Top Reconstruction with Local Hadron Calibration

Local Hadron Calibrated Jets in Top Mass Reconstruction

progress report of work at MPI München

cuts and reconstruction method

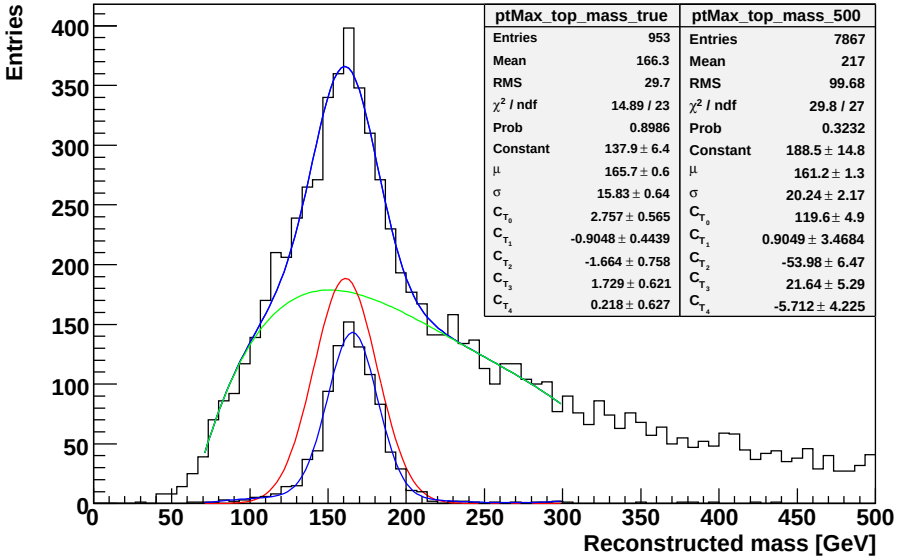
- electron cuts:
  - min pT : 20 GeV
  - max abs(eta) : 2.5
  - author : 1
  - isEM bitpattern: 0X37F7FF3
  - max etcone20 : 6 GeV
- muon cuts:
  - min pT : 20 GeV
  - max abs(eta) : 2.5
  - max etcone20 : 6 GeV
- jet cuts:
  - min pT : 20 GeV
  - max abs(eta) : 2.5
  - min distance to leptons: 0.4

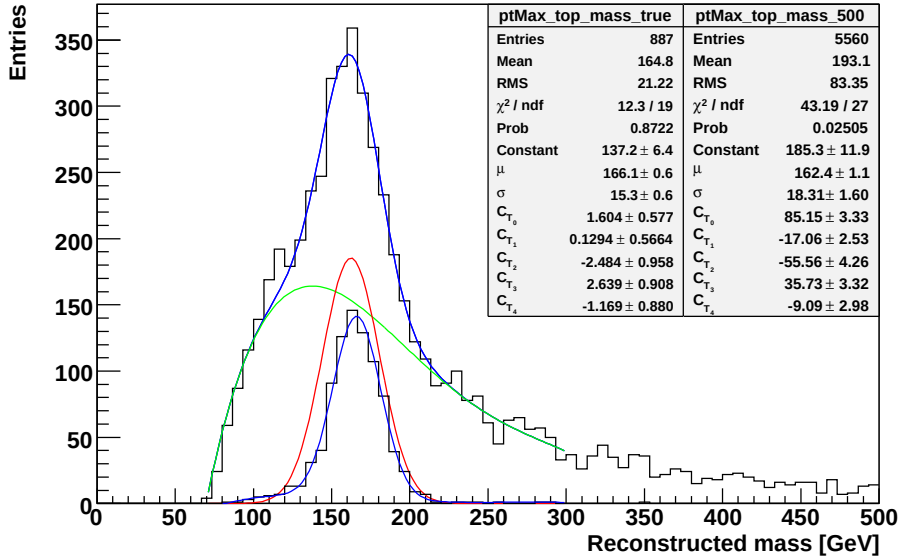
- event selection cuts:
  - leptons : exactly 1
  - #jets : > 4
    (3 of them > 40 GeV)
  - min missingET : 20 GeV

- take jet triplet maximising pt as top
- boost to top CM and take jj of jjj with minimal dR(j,j) as W

  OR boost to top CM and take jj of jjj not using the jet with highest momentum (would be the b) as W

influence of purification cut

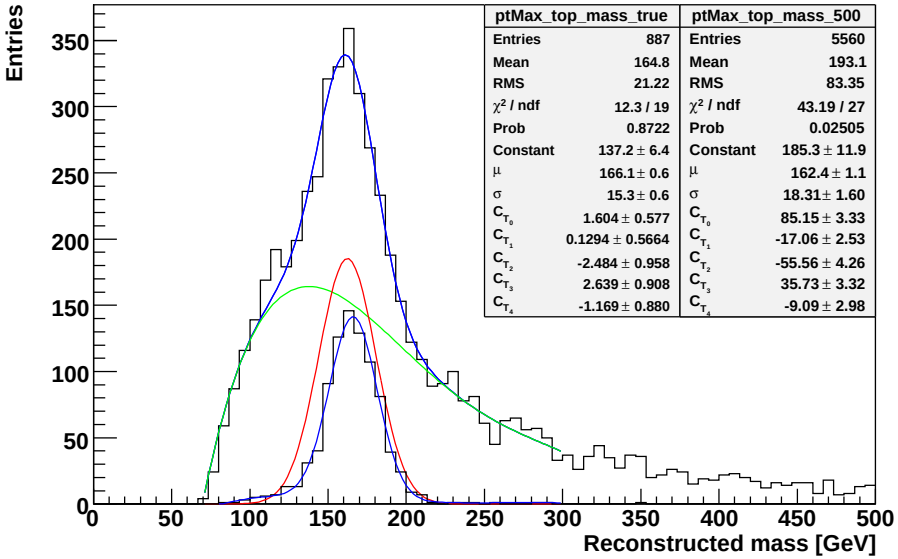


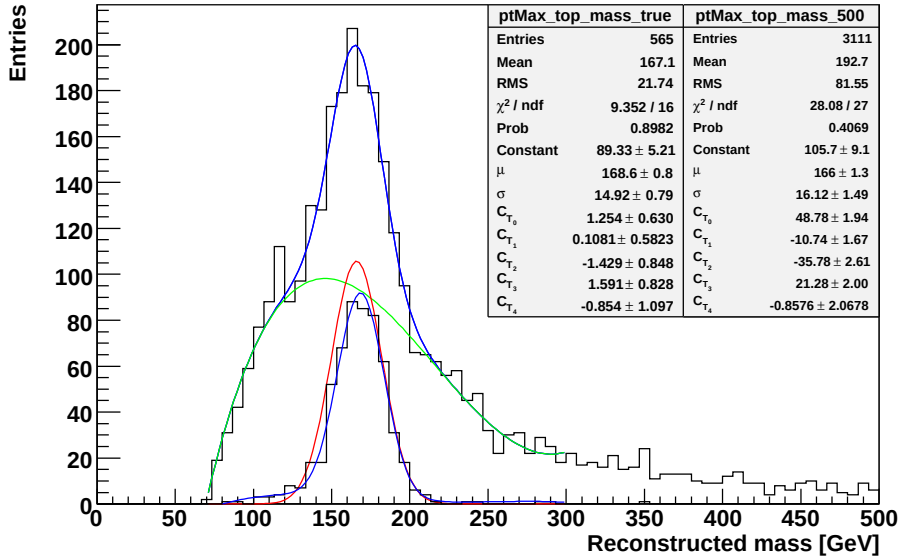


- jjj mass spectrum fitted with Gaussian (red) + Chebychev (green)
- small histogram shows subset for $dR(top_{truth}, top_{reco}) < .1$

- at least one two jet combination of the jet triplet is within 20GeV window around W mass

