Shower Reconstruction

Bruce Baller

March 31, 2009

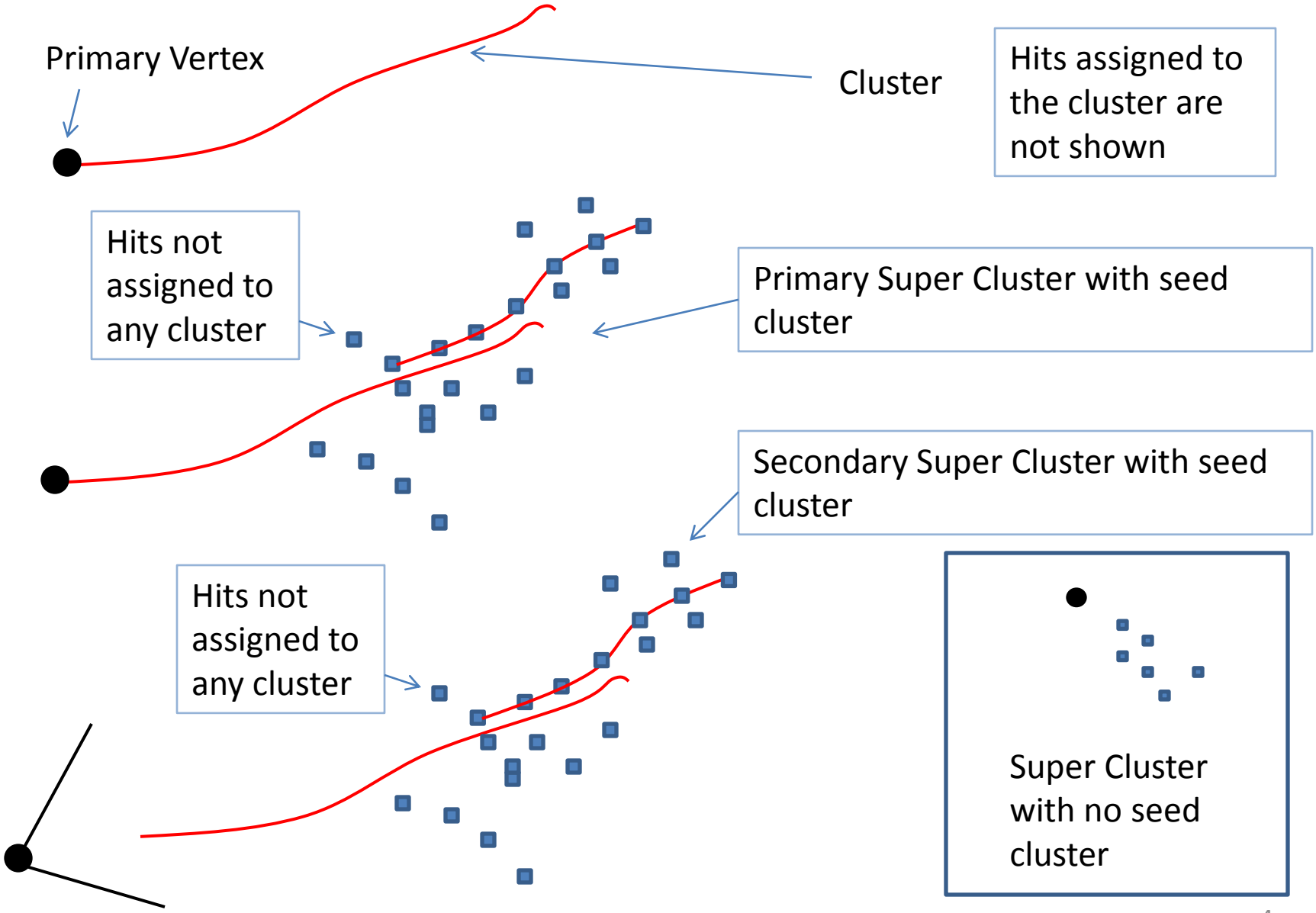
Goal

- Reconstruct EM showers
  - Distinguish electrons from gammas
  - Estimate EM energy resolution
- Why now?
  - Desirable information for the CDR
- Implemented in Fortran

