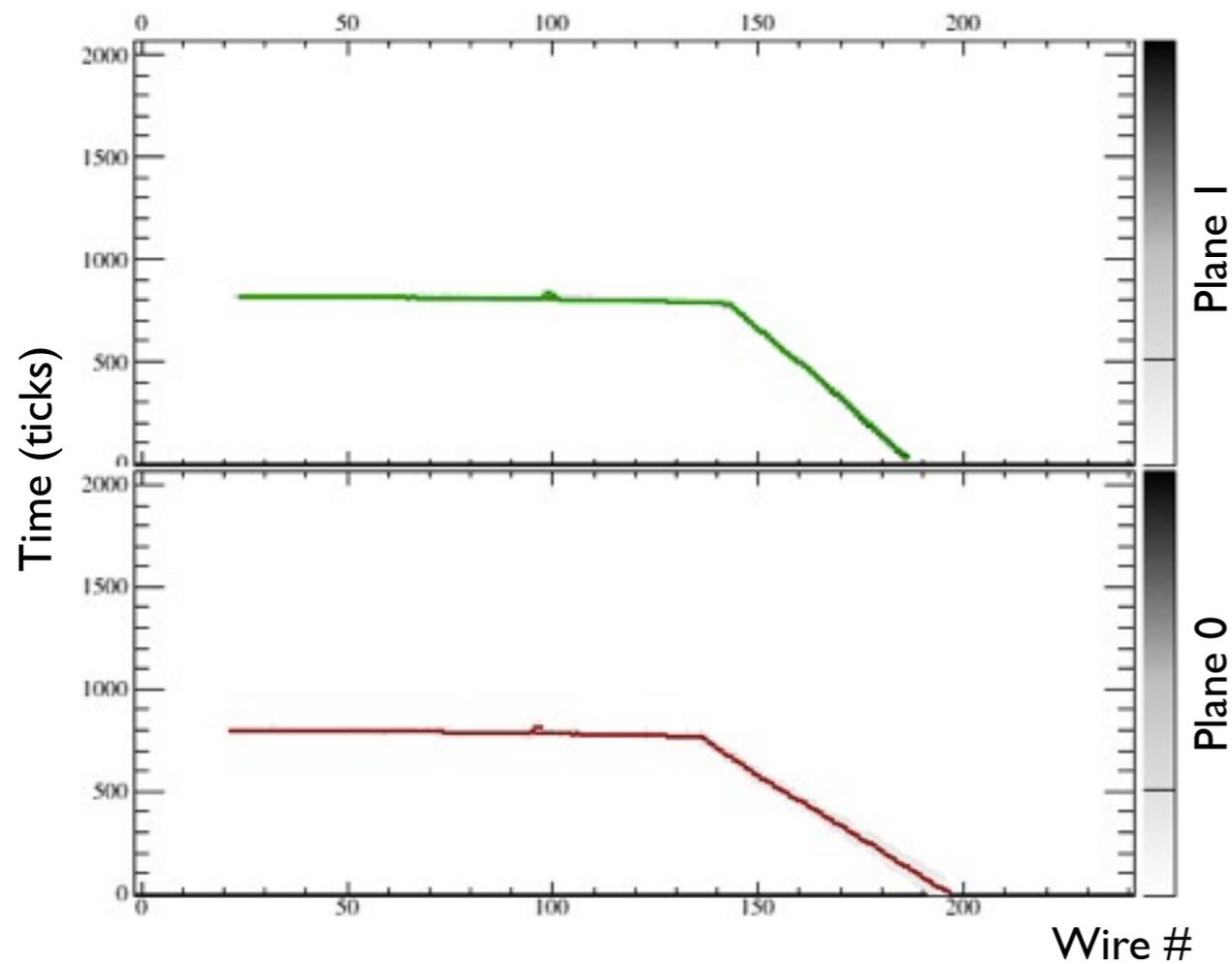


Single Charge Exchange Event Identification

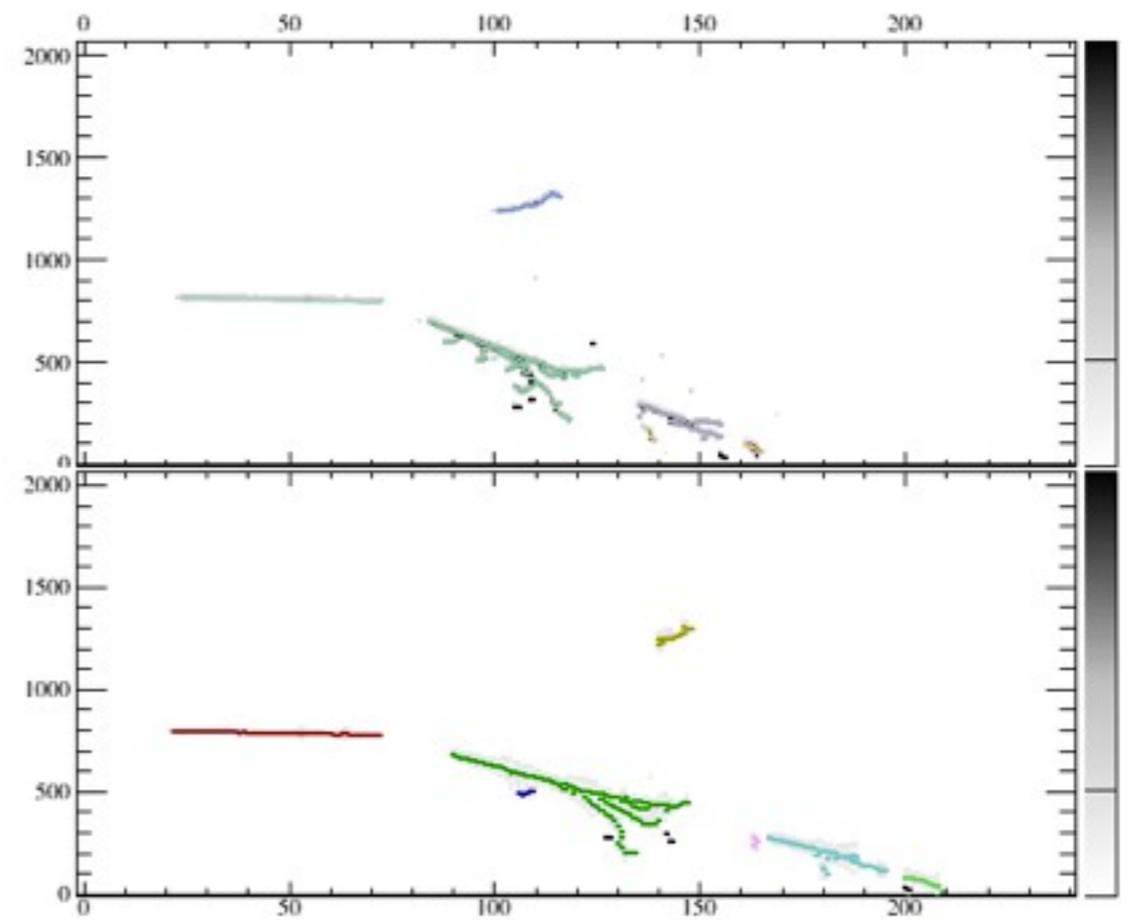
Ryan Linehan
Boston University

I'm interested in characterizing pion-Ar interactions for my thesis due in ~ 1 month

- Determine cross sections of different processes:
 - Elastic scattering
 - Inelastic scattering
 - Absorption
 - Charge exchange
- Focus on 2-D clustering for now - want to keep event ID'ing simple while time is short
 - Developing 2 modules to help with 2 kinds of event ID'ing:



Elastic scattering: want to divide clusters to see vertex



Single charge exchange: want to group clusters into showers

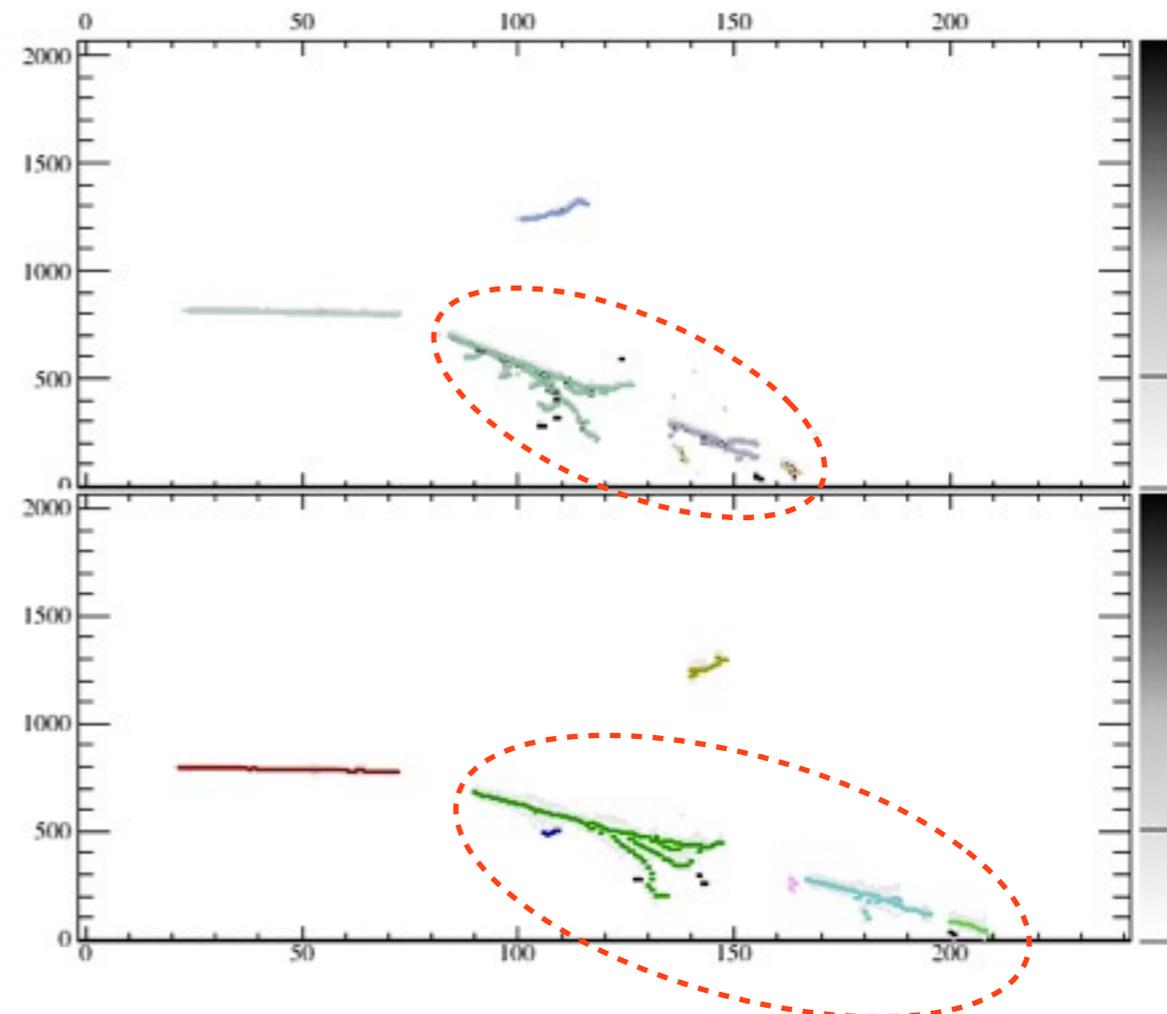
ShowerClusterMerger

Motivation: identify SCE based on showers from π^0 decay

- Ideally want 3 clusters per plane: primary + 2 EM showers above some hit # threshold
- Showers not always contiguous - want to group shower clusters together
- Existing clustering mechanisms didn't have great performance for this specific task

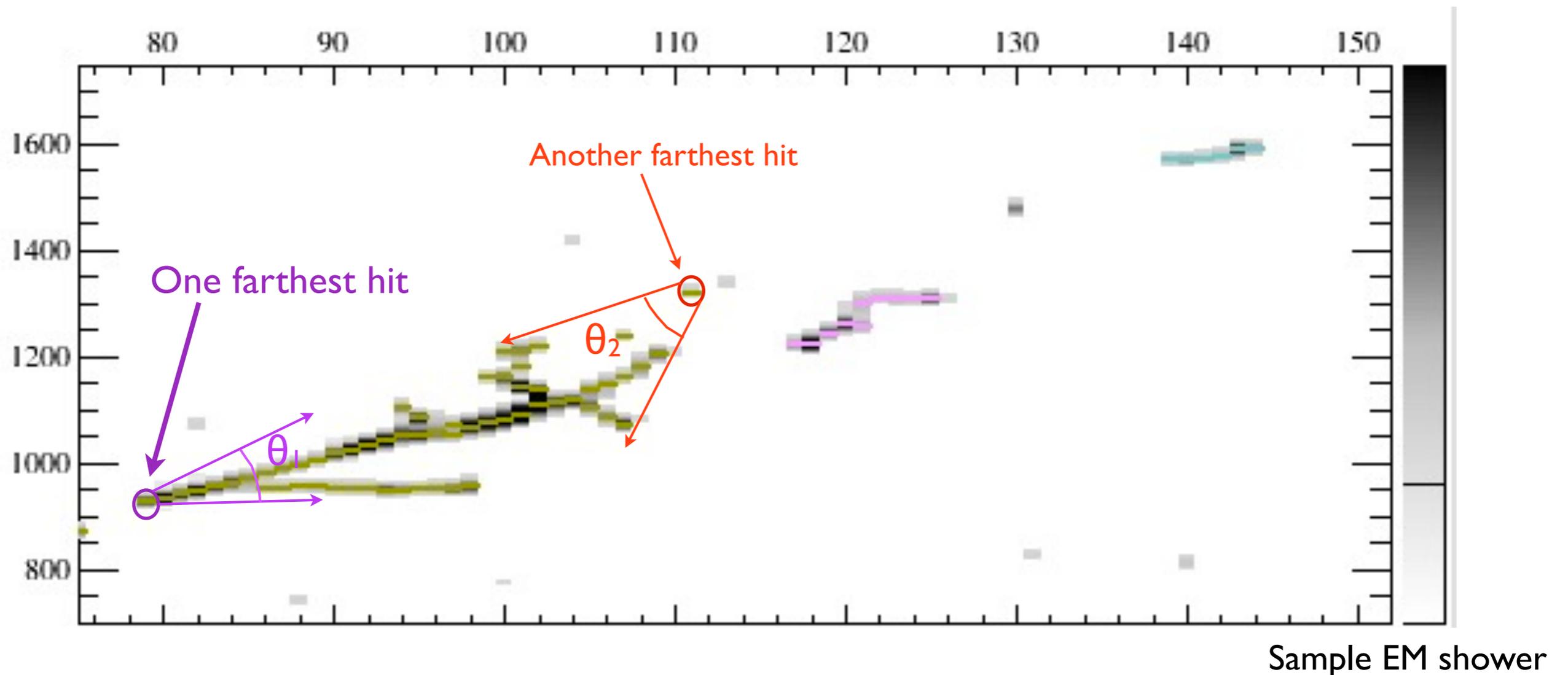
So I made my own way!

