Tau decay mode identification

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Outline

- Objective
- Starting point
- Improvements
- Plans

Objective

- Provide tau decay mode identification with optimized efficiency and purity for use in the tau polarization measurement.

- Deliverable: Reconstructed taus with reconstructed daughters (including the pi0's)

Starting point – decay modes considered

- Leptonic: e nu nu, gamma e nu nu
- Leptonic: mu nu nu, gamma mu nu nu
- pi nu, k nu
- rho nu
- a1 nu, a1-> 3pi+/-
- a1 nu, a1 -> 2pi0pi+/-
- other: lump together k*, W, radiative

Starting point – data sample

- Use the SLAC tautau sample to train, so full DESY sample usable for analysis.

- Use the PFA reconstruction + lepton ID to produce tau jets and filter data. So far only looking at signal events, so use similar cuts as ILD.(Should result in reasonable backgrounds from full SM sample)

- Improved reconstruction for event selection not an option – would need to be run over full SM sample.
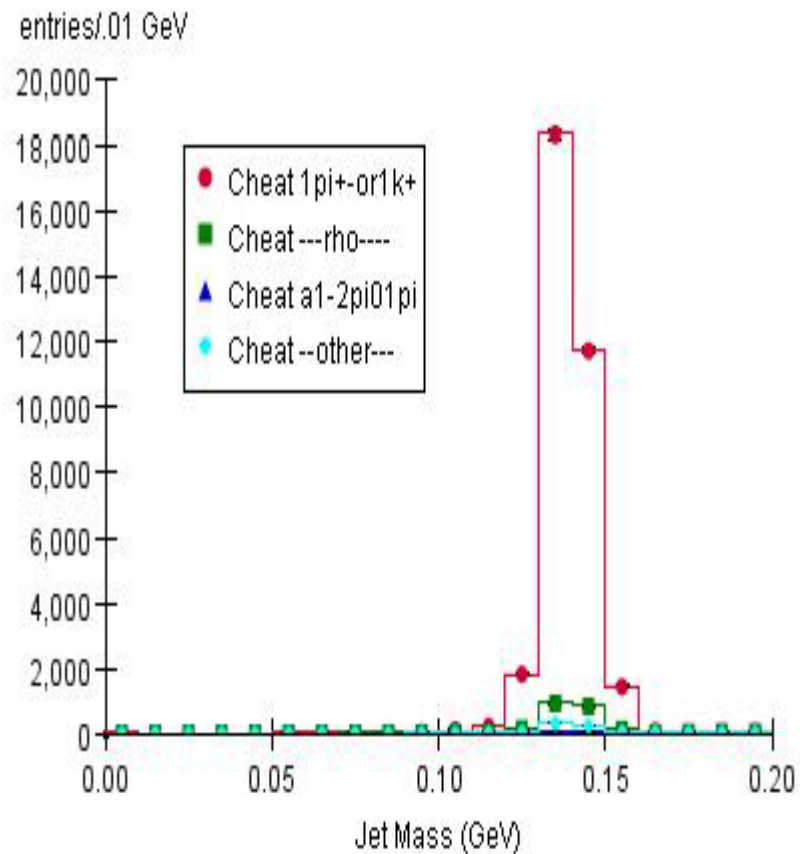
Data sample

