Directed Tree Clustering Algorithm

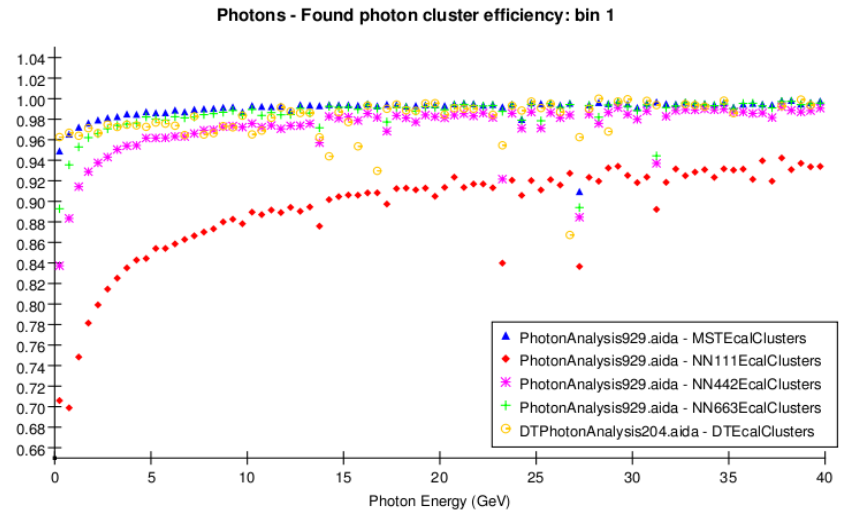
- Cal-only clustering developed at NIU (V.Zutshi):
  - density neighborhood (fixed, used to find hit densities D_i)
  - clustering neighborhood (adaptive, based on hit's density)
  - density gradient for cells i,j (j in the neighborhood of i)
    -->hit-density difference divided by distance d_{ij}:

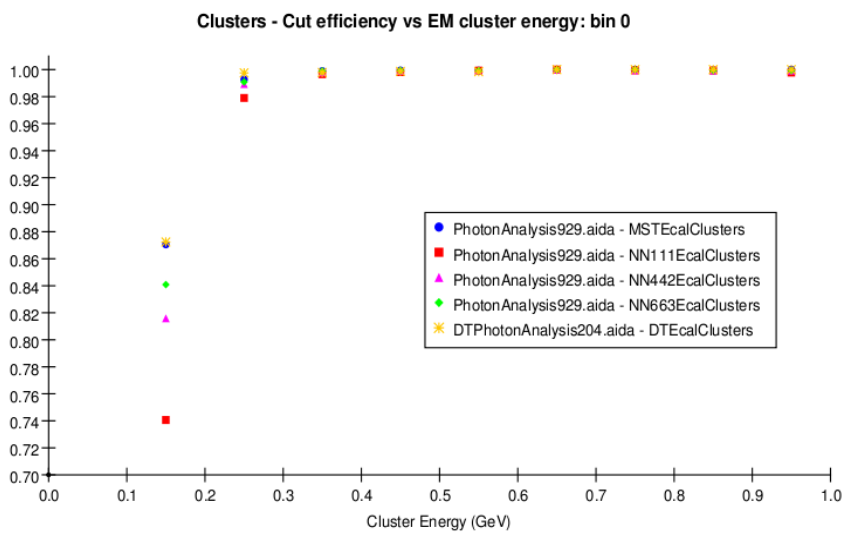
    $$D_{ij} = (D_j - D_i)/d_{ij}$$

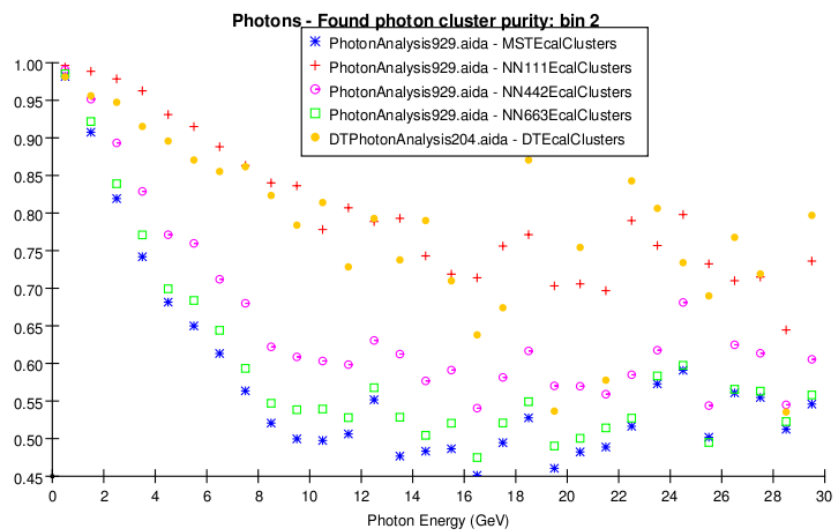
  - each cell attaches itself to the hit j with maximum hit-density gradient in its clustering neighborhood
  - Cells with local density maxima become cluster seeds (or directed tree roots)
- Hit selection: $E > E_{MIP} / 4$, and time < 100ns (applied before the clustering)

Directed tree clustering - performance

- Studied by Ron Cassell (SLAC)
- Preliminary results presented at Vancouver ILC workshop





