

ttbar Analysis Status

NTUA

28/5/2020

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Mass Fit

- Contamination is not only from ttbar:
 - Subdominant bkg contamination of CR as shown in Contamination plots
 - By looking at the Loose WP when inverting the btagging requirement:
 - Ttbar contamination is much lower
 - Subdominant bkg contamination is not affected much
- Mass fit results (fit only the 2btag region) by removing ttbar and subdominant bkg contributions from the data CR:
 - $\text{QCD} = \text{Data} - \text{Ttbar} - \text{Subdominant in CR}$
- Simultaneous fit without removing the contributions of the ttbar and subdominant bkg
 - We let the fit do this for us
 - We leave b-tagging efficiency free to check that the result is compatible with what we have found from MC
- Solution (?): find a Subdominant bkg dominated region and perform a simultaneous fit in three regions:
 - Signal Region (ttbar dominated)
 - Control Region 1 (QCD dominated)
 - Control Region 2 (Subdominant bkg dominated)
- All things shown today (except slide 5) use the previous btagging selection:
 - Medium b-tag WP for both Signal and Control Region

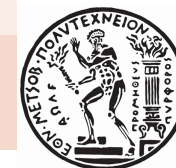


Signal Selection

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	

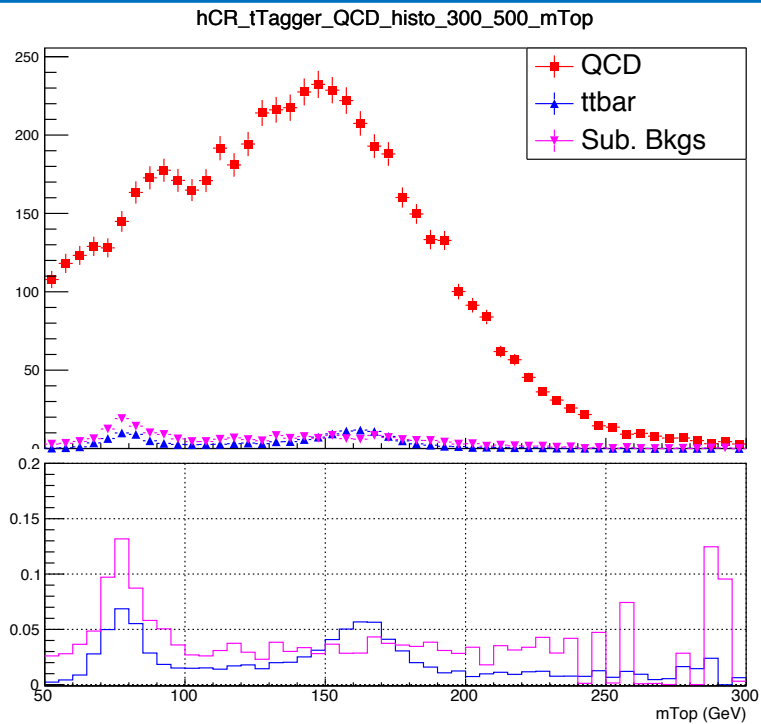
Control Region Selection

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	

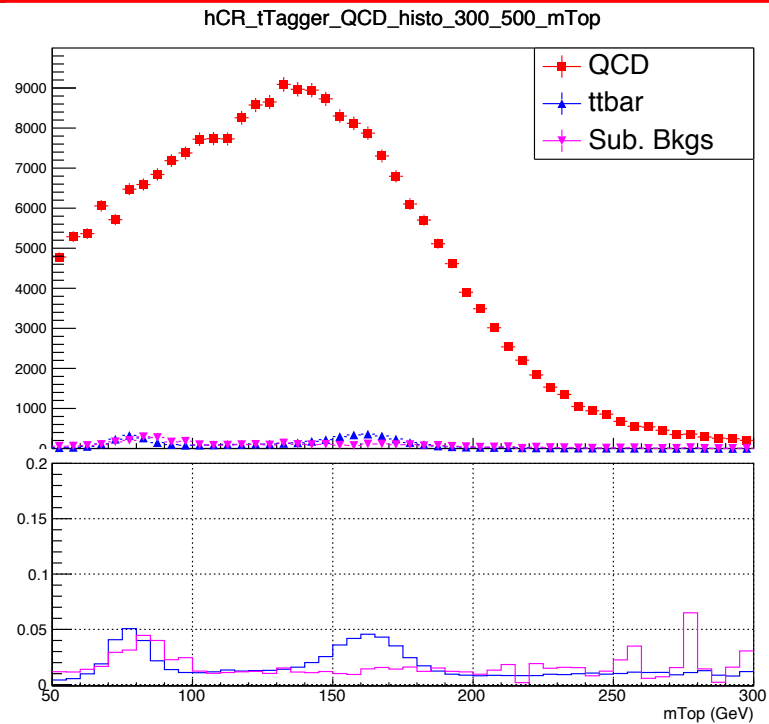


Contamination Plots Medium WP (CR, SR)

