Reconstruction Status in LArSoft

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liquid Argon reconstruction

- LArSoft - Liquid Argon Software

- several smaller detectors - ArgoNeuT, µBooNE, LArDBT - all LAr Time Projection Chambers

- develop reconstruction algorithms for all detectors and take advantage of solutions for shared challenges

  - hit, tracking algorithms, vertexing, clustering

- individual experiments extend LArSoft for detector specific effects
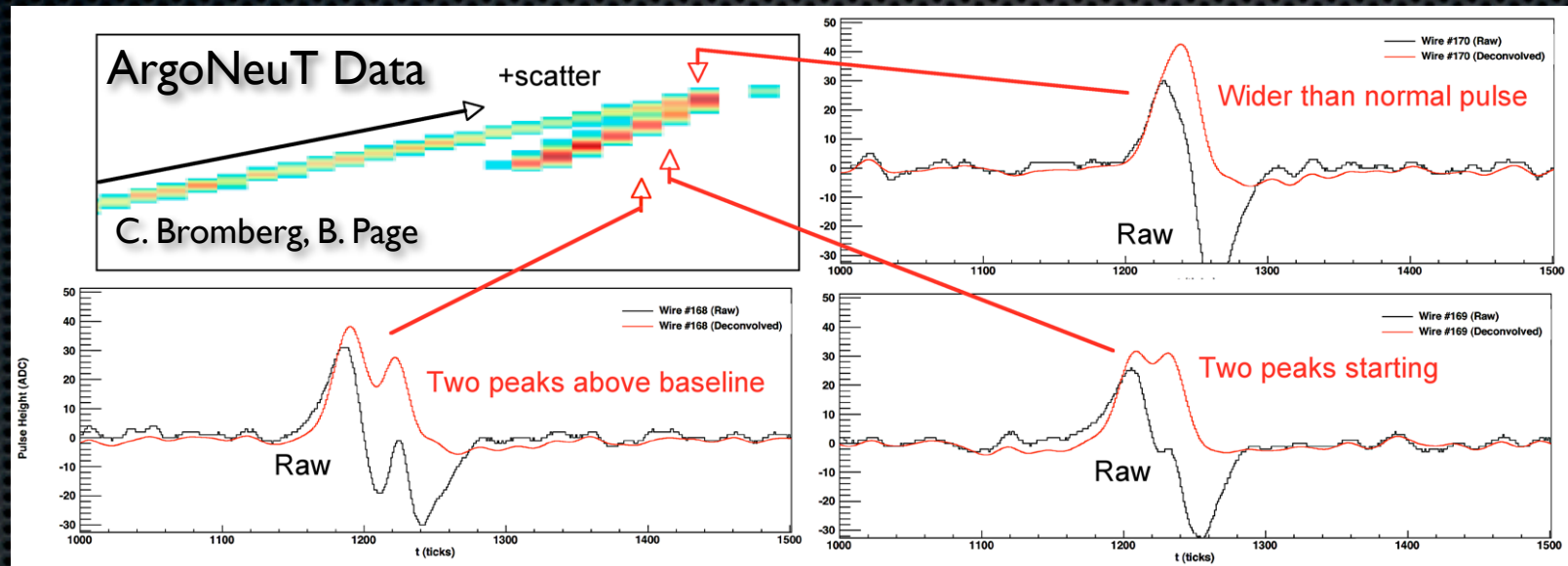
LAr event reconstruction
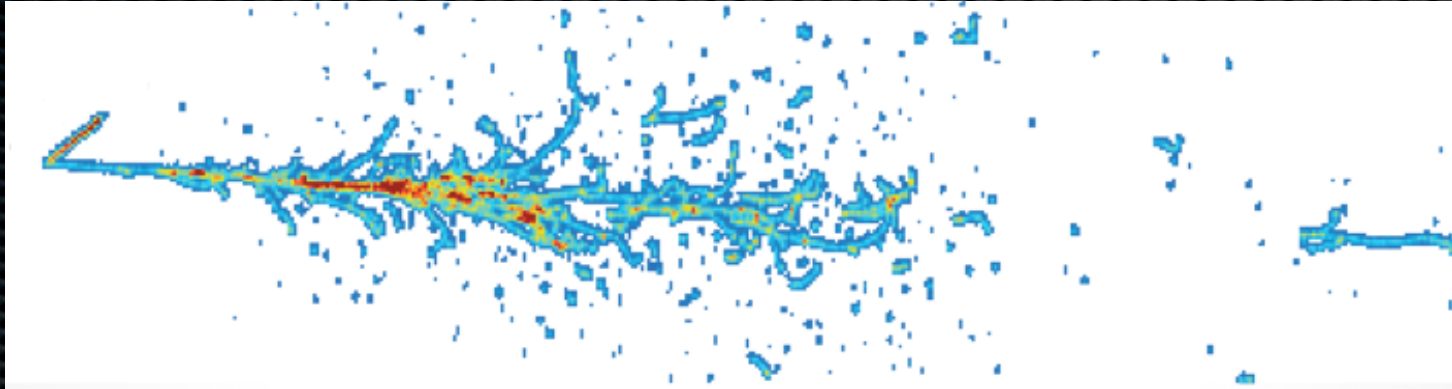
- reconstruct all of the interacting partciles

