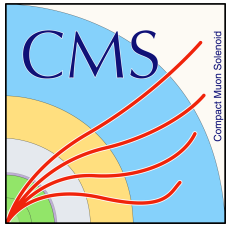
Mass Fit results and btagging efficiency

George Bakas, Ioannis Papakrivopoulos



Simultaneous Fit in 3 regions

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

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

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

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

  - $N_{sub}^{(0)}$ is limited in $0.9N_{sub,MC}^{(0)}$ $up\ to$ $1.1N_{sub,MC}^{(0)}$
  - 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

    - With mass restriction loose (50,300) GeV: $\mathrm{e_b}$ = 0. 0.629909
    - With mass restriction tight (120,220) GeV $\mathrm{e_b}$ = 0.656748

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

Purpose of this presentation

- We calculate and present the fit result in two ways:
  - Fix the e_b parameter at a certain value → This will be Method A
  - Let the e_b parameter free on the interval [0.5,0.8] → This will be Method B

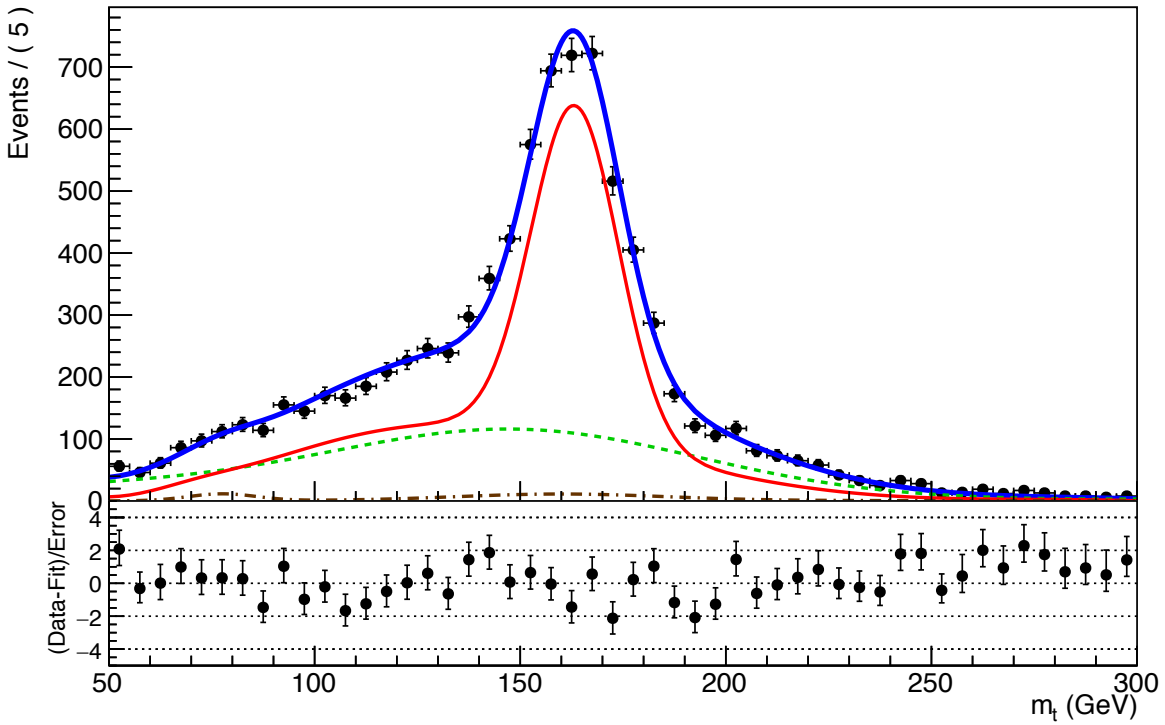
- Results:
  - Method A: r = 0.85347 with Ntt expected (MC) = 16351 and Ntt observed = 13955
  - Method B: r = 1.02045 with Ntt expected (MC) = 16351 and Ntt observed = 16686

