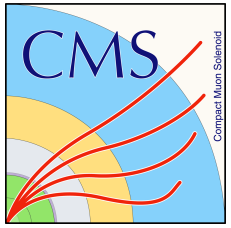
ttbar Analysis Status
NTUA
1/9/2020

George Bakas, Ioannis Papakrivopoulos



Introduction

Signal Selection

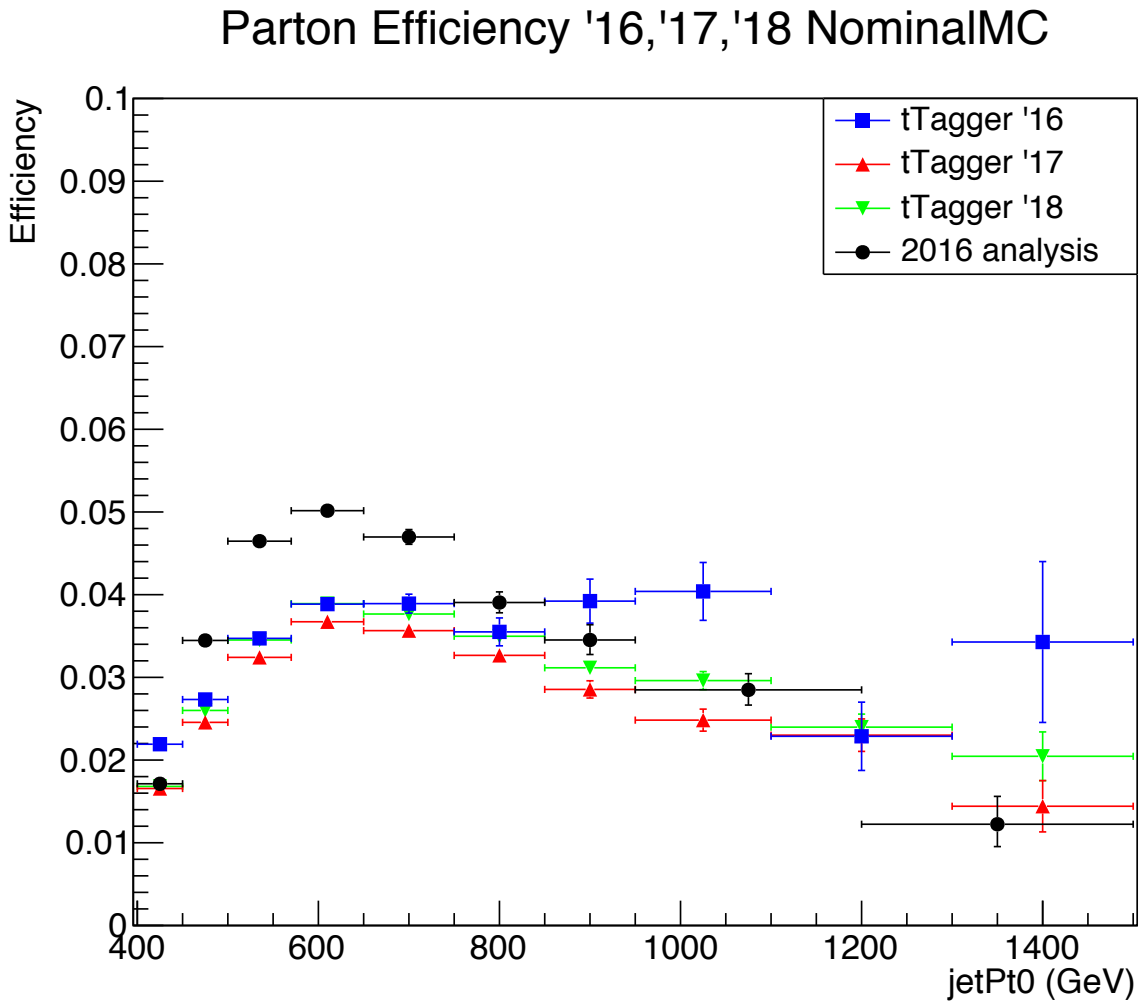
Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2, 0, 0.1
B tagging (2 btagged jets)	> Medium WP
Signal Trigger	

Control Region Selection

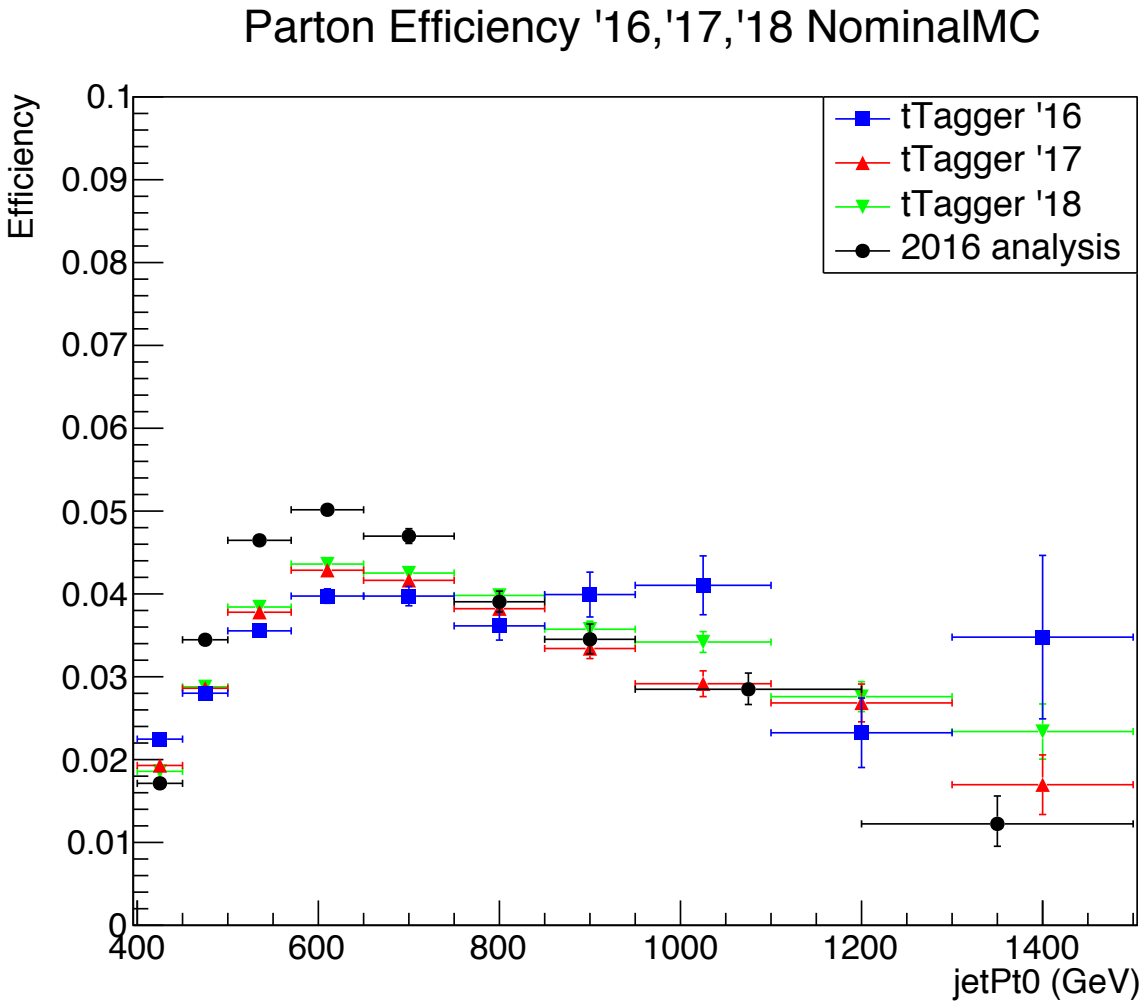
Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2, 0, 0.1
B tagging (0 btagged jets)	< Medium WP
Control Trigger	

Efficiency and Acceptance Plots

b tagging SF's

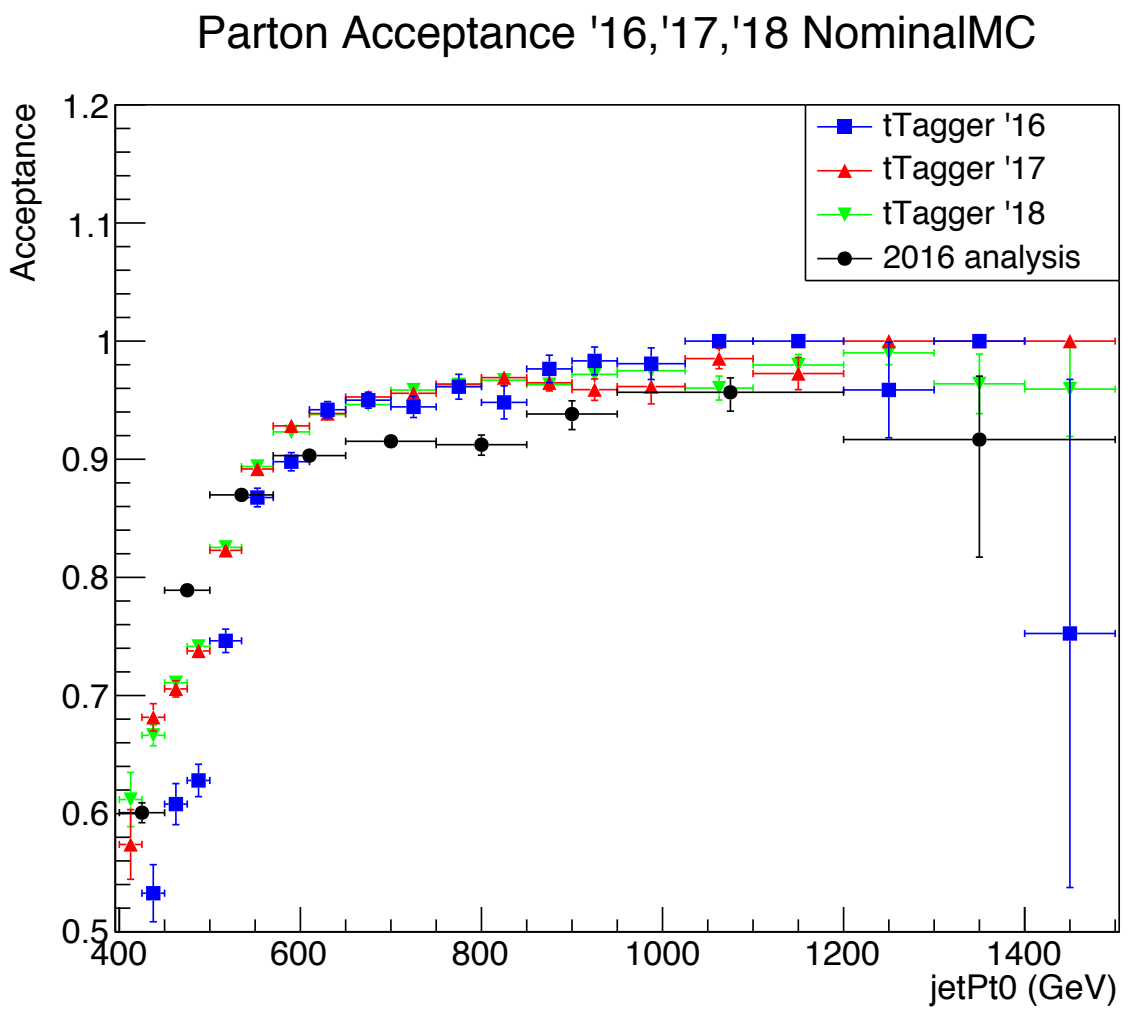


without b tagging SF's



Efficiency and Acceptance Plots

b tagging SF's



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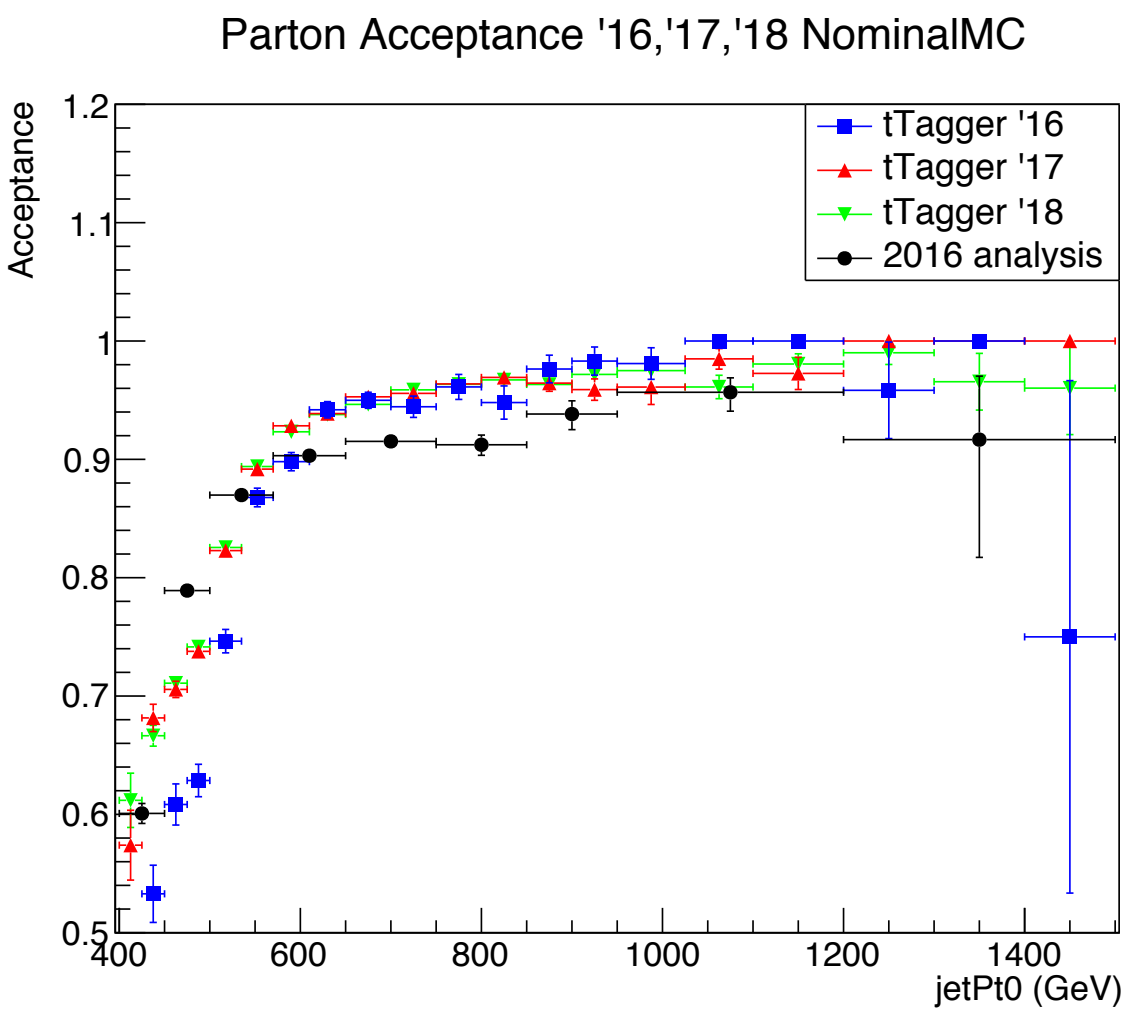
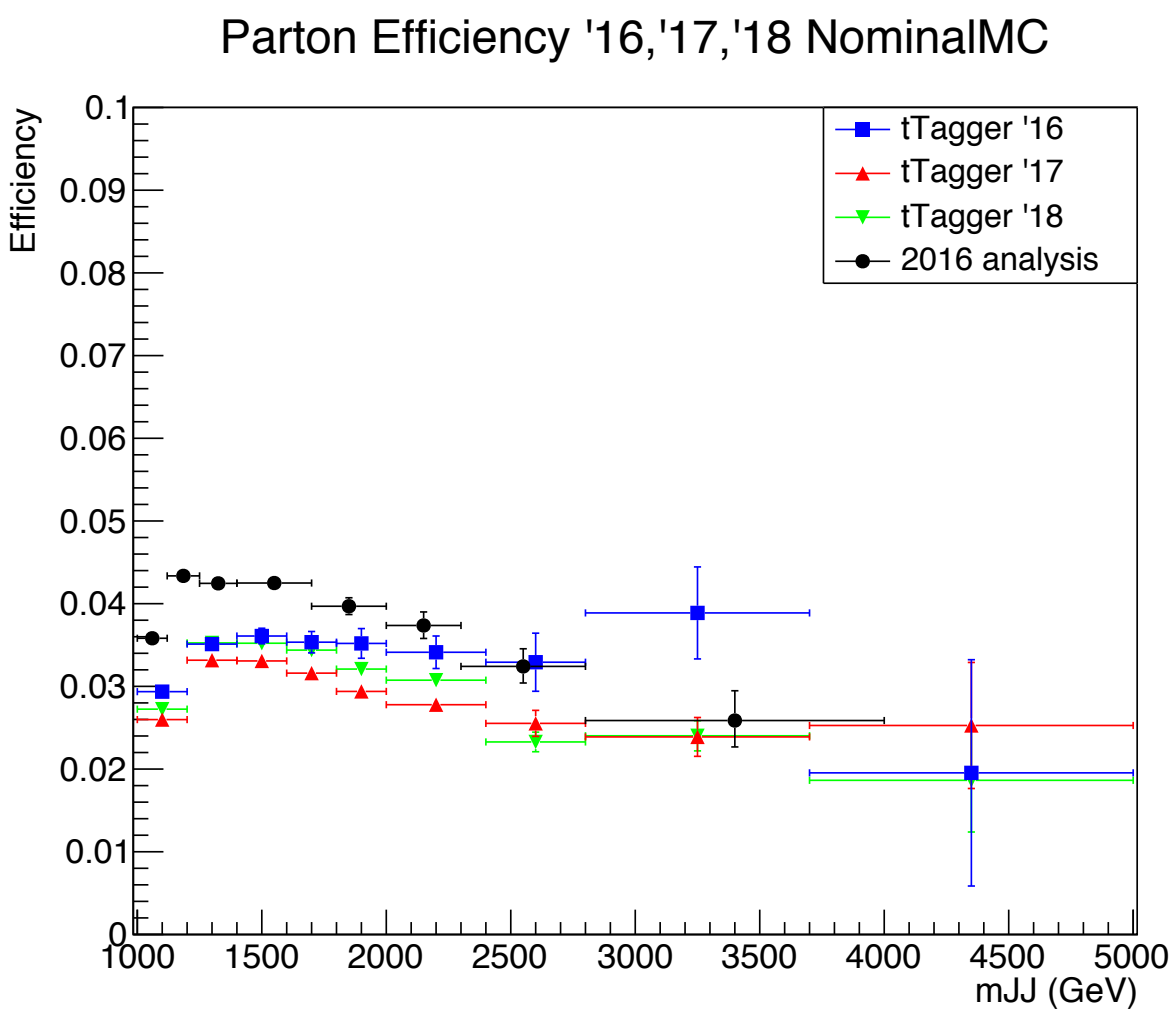


Efficiency and Acceptance Plots

b tagging SF's



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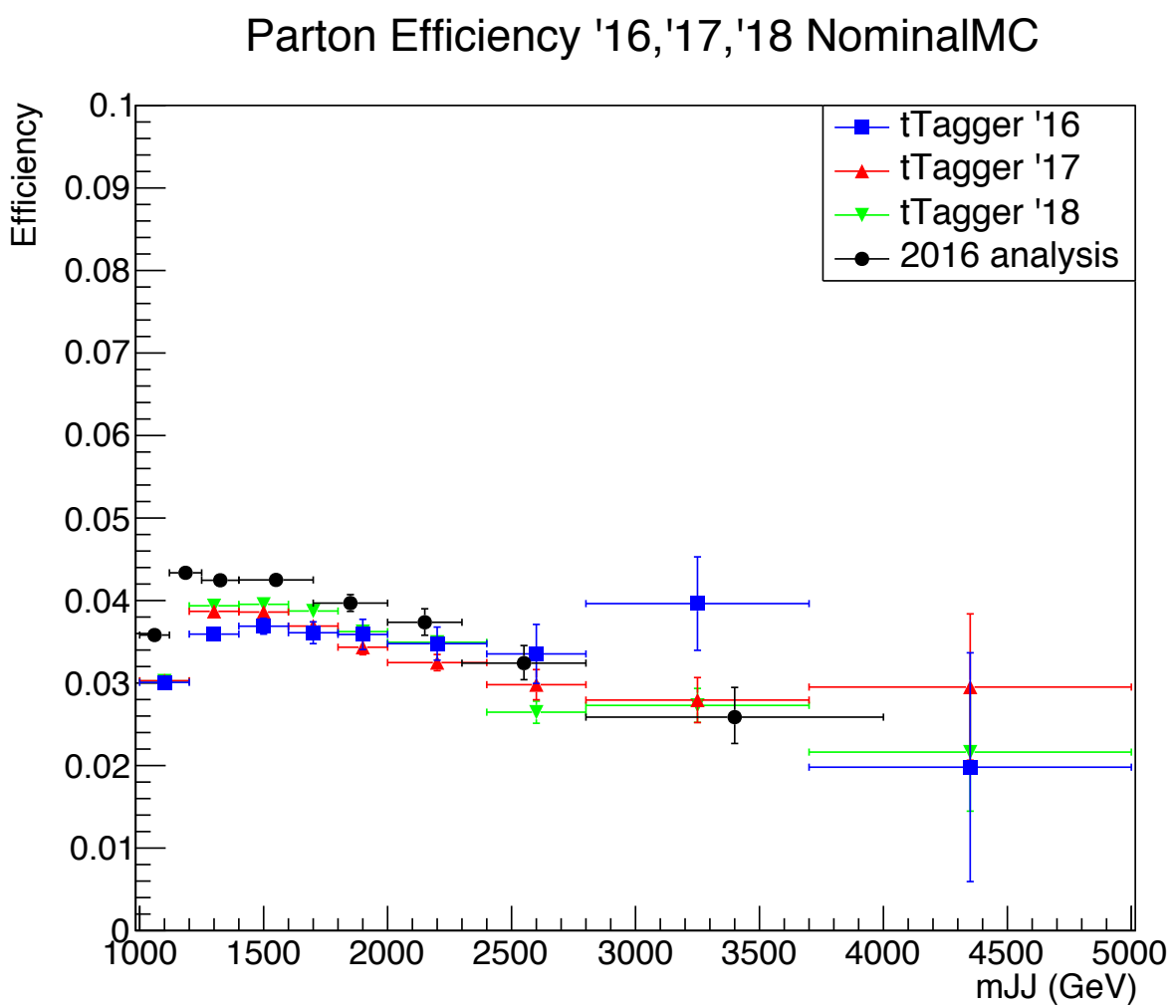
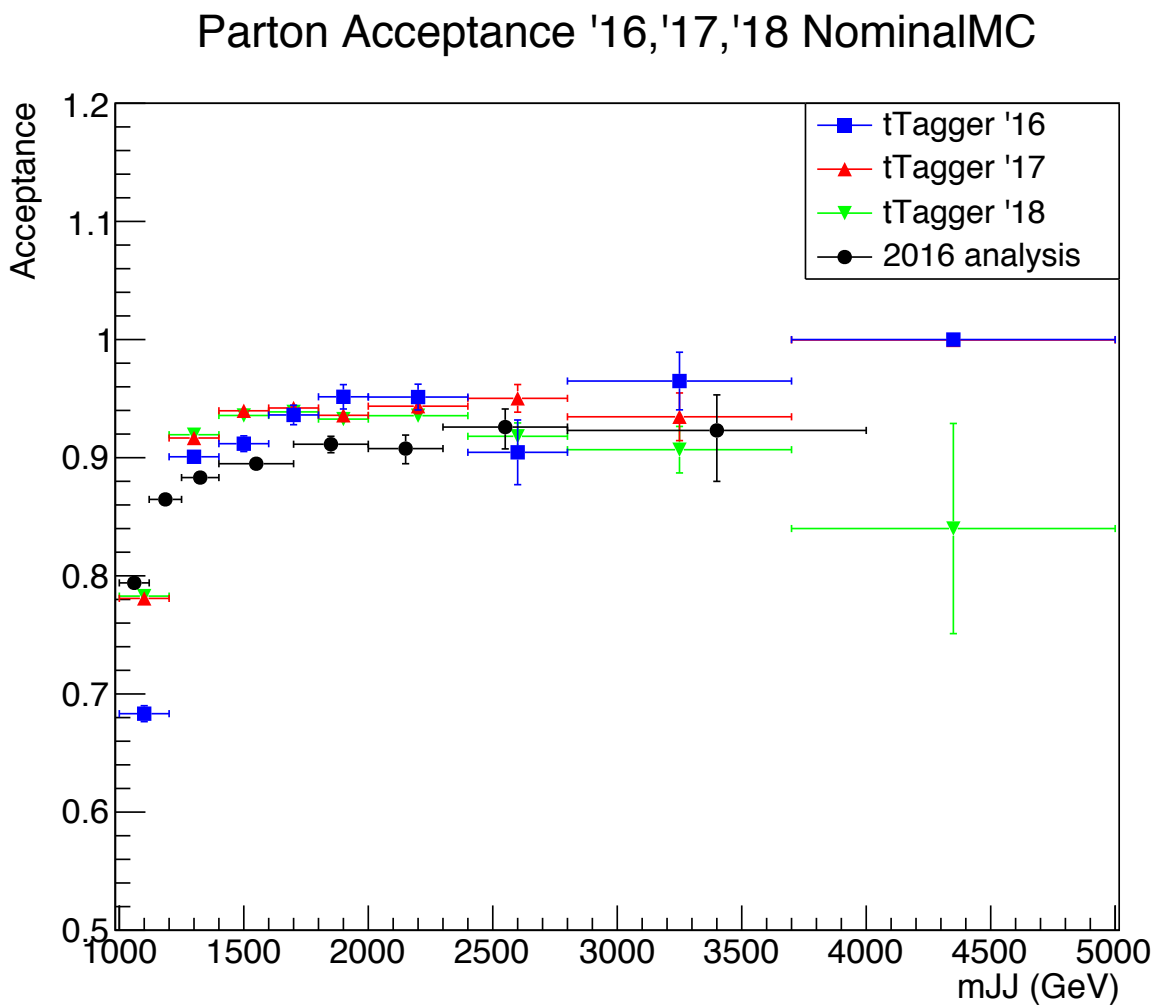


