On-line (pre-)selection Requisites for:

- **Jets:** number > 5
- **Muons plus 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 jets)
  btagDeepFlavB > 0.7489 (for at least one jet)
- **Muons:** has tightId, |η|<2.4 and miniPFRelIso_all<0.15 (for at least 1)

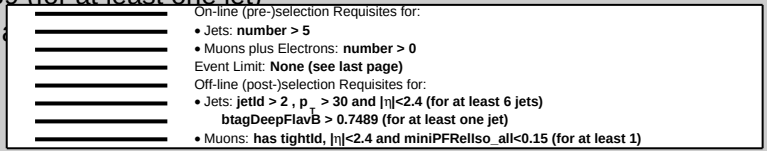
On-line (pre-)selection Requisites for:

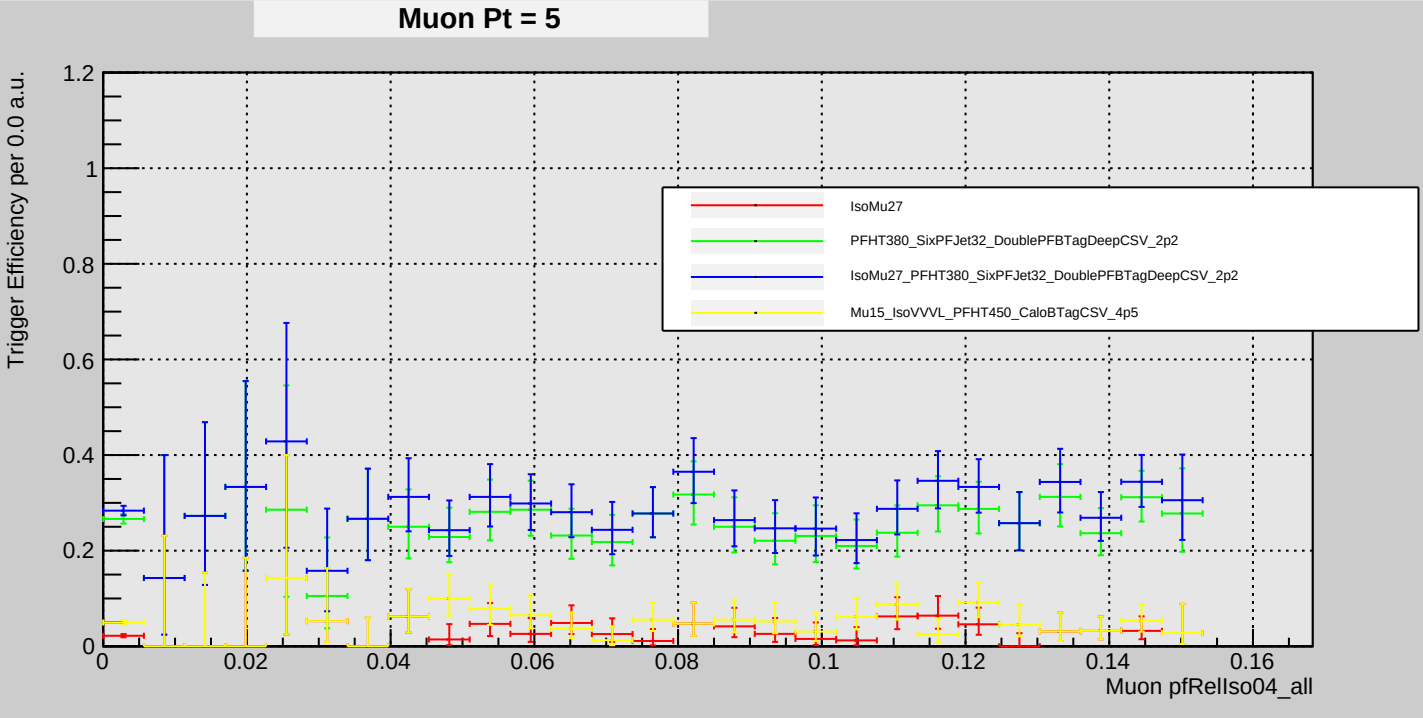
- **Jets:** number > 5
- **Muons plus Electrons:** number > 0

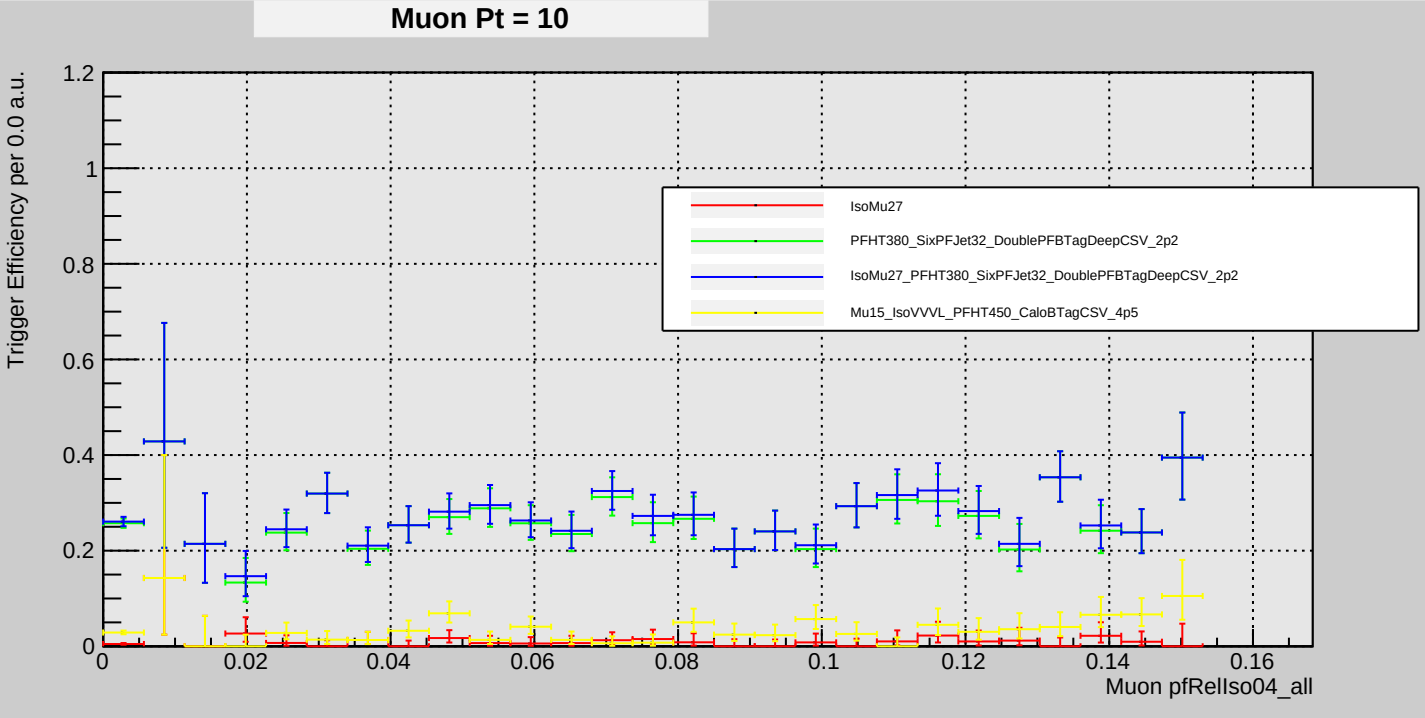
Event Limit: None (see last page)

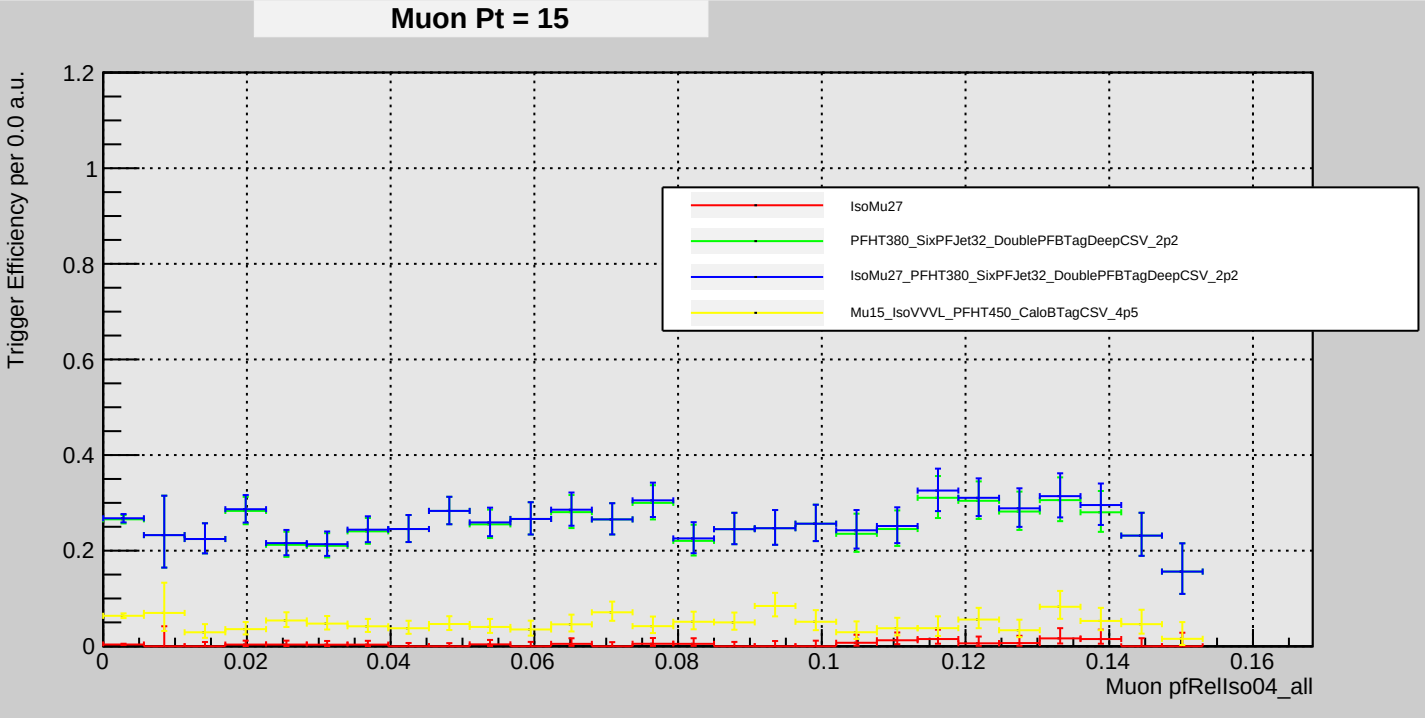
Off-line (post-)selection Requisites for:

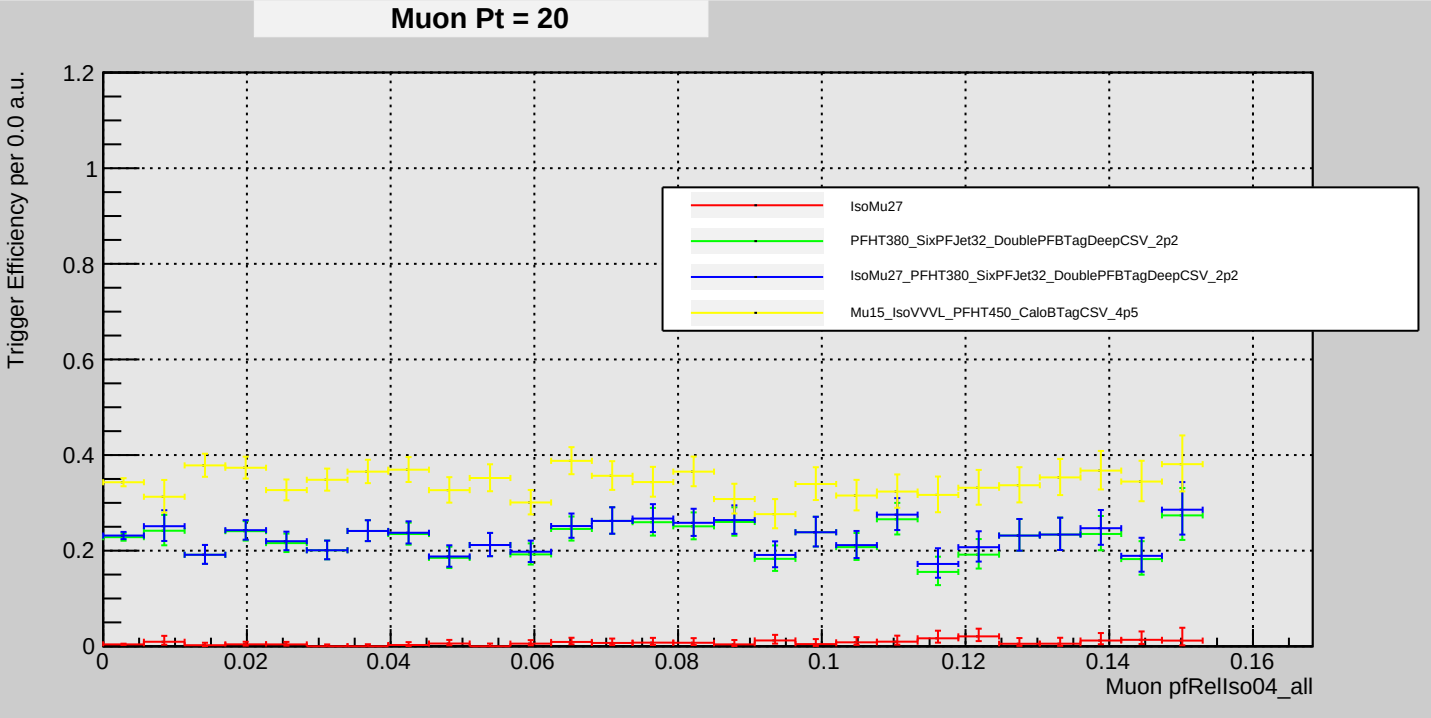
- **Jets:** jetId > 2 , p_T > 30 and |η|<2.4 (for at least 6 jets)
  btagDeepFlavB > 0.7489 (for at least one jet)
- **Muons:** has tightId, |η|<2.4 a

