Updates from the measurements group

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New DUNE working groups

- The structure of the protoDUNE groups was change.

- There is a new **ProtoDUNE Sim Reco and Analysis Working Group** under the **Software and Computing WG**

- However, there is obviously a strong connection with the **Detector Prototype WG**

- The group website is (https://web.fnal.gov/collaboration/DUNE/SitePages/ProtoDUNE%20Sim%20Reco%20and%20Analysis%20Working%20Group.aspx)

Meetings

- Next meeting will be next week (Physics week) and the meeting will be every other week.

- Doodle poll for the new time of the meeting

- http://doodle.com/poll/xqp95nvty5kc25nsh3v3udxf/admin#table

protoDUNE MC Status

Elizabeth W.

- **MC Details:**
  - LArSoft dunetpc v04_23_00
  - Geometry: protoDune_v1
  - New protoDune services:
    - protoDune_services
    - protoDune_simulation_services
    - protodune_photonvisibilityservice (thanks to A. Himmel for generating the photon library)
  - Sample fcl files in dunetpc/fcl/protodune/

- **MC Samples:**
  - μ^+, μ^-, π^+, π^-, p, e^-, K^+
  - Includes subset of samples with vertical beam angle +6°
  - Details of generated samples: http://www.phy.bnl.gov/~etw/protodunemc.html

- **Status of generation:**
  - Root files in /pnfs/lbne/scratch/users/protoDuneProd/
  - Full detector simulation: detsim_protodune_<PARTICLE>_<ENERGY>_<JOBNO>.root
  - Detector simulation jobs still in progress
  - Standard reconstruction will be run with output in same area: reco_protodune_*.root
  - Still learning most efficient methods for grid generation – likely some files will be missing this round of generation – next round should go more smoothly
  - Please contact ETW with any problems analyzing the MC output or requests (data products and/or additional samples) to include in next generation
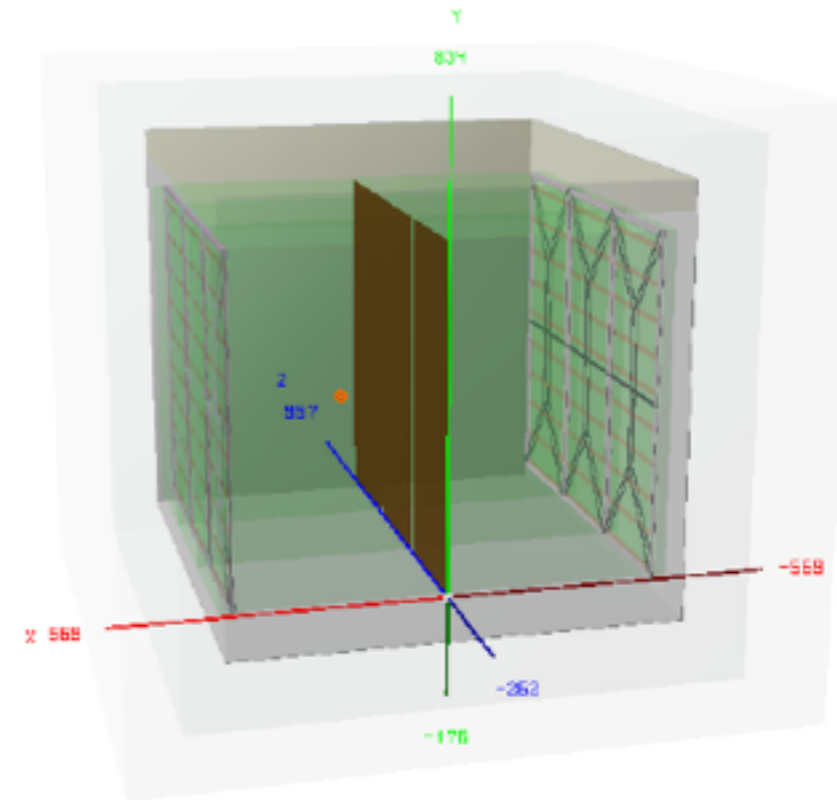
MC samples

- We now have a number of MC sample for studies.

