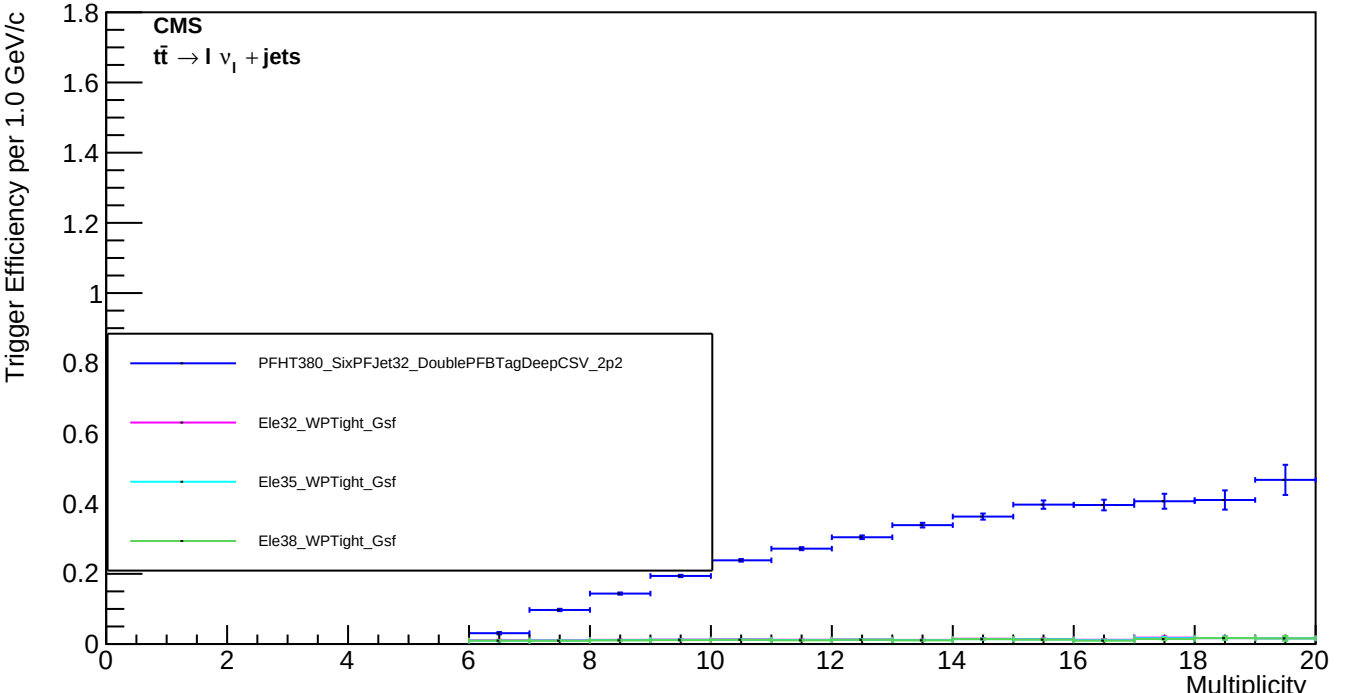
IsoMu24

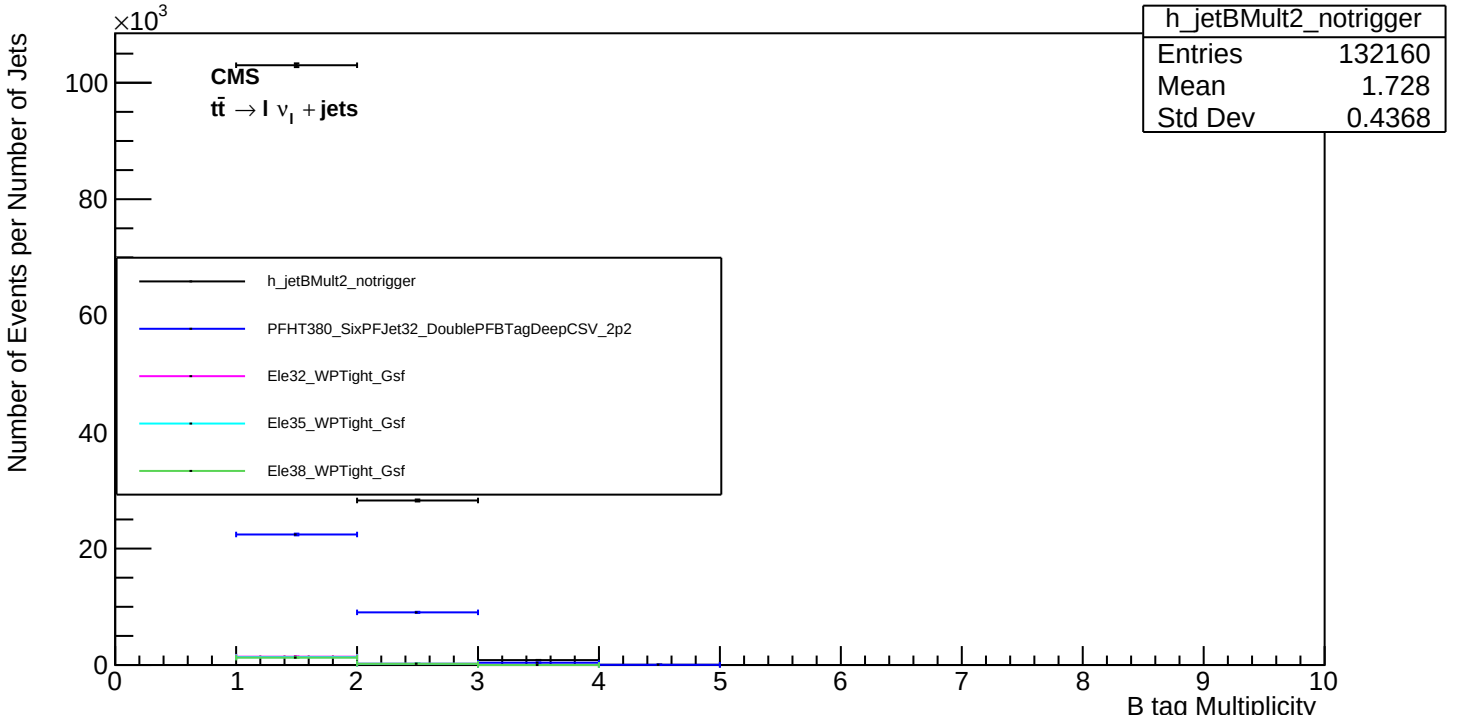

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 0.0466666666667 GeV/c
Muon η
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2

