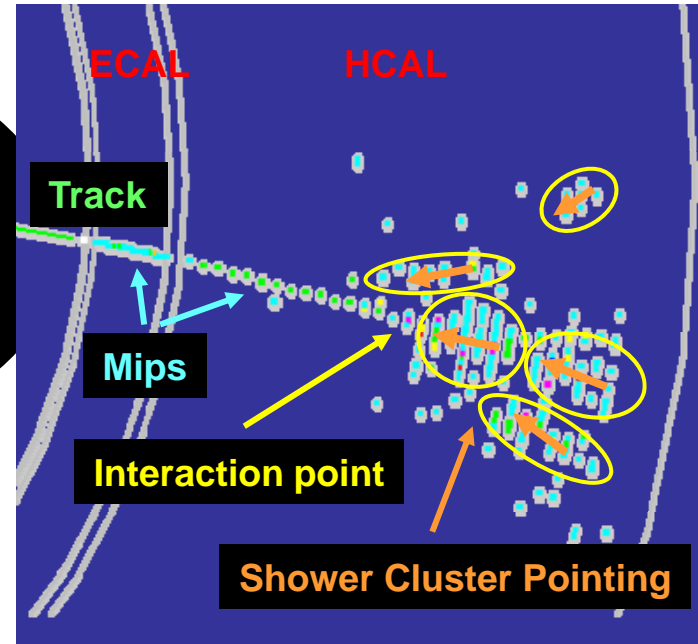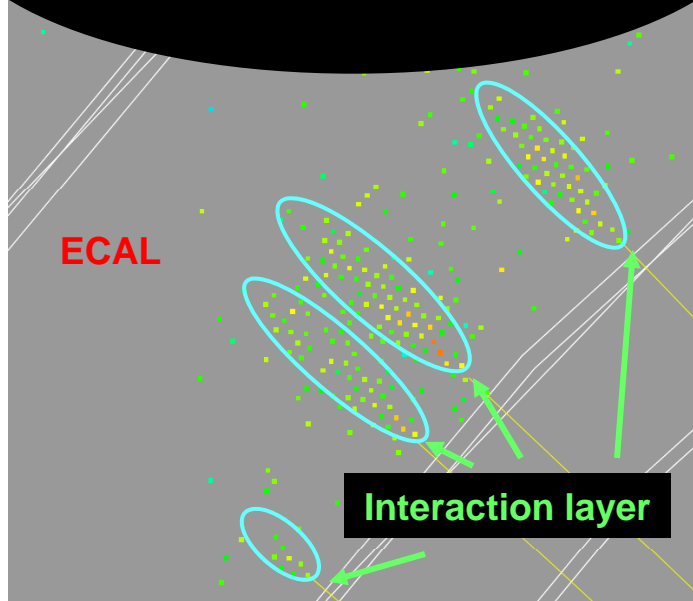PFA Template

**Track/CalCluster Association**
Track extrapolation
Mip finding
Shower interaction point
Shower cluster pointing
Shower proximity match

ECAL HCAL

Track

Mips

Interaction point

Shower Cluster Pointing

Photon ID
Shower interaction layer
Longitudinal E profile (H-Matrix)

ECAL

Interaction layer

Neutral Hadron ID
Shower interaction layer
EM/HAD Cluster Merge

Interaction layer

ECAL

HCAL

Cluster Merge
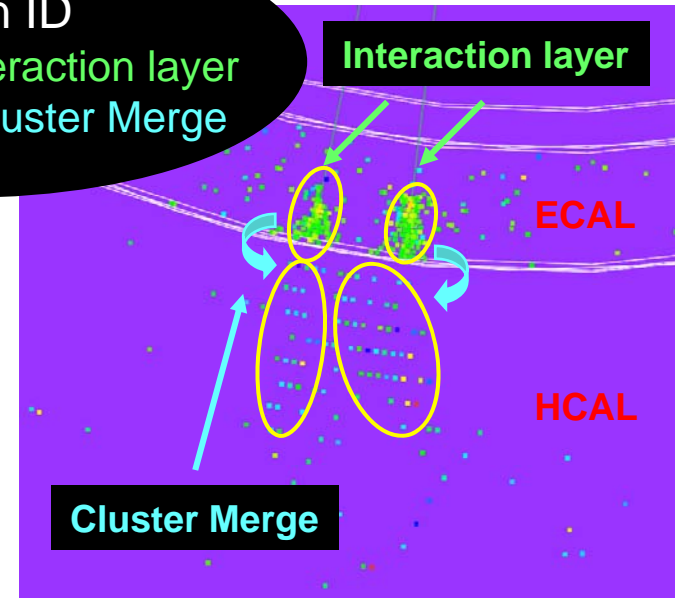
Track-Mip/Shower Interaction Point Algorithm