influence of semi leptonic quark decays



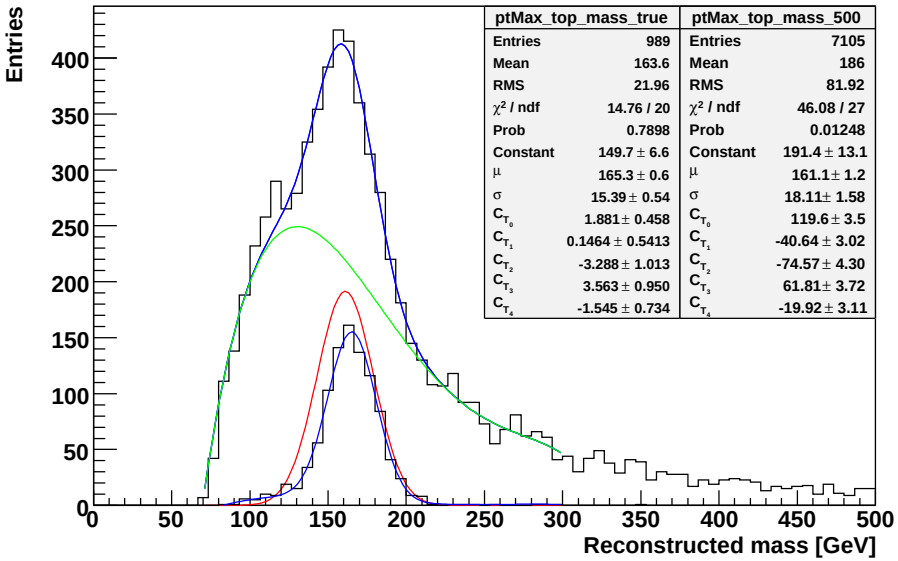


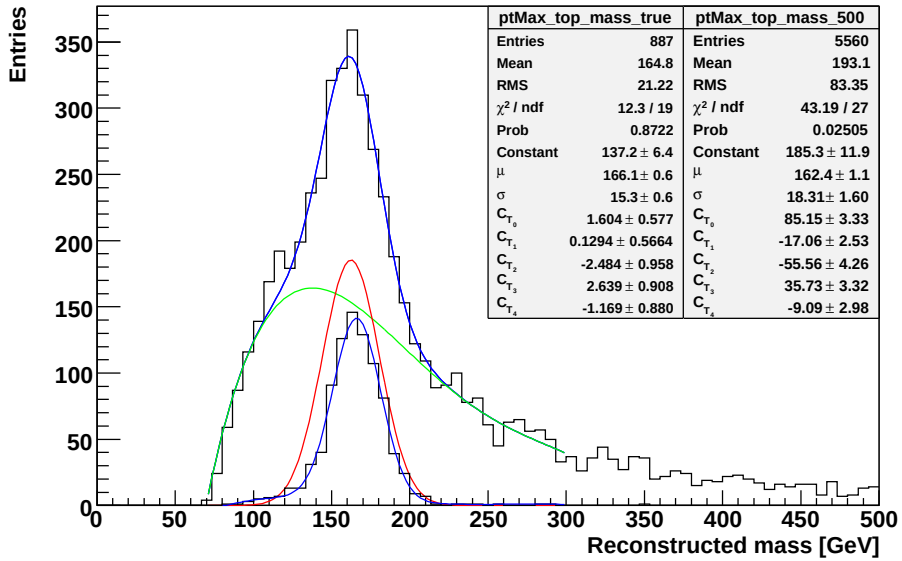
- again jjj spectrum maximising pt with purification cut

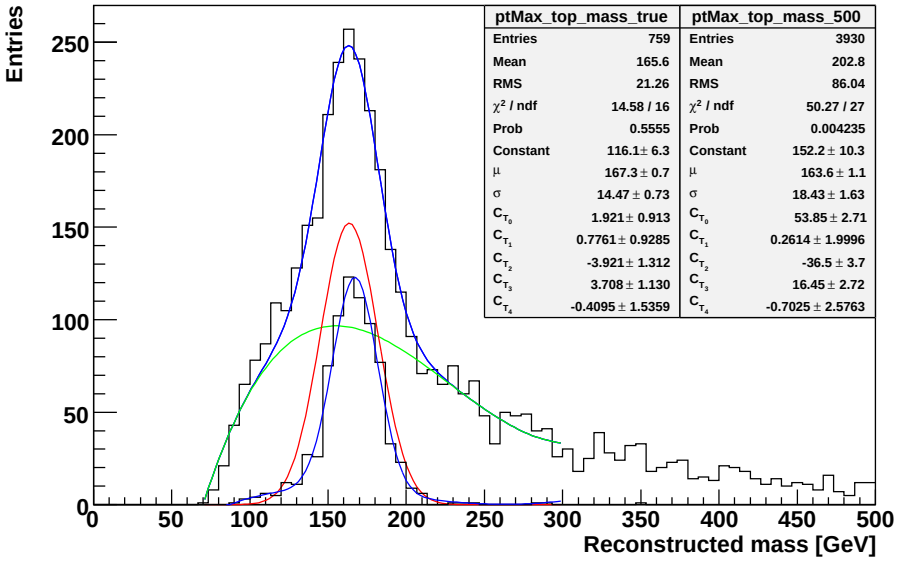
- no events with semi leptonic decays (of neither b nor W daughters)
- mean of Gaussian shifts from 162.4 to 166 GeV (166.1 to 168.6 in matched case)

$\Rightarrow$ in data one would hope to tag these events using a soft lepton tag

top influence of jet pt cut



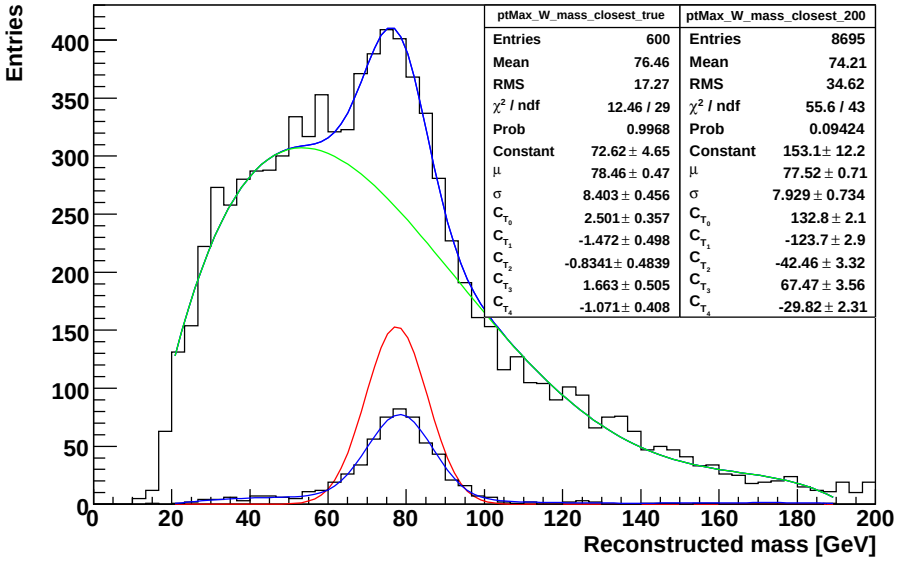


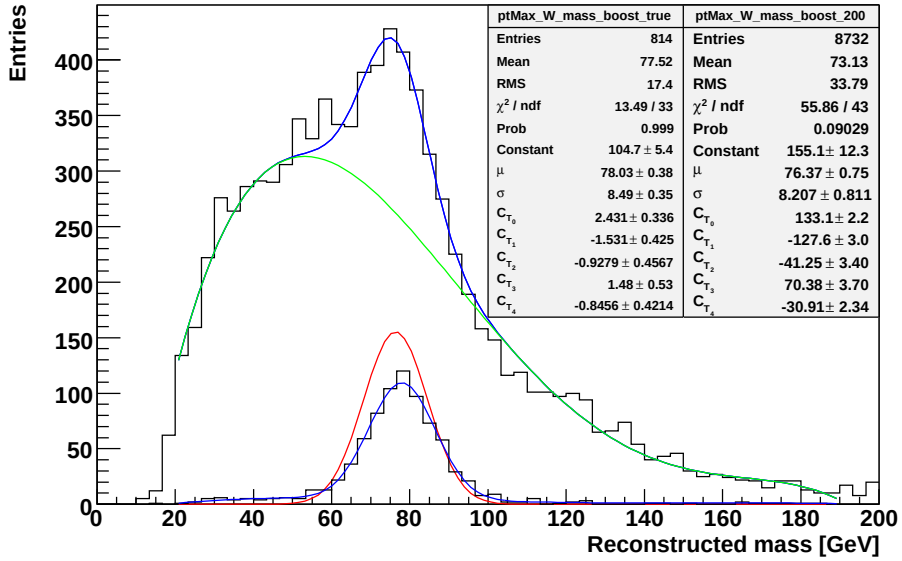


- again pt max top with W-window cut now with 3 different jet-pt selection cuts 3 jets 30/40/50 (top left / right / bottom) + 1 jet 20 GeV

