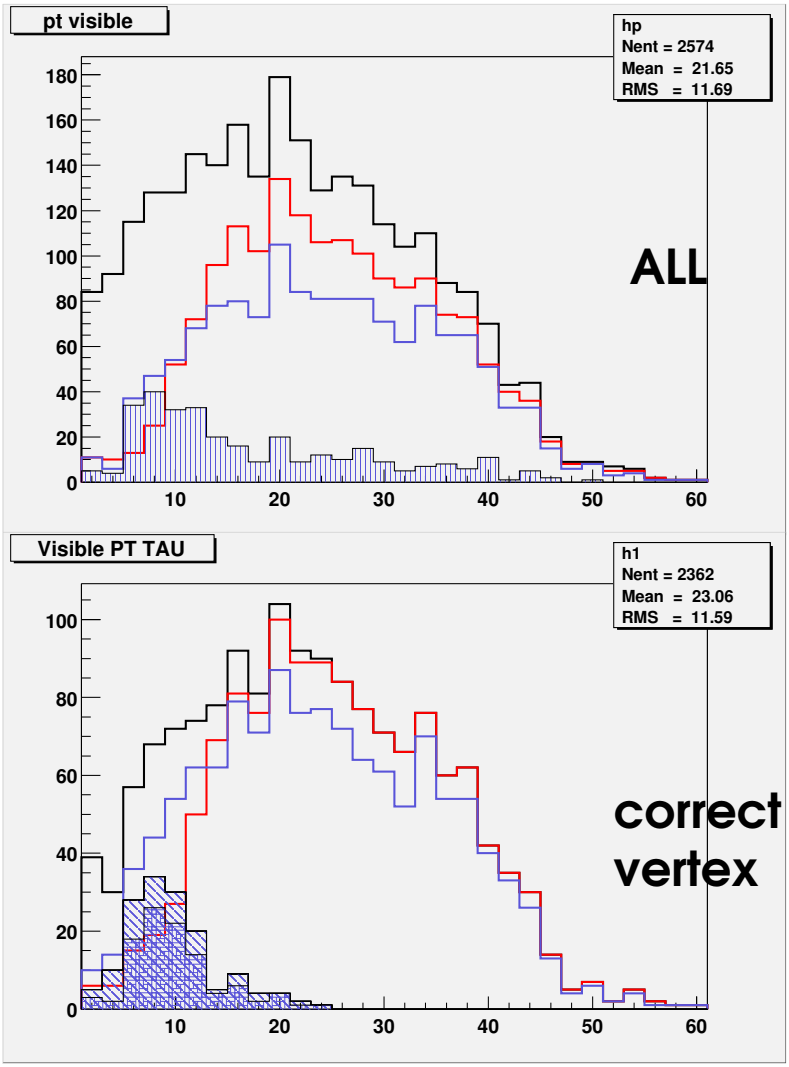
Tau reco in P09

- Big changes
  - new clustering algorithms
  - new reconstruction strategy
- Status and tests

What we had

- P08: *(and P05)*
  - Cone clusters in calorimeter are the seeds
    - Et>8 GeV
  - Tracks are matched to the cluster
    - misvertexing reduces efficiency
  - PS clusters in a wide (0.2x0.2) window are matched to the cluster
    - ghosts, misvertexing
  - Global jet variables are calculated
    - rms, profile, cal. layer fractions

Efficiency and Misvertexing



Black – all MC taus

Red - with Cal clus

Blue – with 4 GeV track

Blue hatched – with 4 GeV track but without a cluster

- Eventually when tracking and veretxing is perfect should not be a problem. But need cure now!

Clustering

- Calorimeter seeded
  - seeded by high Et tower
  - towers inside core are added
  - cone center is recalculated each time a new tower is added
  - Isolation towers are then added
  - A cut on Eiso is possible; currenly set very loose **(Eiso-Ecore)/Ecore<1**
  - Current settings:

    cone=0.3, iso=0.5
- Track seeded
  - seeded by high pt track (now = 5GeV)
  - to avoid dependence on vertex set cone center at the intersection of the track and PS
  - Mimic simple cone algo: provide core and isolation (takes cone R's from same RCP)
  - A cut on track isolation is possible; currently set very loose **(ΣE_T<10 GeV)**

Tracking in Taus

Separation between tau tracks and underlying event tracks

- If all tau's were one-prongs clearly the best separation is Pt

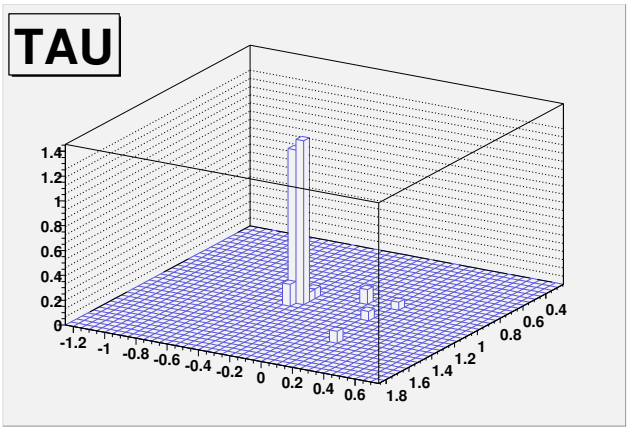
- order tracks in AOI by p_t
- start with highest p_t track
- go down the list and add tracks only if:
  - Ntrk ≤ 3
  - Z at DCA is within 5cm from Z at DCA of the leading track
  - mass < 2 GeV
  - track p_t> 1.5 GeV
  - charge is O.K

