How to Calculate the Visible Energy of an Event (Work in Progress)

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Motivation

For my cross section measurement, I will use the electron neutrino events to calculate the tau neutrino cross section. As a check, I will assume the tau neutrino cross section is equal to the electron neutrino cross section and use the energy distribution of the electron events to predict the energy distribution of the tau events. I will then compare this predicted distribution to the actual distribution.

To do this, I need a general method of measuring the visual energy of both electromagnetic and hadronic events.

Possible Tools

- sfenergy.sf - this is a routine Reinhard wrote to estimate the total visible energy using the SFT. He provides two estimates for this energy - one assuming the event is electromagnetic and the other assuming the event is hadronic

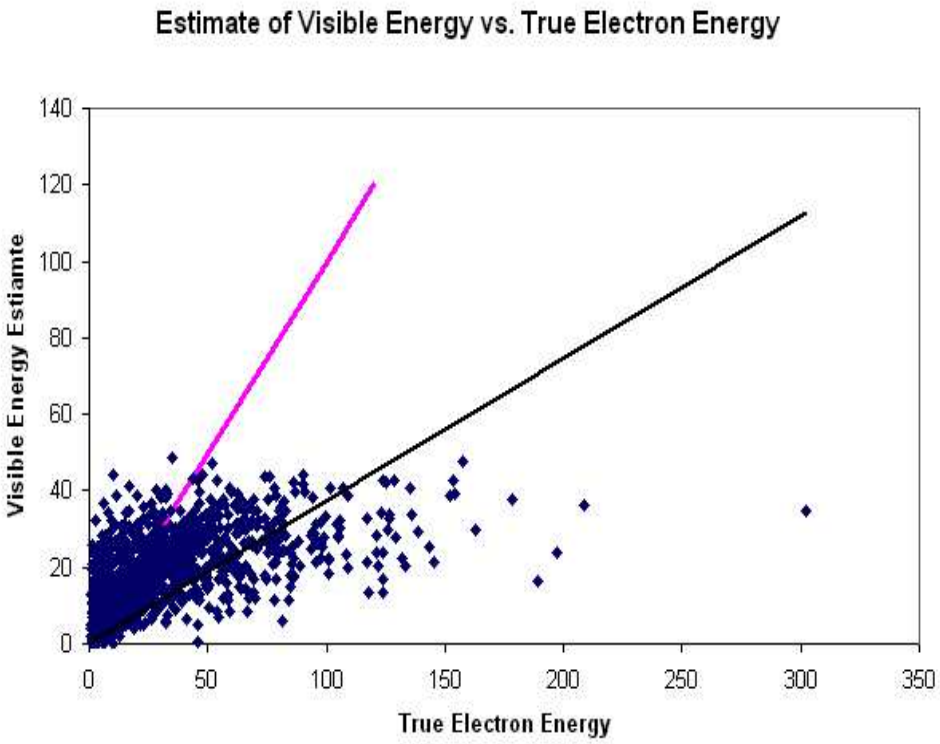
- emcal_com.inc/emanal.sf - which I believe are the routines Byron used to estimate the energy in the EMCAL

I can use these to estimate the energy and compare to Monte Carlo.

