LArSoft/Tools Update

Eric/Herb

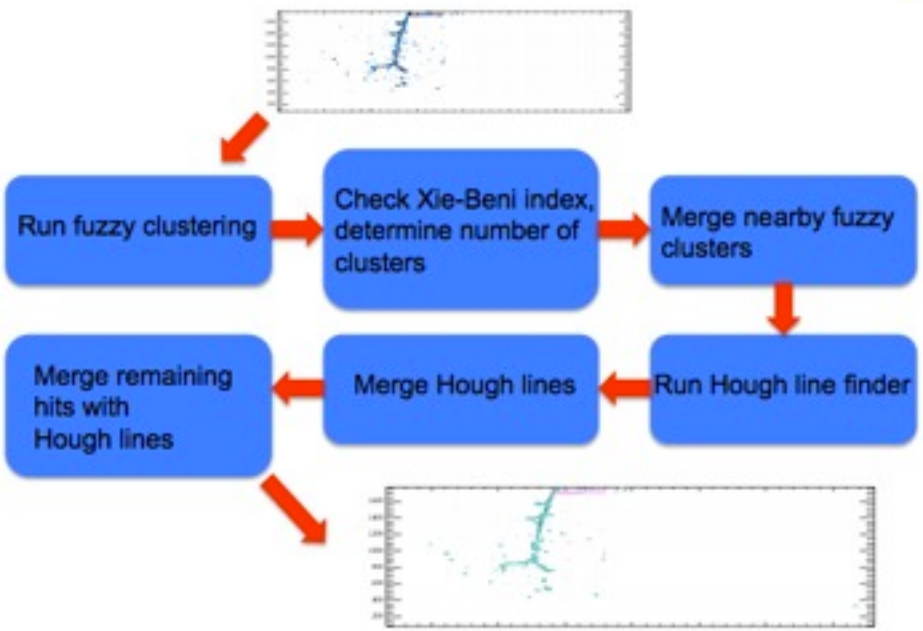
6 Sep, 2012

Outline

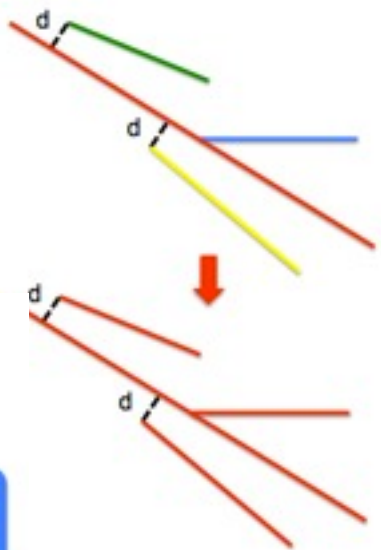
- LArSoft reconstruction/infrastructure developments since last meeting
- Disproportionate # (3) of slides on High-minded considerations of where we're going
- MC challenge
- uBooNE codebase

Fuzzy Clusters

Ben Carl's work



Showers with Hough lines

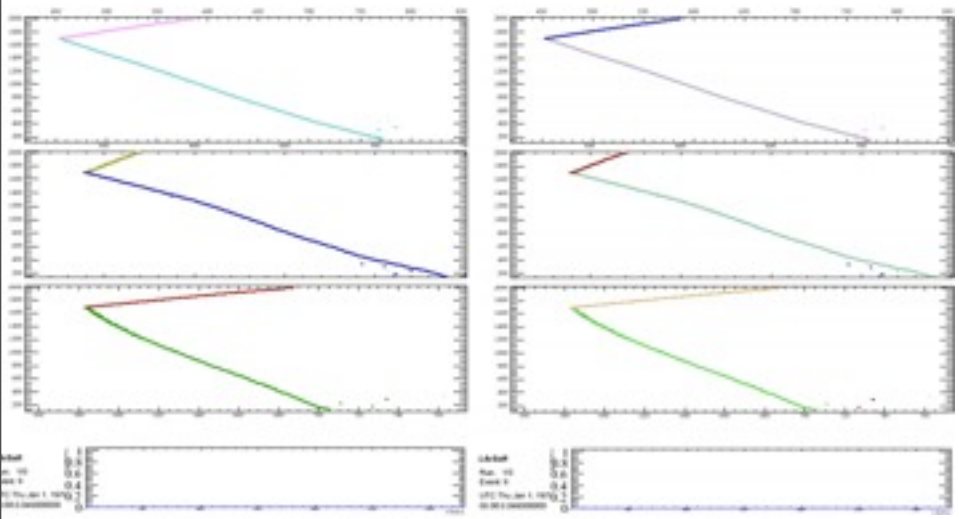


Hough line finder very effective at finding lines in showers

Now aiming to capitalize on this, merging Hough lines together to construct showers

