

ttbar Analysis Status

NTUA

1/9/2020

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Introduction

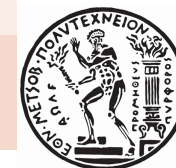


Signal Selection

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	

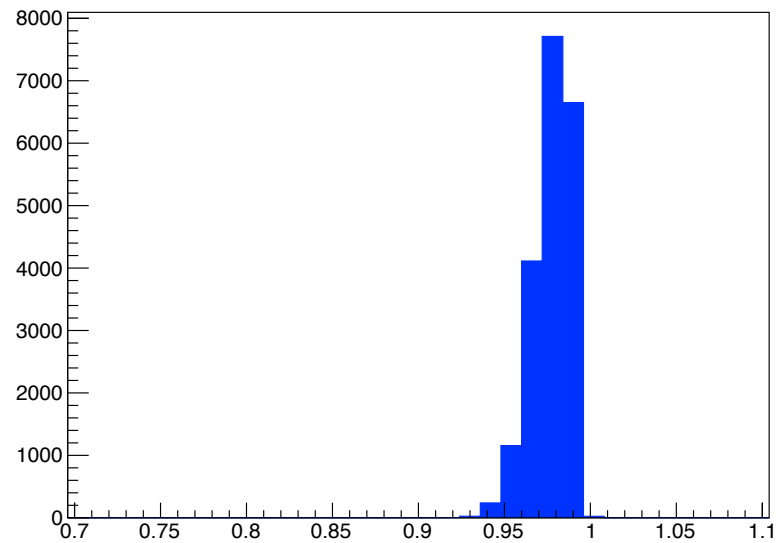
Control Region Selection

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	

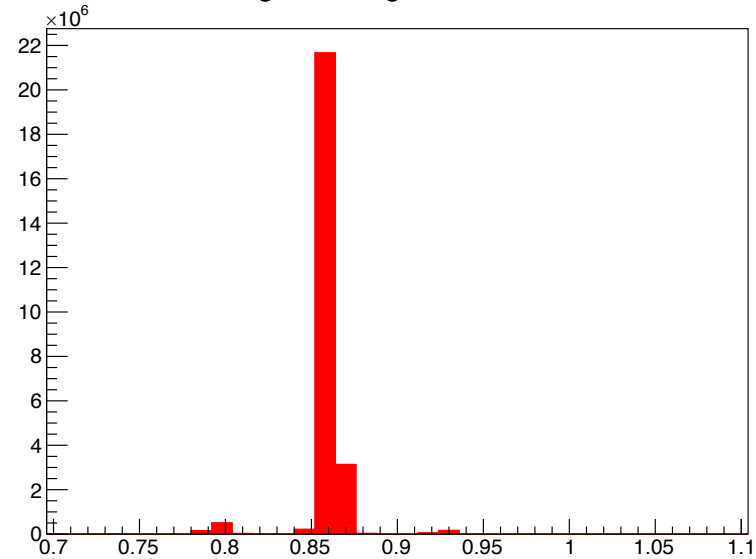


bTagging Scale Factor distributions in Signal Region

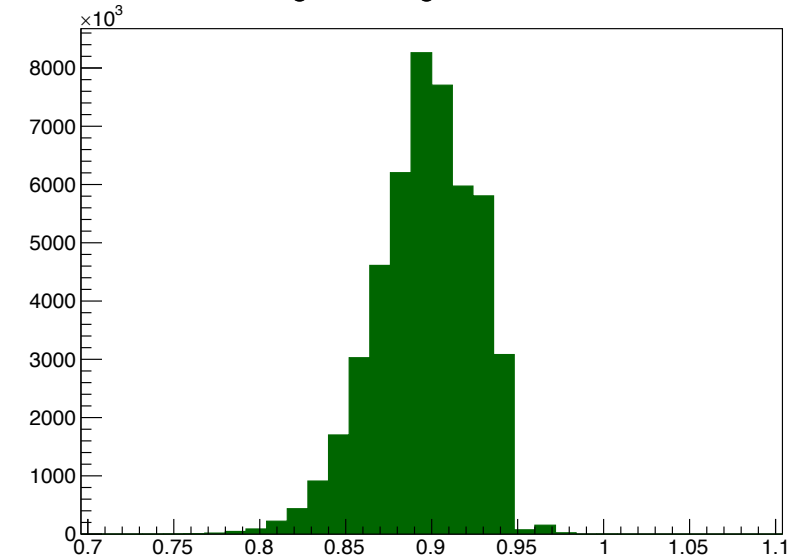
2016 bTagEvtWeight Distribution in SR



2017 bTagEvtWeight Distribution in SR



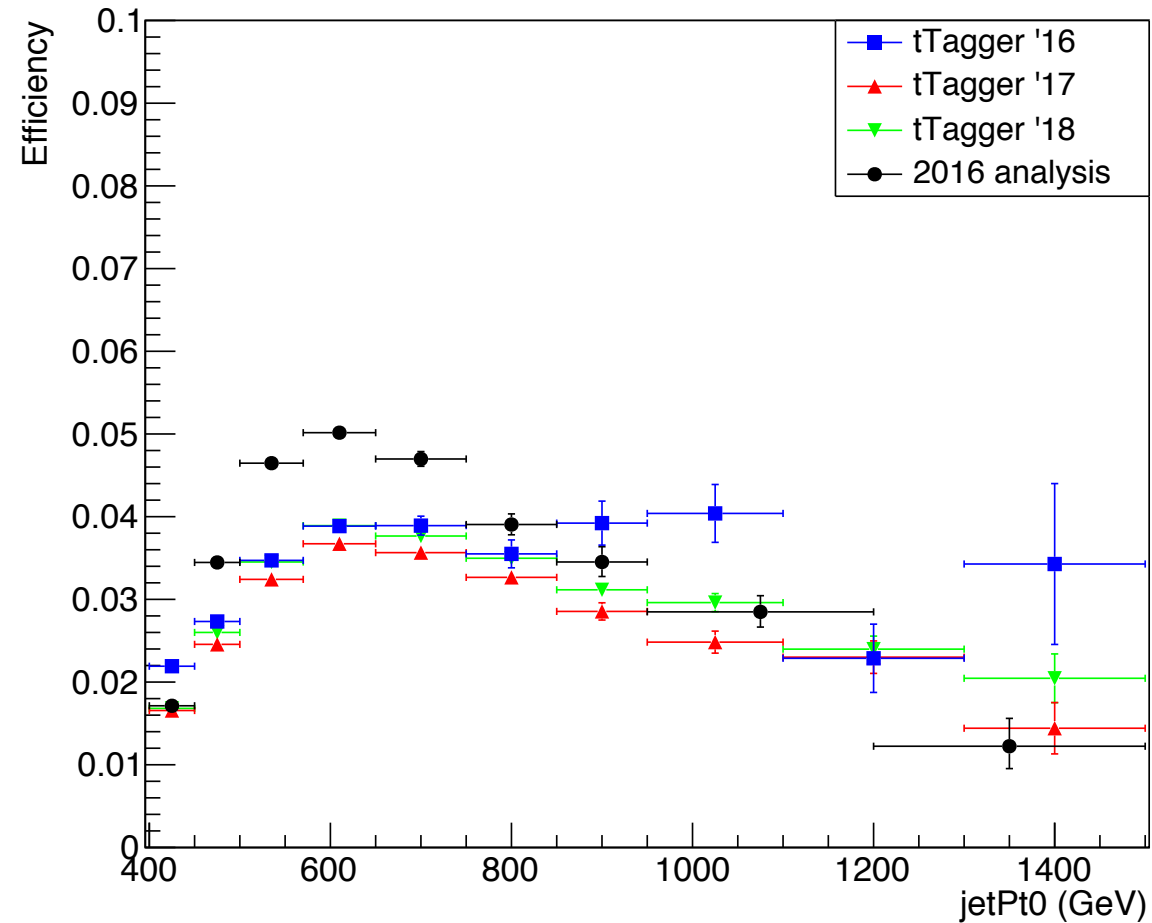
2018 bTagEvtWeight Distribution in SR



Efficiency and Acceptance Plots

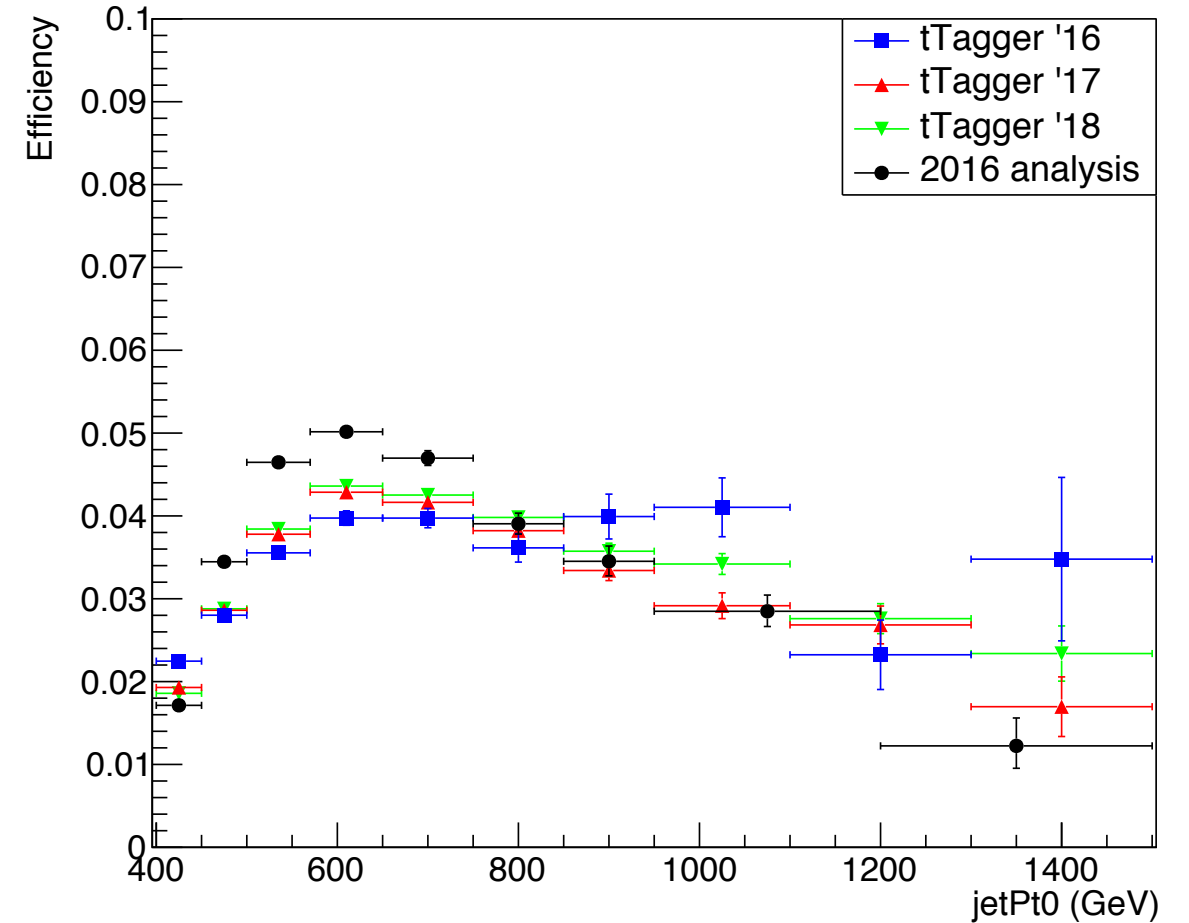
b tagging SF's

Parton Efficiency '16,'17,'18 NominalMC



without b tagging SF's

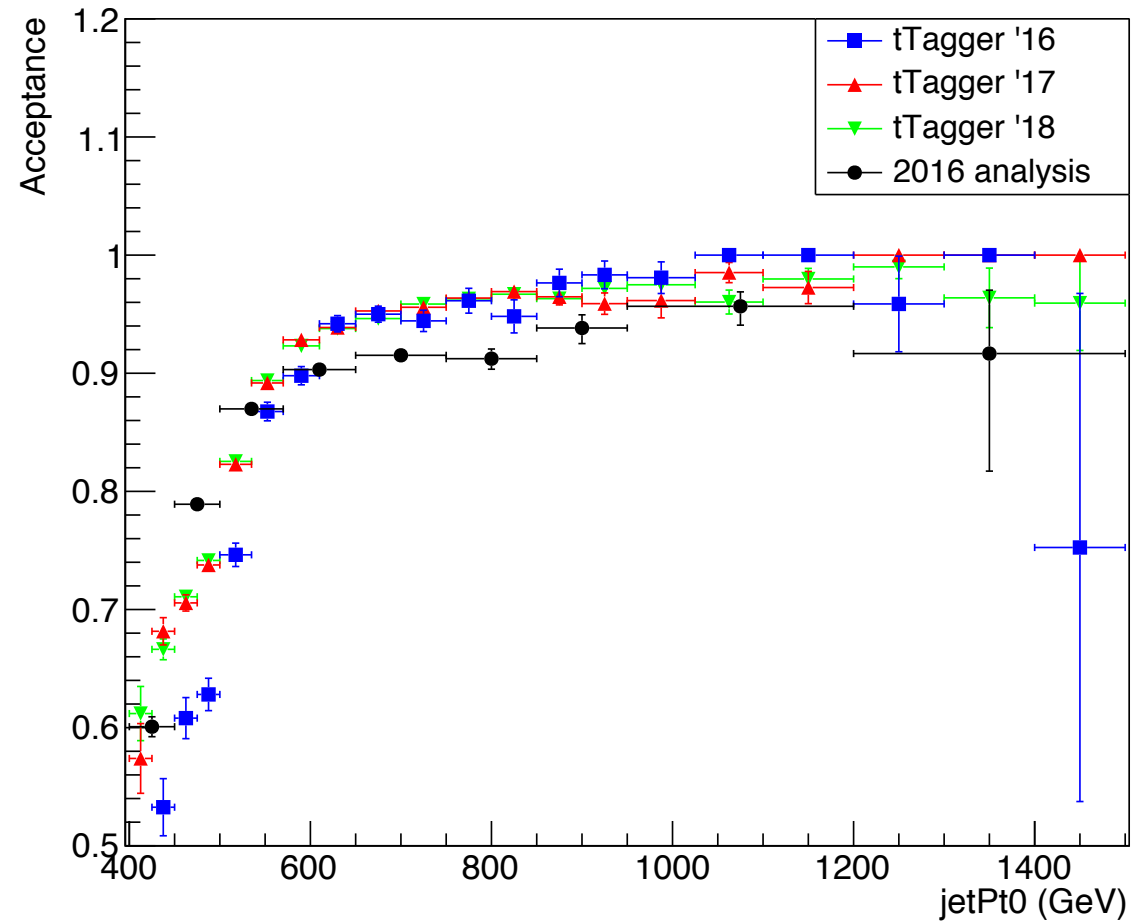
Parton Efficiency '16,'17,'18 NominalMC



Efficiency and Acceptance Plots