- Takes shower-like clusters created by dbcluster module and groups them into a new cluster
- Works by “guessing” a vertex



Example Single Charge Exchange Event with ungrouped shower clusters

“Guessing” the Vertex



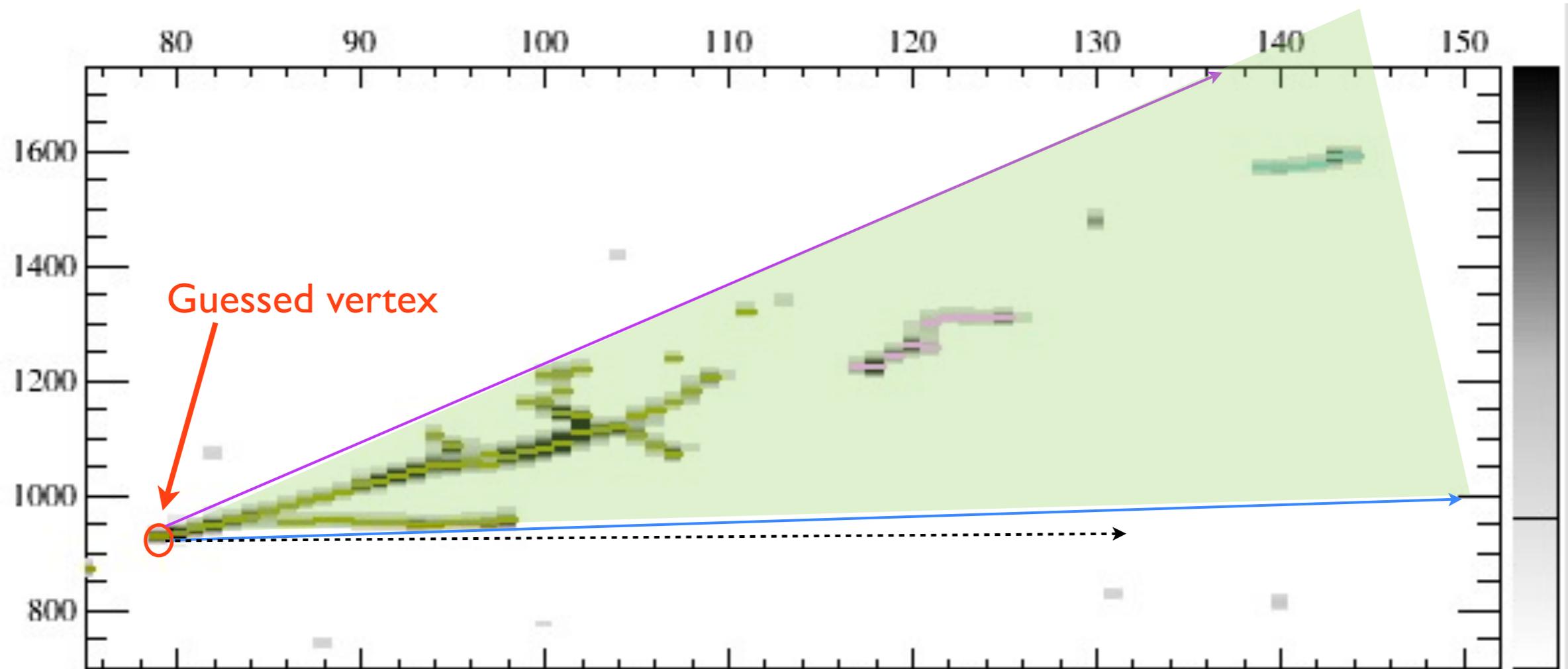
For each of the 4 cardinal directions (left, right, up, down), find the farthest hit in the cluster (sometimes, hits can double count as extremes)

- Find angular spreads ($\theta_{1,2}$ in the diagram) of the cluster relative to these farthest hits, and compare

Interpretation: whichever θ is lowest gives a reasonable vertex and thus a decent idea of the “direction” of the cluster

- Based on idea that large deflection happens at end of shower, will cause end-of-shower theta spreads to be large