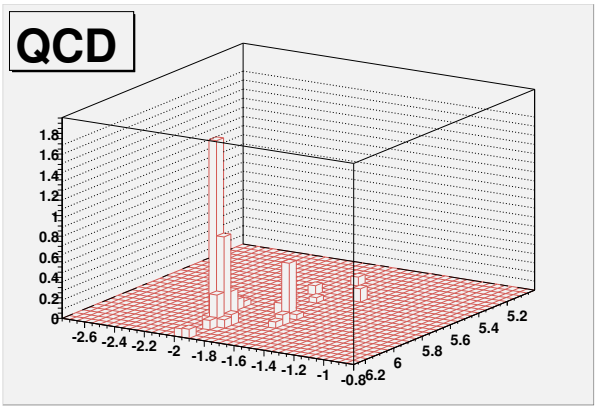
Energy in EM3

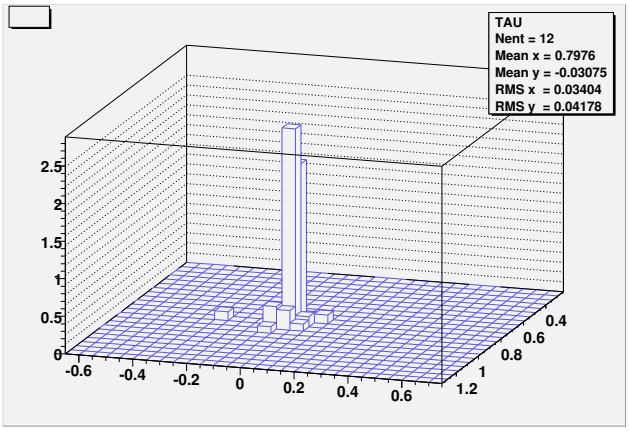
- EM3 is the most finely segmented portion of the calorimeter and more than half of all EM energy is deposited there
- Can try to distinguish
  - few high-pt photons (tau)
  - many low-pt photons (QCD)
- Implemented Nearest Neighbor clustering of EM3 cells of the tau jet

