

Progress report on track reconstruction efficiency @ low energies

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Outline

- Tuning of Tracking parameters
- Results on 0.5 GeV FARDET file on:
 - Efficiency
 - Tracking quality (completeness and purity)
- Summary-Ongoing work

Tuning of tracking parameters

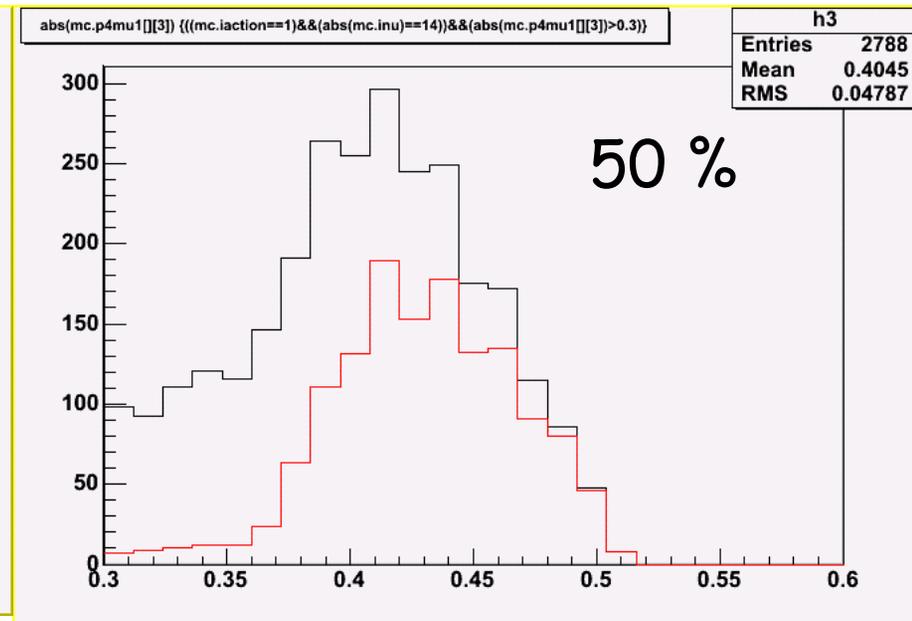
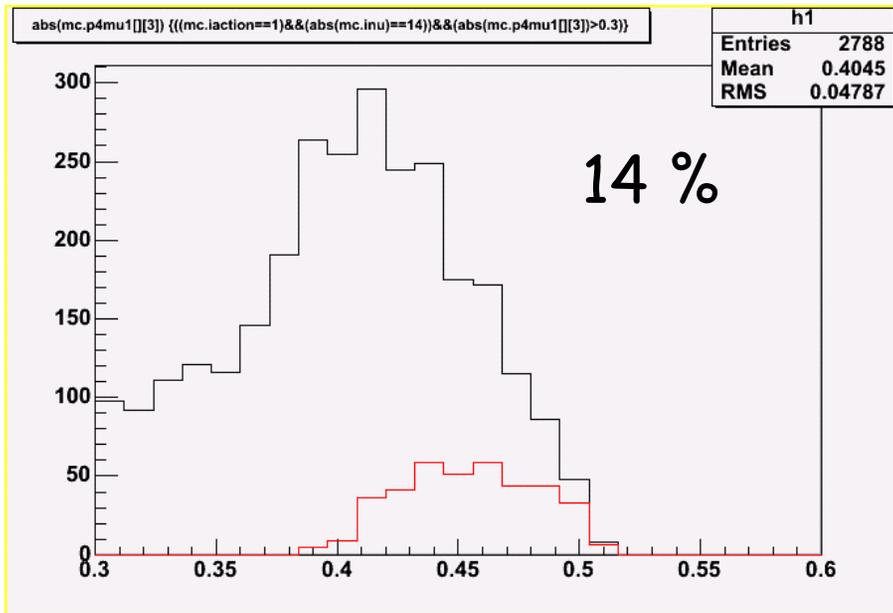
- Being motivated by David's talk in the last collaboration meeting I started looking at track failures in relatively low neutrino (and muon) energies.
- It turned out that I had to tune 2 tracking code parameters:
 - `SingeHitDef` : This parameters defines the maximum number of strips to be defined as single "hit" in a seed cluster.
 - `Trk2DLinA0`: is used in the calculation of the maximum residual for a given track.

Results on Track reconstruction efficiency @ 0.5 GeV

previous

current

Number of events



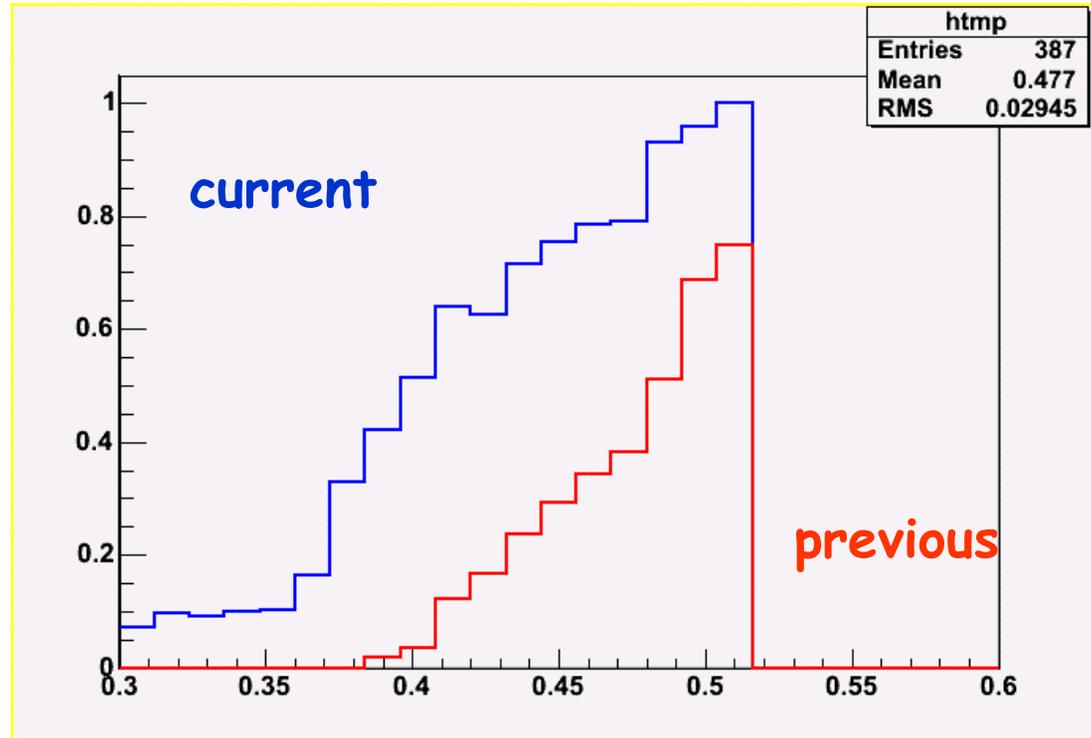
Muon energy (GeV)