Floating Parameter	FinalValue +/- Error
kMassResol	9.2150e-01 +/- 2.07e-02
kMassScale	1.0023e+00 +/- 1.60e-03
kQCD_1b	6.3680e-03 +/- 4.58e-04
kQCD_2b	5.9385e-02 +/- 3.48e-02
nFitBkg_0b	4.5269e+03 +/- 4.25e+01
nFitBkg_1b	2.3356e+03 +/- 2.73e+02
nFitBkg_2b	2.0703e+02 +/- 2.32e+01
nFitQCD_0b	8.8323e+04 +/- 3.13e+02
nFitQCD_1b	3.0542e+04 +/- 2.62e+02
nFitQCD_2b	2.8400e+03 +/- 1.55e+02
nFitSig	1.3955e+04 +/- 3.69e+02

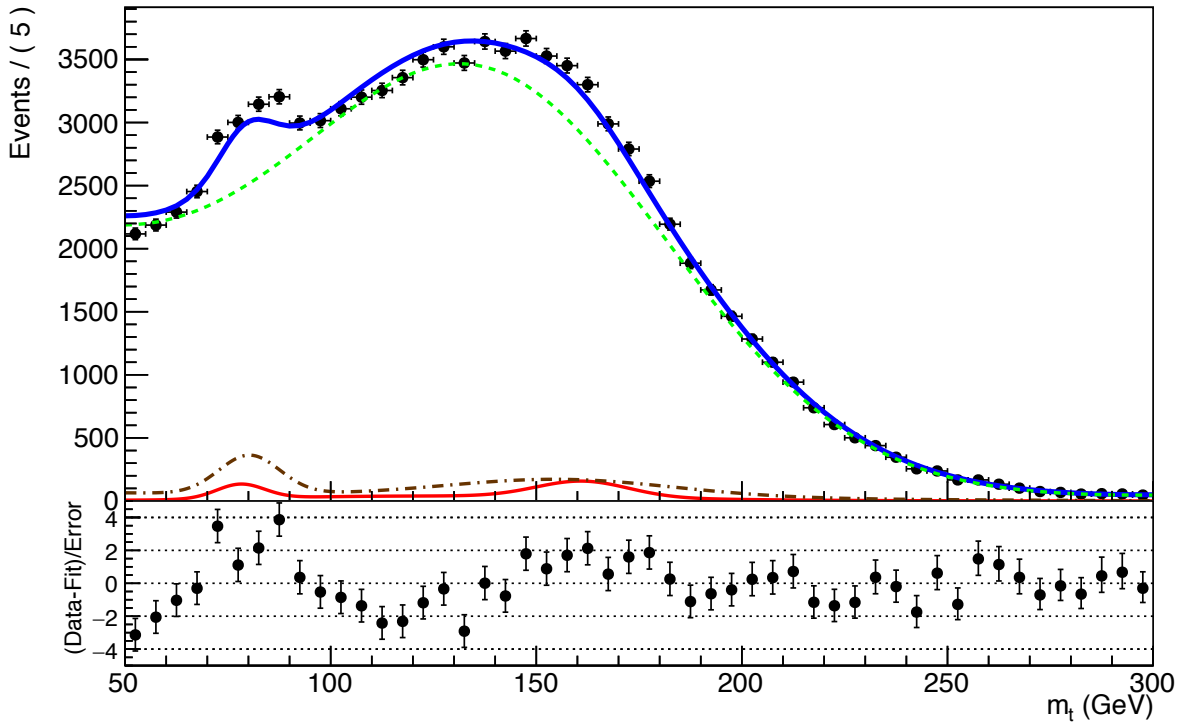
Floating Parameter	FinalValue +/- Error
btagEff	5.6029e-01 +/- 1.17e-02
kMassResol	9.6557e-01 +/- 2.29e-02
kMassScale	1.0020e+00 +/- 1.60e-03
kQCD_1b	5.8296e-03 +/- 4.50e-04
kQCD_2b	7.7313e-02 +/- 4.98e-02
nFitBkg_0b	4.5269e+03 +/- 5.63e+01
nFitBkg_1b	2.3159e+03 +/- 4.02e+02
nFitBkg_2b	2.3726e+02 +/- 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

