MiniBooNE Topological Reconstruction

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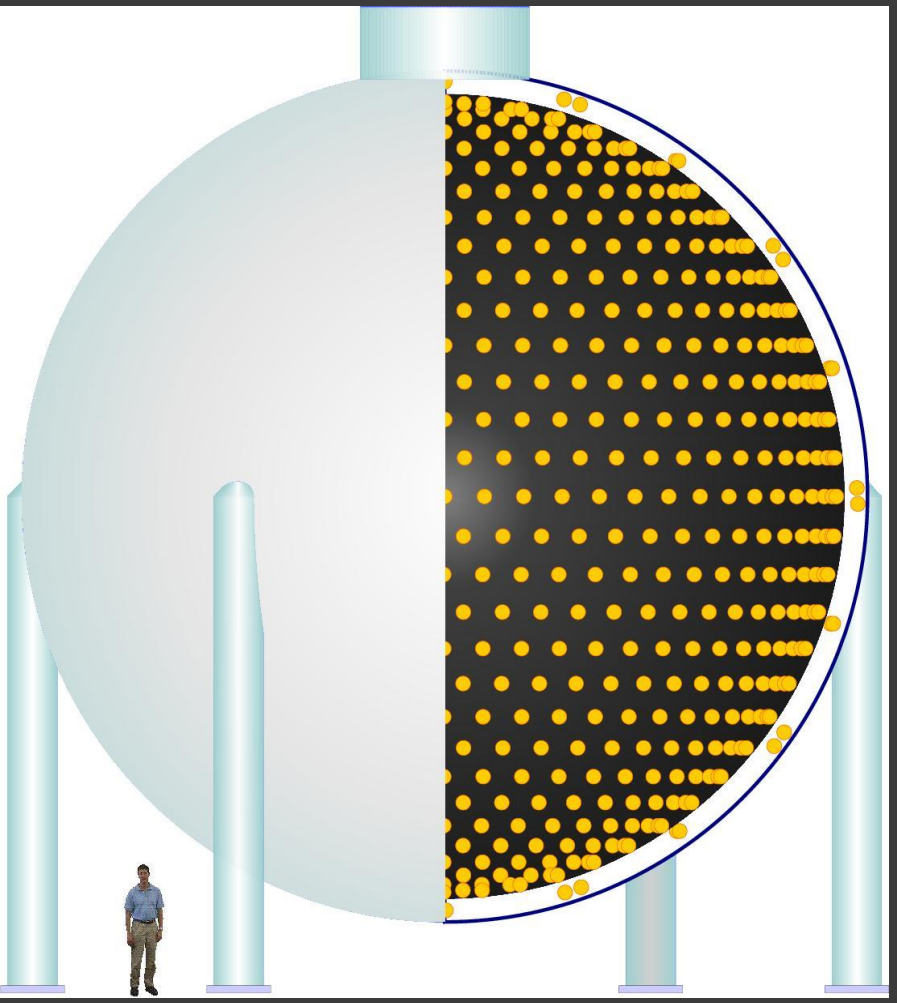
The MiniBooNE Detector



- 541 meters downstream of target
- 3 meter overburden
- 12 meter diameter sphere
  - (10 meter "fiducial" volume)
    - Filled with 800 t
    - of pure mineral oil (CH_2)
    - (Fiducial volume: 450 t)
    - 1280 inner phototubes,
    - 240 veto phototubes

A. A. Aguilar-Arevalo et al., NIM A599, 28 (2009)

The MiniBooNE Topological Rconstruction

Particle location by photon TOF clustering
(Traceback method)
Developed by C. Anderson