Muon energy (GeV)

- Processed 10.000 numu FARDET events of 0.5 GeV neutrino energy out of which 3556 numu CC events were written out (passed the cuts).
- The **efficiency of muon reconstruction** increased from **14 %** (387 events with a reconstructed muon) to **50 %** (1391 events with a reconstructed muon)

Results on Track reconstruction efficiency @ 0.5 GeV con't

Muon reconstruction efficiency



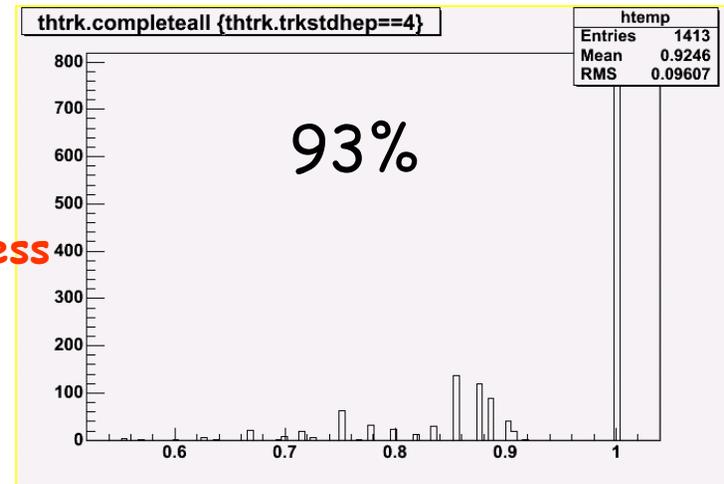
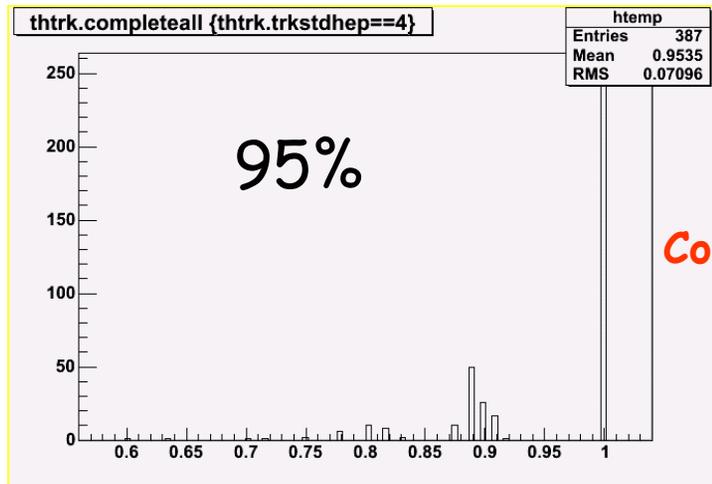
Muon energy (GeV)

- The same information as in previous plots, showing the muon reconstruction efficiency as a function of the muon momentum.

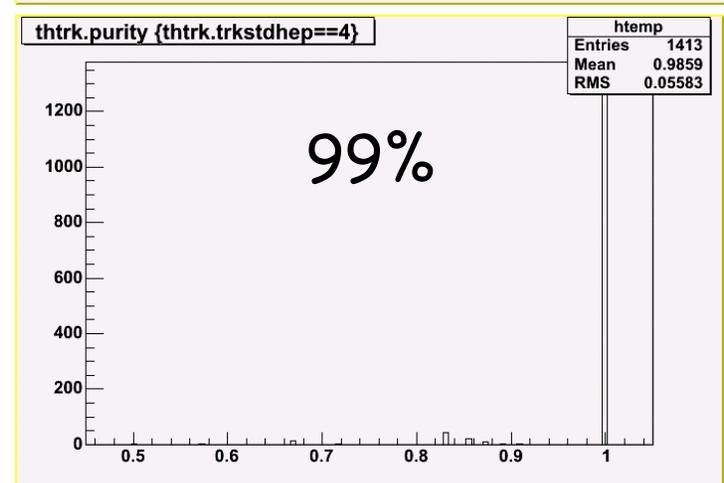
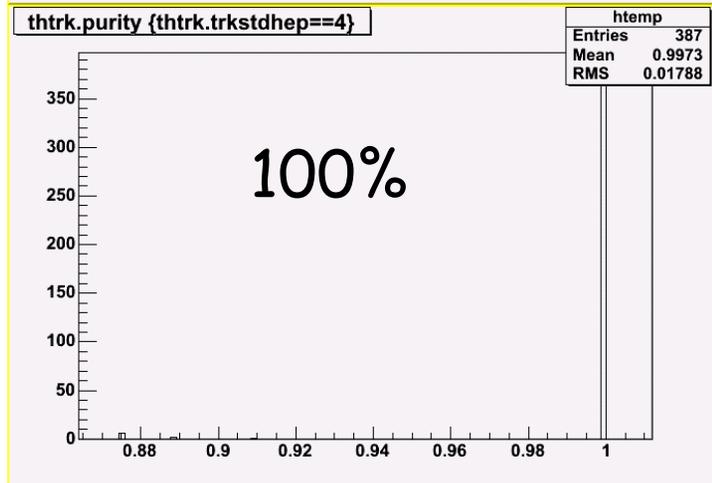
Results on Track reconstruction characteristics