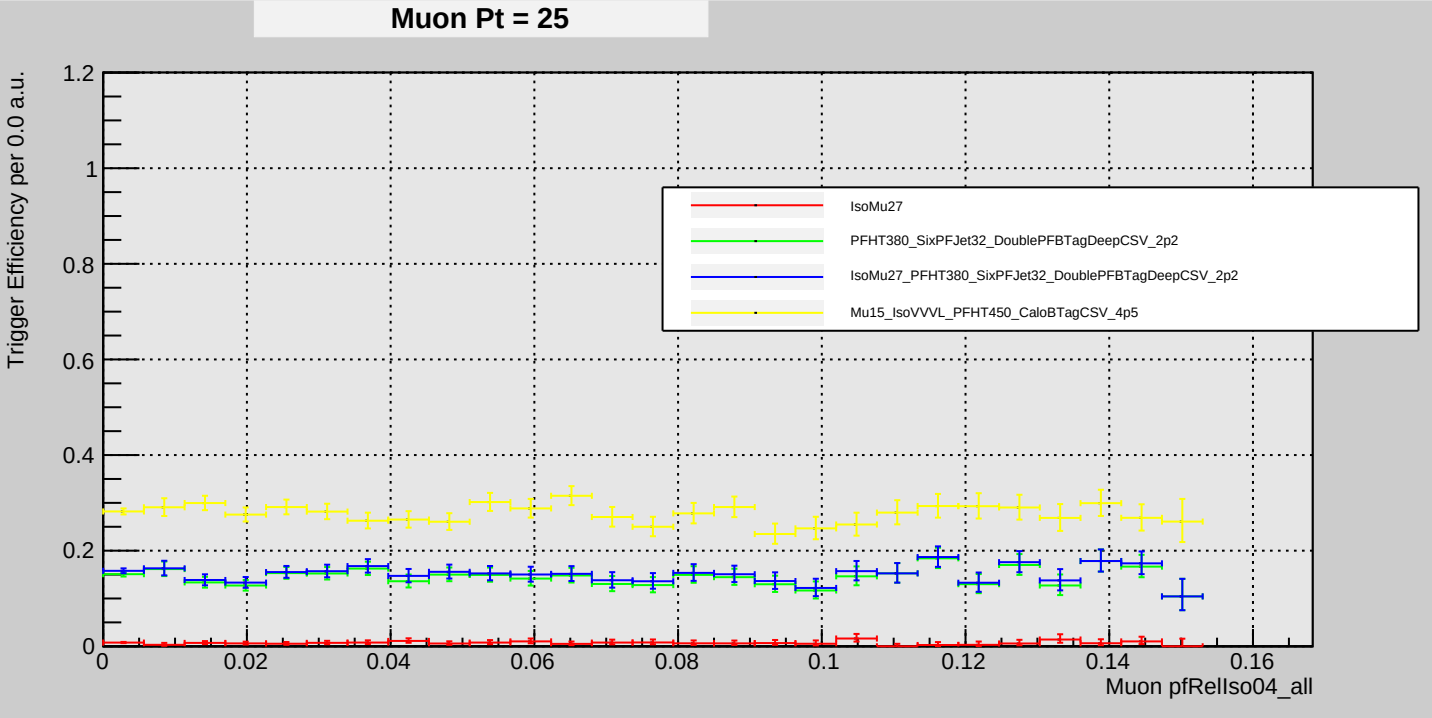


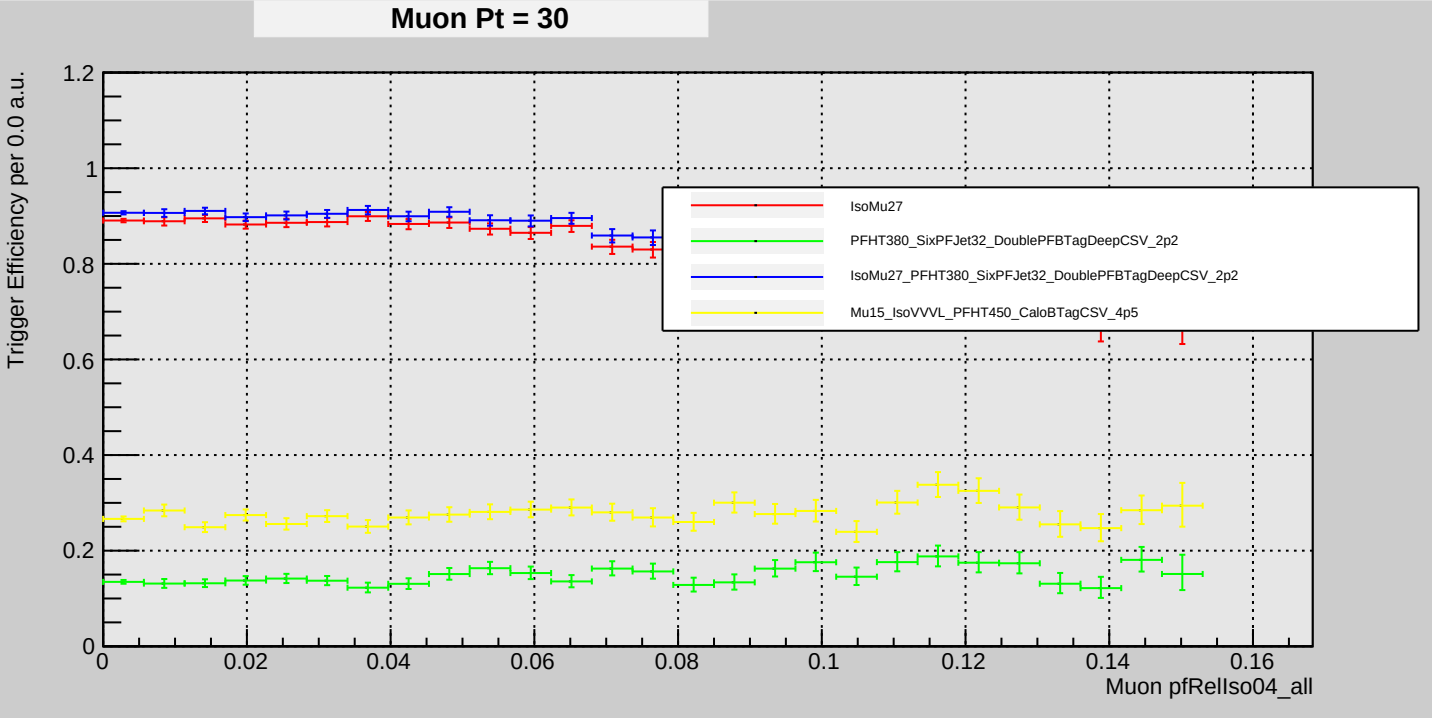

Muon Pt = 5
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

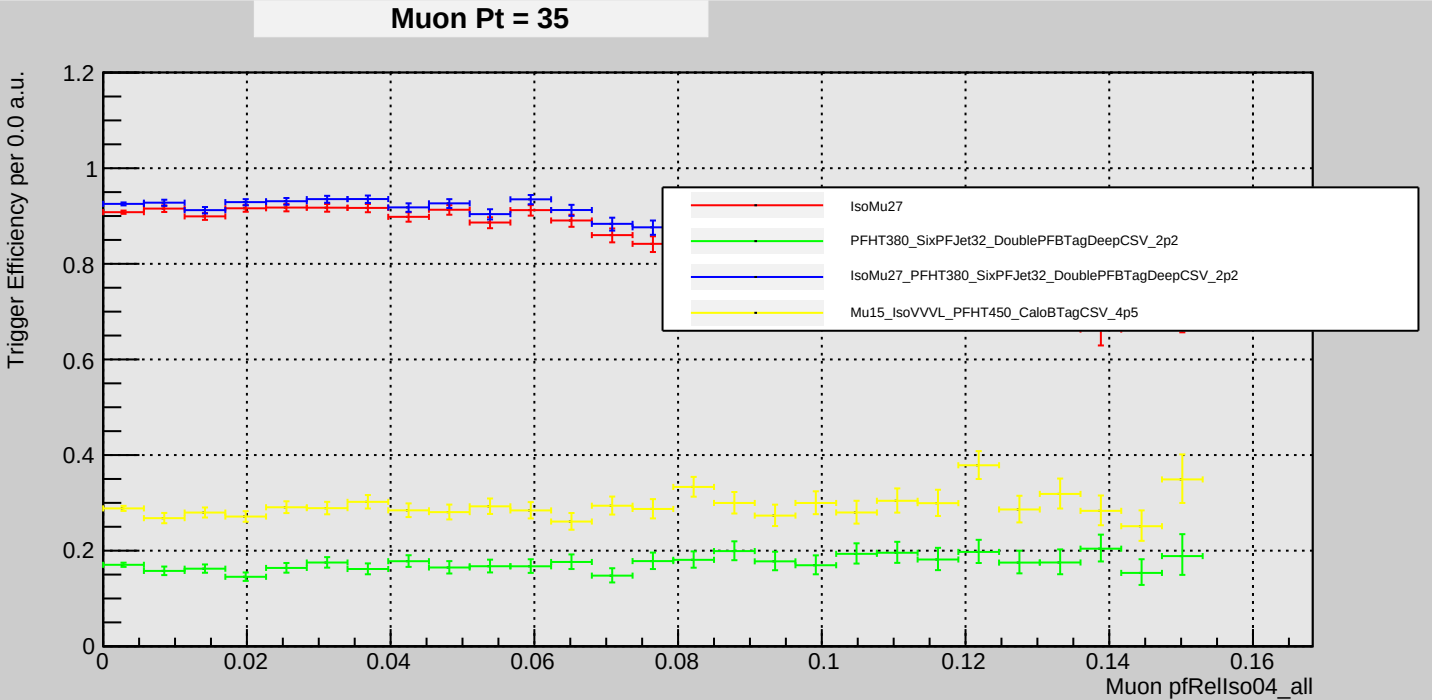

Muon Pt = 10
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

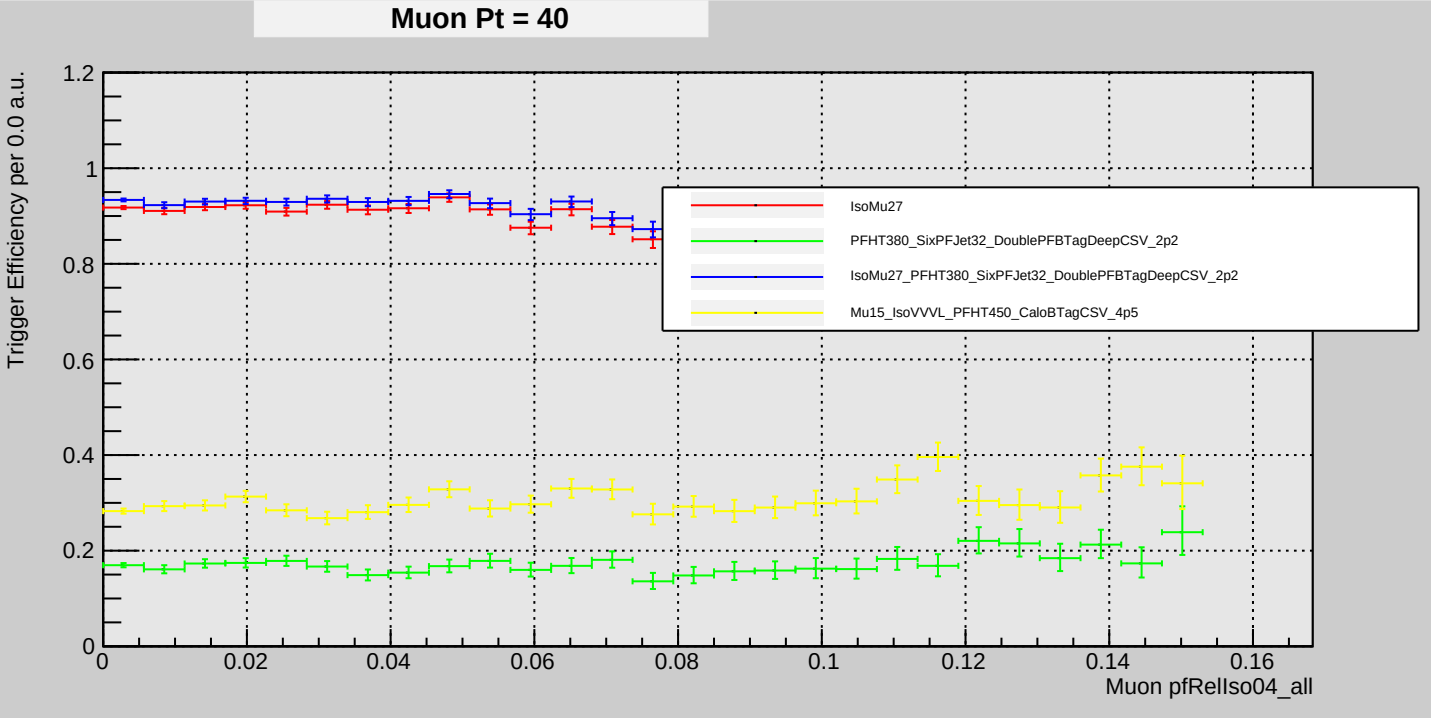

Muon Pt = 15
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

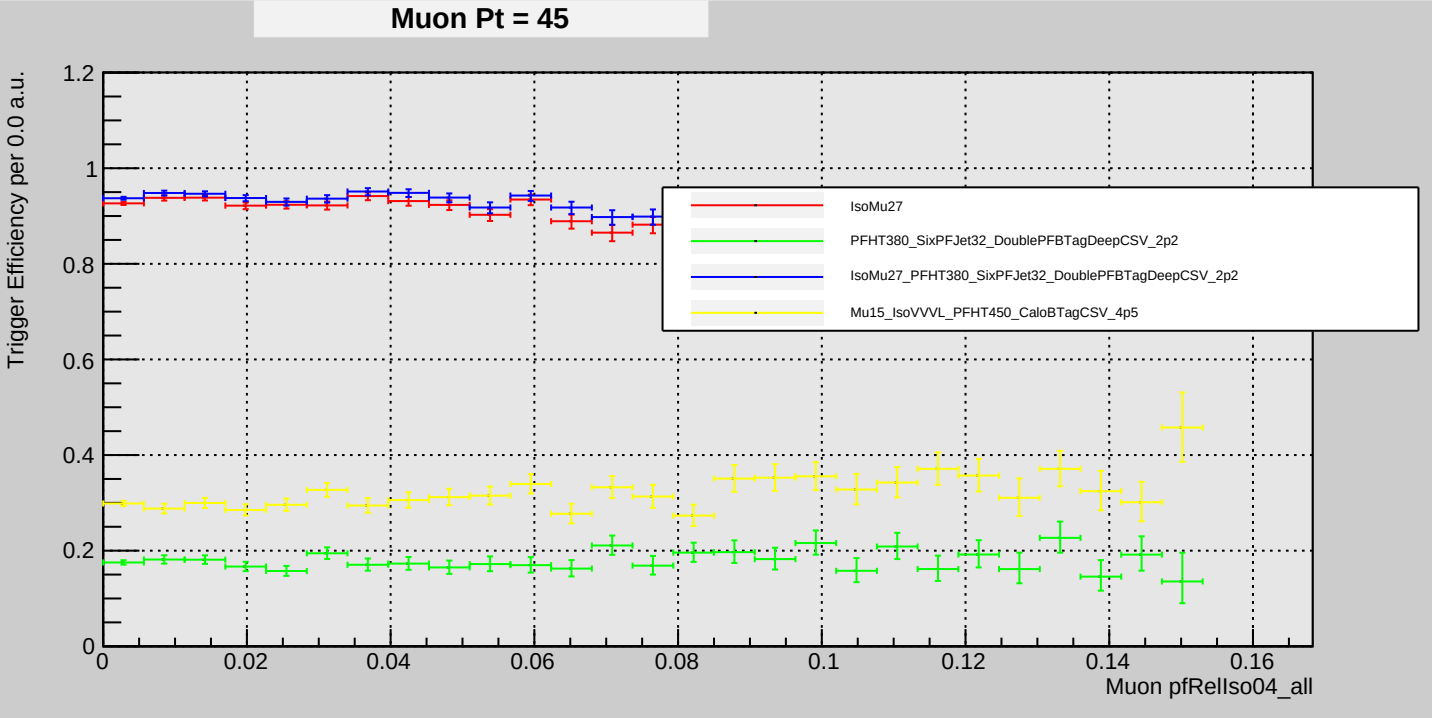