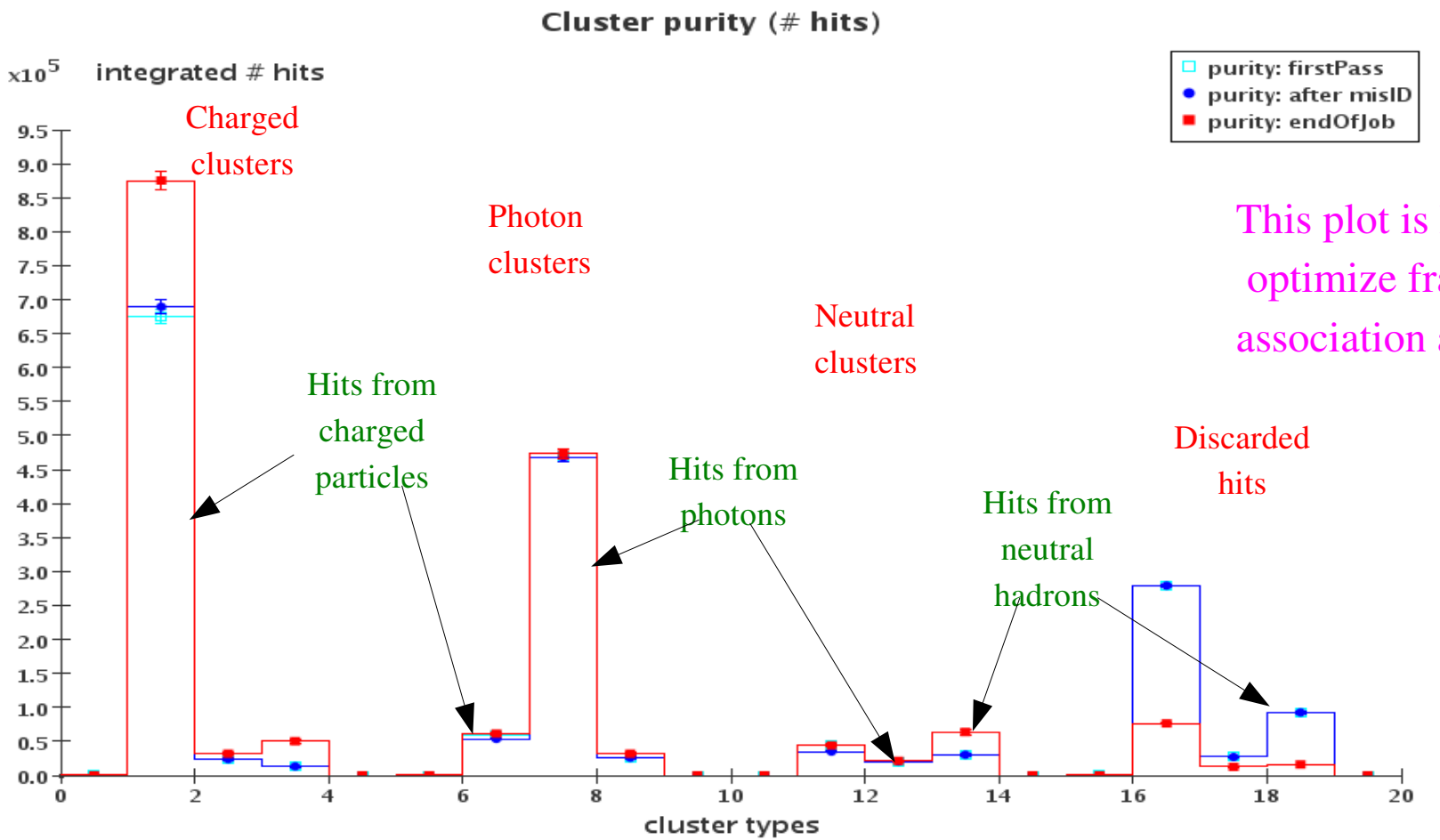


Developing a realistic Particle Flow Algorithm

- Development based on:
  - Z --> q $\bar{q}$ (light quarks) on sidaug05_tcmt geometry
  - Data sample generation: SLIC v1.13 + Geant4 v8.0
  - Java-based framework (org.lcsim)

- Algorithm description:
  - Inputs: Directed tree clusters in ECal and HCal, reconstructed tracks
  - Track extrapolations --> track-cluster associations --> seeds for charged clusters
  - Photon-ID: use an Hmatrix (longitudinal cluster profile) --> seeds for photon clusters
  - Shower pattern recognition: algorithms to merge clusters based on cluster shapes and distances
  - Remaining clusters: sorted by size/energy --> seeds for neutral hadron clusters
  - Low multiplicity fragments are discarded (reduce confusion, but degrades final resolution)