Problems I Have Encountered

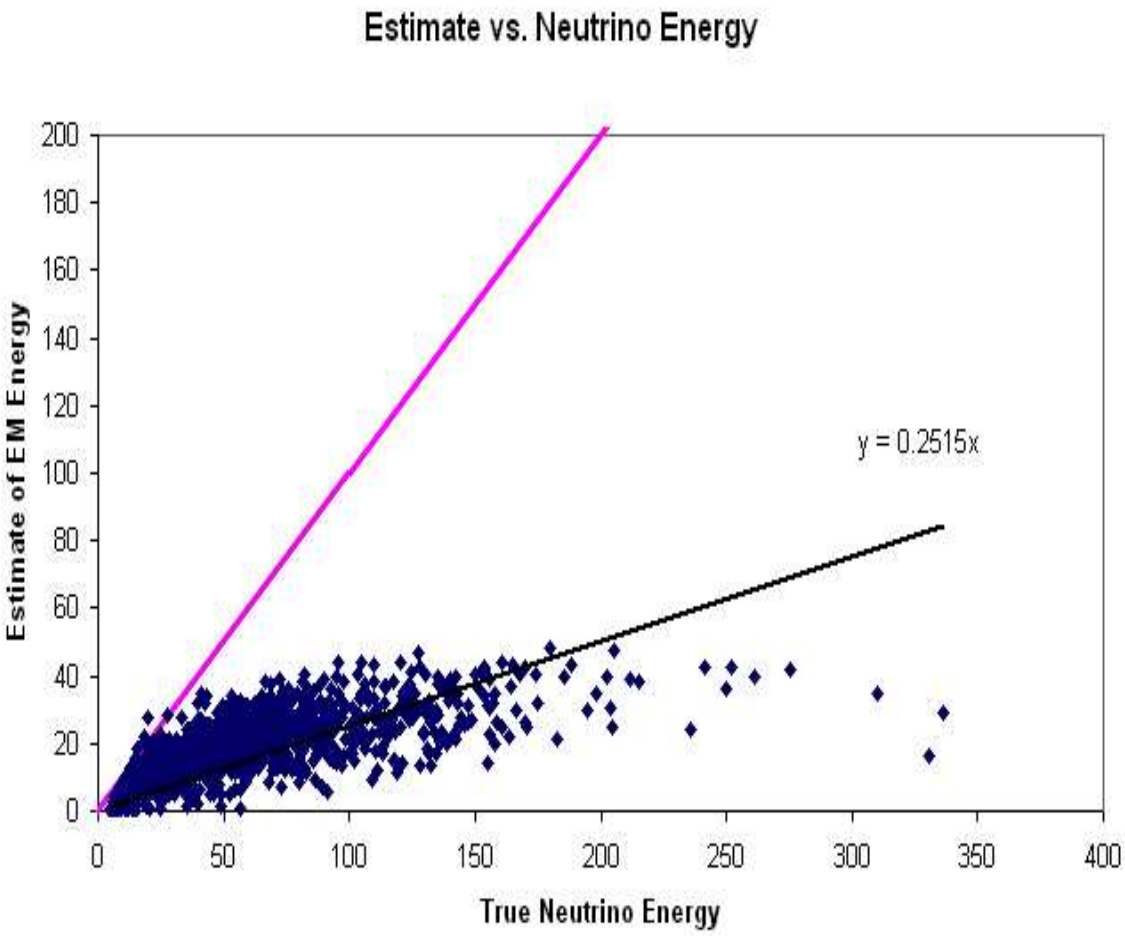
- From the MC, I can (so far) only find the energy of the neutrino and the energy of the primary lepton. I have estimates for the visible energy of the event.
  - For muon cc events, I can subtract the true muon energy from the true neutrino energy and compare to the estimate of visible hadronic energy.
  - For electron cc events, it is more complicated. I will compare the estimates to both the true neutrino energy and the true electron energy.
- I do not have emanal.sf running yet.