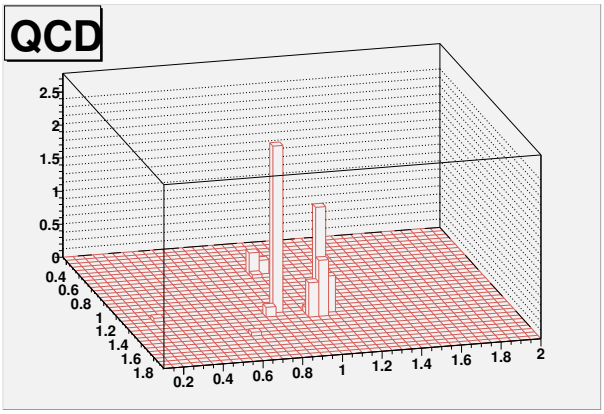
Displays of "Typical" Events

- Cell threshold: 50 MeV -> high enough to kill all noise



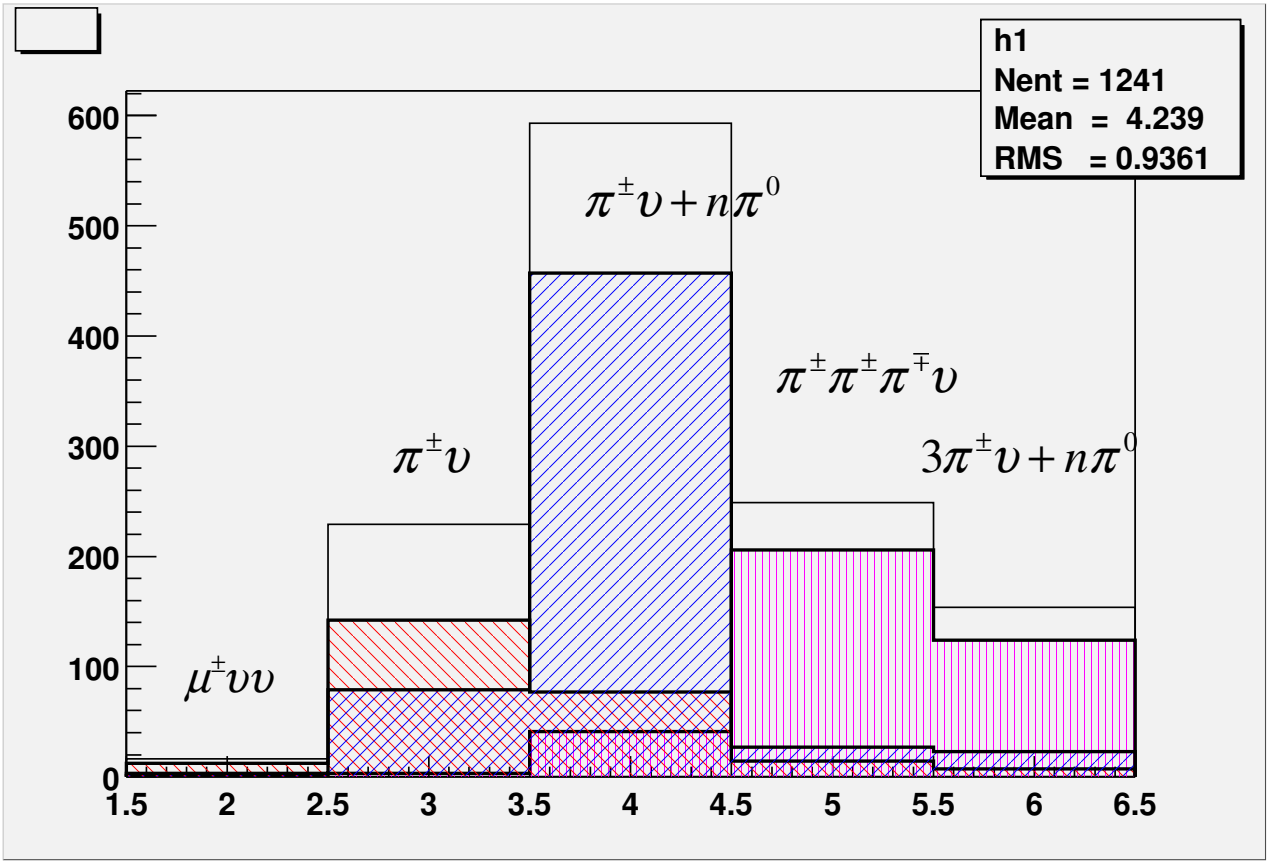






Three Tau Types

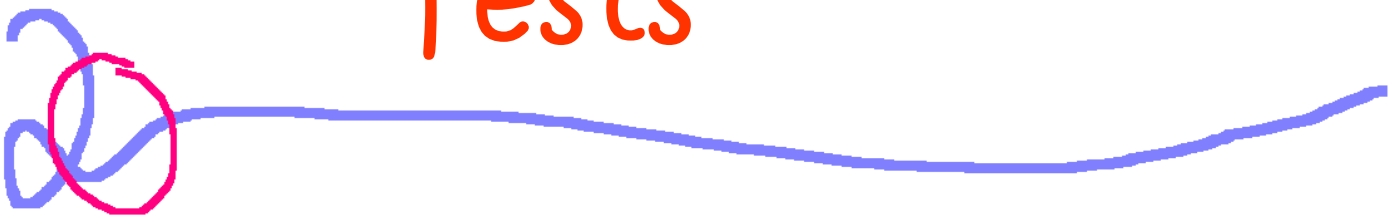
1. $N_{trk}=1$, $Et_{em3clus}<0.8$ GeV
2. $N_{trk}=1$, $Et_{em3clus}>0.8$ GeV
3. $N_{trk}>1$



Strategy summary

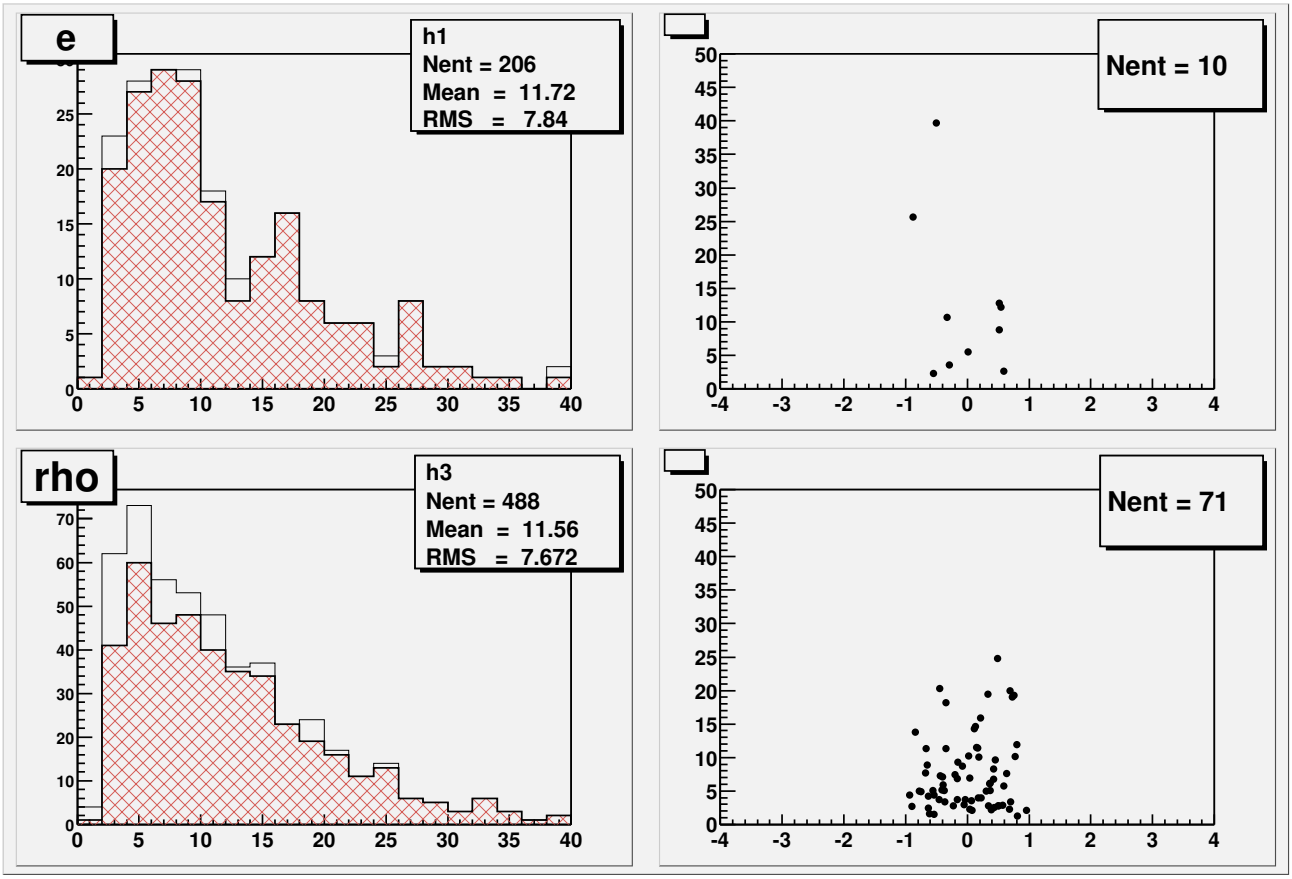
- Calorimeter clusters seeded from high towers and isolated tracks
- Tracks are matched without PV bias and divided into "tau"-tracks and "underlying" tracks
- EM clusters are found inside tau jets
- PS hits are looked for in a narrow window w/respect to the EM cluster

