Visual Comparison of Events in Different Trackers

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DUNE ND Workshop

11/3/2017

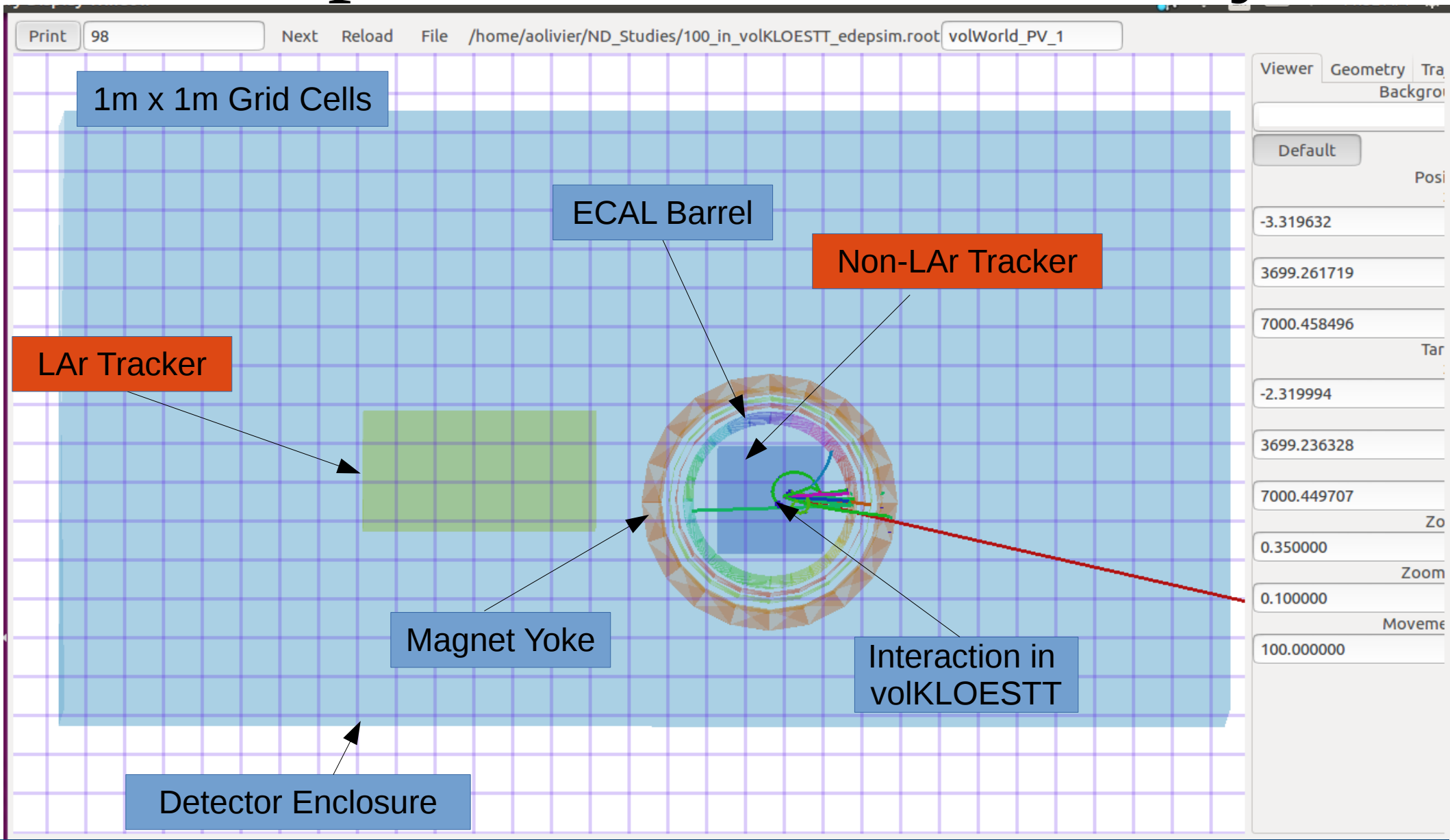
Simulation Method

- 100 GENIE events from the DUNE near detector nominal flux
- Simulated all 100 events using edepsim in each of 4 geometries:
  - The KLOE straw tube tracker
  - The KLOE liquid argon tracker
  - Replaced KLOE STT with block of gaseous argon at about 10 atm
  - Replaced KLOE STT with block of Minerva's Scintillator

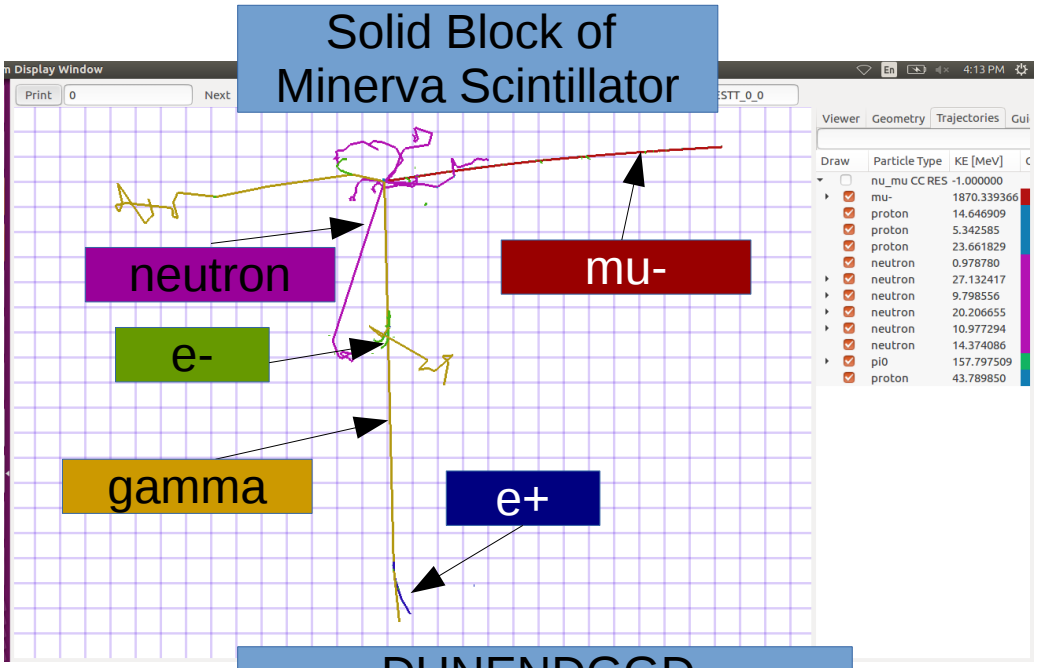
Visualization

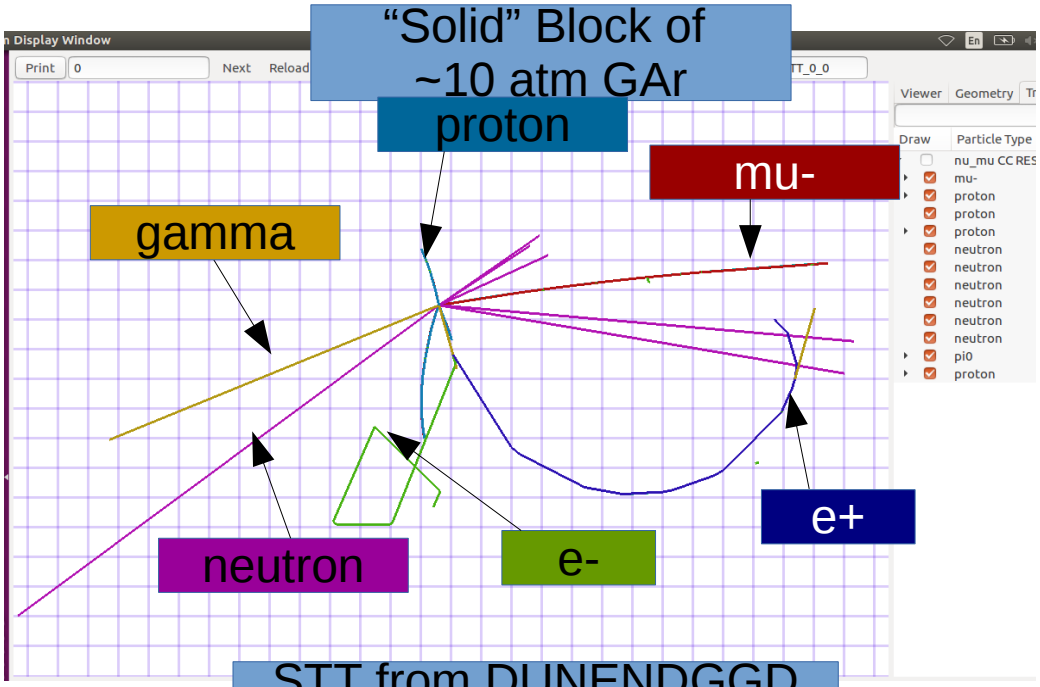
- Developed an executable that reads edepsim's output files and draws:
  - Nodes from the ROOT geometry edepsim saved
  - Trajectory points from true particles
    - Mapped particle type to color
    - Linear interpolation between trajectory points. No fitting for B field.
    - Exiting trajectories are interpolated to the end of the sensitive volume.
  - True energy deposits
    - Color from log(dE/dx/density*A/Z) to show energy loss while getting same order of magnitude for all four trackers
    - Linear interpolation between start and end. No fitting for B field.
- All distances in mm and energies in MeV