Clusters & Super Clusters

- Cluster is a 2D track like object
  - Position, direction, fit χ^2, momentum, nhit
  - Pointers
    - Cluster → hit
    - Hit → cluster
- Super cluster is a shower like object
  - Composed of hits and (optional) seed cluster
  - Position, direction, length, nhit
  - Pointers
    - Super cluster → seed cluster (may be 0)
    - Hit → super cluster

Note that there is no super cluster → cluster → cluster → hit hierarchy

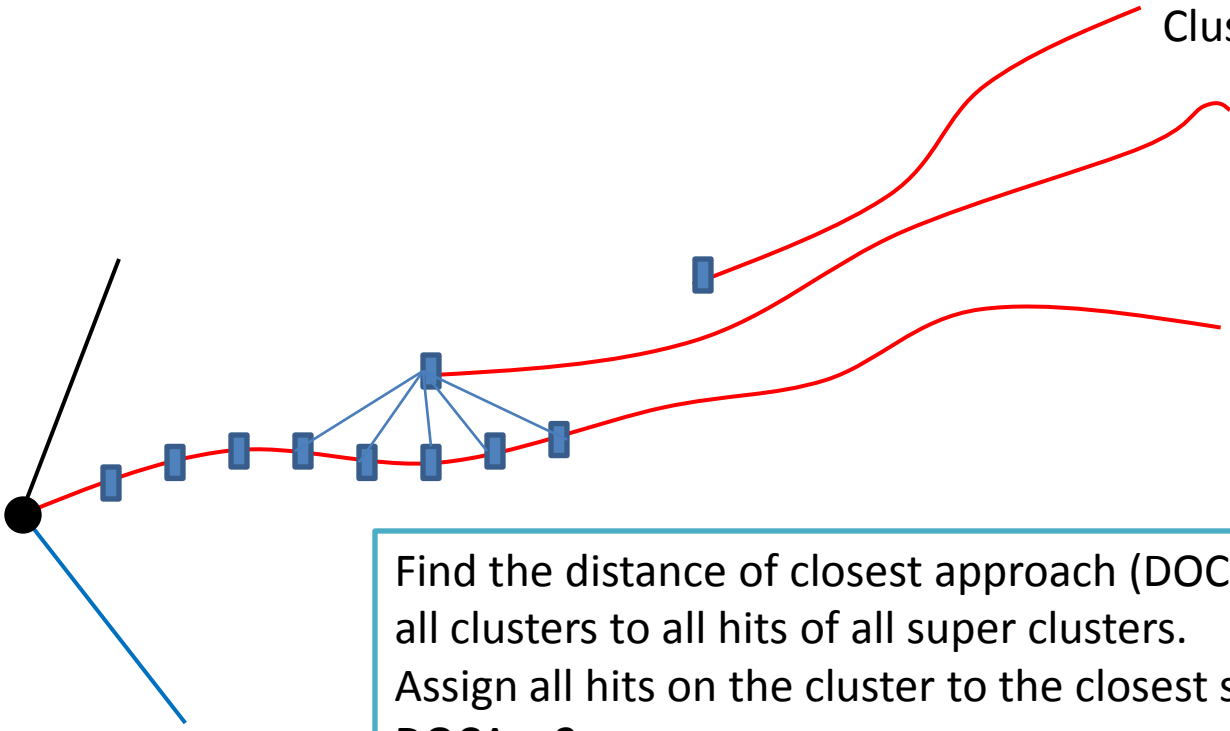

Primary Vertex
Cluster
Hits assigned to the cluster are not shown
Hits not assigned to any cluster
Primary Super Cluster with seed cluster
Secondary Super Cluster with seed cluster
Hits not assigned to any cluster
Super Cluster with no seed cluster