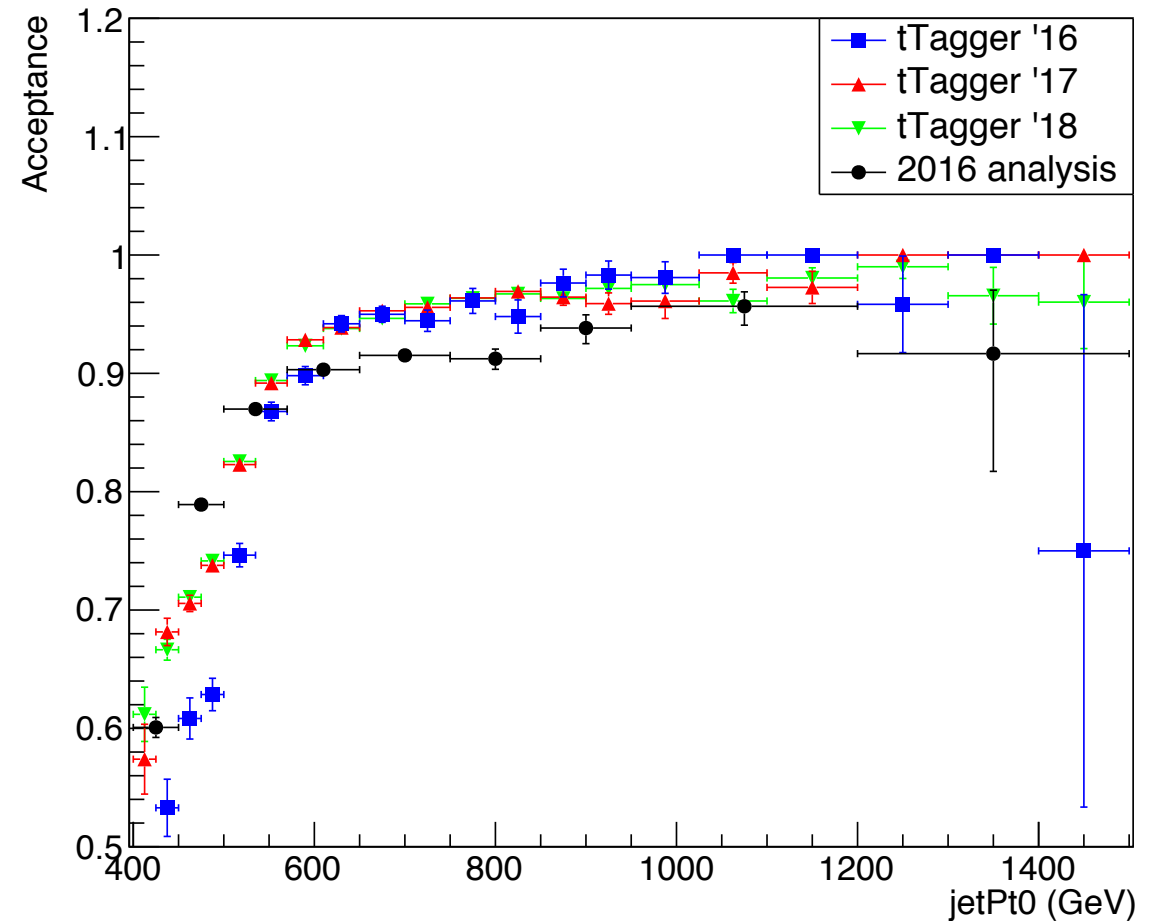
b tagging SF's

Parton Acceptance '16,'17,'18 NominalMC



without b tagging SF's

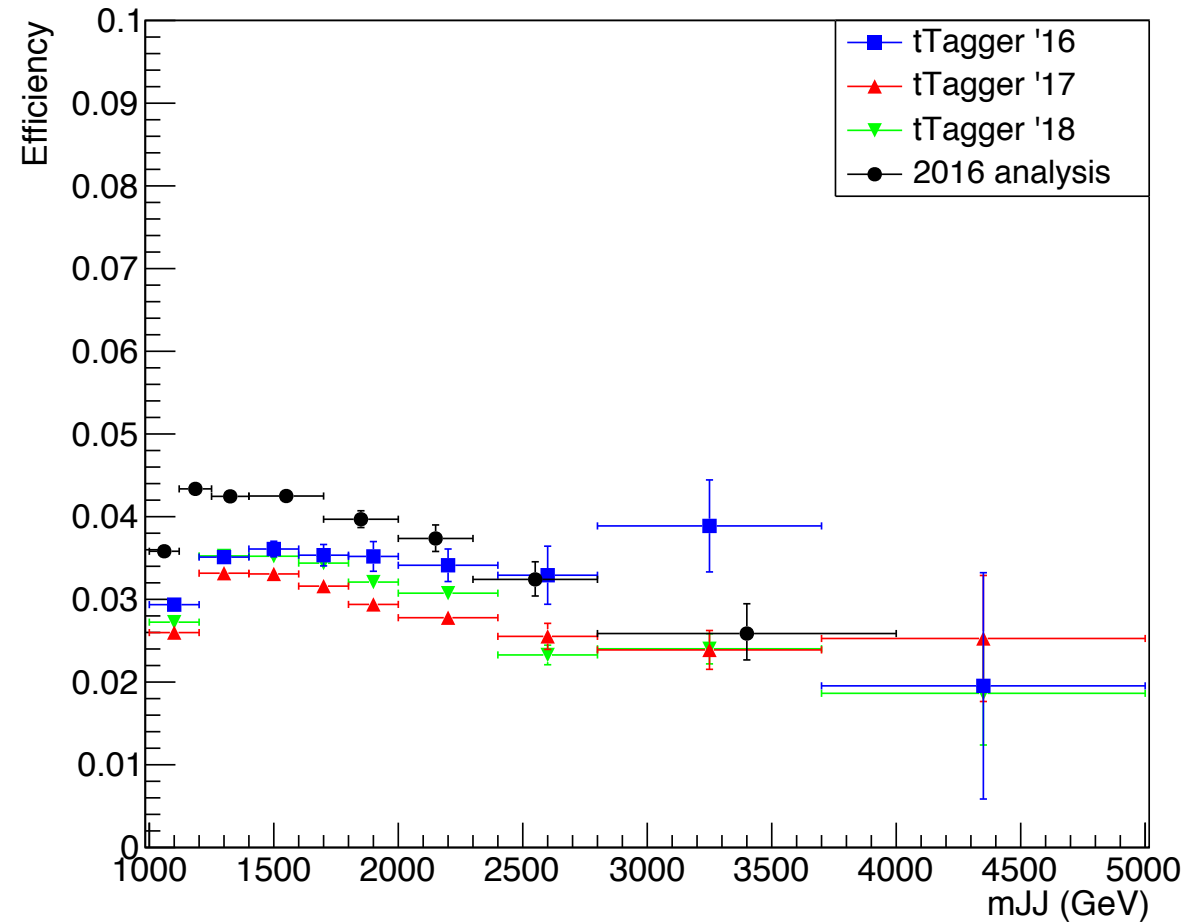
Parton Acceptance '16,'17,'18 NominalMC



Efficiency and Acceptance Plots

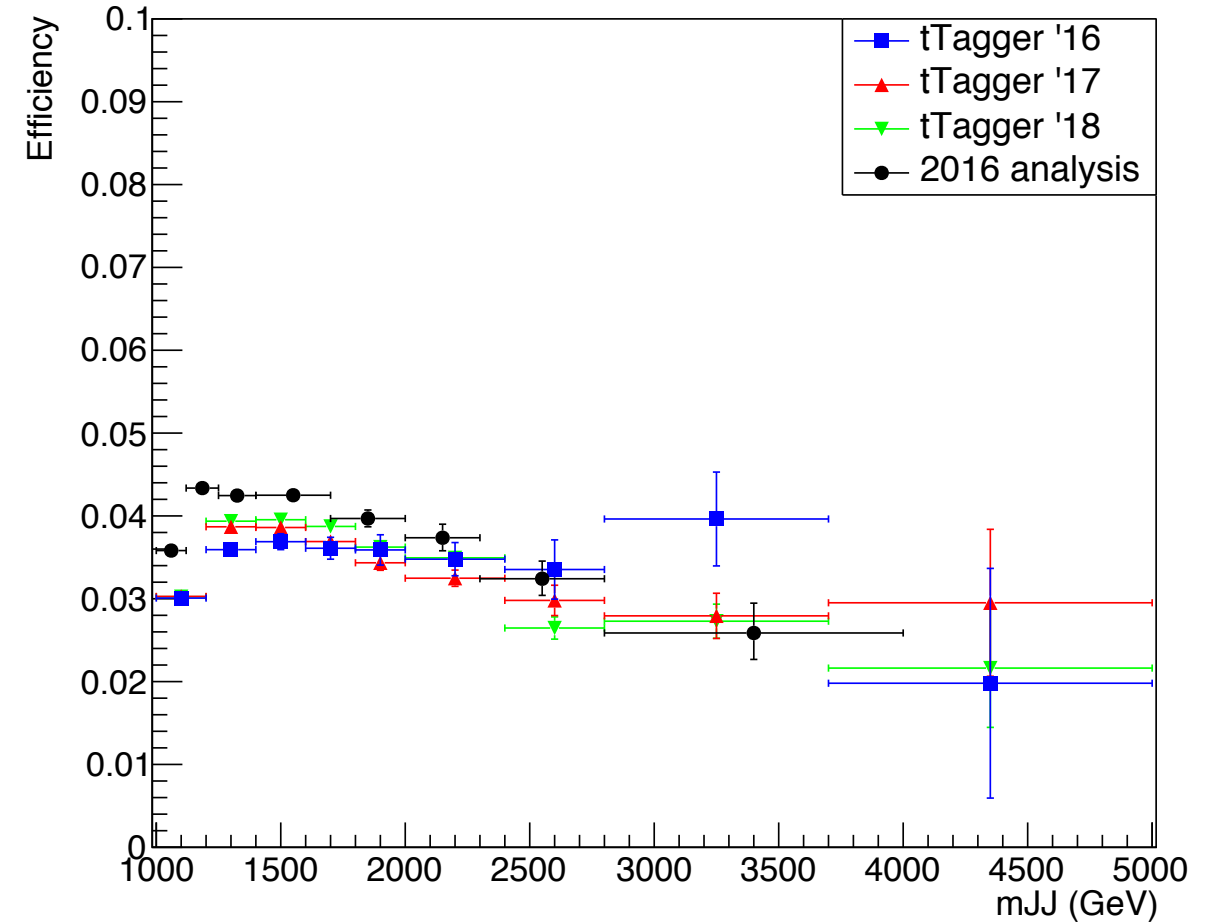
b tagging SF's

Parton Efficiency '16,'17,'18 NominalMC



without b tagging SF's

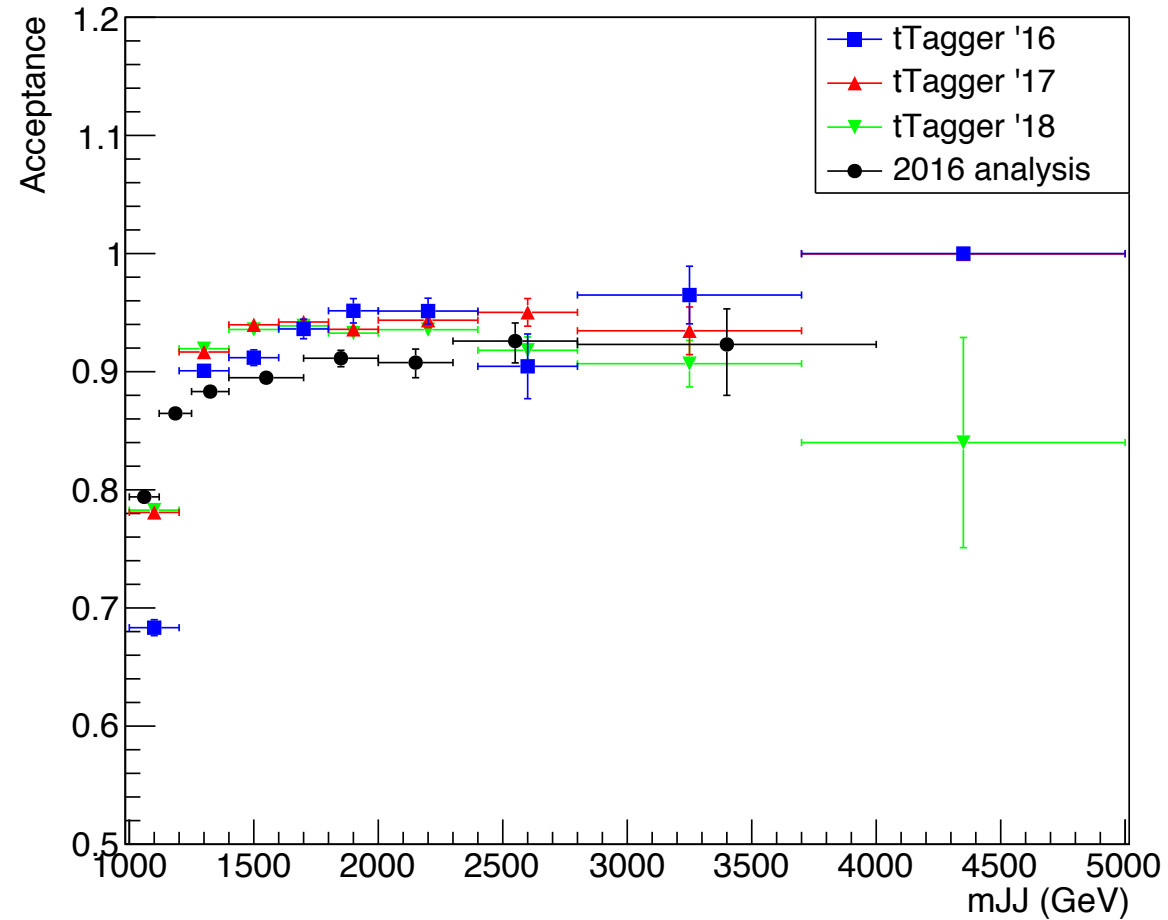
Parton Efficiency '16,'17,'18 NominalMC



Efficiency and Acceptance Plots

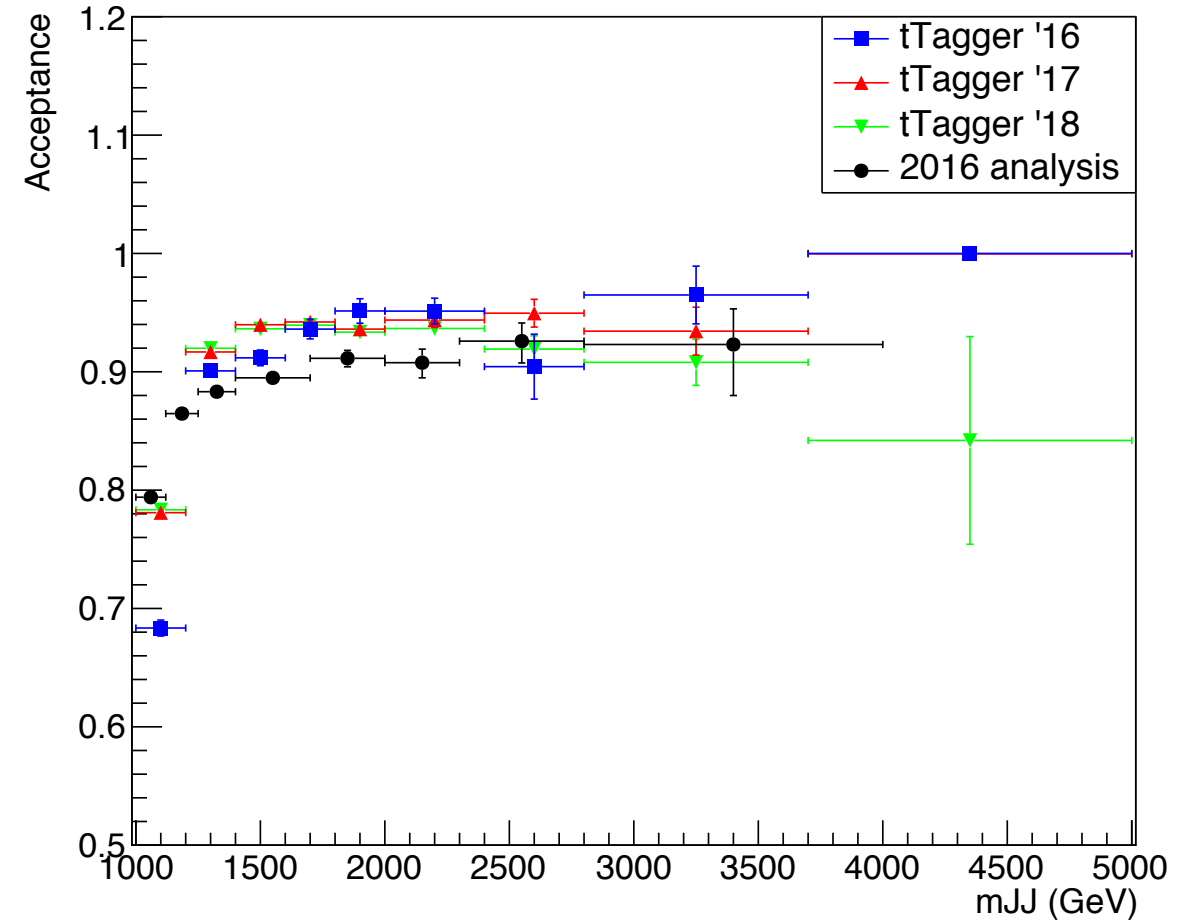
b tagging SF's

Parton Acceptance '16,'17,'18 NominalMC



without b tagging SF's

Parton Acceptance '16,'17,'18 NominalMC

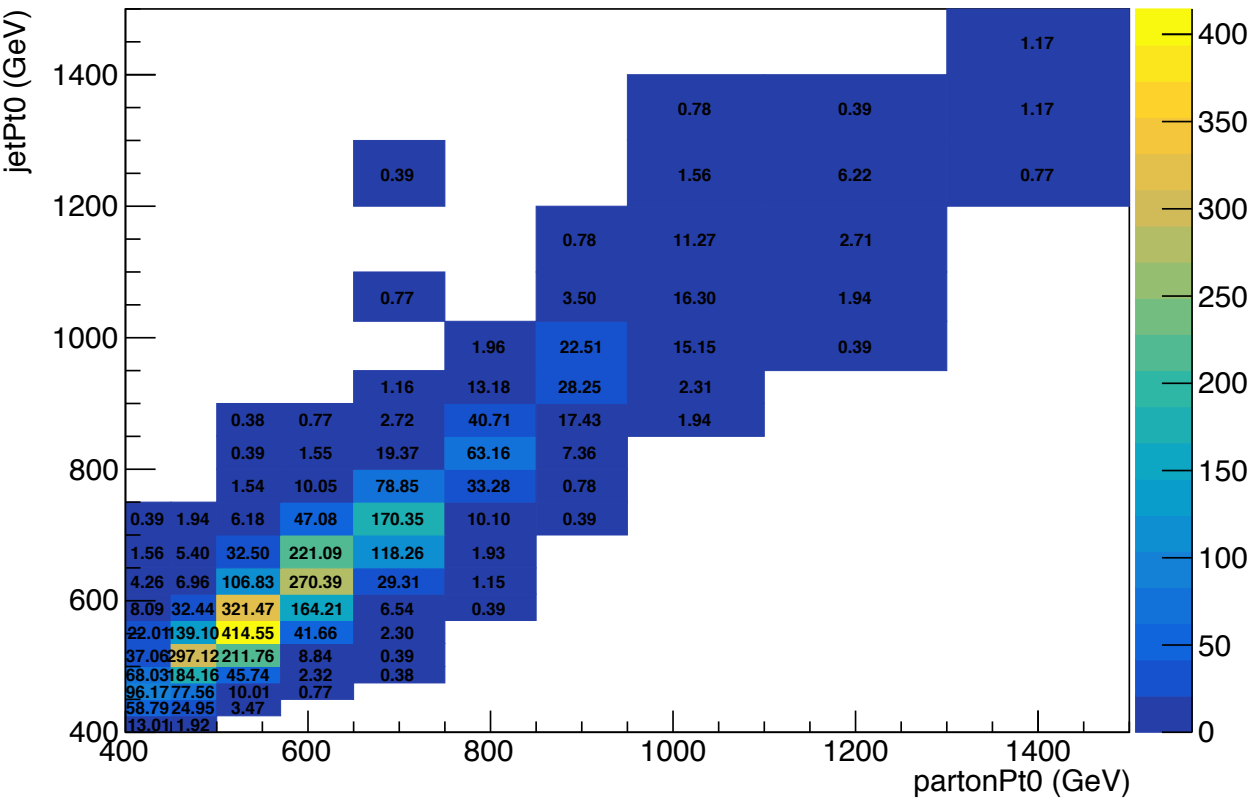


Response Matrices 2016

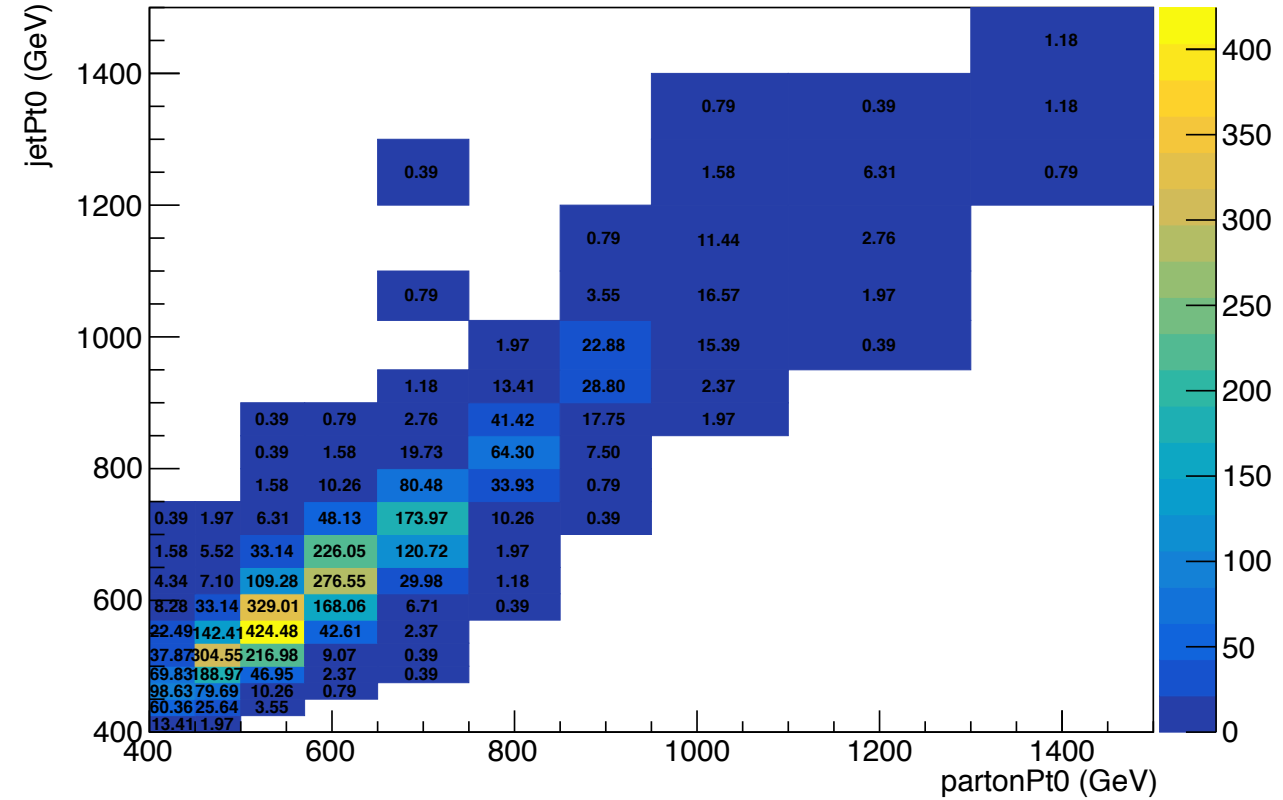
b tagging SF's

without b tagging SF's

Response Reco-Parton jetPt0 2016 NominalMC



Response Reco-Parton jetPt0 2016 NominalMC

