ttbar Analysis Status
NTUA
28/5/2020

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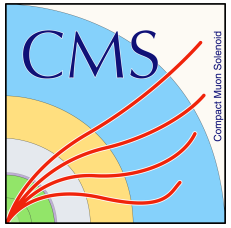


Introduction

- We have identified that the contamination in the control region coming form the subdominant processes is also significant and, in some cases, even more significant than the one coming from ttbar.
- Although it can be seen that selecting the b-tagging loose working point for our control region improves the situation concerning the ttbar contamination, the subdominant bkg still remains significant especially in the area around the W mass.

We tried 3 different fitting methods, all using the medium b-tagging working point for both regions (Signal and Control region).

- First, we fit only the 2btag region but we use a ttbar and subdominant bkg free area to generate the qcd template.
  We calculate this area using QCD = Data(0btag) – ttbar (0btag) – subdominant (0btag) where both ttbar and subdominant are taken from MC.

- We do a simultaneous fit in the 0btag and 2 btag regions where we add an extra Gaussian in the QCD template in order to compensate for the contamination coming from the subdominant backgrounds.

- We do a simultaneous fit where we use the initial fitting procedure with nothing extra.

Signal Selection

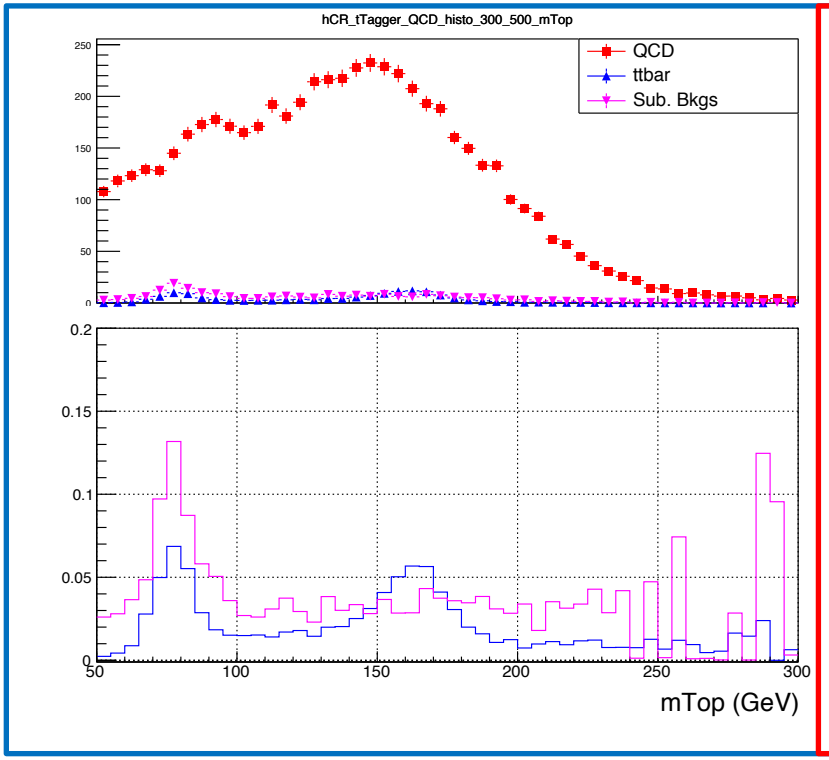
Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2
B tagging (2 btagged jets)	> Medium WP
Signal Trigger	

Control Region Selection

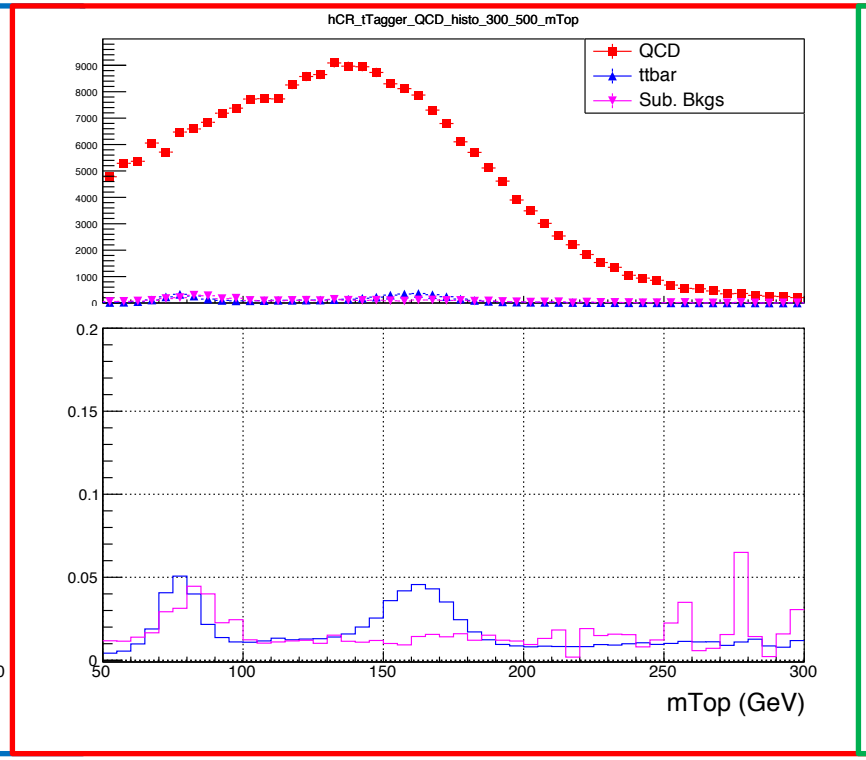
Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2
B tagging (0 btagged jets)	< Medium WP
Control Trigger	

Contamination Plots Medium WP (CR, SR)