The MiniBooNE Topological Rconstruction

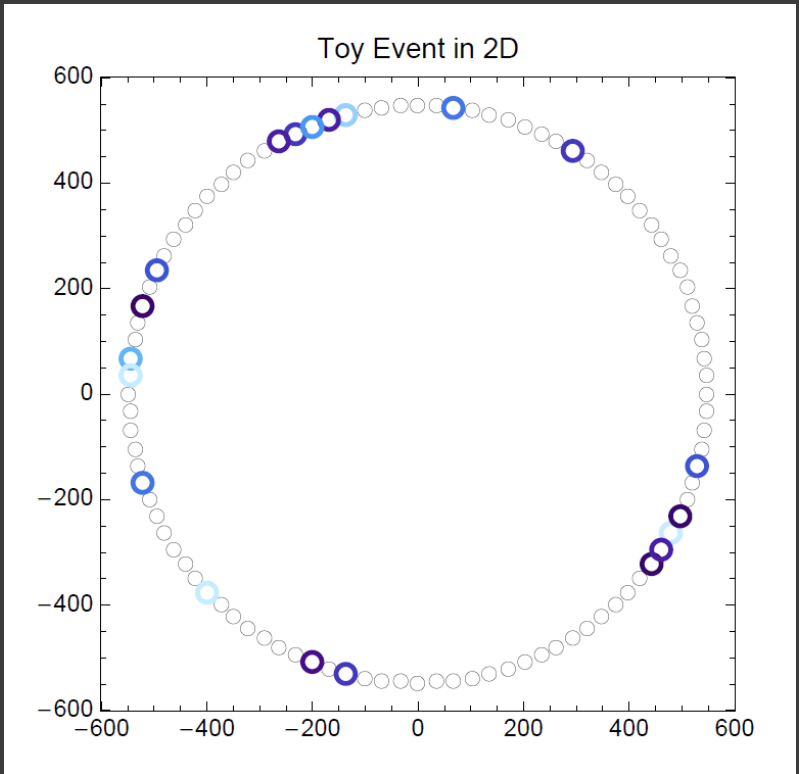
Concept

The idea is to determine common points of photon emission in the detector volume...

The MiniBooNE Topological Rconstruction

Concept

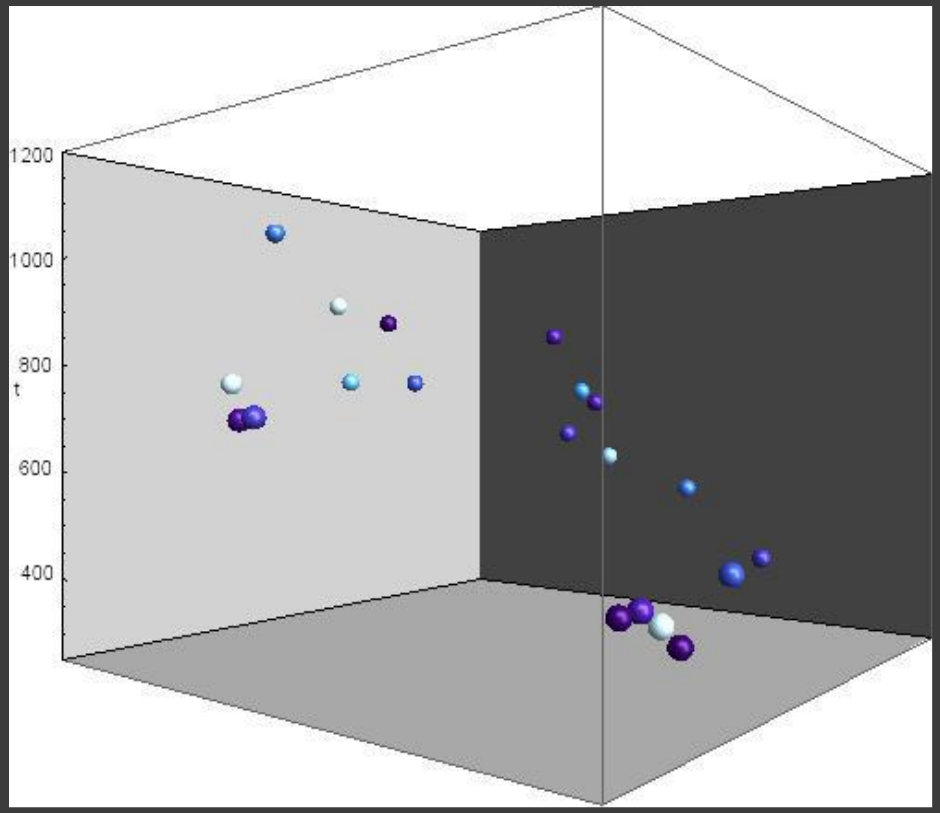
Consider a toy ”event” in a 2D version of MiniBooNE