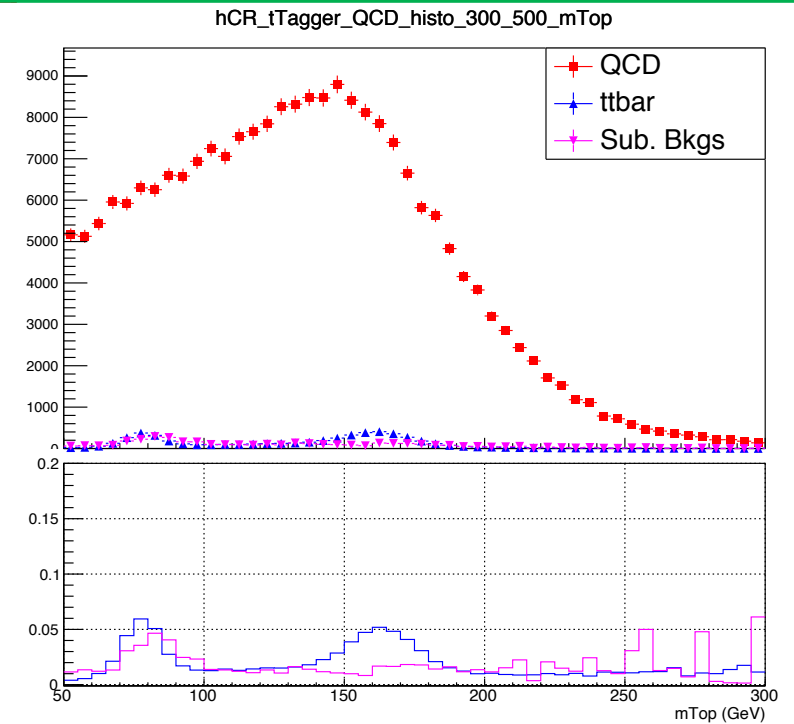
2016



2017

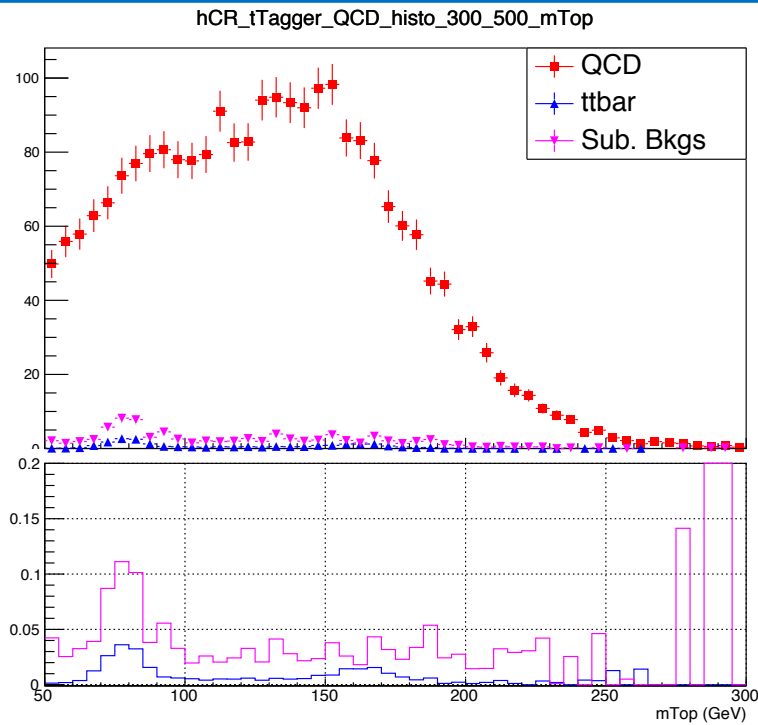


2018

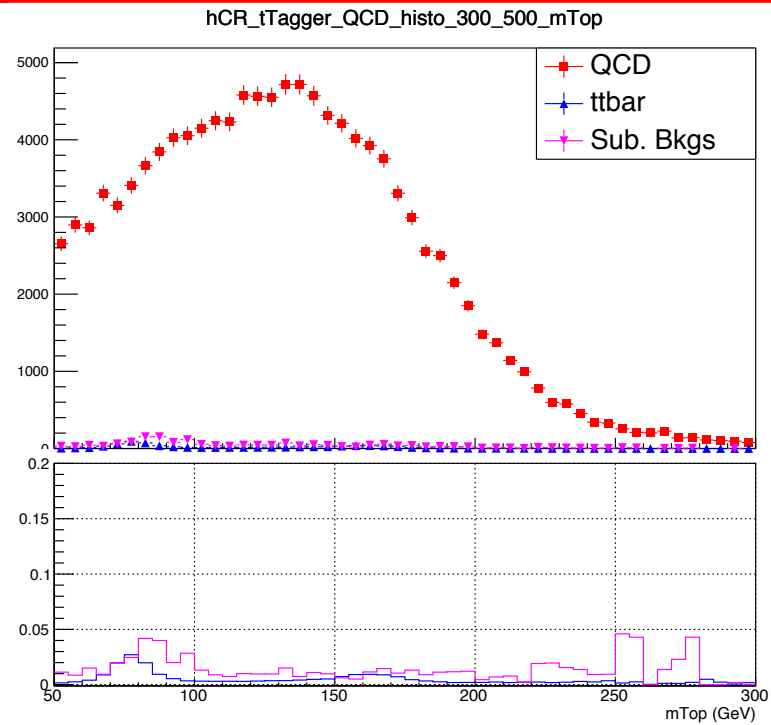


Contamination Plots Medium WP SR, Loose WP CR

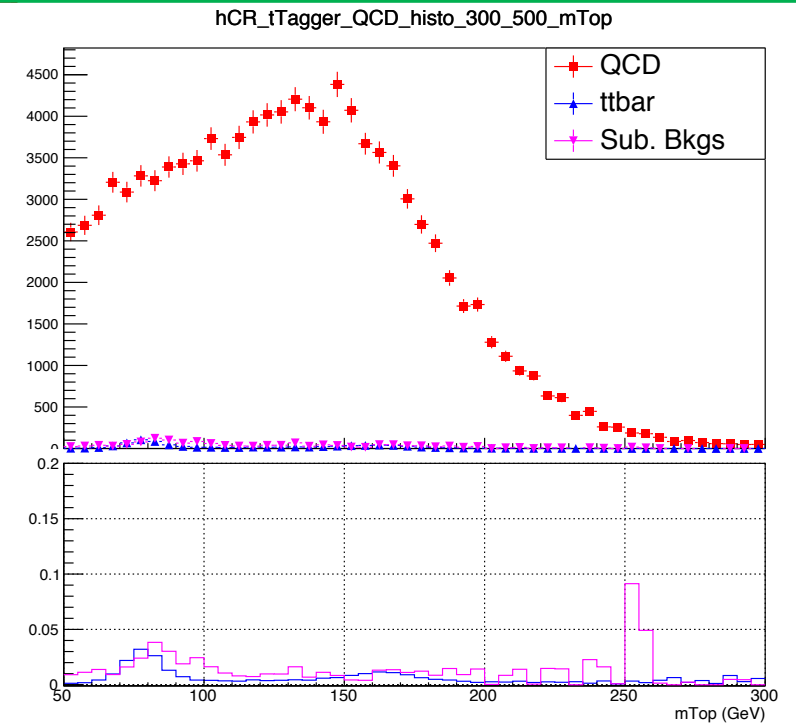
2016



2017



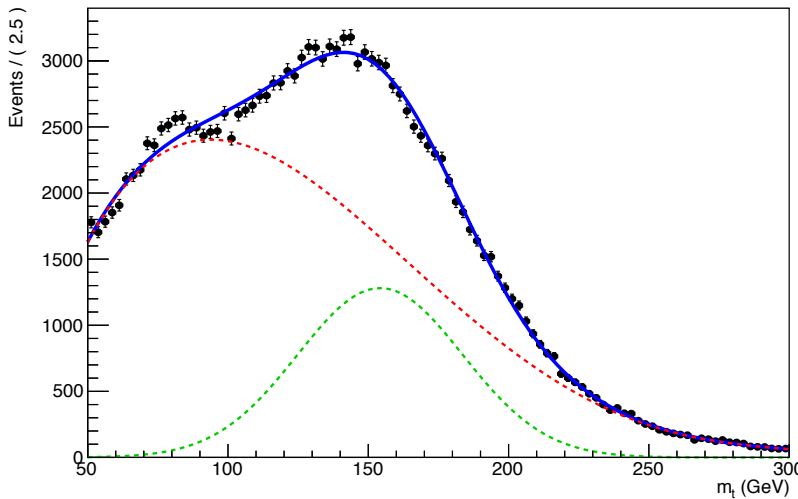
2018



Mass Fit – Template fit results 2017

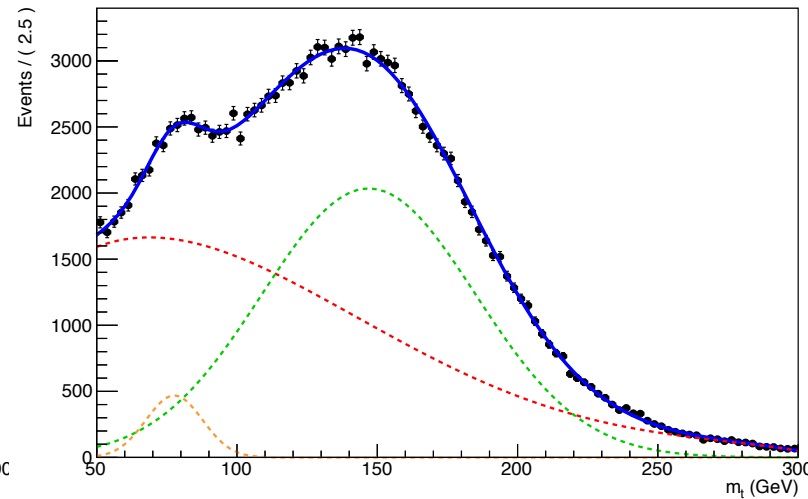
No subtraction, no extra Gauss

A RooPlot of "mTop"