Efficiency and Acceptance Plots

b tagging SF's



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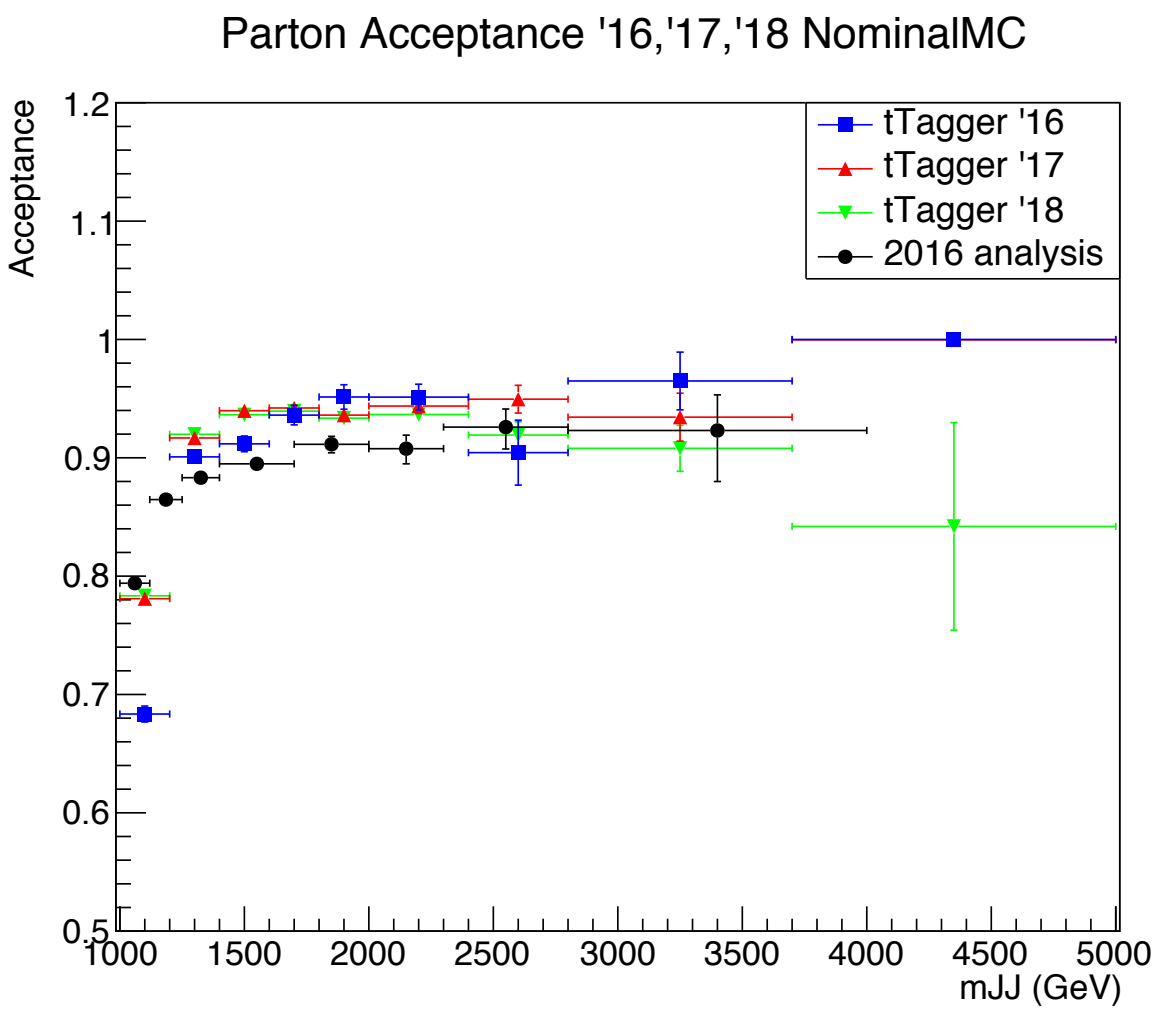
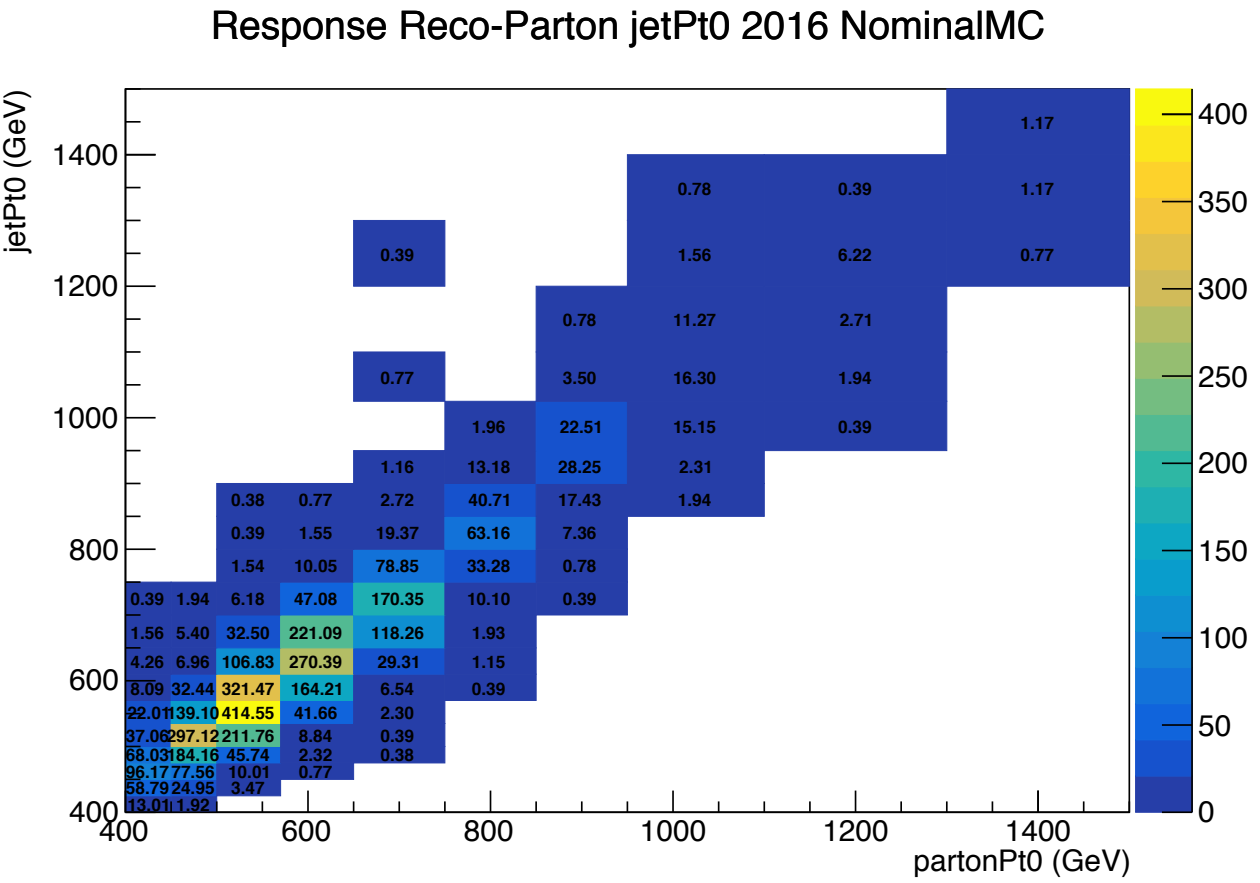
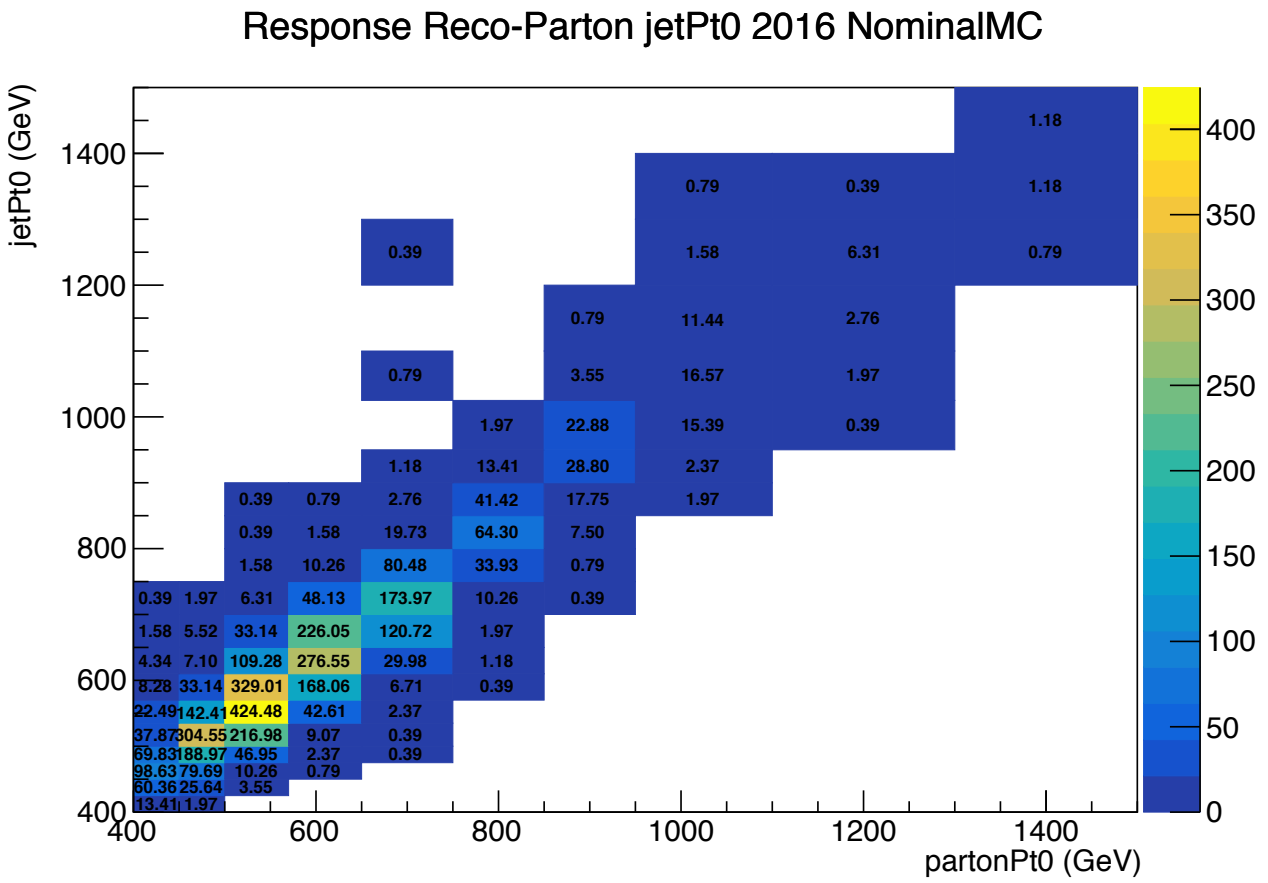