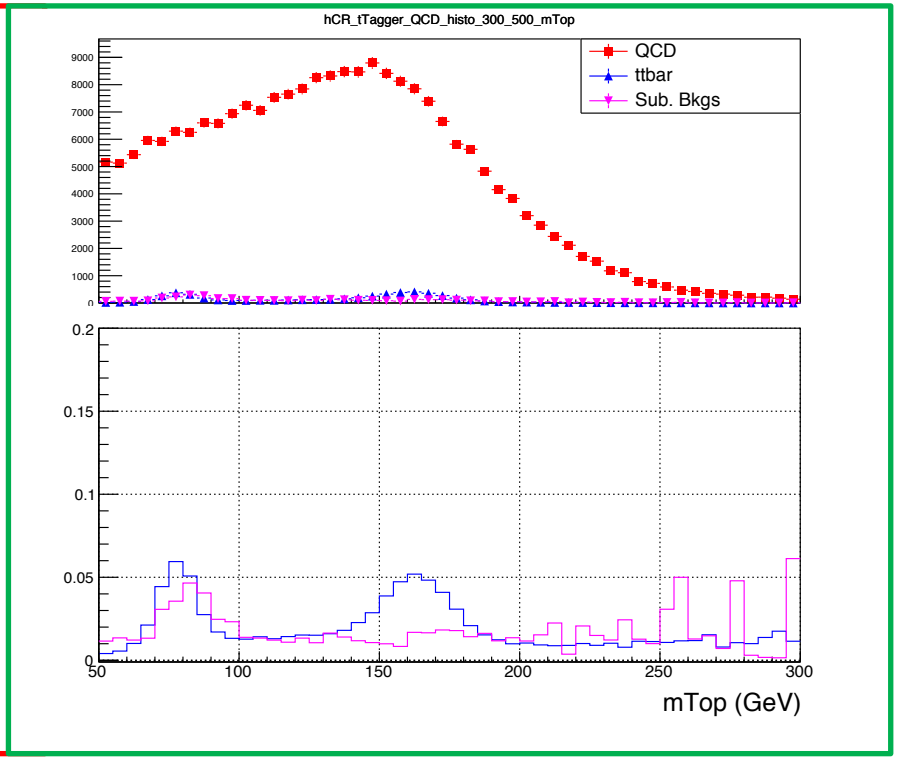
2016



2017

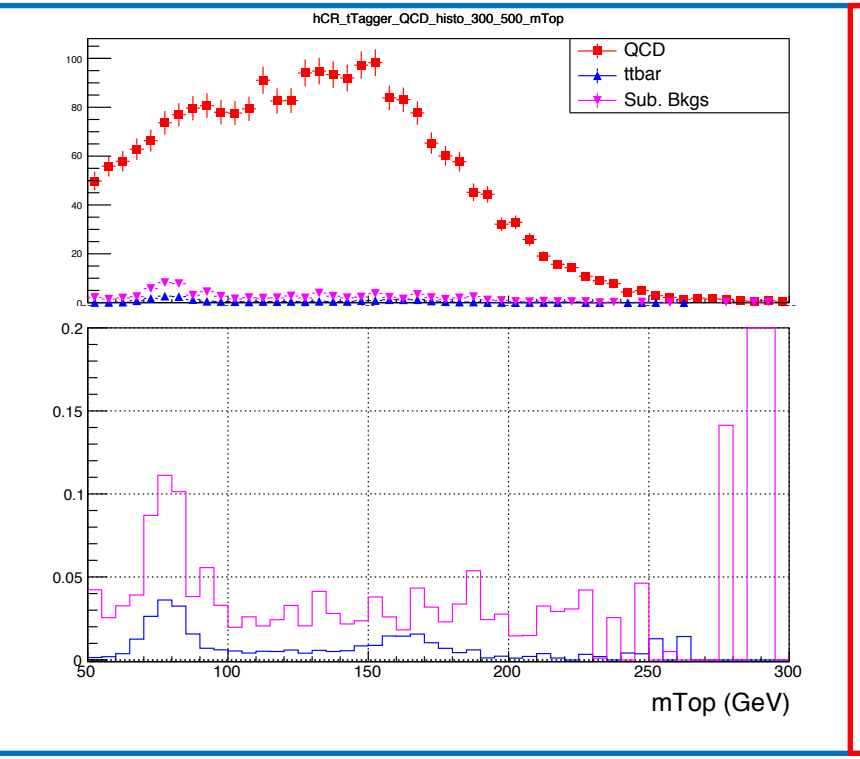


2018

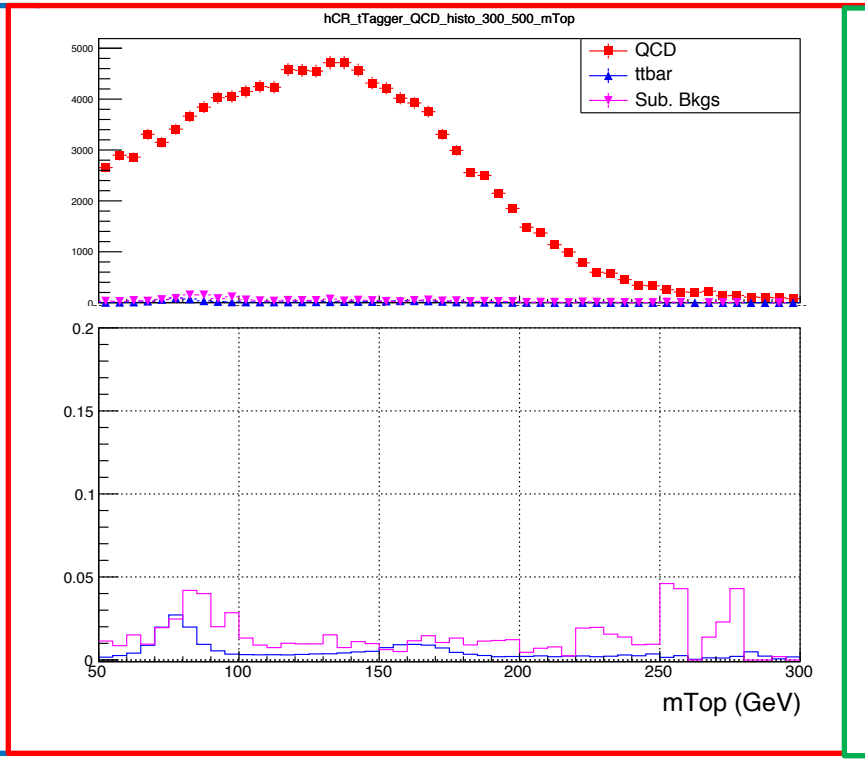


Contamination Plots Medium WP SR, Loose WP CR

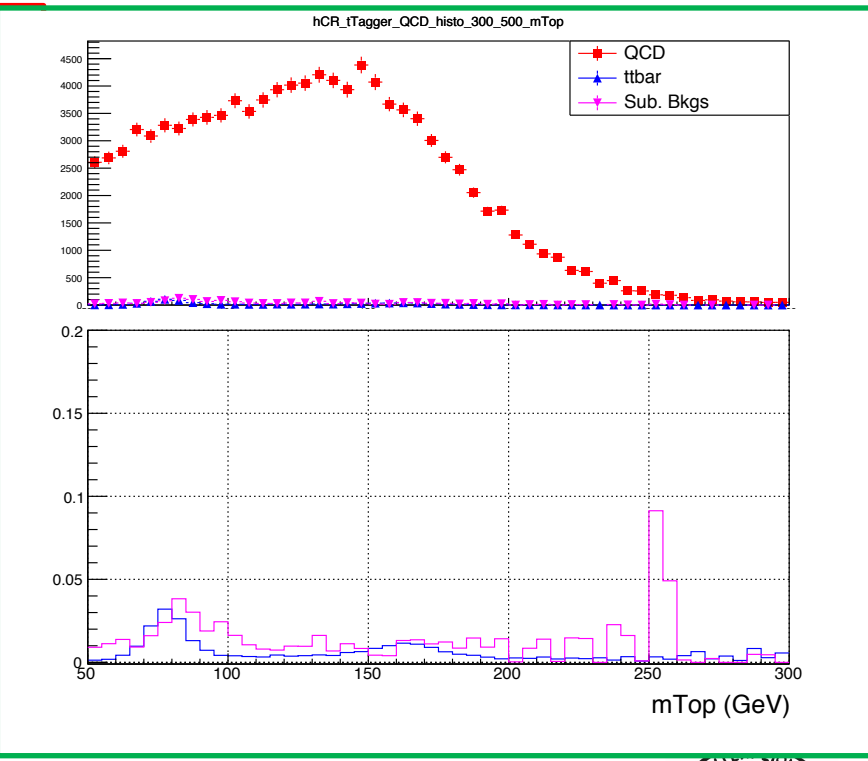
2016



2017



2018

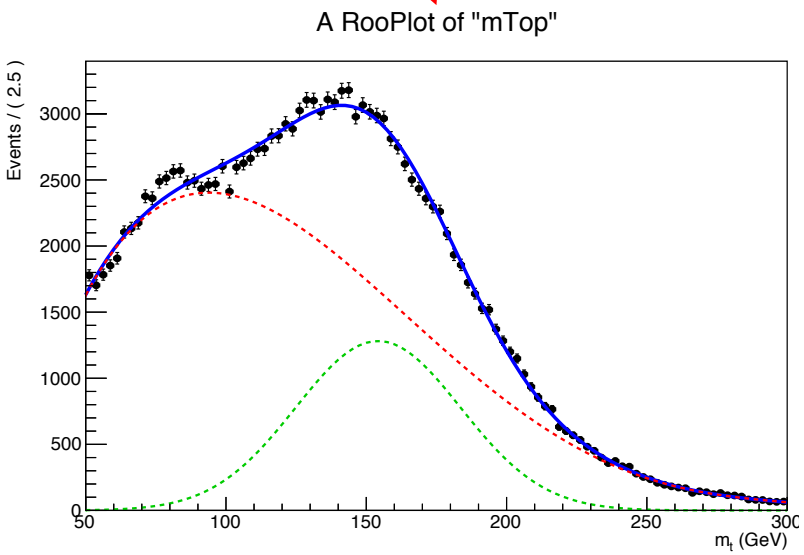


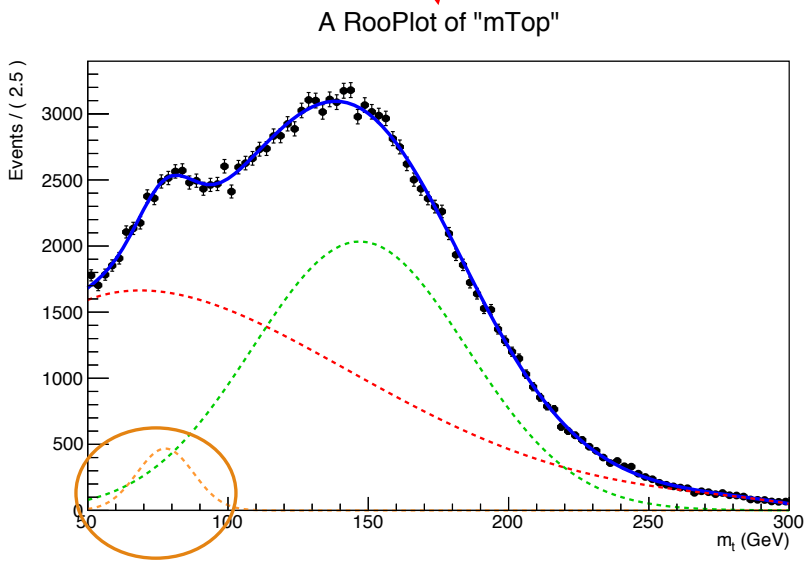
Mass Fit – Template fit results 2017