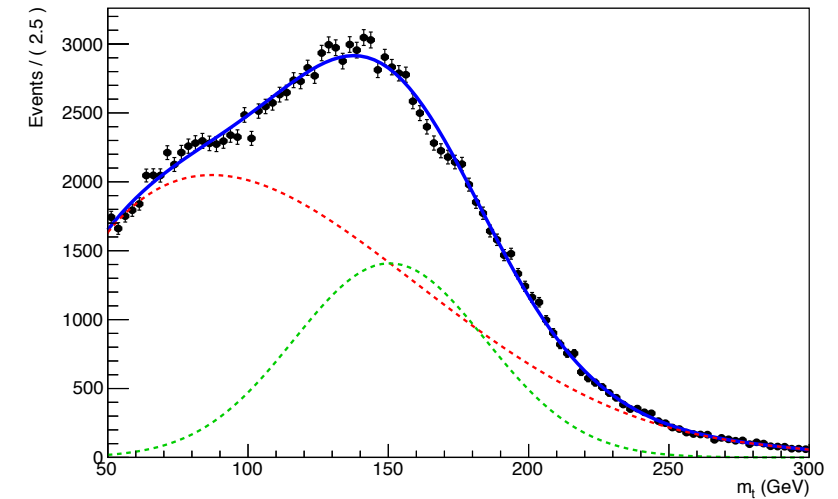
Extra Gaussian to explain peak at 75 GeV

A RooPlot of "mTop"



Subtracted tt, subdominant bkg from Data

A RooPlot of "mTop"



- 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

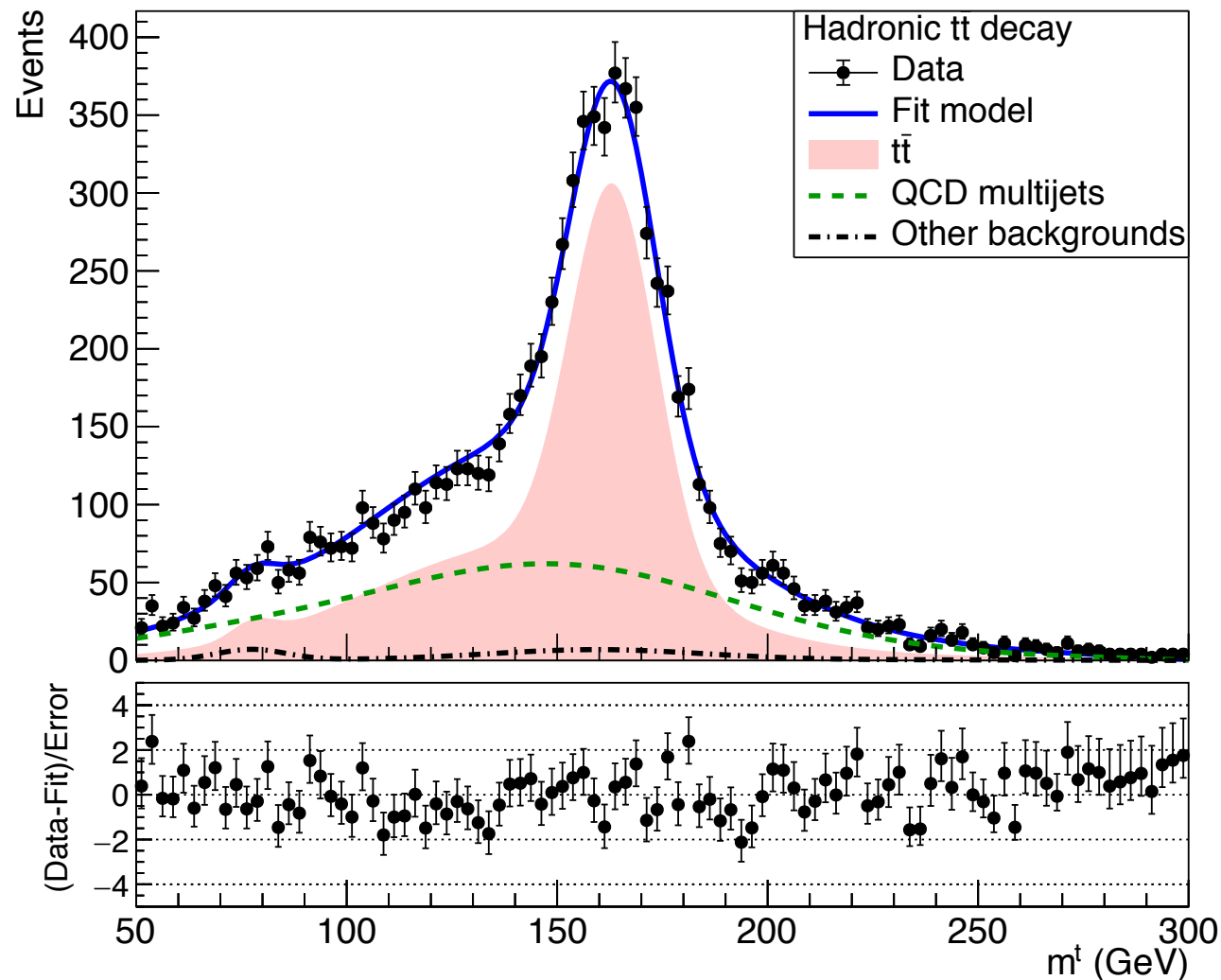
- Both SR and Control Region use the Medium btag WP.
- Intuition is to remove the $t\bar{t}$ and subdominant bkg contribution from the data Control Region

