Status Report
Mass Fit and bTagging Efficiency (2016 and 2017)

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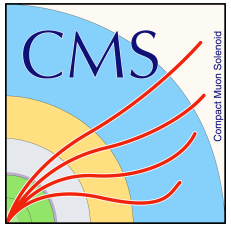


Status Report

- Working with 2017 data and MC
  - Found a problem in the 2017 Data files, fix and new production
  - Missing subdominant W+Jets bkg (only HT 400-600, 600-800, 800-Inf whereas in 2016 we are using the HT180)
  - Simultaneous fit In 3 regions for 2017 also
  - Btagging efficiency and acceptance

- 2018 Analysis:
  - Production with 2018 data
  - MC's for signal and bkg are already being used
  - Subdominant bkg's: haven't found any MC's → request samples

- Preparation for a presentation in the following ttX meeting

Simultaneous Fit in 3 regions

- As decided the previous week → Simultaneous fit in 3 regions (2btag, 1btag and 0btag) (now for 2017!)

$$D(x)^{(0)} = N_{tt}^{(0)} T^{(0)}(x, kMassScale, kMassResolution) + N_{bkg}^{(0)} B(x, \vec{p}) + N_{sub}^{(0)} O^{(0)}(x)$$

$$D(x)^{(2)} = N_{tt}^{(2)} T^{(1)}(x, kMassScale, kMassResolution) + N_{bkg}^{(2)} B(x, \vec{p})(1 + k_1 x) + N_{sub}^{(2)} O^{(1)}(x)$$

$$D(x)^{(1)} = N_{tt}^{(1)} T^{(2)}(x, kMassScale, kMassResolution) + N_{bkg}^{(1)} B(x, \vec{p})(1 + k_2 x) + N_{sub}^{(1)} O^{(2)}(x)$$

  - $N_{sub}^{(0)}$ is limited in $0.9 N_{sub,MC}^{(0)}$ *up to* $1.1 N_{sub,MC}^{(0)}$
  - We assume that $N_{tt}^{(0)} = (1 - \mathrm{e_b})^2 \mathrm{N_{tt}}$, $\mathrm{N_{tt}^{(2)}} = \mathrm{e_b^2 N_{tt}}$ and $\mathrm{N_{tt}^{(1)}} = 2(1 - e_b) e_b N_{tt}$ where $\mathrm{e_b}$ is the b tagging efficiency and $\mathrm{N_{tt}}$ is the total ttbar yield.

  We can either have $\mathrm{e_b}$ and $\mathrm{N_{tt}}$ as free parameters in the fit or $N_{tt}^{(0)}, N_{tt}^{(1)}, N_{tt}^{(2)}$

- We found out the the btagging efficiency and the Ntt yield are highly correlated.
  - We decided to try and fix the btagging parameter by measuring it ourselves
  - For the btagging efficiency calculation:

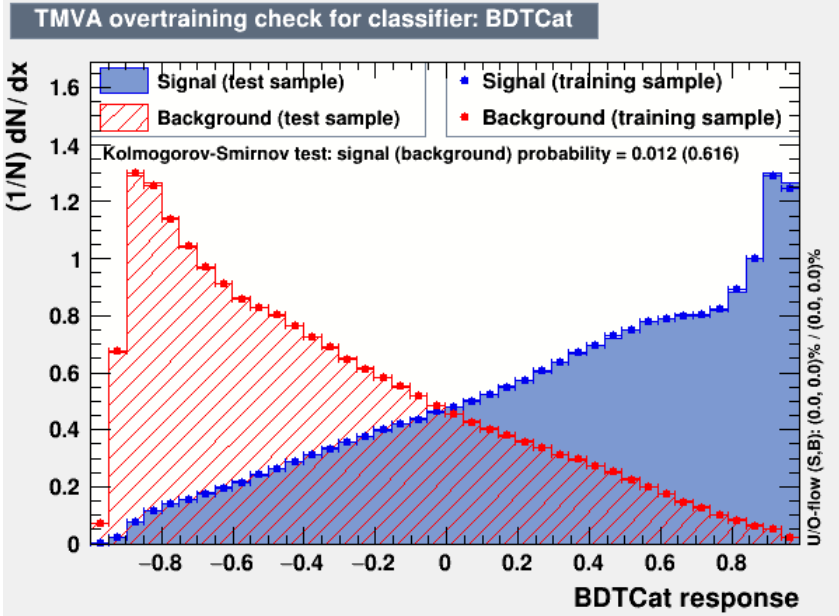
$e_b = \frac{\#subjets\ with\ flavour\ id\ requirement + deepCSV\ btagged}{\#subjets\ with\ flavour\ id\ requirement\ (b)}$, where all selected events pass baseline + parton selection

Overview of SR_A region

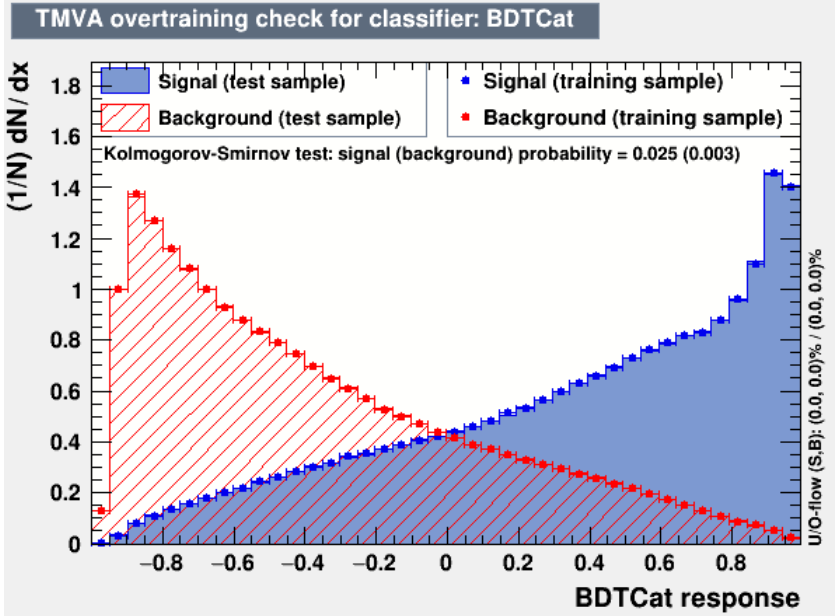
- Extension of Signal Region → SR_A = SR – Mass Selection cuts
- Selection:
  - Jet Matching
  - Parton cuts:
    - partonPt[0],[1] > 400
    - |partonEta[0],[1]| < 2.4
    - mTTbarParton > 1000
- Reco cuts:
  - nJets > 1
  - nLeptons = 0
  - mJJ > 1000
  - jetPt[0],[1] > 400
  - |jetEta[0],[1]| < 2.4
  - bTagging cut (mediugm WP **deepCSV**) (2016: 0.6321, 2017: 0.4941, 2018: 0.4184)
  - Tagger cut (**top Tagger**) (2016: 0.2, 2017:0.0, 2018: 0.1)
  - TriggerBit

Training Outputs

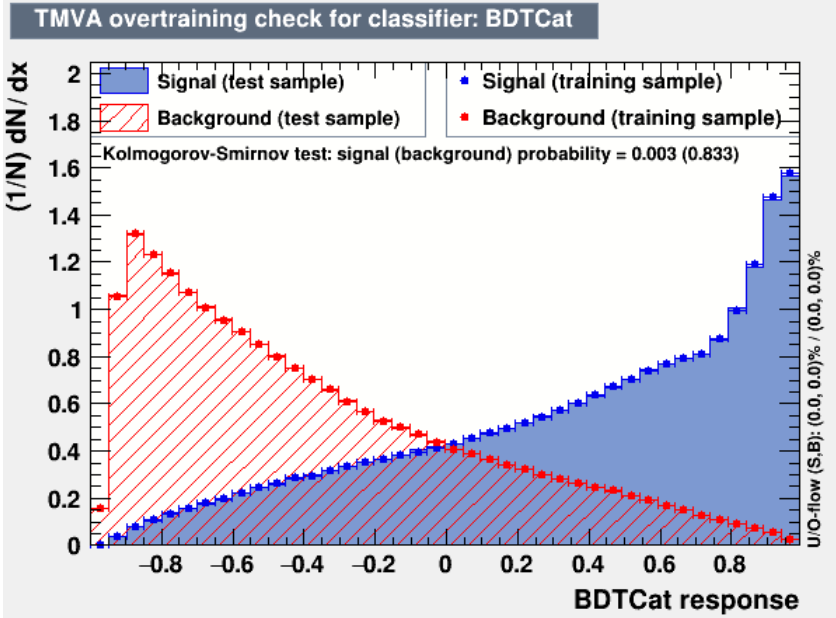
2016



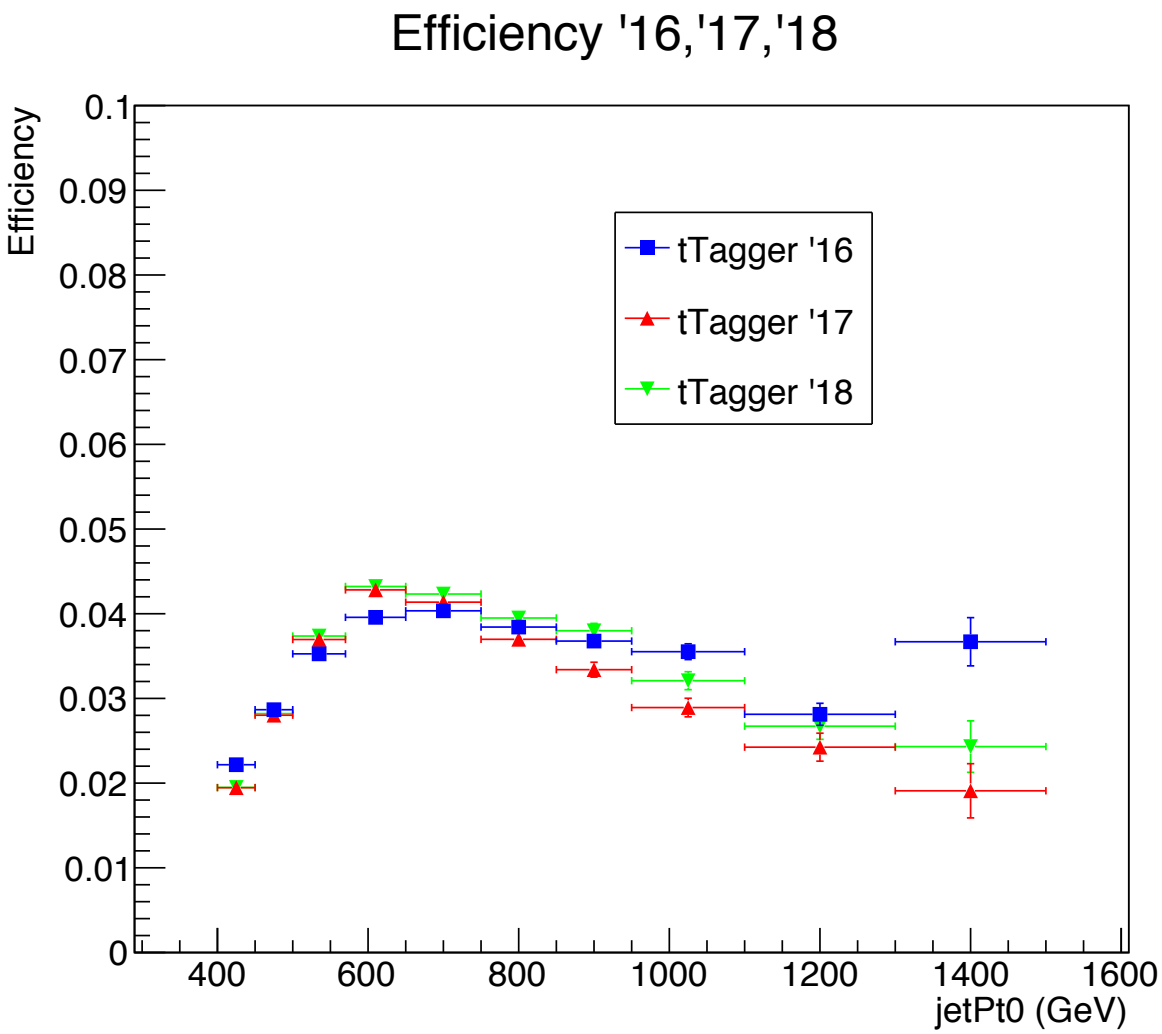
2017

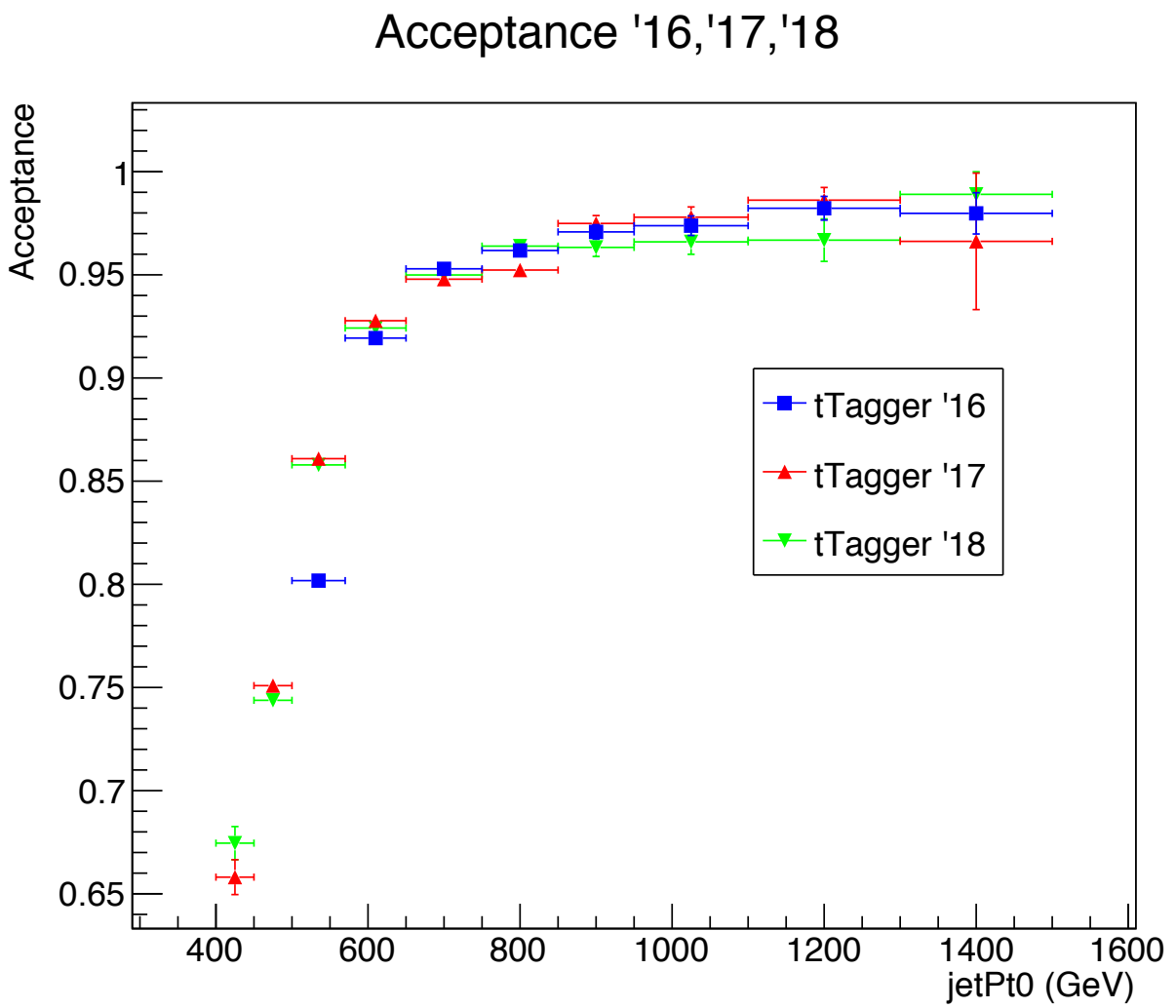


2018



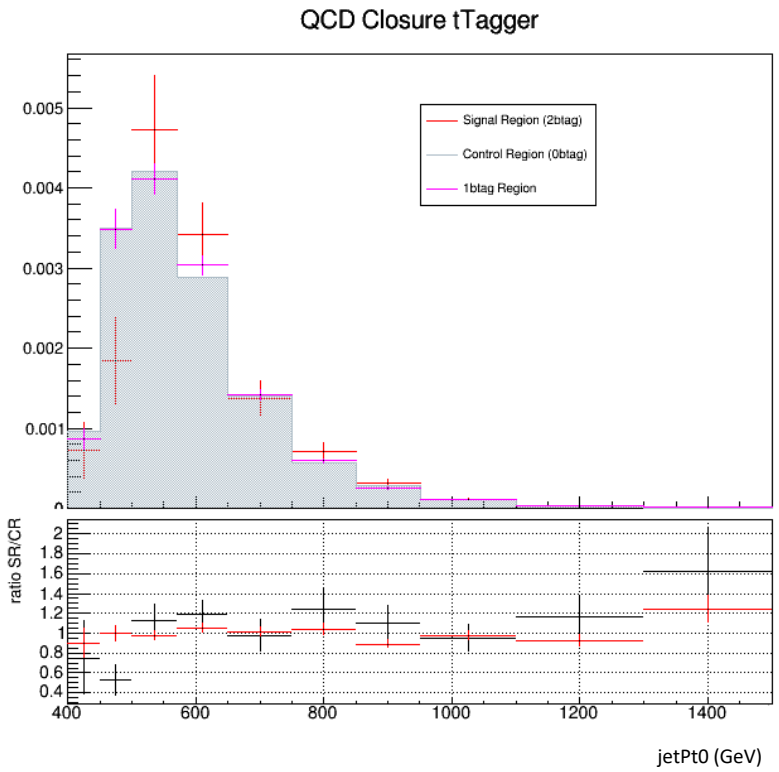
Efficiency and Acceptance for 2016, 2017 and 2018