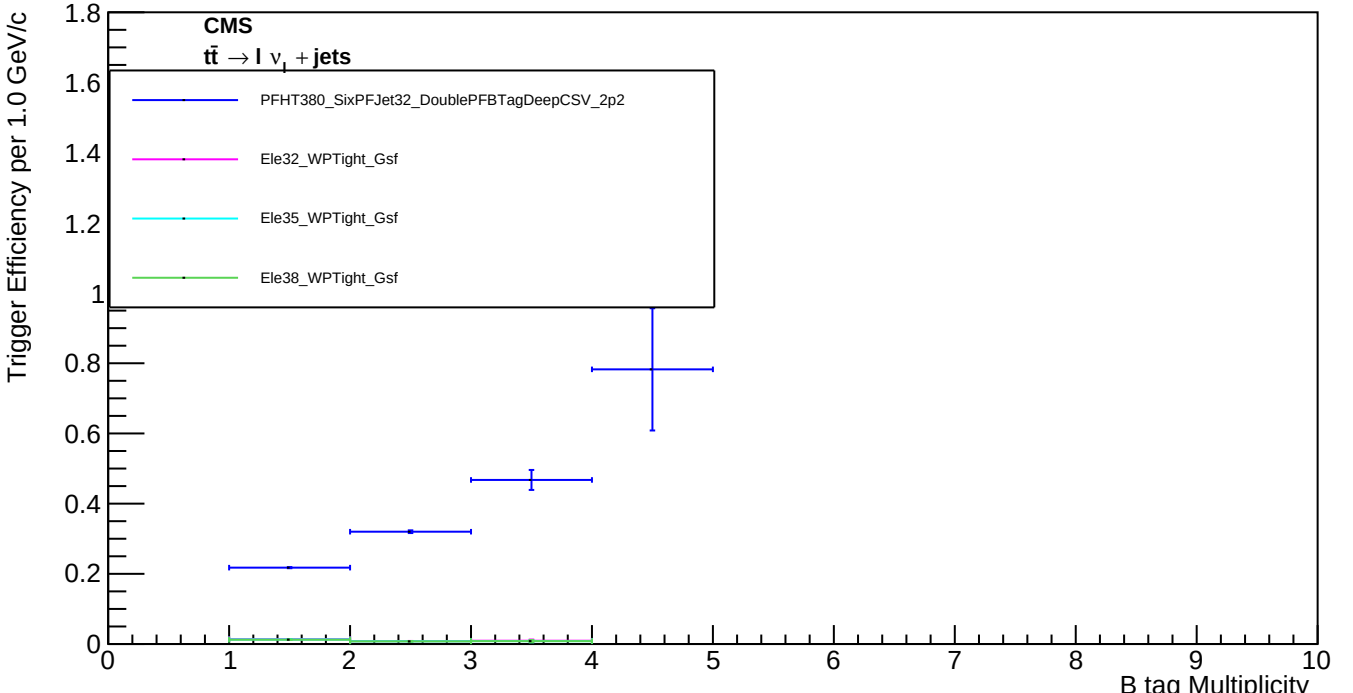

h_jetHt2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
h_jetHt2_notrigger
Entries 132160
Mean 640.9
Std Dev 242.4
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Number of Events per 10 GeV/c
H_T (GeV/c)
0
500
1000
1500
2000
2500
3000

