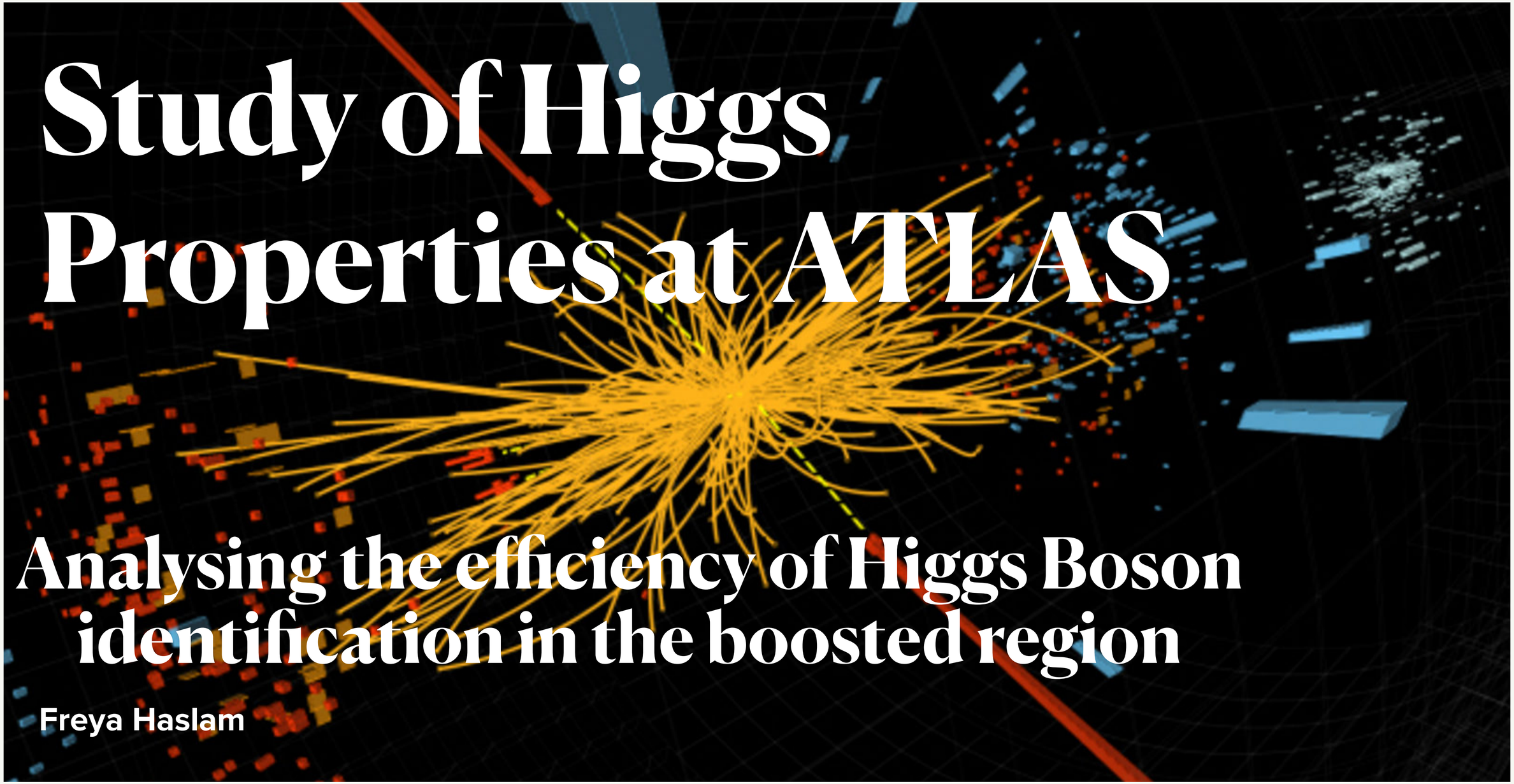


Study of Higgs Properties at ATLAS

Analysing the efficiency of Higgs Boson identification in the boosted region

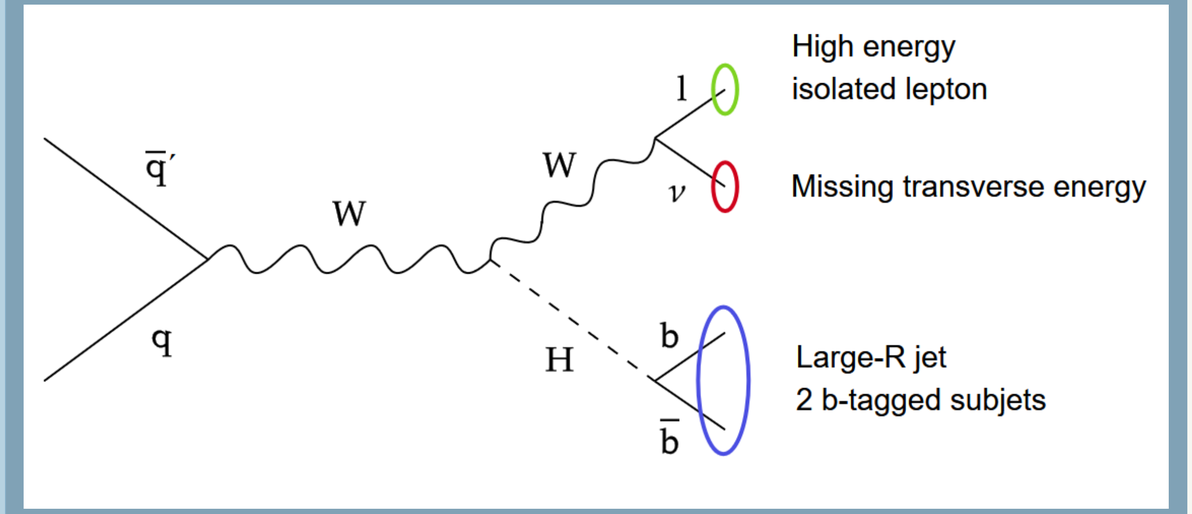
Freya Haslam

Why is this Necessary?

Background information

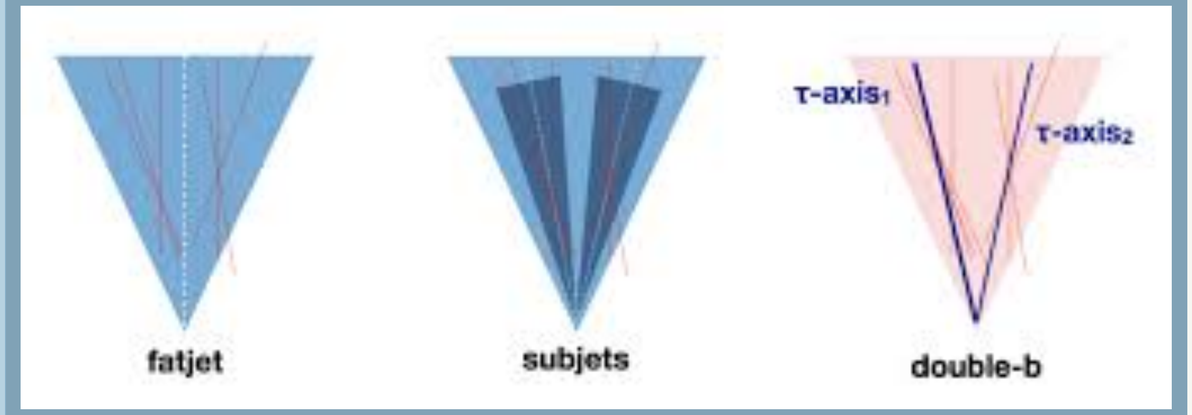
Higgs interactions

- Quark interaction
- Production of W boson
- Emission of Higgs
- Immediate decay into b quarks



Jets & B-Tagging

- The fat jet is a jet with a large radius produced from the decay of a particle.