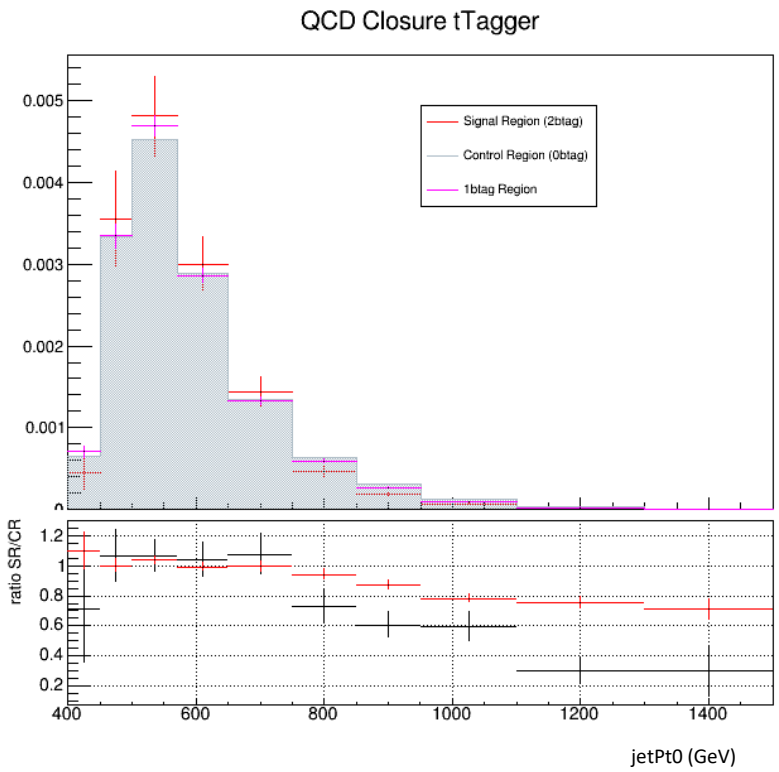


QCD Closure Tests ’16, ‘17, ’18 jetPt0

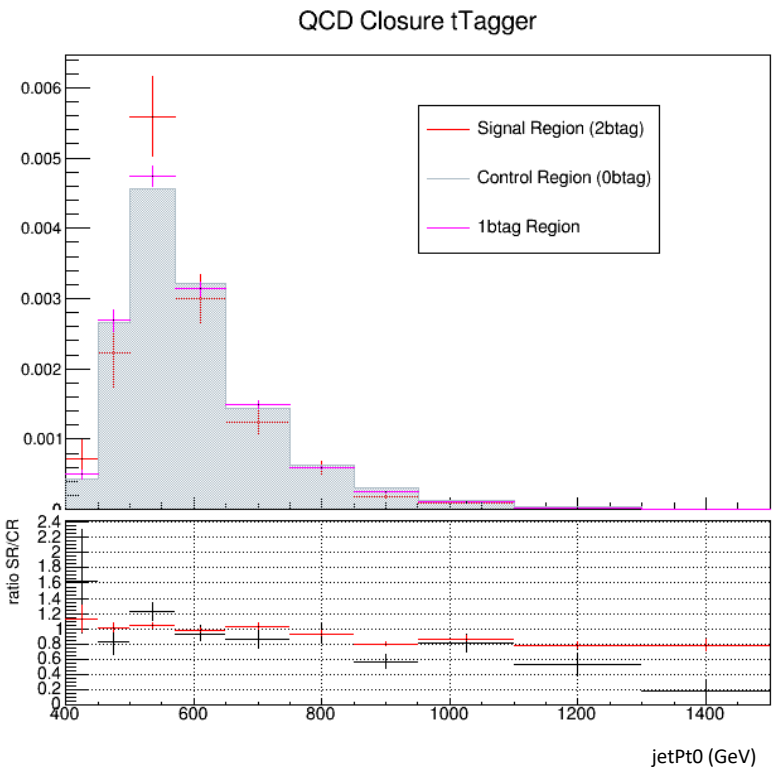
2016



2017



2018

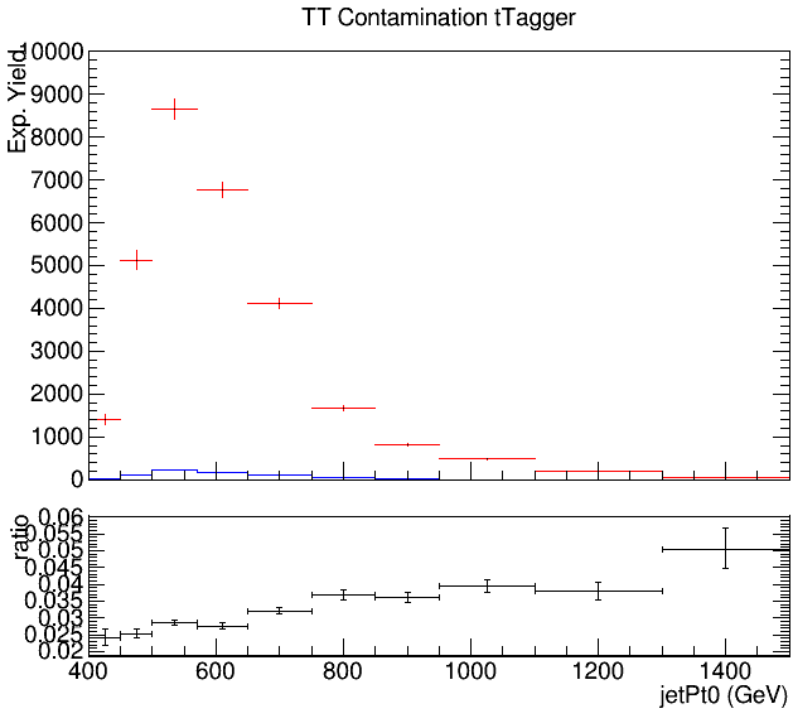


CR Contamination ’16,’17,’18 jetPt0

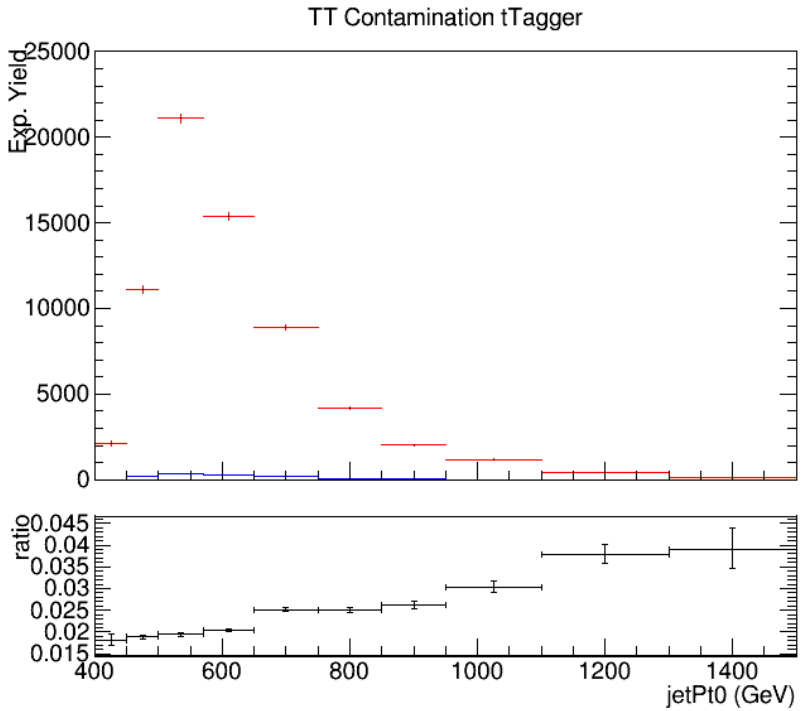
Control Region QCD sample

Control Region TT sample

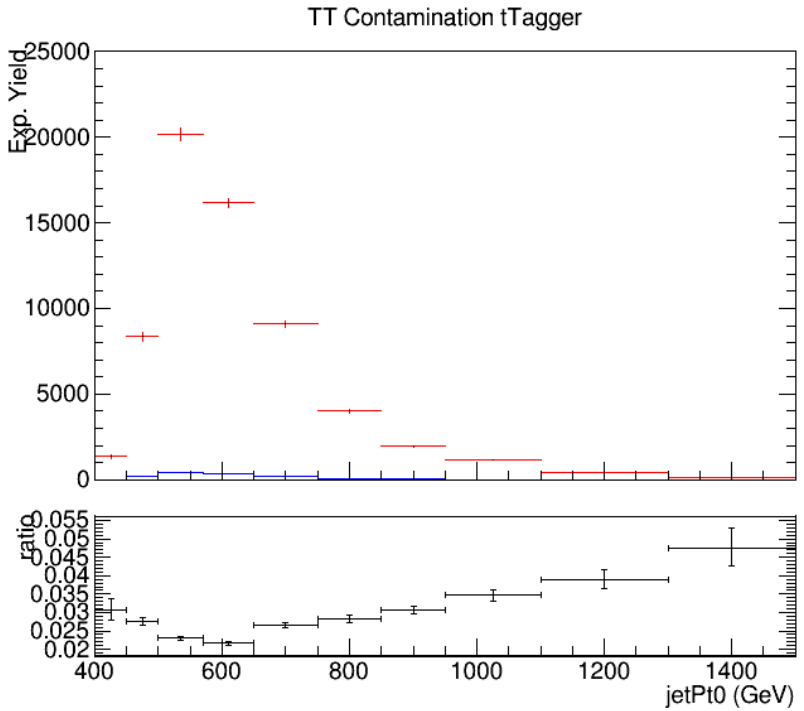
2016



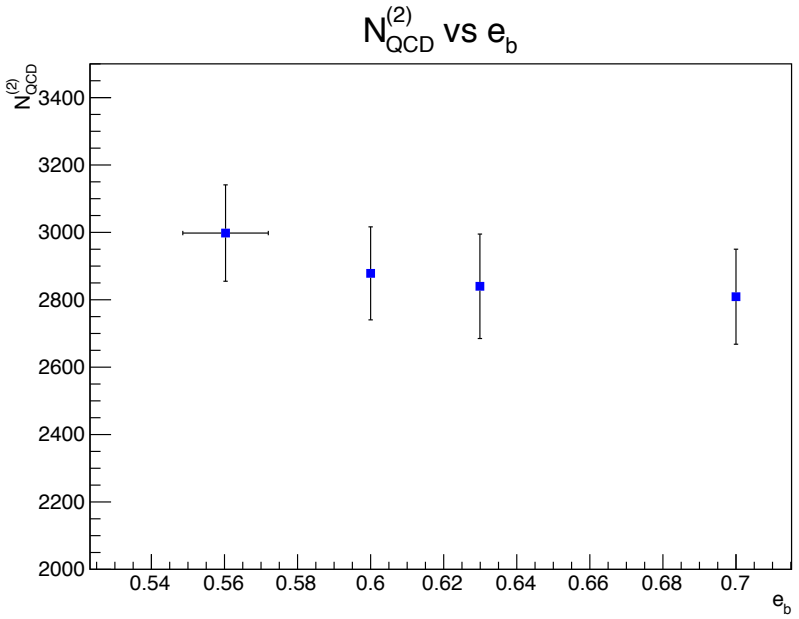
2017

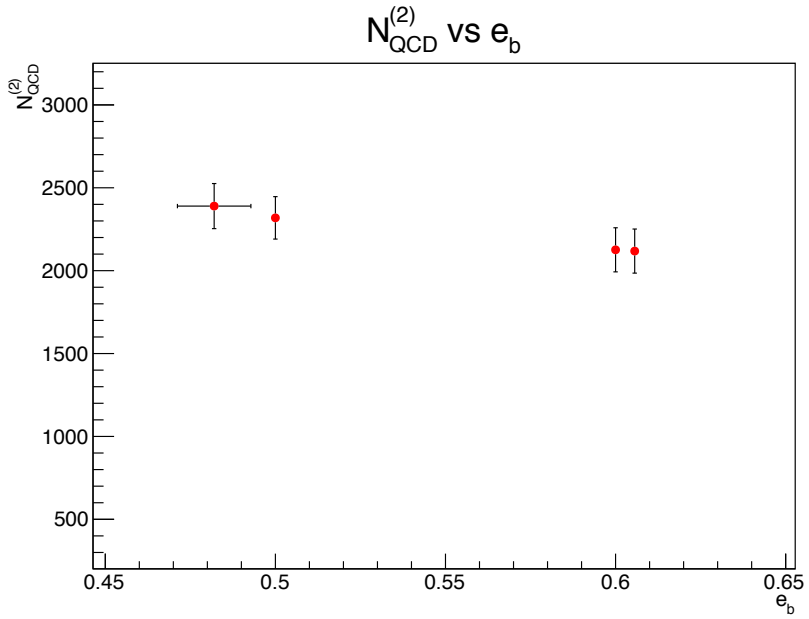


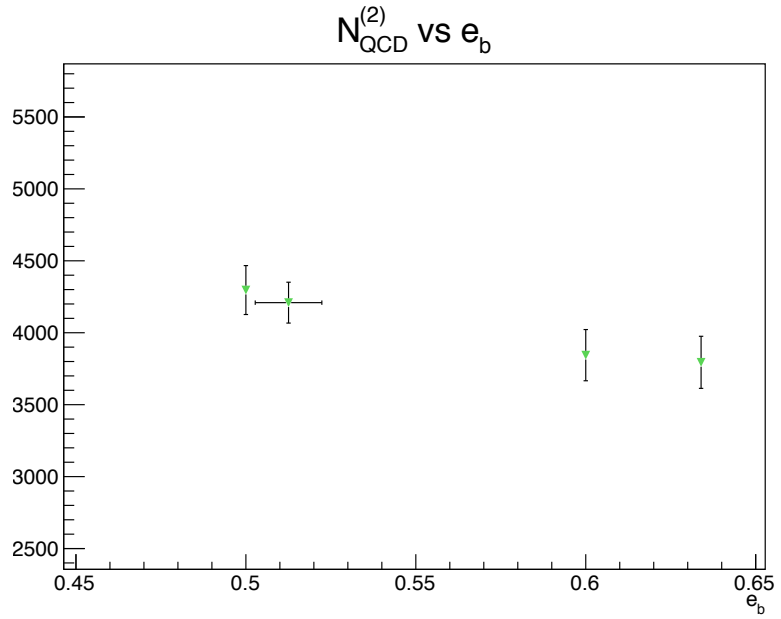
2018

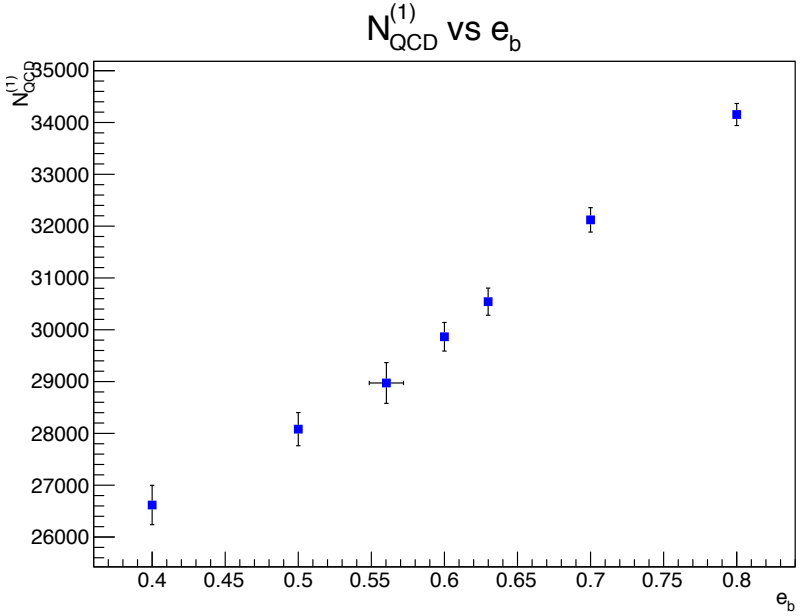


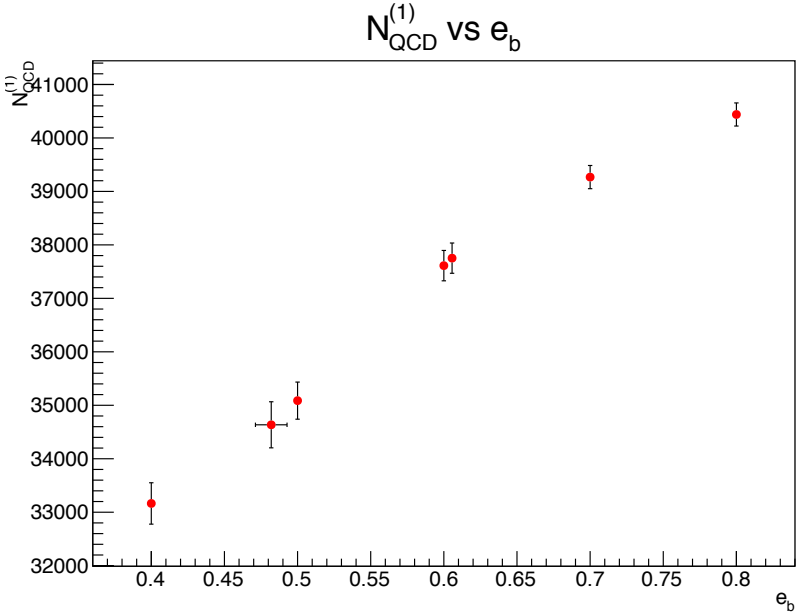
- We are checking for different values of e_b , the output of the $N^{(2)}_{QCD}$ for 2016 and 2017
- Points of interest are from 0.4 - 0.8 but especially 0.5-0.7 for 2016 and 0.45-0.6 5 for 2017
  - Calculated btagging efficiency for both years
  - btagging efficiency when the parameter is set as a free nuisance in the simultaneous fit
  - 2016: eb (fit) ≈ 0.56 and eb (calculated) ≈0.63
  - 2017: eb(fit) ≈ 0.48 and eb (calculated) ≈ 0.61
  - 2018: eb(fit) ≈ 0.52 and eb (calculated) ≈ 0.63

