Near Detector Event Reconstruction

- J. Musser

- Cambridge 2004

Summary

- Here we focus on near-detector specific reconstruction issues, ie event slicing, and tracking in the spectrometer.

Costas will discuss in more detail the status of his new slicer in a separate talk – I will show a few event displays illustrating slicing difficulties, and comparing the AltSlicer with the SR slicer as matters stand at this moment.

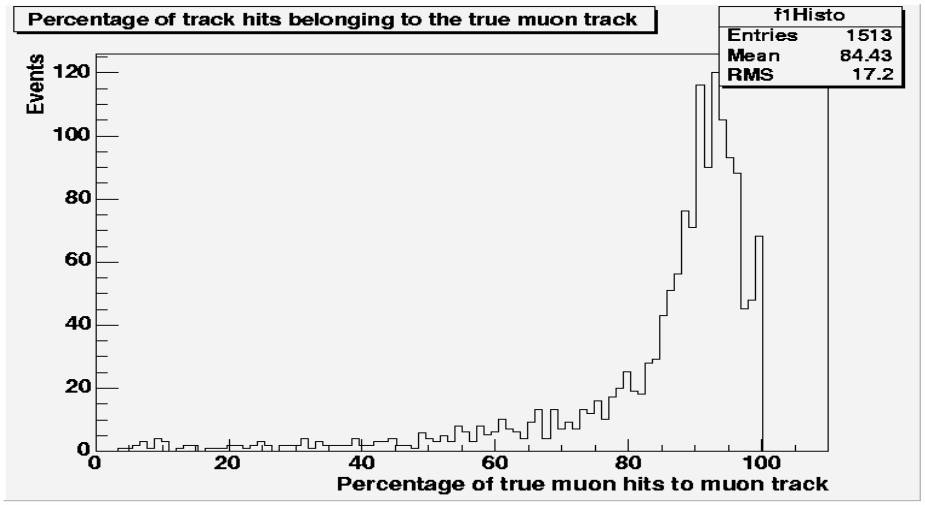
Tracking

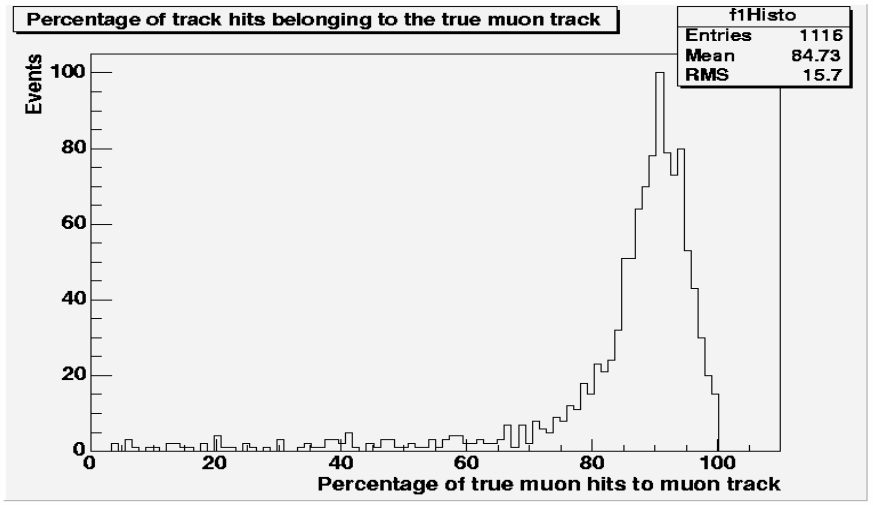
- The problem of tracking in the ND spectrometer has been solved independently by N. Saoulidou and J. Musser. Niki's overall approach is superior, and in addition she has done some tuning of the tracking finding parameters for the near detector, and her work be the one adopted. For now, Musser's code is running as the default, using Niki's parameters.
- ***The basic algorithm. …***
  - *All 2D tracks found in the forward detector within a slice are swum into the spectrometer. The track growing algorithm used is the same as in the forward detector, with parameters tweaked to compensate for large active plane separation.*
- *The next couple slides are provided by Niki, comparing performance with/without her parameter tweaks.*

Effect of Niki's parameter tuning

The parameter tweaks Niki has made for near det. Tracking improves the track finding efficiency substantially, and the track completeness, as shown below.

Note (Niki's definition of completeness used in the plots below is likely different than the one adopted in TruthHelper, described Yesterday (and used in some later plots). Her values are in general lower (perhaps cross-talk hits are included in the truth hit list in her case?)



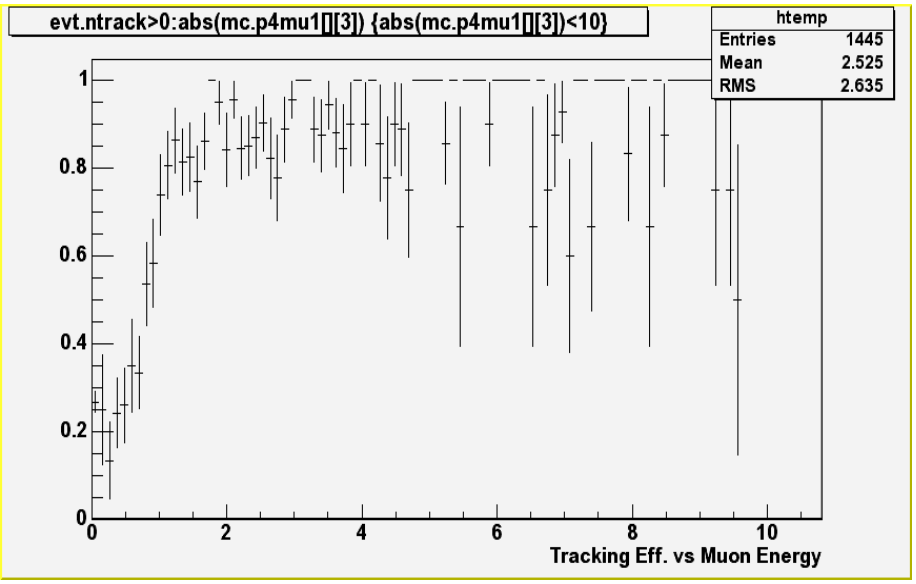


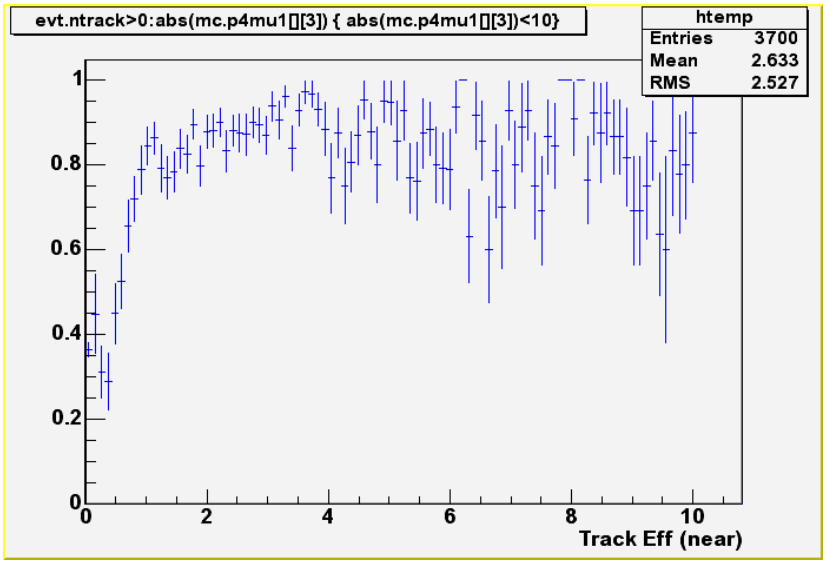
Near Far Tracking and Shower Reconstruction Comparisons

- In the slides which follow, we show various metrics for reconstruction performance, comparing the near and far detector results.