Tests



- Samples:
  - Z->tau tau + 2.5 mb
  - 3-tau SUSY + 0 mb
    (from Ryan Hooper)
  - QCD-incl 20-500 GeV
    (Lancaster)
- Tried many cones for core (0.3, 0.4, 0.5) and isolation and tracking (0.5, 0.6, 0.7) and other reconstruction parameters
- Macros: **~gerstein/wz2/t139/rundir**

CPS only

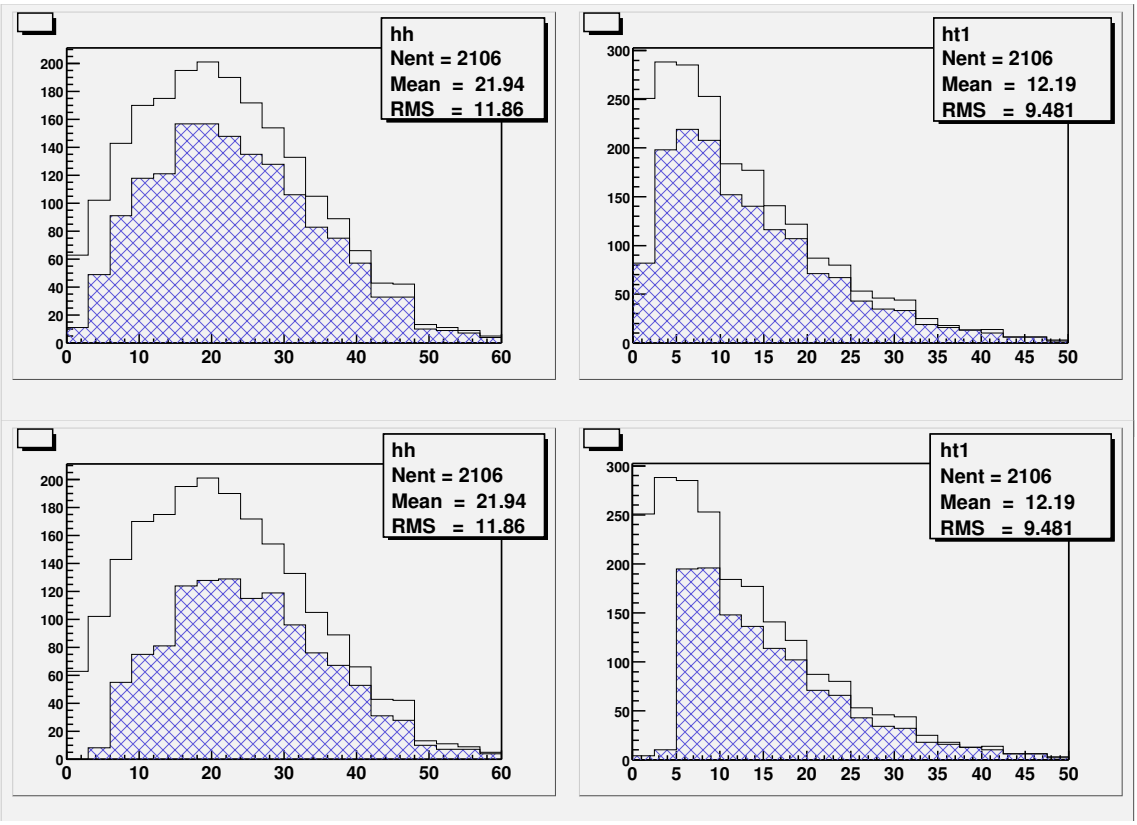


Eff for electrons – 196/206=95% -> too low! Matching?