- Inside of the fat jet there are subjets.
- If these subjets contain a b quark they are then b-tagged.
- The existence of 2 b-tagged jets is consistent with a Higgs decay.
- In the latest ATLAS study only the 2 leading sub jets were used to look at for b hadrons.



My Objective:

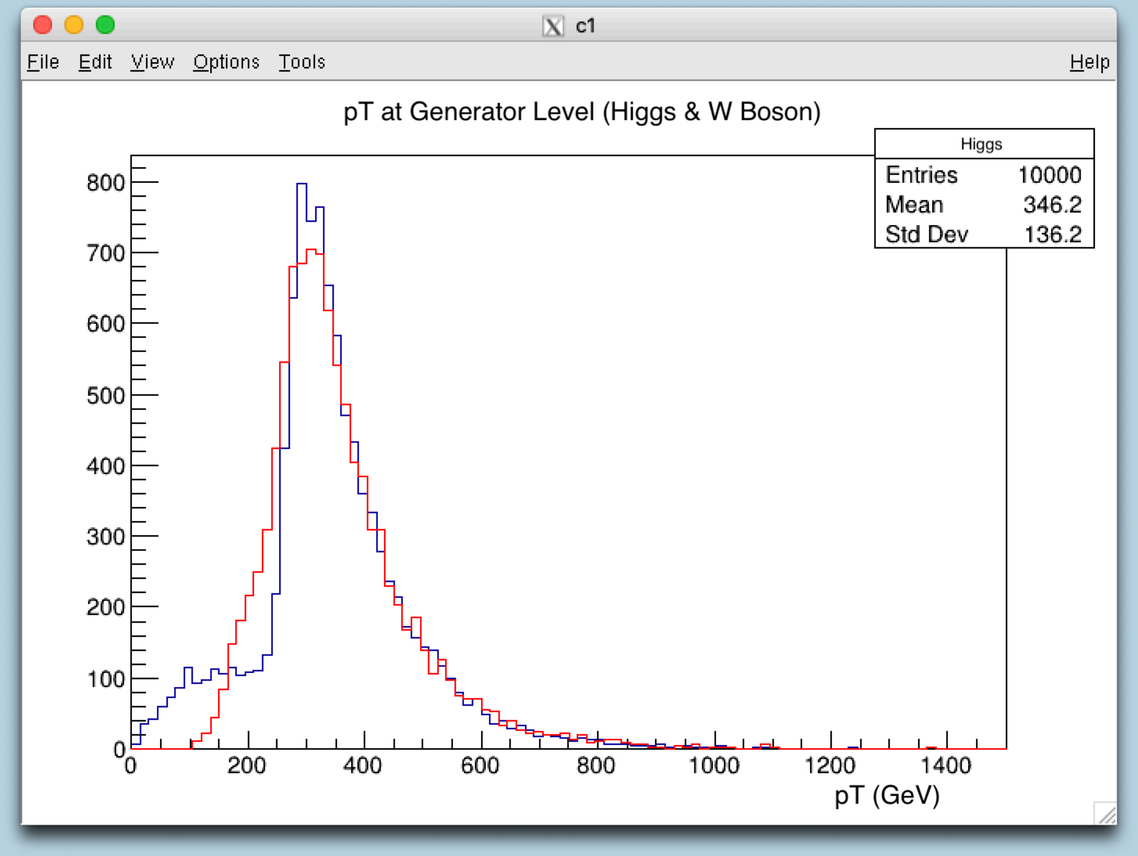
To look at the efficiency of Higgs identification and determine if it is necessary to look at the 3rd leading sub jet

