Status of MIND Simulation

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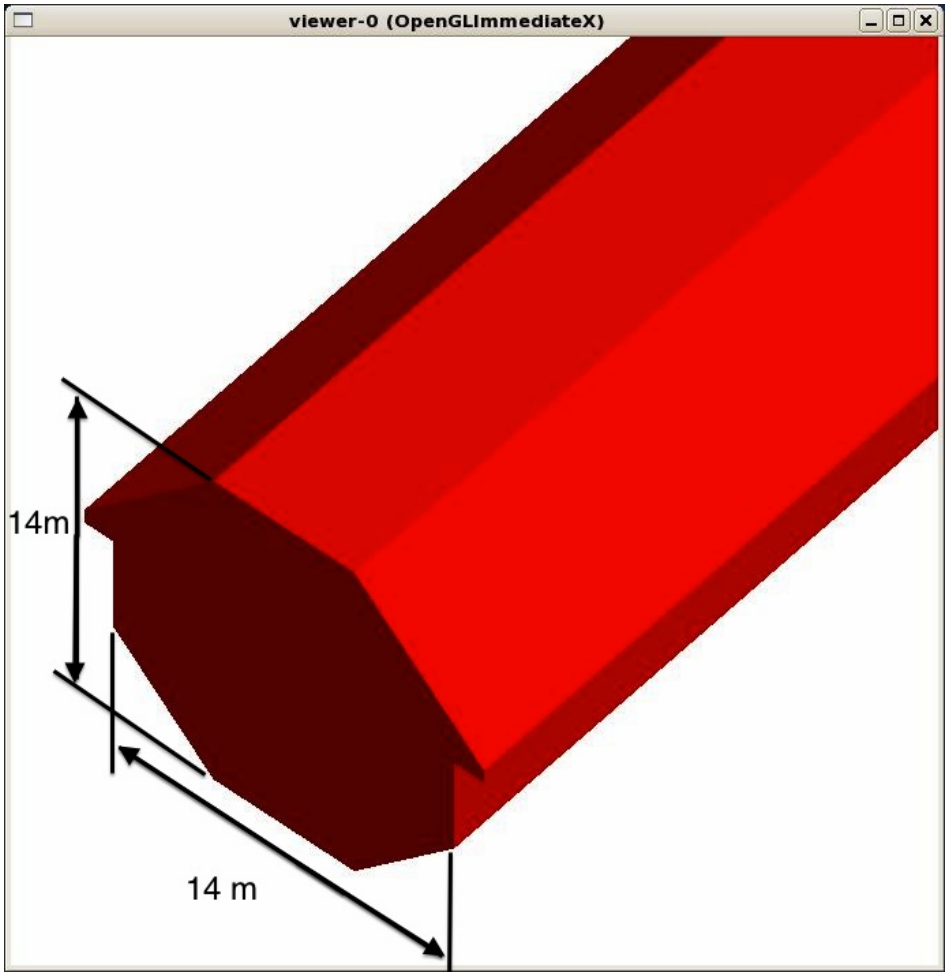
Outline