ptcut [GeV]	30	40	50
matched mean [GeV]	165.3	166.1	167.3

W reconstruction

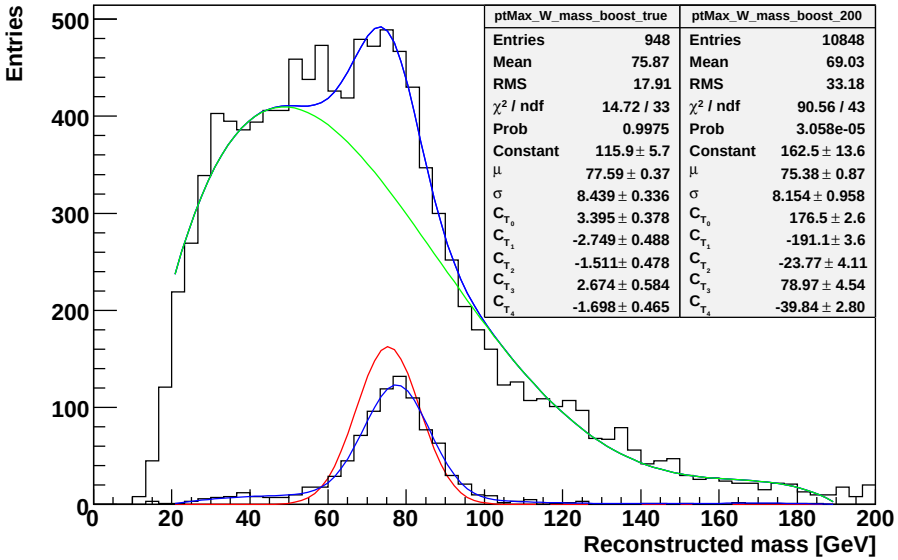


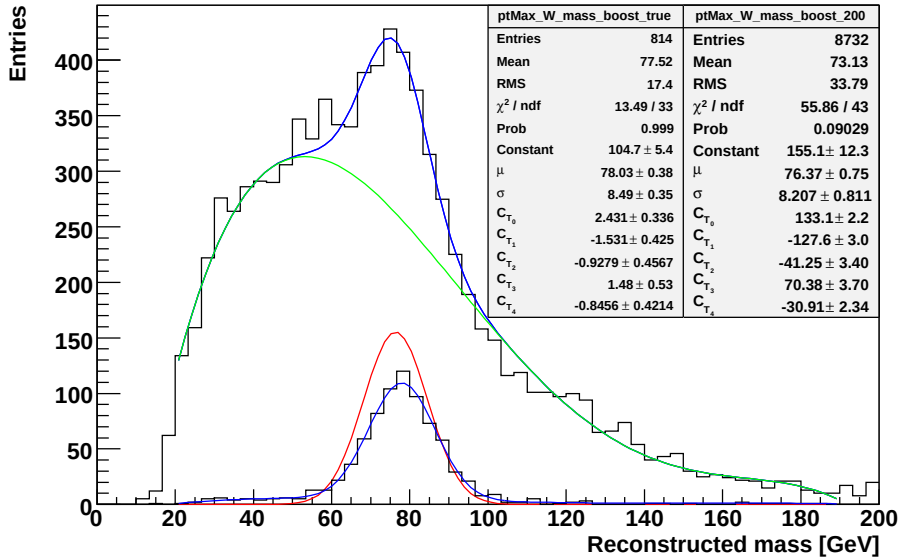


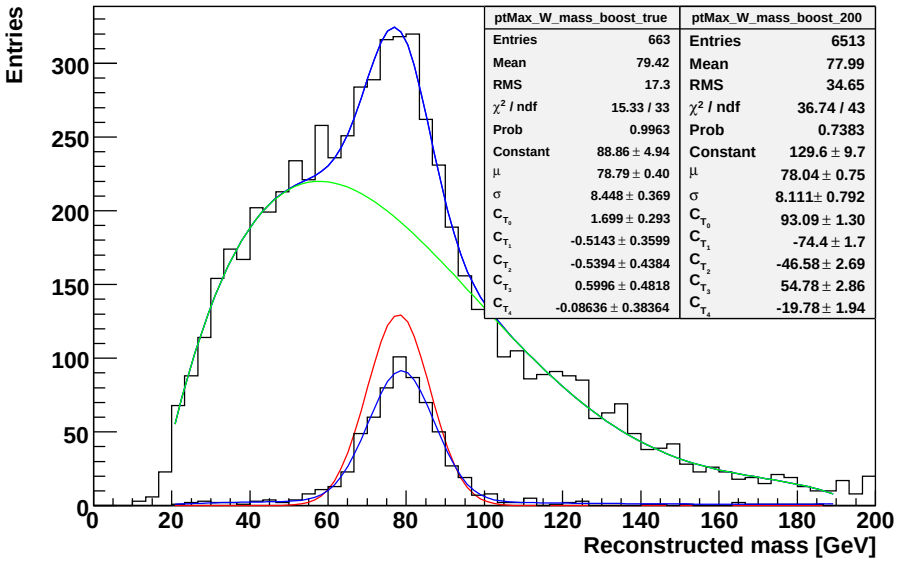
- boost jjj to top CMS and take jj of jjj with minimal dR(j,j) as W fitted with Gaussian (red) + Chebychev (green)
- small histogram shows subset for $dR(q, jet) < .2$

- boost jjj to top CMS and take jj of jjj not using the jet with highest momentum (would be the b) as W

W influence of jet pt cut



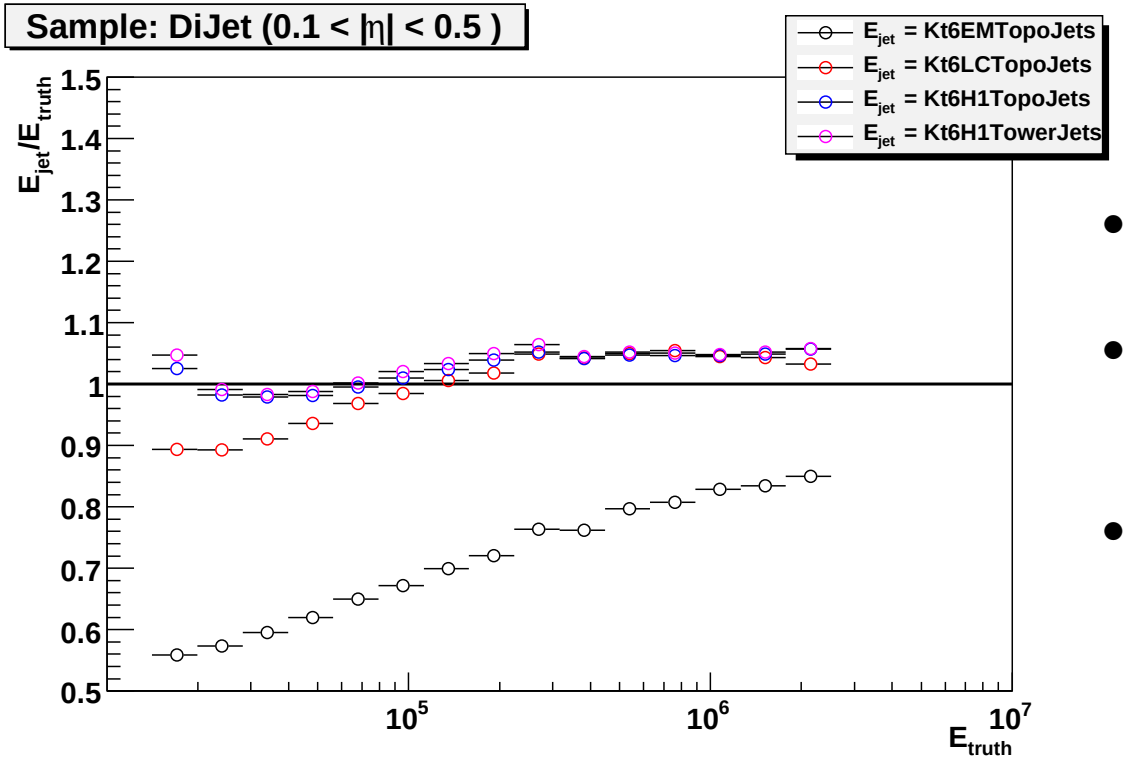




- W now with 3 different jet-pt selection cuts 3 jets 30/40/50 (top left / right / bottom) + 1 jet 20 GeV

ptcut [GeV]	30	40	50
matched mean [GeV]	77.59	78.03	78.79

reconstructed energy in jets



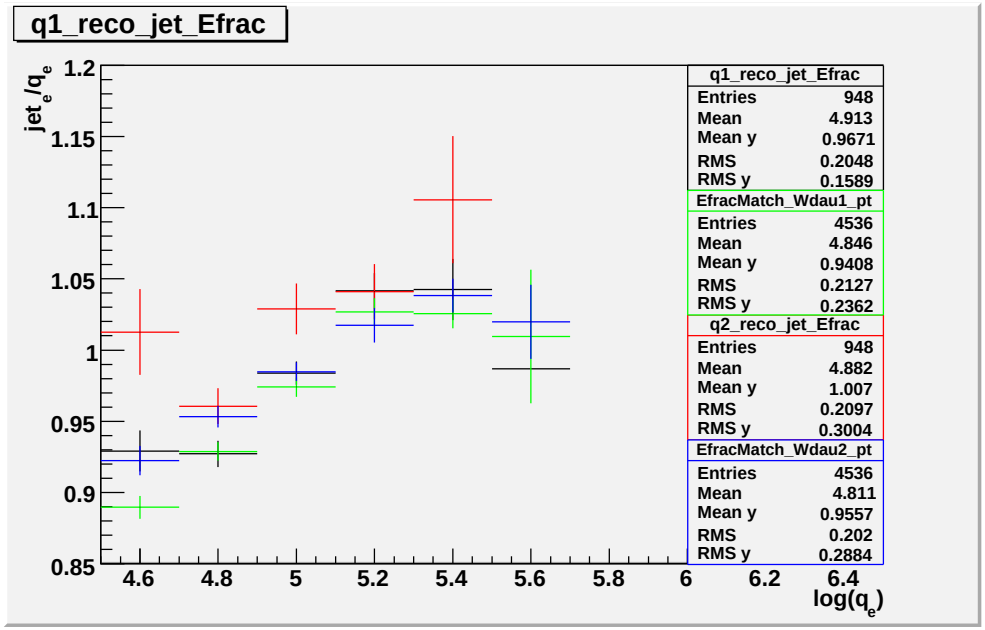
- plot by Andreas Jantsch showing scale of jets at different calibration scales
- red circles give an idea of what to expect from Local Hadron Calibration, but jets (Kt6) and sample (Di-Jet) are different
- jet level corrections to bring linearity to 1 (see respective talks)