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

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: $r = 0.671244$

A RooPlot of "mTop"

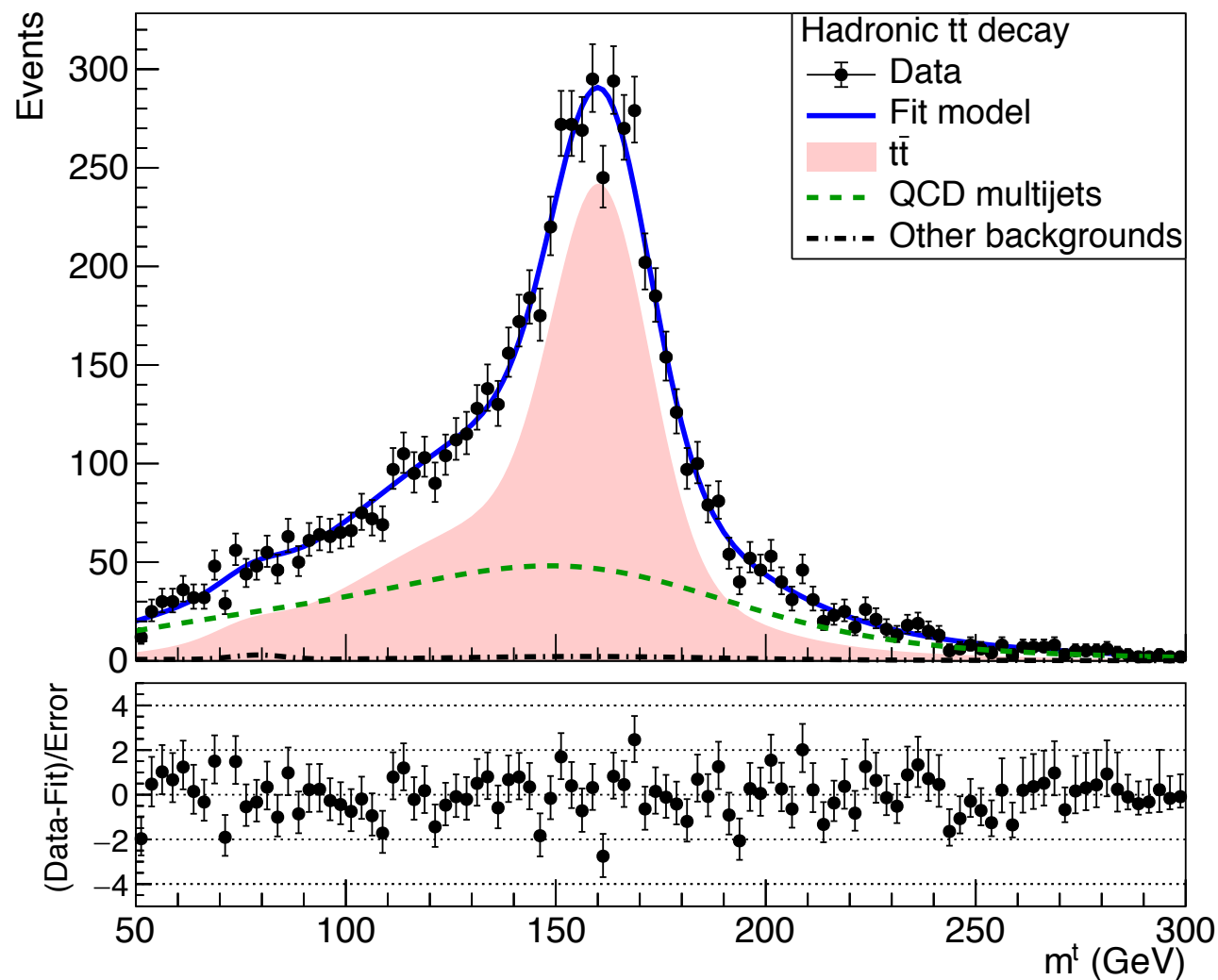


Simple Mass Fit 2017

A RooPlot of "mTop"