Response Matrices 2016

b tagging SF's

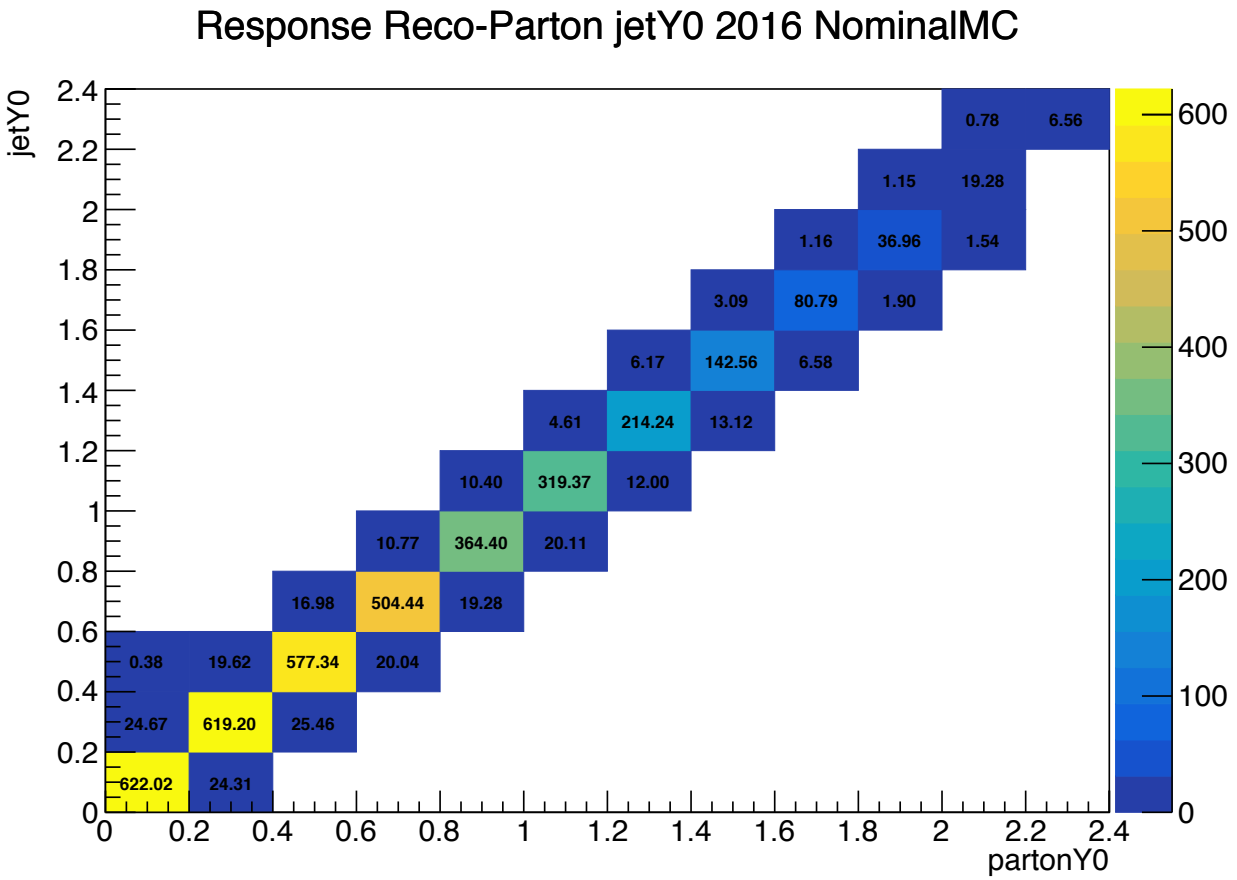


without b tagging SF's

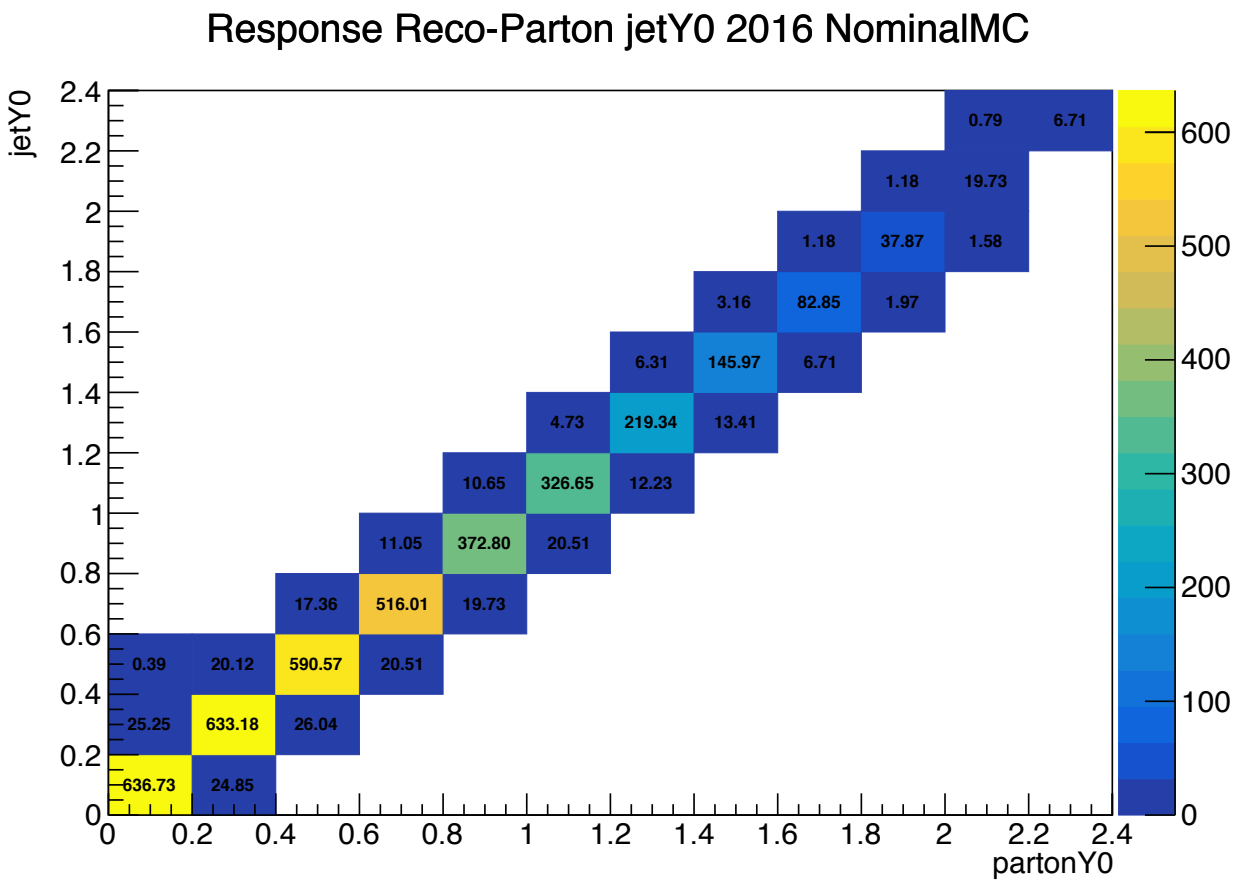


Response Matrices 2016

b tagging SF's

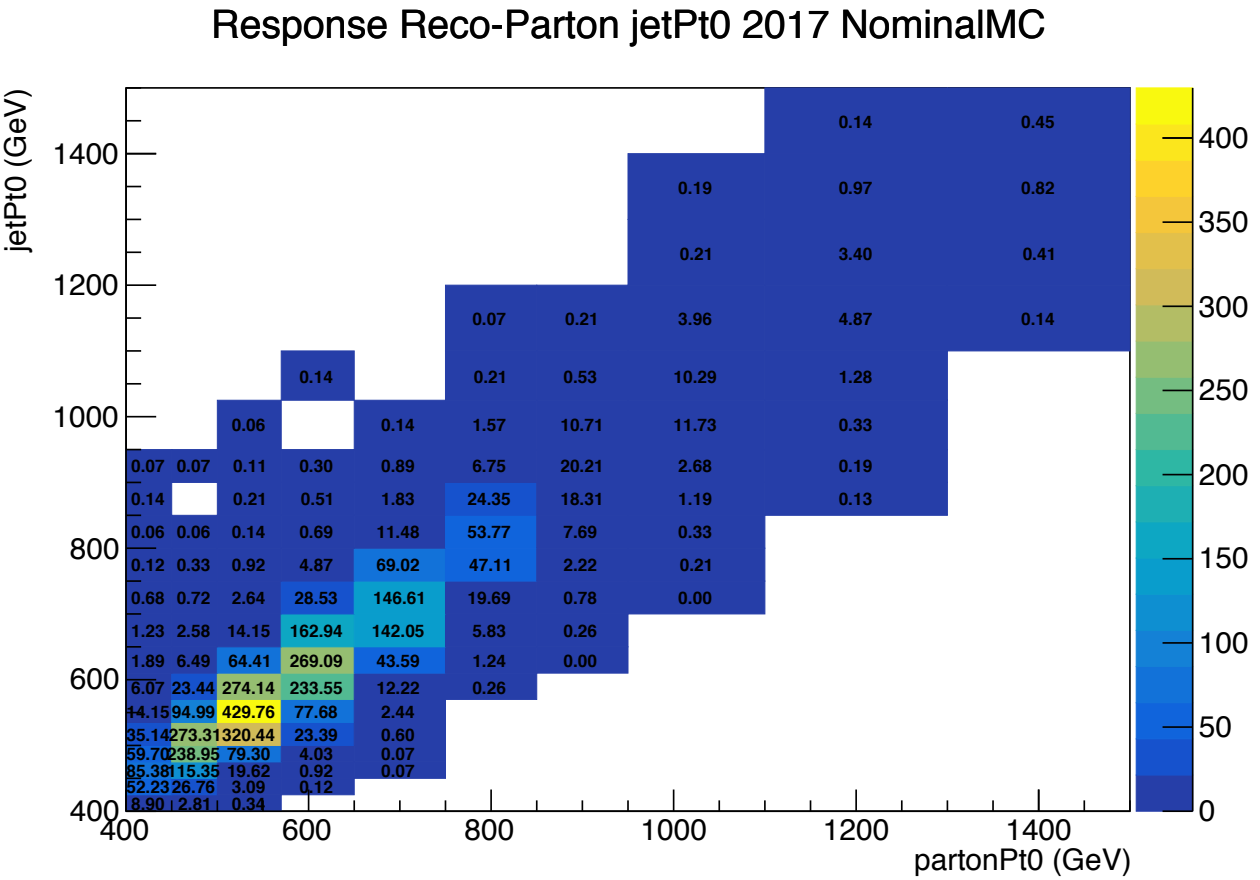


without b tagging SF's

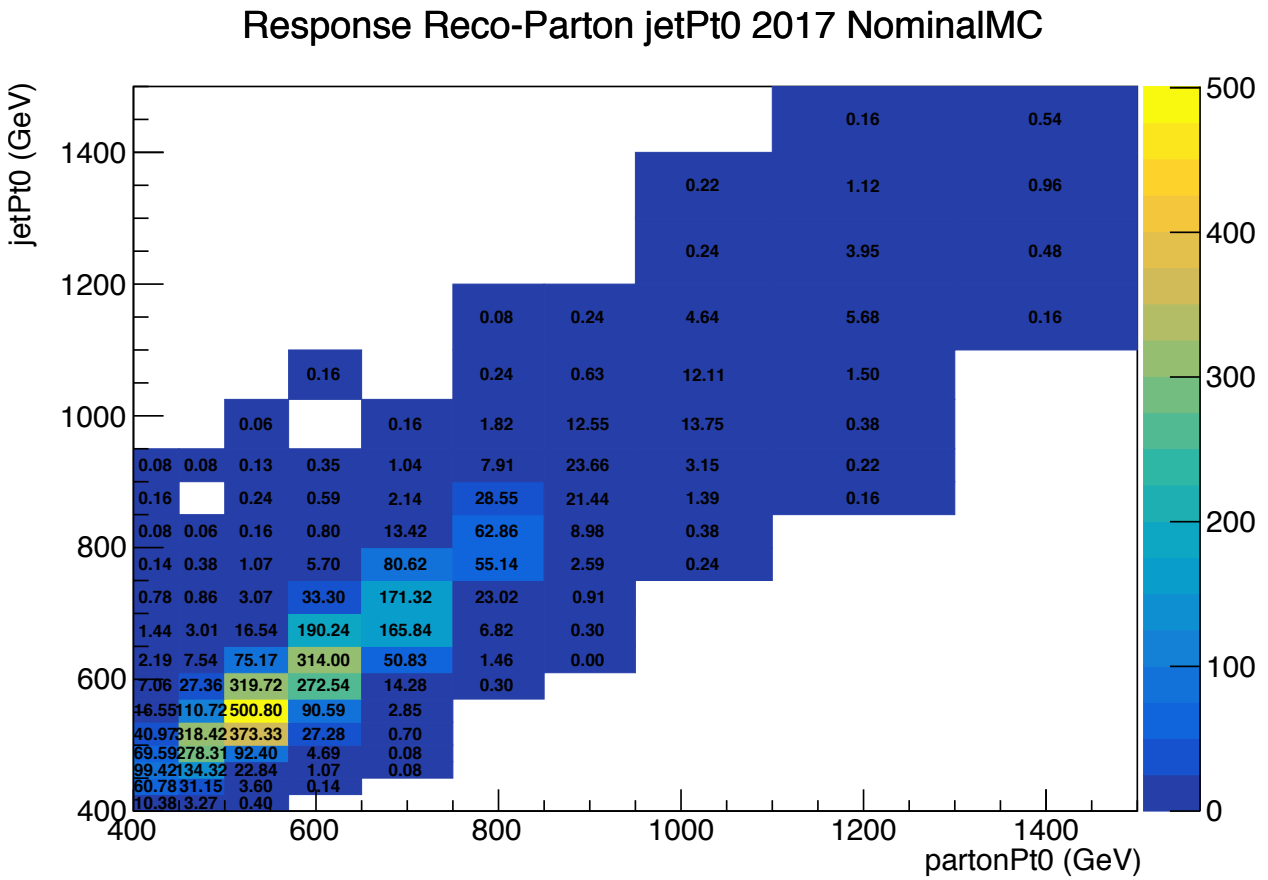


Response Matrices 2017

b tagging SF's



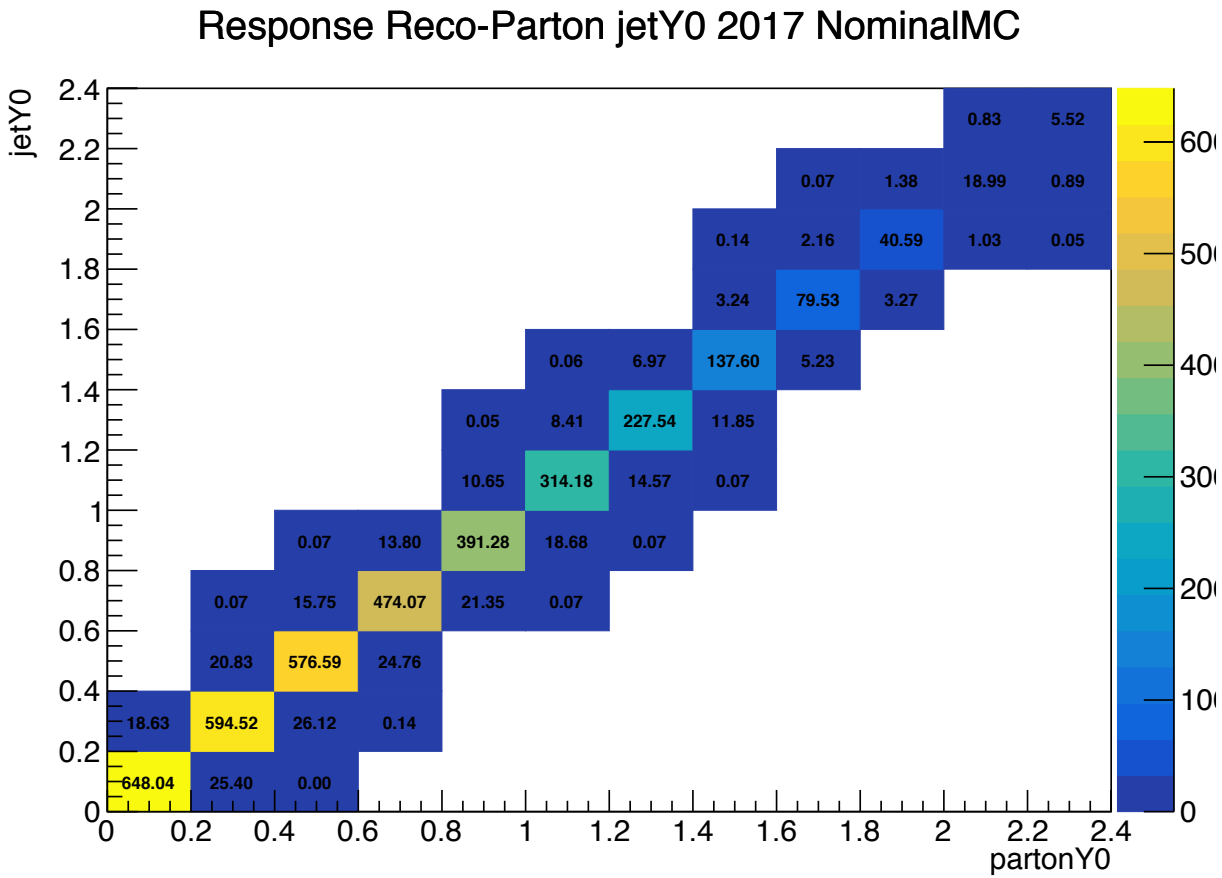
without b tagging SF's

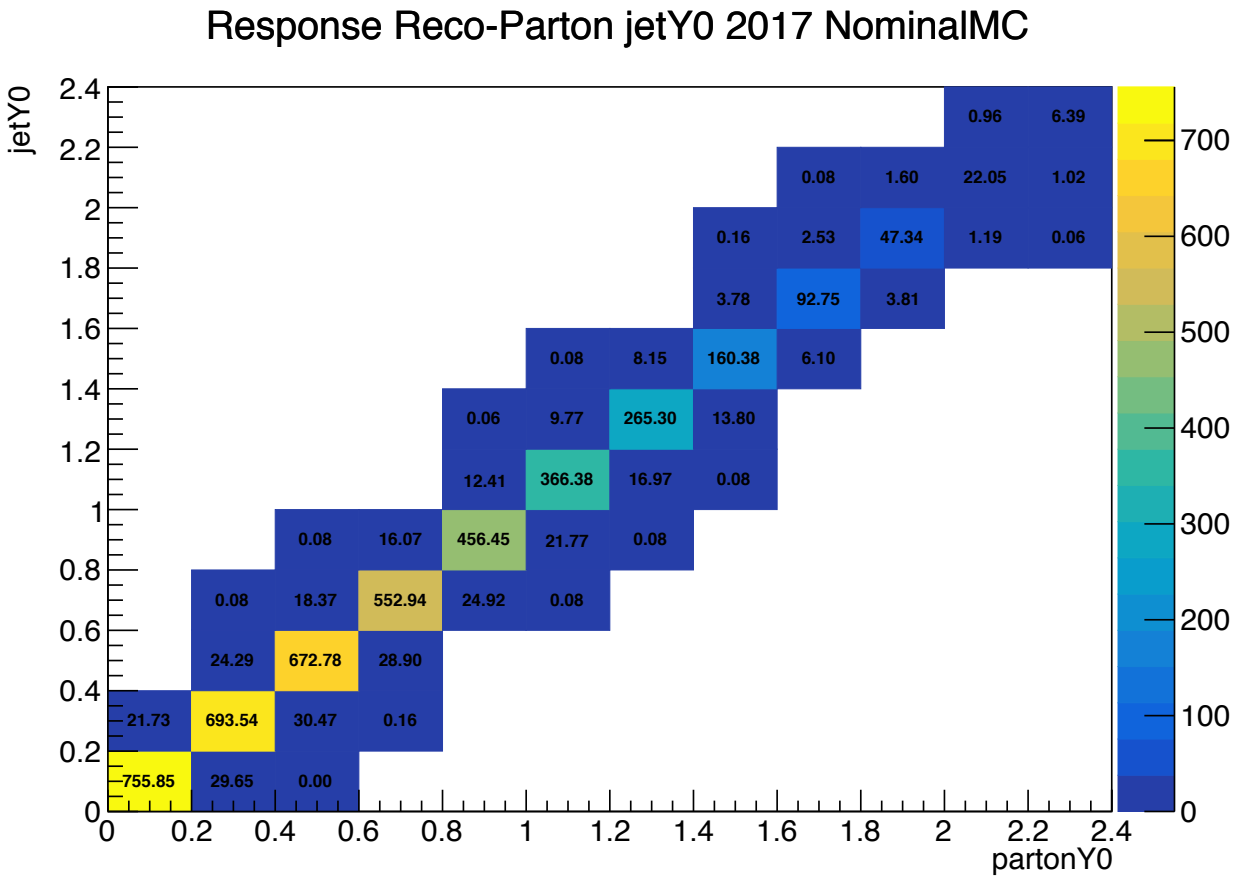


Response Matrices 2017

b tagging SF's

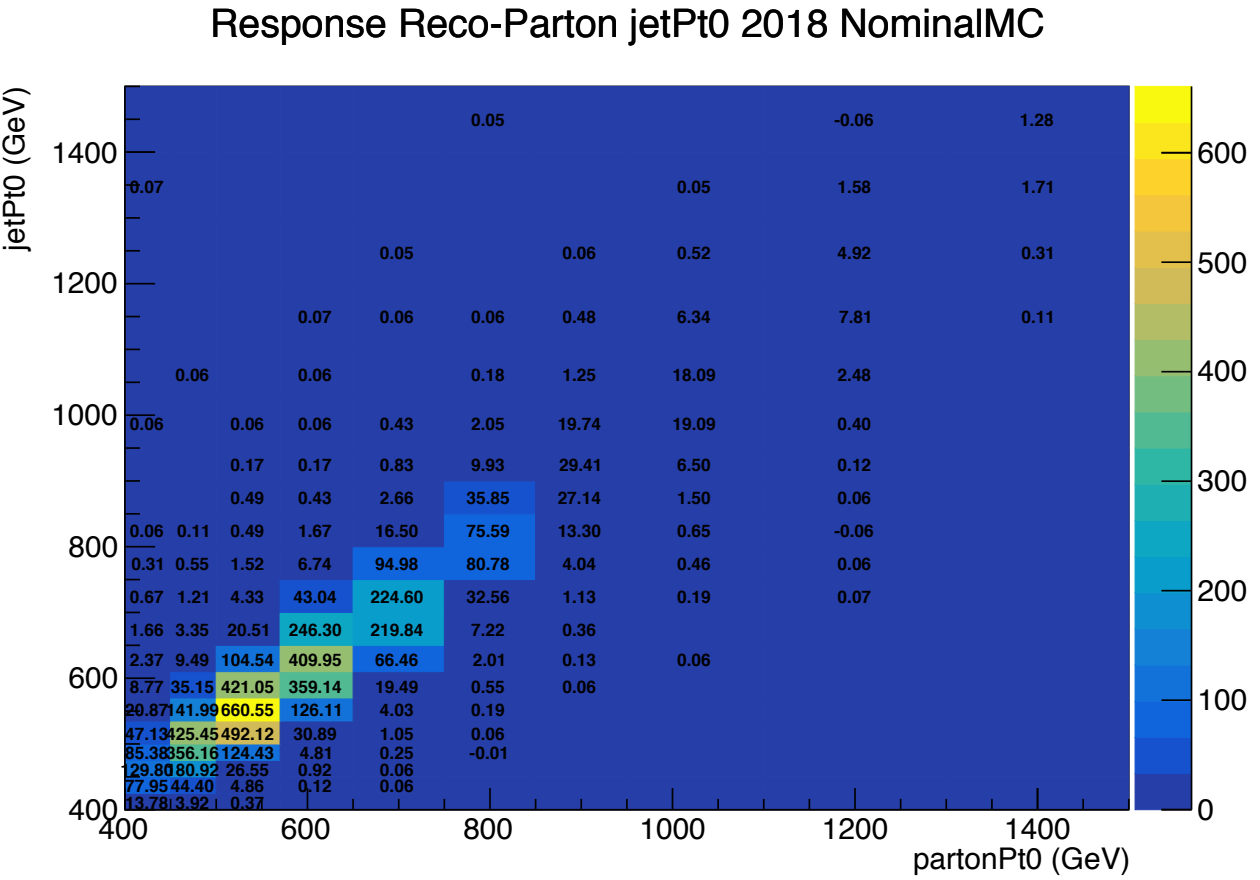
without b tagging SF's





Response Matrices 2018

b tagging SF's



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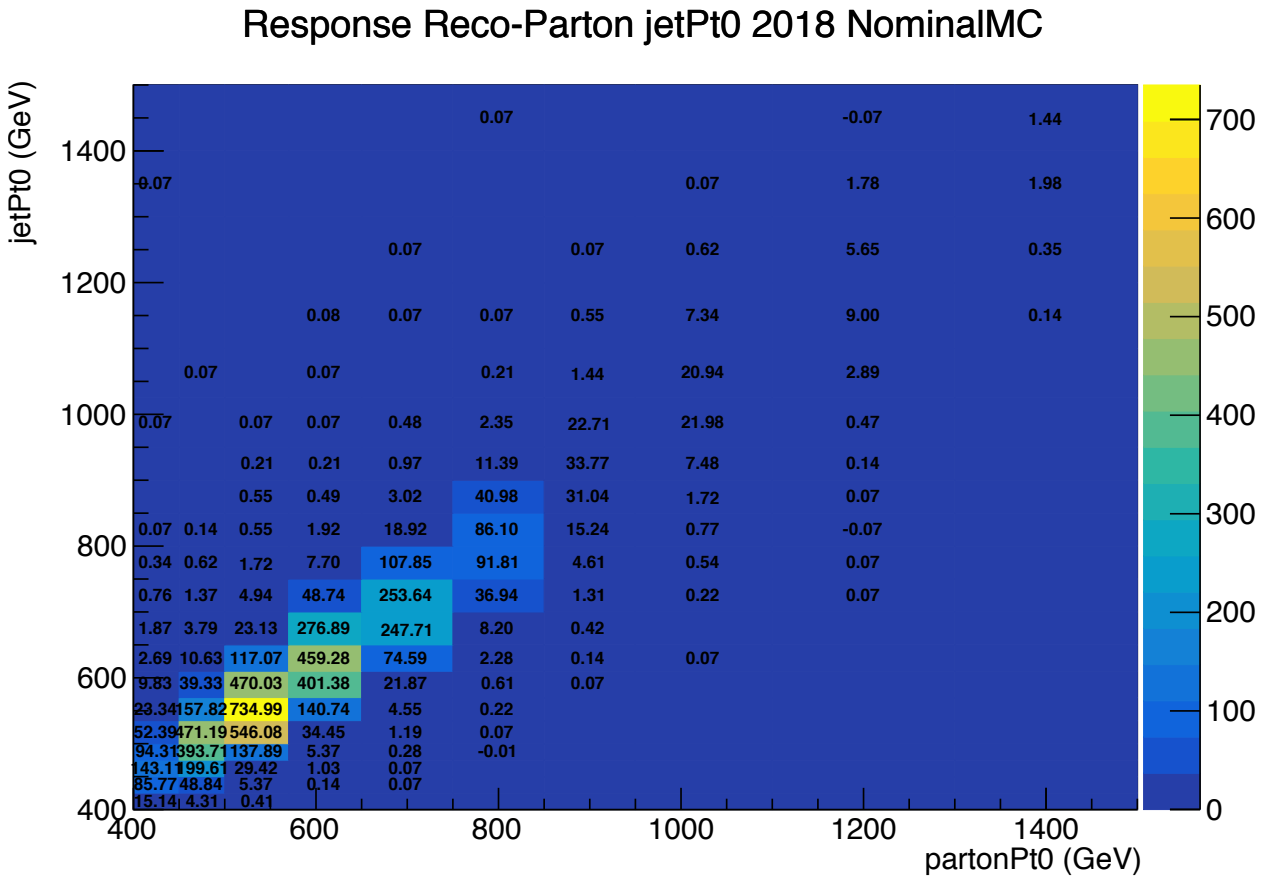
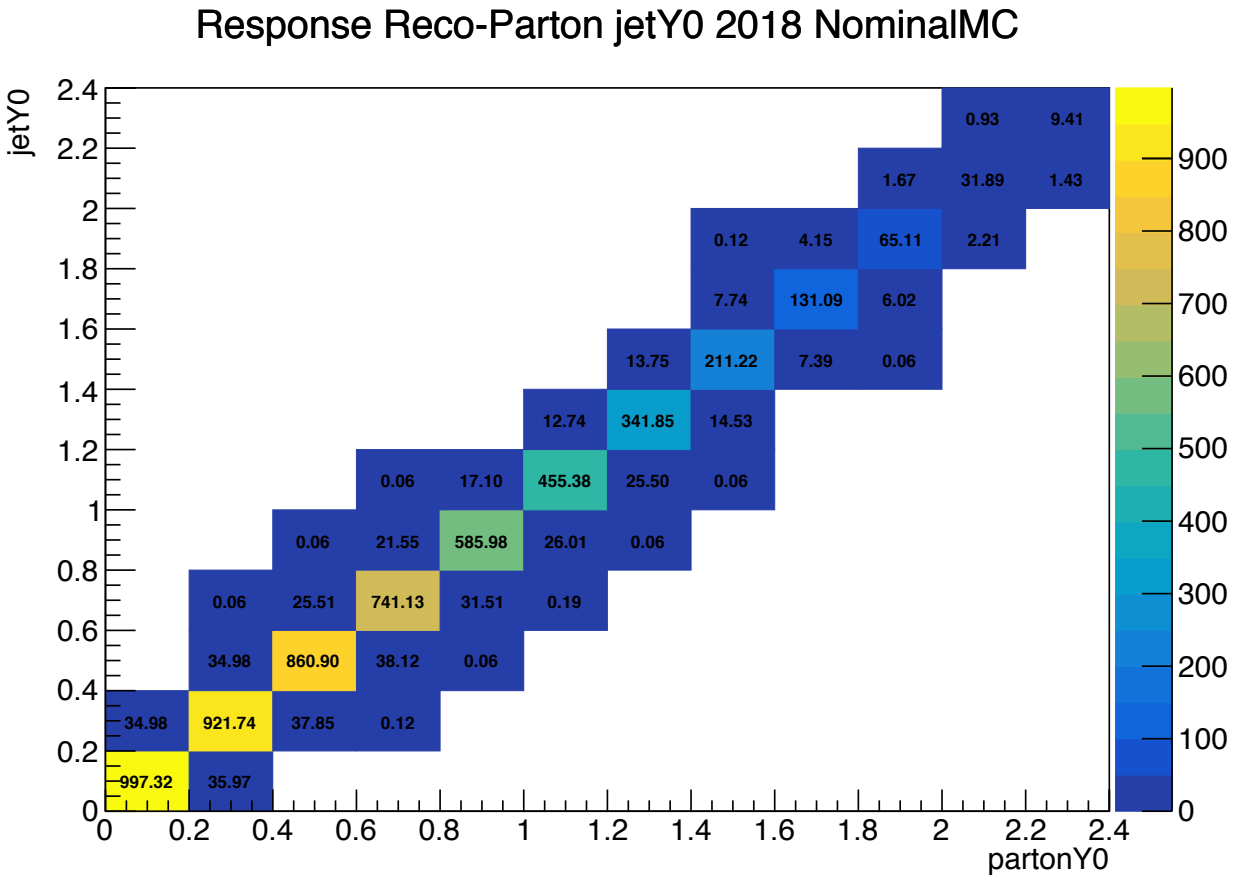