- electron/photon discrimination - dE/dX

- improved cluster energy resoultion

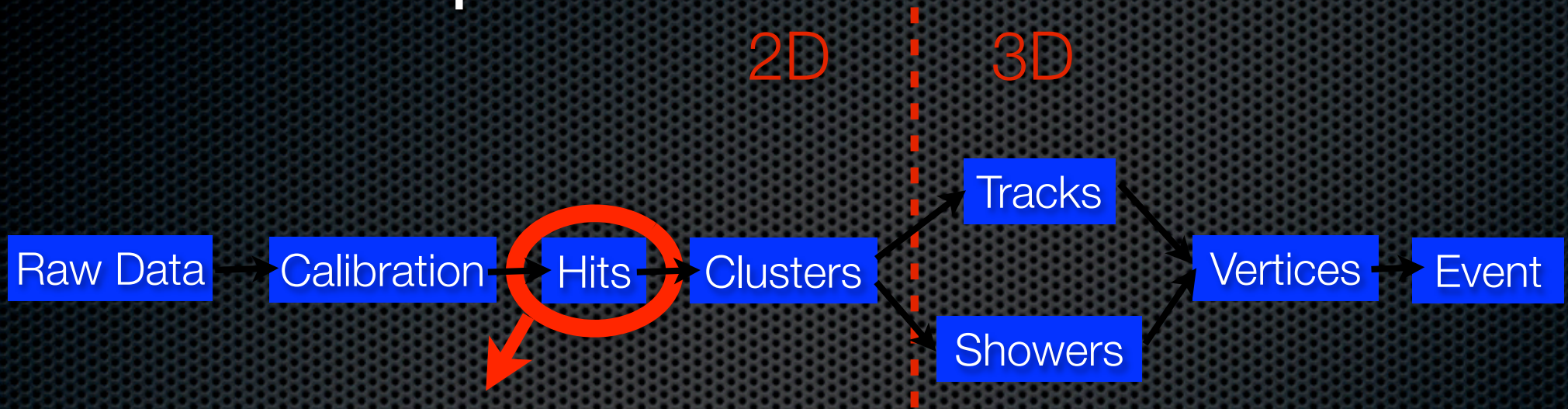- vertex reconstruction from 3D tracks