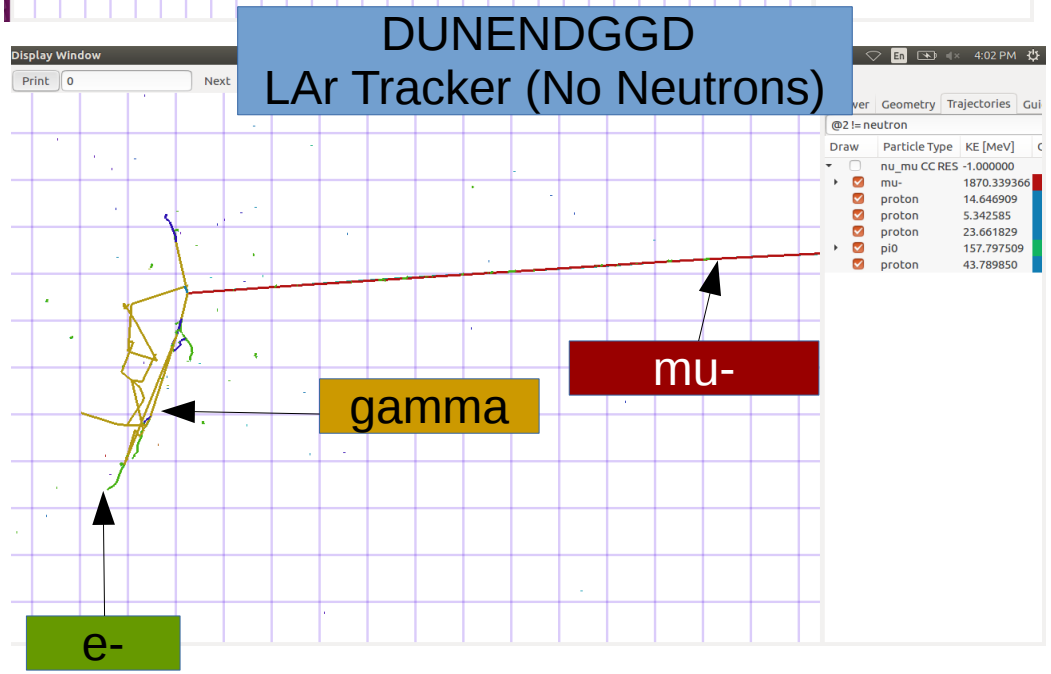
Simplified KLOE Geometry

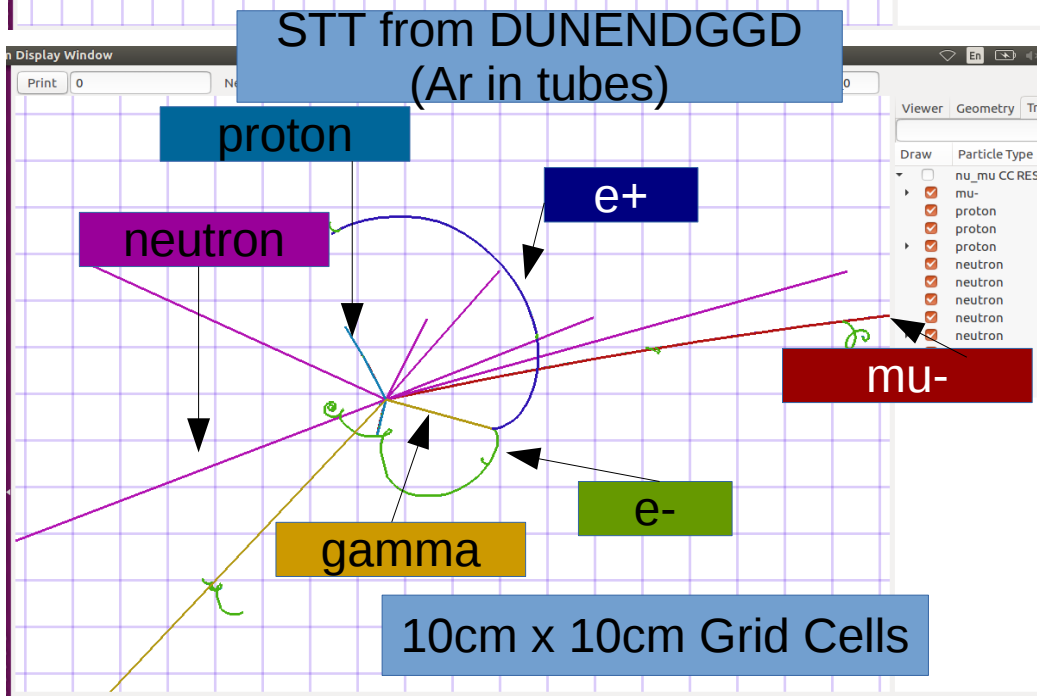


Charged Current Resonant Pi0 Production



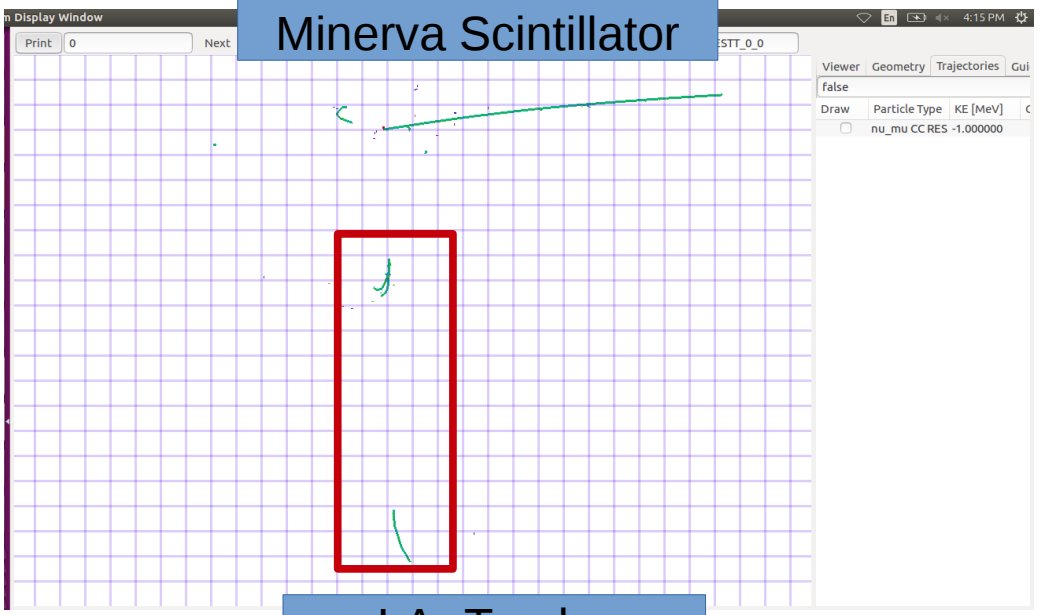




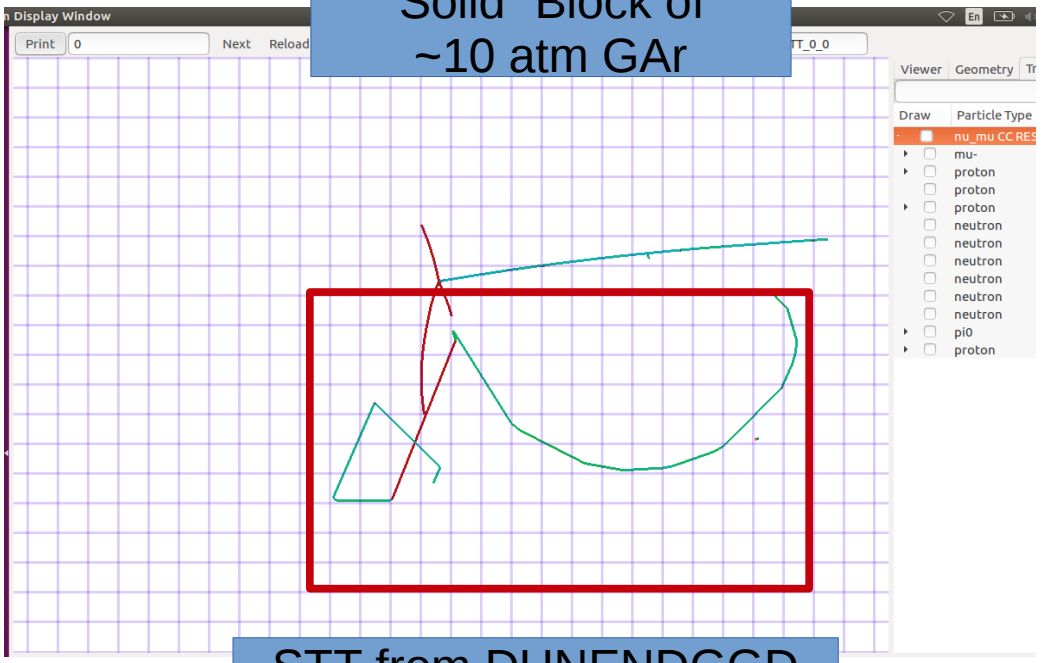


Photon Conversion Energy Deposits

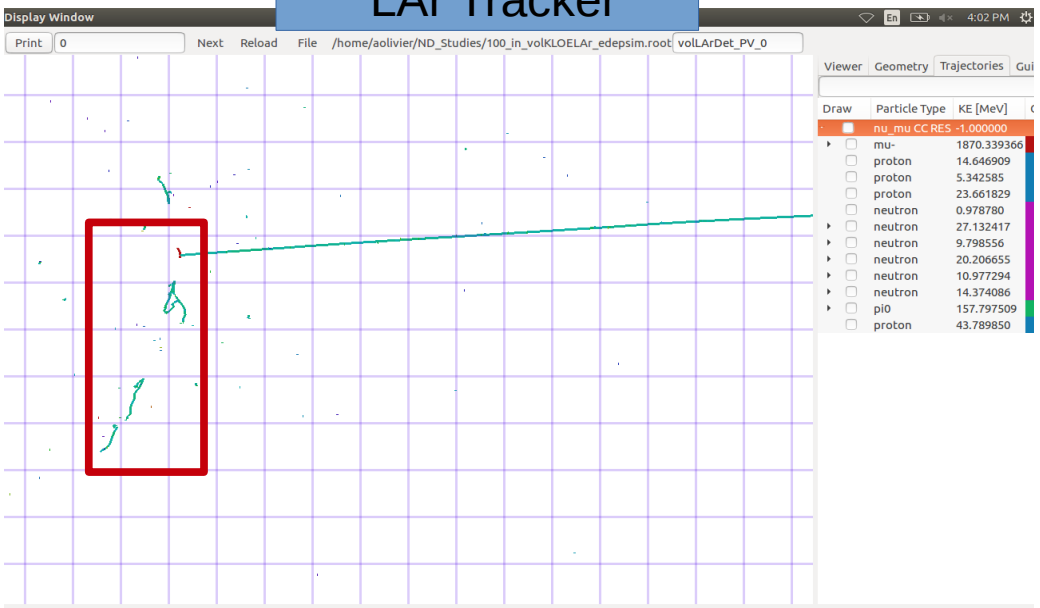
Solid Block of Minerva Scintillator



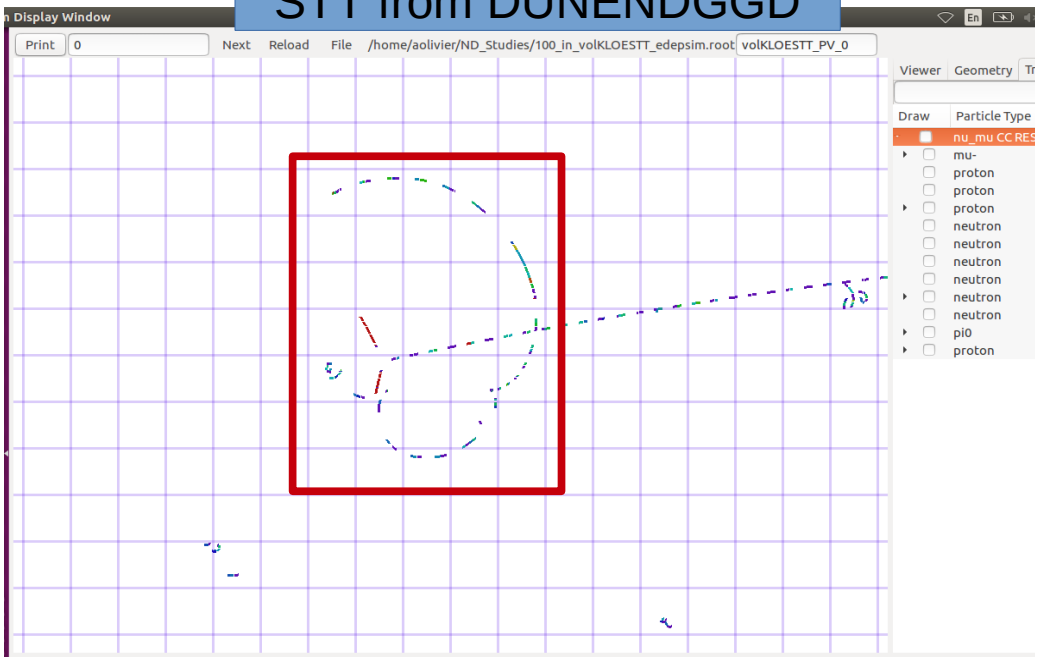
"Solid" Block of ~10 atm GAr