Response Matrices 2018

b tagging SF's



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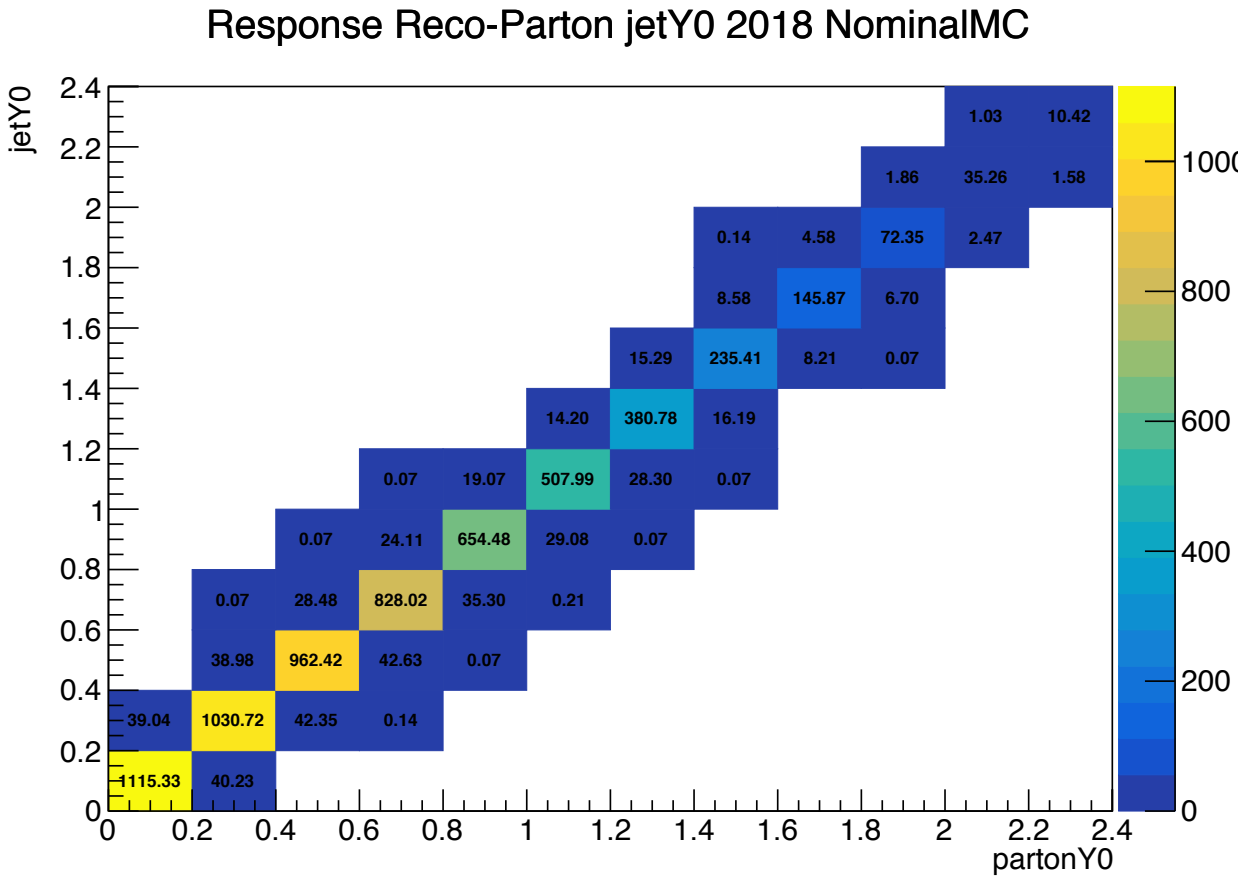
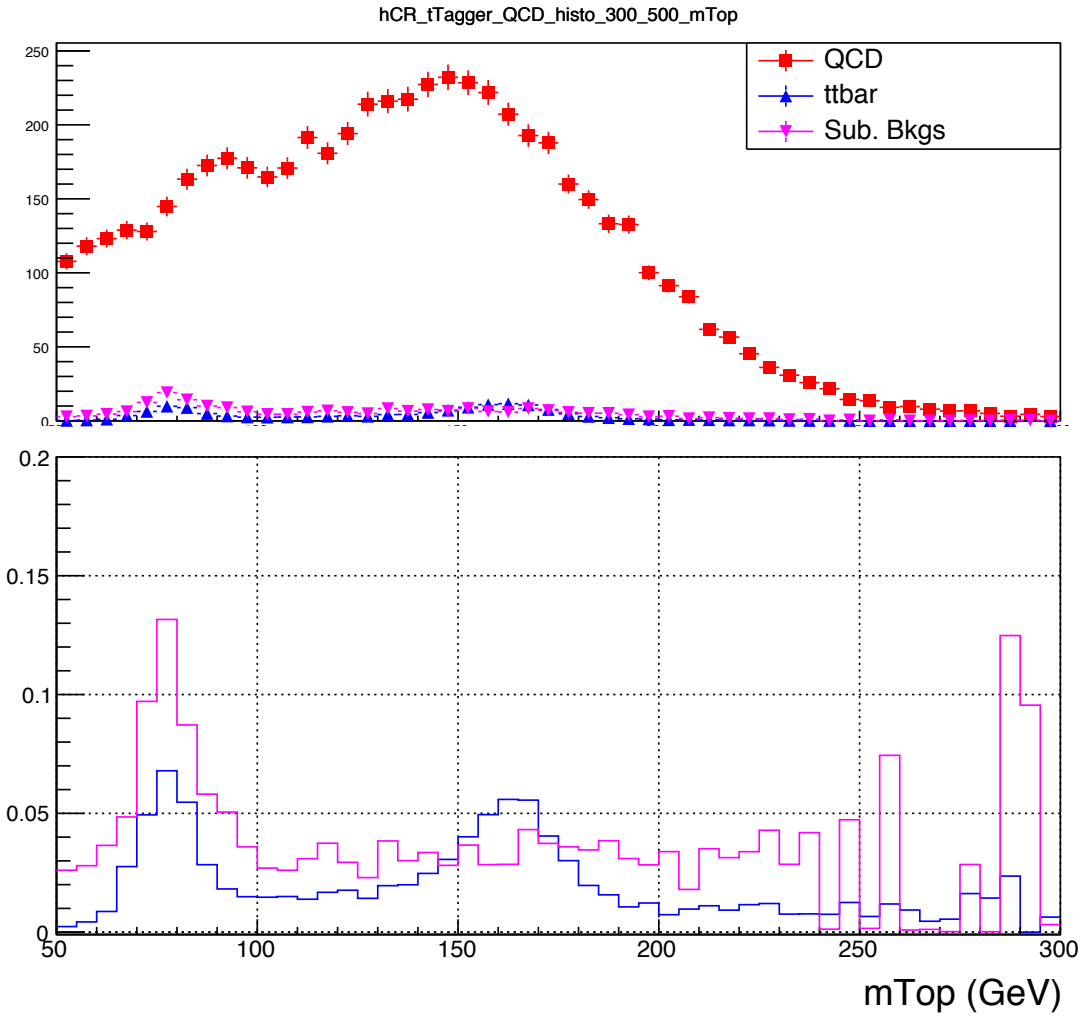


Contamination Plots Medium WP (CR) 2016

b tagging SF's



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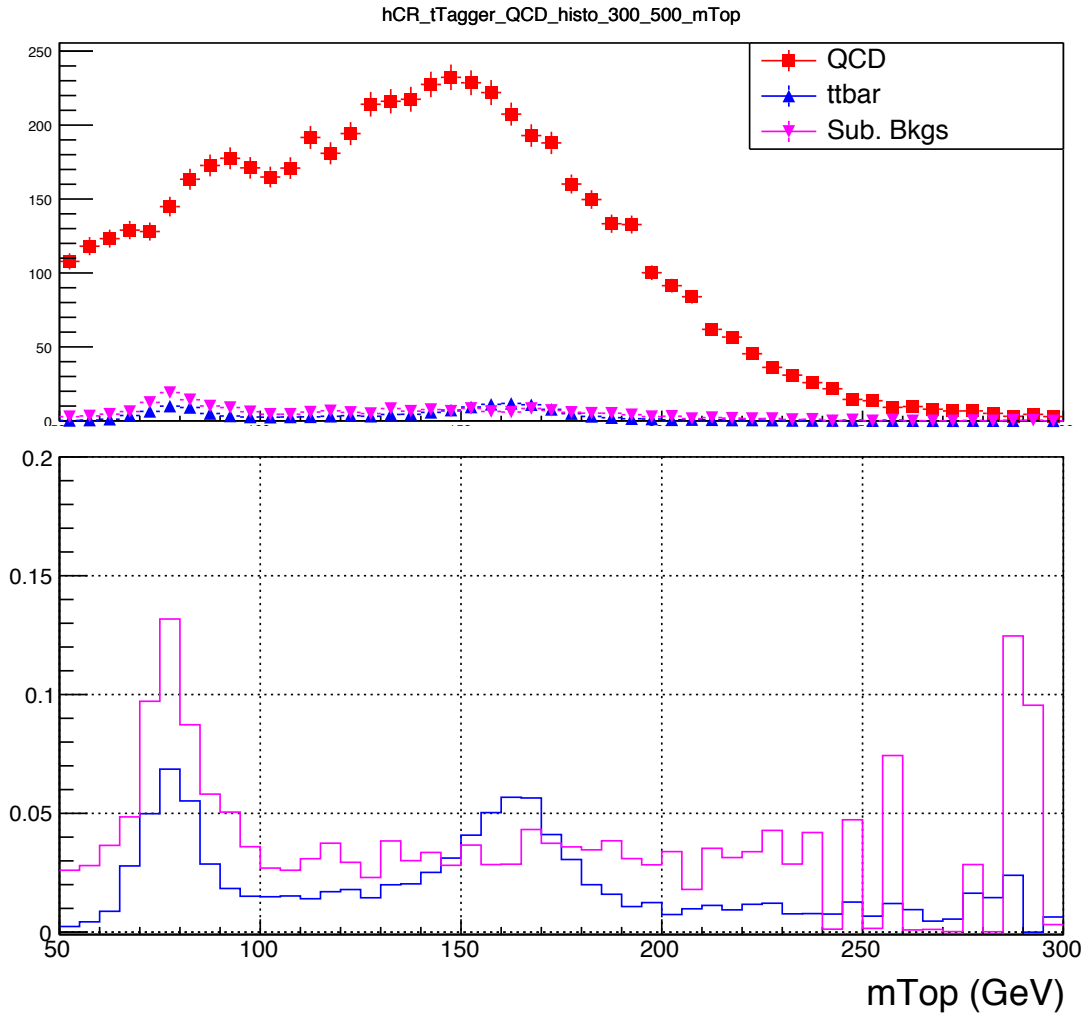
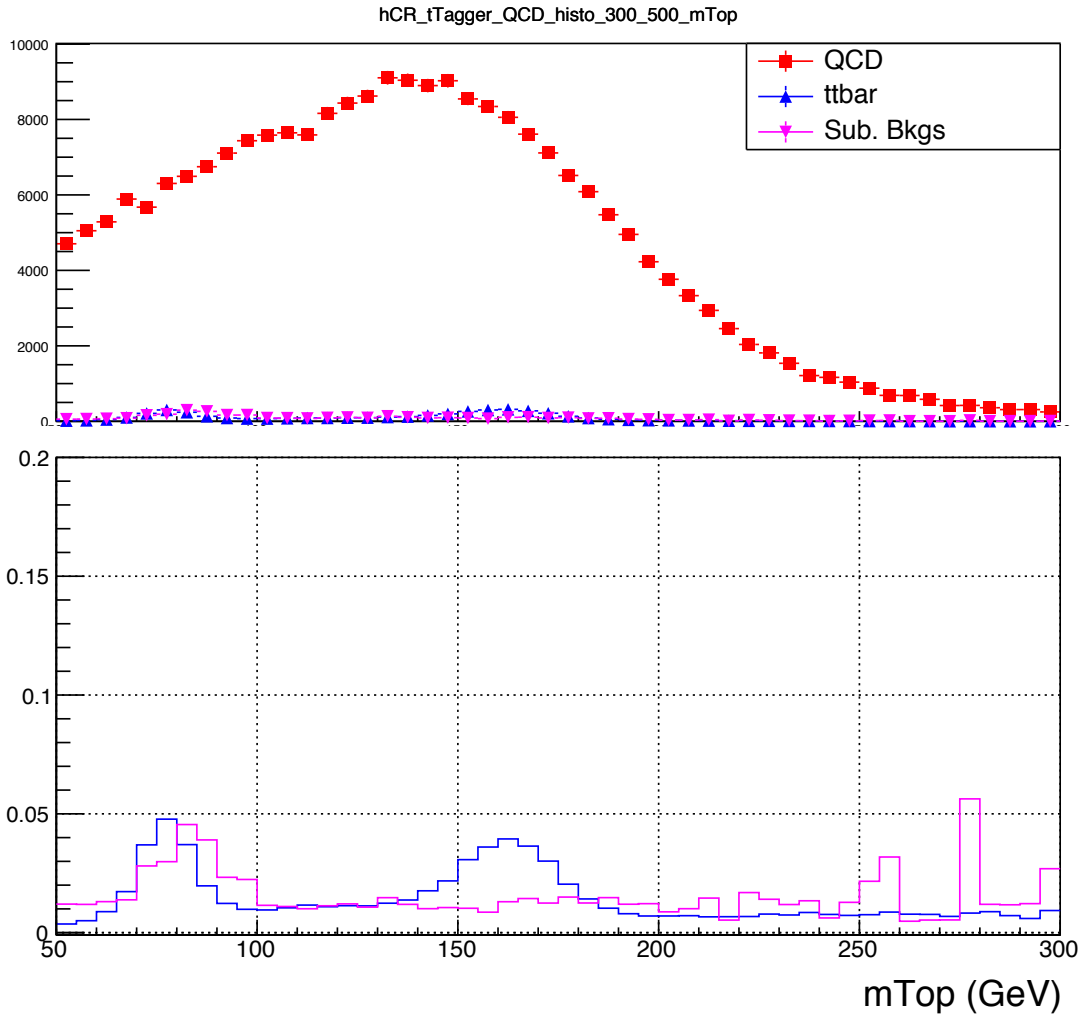
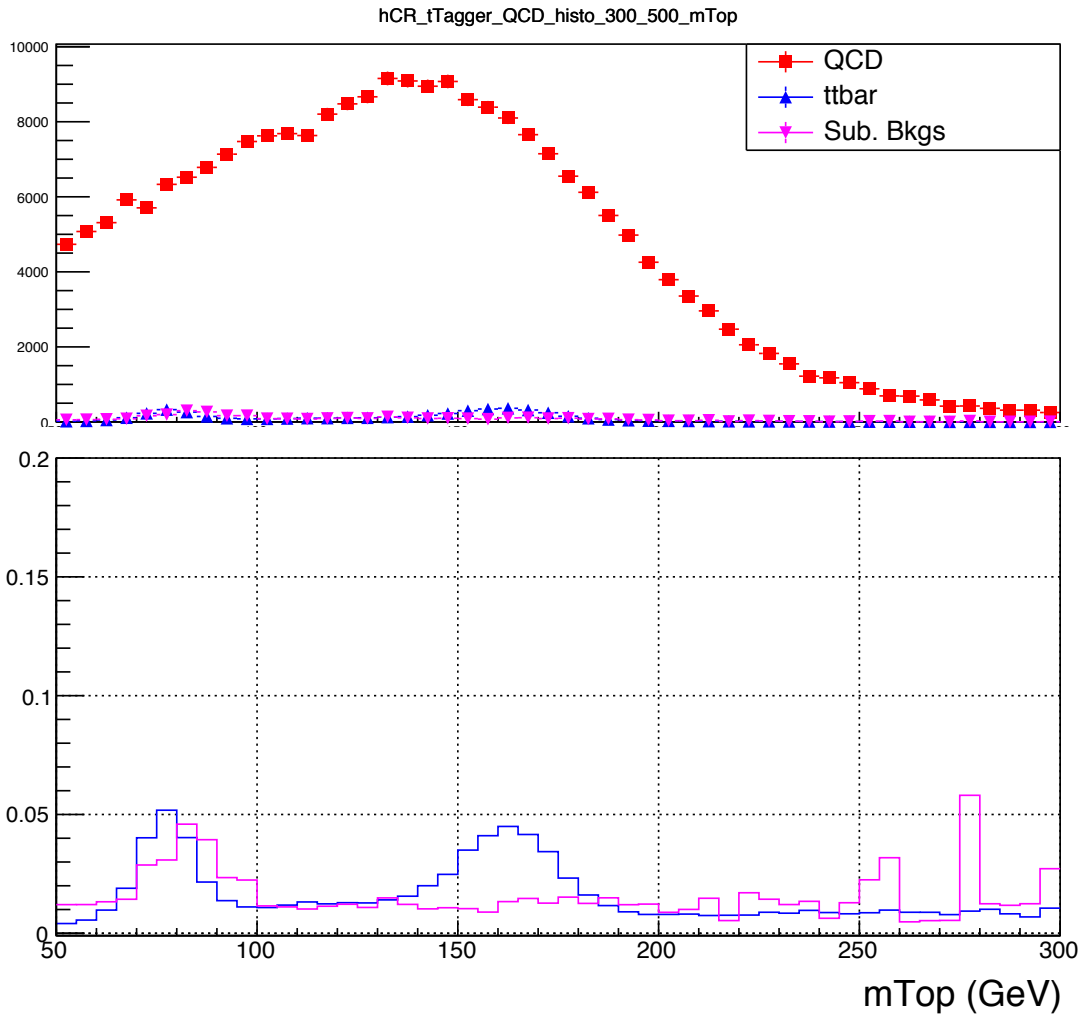


Contamination Plots Medium WP (CR) 2017

b tagging SF's

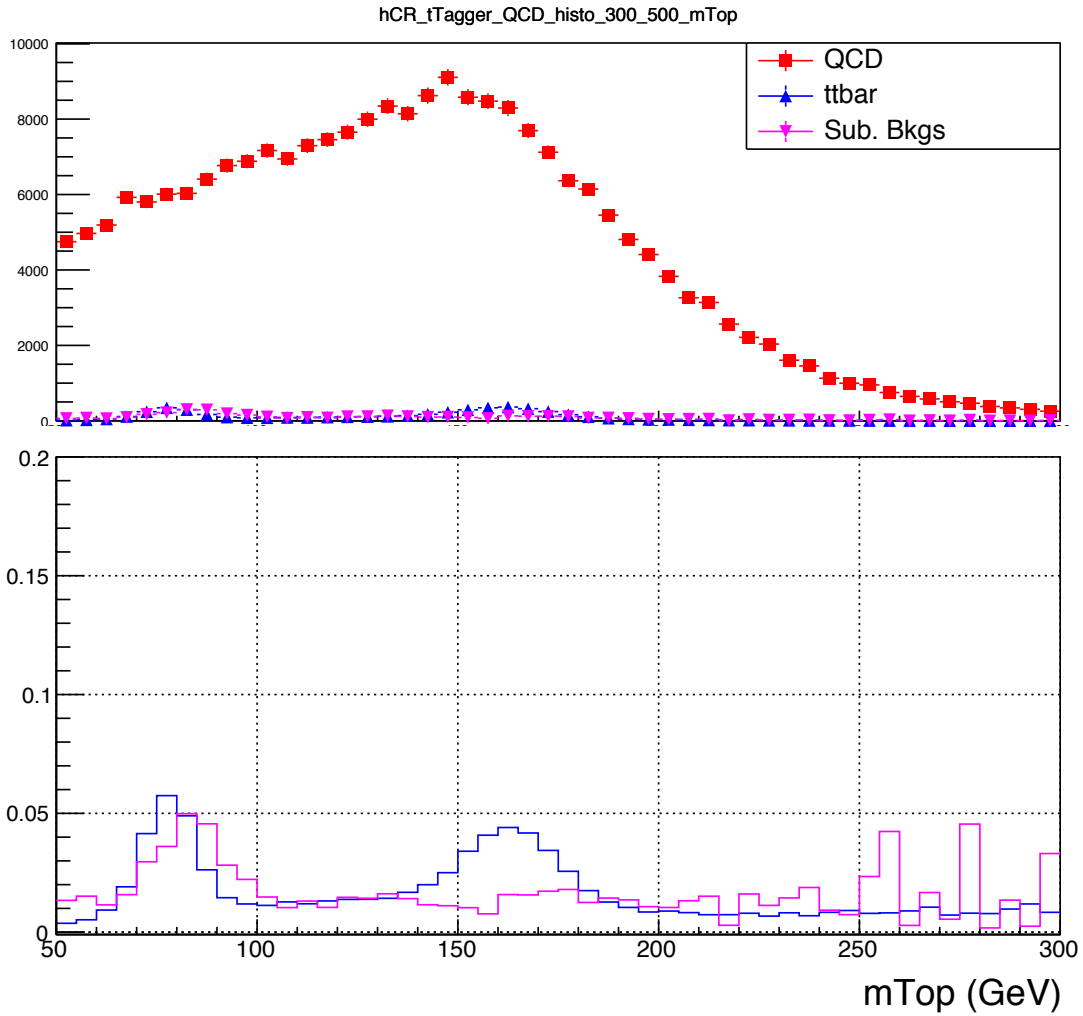


without b tagging SF's

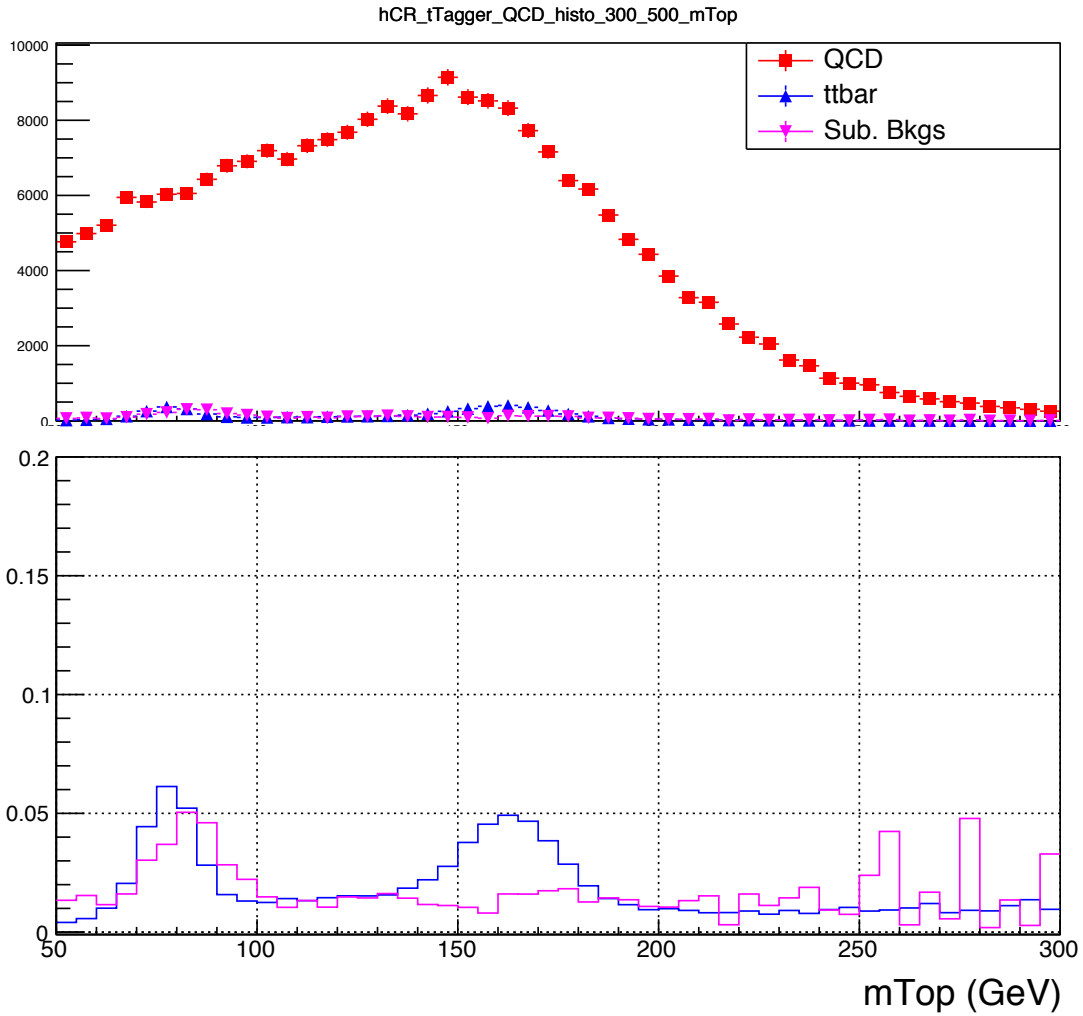


Contamination Plots Medium WP (CR) 2018

b tagging SF's



without b tagging SF's



Contamination Plots Medium WP (CR, SR) 2018

Comment

Shapes and in general contamination is NOT affected by btagging by Scale factors

Simple Mass Fit 2016

- Both SR and Control Region use the Medium btag WP.
- Intuition is to remove the ttbar and subdominant bkg contribution from the data Control Region

$$QCD_0(m^t) = D_0(m^t) - T_0(m^t) - Sub_0(m^t)$$

Without tag SF:

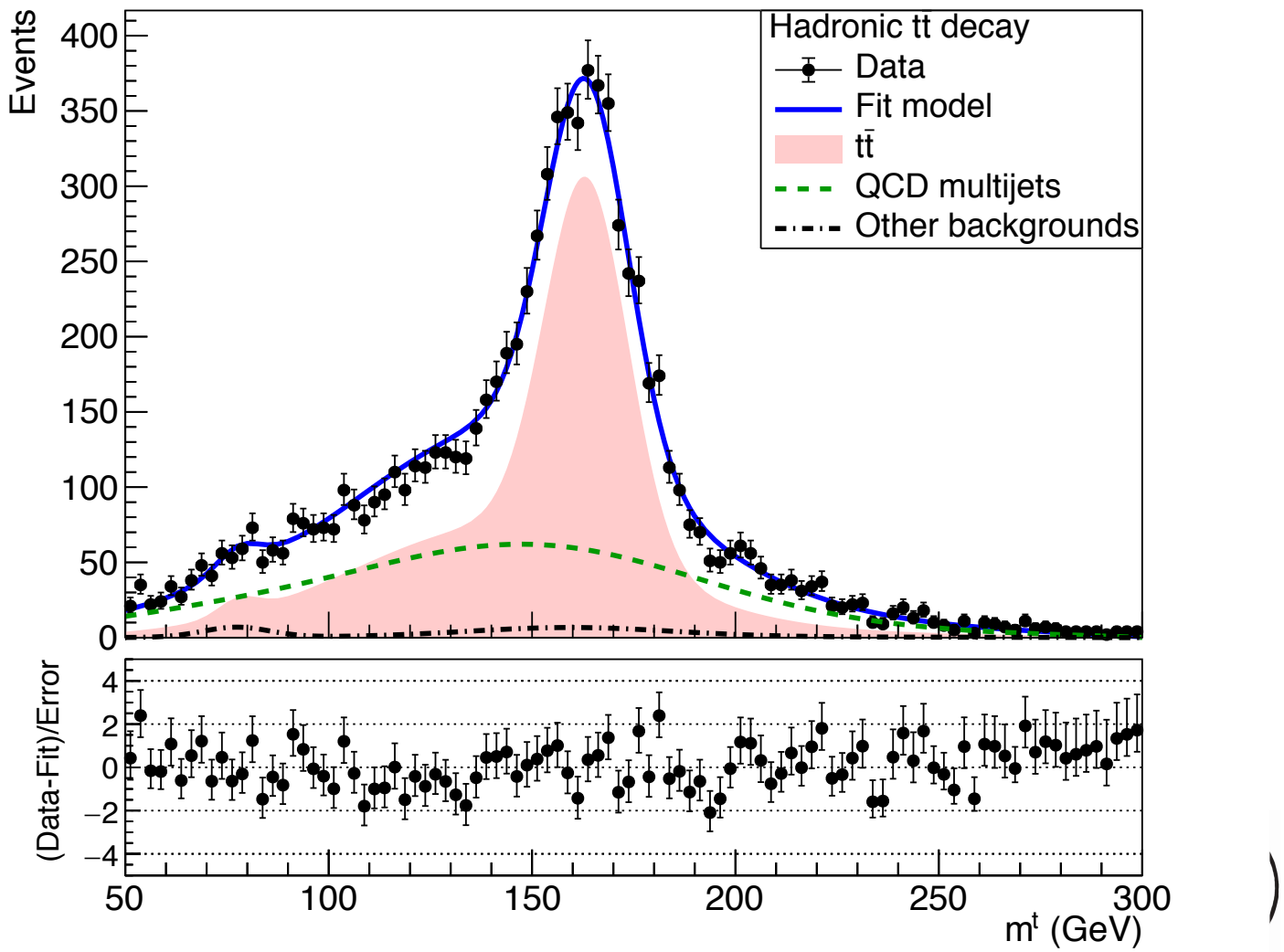
Floating Parameter	FinalValue +/- Error
kMassResol	9.2245e-01 +/- 2.72e-02
kMassScale	9.9906e-01 +/- 2.01e-03
kQCD_2b	6.8926e-02 +/- 5.06e-02
nFitBkg_2b	2.5236e+02 +/- 1.44e+02
nFitQCD_2b	2.9886e+03 +/- 1.73e+02
nFitSig2b	5.2694e+03 +/- 1.65e+02

Signal strength: r = 0.671244 ± 0.0252439 (old)

With b tag sf:

Floating Parameter	FinalValue +/- Error
kMassResol	9.2251e-01 +/- 2.73e-02
kMassScale	9.9891e-01 +/- 2.01e-03
kQCD_2b	6.9753e-02 +/- 5.26e-02
nFitBkg_2b	2.4472e+02 +/- 1.47e+02
nFitQCD_2b	2.9890e+03 +/- 1.74e+02
nFitSig2b	5.2763e+03 +/- 1.67e+02

Signal strength: r = 0.686668 ± 0.0263103



Simple Mass Fit 2017

Without b tag SF:

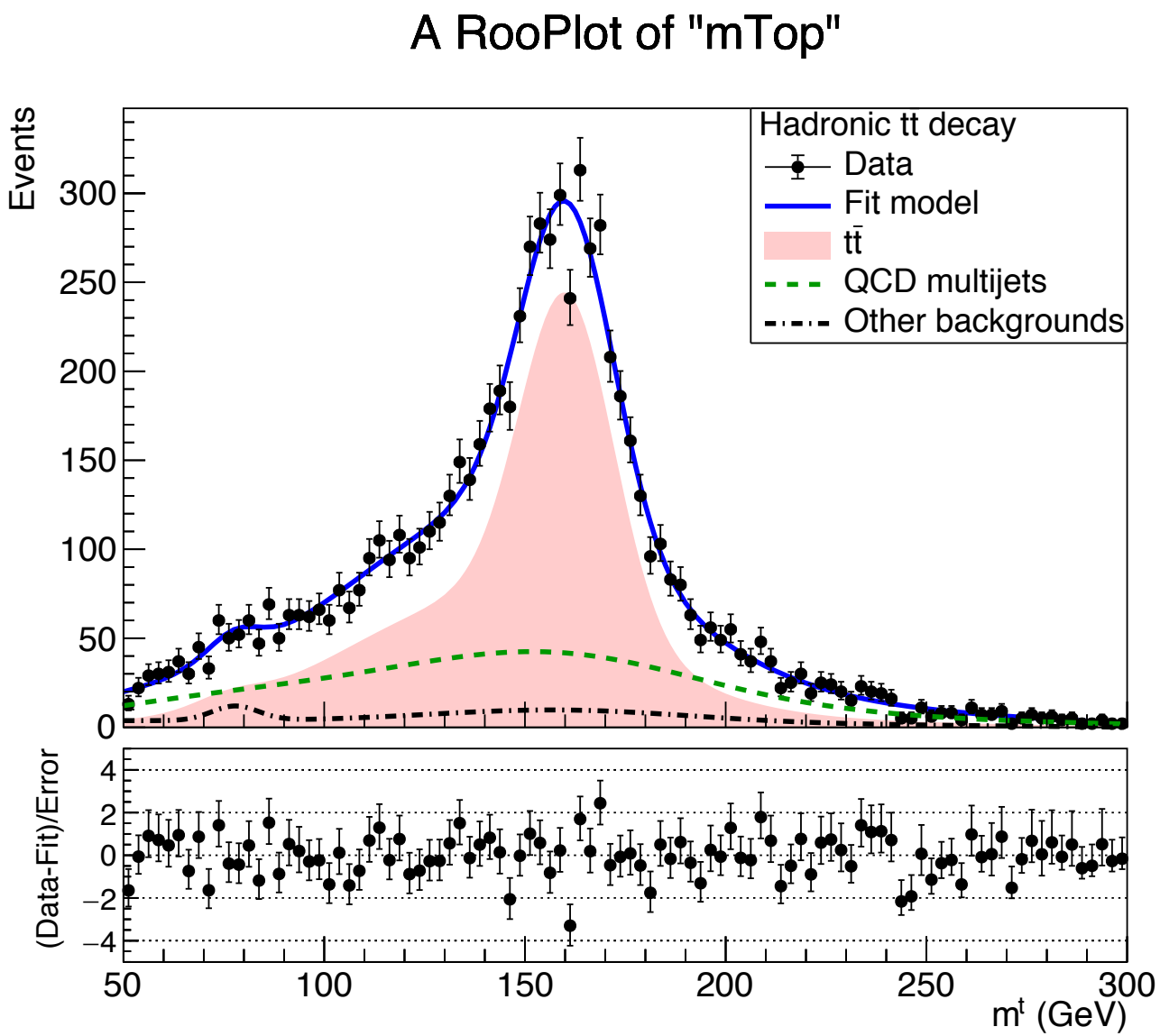
Floating Parameter	FinalValue +/- Error
kMassResol	1.0990e+00 +/- 4.05e-02
kMassScale	9.8328e-01 +/- 2.64e-03
kQCD_2b	1.6702e-02 +/- 7.79e-03
nFitBkg_2b	6.3994e+02 +/- 2.81e+02
nFitQCD_2b	2.0219e+03 +/- 3.23e+02
nFitSig2b	4.8080e+03 +/- 1.51e+02

Signal strength: r = 0.553099 ± 0.0198563 (old)

With b tag SF:

Floating Parameter	FinalValue +/- Error
kMassResol	1.0998e+00 +/- 4.02e-02
kMassScale	9.8340e-01 +/- 2.66e-03
kQCD_2b	1.6593e-02 +/- 7.44e-03
nFitBkg_2b	4.9791e+02 +/- 2.68e+02
nFitQCD_2b	2.1662e+03 +/- 3.11e+02
nFitSig2b	4.8059e+03 +/- 1.50e+02

Signal strength: r = 0.644361 ± 0.023851 (new)



Simple Mass Fit 2018

Without b tag SF:

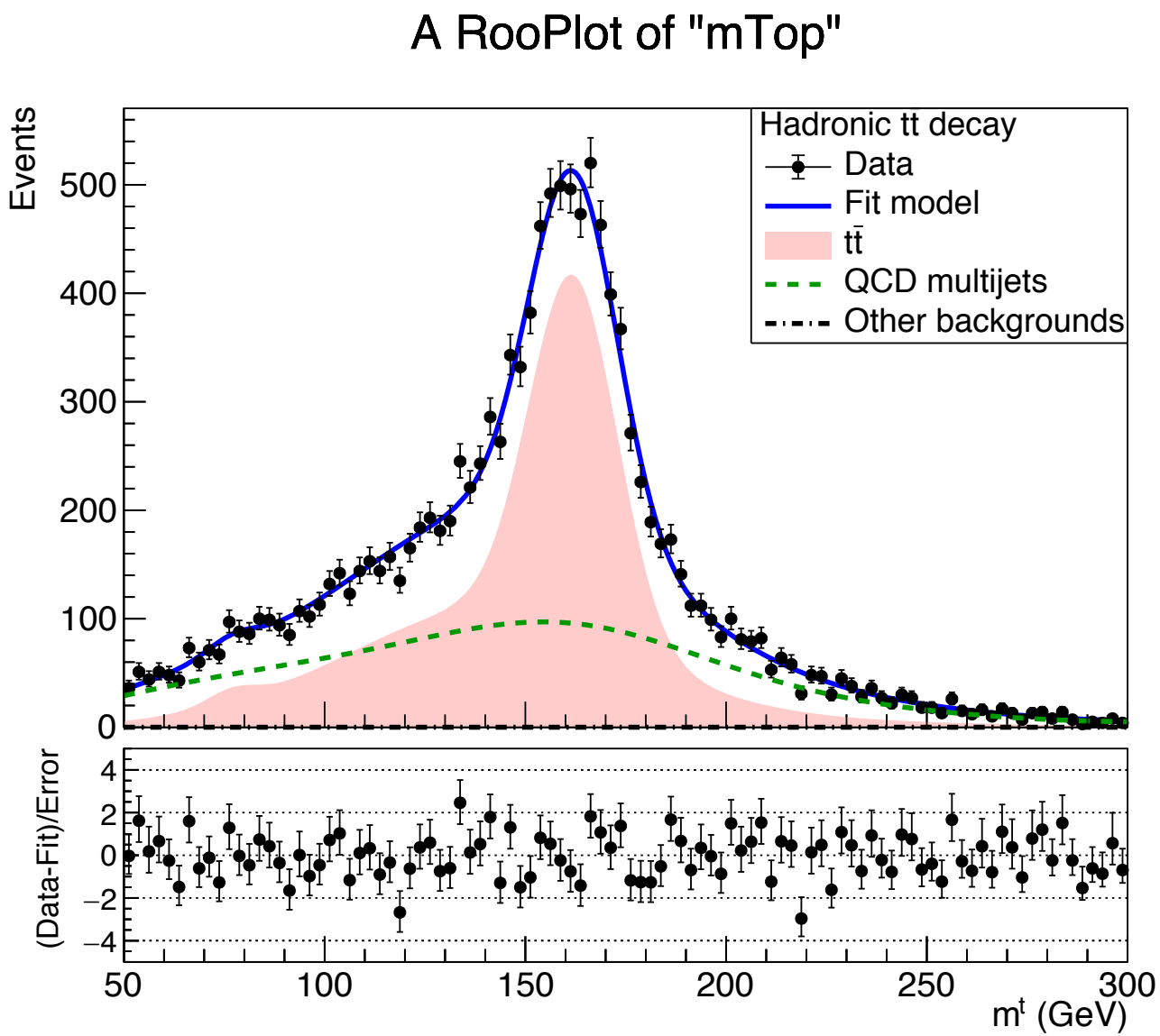
Floating Parameter	FinalValue +/- Error
kMassResol	1.0171e+00 +/- 2.87e-02
kMassScale	9.8961e-01 +/- 1.92e-03
kQCD_2b	1.3178e-02 +/- 3.01e-03
nFitBkg_2b	3.0164e+02 +/- 2.73e+02
nFitQCD_2b	4.7747e+03 +/- 3.04e+02
nFitSig2b	7.7140e+03 +/- 1.85e+02

Signal strength: r = 0.615816 ± 0.017298 (old)

With b tag SF:

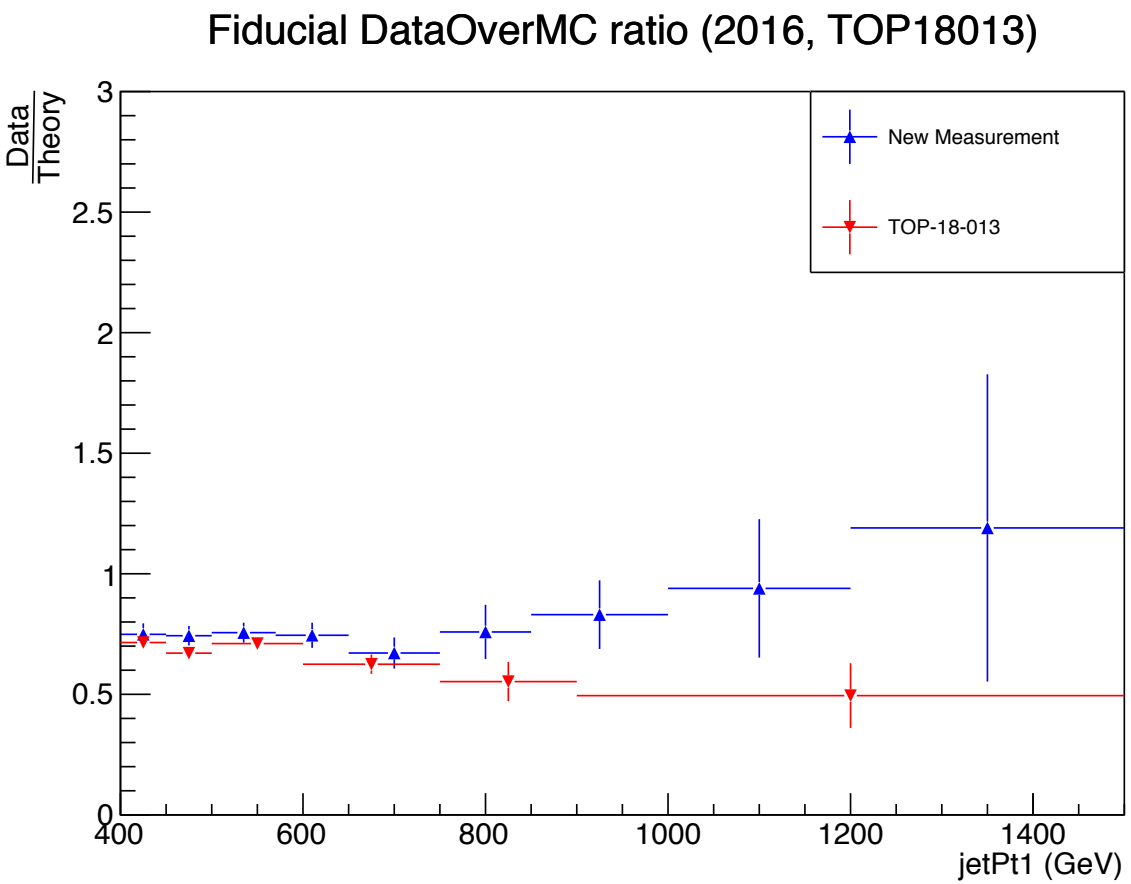
Floating Parameter	FinalValue +/- Error
kMassResol	1.0156e+00 +/- 2.79e-02
kMassScale	9.8998e-01 +/- 1.92e-03
kQCD_2b	1.2365e-02 +/- 2.50e-03
nFitBkg_2b	1.6612e+00 +/- 6.55e+03
nFitQCD_2b	5.0843e+03 +/- 1.80e+02
nFitSig2b	7.7041e+03 +/- 1.80e+02