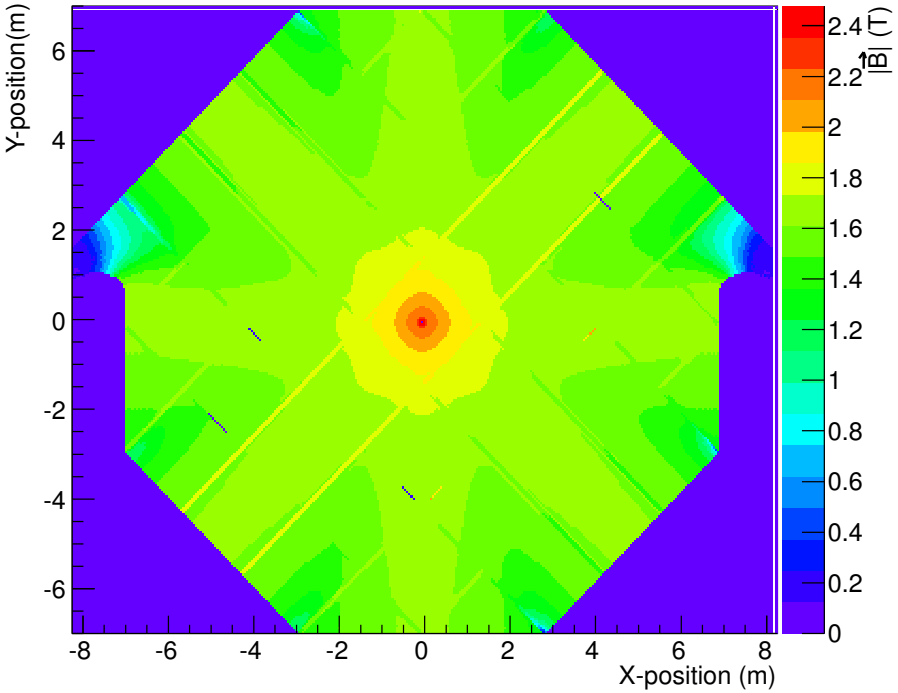
Current Geometry

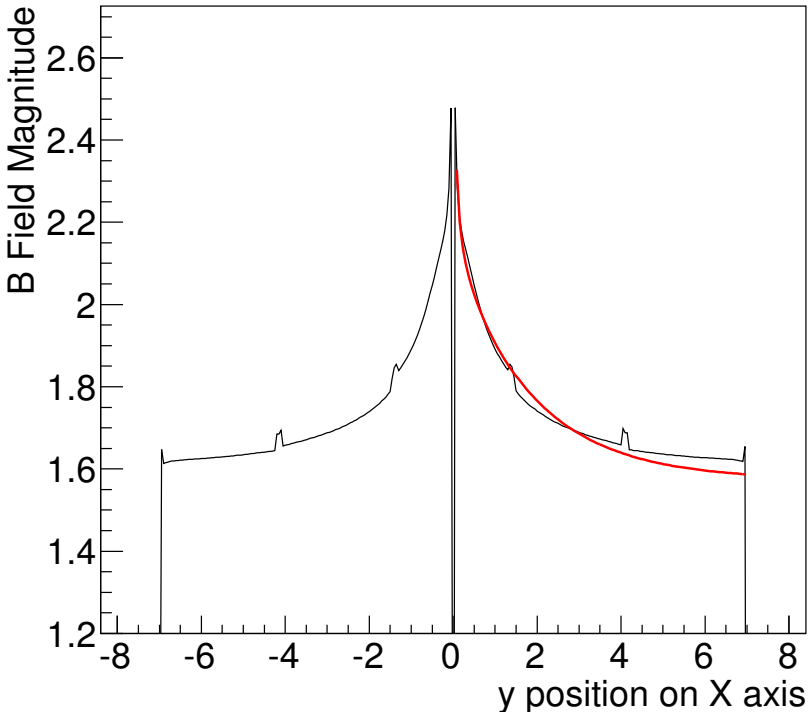
- Using Octagonal geometry
  - Update from cuboid geometry in IDR
- Cross-sectional dimensions taken from engineering drawings in IDR
- Assuming a length of 62.5 m.
- 7 cm diameter copper tube in 10 cm diameter bore has been added to simulate STL.



Magnetic Field Map

Using field map supplied by Bob Wands and Alan Bross (May 2011).