Algorithm

- Primary vertex must be located
  - Primary clusters are associated with the primary vertex
- Create a super cluster for every primary vertex cluster (the seed cluster)
- Cluster Algorithm: Search for clusters > 2 cm from the prim vtx associated with super clusters (slide 6)
- Hit Algorithm: Search for hits > 2 cm from the prim vtx associated with super clusters (slide 7)
- Create super clusters using un-assigned hits within 2 cm of the prim vtx
  - Require super cluster hit $\delta\theta$ wrt primary vertex > 0.4
- Create super clusters from isolated clusters

Algorithm uses 3 cuts

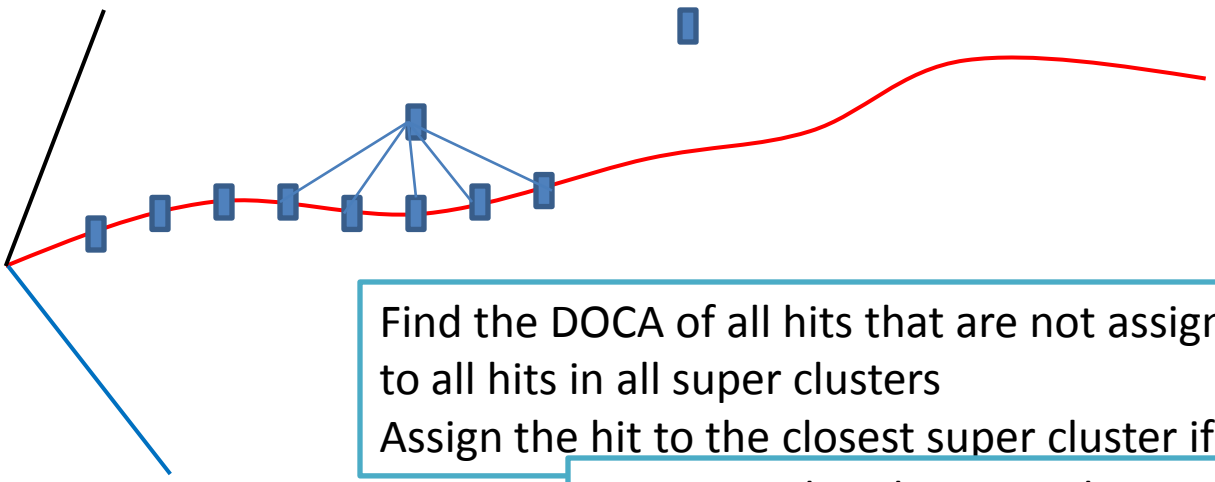
Cluster Algorithm



Find the distance of closest approach (DOCA) of the first hit of all clusters to all hits of all super clusters.
Assign all hits on the cluster to the closest super cluster if DOCA < 2 cm