- Important note: No event overlays in the near detector! This introduces a separate set of issues, addressed later.

Tracking Eff (near & far)



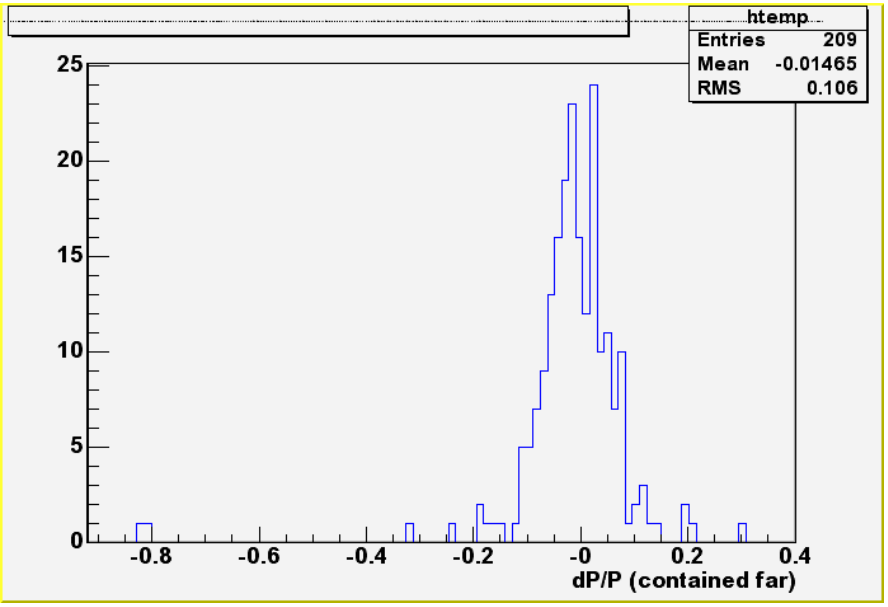


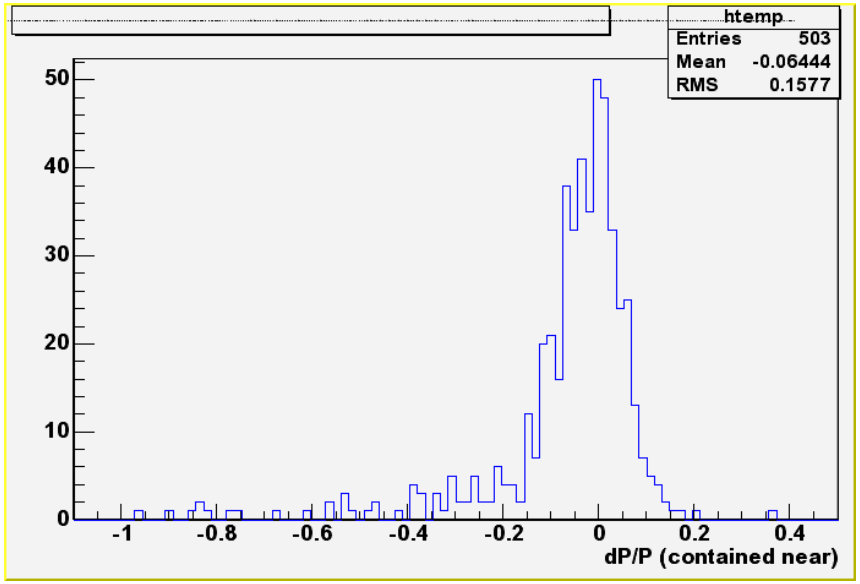
Far

Near

Raw Track finding efficiency is not obviously degraded
In the near detector data set (remember, no overlays!)