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: $r = 0.54567$

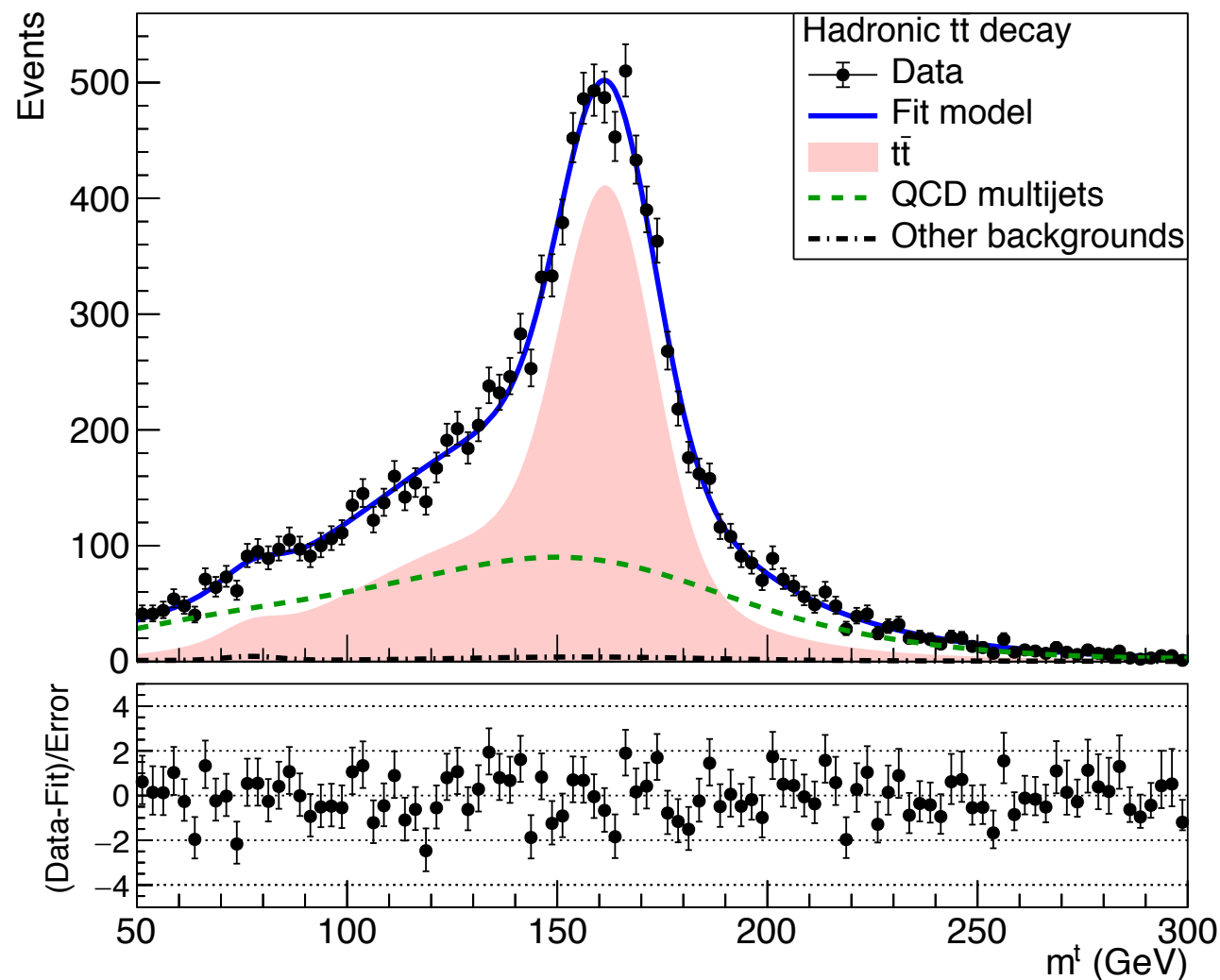


Simple Mass Fit 2018

A RooPlot of "mTop"

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: $r = 0.620045$



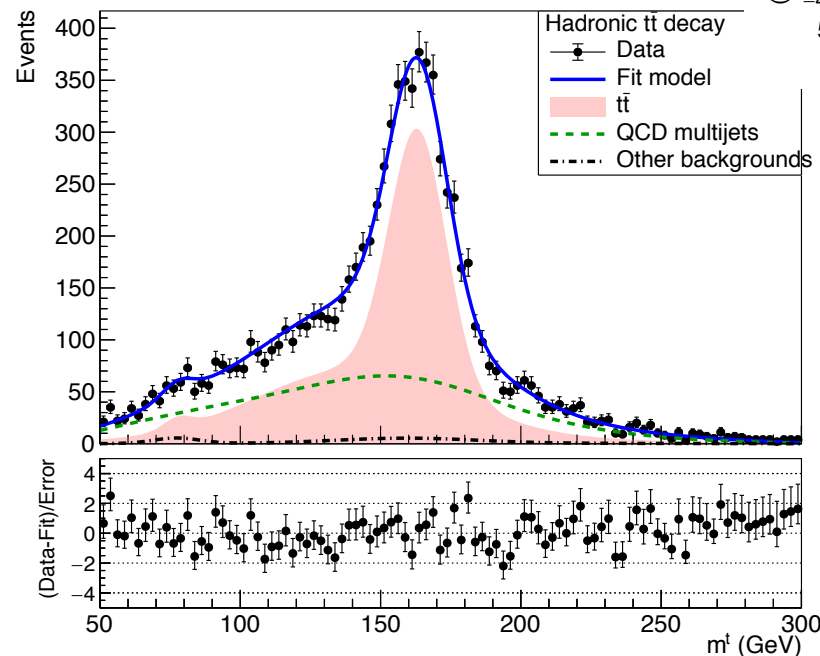
Simultaneous Mass Fit Results 2016

- 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

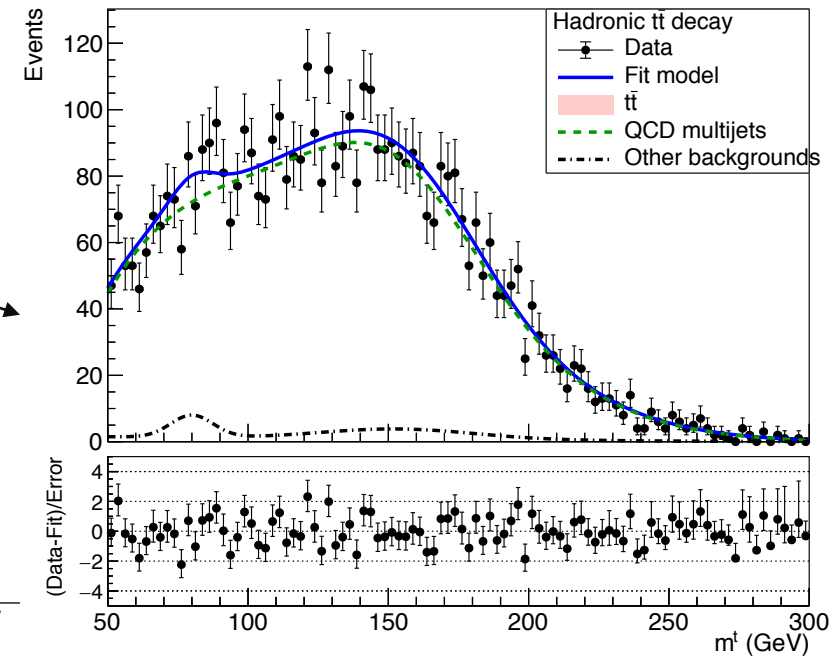
Floating Parameter	FinalValue +/- Error
! btagEff_2	9.9760e-01 +/- 4.10e-01
kMassResol	9.2001e-01 +/- 2.73e-02
kMassScale	9.9876e-01 +/- 2.03e-03
kQCD_2b	8.1748e-02 +/- 6.63e-02
nFitBkg_0b	2.0172e+02 +/- 3.55e+01
nFitBkg_2b	1.9419e+02 +/- 3.42e+01
nFitQCD_0b	4.7059e+03 +/- 7.37e+01
nFitQCD_2b	3.1083e+03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

$N_{0_observed} = 0.0301517$, $N_{2_observed} = 5206.89$
 $N_{tt_expected} = 7999.61$
 $N_{tt_observed} = 5206.92$
 Signal strength r : **0.650896**
 Signal strength r in 2btag: 0.663284

A RooPlot of "mTop"



A RooPlot of "mTop"