The MiniBooNE Topological Rconstruction

Concept

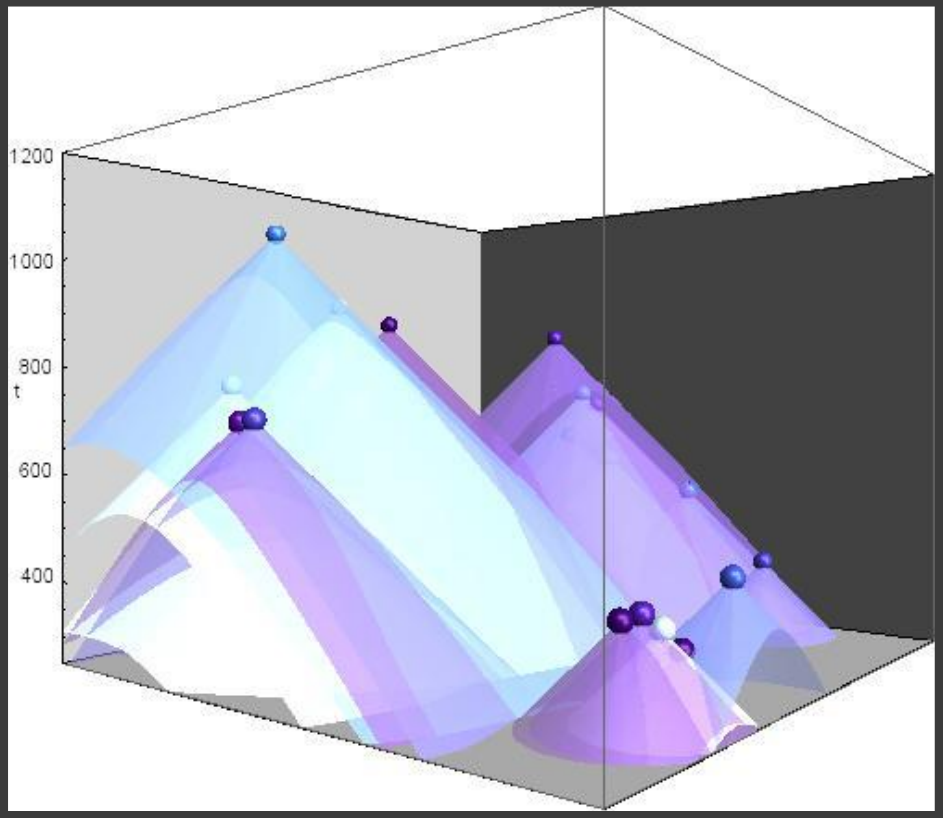
PMT hits give photon positions in n + 1 dimensions



The MiniBooNE Topological Rconstruction

Concept

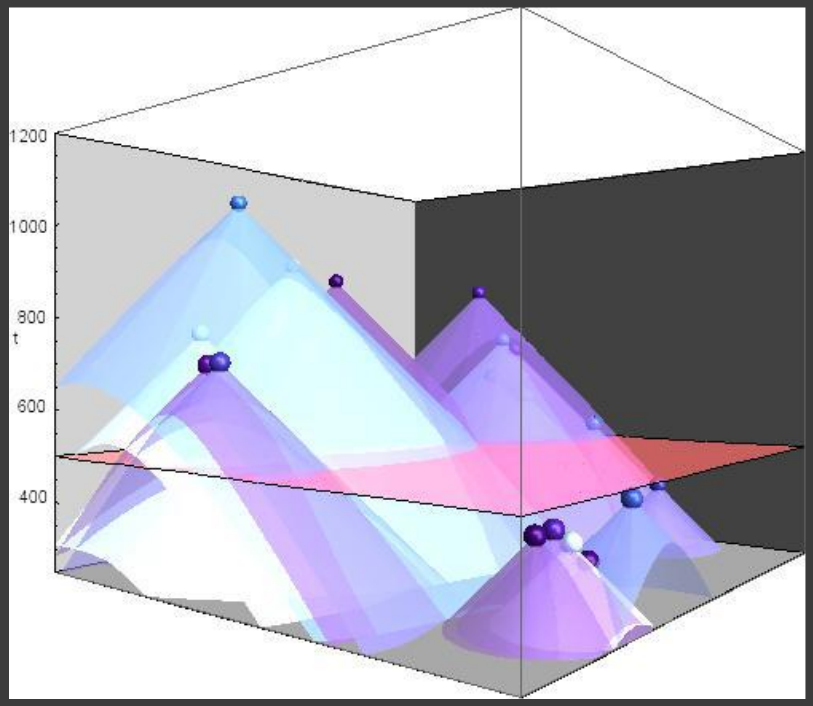
Treating the hits as point measurements, the source photons must originate on light cones pointing back from the hit