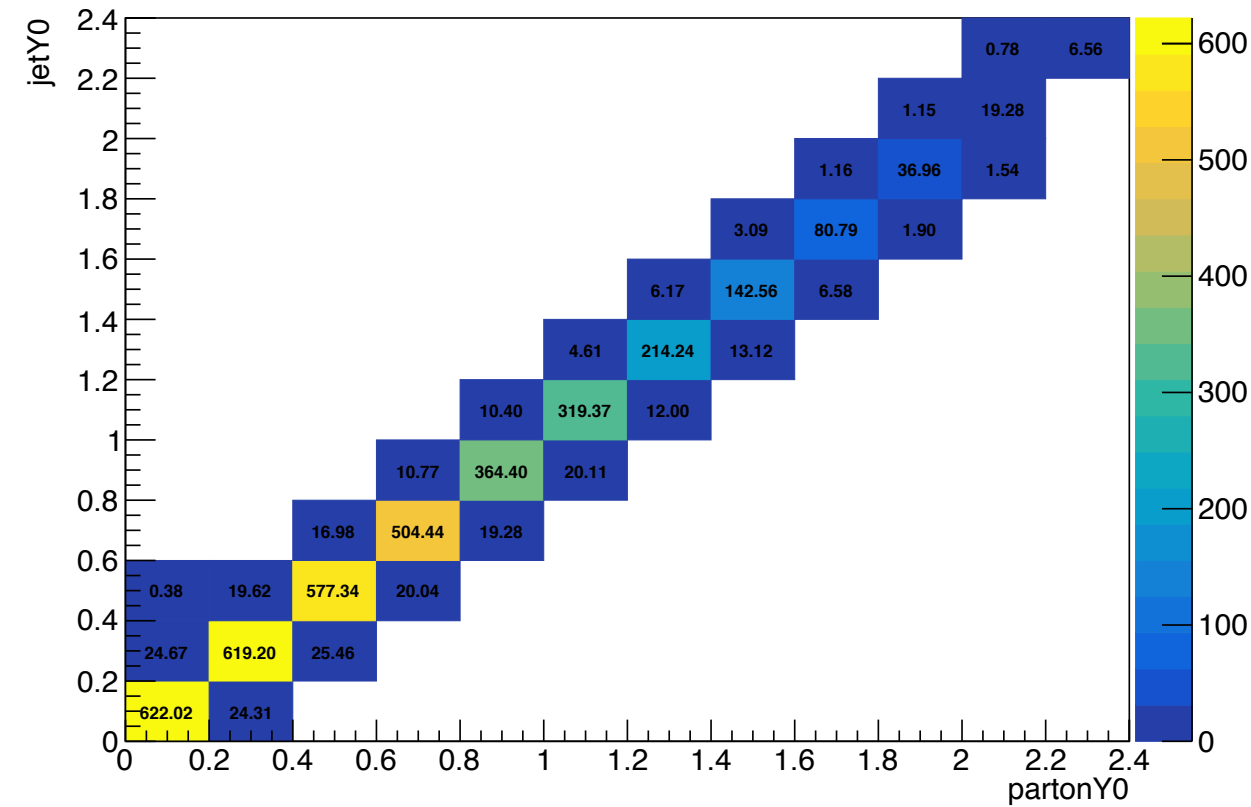


Response Matrices 2016

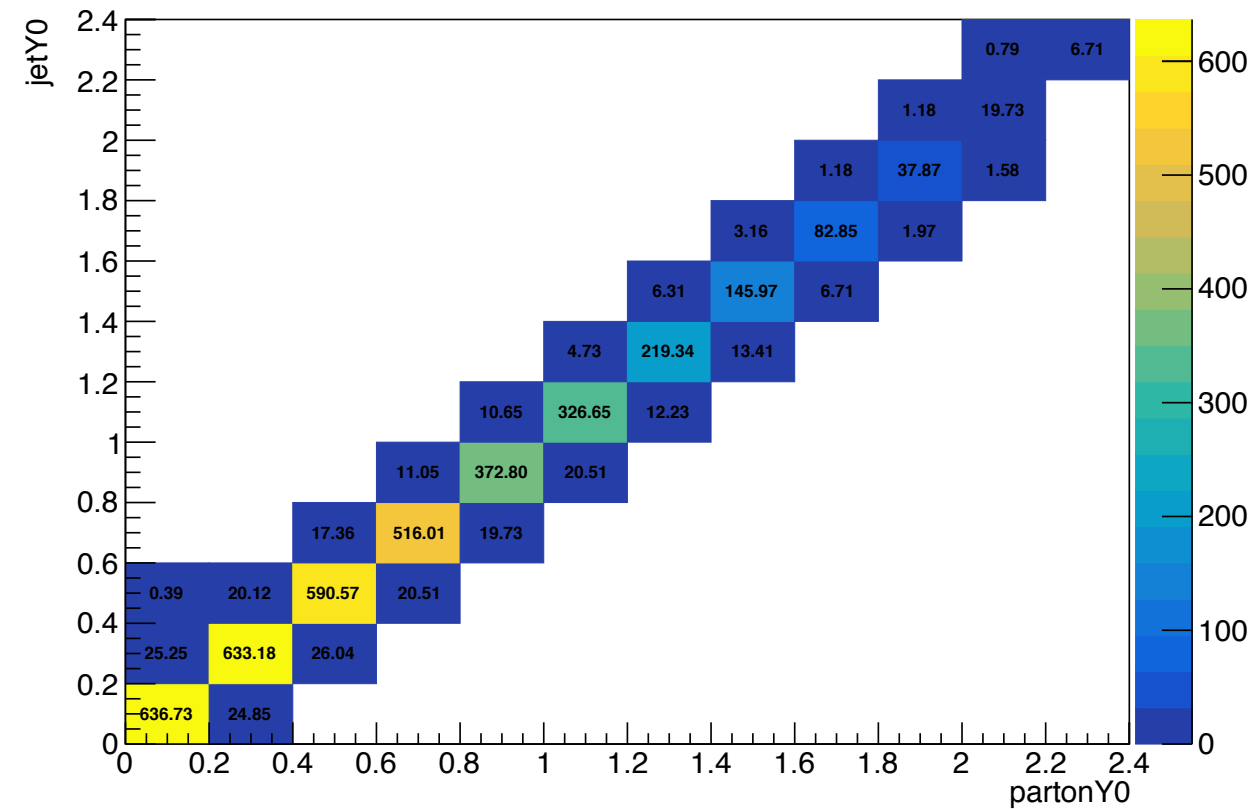
b tagging SF's

without b tagging SF's

Response Reco-Parton jetY0 2016 NominalMC



Response Reco-Parton jetY0 2016 NominalMC

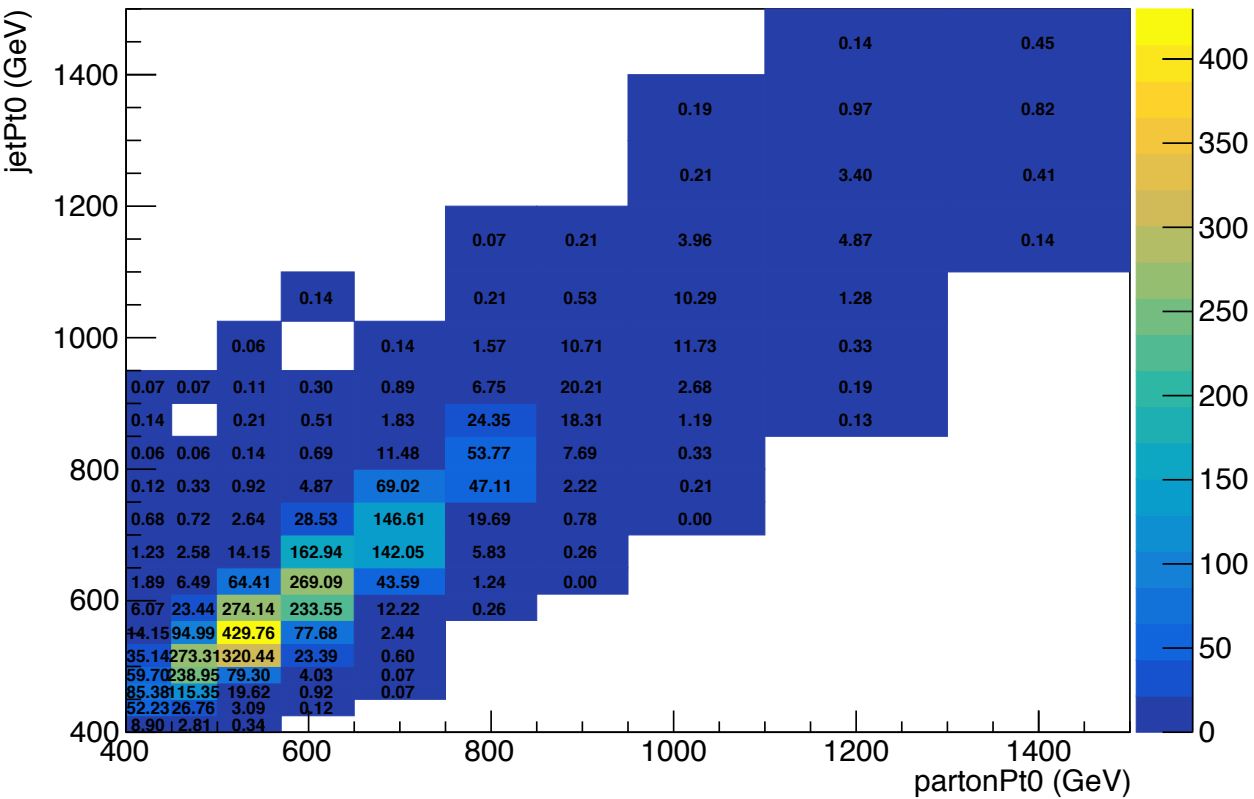


Response Matrices 2017

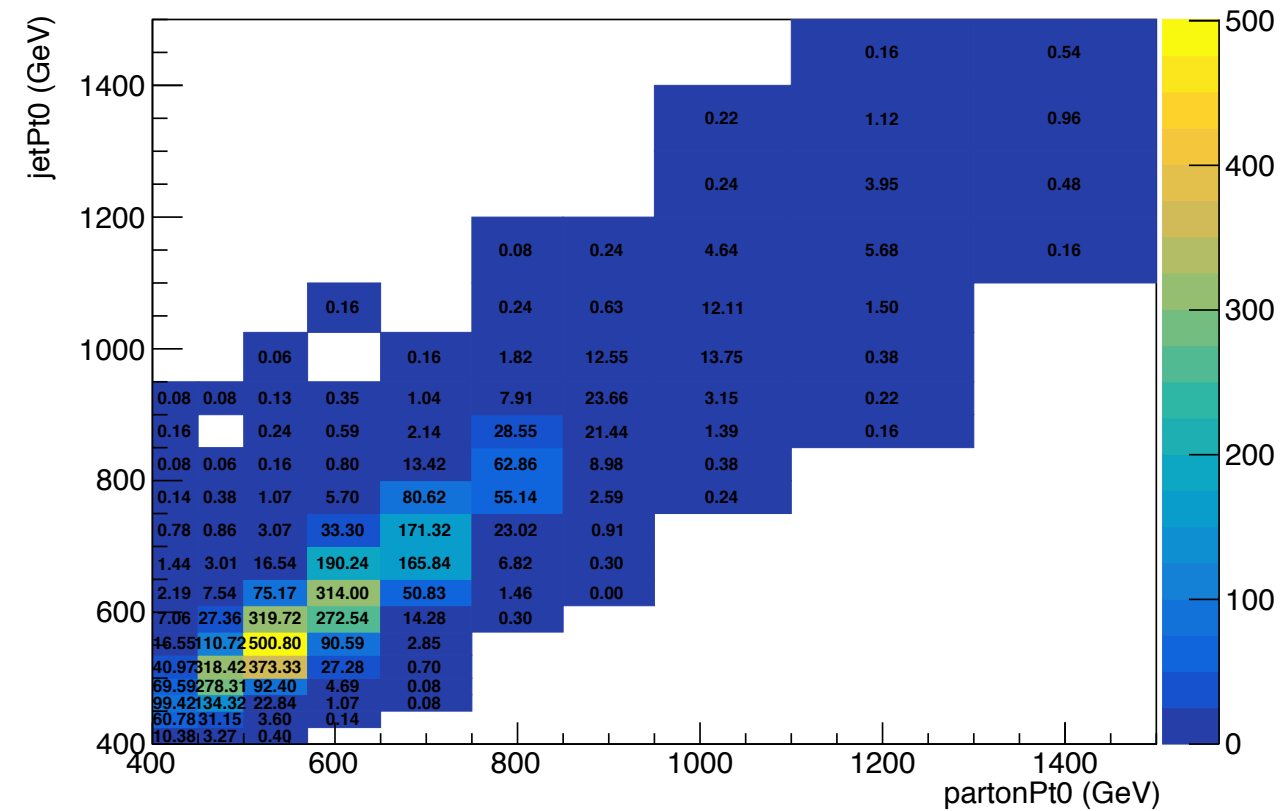
b tagging SF's

without b tagging SF's

Response Reco-Parton jetPt0 2017 NominalMC



Response Reco-Parton jetPt0 2017 NominalMC

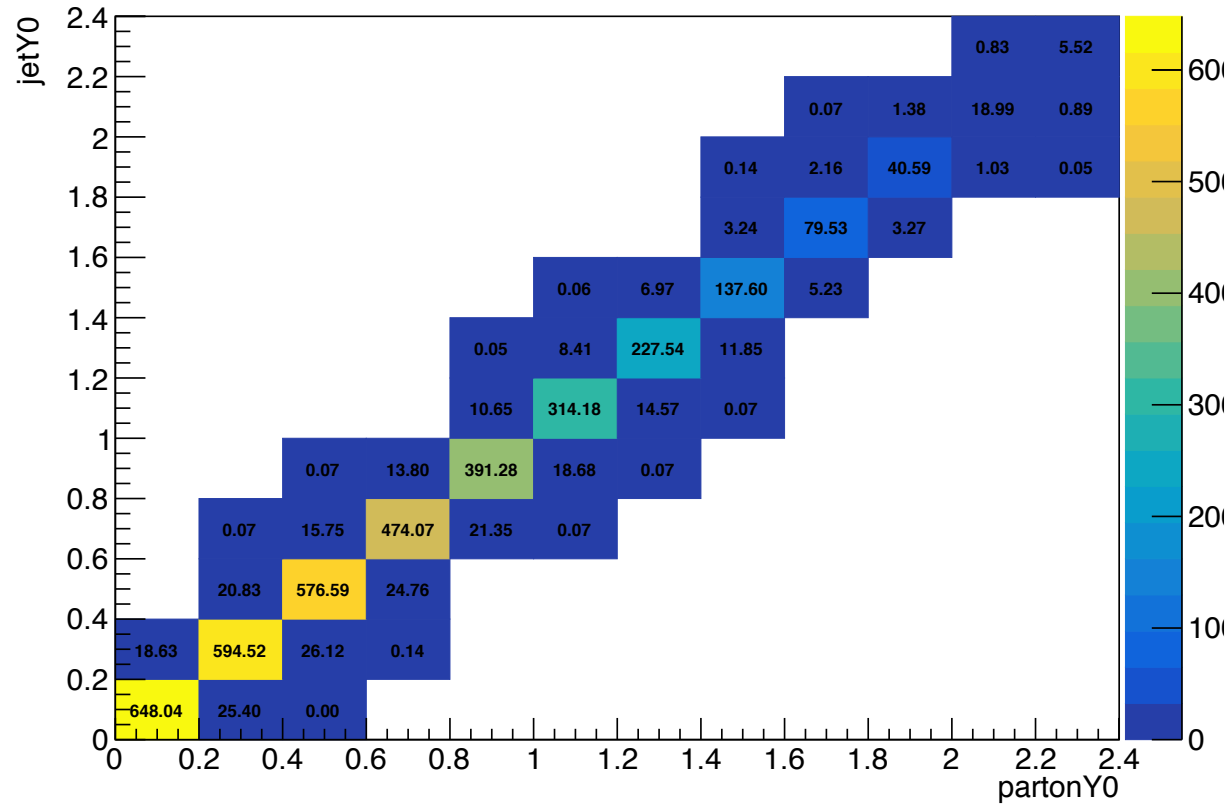


Response Matrices 2017

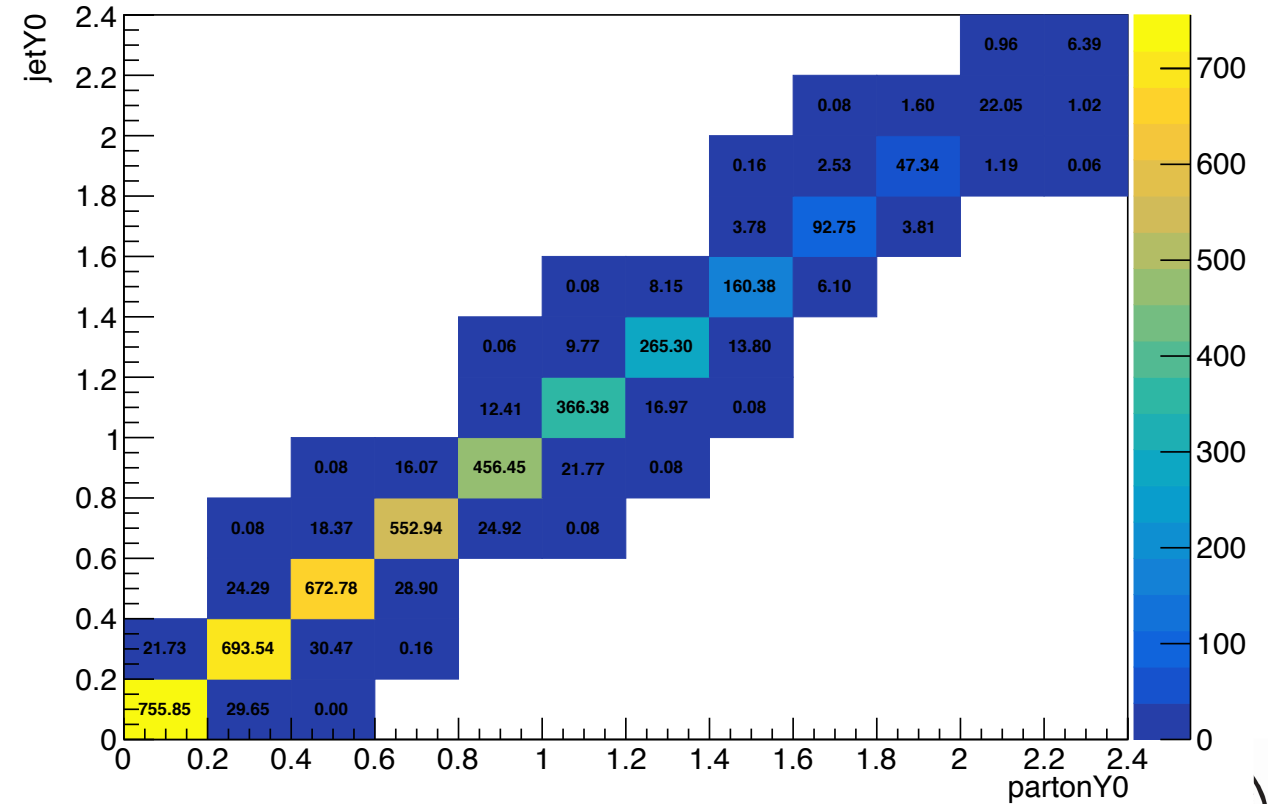
b tagging SF's

without b tagging SF's

Response Reco-Parton jetY0 2017 NominalMC



Response Reco-Parton jetY0 2017 NominalMC

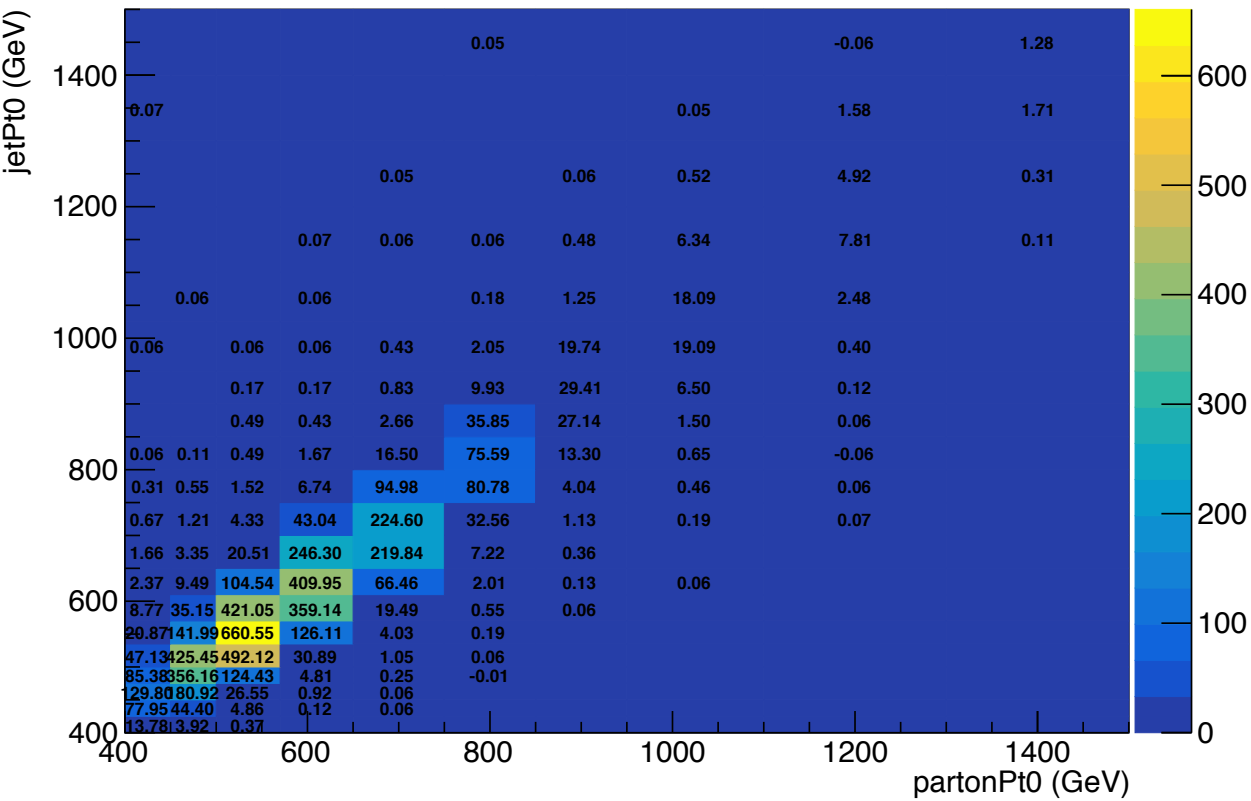


Response Matrices 2018

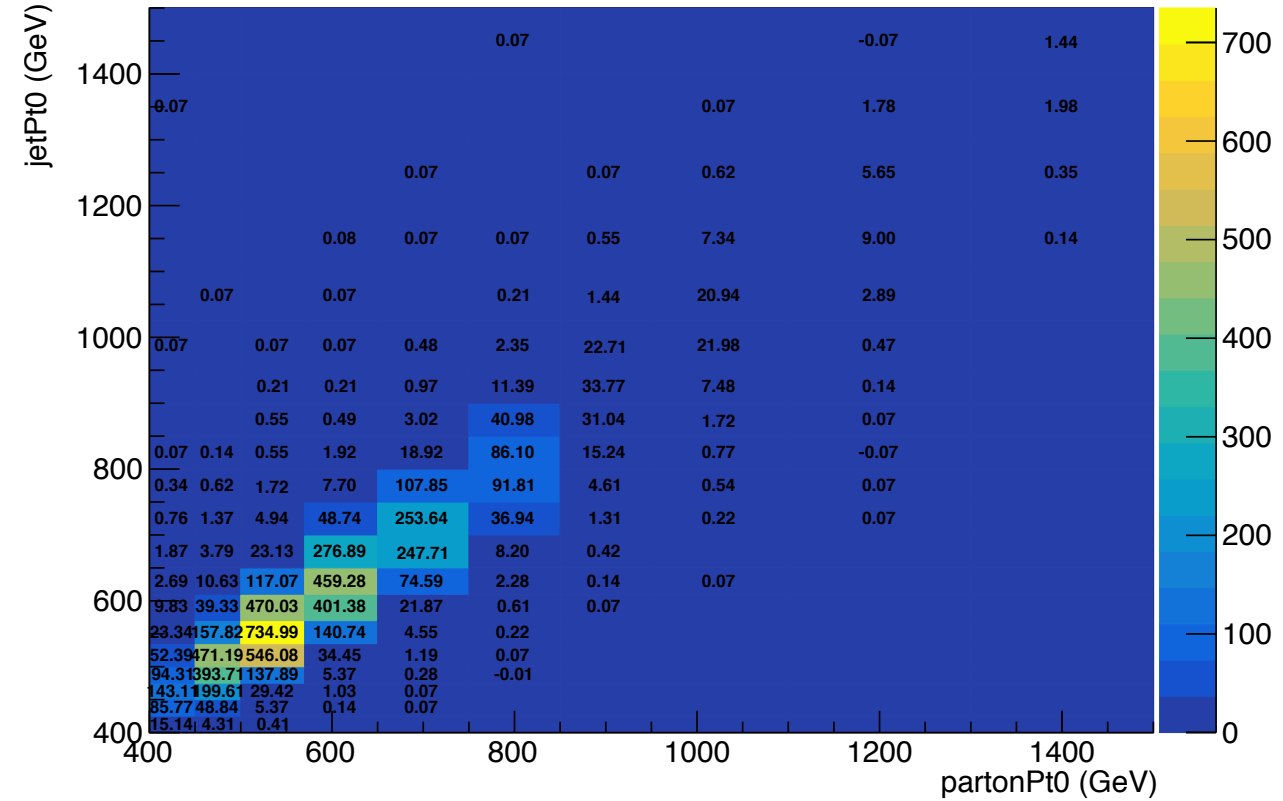
b tagging SF's

without b tagging SF's

Response Reco-Parton jetPt0 2018 NominalMC