Simultaneous Fit in 3 regions Method A

Signal Region (2btag)



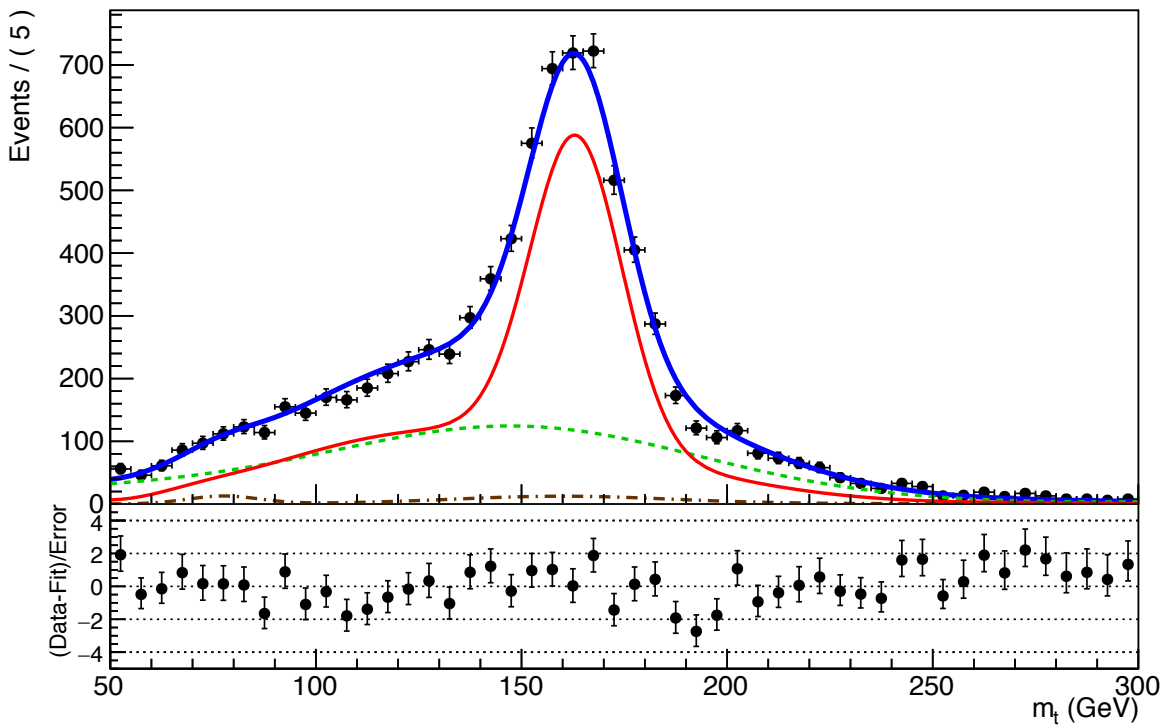
Control Region (0btag)



