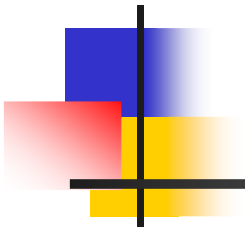


Update on Stanford Effort on TASD Simulations

Stan Wojcicki

NOνA Collaboration Meeting

October 3, 2004

Topics to be Discussed

- Overview of the Analysis Procedure
- Status at the Beginning of This Summer
- Summer Investigations
- Current Situation of Computations
- Visual Scan
- Conclusions

General Analysis Procedure

- 1st step - GEANT (by Leon Mualem)
- 2nd step - RECO MINOS
  - Track finding and fitting
  - Particle identification using loose criteria
  - Rejection of obvious non-ν_e oscillated events
- 3rd step - ntuple analysis - imposition of cuts
  - Total measured energy within +-25% of nominal
  - No significant energy deposition near boundaries
  - Electron in each view
  - No gap(s) in track near vertex; track starts near vertex
  - No μ or γ in event
- 4th step - maximum likelihood analysis of events passing the cuts above

Variables used in maximum likelihood analysis

- Total measured energy
- Fraction of total energy contained in electron
- Mean pulse height near the origin of the electron
- Pulse height/plane for electron
- No of hits/plane for electron
- Energy upstream of vertex
- Curvature of electron
- Missing transverse momentum
- Fraction of total electron pulse height in its first half
- Rms deviation of hits on electron wrt fitted curve
- No of tracks identified as hadrons in event

Results of this analysis (spring 2004)

Number of events processed

ν_e - low energy (0 - 6 GeV) - CC	120K
ν_μ - low energy - NC	~145K
ν_μ - all energies (0 - 20GeV) - NC	120K
ν_μ - low energy - CC	120K