Response Reco-Parton jetPt0 2018 NominalMC

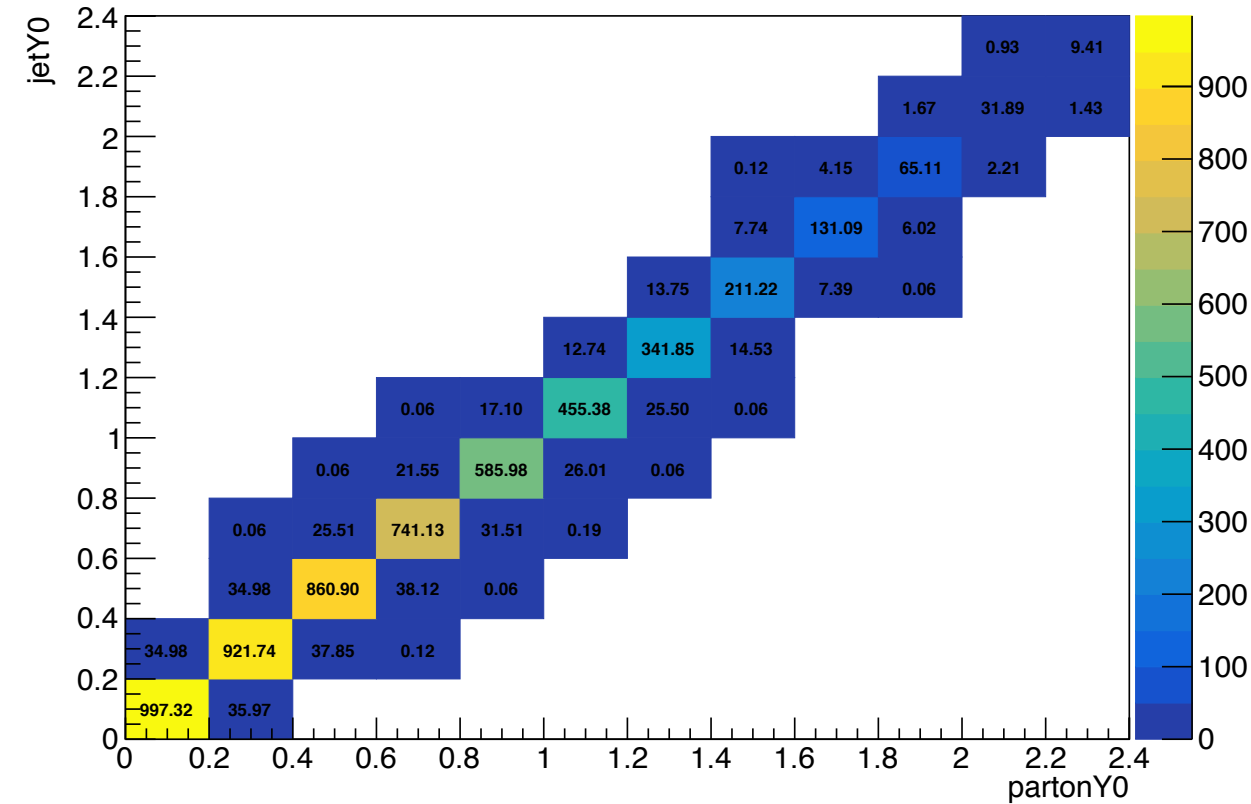


Response Matrices 2018

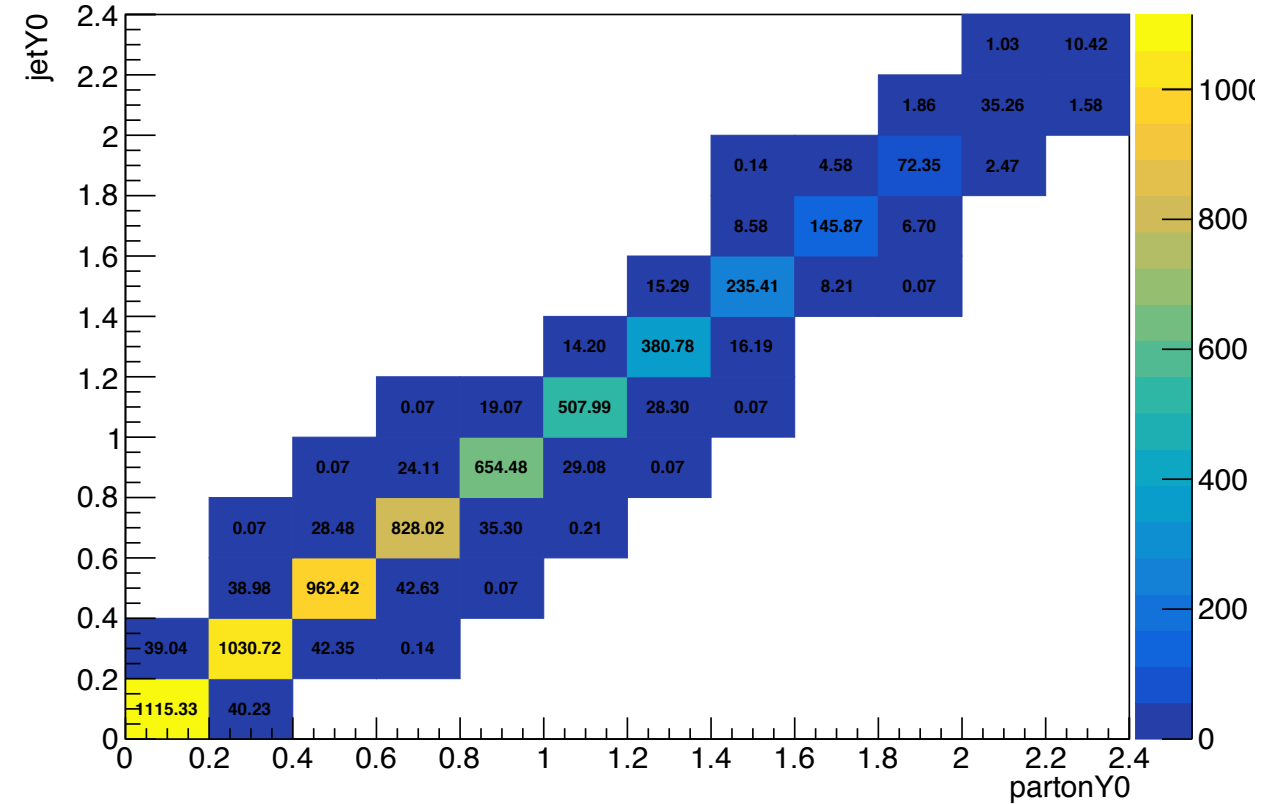
b tagging SF's

without b tagging SF's

Response Reco-Parton jetY0 2018 NominalMC

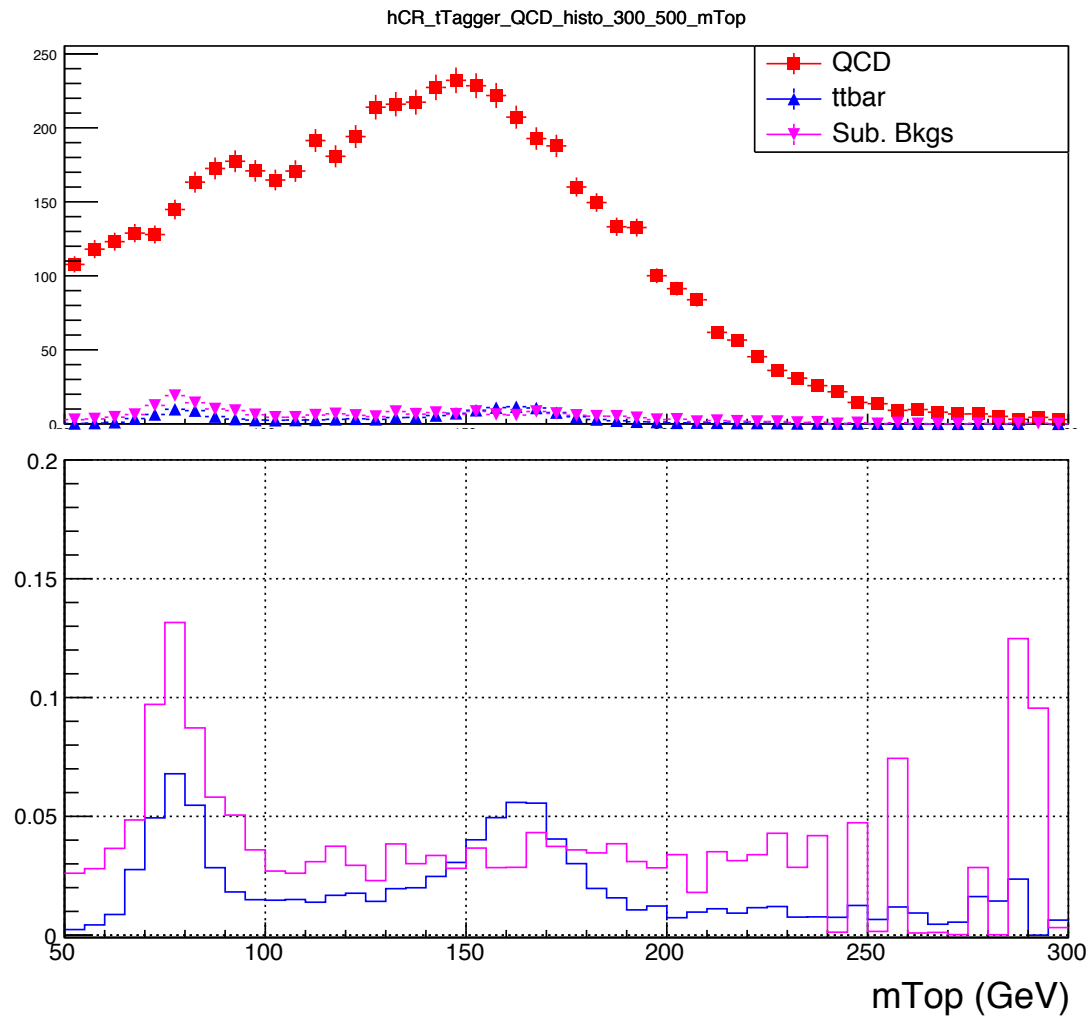


Response Reco-Parton jetY0 2018 NominalMC

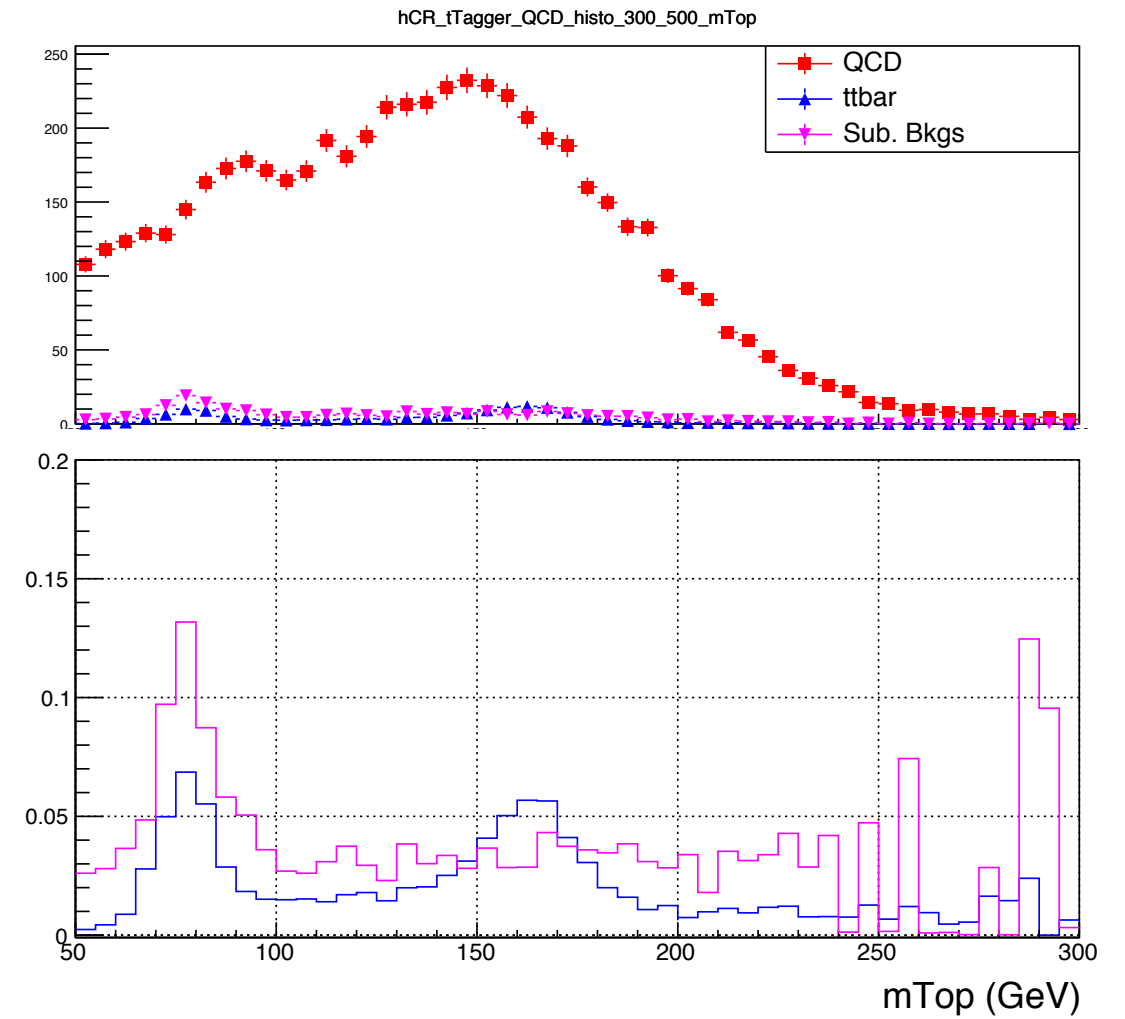


Contamination Plots Medium WP (CR) 2016

b tagging SF's

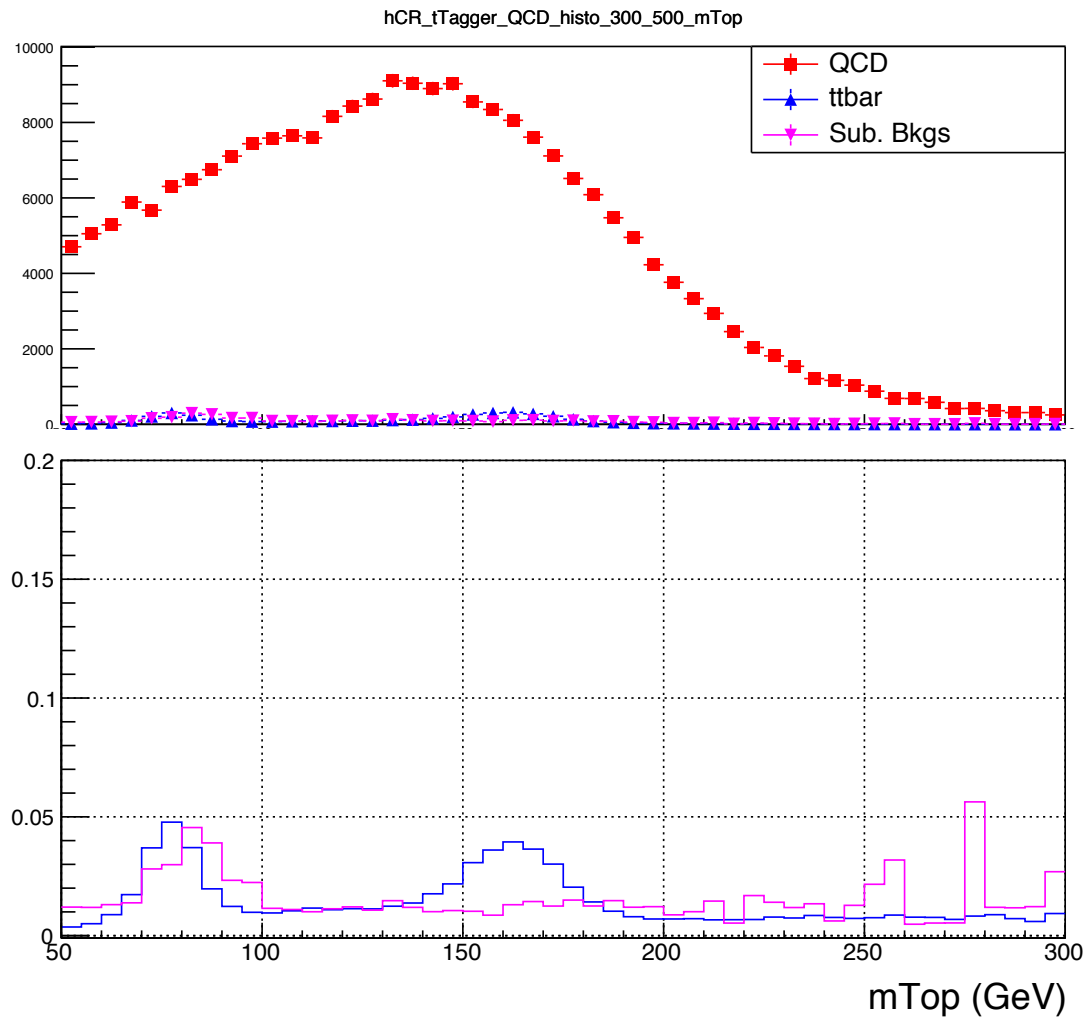


without b tagging SF's

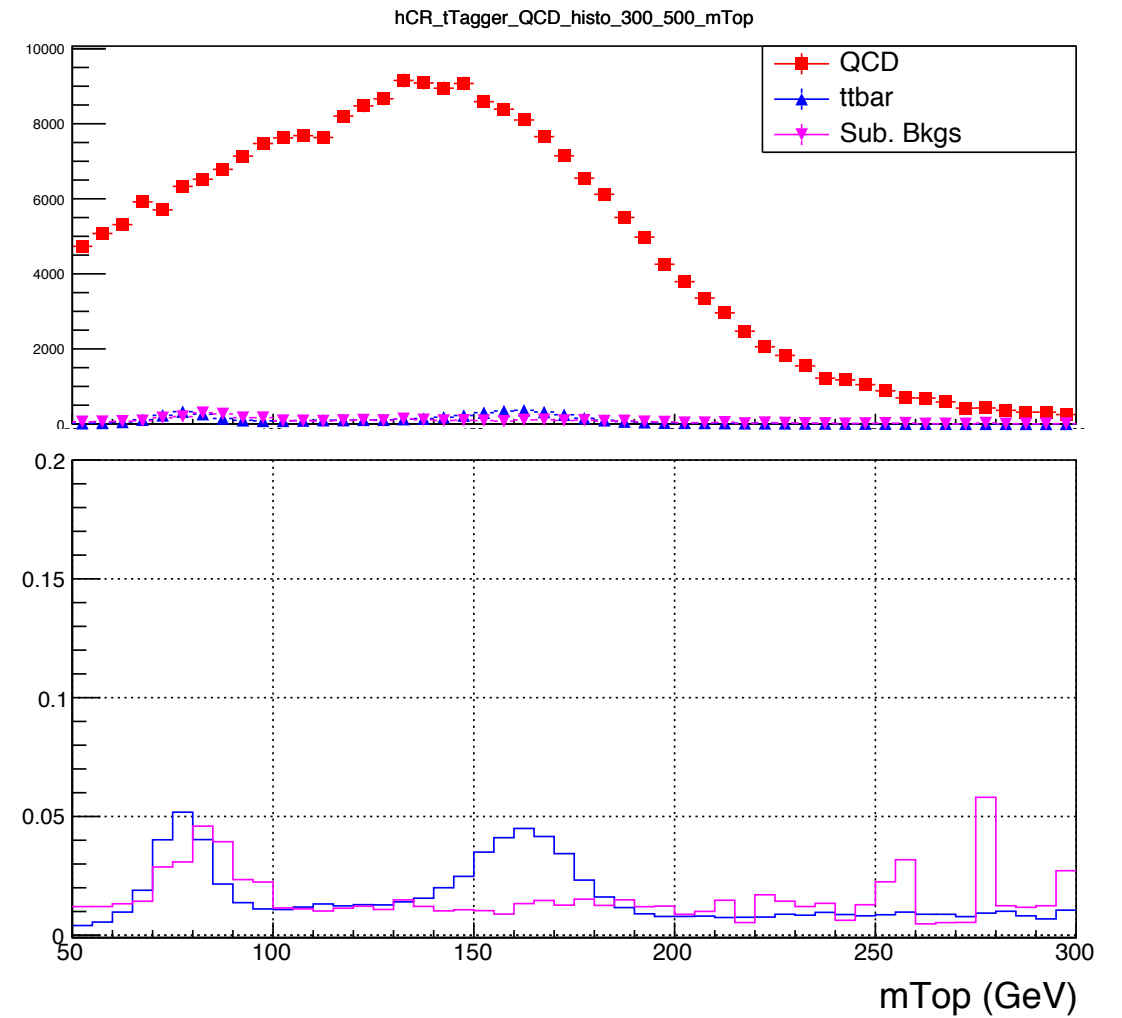


Contamination Plots Medium WP (CR) 2017

b tagging SF's

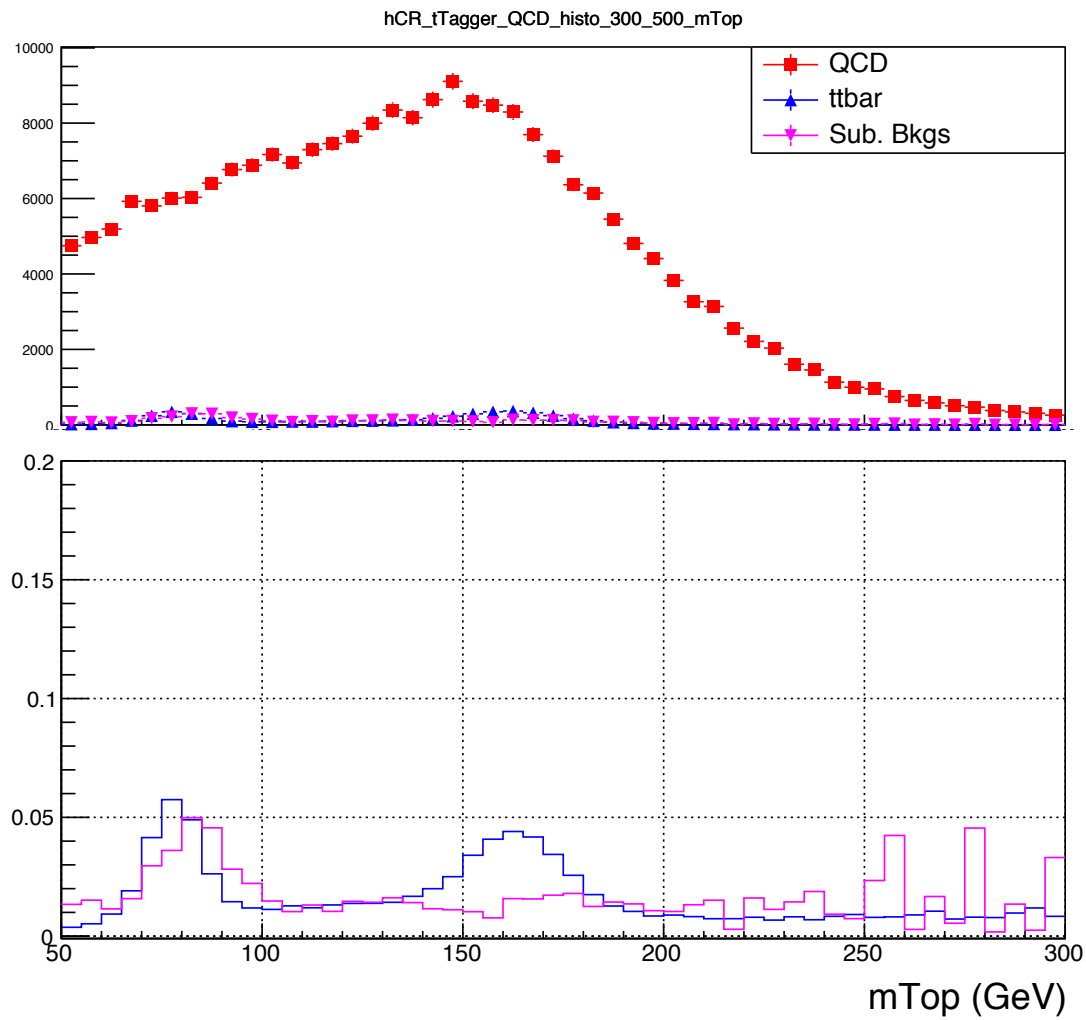


without b tagging SF's

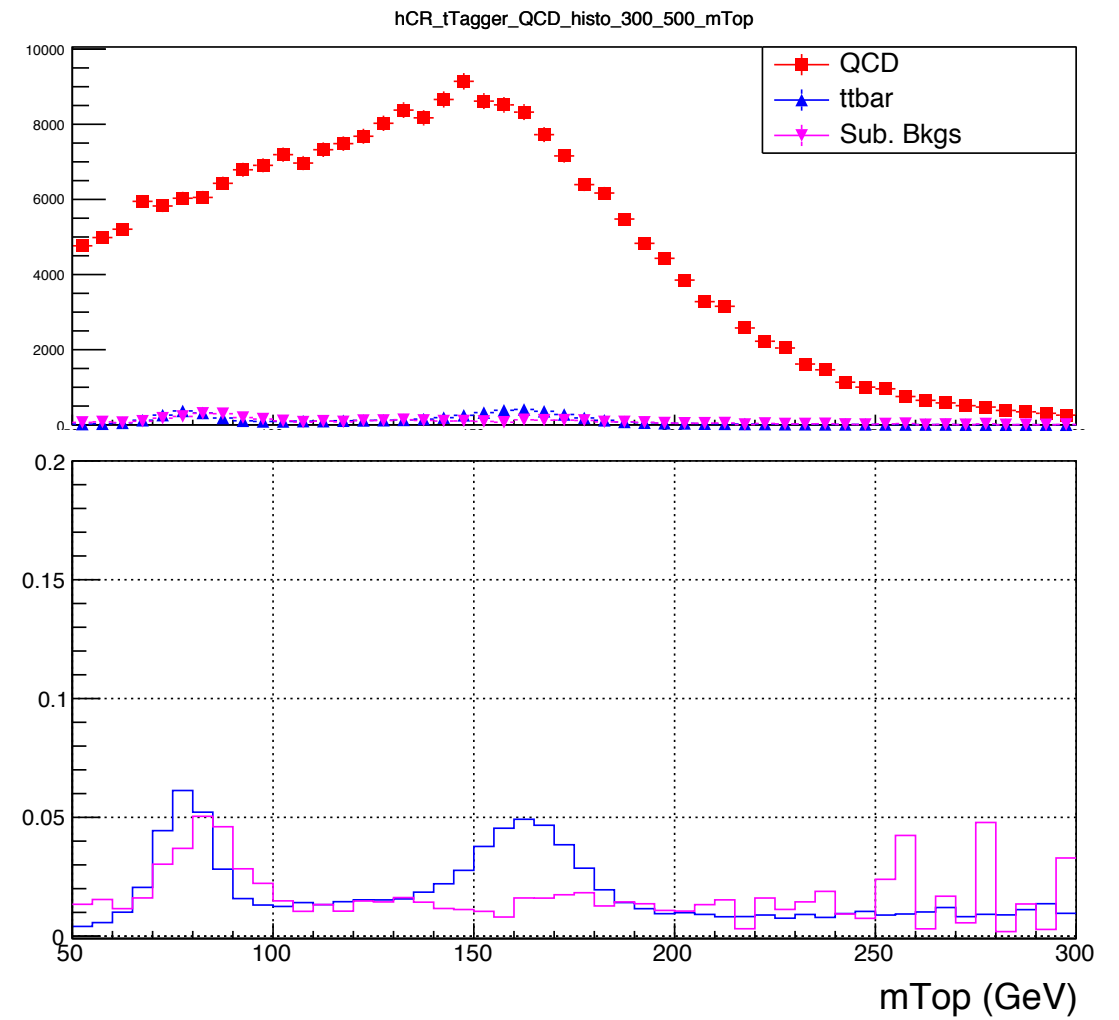


Contamination Plots Medium WP (CR) 2018

b tagging SF's



without b tagging SF's



Contamination Plots Medium WP (CR, SR) 2018



- 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

Simple Mass Fit 2016

A RooPlot of "mTop"