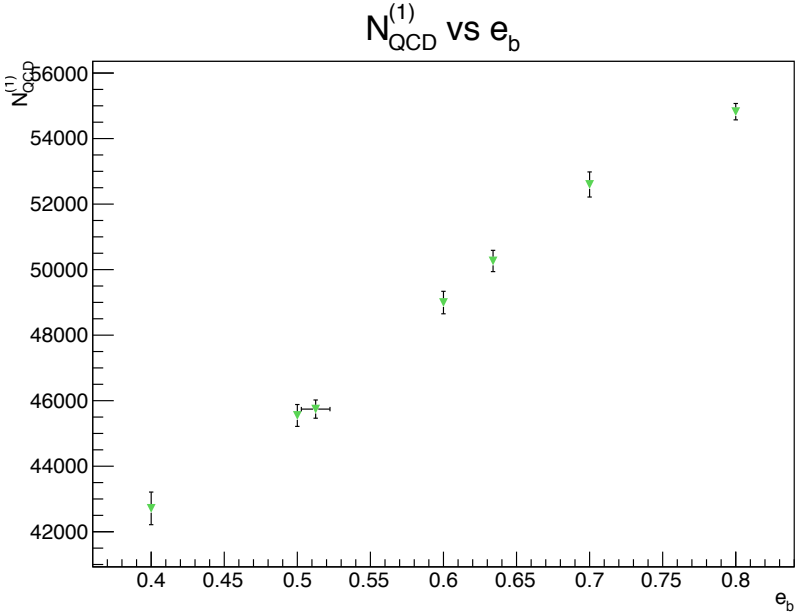








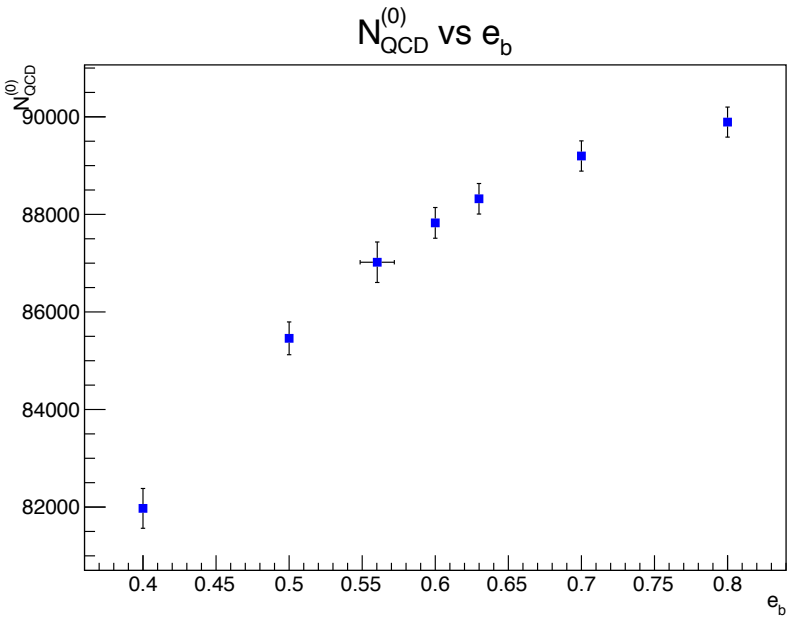


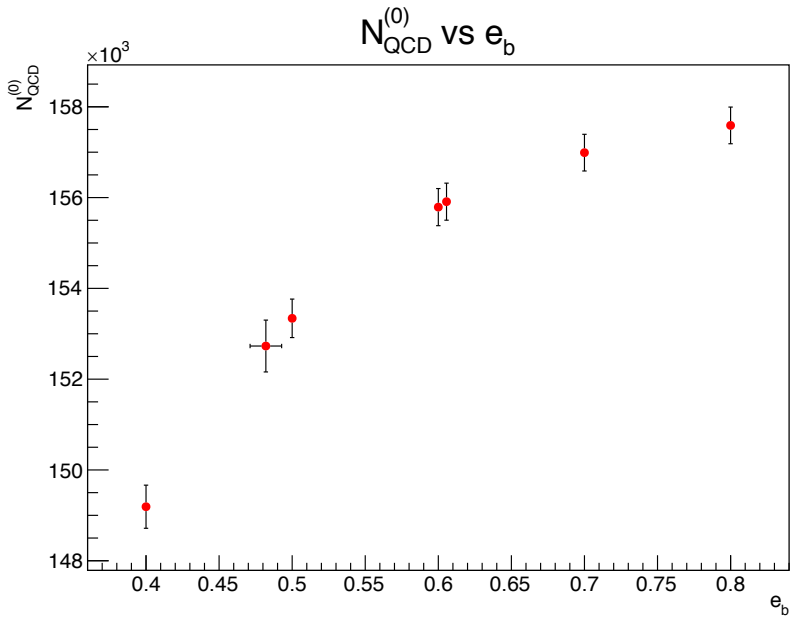


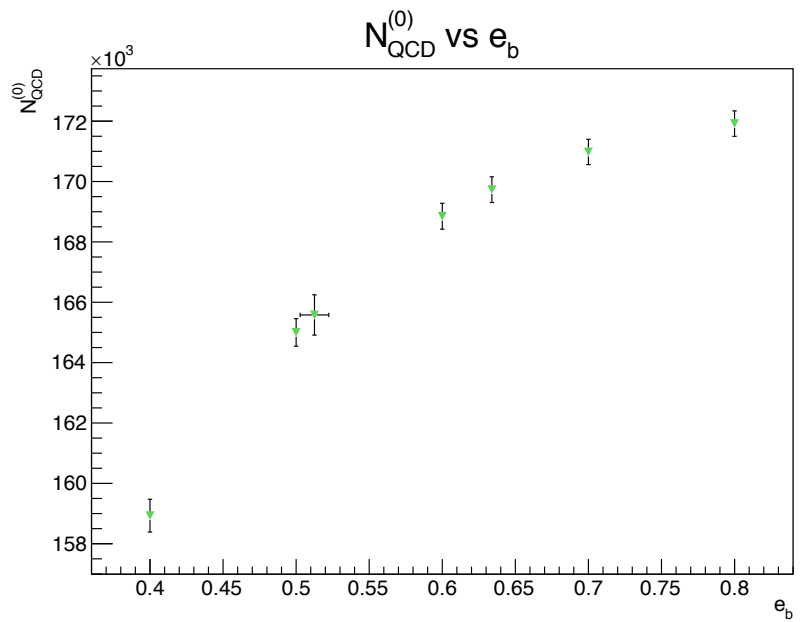
2016

2017

2018

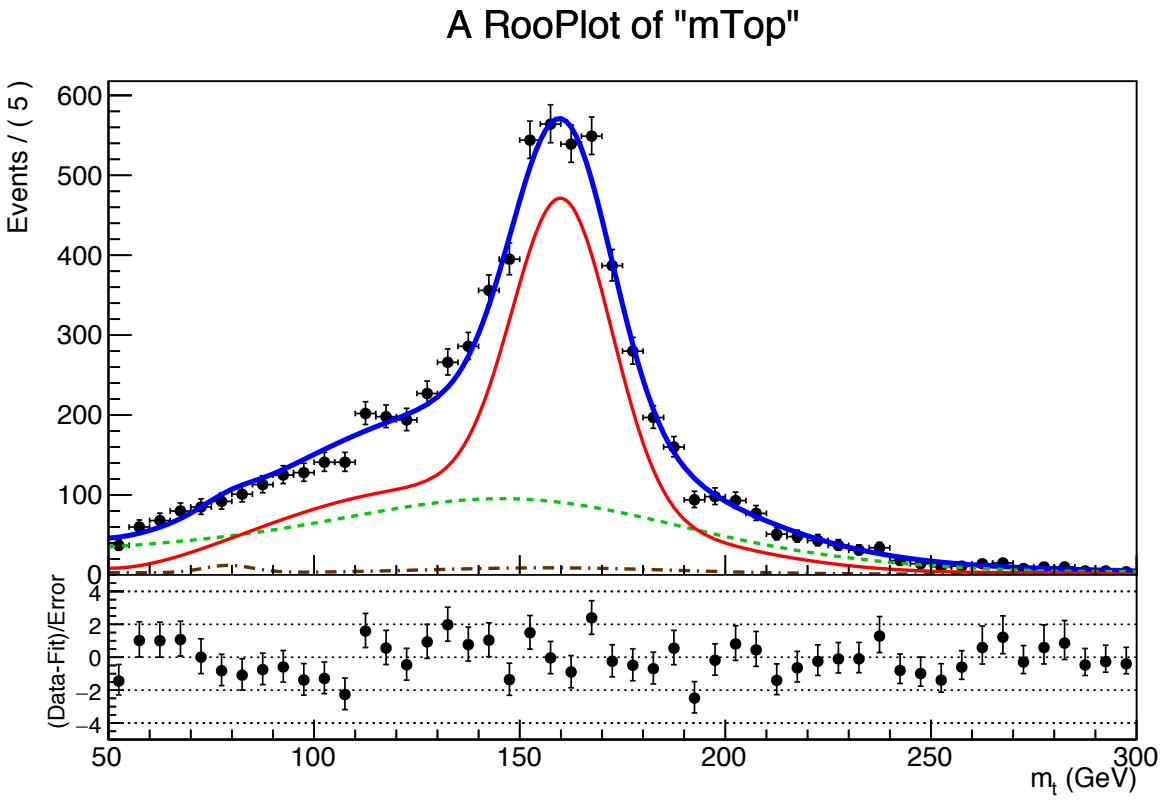




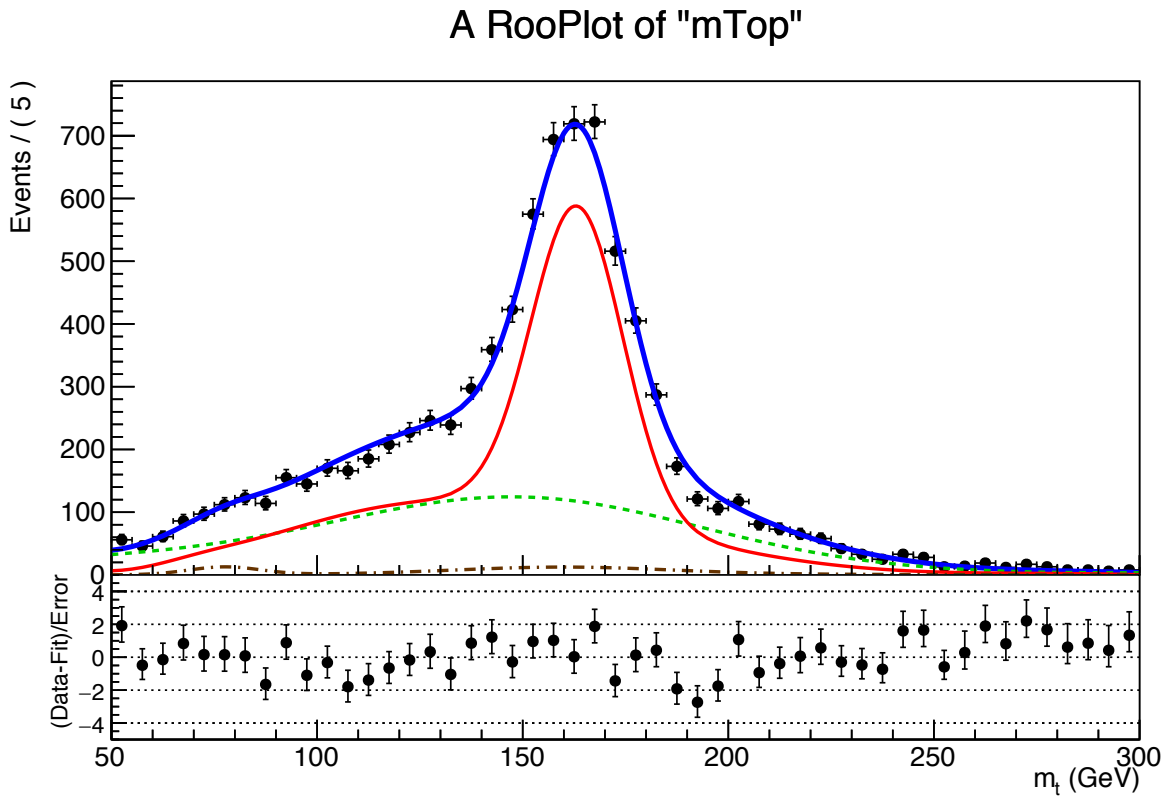


Simultaneous Fit in 3 regions for 2017 and 2016 when eb is free

Signal Region (2btag) (2017)



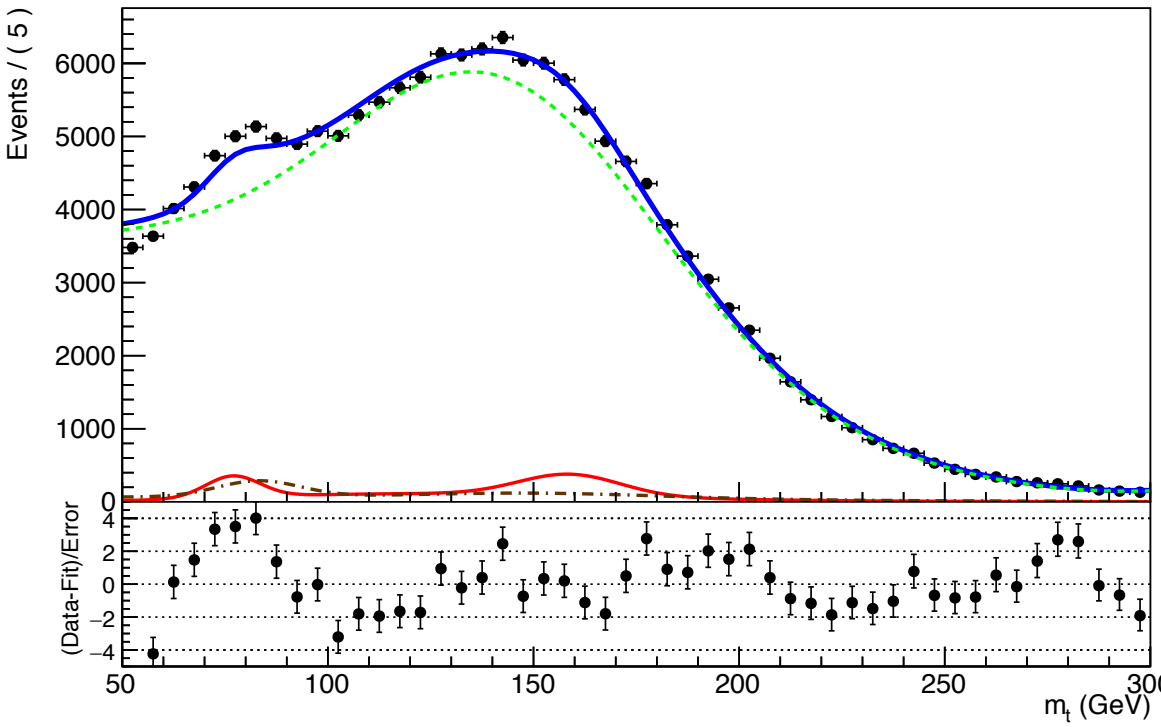
Signal Region (2btag) (2016)



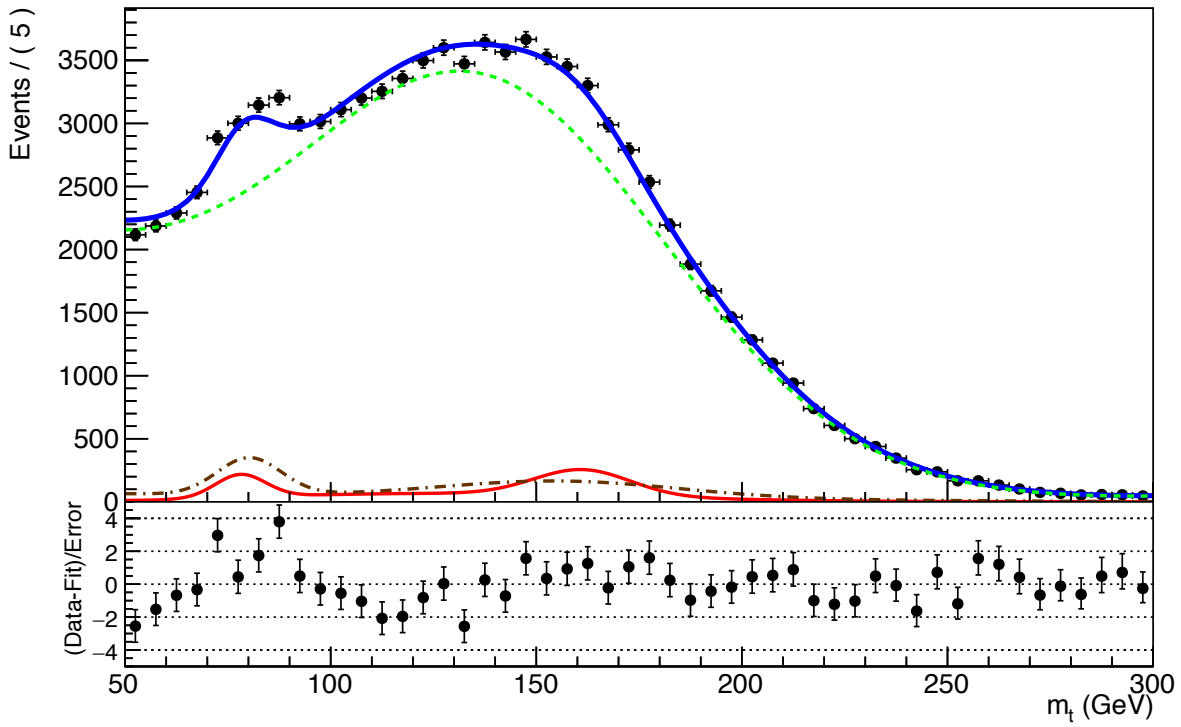
Result of the template fit on data in SR. The red line shows the ttbar contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions for 2017 and 2016 when eb is free

Control Region (0btag) (2017)



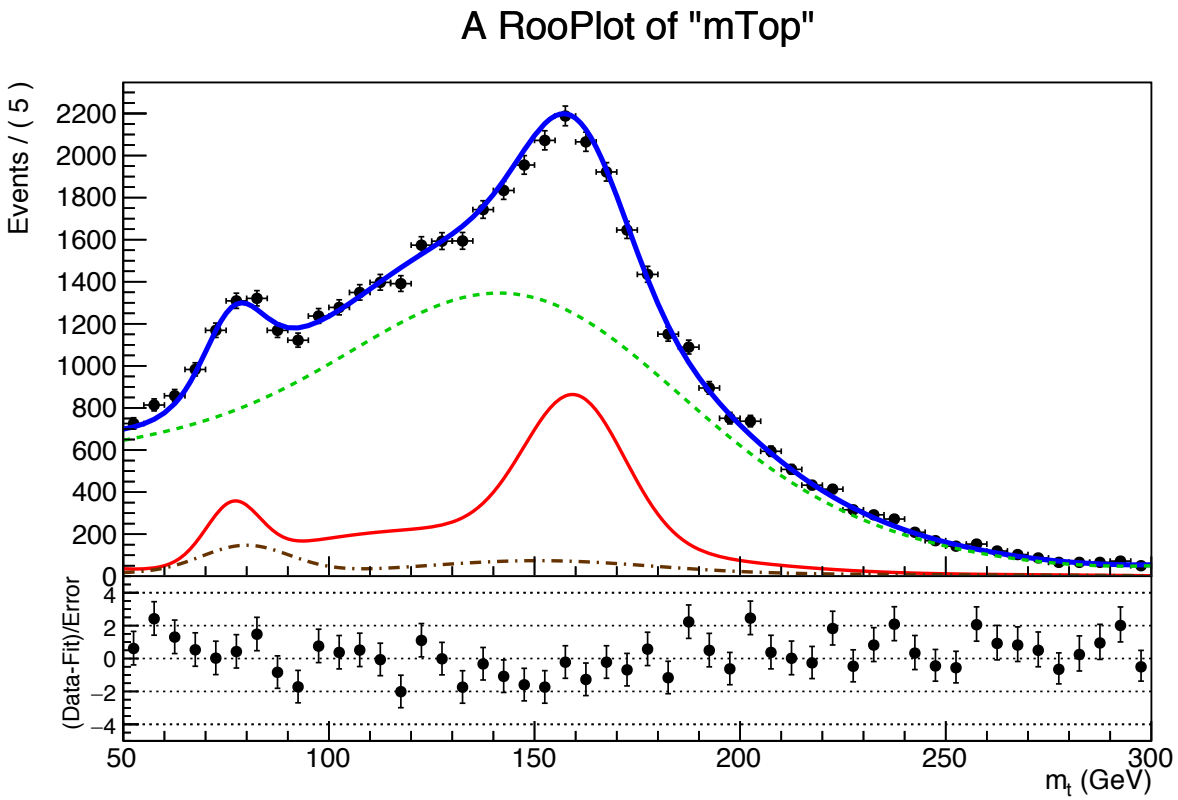
Control Region (0btag) (2016)