Muon Pt = 20
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

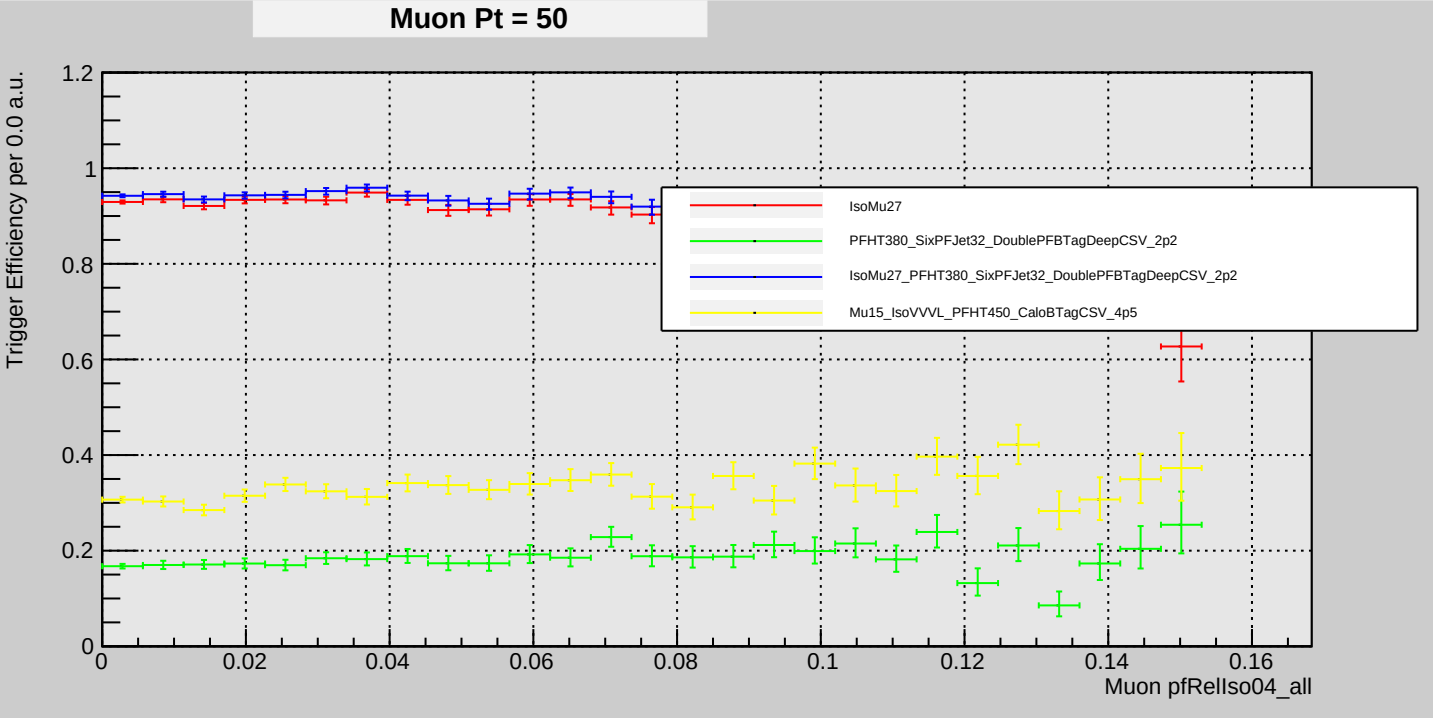

Muon Pt = 25
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

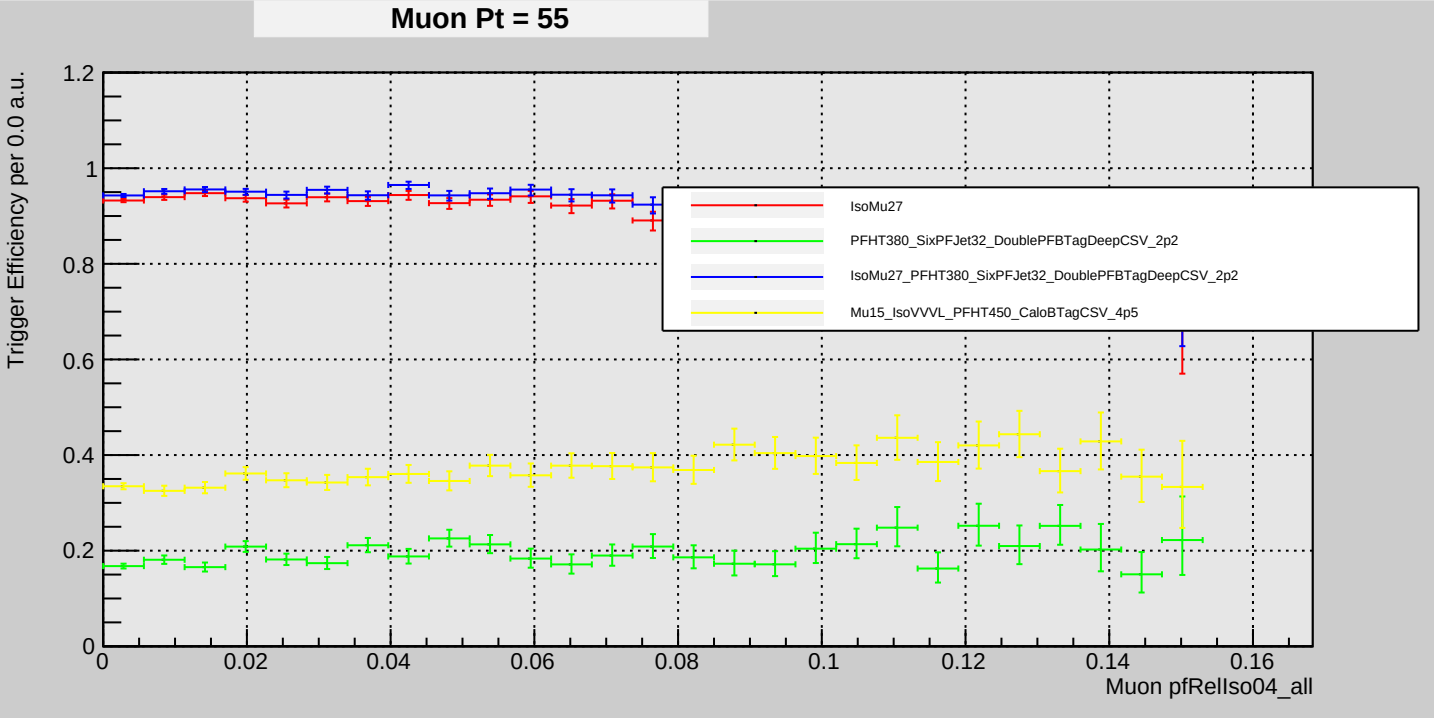

Muon Pt = 30
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

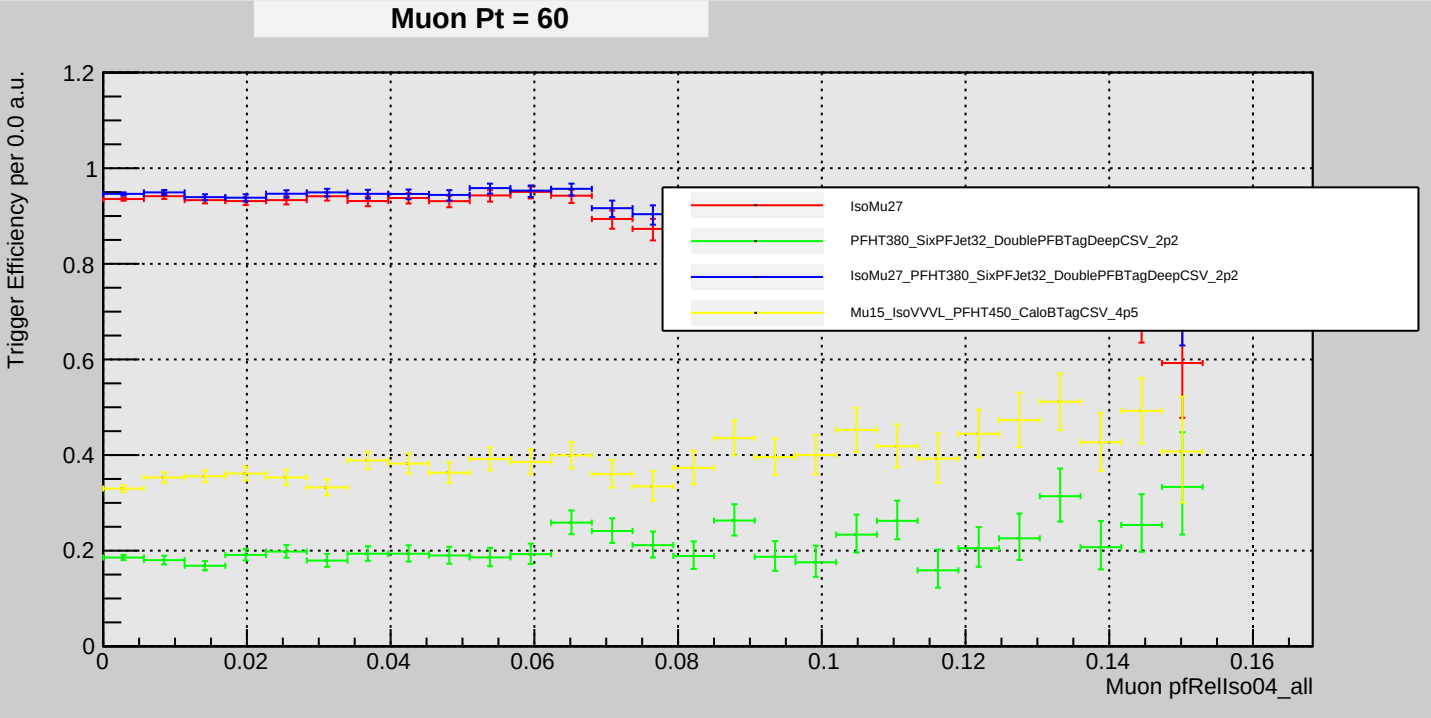

Muon Pt = 35
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

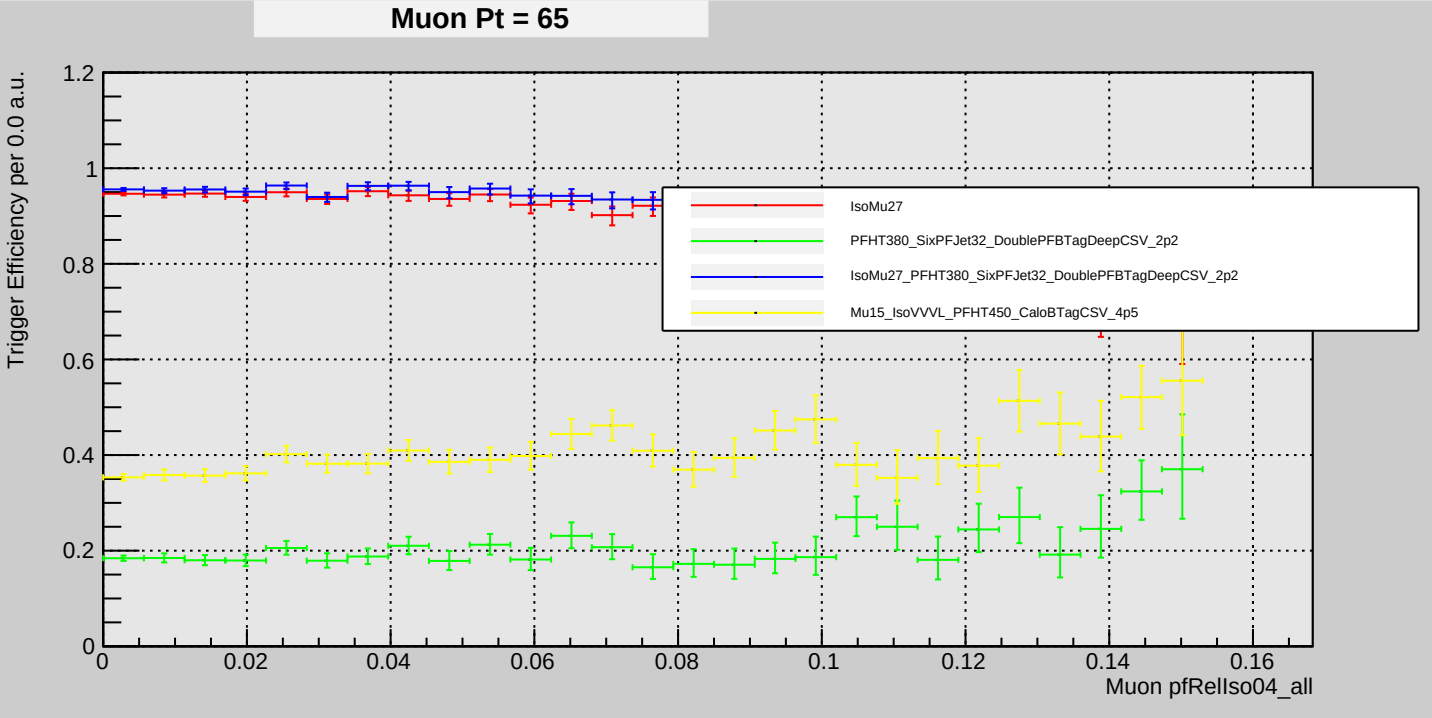