Merge Hough lines using the distance between the line segments and angle between slopes < 20°

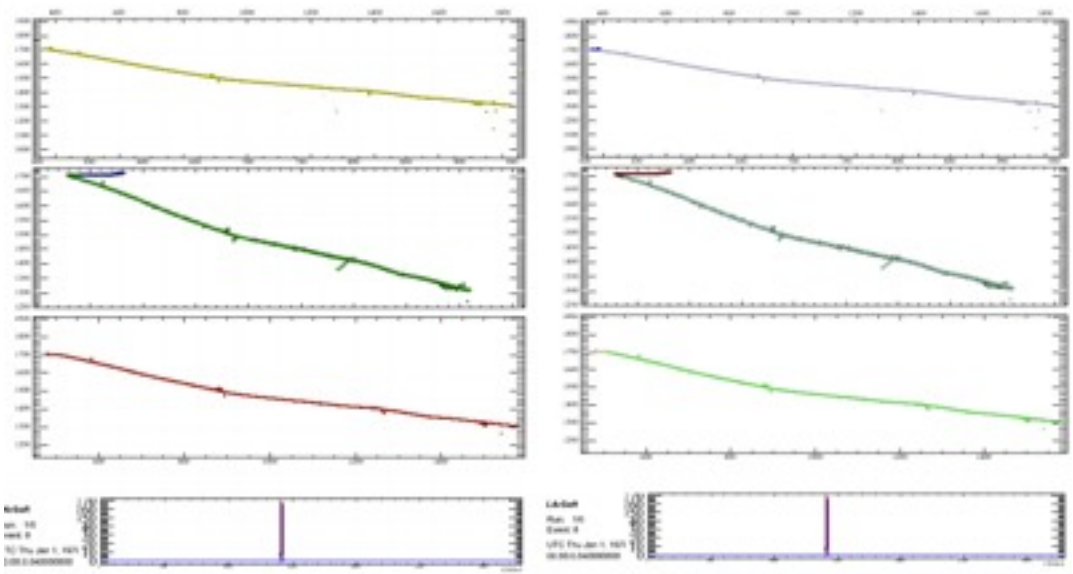
Fuzzy 2



Fuzzy and Hough line clustering

Cluster cheater

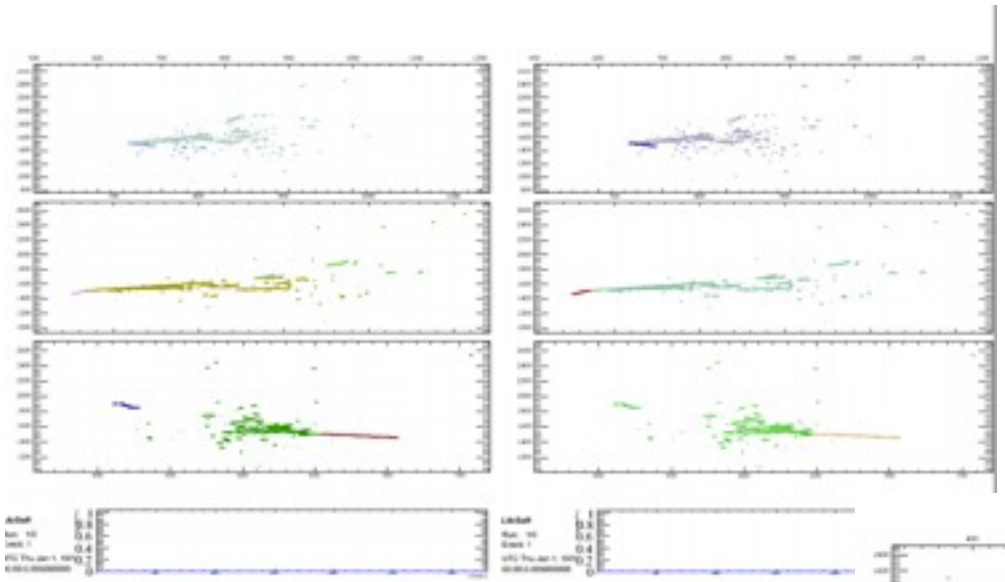
numu CCQE



Fuzzy and Hough line clustering

Cluster cheater

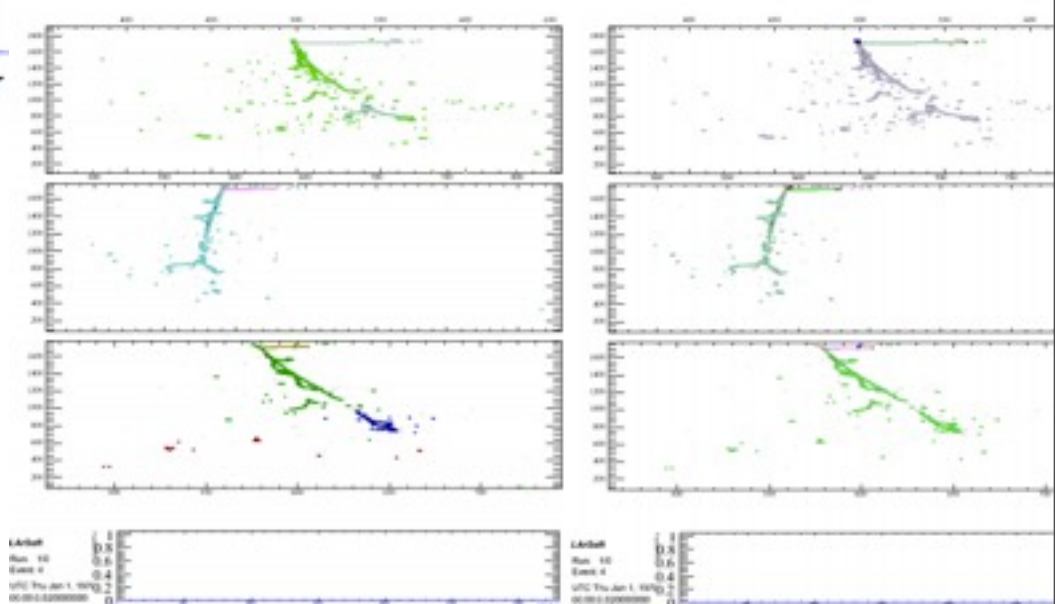
Fuzzy 3



Fuzzy and Hough line clustering

Cluster cheater

nue CCQE



Fuzzy and Hough line clustering

Cluster cheater

AnalysisBase module

- Tingjun and Brian R, to hold data from an analysis. So far, Calorimetry and pID

