Report from measurement group

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for the meas. group

Recent activities were mainly on the reconstruction.

Working on the preparation of tools needed to realize measurement plan, so short remainder of relation of reco and measurements first:

- Calibration of hadronic and EM energy measurement
  - samples of beam particles at various momenta
  - reconstruct details for low momenta hadrons (energy via calorimetry, dE/dx, secondaries)
  - at high energy: calibration factors as a function of shower overall properties: energy, track and vertex configurations, …
  - find what is low/high energy as reconstruction is developing
- Particle identification patterns (hadrons, muon, electron/gamma)
- Proton decay id and miss-id (which is also PID)
- dE/dx detector response, recombination effects (which is also needed for PID and enrgy)
  - only a small range of beam angles available
  - electron patterns from electron beam runs
  - gamma patterns from π^0's generated in p, π^+, K events at 1-2GeV
  - stopping particle patterns from beam particles and secondaries
  - dE/dx angular dependencies from beam particles and secondaries

That's why we asked for large samples of p, π at 1-2GeV, also needed to get kaons.

- Reconstruction validation, preparation of optimal reco chain for data

  includes using beam particle interactions to develop/validate vertex region reconstruction and interpretation

Reconstruction: track-vertex structures with Projection Matching Algorithm

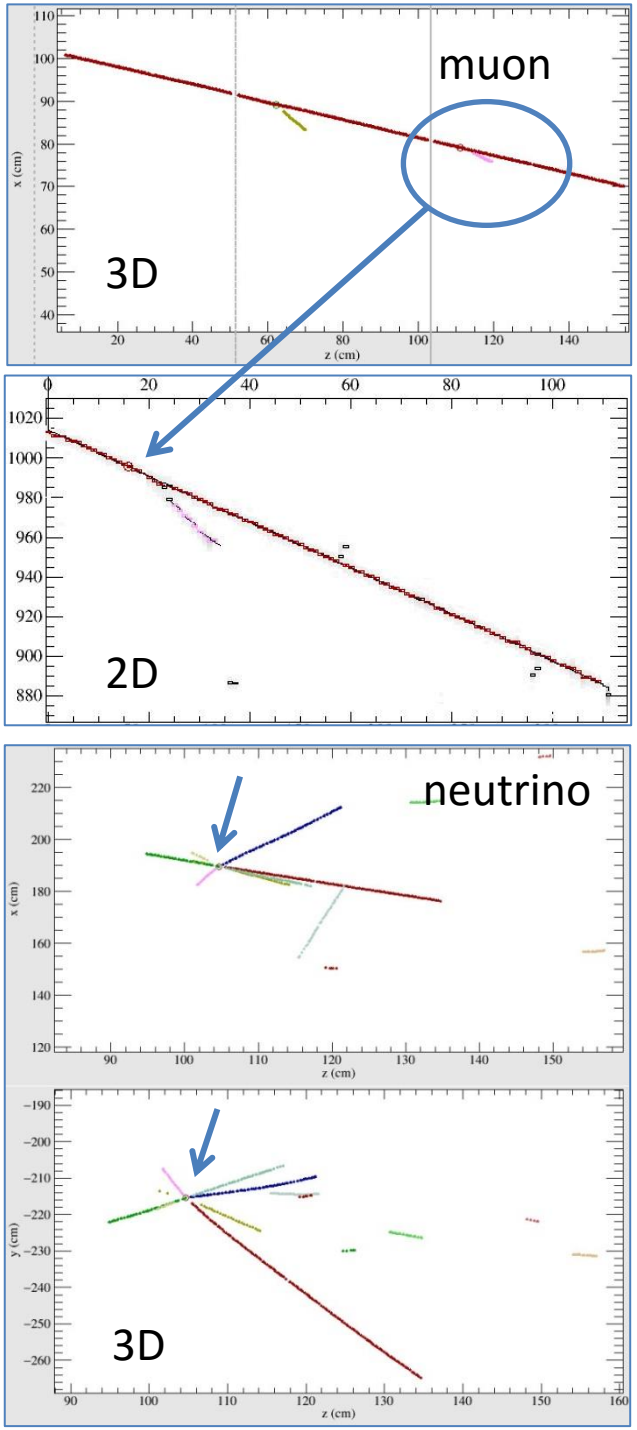
Optimization applied to complex structures of tracks interconnected with vertices:

- Build, extend, stitch isolated track first
- Find candidates for track intersections and points where multiple candidates point to
- Join tracks in vertex candidates, reoptimize all tracks together
- Uses local information from multiple tracks to fit the best position of vertex
- Improve 2D pattern recognition output
- Implemented (almost) full grammar of possible tracks and track structures merging/splitting to replace first, oversimplified version that was always breaking a track on each vertex

New features used in MCC5.0, see slides:
https://indico.fnal.gov/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=11076 (T. Yang at FD Sim.Reco. meeting)
https://indico.fnal.gov/getFile.py/access?contribId=1&resId=0&materialId=slides&confId=11056 (T. Yang at Long-baseline Nu. Osc. meeting)

which explain how to access reco output, can help in preparation of analysis scripts for protoDUNE measurements.

Good support for dE/dx implemented in PMA some time ago.