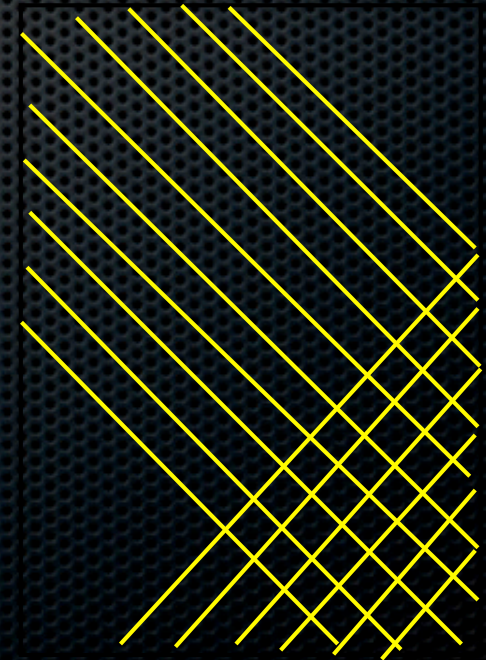
Reconstruction Chain
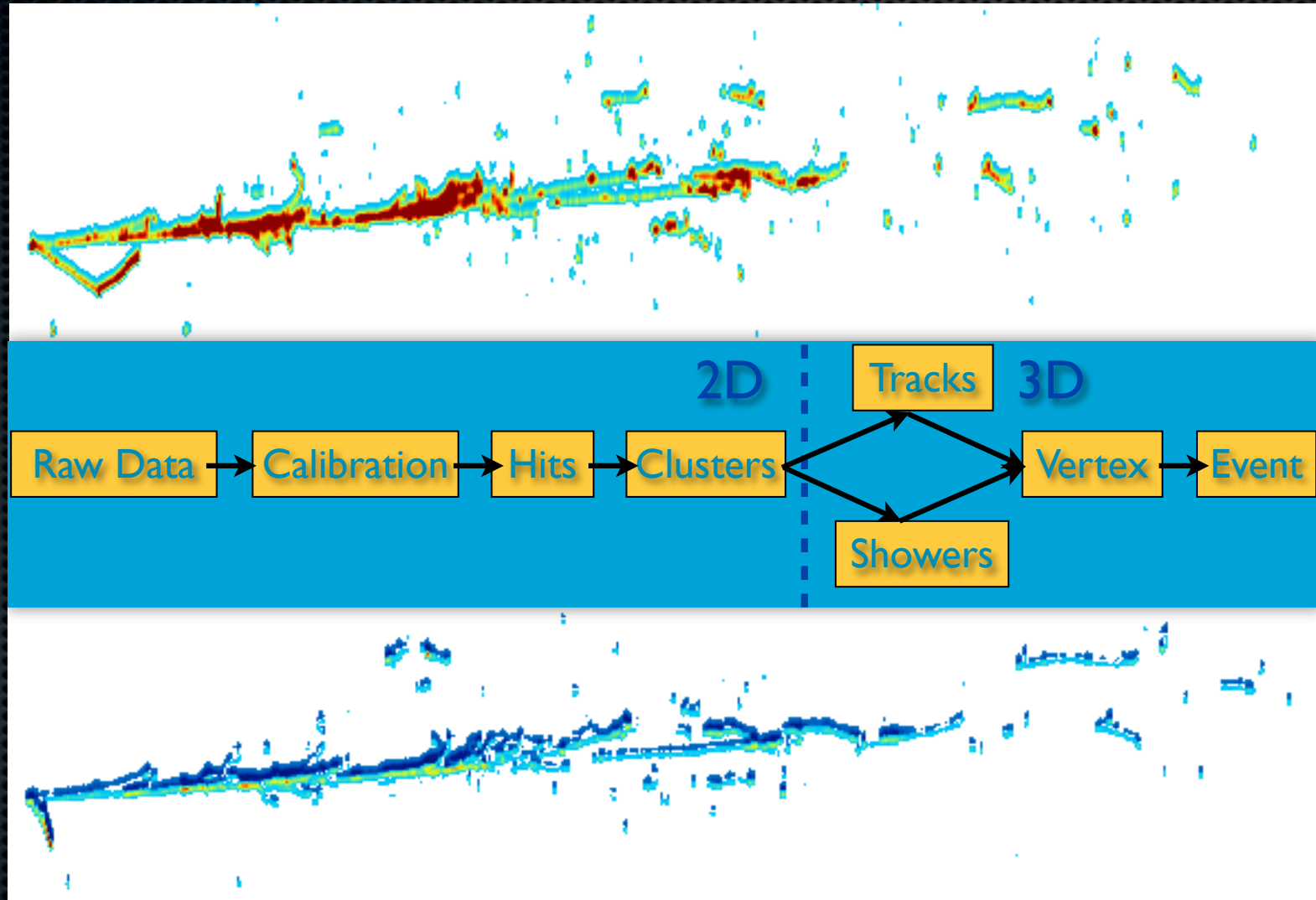
Hit Reconstruction