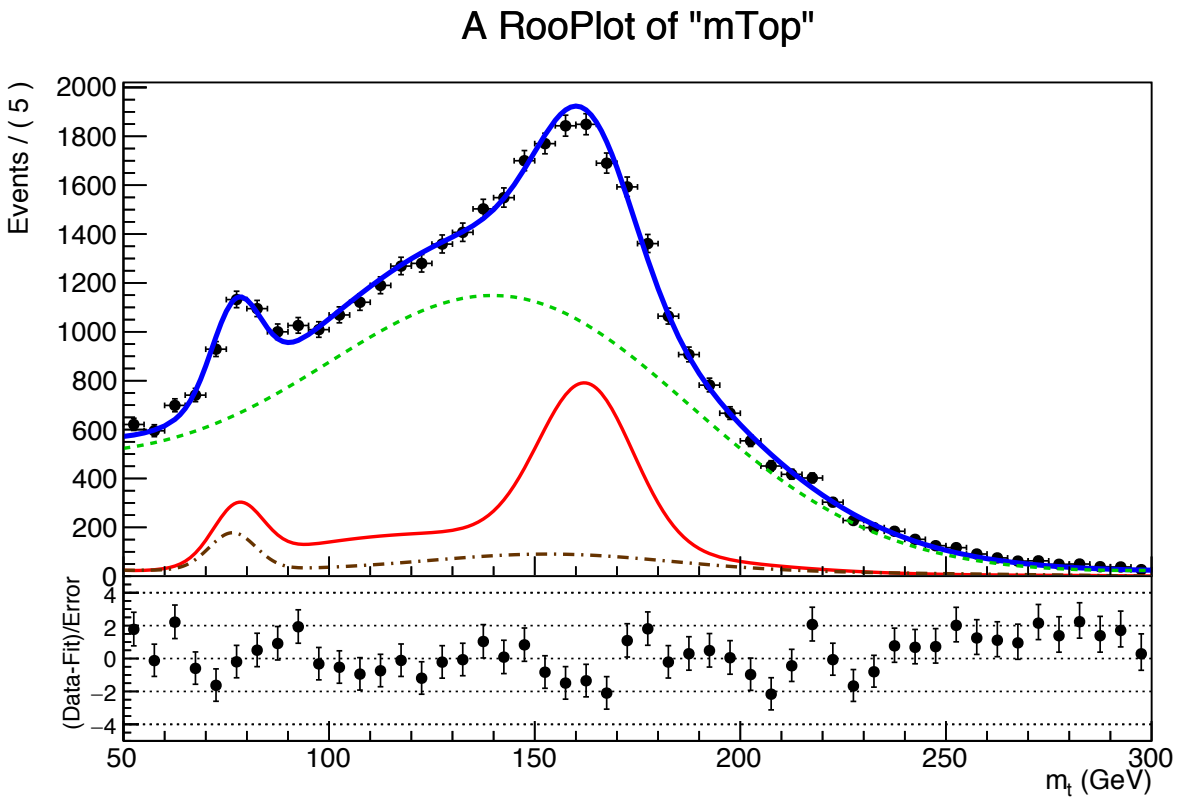
Result of the template fit on data in CR. The red line shows the tt contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions for 2017 and 2016 (1btag Region)

2017

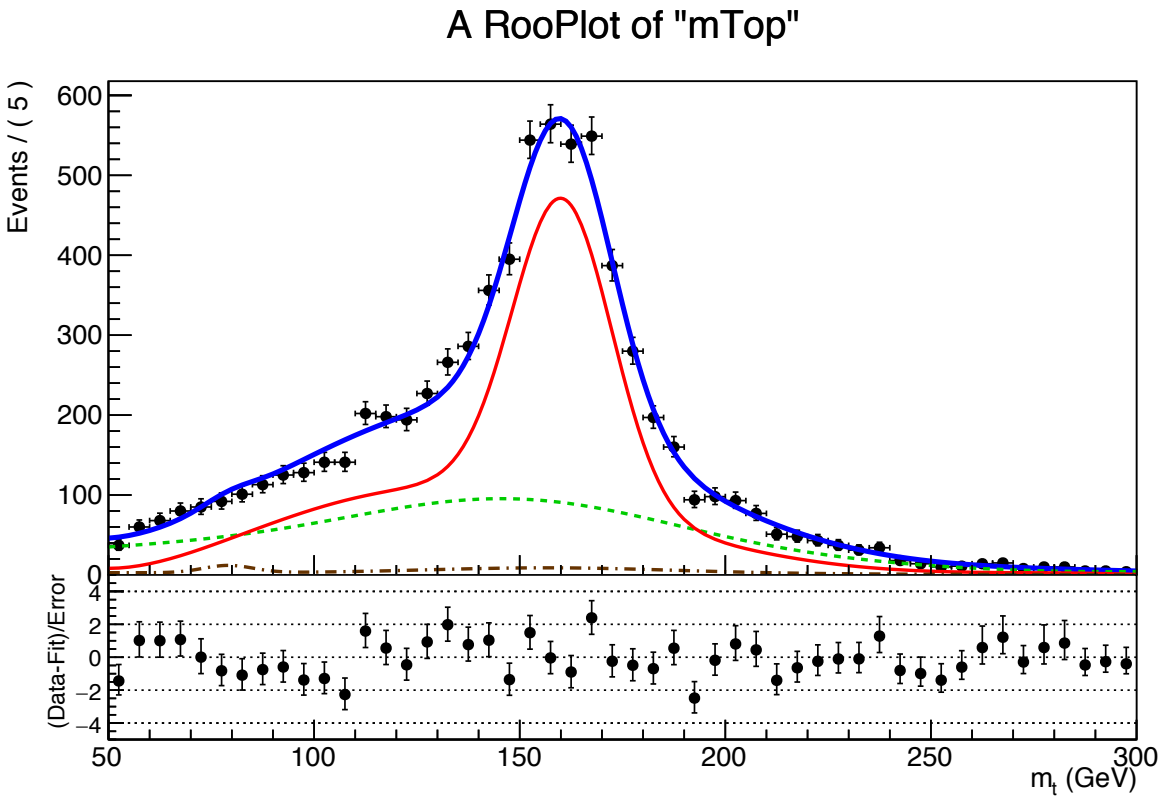


2016

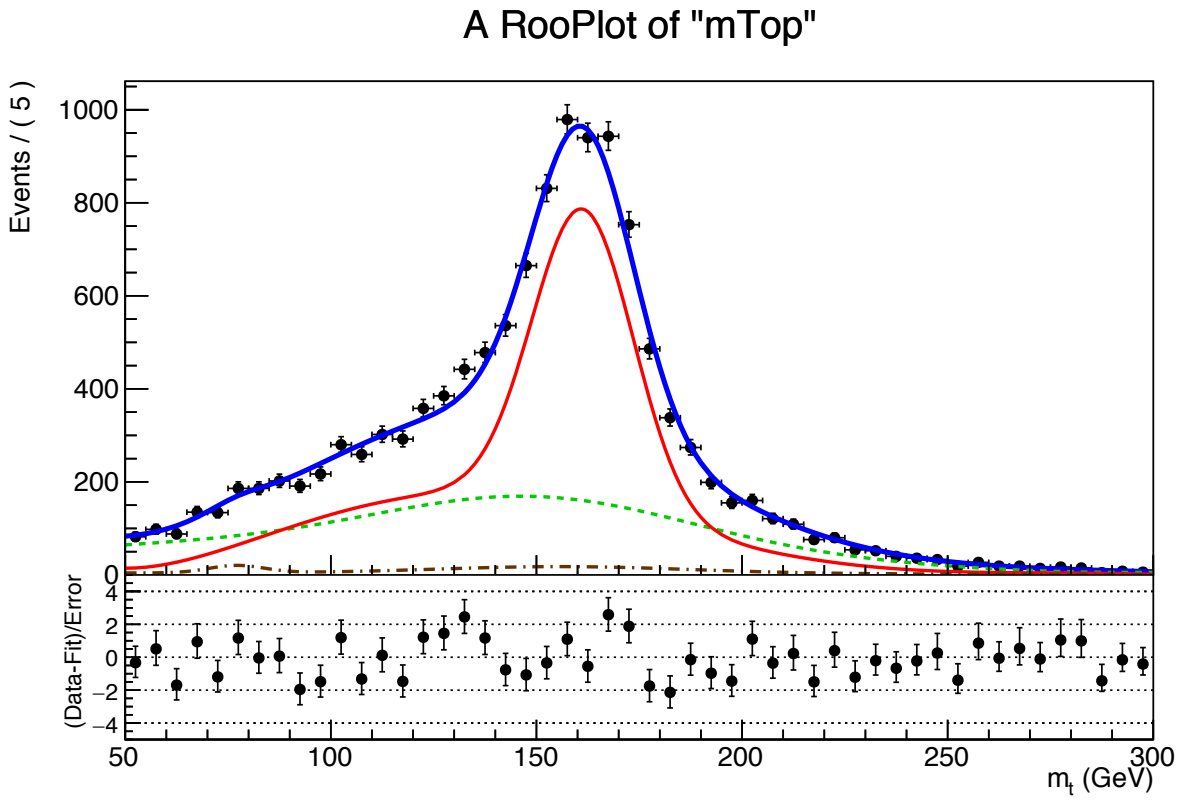


Simultaneous Fit in 3 regions for 2017 and 2018 when eb is free

Signal Region (2btag) (2017)



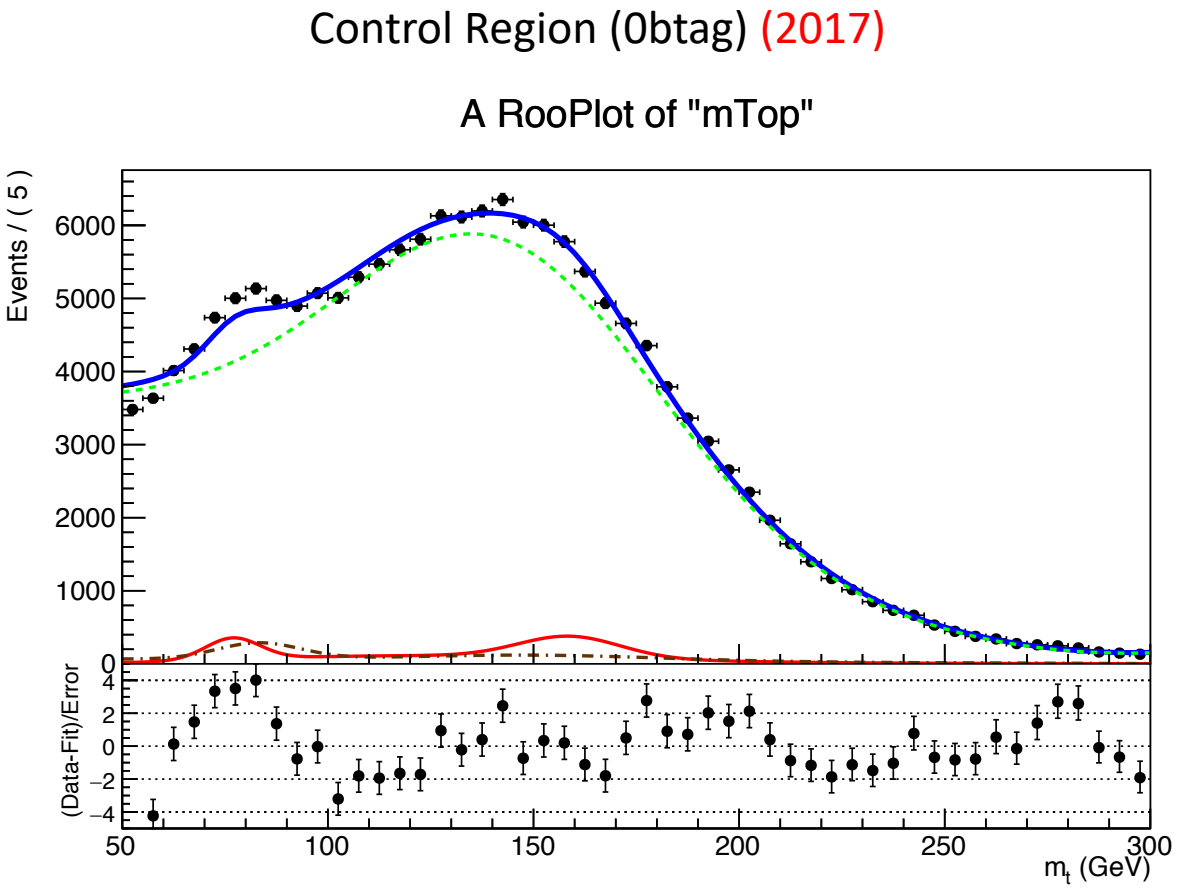
Signal Region (2btag) (2018)



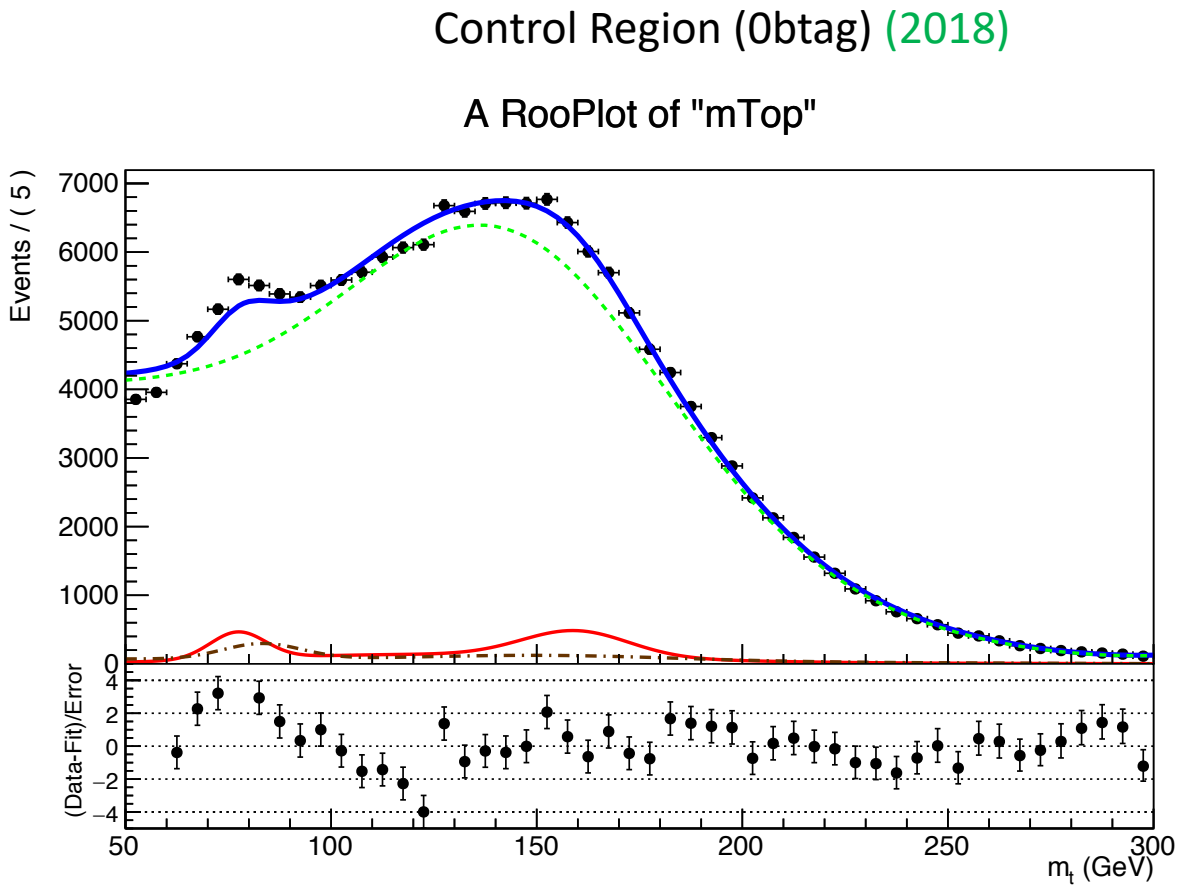
Result of the template fit on data in SR. The red line shows the ttbar contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions for 2017 and 2018 when eb is free

Control Region (0btag) (2017)



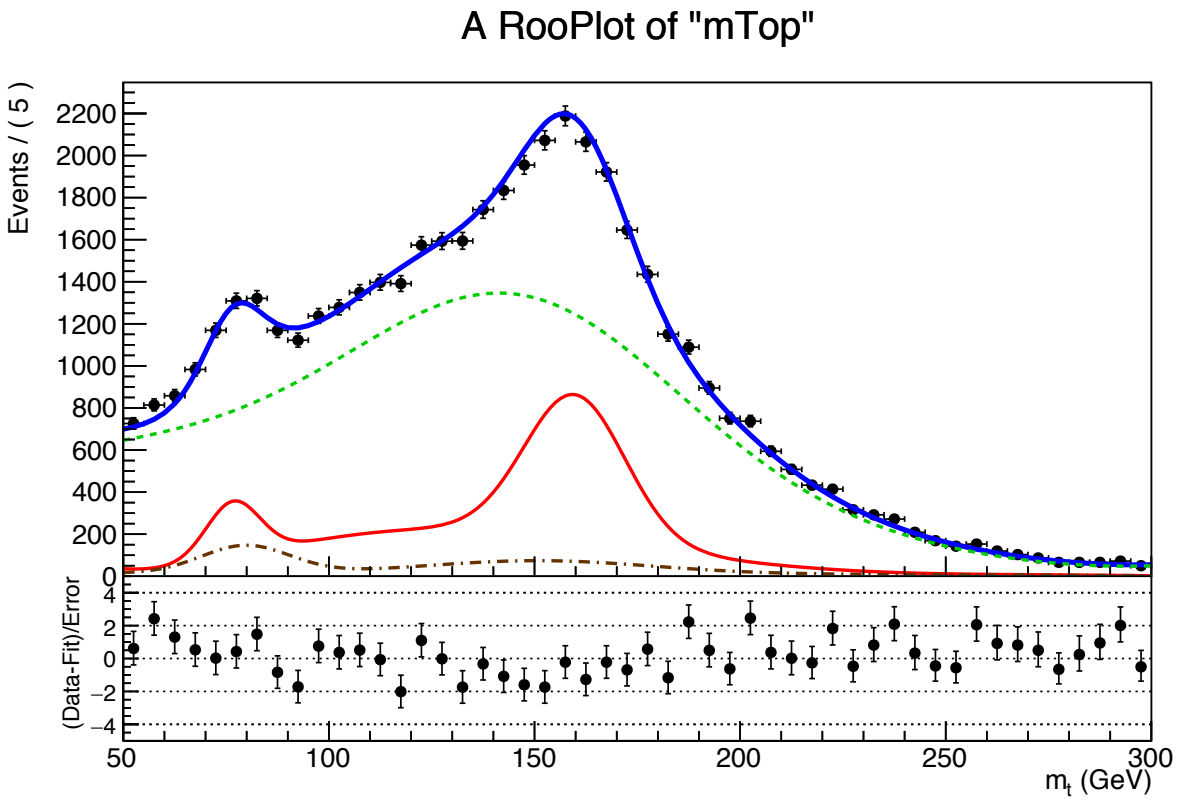
Control Region (0btag) (2018)