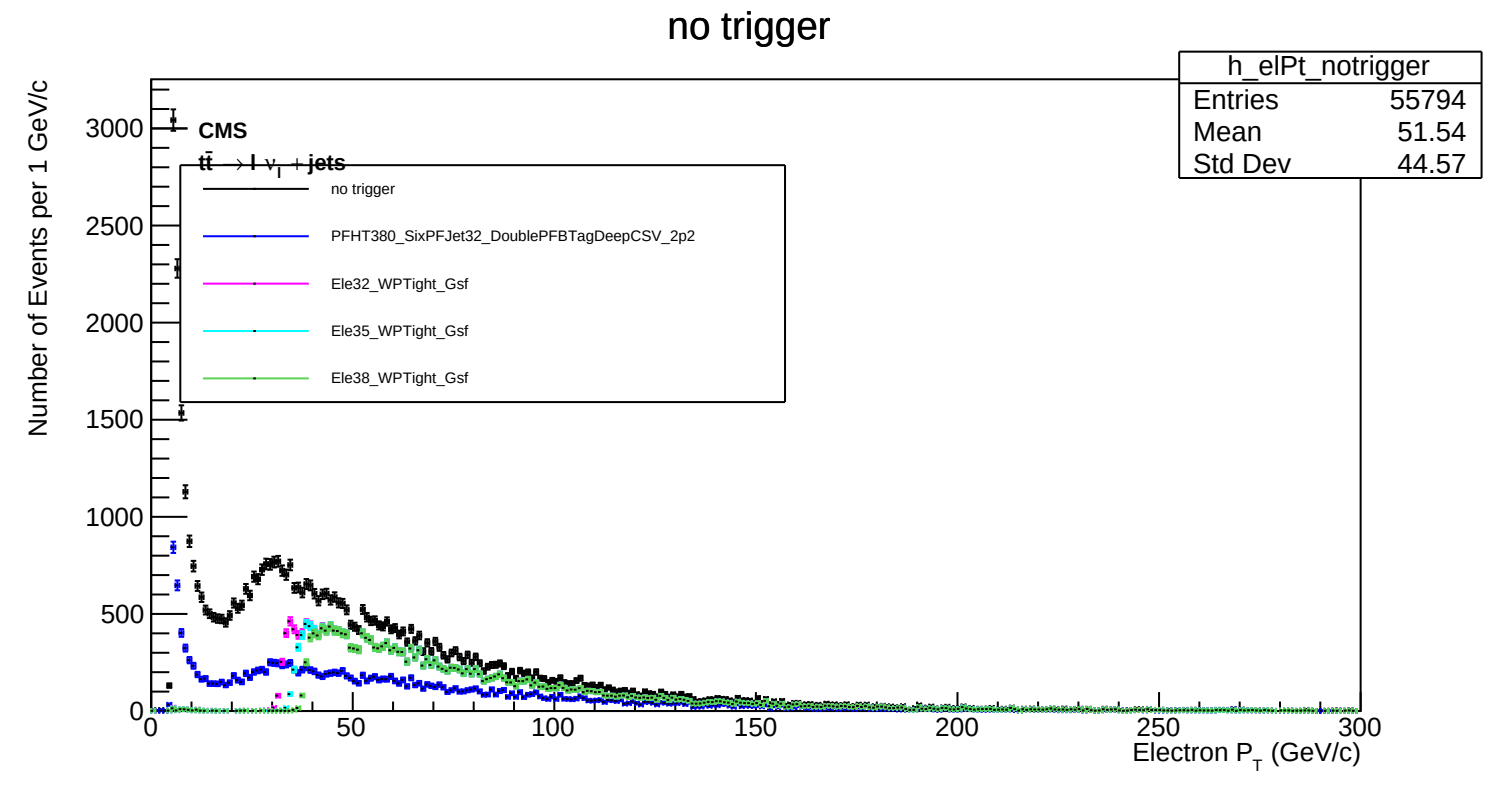

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Trigger Efficiency per 10.0 GeV/c
H_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
500
1000
1500
2000
2500
3000

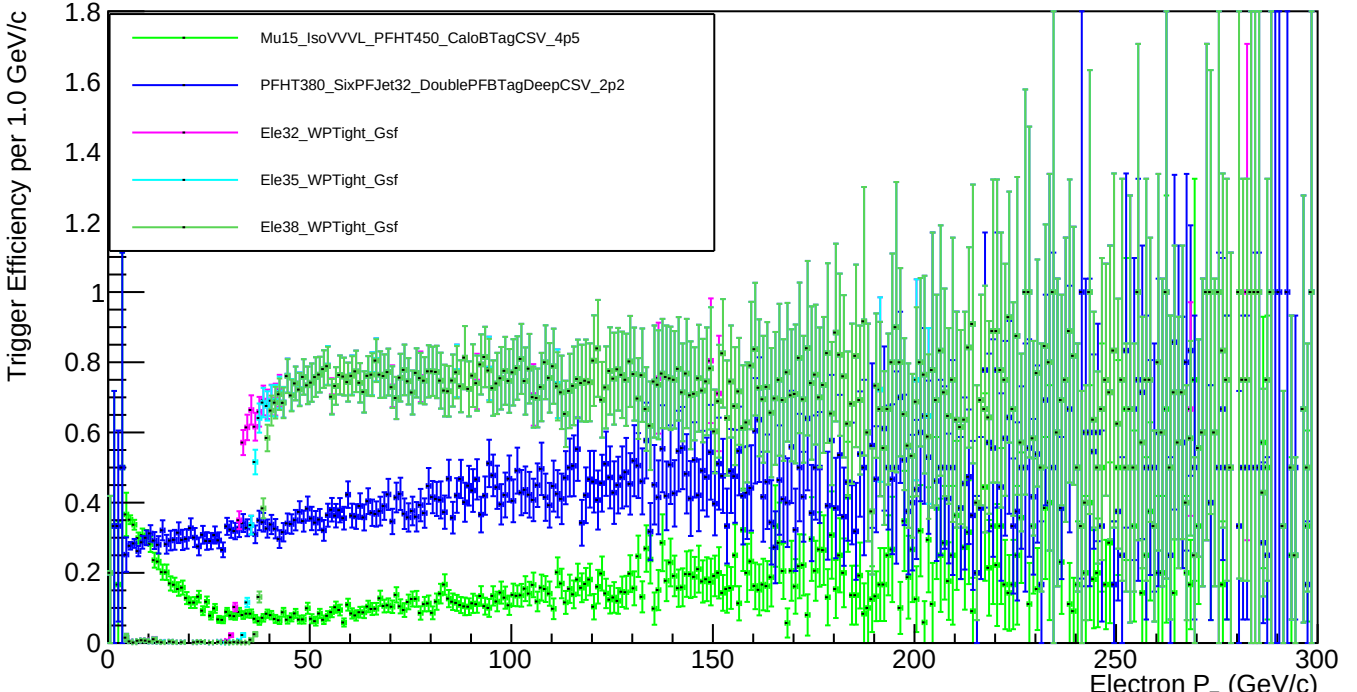

h_jetMult2_notrigger
132160
10.46
2.459
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
h_jetMult2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per Number of Jets
Multiplicity
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
0
2
4
6
8
10
12
14
16
18
20