Iterate until nothing new happens

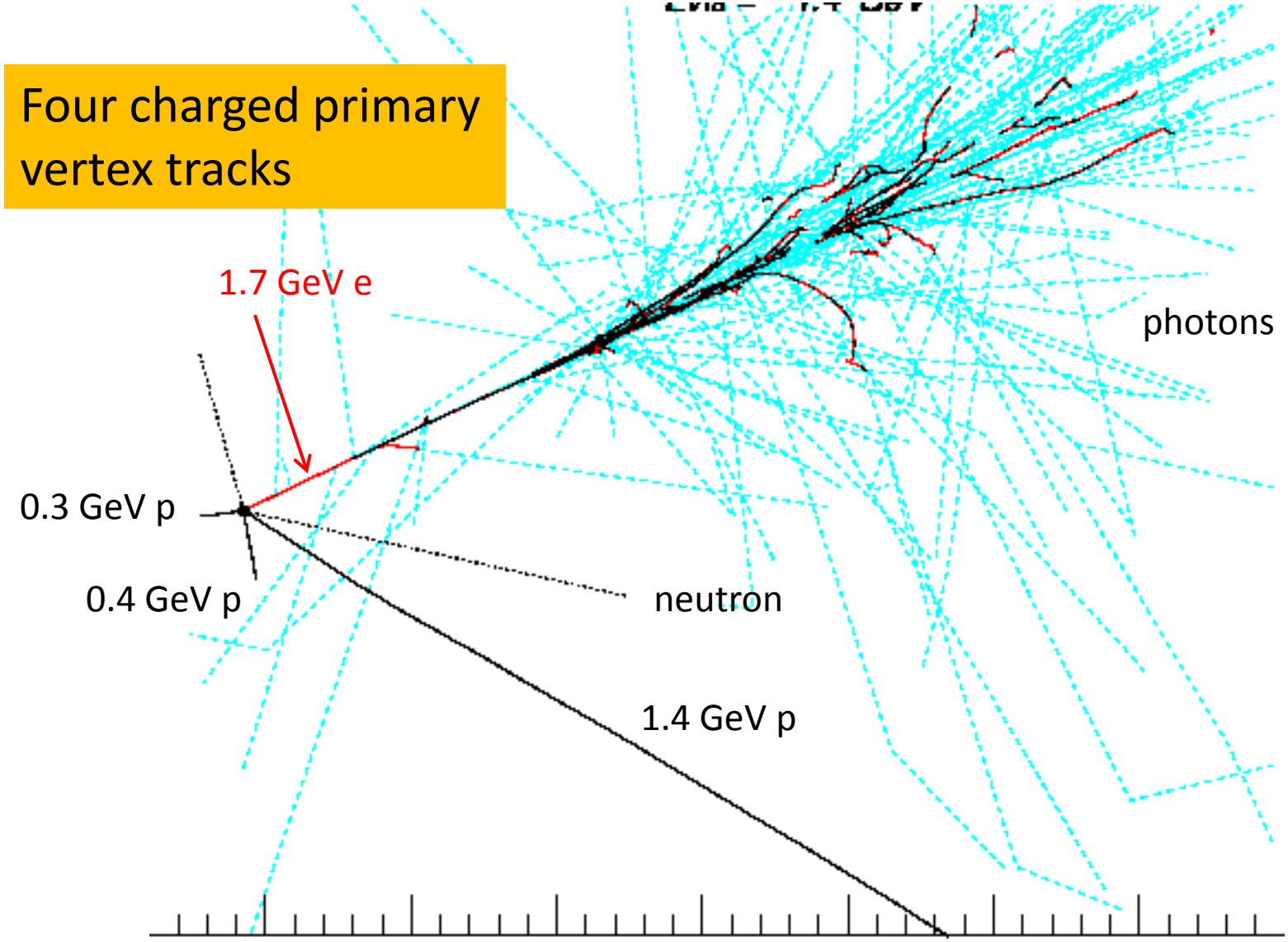
Hit Algorithm



Find the DOCA of all hits that are not assigned to any cluster to all hits in all super clusters
Assign the hit to the closest super cluster if DOCA < 2 cm

