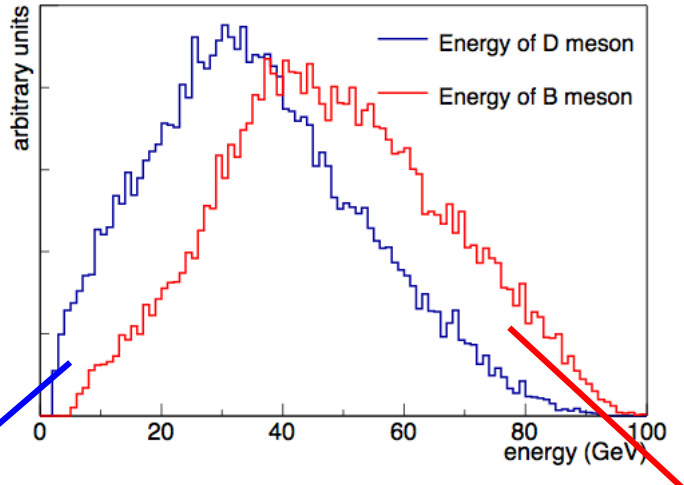
A quick look at possible flavor tag improvements

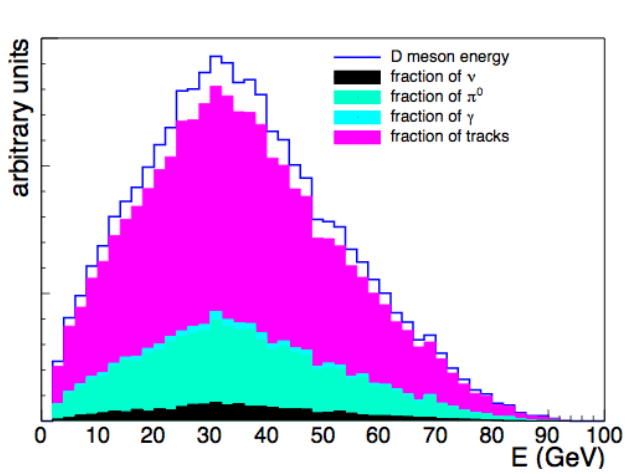
Jan Strube
Tohoku University

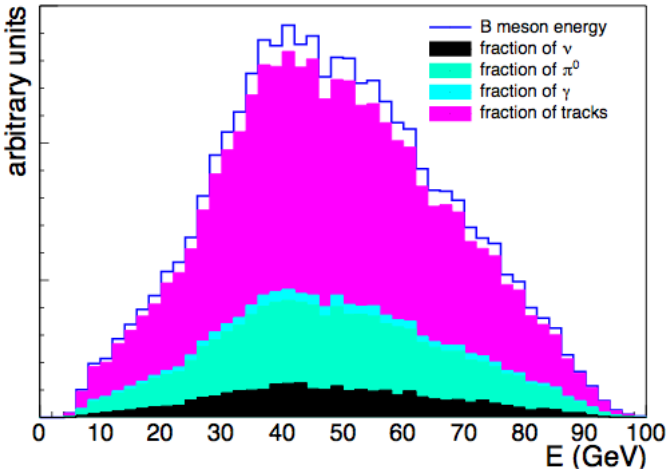
Premise

- One of the strengths of the ILC is c-tagging. Not possible at LHC.
- Biggest background to c-tagging is from b - either mis-reconstructed or too many neutrals.
- At Oregon we had looked into using pi0 to improve c-tagging. Studies were done with fast MC and before PFA and before LCFI, but showed potential.
- Is this still useful with PFA and LCFI?

Introduction -- MC Particles







Strategy

D Mesons: $m_D \sim 2$ GeV

B Mesons: $m_B \sim 5$ GeV

Fully reconstructed B mesons are easy to distinguish from D mesons. Neutrals aren't part of the vertex finding due to calorimeter resolution. → pt-corrected mass takes difference between B flight direction and jet axis for a minimal correction.

Explicitly adding neutrals might work better.