Range-Based Muon Energy



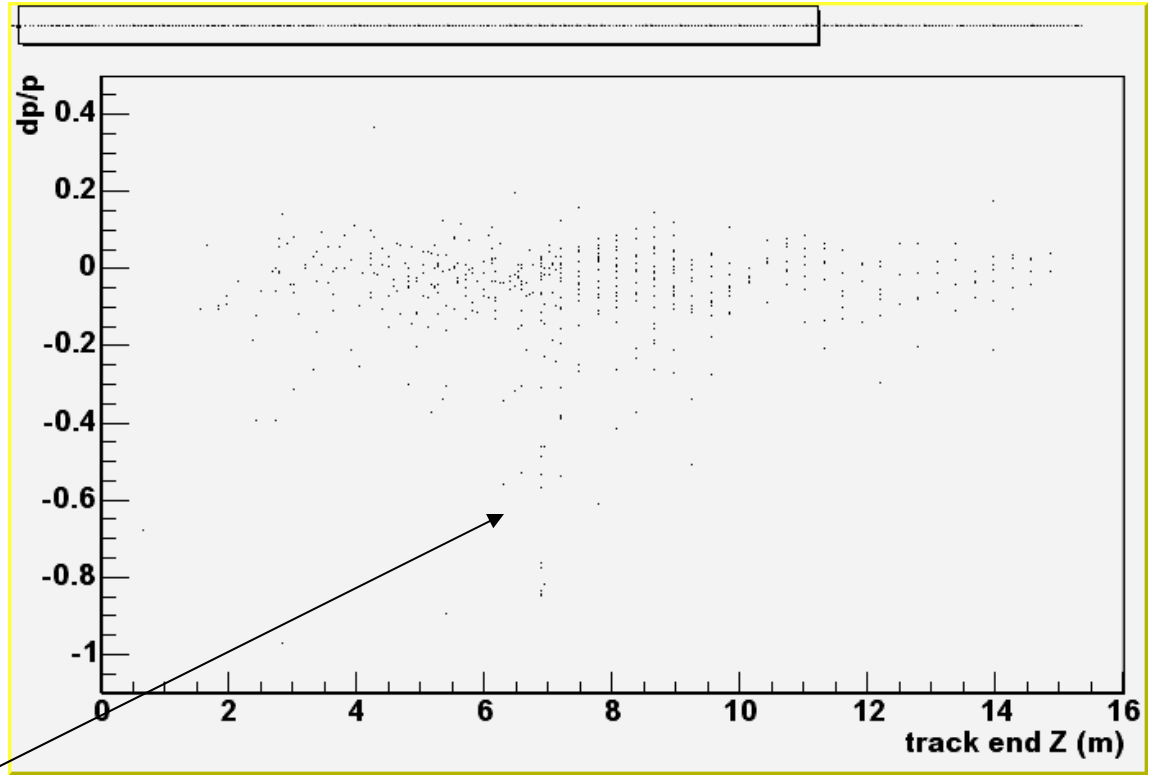


Far

Near

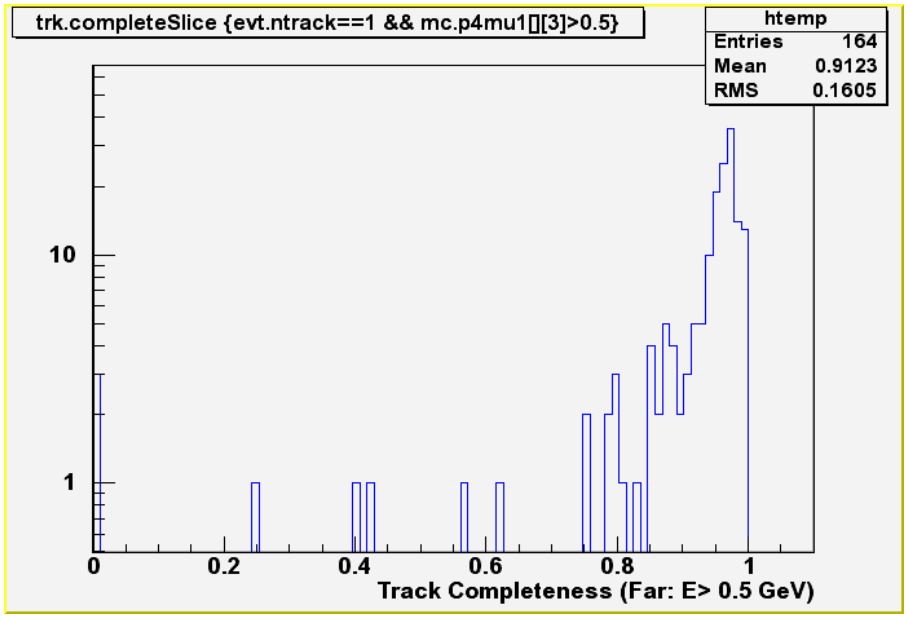
The low-side range-based dP/P tail for contained muons is significantly worse in the near detector. We see why in the next viewgraph.

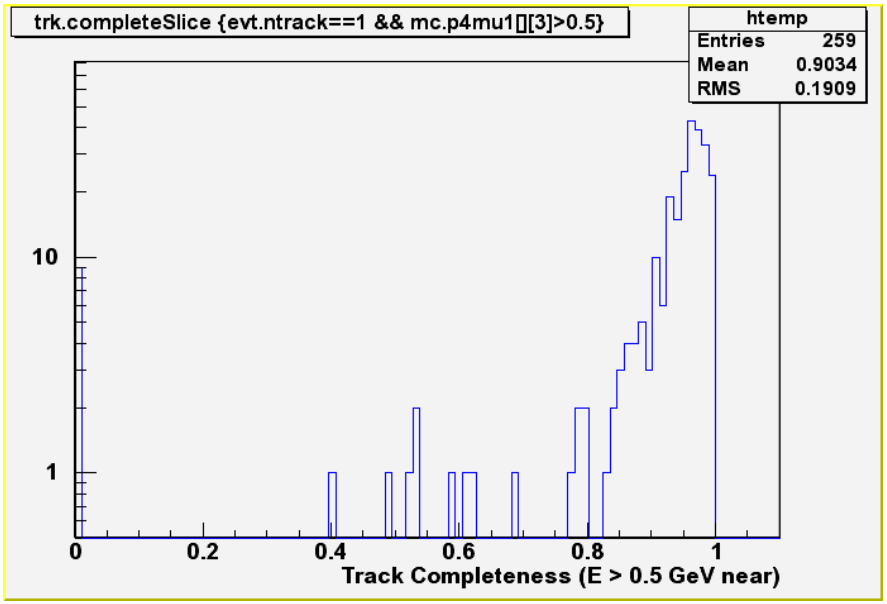
dP/P vs Track End Z (near)



The low side dP/P tail is enhanced by tracks in which the reconstructed track is claimed to end at the spectrometer boundary – spectrometer track matching has failed…

Track Completeness (near & far)

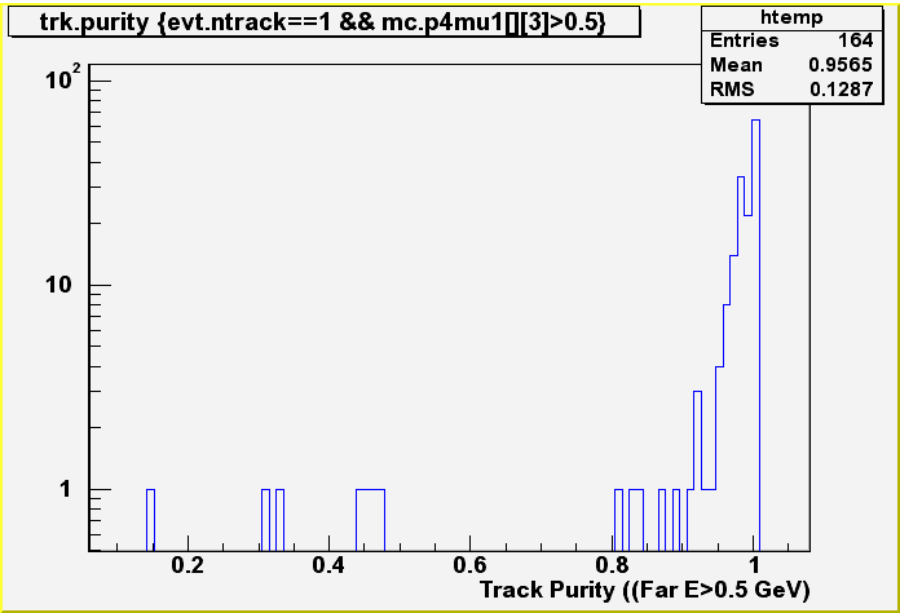


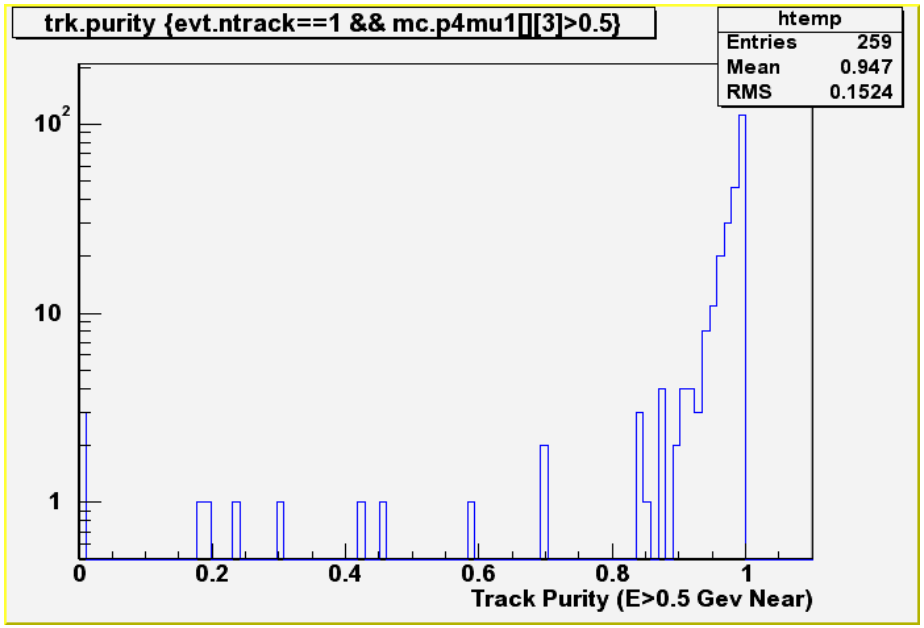


Far *Near*

On the whole track completeness is only marginally worse for near detector, as shown in the completeness distributions above.