Before

After



Completeness



Purity

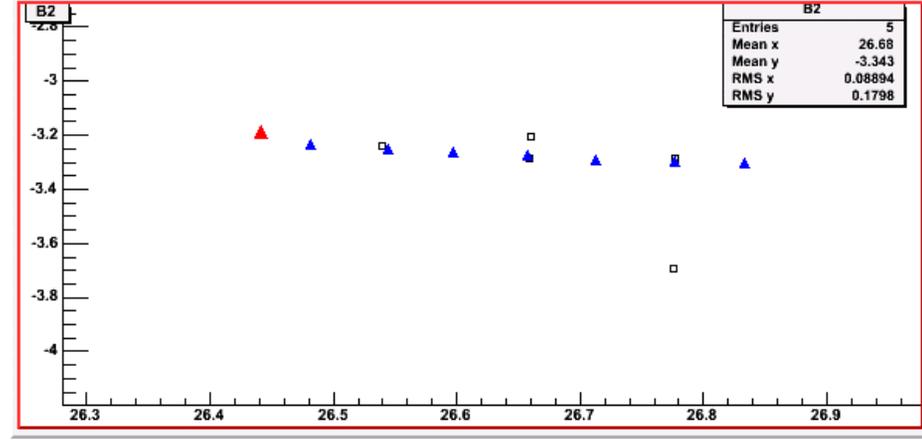
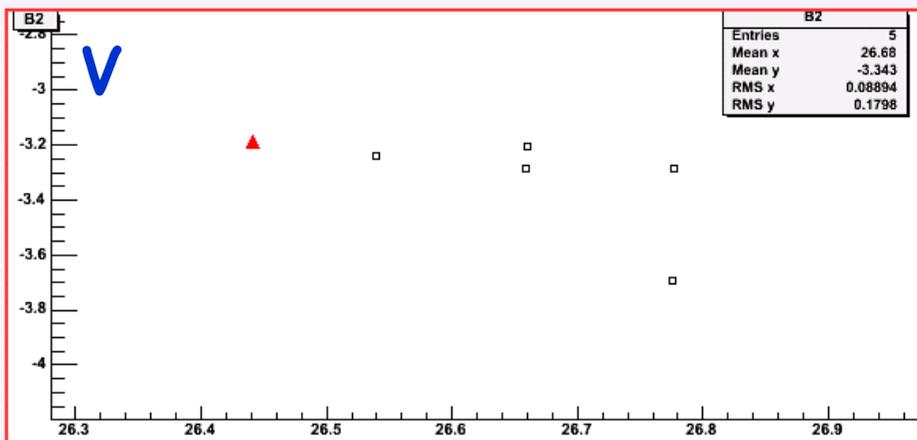
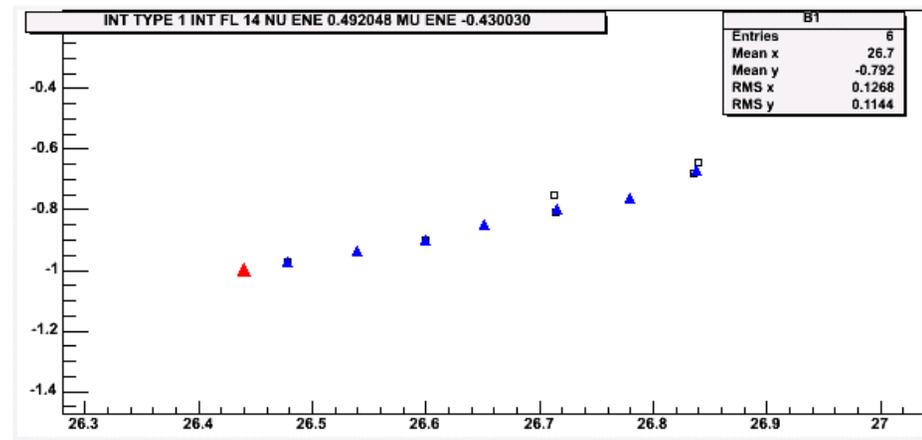
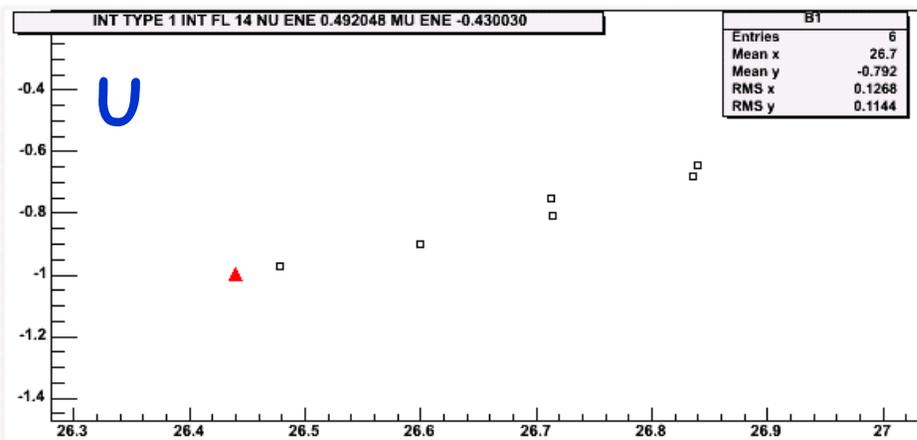
- The track completeness and purity remained very high and practical unchanged, given the small number of planes per track.

Examples of numu CC events

1

Before

After



- ▲ True neutrino vertex Hit Z
- Strip
- ▲ Reconstructed Muon Track

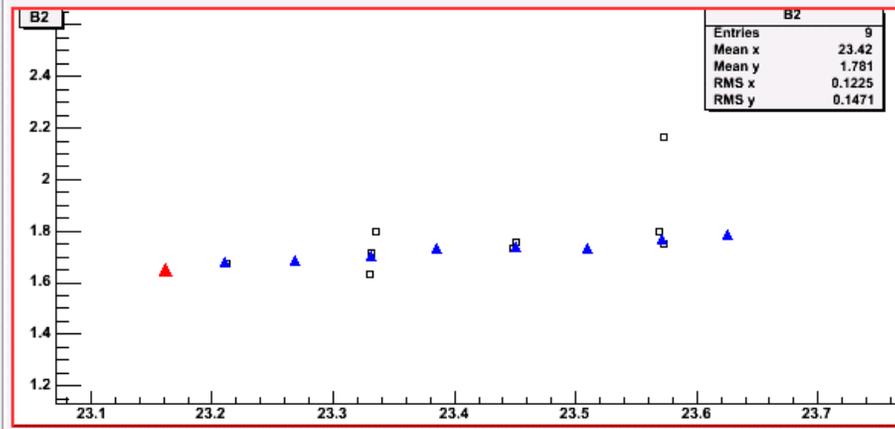
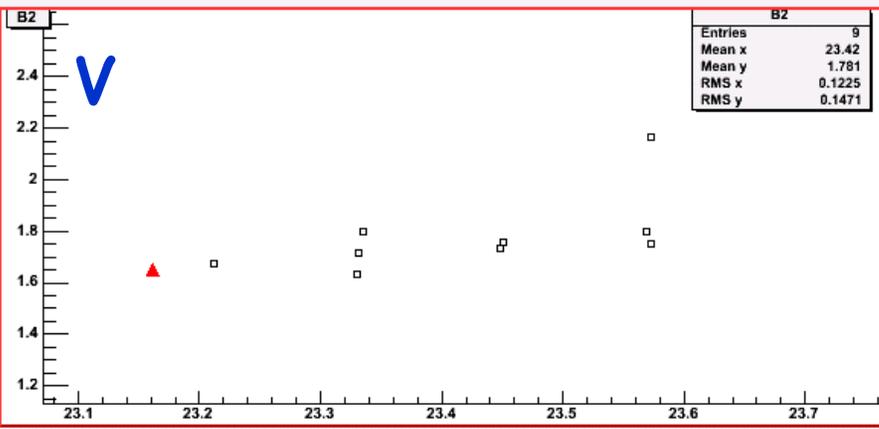
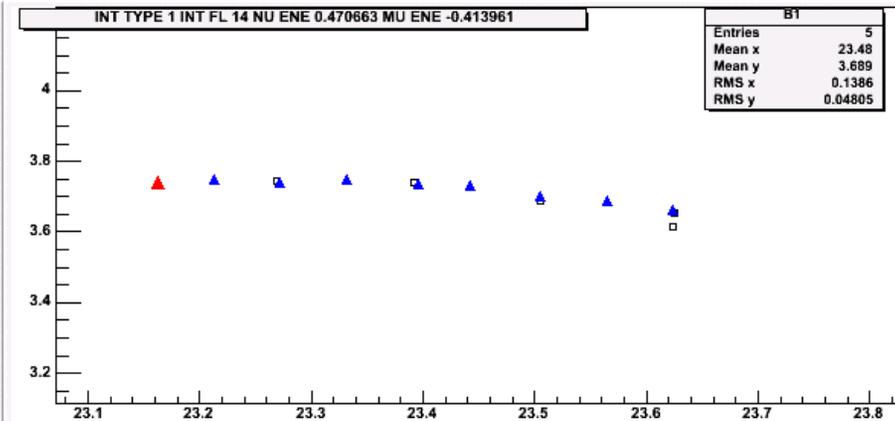
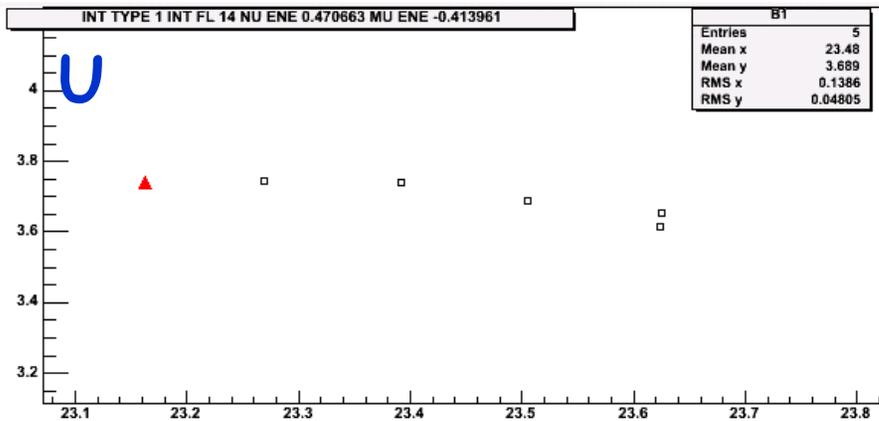
$E_{\nu} = 0.49 \text{ GeV}$
 $E_{\mu} = 0.43 \text{ GeV}$