- Hits are signals on a wire that have gone above a determined ADC threshold

- Hits are found using a Gaussian fit

- Closely spaced hits are identified using multiple-Gaussian fit

LBNE specific needs

2D | 3D

Raw Data → Calibration → Hits → Clusters → Tracks → Vertices → Event

Clusters → Showers → Vertices

- hit from wrapped wires in anode plane assemblies

- interface with simulation group

- use other detector elements

- dead channel effects

LBNE specific needs

2D | 3D

Raw Data → Calibration → Hits → Clusters → Tracks / Showers → Vertices → Event
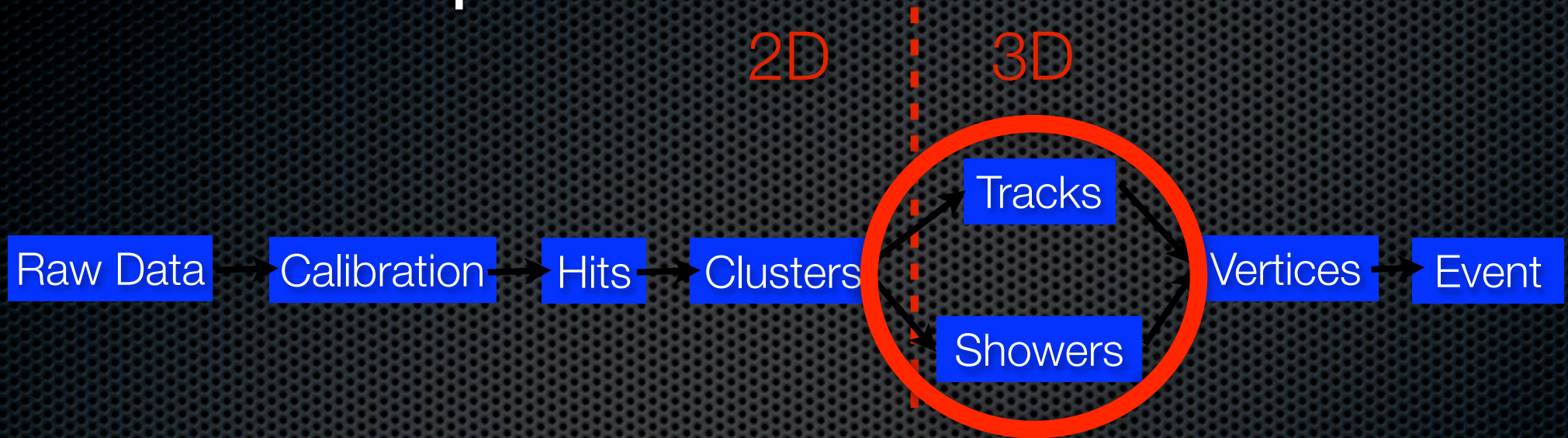
- tracks that cross TPC/cryo module boundary

- understand effect on acceptance and resolution

- calorimetry across TPCs
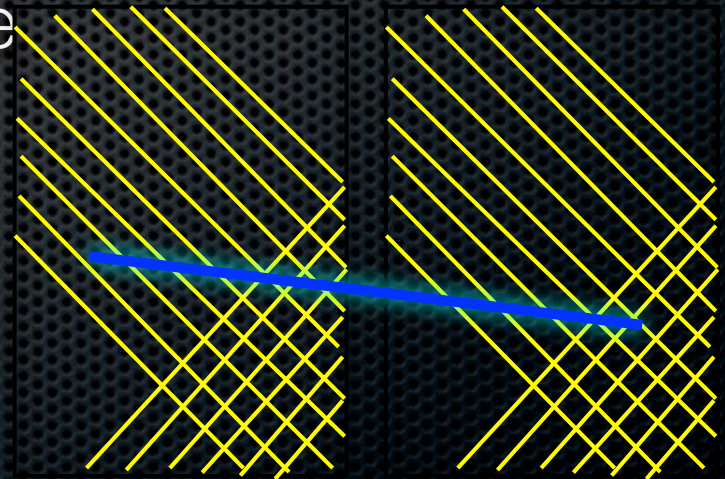
Getting to Tracks

