Liquid Argon TPC Simulation and Track Fitting

Matt Robinson

Simulation

- Neutrino interactions modelled by GENIE, supplied by Ben Morgan in ROOT format.
- Geant4 detector simulation follows secondary and tertiary particle through Argon.
- Energy depositions counted with 0.1 mm precision, converted into freed electrons.
- Diffusion modelled using published figures for electrons in Argon.

 $1 \; GeV \; \nu_{\mu} \; QEL\text{-}CC$ Colour indicates $\log_{10}(\text{\#Electrons})$



Detector Simulation

- 3.2 m³ of Liquid Argon in a cylinder.
- Drift speed of 2 mm/ μ s
- Electron lifetime of 3 ms.
- Standard Physics.

Electron release, Diffusion and Readout

- Assumed I electron released per 23.6 eV
- Mean delta R of electrons 45 mm/s.
- Assumed readout resolution of 3 mm.

Event Viewer

- Reads output from geant4.
- 3d OpenGL view, 3x 2d projections.
- On-the-fly track fitting.

• 15 GeV numu DIS

| ARgon CONstruction 0.0.9 | | | | |
|--|-----|------------|------|----------|
| | | | | |
| position: 5060 _1839 _5958 | # X | /mm Y/mm | Z/mm | ke- |
| position. 5000, -1055, -5550 | 0 | 4698 -1679 | -752 | 873.06 |
| | 1 | 3977 -1228 | -359 | 843.87 |
| | 2 | 3980 537 | 381 | 721.10 |
| | 3 | 4333 -1098 | -119 | 712.510 |
| | 4 | 6278 1390 | 601 | 611.371 |
| | 5 | 3976 -1229 | -356 | 587.810 |
| | 6 | 150 16 | 5 59 | 586.18 |
| | 7 | 3974 -1233 | -349 | 520.97 |
| | 8 | 3180 -815 | -265 | 518.38 |
| | 9 | 166 23 | 60 | 487.56! |
| | 10 | 170 25 | 60 | 476.69 |
| | 11 | 4582 -1577 | -681 | 445.091 |
| | 12 | 6863 1699 | 663 | 431.574 |
| | 13 | 9191 3496 | 956 | 423.89 |
| | 14 | 1059 -180 | -71 | 420.97 |
| | 15 | 3972 -1237 | -342 | 419.63 |
| | 10 | 5726 1143 | -338 | 410.80: |
| | 10 | 9600 2004 | 900 | 413.80 |
| | 10 | 1184 -206 | -70 | 405.950 |
| and the second | 20 | 6024 1268 | 576 | 399.95 |
| and the second | 21 | 1984 - 395 | -143 | 389.40 |
| | 22 | 217 78 | 51 | 388.771 |
| | 23 | 2132 167 | 185 | 380.39(~ |
| | 24 | 4825 797 | 461 | 378.61 |
| | | | | |
| ● Move ○ Pan ○ Zoom/Twist ○ Origin Reset Snapshot Record Vessel Scale C |)• | • • 0.3 mm | /ke- | |
| File /Users/robinson/data/lam/sample2.root - 1 | C | + | | |















Track fitting

- Draw a cylinder along the axis connecting 2 randomly selected points to produce track candidate
- Select track candidates by total energy and uniformity.
- Combine/break track candidates based on proximity and gaps.





Not done

- Realistic readout modelling
- Optimise track fitting.
- Stability still lacking, mainly on handling root files.