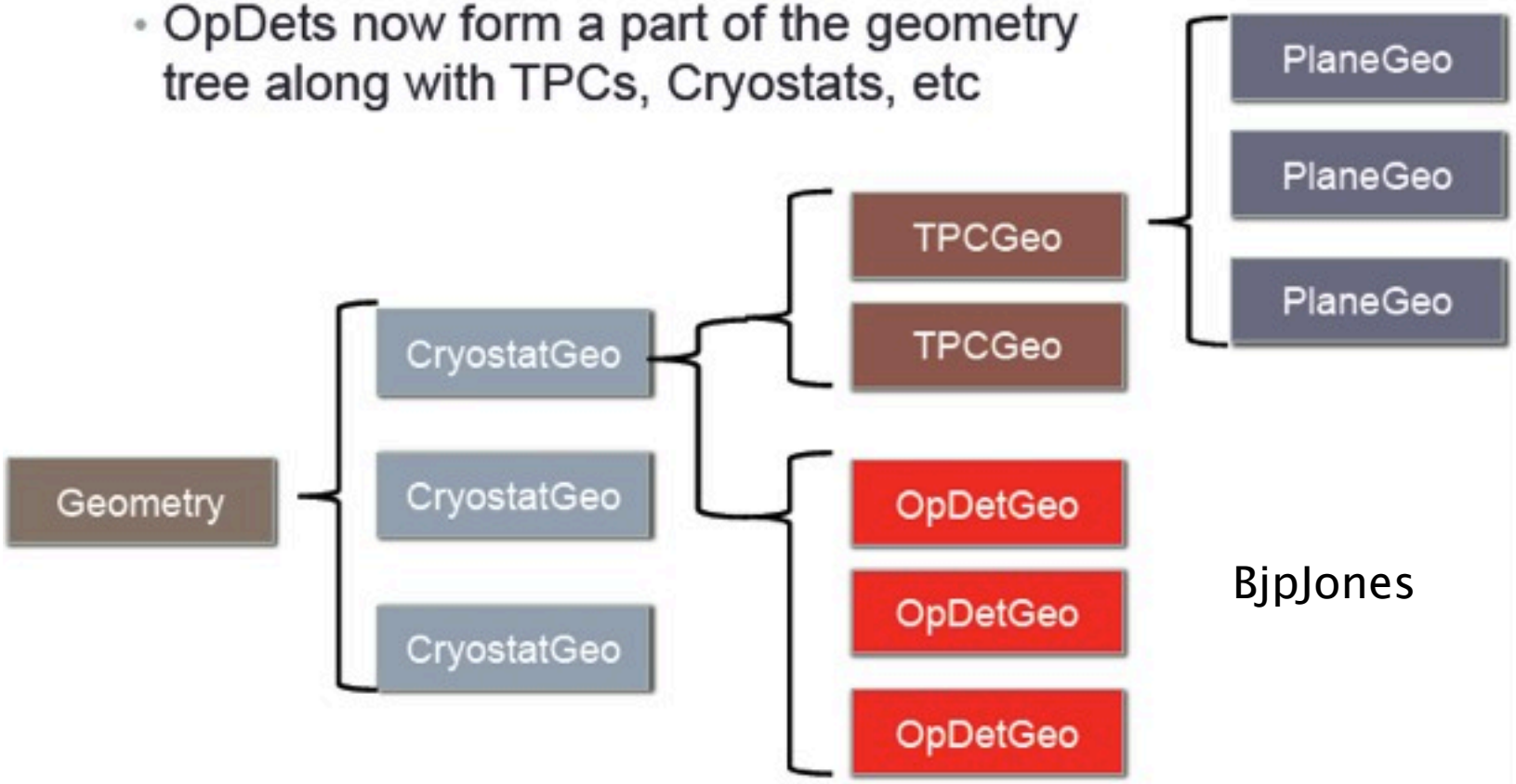
anab::ParticleID

- A module to save particleID information.
- int fPdg; ///< determined particle ID
- int fNdf; ///< ndf for chi2 test
- double fMinChi2; ///< Minimum reduced chi2
- double fDeltaChi2; ///< difference between two lowest reduced chi2's
- double fChi2Proton; ///< reduced chi2 using proton template
- double fChi2Kaon; ///< reduced chi2 using kaon template
- double fChi2Pion; ///< reduced chi2 using pion template
- double fChi2Muon; ///< reduced chi2 using muon template
- double fMissingE; ///< missing energy for contained particle
- double fMissingEavg; ///< missing energy from average of hits
- Added association between anab::ParticleID and recob::track.
- There exists a module ParticleIdentification/Chi2ParticleID that does particle identification based on calorimetry information and saves particleid information to art::event.