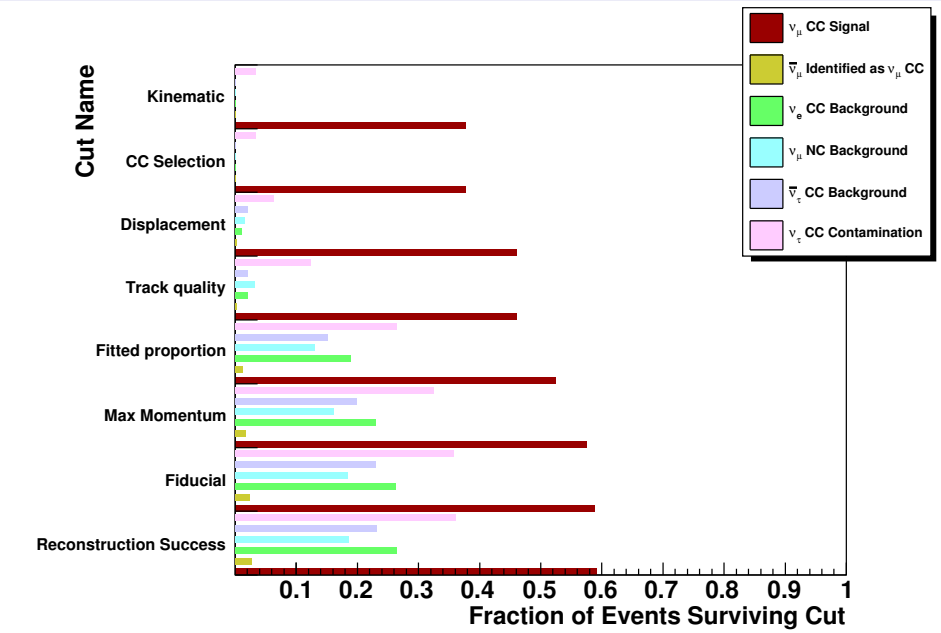




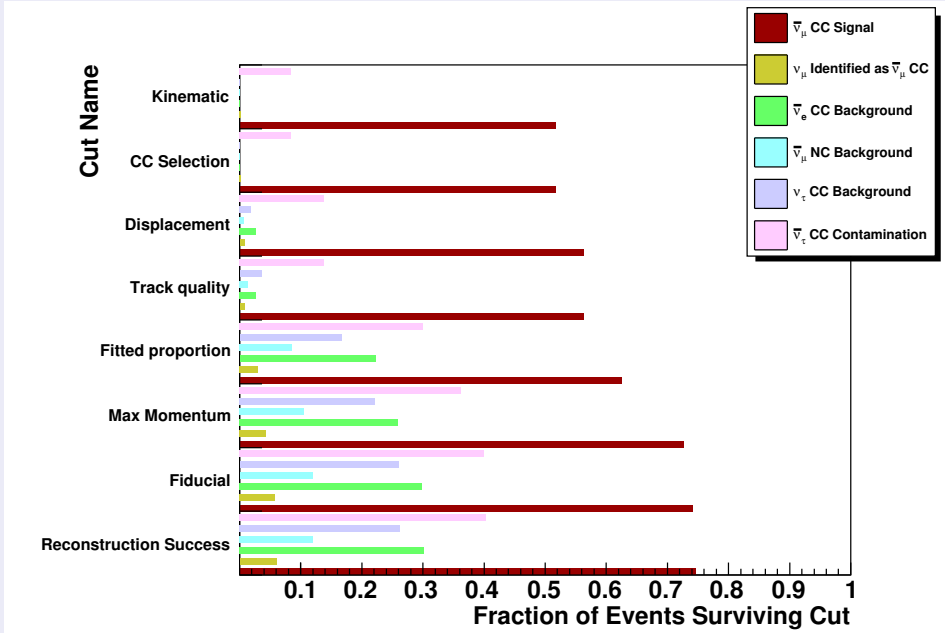
- Field map simulated using 100 kA current.
- Map interpolated using nearest neighbour data points.
- Map used in iron, 0 Tesla elsewhere.
- Option to use “Idealized” field available.

Cuts Based Analysis

ν_μ CC Signal



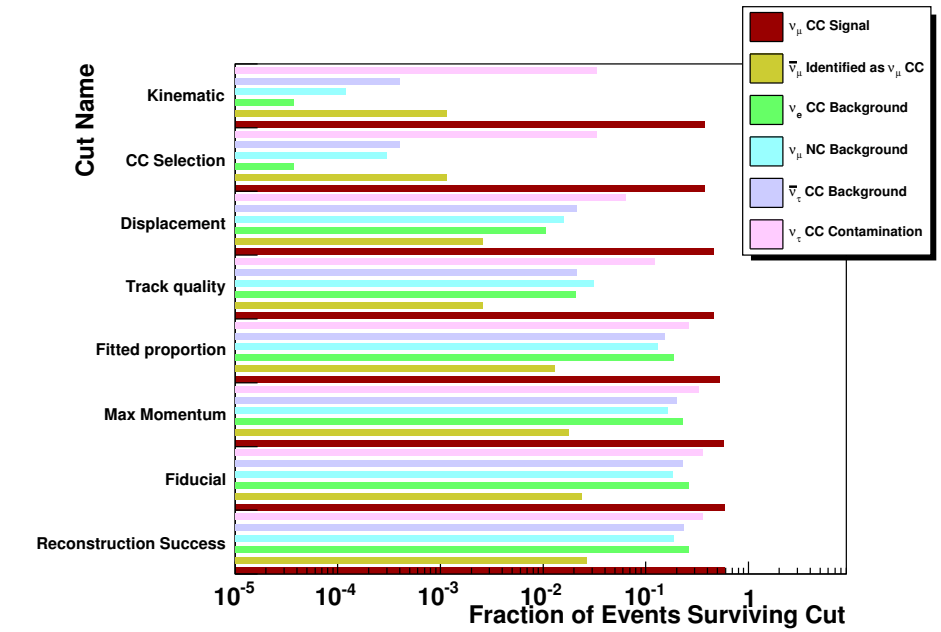
$\bar{\nu}_\mu$ CC Signal



- Assumes the Golden channel analysis from the cuboid geometry.
- “Displacement” cut “turned off”; assumes a dipole field.
- “Kinematic” cut ineffective because of a previously unknown bug.