Preliminary Results



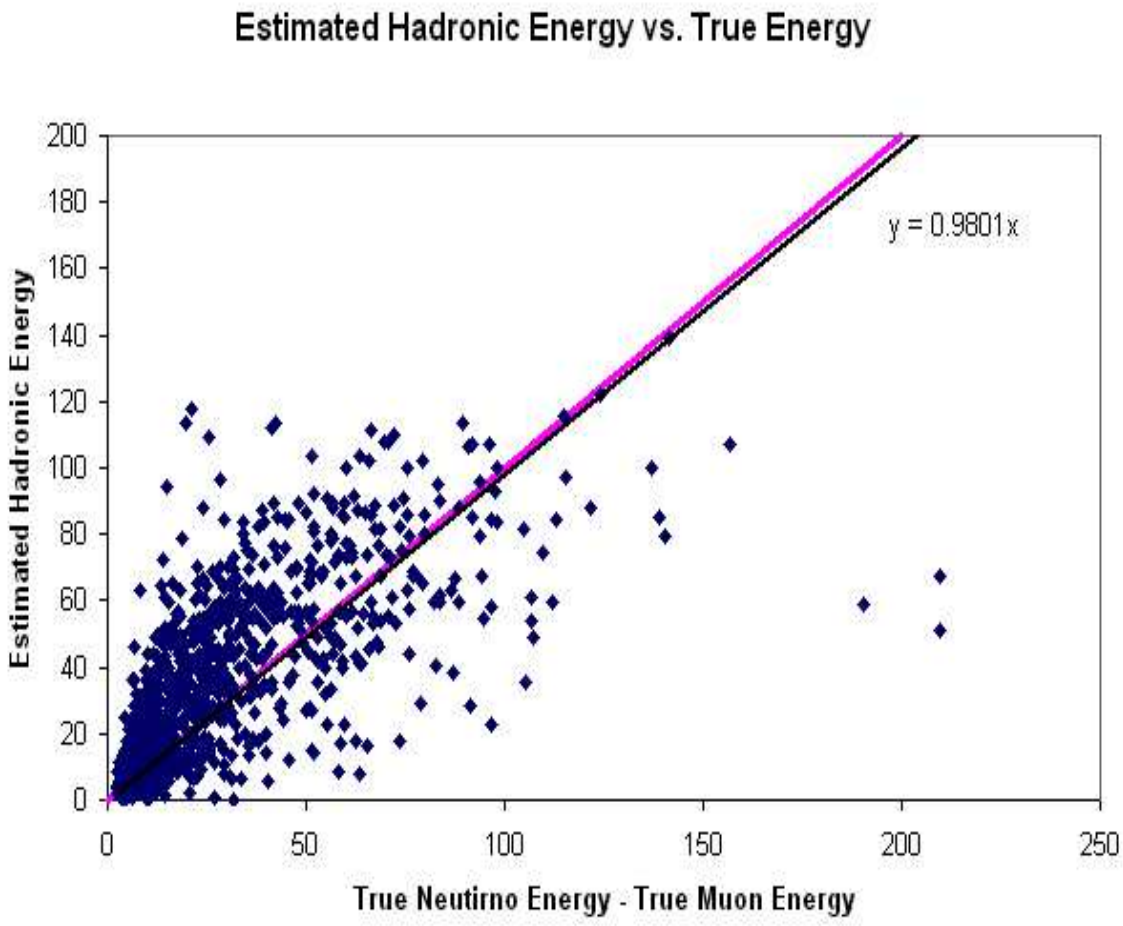
This is a plot of the total electromagnetic energy estimate vs the true electron energy for 1000 Monte Carlo events. The pink is $y = x$, and the black is the fit, which is $y = 0.37x$.

Electron CC Events



This is a plot of the true neutrino energy vs the electromagnetic energy estimate for the same events. Again the pink is $y = x$, and the black is the fit, which is $y = 0.25x$.