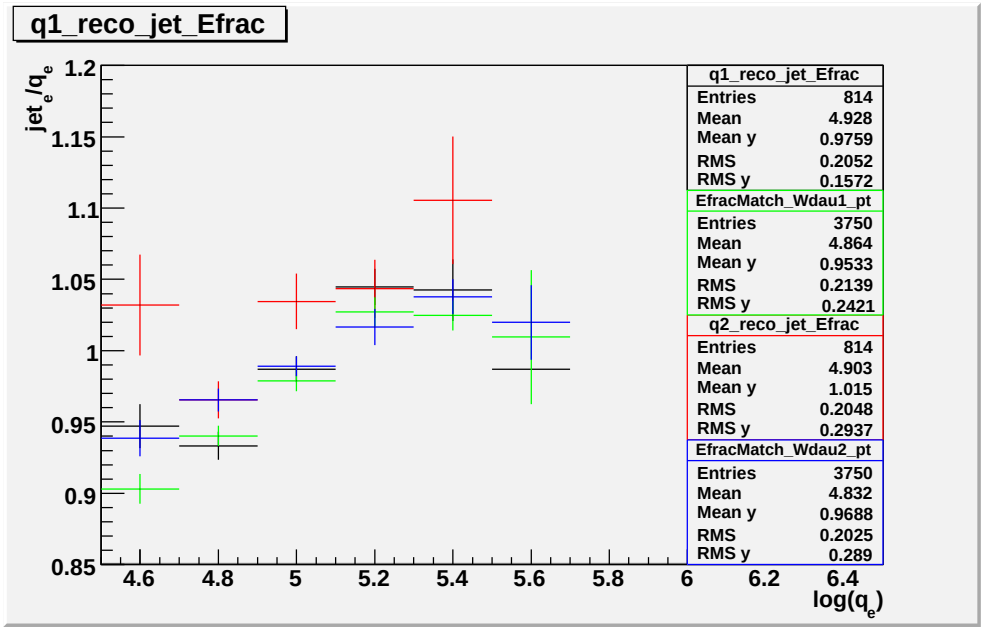
- look at energy fraction jet_e/q_e
- **1** for qqb looking for jet with best match in all reco jets in container requiring $dR(q, jet) < .2$

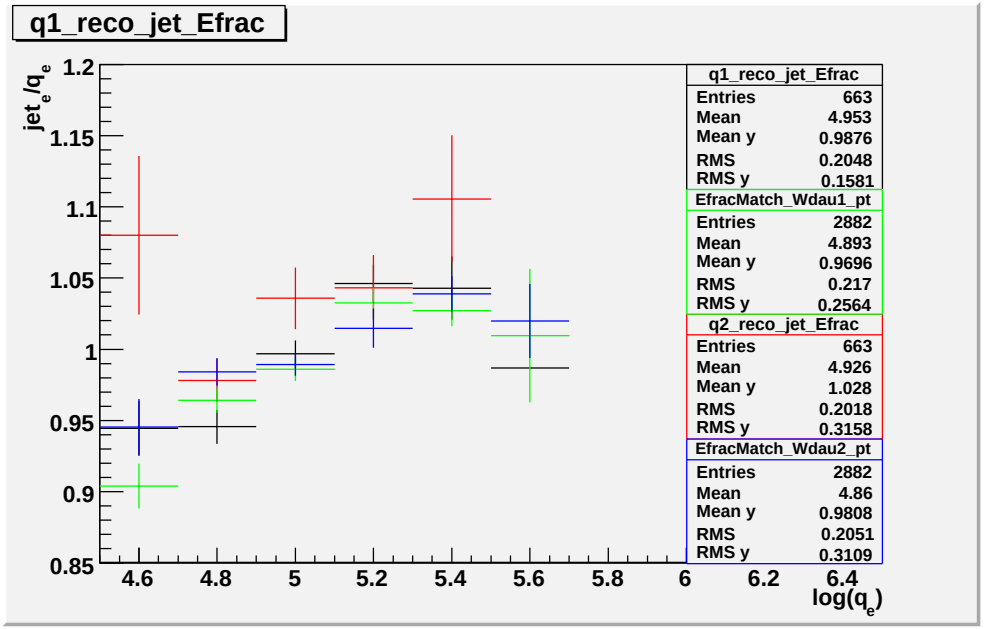
  $\Rightarrow$ expect some bias from pt cut in event selection
- **2** matching those jets used for top to qqb and for W to qq requiring $dR(q, jet) < .2$

  $\Rightarrow$ expect additional bias from pt maximising reconstruction decision

light JES influence of jet pt cut

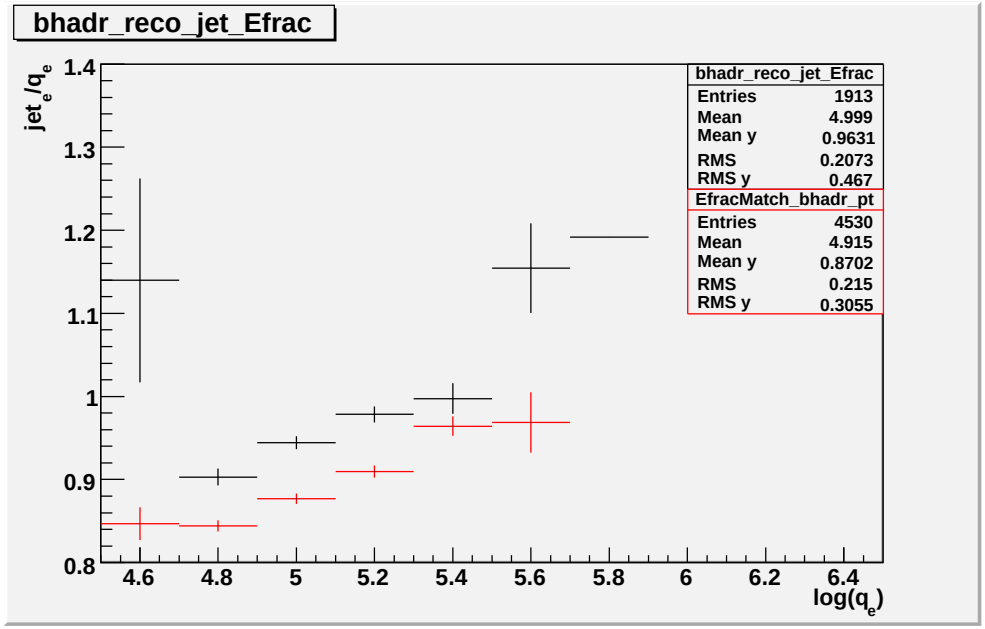


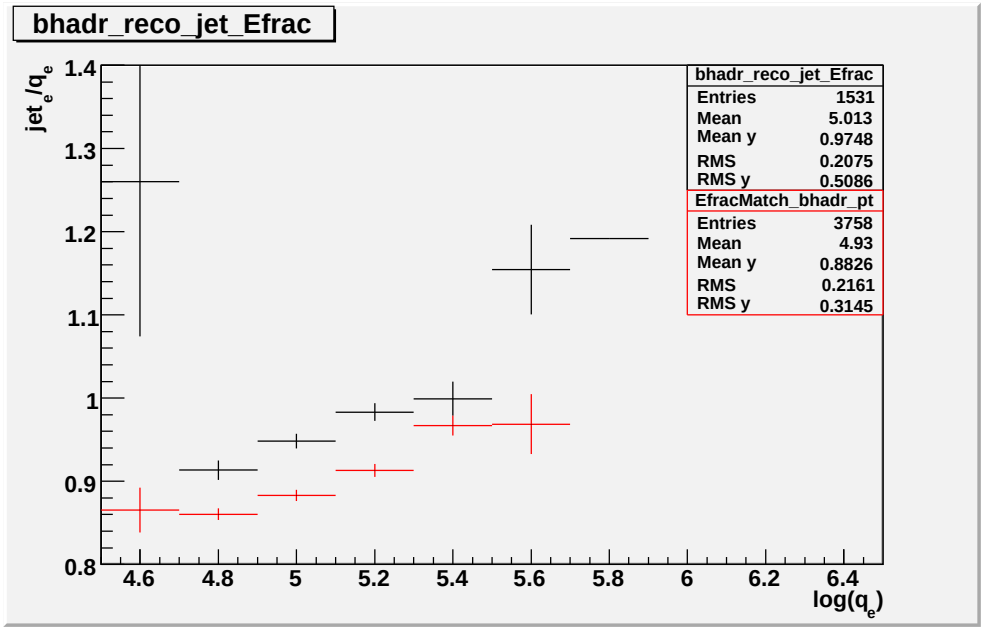


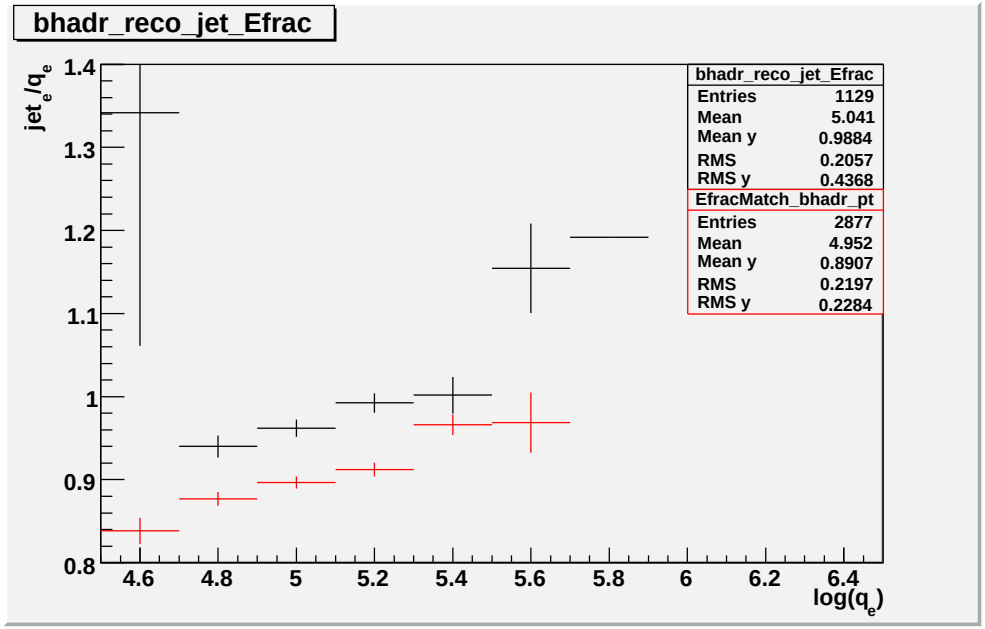


- jet_e/q_e vs $log(q_e)$ for match to all jets in container (green/blue) and to jets used in top/W (black/red)
- again with 3 different jet-pt selection cuts 3 jets 30/40/50 (top left / right / bottom) + 1 jet 20 GeV