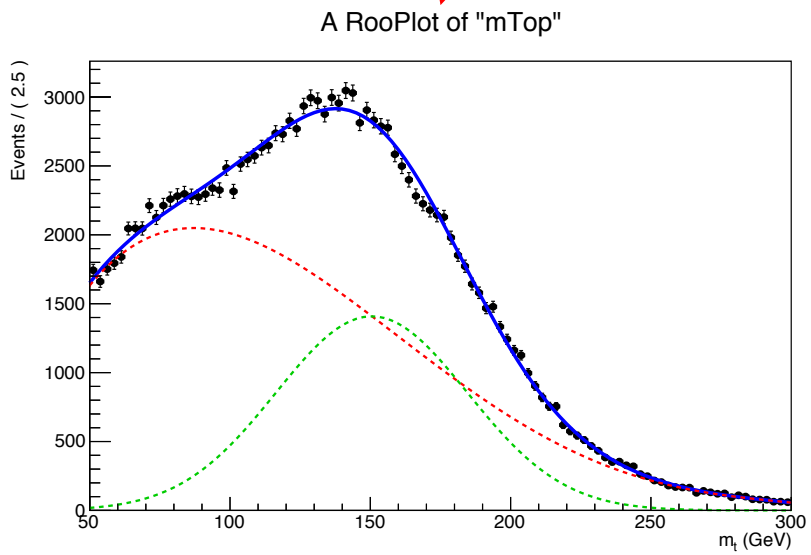
No subtraction, no extra Gauss

Extra Gaussian to explain peak at 75 GeV

Subtracted tt, subdominant bkgs from Data







- Medium WP for both SR and CR
- This happens also for using the Medium btag WP for SR and the Loose btag WP for the CR
- This is same for 2018
- 2016 not very sensitive because we have very few statistics → Control trigger with 1.67 pb-1