Muon Pt = 40
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

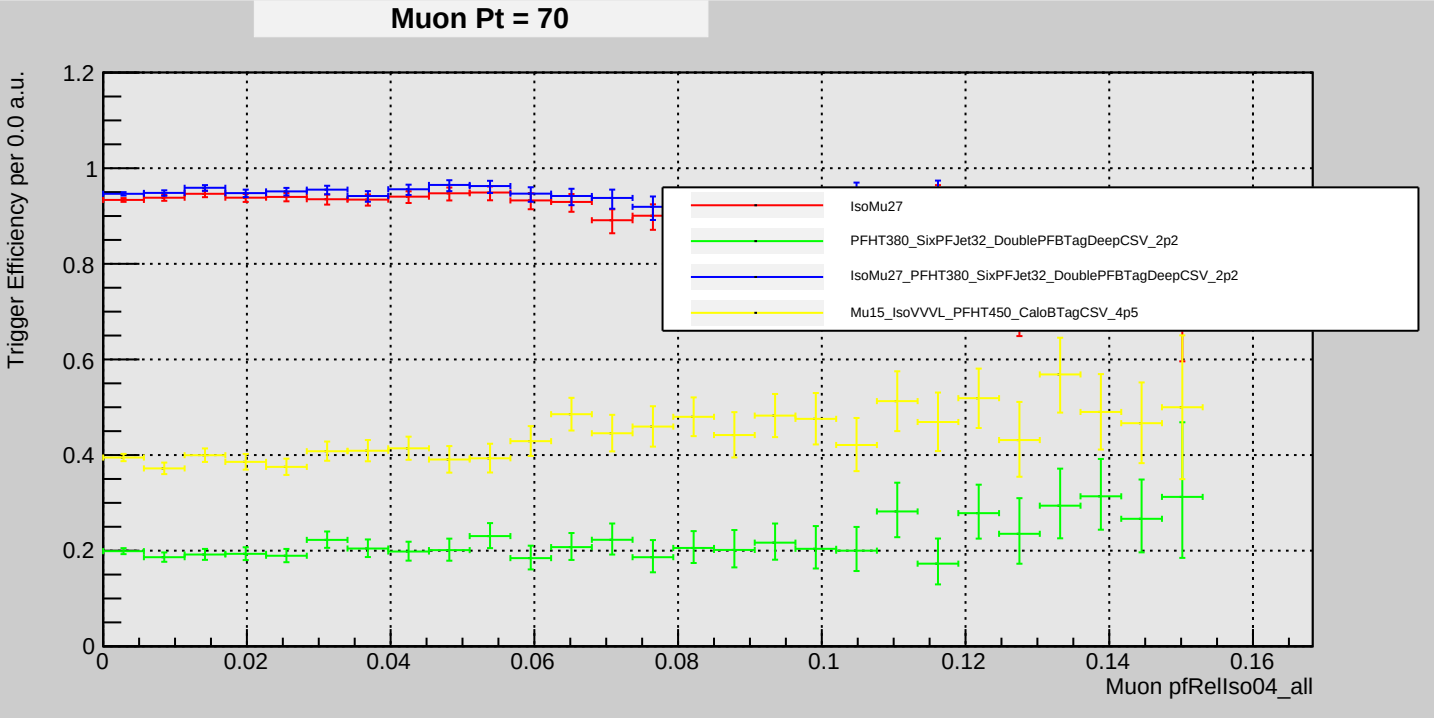

Muon Pt = 45
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

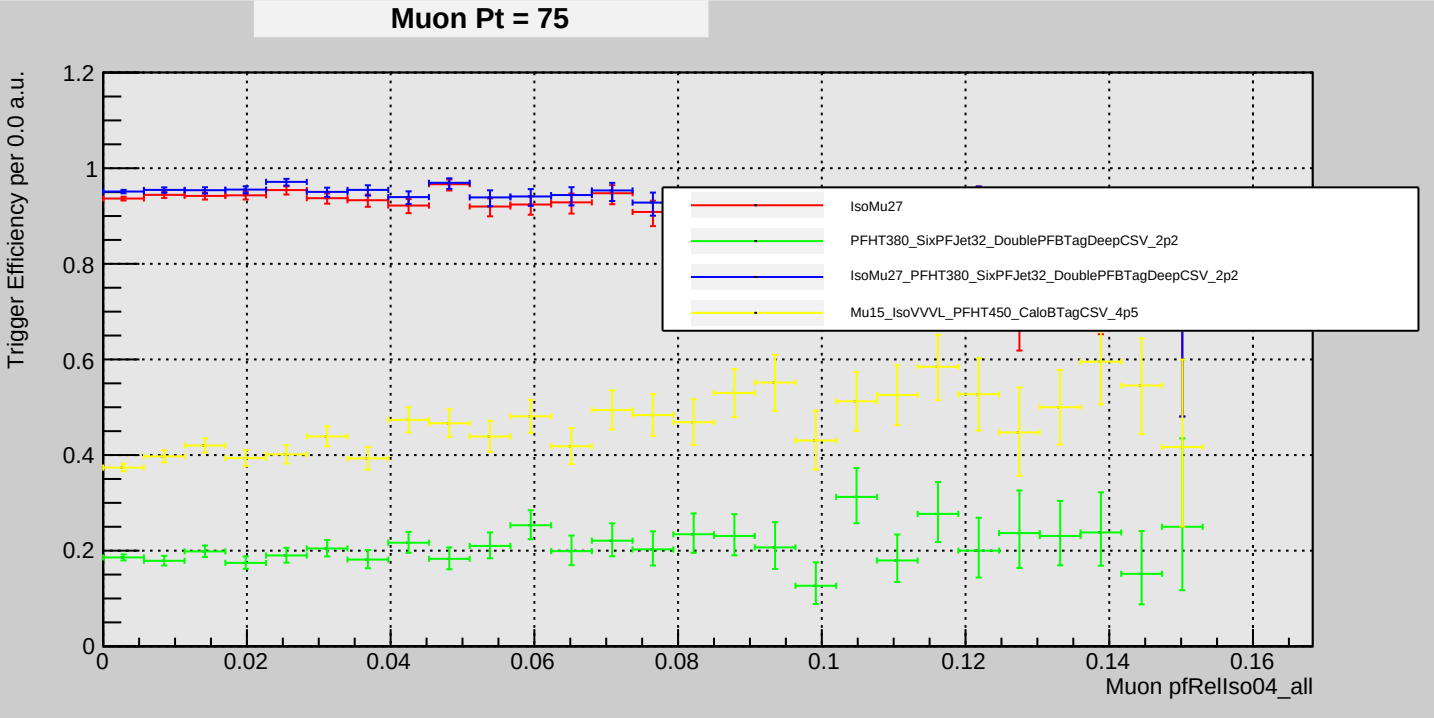

Muon Pt = 50
Trigger Efficiency per 0.0 a.u.
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
0
0.2
0.4
0.6
0.8
1
1.2
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16

