News and Updates

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Private Citizen

Reaching Me

- lecompte@anl.gov has been shut off
  - It is not bouncing either, so one might think the email is being delivered. It's not.
- The SLAC email is in the works
- For now, the best way to reach me is Slack or Slack Direct Messages

The TMS Review

- Hiro's plan is to make this virtual – send the slides (2^7 of them) around to reviewers and then have a meeting for Q&A
  - I am willing to present them anyway, but it's 3-4 hours

LBNC Interaction

- We met with the LBNC the week before last. Showed them three relatively major updates: magnet, switch to single SiPM, and reconstruction (thanks, Mat)
  - Prototyping was shown in the context of addressing unresolved issues and not its own thing.
- They were impressed by the progress (as was I – good work, team!) and the increasing university involvement
- They had no advice on changing any aspects of the design
- They are concerned about the amount of scientific technical effort we have
  - So am I
  - It is particularly acute in effort on big heavy things: magnet, steel plates, support structure, etc.

Overall Schedule

- Chris Mossey mentioned a delay of “up to 48 months” in his talk last week – what is the TMS impact?
  - We don’t know. This is based on a very, very high level schedule and we’re still working on the details.

- My priorities are the same as they were:
  - 1. Give ND-GAr/ND-GAr(Lite) as much time as we can to let them find the necessary resources
  - 2. Finish and install the TMS as early as possible so we are out of ND-LAr’s way.

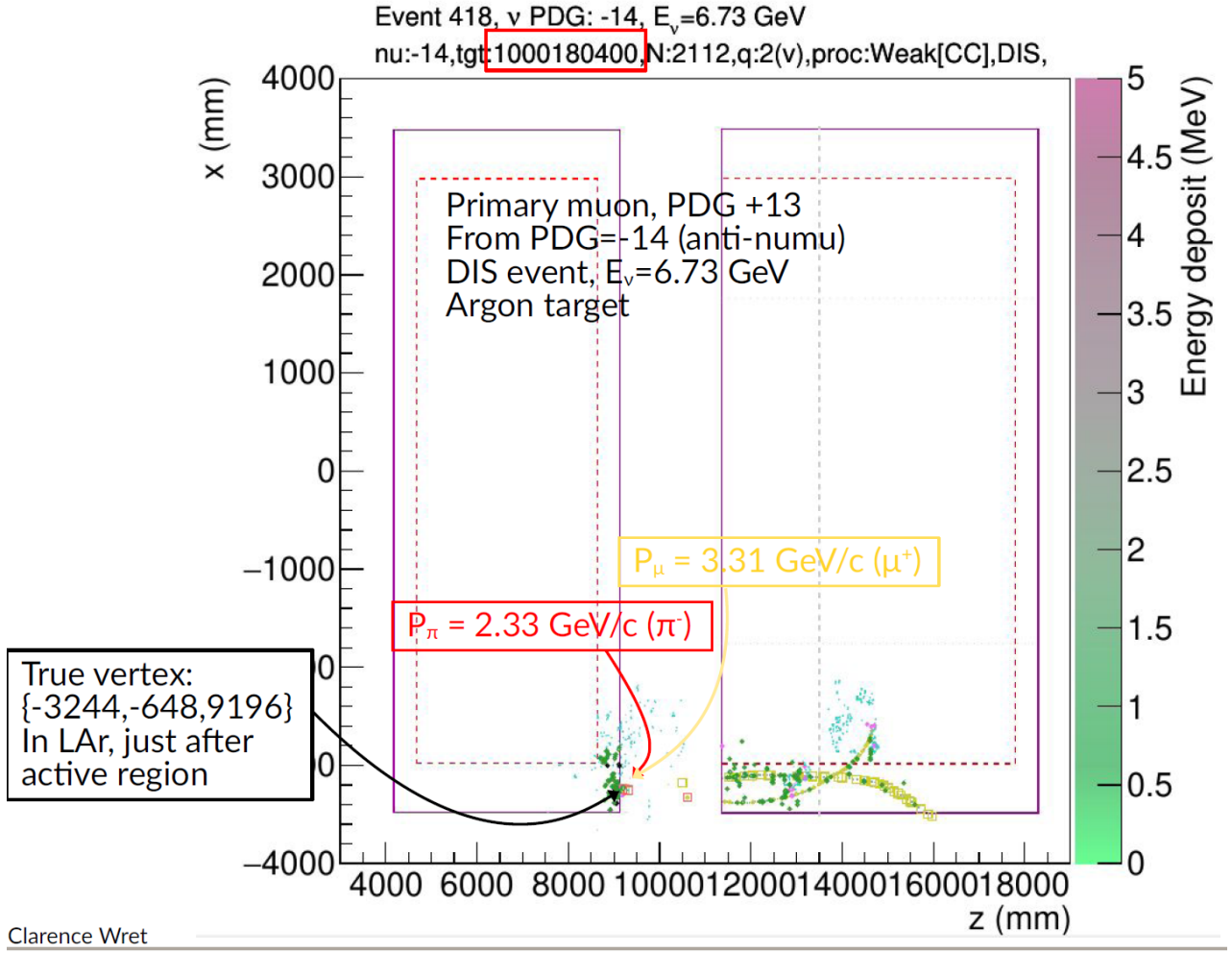
- These are somewhat in tension, and in any event have to be considered within global priorities