LAr Tracker

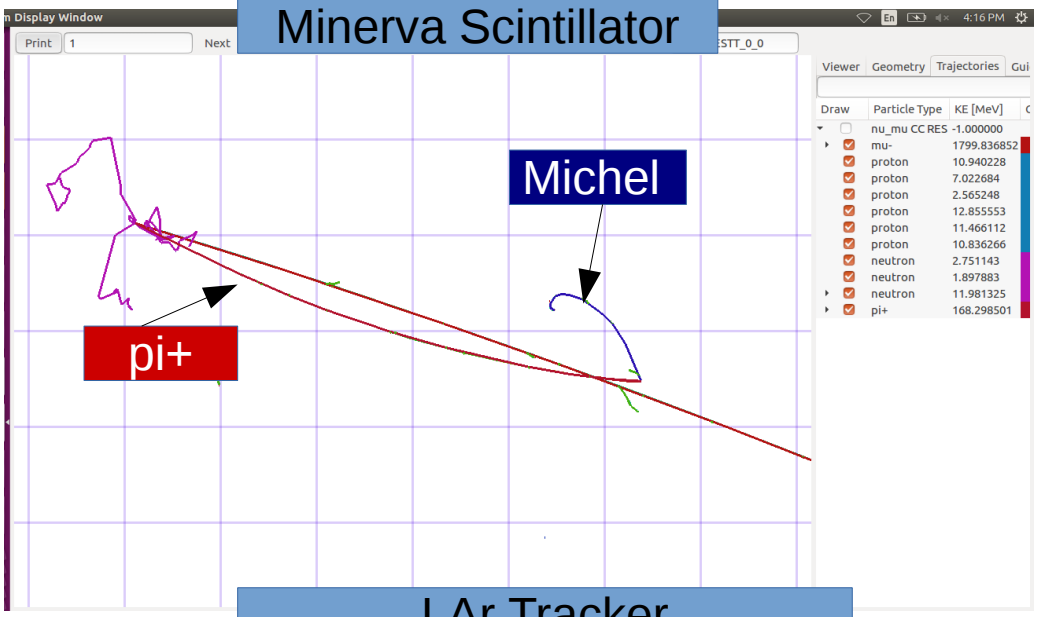


STT from DUNENDGGD

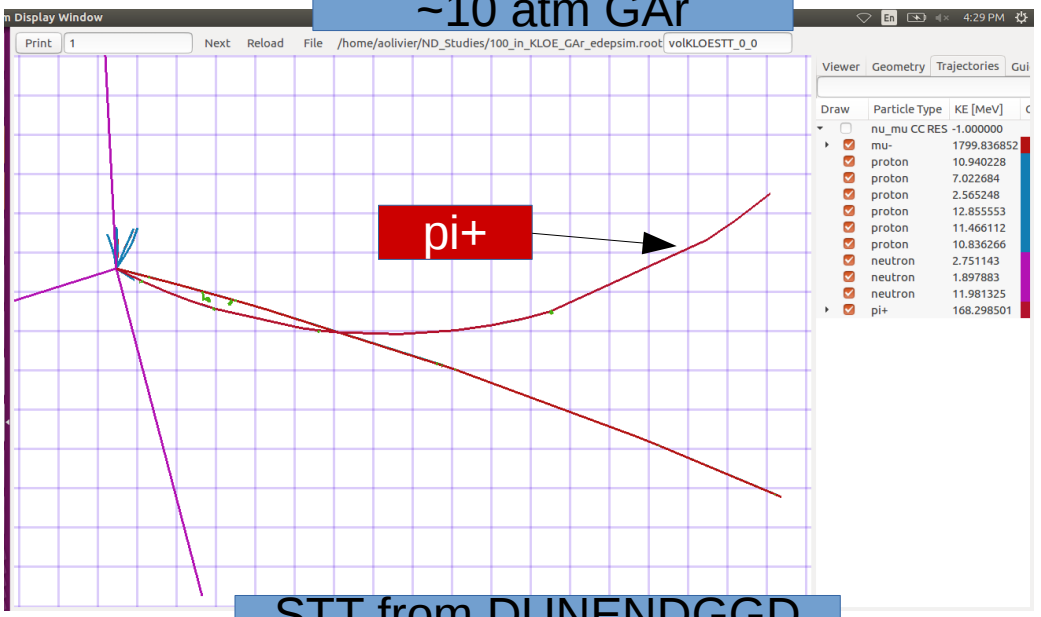


Charged Current Resonant Pi+ Production

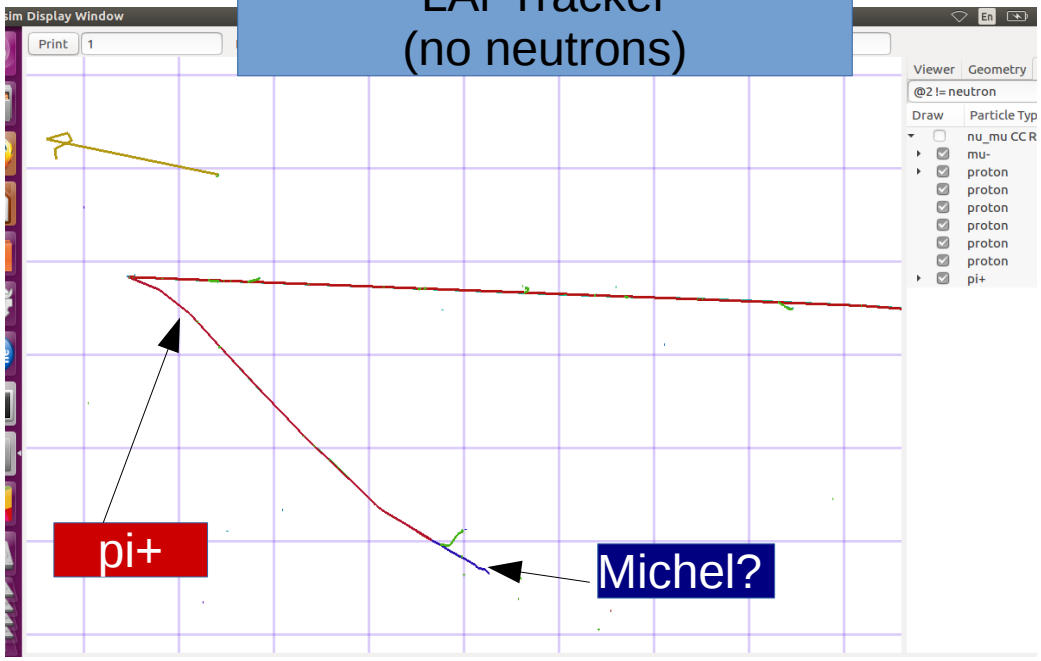
Solid Block of Minerva Scintillator



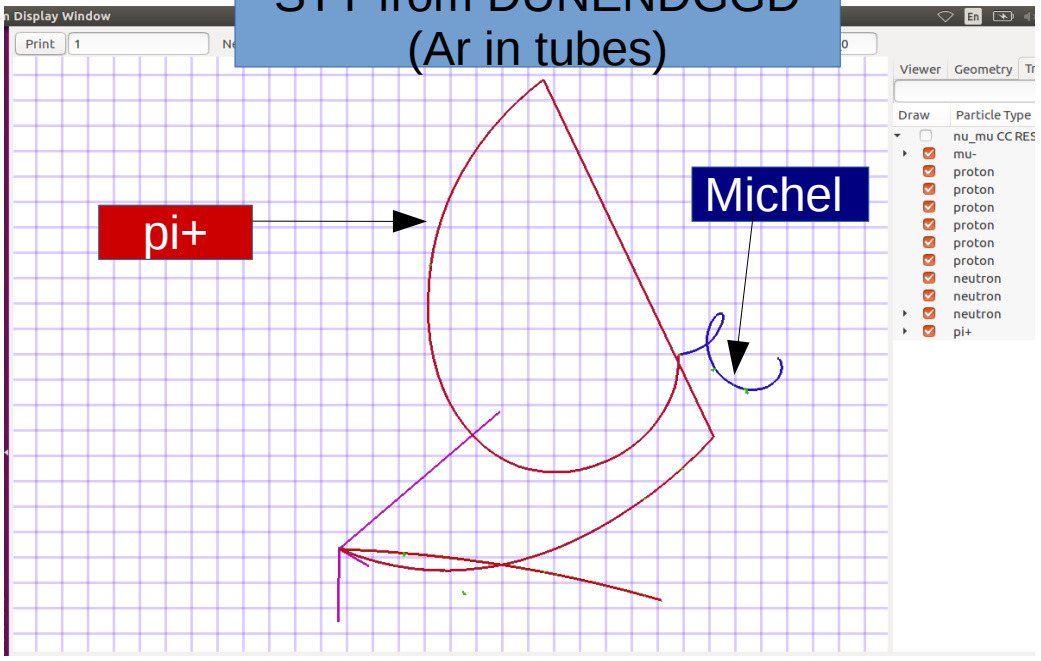
"Solid" Block of ~10 atm GAr



LAr Tracker (no neutrons)

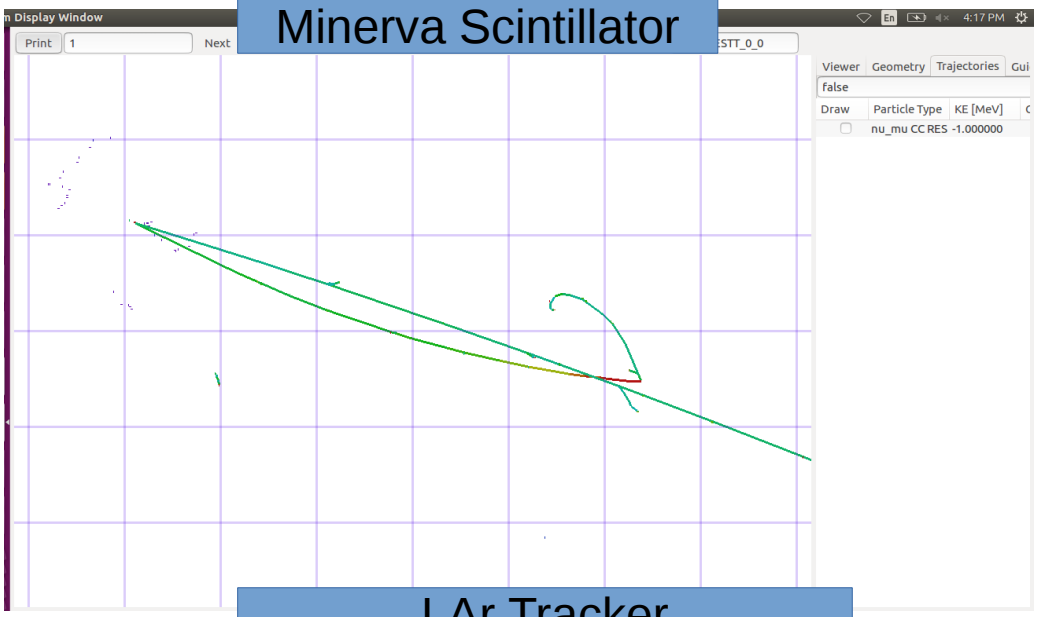


STT from DUNENDGGD (Ar in tubes)