Reorganized Optical Detector Module

geo::OpDetGeo

- OpDets now form a part of the geometry tree along with TPCs, Cryostats, etc

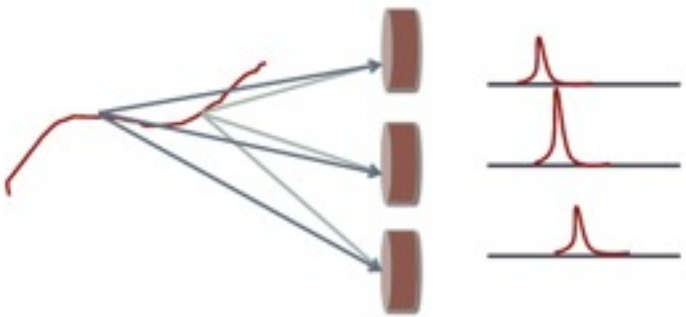


BjpJones

Optical Detector 2

TrackTimeAssoc

- Analyzer in the OpticalDetector package
- Make a quick hypothesis for the light from each track in the event per PMT
- Step along a bezier track in uniform intervals, querying the visibility at each point and multiplying by local dQdx.
- Light production can be dropped by quenching function. Visibility and quenching are both controlled by the PhotonVisibilityService

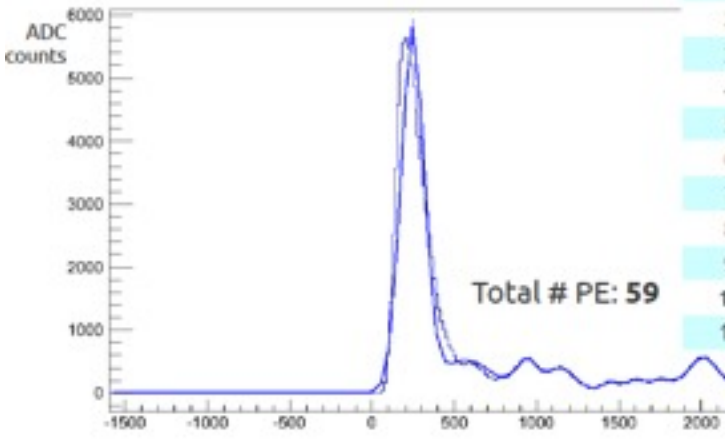


BJPJones: On its way. Building photon library now.

Christie Chu:
59 pe, and as many as 6-7 sub-events detected. 7 overlaid muons.