Examples of numu CC events

2

Before

After



- ▲ True neutrino vertex Hit
- ◻ Strip
- ▲ Reconstructed Muon Track

Z

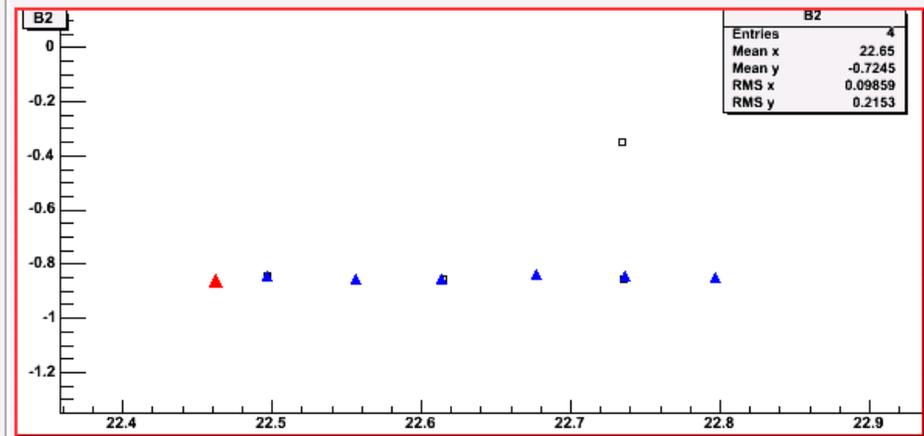
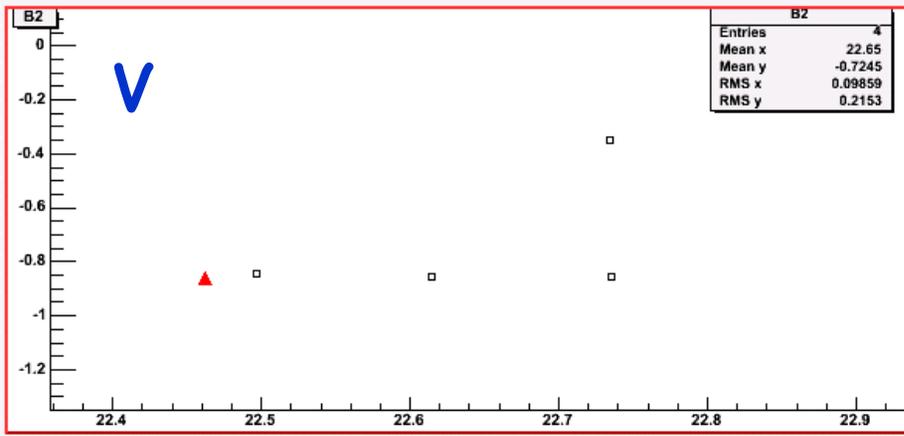
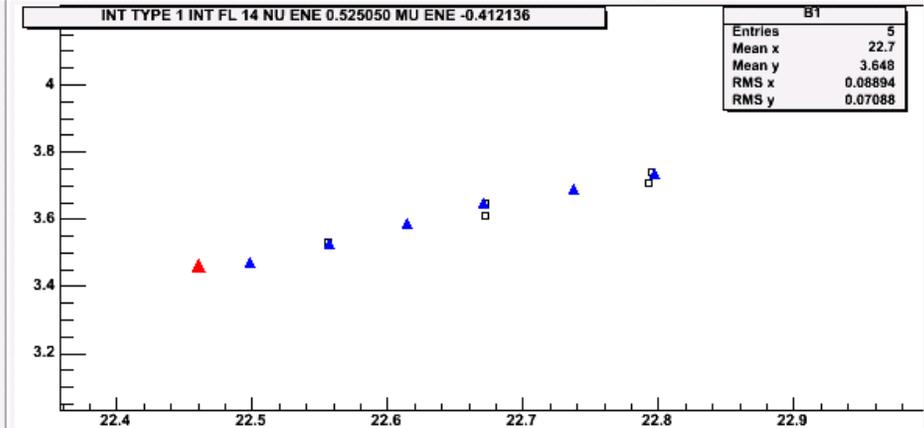
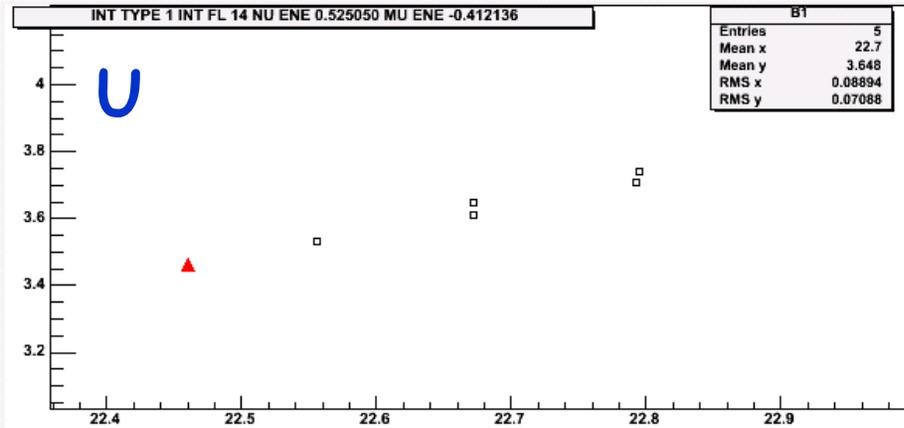
$E_{\nu} = 0.47 \text{ GeV}$
 $E_{\mu} = 0.41 \text{ GeV}$