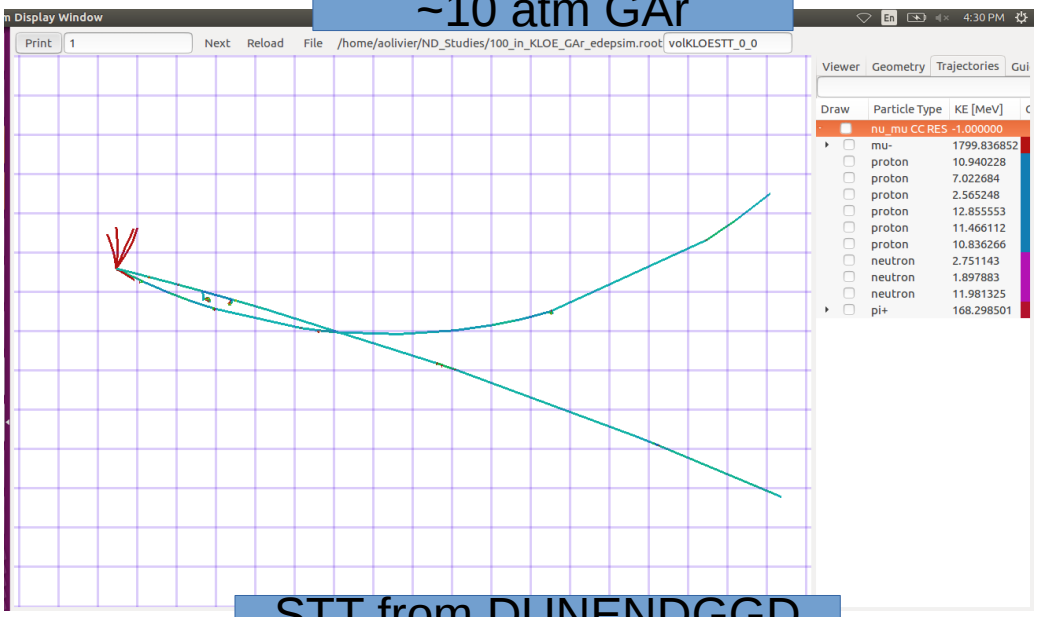


Michel Electron Energy Deposits

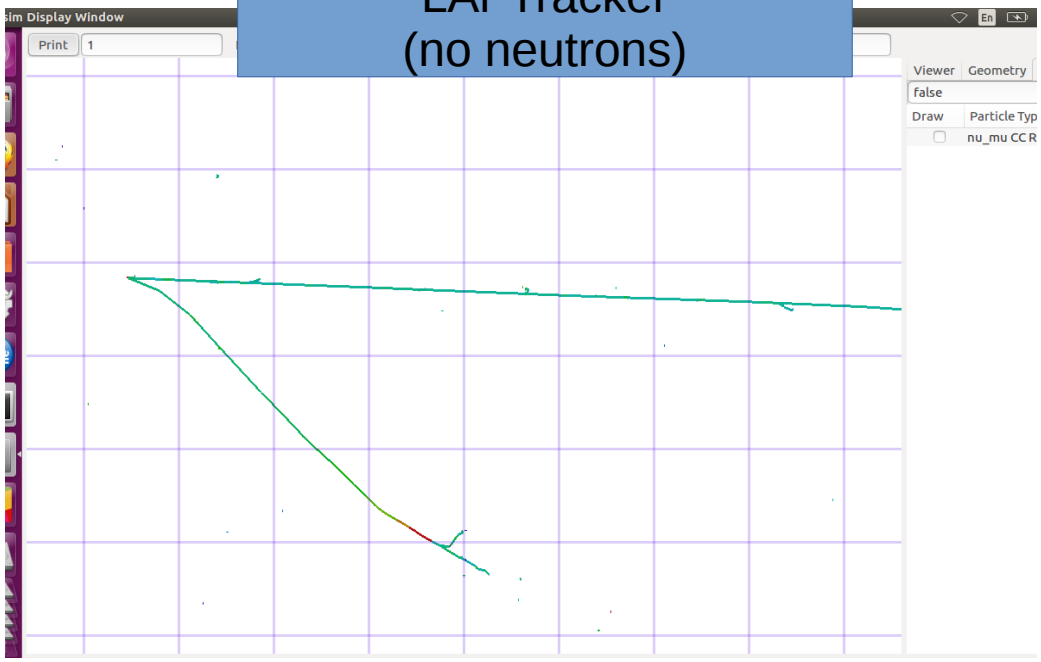
Solid Block of Minerva Scintillator



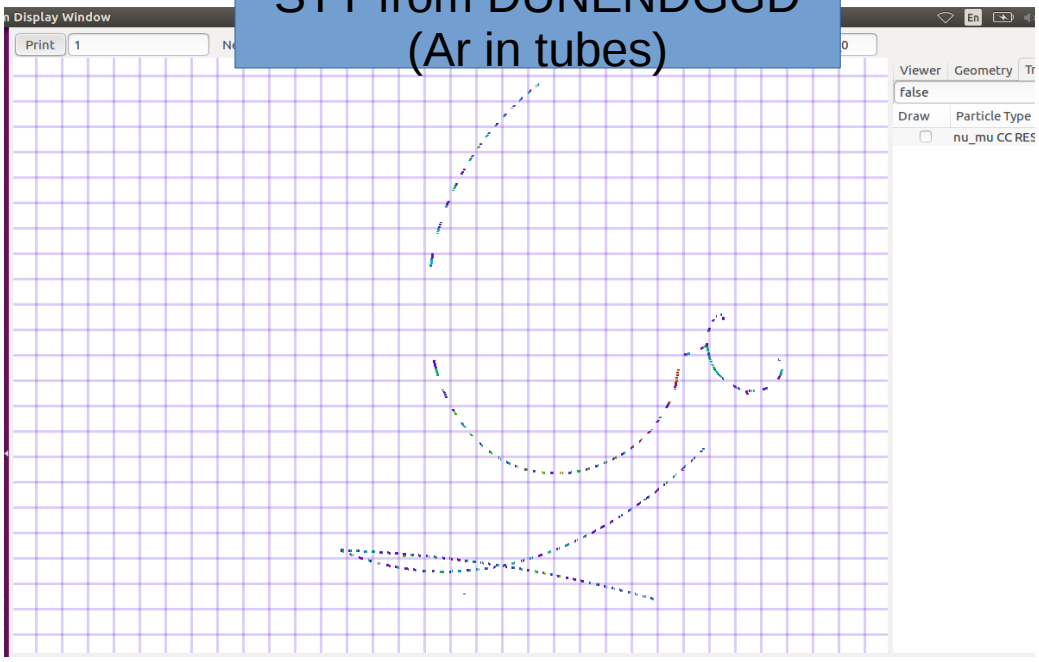
"Solid" Block of ~10 atm GAr



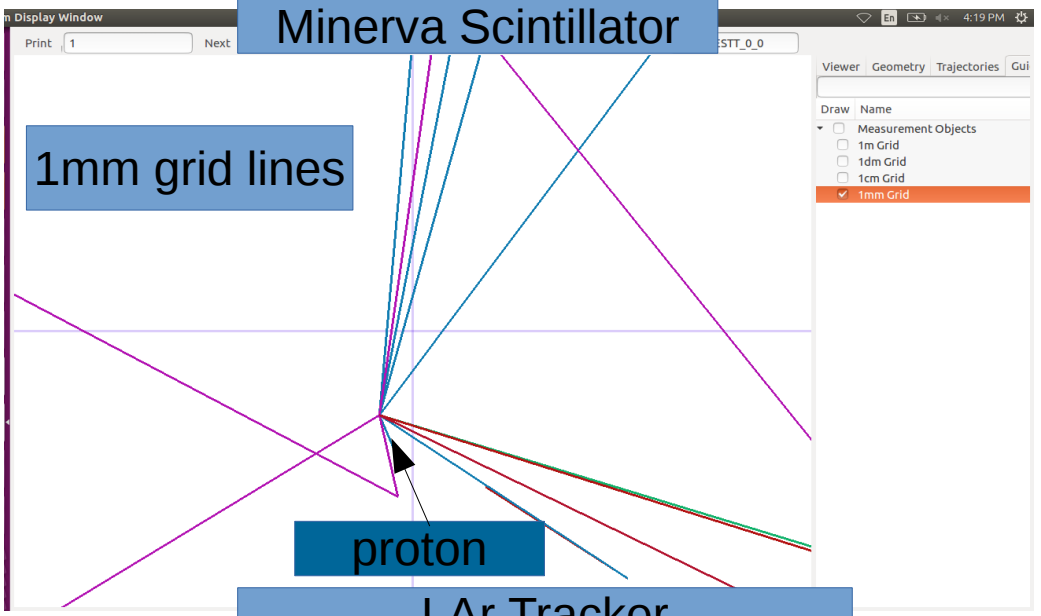
LAr Tracker (no neutrons)

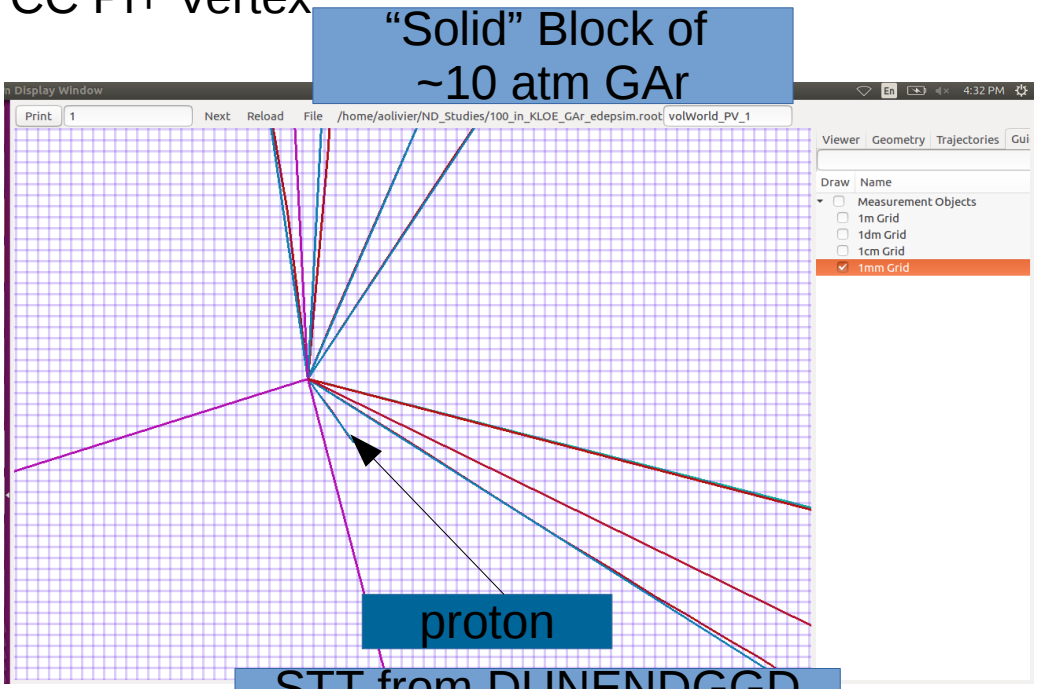


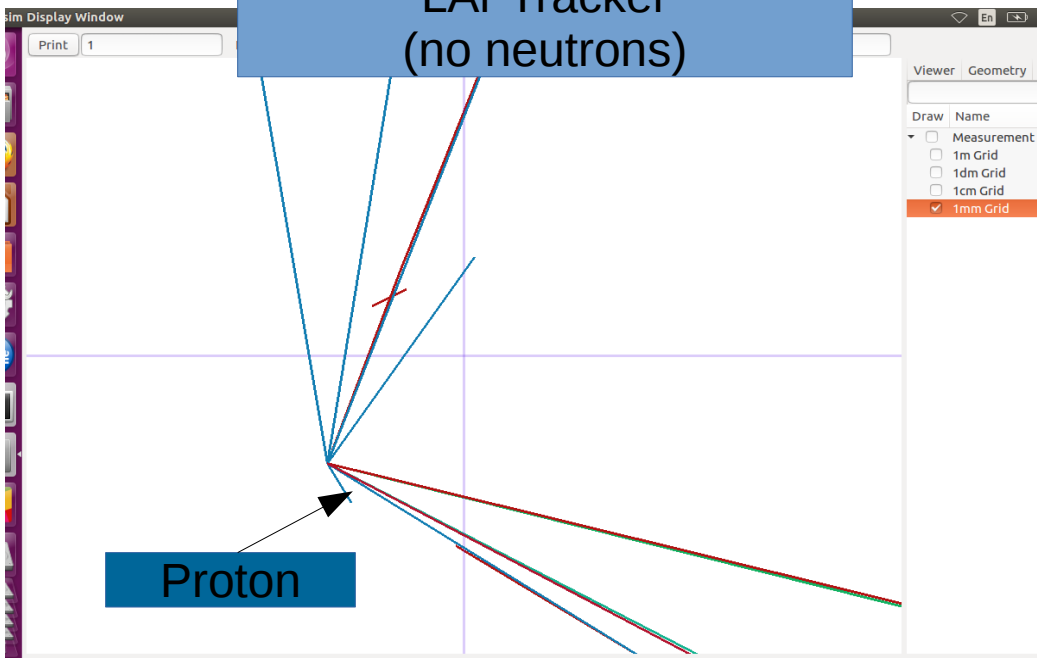
STT from DUNENDGGD (Ar in tubes)