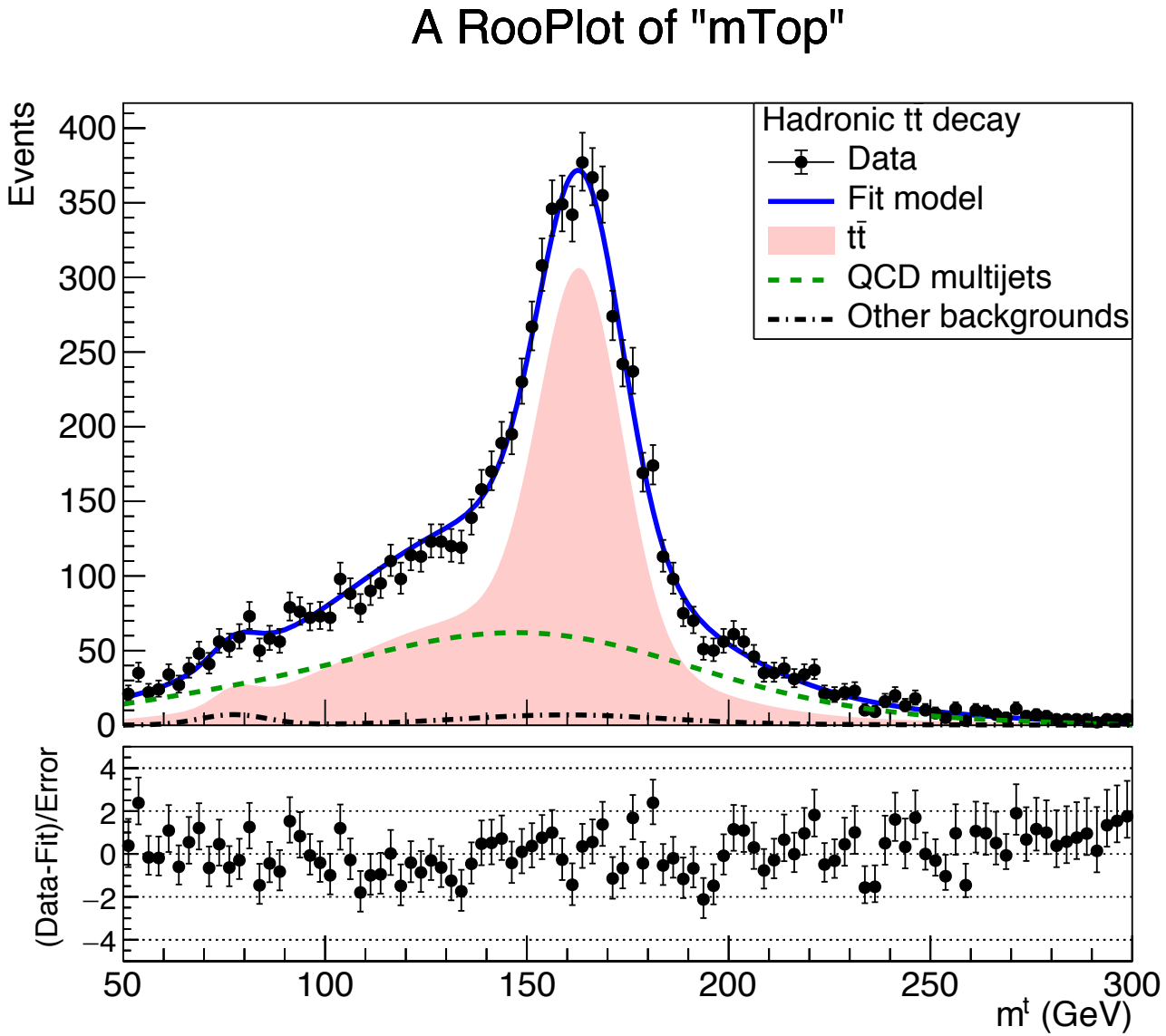
Simple Mass Fit 2016

- 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

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

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

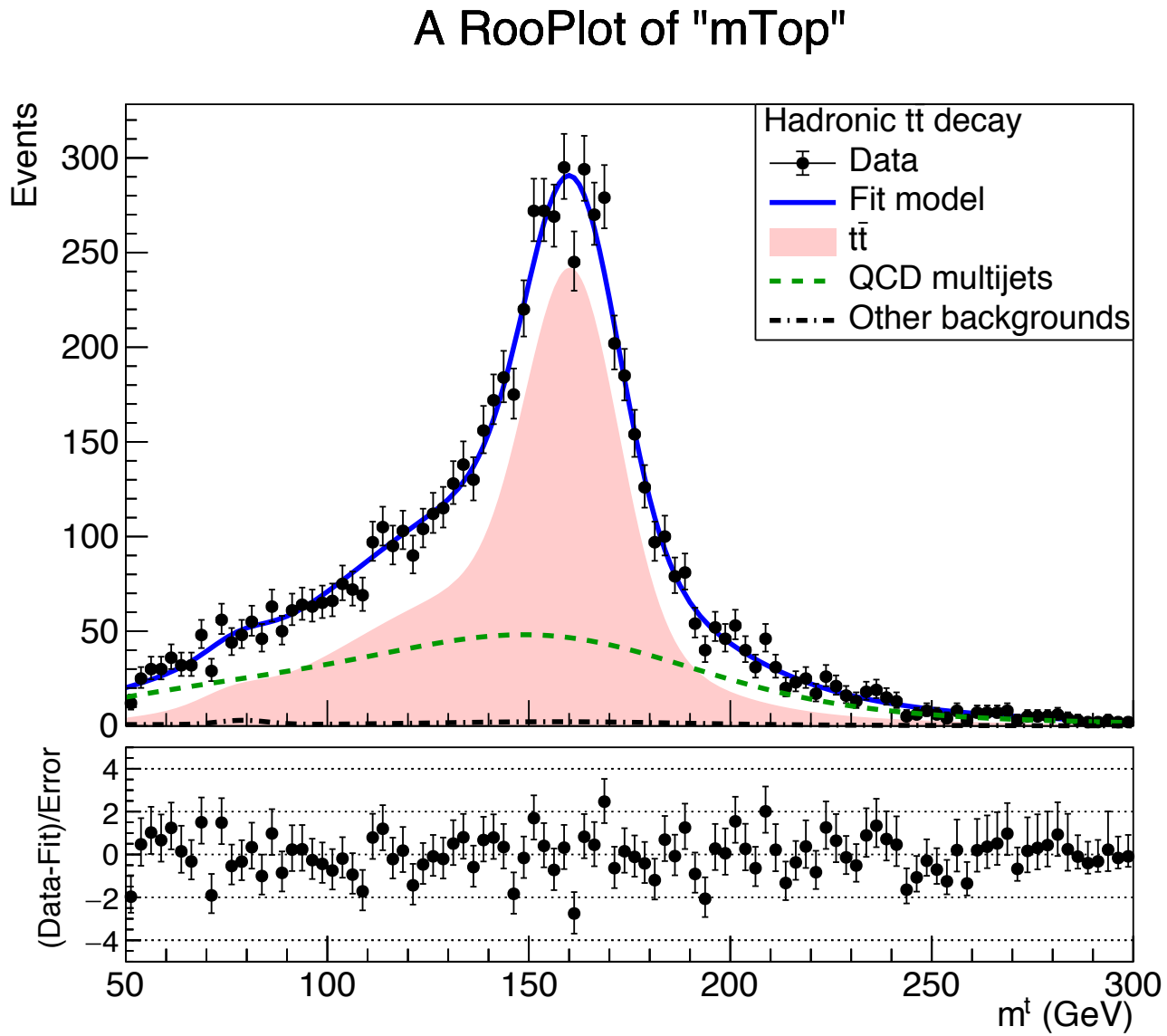
Signal strength: r = 0.671244



Simple Mass Fit 2017

Floating Parameter	FinalValue +/-	Error
kMassResol	1.0768e+00 +/-	3.81e-02
kMassScale	9.8571e-01 +/-	2.64e-03
kQCD_2b	1.4907e-02 +/-	5.33e-03
nFitBkg_2b	1.0582e+02 +/-	2.10e+02
nFitQCD_2b	2.4252e+03 +/-	2.47e+02
nFitSig2b	4.7140e+03 +/-	1.45e+02