Reconstruction: merging PMA with other reco chains

Now we are using:

A hits -> 2D pattern recognition -> PMA: 3D pattern recognition + track/vertex fit

native LArSoft algorithms

LArSoft's module for PMA tracking/vertexing modified in order to combine with other algorithms (also requested by uBoone).
Last corrections and tests done, code now goes to the LArSoft release 4.31.

test using fit only

B hits -> 2D pattern recognition -> PMA: 3D pattern recognition + track/vertex fit

use Pandora pattern recognition

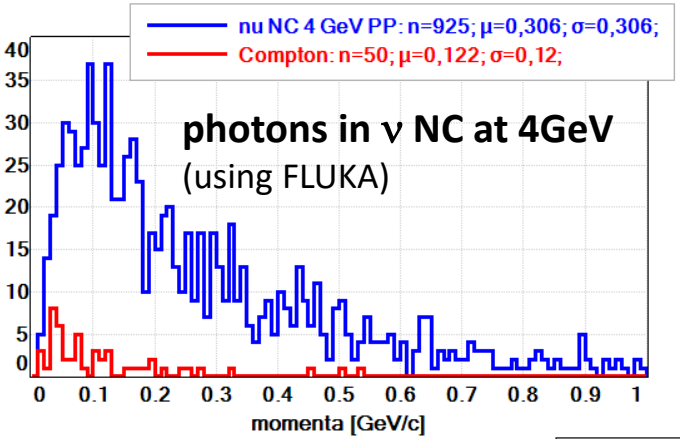
Also needed to start work on merging with Wire-Cell approach:

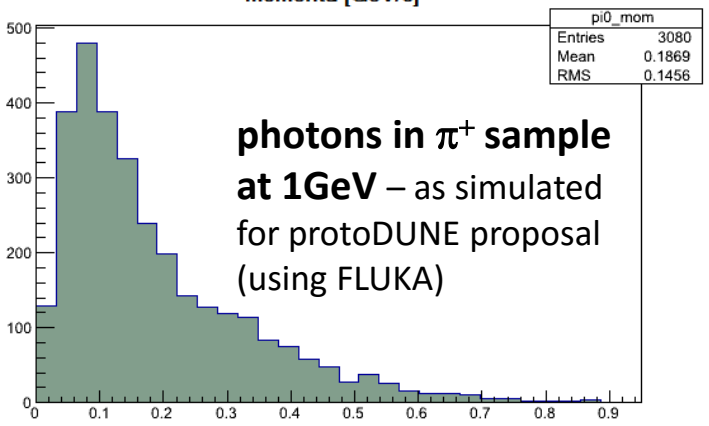
C hits -> 2D pattern recognition -> PMA: 3D pattern recognition + track/vertex fit

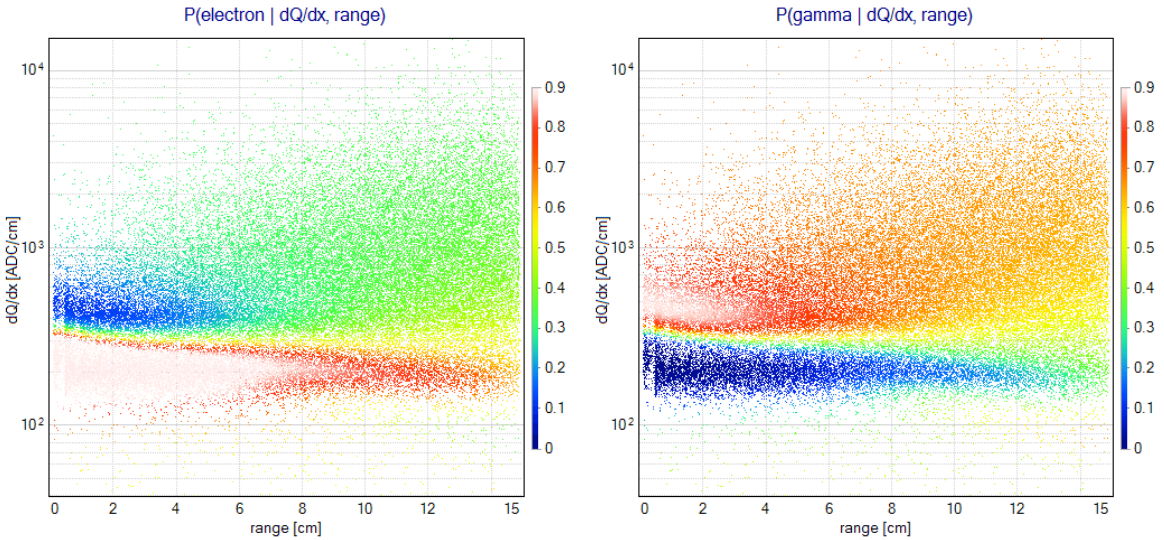
test using with Wire-Cell output

Reconstruction: e / gamma patterns

- Started ν_eCC / νNC separation studies with combined detection of:
  - cascade displaced from primary vertex
  - electron-like cascade start by dE/dx
  - https://indico.fnal.gov/getFile.py/access?contribId=1&resId=0&materialId=slides&confId=11076 (D. Stefan, FD Sim.Reco. meeting) and **updates on coming Monday**
- high potential in statistical difference observed in dE/dx evolution – results now better understood and settled
- now using all 3 wire planes to maximize efficiency / background rejection







P(e) and P(γ) probability patterns for EM cascade starting part

- real data patterns needed, as for other PID purposes
- range of γ momenta designed for meas.plan well matches the interesting range in νNC background

Summary

- Stable progress on spatial reconstruction algorithms towards tools needed for the measurement plan.

- Much effort spent on e/gamma separation. The more advanced approaches, the more needed validation on real data, otherwise we overfit to MC.

- No new dedicated MC productions, at this level of floating parameters not reasonable, reconstruction / analysis preparation can progress without this for now (also useful single particle simulations in MCC5.0).