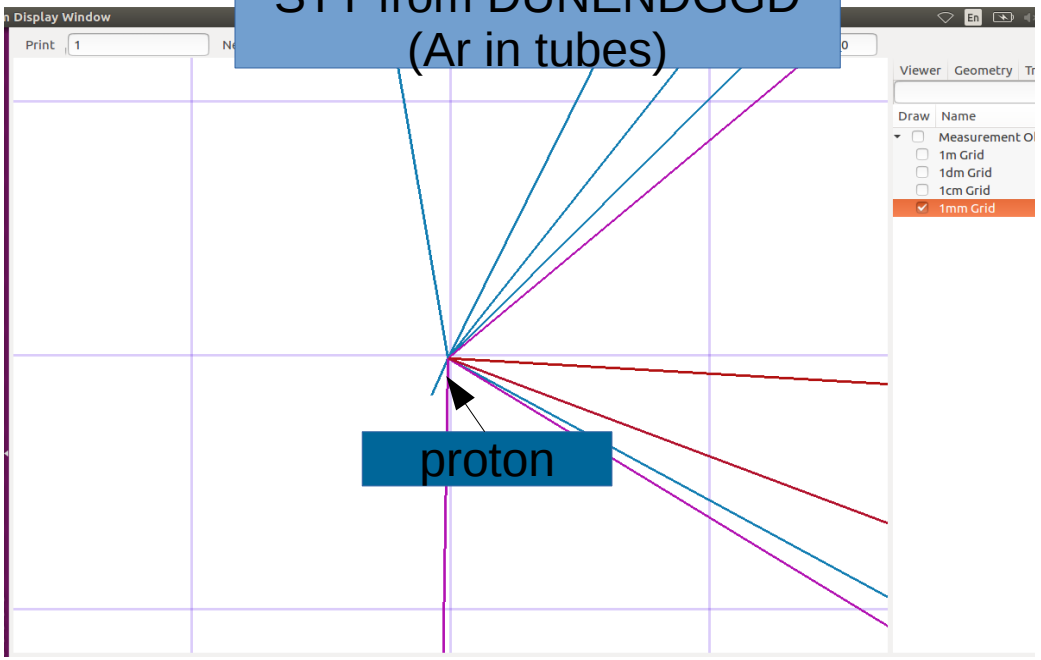


A Closer Look at a CC Pi+ Vertex



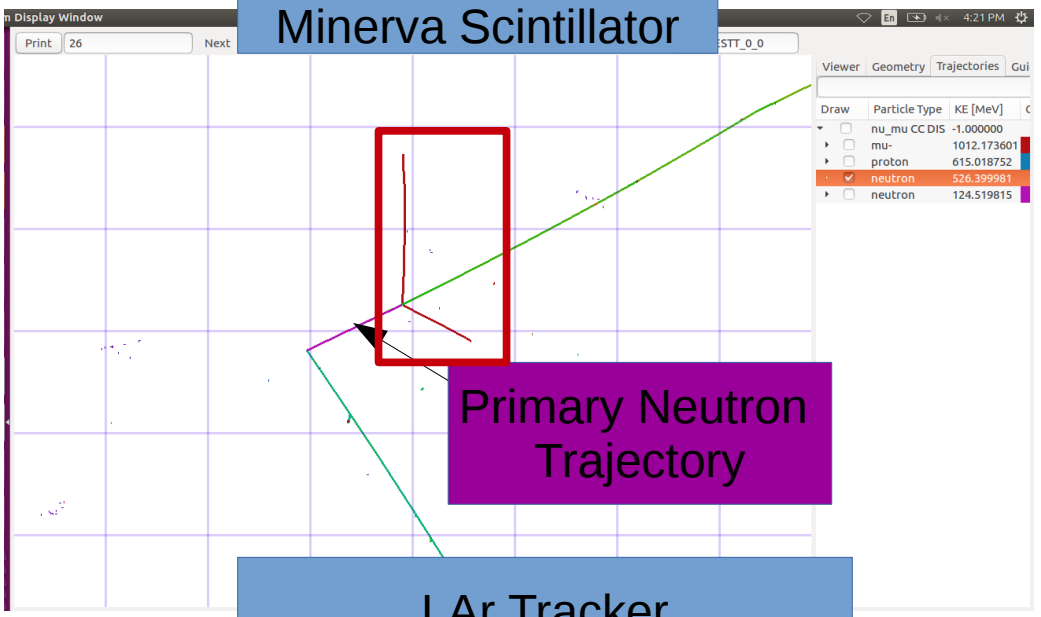




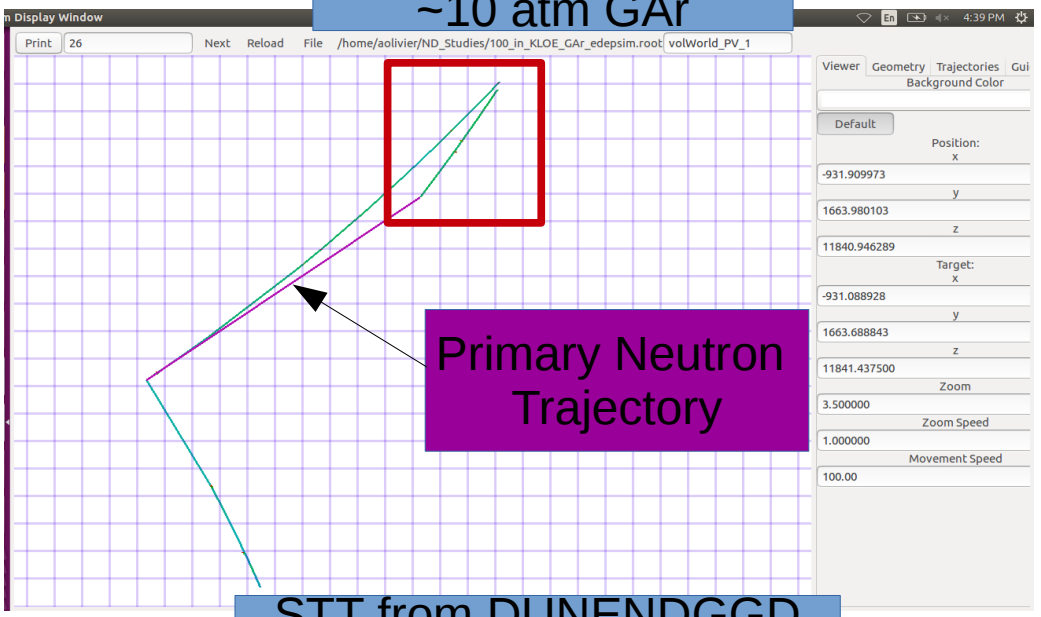


Neutron Energy Deposits

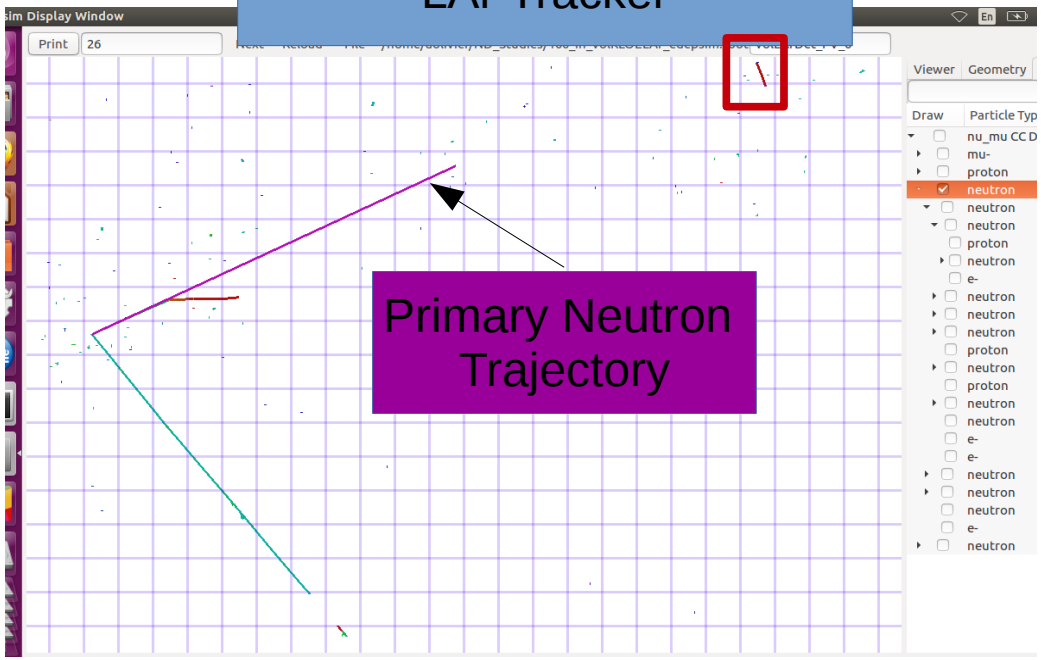
Solid Block of Minerva Scintillator



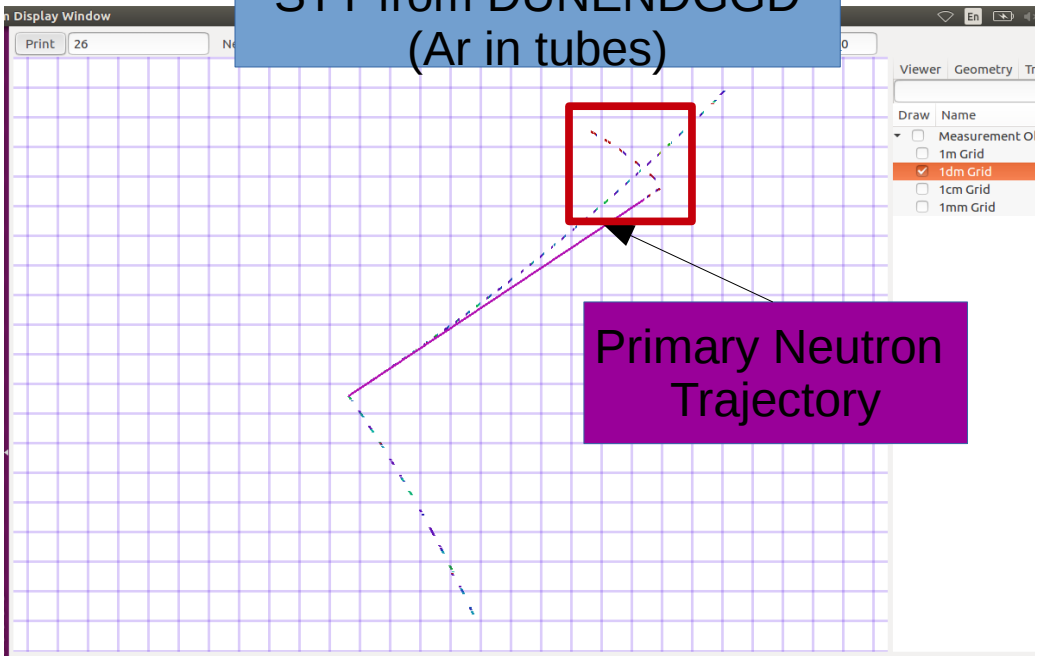
“Solid” Block of ~10 atm GAr



LAr Tracker

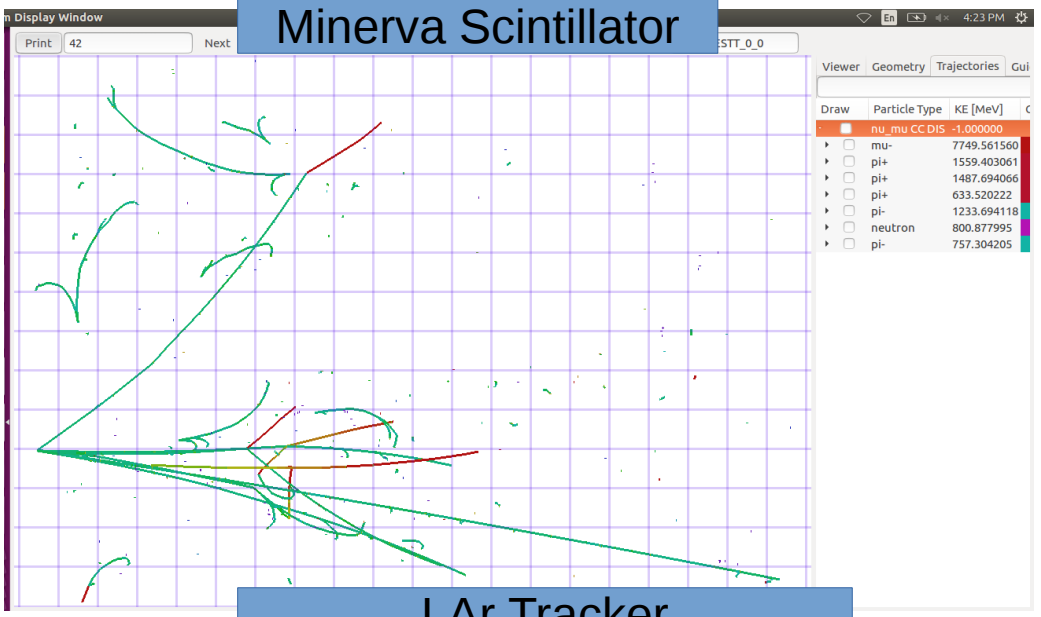


STT from DUNENDGGD (Ar in tubes)