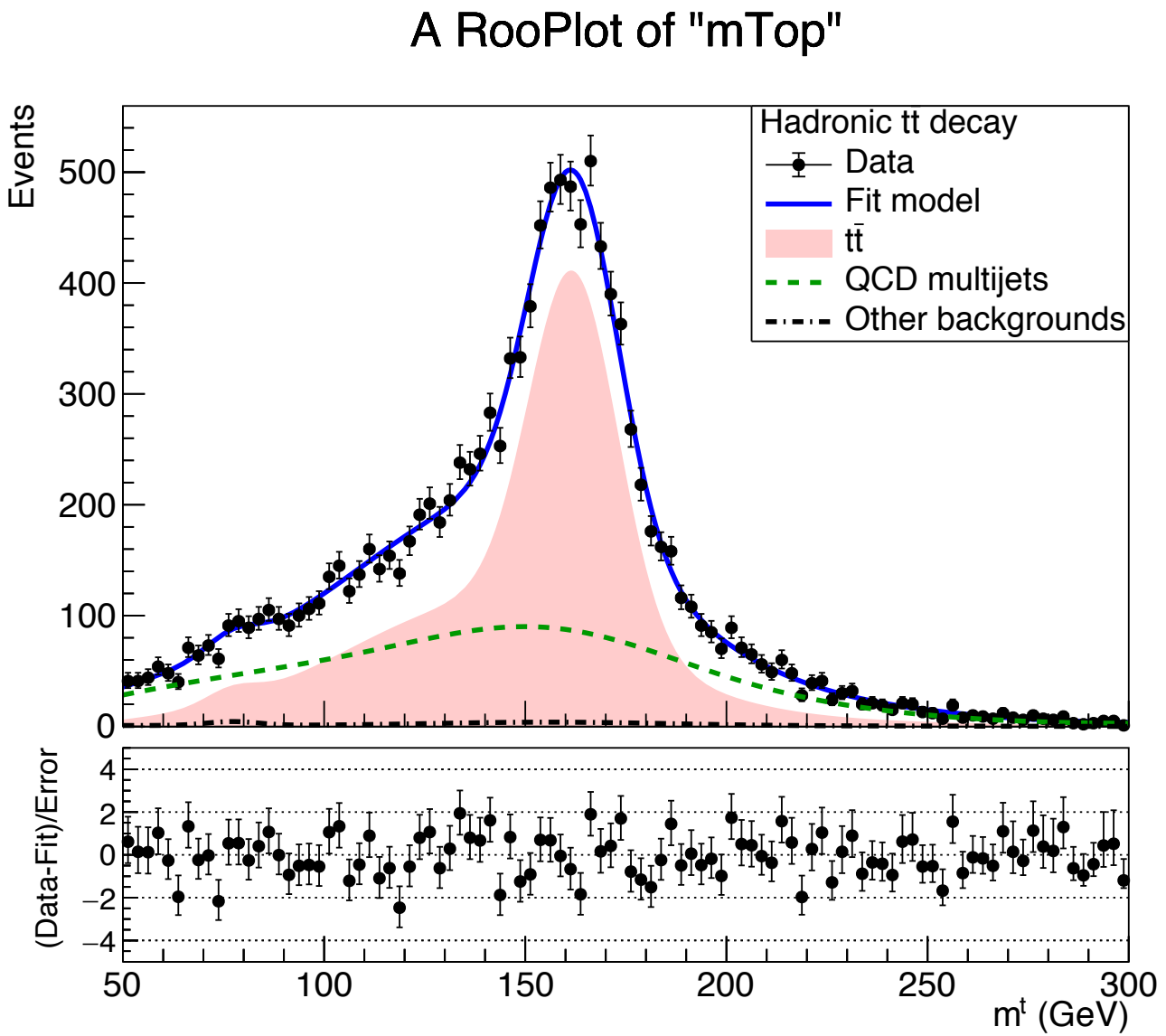
Signal strength: r = 0.54567



Simple Mass Fit 2018

Floating Parameter	FinalValue +/-	Error
kMassResol	1.0255e+00 +/-	2.90e-02
kMassScale	9.9031e-01 +/-	1.93e-03
kQCD_2b	1.4174e-02 +/-	3.50e-03
nFitBkg_2b	1.7555e+02 +/-	2.75e+02
nFitQCD_2b	4.4847e+03 +/-	3.13e+02
nFitSig2b	7.6642e+03 +/-	1.93e+02

Signal strength: r = 0.620045



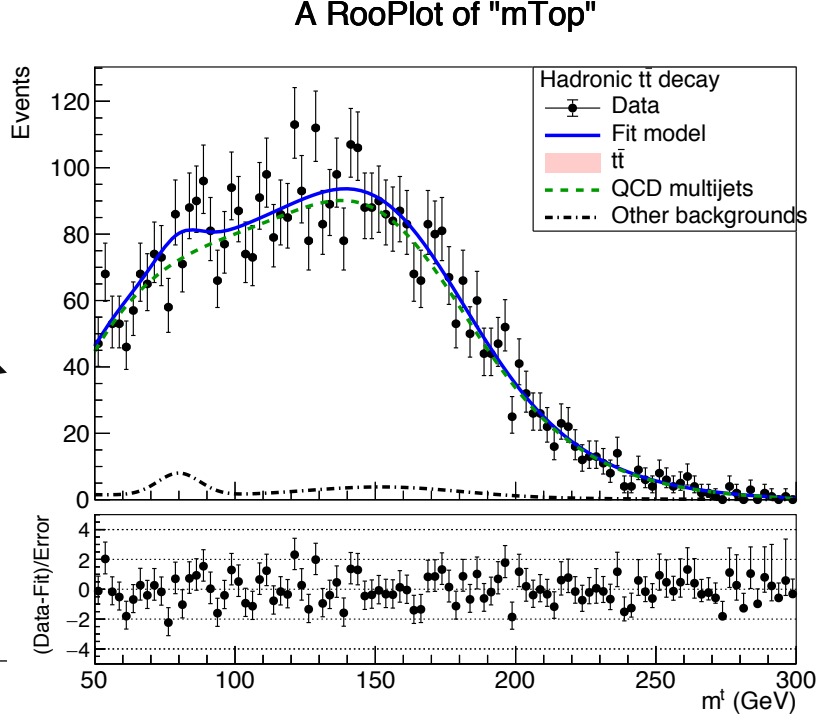
Simultaneous Mass Fit Results 2016

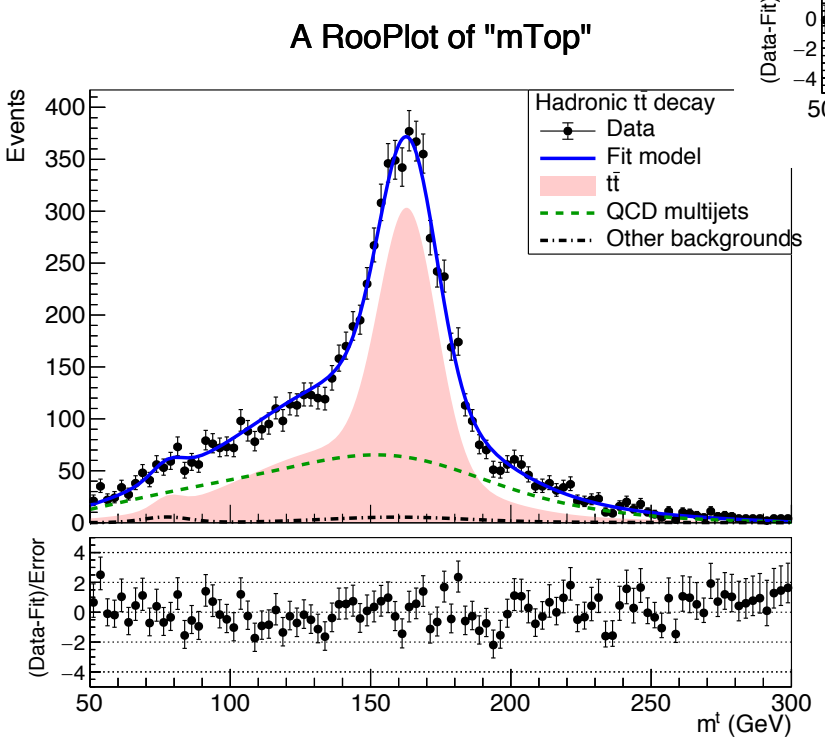
- Template fit: for the QCD bkg (CR) we subtract nothing from data
- Do not impose a gaussian around 75 GeV
- b-tagging efficiency free in fit

Floating Parameter	FinalValue +/- Error
btagEff_2	9.9760e-01 +/- 4.10e-01
kMassResol	9.2001e-01 +/- 2.73e-02
kMassScale	9.9876e-01 +/- 2.03e-03
kQCD_2b	8.1748e-02 +/- 6.63e-02
nFitBkg_0b	2.0172e+02 +/- 3.55e+01
nFitBkg_2b	1.9419e+02 +/- 3.42e+01
nFitQCD_0b	4.7059e+03 +/- 7.37e+01
nFitQCD_2b	3.1083e+03 +/- 1.53e+02
nFitSig	5.2320e+03 +/- 4.92e+02

N0_observed = 0.0301517, N2_observed = 5206.89
Ntt expected: 7999.61
Ntt observed: 5206.92
Signal strength r: 0.650896
Singal strength r in 2btag: 0.663284