Cluster Merging



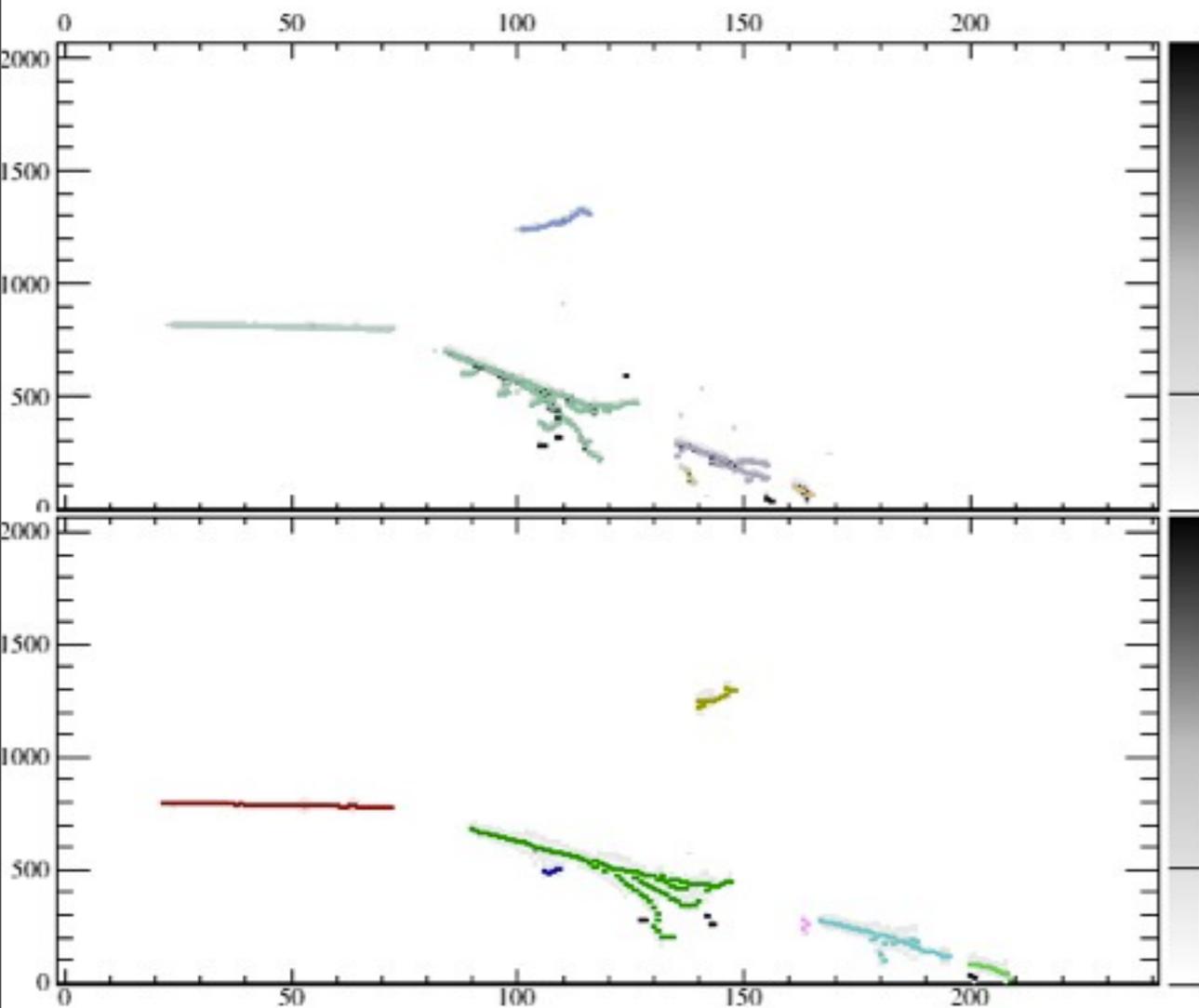
Once a vertex is guessed, look for all clusters on the same plane within the vertex's angular spread

- If a cluster is in here, then add it to the cluster with the guessed vertex
- This is the re-clustering / merging part