Cuts Based Analysis

ν_μ CC Signal



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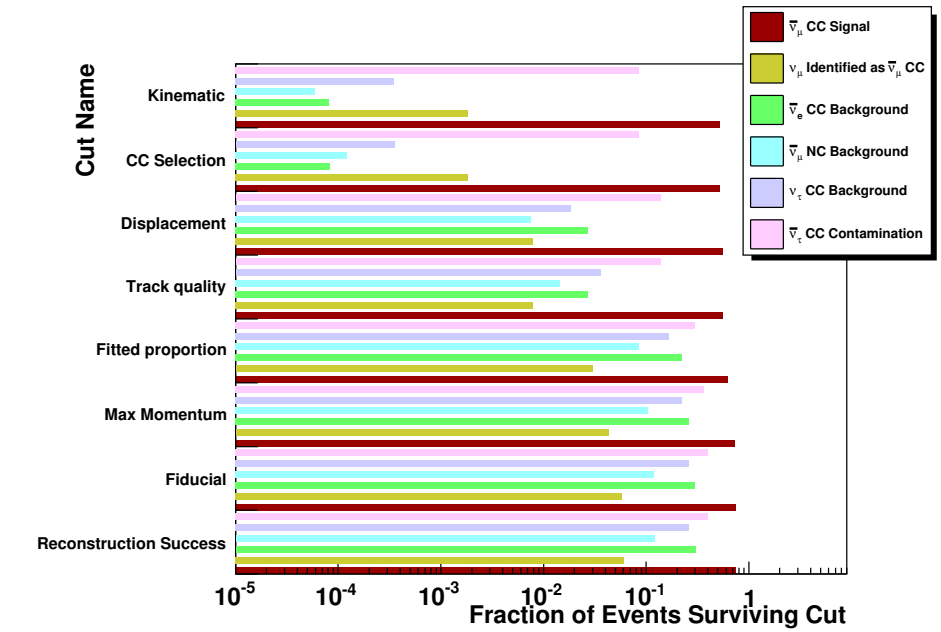

