

# Measurement Sub-group Report

October 23, 2015

# Recent Progress

- Resumed regular bi-monthly meeting schedule.
- Next meeting is Tuesday October 27 at (2pm Fermitime).

## Main efforts:

- MC samples generation - INITIAL PASS NOW COMPLETE (E. Worcester)
- Geometry Work
  - ▶ Beam window - implemenation and validation- Matt Kramer (& Cheng-ju).
  - ▶ Ongoing refinements to initial geometry - M. Tzanov
- Reconstruction studies and refinements - Robert and Dorota

More effort is needed to perform reconstruction and physics studies.

⇒ New involvement especially in this area would be welcomed.

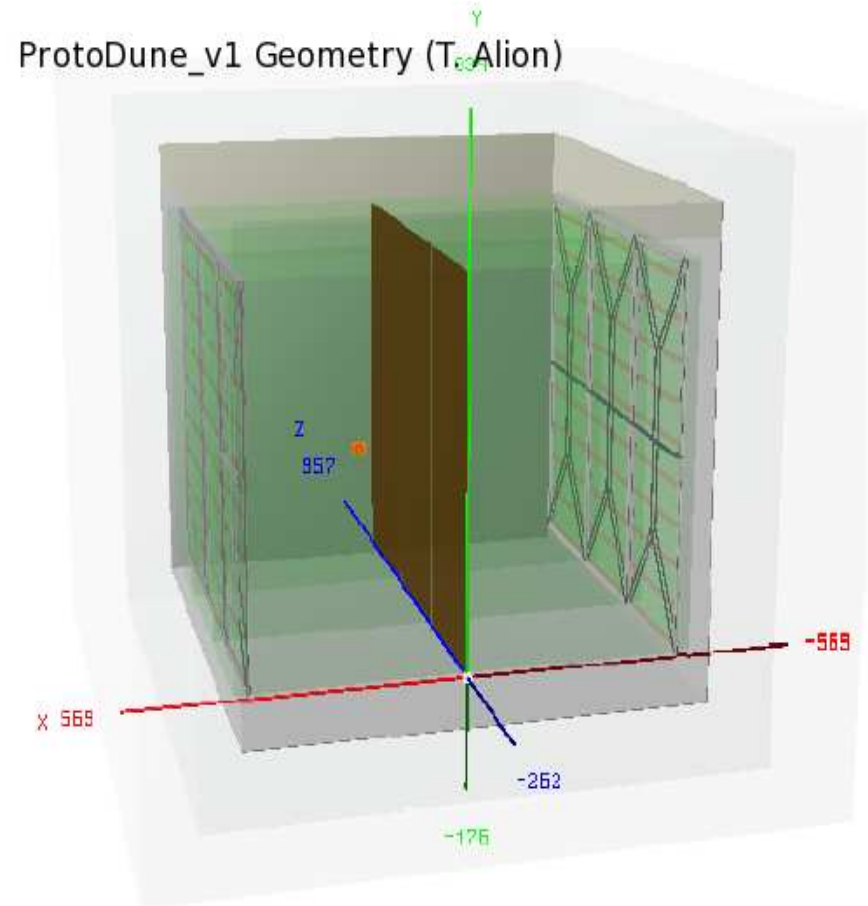
# MC Samples Generated

E. Worcester (update Oct 13 meeting)

- Samples of  $\mu^\pm$ ,  $\pi^\pm$ ,  $p$ ,  $e$ ,  $K$  with energies matched to the proposal.
- Using protoDune\_v1 geometry and LArSoft dunetpc v04\_23\_00.
- Full detsim\_protodune and reco\_protodune stages.

Generation parameters:

- Initial position: Middle of front face of left TPC
  - $x = 180$  cm,  $y = 360$  cm,  $z = 0$
  - Gaussian with  $\sigma_{x,y} = 10$  cm
- Initial momentum:
  - Gaussian with  $\sigma_p/p = 5\%$
  - $\theta_{xz}$  (horizontal plane) =  $-10^\circ$
  - $\theta_{yz}$  (vertical plane) =  $-6^\circ$  (some subset with  $+6^\circ$  for angle studies)
  - No variation in angle



# To get the files...

See info posted on our working group page (E. Worcester)

[https://web.fnal.gov/collaboration/DUNE/SitePages/ProtoDUNE Sim Reco and Analysis Working Group.aspx](https://web.fnal.gov/collaboration/DUNE/SitePages/ProtoDUNE%20Sim%20Reco%20and%20Analysis%20Working%20Group.aspx)