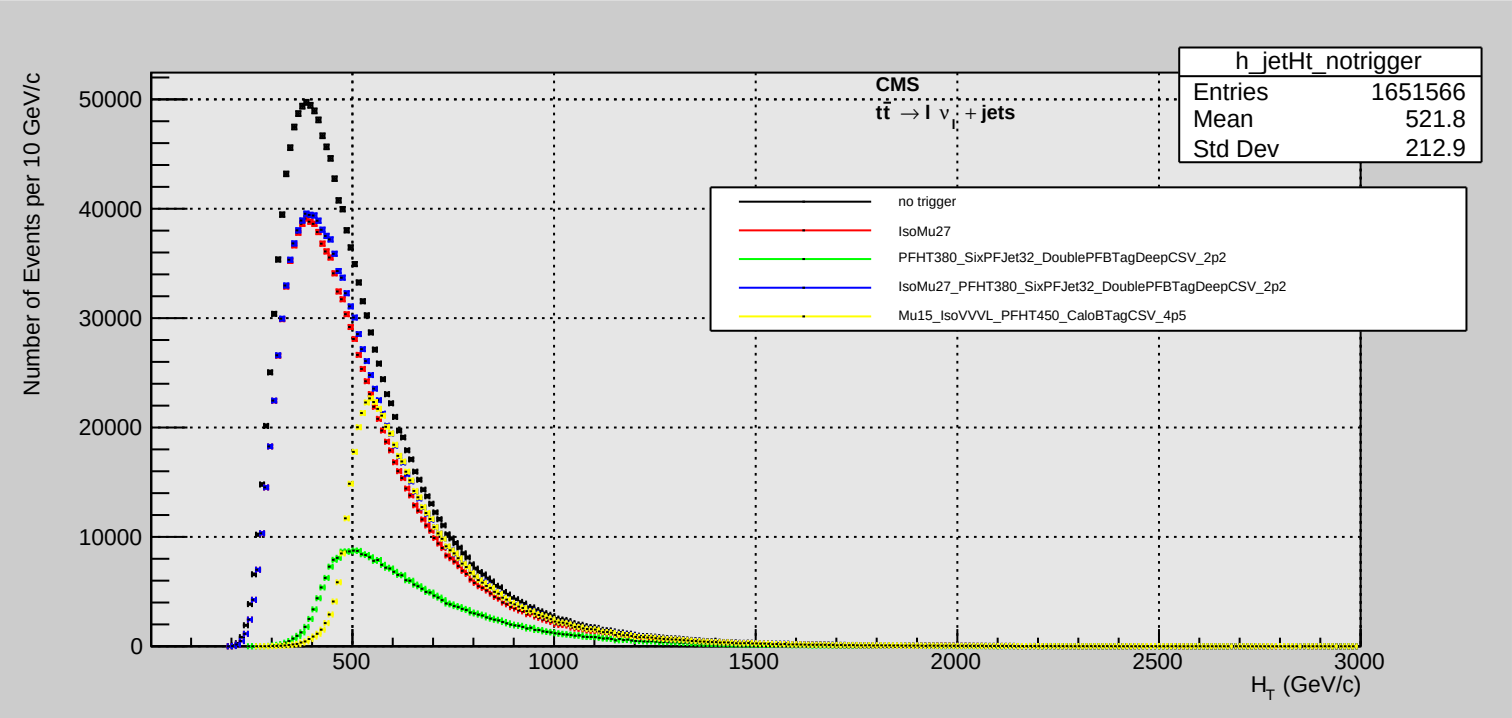

Muon Pt = 55
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

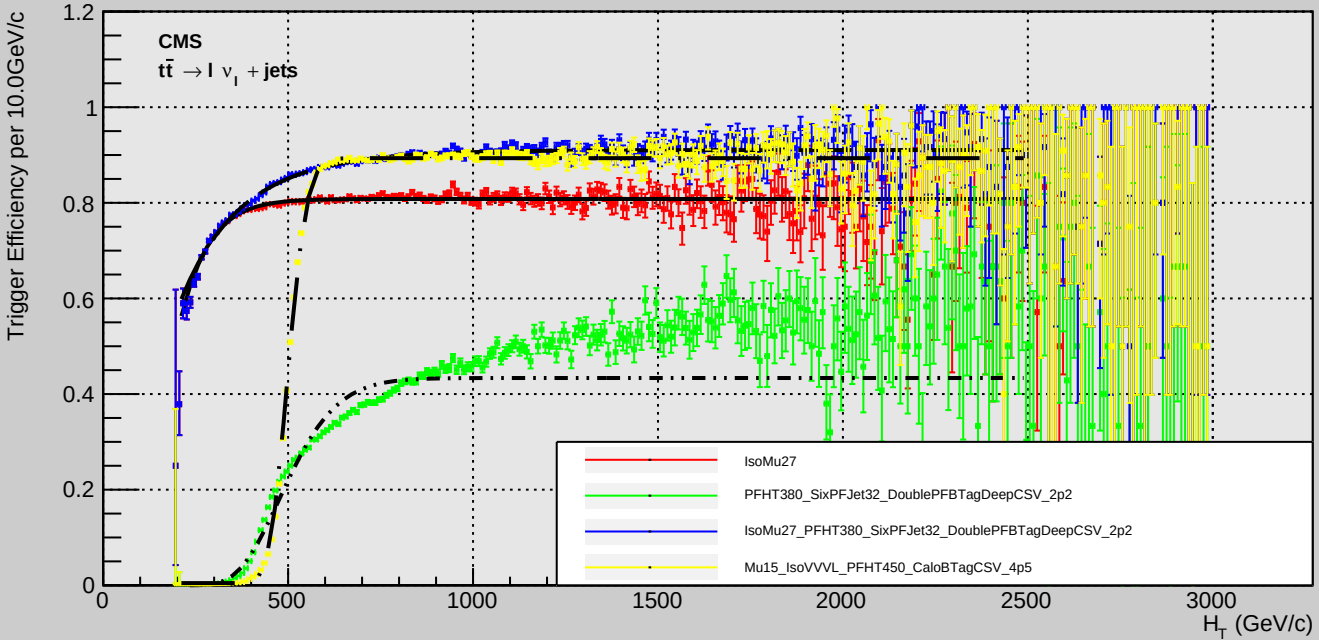

Muon Pt = 60
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

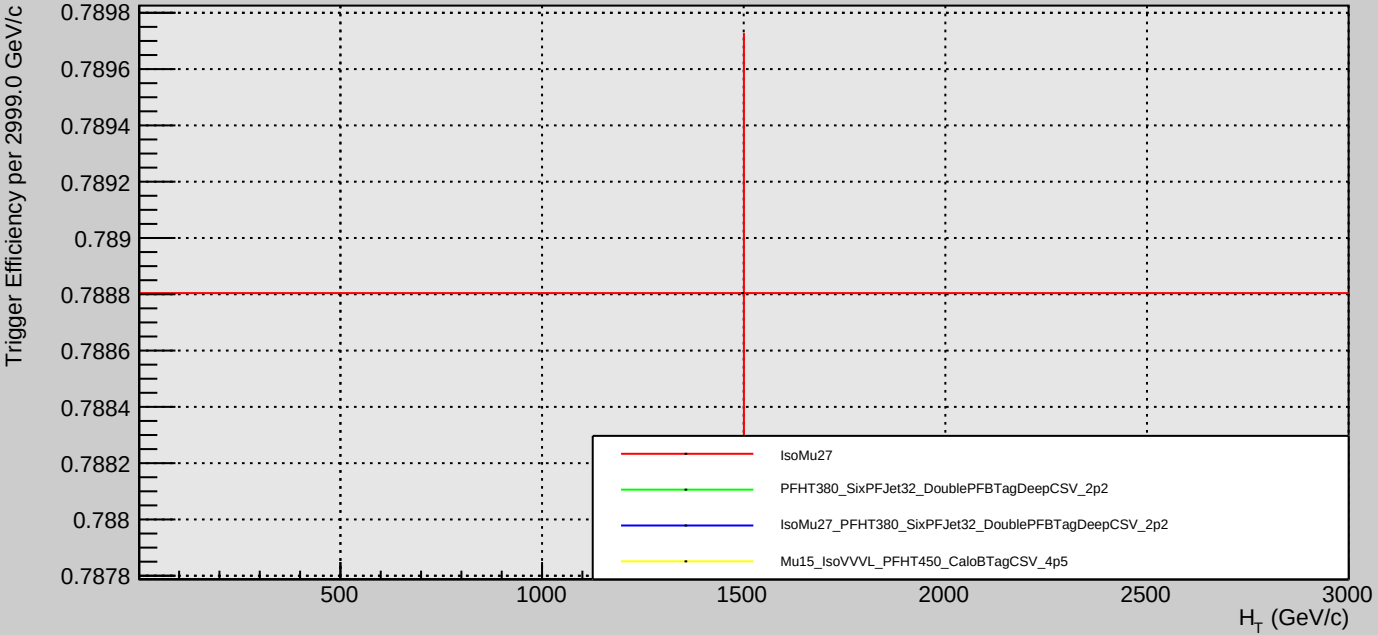

Muon Pt = 65
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

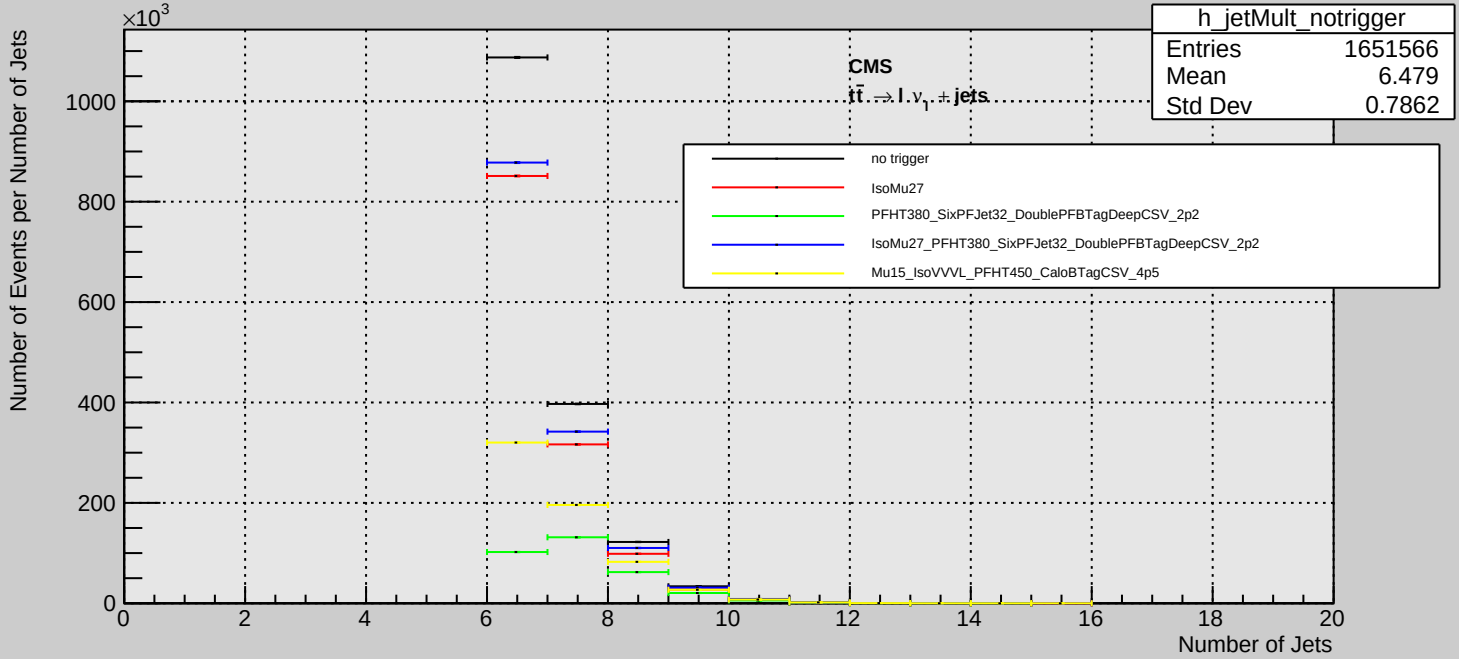

Muon Pt = 70
Trigger Efficiency per 0.0 a.u.
1.2
1
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

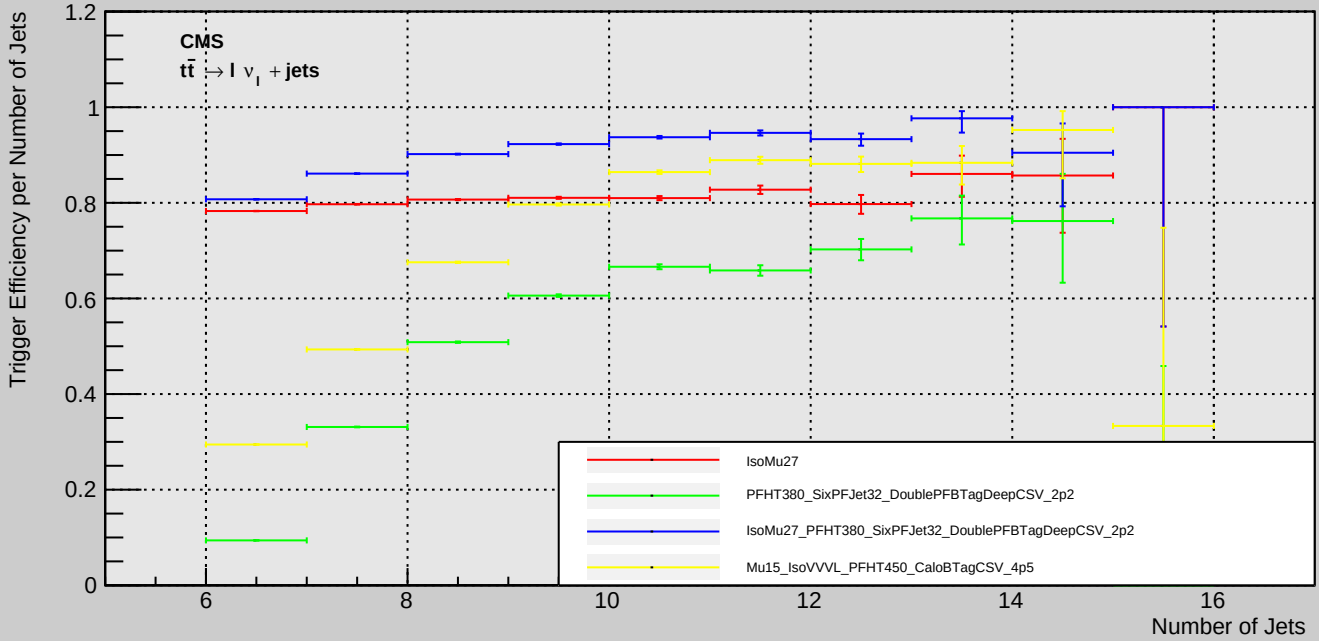

Muon Pt = 75
Trigger Efficiency per 0.0 a.u.
Muon pfRelIso04_all
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
0
0.2
0.4
0.6
0.8
1
1.2
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16