Muon CC Events

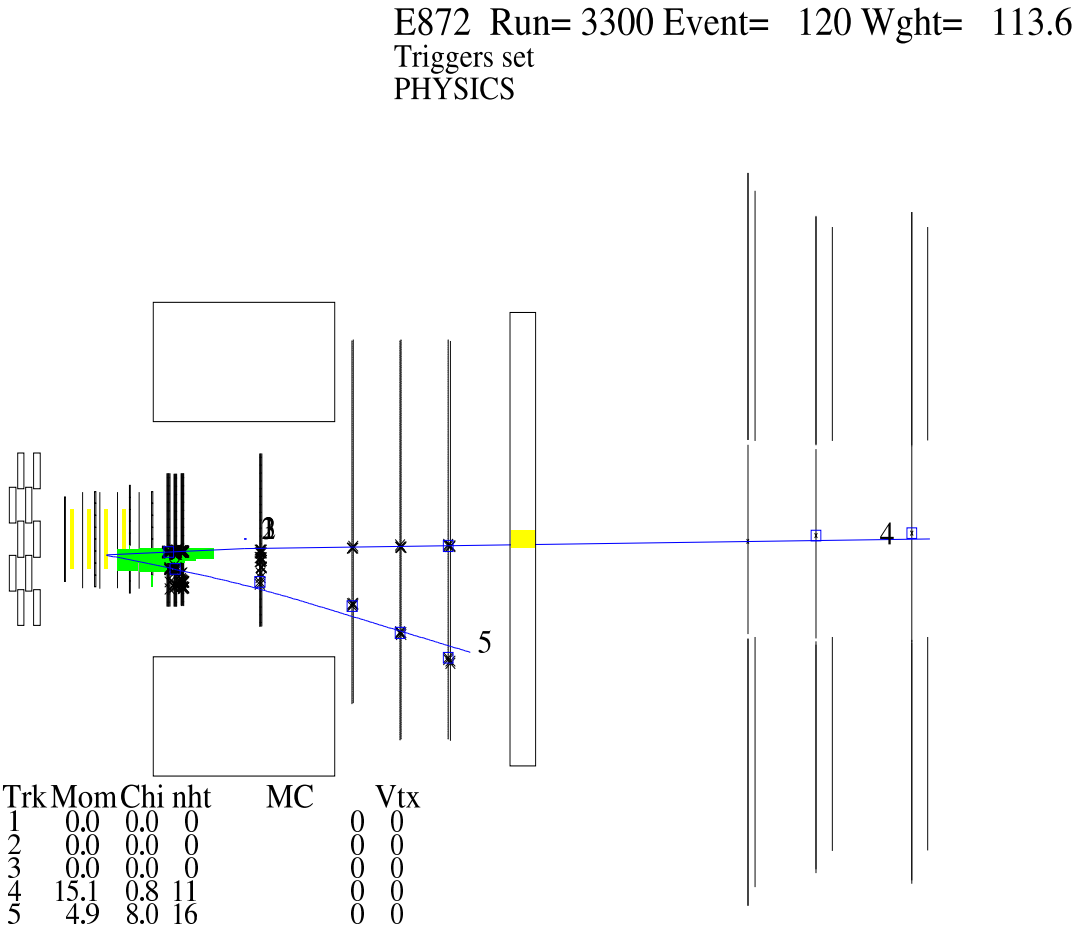


This is a plot of the estimate of the hadronic energy vs the true neutrino energy minus the true muon energy. Again the pink is $y = x$, and the black is the fit, which is $y = 0.98x$.

Outlying Points

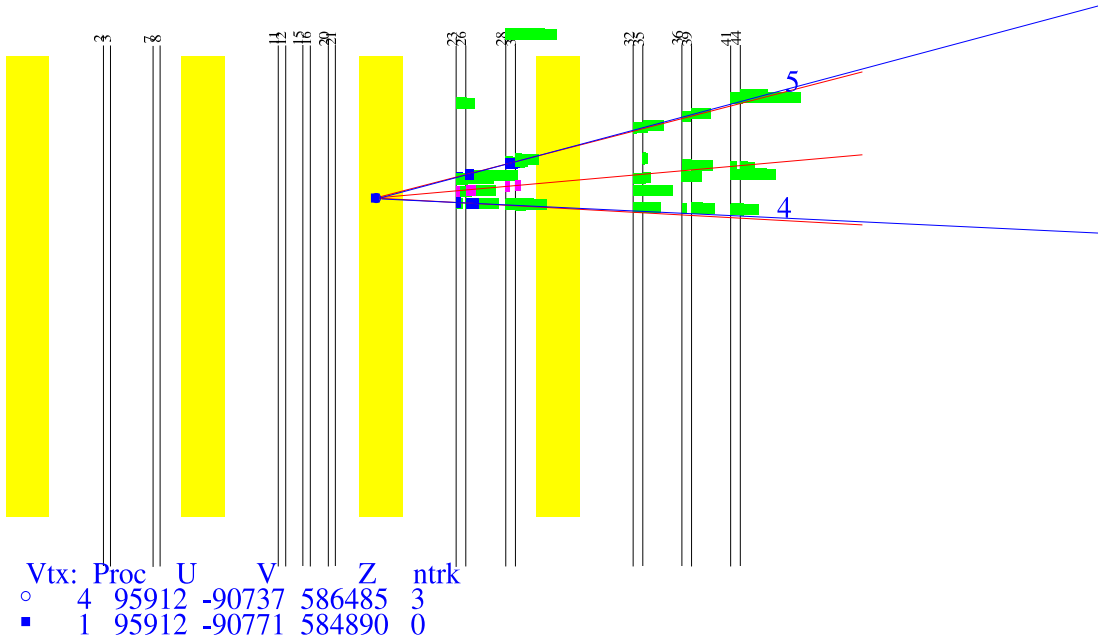
Most of the electron outlying points tend to have high energies and have estimates which underestimate the true energy. The muon events have outlying events on either side of the fit, and I have not found any common characteristics of these outlying points. I will show a muon and an electron example.