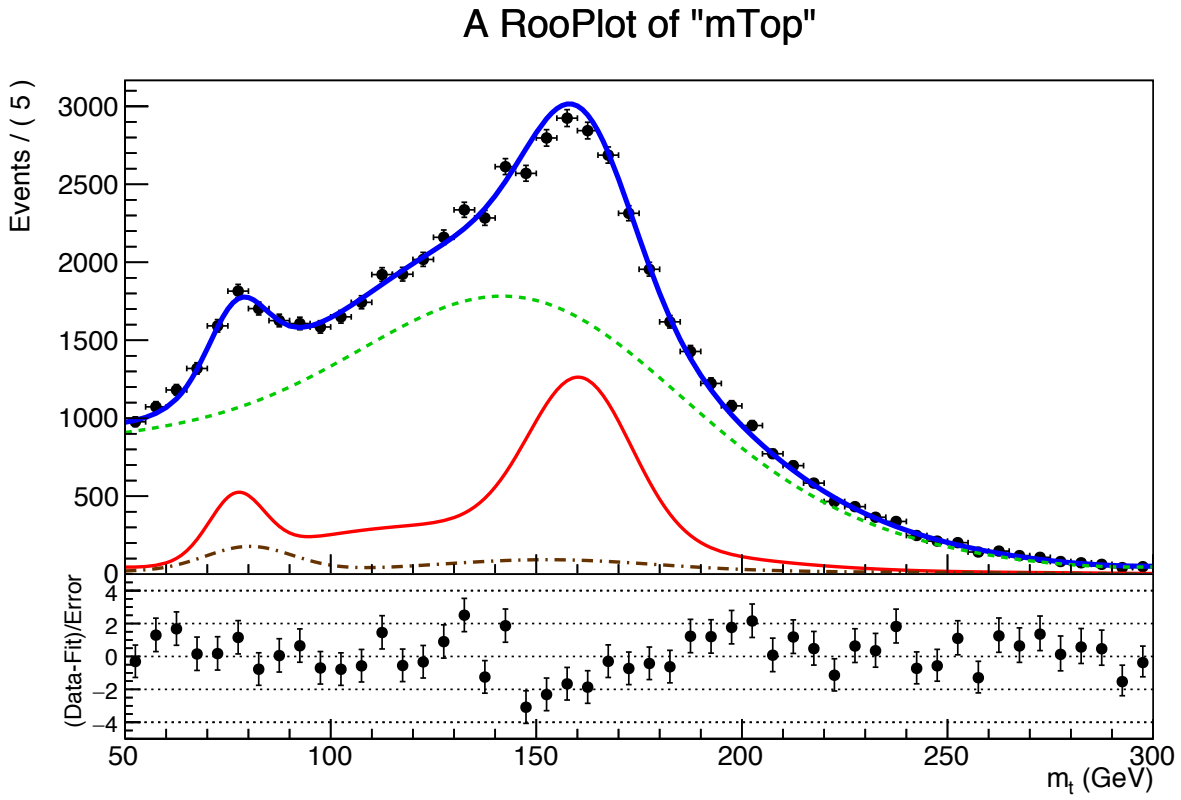
Result of the template fit on data in CR. The red line shows the tt contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions for 2017 and 2018 (1btag Region)

2017



2018



Simultaneous Fit in 3 regions for 2016 ,2017 and 2018 (nuisances)

2016

Floating Parameter	FinalValue +/-	Error
btagEff	5.6029e-01 +/-	1.17e-02
kMassResol	9.6557e-01 +/-	2.29e-02
kMassScale	1.0020e+00 +/-	1.60e-03
kQCD_1b	5.8296e-03 +/-	4.50e-04
kQCD_2b	7.7313e-02 +/-	4.98e-02
nFitBkg_0b	4.5269e+03 +/-	5.63e+01
nFitBkg_1b	2.3159e+03 +/-	4.02e+02
nFitBkg_2b	2.3726e+02 +/-	4.25e+01
nFitQCD_0b	8.7019e+04 +/-	4.15e+02
nFitQCD_1b	2.8973e+04 +/-	3.93e+02
nFitQCD_2b	2.9980e+03 +/-	1.43e+02
nFitSig	1.6686e+04 +/-	6.56e+02

Ntt expected = 16351.2
Ntt observed = 16685.5
r = 1.02045

2017

Floating Parameter	FinalValue +/-	Error
btagEff	4.8200e-01 +/-	1.08e-02
kMassResol	1.0643e+00 +/-	2.78e-02
kMassScale	9.8669e-01 +/-	1.87e-03
kQCD_1b	4.3736e-03 +/-	3.14e-04
kQCD_2b	1.3374e-02 +/-	4.41e-03
nFitBkg_0b	4.0852e+03 +/-	6.06e+01
nFitBkg_1b	2.0763e+03 +/-	3.69e+02
nFitBkg_2b	2.1330e+02 +/-	4.69e+01
nFitQCD_0b	1.5273e+05 +/-	5.71e+02
nFitQCD_1b	3.4635e+04 +/-	4.31e+02
nFitQCD_2b	2.3896e+03 +/-	1.36e+02
nFitSig	1.9783e+04 +/-	7.97e+02

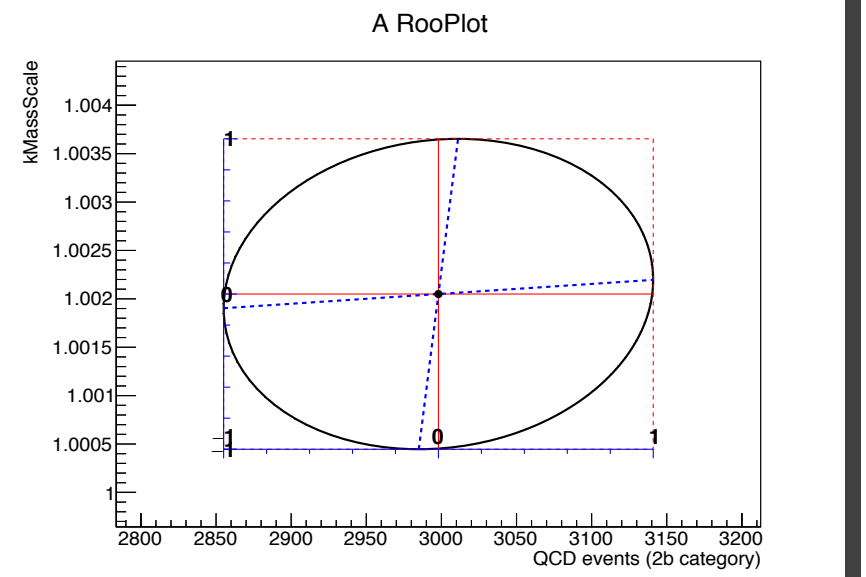
Ntt expected = 23720.7
Ntt observed = 19782.6
r = 0.833981

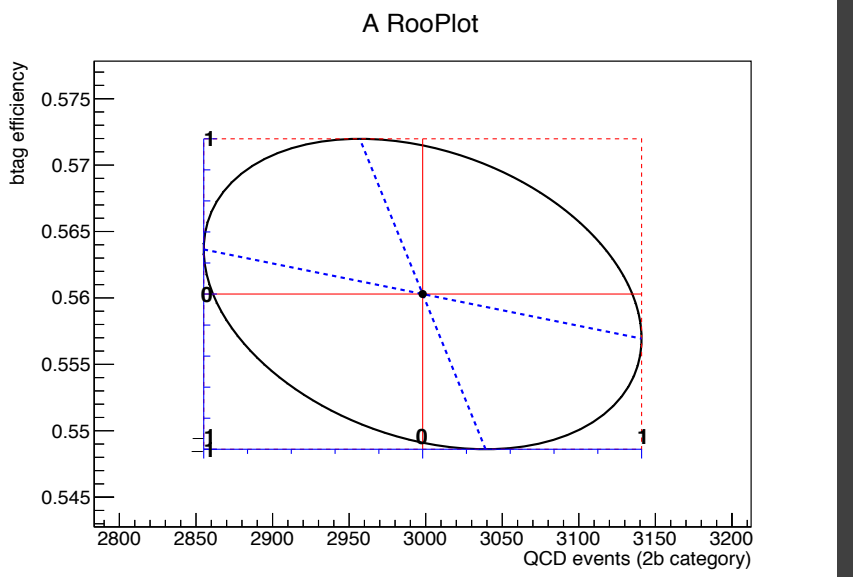
2018

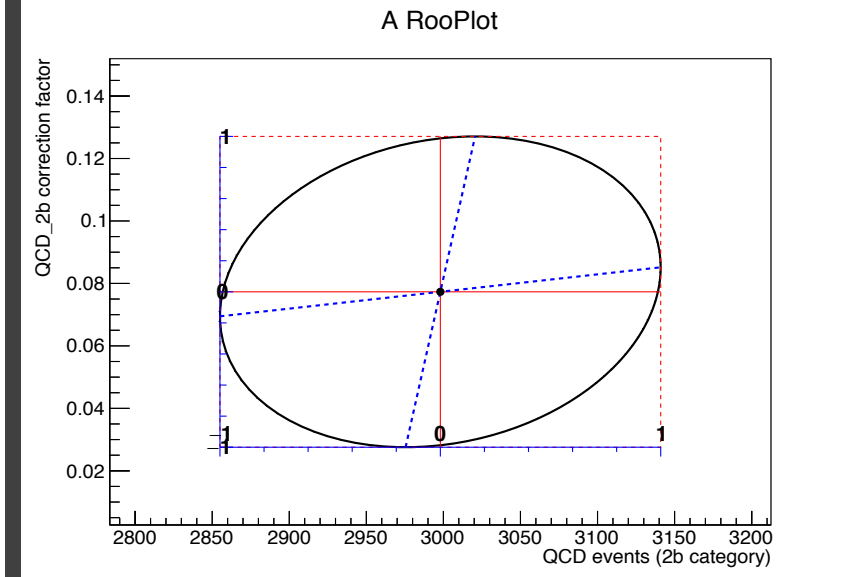
Floating Parameter	FinalValue +/-	Error
btagEff	5.1228e-01 +/-	1.08e-02
kMassResol	1.0730e+00 +/-	2.43e-02
kMassScale	9.8917e-01 +/-	1.69e-03
kQCD_1b	3.5721e-03 +/-	7.53e-04
kQCD_2b	1.2218e-02 +/-	2.77e-03
nFitBkg_0b	4.1842e+03 +/-	4.92e+01
nFitBkg_1b	2.5677e+03 +/-	2.98e+02
nFitBkg_2b	4.1750e+02 +/-	7.27e+01
nFitQCD_0b	1.6558e+05 +/-	6.68e+02
nFitQCD_1b	4.5743e+04 +/-	2.78e+03
nFitQCD_2b	4.2092e+03 +/-	1.42e+02
nFitSig	2.9030e+04 +/-	1.40e+03

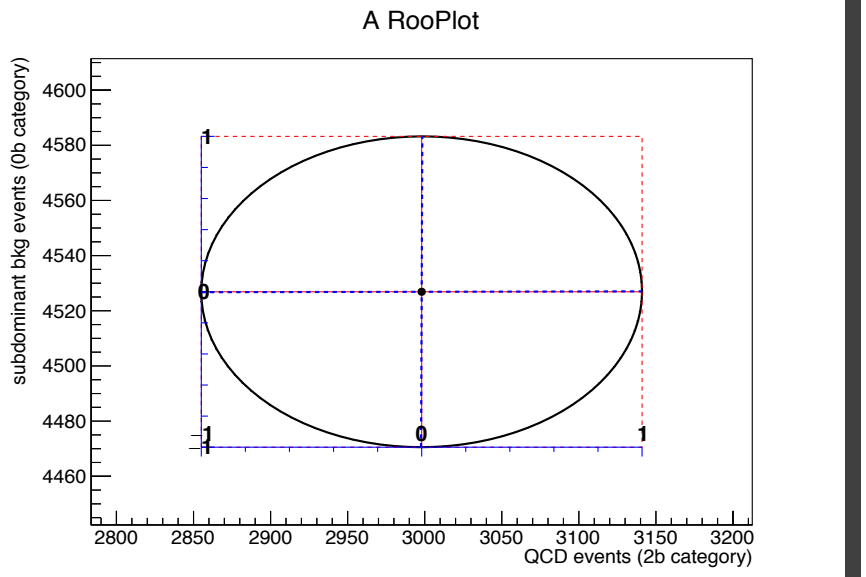
Ntt expected = 30676.2
Ntt observed = 29030.2
r = 0.94634

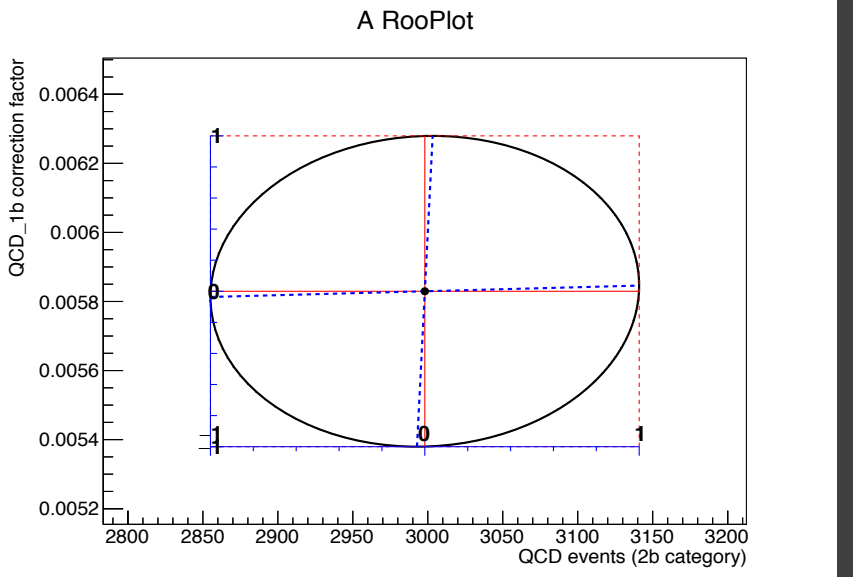
Correlation plots $N_{QCD(2)}$ vs all nuisances from fit when eb runs free for 2016