- 2D track reconstruction strategy
  - start with Hits and build tracks in 2D (HoughLineFinder)
  - combine 2D tracks into 3D tracks (Track3Dreco)
  - ArgoNeuT
- 3D track reconstruction using SpacePoints
  - start by building SpacePoints from Hits
  - build 3D tracks from SpacePoints
  - this strategy with a 3D Kalman Filter
- 3D track with 2D Hits as inputs
 - Kalman Filter being implemented with potential seeds from 2D stubs
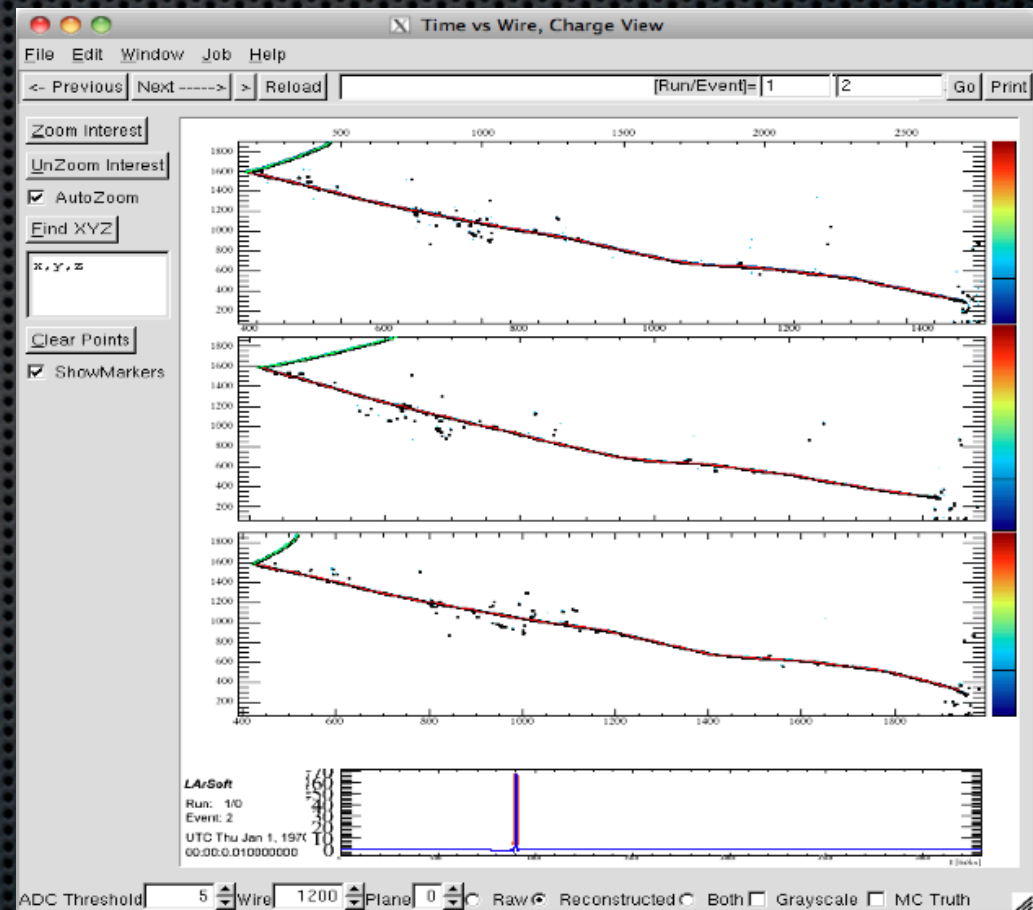
Next steps in tracking

- Additional ideas based on seeds and fast implementations for ArgoNeuT being considered