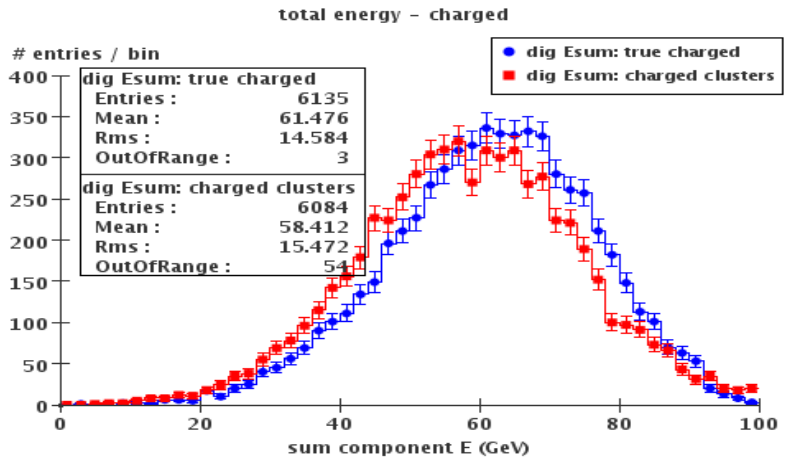
Cluster purity and fragment association

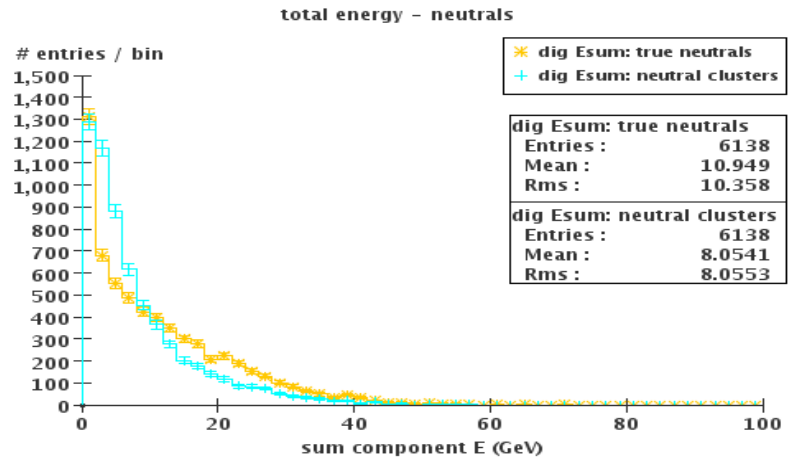


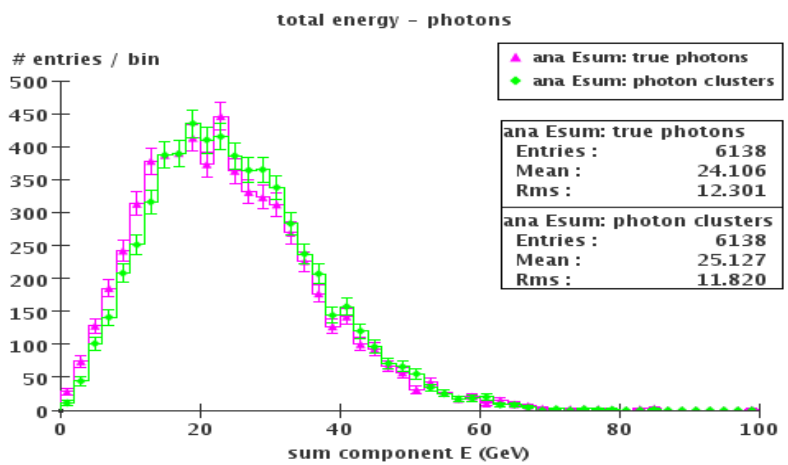
This plot is helpful to optimize fragment association algorithms

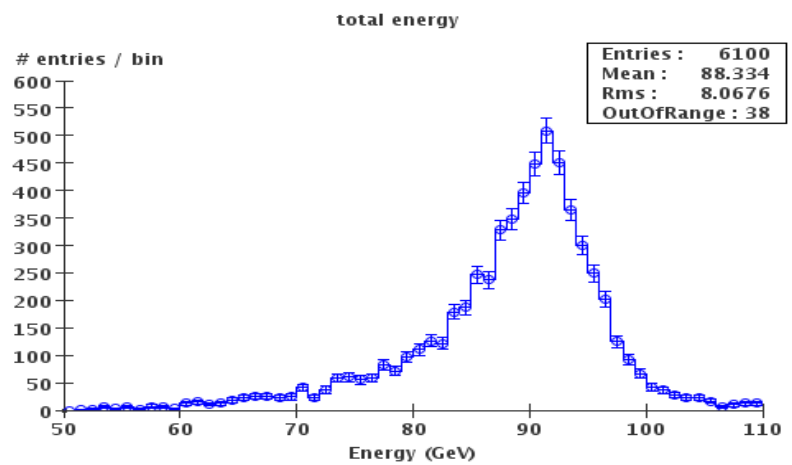
Current PFA results (preliminary)

