

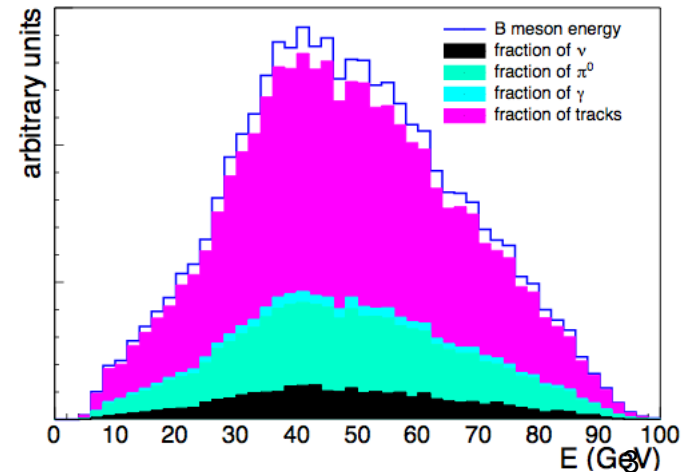
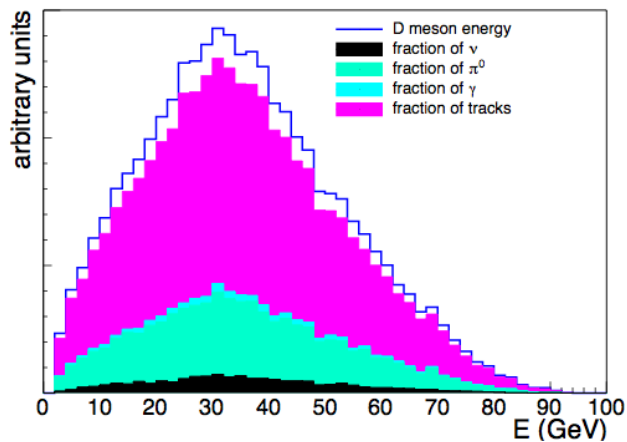
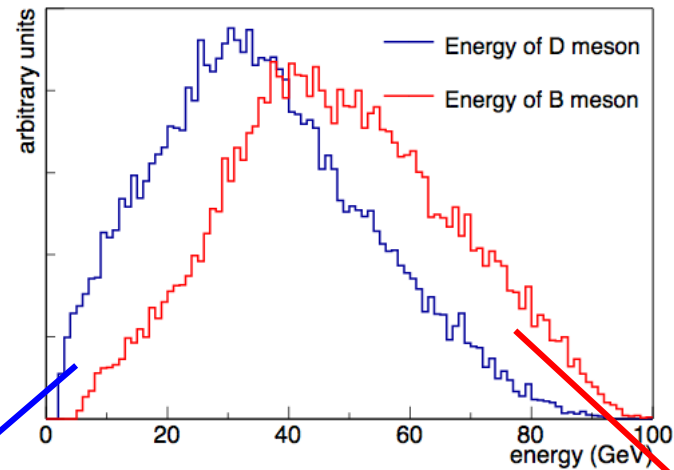
# **A quick look at possible flavor tag improvements**

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  $\pi^0$  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:  $m_D \sim 2 \text{ GeV}$

B Mesons:  $m_B \sim 5 \text{ GeV}$

Fully reconstructed B mesons are easy to distinguish from D mesons. Neutrals aren't part of the vertex finding due to calorimeter resolution.  $\rightarrow$  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  $\pi^0$  and  $\gamma$