- Hope to have stable tracking on the scale of 6 months

- Continue to explore both SpacePoint and 2D Hit strategies

- Next step is Vertex reconstruction

    - currently have 2D vertexing for ArgoNeut and needs to be extended

2D Vertexing in ArgoNeuT
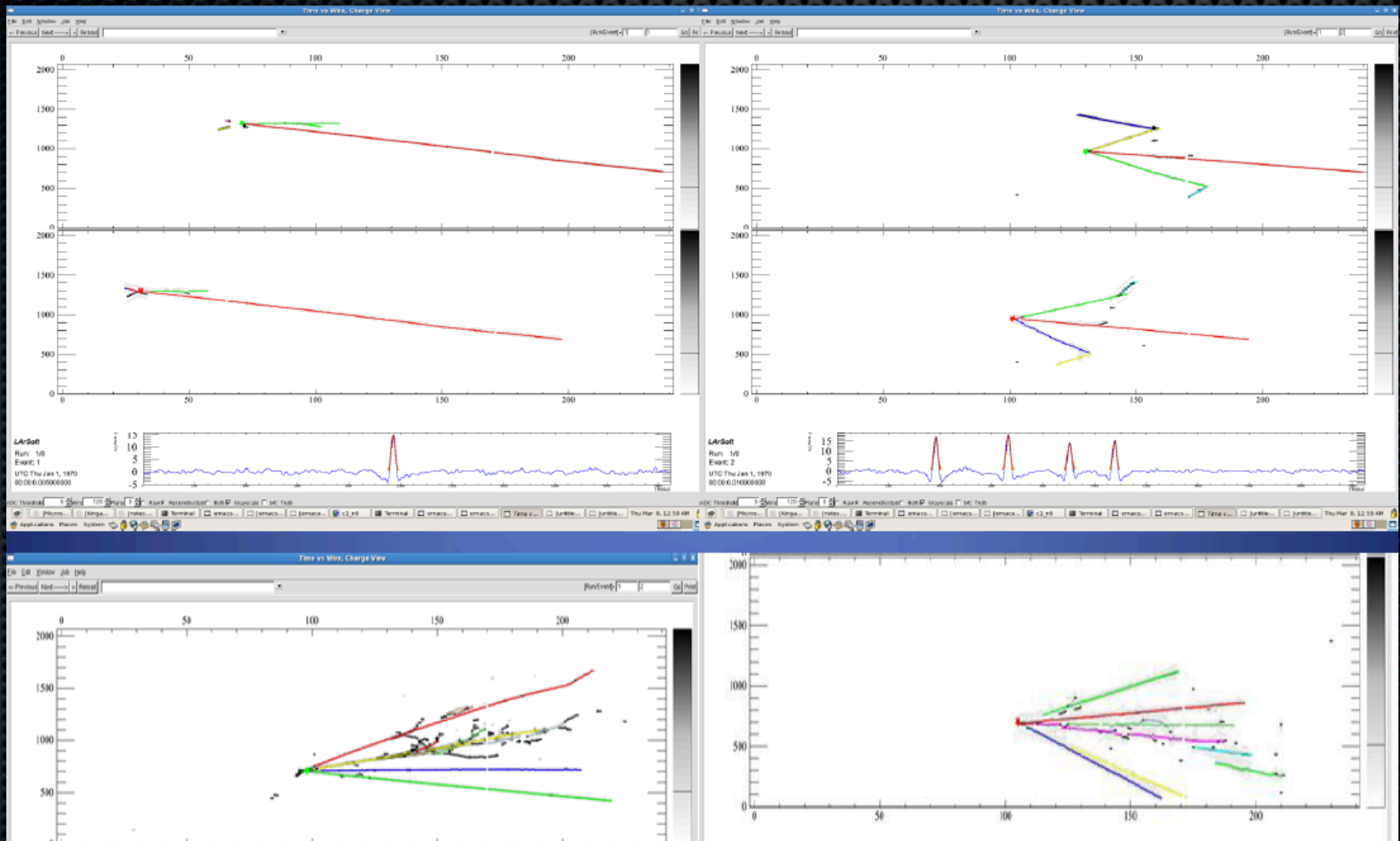
Cluster Reconstruction
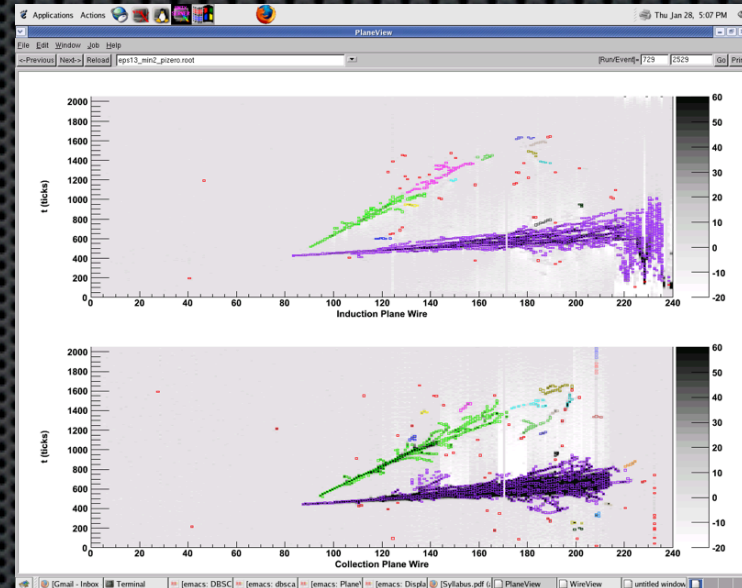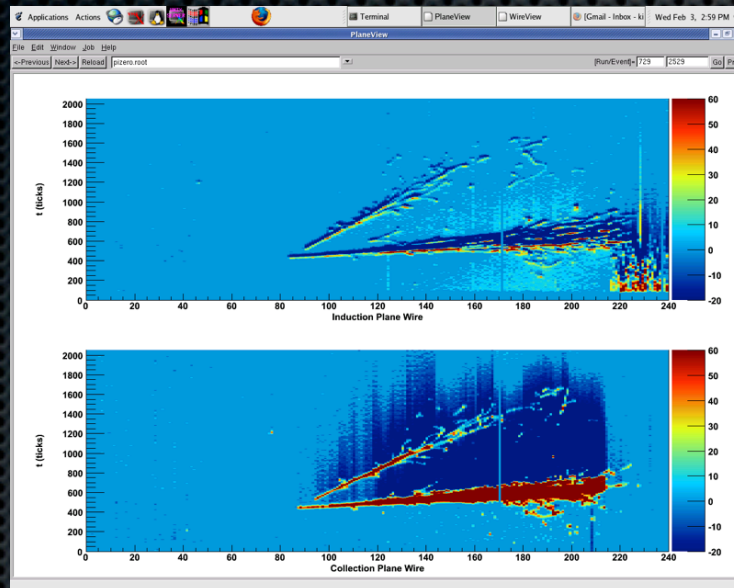
- Clusters are defined as groups of hits that are associated in time and space