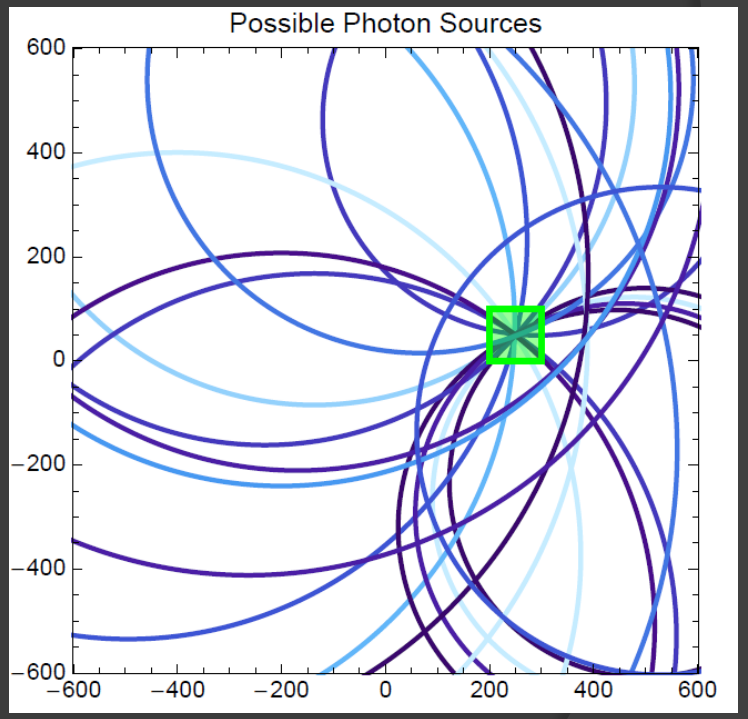


The MiniBooNE Topological Rconstruction

Concept

Regions of with numerous intersections of light cones will be likely particle positions. Take time slice to begin search for intersections. Describe s(t).