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

Without tag SF:

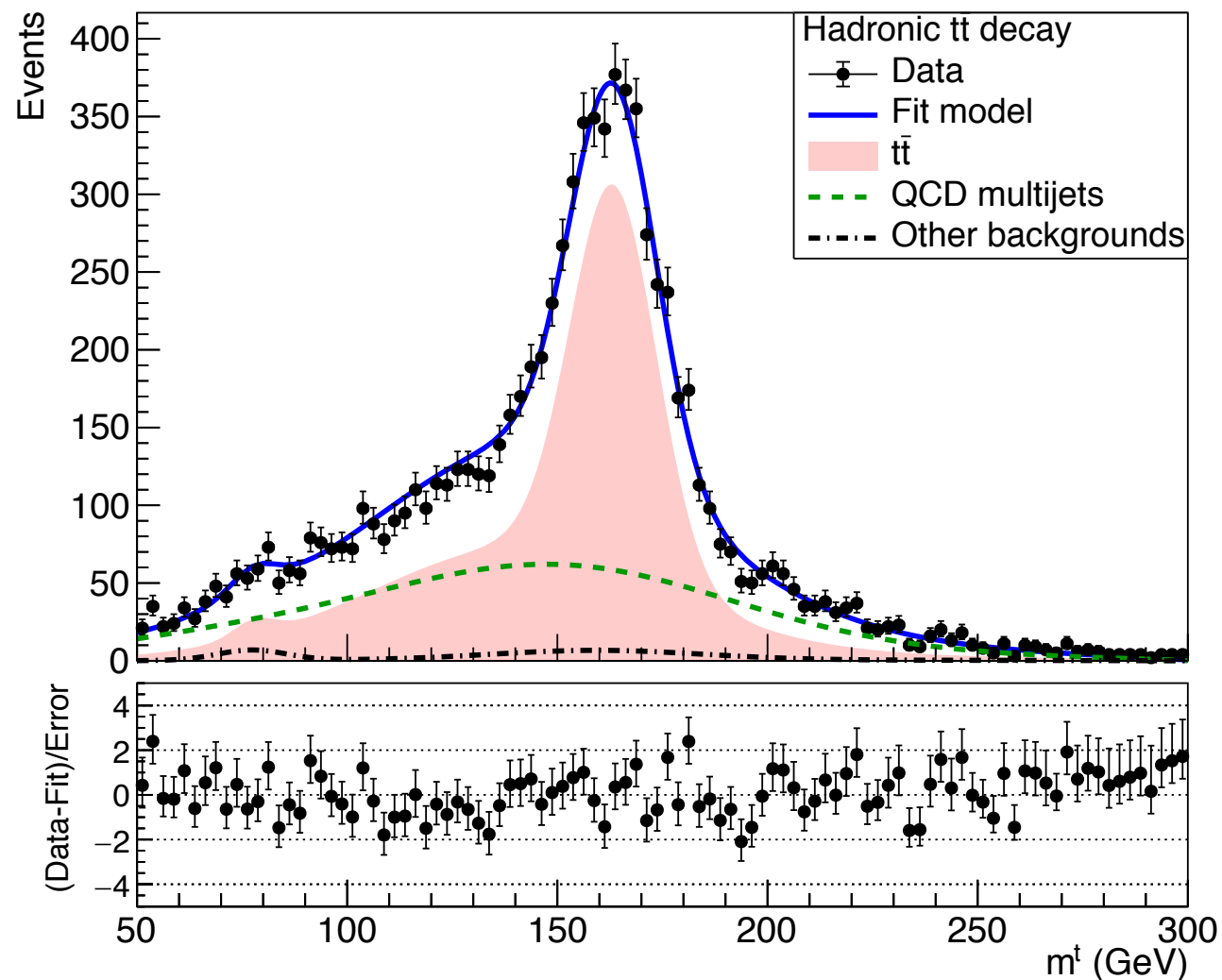
Floating Parameter	FinalValue +/-	Error
kMassResol	9.2245e-01 +/-	2.72e-02
kMassScale	9.9906e-01 +/-	2.01e-03
kQCD_2b	6.8926e-02 +/-	5.06e-02
nFitBkg_2b	2.5236e+02 +/-	1.44e+02
nFitQCD_2b	2.9886e+03 +/-	1.73e+02
nFitSig2b	5.2694e+03 +/-	1.65e+02

Signal strength: $r = 0.671244 \pm 0.0252439$ (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: $r = 0.686668 \pm 0.0263103$ (new)



Simple Mass Fit 2017

A RooPlot of "mTop"

Without b tag SF:

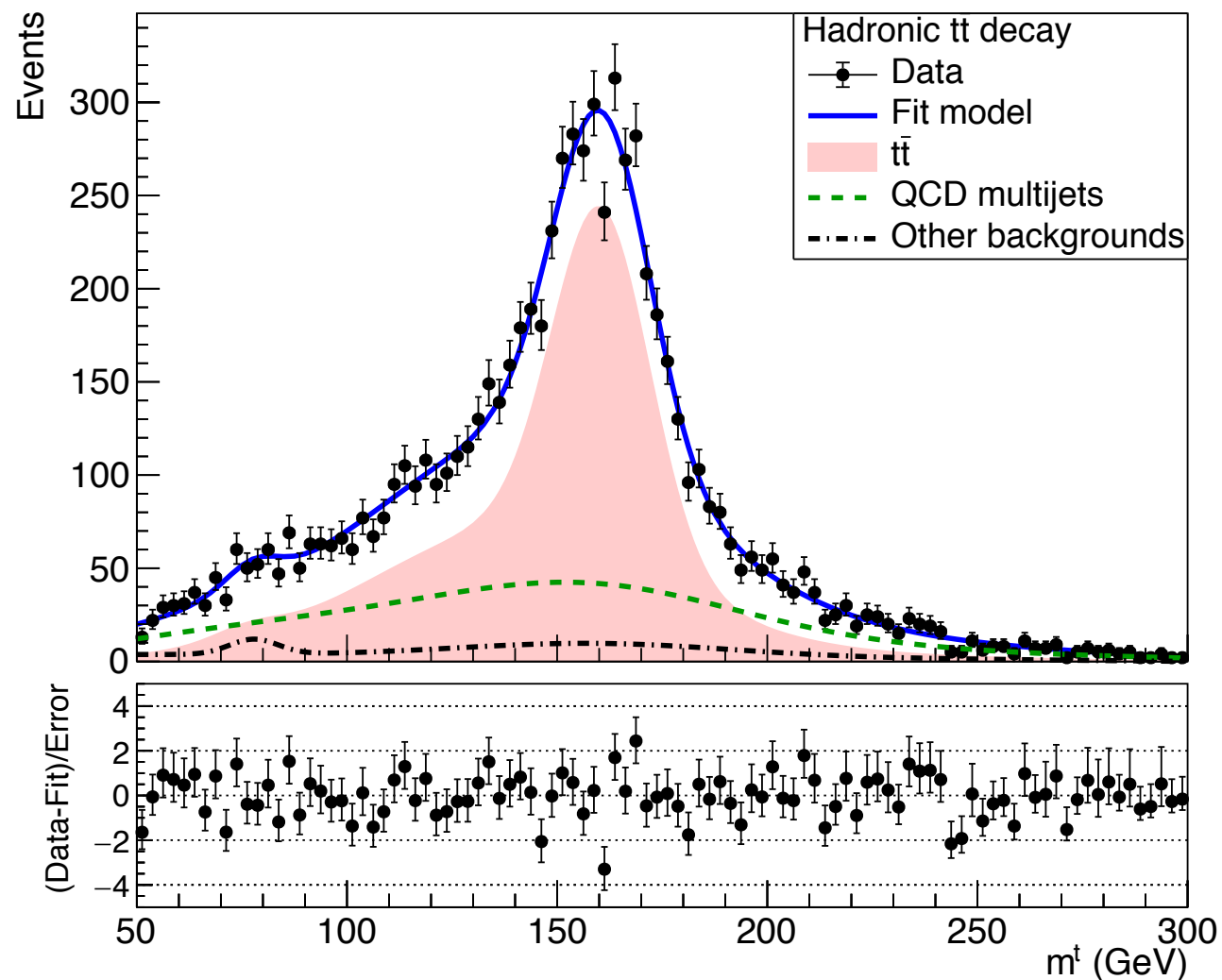
Floating Parameter	FinalValue +/-	Error
kMassResol	1.0990e+00 +/-	4.05e-02
kMassScale	9.8328e-01 +/-	2.64e-03
kQCD_2b	1.6702e-02 +/-	7.79e-03
nFitBkg_2b	6.3994e+02 +/-	2.81e+02
nFitQCD_2b	2.0219e+03 +/-	3.23e+02
nFitSig2b	4.8080e+03 +/-	1.51e+02

Signal strength: $r = 0.553099 \pm 0.0198563$ (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: $r = 0.644361 \pm 0.023851$ (new)



Simple Mass Fit 2018

A RooPlot of "mTop"

Without b tag SF:

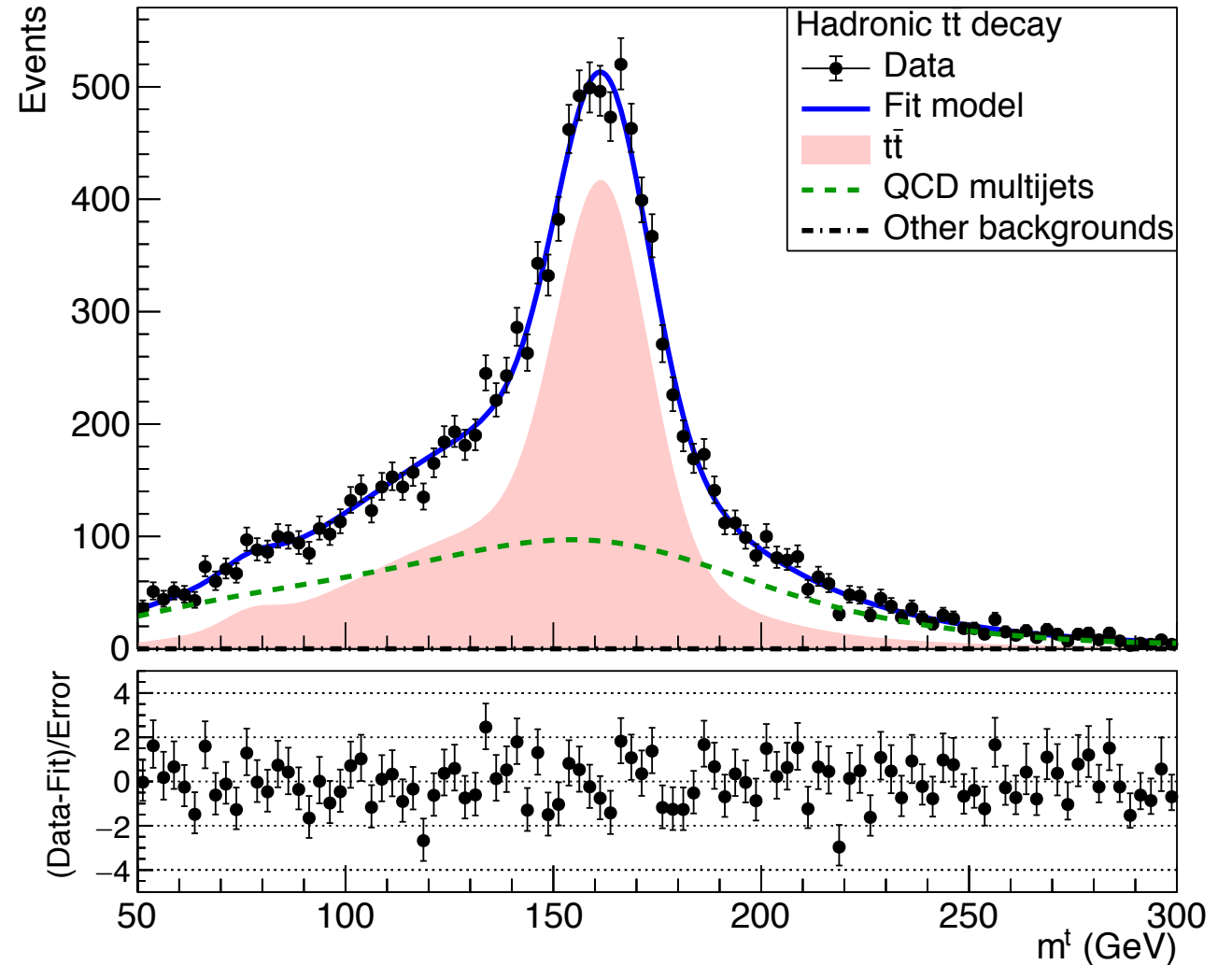
Floating Parameter	FinalValue	+/-	Error
kMassResol	1.0171e+00	+/-	2.87e-02
kMassScale	9.8961e-01	+/-	1.92e-03
kQCD_2b	1.3178e-02	+/-	3.01e-03
nFitBkg_2b	3.0164e+02	+/-	2.73e+02
nFitQCD_2b	4.7747e+03	+/-	3.04e+02
nFitSig2b	7.7140e+03	+/-	1.85e+02

Signal strength: $r = 0.615816 \pm 0.017298$ (old)

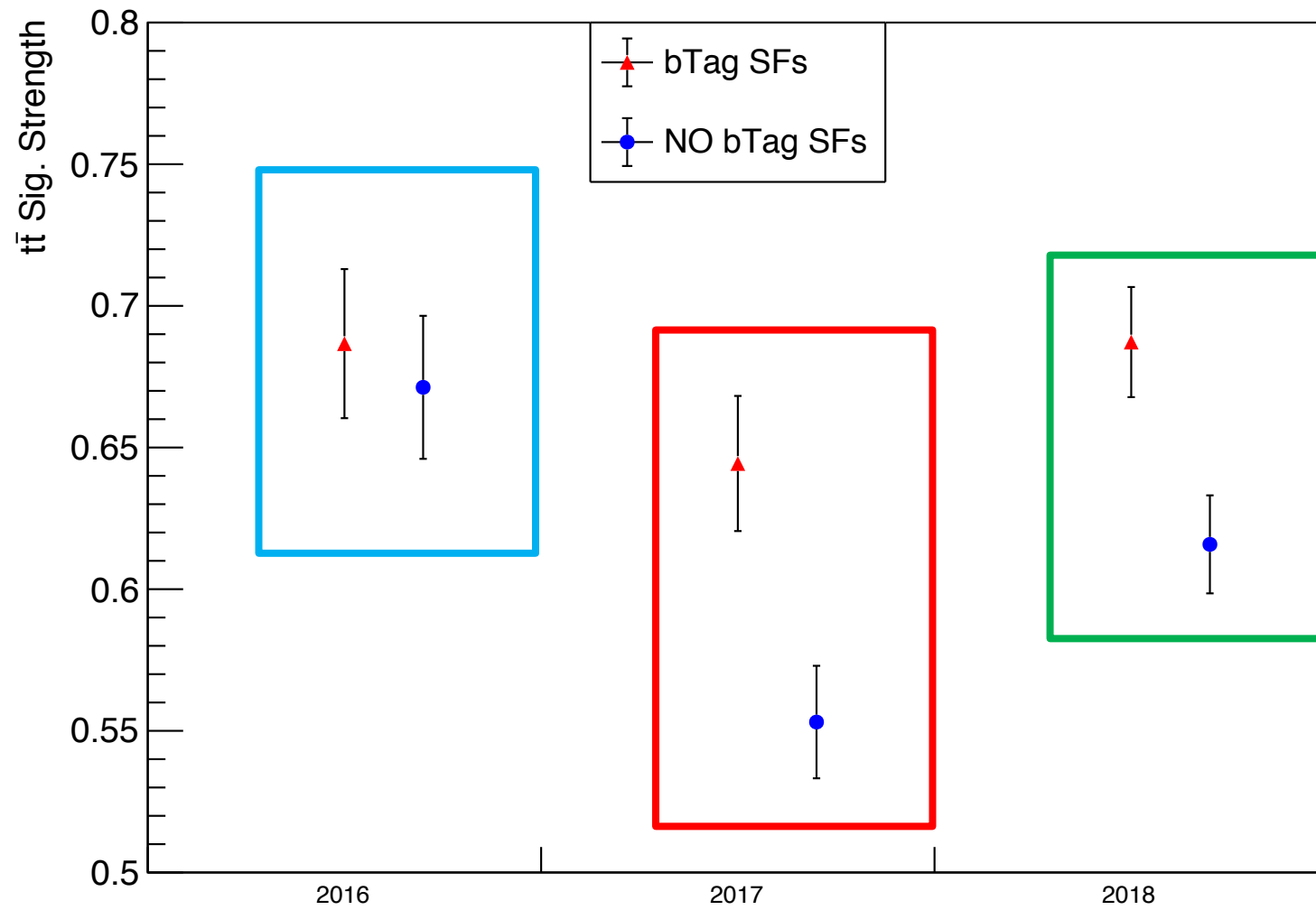
With b tag SF:

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: $r = 0.687217 \pm 0.0194349$ (new)



Signal Strength Results

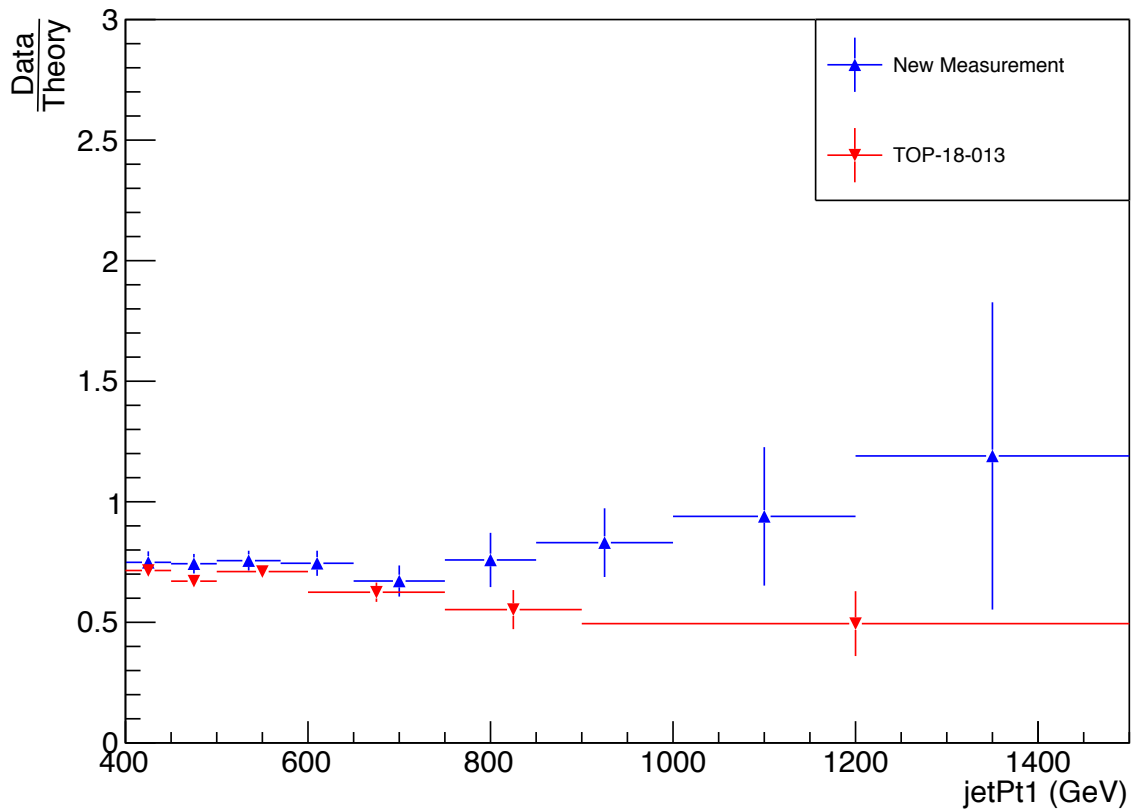


Signal Extraction 2016

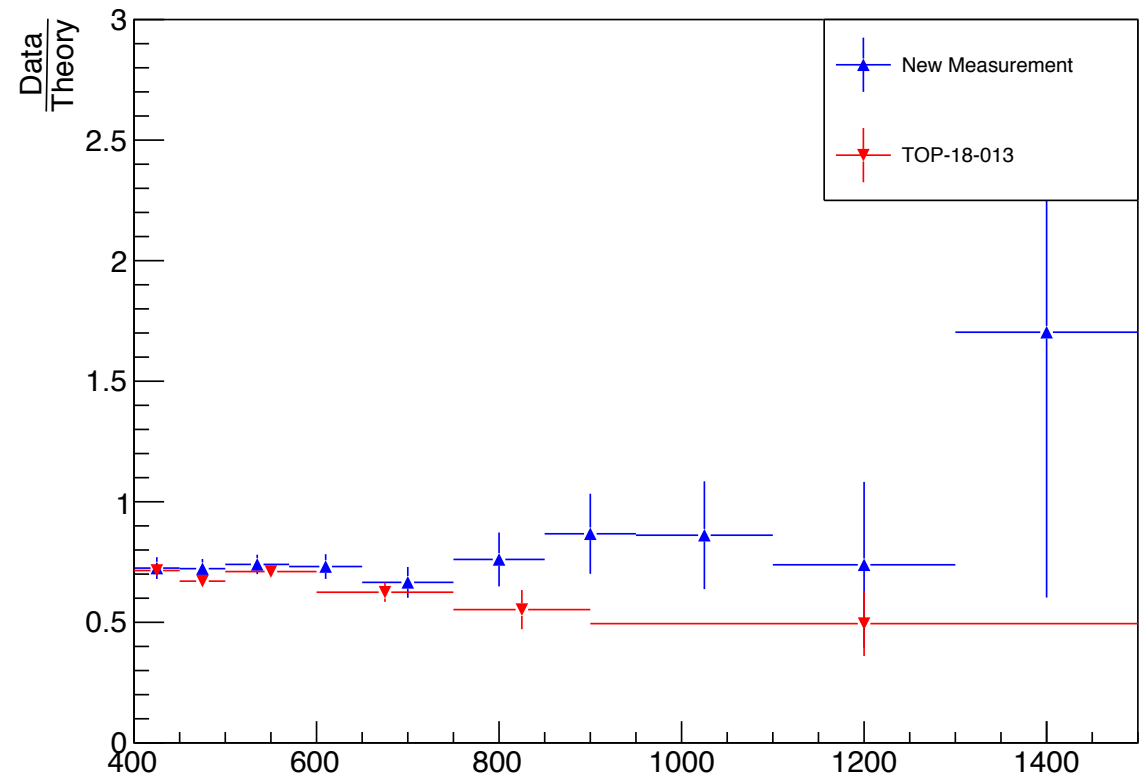
b tagging SF's

without b tagging SF's

Fiducial DataOverMC ratio (2016, TOP18013)