- Use Harris transform (image processing technique) to identify end points in 2D views as seeds for clusters

- Several current clustering techniques in use, can identify straight lines using a Hough transform and arbitrary shapes using a density based algorithm

Particle ID based on dE/dX
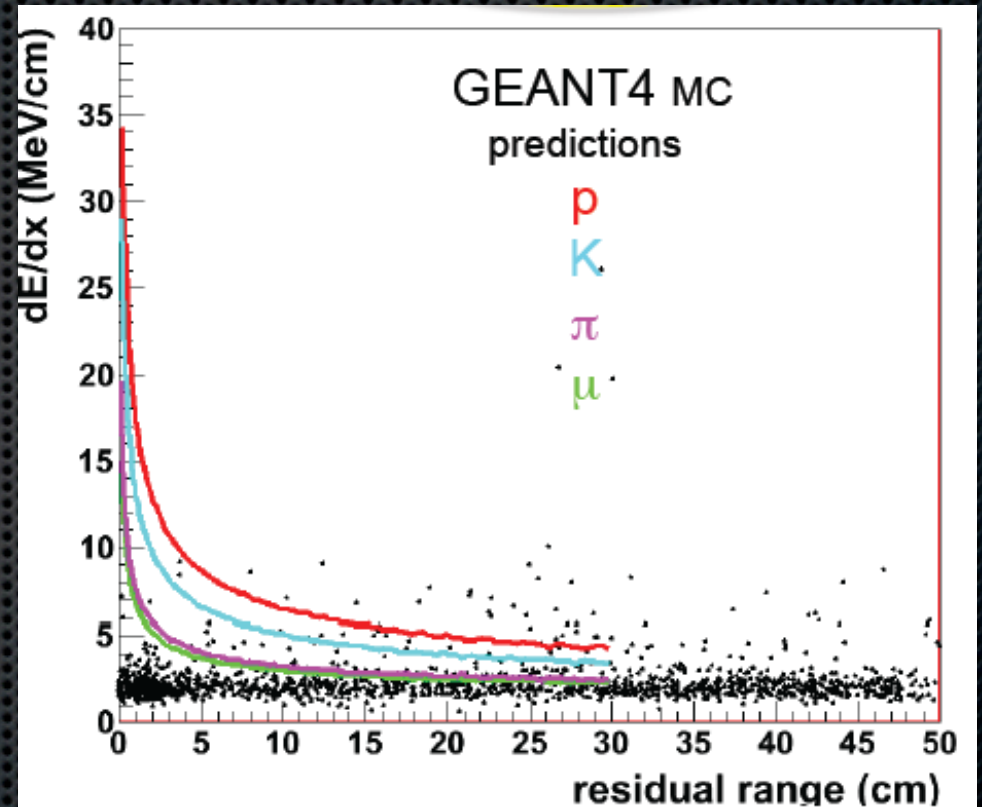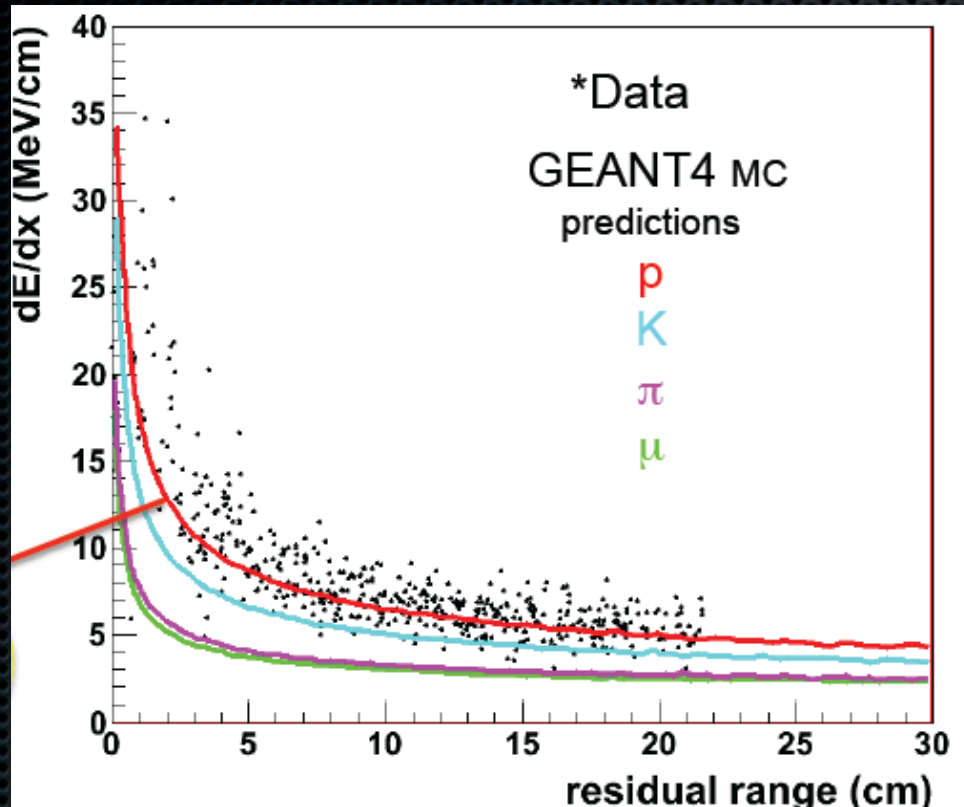
- ✺ protons in ArgoNeut data
- ✺ muons in μBooNE MC

Summary

- LArSoft continues to very actively be developed

  - improvements in hit, track, vertex, and cluster expected in the very near future

- Work ongoing to develop LBNE far detector geometries - specifically wrapped wire APAs

- large scale simulation generation has begun for μBooNE which should provide an excellent sandbox

- ArgoNeuT data playing a key role in validation