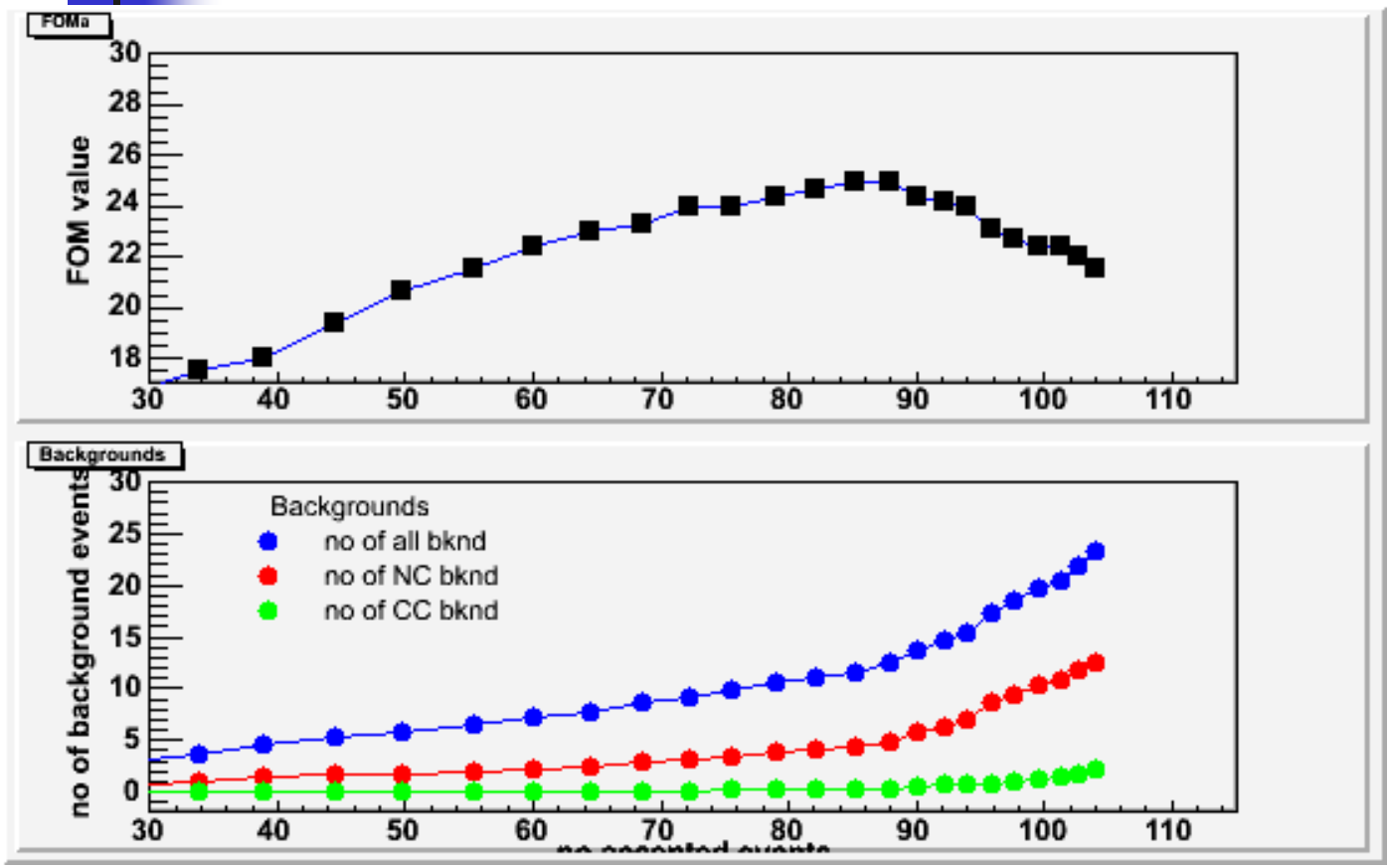
Results

Event selection	FOM training	FOM test/free bin	FOM test/bin forced
All	24.71 +- 0.54		
Odd/even	24.77 +- 0.77	24.99 +- 0.78	24.34 +- 0.77
Even/odd	24.77 +- 0.77	24.30 +- 0.77	23.71 +- 0.77
Average			24.02 +- 0.54

Work this summer (Jake Klamka)

- A number of efforts was made to improve the FOM at the ntuple analysis level:
  - Adding (substituting) 2D histograms in the ML analysis
  - Using separate likelihood functions for NC and CC backgrounds
  - Using neural networks instead ofr maximum likelihood
  - Boosted decision trees
- The bottom line is that none of them gave significant improvement; 2D histograms might give about 0.5 - 1 unit of FOM improvement
- In my opinion any significant improvement has to come from:
  - Improvements in RECO MINOS tracking and particle ID
  - Additional visual analysis