b JES influence of jet pt cut

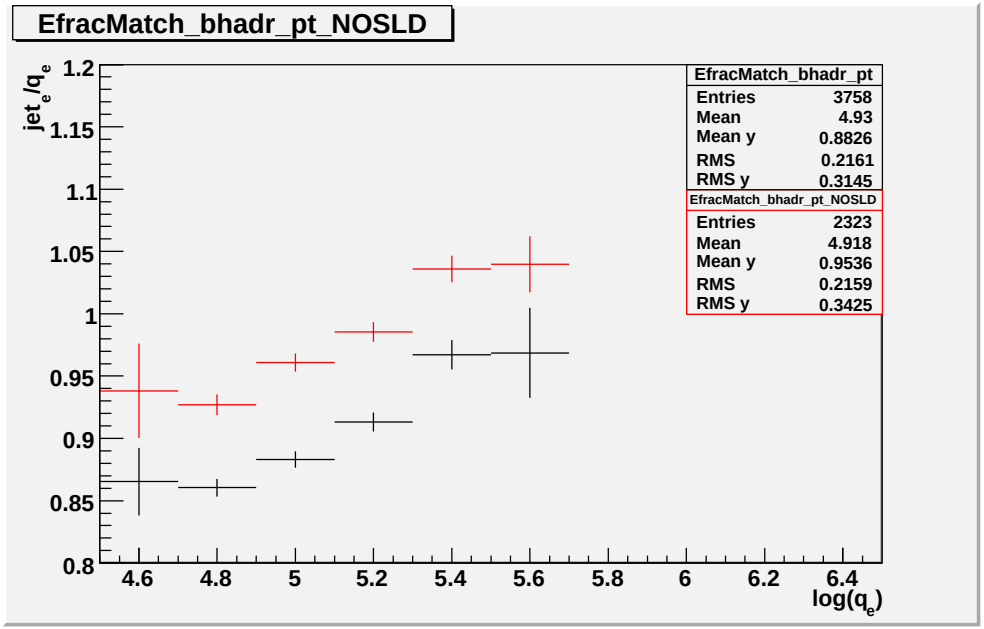


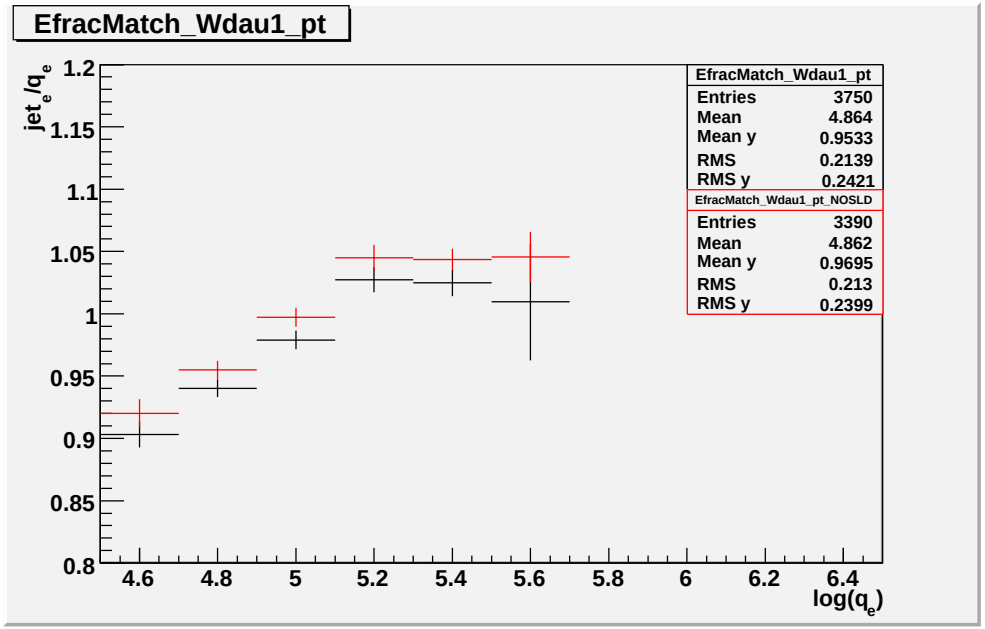




- jet_e/b_e vs $log(b_e)$ for match to all jets in container (green/blue) and to jet used in top/W (black/red)
- again with 3 different jet-pt selection cuts 3 jets 30/40/50 (top left / right / bottom) + 1 jet 20 GeV

b JES influence of semi leptonic quark decays

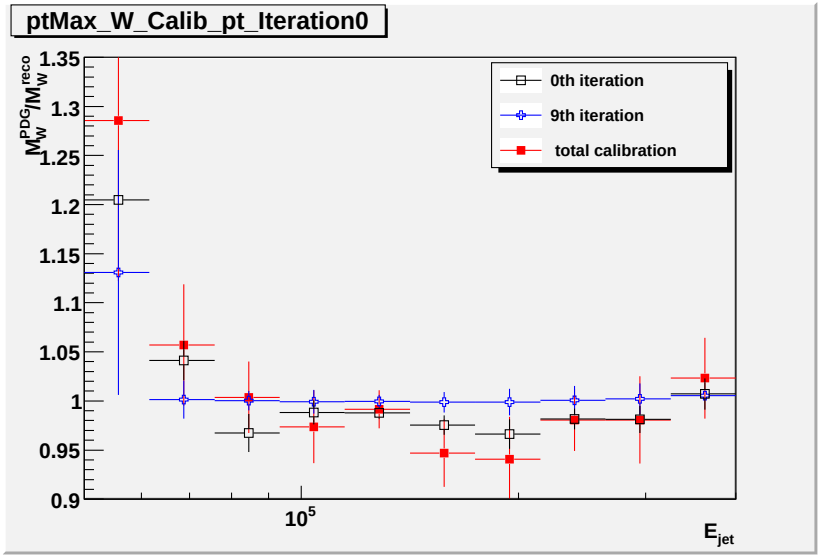


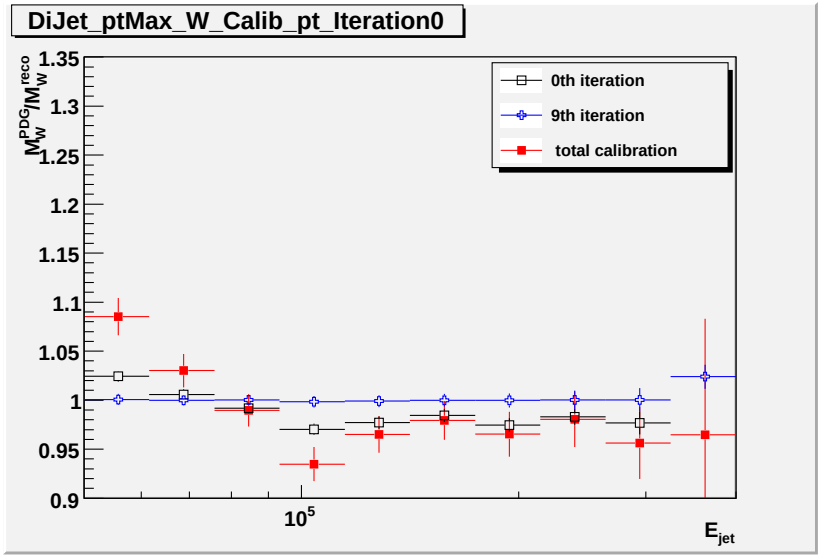


- red histo: no events with semi leptonic b decays

- red histo: no events with semi leptonic decays of W daughter quarks

in situ calibration





- take jets reconstructed W and look at M_W^{PDG}/M_W^{reco} (left) or take all 2 jet combinations and look at M_W^{PDG}/M_{jj}^{reco} (right) in different energy bins after fitting

$\Rightarrow$ the prior has the benefit of taking into account all other biases and features of the reco method

$\Rightarrow$ the latter has the benefit of being more universal.