Examples of numu CC events

3

Before

After



- ▲ True neutrino vertex Hit
- Strip
- ▲ Reconstructed Muon Track

Z

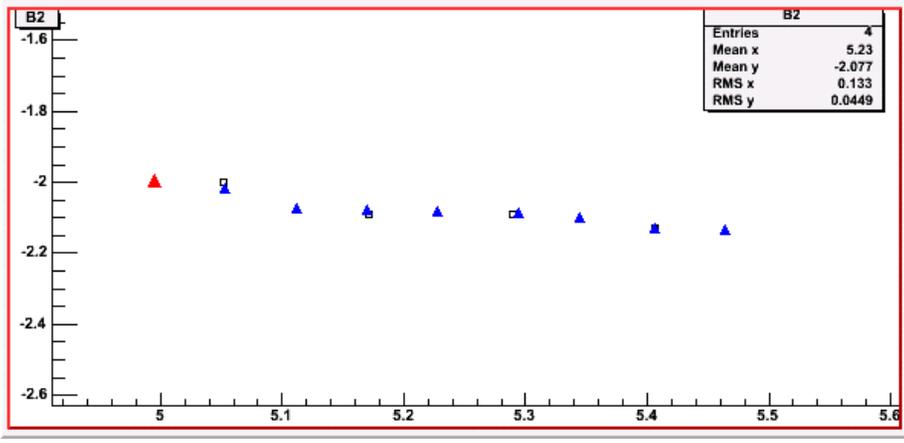
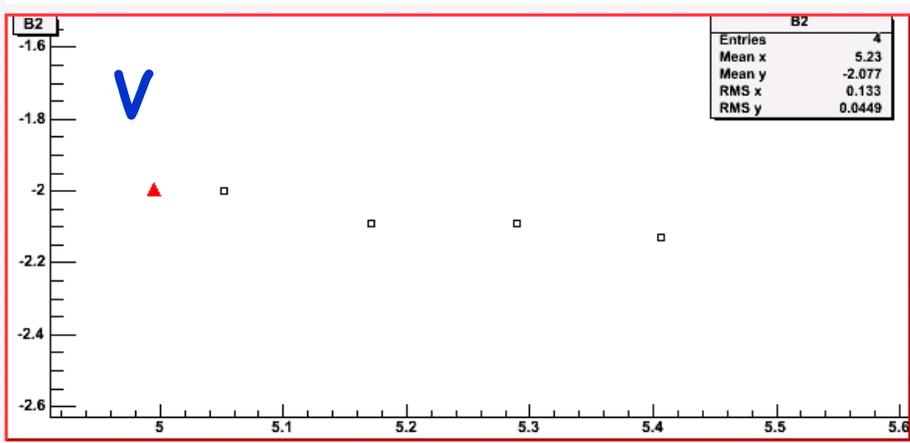
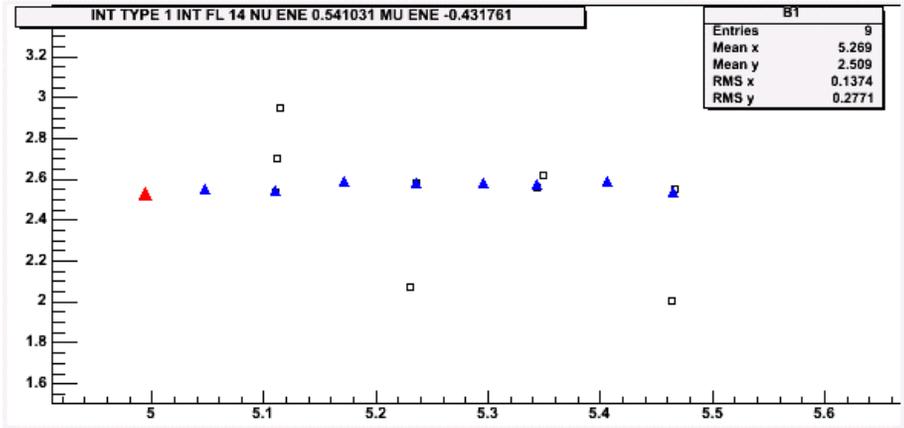
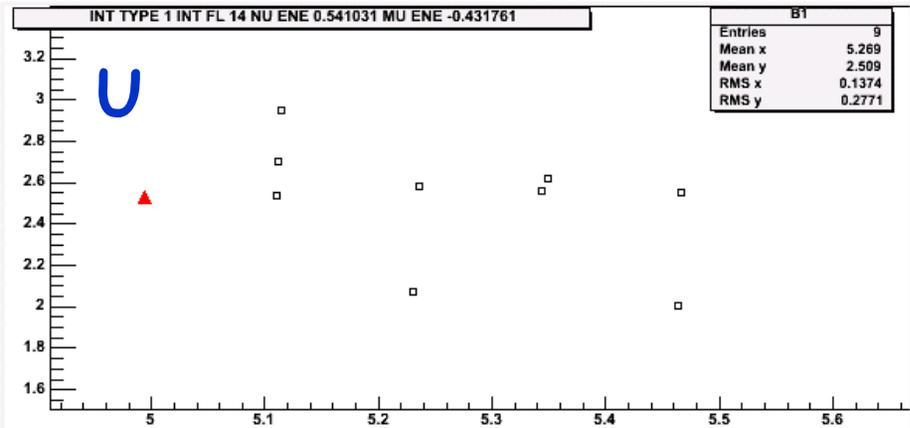
$E_{\nu} = 0.52 \text{ GeV}$
 $E_{\mu} = 0.41 \text{ GeV}$