Data extraction

Use pulse area to find # of PE

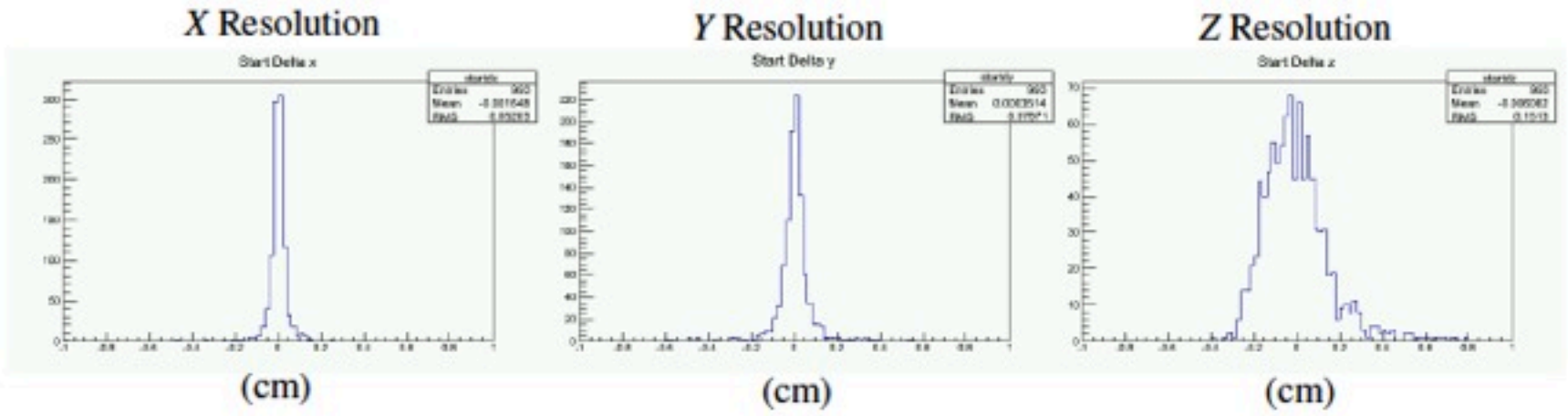


Peak #	Time (ns)	# PE
1	244.57	35
2	571.87	7
3	937.04	3
4	1144.23	3
5	1446.40	1
6	1593.93	1
7	1753.99	1
8	2011.53	4
9	2252.10	1
10	2507.35	2
11	2777.83	1

KalmanHit 1

Track Start Position Resolution

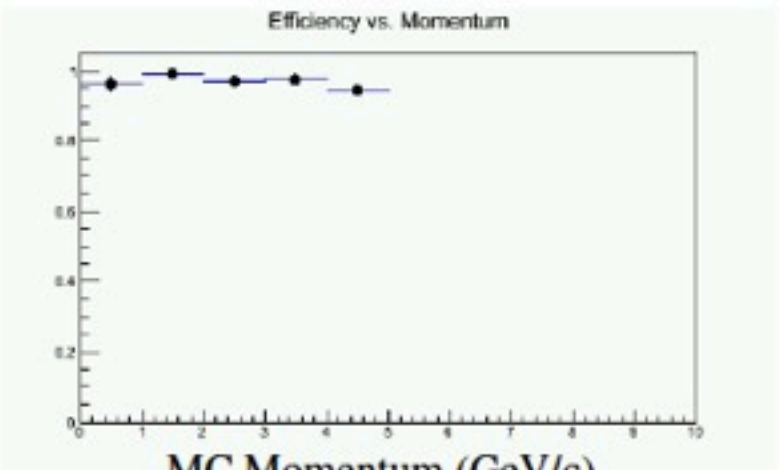
Herb gets 0.5-1.5 mm resolution on Track start point.