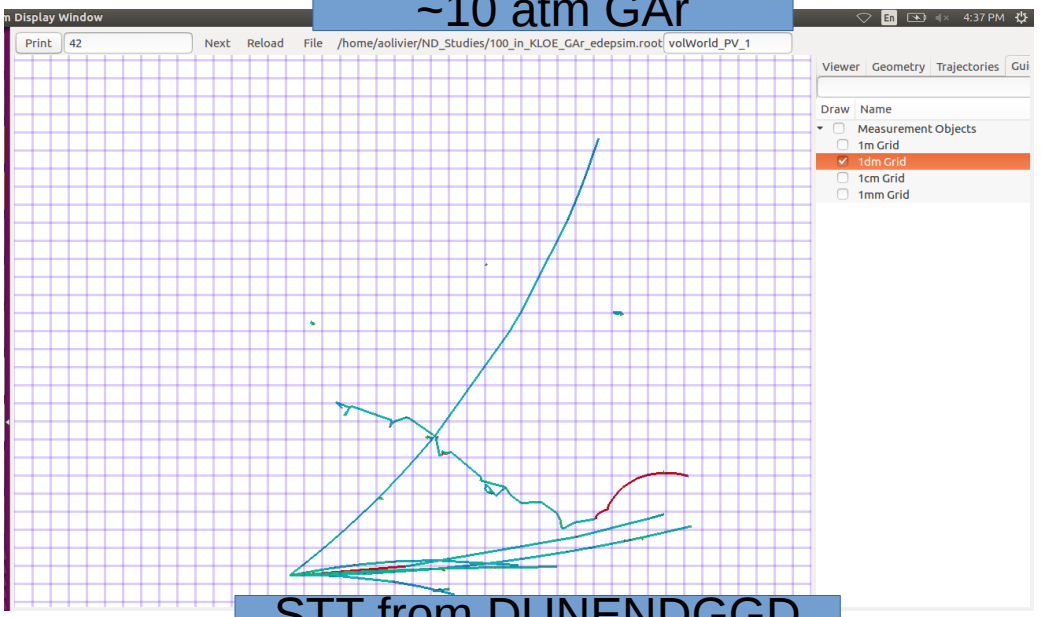


DIS Energy Deposits

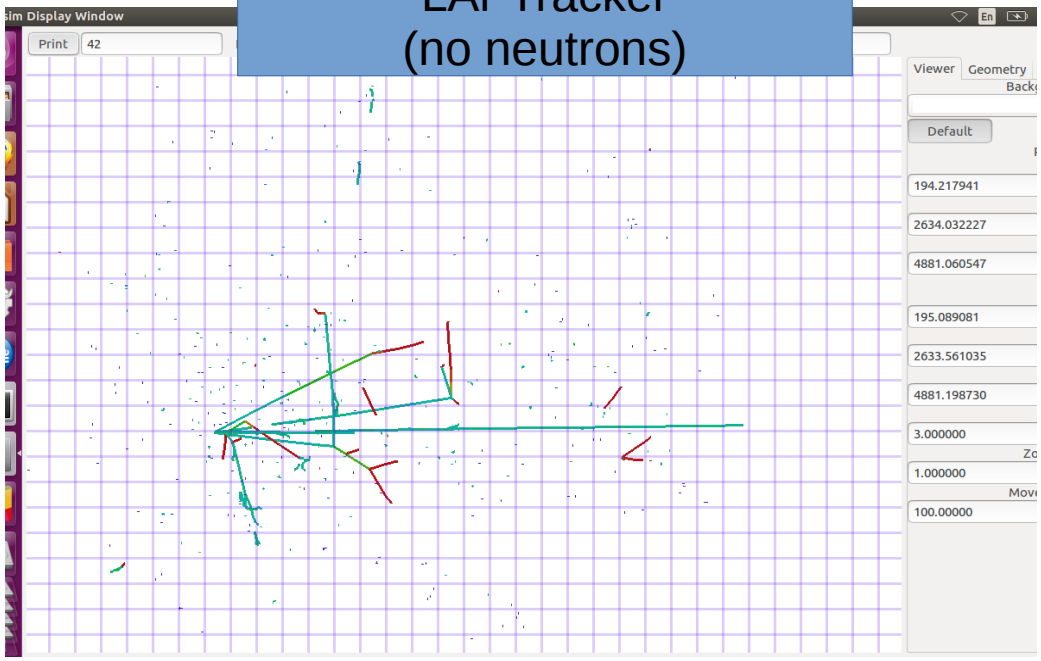
Solid Block of Minerva Scintillator



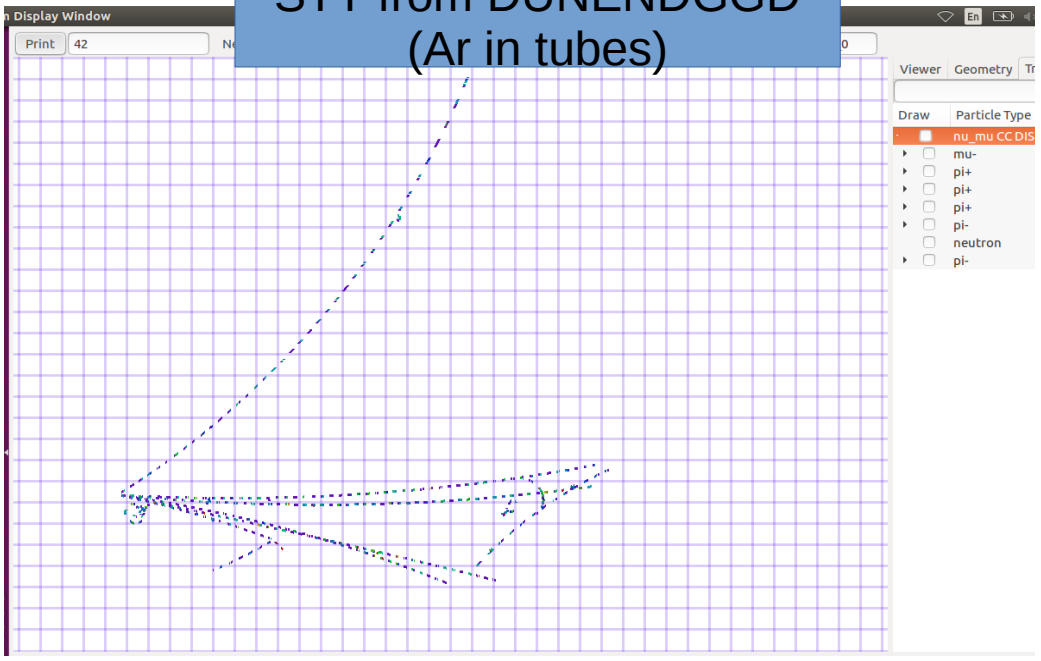
"Solid" Block of ~10 atm GAr



LAr Tracker (no neutrons)

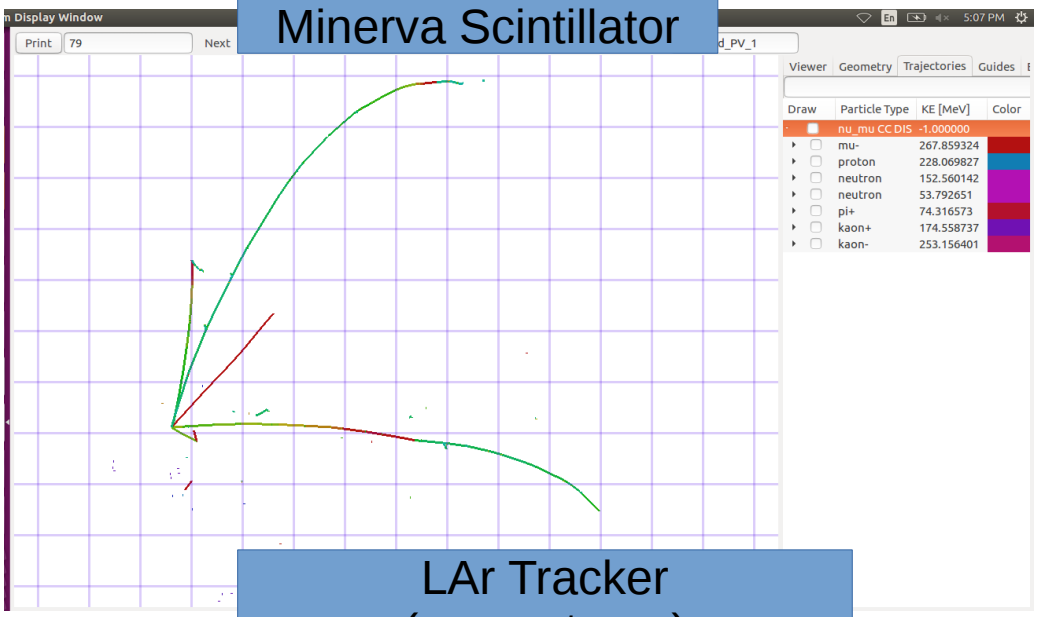


STT from DUNENDGGD (Ar in tubes)