Examples of numu CC events

4

Before

After



- ▲ True neutrino vertex Hit
- Strip
- ▲ Reconstructed Muon Track

Z

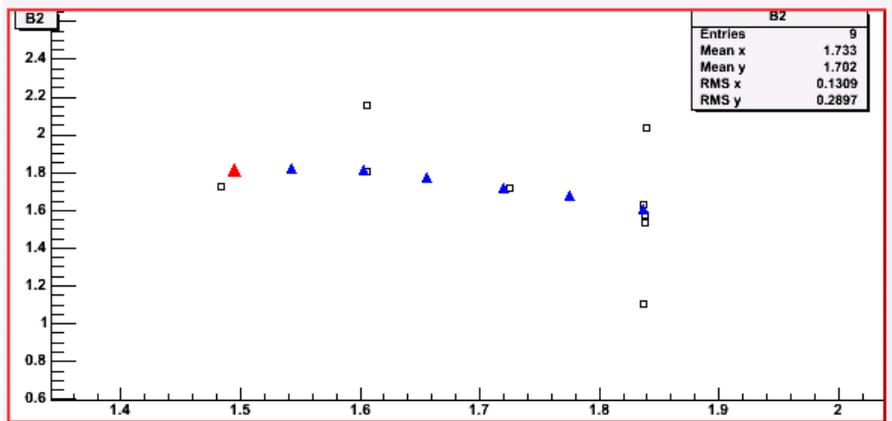
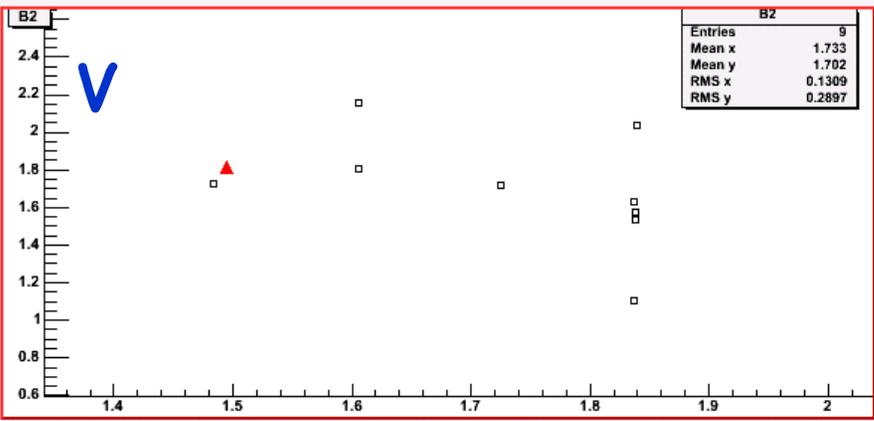
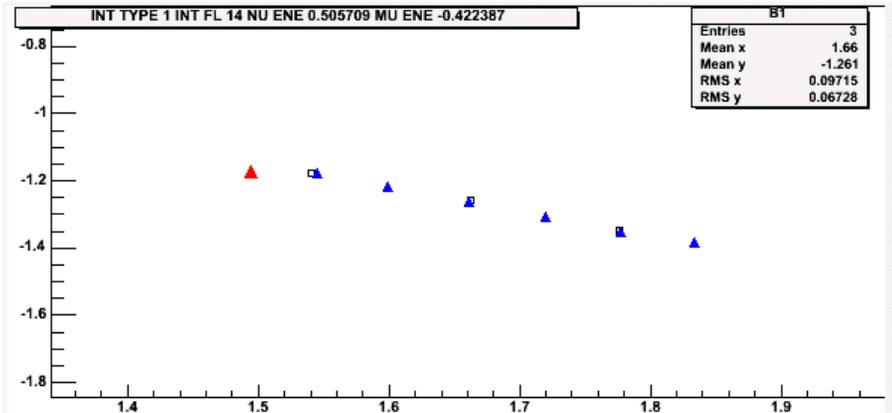
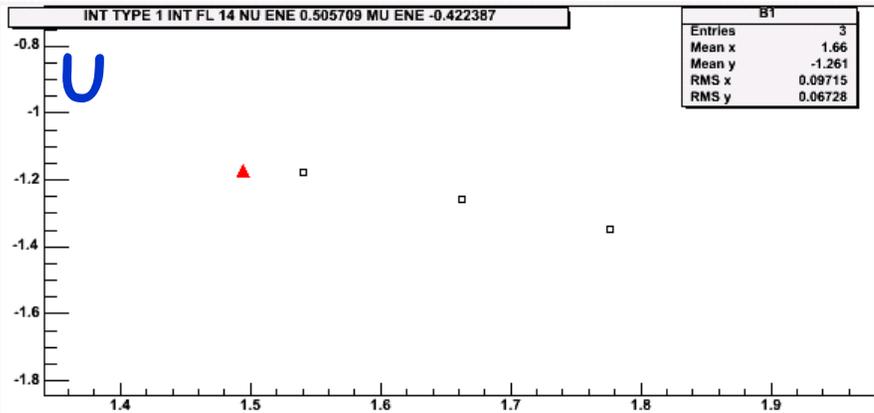
$E_{\nu} = 0.54 \text{ GeV}$
 $E_{\mu} = 0.43 \text{ GeV}$