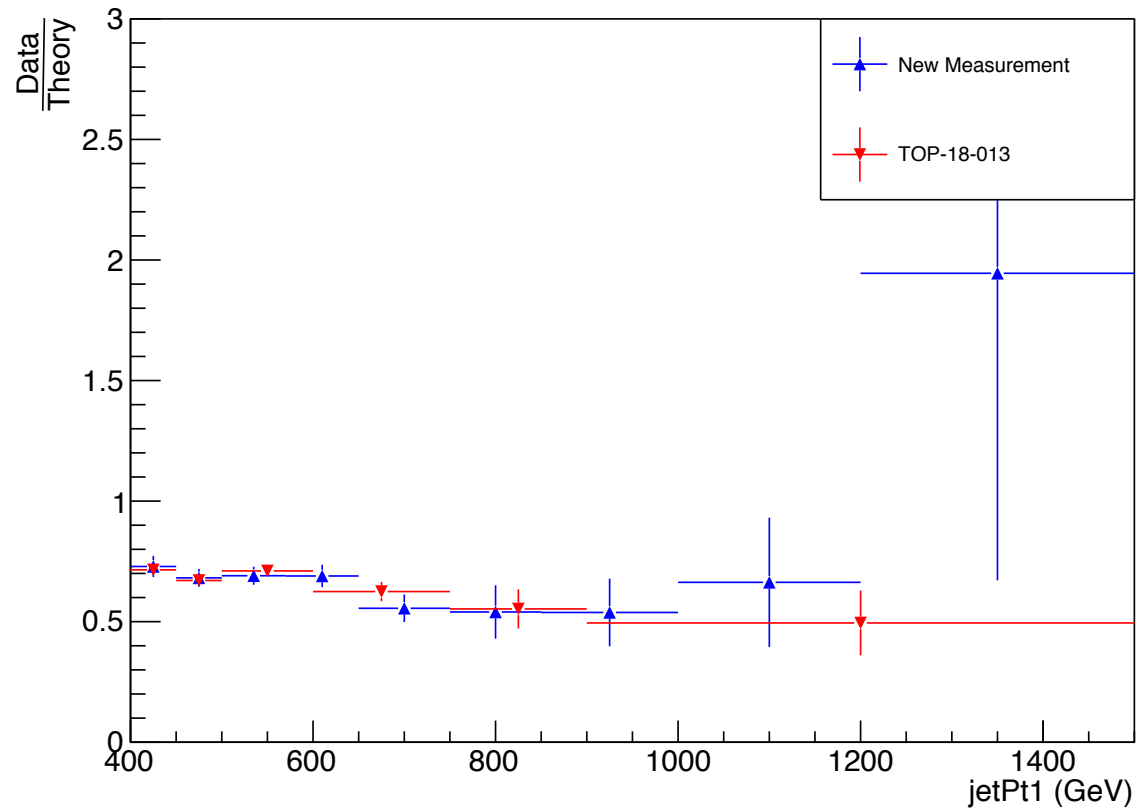
Fiducial DataOverMC ratio (2016, TOP18013)



Signal Extraction 2017

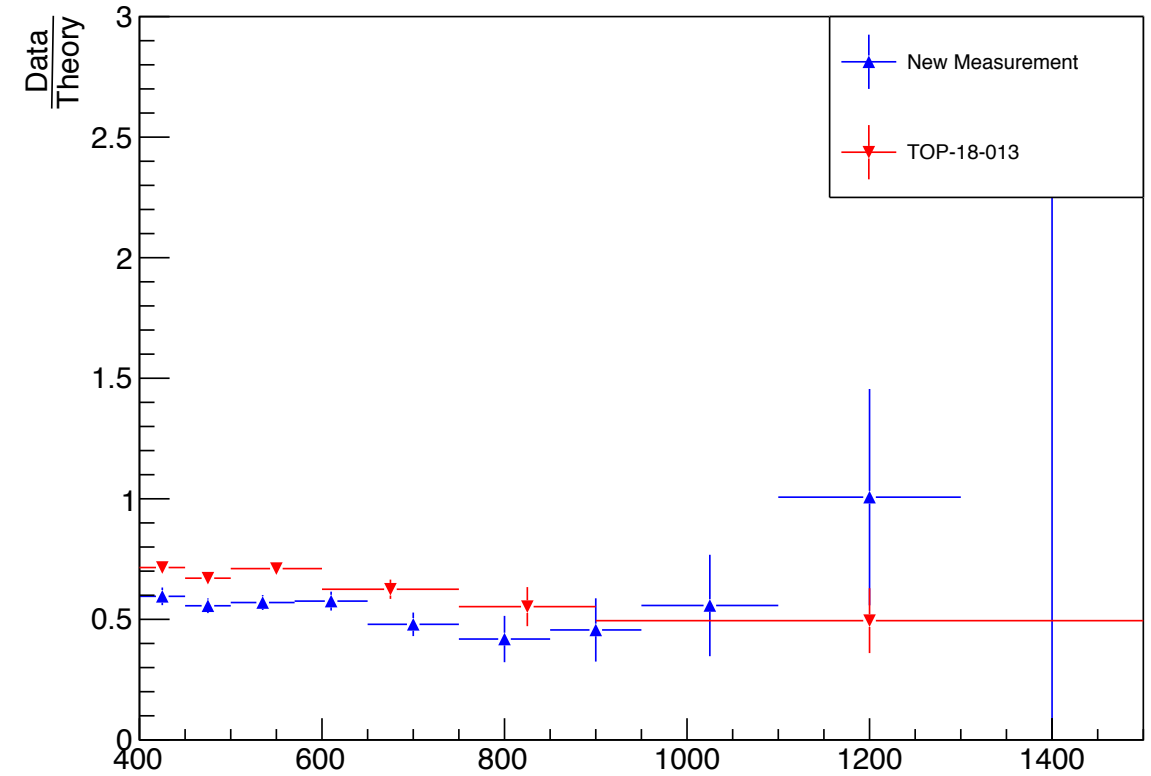
b tagging SF's

Fiducial DataOverMC ratio (2017, TOP18013)



without b tagging SF's

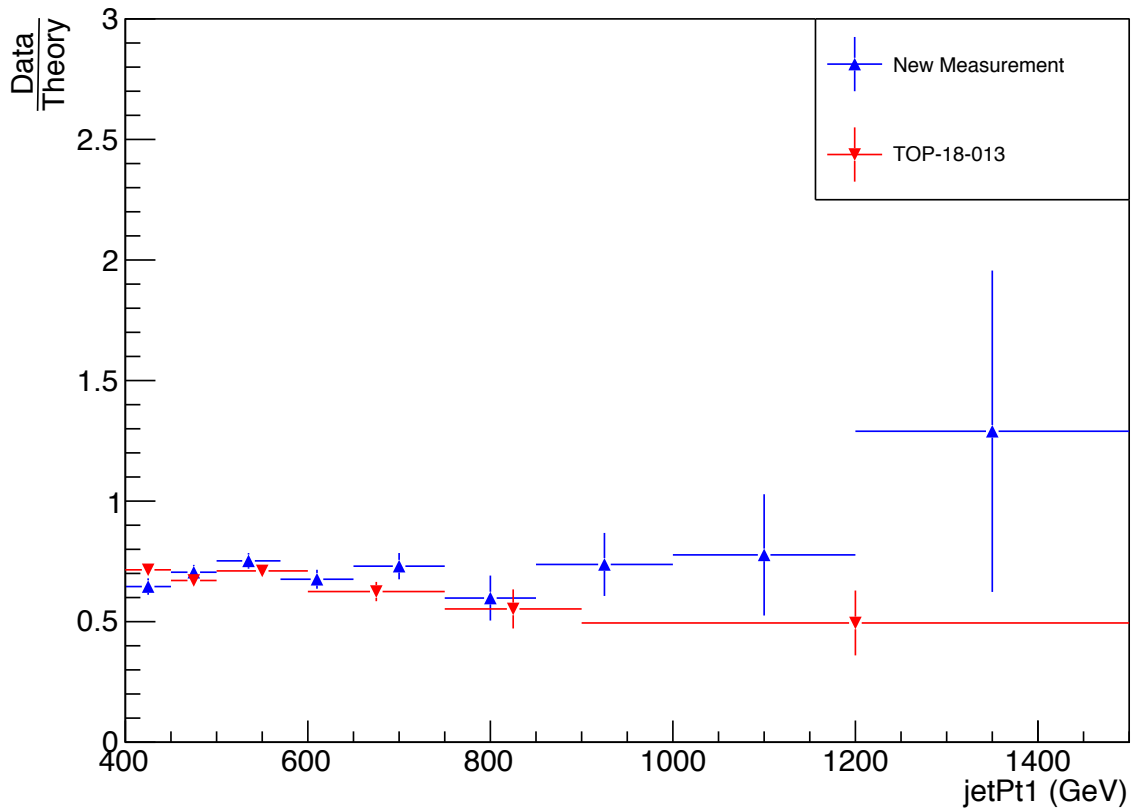
Fiducial DataOverMC ratio (2017, TOP18013)



Signal Extraction 2018

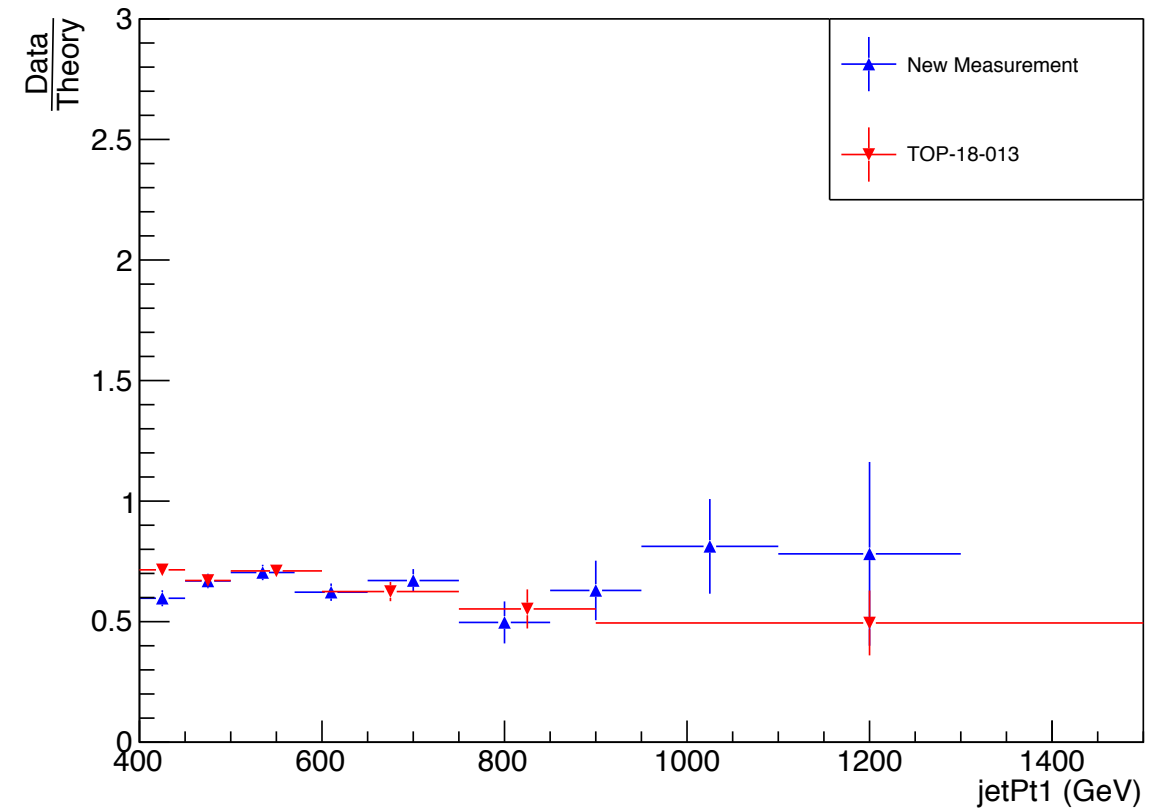
b tagging SF's

Fiducial DataOverMC ratio (2018, TOP18013)



without b tagging SF's

Fiducial DataOverMC ratio (2018, TOP18013)



Tag And Probe

- Top Tagger Scale Factors

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

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

- 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

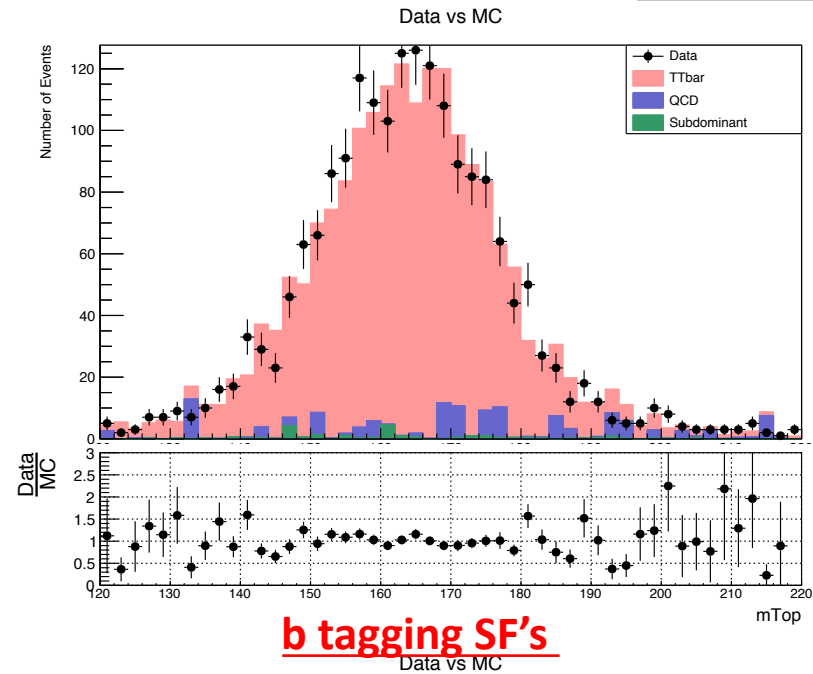
eff ttbar pT[600-800]: 0.748 ± 0.031

eff data pT[800-Inf]: 0.888 ± 0.161

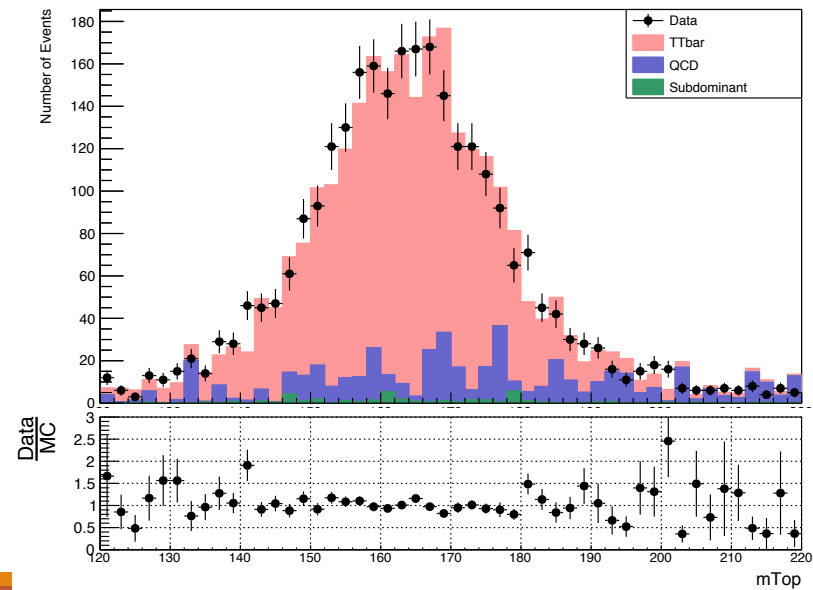
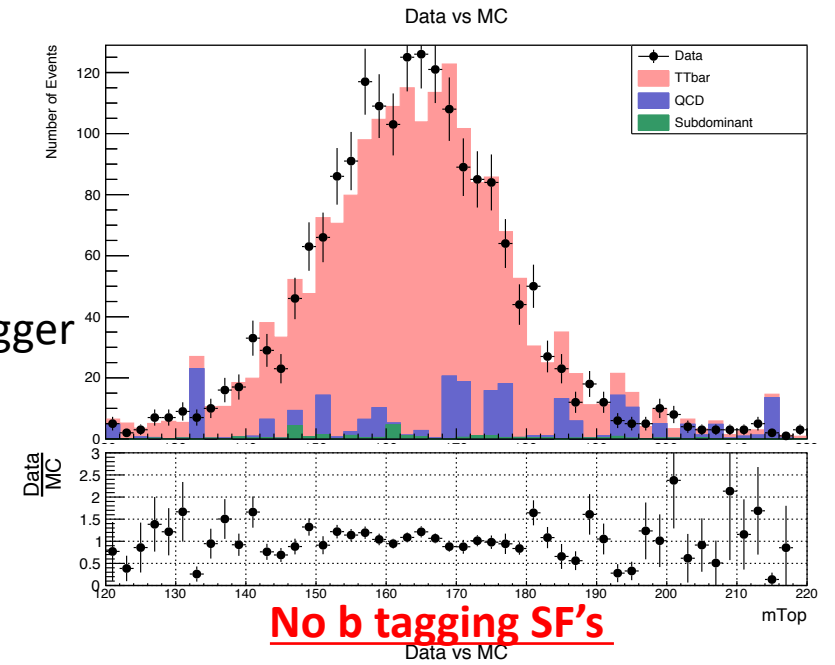
eff ttbar pT[800-Inf]: 0.775 ± 0.064



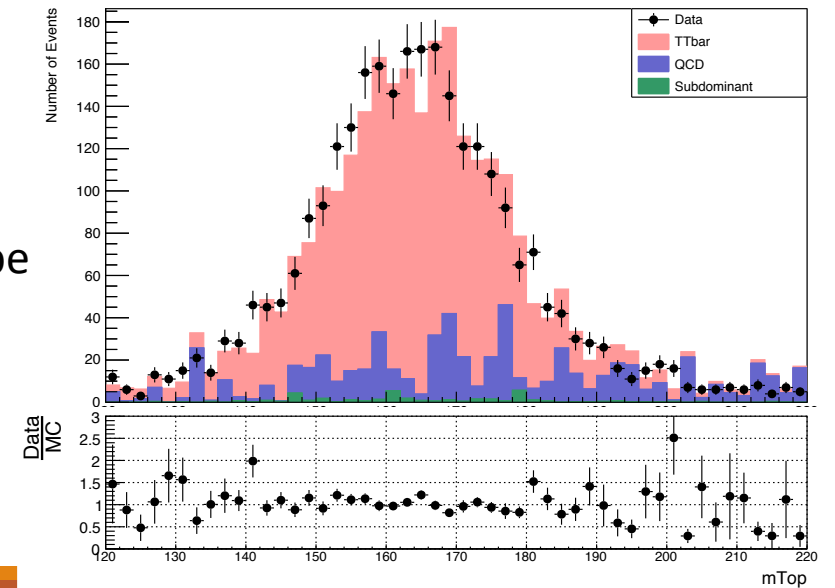
TagAndProbe Efficiency (2016)



Tight TopTagger + SR TopTagger



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

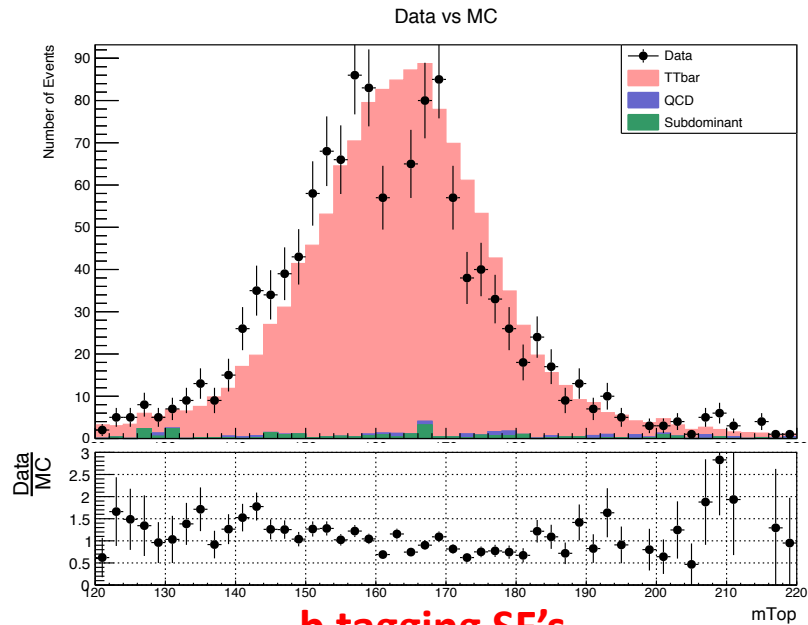
eff ttbar pT[600-800]: 0.876 ± 0.018

eff data pT[800-Inf]: 0.796 ± 0.2

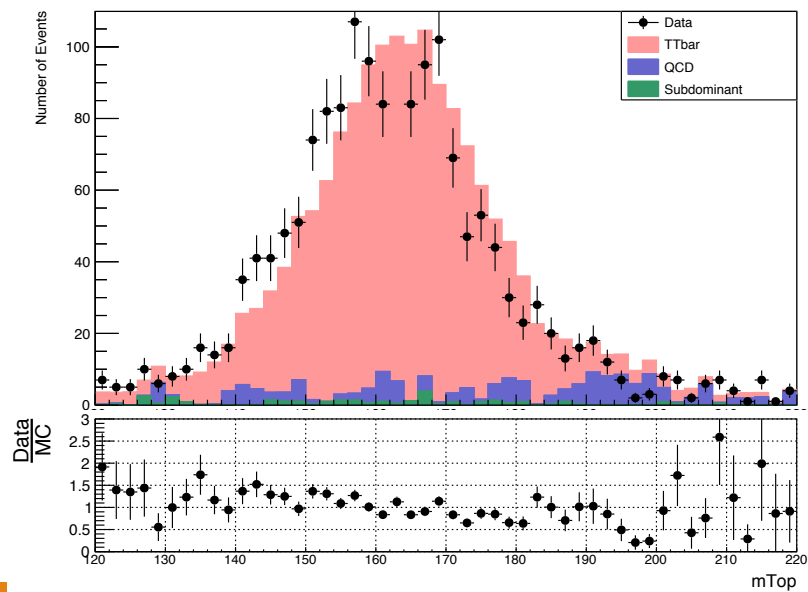
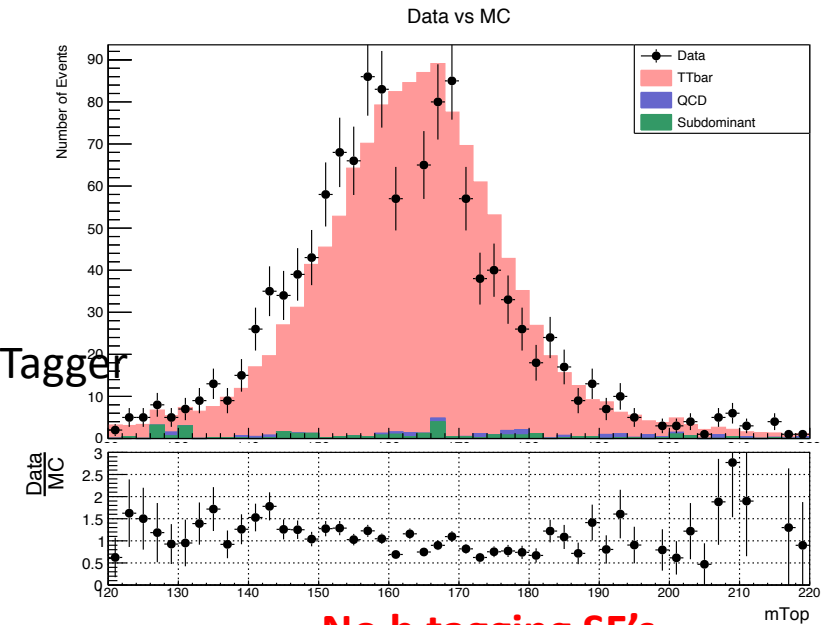
eff ttbar pT[800-Inf]: 0.898 ± 0.045