## Monte Carlo Samples:

- Talk describing samples is here: <https://indico.fnal.gov/conferenceDisplay.py?confId=10534>
- MC samples are in `/pnfs/lbne/scratch/users/protoDuneProd/`
- Filenames for simulation: `detsim_protodune_<PARTICLE>_<ENERGY>_<JOBNO>.root`
- Filenames for reconstruction: `reco_protodune_<PARTICLE>_<ENERGY>_<JOBNO>.root`
- Notes: Reconstruction is "out-of-the-box" so no guarantees as to how well this has worked. Additionally, some jobs have not finished successfully. Contact Elizabeth ([etw@bnl.gov](mailto:etw@bnl.gov)) with any requests to track down missing files, any problems with the MC or reconstruction that should be corrected for future iterations, or any other requests regarding protoDUNE MC production.
- Links to small samples of events in BEE:
  - [Electrons](#)
  - [Muons](#)
  - [Pions](#)
  - [Protons](#)
  - [Kaons](#)

# MC Sample generation

## Future plans

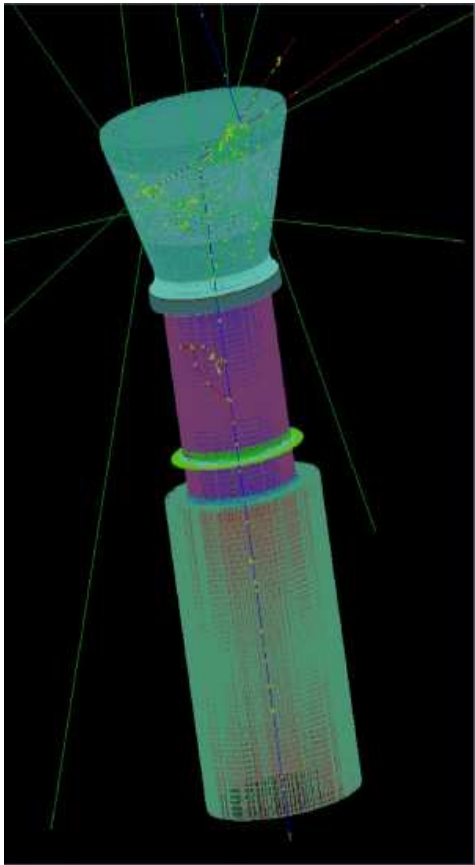
- Implement space charge effects into simulation.
  - ▶ adapt  $\mu$ BooNE code from M. Mooney.
- Include cosmic overlays
  - ▶ generated separately with CRY generator and combined with single particle samples.

Both are important in the long run but require non-trivial effort and not needed in the short term (not currently high priority).

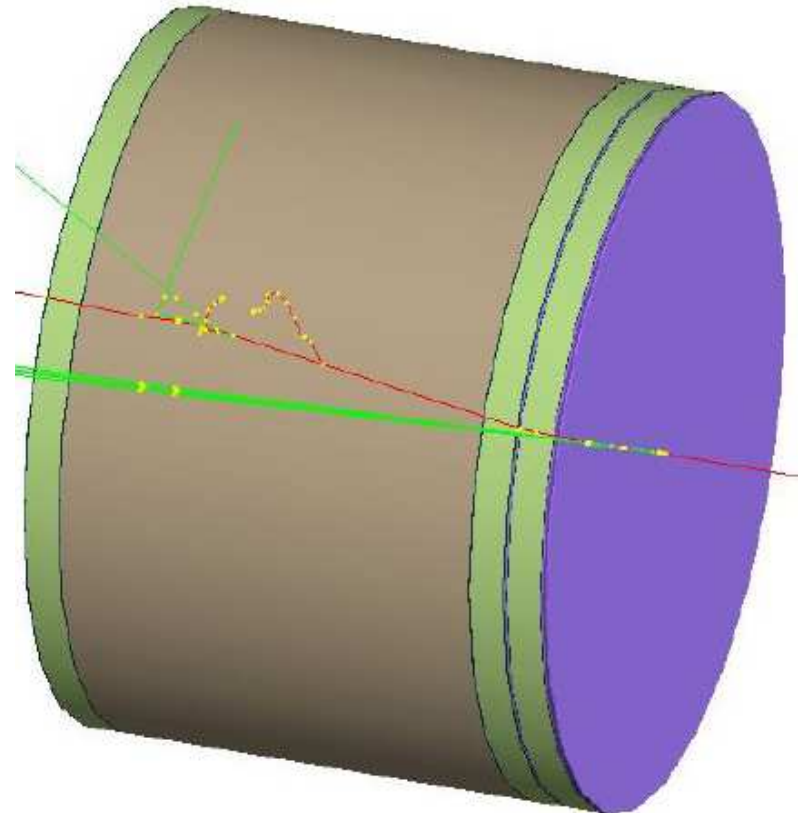
# Geometry Refinements

- Refinements & add realistic materials and environment (M. Tzanov)
  - ▶ Report at meeting next week.
- Implement beam window. (Matt Kramer & Cheng-ju)

Original plan- import CAD model.