Track Purity (near & far)

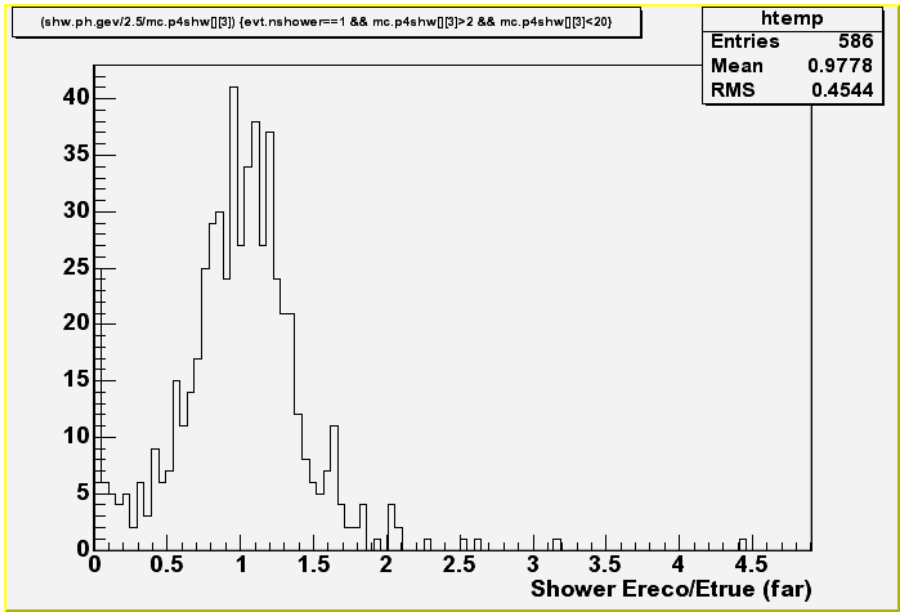


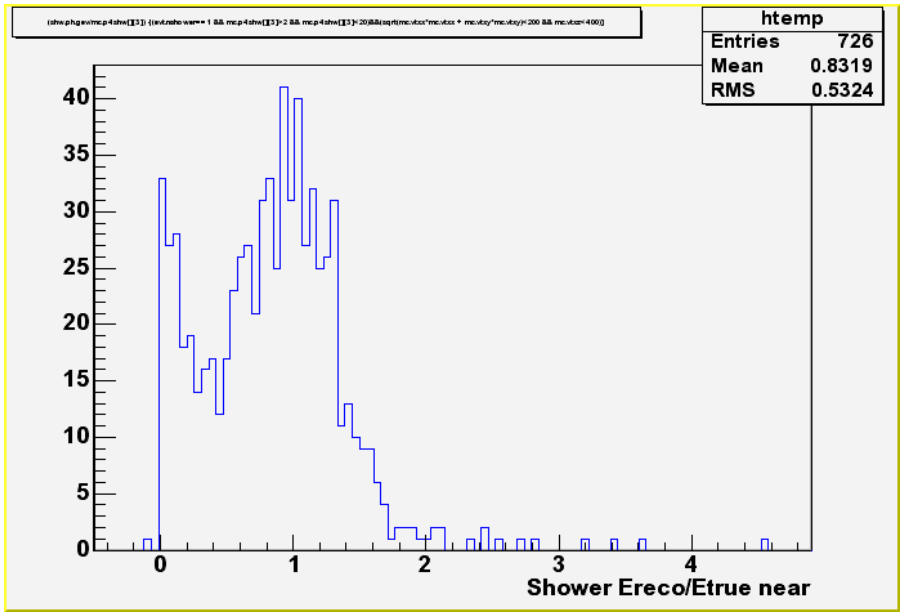


Far *Near*

Track purity is comparable near/far, in the absence of event overlays

Shower Ereco/Etrue (near & far)

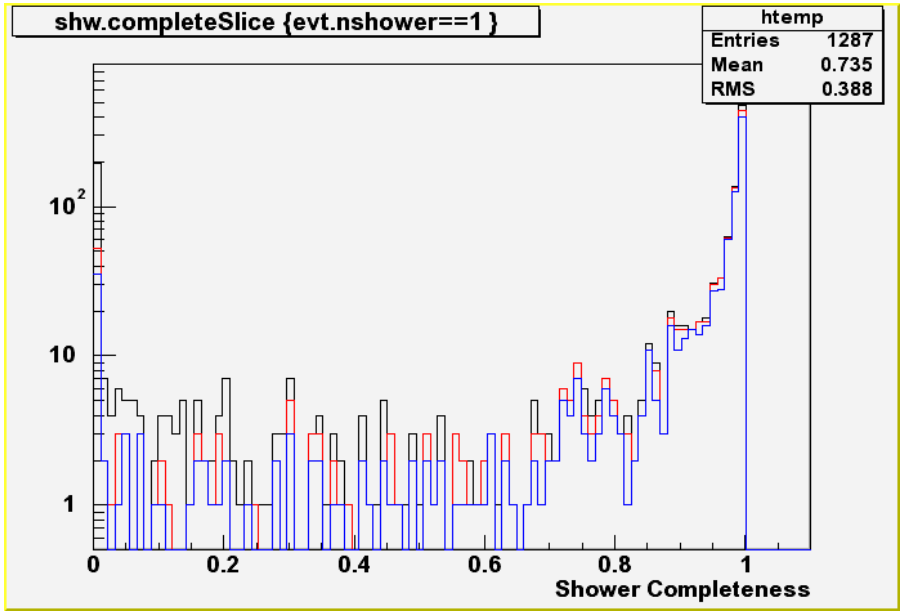


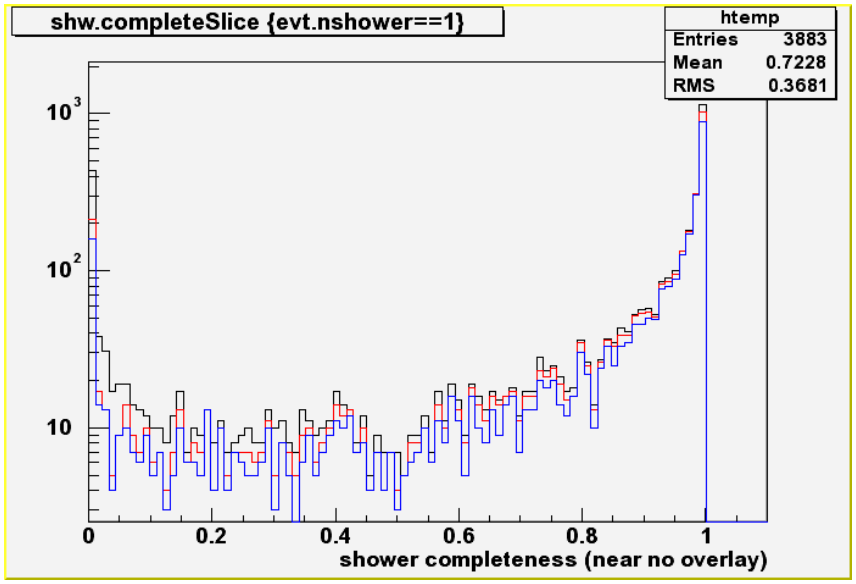


Slicing rears it's head…. (note: SR slicer is used here for all ND plots – the slicer is disabled for far far detector processing.)

In the near detector, there is a pronounced tail in the distribution of Ereco/Etrue, which is not present in the far detector. This is due to loss of some fraction of the shower in the event slicing step.