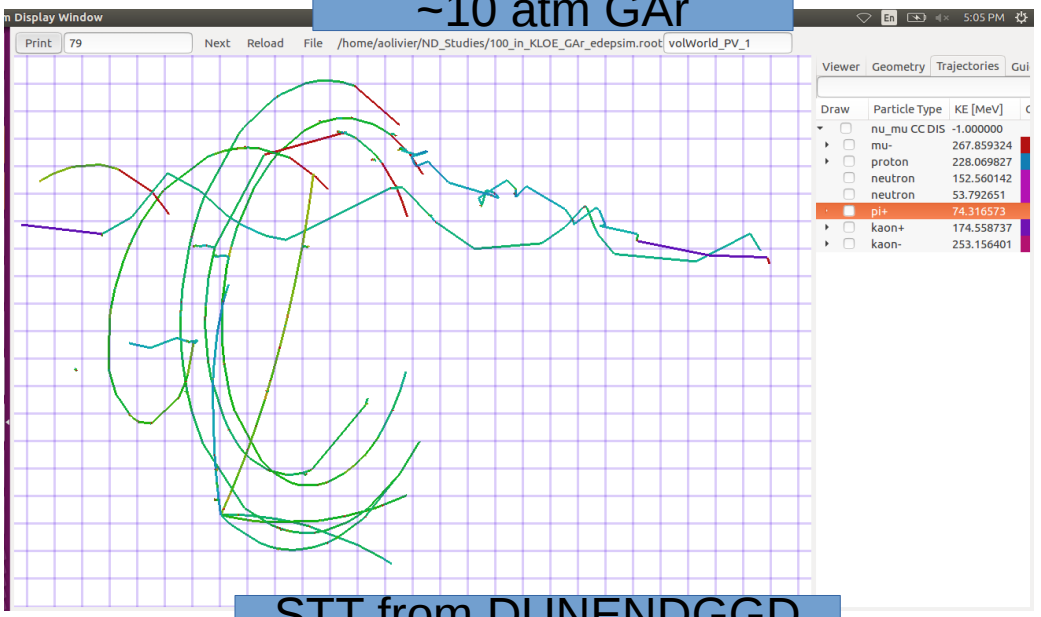


Michel Electron Energy in a CC DIS Event

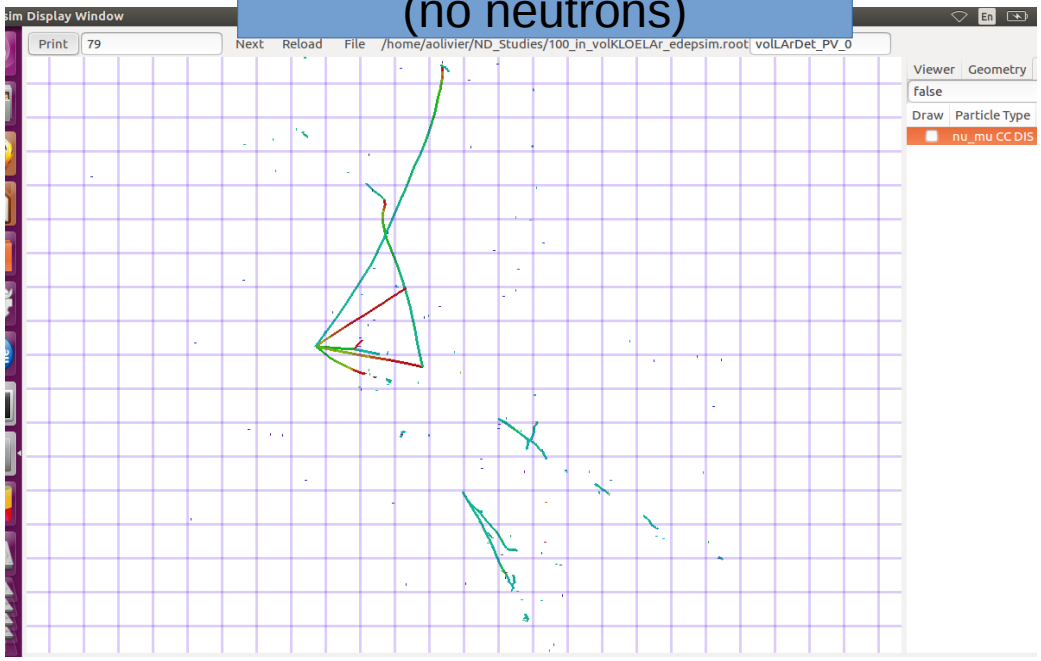
Solid Block of Minerva Scintillator



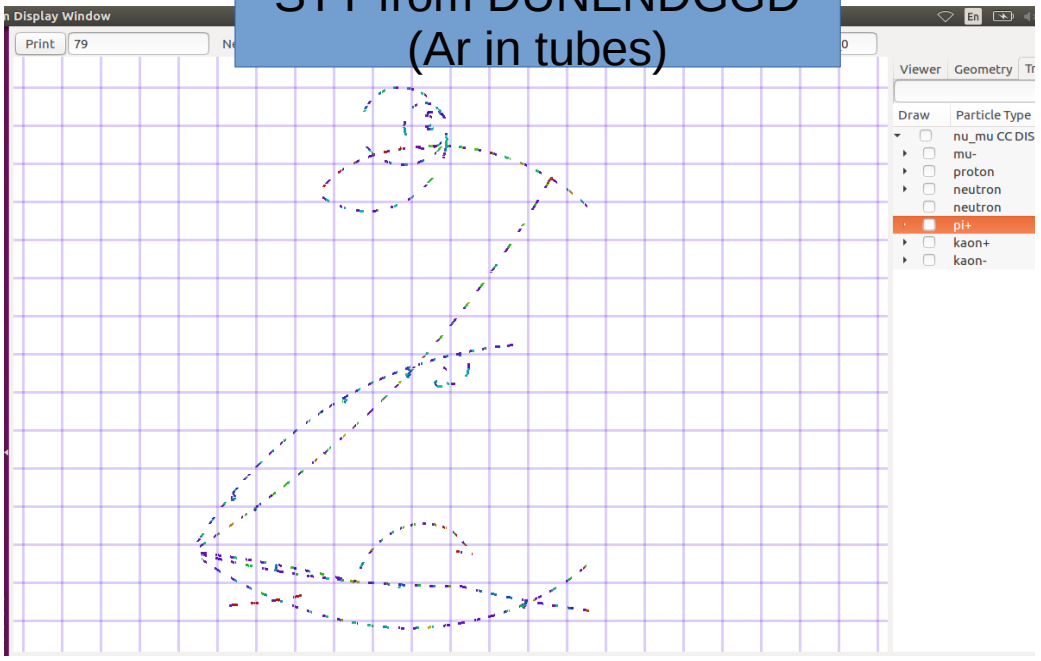
"Solid" Block of ~10 atm GAr



LAr Tracker (no neutrons)

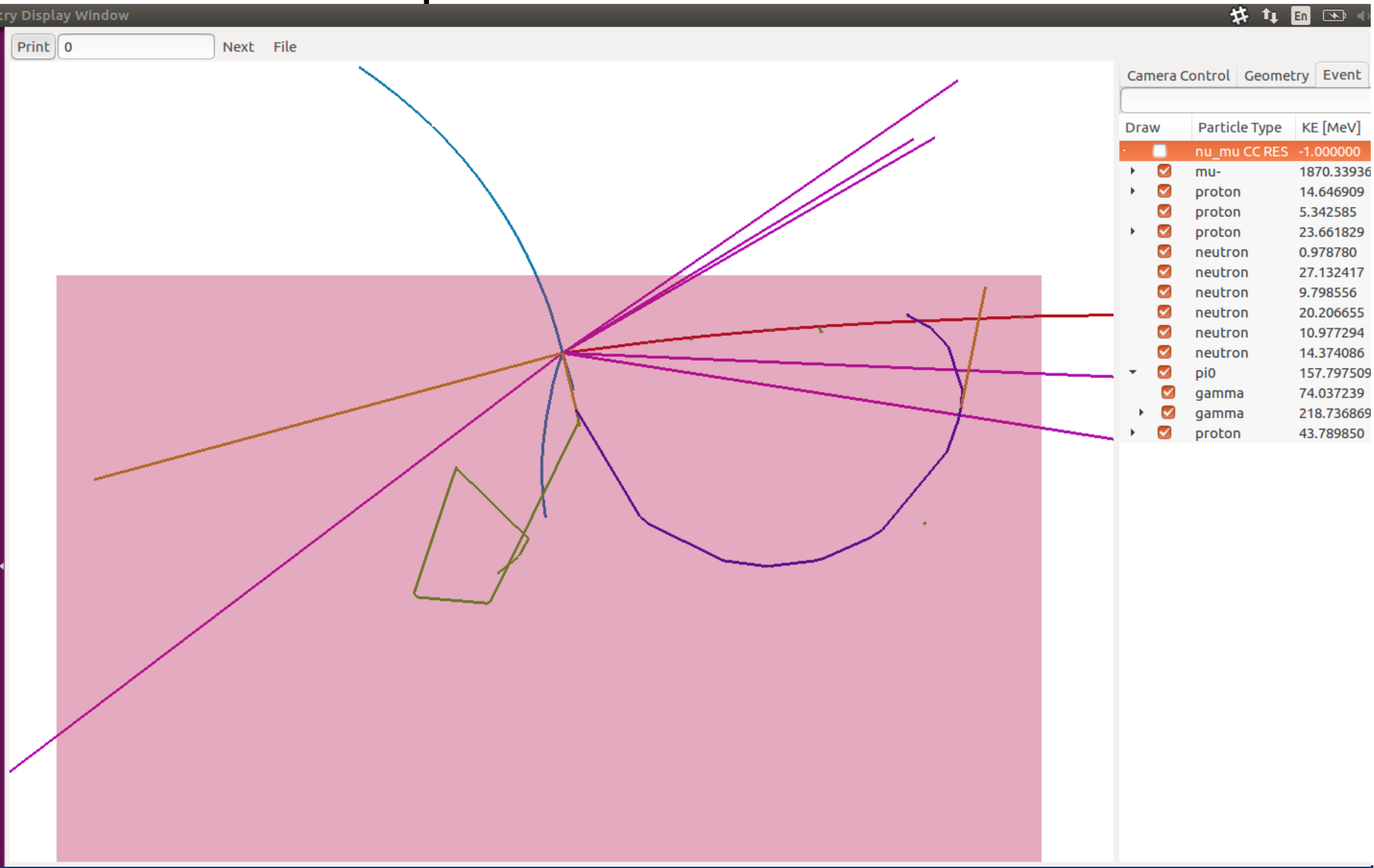


STT from DUNENDGGD (Ar in tubes)