My Method

- Look at pT, eta, phi of Higgs and W boson at generator level.
- Look at pT, eta, phi of the leading fat jet.
- Compare the pT, eta, phi of the 3 leading sub jets within the fat jet.
- Calculate the fraction of events with 2 sub jets, 3 sub jets, > 3 sub jets, an additional sub jet outside of the fat jet, an additional calorimeter jet outside of the fat jet.
- Calculate the fraction of events with 2 b-tagged jets in the 2 leading sub jets and compare with the number of events with 2 b-tagged jets in the 3 leading sub jets.

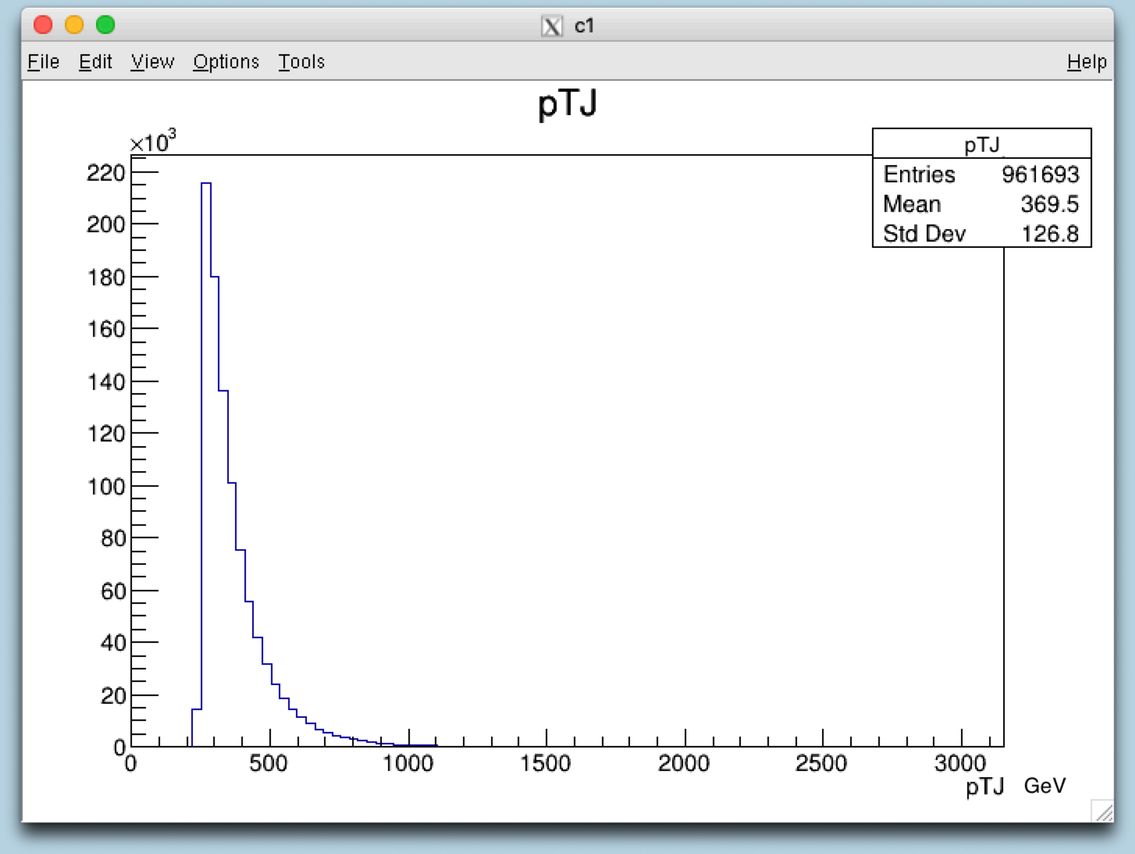
Results

pT of Higgs & W Boson

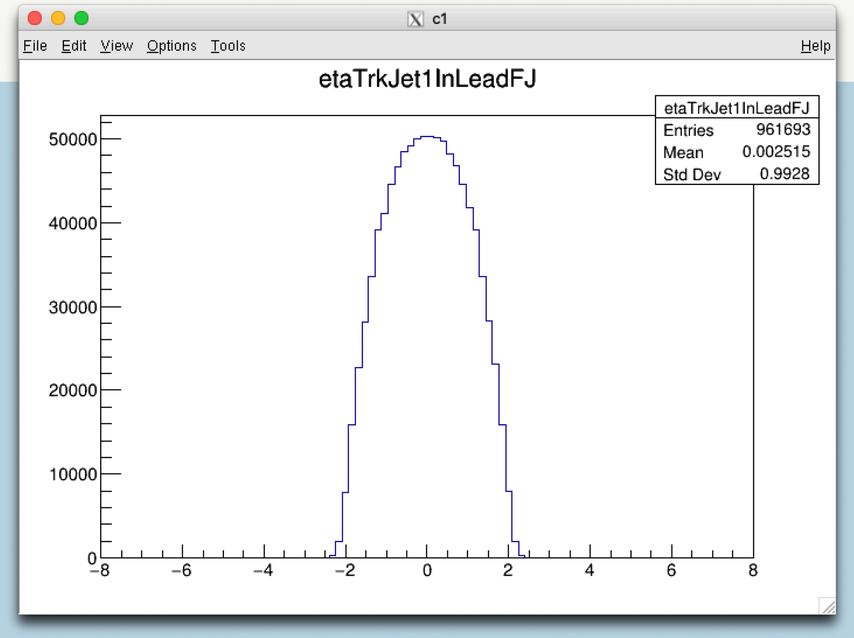


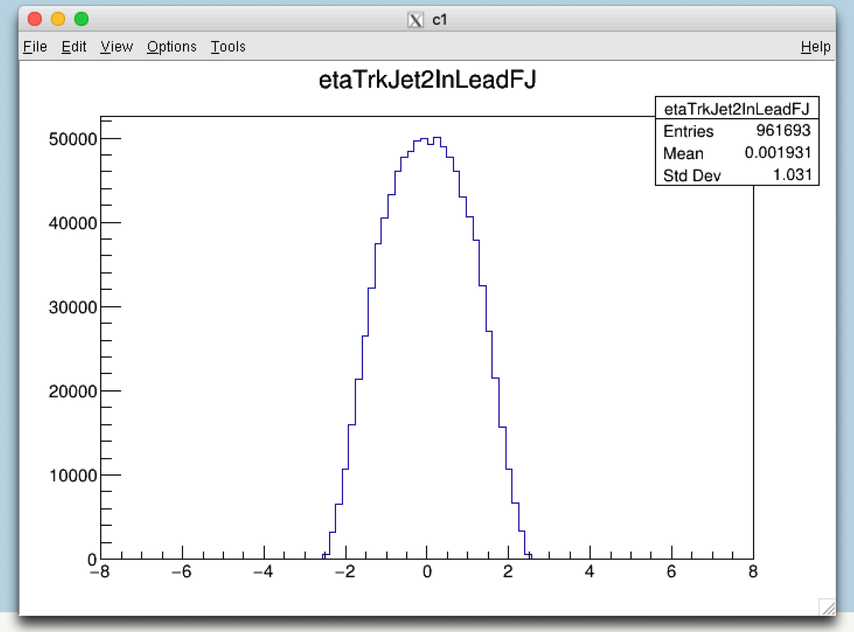
- Peak at 346 GeV
- Higgs data has an unexpected bump below 200 GeV

