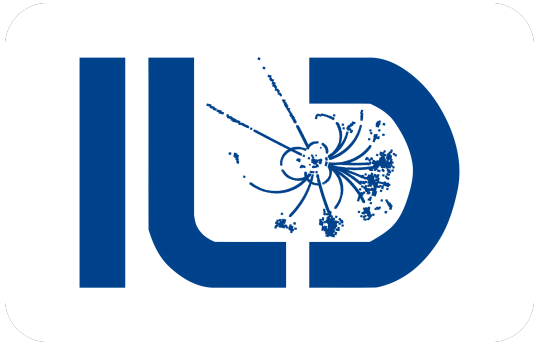
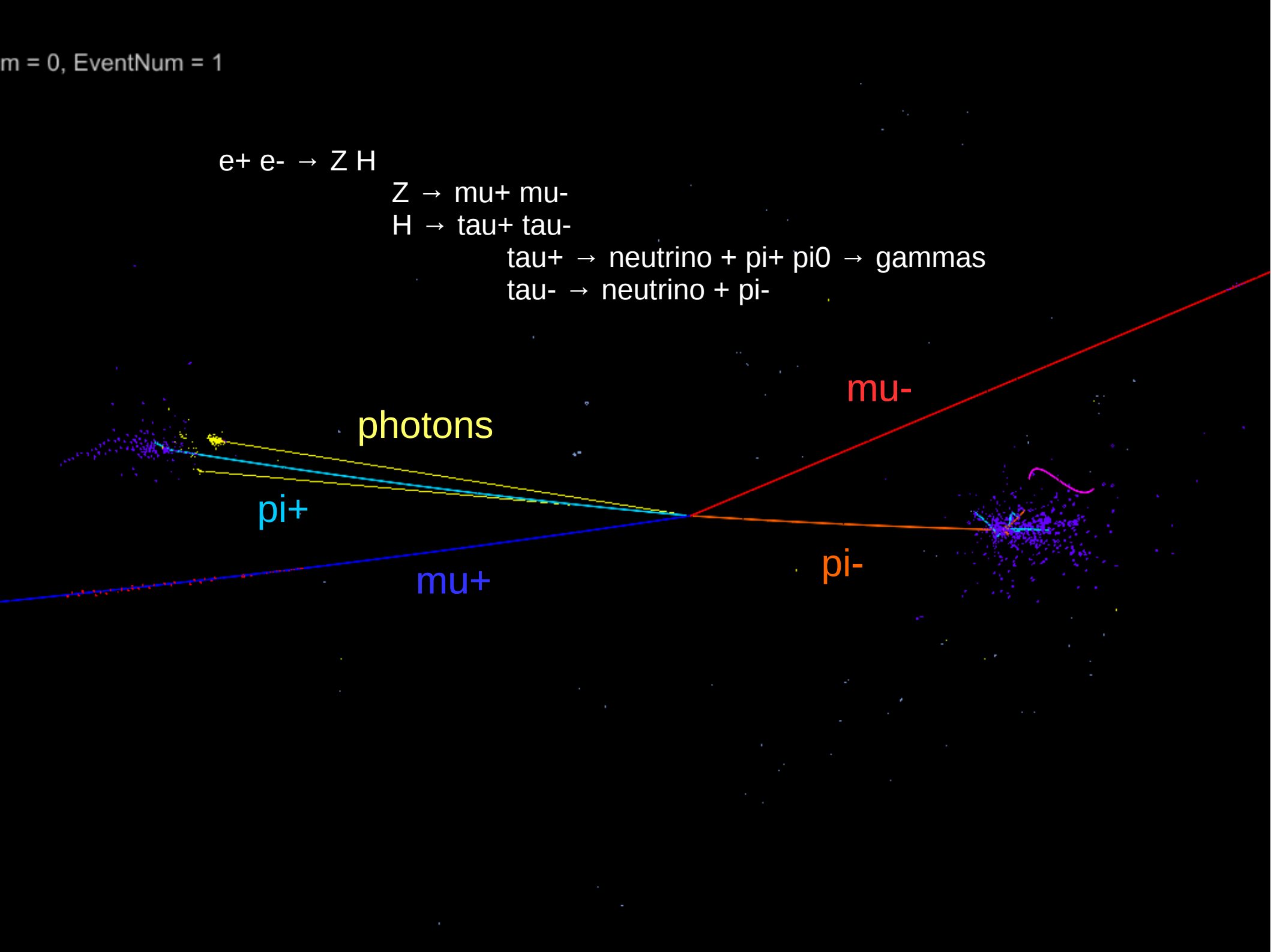


tau lepton reconstruction

Daniel Jeans, KEK
ILD sw/analysis premeeting Feb 2018


m = 0, EventNum = 1
e+ e- → Z H
Z → mu+ mu-
H → tau+ tau-
tau+ → neutrino + pi+ pi0 → gammas
tau- → neutrino + pi-
photons
mu-
pi+
pi-
mu+

tau finding:

decide which reconstructed PFOs are tau decay daughters

typically:

find a narrow, low-mass jet

with 1 or 3 charged tracks

and | total charge | = 1

this is quite process dependent:

e.g.