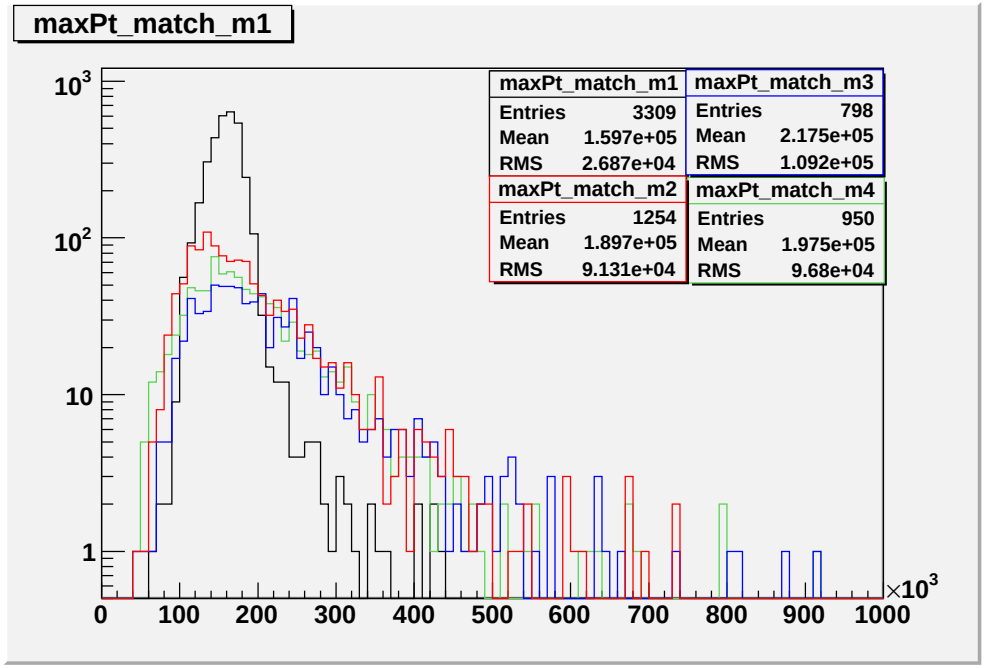
Should try to understand bias in more detail and then find correction from method with reco selected jets to jj spectrum

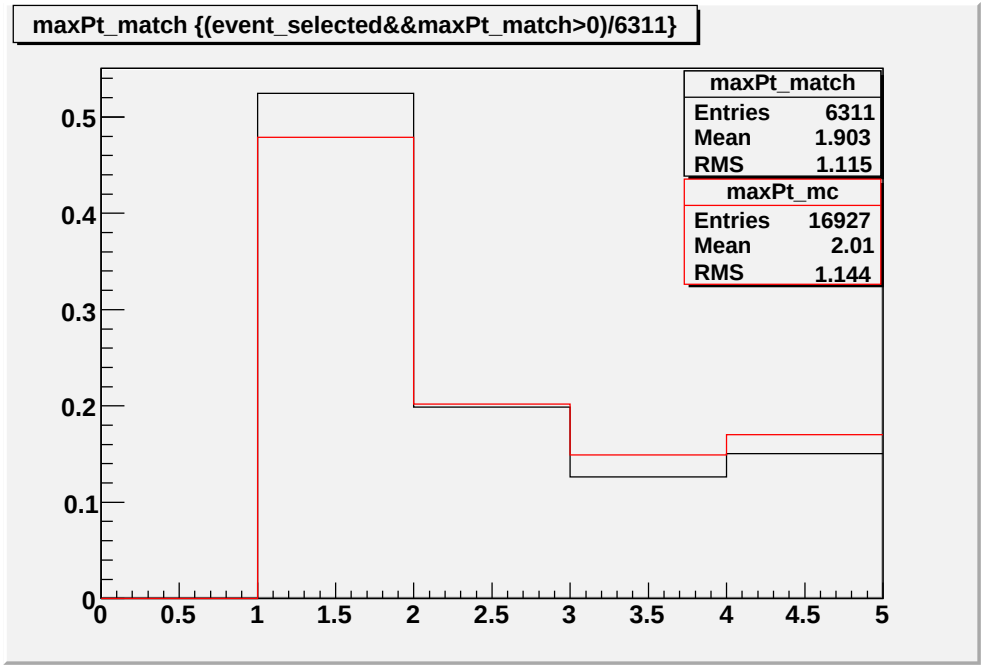
summary and outlook

- local hadron calibrated jets are well suited for top mass reconstruction
- top decay offers good channel to study and give feedback to local hadron calibration
- will try to get better understanding of biases especially in b JES and the two in-situ calibration approaches
- already started to use 105200 sample and physics background samples
- current status for LC:
  - new weights are being computed for QGSP_BERT (currently QGSP_EMV)
  - jet level corrections are being developed to compensate effects which can not be corrected at cluster level
  - see talks at dedicated meetings Jet-ETMiss and Hadronic Calibration this week

Backup Slides

top reco method

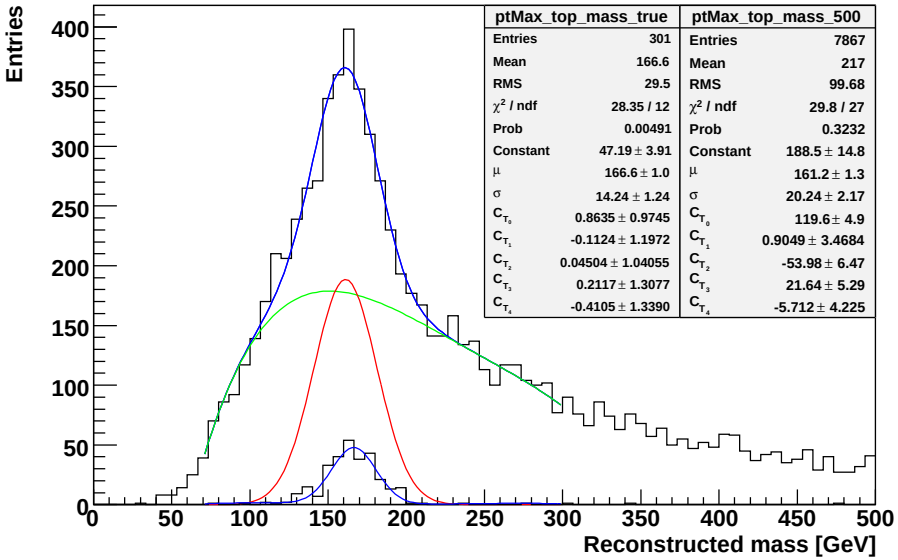




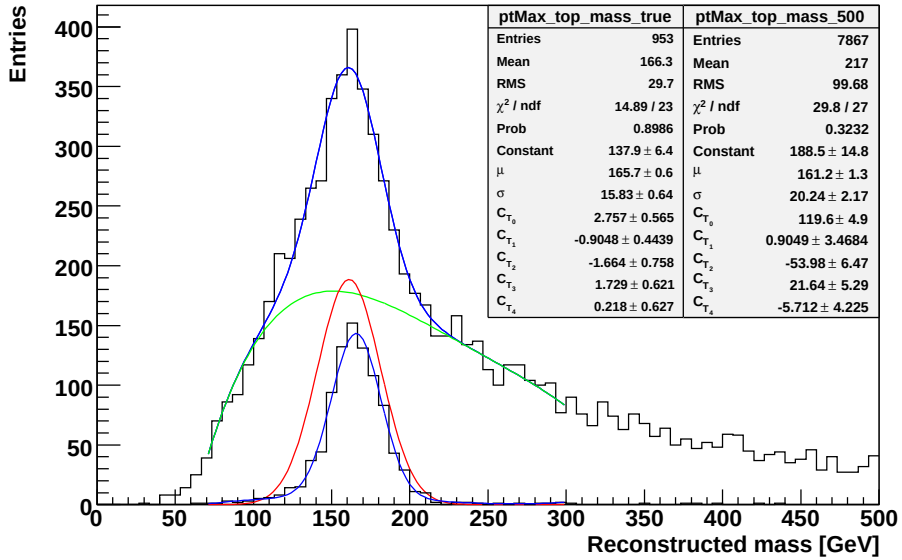
- ideal case regarding qqbb plotting mass of highest pt object
- case 1 qqbh, 2 qqbl, 3 bhblq1, 4 bhblq2