0 btag





2 btag

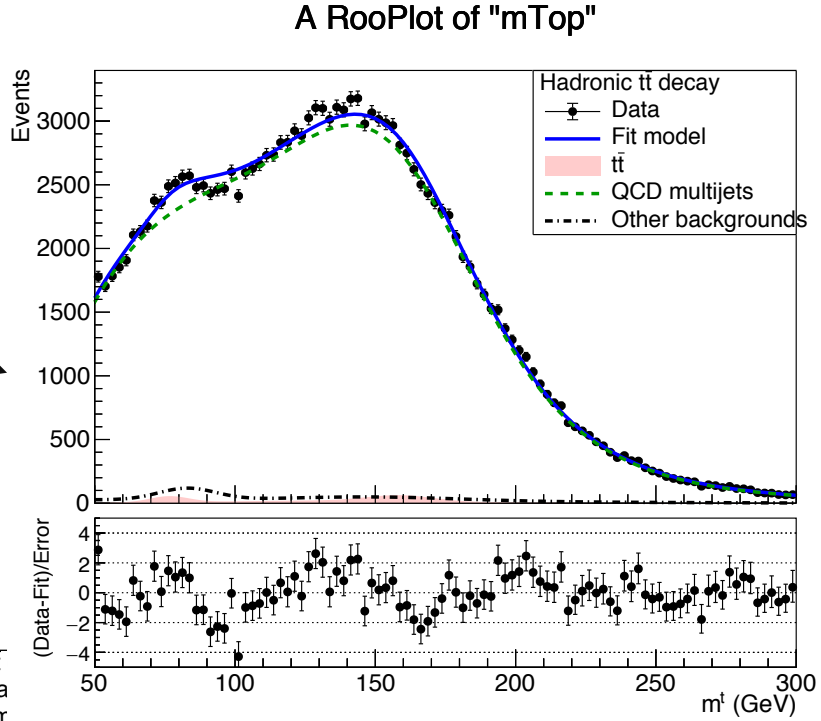
Simultaneous Mass Fit Results 2017

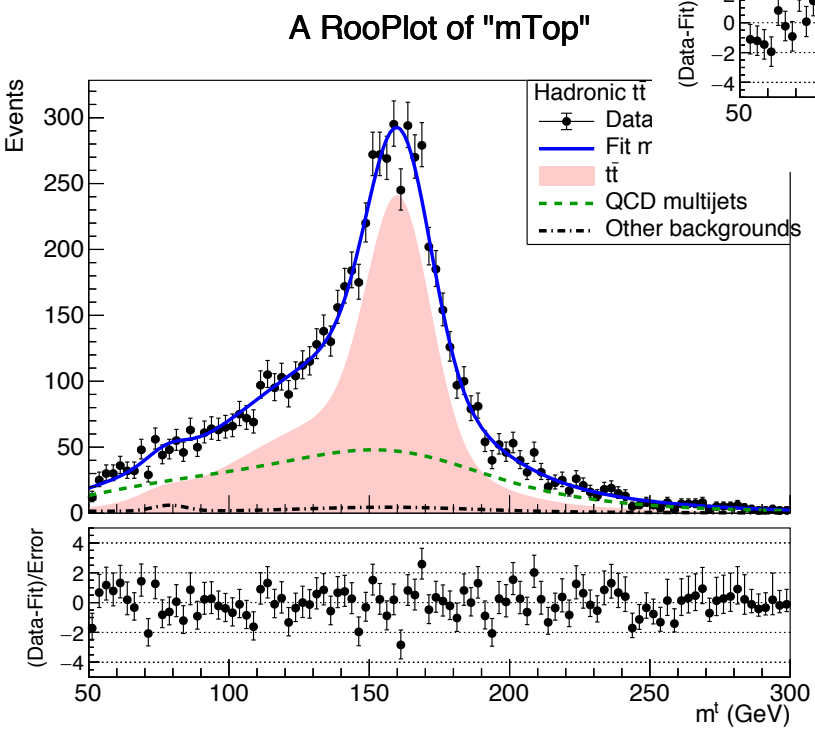
Consistent with what we have found: 0.6056

Floating Parameter	FinalValue +/-	Error
btagEff_2	6.2072e-01 +/-	6.11e-02
kMassResol	1.0641e+00 +/-	3.83e-02
kMassScale	9.8394e-01 +/-	2.60e-03
kQCD_2b	1.8390e-02 +/-	6.33e-04
nFitBkg_0b	3.3426e+03 +/-	6.15e+02
nFitBkg_2b	2.1336e+02 +/-	4.46e+01
nFitQCD_0b	1.5713e+05 +/-	9.94e+02
nFitQCD_2b	2.3790e+03 +/-	1.41e+02
nFitSig	1.2070e+04 +/-	2.38e+03

N0_observed = 1736.32, N2_observed = 4650.58
Ntt expected: 13425
Ntt observed: 6386.91
Signal strength r: 0.475747
Singal strength r in 2btag: 0.538328

0 btag





2 btag

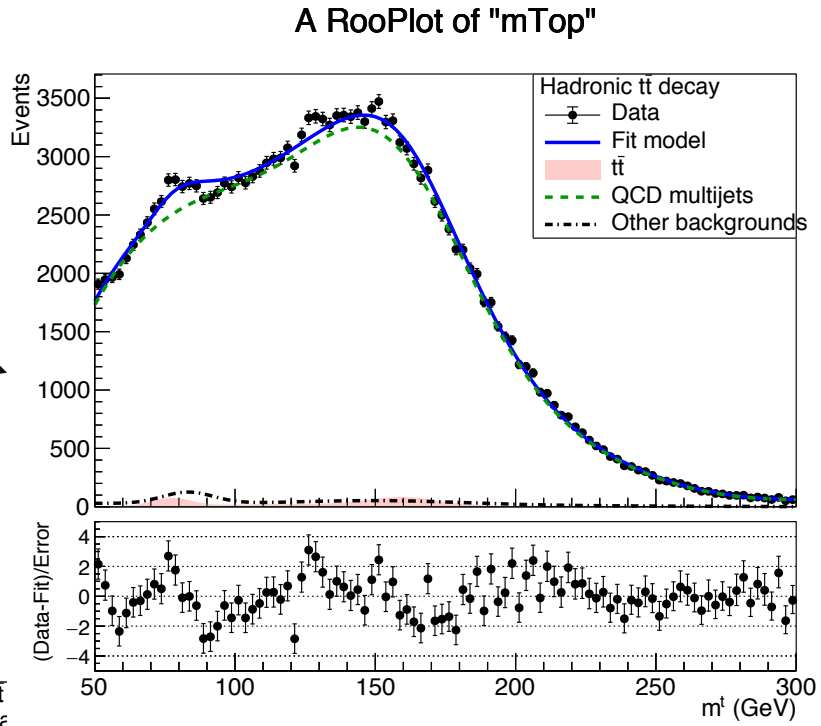
Simultaneous Mass Fit Results 2018

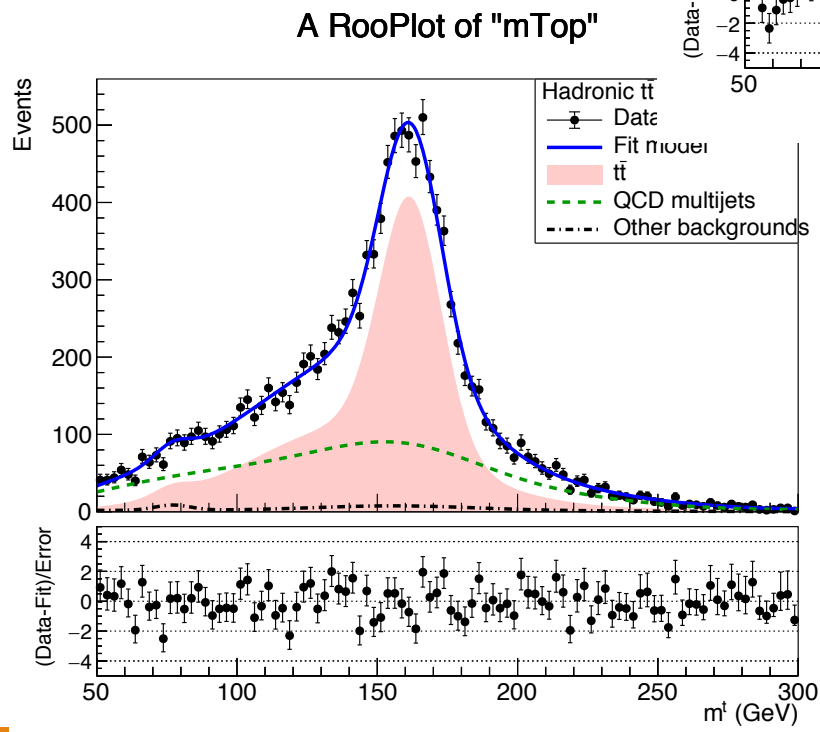
Consistent with what we have found: 0.6339