For photons from rho - 85%

Matching tracks

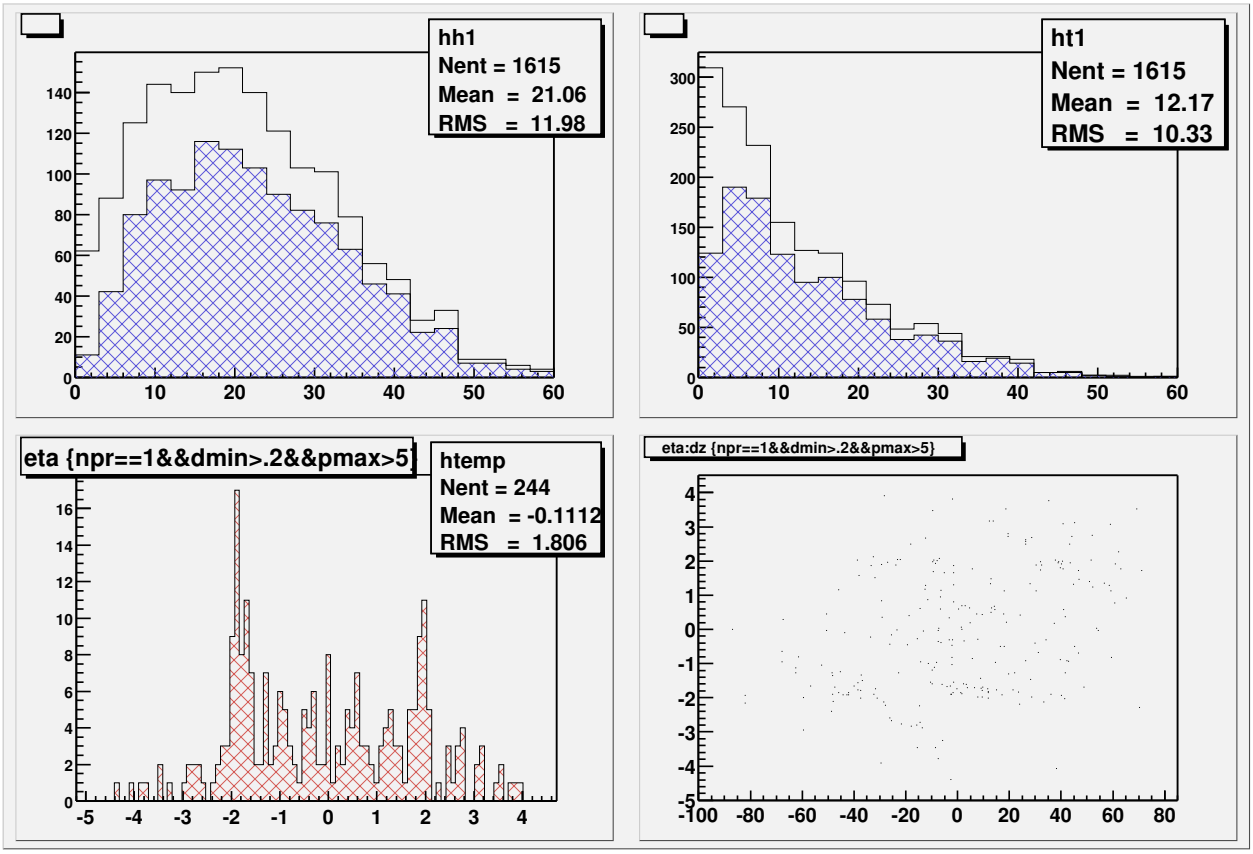
- As good as it was
  - pt>1.5 GeV = 75%
  - pt>5.0 GeV = 60%
- Some high pt tracks are lost



Et(visible) Et(MC track)

One Prongs

- Looks "familiar"