- fraction of events

top matching and reconstruction goodness

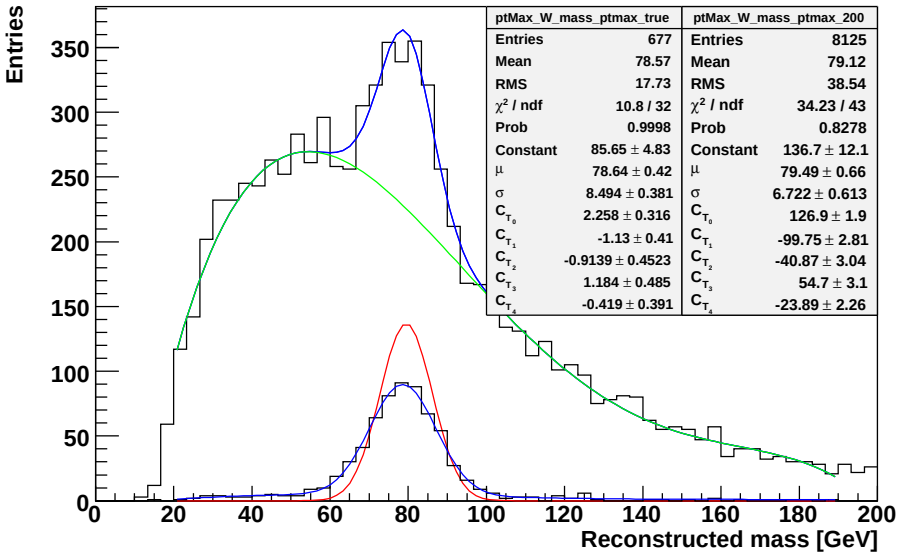


- $dR(q, jet) < .2$ for all 3 jets

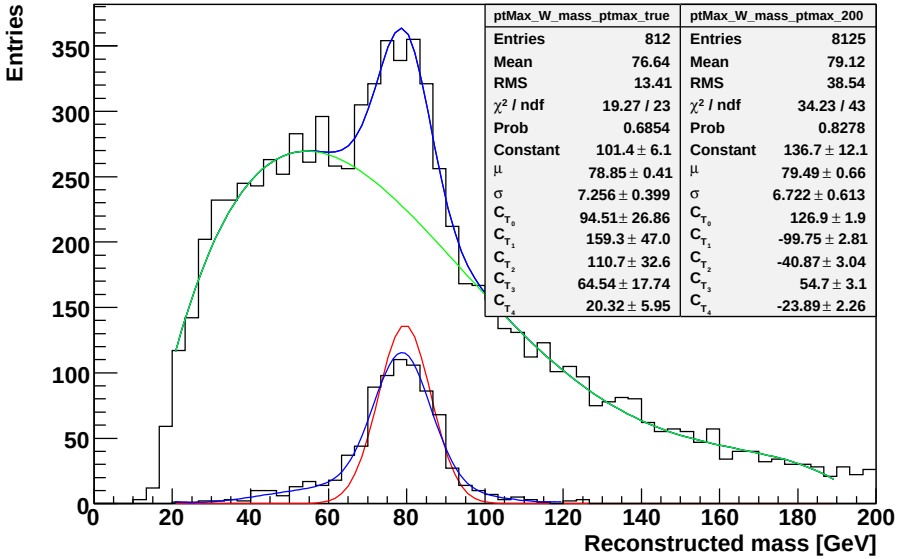


- $dR(top_{truth}, top_{reco}) < .1$

W matching and reco goodness

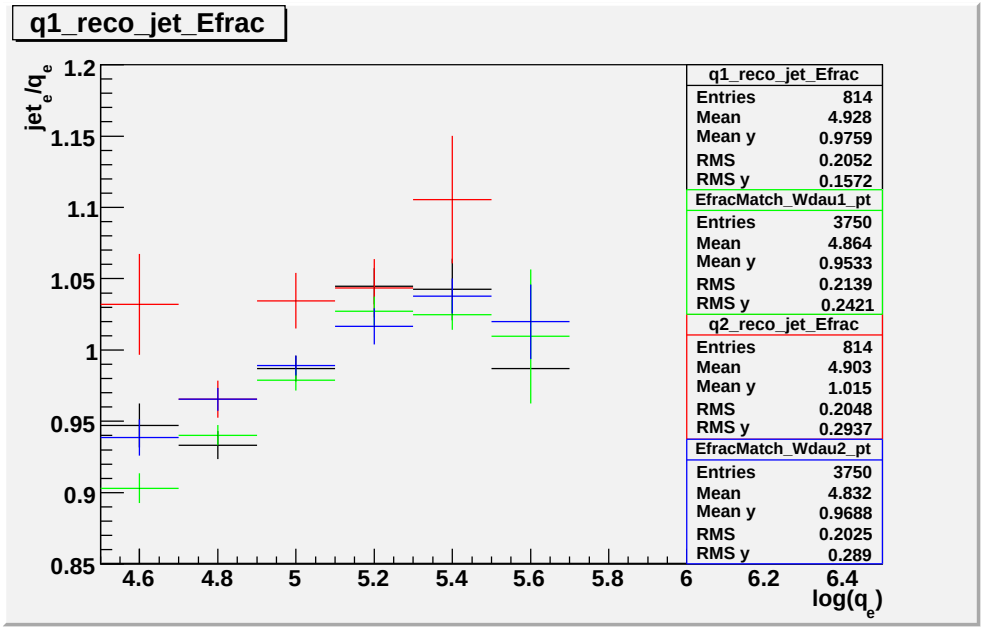


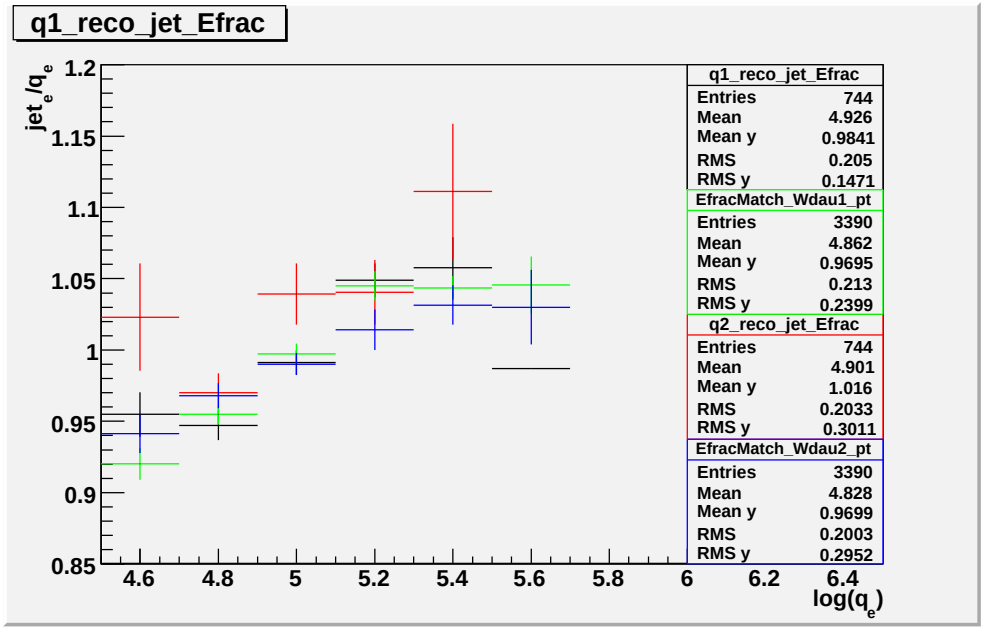
- $dR(q, jet) < .2$ for 2 jets



- $dR(W_{truth}, W_{reco}) < .1$

b JES influence of semi leptonic quark decays





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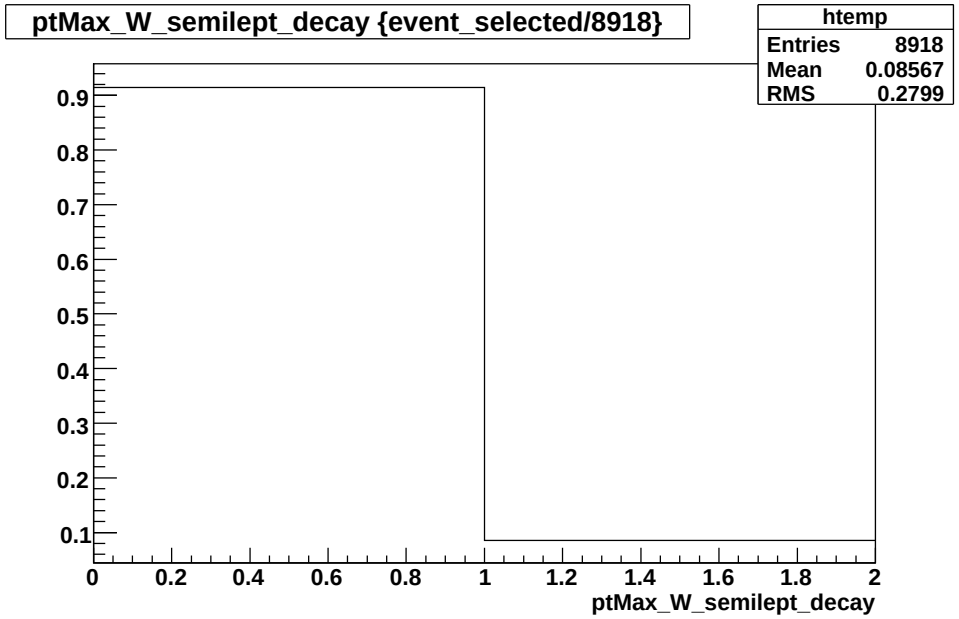
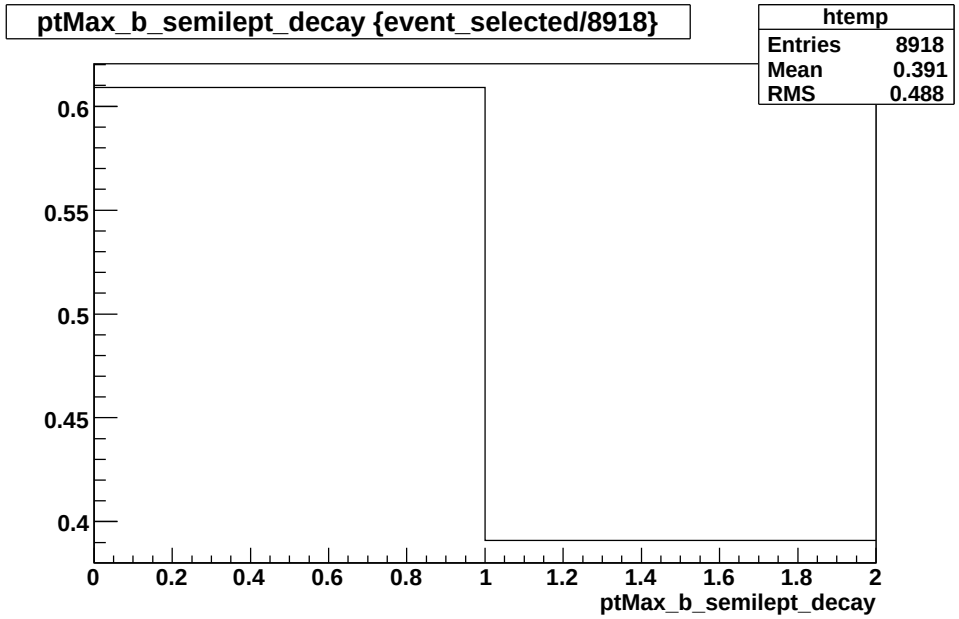
- no events with semi leptonic decays of W daughter quarks