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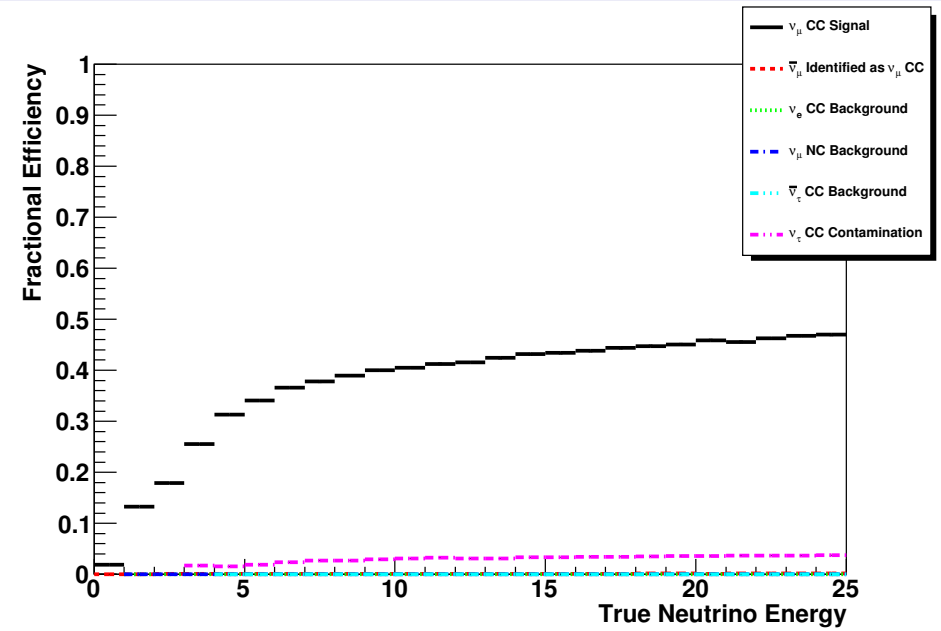
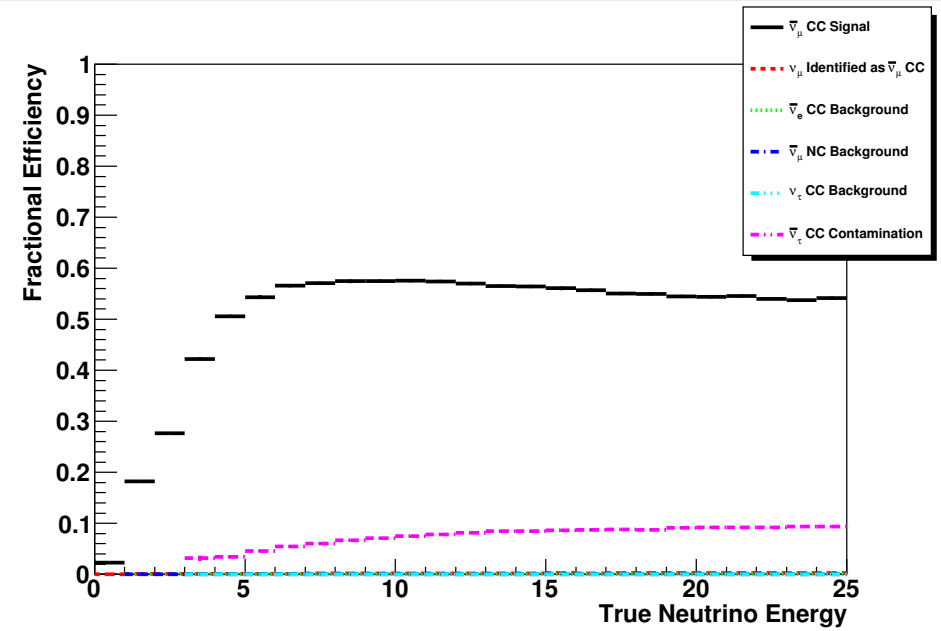
Efficiency