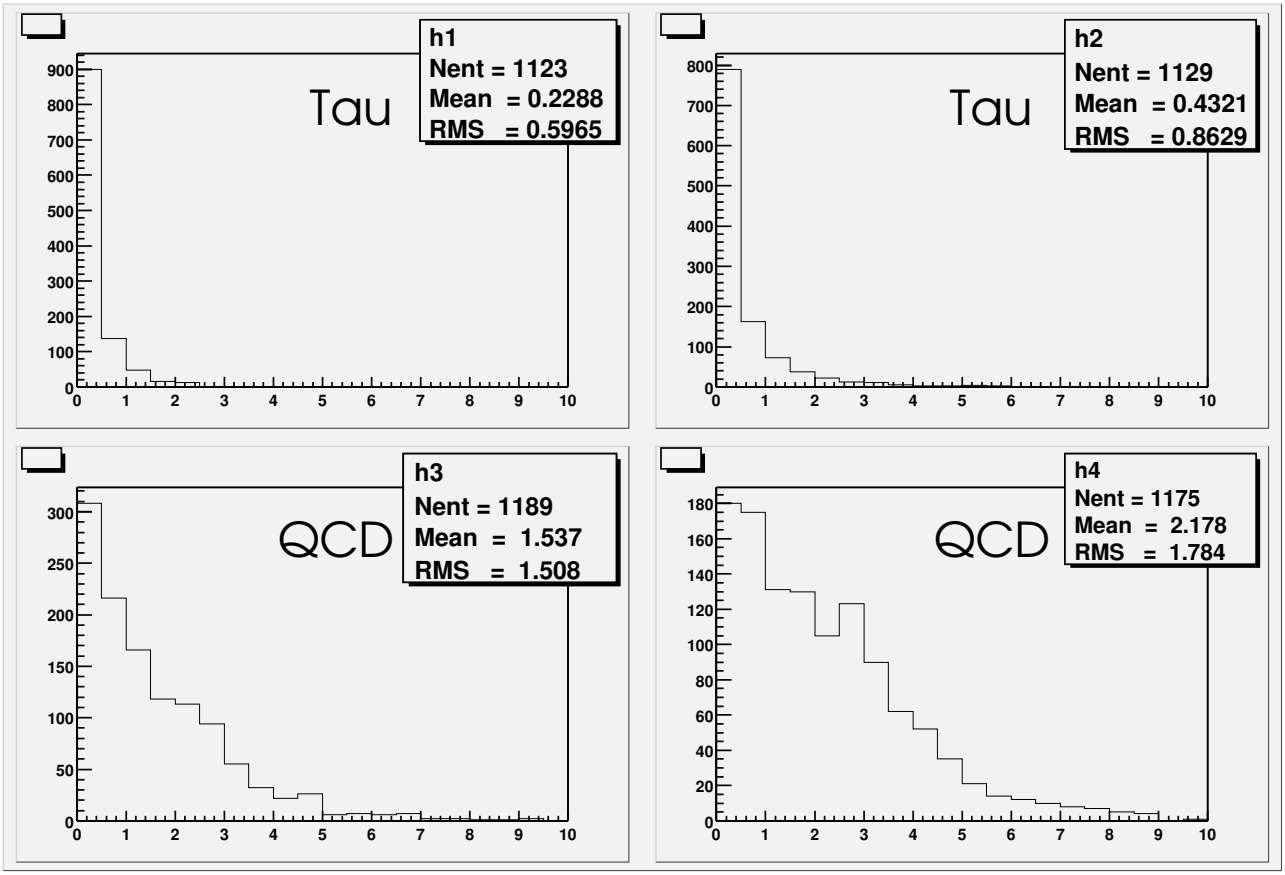
eta MC

Zvertex MC

Z->tau tau

- Energy flow in the tracker for 1-prong taus

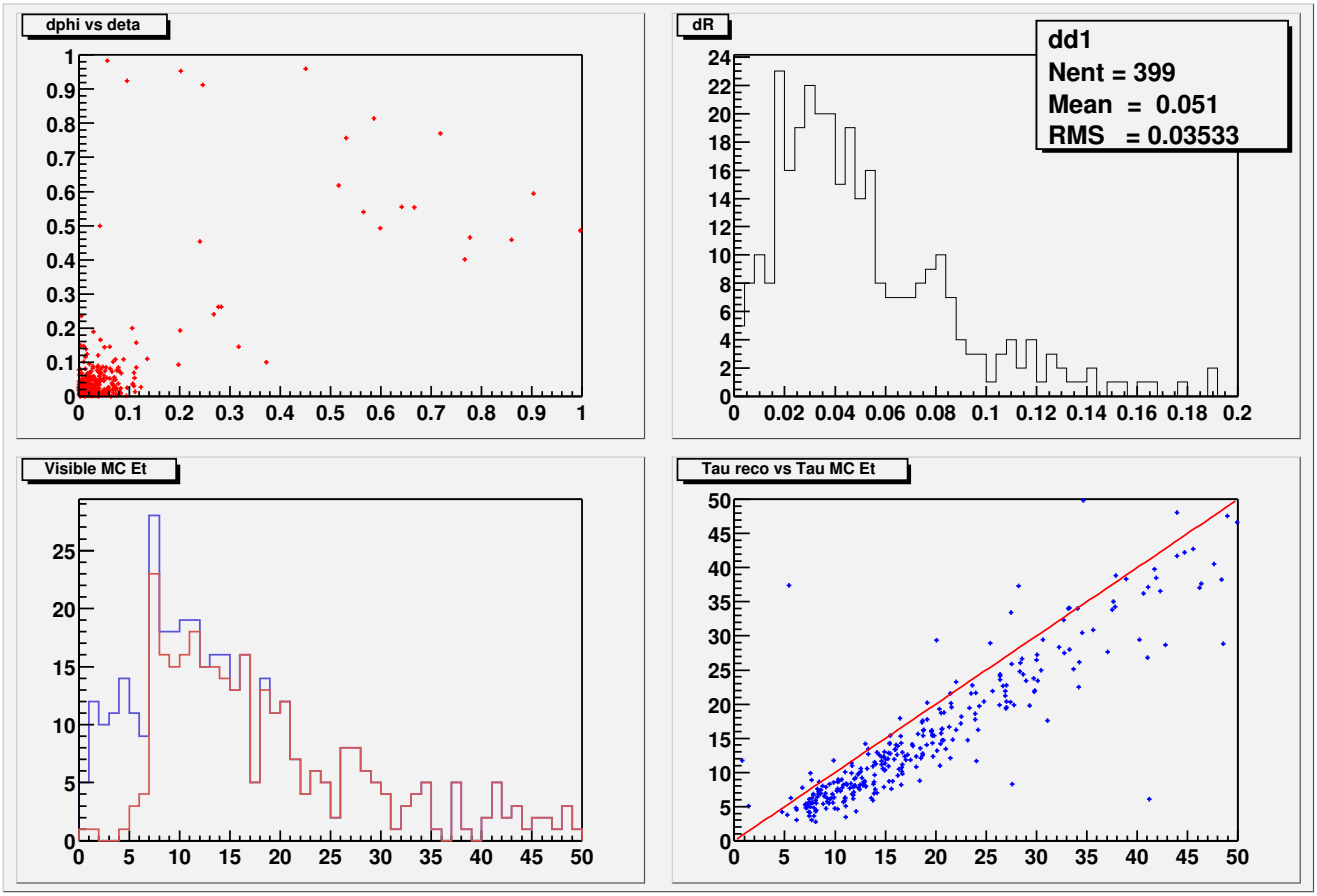
Cone R = 0.5 Cone R = 0.7



SUSY

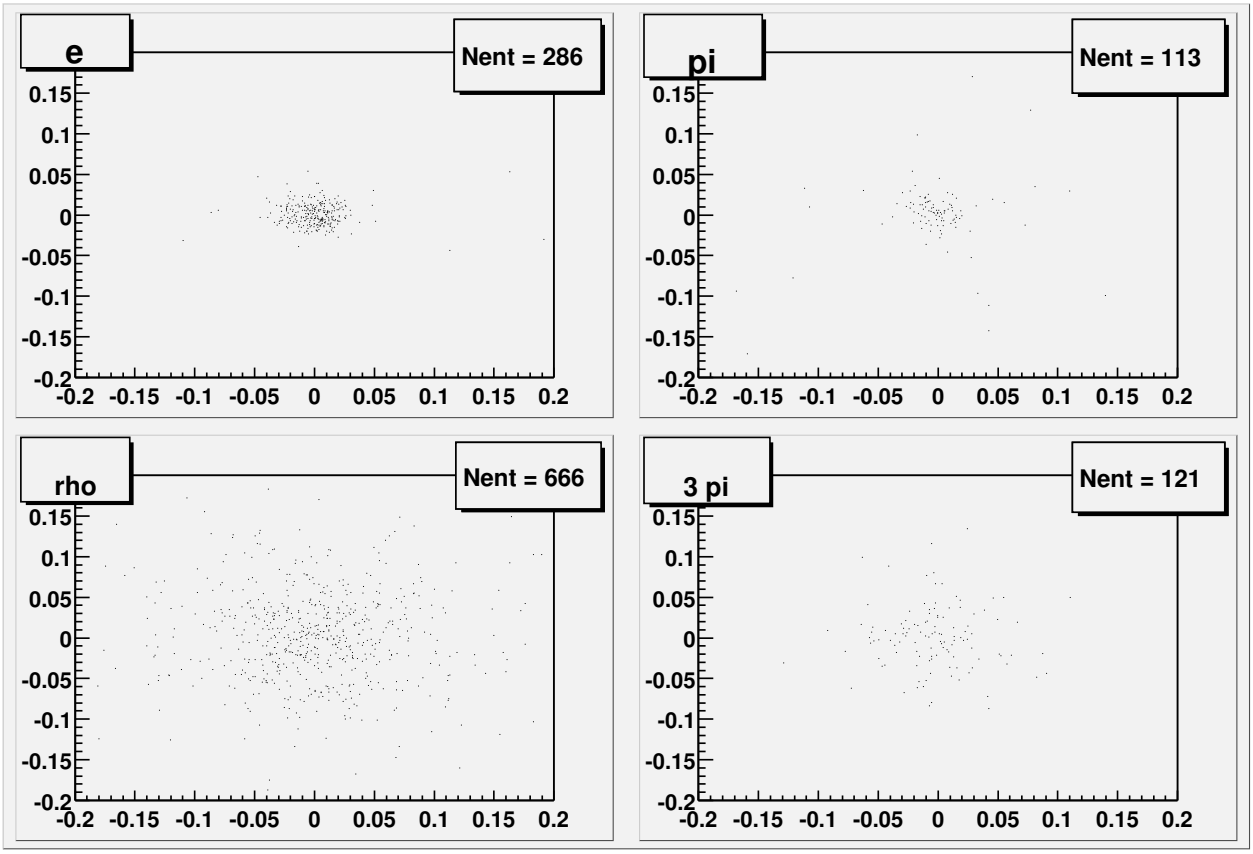
- Cones: 0.3/0.5/0.5
- Et> 4 GeV (Cal-seeded)
  > 2 GeV (track seeded)