Sources of background



6.75 ν_e-beam

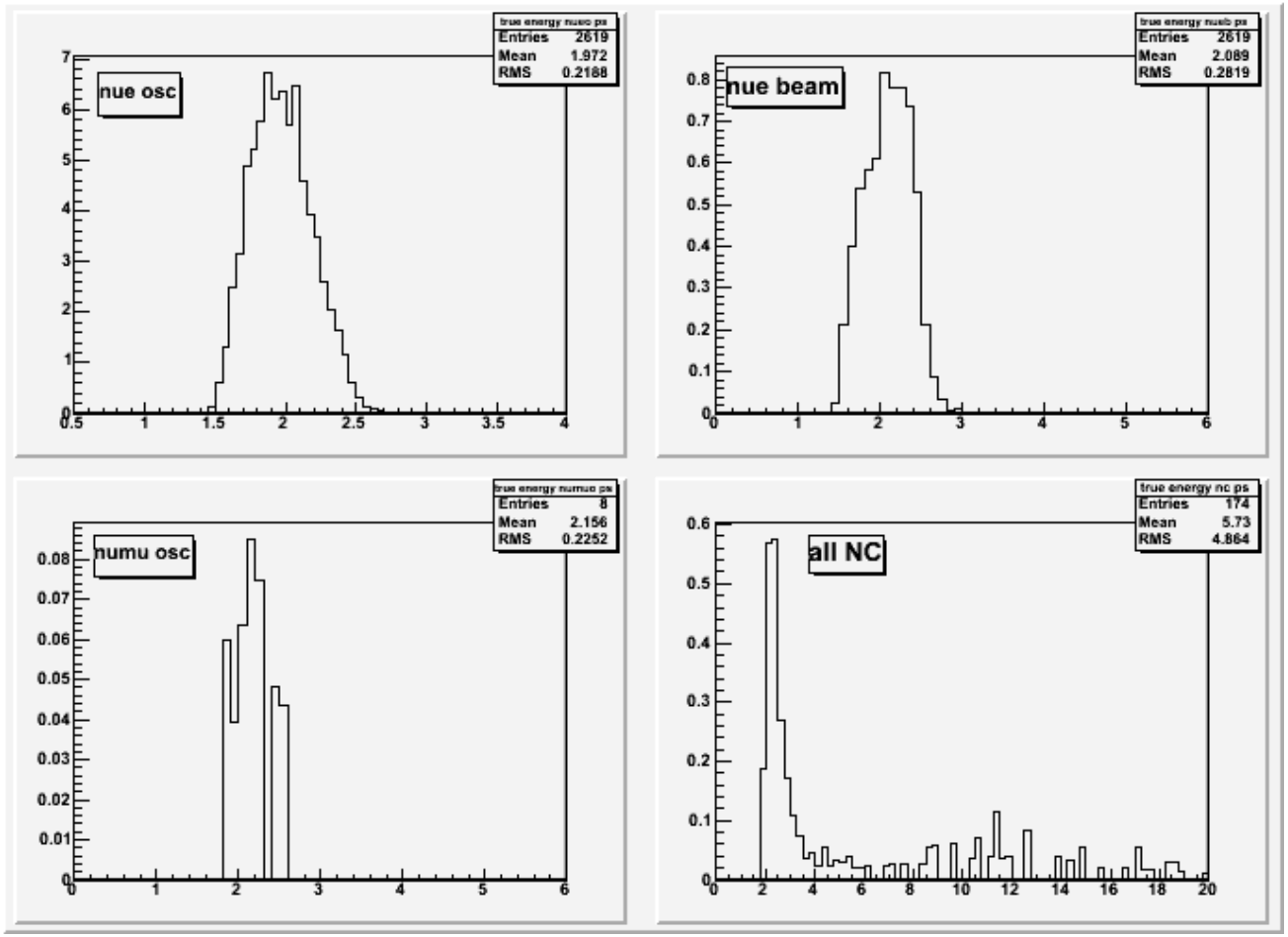
4.08 NC

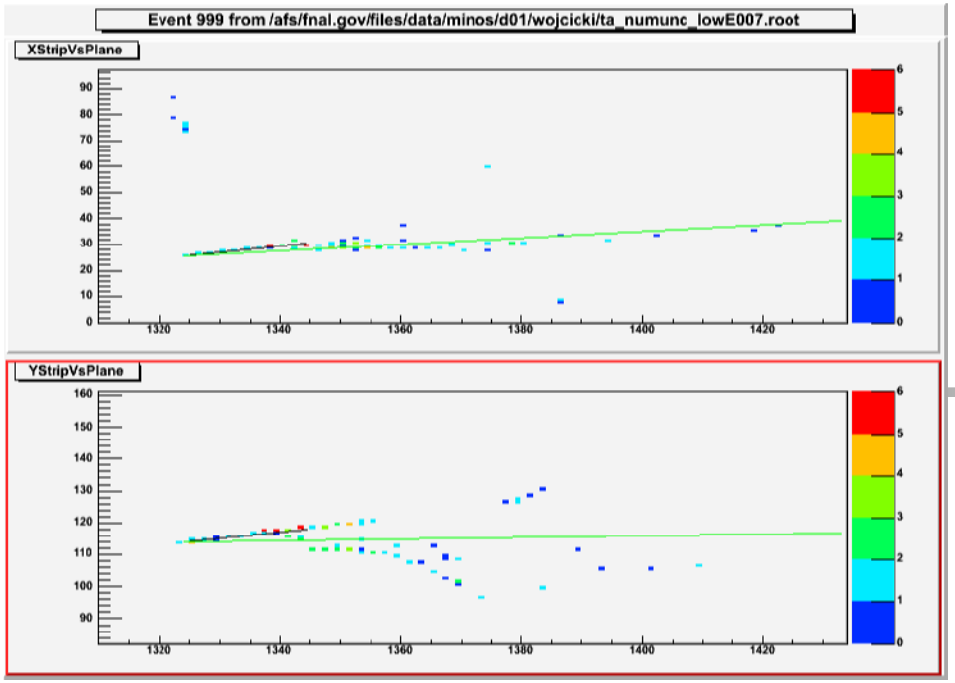
0.26 ν_μ CC

Visual Scan Summary

- Most of the non-ν_e^{beam} background comes from NC events around 2 GeV
- To investigate their nature, I have scanned 10 of these events (events with highest weights)
- There appear to be some characteristic features which may well allow us to eliminate most of these events
- It also means that we may be able to relax our selection criteria to gain higher acceptance for genuine oscillated ν_e events