Energy sums of each component in event

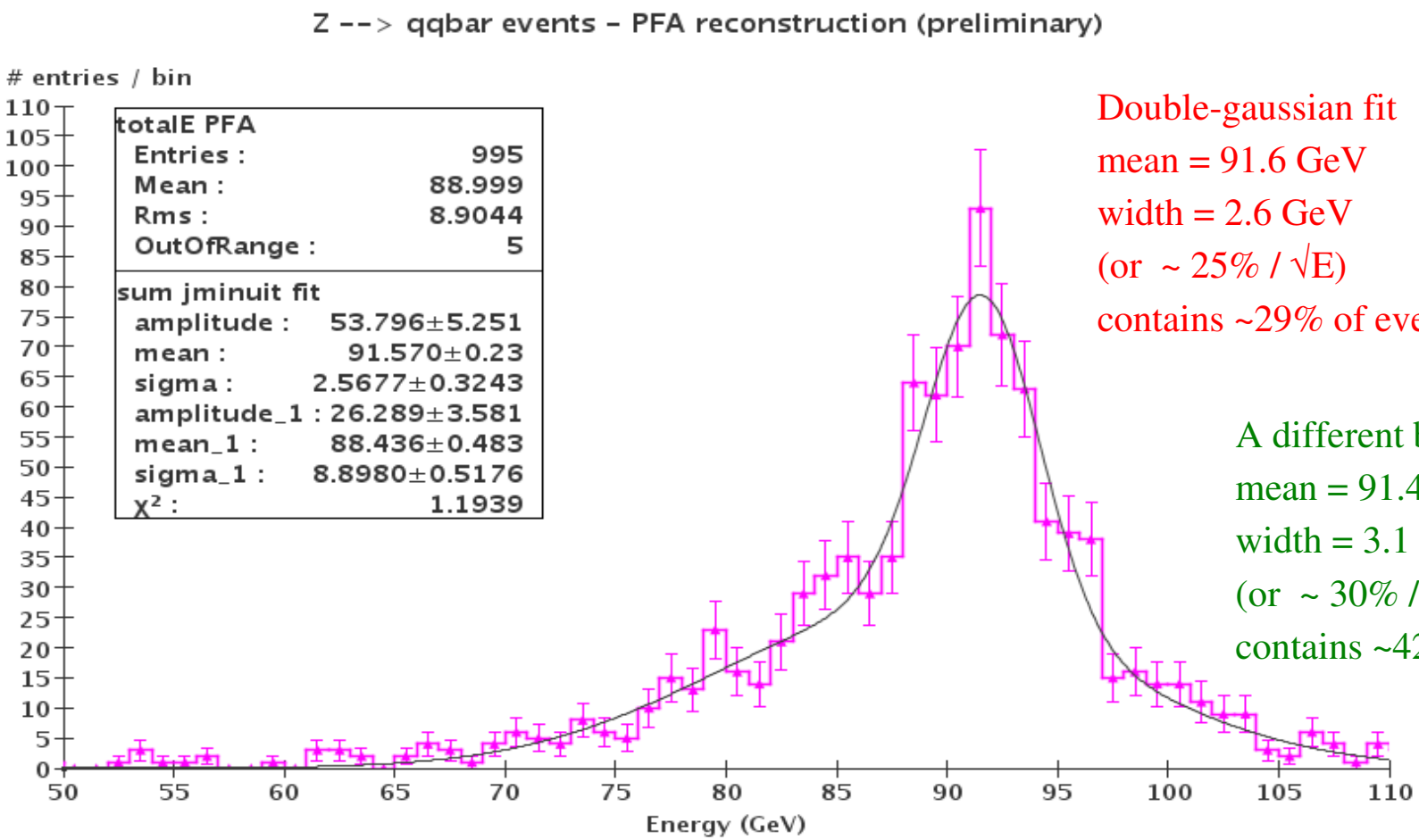








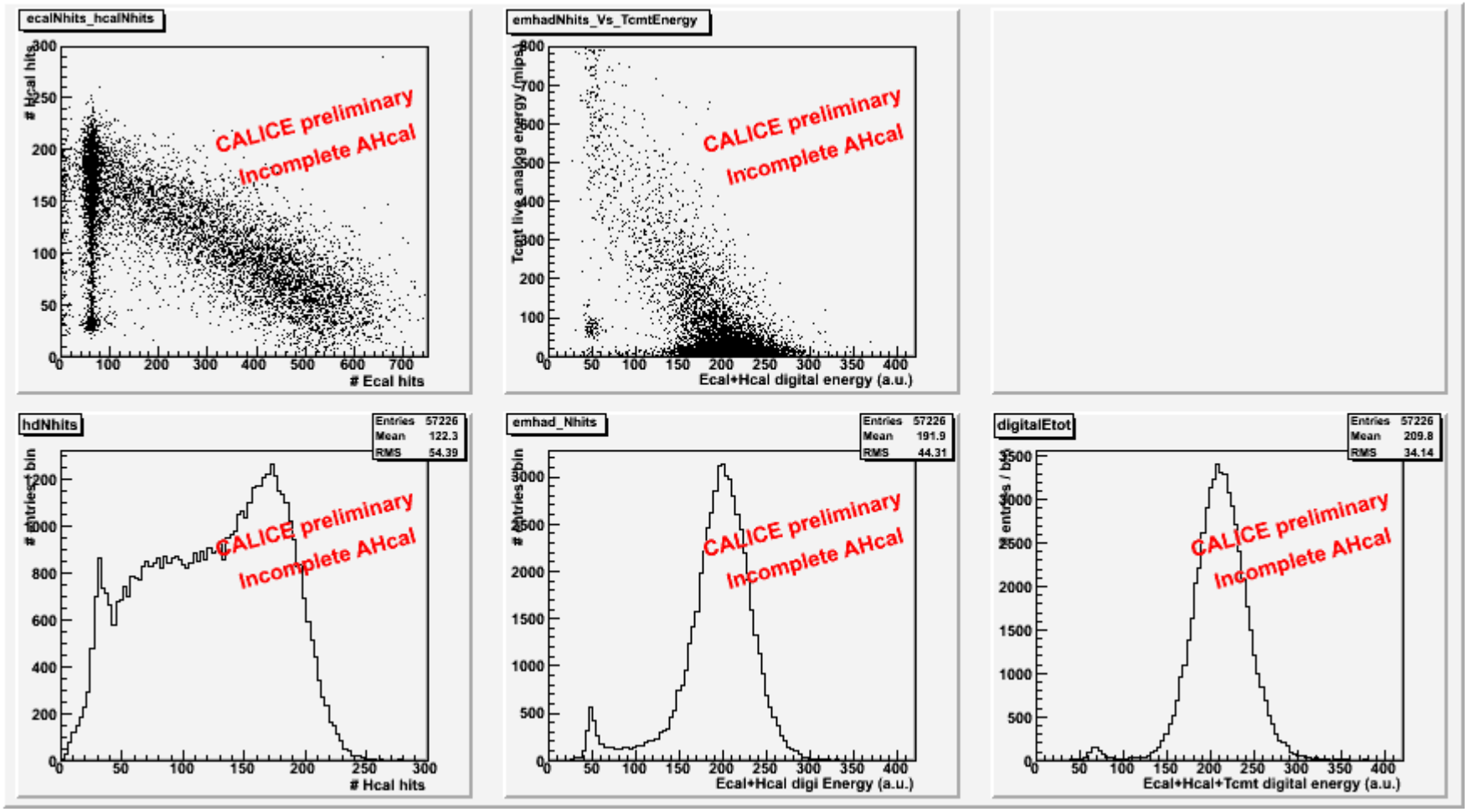
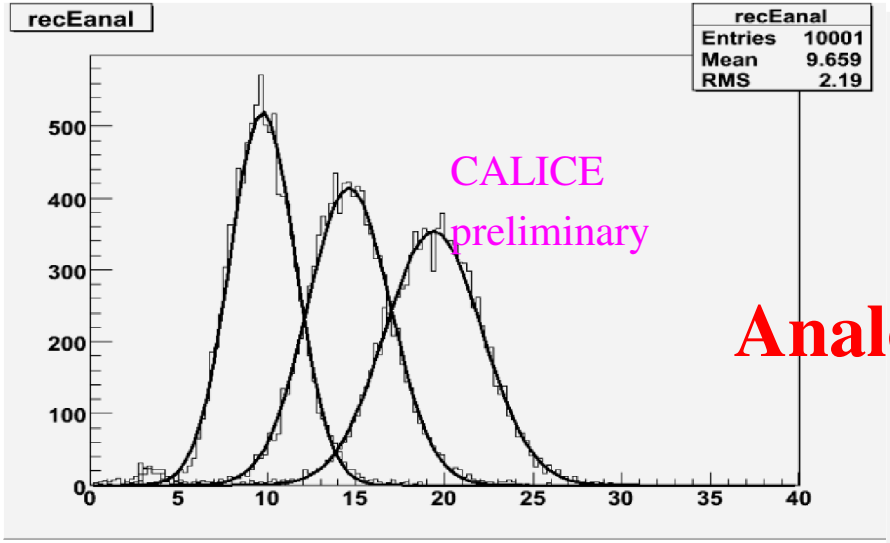
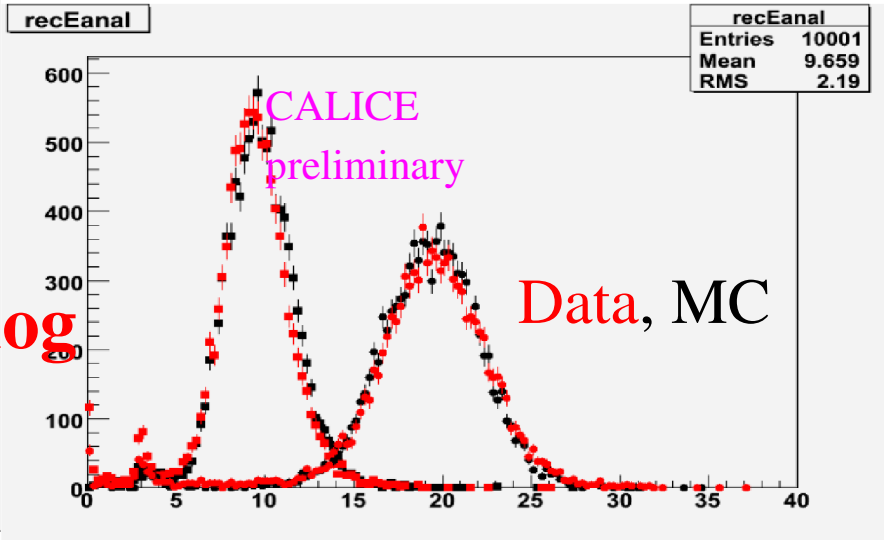