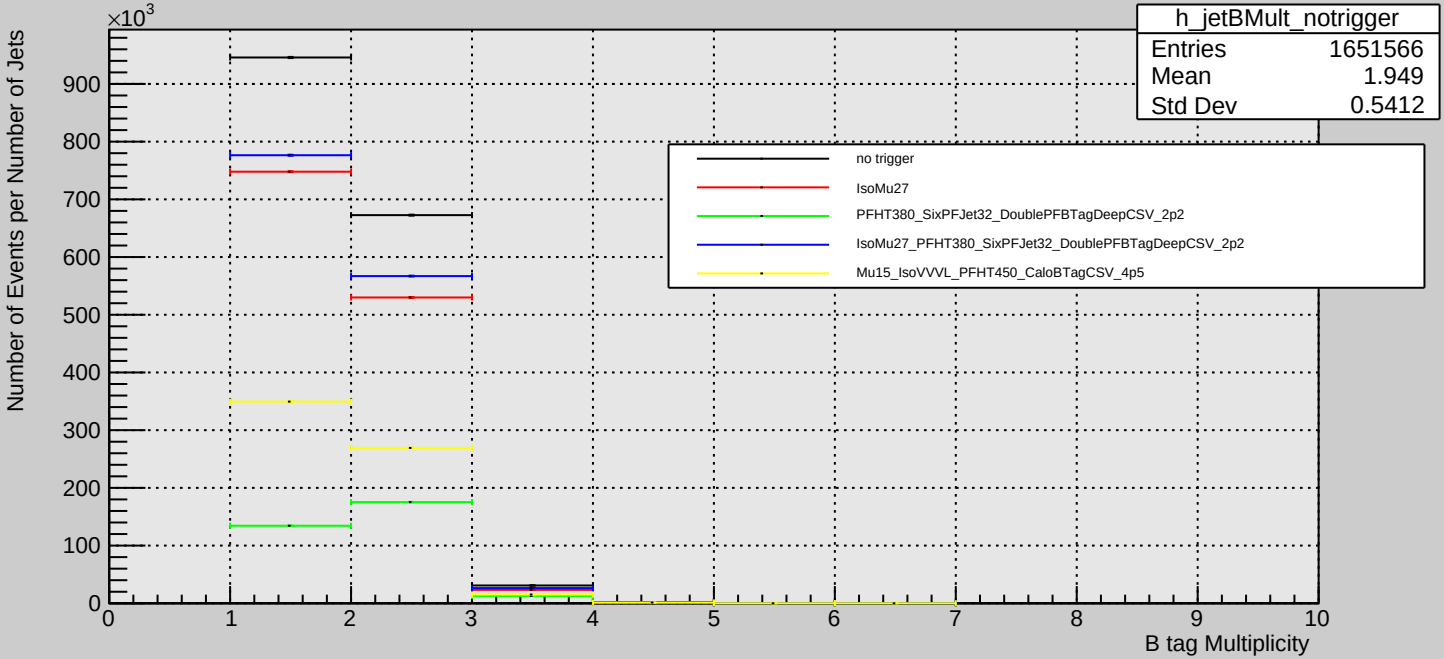

h_jetHt_notrigger
Entries 1651566
Mean 521.8
Std Dev 212.9
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
Number of Events per 10 GeV/c
H_T (GeV/c)
0
10000
20000
30000
40000
50000
500
1000
1500
2000
2500
3000

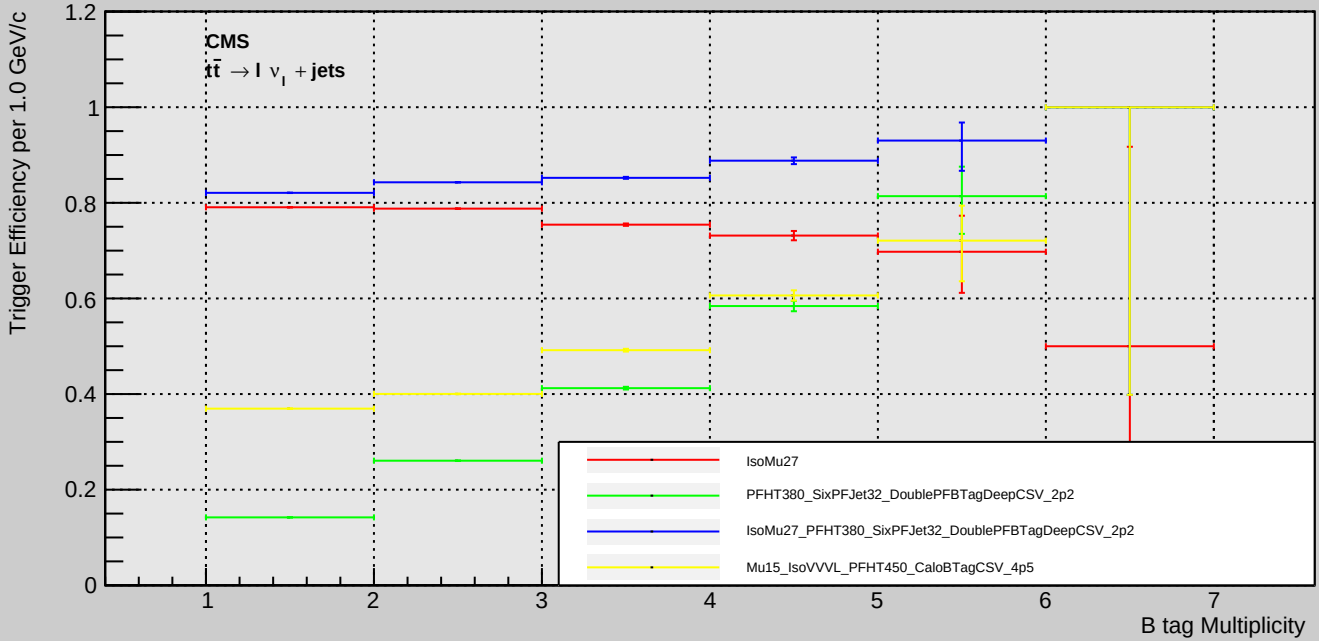

CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 10.0GeV/c
H_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
500
1000
1500
2000
2500
3000
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

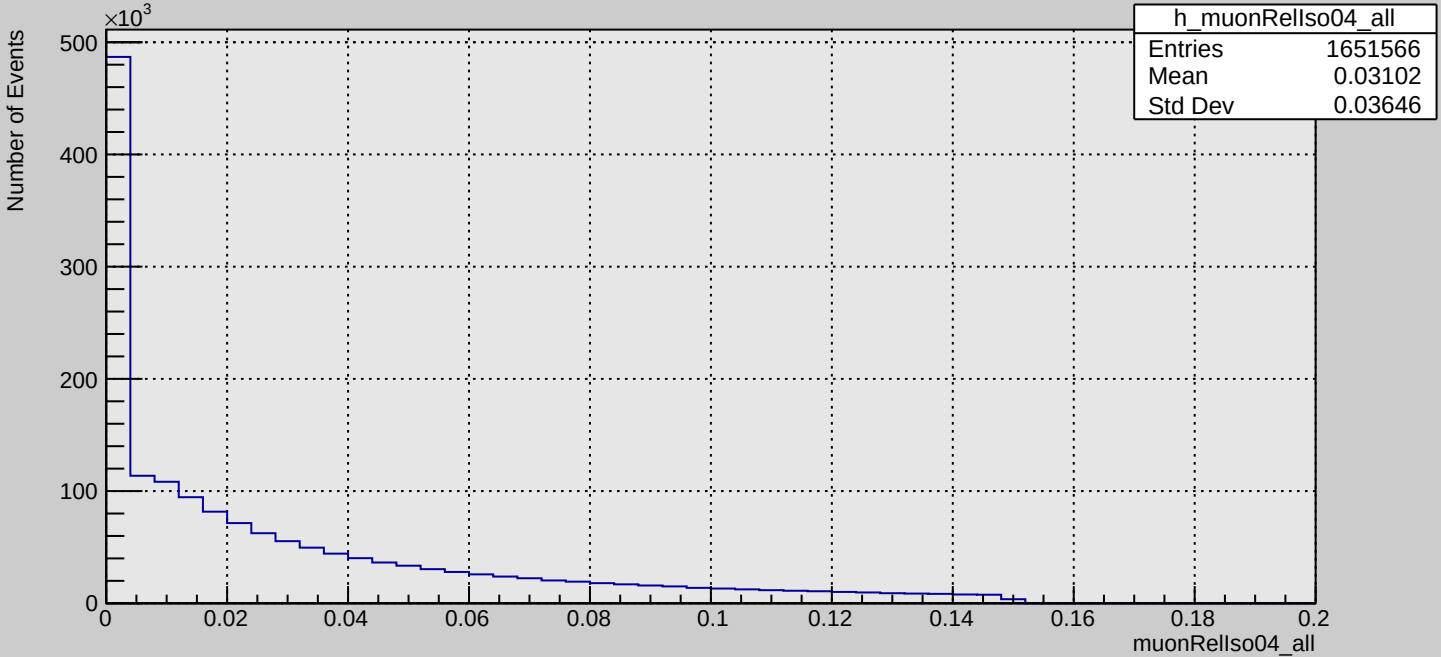

Trigger Efficiency per 2999.0 GeV/c
0.7898
0.7896
0.7894
0.7892
0.789
0.7888
0.7886
0.7884
0.7882
0.788
0.7878
500
1000
1500
2000
2500
3000
H_T (GeV/c)
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

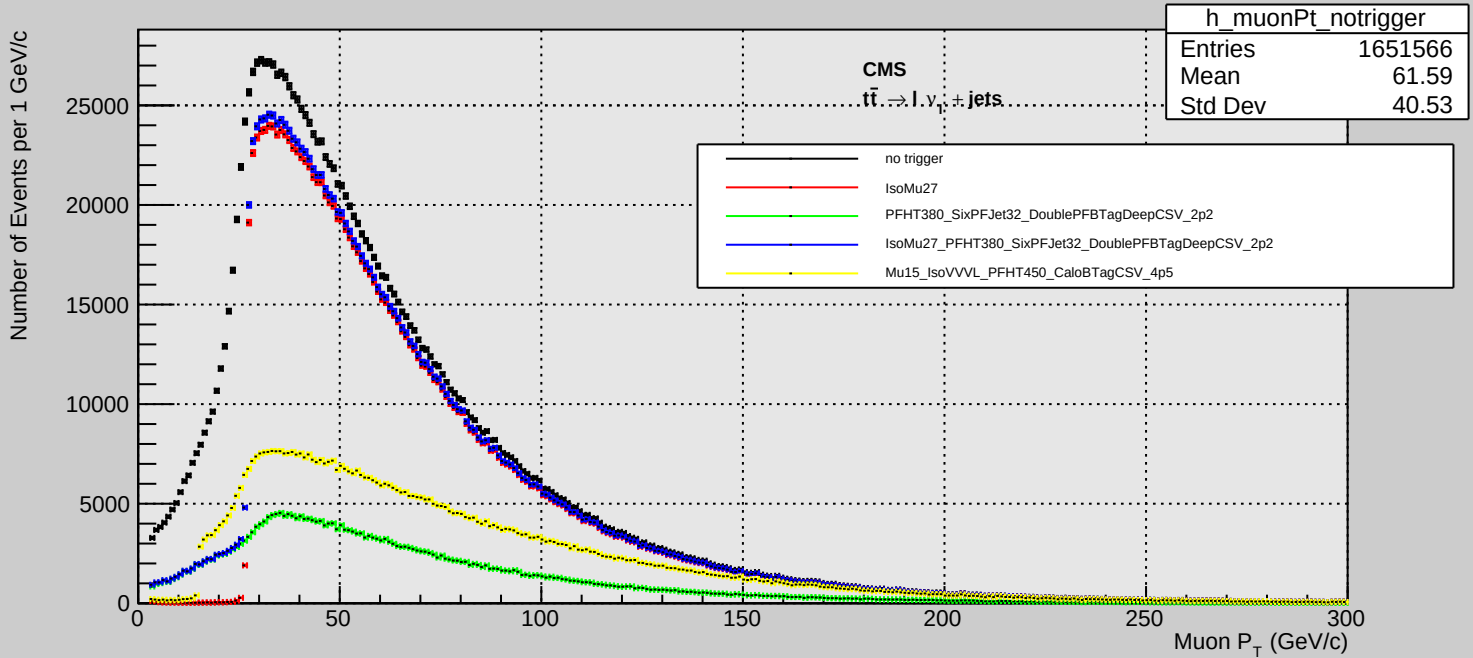

h_jetMult_notrigger
Entries 1651566
Mean 6.479
Std Dev 0.7862
CMS
$t\bar{t} \rightarrow l\nu_l + jets$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
×10^3
Number of Events per Number of Jets
Number of Jets
0
200
400
600
800
1000
0
2
4
6
8
10
12
14
16
18
20