tau + N jets final state

rather more difficult that

simple di-tau events

probably not linked to detector performance at 1st order

such tools do exist in

MarlinReco/Analysis/TauFinder/

TaJetClustering → Taikan Suehara

"mainly targetted to obtain isolated tau from jet environment"

TauFinder → Astrid Muennich

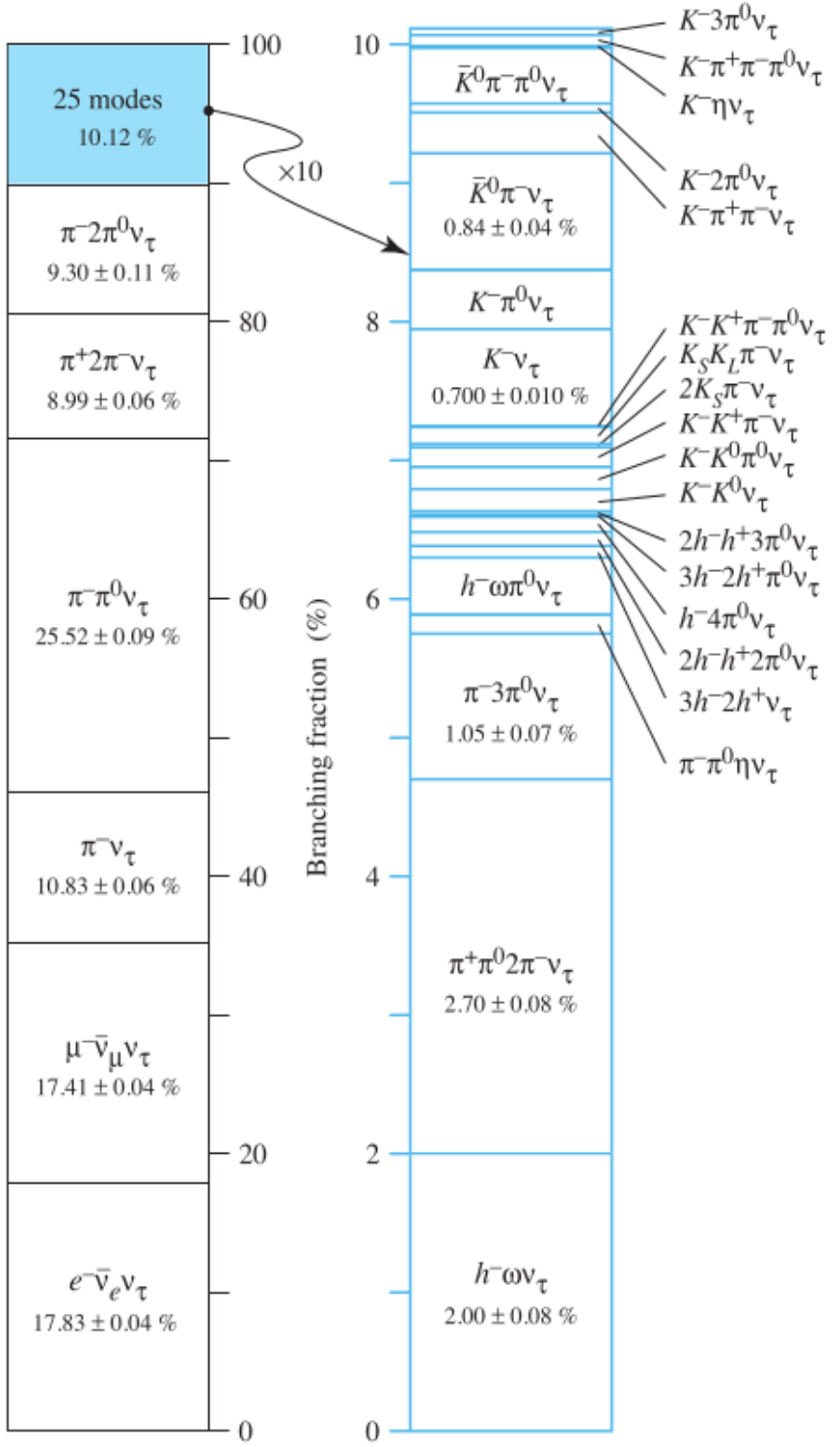
I have (almost?) never used them,

nor seen (m)any recent presentations which do

my feeling is that more
- tau decay mode specific finding
- will be more helpful
- than generic algorithms
- for > 90% of tau decays

possible thanks to detector granularity
- → Particle Flow

look for particular decay modes
- single prong: electron, muon, charged pi/K
- vertices with 3 (5) charged pions
- neutral pion, eta, K, omega, ...