Eff Vertex = 0.98 Eff tau = 0.8



EM clusters

- Match between extrapolation of a track into PS and EM sub-cluster (for $3\pi\pi^0$ track direction is taken at the vertex)



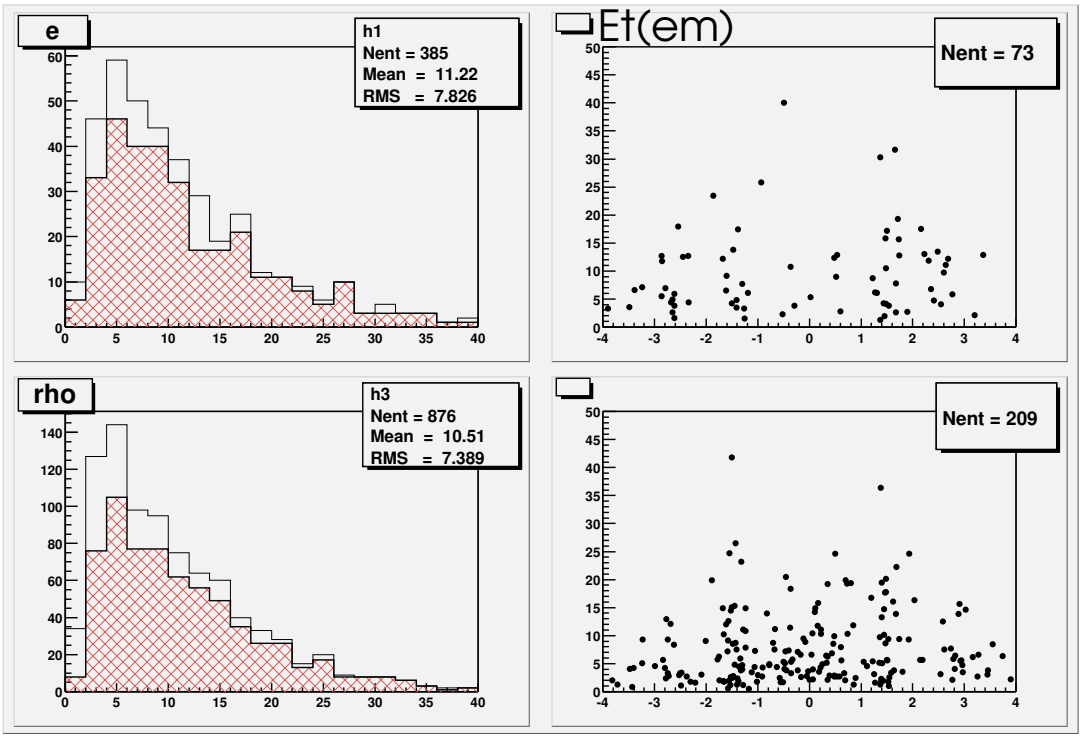
Matching Preshower

- PS match same way as in EM ID:
  - 0.05 eta-phi for CPS
  - 0.10 theta-phi for FPS