The first example is a muon cc event. The true hadronic energy ($E_\nu - E_\mu$) is 190.3 and the estimate is 59.1.



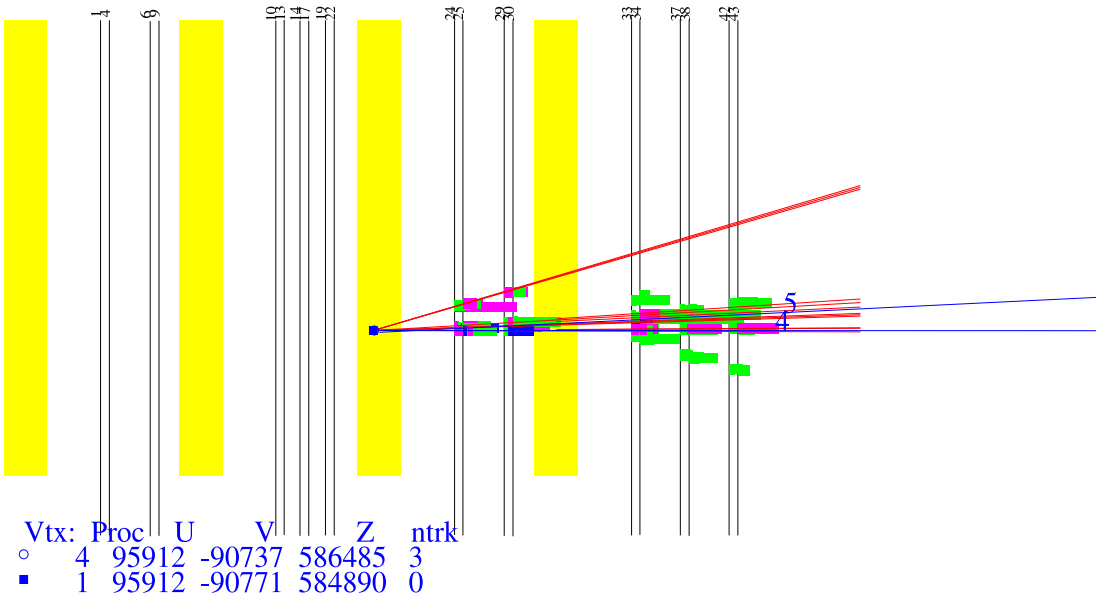
E872 Run= 3300 Event= 120 Wght= 113.6