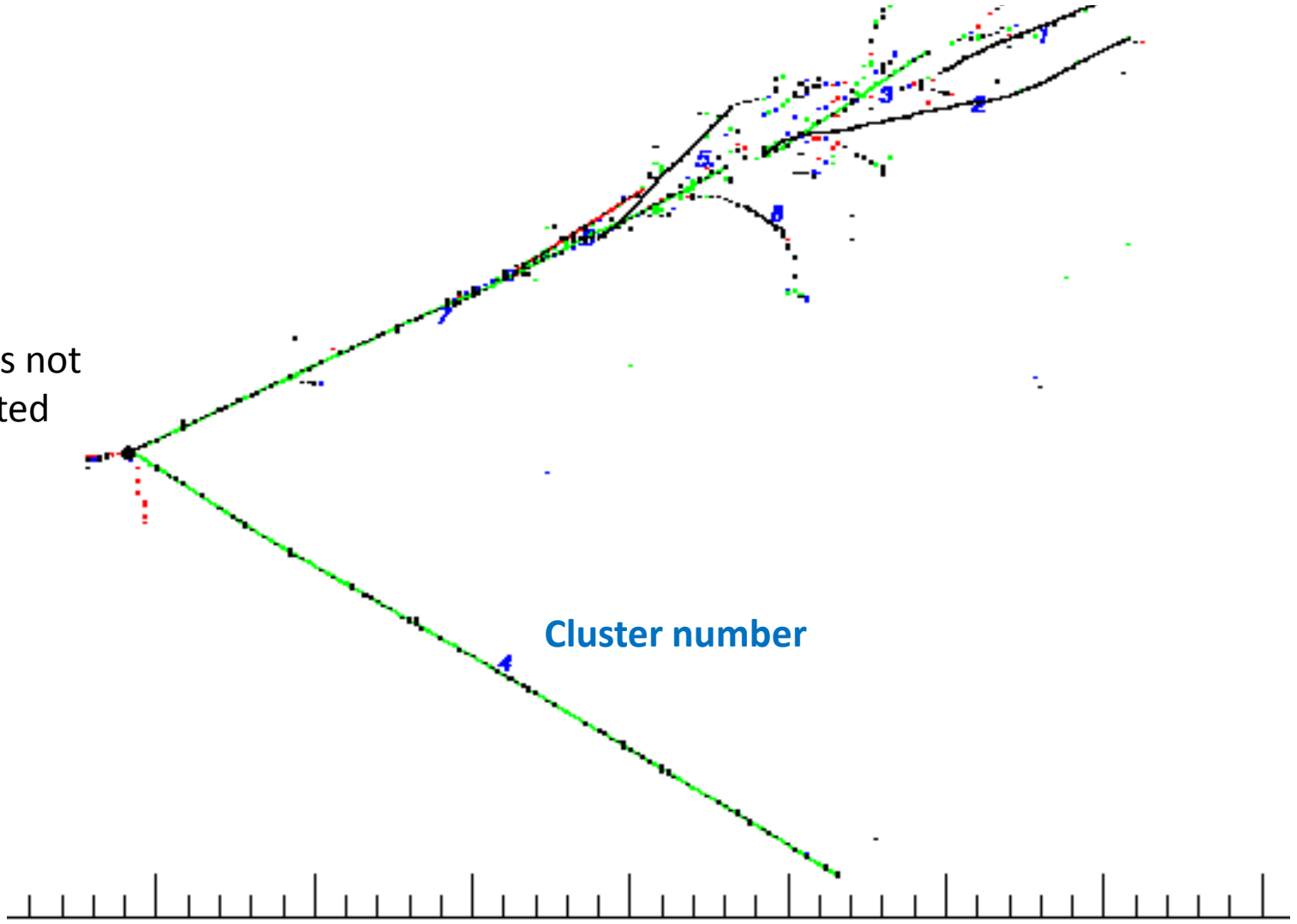
Iterate until nothing new happens

2.8 GeV CCe - Truth



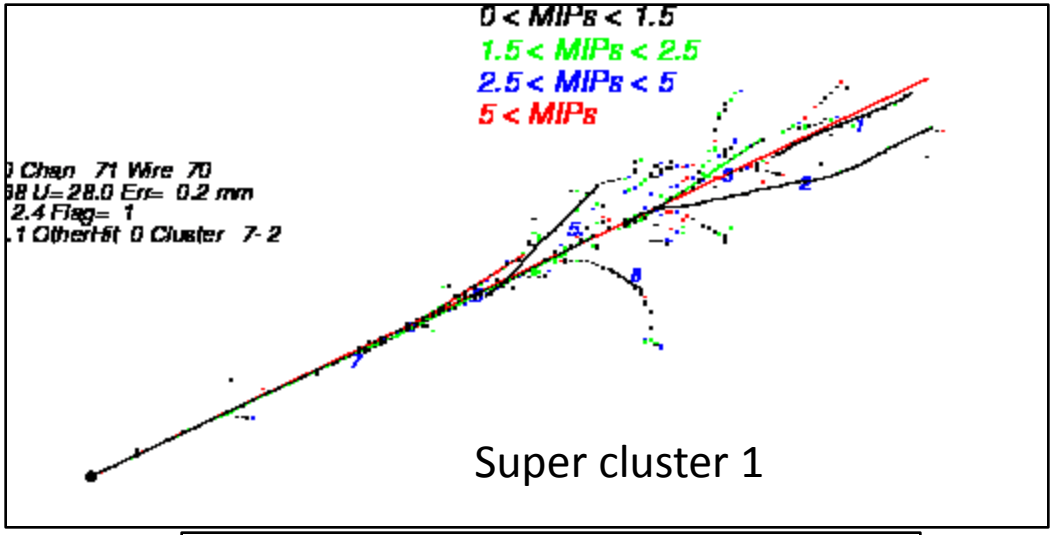
Reconstructed Hits & Clusters

Short tracks not reconstructed

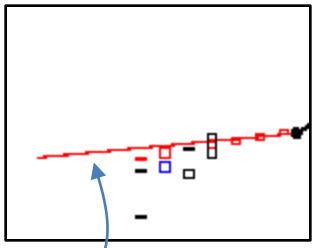


Reconstructed Super Clusters

Crude event display scheme for showing super clusters – only draw one super cluster at a time