Analysis Outline

Added variables to the LCFIPlus ntuple.

a) raw vertex mass (tracks only)

b) pt-corrected mass

c) vertex mass + random 30% of true π^0 and γ

d) vertex mass + random 50% of true π^0 and γ

e) vertex mass + random 80% of true π^0 and γ

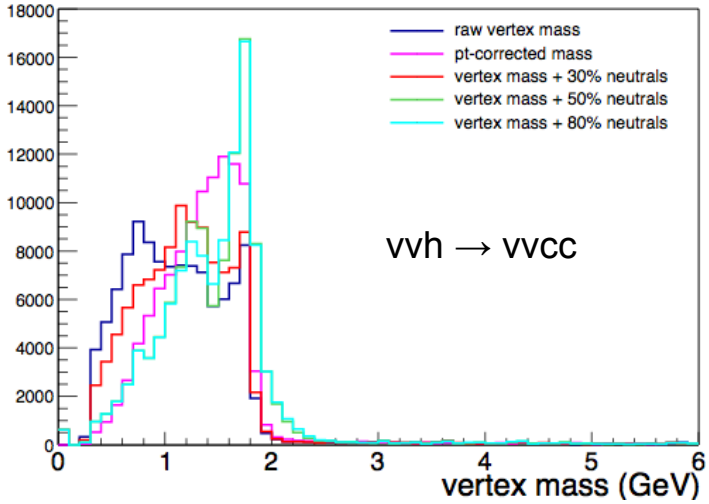
just to see if this is worthwhile pursuing.

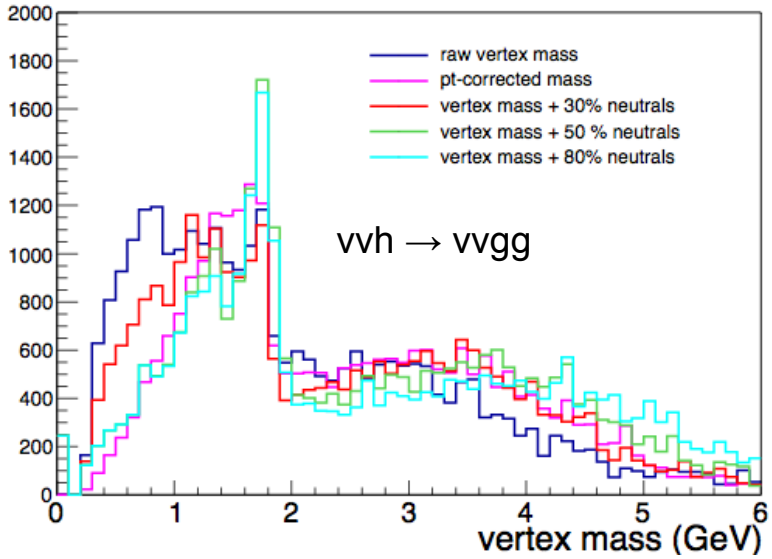
No confusion term added, i.e. different efficiency, always 100% purity.

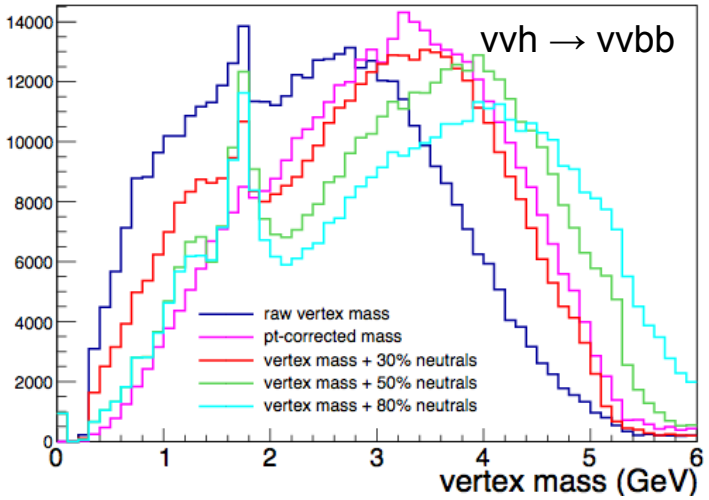
Reconstruction

- generated nu nu H events with explicit decays to b, c, or g
- modified LCFIPlus to add cheated variables: Find the MC Truth hadron belonging to the vertex, add a random 30%, 50%, 80% of its daughter photons and π^0 to the vertex mass
  - Very simplistic: everything added to the closest secondary vertex. Nothing added to daughter vertices.
- Added new variables to flavor tag training.