U View



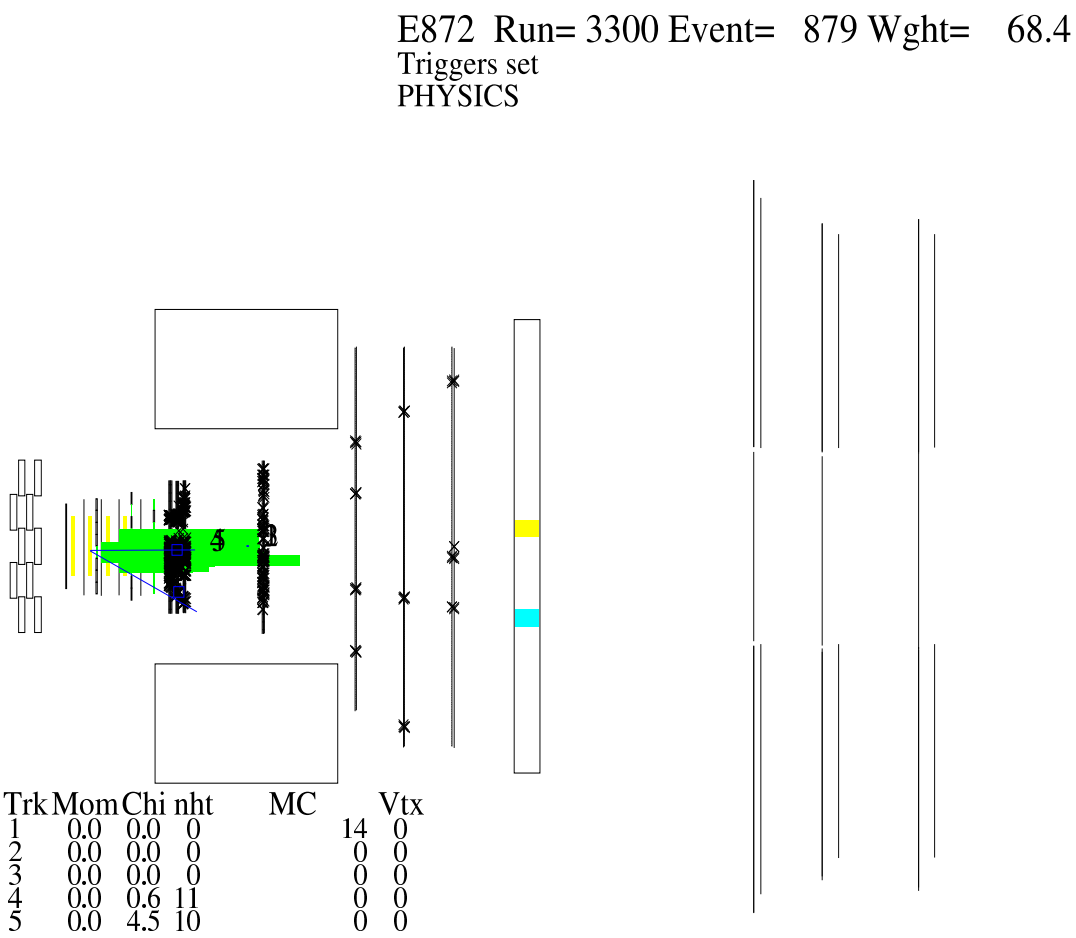
E872 Run= 3300 Event= 120 Wght= 113.6

V View



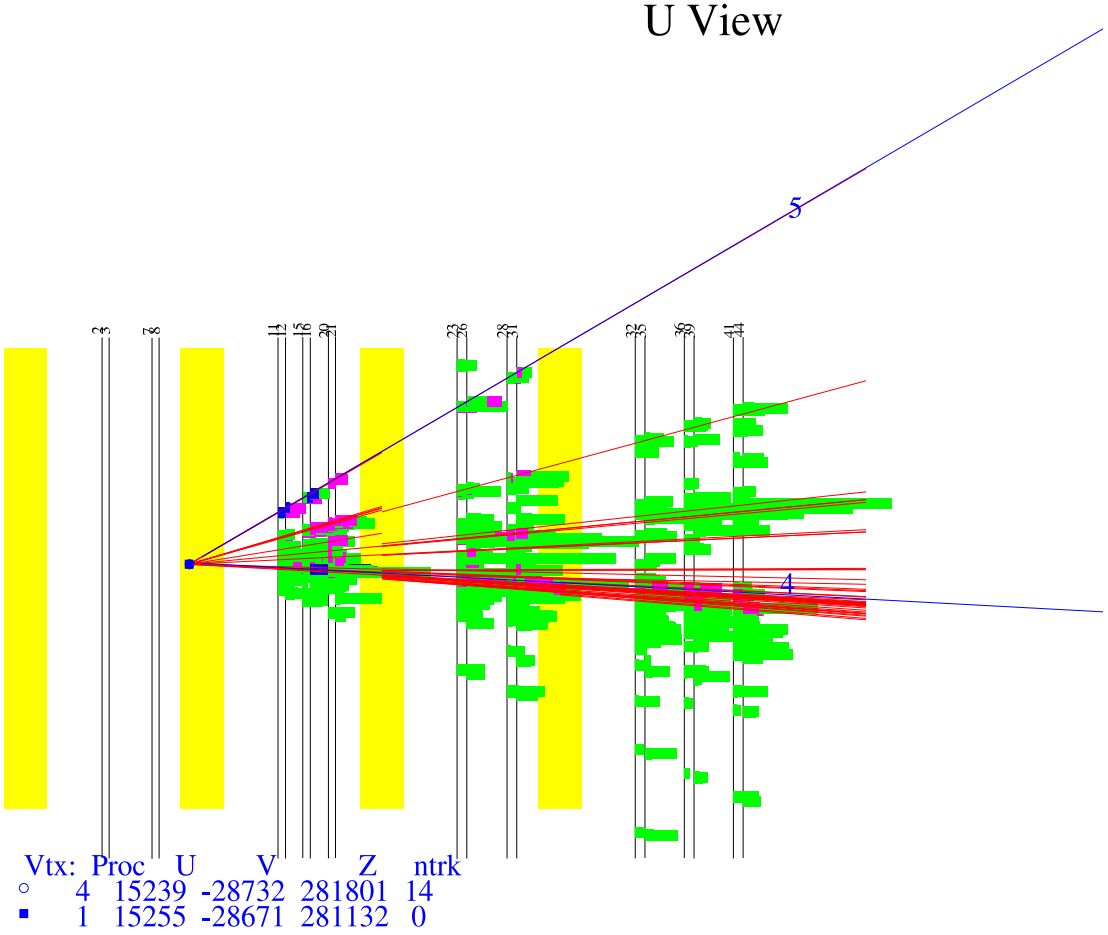
I see nothing peculiar about this event.