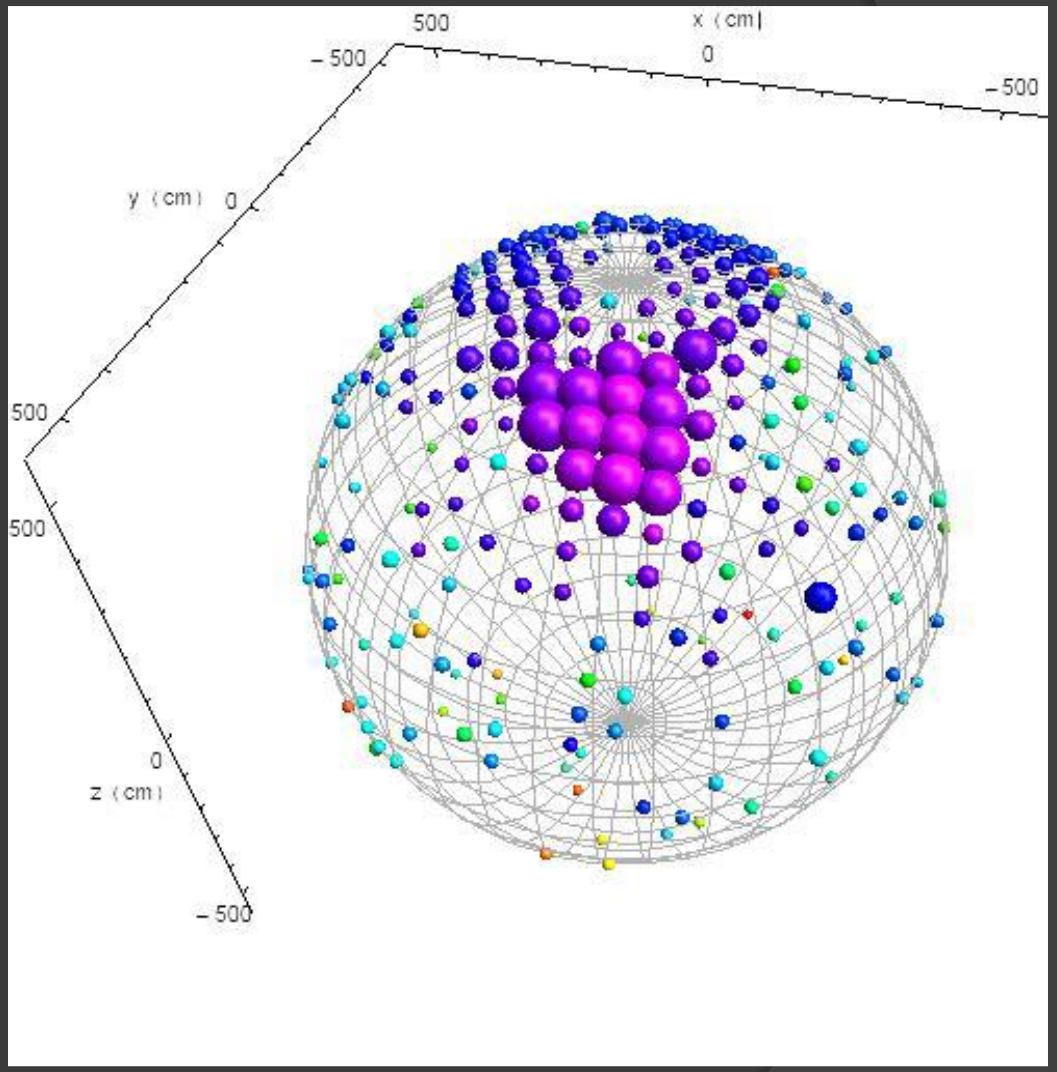




The MiniBooNE Topological Rconstruction

Trial Event

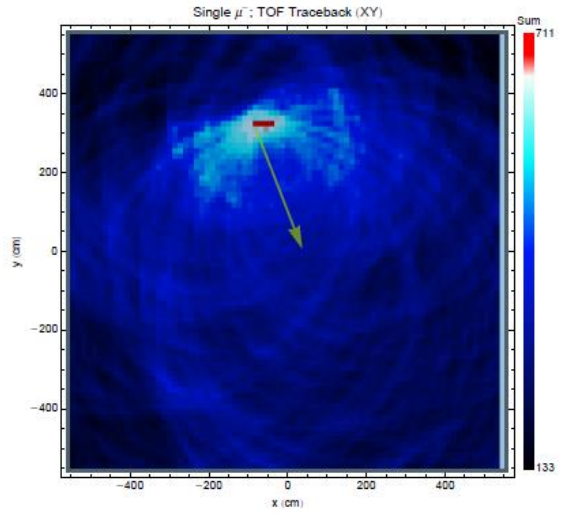
Single μ^- from eGen
E = 4.34GeV



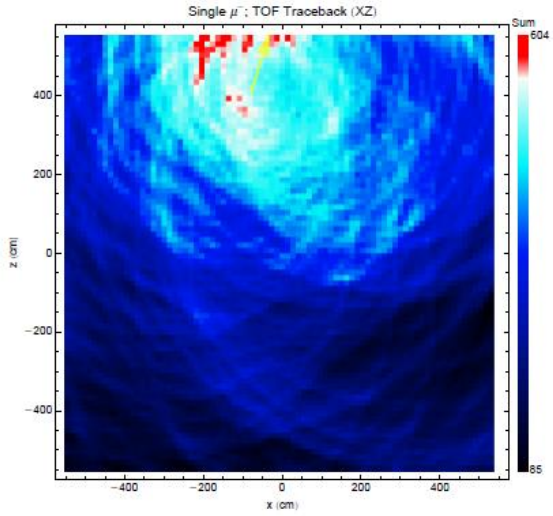
The MiniBooNE Topological Rconstruction

Traceback Projections

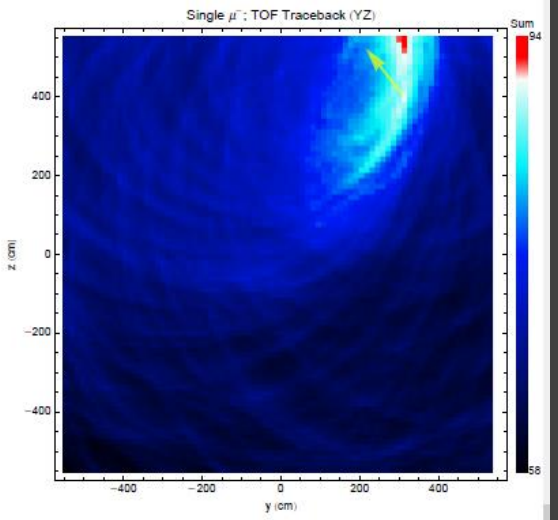
Traceback at $t = 0$ ns



(k) XY



(l) XZ

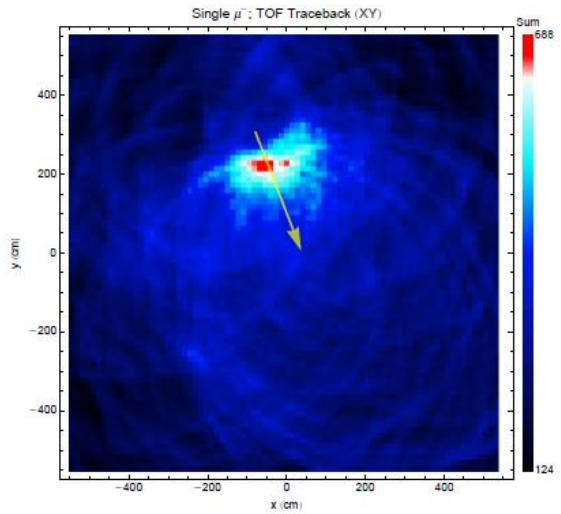


(m) YZ