Vertex Mass


raw vertex mass
pt-corrected mass
vertex mass + 30% neutrals
vertex mass + 50% neutrals
vertex mass + 80% neutrals
vvh → vvcc
vertex mass (GeV)

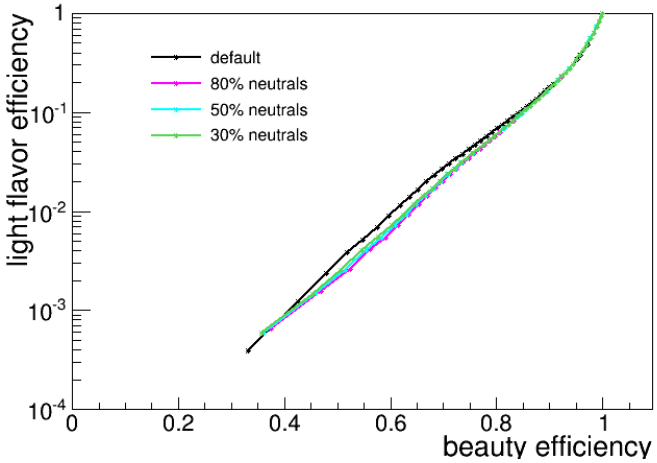

raw vertex mass
pt-corrected mass
vertex mass + 30% neutrals
vertex mass + 50 % neutrals
vertex mass + 80% neutrals
vvh → vvgg
vertex mass (GeV)

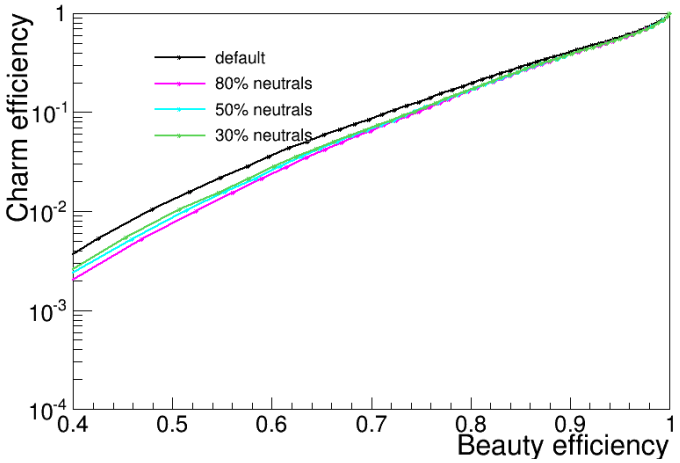

vvh → vvbb
raw vertex mass
pt-corrected mass
vertex mass + 30% neutrals
vertex mass + 50% neutrals
vertex mass + 80% neutrals
vertex mass (GeV)

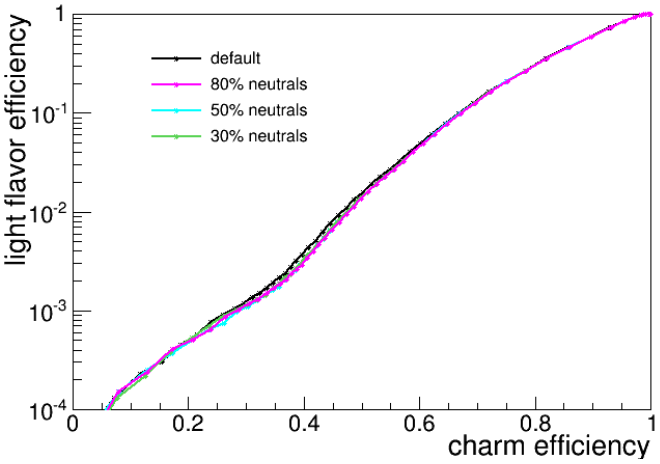
Vertex Mass observations

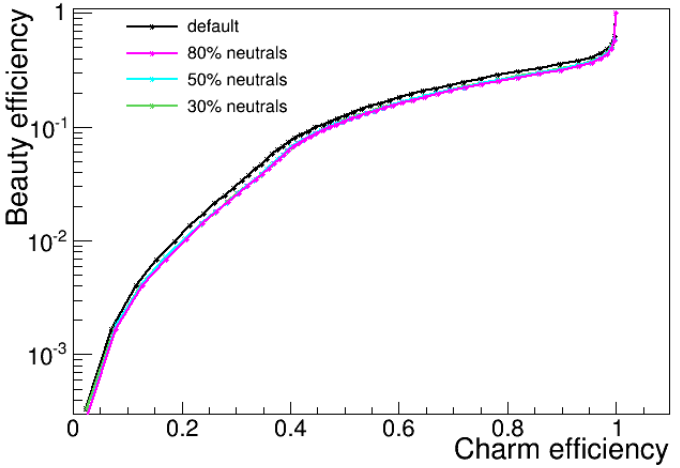
- Adding a random 30% of the true photons results in a smaller vertex mass than obtained from the pt-corrected mass
- Getting at least ½ of the photons from the decay improves the vertex mass significantly over the pt-corrected mass
- There is a clear peak in the vertex mass in B events, which looks like it comes from D mesons. This peak is much less pronounced in the pt-corrected mass.