Shower Completeness (in slice)

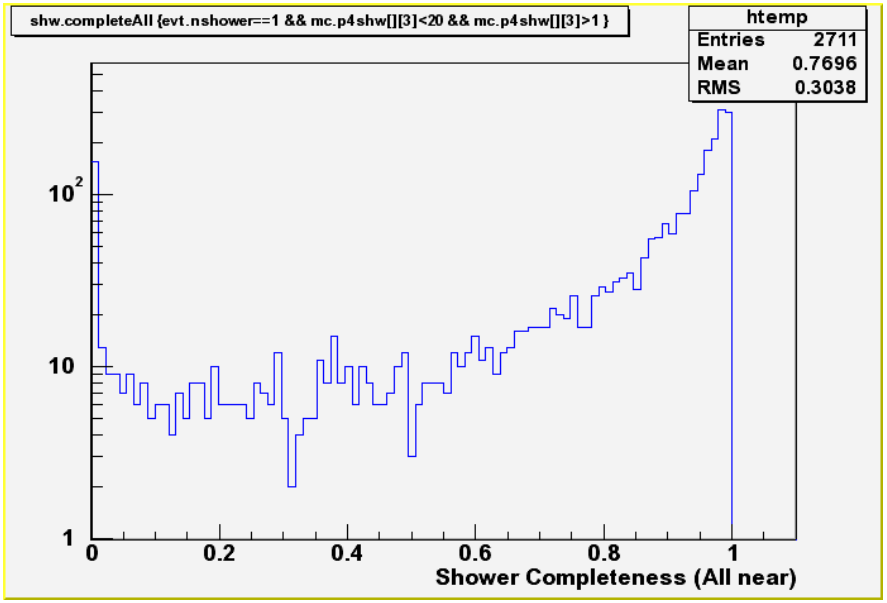




Far *Near*

The shower reconstruction near/far finds the same fraction of the true shower hits contained Within the slice, as demonstrated by the two plots above. In these plots, completeness is defined as the fraction of true shower energy WITHIN THE SLICE that is found.

Shower Completeness (all)



In the near detector data processing, the slicing algorithm is activated. The plot above shows shower completeness, defined in this case as the fraction of true Shower energy WITHIN THE ENTIRE SNARL that is found. The larger number of showers populating the low completeness region of this plot relative to the Previous represents the deleterious effect of the slicer on completeness.

A Visual Comparison of SR and Alt Slicer

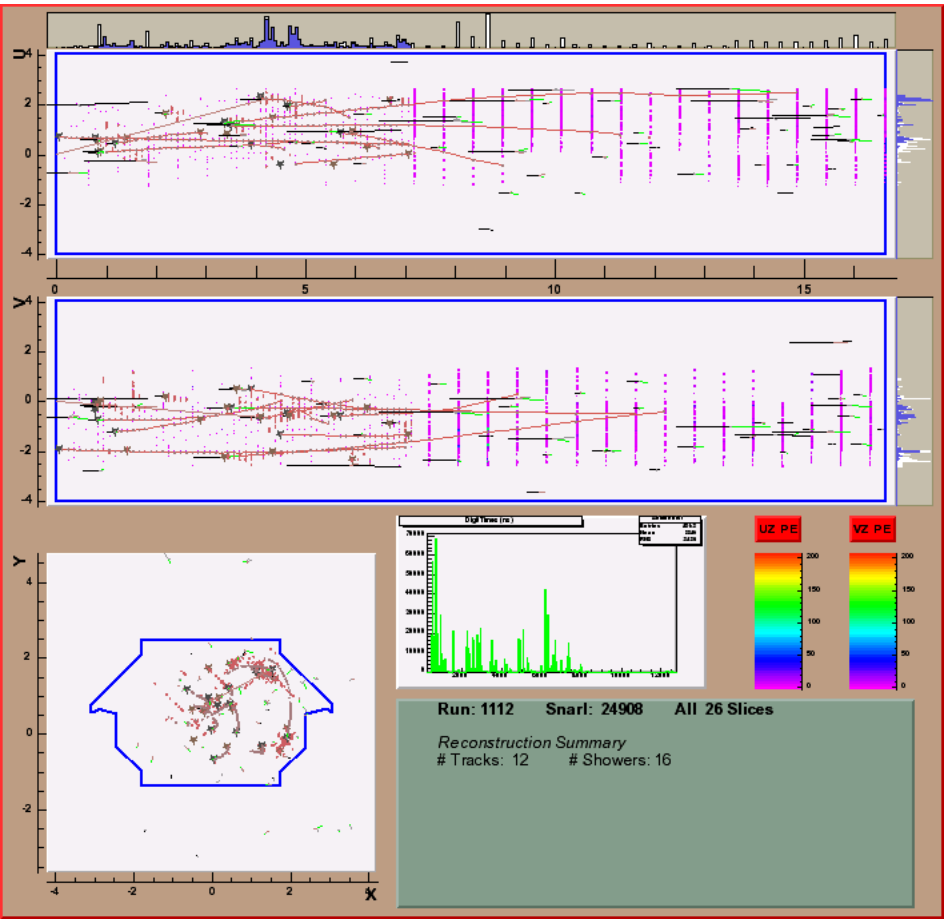
- In the next few slides, we show a side by side comparison of the reconstruction of the slices in a single snarl in an overlay event. The display on the left is the Alt slicer, on the right SR. Other than the slicer, all else in the analysis is identical.

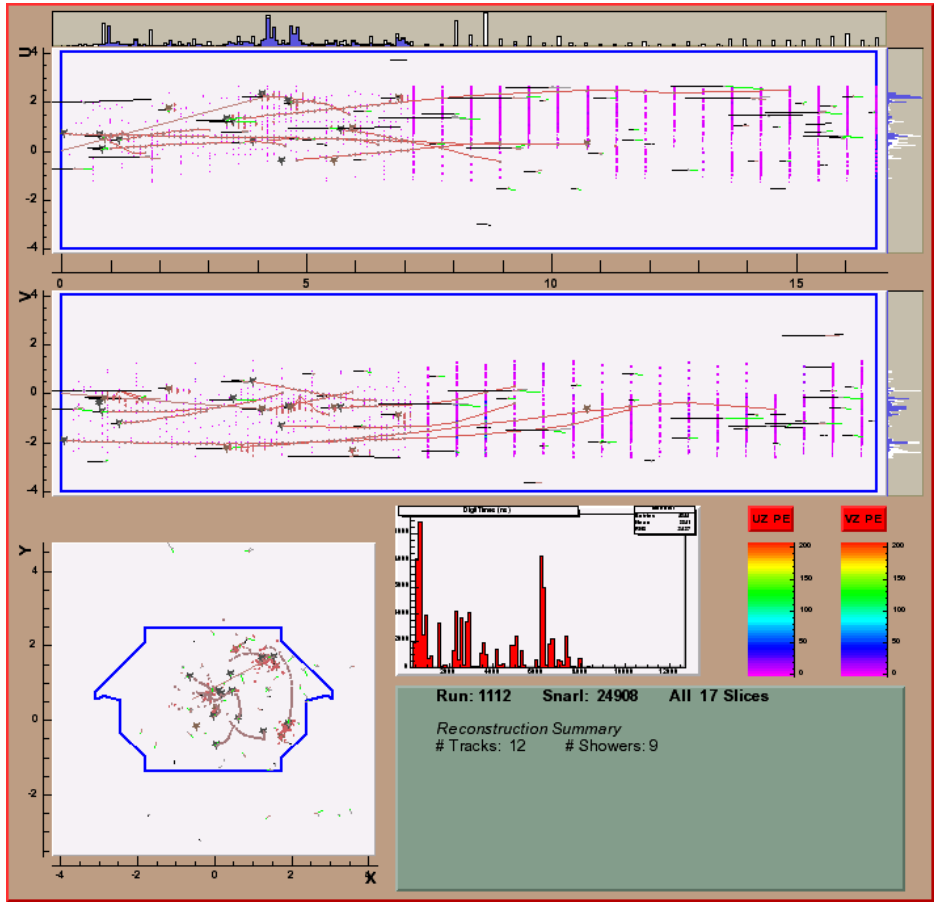
- The first display is the entire snarl. Subsequent displays isolate on individual slices.
- Some note of clarification in what follows….

On the slice displays, I am selecting time windows to restrict hits to those near slice time. This time window is not necessarily the same in the Alt and SR displays, so some hits within one window and outside the other will only show up in one display.

Ignore truth, purity, and completeness values displayed – there was a bug in truthhelper when these displays were generated.