d) vertex mass + random 50% of true  $\pi^0$  and  $\gamma$

e) vertex mass + random 80% of true  $\pi^0$  and  $\gamma$

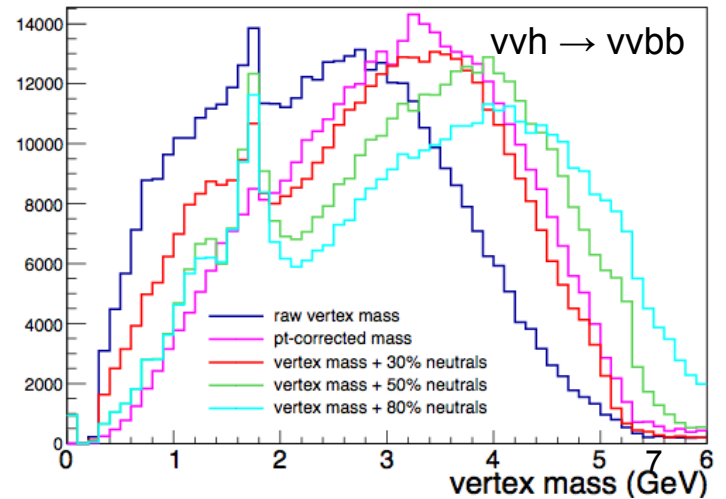
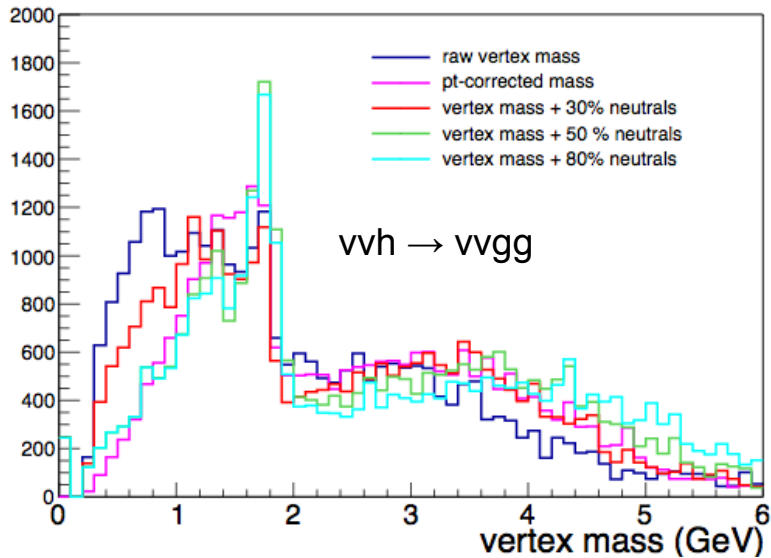
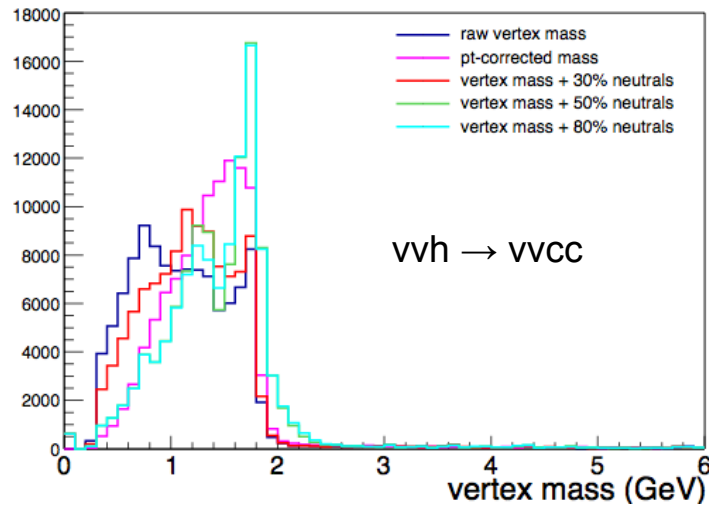
just to see if this is worthwhile pursuing.