The next example is an electron cc event. The outlying electron events are outliers on both plots. This event has $E_\nu = 235.7$, $E_e = 196.9$, and $E_{\text{est}} = 82.8$.



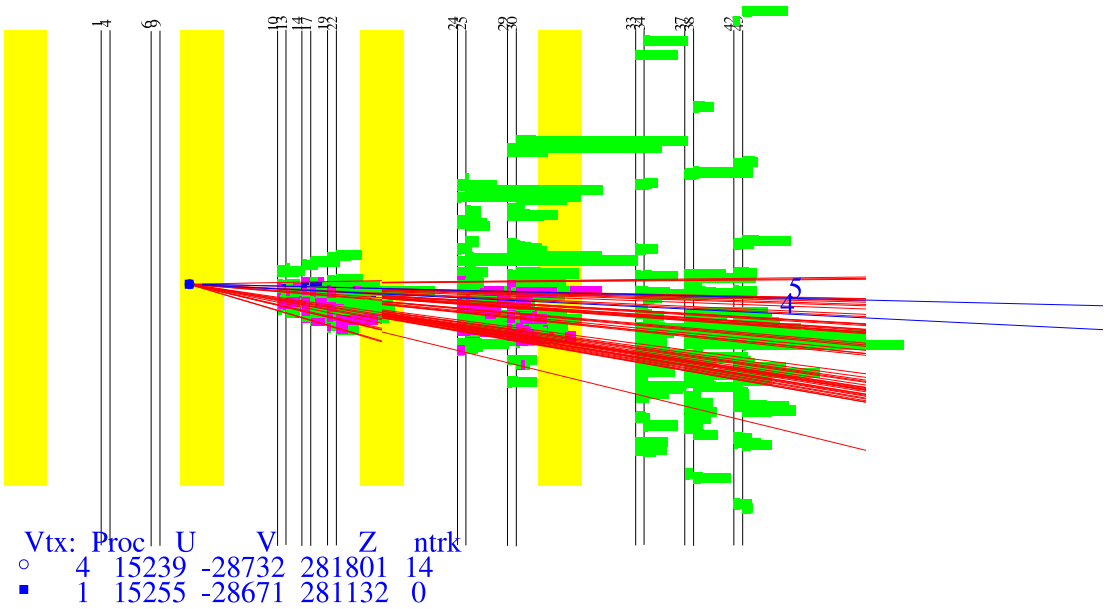
E872 Run= 3300 Event= 879 Wght= 68.4

U View



E872 Run= 3300 Event= 879 Wght= 68.4

V View



Again I see nothing peculiar about this event.

Future Work

- Get emanal.sf running and compare its estimates to sfenergy and Monte Carlo

- Investigate the outlying points further