Full Snarl

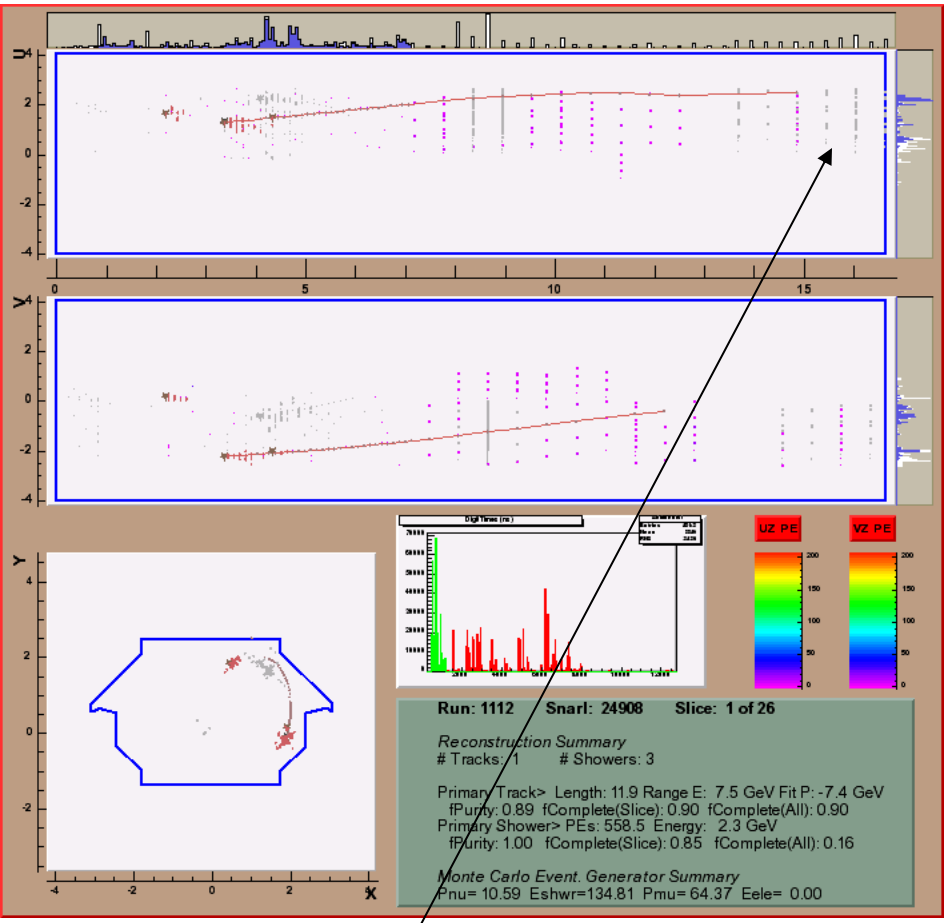


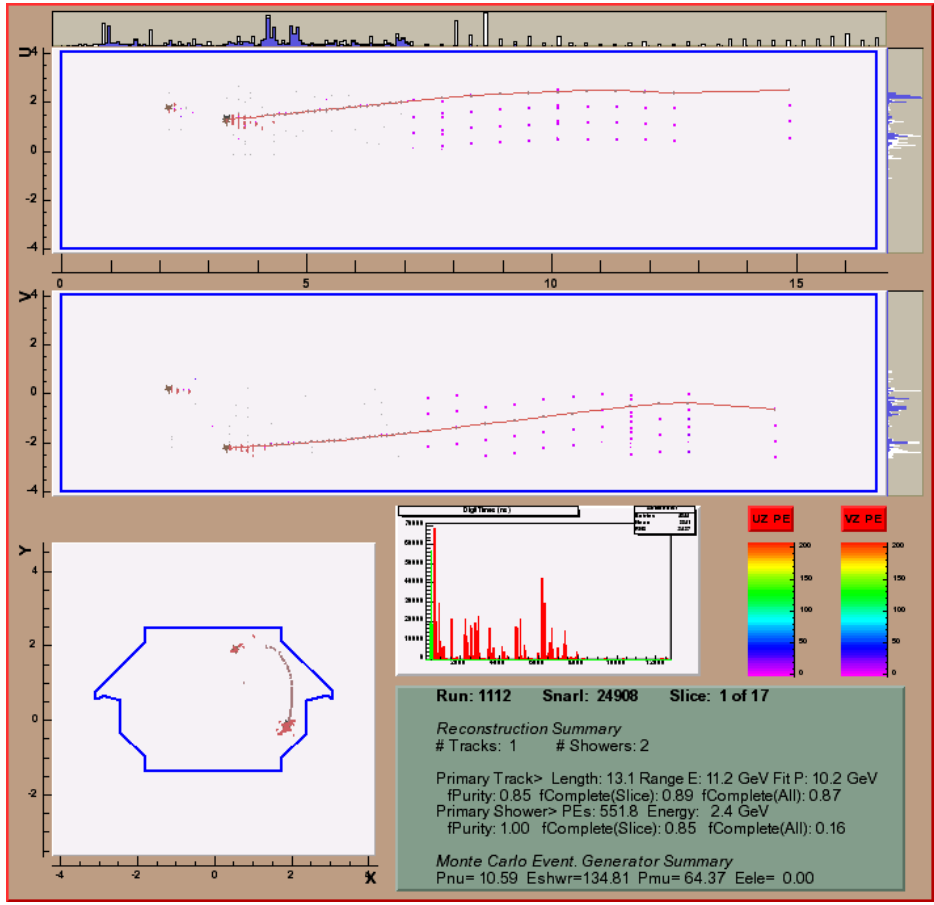


AltReco

SR

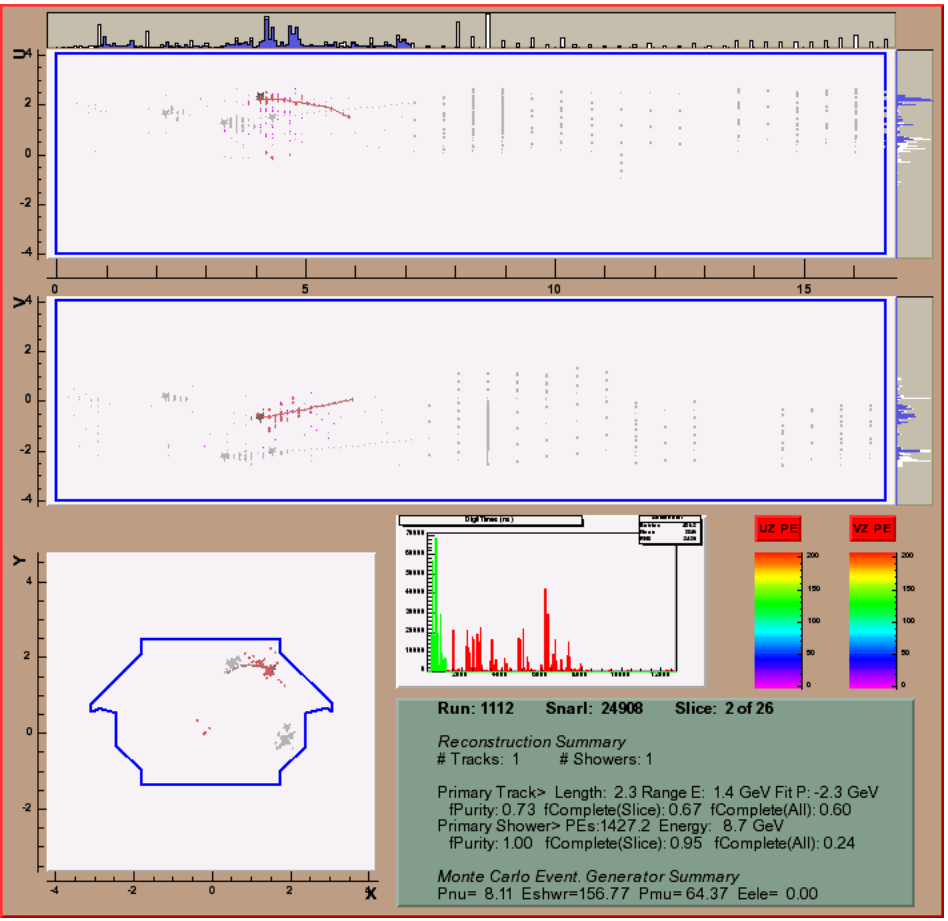
Slice 1

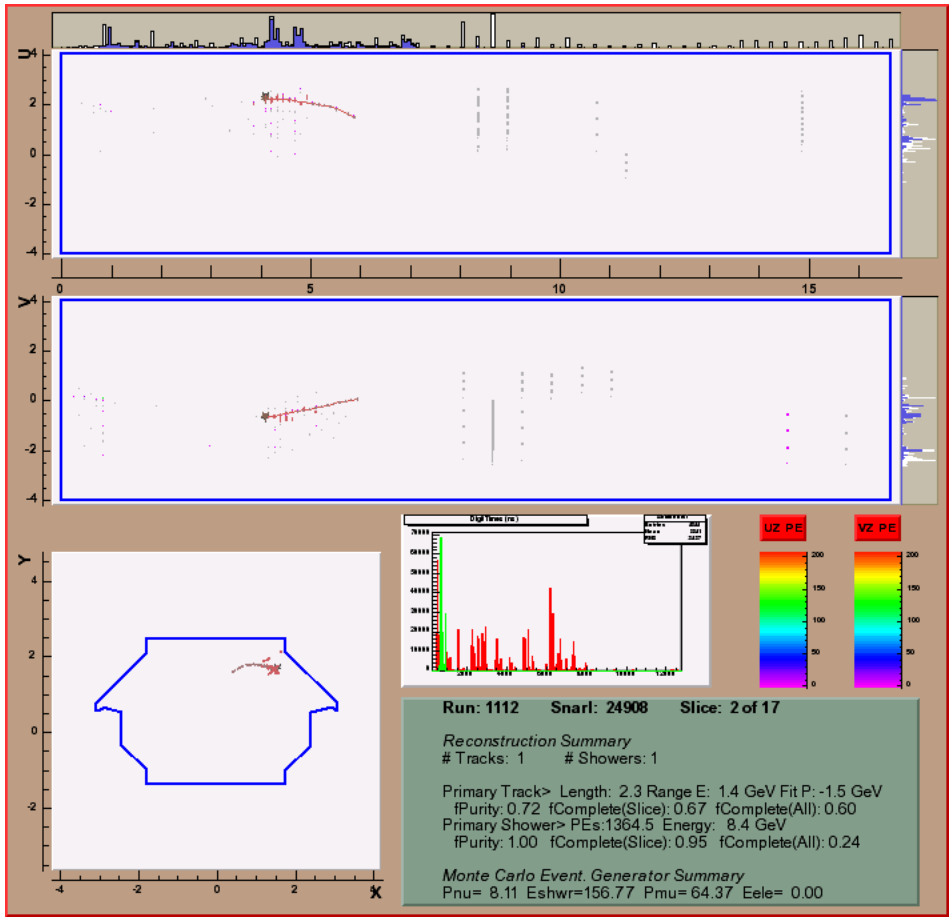




Late hits in back part of spectrometer missed by both slicers – track range underestimated. (Grey means Hits not in slice.)