ν_μ CC Signal



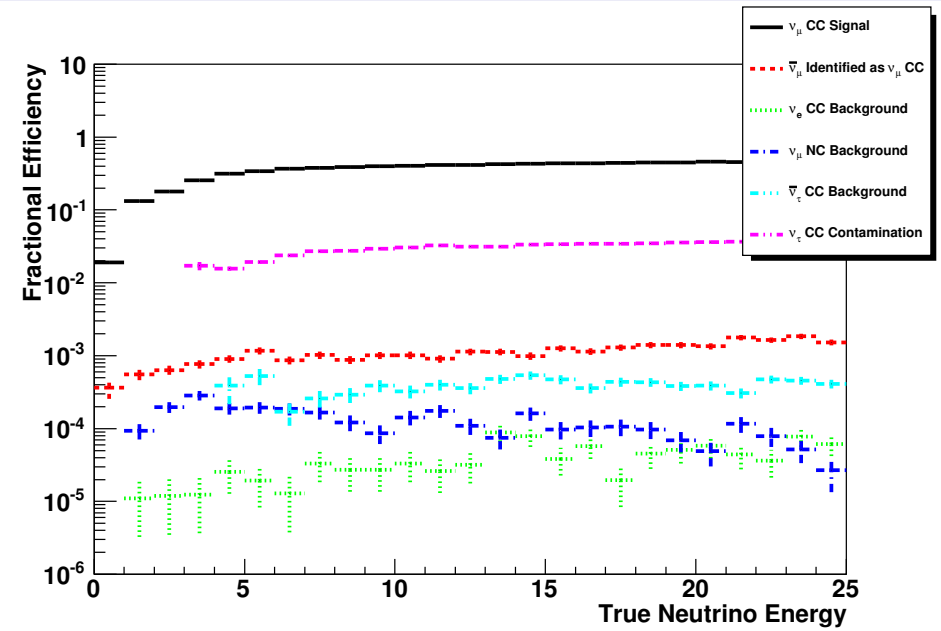
$\bar{\nu}_\mu$ CC Signal



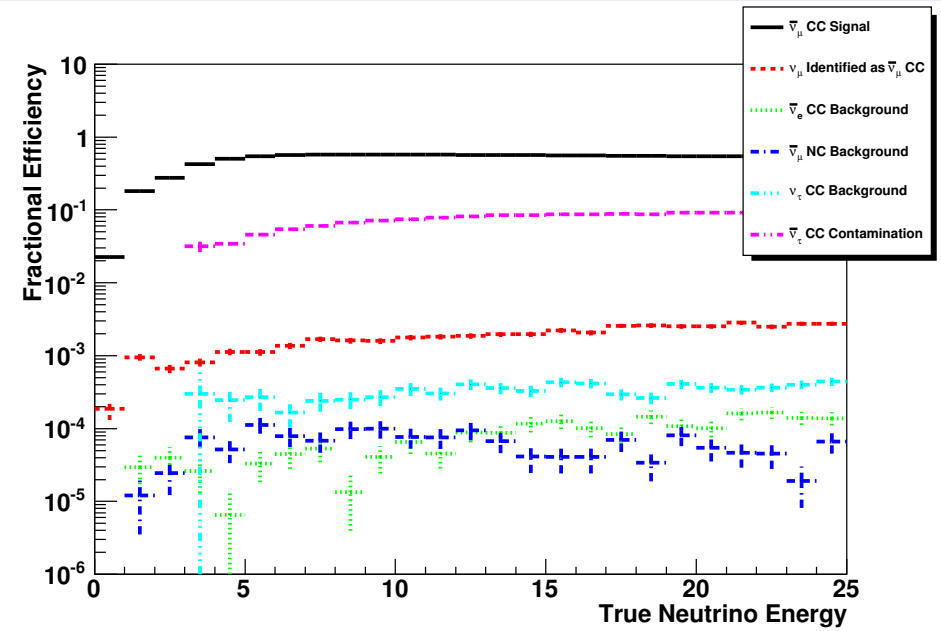
- Signal efficiency still very low.
- Backgrounds are a significant fraction of signal.
- Selection is not optimum.

Efficiency

ν_μ CC Signal



$\bar{\nu}_\mu$ CC Signal



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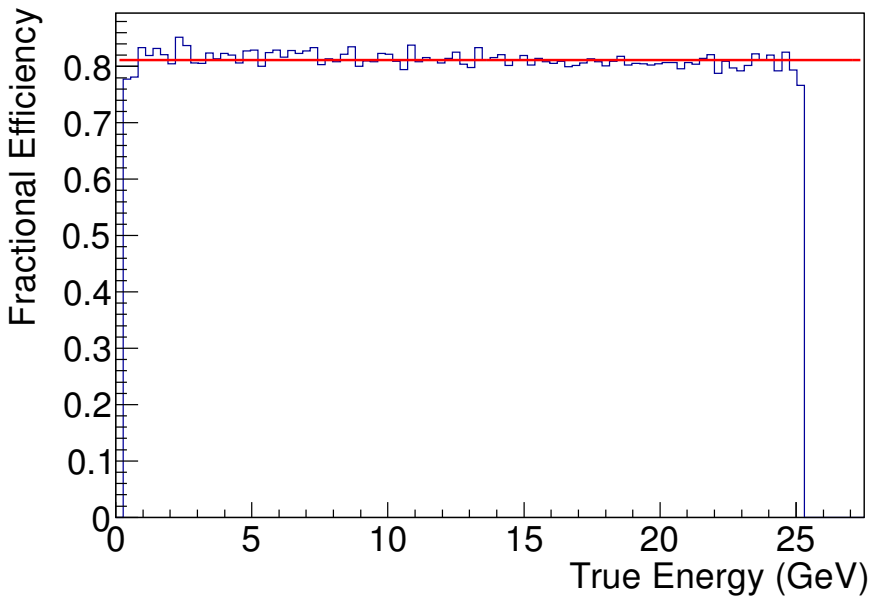
Charge Identification