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

$N_{0_observed} = 1736.32$, $N_{2_observed} = 4650.58$

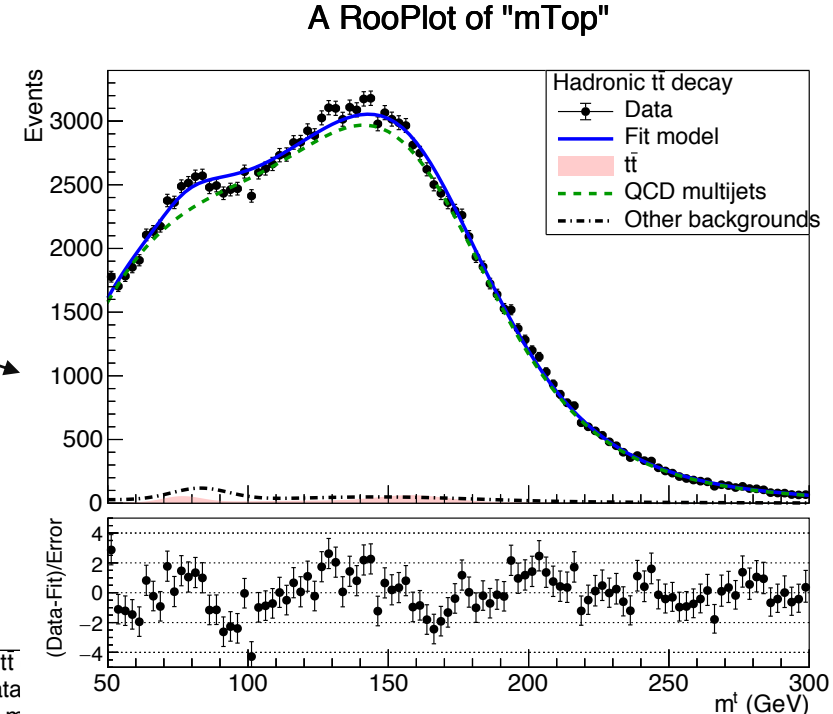
N_{tt} expected: 13425

N_{tt} observed: 6386.91

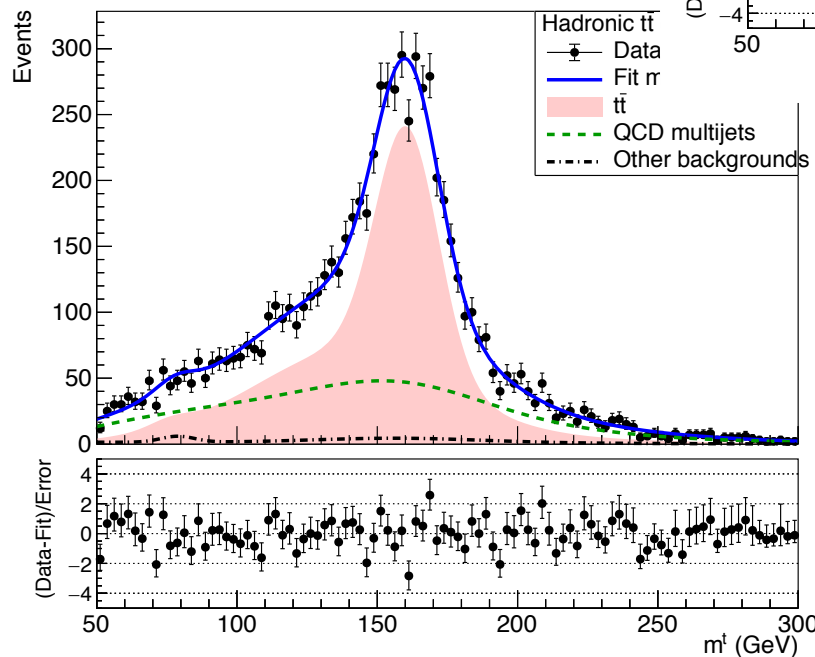
Signal strength r : 0.475747

Signal strength r in 2btag: 0.538328

0 btag



A RooPlot of "mTop"



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

$N_{0_observed} = 2236.29$, $N_{2_observed} = 7559.18$

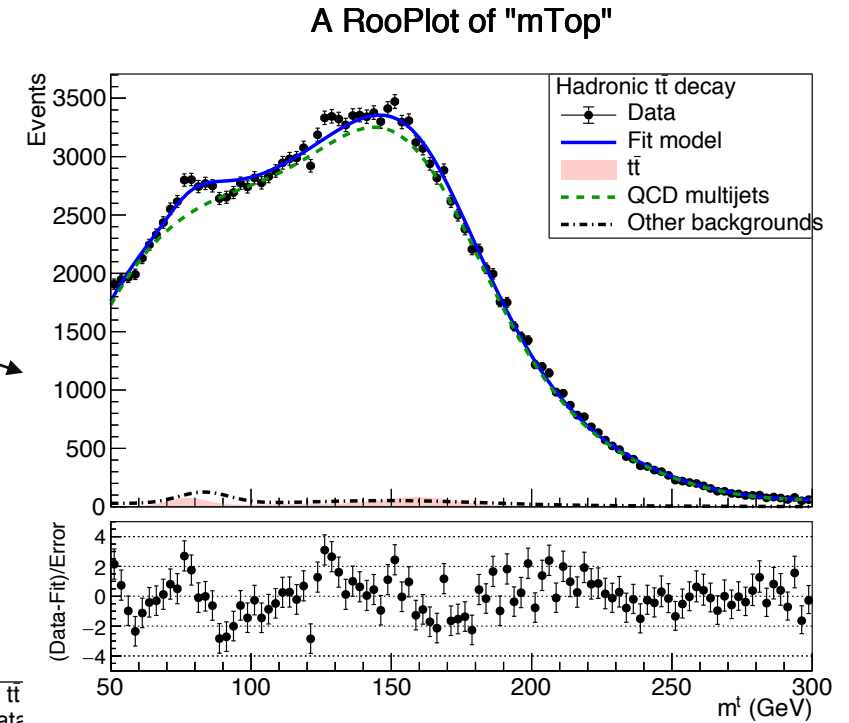
$N_{tt_expected} = 17721.3$

$N_{tt_observed} = 9795.47$

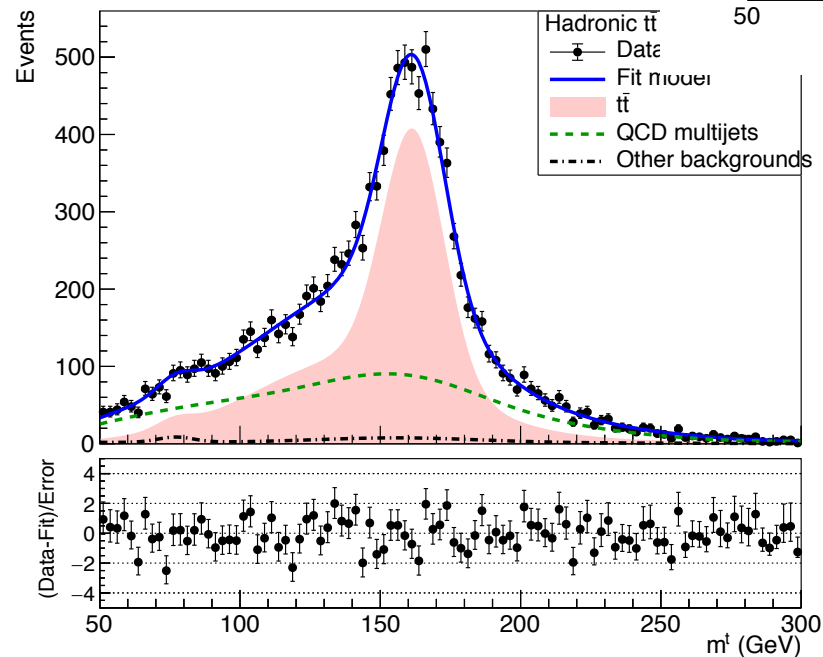
Signal strength r : 0.55275

Signal strength r in 2btag: 0.611552

0 btag



A RooPlot of "mTop"