Signal strength: r = 0.687217 ± 0.0194349

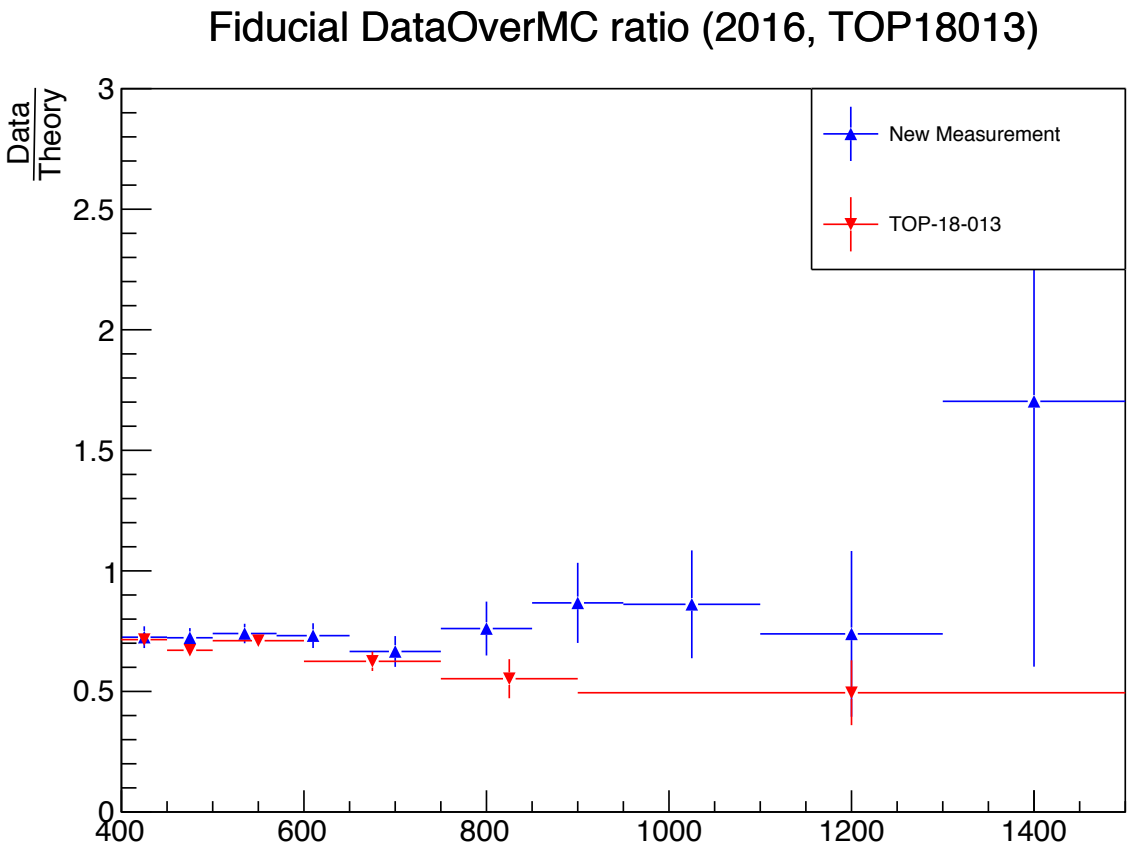


Signal Extraction 2016

b tagging SF's

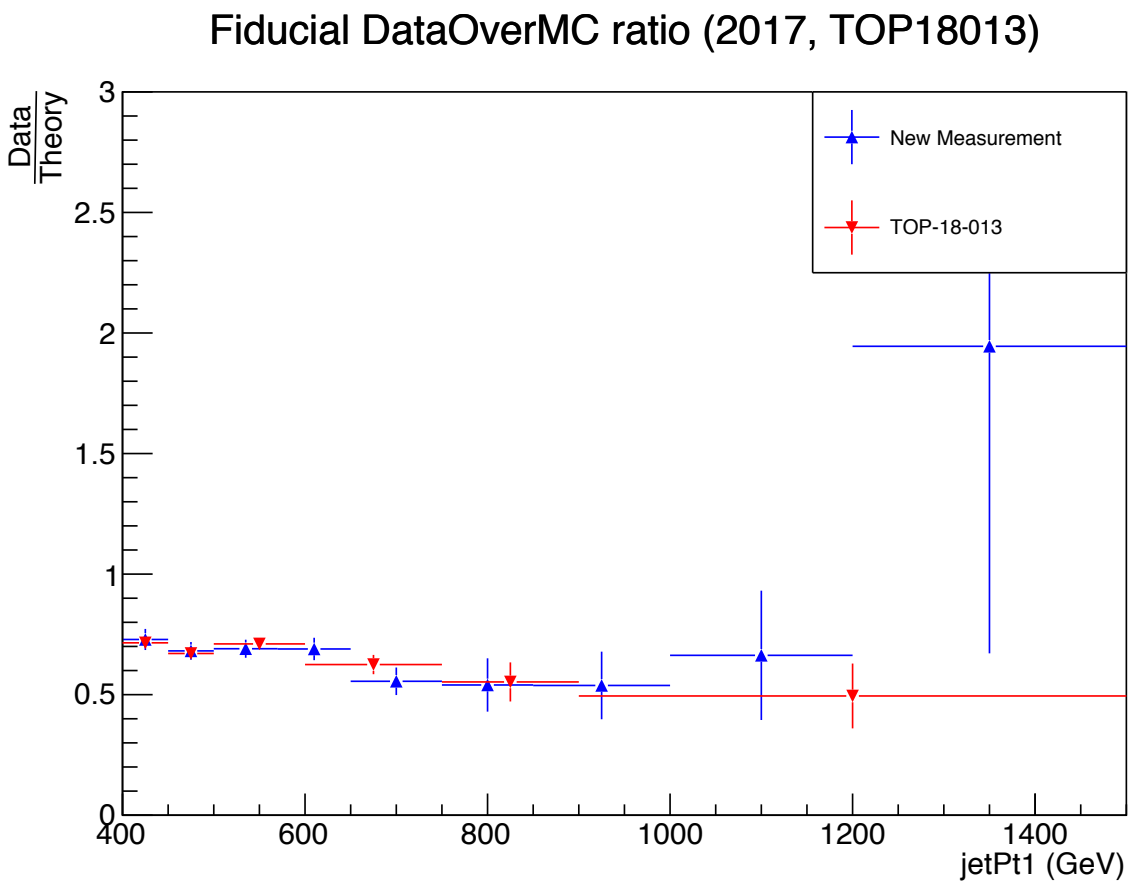


without b tagging SF's

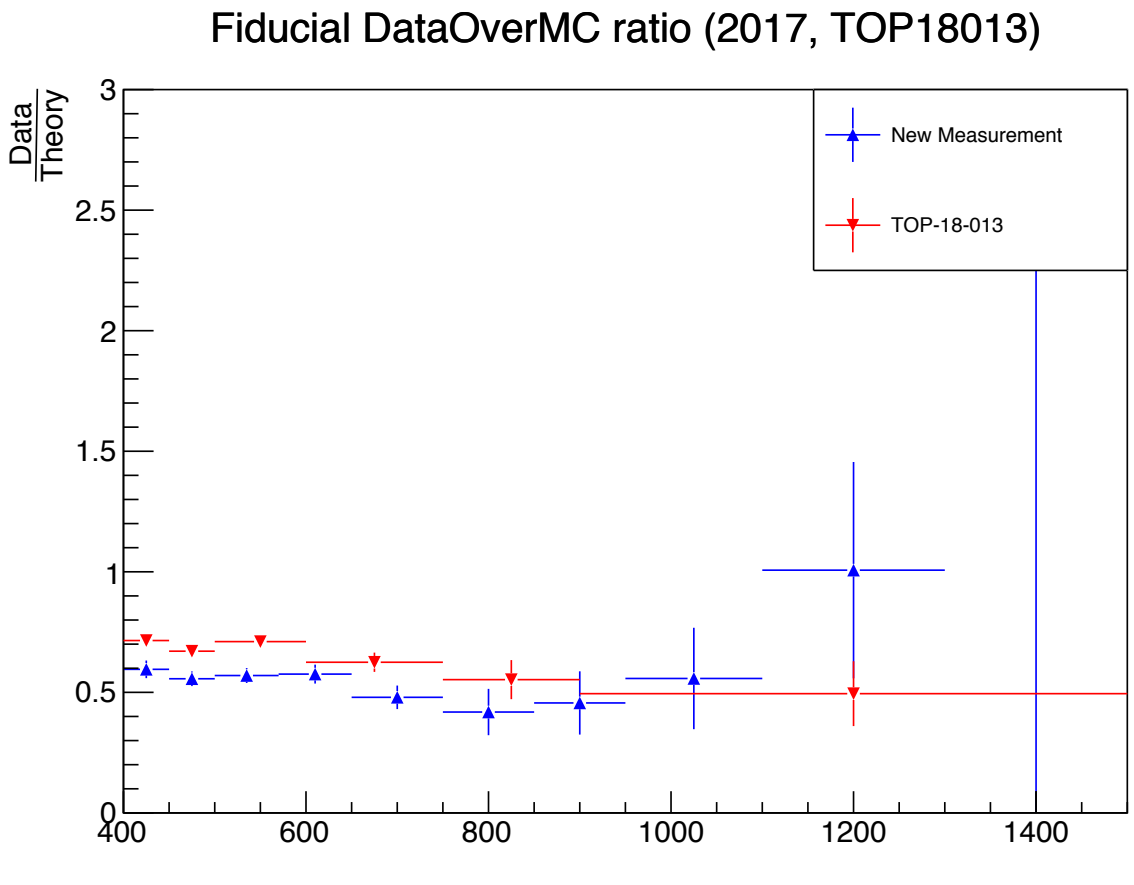


Signal Extraction 2017

b tagging SF's

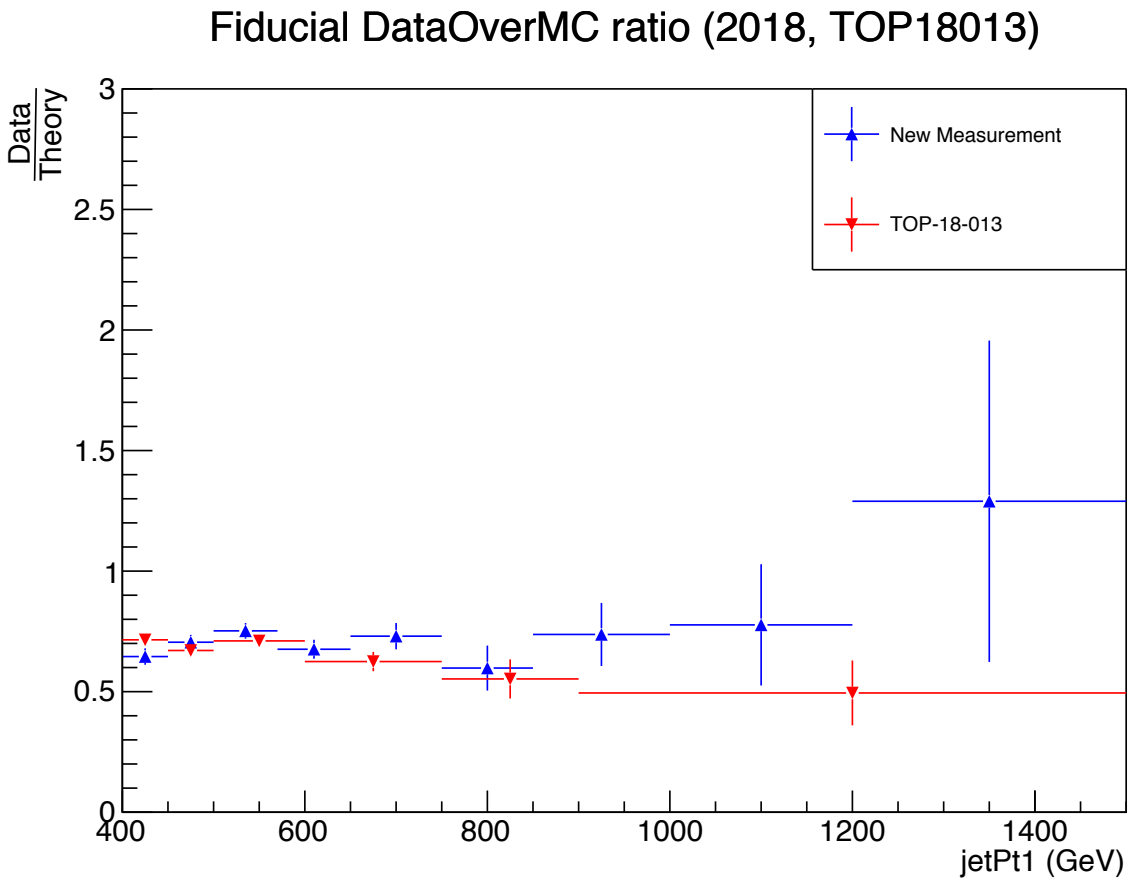


without b tagging SF's

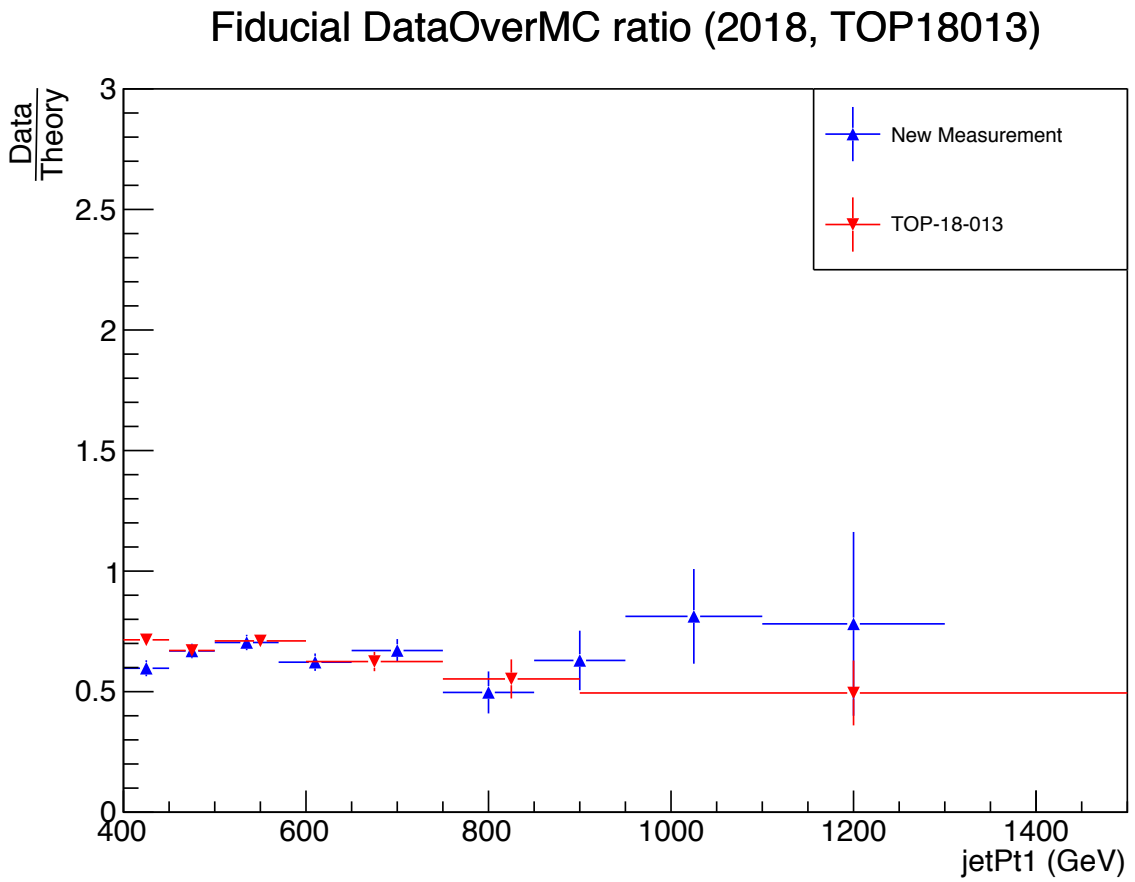


Signal Extraction 2018

b tagging SF's



without b tagging SF's



Tag And Probe

- Top Tagger Scale Factors
  - Tag and Probe: Data and MC don't show inconsistency
  - Data is subtracted QCD and Subdominant bkgs (MC) so that the data sample is pure

$$efficiency = \frac{\#\,(1\ jet\ pass\ baseline + Tight\ TopTagger\ Cut\ AND\ 1\ jet\ pass\ SR)}{\#\,(1\ jet\ pass\ baseline + Tight\ TopTagger\ Cut\ AND\ 1\ jet\ pass\ only\ baseline)}$$

  - Randomization (check random jet) to fill histogram to avoid pT bias
  - mTop candidate distributions for Numerator and Denominator of efficiency
    - To scale the ttbar → fit the mTop in each of these regions (ttbar compatible ~ with SR)
  - Divide the phase space into pT regions: [400-600] GeV, [600-800] GeV, [800-Inf] GeV
    - Again no inconsistencies

Tag And Probe Calculations 2016

b tagging SF's

Efficiency--with btagging SF's
eff data: 0.781 ± 0.038
eff ttbar: 0.772 ± 0.014

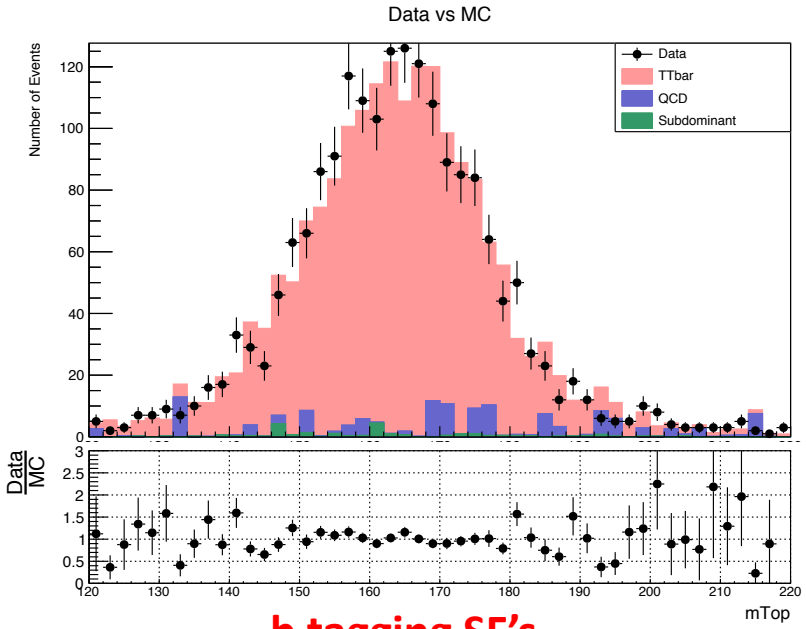
Efficiency per Pt region
eff data pT[400-600]: 0.761 ± 0.042
eff ttbar pT[400-600]: 0.778 ± 0.016
---
eff data pT[600-800]: 0.851 ± 0.100
eff ttbar pT[600-800]: 0.748 ± 0.031
---
eff data pT[800-Inf]: 0.886 ± 0.160
eff ttbar pT[800-Inf]: 0.775 ± 0.063

without b tagging SF's

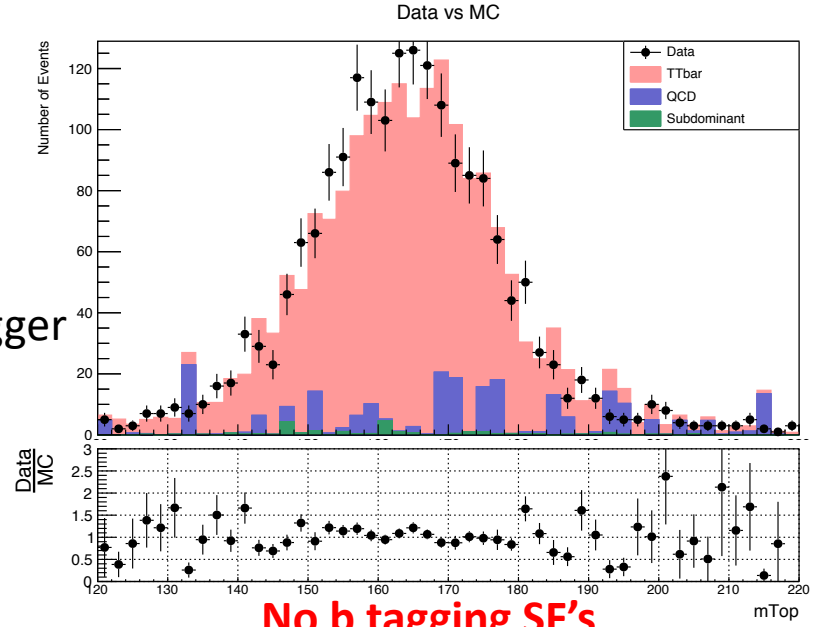
Efficiency--without btagging SF's
eff data: 0.782 ± 0.039
eff ttbar: 0.772 ± 0.014

Efficiency per Pt region
eff data pT[400-600]: 0.762 ± 0.043
eff ttbar pT[400-600]: 0.778 ± 0.016
---
eff data pT[600-800]: 0.854 ± 0.103
eff ttbar pT[600-800]: 0.748 ± 0.031
---
eff data pT[800-Inf]: 0.888 ± 0.161
eff ttbar pT[800-Inf]: 0.775 ± 0.064

TagAndProbe Efficiency (2016)

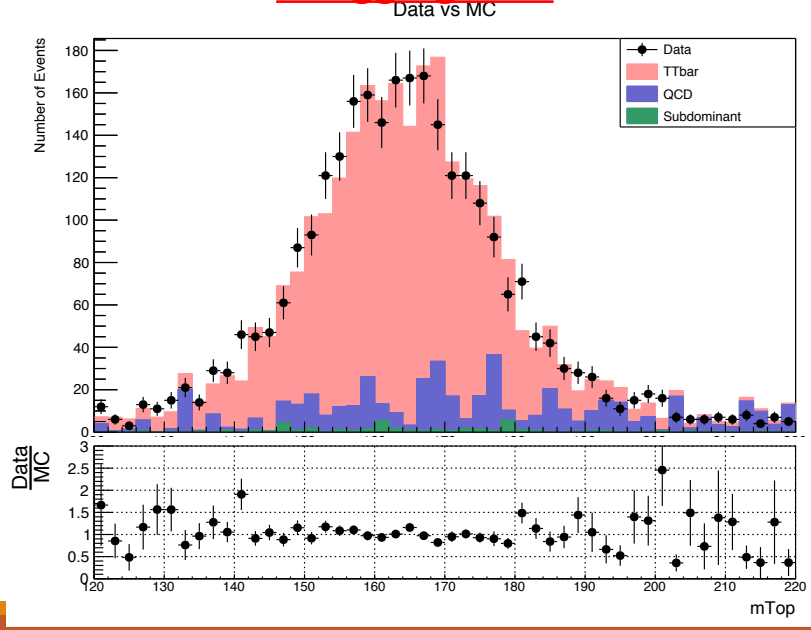


Tight TopTagger + SR TopTagger

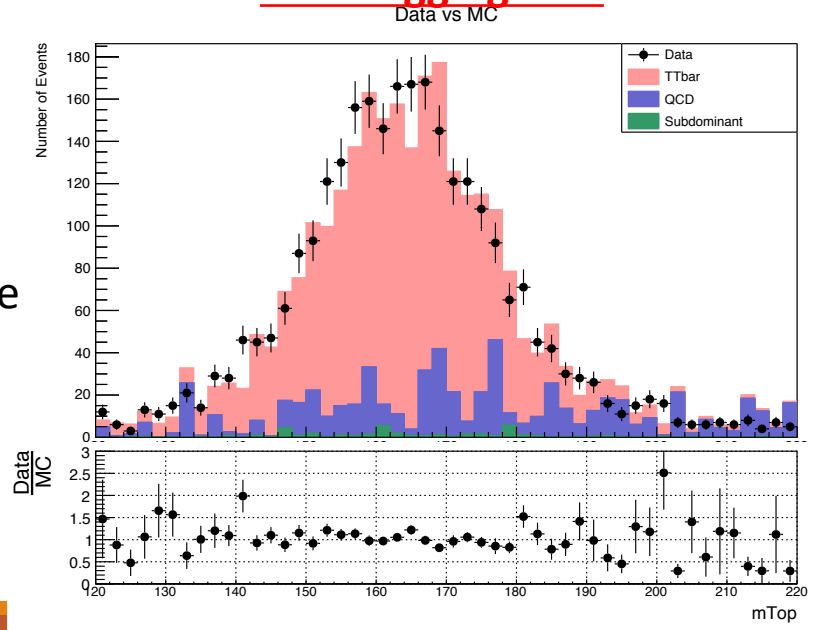


b tagging SF's

No b tagging SF's



Tight TopTagger + Probe



Tag And Probe Calculations 2017

b tagging SF's

Efficiency-- with btagging SF's
eff data: 0.857 ± 0.040
eff ttbar: 0.875 ± 0.0072

Efficiency per Pt region
eff data pT[400-600]: 0.872 ± 0.047
eff ttbar pT[400-600]: 0.874 ± 0.008
---
eff data pT[600-800]: 0.795 ± 0.088
eff ttbar pT[600-800]: 0.876 ± 0.018
---
eff data pT[800-Inf]: 0.797 ± 0.186
eff ttbar pT[800-Inf]: 0.899 ± 0.045

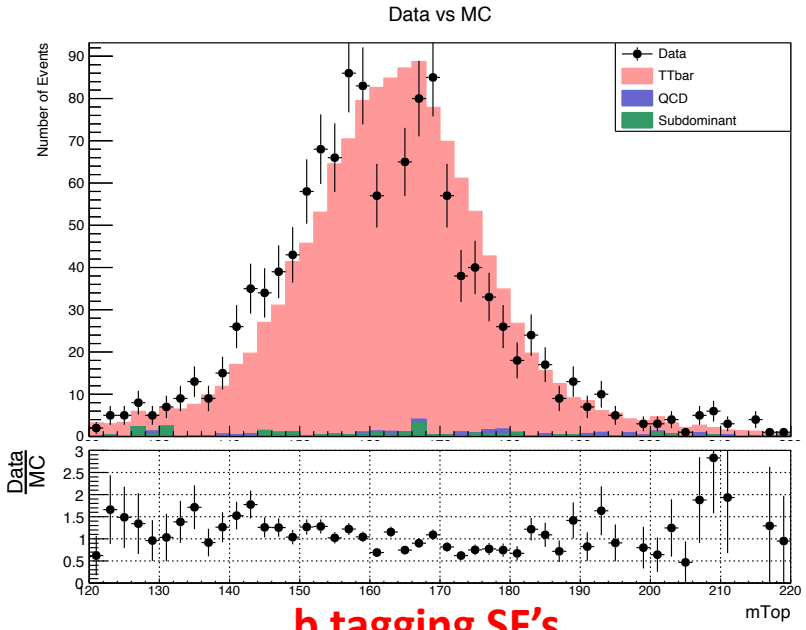
without b tagging SF's

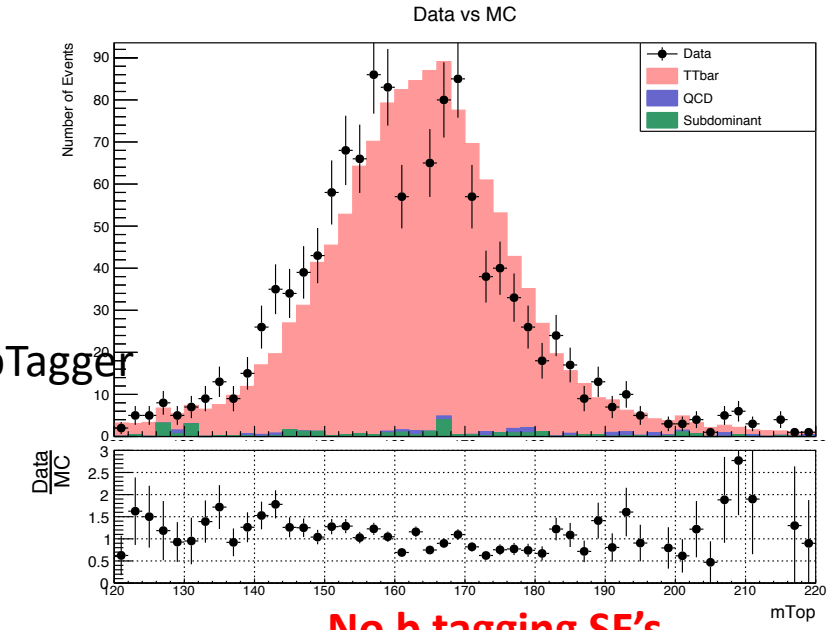
Efficiency-- without btagging SF's
eff data: 0.864 ± 0.043
eff ttbar: 0.875 ± 0.007