fraction of events with semi leptonic decays

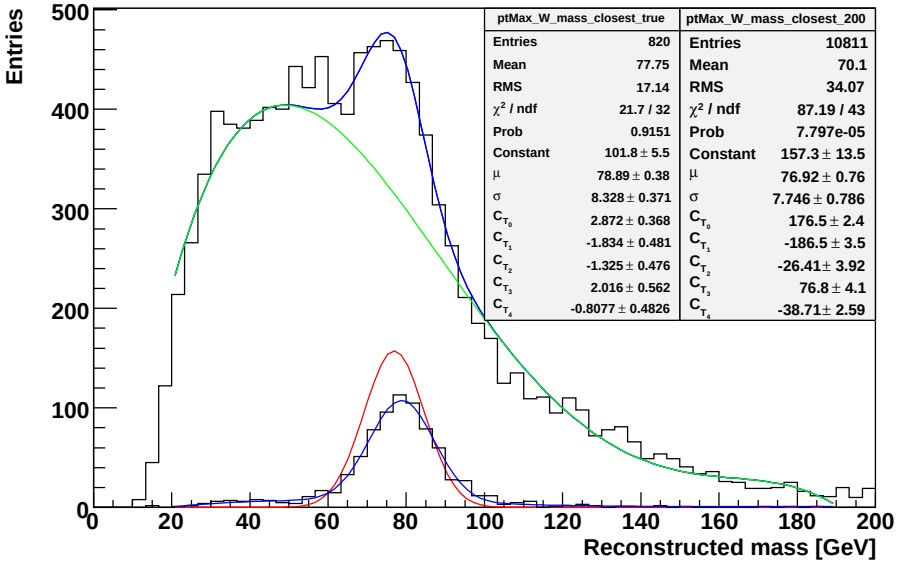


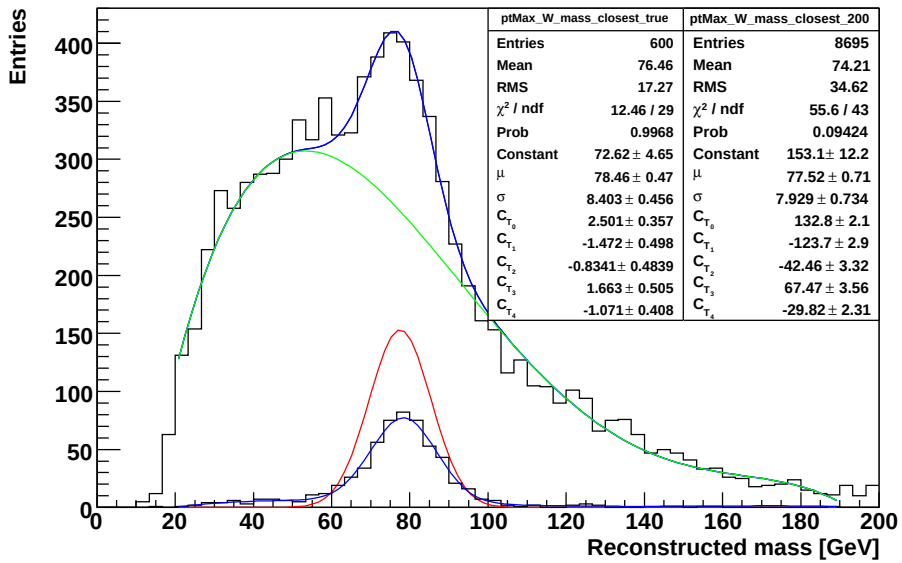
- fraction of events with semi leptonic decays of W daughter quark

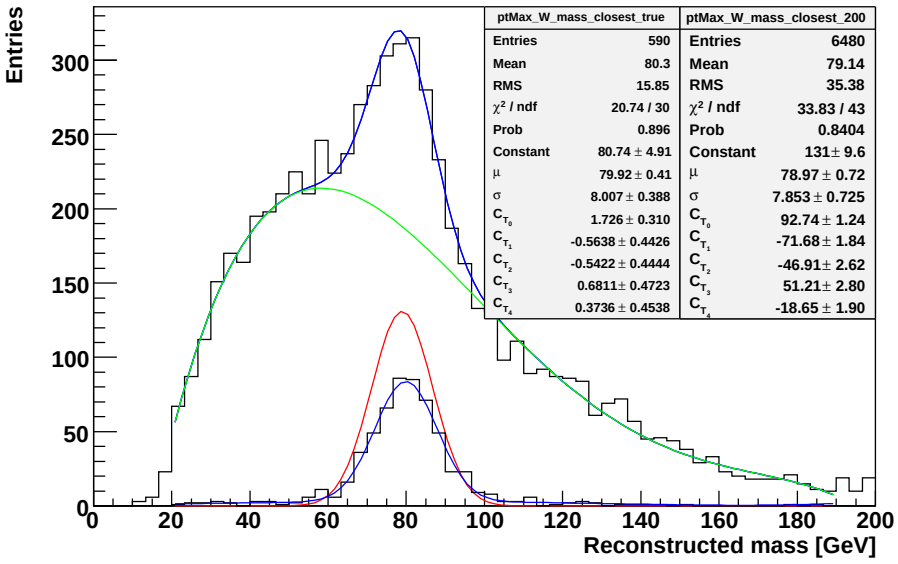


- fraction of events with semi leptonic b decays

W influence of jet pt cut for dR min W



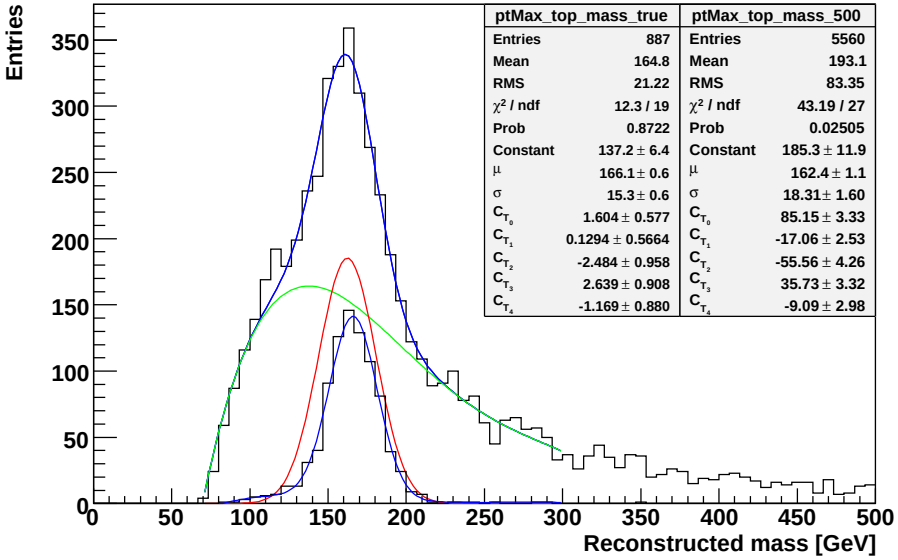




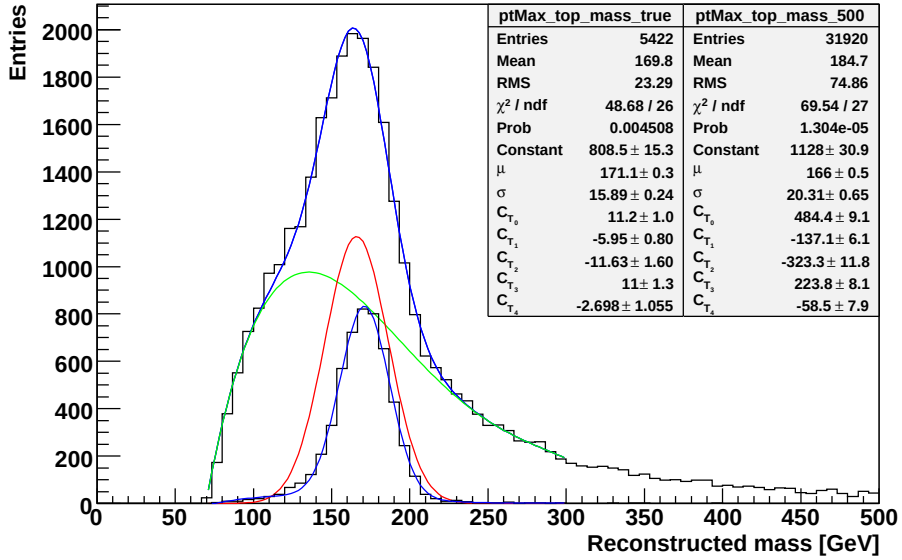
- W now with 3 different jet-pt selection cuts 3 jets 30/40/50 (top left / right / bottom) + 1 jet 20 GeV

ptcut	30	40	50
mean	76.92	77.52	78.97
matched	78.89	78.46	79.92

top influence of sample



- sample mc08.005568



- sample mc08.105200

quark sorting