2 btag



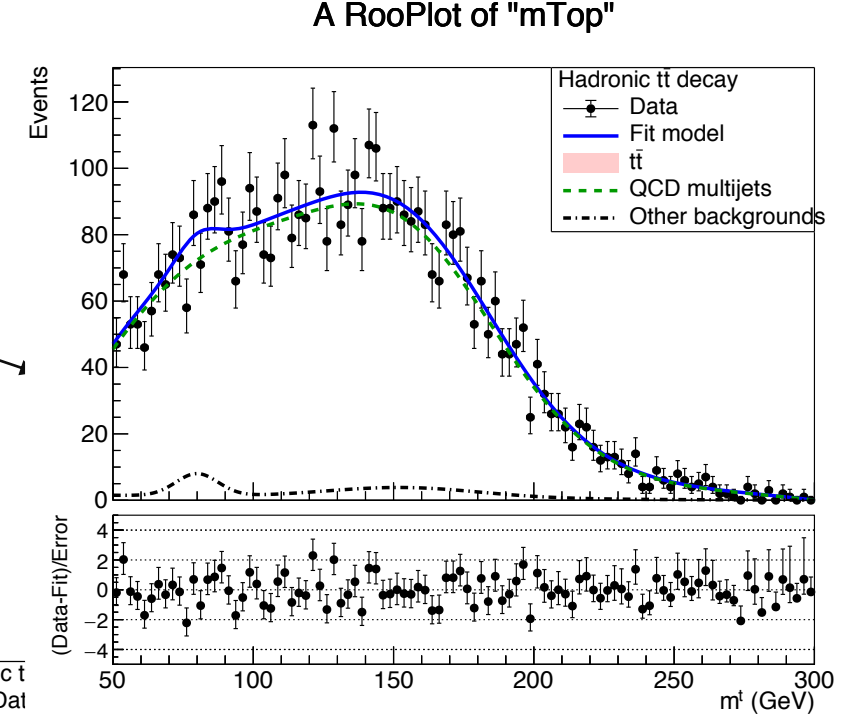
Simultaneous Mass Fit Results 2016

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

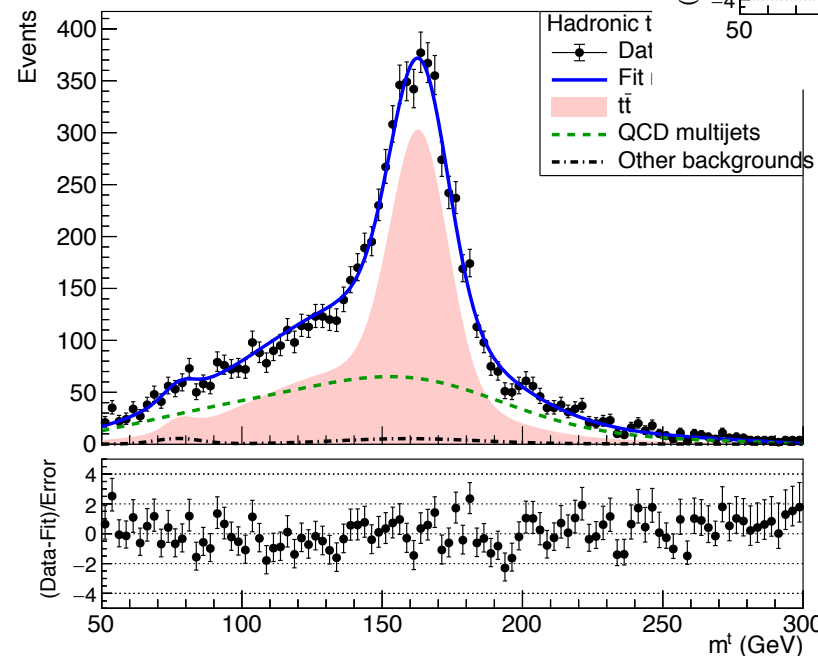
Floating Parameter	FinalValue	+/-	Error
 btagEff_2	9.9729e-01	+/-	2.87e-02
kMassResol	9.1788e-01	+/-	2.72e-02
kMassScale	9.9835e-01	+/-	2.03e-03
kQCD_2b	9.0137e-02	+/-	7.70e-02
nFitBkg_0b	2.0172e+02	+/-	3.81e+01
nFitBkg_2b	1.9417e+02	+/-	2.84e+01
nFitQCD_0b	4.7064e+03	+/-	7.37e+01
nFitQCD_2b	3.1218e+03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

$N_{0_observed} = 0.0383764$, $N_{2_observed} = 5191.63$
 $N_{tt \text{ expected}} = 7999.61$
 $N_{tt \text{ observed}} = 5191.67$
 Signal strength $r = 0.64899$
 Singal strength r in 2btag: **0.66134**

0 btag




A RooPlot of "mTop"