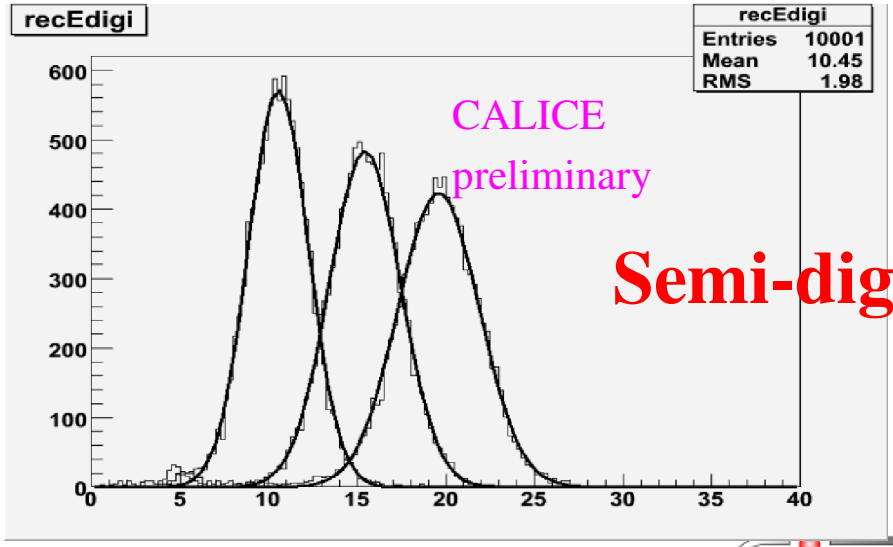
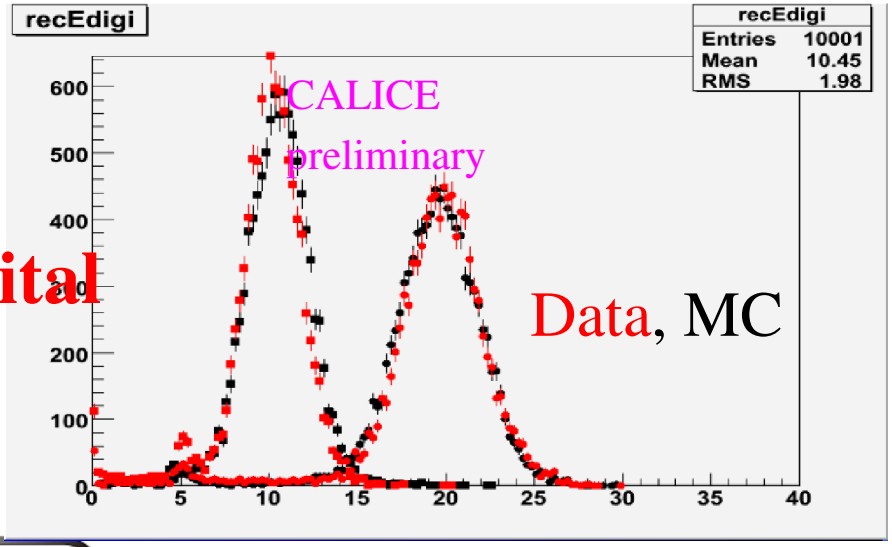
Current PFA result (preliminary)



Double-gaussian fit
mean = 91.6 GeV
width = 2.6 GeV
(or ~ 25% / √E)
contains ~29% of events

A different binning:
mean = 91.4 GeV
width = 3.1 GeV
(or ~ 30% / √E)
contains ~42% of events

CALICE test beam: preliminary results



CALICE test beam: preliminary results