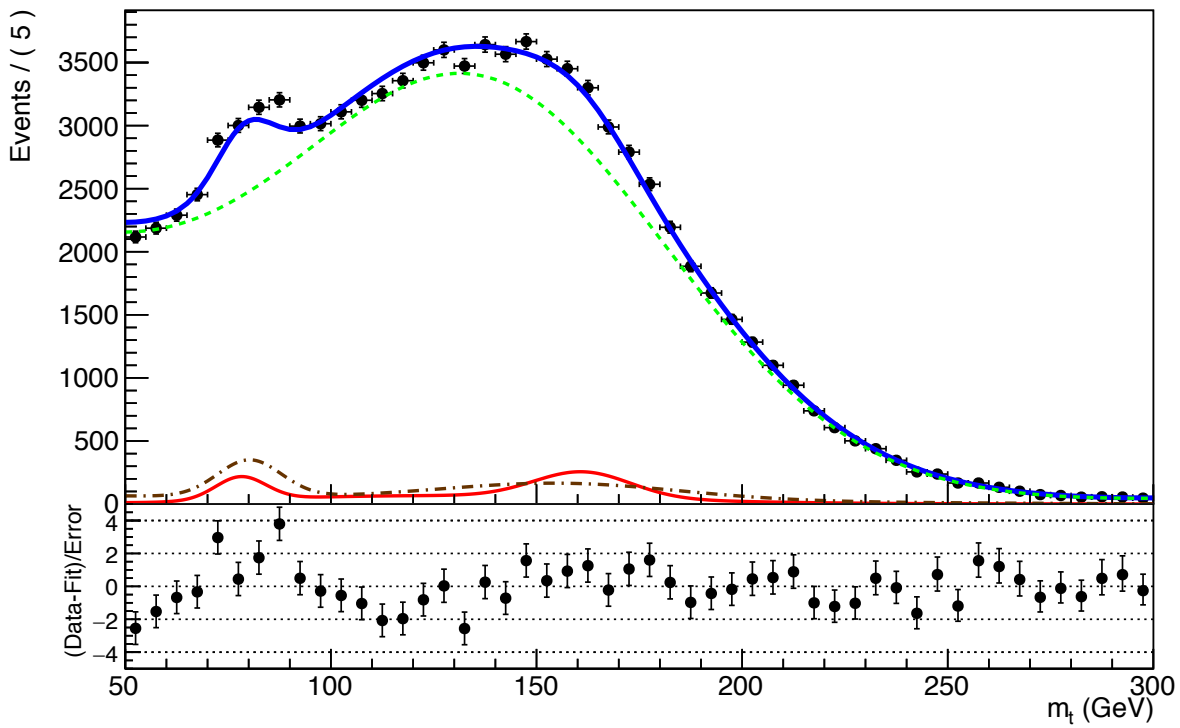
Result of the template fit on data in SR and CR. The red line shows the tt contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions Method B

Signal Region (2btag)



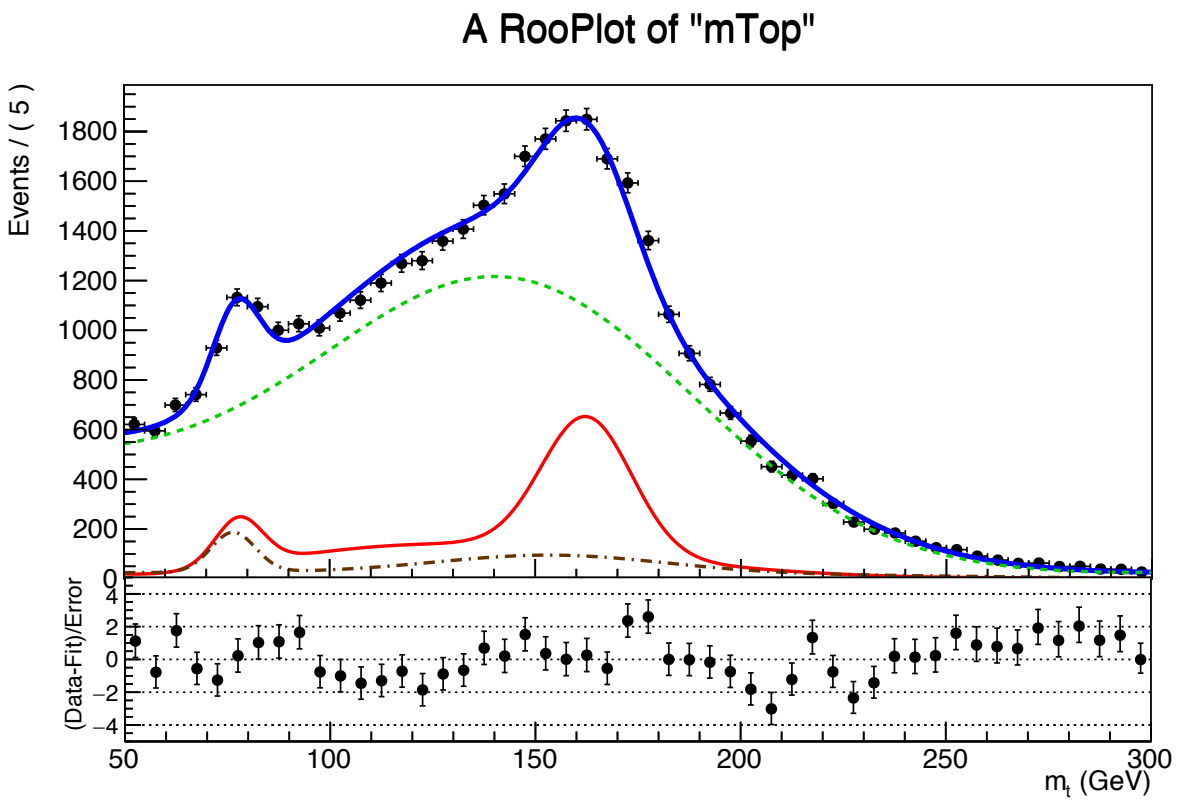
Control Region (0btag)