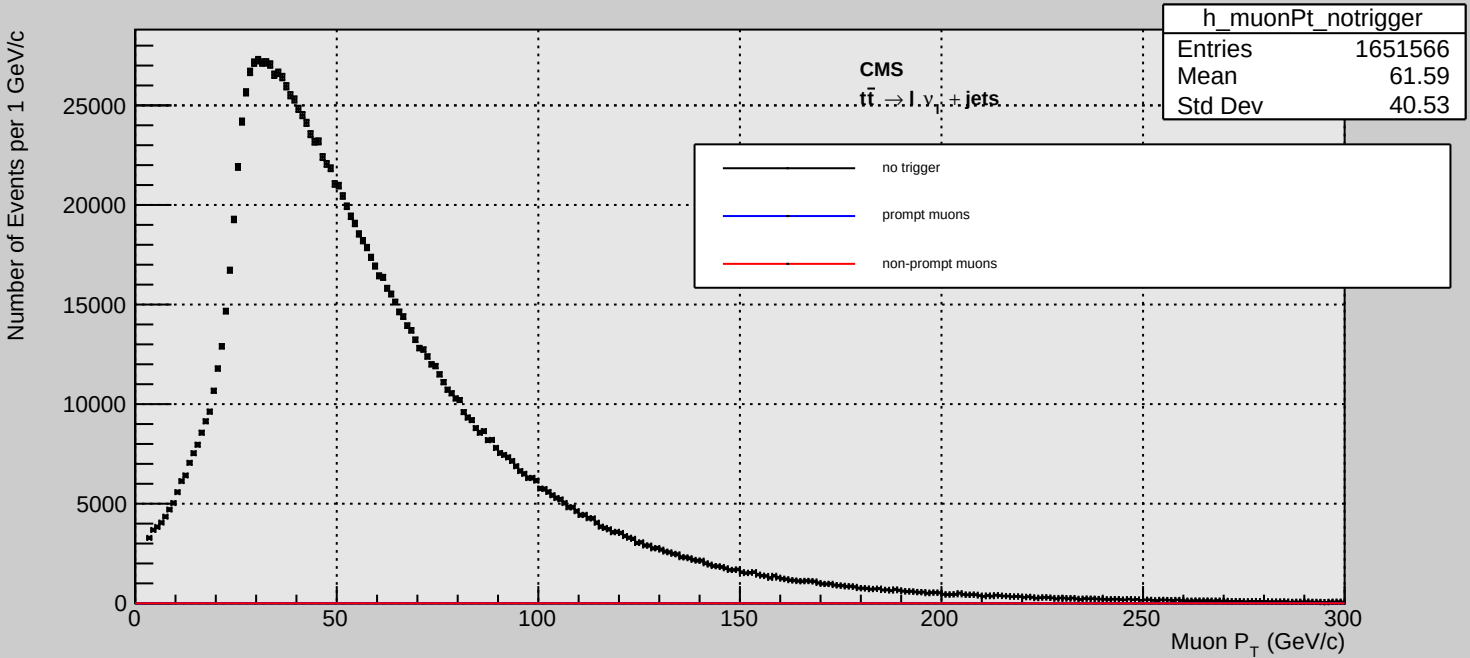

CMS
$t\bar{t} \to l\ \nu_l$ + jets
Trigger Efficiency per Number of Jets
Number of Jets
0
0.2
0.4
0.6
0.8
1
1.2
6
8
10
12
14
16
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

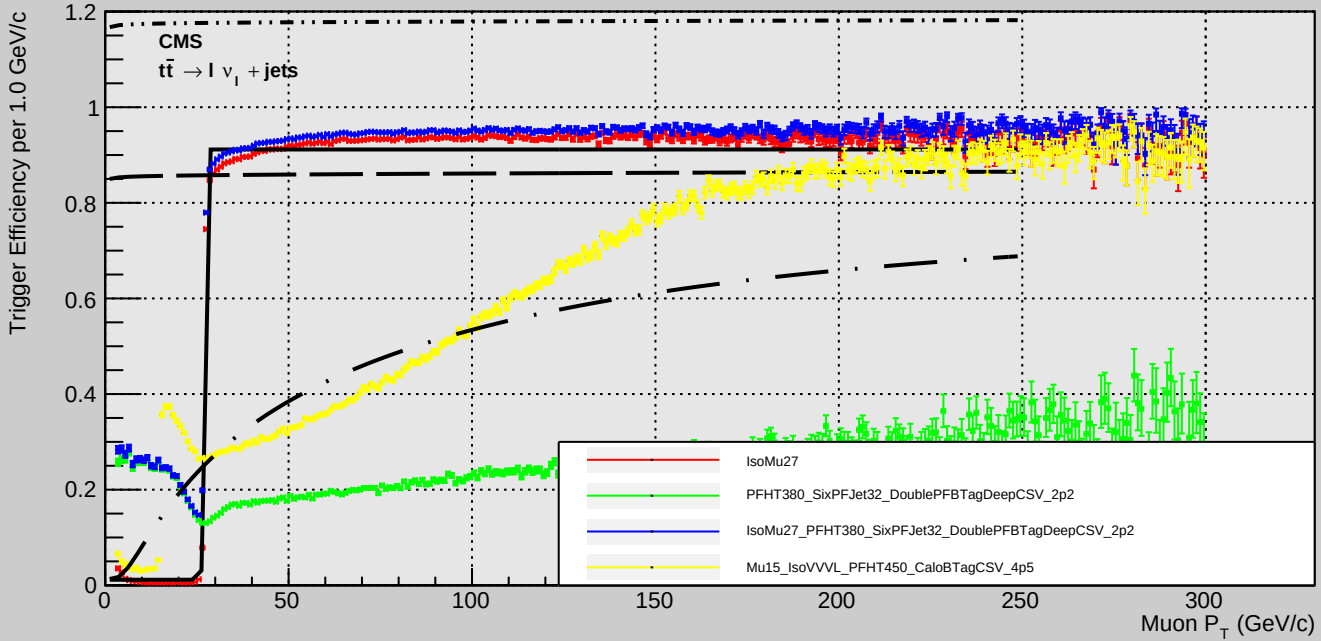

h_jetBMult_notrigger
Entries 1651566
Mean 1.949
Std Dev 0.5412
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
×10^3
Number of Events per Number of Jets
B tag Multiplicity
0
100
200
300
400
500
600
700
800
900
1
2
3
4
5
6
7
8
9
10

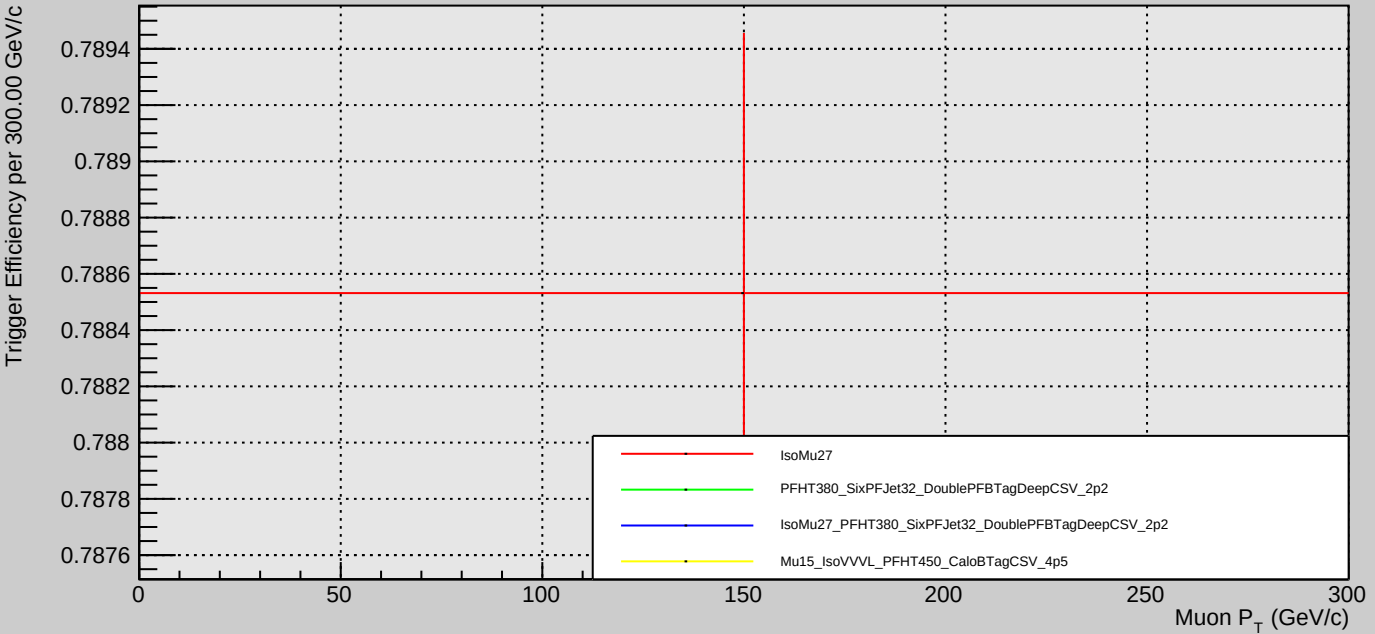

CMS
$t\bar{t} \rightarrow l\ \nu_l$ + jets
Trigger Efficiency per 1.0 GeV/c
B tag Multiplicity
0
0.2
0.4
0.6
0.8
1
1.2
1
2
3
4
5
6
7
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

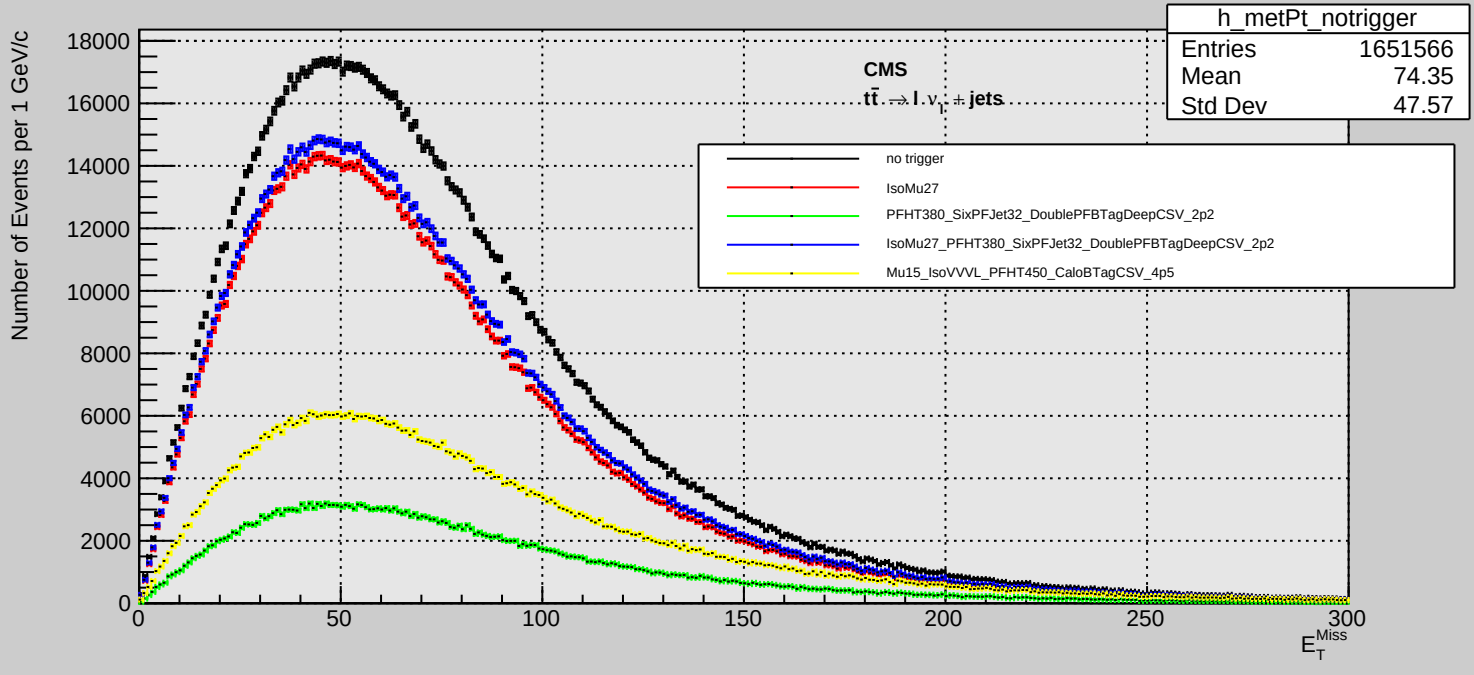

h_muonRelIso04_all
Entries 1651566
Mean 0.03102
Std Dev 0.03646
×10^3
Number of Events
500
400
300
200
100
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
muonRelIso04_all