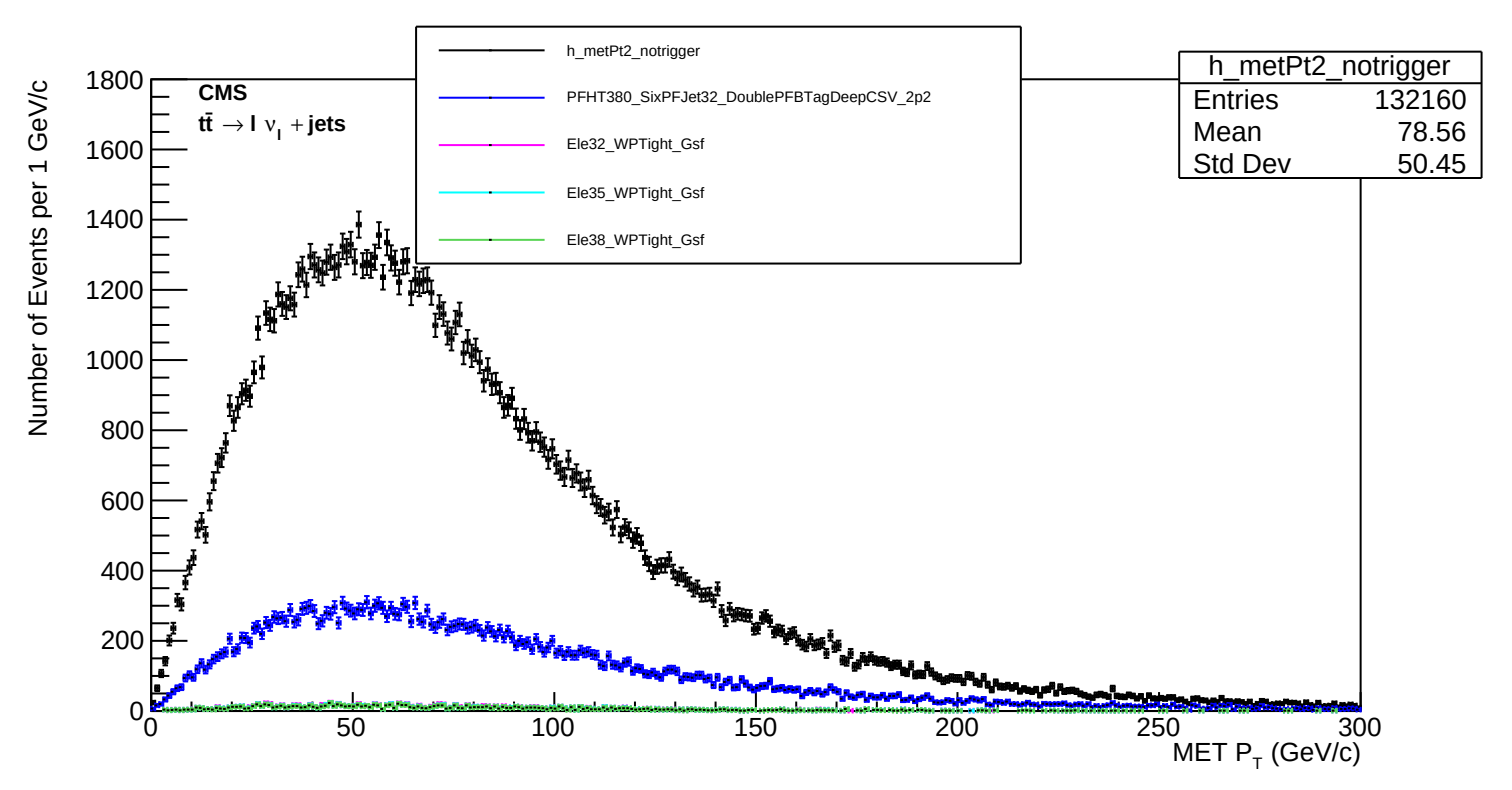

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.0 GeV/c
Multiplicity
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
2
4
6
8
10
12
14
16
18
20

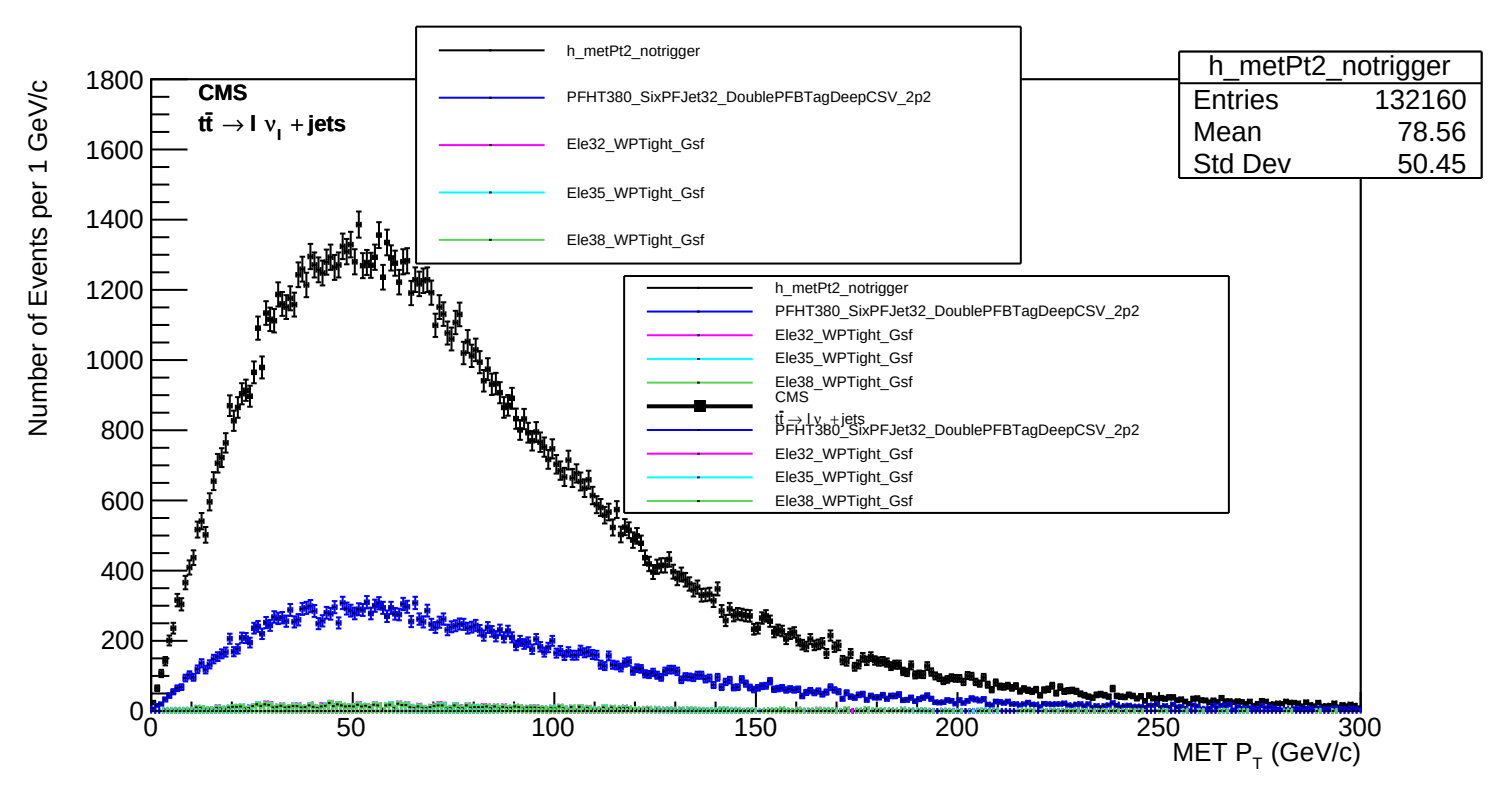

h_jetBMult2_notrigger
Entries 132160
Mean 1.728
Std Dev 0.4368
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
h_jetBMult2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
×10^3
Number of Events per Number of Jets
B tag Multiplicity
0
20
40
60
80
100
0
1
2
3
4
5
6
7
8
9
10