Efficiency per Pt region
eff data pT[400-600]: 0.880 ± 0.049
eff ttbar pT[400-600]: 0.874 ± 0.008
---
eff data pT[600-800]: 0.8 ± 0.091
eff ttbar pT[600-800]: 0.876 ± 0.018
---
eff data pT[800-Inf]: 0.796 ± 0.2
eff ttbar pT[800-Inf]: 0.898 ± 0.045

TagAndProbe Efficiency (2017)

Tight TopTagger + SR TopTagger

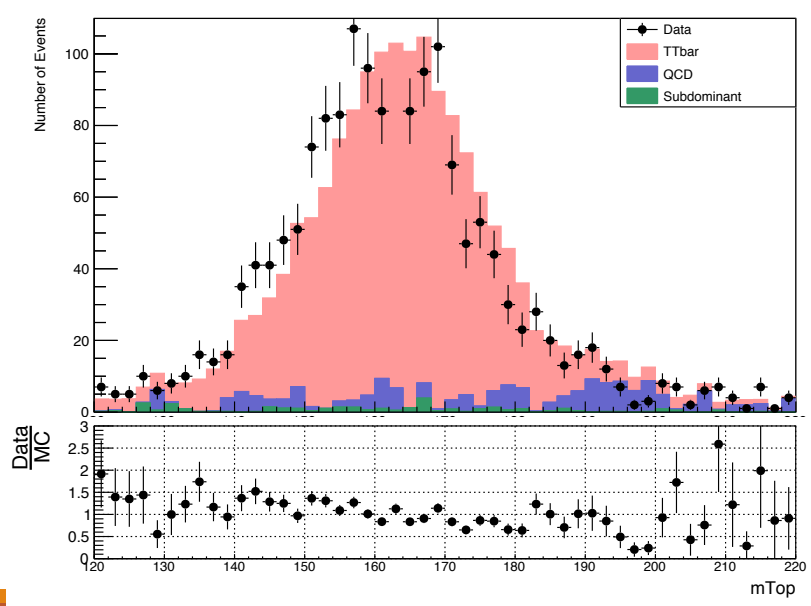


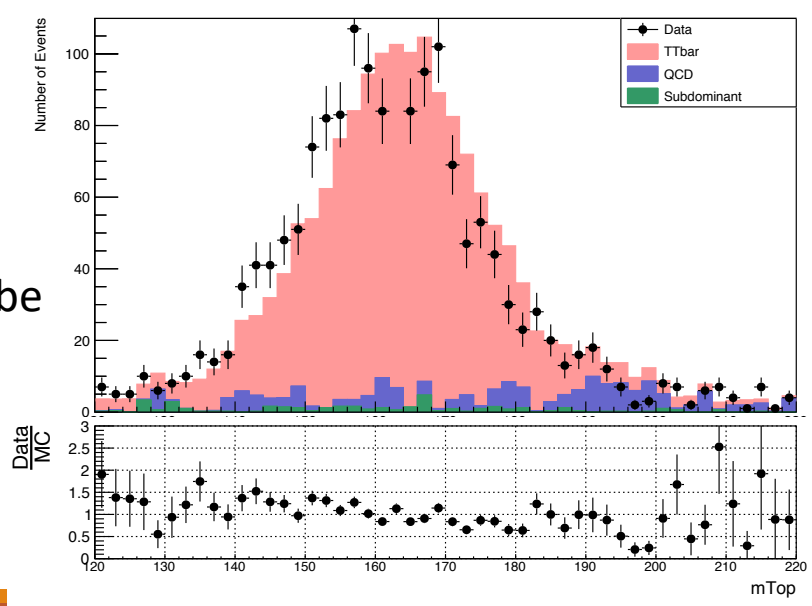


b tagging SF's

No b tagging SF's

Tight TopTagger + Probe





Tag And Probe Calculations 2018

b tagging SF's

Efficiency-- with tag SF's
eff data: 0.816 ± 0.032
eff ttbar: 0.839 ± 0.005

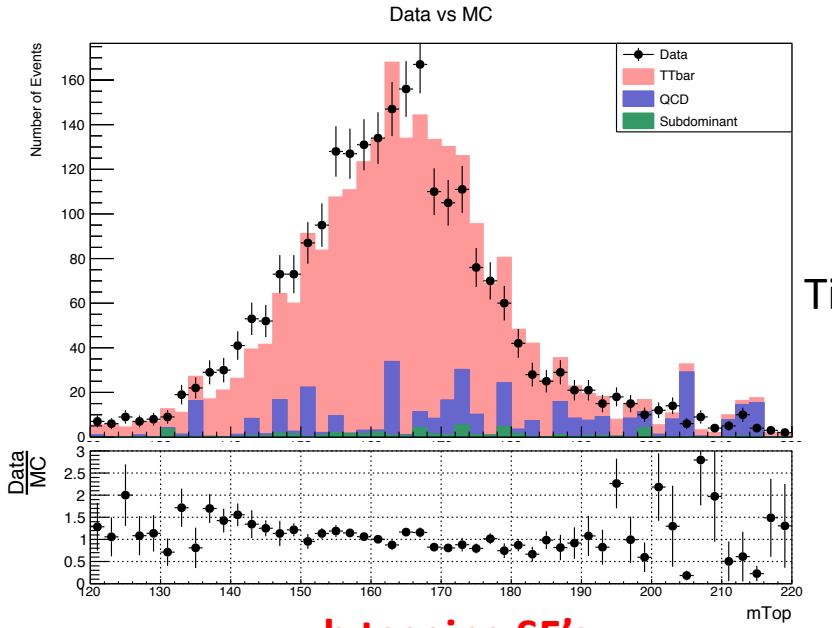
Efficiency per Pt region
eff data pT[400-600]: 0.8176 ± 0.038
eff ttbar pT[400-600]: 0.837 ± 0.006
---
eff data pT[600-800]: 0.809 ± 0.063
eff ttbar pT[600-800]: 0.847 ± 0.013
---
eff data pT[800-Inf]: 0.772 ± 0.132
eff ttbar pT[800-Inf]: 0.868 ± 0.032

without b tagging SF's

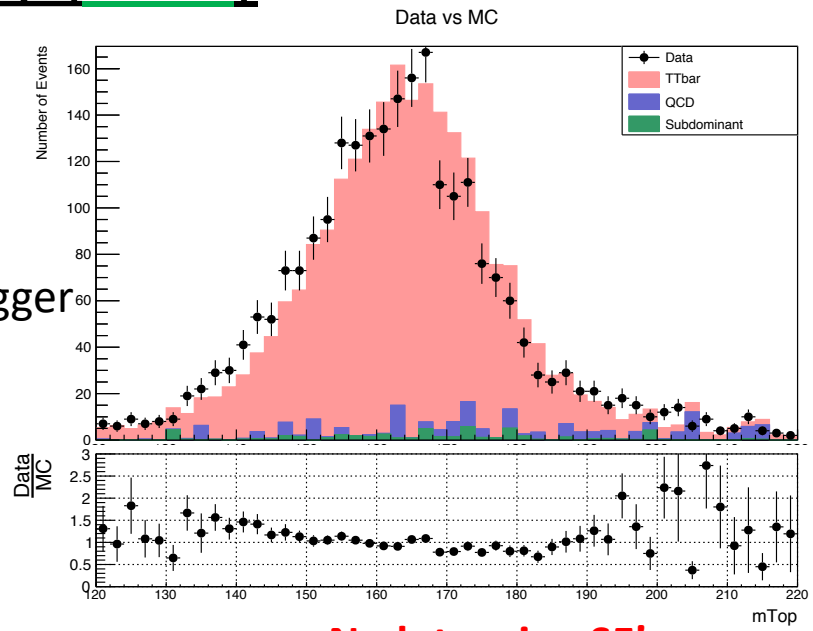
Efficiency-- without tag sf's
eff data: 0.822 ± 0.034
eff ttbar: 0.839 ± 0.005

Efficiency per Pt region
eff data pT[400-600]: 0.824 ± 0.039
eff ttbar pT[400-600]: 0.837 ± 0.006
---
eff data pT[600-800]: 0.819 ± 0.066
eff ttbar pT[600-800]: 0.847 ± 0.013
---
eff data pT[800-Inf]: 0.789 ± 0.141
eff ttbar pT[800-Inf]: 0.868 ± 0.032

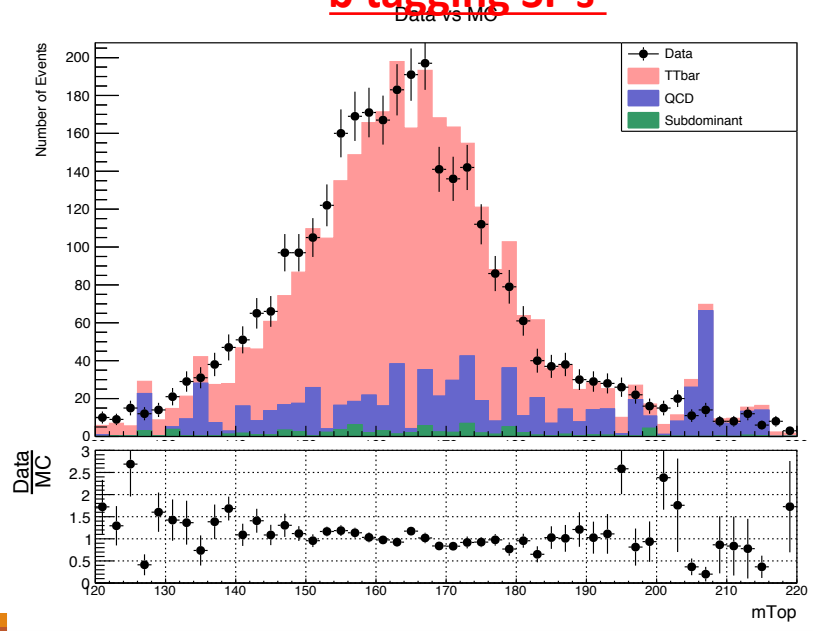
TagAndProbe Efficiency (2018)



Tight TopTagger + SR TopTagger

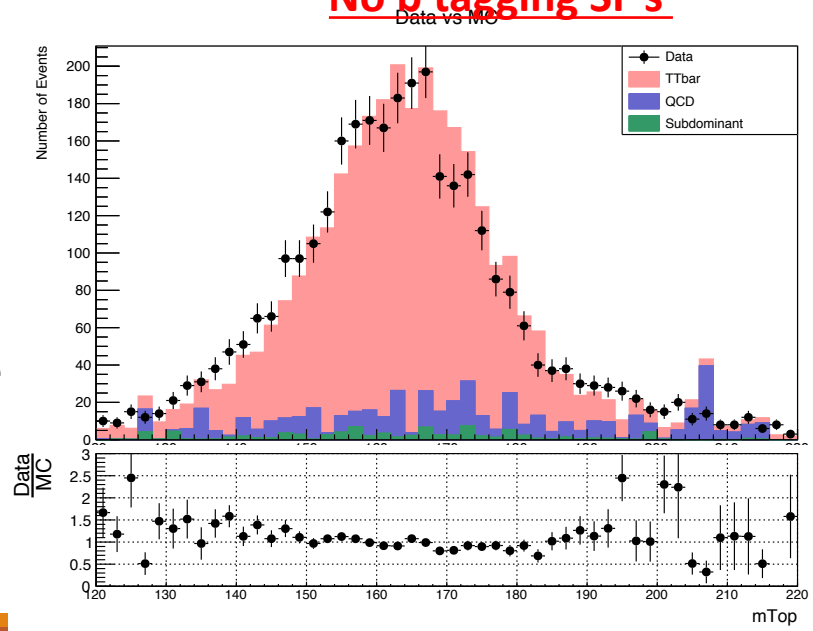


b tagging SF's



Tight TopTagger + Probe

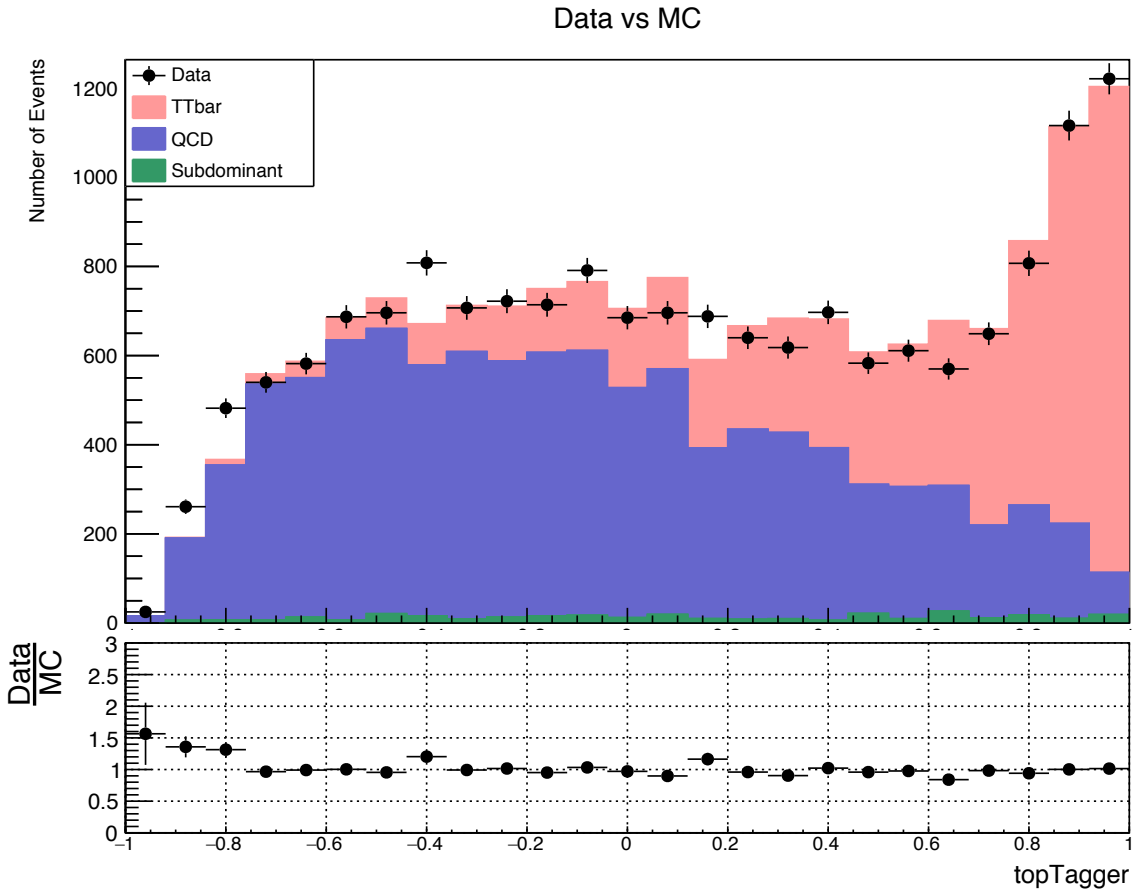
No b tagging SF's



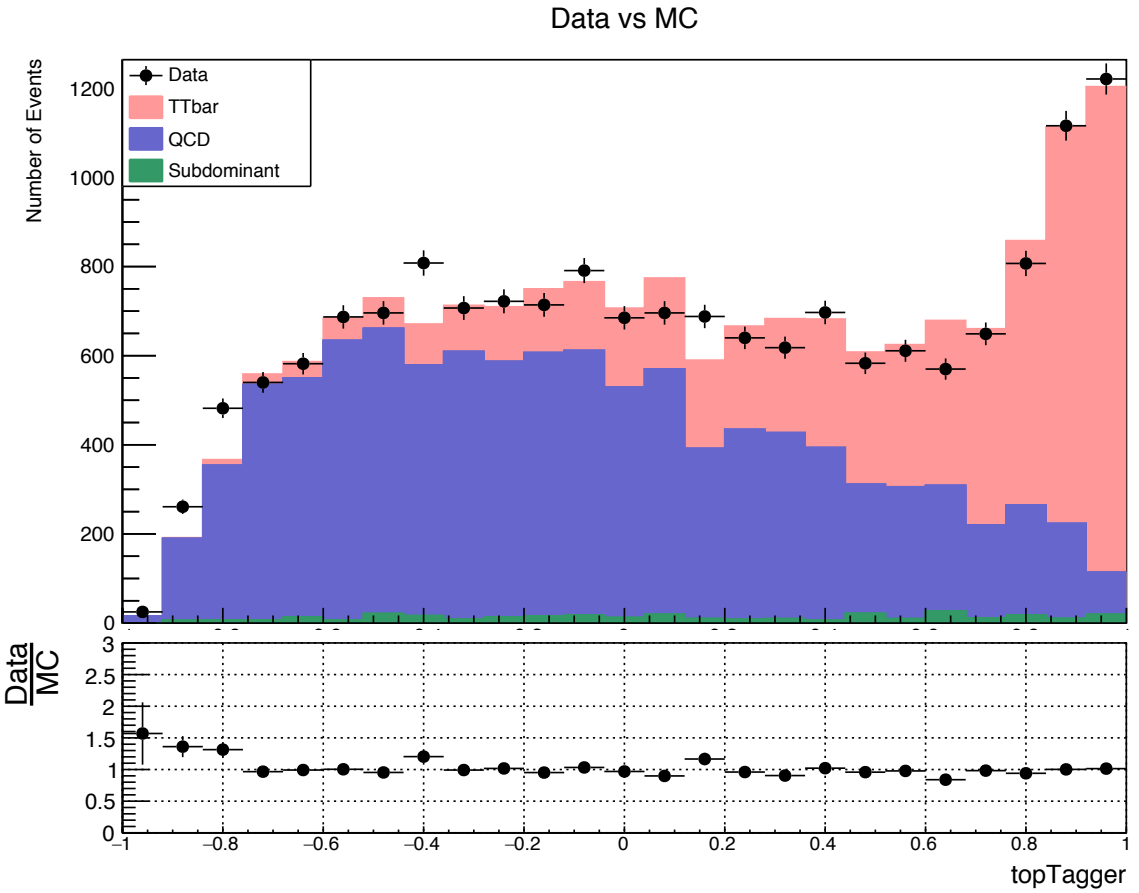
Data Vs MC Stacks for BDT output 2016

- BDT Output scores SR_B
  - SR_B : Baseline selection + tight Mass Cut (120,220) GeV, no TopTagger Selection
  - QCD scaled to data (k-factor)