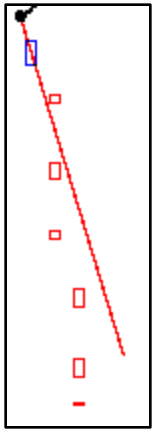


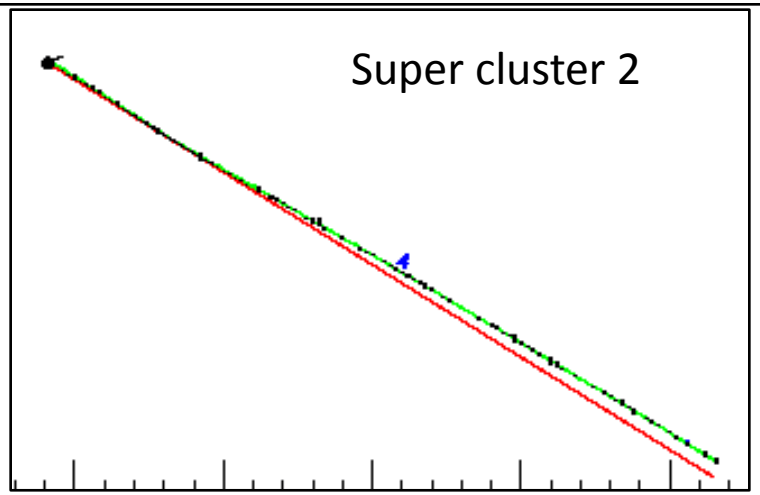
Super cluster 4



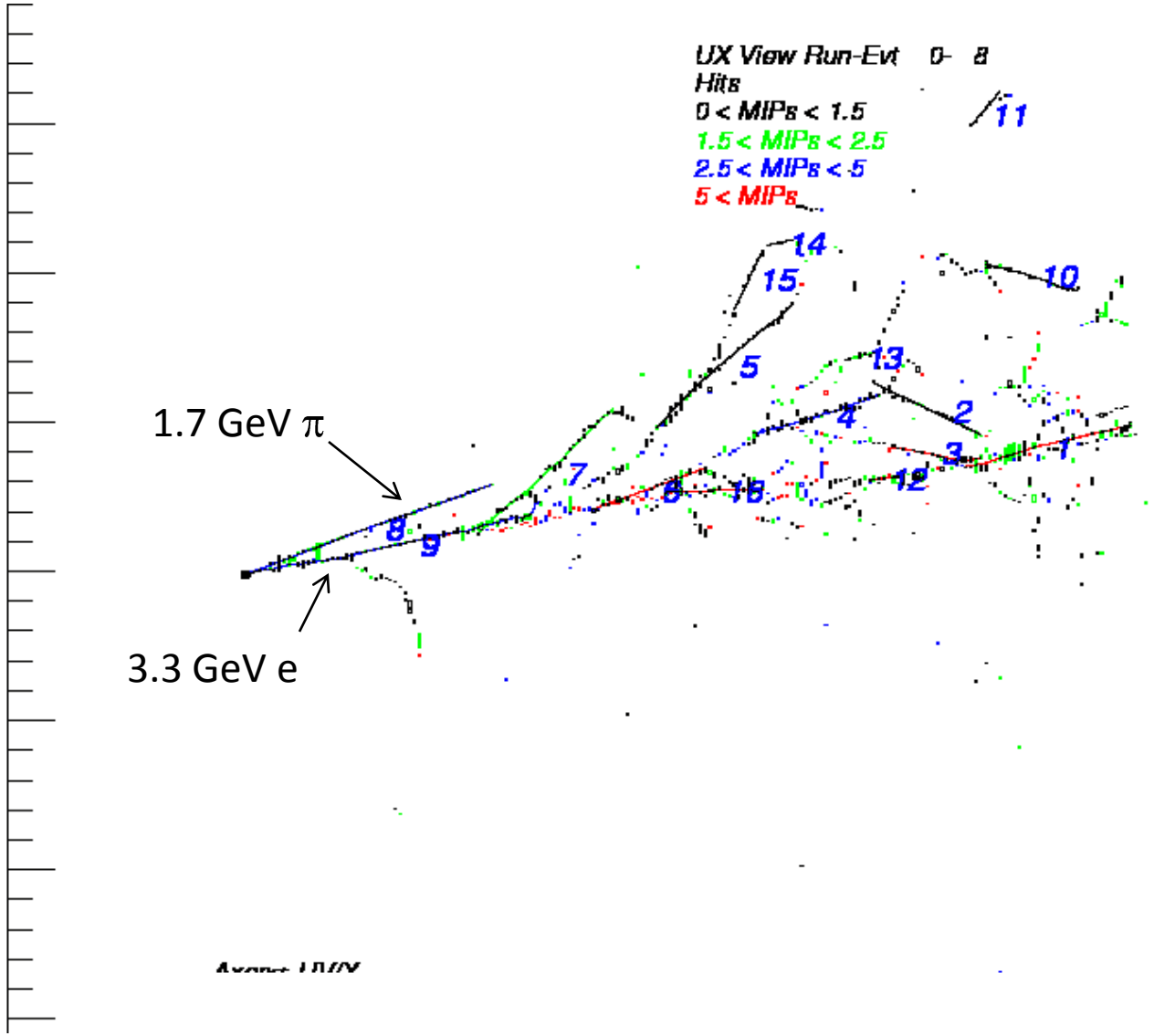
Red line shows the super cluster direction & length