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  $\pi^0$  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

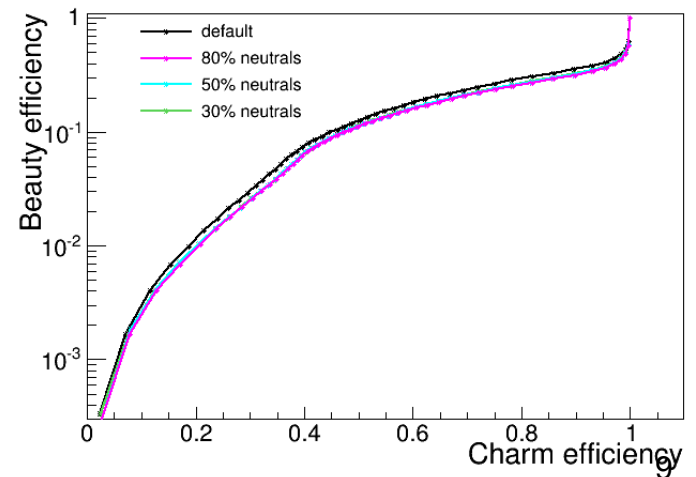
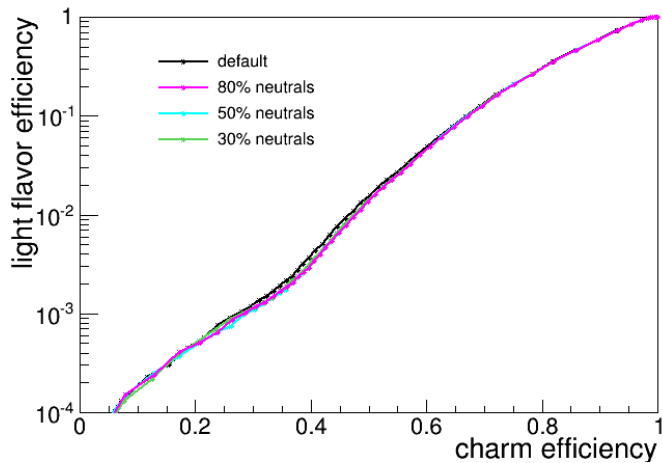
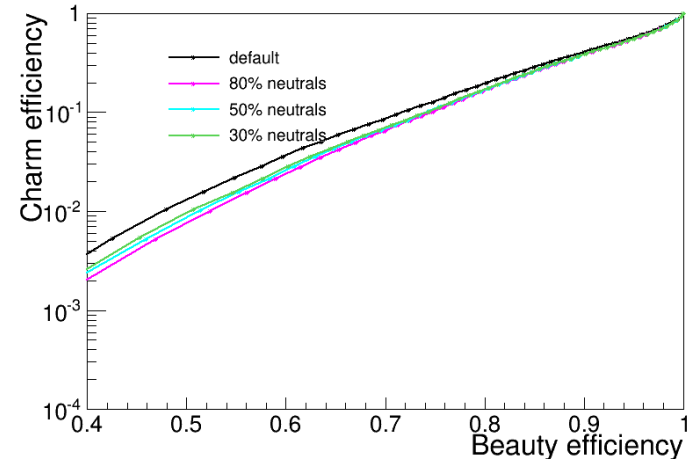
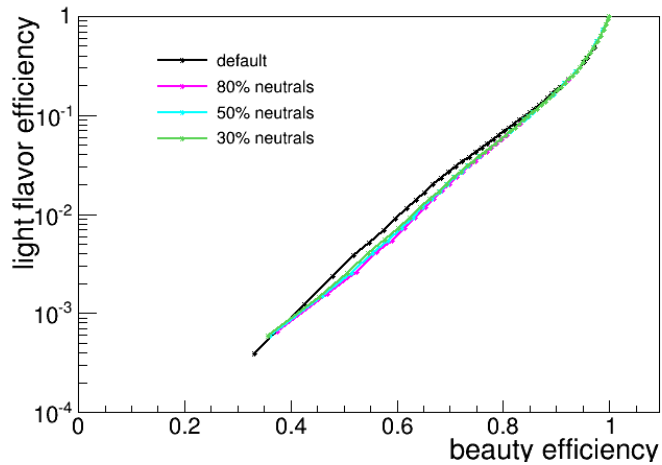


# Vertex Mass observations

- Adding a random 30% of the true photons results in a smaller vertex mass than obtained from the pt-corrected mass
- Getting at least  $\frac{1}{2}$  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.