Features :
- CalorimeterHits matched layer-by-layer to extrapolated tracks
- Uses hit position and calorimeter layer number from detector geometry
- No hit energy used, mip test based on internally-calculated hit densities
- Interaction point set at layer where hit density too large or 0 in extrapolated region
- Mipclusters, interaction spacepoint linked to tracks

With Test Beam data now :

Algorithm tests
    Optimize density parameter in algorithm
    Test interaction spacepoint distribution

MC shower model tests
    Particle propagation –> interaction layer

Detector tests
    Number of hits per mip – delta rays

Interaction Layer all Tracks

Entries : 4939
Mean : 12.489
Rms : 14.016
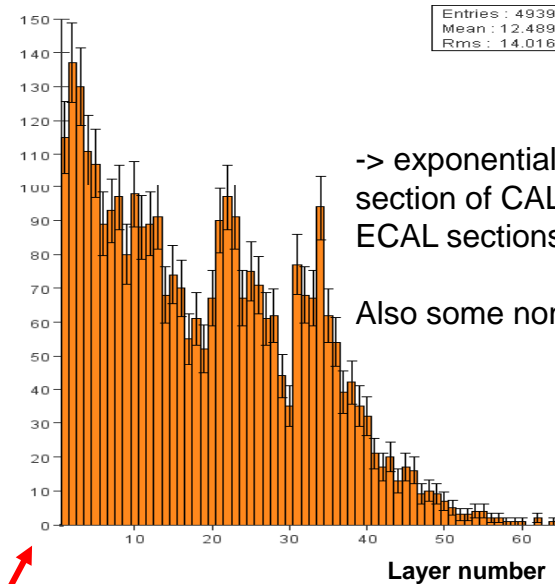
-> exponential behavior for each section of CAL – 20/10 layer ECAL sections and 34 layer HCAL

Also some non-interacting pions

Layer number

Mip endpoint – MC Track endpoint

Entries : 500
Mean : -75.691
Rms : 304.94

rms90 = 4.5 cm

Difference (mm)

Cluster Pointing Algorithm

Features :
- Uses IL spacepoint from Track-Mip Alg.
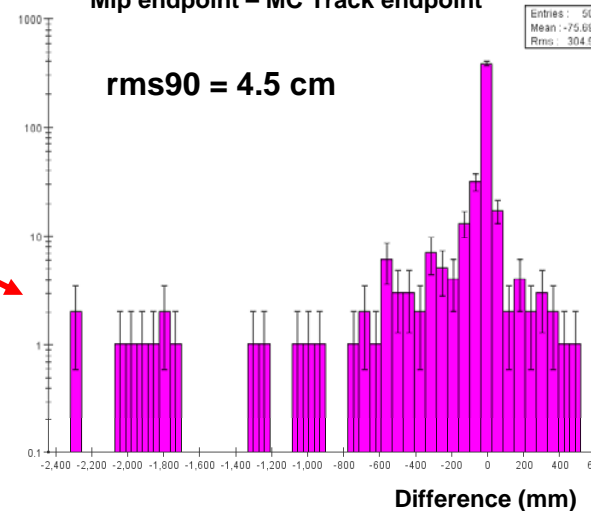- Cluster CalorimeterHits with DT clusterer – 4 hit min for principal axes determination
- Needs full CalorimeterHit info and detector geometry (including sampling fractions)
- Compare cluster pointing to IL spacepoint direction and IP direction :

    If IL spacepoint comparison < IP comparison -> points at IL spacepoint, linked to track
    Else if IP direction comparison small enough -> points at IP
    Else NP (non-pointing) Cluster

With Test Beam data now :
Algorithm tests
    Cluster algorithms (DT + others)
MC shower model tests
    Cluster properties (# frags, size, shape)
    Cluster fragment pointing properties
Detector tests
    ? (haven't thought of any yet)