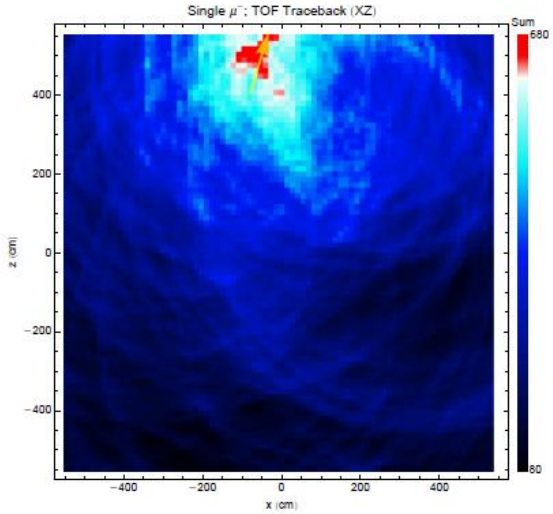
The MiniBooNE Topological Rconstruction

Traceback Projections

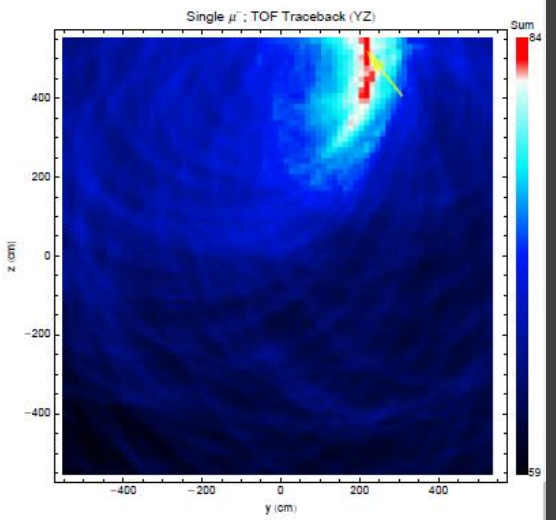
Traceback at $t = 5$ ns



(n) XY



(o) XZ

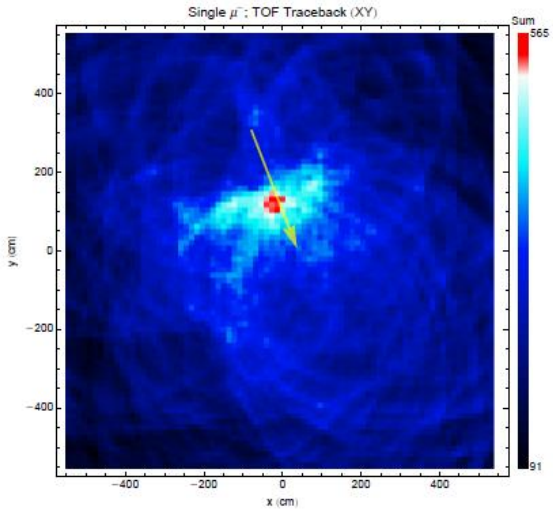


(p) YZ

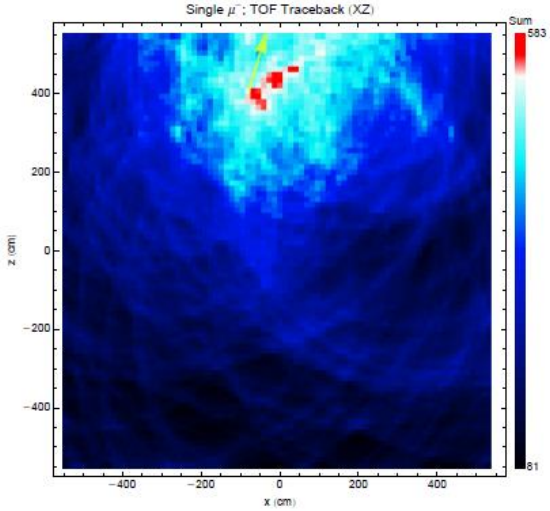
The MiniBooNE Topological Rconstruction

Traceback Projections

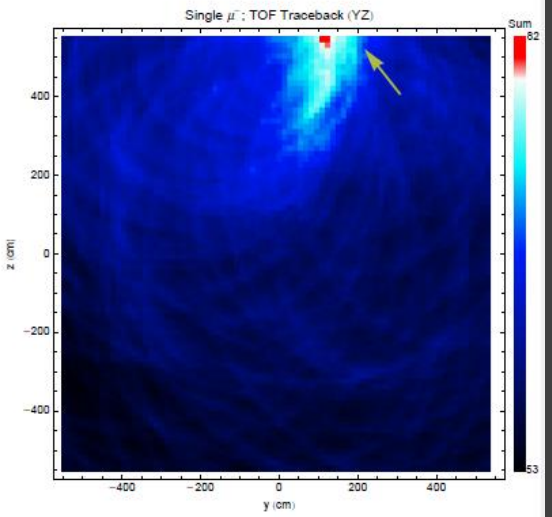
Traceback at $t = 10$ ns



(q) XY



(r) XZ



(s) YZ

Plans for THEIA

- This method transforms from PMT charge and time to 3D hits in time slices describing s(t)
  … or combine all time slices into a 3D density plot
- Good for tracks and showers
- Sensitive to detector resolution, etc.
- A undergrad student at LSU to work on implementing simple fast reconstruction tools into RAT-PAC. Can be used for seeding advanced reco methods.

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