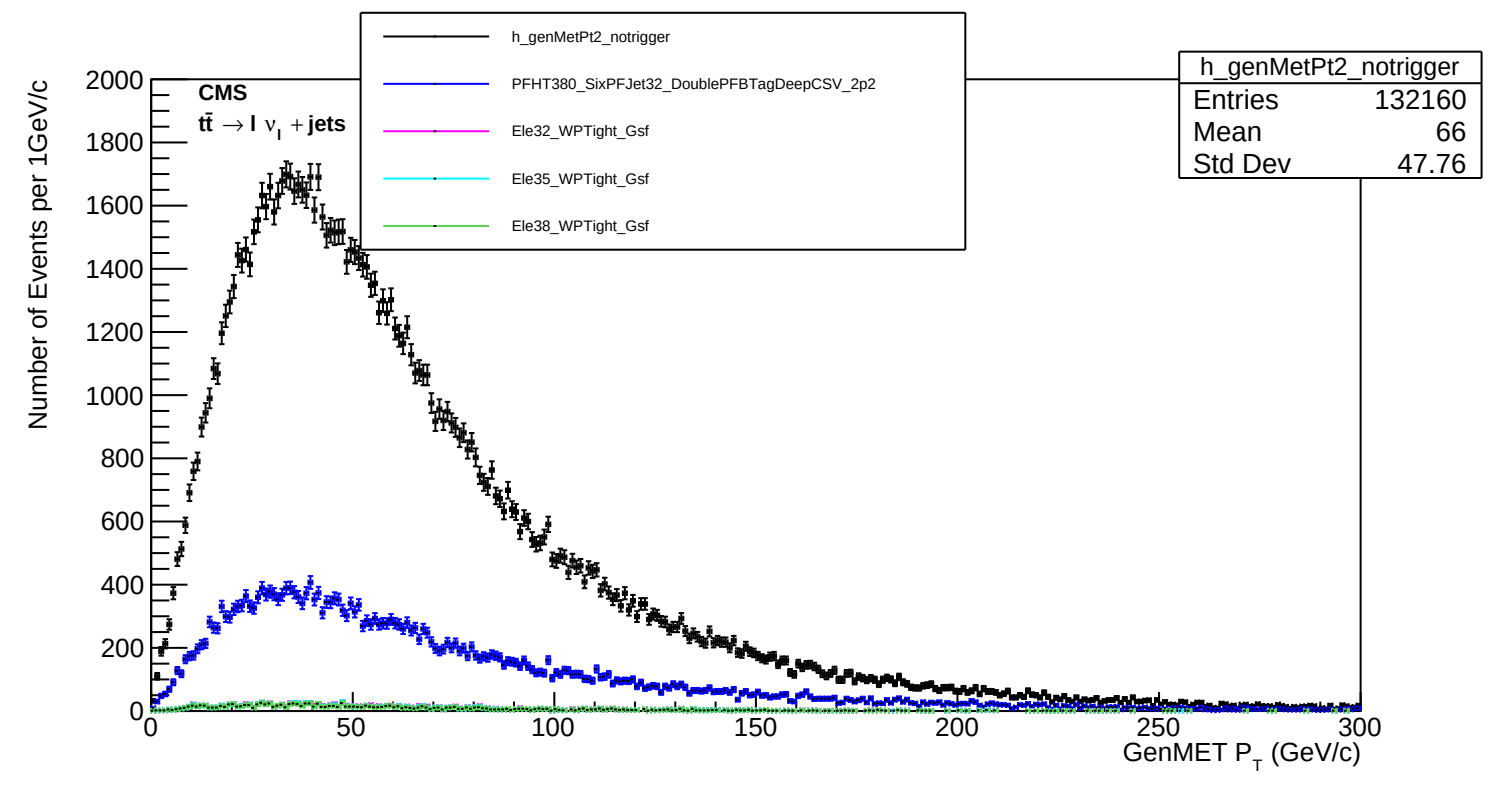

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Trigger Efficiency per 1.0 GeV/c
B tag Multiplicity
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
1
2
3
4
5
6
7
8
9
10