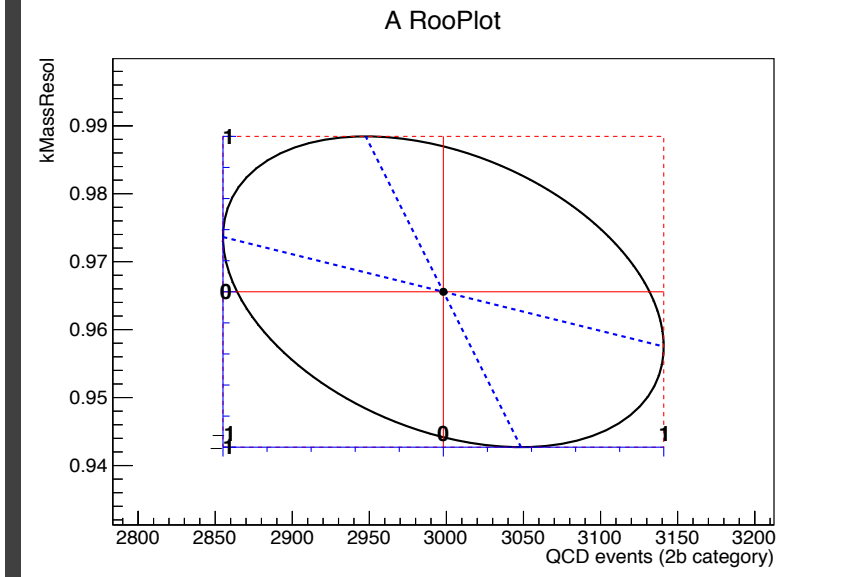




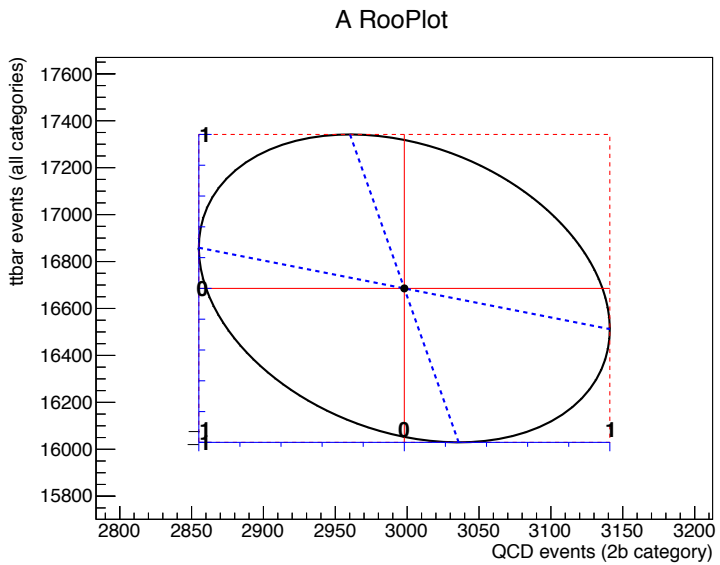


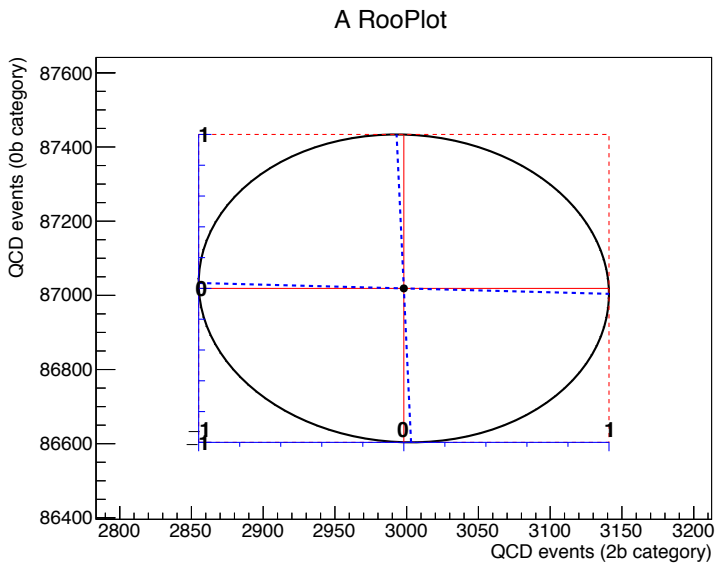


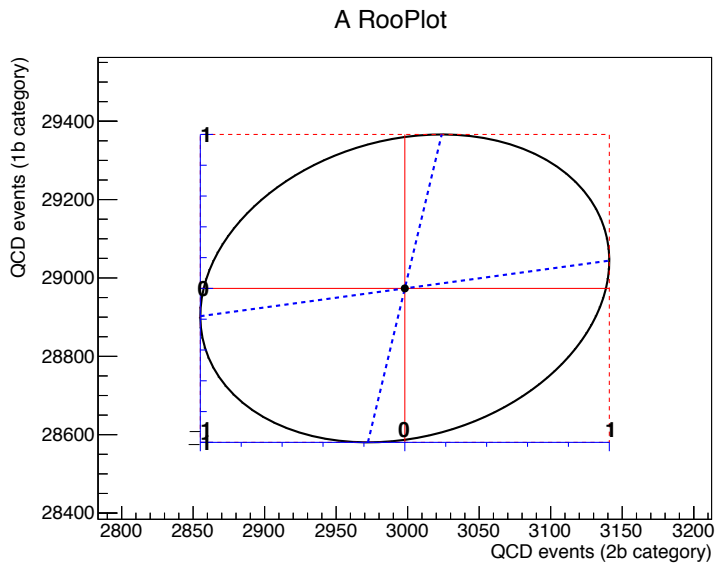


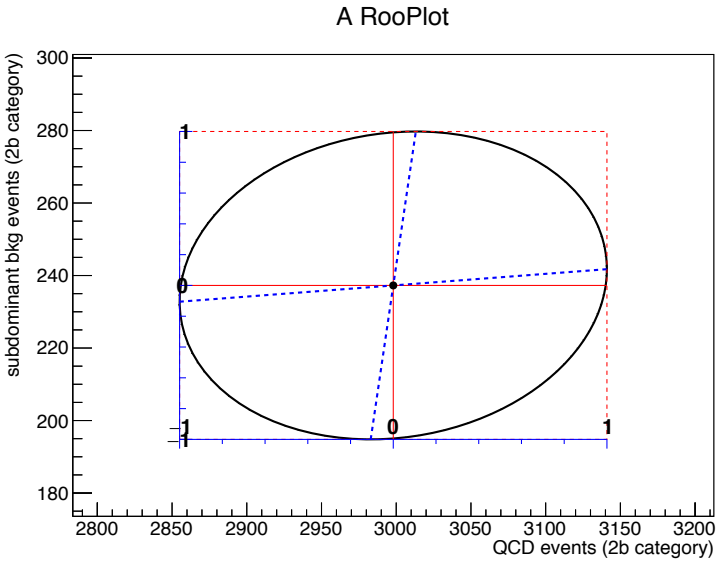


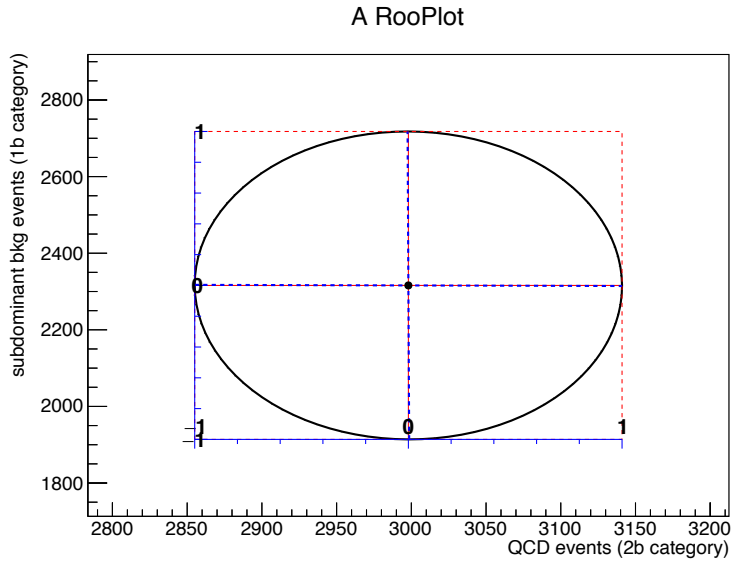
Correlation plots $N_{QCD(2)}$ vs all nuisances from fit when eb runs free for 2016