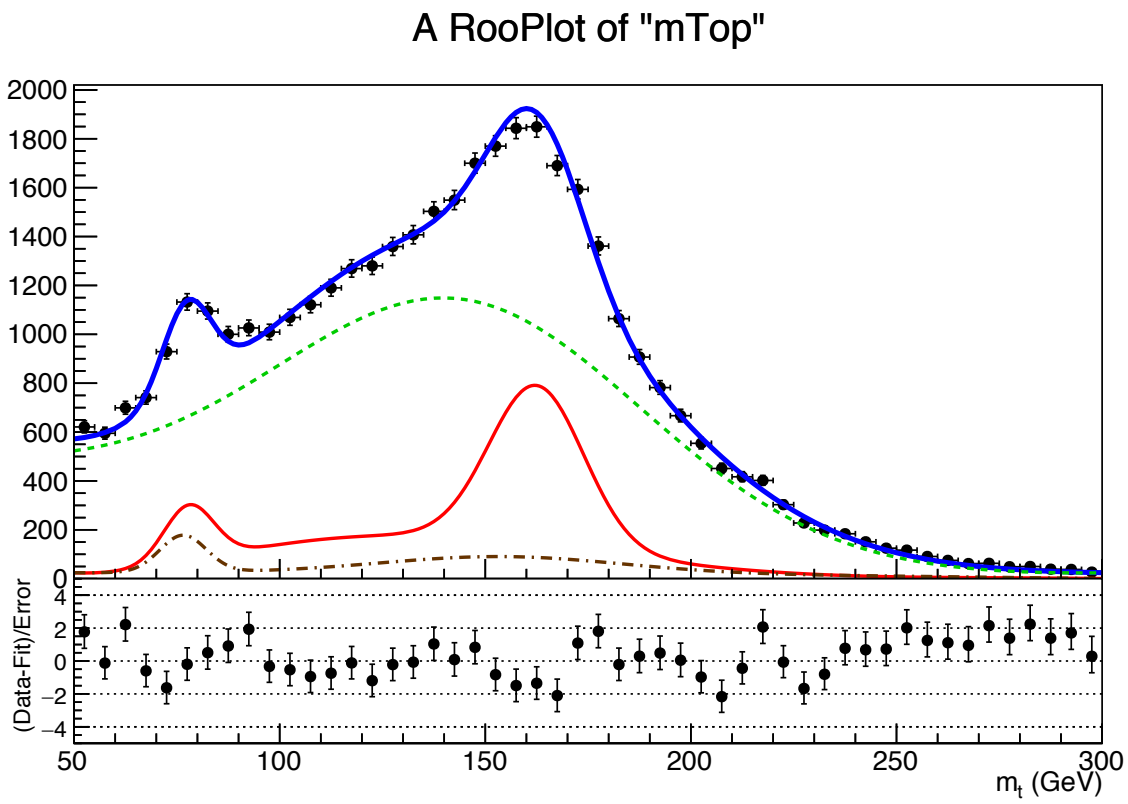
Result of the template fit on data in SR and CR. The red line shows the tt contribution, the green line shows the QCD, and the brown line shows the subdominant backgrounds

Simultaneous Fit in 3 regions (1btag Region)