Floating Parameter	FinalValue +/-	Error
btagEff_2	6.4771e-01 +/-	3.92e-02
kMassResol	1.0201e+00 +/-	2.91e-02
kMassScale	9.8907e-01 +/-	1.93e-03
kQCD_2b	1.6331e-02 +/-	4.28e-03
nFitBkg_0b	3.4235e+03 +/-	5.95e+02
nFitBkg_2b	3.4162e+02 +/-	7.58e+01
nFitQCD_0b	1.7113e+05 +/-	8.78e+02
nFitQCD_2b	4.4199e+03 +/-	1.90e+02
nFitSig	1.8018e+04 +/-	2.20e+03

N0_observed = 2236.29, N2_observed = 7559.18
Ntt expected: 17721.3
Ntt observed: 9795.47
Signal strength r: 0.55275
Singal strength r in 2btag: 0.611552

0 btag





2 btag

Simultaneous Mass Fit Results 2016

- Template fit: for the QCD bkg (CR) we subtract nothing from data
- Gaussian around 75 GeV
- b-tagging efficiency free in fit

Floating Parameter	FinalValue +/-	Error
btagEff_2	9.9729e-01 +/-	2.87e-02
kMassResol	9.1788e-01 +/-	2.72e-02
kMassScale	9.9835e-01 +/-	2.03e-03
kQCD_2b	9.0137e-02 +/-	7.70e-02
nFitBkg_0b	2.0172e+02 +/-	3.81e+01
nFitBkg_2b	1.9417e+02 +/-	2.84e+01
nFitQCD_0b	4.7064e+03 +/-	7.37e+01
nFitQCD_2b	3.1218e+03 +/-	1.53e+02
nFitSig	5.2199e+03 +/-	2.35e+02