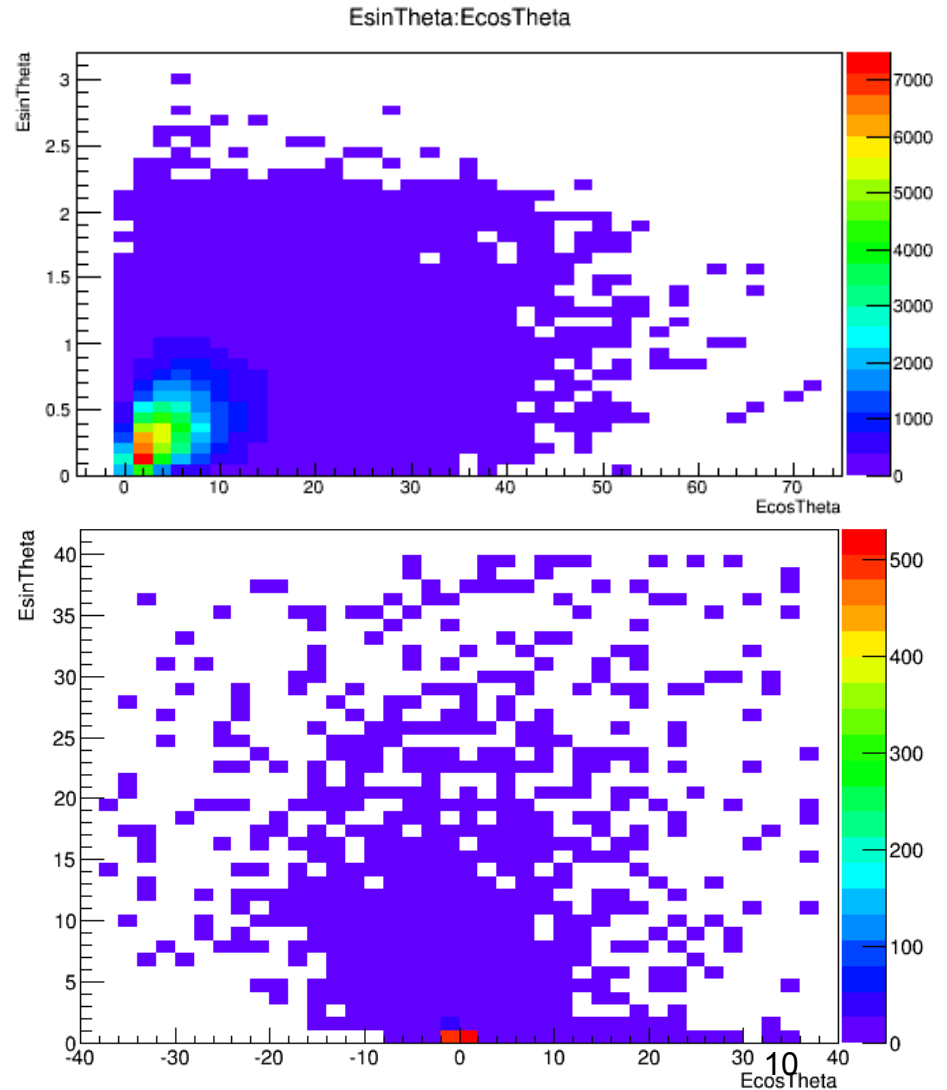
# Results of Flavor Tag Training



# Distribution of $\pi^0$ wrt B decay

Distribution of  $\pi^0$  along B decay length should be significantly different from other  $\pi^0$

This is MC only. Plot needs to be made with reconstructed  $\pi^0$  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  $p_T$ -corrected vertex mass
- First look shows promise, next step is to use reco rather than MC to add neutrals.