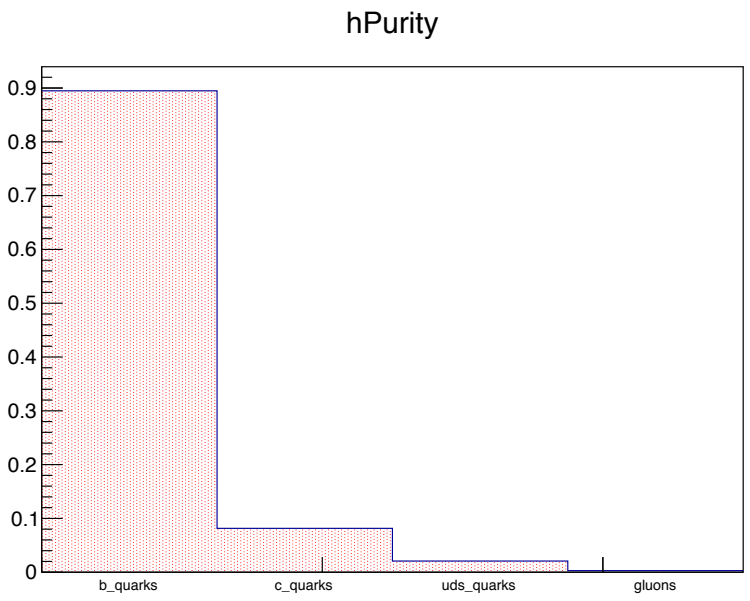






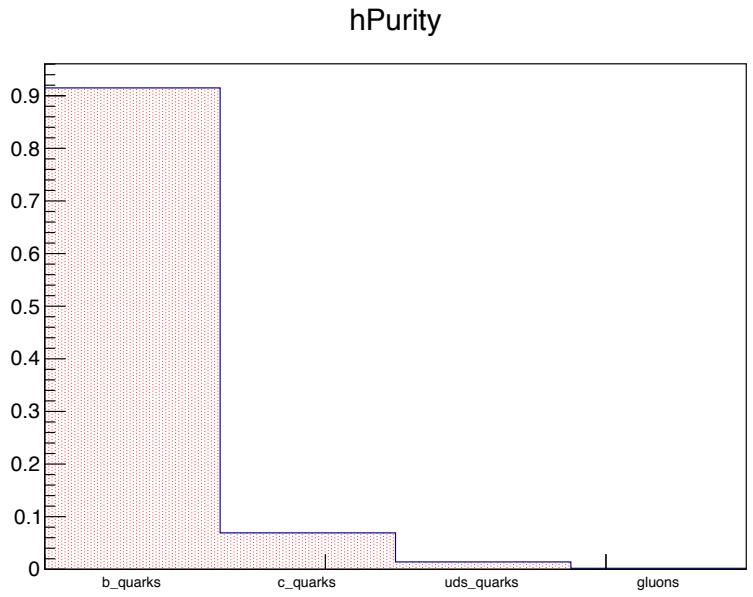
Btagging purity

2016



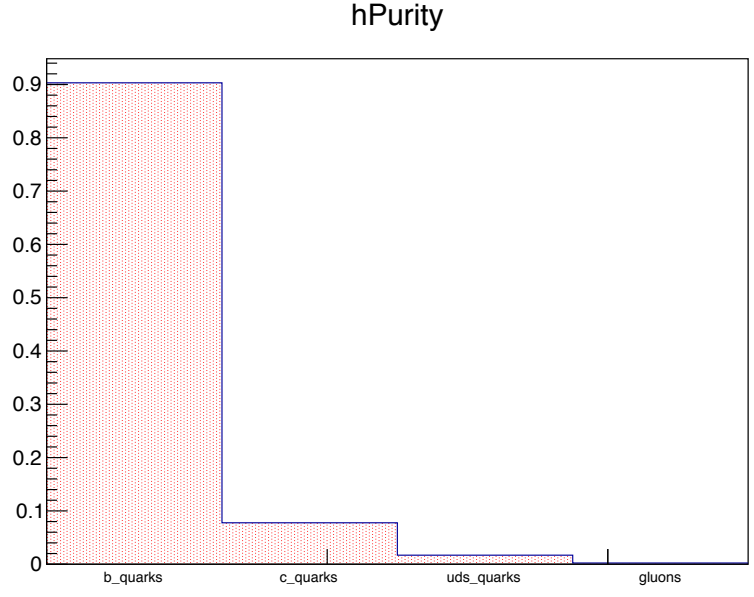
Purity ≈ 0. 894

2017



Purity ≈ 0.915

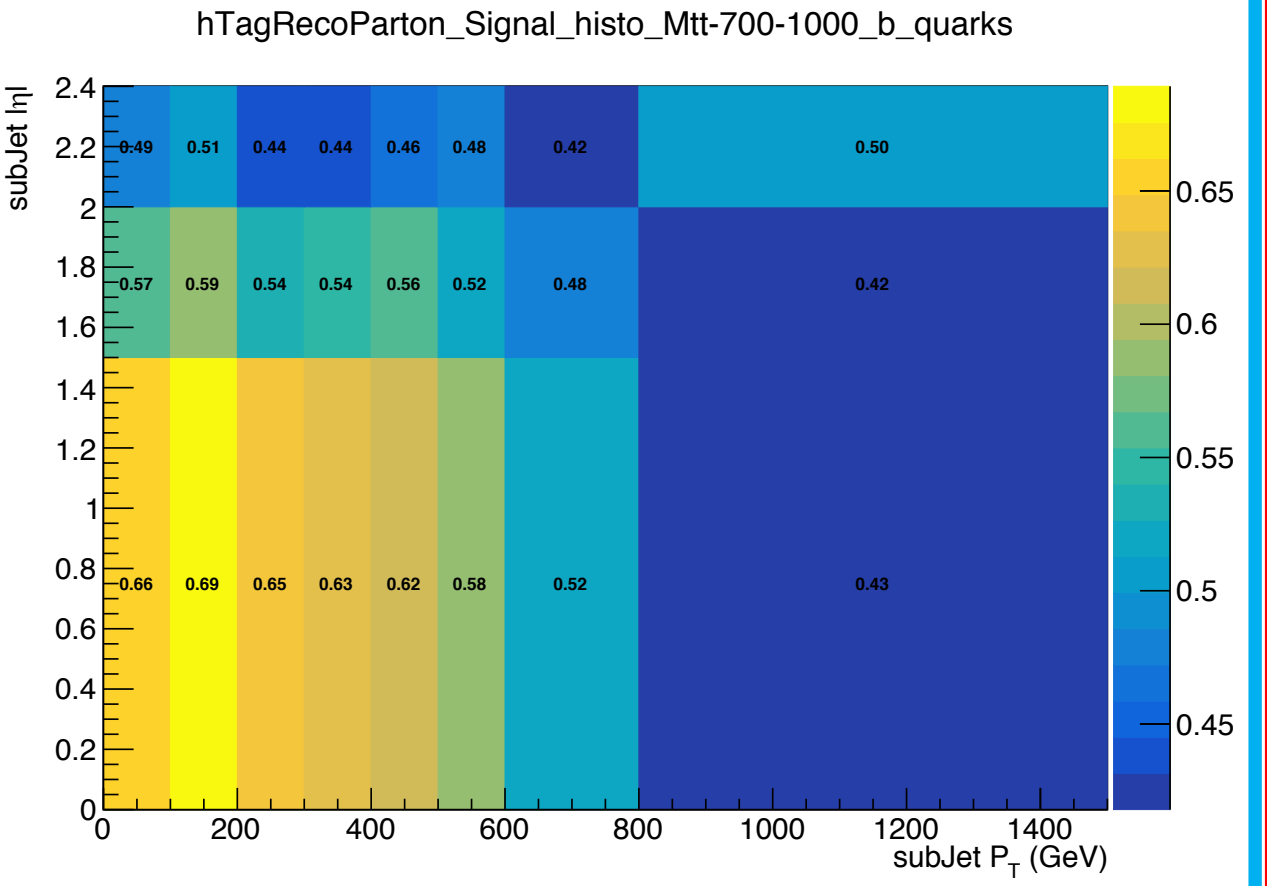
2018



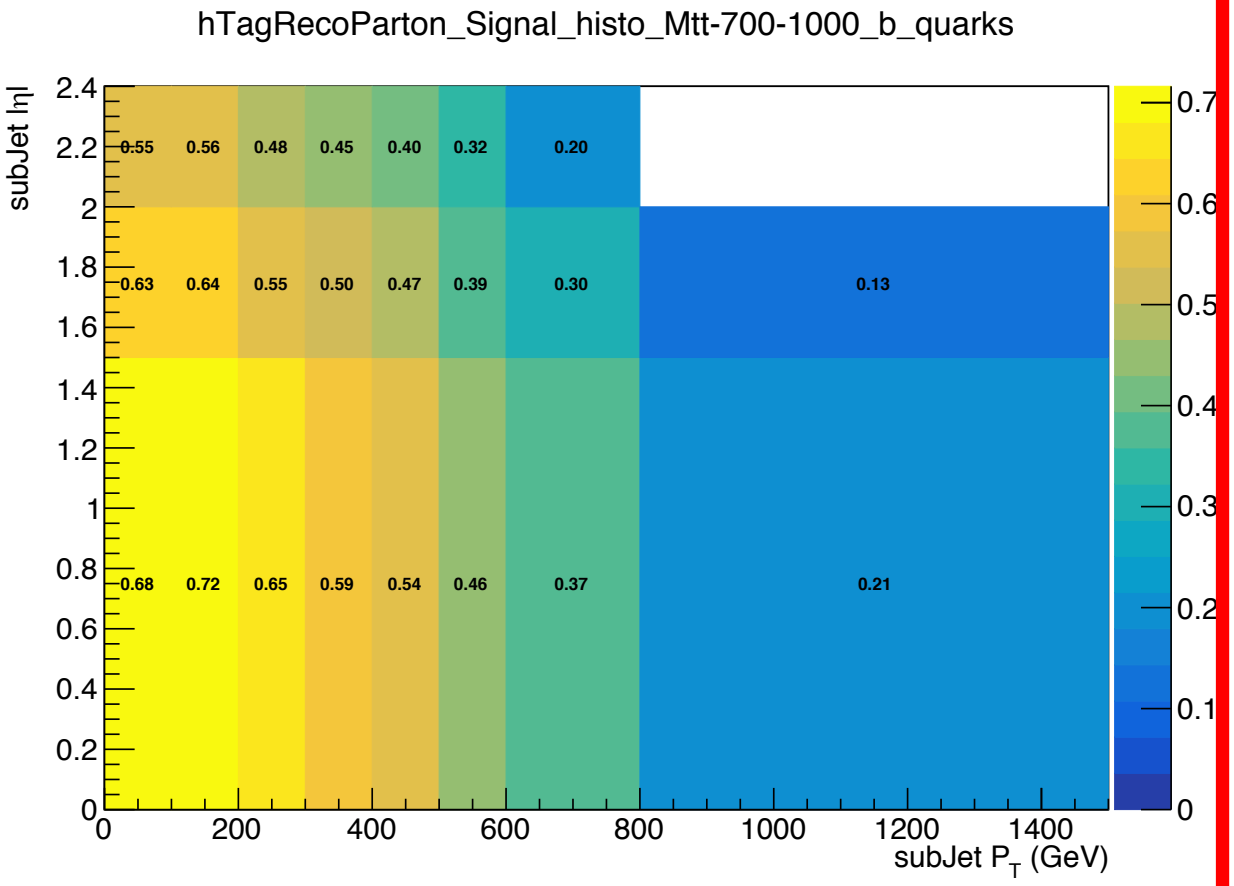
Purity ≈ 0.903

Btagging efficiency in eta, pT_{subJet} phase space

2016

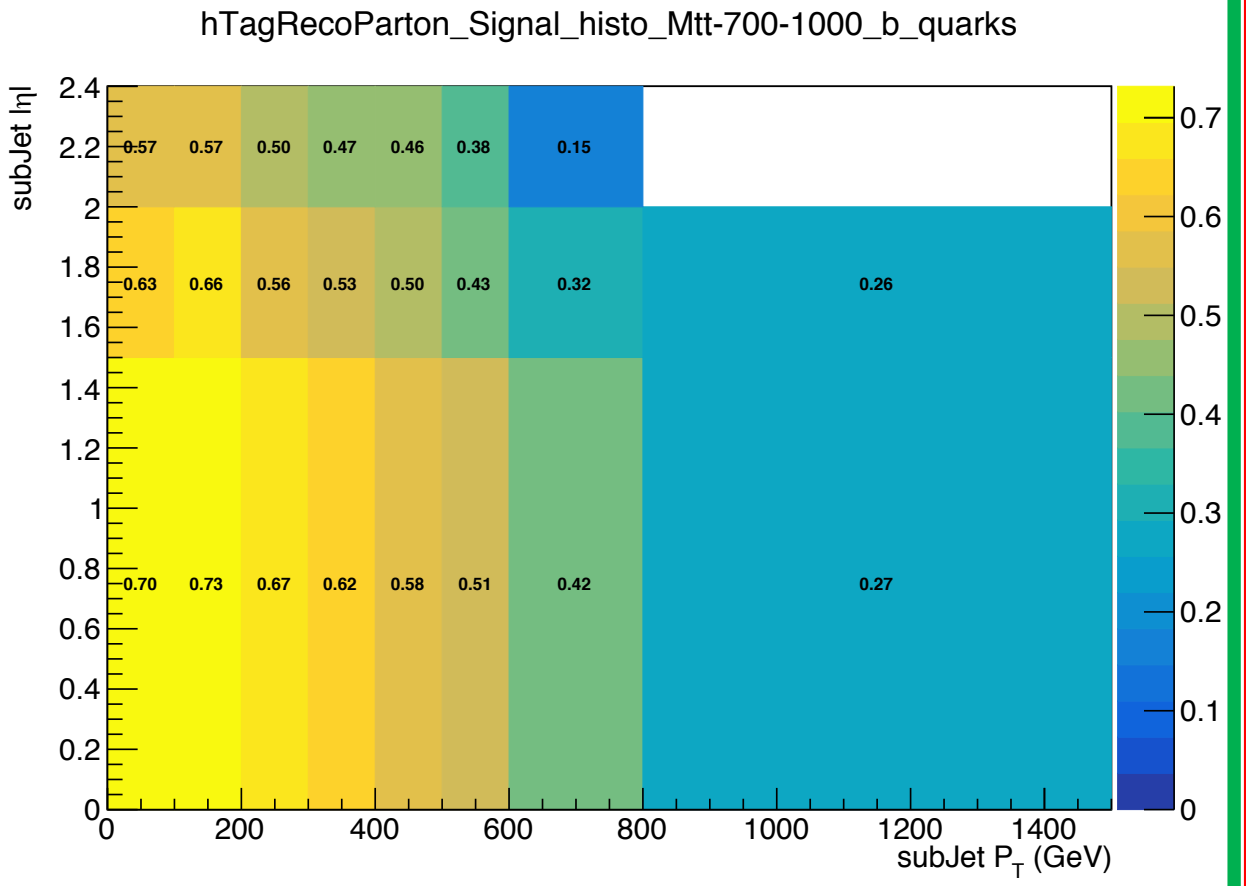


2017

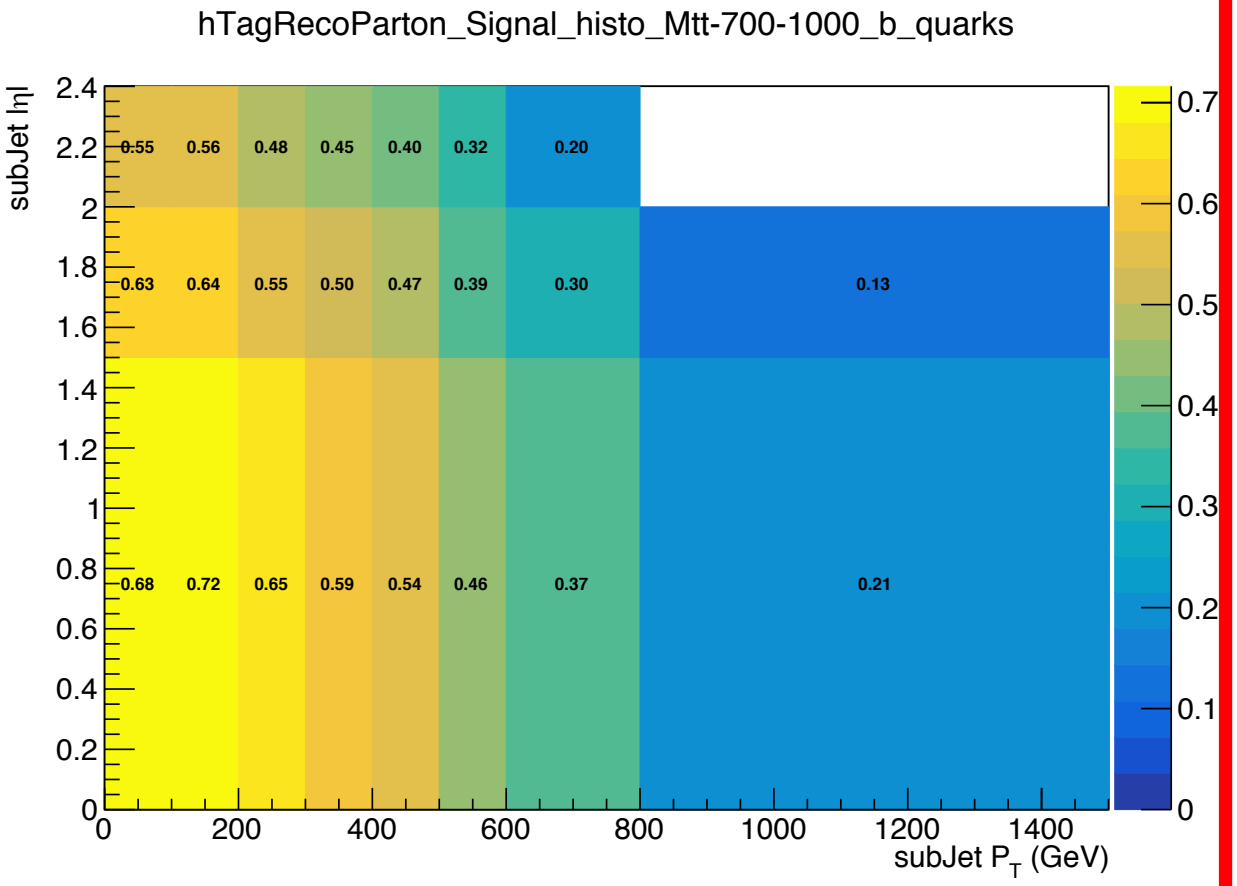


Btagging efficiency in eta, pT_{subJet} phase space

2018



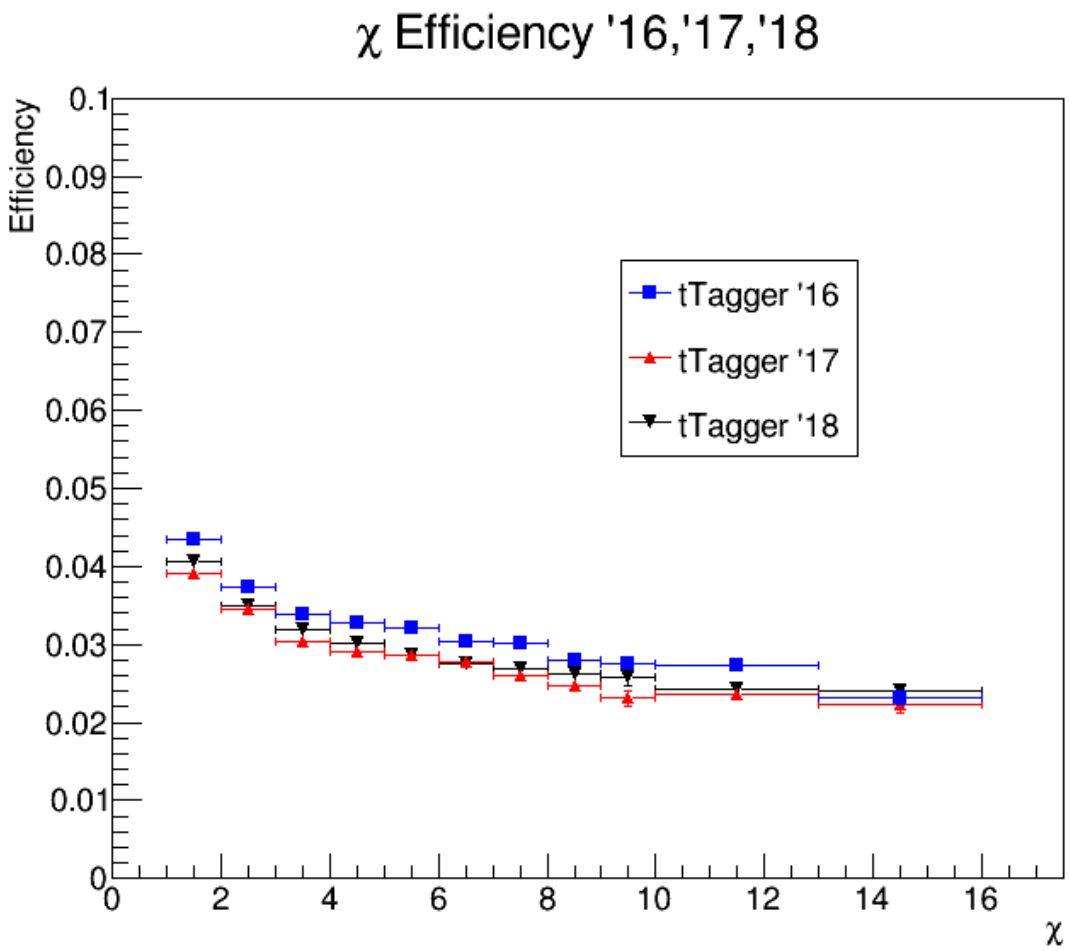
2016

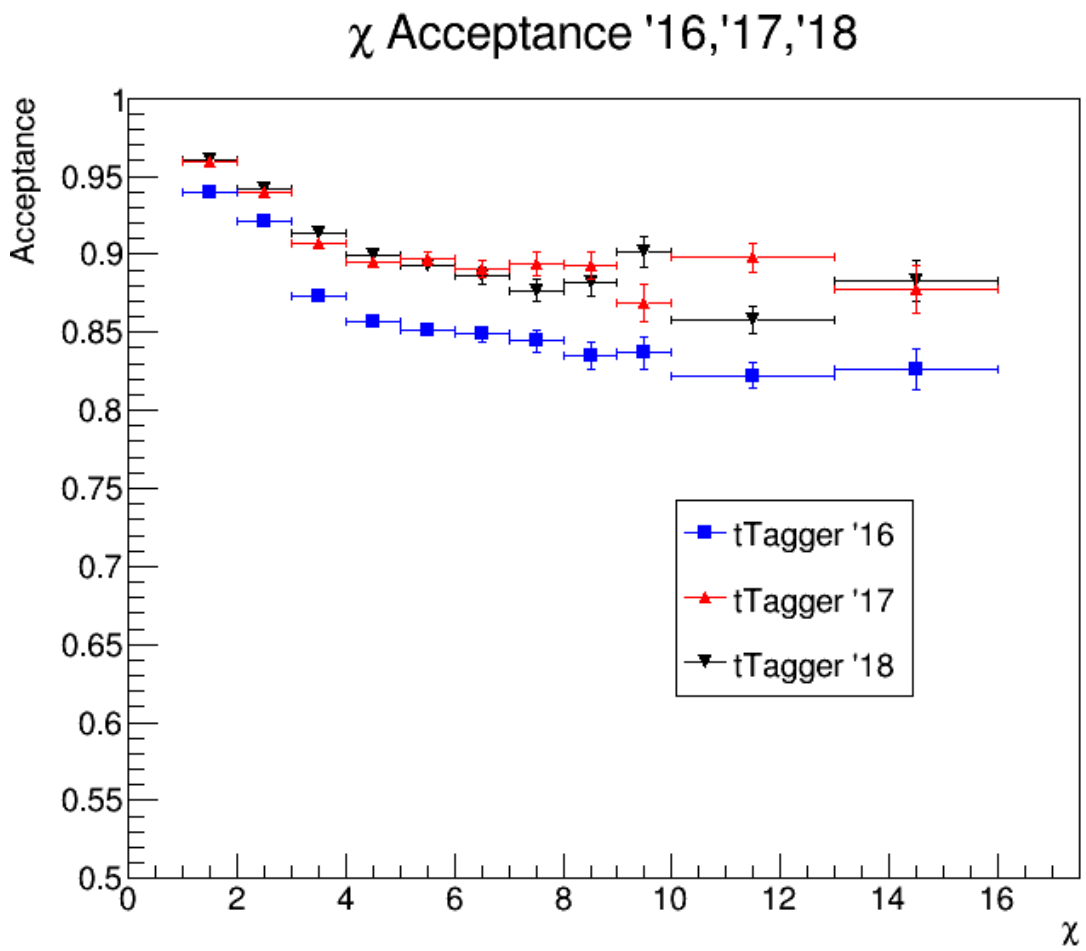


Angular Distributions

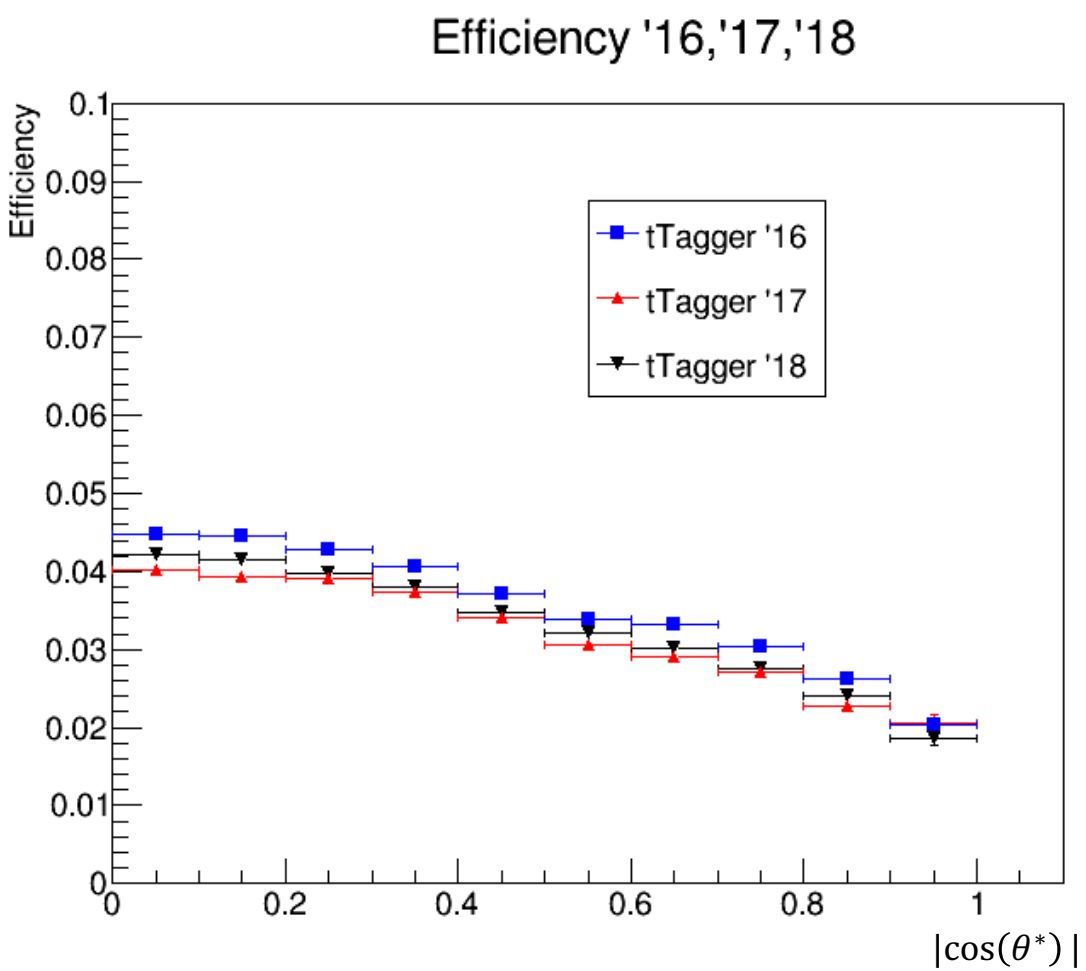
- Acceptance, Efficiency for χ, $|\cos(\theta)|$ distributions
- Stability and purity for χ and $|\cos(\theta)|$distributions
- Closure tests and TT contamination
- I measure the χ using the exponential
- Here you will find a comparison of 2016, 2017 and 2018 MC's. (I only use the Mtt 1000-Inf file)
- Using DeepCSV for btagging
- topTagger WP:
  - 2016: 0.1
  - 2017: 0.0
  - 2018: 0.1