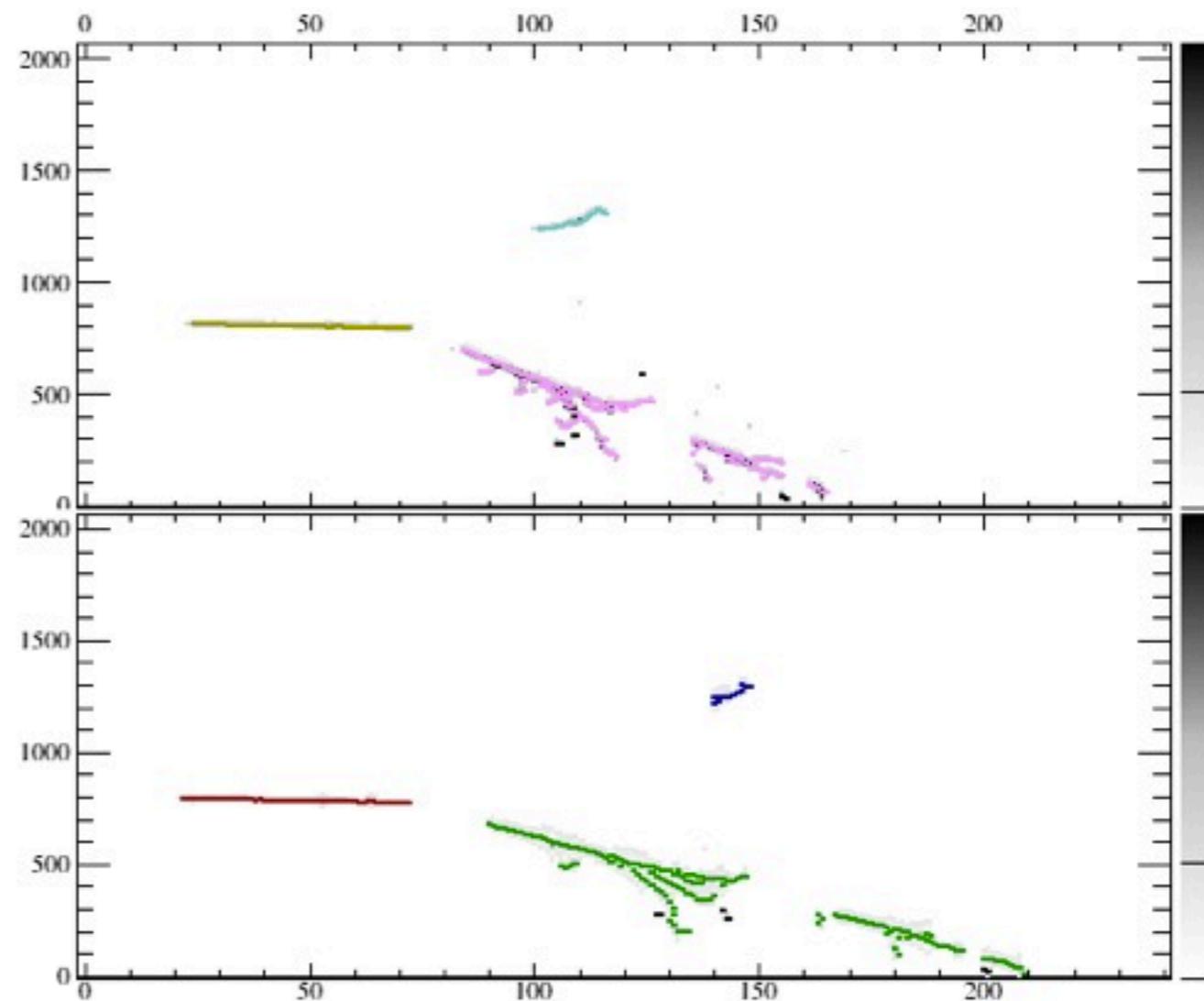
ShowerClusterMerger

Examples of the module at work:

Clustering only with dbCluster



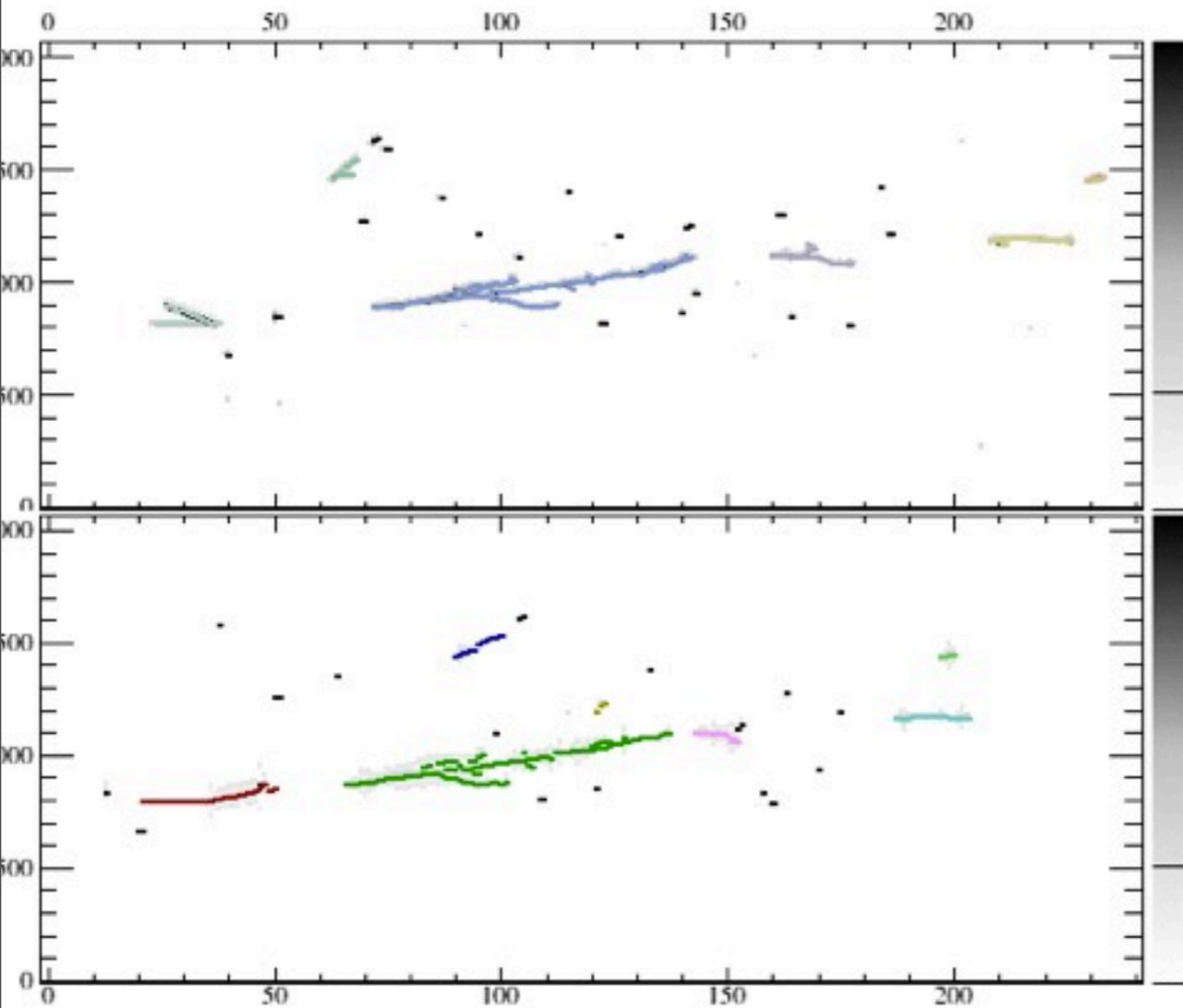
Clustering with additional
ShowerClusterMerger