1 – Make tau clusters

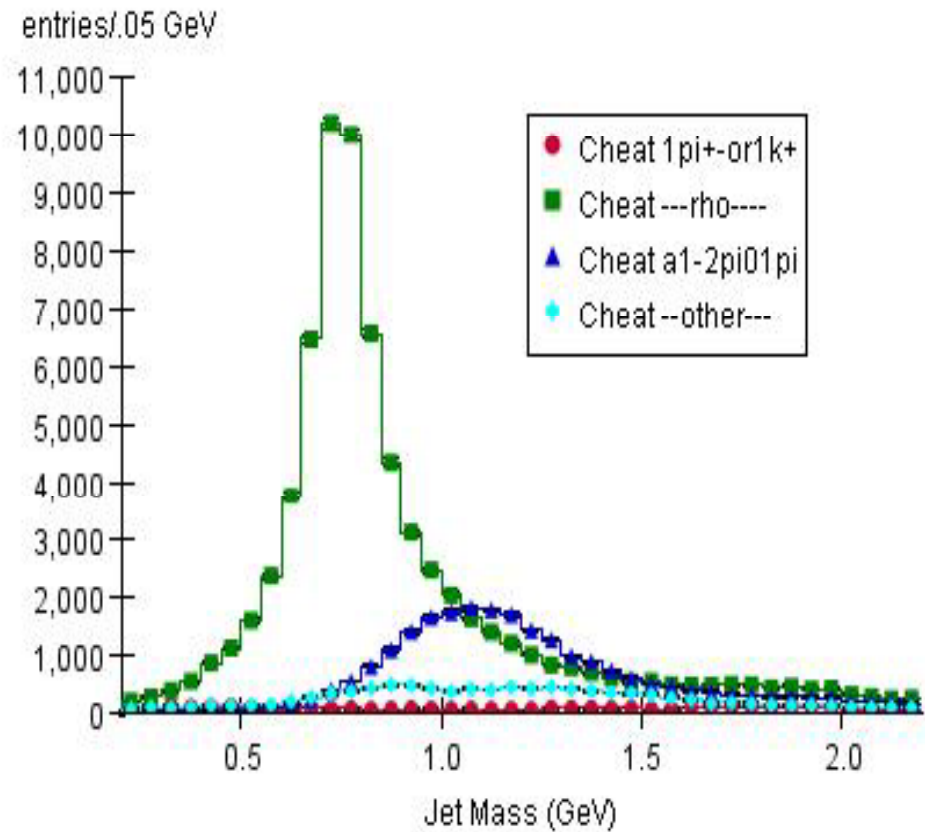2 – Cut on tau clusters

19% of events accepted
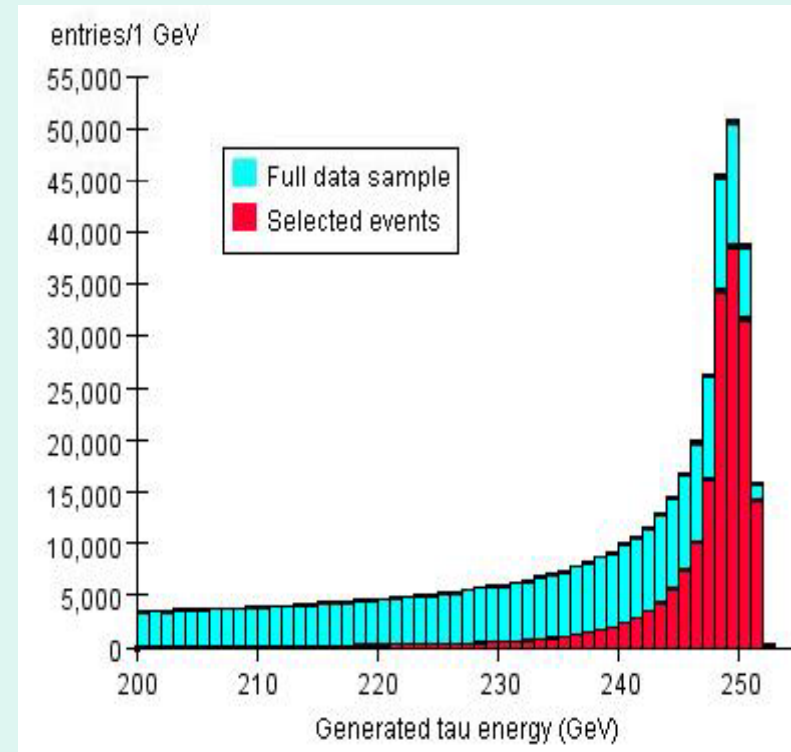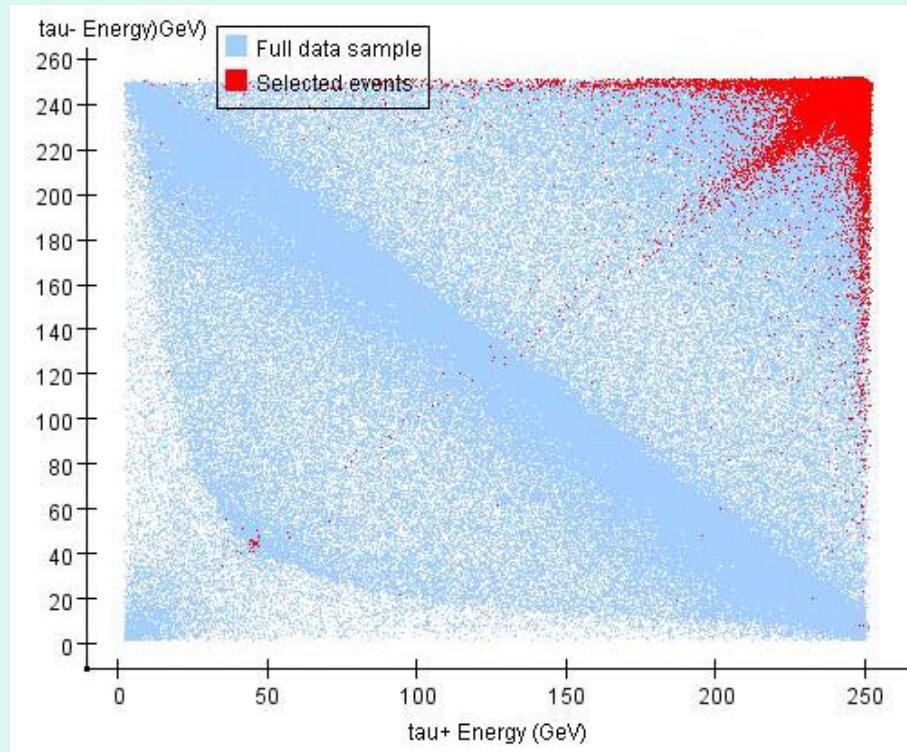
Tau cluster mass

Starting point – mode ID

- Using only the PFA reconstruction and lepton ID, try to separate the decay modes.

Decay mode	efficiency	purity
e leptonic	0.875*	0.950
mu leptonic	0.994	0.990
pi or k	0.901	0.826*
rho	0.729	0.804
a1 -> pi 2pi0	0.537	0.567
a1 -> 3pi	0.936	0.861
other	0.561	0.450

Improvements

- So far, the only substantial improvement is in the electron ID.

- A few other cuts in neutral acceptance have been tried, but it is clear that separating the 1-prong modes will require a new reconstruction.

- Working on it.

Improvements – where we are now

Decay mode	# Generated	# recon IDed	# correct IDs	efficiency	purity
e leptonic	57014	58129	56569	0.992*	0.973*
mu leptonic	55819	56249	55613	0.996	0.989
pi or k	36924	35972	33189	0.899	0.923*
rho	84212	72790	61171	0.726	0.840
a1 -> pi 2pi0	29595	27283	16281	0.550	0.597
a1 -> 3pi	28026	29372	25823	0.921	0.879
other	32156	43951	21471	0.668	0.489

Plans

- Write new reconstruction for these special events.

- Find the pi0's! Even if the mode separation eff/pur was sufficient, still need the pi0 4-vectors for the polarization analysis.

- Hope to have usable algorithm next week.