NEW- coded material cylinder stack.

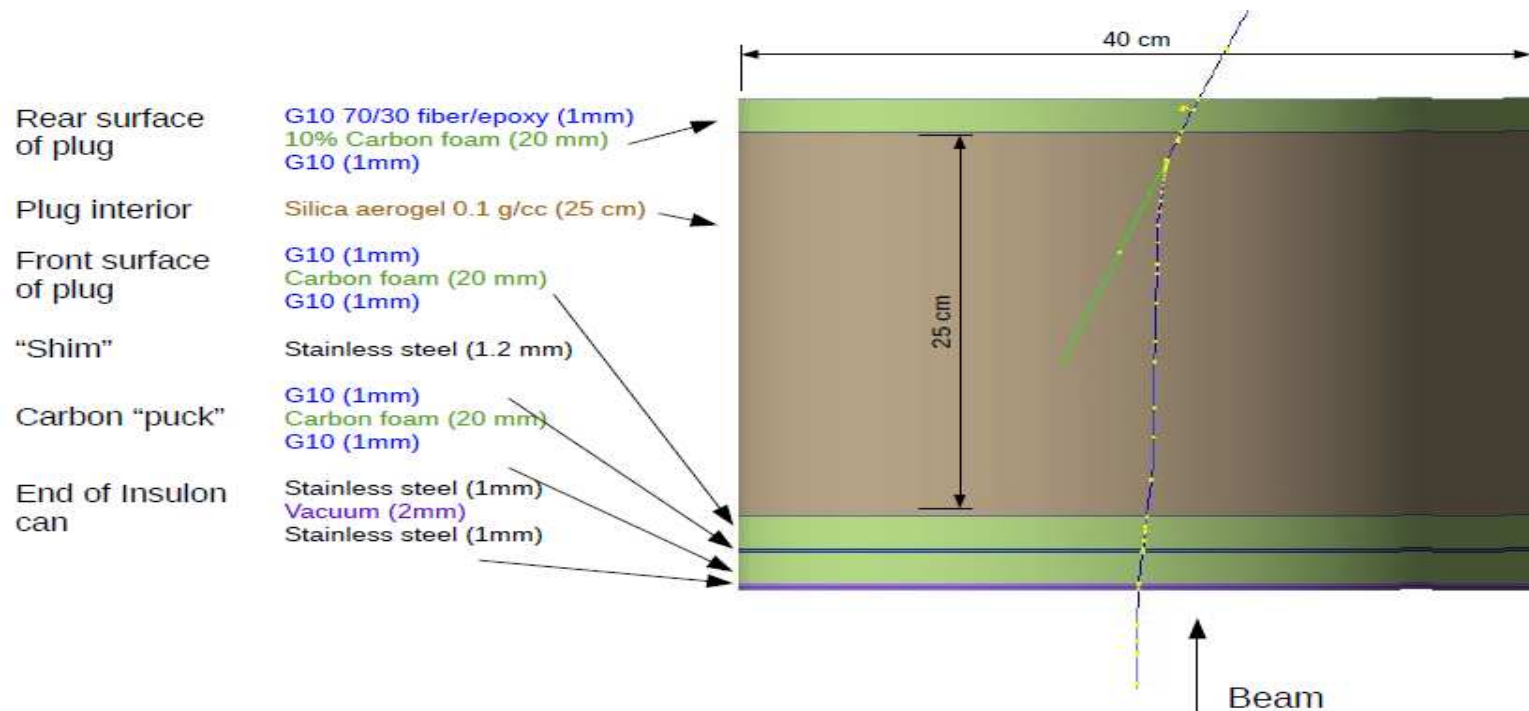


# Geometry Refinements (cont'd)

Cylinder stack vs CAD model pros and cons

- CAD model imported into Geant4 using tessellated meshes- problematic to incorporate into existing geometry & slow,
- Solid model is simpler to incorporate & runs much faster.

Design changes can be easily implemented and tested in either model.