Method A

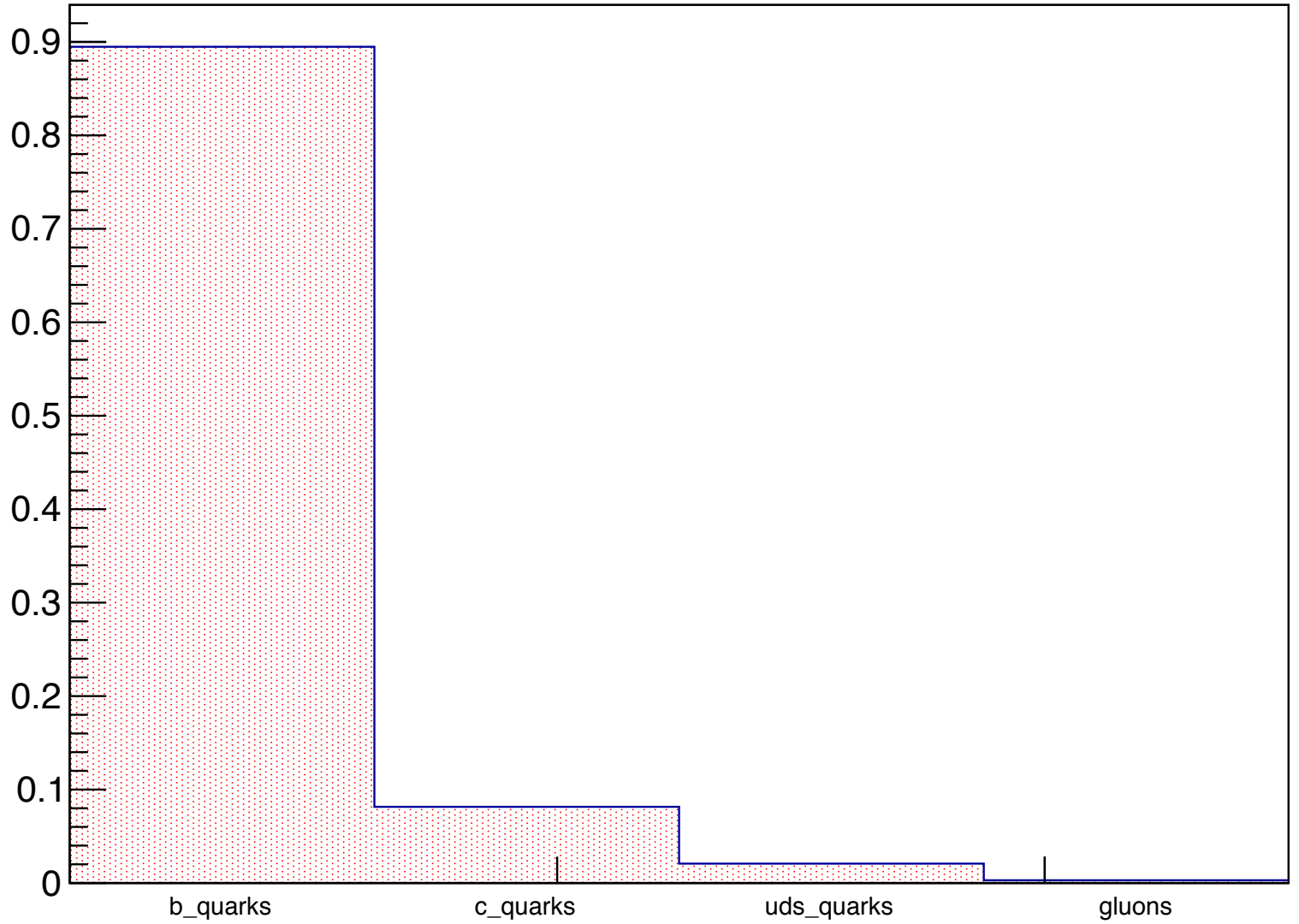


Method B



b-tagging Purity

Distribution of the parton flavor for each b tagged subjet.



b-tagging Efficiency