in my ZH, H→tau tau analysis,

I look only for hadronic single prong decays, with 0 or 1 pi0s

for Z → e, mu:

first find Z, then take most energetic remaining charged PFOs as tau seeds

attempt to combine photons into pi0

match pi0, remaining photons to closest tau seeds

with some mass constraints

for Z → hadrons:

look for isolated charged PFOs → tau seeds

attempt to combine nearby photons into pi0

match pi0, remaining photons to closest tau seeds

with some angular, mass constraints

rest of event assigned to Z

to use taus as polarimeters
we must get spin sensitive information from them

key points:
- identify decay mode
- measure momentum of each constituent particle
charged hadron, lepton, pi0, ...

precision on charged particles' impact parameters
→ powerful tool to fully reconstruct tau momentum

for multi-prong decays,
precise vertexing

full tau reconstruction really needs particle flow:
not just total jet energy
but properties of each particle in jet

→ e.g. combining 2 photons into 1 PFO
is benign for JER
is not good for tau

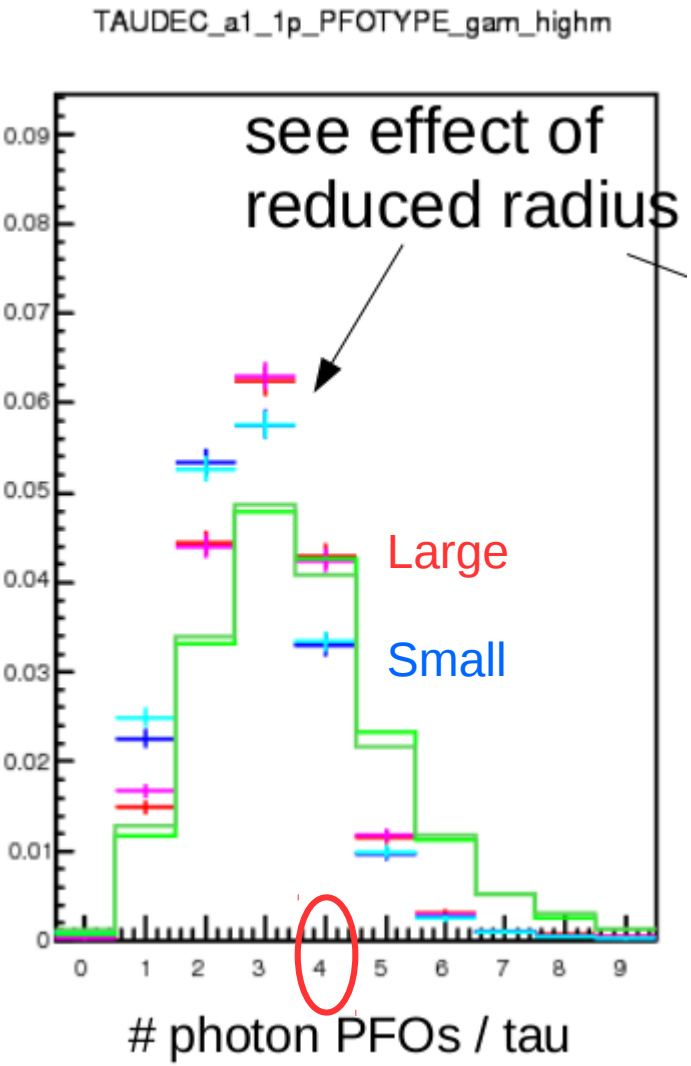
this can be affected by detector radius

e.g. tau decays to 1 pi+, 2 pi0
expect 4 photons

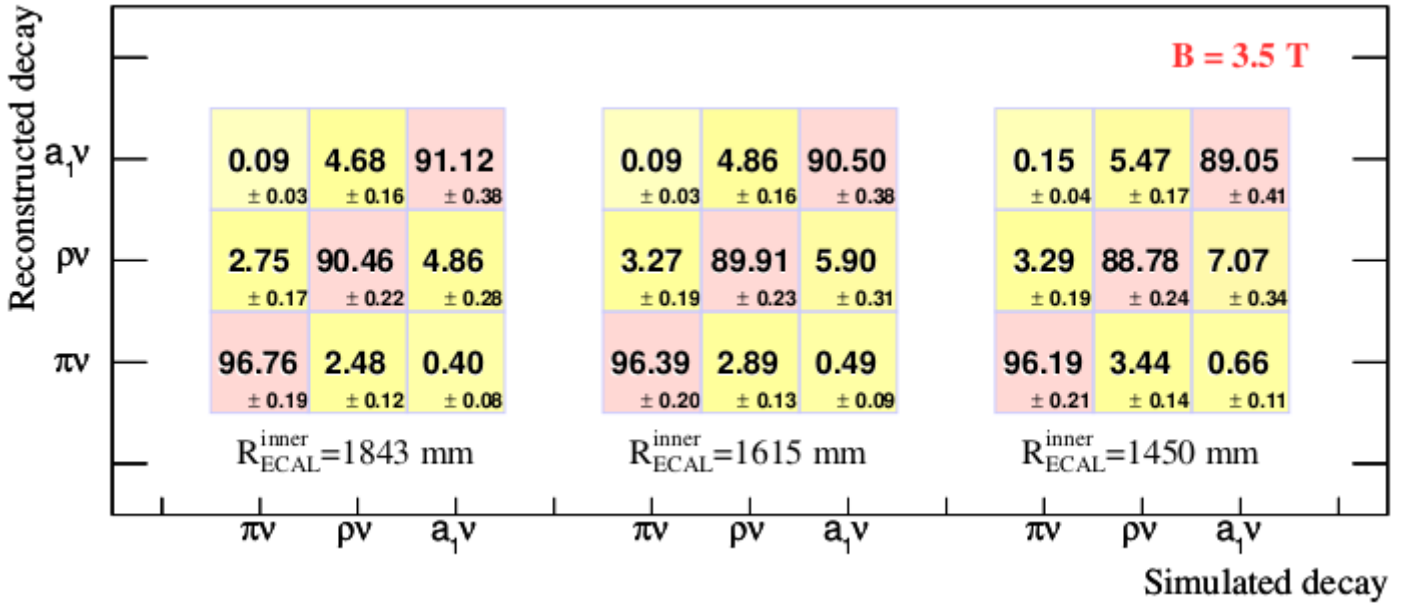
latest simulation models,
Pandora PFOs

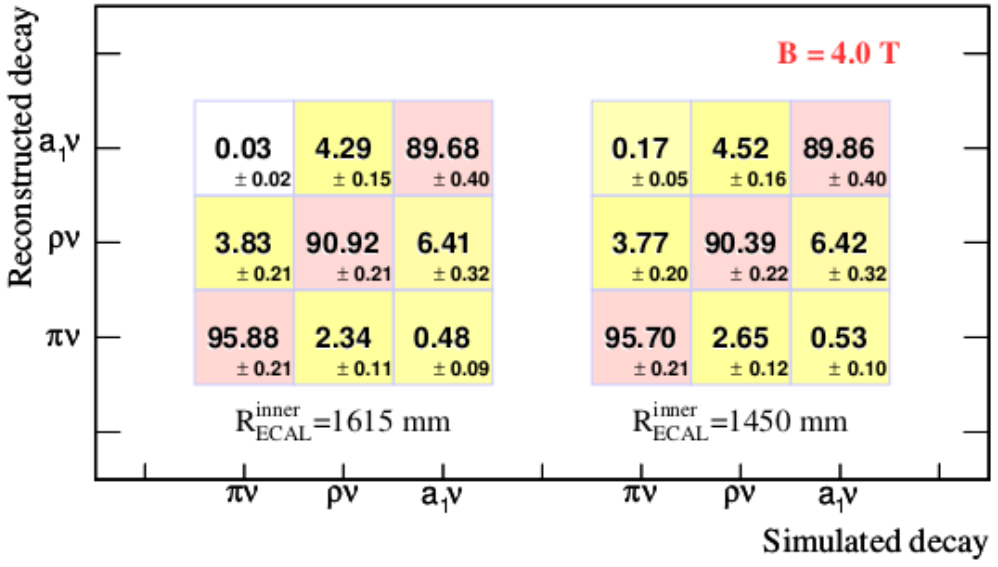
number of reconstructed photons
clearly different in large/small models

of course, also depends on the
reconstruction algorithm



T. Hieu Tran's study arXiv:1510.05224
using GARLIC, and including mass information
to identify tau decay modes (for 125GeV taus)
also saw some modest dependence on size, Bfield





summary

taus are powerful tools to probe Higgs and other physics at ILC

they have a rather small number of possible decay modes

a couple of generic tau jet finders exist

optimal tau finding should make use of detailed particle-by-particle information,
taking into account the well-known decay modes

full particle-by-particle information also allows access to tau spin