2 btag

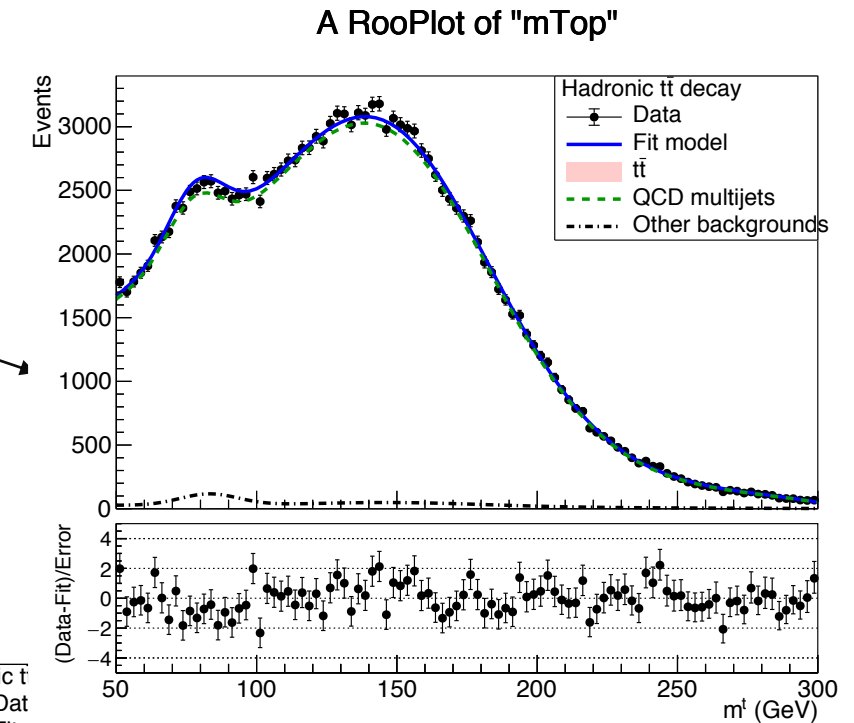


Simultaneous Mass Fit Results 2017

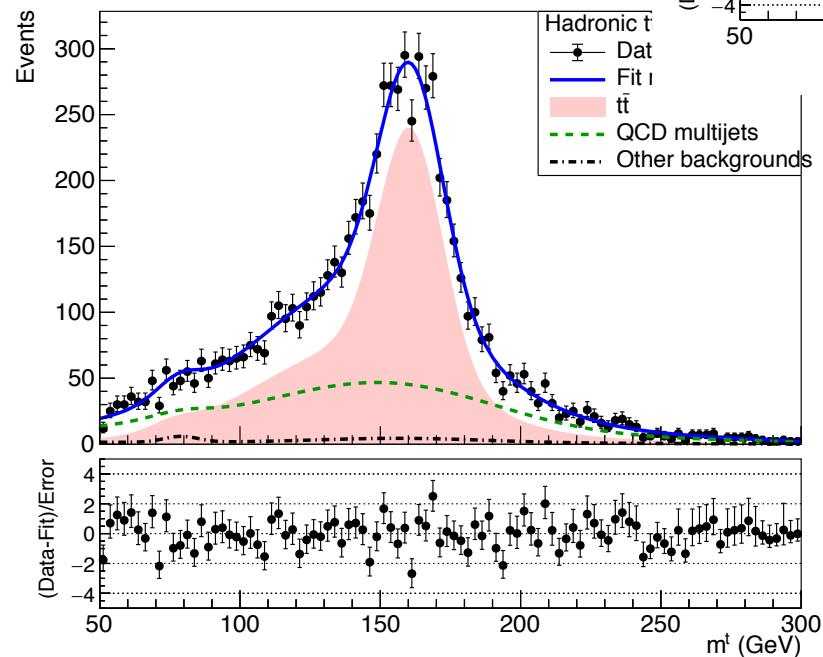
Floating Parameter	FinalValue	+/-	Error
 btagEff_2	8.3385e-01	+/-	1.37e-02
kMassResol	1.0846e+00	+/-	3.77e-02
kMassScale	9.8545e-01	+/-	2.62e-03
kQCD_2b	1.6843e-02	+/-	5.91e-03
nFitBkg_0b	3.3424e+03	+/-	1.23e+02
nFitBkg_2b	2.1330e+02	+/-	4.63e+01
nFitQCD_0b	1.5869e+05	+/-	4.11e+02
nFitQCD_2b	2.3312e+03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

$N_{0_observed} = 186.739$, $N_{2_observed} = 4703.65$
 $N_{tt \text{ expected}} = 13425$
 $N_{tt \text{ observed}} = 4890.39$
 Signal strength r : 0.364275
 Singal strength r in 2btag: 0.544471

0 btag



A RooPlot of "mTop"



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

$N_{0_observed} = 289.116$, $N_{2_observed} = 7624.71$

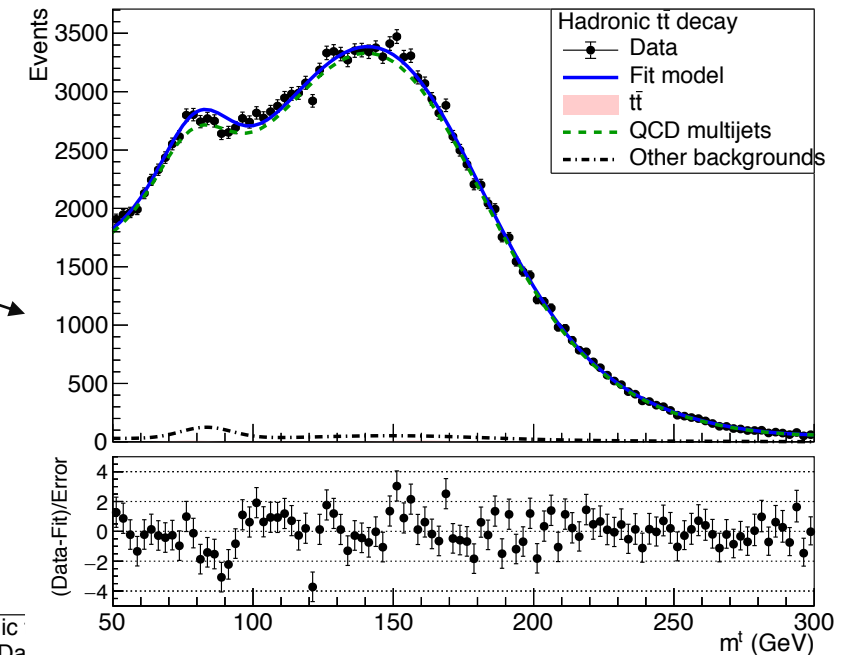
$N_{tt_expected} = 17721.3$

$N_{tt_observed} = 7913.83$

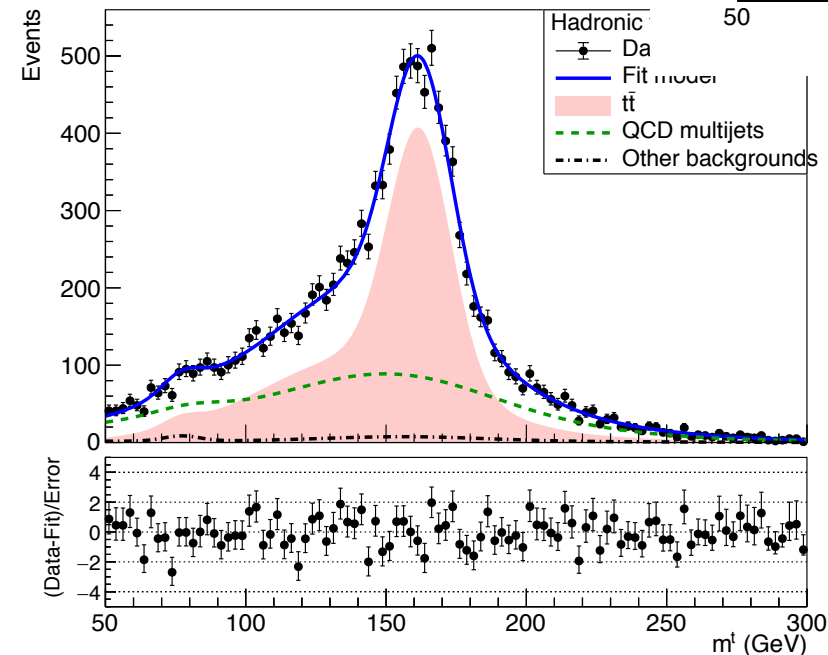
Signal strength r : 0.446571

Signal strength r in 2btag: 0.616854

0 btag



A RooPlot of "mTop"



2 btag