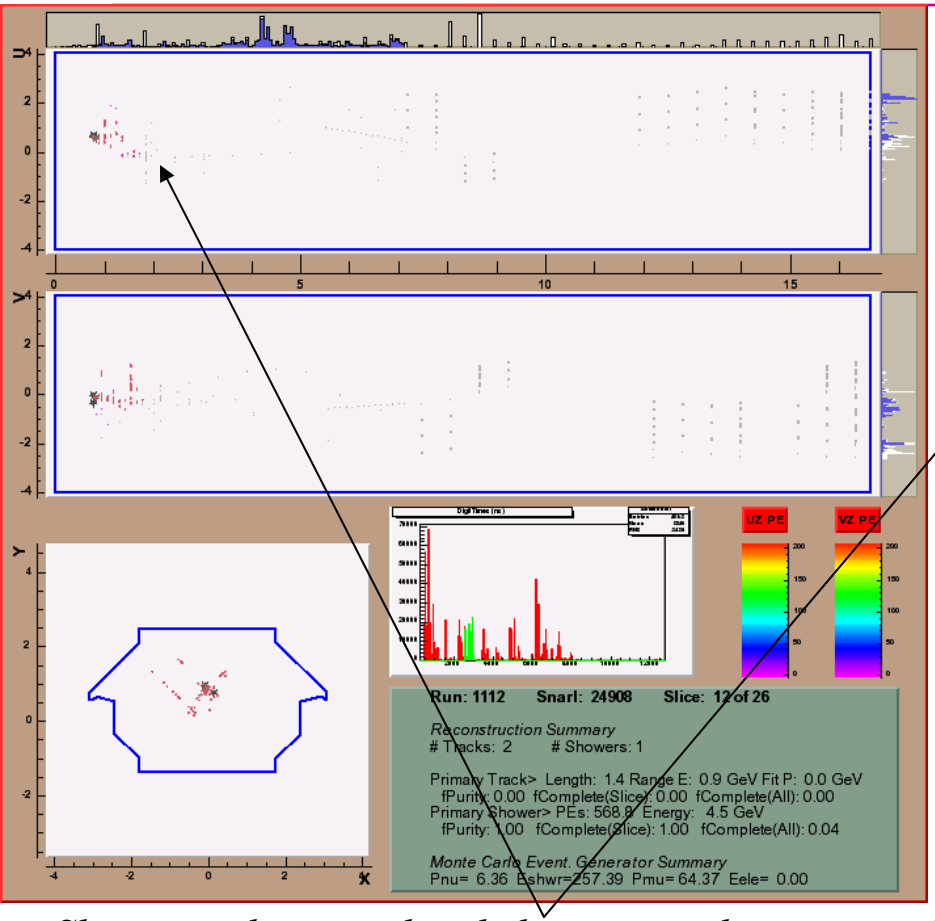
Slice 2

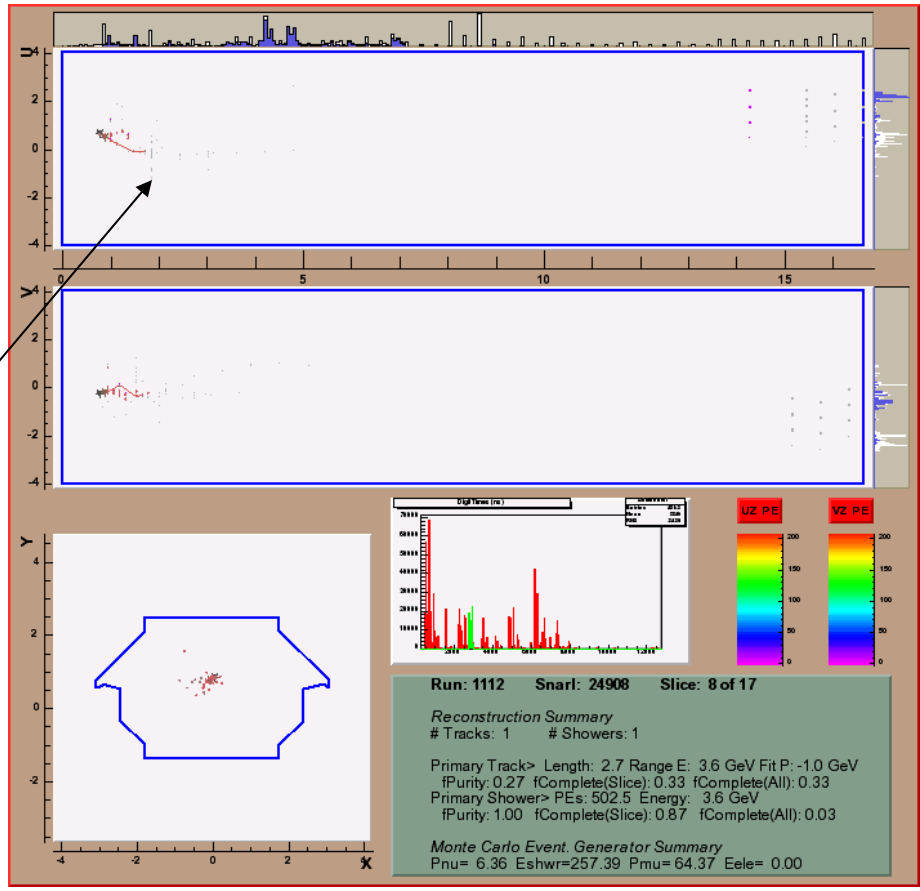




Alt slicer shower energy = 8.7 GeV, SR = 8.4 GeV. Difference is lost energy in slicing step.

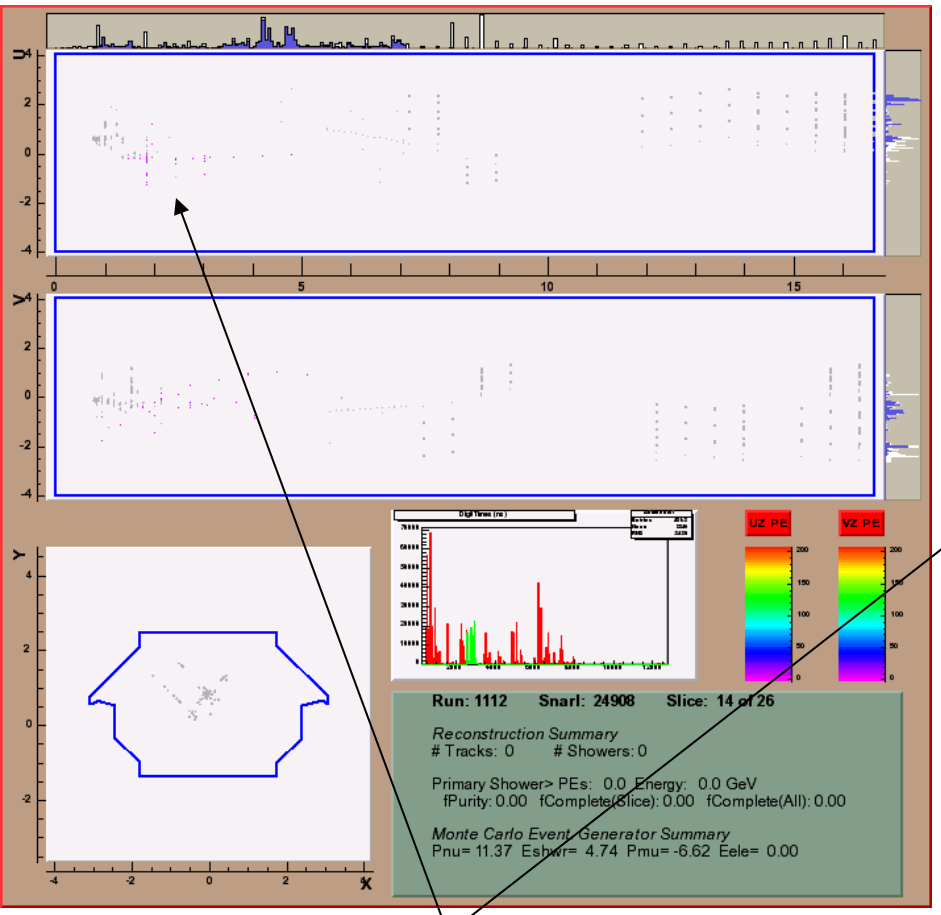
Slice 8

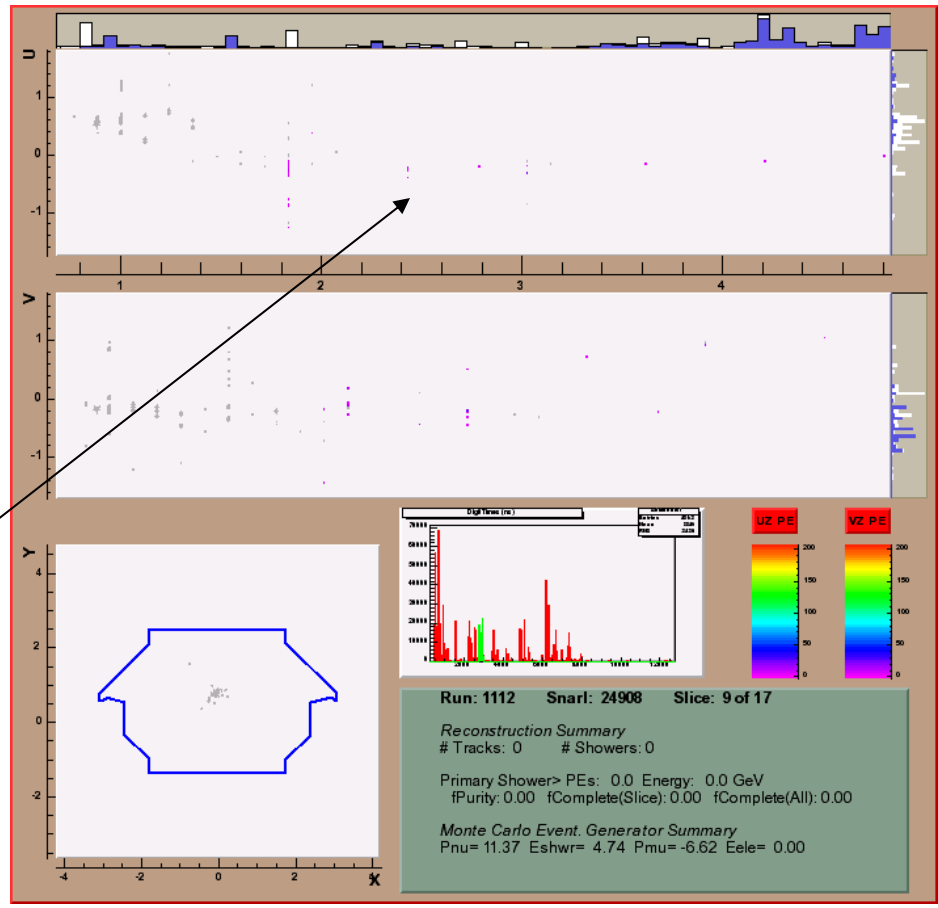




Shower with two isolated clusters is split into two slices by both slicers. Here we show the first piece.

Slice 9





Here is the second piece of this event, in the next slice. The SR display has been zoomed.

Conclusion

Of the two near-det specific reconstruction issues, tracking is under the best control, and although continuous improvements are likely over the near term, is marginally ready for the mock data challenge.

Slicing is another issue, and need to be the real focus of effort. We lack good quantitative measures of reconstruction degradation due to slicing, other than effect on shower energy reconstruction, which looks unacceptable at this moment.

Maybe Costas has made a miracle in the last few days??