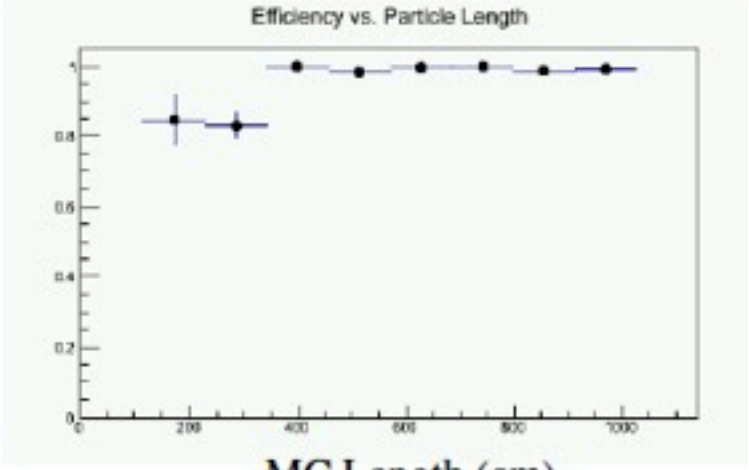


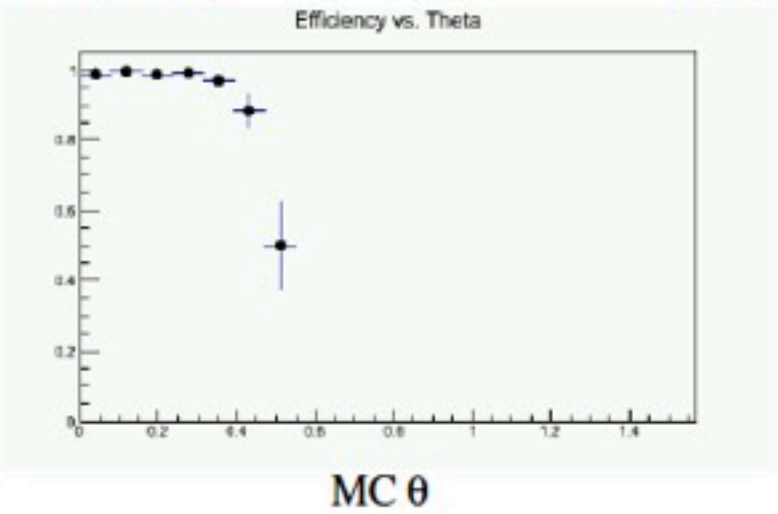
single muons of varying momenta

KalmanHit 2

Track Efficiency



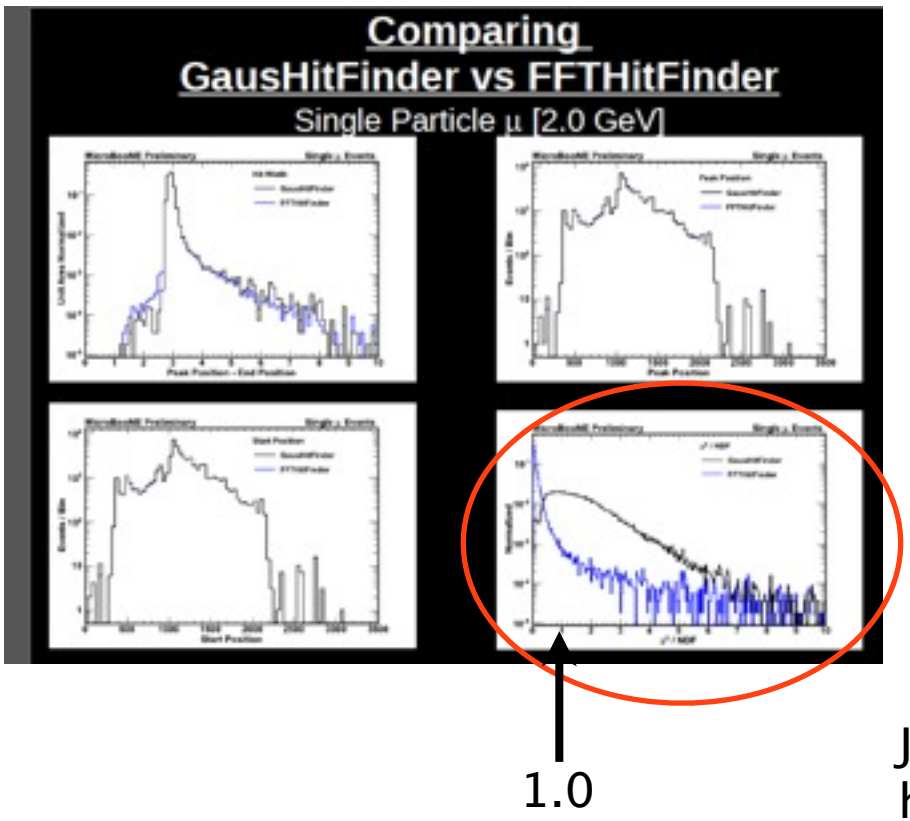


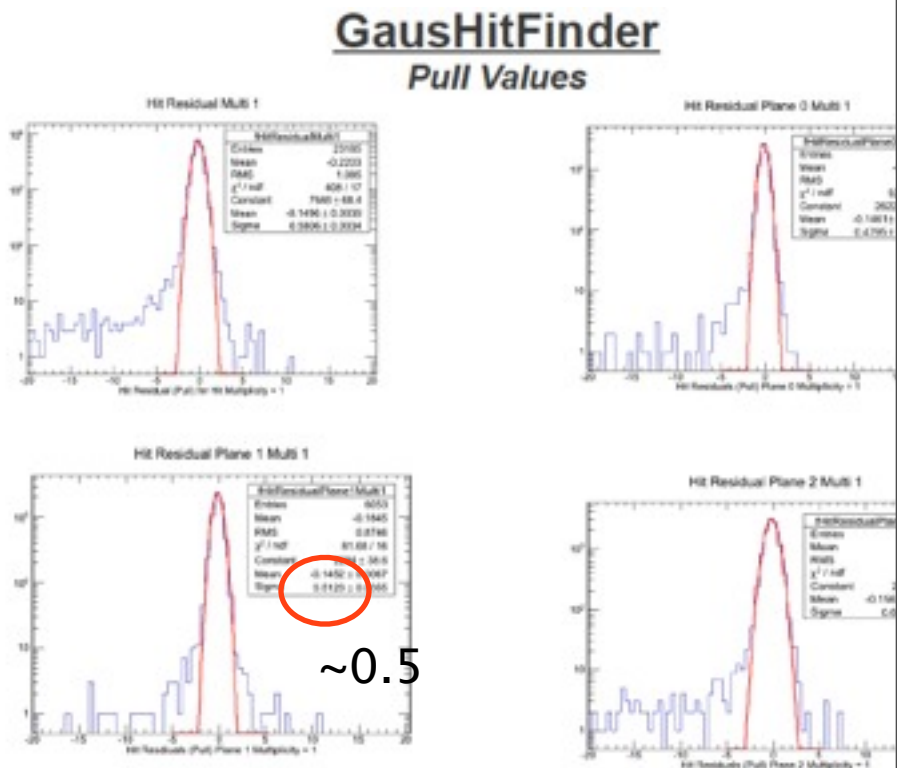


Pulls (not shown here) give results consistent with correct sized measurement errors attributed.

