PLAN FOR MC DEMO OF PROTODUNE SPACE CHARGE CALIBRATION

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Planning Meeting Summary

- Planning meeting held yesterday (12/14) to discuss overall plan and divide task list

- Attended by Jarrett Brown, Mike Mooney, Arbin Timilsina, Elizabeth Worcester, Matt Worcester

- MicroBooNE public technote is useful reference for calibration strategy: http://www-microboone.fnal.gov/publications/publicnotes/MICROBOONE-NOTE-1018-PUB.pdf

- Divided tasks among meeting attendees – others are very welcome – please contact Mike and Elizabeth if you'd like to contribute

Task List

1. Determine appropriate request for MCC production

2. Define hits in CRT

3. Match reconstructed TPC tracks to CRT hits

4. Select reconstructed TPC tracks that cross APAs/CPAs

5. Determine t_0 and "true" track trajectory for each track

6. Extract space charge correction from combinations of selected tracks, using t_0 and "true" track trajectory from previous steps as input

7. Apply space charge correction to independent MC samples and evaluate effectiveness of correction

1) MC Production

- New protoDUNE geometry will include front and back CRT
  - Currently based on Ed Blucher's presentation at collaboration meeting
  - Likely will not have realistic segmentation
  - Actual geometry of installed CRT not yet determined
  - Some guidance about most likely configuration would be helpful
- MCC production will include simulation of beam flux (including beam halo events) thanks to new interface from Leigh
- Dorota has proposed samples for next MCC: https://web.fnal.gov/collaboration/DUNE/SitePages/ProtoDUNE%20Sim%20Reco%20and%20Analysis%20Working%20Group.aspx
- For the SCE calibration demo, need a sample of beam (including halo) overlaid with cosmics, with SCE position effect included
  - This is already part of Dorota's proposed plan
  - Matt and Jarrett have done "illumination" studies (see previous talks in calibration meetings) – they will compare notes to make an estimate of the number of readout windows we will need to produce a calibration
  - Required statistics will depend on voxel size for calibration

2) Define hits in CRT

- No detailed CRT segmentation in gdml and no reconstruction available yet – will define hit positions using MC truth smeared by the expected CRT position resolution
- Do we consider only tracks tagged by front & back or also include "single" tags?
  - Matt will work on this – he is familiar with CRT details
  - Matt's work on this may evolve into porting of CRT reconstruction from Double Chooz – he will coordinate with Ed Blucher

3) Match tracks to CRT hits

- Matching tracks to hits may require some "pre-correction" to avoid confusion from space charge position distortion
  - Arbin will work on this – already familiarizing himself with AnaTree

4) Select APA/CPA crossing tracks

- May require some improvements to reconstruction to "stitch" tracks across boundaries
  - Jarrett is learning LArSoft, will work on this topic with help/guidance from Mike

5) Find t_0 and "true" track trajectory

- Trivial for tracks tagged with CRT
- A bit more involved for APA/CPA crossing tracks
  - Will be done by Arbin and Jarrett in conjunction with steps 3 & 4 above, in consultation with Mike

6) Generate correction

- Take all samples of tracks, including t_0 and "true" trajectory, identified in previous steps as input and combine information appropriately to produce calibration map
  - Mike will take the lead on this with help from the team as needed
  - Mike's work will be informed by data-MC comparisons in uBooNE

7) Evaluate correction with independent MC

- Obviously can check using truth for MC
- Need to develop data-driven metrics which may be used in actual experiment (eg: angular difference between track at entry and exit points)
  - Will assign responsibility later, likely a team effort
  - Mike has some ideas about data-driven metrics to consider

Summary

- We have a plan to produce a MC-based demonstration of the space charge calibration plan

- More certainty about the CRT plan would be helpful

- We have not yet produced an estimate of how long this exercise will take – will likely become clearer once we begin the work

- Suggestions and volunteers are welcome