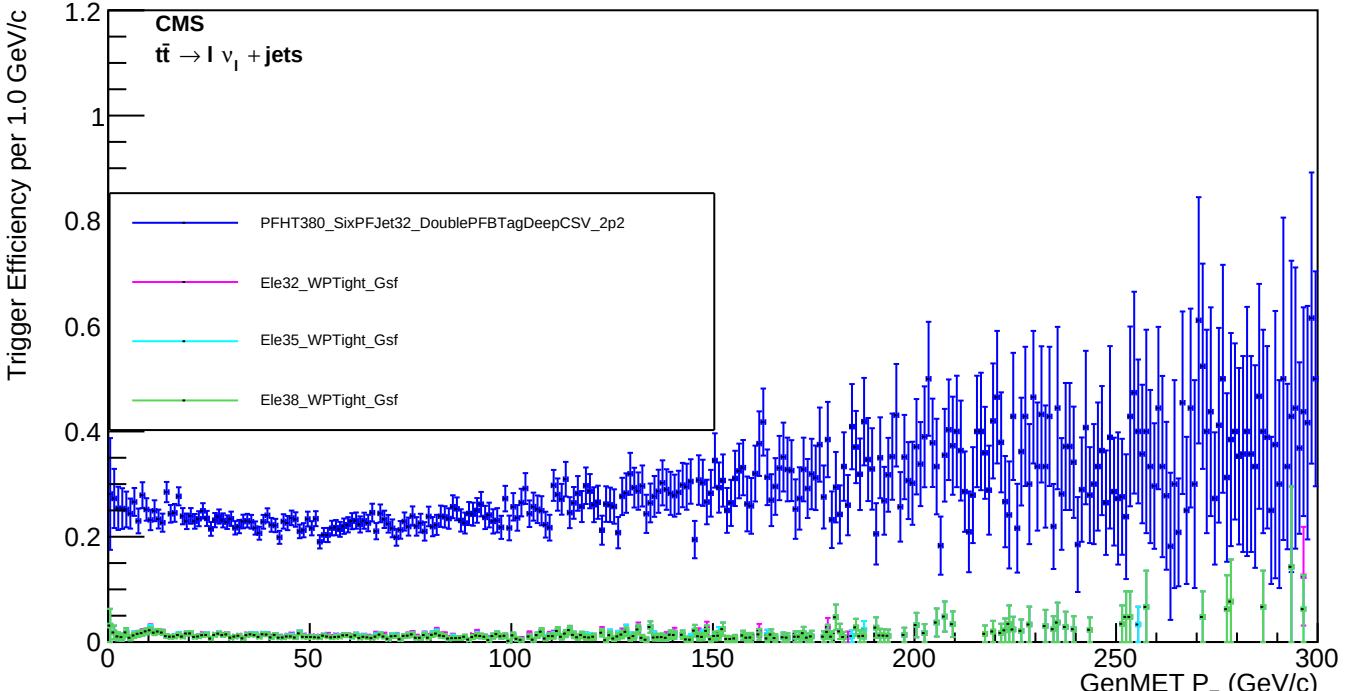

no trigger
h_elPt_notrigger
Entries 55794
Mean 51.54
Std Dev 44.57
CMS
tt̄ → l ν_l + jets
no trigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per 1 GeV/c
Electron P_T (GeV/c)
0
500
1000
1500
2000
2500
3000
0
50
100
150
200
250
300

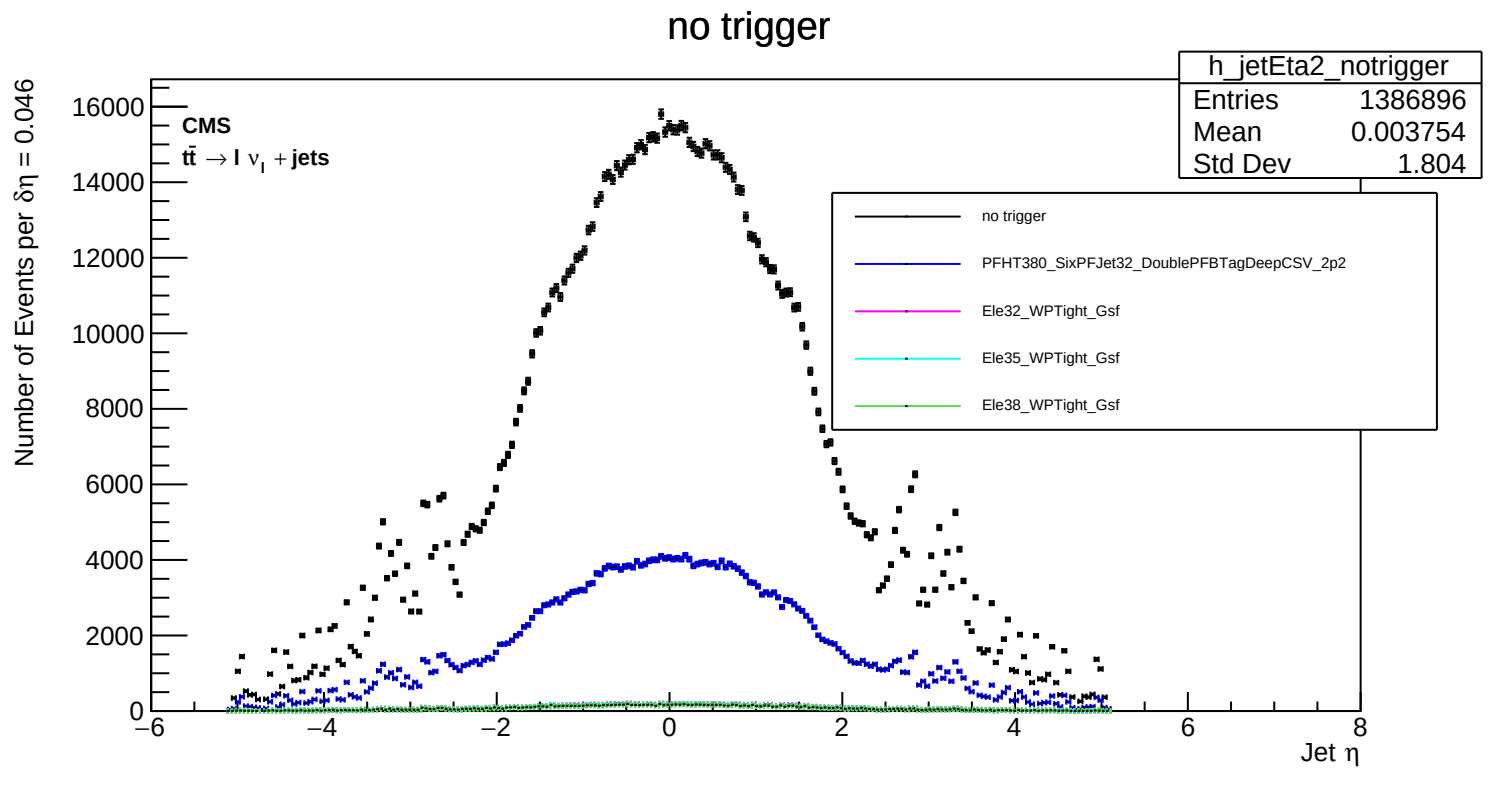

Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Trigger Efficiency per 1.0 GeV/c
Electron P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
50
100
150
200
250
300