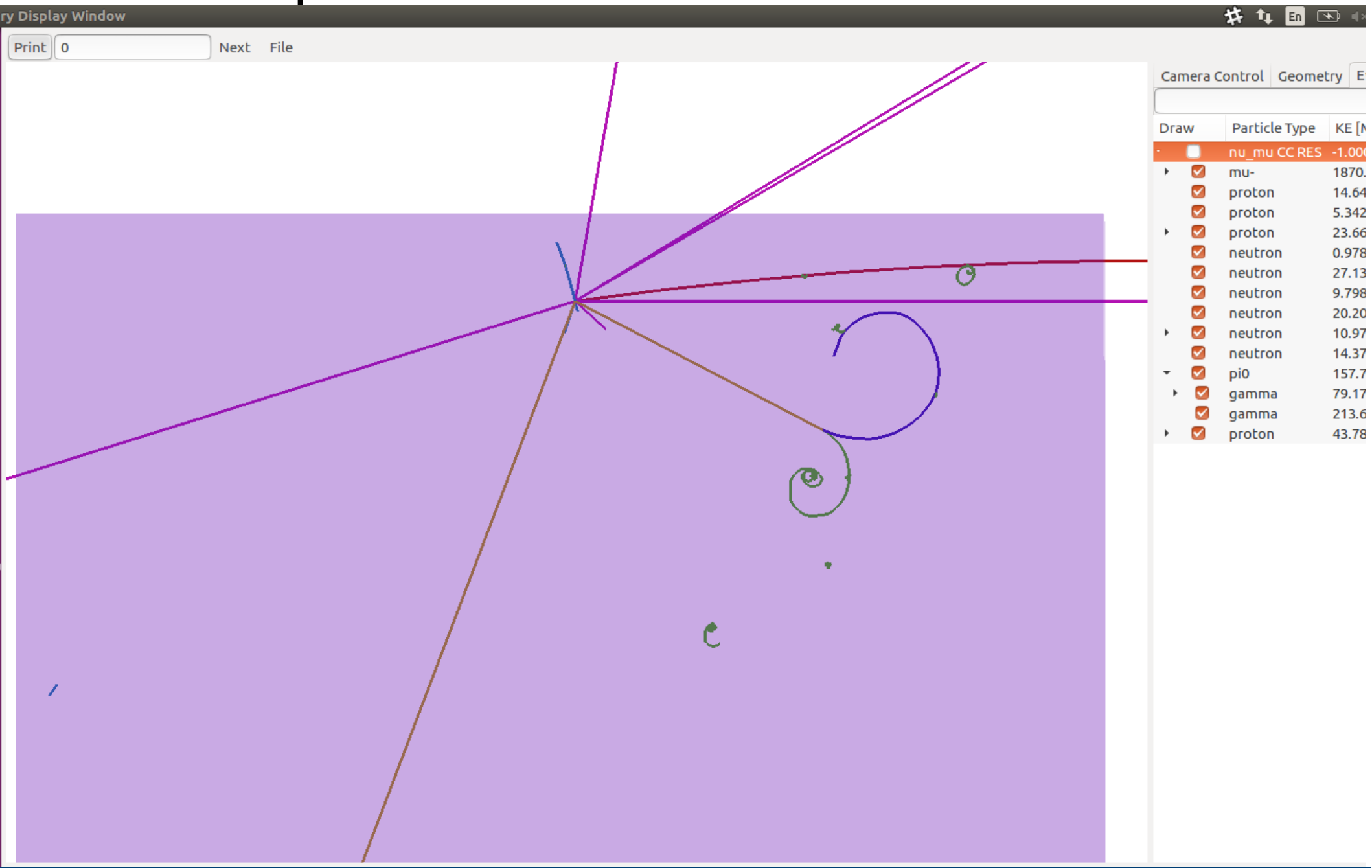


Backup Slides Follow

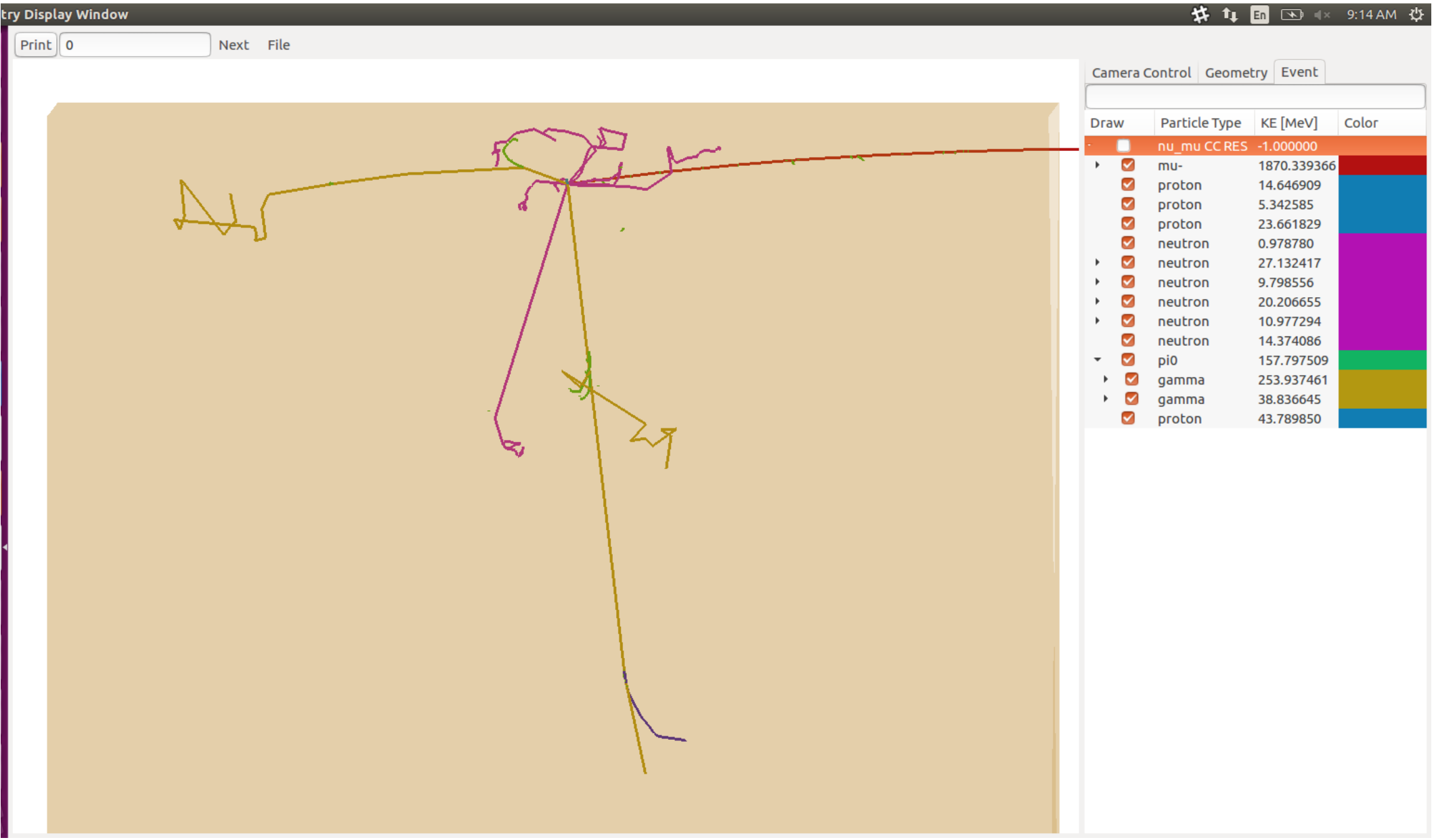
Backup: Closer View of GAr TPC



Backup: Closer View of Straw Tube Tracker



Backup: Closer View of Minerva-like Scintillator



Backup: Simulation Method Details

- Started with 100 GENIE events from the DUNE near detector nominal flux
- Simulated all 100 events using edepsim on my laptop in each of 4 geometries:
  - The KLOE geometry file's argon-filled straw tube tracker. Made volKLOESTT gevgen_fnal's target volume.
  - The KLOE geometry's liquid argon tracker which is not in a magnetic field. Transformed GENIE interaction records from volKLOESTT to volLArTracker. Can provide a ROOT script to do this given the geometry file GENIE used.
  - Replaced the KLOE STT with a block of the HP gaseous argon mix from dunendggd . Used GENIE interaction records from volKLOESTT.
  - Replaced the KLOE STT with a block of scintillator from Minerva's gdml file for the Inner Detector. Used GENIE interaction records from volKLOESTT.

Backup: Visualization Details

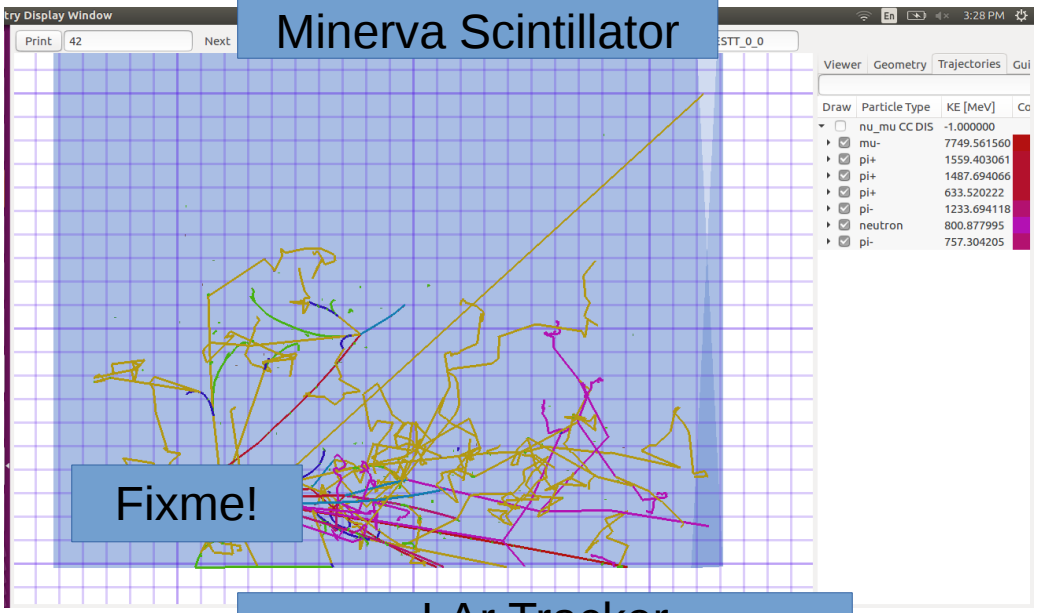
- Developed an application in c++ with a gtkmm 3.18 GUI that reads edepsim's ROOT output files and uses the opengl 3.3 core profile to draw:
  - Nodes from the ROOT geometry edepsim saved. Performs translations with TGeoMatrix
    - Color has no special meaning
    - Could be cut by material
    - Only first 7 levels of hierarchy included to reduce time to load each new file
  - Trajectory points from true particles
    - Mapped PDG code to color
    - Linear interpolation between trajectory points. Interpolate to end of sensitive volume for true trajectories that leave it. No fitting for B field
  - True energy deposits
    - Color from log(dE/dx) in MeV/cm. Same scale for each detector
    - Linear interpolation between start and end. Can only be in sensitive volume because of edepsim. No fitting for B field
  - Grids with distances from 1m x 1m to 1mm x 1mm for units in powers of 10.
    - Most plots show a 1dm x 1dm grid and a 1m x 1m grid.
- All distances in mm and energies in MeV

Backup: Software Details

- Built everything on ubuntu 16.04 LTS except gevgen_fnal, which I ran on dunegpvm02
- KLOE geometry file from dunendggd
- dunendggd depends on gegede
- gcc 5.4.0
- ROOT 6.09/01 built from source with GDML support and MINUIT 2 enabled for another project
- Geant 4.10.3 built from source
- edepsim from github built from source
- Gtkmm 3.18
- Opengl 3.3 core profile → no fixed function pipeline like glBegin().

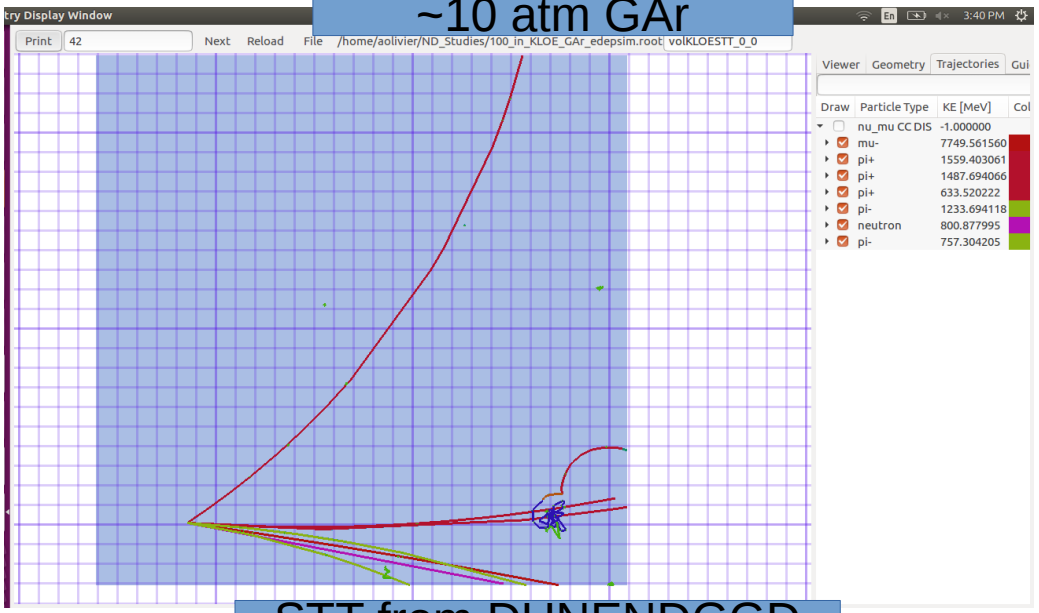
Charged Current Deep Inelastic Scattering with Charged Pions

Solid Block of Minerva Scintillator

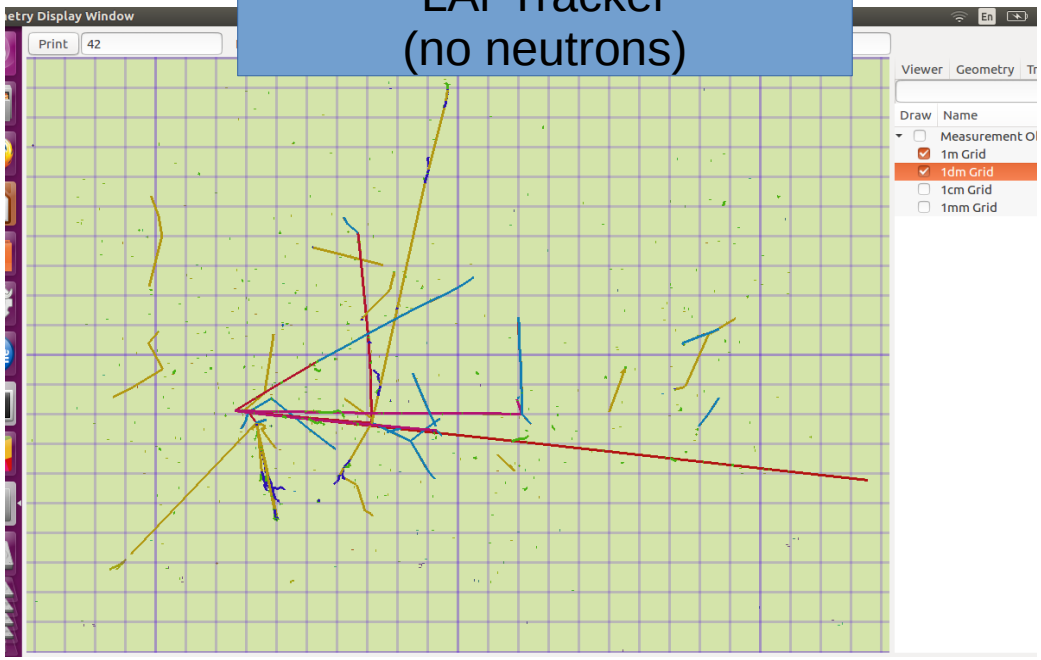
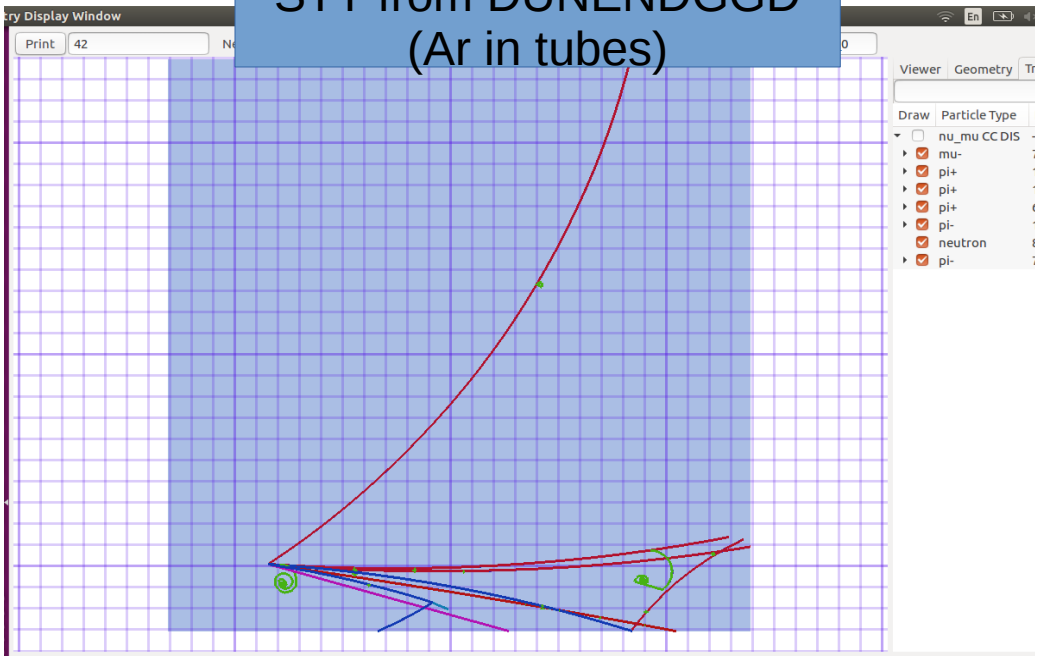


Fixme!

"Solid" Block of ~10 atm GAr



LAr Tracker (no neutrons)



STT from DUNENDGGD (Ar in tubes)