pT of Fat Jet

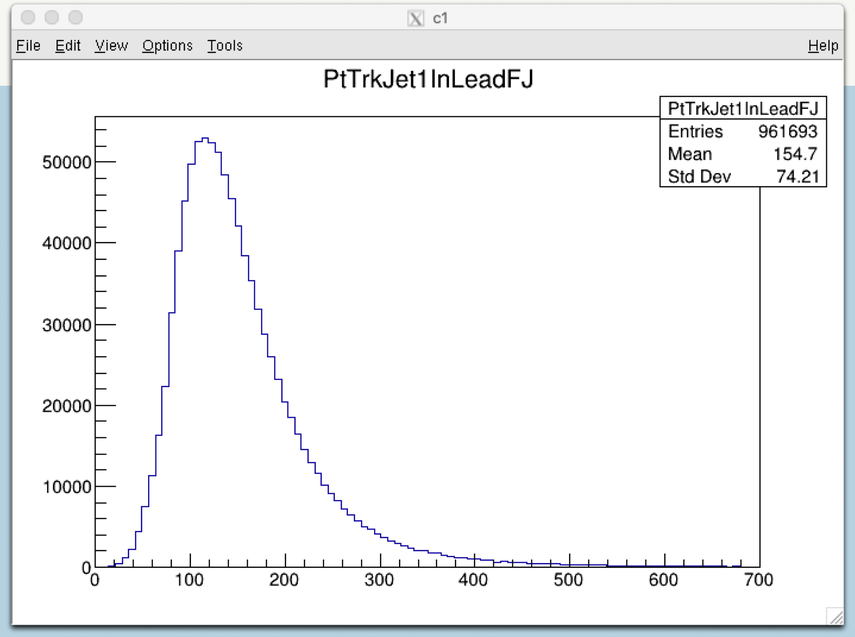


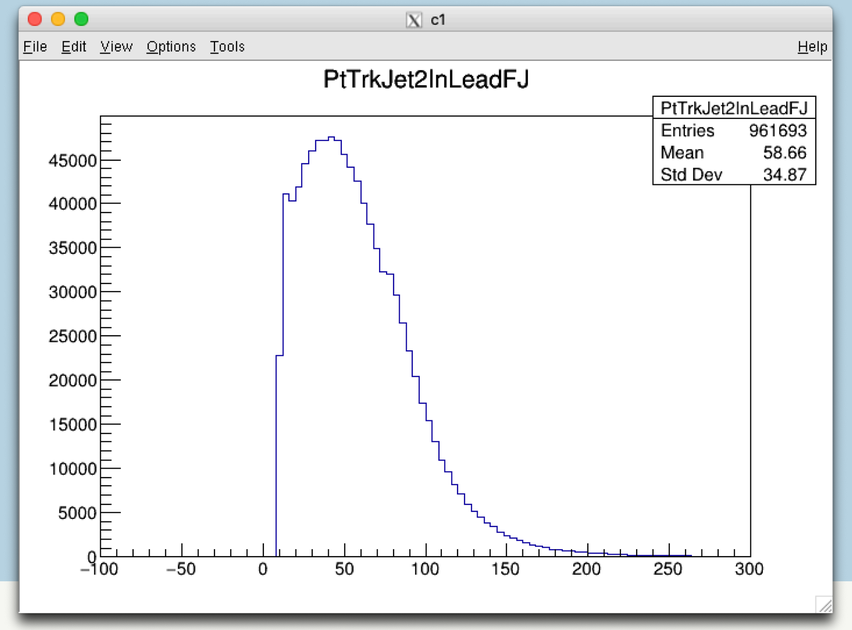
- Peak at 368 GeV
- Similar to pT of Higgs at generator level





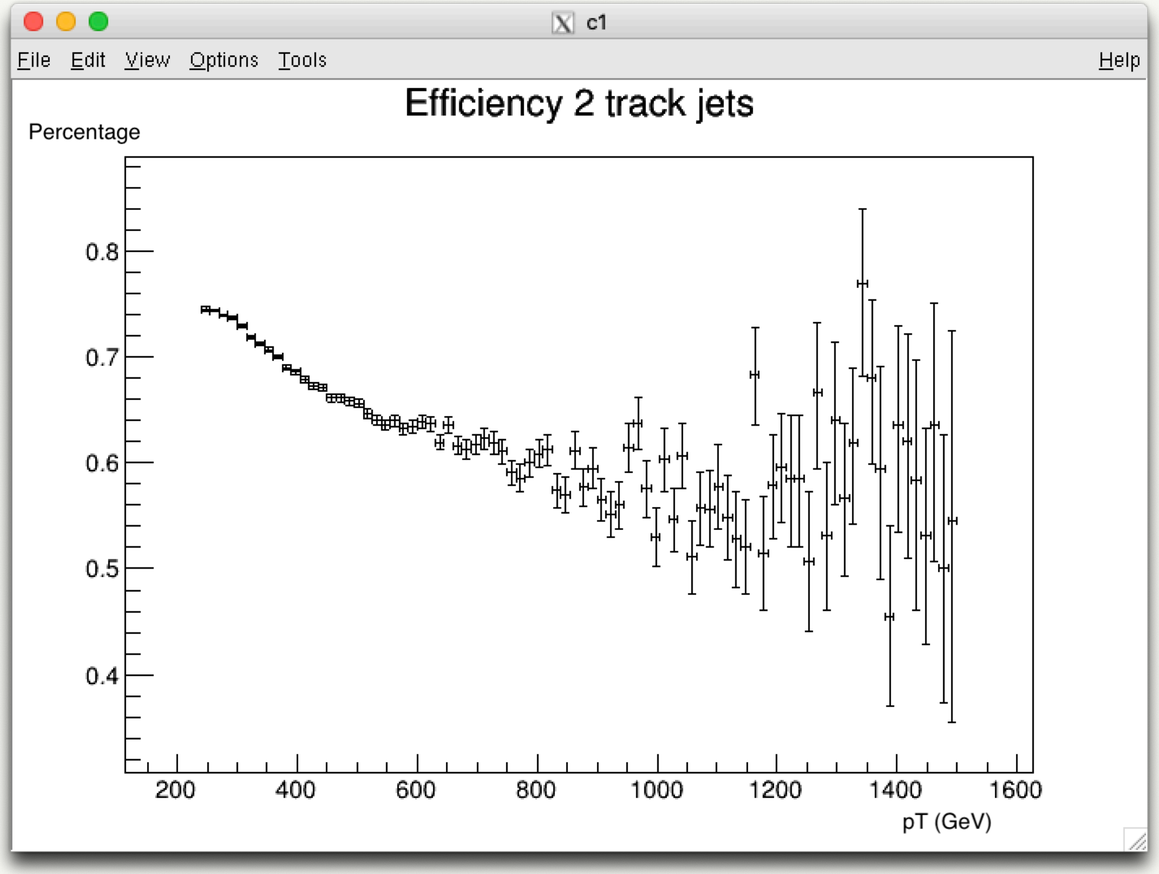
Pseudorapidity (eta)