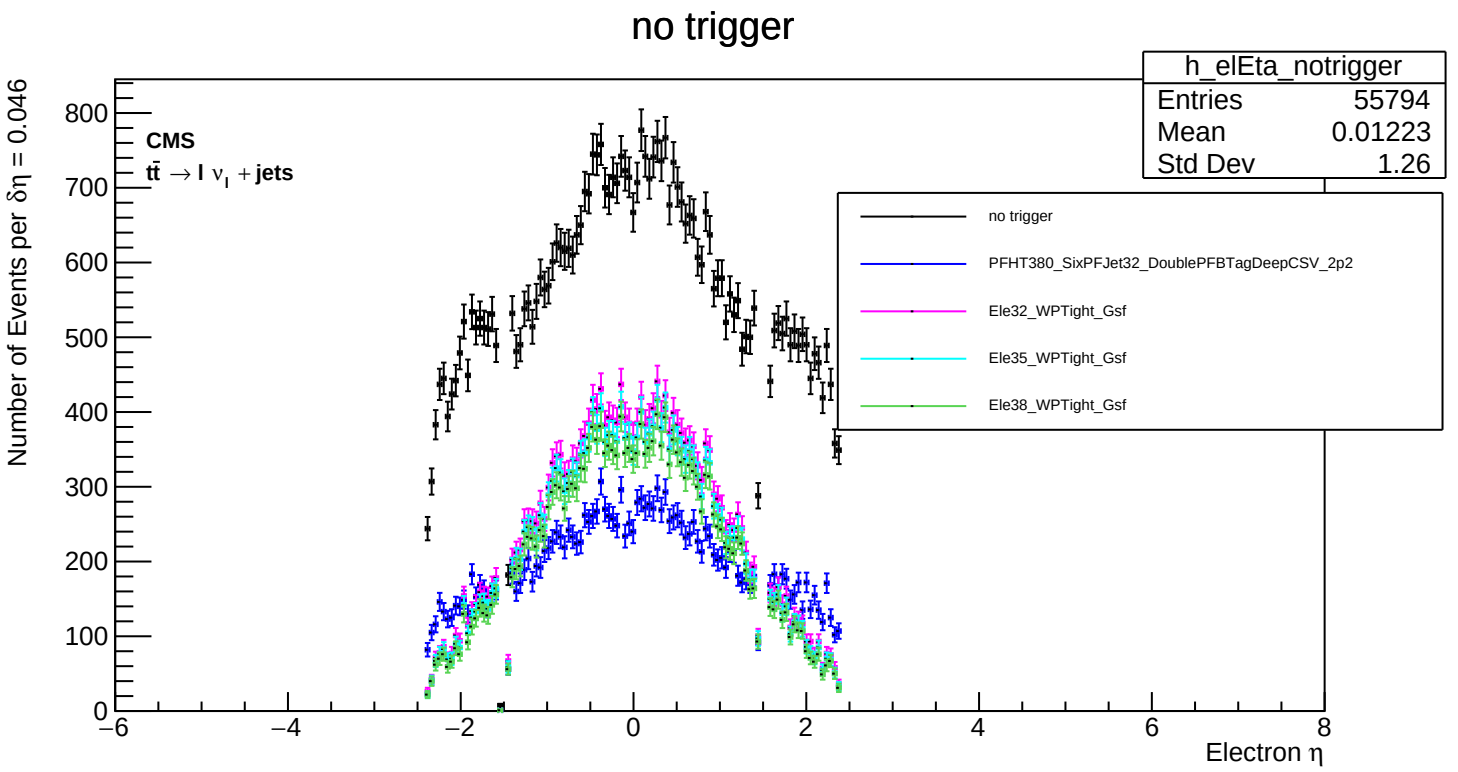

h_metPt2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
h_metPt2_notrigger
Entries 132160
Mean 78.56
Std Dev 50.45
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Number of Events per 1 GeV/c
MET P_T (GeV/c)
0
200
400
600
800
1000
1200
1400
1600
1800
0
50
100
150
200
250
300

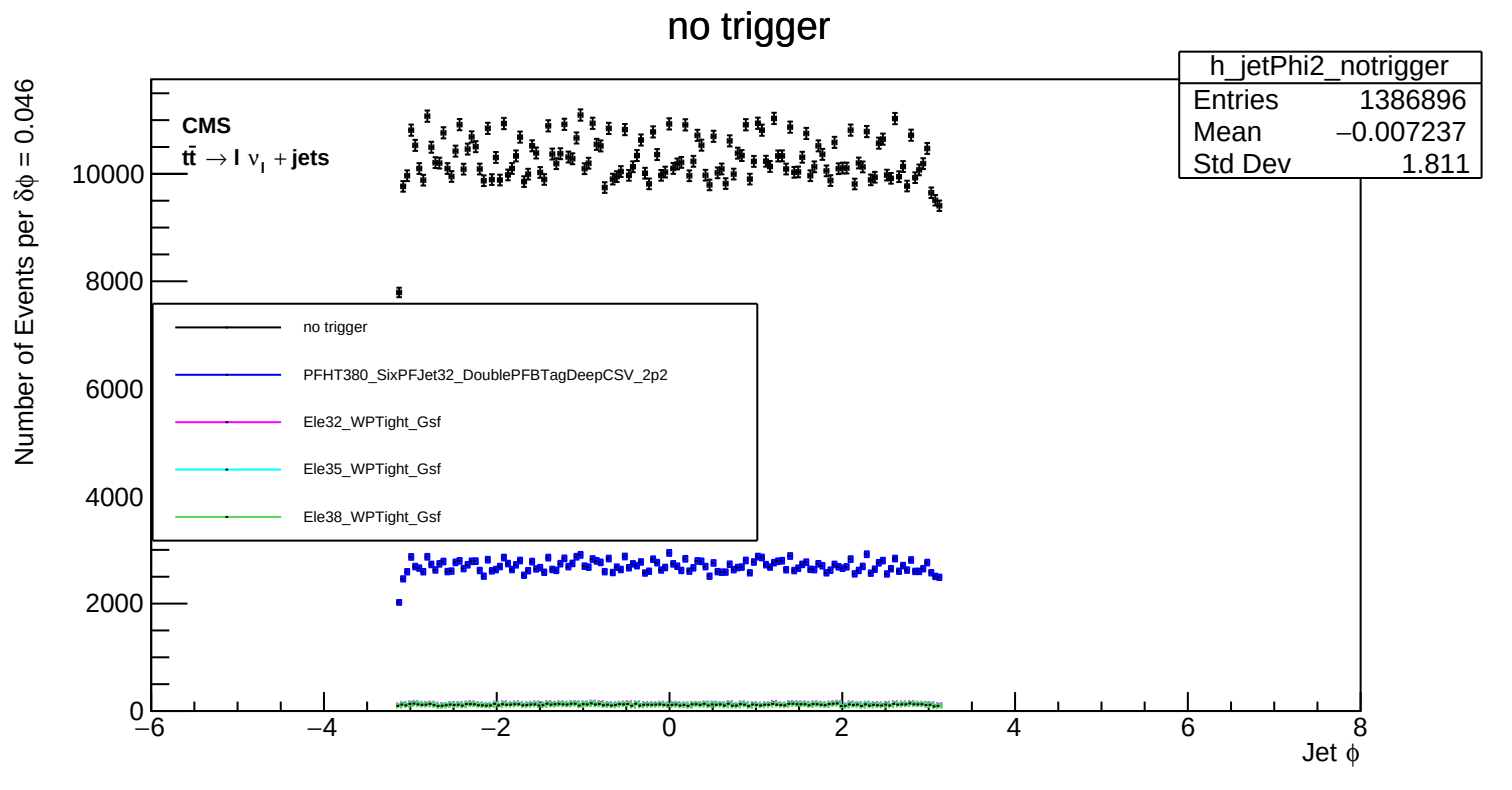

h_metPt2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
h_metPt2_notrigger
Entries 132160
Mean 78.56
Std Dev 50.45
CMS
$t\bar{t} \rightarrow l\,\nu_l + jets$
Number of Events per 1 GeV/c
MET P_T (GeV/c)
0
200
400
600
800
1000
1200
1400
1600
1800
0
50
100
150
200
250
300