True energy of accepted events

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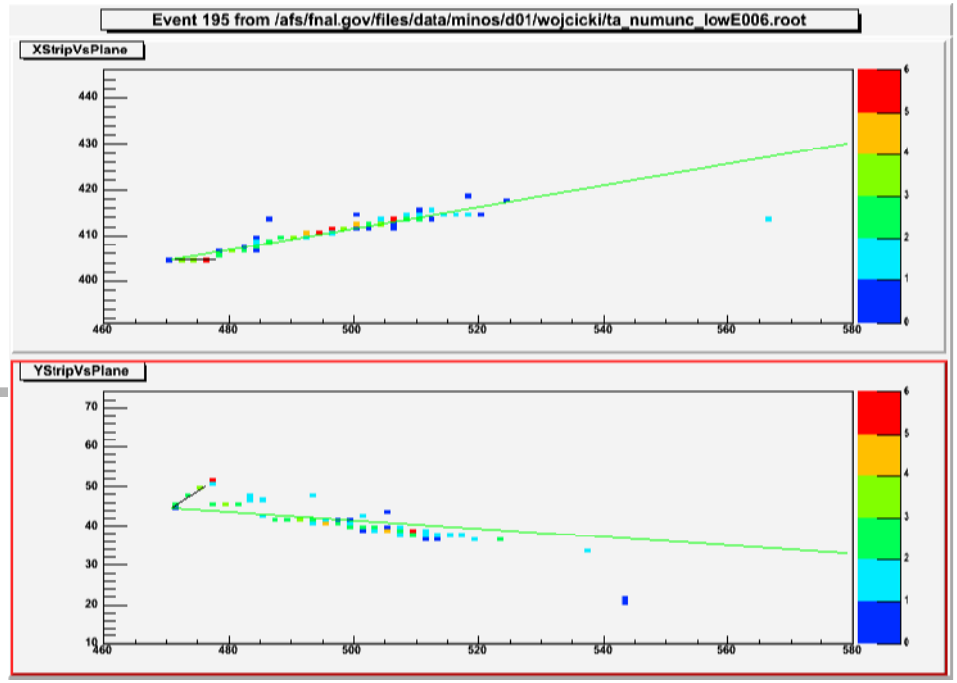
XStripVsPlane
YStripVsPlane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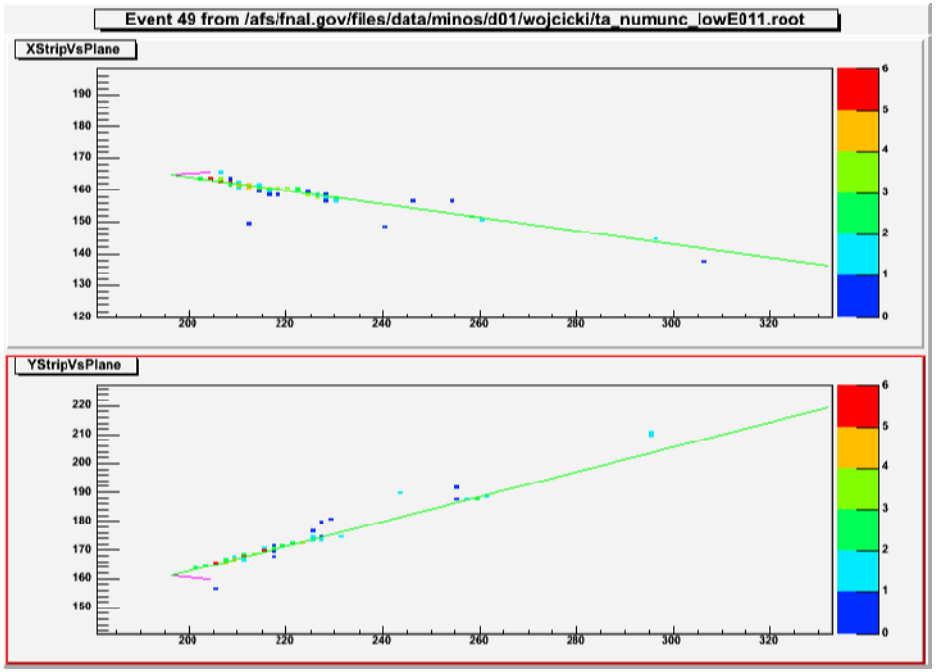
YStripVsPlane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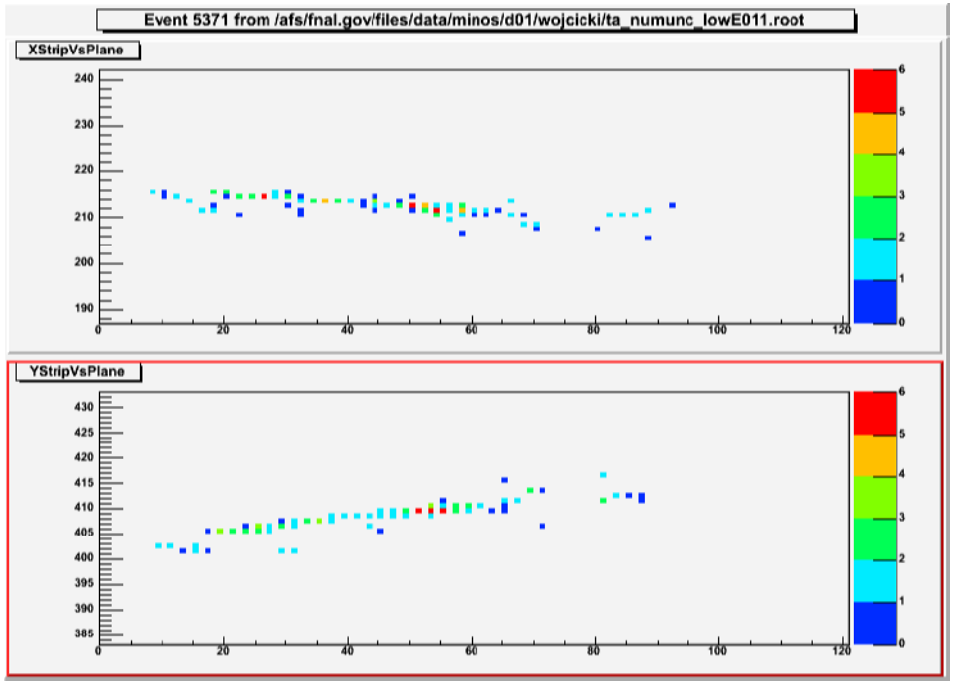
XStripVsPlane