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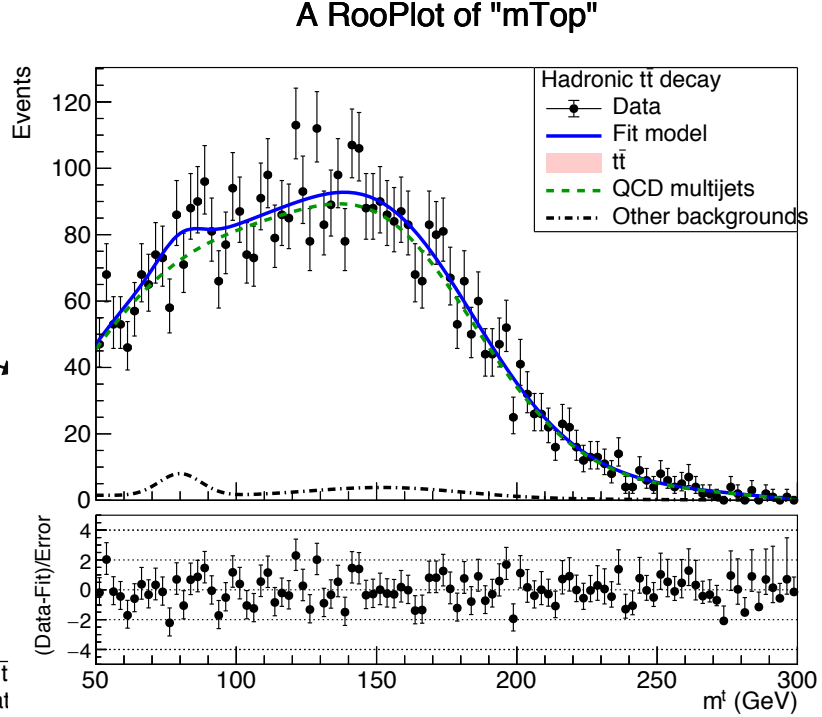
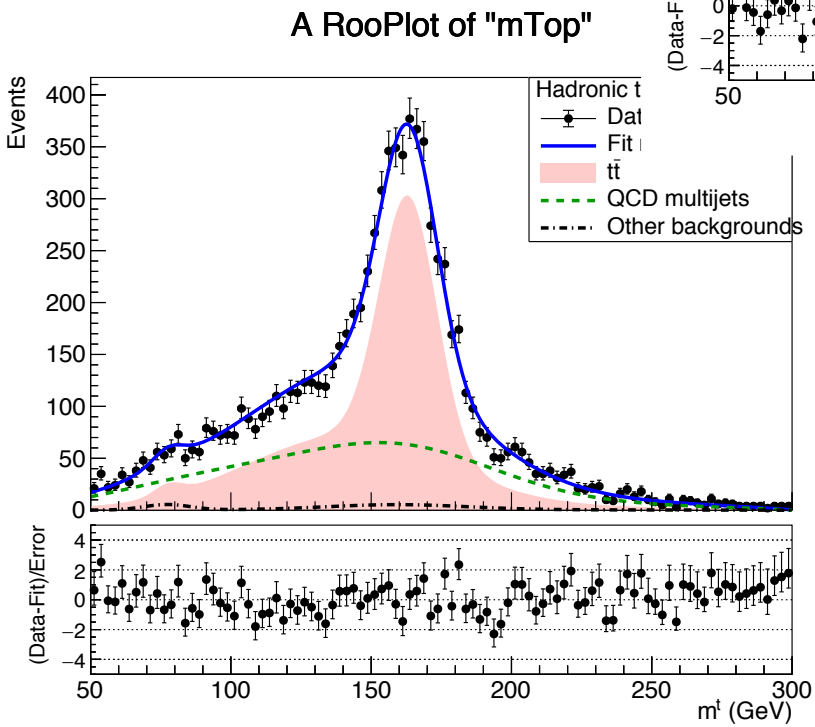
N0_observed = 0.0383764, N2_observed = 5191.63
Ntt expected: 7999.61
Ntt observed: 5191.67
Signal strength r: 0.64899
Singal strength r in 2btag: 0.66134
```

0 btag





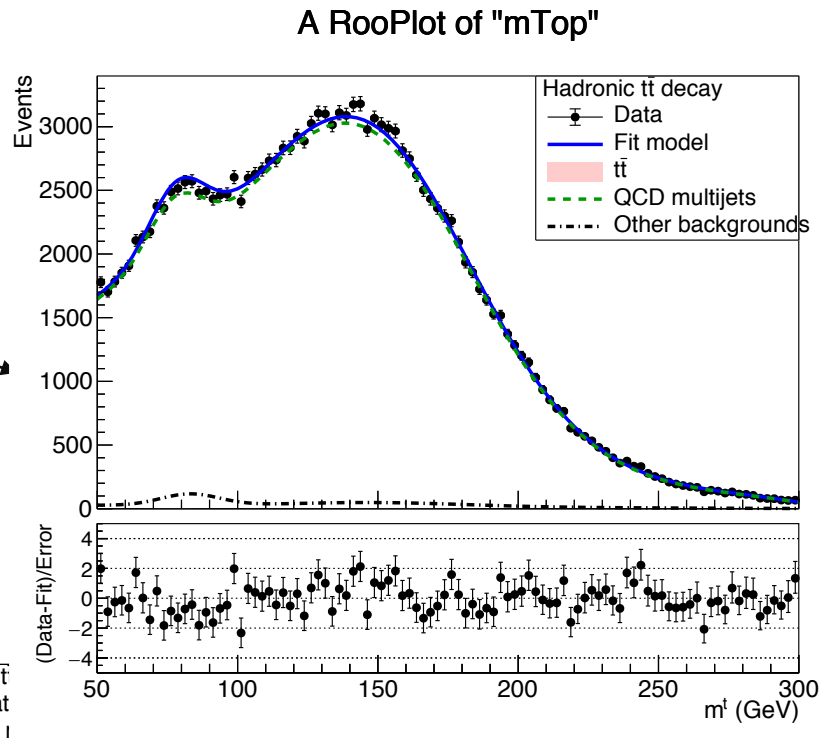
2 btag

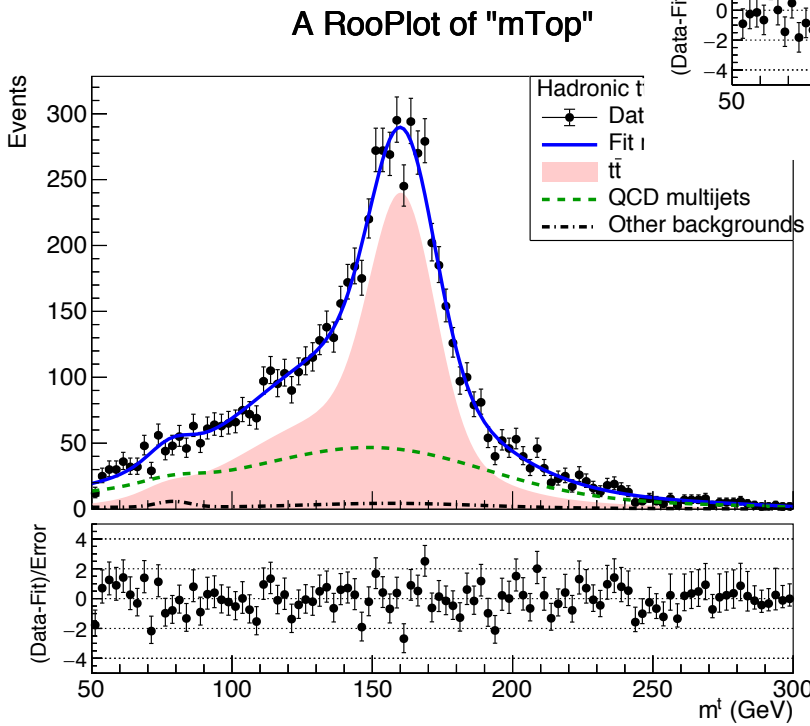
Simultaneous Mass Fit Results 2017

Floating Parameter	FinalValue +/-	Error
btagEff_2	8.3385e-01 +/-	1.37e-02
kMassResol	1.0846e+00 +/-	3.77e-02
kMassScale	9.8545e-01 +/-	2.62e-03
kQCD_2b	1.6843e-02 +/-	5.91e-03
nFitBkg_0b	3.3424e+03 +/-	1.23e+02
nFitBkg_2b	2.1330e+02 +/-	4.63e+01
nFitQCD_0b	1.5869e+05 +/-	4.11e+02
nFitQCD_2b	2.3312e+03 +/-	1.35e+02
nFitSig	6.7648e+03 +/-	1.42e+02

N0_observed = 186.739, N2_observed = 4703.65
Ntt expected: 13425
Ntt observed: 4890.39
Signal strength r: 0.364275
Singal strength r in 2btag: 0.544471

0 btag





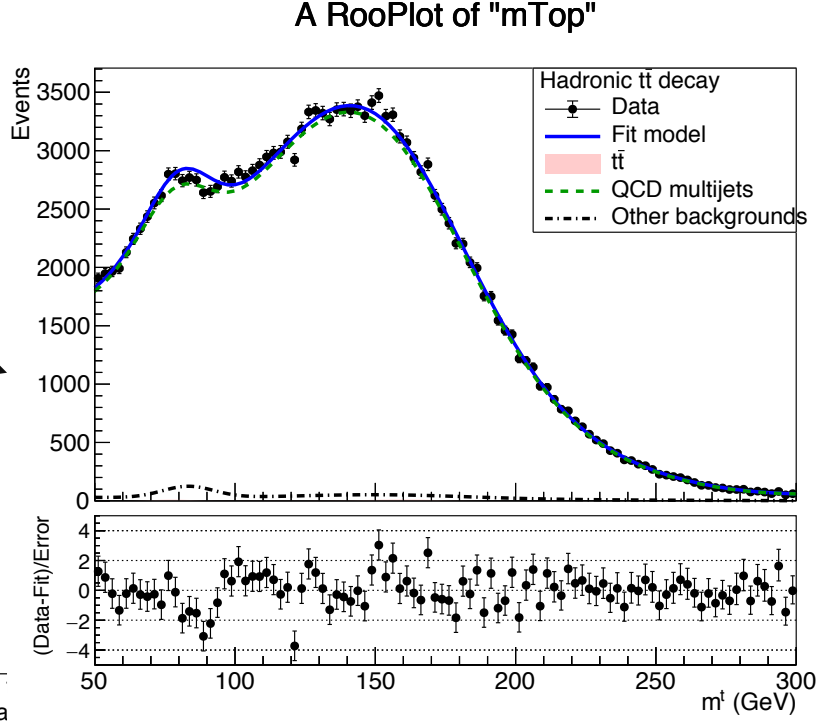
2 btag

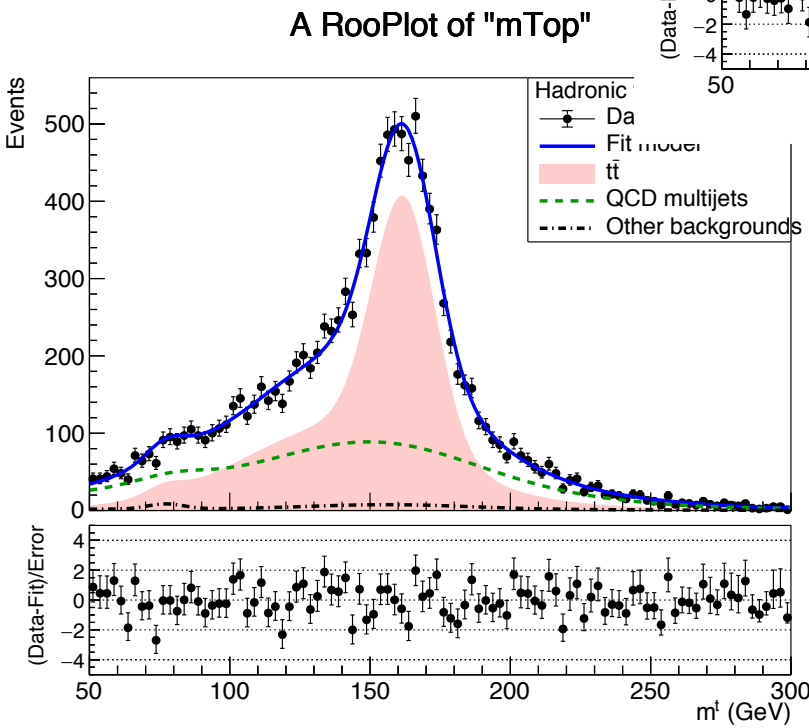
Simultaneous Mass Fit Results 2018

Floating Parameter	FinalValue +/-	Error
btagEff_2	8.3701e-01 +/-	7.74e-02
kMassResol	1.0310e+00 +/-	2.85e-02
kMassScale	9.9022e-01 +/-	1.92e-03
kQCD_2b	1.5372e-02 +/-	3.80e-03
nFitBkg_0b	3.4235e+03 +/-	1.18e+02
nFitBkg_2b	3.4167e+02 +/-	6.86e+01
nFitQCD_0b	1.7309e+05 +/-	5.32e+02
nFitQCD_2b	4.3611e+03 +/-	1.80e+02
nFitSig	1.0883e+04 +/-	2.04e+03

N0_observed = 289.116, N2_observed = 7624.71
Ntt expected: 17721.3
Ntt observed: 7913.83
Signal strength r: 0.446571
Singal strength r in 2btag: 0.616854

0 btag





2 btag