GausHitFinder (sic)

Jonathan's algorithm to properly characterize Gausian (sic) hit fits. Gives reliable chi2 and hit multiplicity

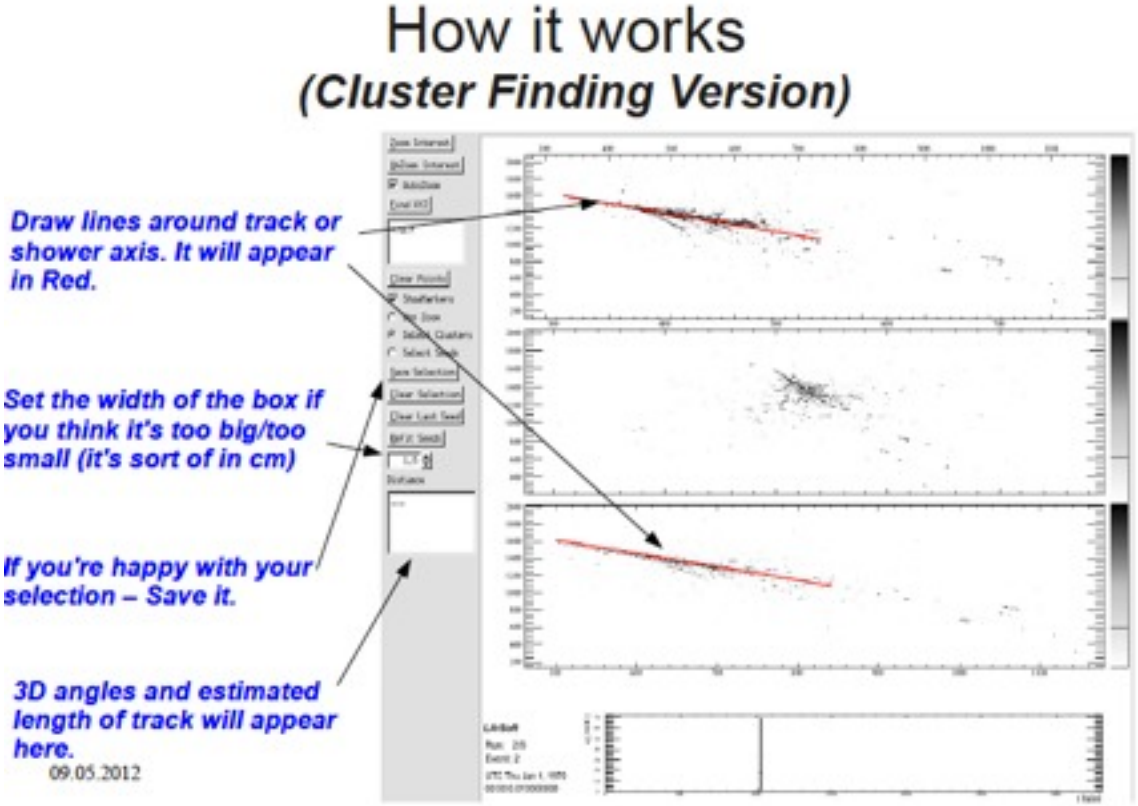




Jonathan has now added Pulls. (In fact, he sees that his currently assigned hit width errors are about 2x too large.) **Seems** ready for primetime.