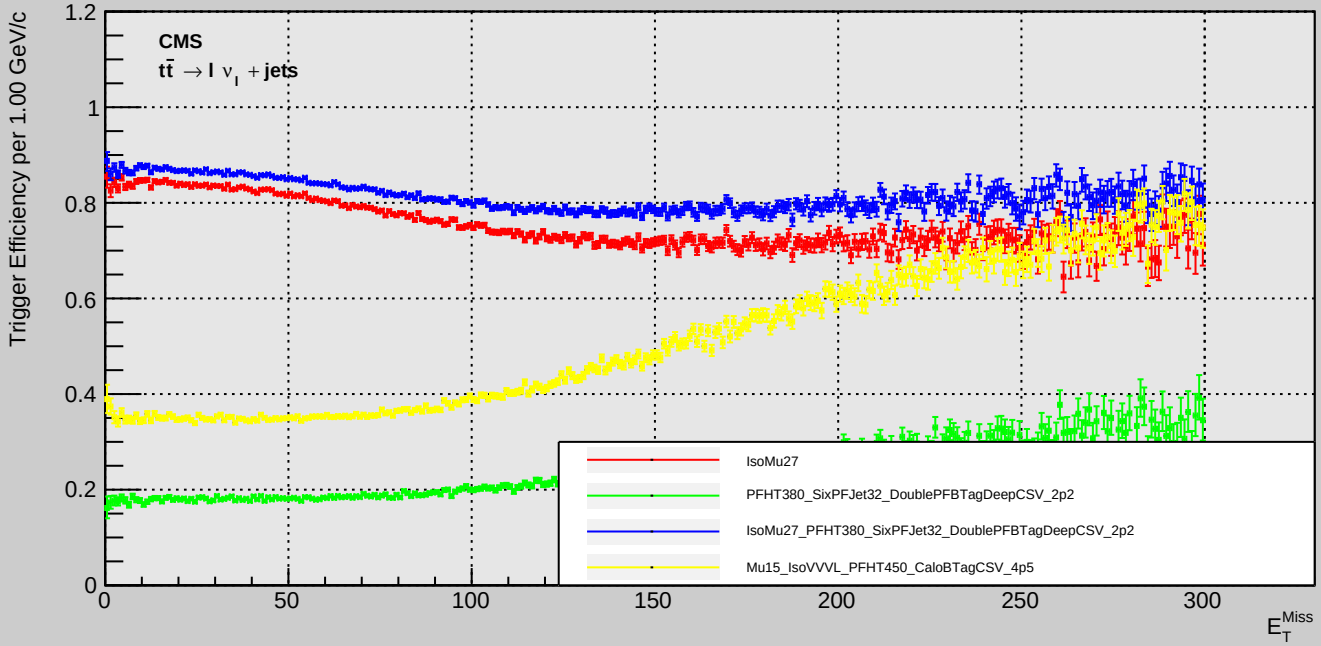

h_muonPt_notrigger
Entries 1651566
Mean 61.59
Std Dev 40.53
CMS
$t\bar{t} \rightarrow l\,\nu_l + jets$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
Number of Events per 1 GeV/c
Muon P_T (GeV/c)
0
5000
10000
15000
20000
25000
0
50
100
150
200
250
300

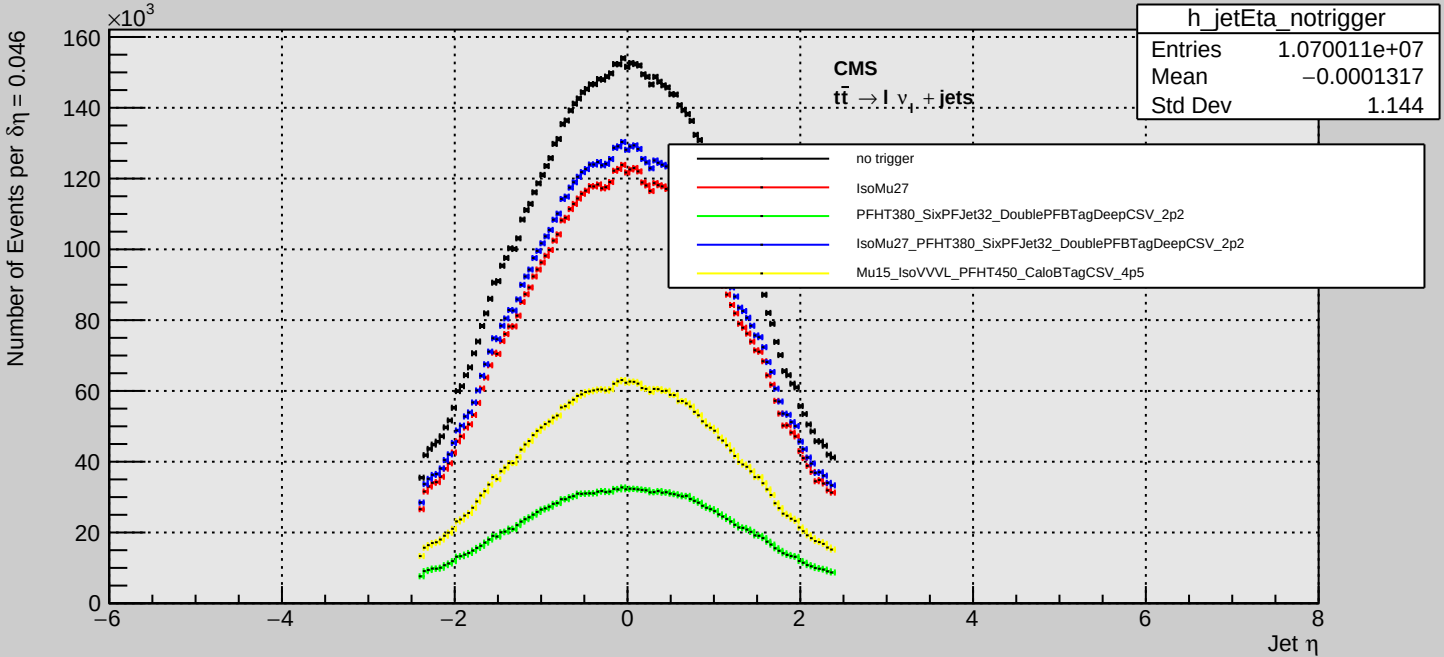

h_muonPt_notrigger
Entries 1651566
Mean 61.59
Std Dev 40.53
CMS
$t\bar{t} \to l\,\nu_l + jets$
no trigger
prompt muons
non-prompt muons
Number of Events per 1 GeV/c
Muon P_T (GeV/c)
0
5000
10000
15000
20000
25000
0
50
100
150
200
250
300

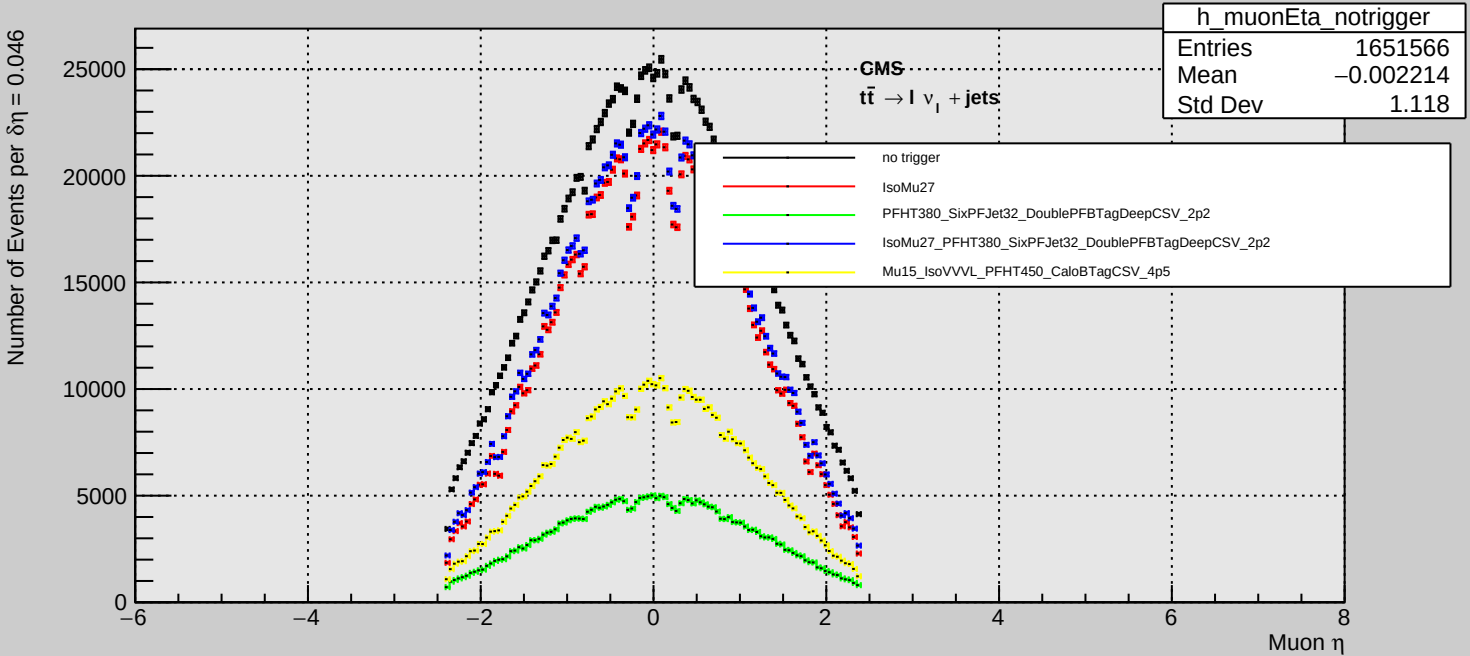

CMS
$t\bar{t} \rightarrow l\ \nu_l$ + jets
Trigger Efficiency per 1.0 GeV/c
Muon P_T (GeV/c)
0
0.2
0.4
0.6
0.8
1
1.2
0
50
100
150
200
250
300
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

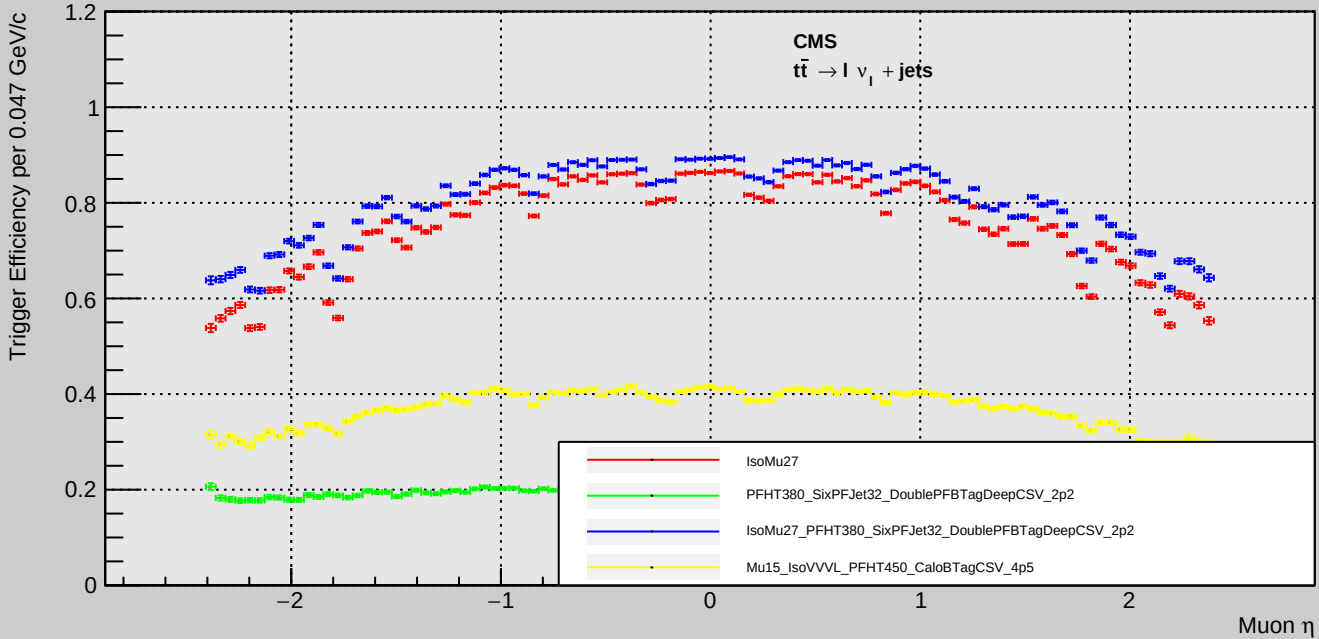

Trigger Efficiency per 300.00 GeV/c
0.7894
0.7892
0.789
0.7888
0.7886
0.7884
0.7882
0.788
0.7878
0.7876
0
50
100
150
200
250
300
Muon P_T (GeV/c)
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5


h_metPt_notrigger
Entries 1651566
Mean 74.35
Std Dev 47.57
CMS
$t\bar{t} \to l\nu_l + jets$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
Number of Events per 1 GeV/c
E_T^{Miss}
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
0
50
100
150
200
250
300


CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
Trigger Efficiency per 1.00 GeV/c
1.2
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
300
E_T^{Miss}
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5


h_jetEta_notrigger
Entries 1.070011e+07
Mean −0.0001317
Std Dev 1.144
CMS
$t\bar{t} \to l\,\nu_l + \text{jets}$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
×10^3
Number of Events per δη = 0.046
Jet η


h_muonEta_notrigger
Entries 1651566
Mean −0.002214
Std Dev 1.118
CMS
$t\bar{t} \rightarrow l\ \nu_l + jets$
no trigger
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
Number of Events per δη = 0.046
Muon η
25000
20000
15000
10000
5000
0
−6
−4
−2
0
2
4
6
8


CMS
$t\bar{t} \rightarrow l\ \nu_l$ + jets
Trigger Efficiency per 0.047 GeV/c
Muon η
1.2
1
0.8
0.6
0.4
0.2
0
−2
−1
0
1
2
IsoMu27
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5

Total Number of Accepted Events
×10^6
35
30
25
20
15
10
5
0
Pre-selection
Post-selection
Mu15_IsoVVVL_PFHT450_CaloBTagCSV_4p5
IsoMu27_PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
PFHT380_SixPFJet32_DoublePFBTagDeepCSV_2p2
IsoMu27
h_eventsPrg
Entries 4.190666e+07
Mean 0.2906
Std Dev 0.8664
Cuts and Triggers