b tagging SF's

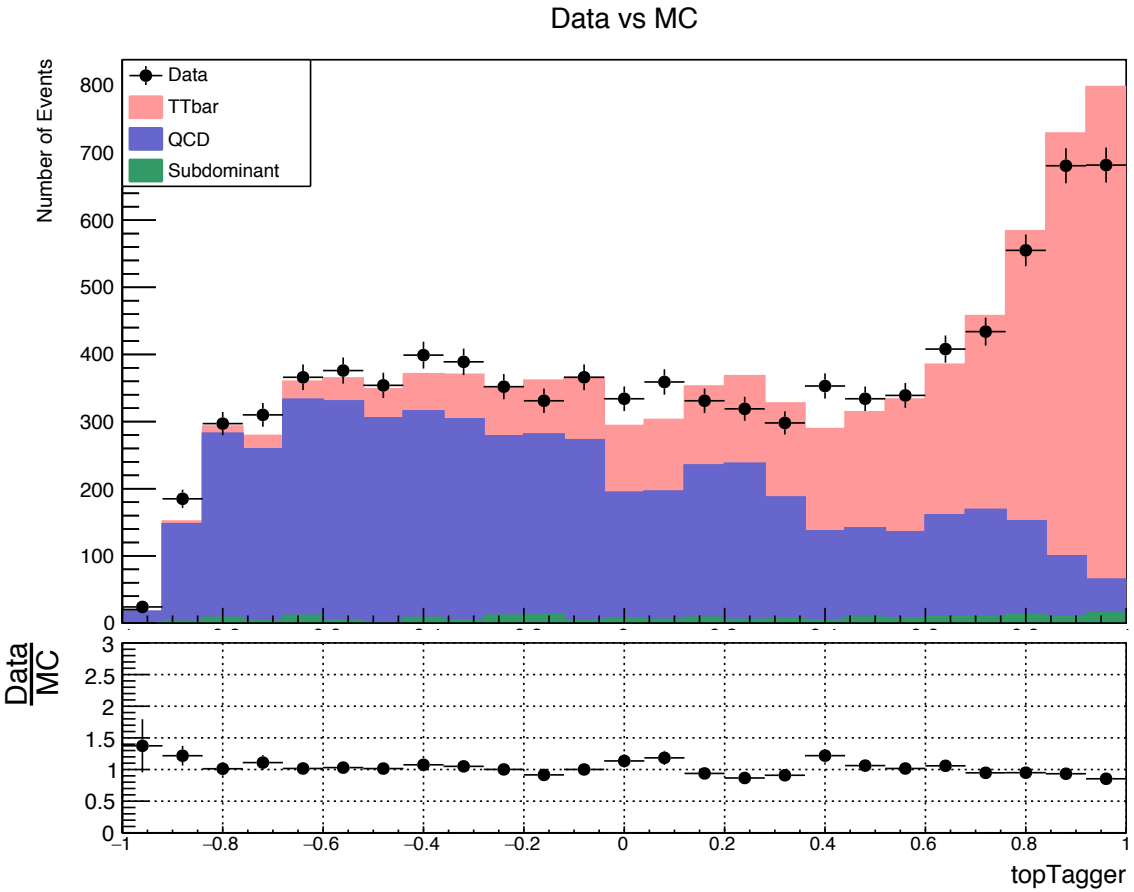


without b tagging SF's

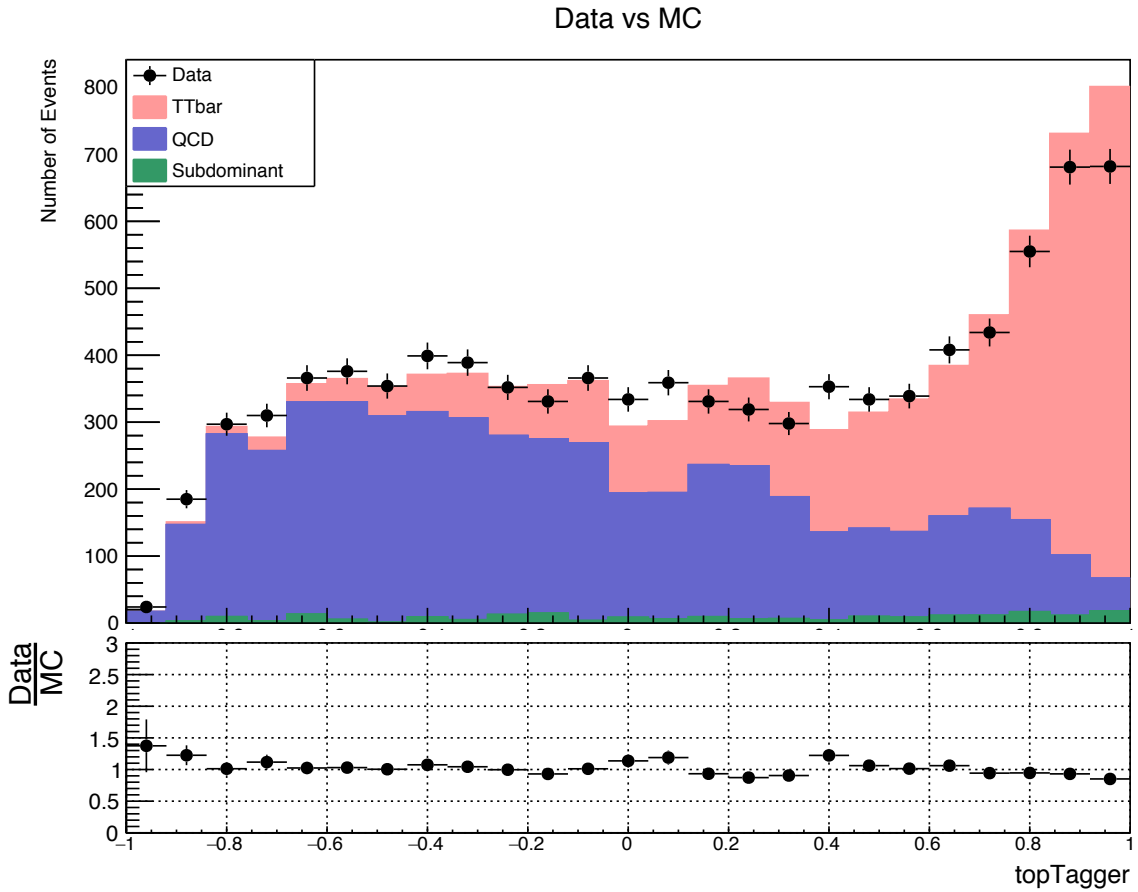


Data Vs MC Stacks for BDT output 2017

b tagging SF's

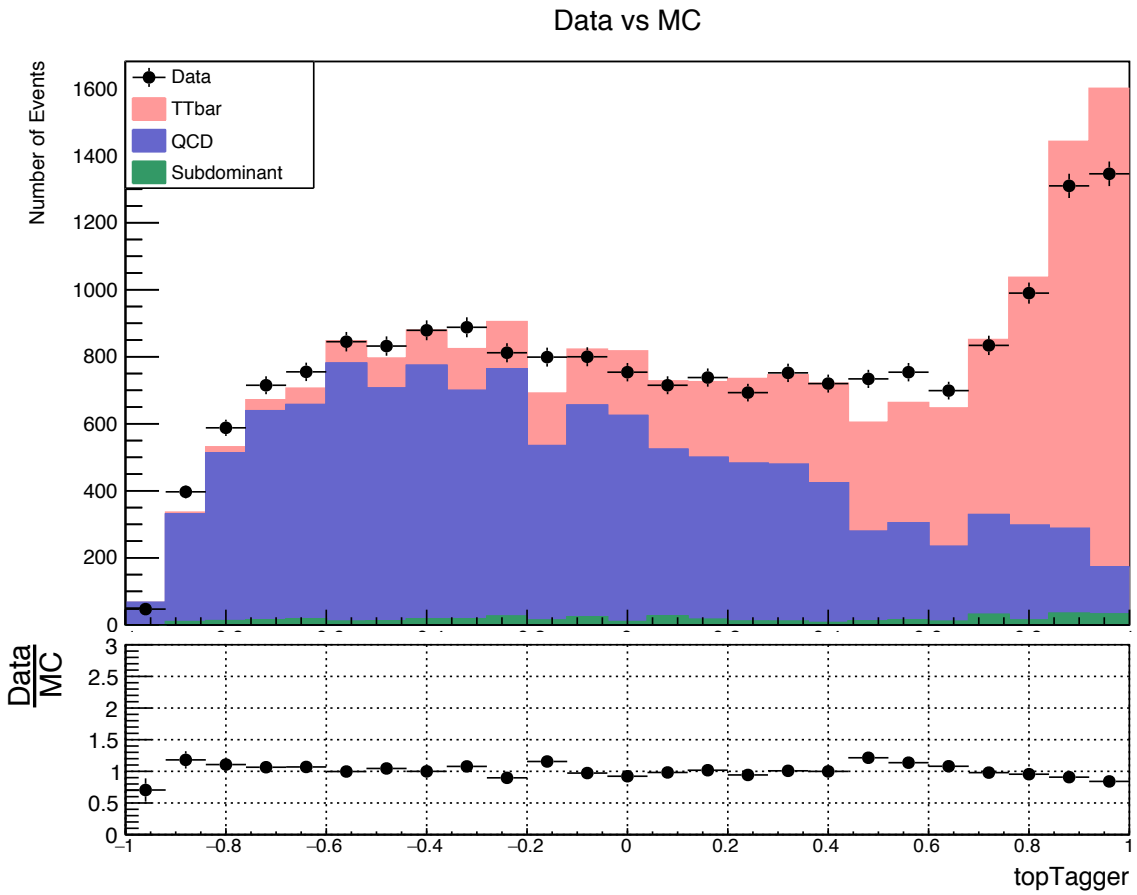


without b tagging SF's

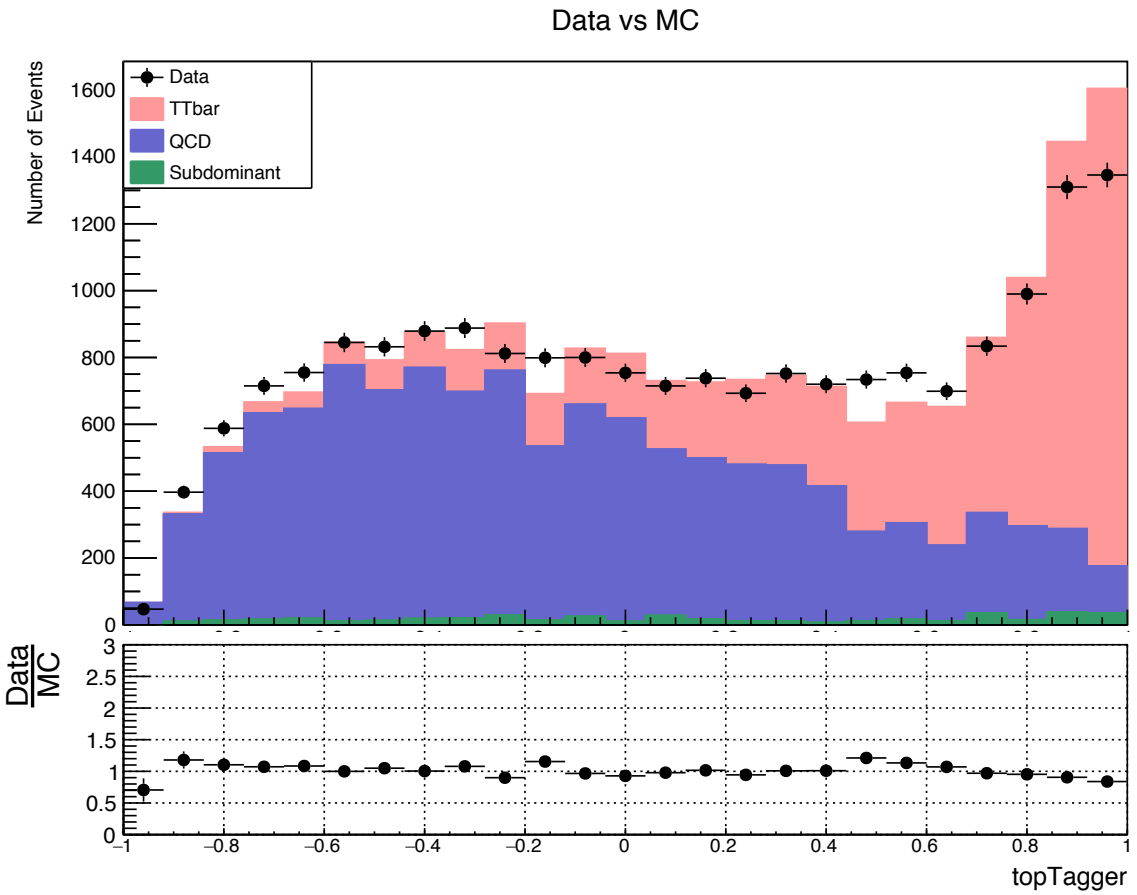


Data Vs MC Stacks for BDT output 2018

b tagging SF's



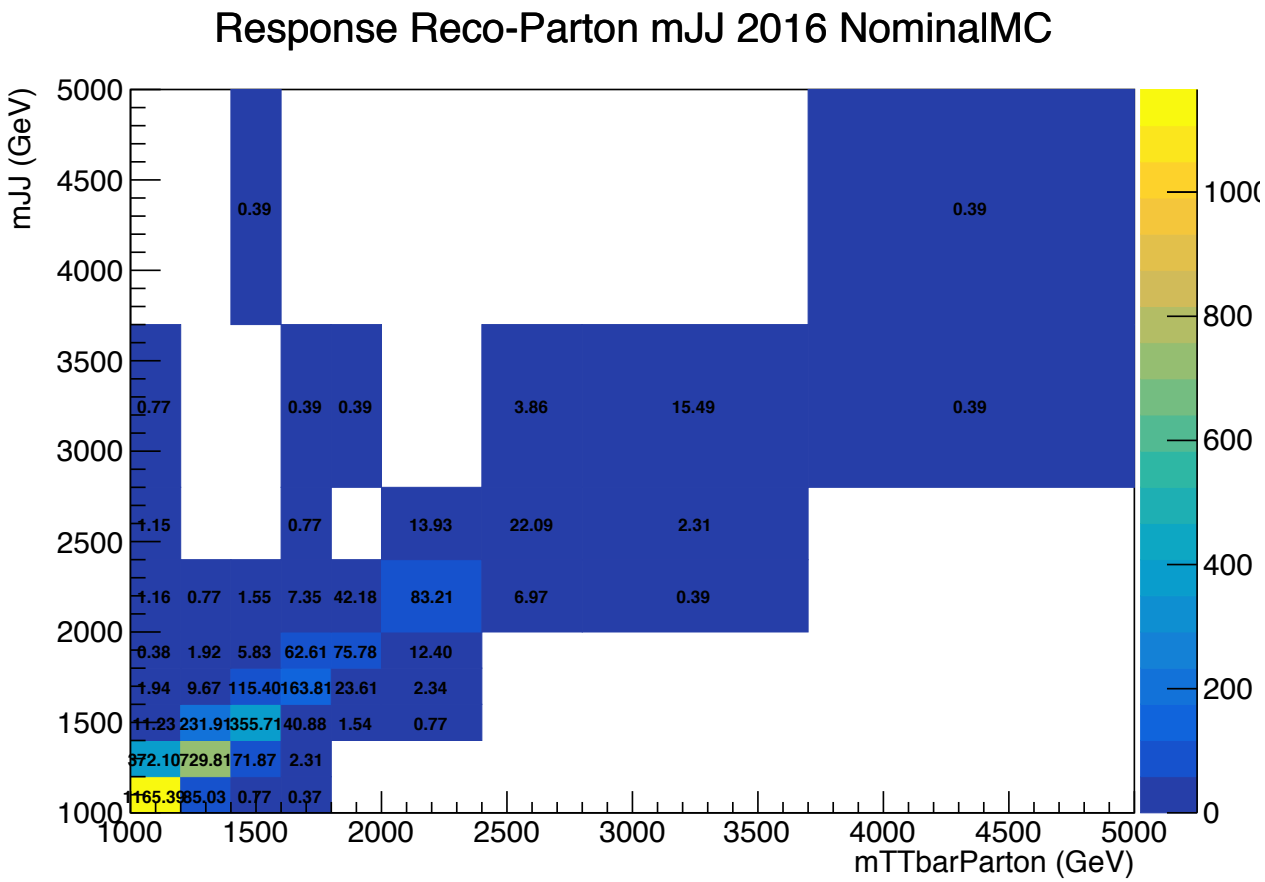
without b tagging SF's



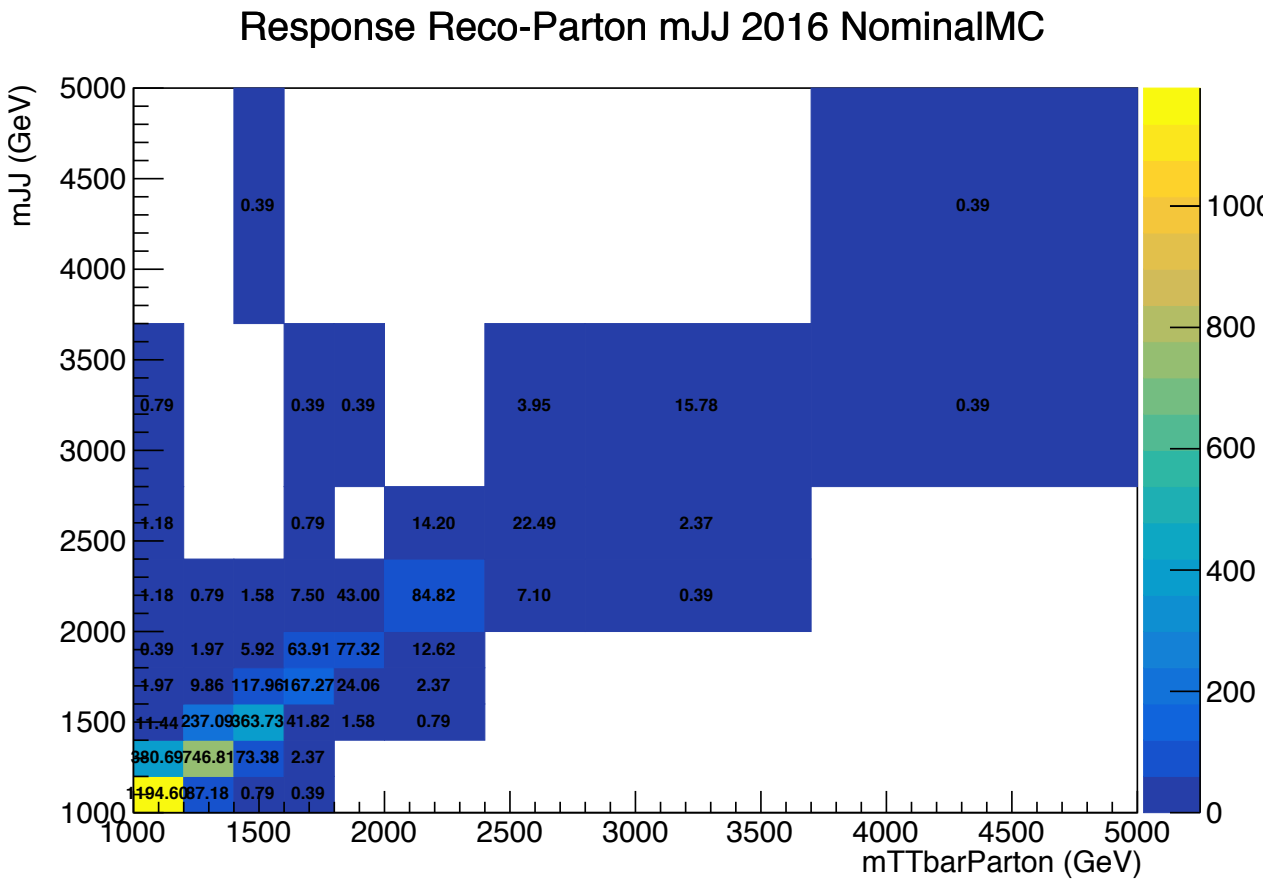
BACKUP SLIDES

Response Matrices 2016

b tagging SF's



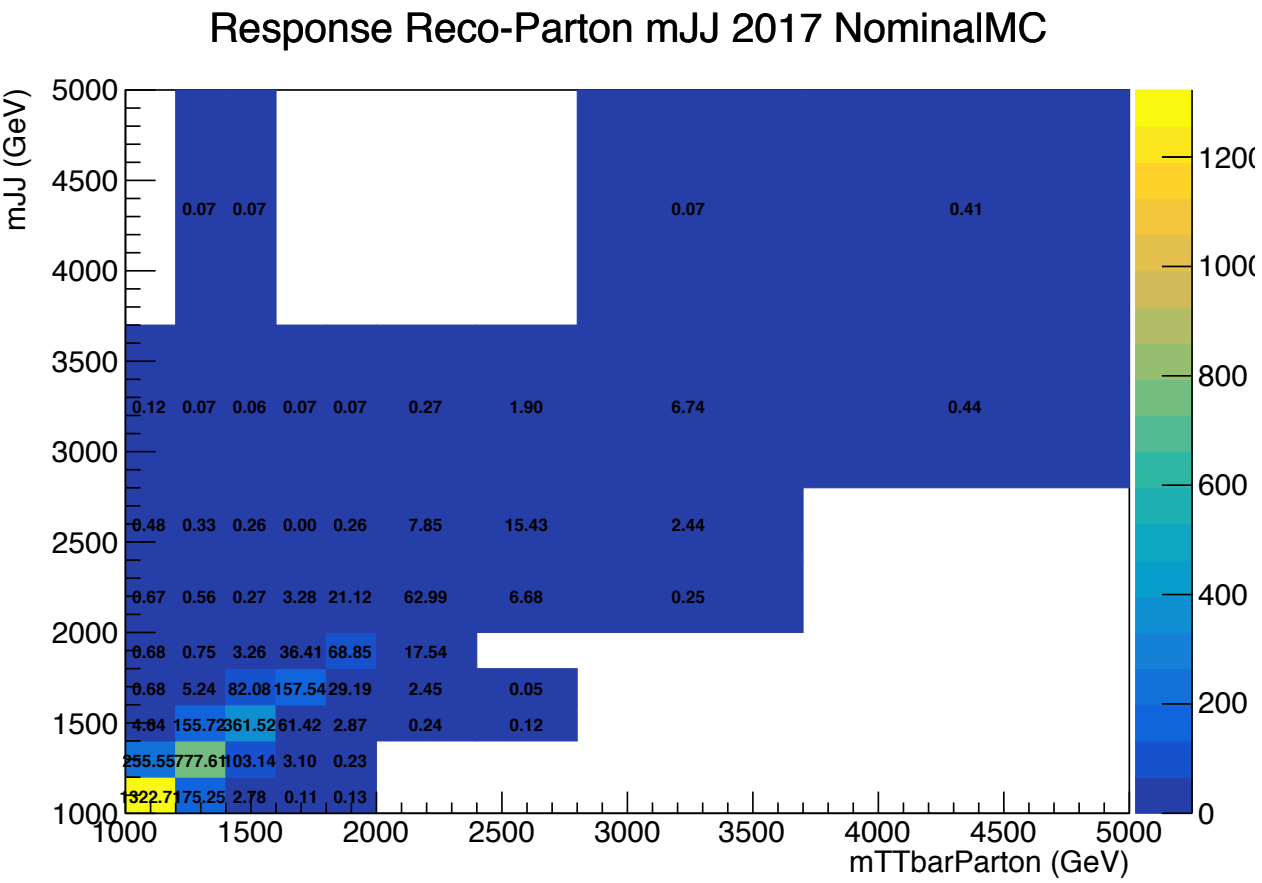
without b tagging SF's

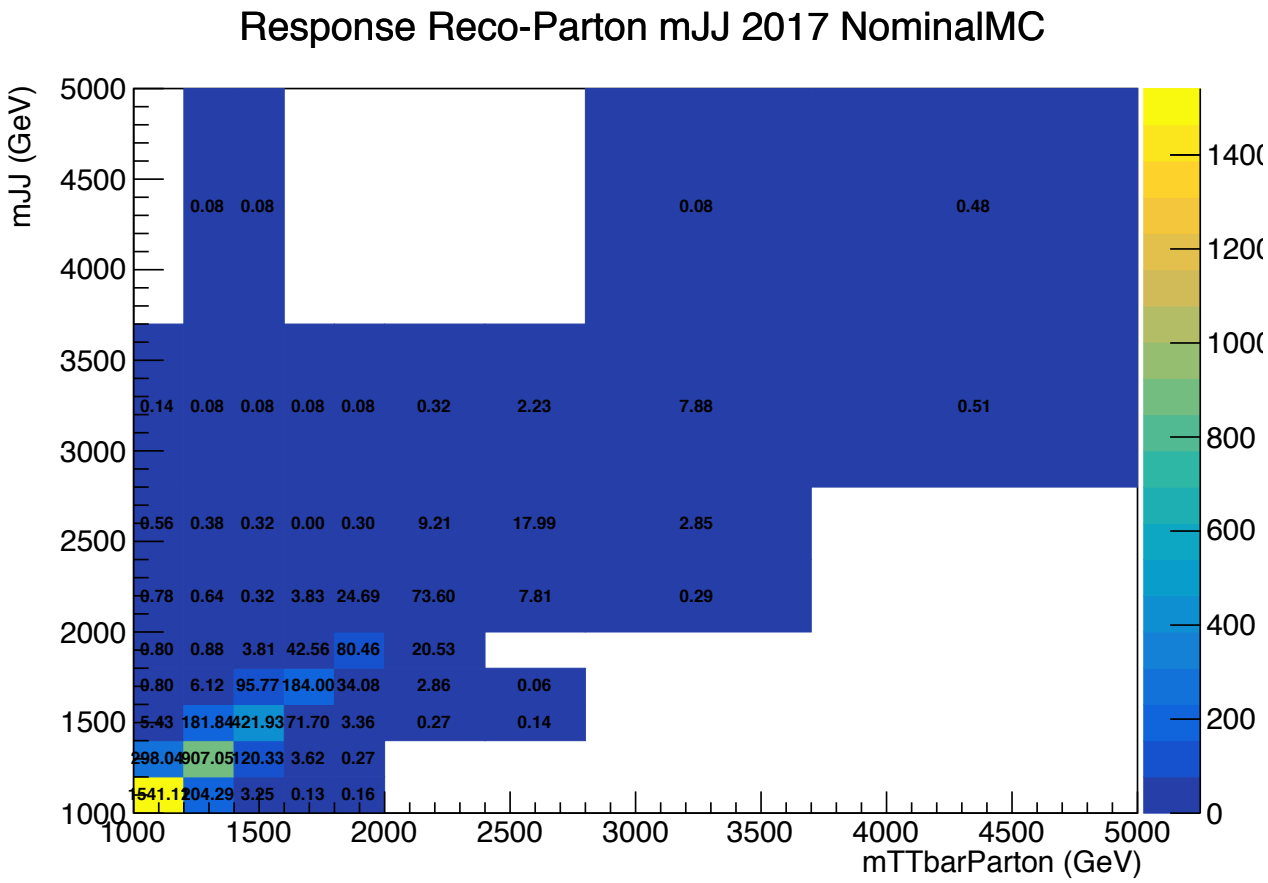


Response Matrices 2017

b tagging SF's

without b tagging SF's





Response Matrices 2018

b tagging SF's

without b tagging SF's