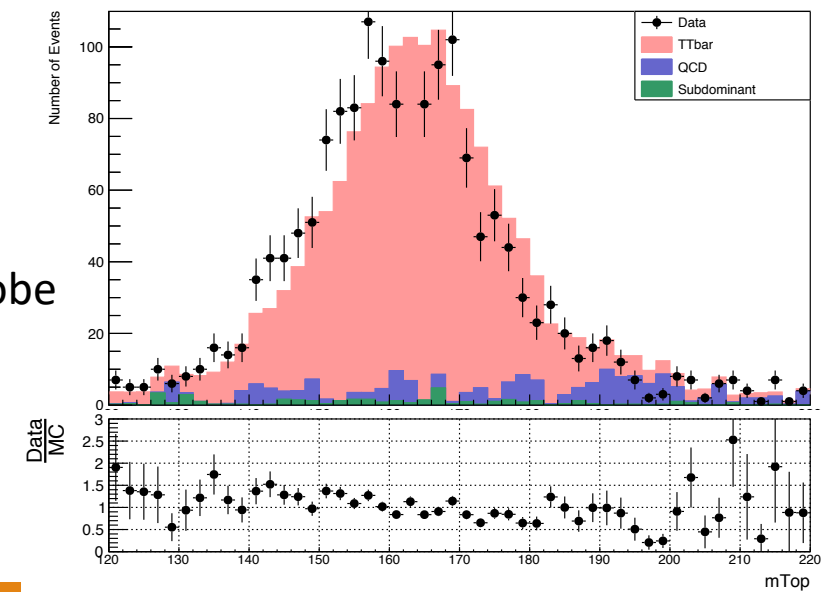
TagAndProbe Efficiency (2017)



Tight TopTagger + SR TopTagger



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

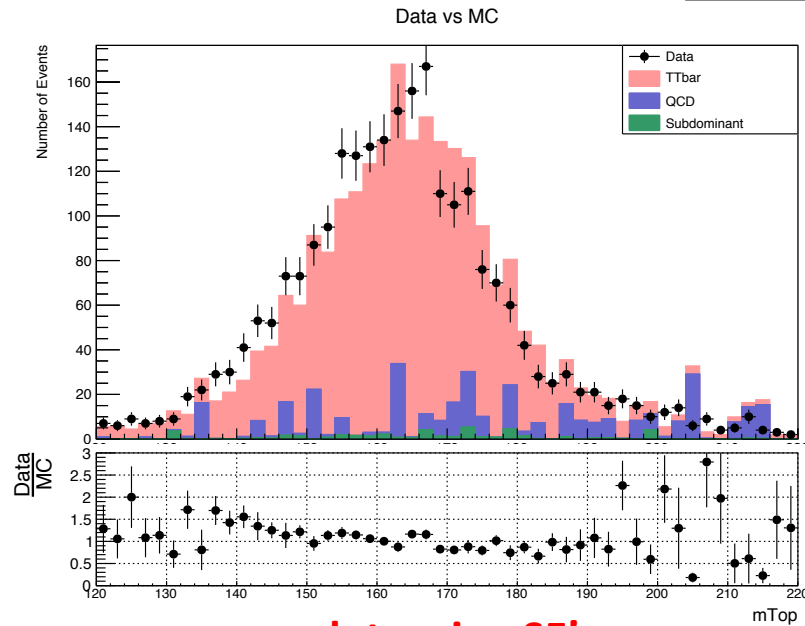
eff ttbar pT[600-800]: 0.847 ± 0.013

eff data pT[800-Inf]: 0.789 ± 0.141

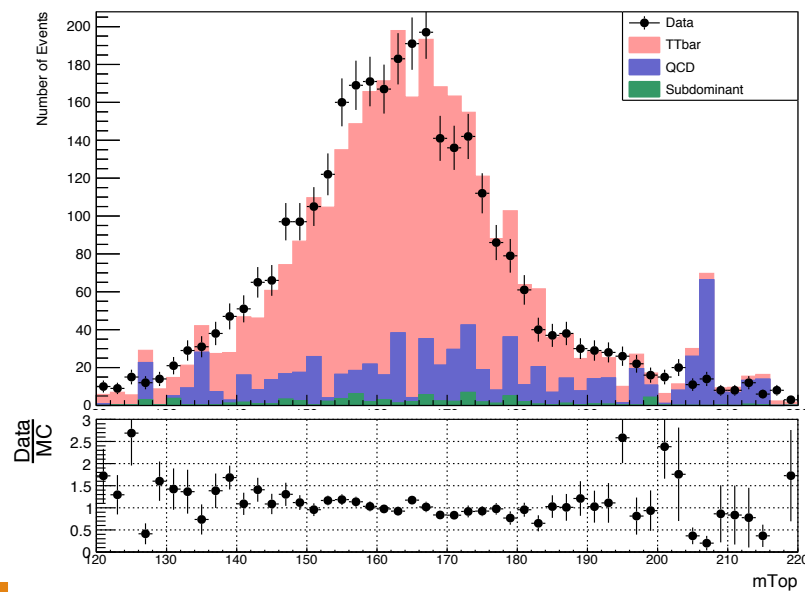
eff ttbar pT[800-Inf]: 0.868 ± 0.032



TagAndProbe Efficiency (2018)

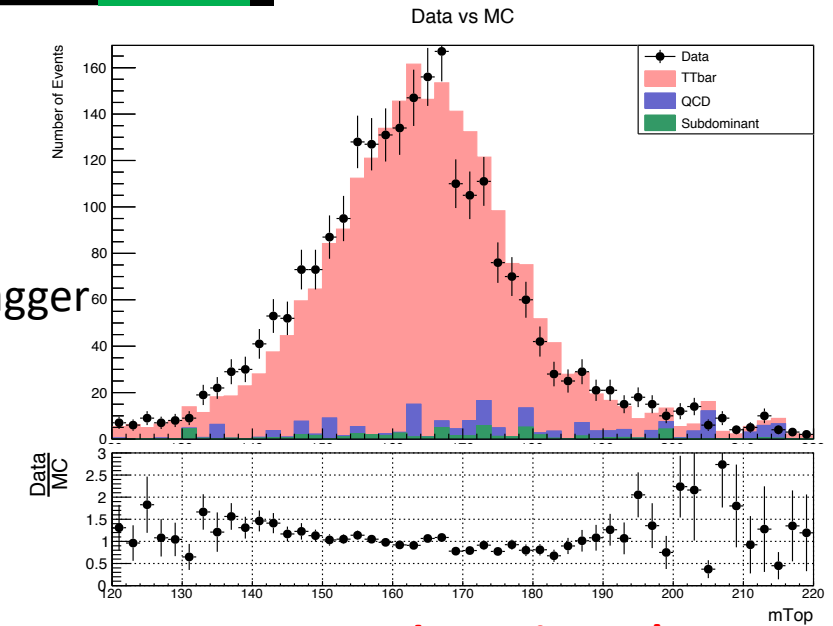


b tagging SF's

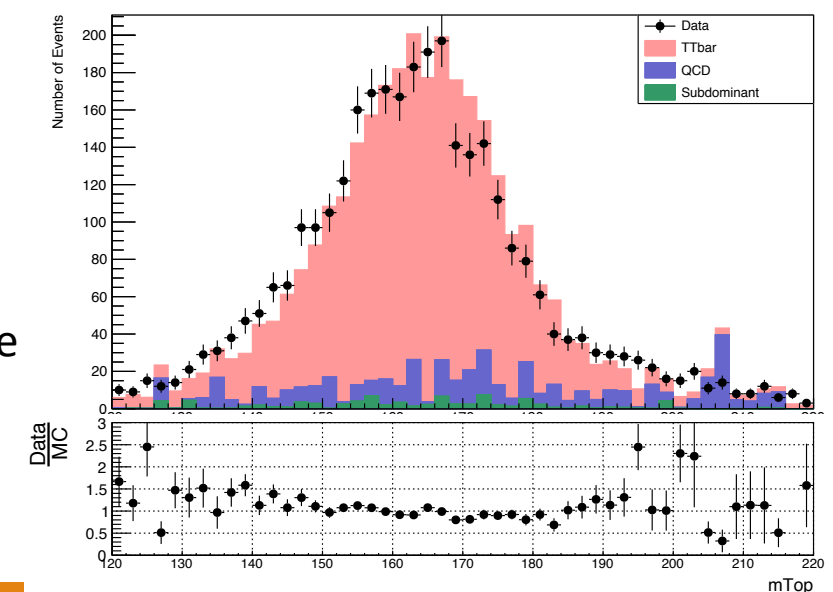


Tight TopTagger + SR TopTagger

Tight TopTagger + Probe



No b tagging SF's

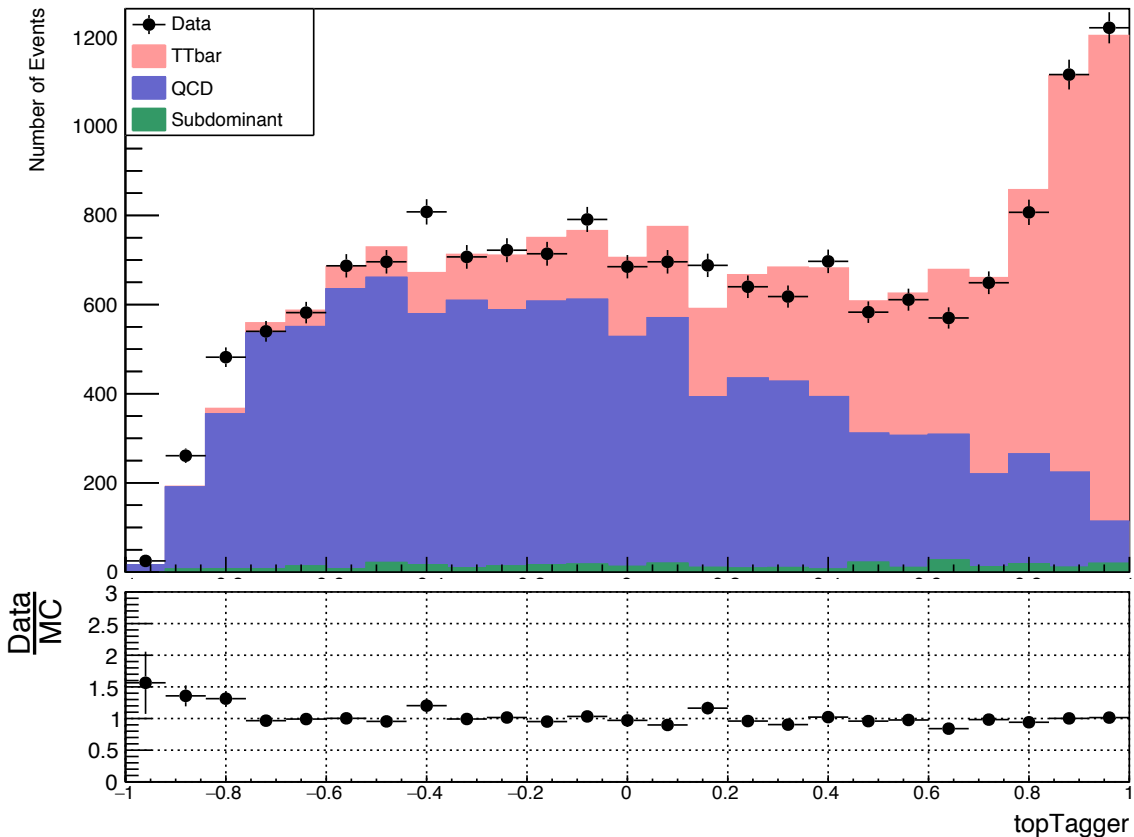


Data Vs MC Stacks for BDT output [2016](#)