Results of Flavor Tag Training





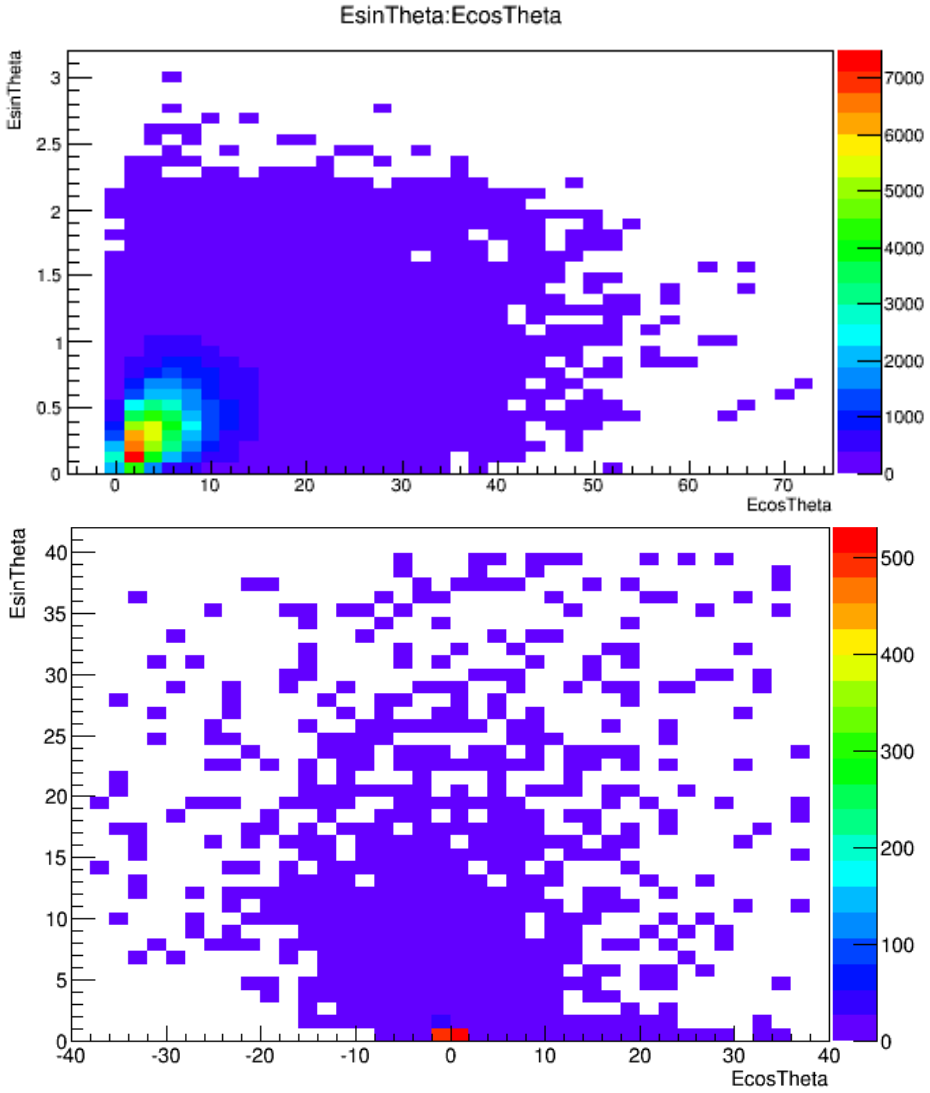




Distribution of pi0 wrt B decay

Distribution of pi0 along B decay length should be significantly different from other pi0

This is MC only. Plot needs to be made with reconstructed pi0 and vertex



Summary

- Charm tagging is a key part of the ILC reconstruction
- b contamination is the largest source of error in c-tagging
- Both, c contamination to b-tagging and b contamination to c-tagging can be significantly reduced by improving upon the pt-corrected vertex mass
- First look shows promise, next step is to use reco rather than MC to add neutrals.