YStripVsPlane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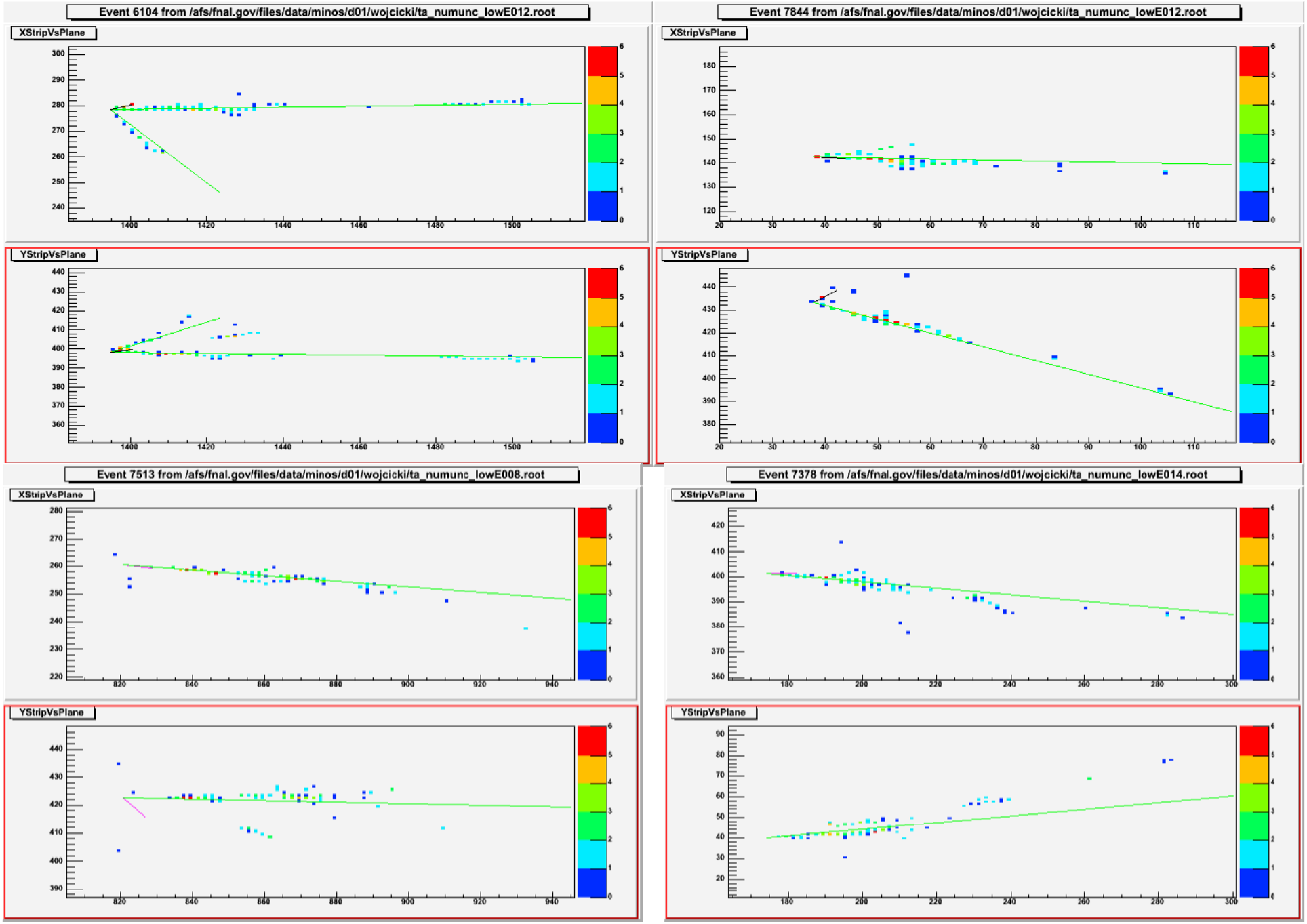
XStripVsPlane
YStripVsPlane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XStripVsPlane
YStripVsPlane
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YStripVsPlane
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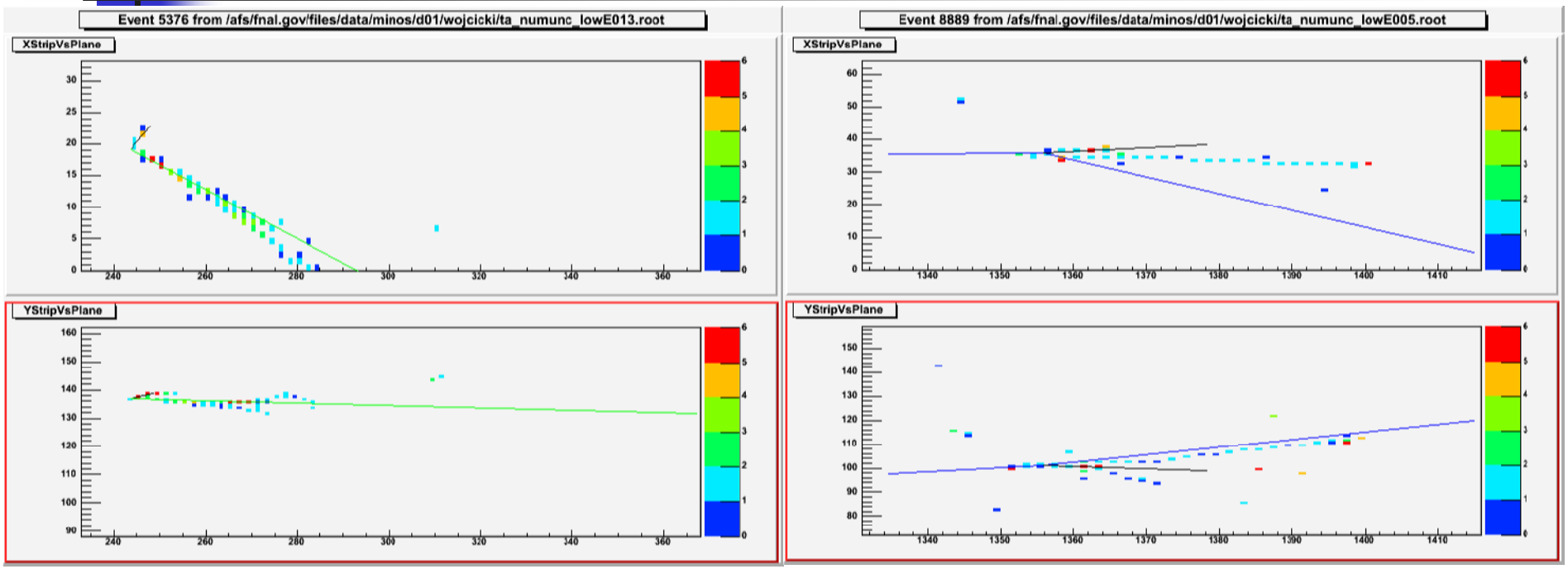
XStripVsPlane
YStripVsPlane

Summary of observations



Of the 10 events inspected:

6 have clear γ's associated, 1 has a possible γ

2 are clean but P_T reasonably large (280 and 300 MeV/c)

1 is an obvious charged pion

Conclusions

- The current analysis appears to have reached an asymptotic FOM value of 24-25
- New approaches appear to have capability of improving the results
- Formulating a bias-free visual analysis of selected events appears to be a reasonable next step