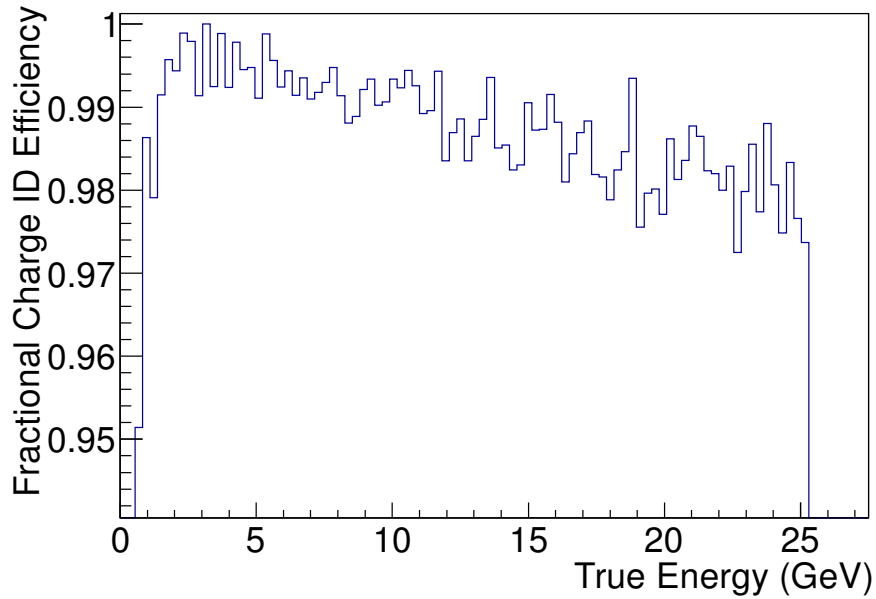
- Analysis uses GENIE samples.
- More physical situation, but charge ID can be complicated.
- Also evaluated charge ID of single particle events.

Overall Efficiency



- Average efficiency of 81%

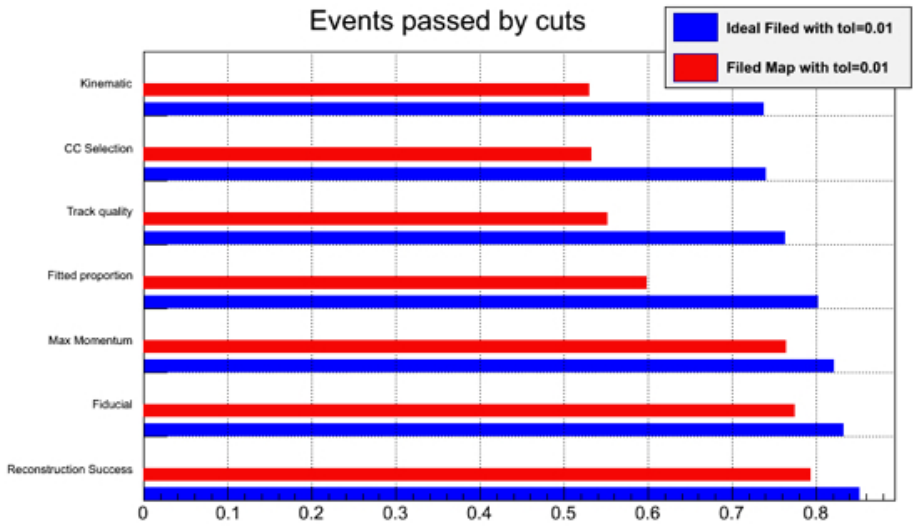
Charge Identification

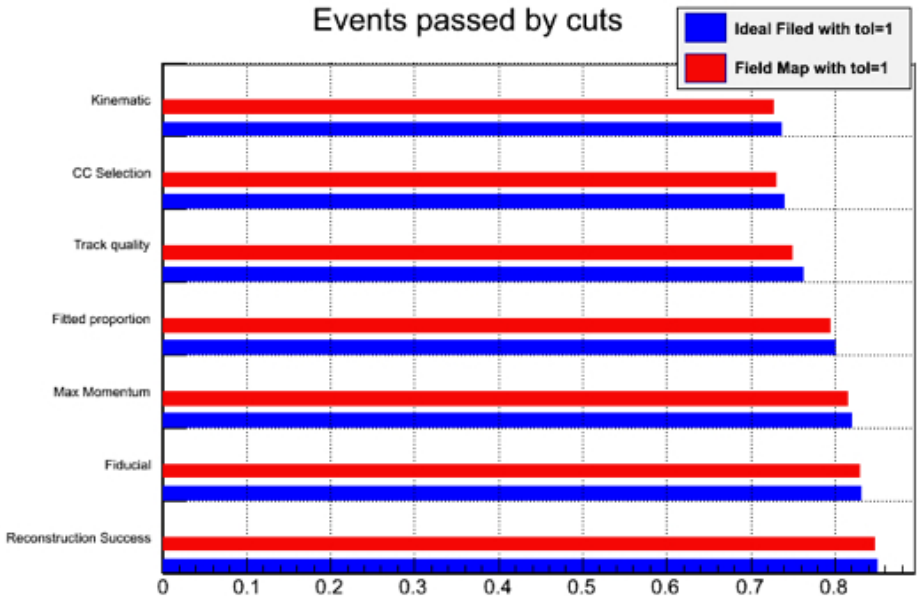


- Charge ID better than 98%

Recent Improvement

- Loss of Golden channel efficiency due to tracking issues.
- Valencia group has made some progress with Recpack.
- Increasing of tolerances in tracking improves efficiencies.