c1
File Edit View Options Tools Help
PtTrkJet1InLeadFJ
PtTrkJet1InLeadFJ
Entries 961693
Mean 154.7
Std Dev 74.21
50000
40000
30000
20000
10000
0
0 100 200 300 400 500 600 700

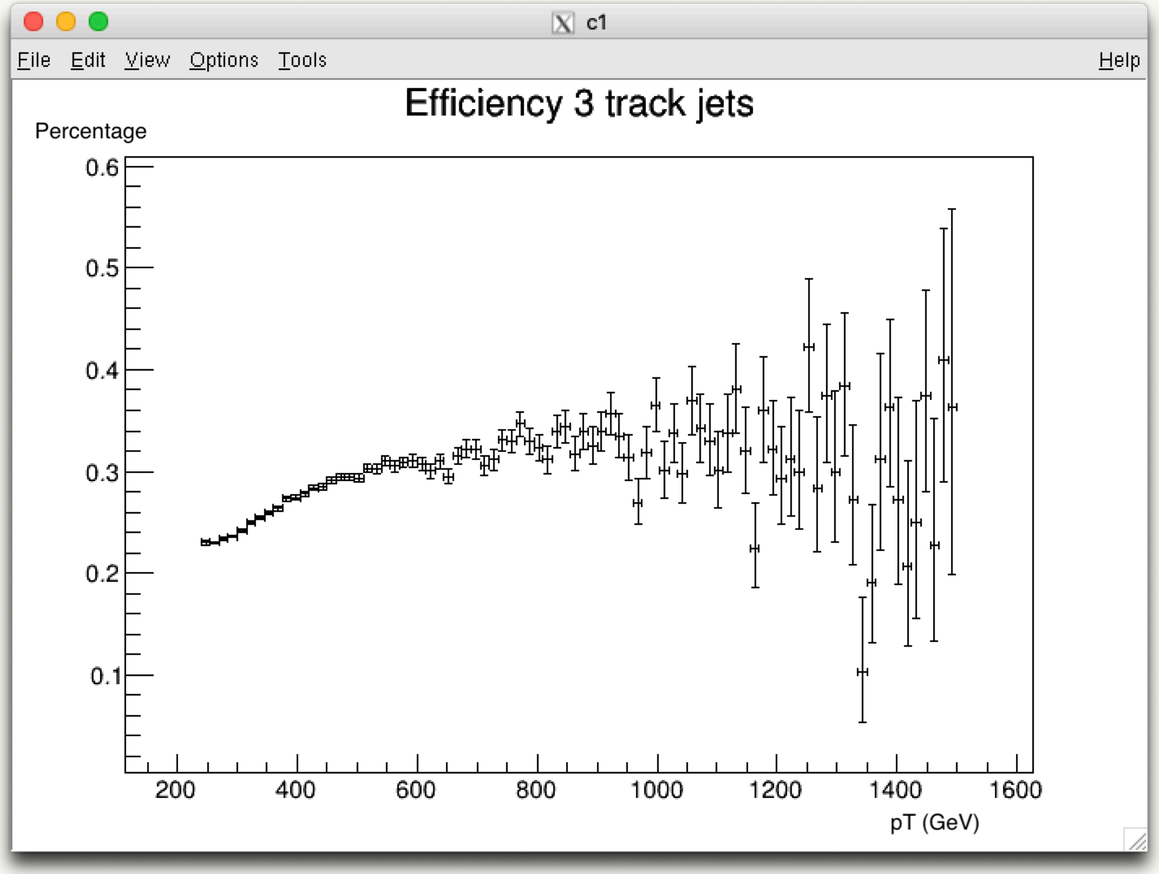

c1
File Edit View Options Tools Help
PtTrkJet2InLeadFJ
PtTrkJet2InLeadFJ
Entries 961693
Mean 58.66
Std Dev 34.87
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
−100 −50 0 50 100 150 200 250 300