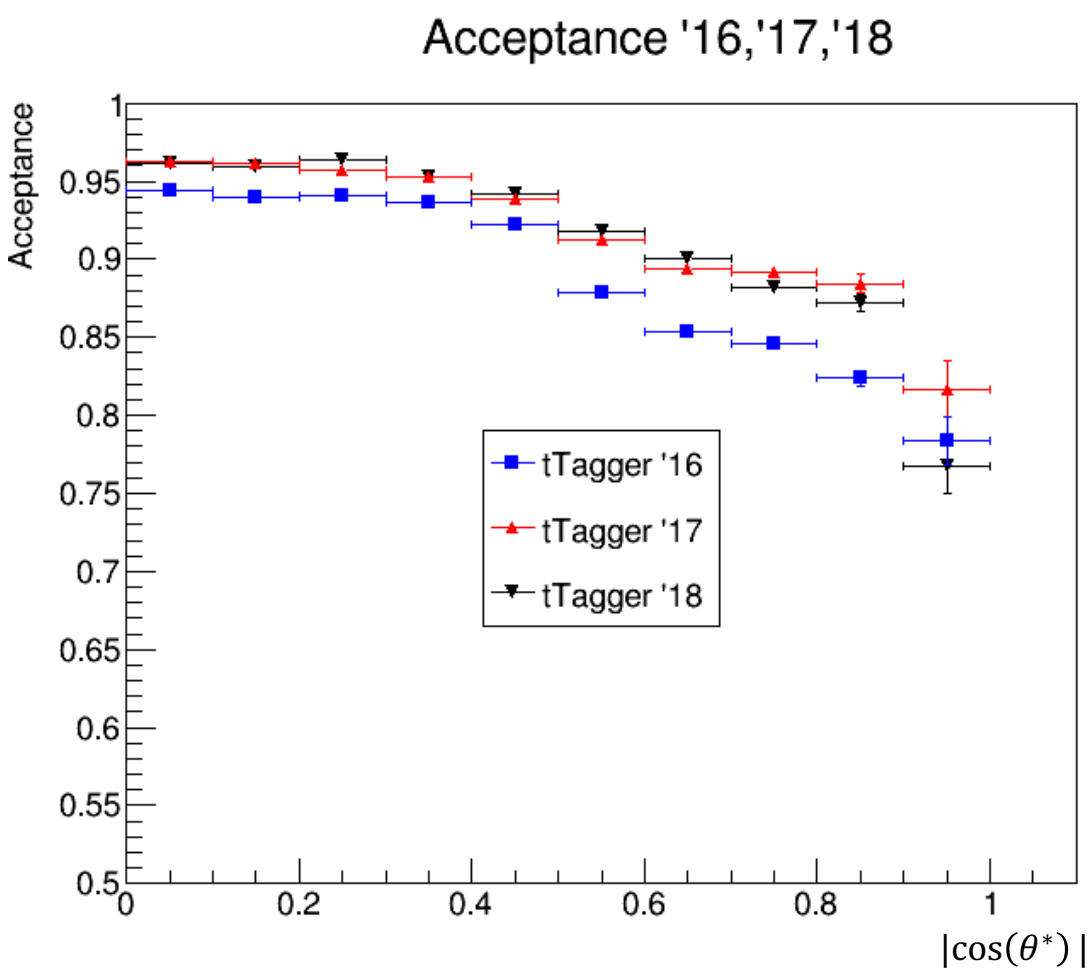
Efficiency, Acceptance for χ





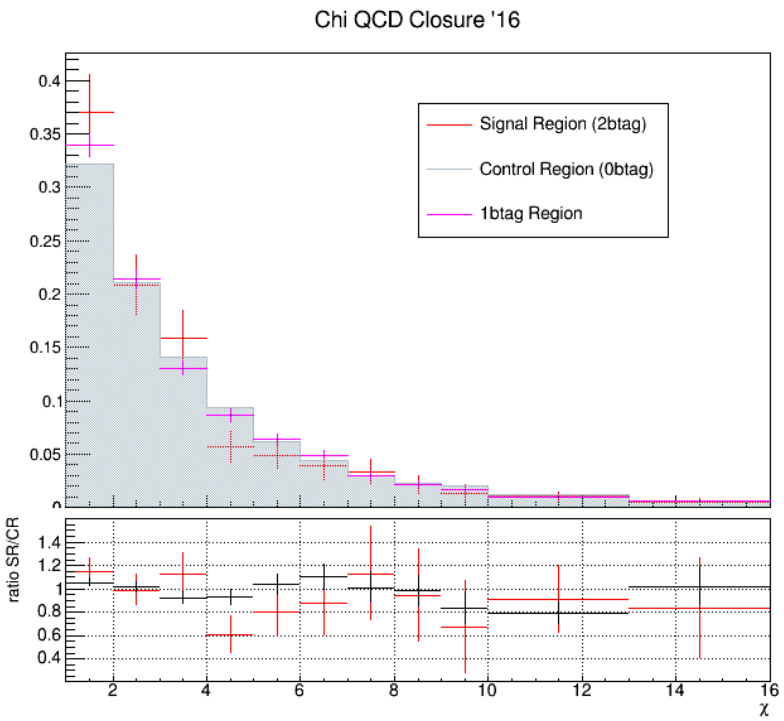
Efficiency, Acceptance for |cos(θ*)|



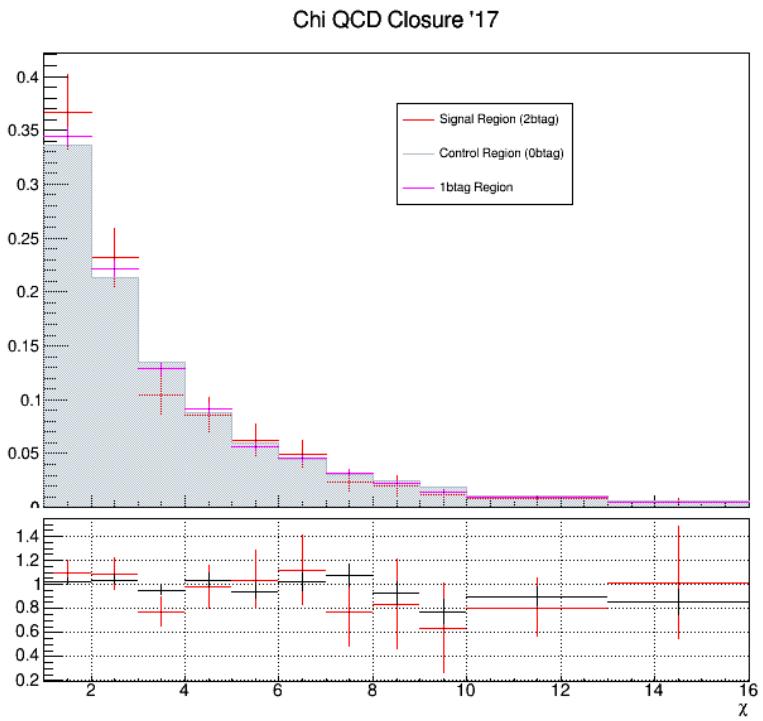


QCD Closure Tests ’16, ‘17, ’18 χ

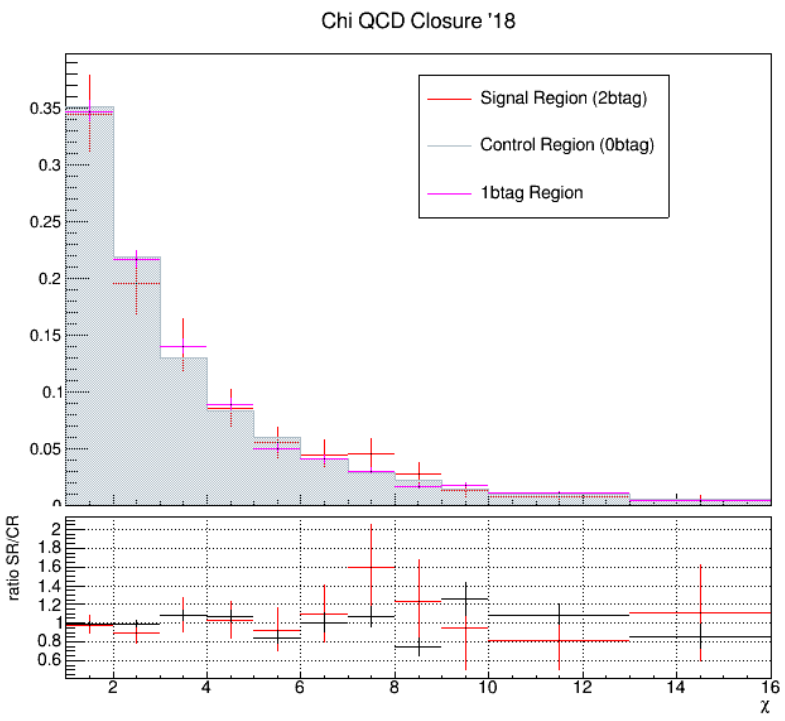
2016



2017



2018

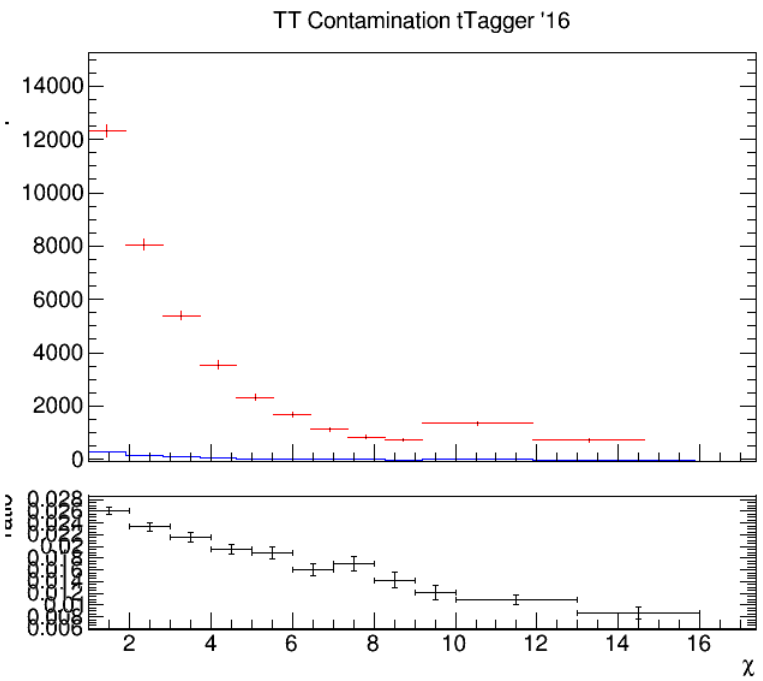


CR Contamination ’16,’17,’18 χ

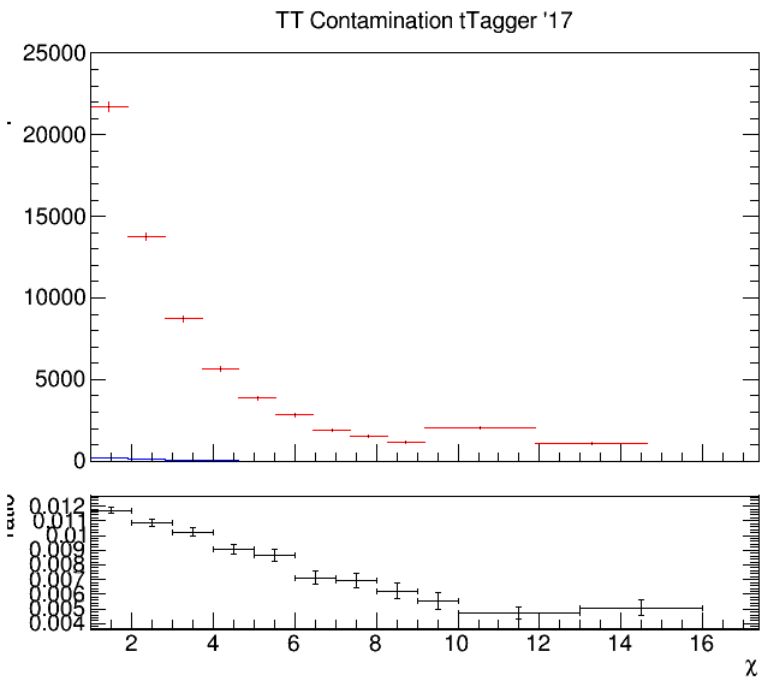
Control Region QCD sample

Control Region TT sample

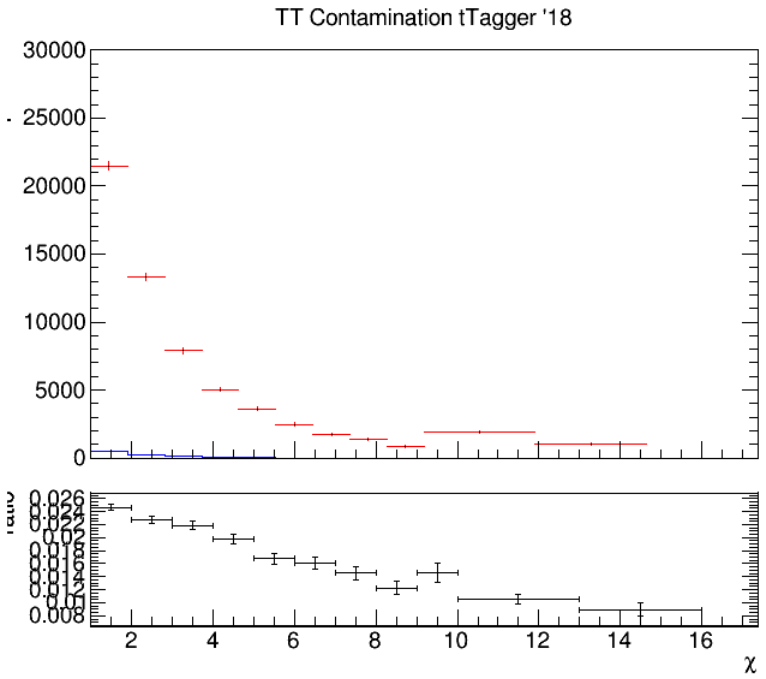
2016



2017

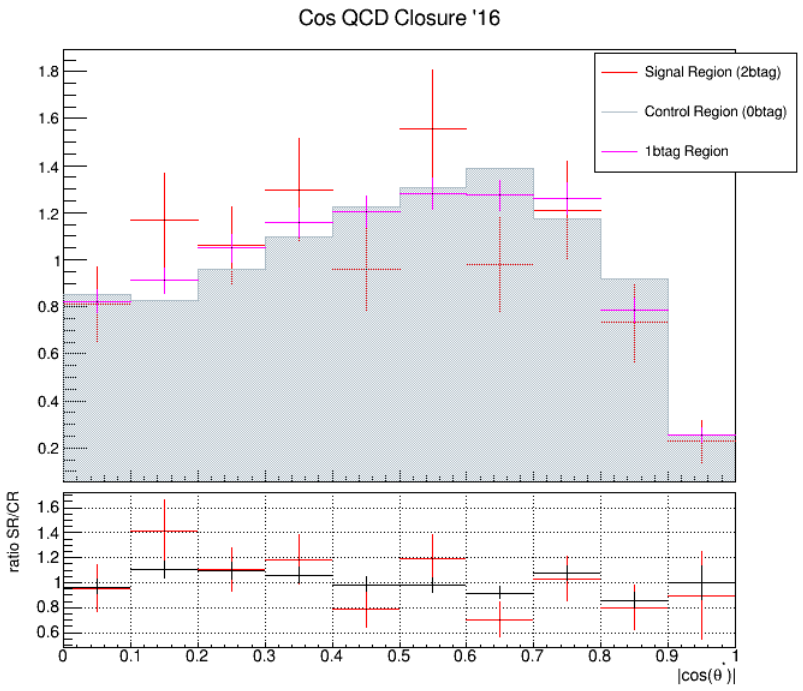


2018

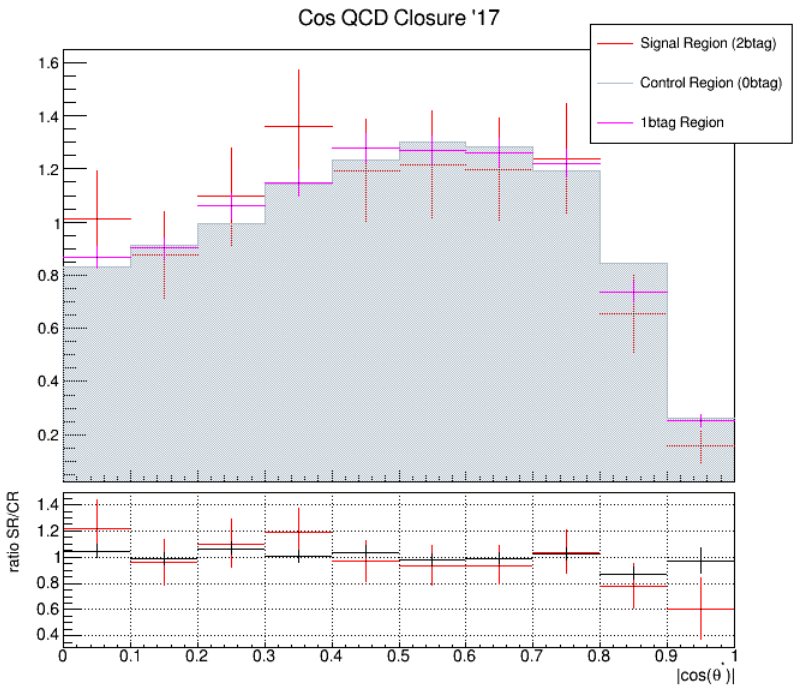


QCD Closure Tests ’16, ‘17, ’18 |cos(θ*)|

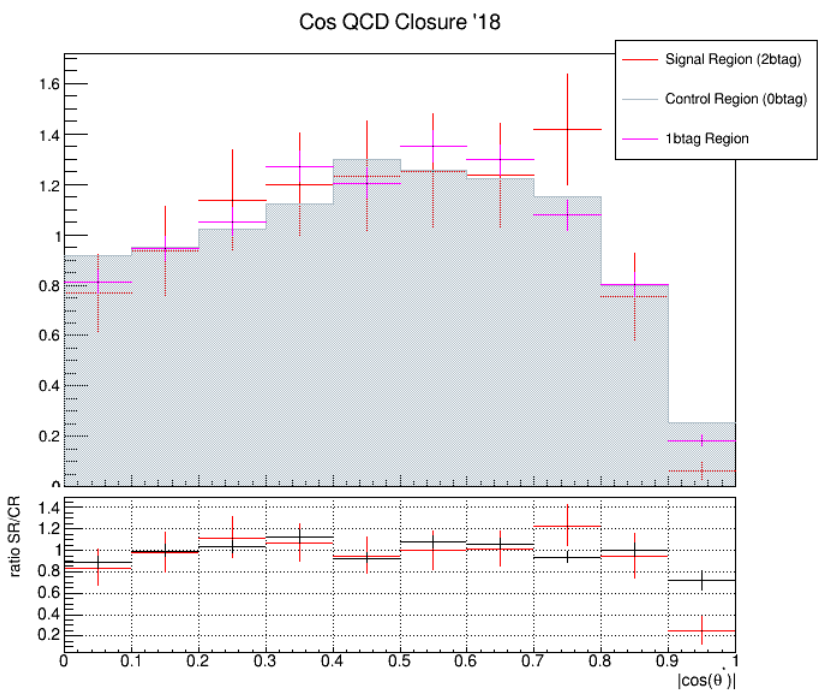
2016



2017



2018

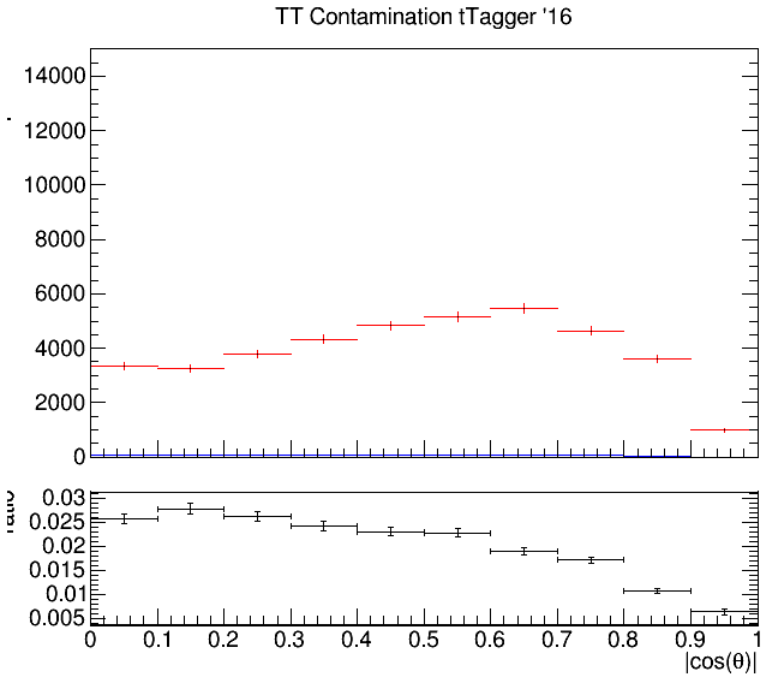


CR Contamination ’16,’17,’18 |cos(θ*)|

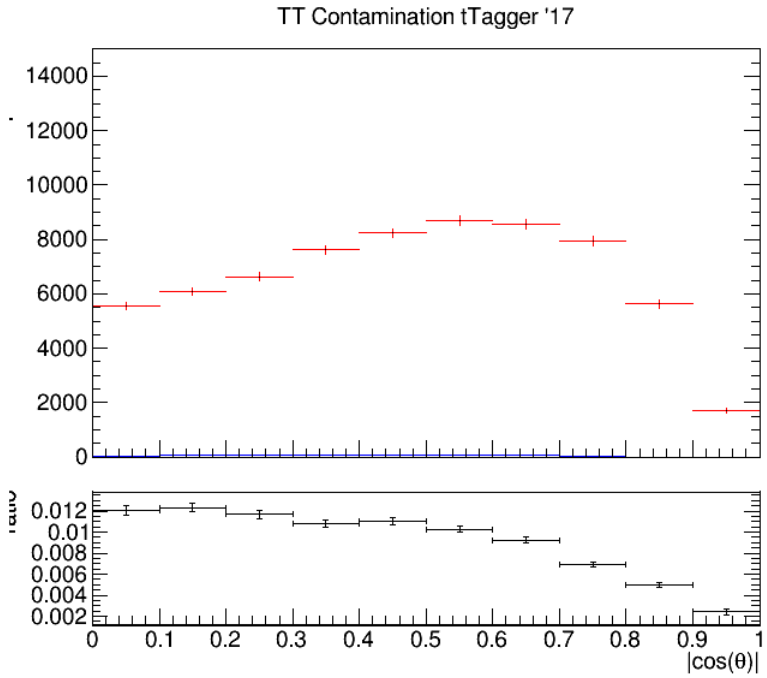
Control Region QCD sample

Control Region TT sample

2016



2017



2018