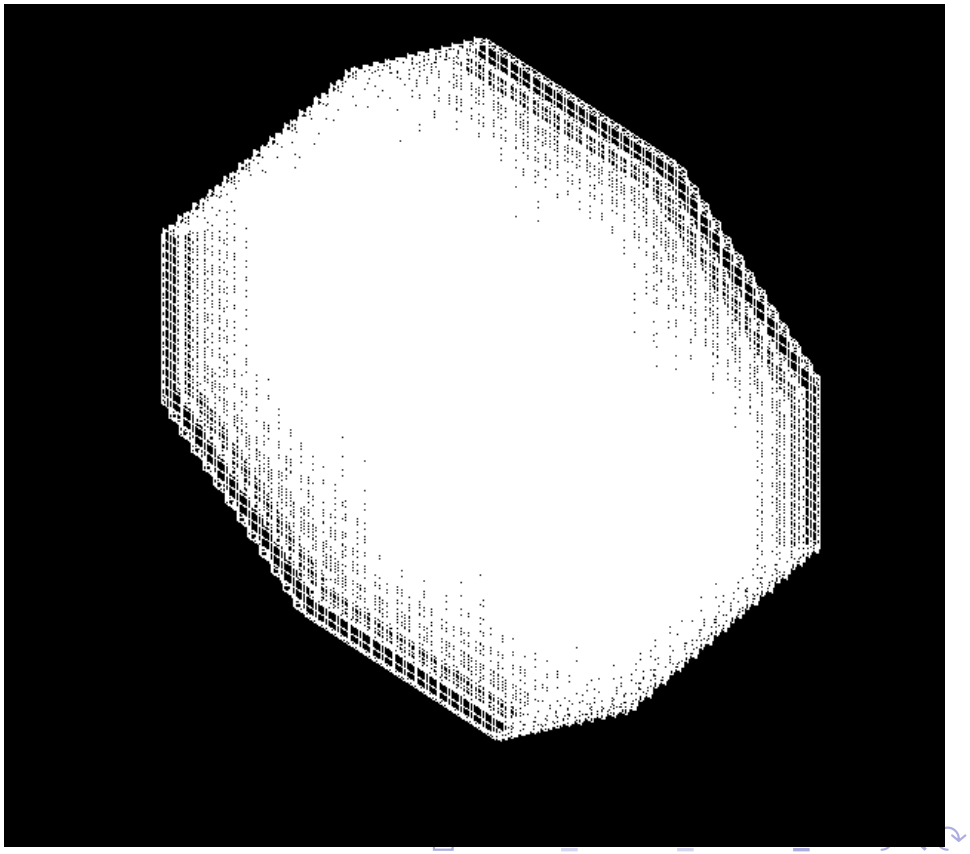




Detector Segmentation

- Inclusion of scintillator bars in the MIND simulation has been completed.
  - 3 cm$\times$1 cm plastic scintillator extrusion with WSF
- Not yet used in main simulation.
- Requires optimization for reconstruction.

- Still some bugs to be addressed.
- Must make sure all variables required for reconstruction are provided rationally.
- Finalizing performance for this change waits on stable reconstruction.



Future Prospects

- Investigating implementation of a multivariate analysis.
  - Proposal is to use ROOT TMVA toolkit.
  - Will make selections based on variables used in cut based analysis.
  - Allows for the optimization of the Golden channel analysis for octagonal geometry.
- Investigating variations of detector.
  - Considering simulations of small (1 m$\times$1 m$\times$2 m) prototype simulation.
  - Simulations of MIND near detectors (3 m$\times$3 m$\times$10 m) have been done by project students.
  - Half thickness Fe plane MIND has been attempted **but** problems have appeared.
  - Imperative that reconstruction and analysis is solid before these options are explored.

Summary

- Realistic MIND geometry has been in place since July 2011.
- Reconstruction in MIND geometry has faced re-evaluation.
  - May soon see progress on this front.
- Golden channel analysis will be regenerated using new methods.
  - Potential for optimization of analysis for signal and background that does not currently exist.
- Simulation is amenable to variations but analysis needs to be stable and provide useful information.