Examples of numu CC events

5

Before

After



- ▲ True neutrino vertex Hit
- Strip
- ▲ Reconstructed Muon Track

Z

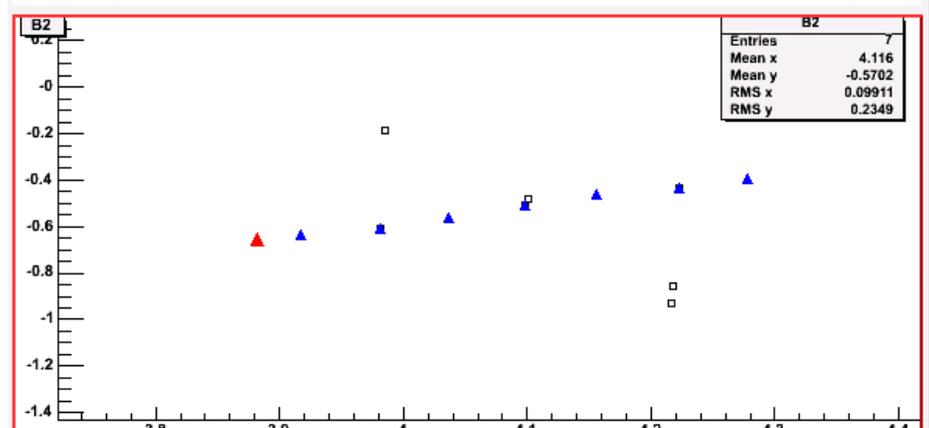
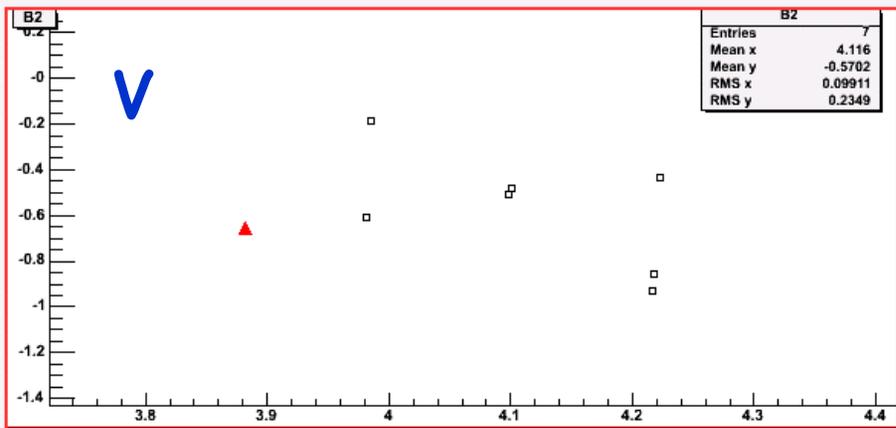
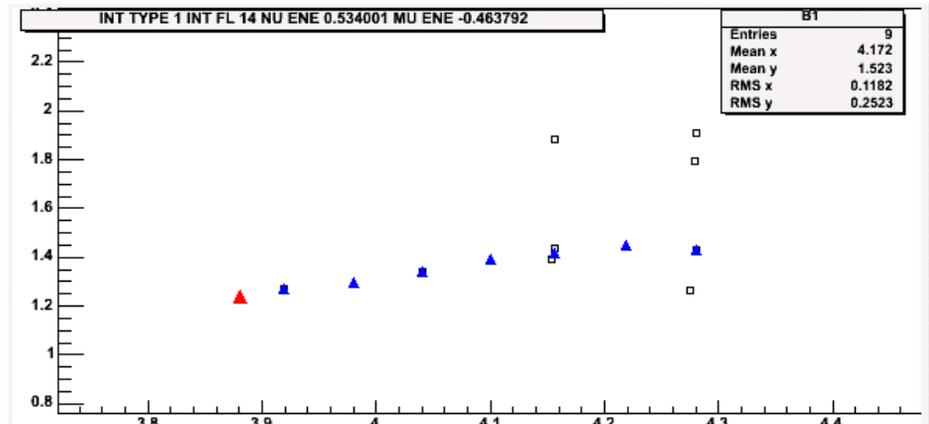
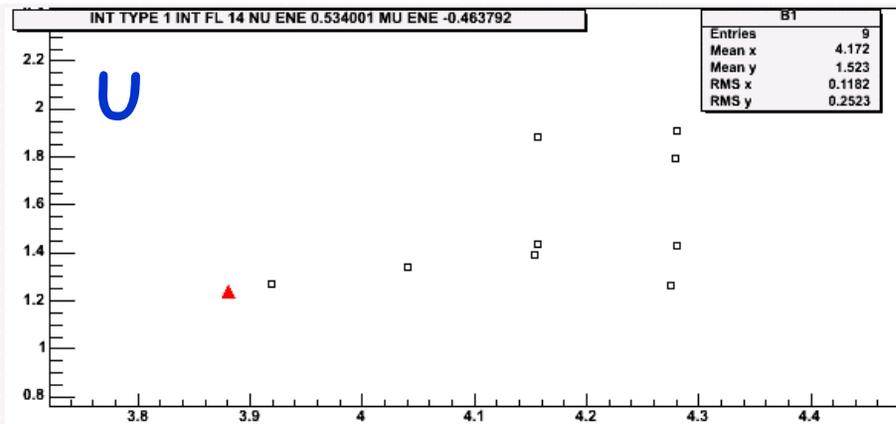
$E_{\nu} = 0.51 \text{ GeV}$
 $E_{\mu} = 0.42 \text{ GeV}$

Examples of numu CC events

6

Before

After



- ▲ True neutrino vertex Hit
- ◻ Strip
- ▲ Reconstructed Muon Track

Z

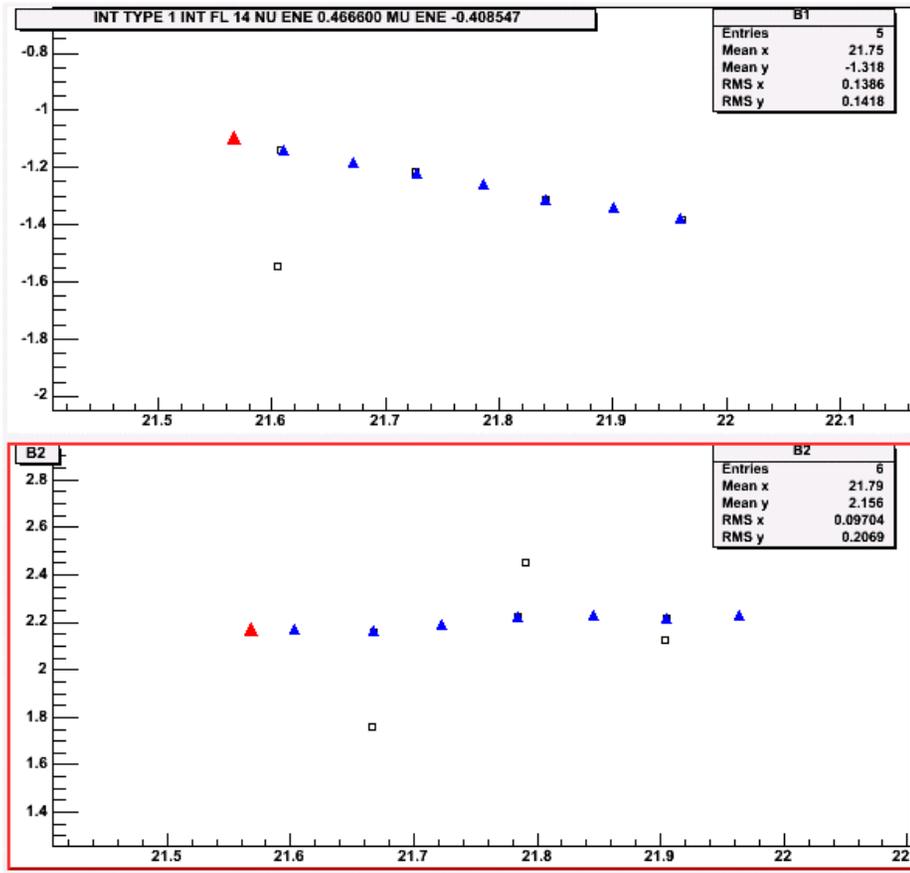
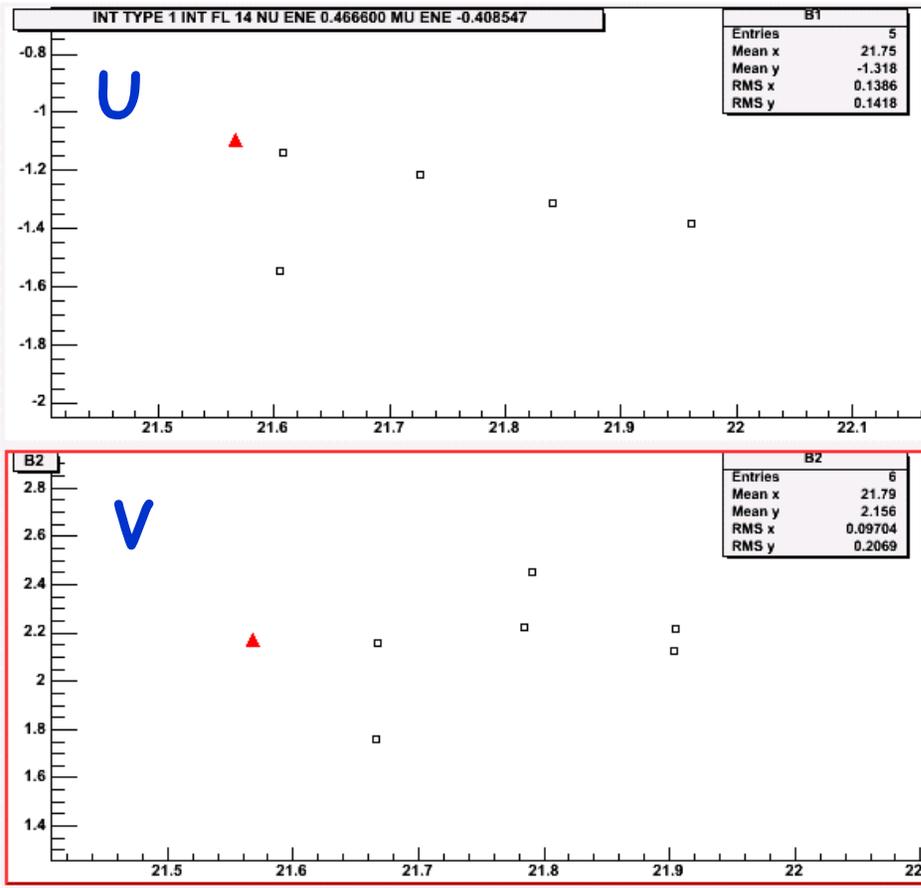
$E_{\nu} = 0.53 \text{ GeV}$
 $E_{\mu} = 0.48 \text{ GeV}$