- Information about existing MC will be send to the reconstruction algorithms developers for study.

- We need someone to run the reconstruction algorithms and compare results.

protoDUNE geometry file

- The first version of the geometry is in the repository and was used for the MC generation.

- The next step will be to include the beam window (Matt K. is working on this. More in Cheng-Ju's talk).

- More details of the detector, cryostat and building will need to be included (particularly important for the cosmic muons studies)

Other short term tasks

- Investigate the design decision with reconstructed/cheated variables. (beam window location, entry point)

- Adapt the cosmic Monte Carlo for protoDUNE

- Overlay cosmic muon MC with beam MC

Proposed measurements and tasks

- **Shower calibration (6 FTE)**
  - E-M showers (π^0, γ, e)
  - Hadronic showers ($\pi^{\pm}$, $K^{\pm}$, p)
  - Various energies
- **Angular dependence (1FTE)**
  - Recombination using different angles of the beam and secondary particles
- **Bethe-Bloch parameterization of charged particles and PID (8FTE)**
  - Each particle, and for various energies and angles
- **Reconstruction effects (3 FTE)**
  - Difficult angles, 2D vs. 3D reconstructions (validation of reconstruction)
- **e/γ separation (1 FTE)**
- **Cross section measurements (2FTE)**
  - Elastic scattering, absorption, charge exchange

Summary

- Since the collaboration meeting:

- New structure of the WGs.

- First MC samples with protoDUNE geometry.

- Cast you vote for the meeting time!

Measurements Programme

* In the proposal we presented an ambitious physics programme

  * Physics measurements: pion/kaon cross sections, ...

  * Reconstruction development and validation

  * MC validation and improvements

Proposed measurements

* **Supernova and Michel electrons (1 FTE)**

* **Charge sign determination (1FTE)**

* **Proton decay sensitivity and background samples (1FTE)**

* **Anti-proton annihilation (1FTE)**

* **Veto cosmic muons and beam halo (1FTE)**

Reconstruction

* There are several automatic reconstruction algorithms

    * PANDORA, Projection Matching, Wire-Cell, Cluster 3D.

    * There are significant differences between them.

    * They are at different levels of sophistication.

* **protoDUNE will be unique as it will provide data of charged particles with good energy resolution and known type of the particles**

Proposed beam for protDUNE Run1 (2018)

Particle	Momenta (GeV/c)	Sample Size	Purpose
π^+	0.2, 0.3, 0.4, 0.5, 0.7, 1, 2, 3, 5, 7	10k	hadronic cal, π^0 content
π^-	0.2, 0.3, 0.4, 0.5, 0.7, 1	10k	hadronic cal, π^0 content
π^+	2	600k	π^o/γ sample
proton	0.7, 1, 2, 3	10k	response, PID
proton	1	1M	mis-ID, PD, recombination
e^+ or e^-	0.2, 0.3, 0.4, 0.5, 1, 2, 3, 5, 7	10k	e-γ separation/EM shower
μ^-	(0.2), 0.5, 1, 2	10k	E_μ, charge sign
μ^+	(0.2), 0.5, 1, 2	10k	E_μ, Michel el.,charge sign
μ^- or μ^+	3, 5, 7	5k	E_μ MCS
anti-proton	low-energy tune	(100)	anti-proton stars
K^+	1	(13k)	response, PID, PD
K^+	0.5, 0.7	(5k)	response, PID, PD
μ, e, proton	1 (vary angle $\times 5$)	10k	reconstruction

Reconstruction validation for protoDUNE

* Event reconstruction tests and validation is to

    * validate algorithms for unique situation (known primary particle, lots of cosmics)

    * compare efficiencies between algorithms

    * compare computing requirements (for future live monitoring of the detector)

* The samples for validations will be produced by Elizabeth

* Here we show only the results for the Projection Matching algorithm.

    * nominal 6 degree up, 10 degree off the wire planes

    * add horizontal & vertical ±15 degree spread to see if any effect

Preliminary list of validation metrics

* vertex and angular resolution for primary particles

* vertex and angular resolution for secondary particles

* multiplicities of secondary particles

* PIDs (efficiencies and purity)

* Energy deconvolution

* …