- Validation of standalone version (cross comparison with CAD model) in progress. p. 7/1

# Reconstruction and Analysis

Robert Sulej and Dorota Stefan

See nice summary of reconstruction status at CERN Neutrino platform meeting this week. <https://indico.cern.ch/event/455067/>

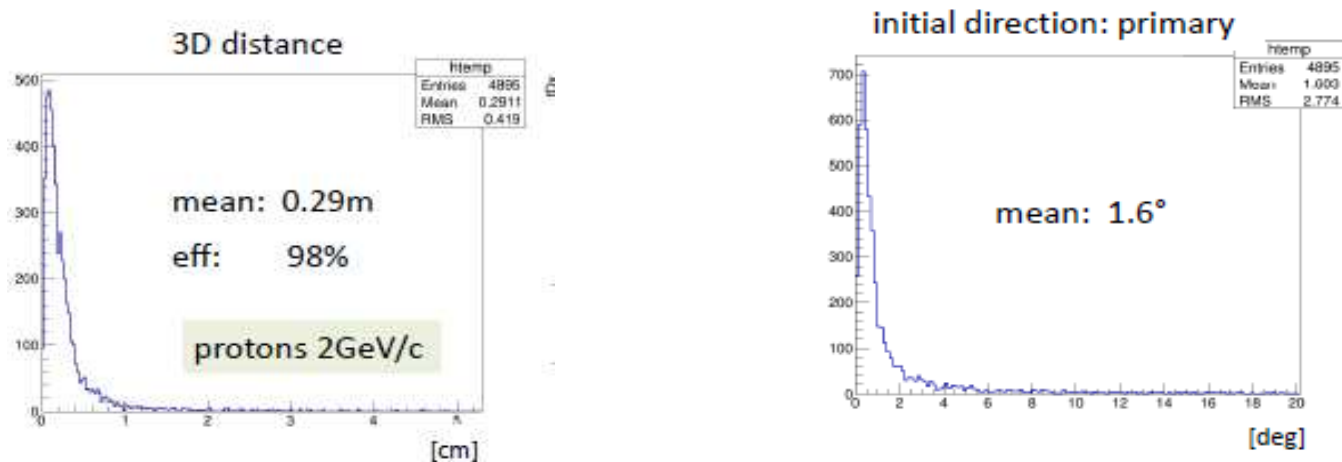
What needs to be reconstructed in ProtoDUNE

- **primary particle:**
  - entry point, initial direction – can be associated with upstream detectors
  - first vertex: interaction (known primary ID  $\rightarrow$  cross-sections), decay or clean stopping particle
  - if primary particle is stopping: PID, energy &  $dE/dx$  calibrations, ...  
 $\rightarrow$  reconstruction does this job quite well nowadays
- **secondaries:**
  - multiplicity of primary particle interaction
  - many goals of the measurement plan: EM showers from  $\pi^0$ 's, secondary protons for PID and angular dependencies study, energy calibrations for showering particles
  - test / compare limits of various reconstruction in real detector conditions
  - **$\pi$  interaction vertex reconstruction can be a testbed for neutrino data**



# Reconstruction and Physics Studies (cont'd)

- Implemented “Projection Matching Algorithm”,
- benchmarking and tuning with particle gun samples in ProtoDUNE geometry.
  - ▶ Primary particles- reconstructed distance to 3D entry position and angle.



- Ongoing work - optimizing vertex finding and reconstruction within PMA.
  - ▶ Needed to reconstruct secondary interactions, critical for many calibrations/studies.
- Ongoing work- improve EM cascade handling within LarSoft framework.

# Reconstruction and Physics Studies

**First pass ProtoDUNE MC samples are available and should now be put to use!**

Summary from Robert and Dorota's talk:

- “Reconstruction working for protoDUNE”
- “Many tasks from measurement plan can be done using present tools”

Also needed testing, comparisons and tuning of reconstruction algorithms

- PANDORA, Wire-Cell, Cluster 3D

⇒ **New involvement especially in this area would be welcomed.**

# LArTPC Requirements Workshop

<https://indico.fnal.gov/conferenceDisplay.py?confId=10394>

Goal: “Identify and document the LArTPC community software needs necessary to meet their physics goals”

ProtoDUNE attendees (T. Junk, remote: R. Sulej, D. Naples, others?)

## Assessments

- Status Reports from experiments with data (Argoneut, Icarus, Microboone, Lariat)

Discussion Breakout sessions (broad coverage of topics and common needs for LarSOFT users)

- Non-beam reconstruction and analysis topics (CR simulation and removal, external triggers)
- Beam reconstruction and analysis topics (Reconstruction and simulation tools).
- Overarching Analysis strategies (analysis workflow, analysis toolkits, DAQ, Data management...)
- Human interactions, interfaces (visualization, software frameworks, validation software, ...)

# LArTPC Requirements Workshop (cont'd)

Produce document: “Requirements for a LArTPC Ecosystem” (editor J. Kowalkowski)

- Document use cases and experiment specific feedback/needs.
- Time scale for document end of November.
  - ▶ Will need expert help and input for editing ProtoDUNE section.
- LArSoft external review in early 2016.