Super cluster 3

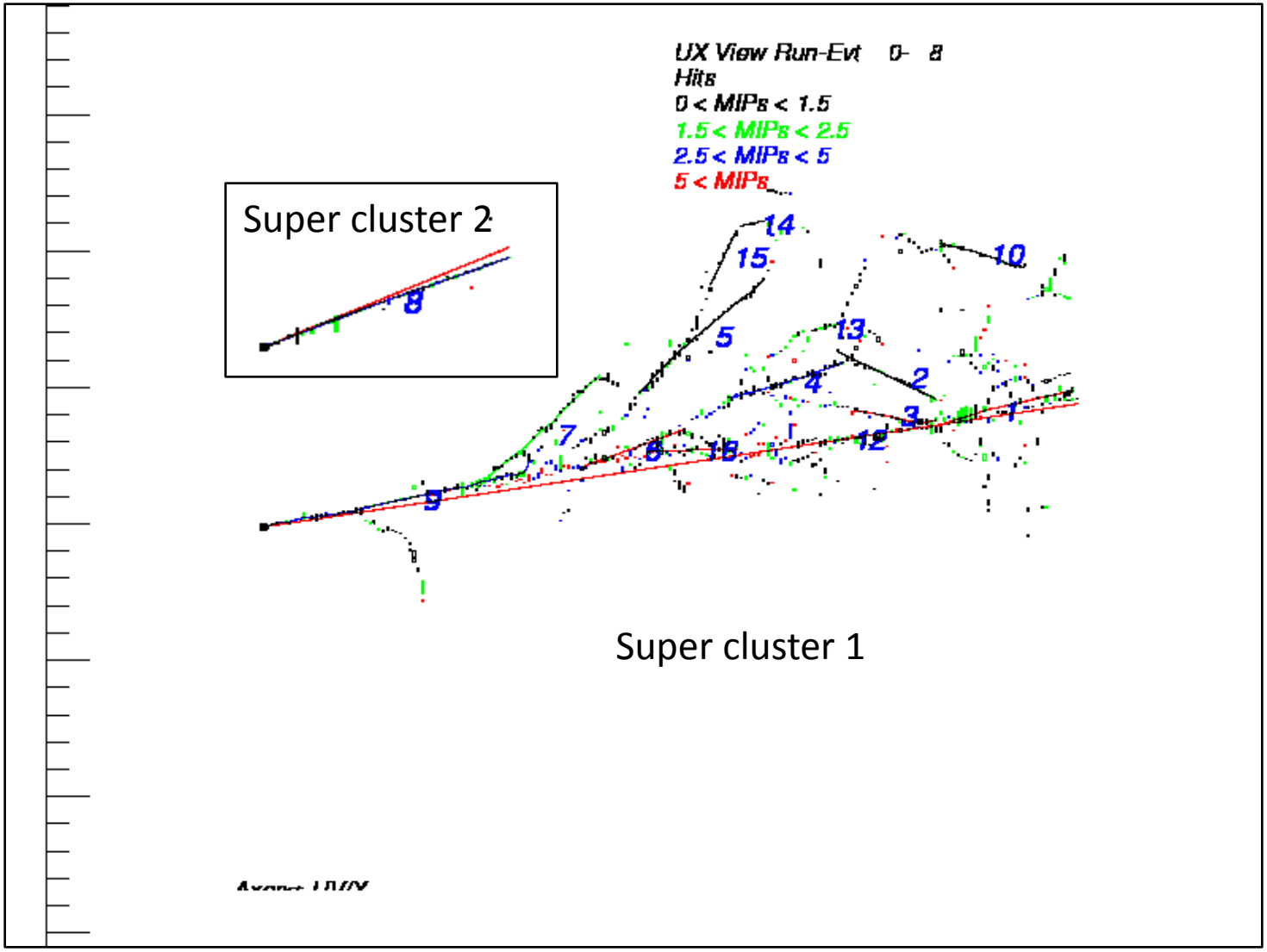




Another Event – Hits & Clusters



Another Event – Super Clusters



Plans

- Generate several thousand single electrons in 0.05 GeV < E < 3 GeV
  - Determine energy resolution
- Develop E/γ tag algorithm
  - (# of seed cluster hits)/(# of super cluster hits) < 0.5
- Develop E – γ separation algorithm (2D)
  - Ave MIP's of seed cluster hits near the vertex