pT

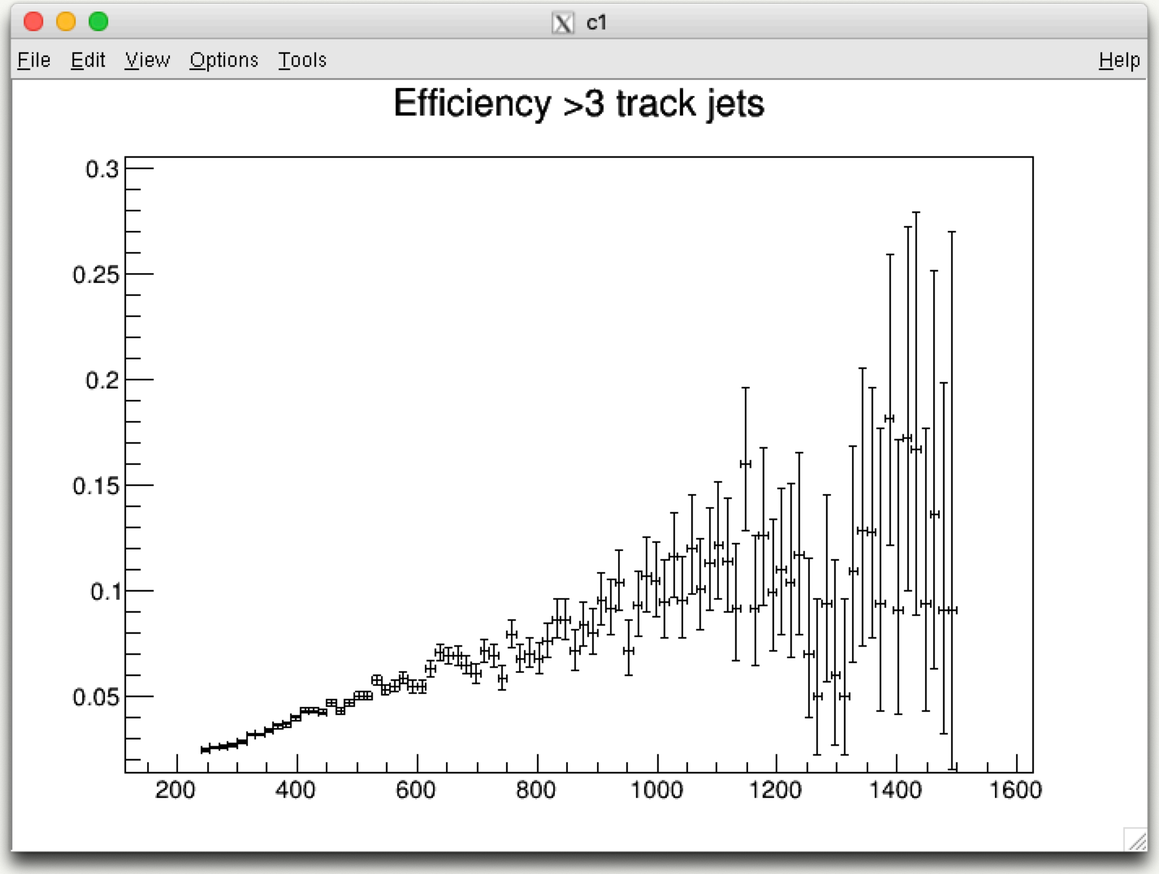
- Most but not all events have 2 sub jets
- Fraction of events decrease as energy gets higher.



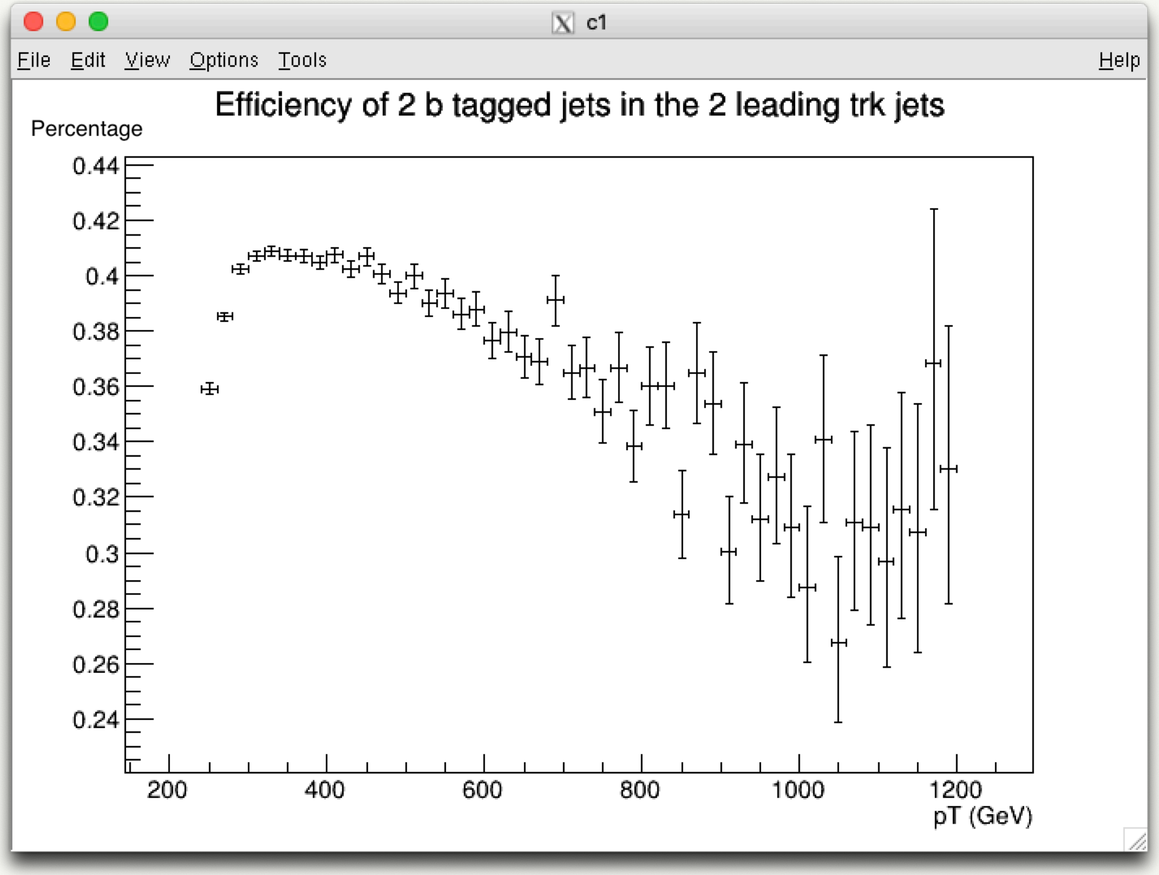
- Smaller fraction of events have 3 sub jets, as expected.
- Unlike with 2 sub jets the fraction increases as energy increases, but at high energies the fraction is still smaller than for 2 sub jets.