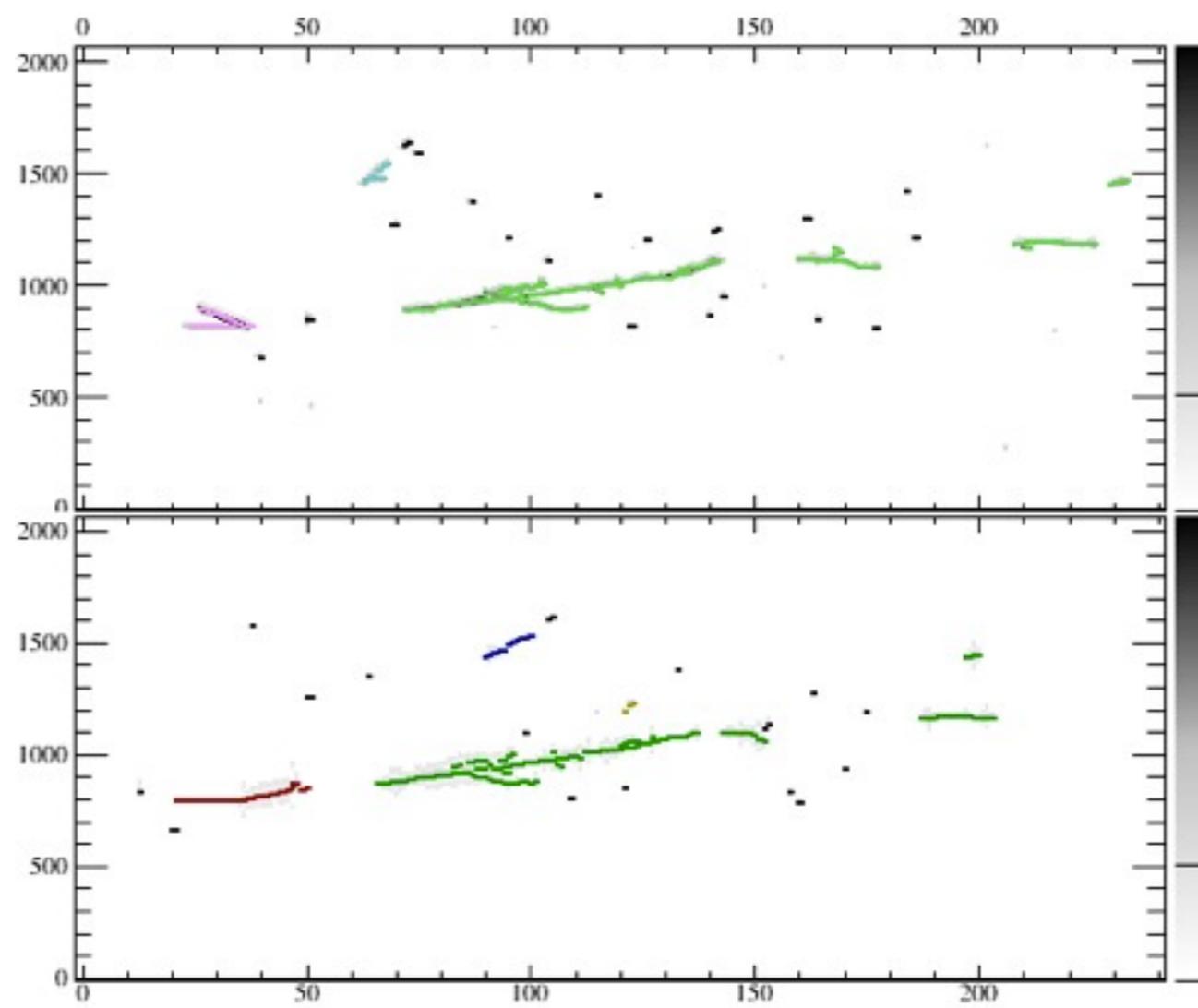
ShowerClusterMerger

Examples of the module at work:

Clustering only with dbCluster



Clustering with additional ShowerClusterMerger

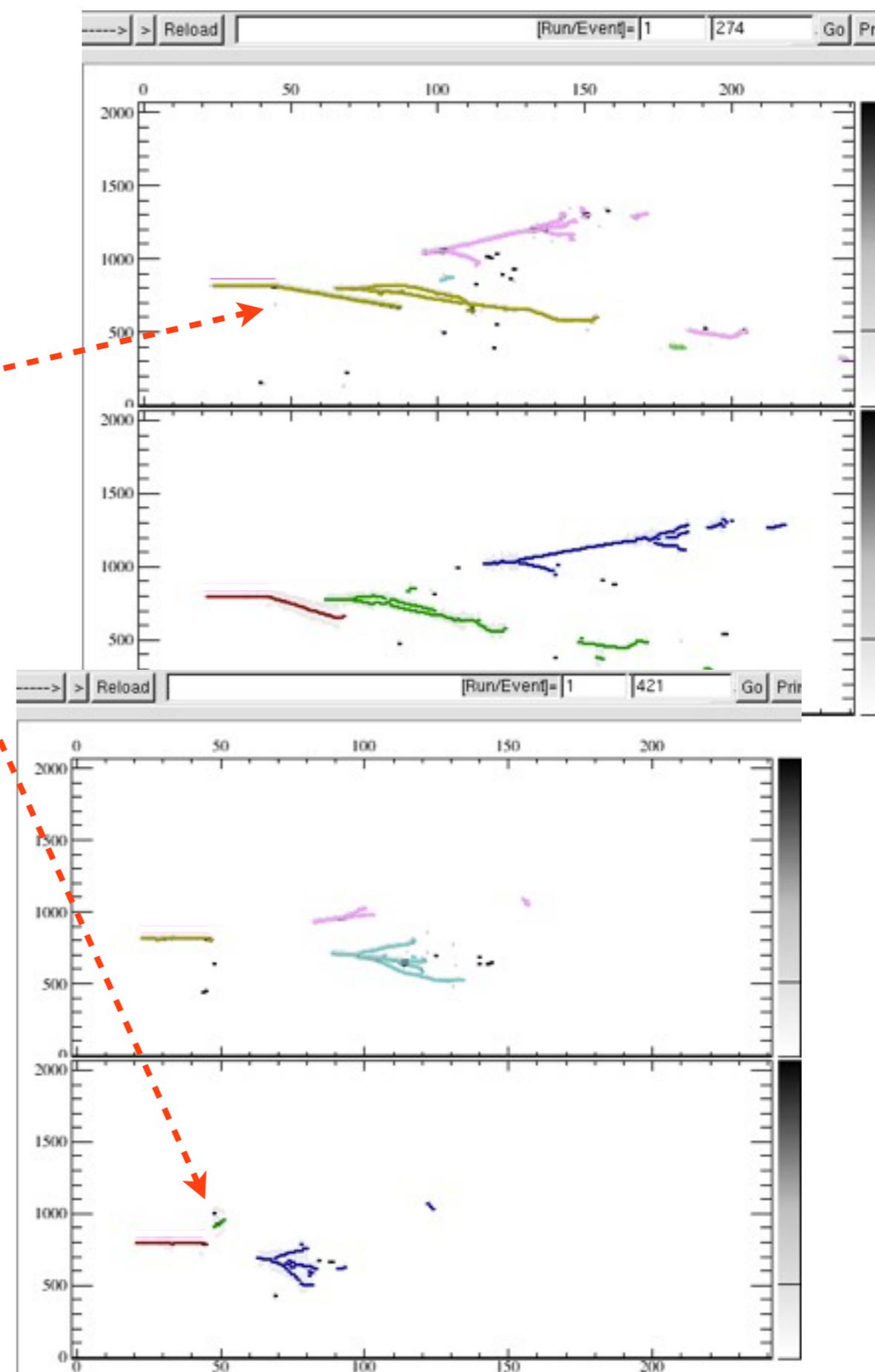


Problem Areas

Took quick sample of 56 single charge exchanges, classified problems that arose.

Problem Type	# Times Occurred
Shower absorbed in primary	29
Imperfect searchlight	13
Showers overlap/merging	7
Shower below hit # threshold	10
Poorly reconstructed vertical hits	6
Other	5

Note: there often were multiple problems with a single event.



Summary

ShowerClusterMerger Module:

- Intended to help identify single charge exchange events by grouping shower clusters

Future steps:

- Compare ID efficiency with existing clustering algorithms
- Find ways to alleviate the problems mentioned

This is still under development, but when finished, should give a bit more control in the event ID'ing necessary for cross section measurements.