DT Clustering with 4 hit minimum, after mip finder
1-10 GeV pions, 4-176 degrees

IL SP Pointing

Entries : 400
Mean : 1.0550
Rms : 0.94972

1.1 Clusters/pion

IP Pointing

Entries : 400
Mean : 0.40500
Rms : 0.68991

0.4 Clusters/pion

Non-Pointing

Entries : 400
Mean : 2.4125
Rms : 2.7133

2.4 Clusters/pion

Number

IP "Photon-like"

Entries : 400
Mean : 0.10000
Rms : 0.36056

25% "photons"

IP "Charged Particle-like"

Entries : 400
Mean : 0.30500
Rms : 0.53570

75% "charged particles"

Number
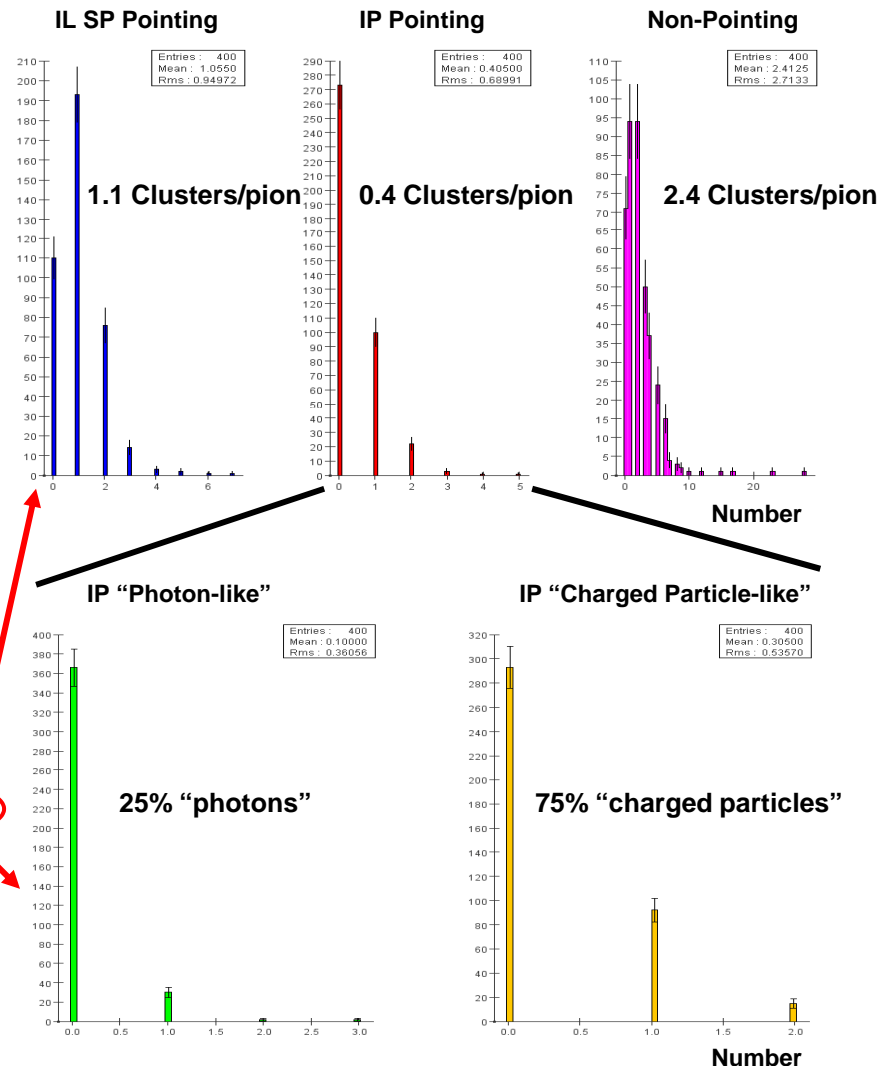
Testing DAQ -> Analysis Chain with Particle Flow Algorithms

Simulation

DigiSim
– hit digitization with noise, timing cuts, threshold cuts, etc.

Data

DAQ Processors

Algorithms independent of "data" source

LCIO Output
- CalorimeterHits, TrackHits, etc

Unnecessary unless test beam setup includes tracker

Track Extrapolation

Track-Mip/Shower Interaction point Algorithm

Cluster Pointing Algorithm

Shower Proximity Algorithm

Testable Algorithms
  - Software package – org.lcsim JAVA source code
  - Geometry – compact.xml -> GeomConverter -> detector.lcdd
  - Conditions data (geometry files, sampling fractions, others) kept in detector zip file accessed by analysis, simulation

Parameter tuning with test beam (limited MC tests)