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

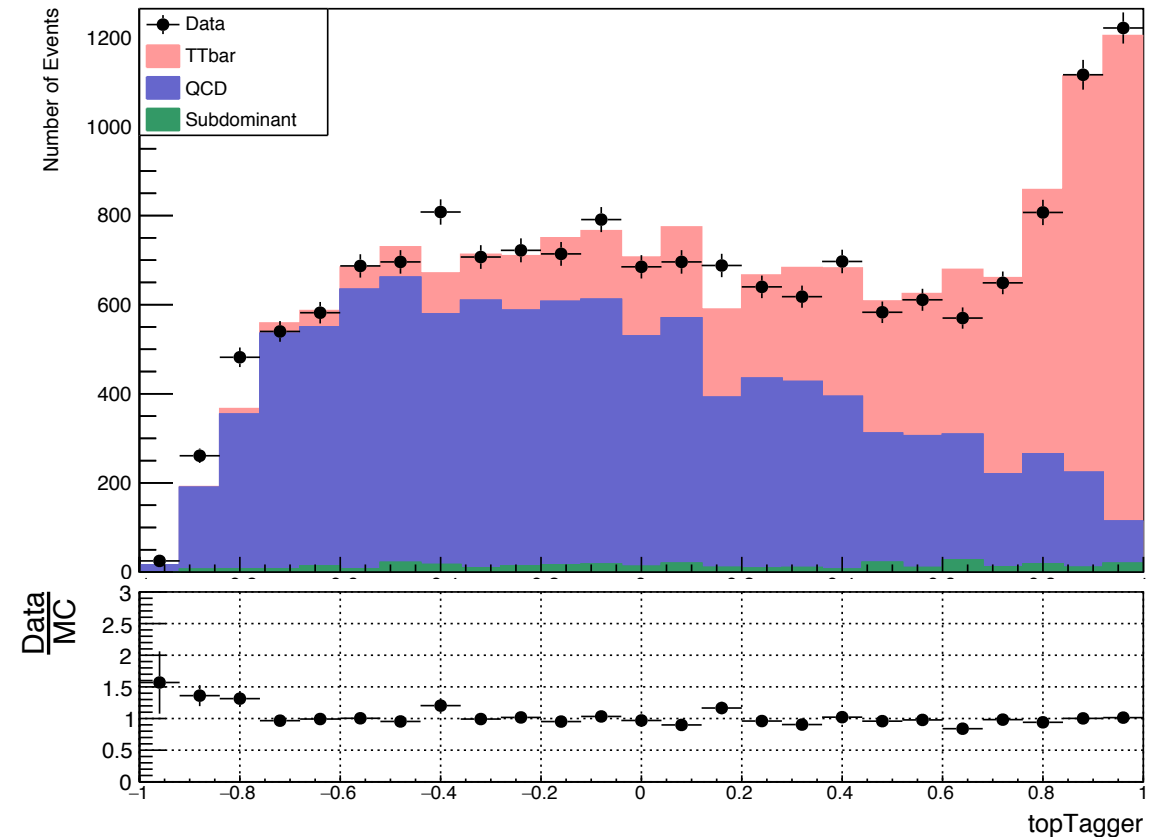
b tagging SF's

Data vs MC



without b tagging SF's

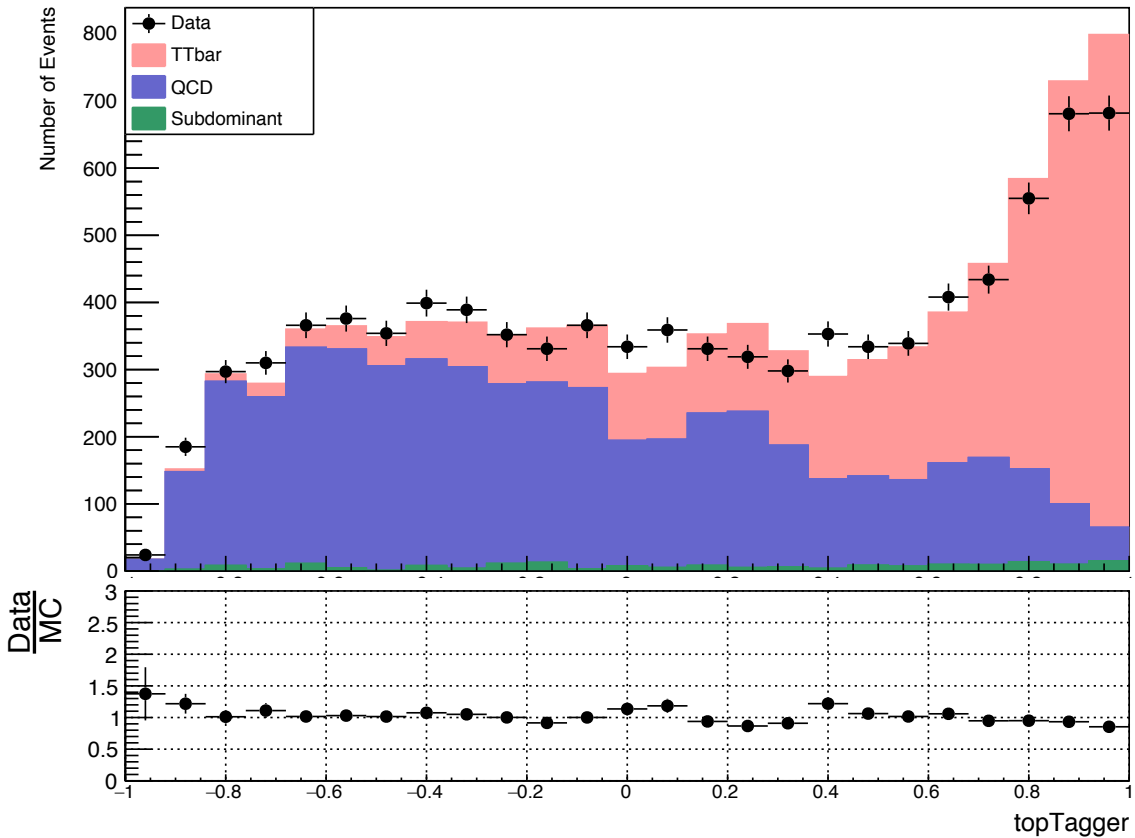
Data vs MC



Data Vs MC Stacks for BDT output 2017

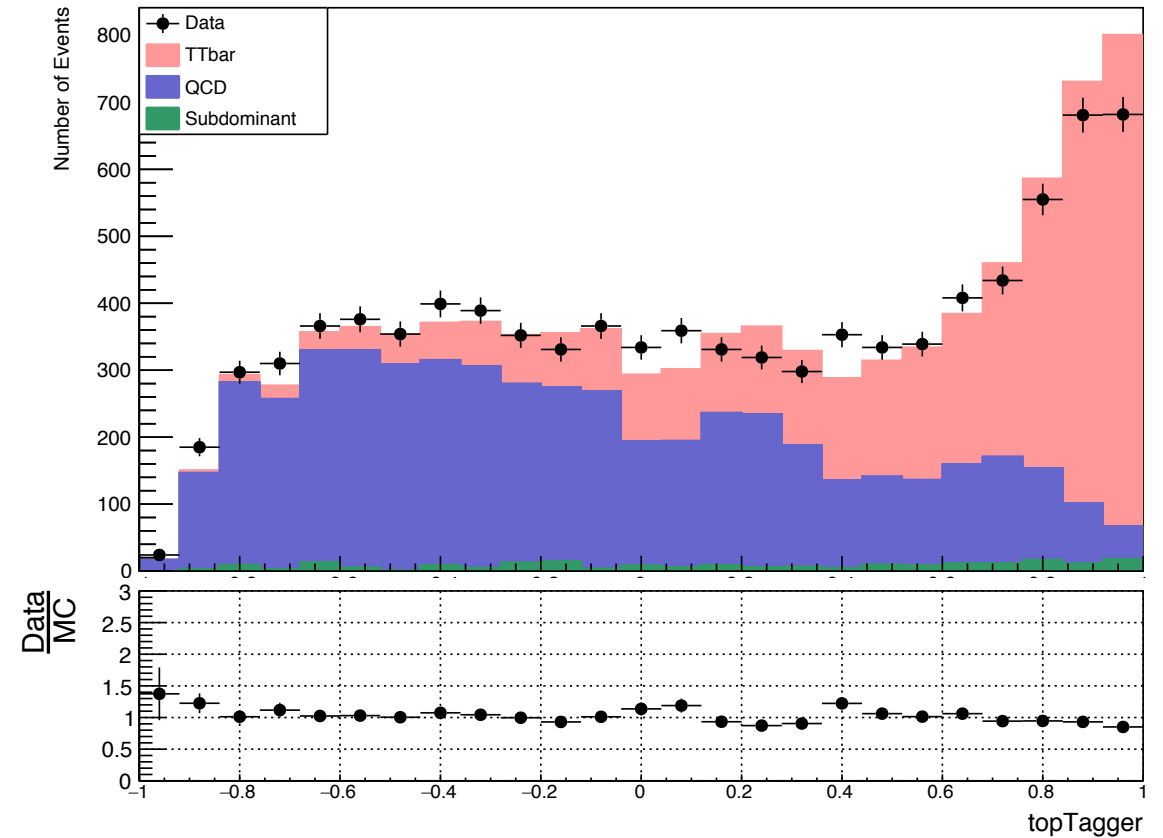
b tagging SF's

Data vs MC



without b tagging SF's

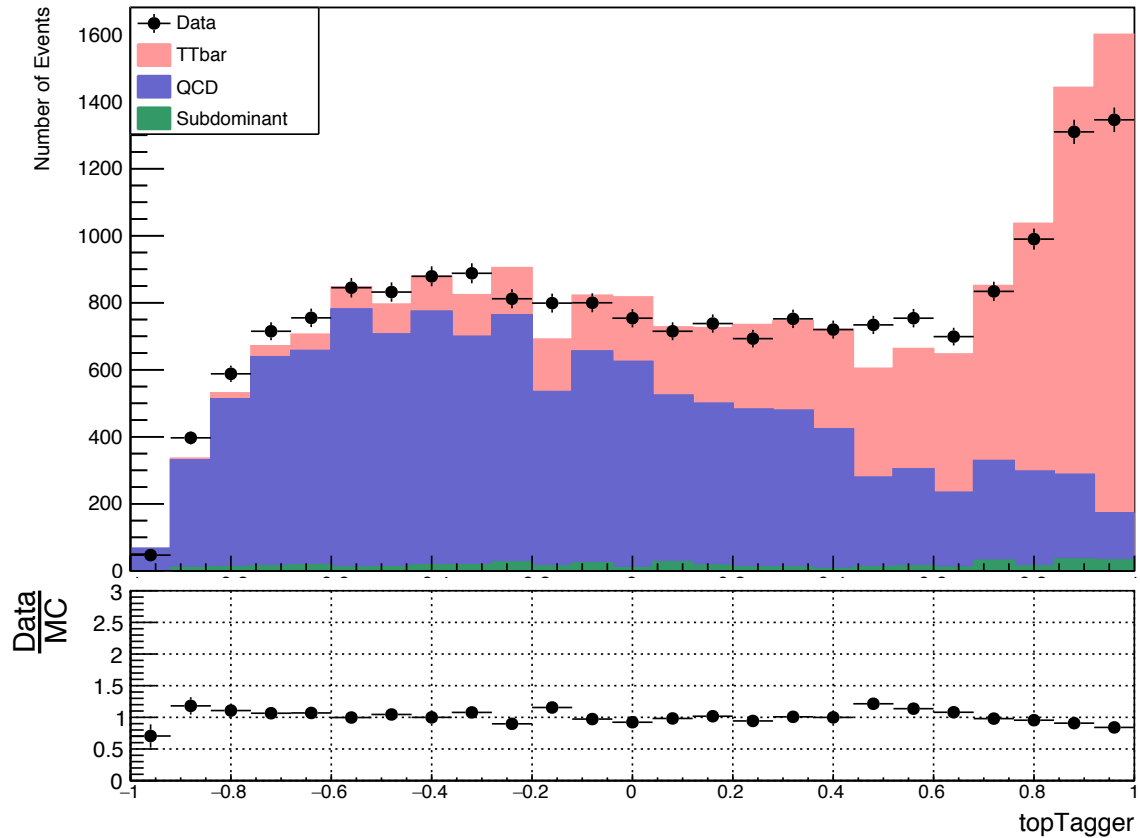
Data vs MC



Data Vs MC Stacks for BDT output 2018

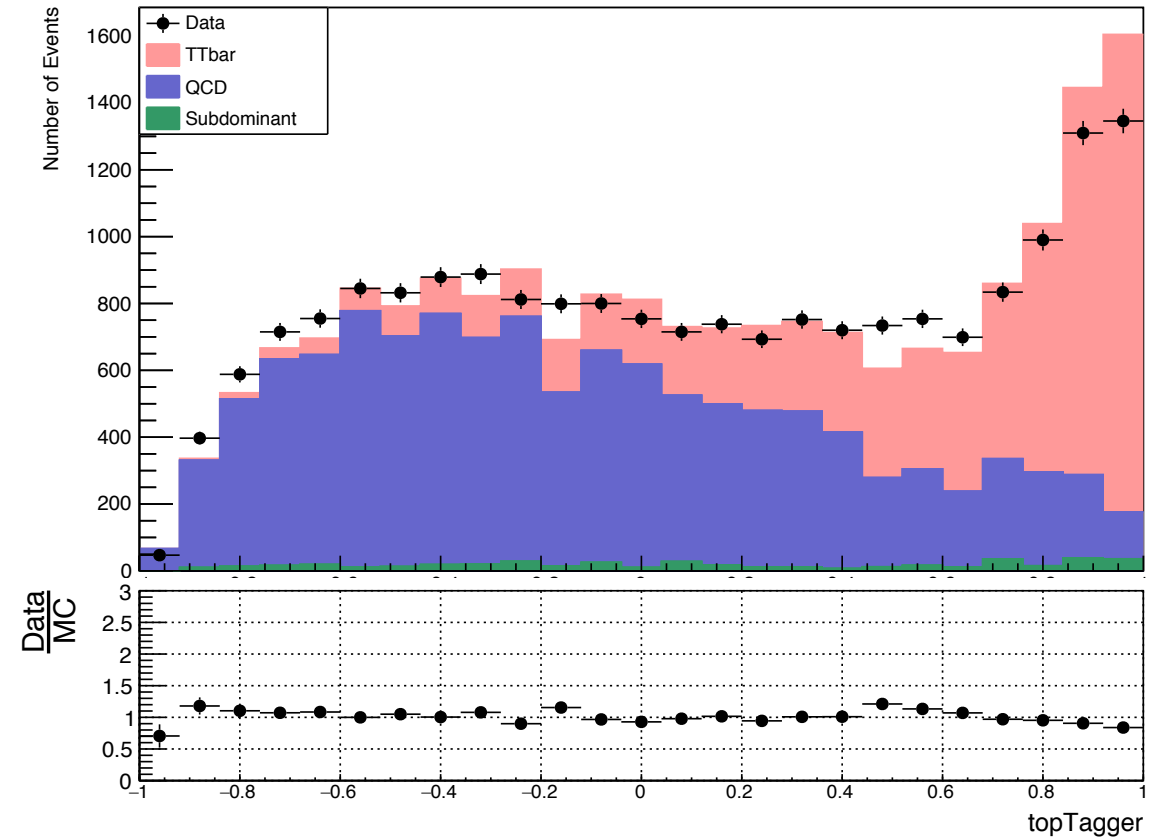
b tagging SF's

Data vs MC



without b tagging SF's

Data vs MC



BACKUP SLIDES

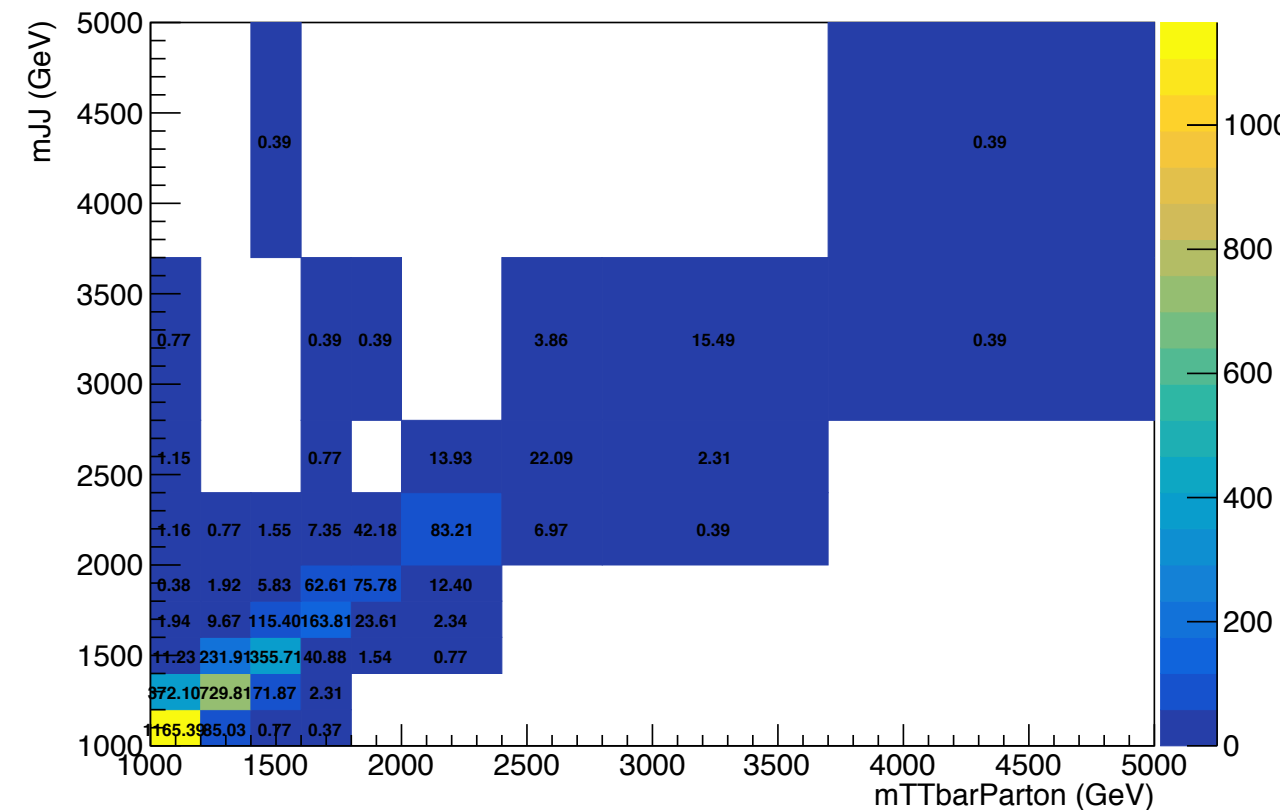


Response Matrices 2016

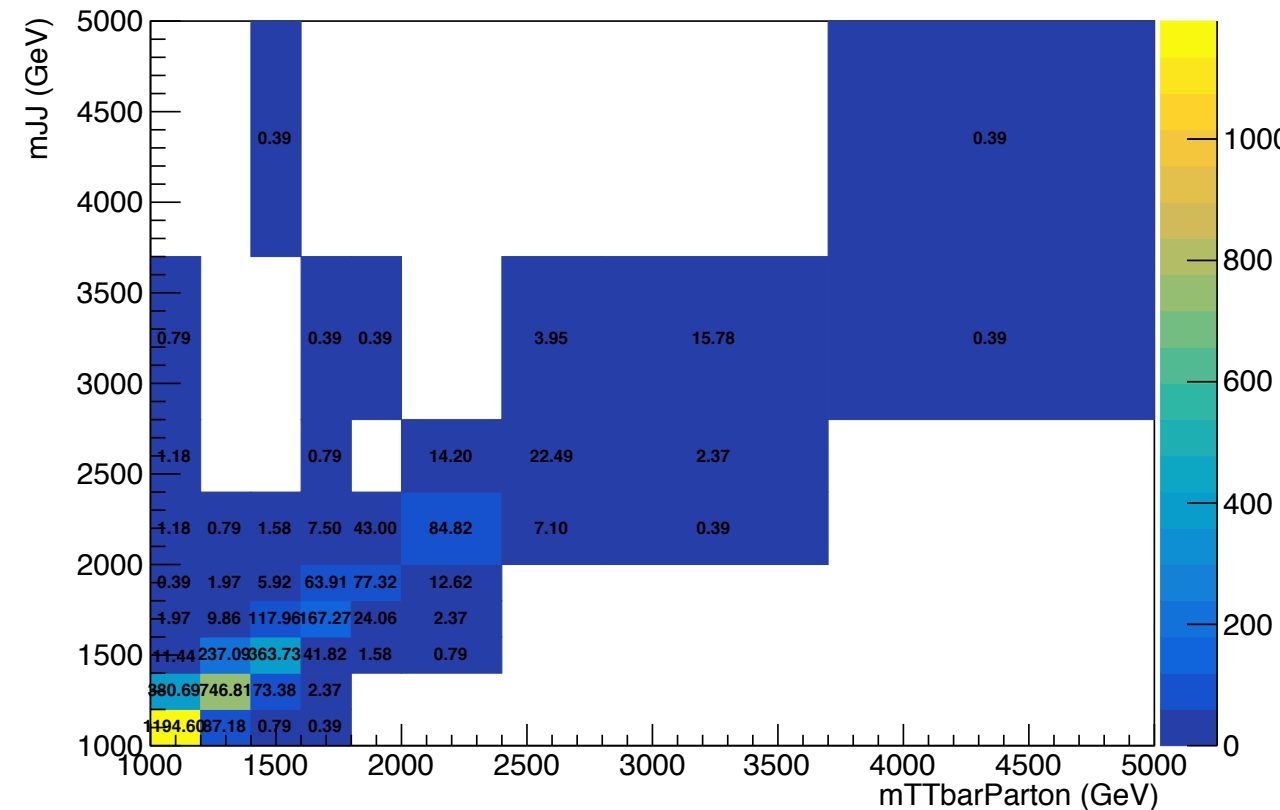
b tagging SF's

without b tagging SF's

Response Reco-Parton mJJ 2016 NominalMC



Response Reco-Parton mJJ 2016 NominalMC

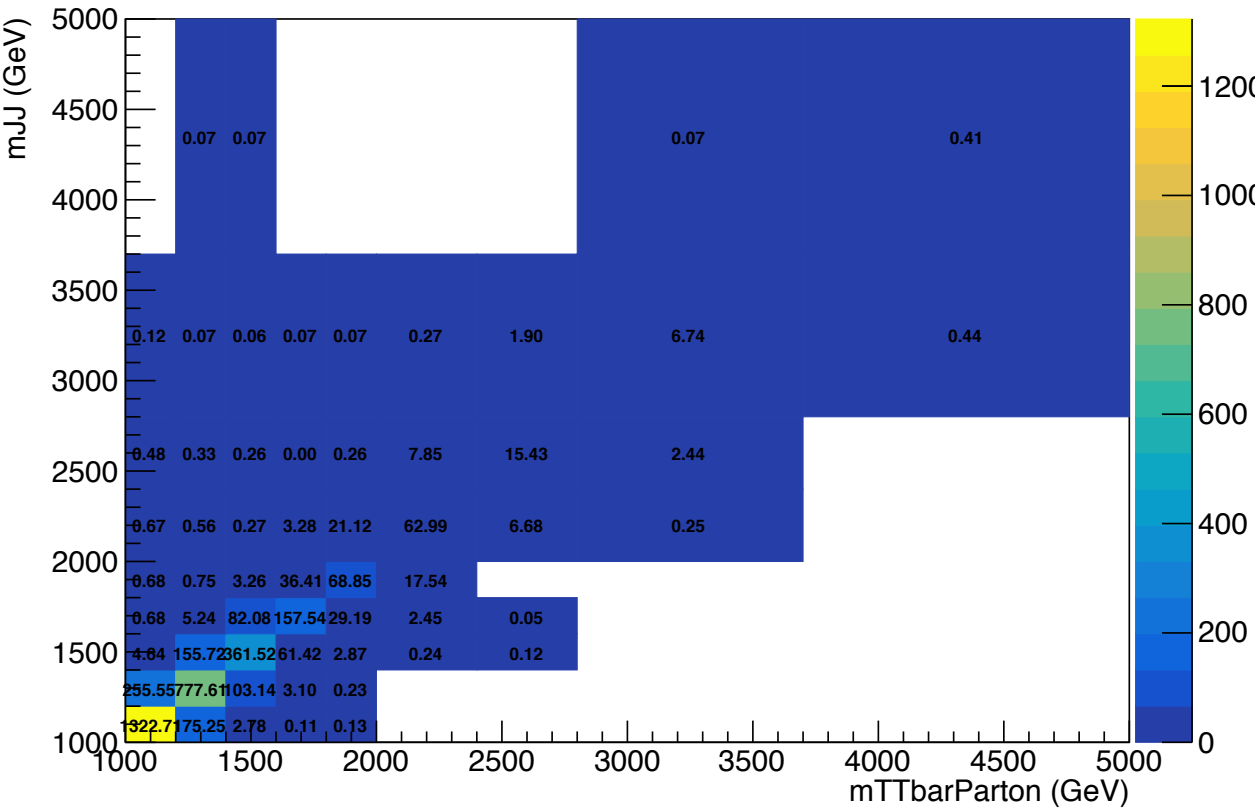


Response Matrices 2017

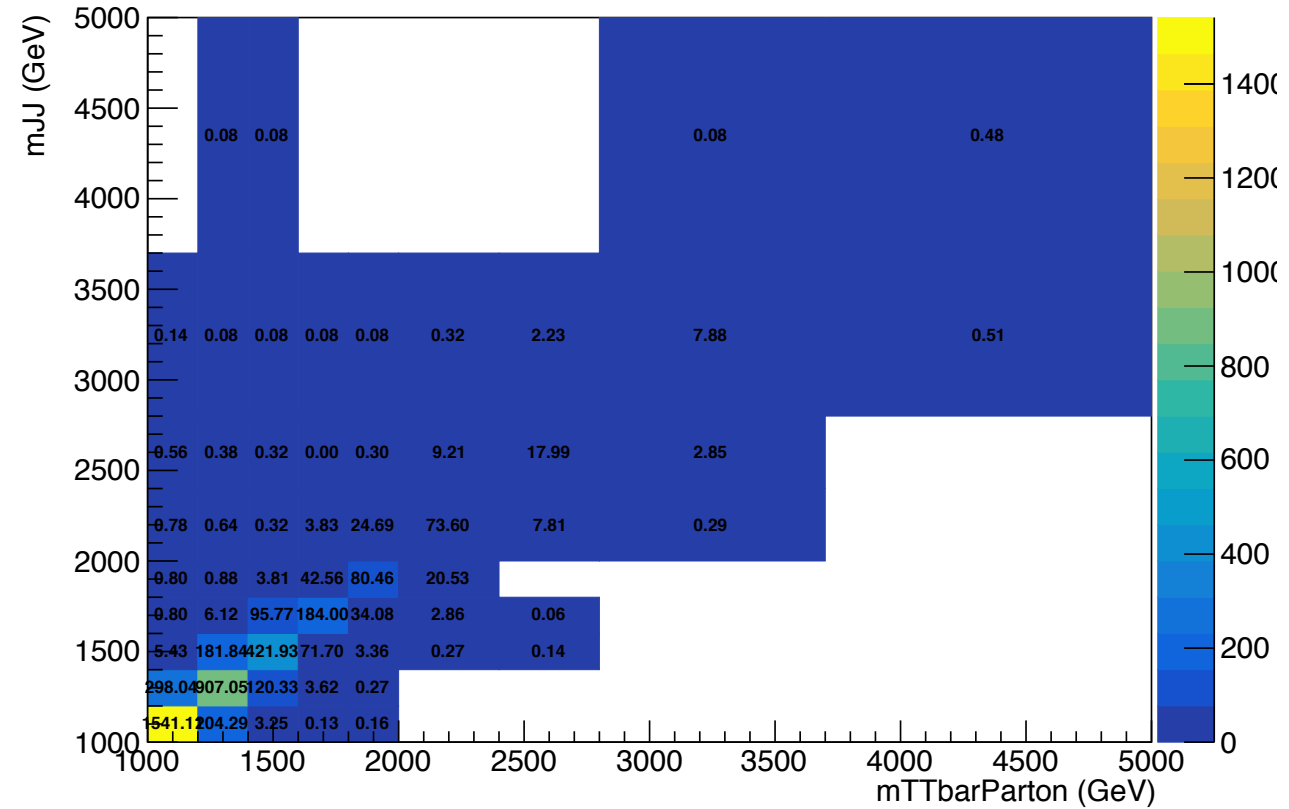
b tagging SF's

without b tagging SF's

Response Reco-Parton mJJ 2017 NominalMC



Response Reco-Parton mJJ 2017 NominalMC

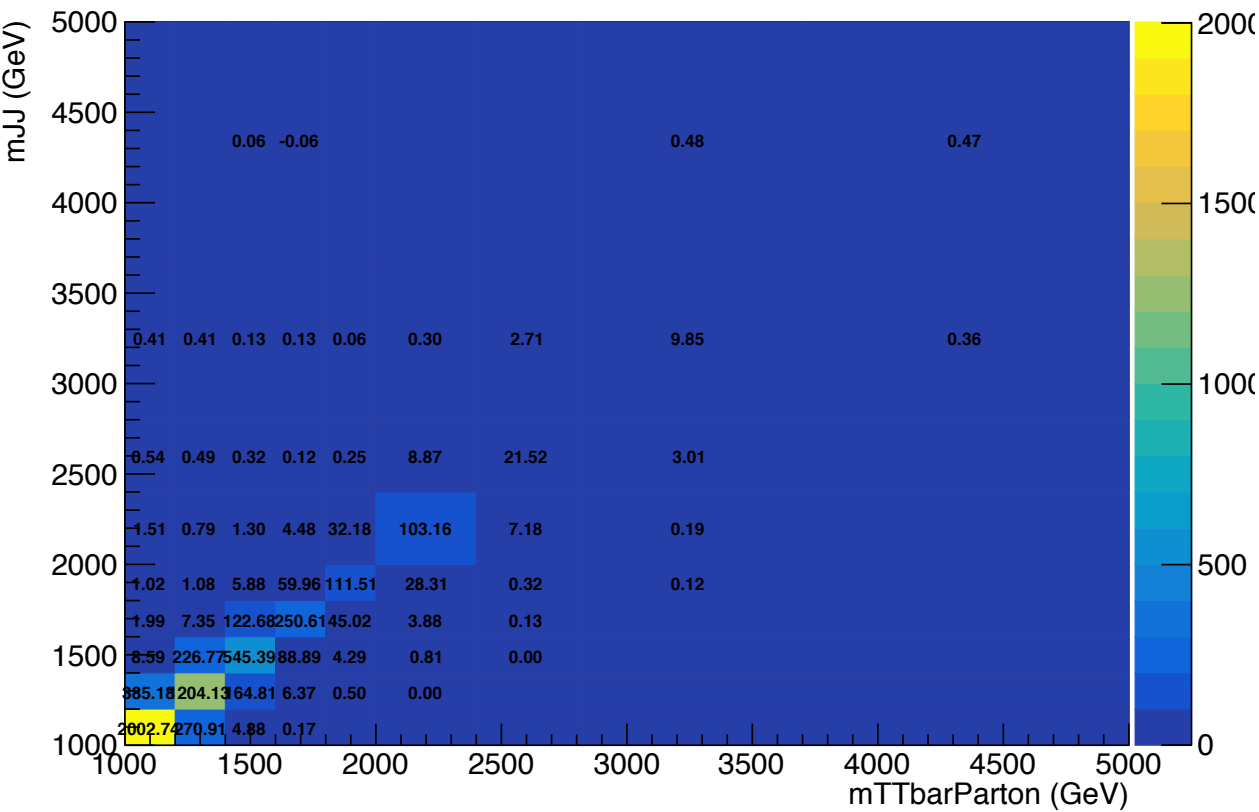


Response Matrices 2018

b tagging SF's

without b tagging SF's

Response Reco-Parton mJJ 2018 NominalMC



Response Reco-Parton mJJ 2018 NominalMC