HandScan Tools 1a (Showers)

- Andrzej's EVD Analysis tool: https://cdcvs.fnal.gov/redmine/documents/537

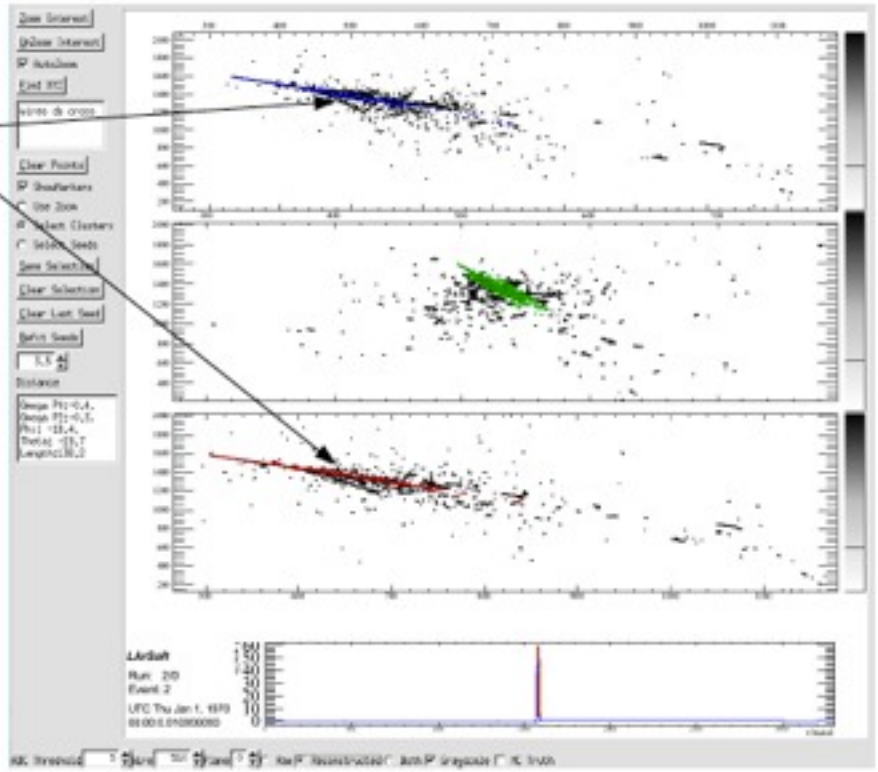


HandScan Tools 1b

How it works
(Cluster Finding Version)

The Event has rerun and GraphCluster has produced shiny new Clusters that you can display, if you so choose in RecoDrawingOptions.

These clusters could have been passed on to further producer modules down the stream. For an Example, see next slide:



09.05.2012

HandScan Tools 2a

- Ben Jones' Interactive 3D Tracking: https://cdcvs.fnal.gov/redmine/documents/535
- Describes how to, by-hand, draw track segments in 2 planes, which turns into a 3rd segment in the 3rd plane. And then they connect amongst each other via Bezier, and voila, a 3D track! ....

HandScan Tools 2b

- Cross fingers and click on the link below and the successive one after that.

- https://cdcvs.fnal.gov/redmine/attachments/download/6981/Screen%20Recording%209.mov

Thoughts from the Naugehyde swivel chairs of the Tools Conveners … 1

- I think the following are true:
  - Shower code works to separate gammas/es, as advertised. Is still under development
  - Tracking code -- Bezier and KalmanHits -- are promising and have made great headway
  - Calorimetry dEdx and likelihood pID exist
  - **Most of the above work has been done on single particle MC.**
- Lots of other great, necessary work, of course, but not necessarily germane to this discussion:
  - HitFinding improvements
  - Vertexing in 2D
  - Electronics simulation/deconvolution, ...

Thoughts 2: Beyond single particle MC

- Tracking: We have seen some CCQE mu+proton events thrown at tracking algos. Just beginning to be tackled in more complicated neutrino events.
- We have not seen m_pi0 tackled yet by putting together two showers' invariant mass. Let alone in a CCQE/Resonant event or DIS neutrino event.
- We've seen some cosmic muon overlays with GENIE evts. Effort at subtracting the cosmics lays ahead.

Thoughts 3: Other Ideas for high-level things we can do to make progress toward the big LArSoft questions ....

- Summing the energy in the hits on a plane for complicated DIS events: how well does that do?
- Do some resonant events lend themselves to the Delta invariant mass being able to be assembled?
- Deciding what gets tracked, what gets shower-recon'd and building modules that do both inside one event, as in a CCpi0 event.
- Generally, can we start bringing our tools to bear on multi-track/shower events?
- ....

Slightly More Pedestrian Thoughts from the Tools Conveners' Naugehyde Swivel Chairs ...

- We've been saying we should have a MC Challenge in the Fall. Fall is in 2 wks!
  - What are the samples desired?
  - Is there a code freeze desired? (End of Sep.)
  - Should there be a MC czar/jefe? (Yes.)
    - In his/her absence, Herb has started writing robust job submission scripts.
  - Should there be a meeting between Tools and Physics Groups conveners? (Probably.)
- uBooNE offline repository reminder!: https://cdcvs.fnal.gov/redmine/projects/ubooneoffline/wiki