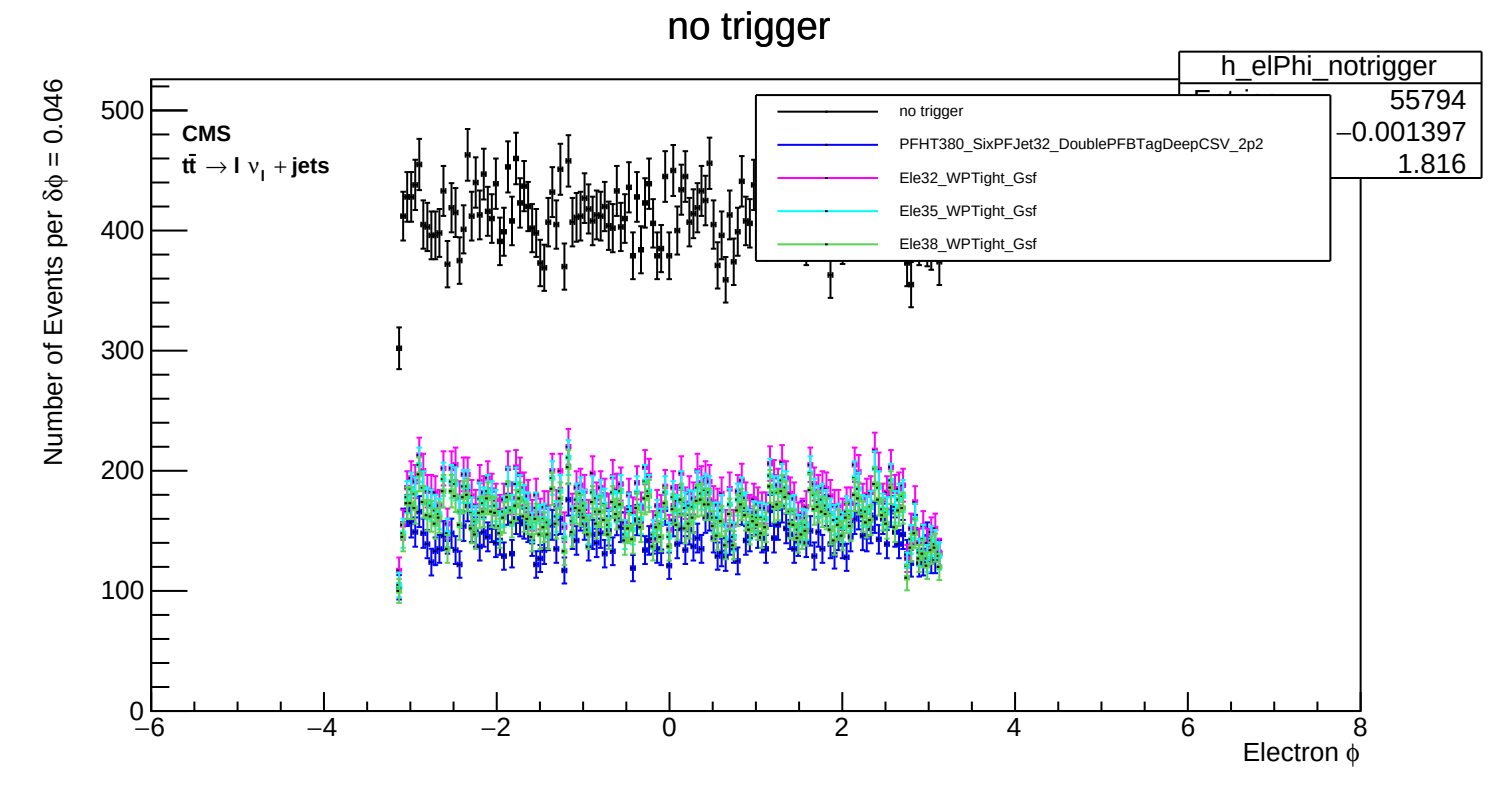

h_genMetPt2_notrigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
h_genMetPt2_notrigger
Entries 132160
Mean 66
Std Dev 47.76
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Number of Events per 1GeV/c
GenMET P_T (GeV/c)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
50
100
150
200
250
300


CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Trigger Efficiency per 1.0 GeV/c
GenMET P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
50
100
150
200
250
300


no trigger
h_jetEta2_notrigger
Entries 1386896
Mean 0.003754
Std Dev 1.804
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
no trigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per δη = 0.046
Jet η
0
2000
4000
6000
8000
10000
12000
14000
16000
−6
−4
−2
0
2
4
6
8


no trigger
h_elEta_notrigger
Entries 55794
Mean 0.01223
Std Dev 1.26
CMS
$t\bar{t} \rightarrow l\,\nu_l + jets$
no trigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per δη = 0.046
Electron η
0
100
200
300
400
500
600
700
800
−6
−4
−2
0
2
4
6
8


no trigger
h_jetPhi2_notrigger
Entries 1386896
Mean −0.007237
Std Dev 1.811
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
no trigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per δϕ = 0.046
Jet ϕ
0
2000
4000
6000
8000
10000
−6
−4
−2
0
2
4
6
8


no trigger
h_elPhi_notrigger
55794
−0.001397
1.816
CMS
tt̄ → l ν_l + jets
no trigger
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Number of Events per δϕ = 0.046
Electron ϕ
0
100
200
300
400
500
−6
−4
−2
0
2
4
6
8

Total Number of Accepted Events
×10^3
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Pre-selection
Post-selection
IsoMu24
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu24_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Ele32_WPTight_Gsf
Ele35_WPTight_Gsf
Ele38_WPTight_Gsf
Cuts and Triggers
h_eventsPrg
Entries 2433724
Mean 0.4087
Std Dev 1.013