Examples of numu CC events

7

Before

After



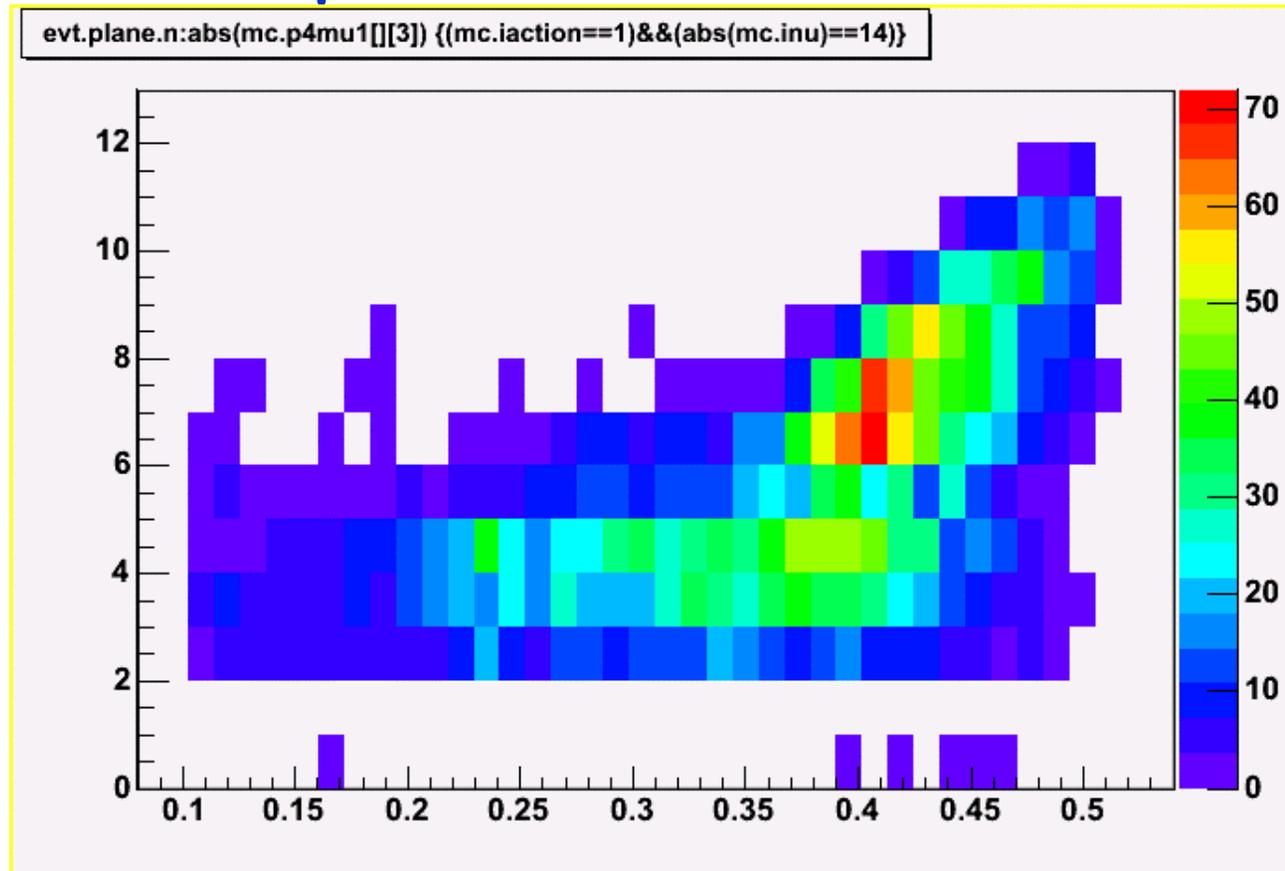
- ▲ True neutrino vertex Hit
- ◻ Strip
- ▲ Reconstructed Muon Track

Z

$E_{\nu} = 0.47 \text{ GeV}$
 $E_{\mu} = 0.41 \text{ GeV}$

Number of planes in each view vs muon energy

Divide by 2 to get the number of planes per view



• Many times doing a “rough” estimate of the number of planes a muon track should have, we use the 30MeV/plane number which apparently does not give a realistic estimate of the actual number of planes a muon has (at least at lower energies) in the detector.

• I.e saying that a 500 MeV muon should have $\sim 500/30=17$ planes in total is far from the ~ 9 planes it actually has, and that has implications in the track reconstruction, since we should have at least 3 planes in each view to be able to reconstruct a track without “turning” everything into a track.

Conclusions & On going work

- Making some tuning on the parameters of the tracking code, the track reconstruction efficiency has been quite significantly increased @ low energies, while track characteristics are kept unchanged and quite high.
- So far I have tested these changes in a monoenergetic FARDET neutrino file of 0.5 GeV, but I want to do the same with neutrino events of $\sim 0.5-1$ GeV.
- Also I want to examine the effect of these changes in NEARDET single and overlay files.