Open hist – all EM clusters

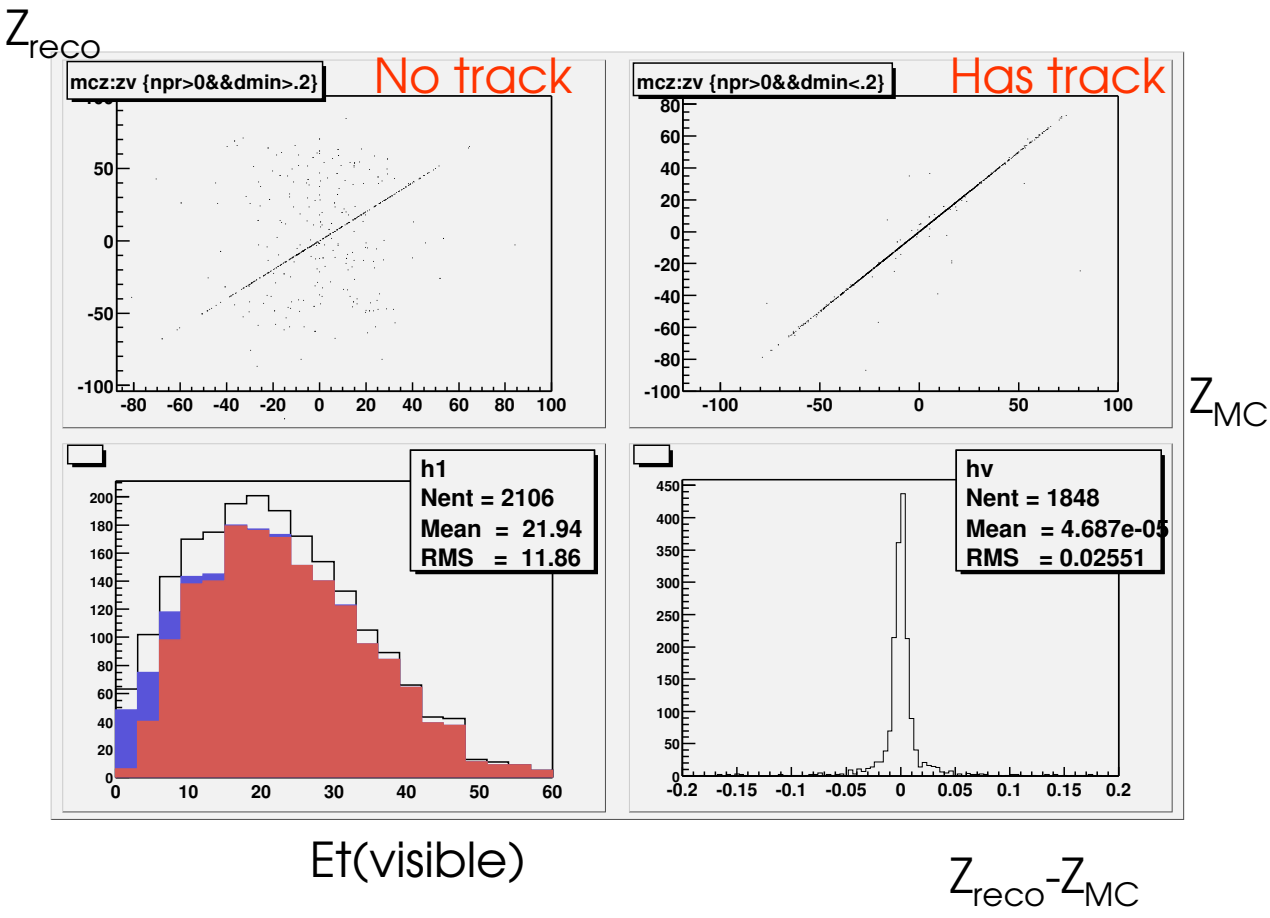
Red-hatched – with PS hit

EM clusters without PS hits



Finding Clusters

- Good!



- Open histogram – all taus
- Blue – vertex is right (88% -> was 58%)
- Red – cluster is reconstructed

Plan for P09

- **April 9:** the new version of code is released. The released code is examined for crashes and used for studies to determine
  - cone size
  - feasibility of isolation cut in SimpleCone
  - isolation in ChargedParticle
- **April 16:** freeze TauQualityInfo contents and RCP parameters and produce large Ntuples of $Z \rightarrow \tau\tau$, $\chi^0\chi^\pm \rightarrow \tau\tau\tau$ and QCD jets
  - need disk space!!! 10 G
- **May 7:** all minor changes are implemented (I.e. particular choice of variables for NN from TauQualityInfo – no new calculations)
- **May 21:** we are on time and happy with the debugged code ☺