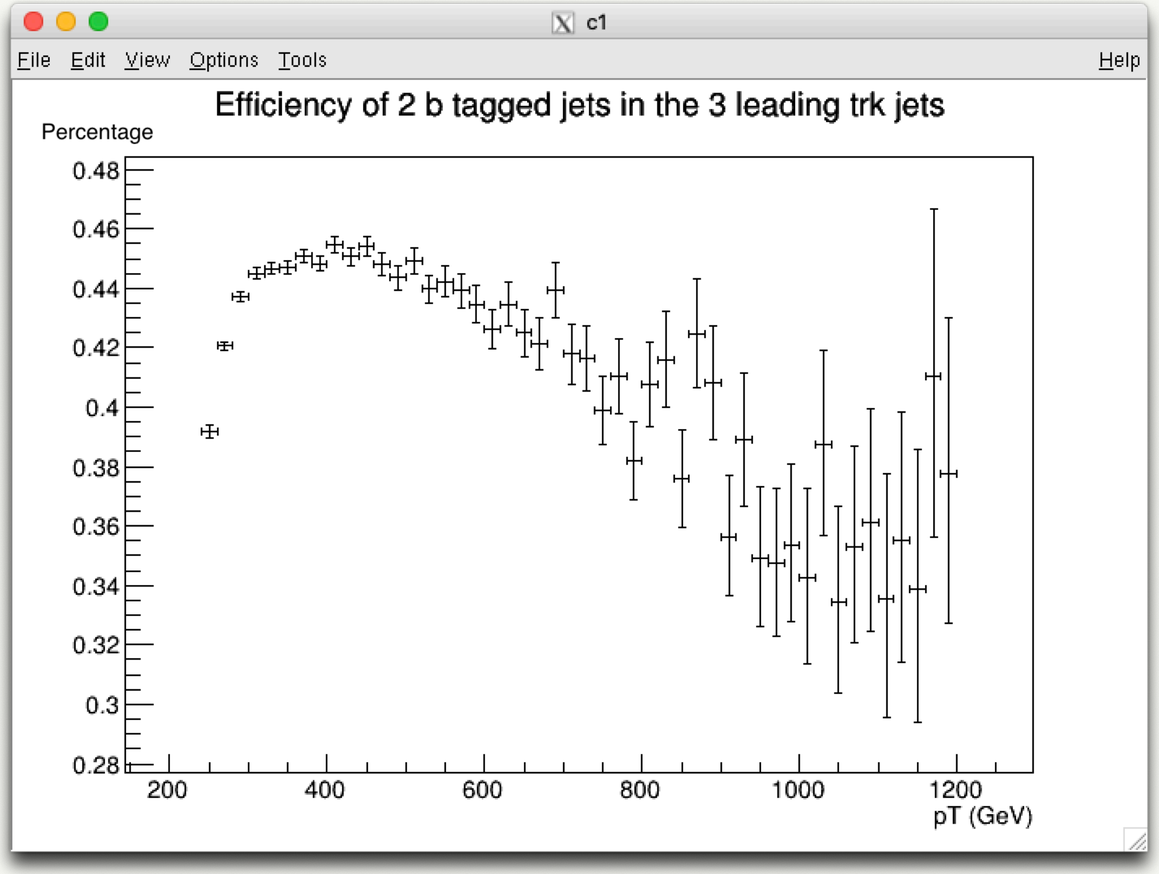
- Very very small percentage of events have more than 3 sub jets.
- Probability increases at higher energies but never more likely than 2 or 3 jets.



- Highest percentage ≈ 42%
- Energy where 2 b-tagged jets is most likely ≈ 350 GeV



- Previous highest percentage ≈ 42%
- Highest percentage after inclusion of 3rd sub jet ≈ 46%, only a 4% increase in events.



Questions?