- We may turn on with some odd configuration nobody really wants as we finish things up. The weirdest one I came up with was TMS + unmagnetized SAND. (If we were waiting on cryo, for example)

Clarence's Event

- Clarence Wret Event is a anagram of Center Newt Cleaver
- Event 418 in `/pnfs/dune/persistent/users/marshalc/LArTMSProductionJun23withLArCV/edep/FHC/00m/00/neutrino.0.edep.root`
- Two muons in the event
  - Primary muon is a 3.3 GeV μ^+
  - There's a second muon in the event, from the decay of a 2.3 GeV π^+ in the gap.

Let's take a ~~better~~ worse look.

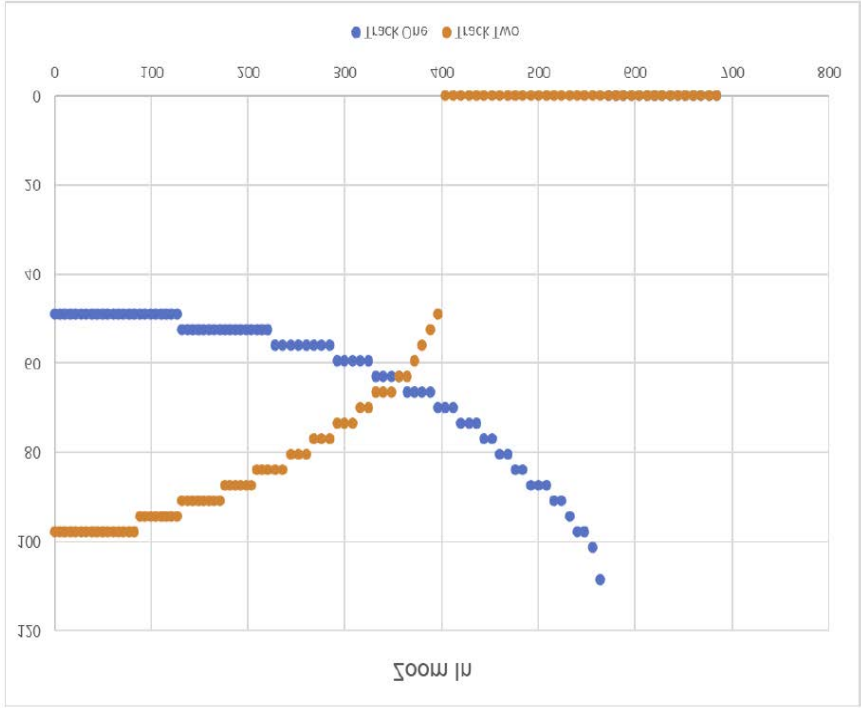


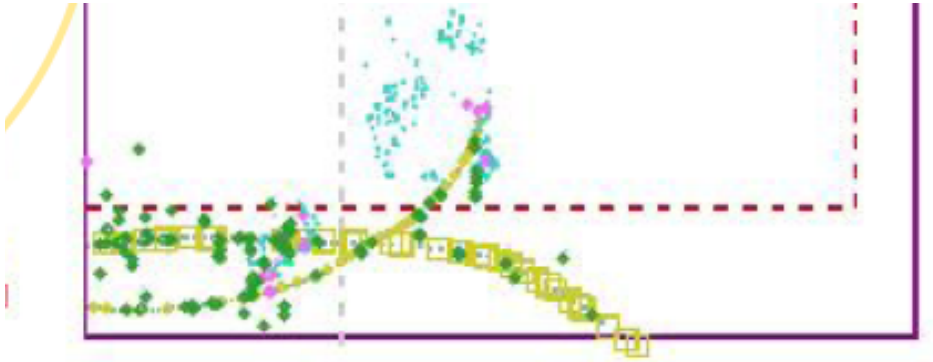
An Event Like Clarence's Event

- A tried to quantize the previous event "by hand" – drawing 100 rectangles in PowerPoint. Bad idea.

- This is a different event, using my Excel tool, with the same kinematics.
  - Unsurprisingly, it looks similar
  - Sorry about the rotation * reflection

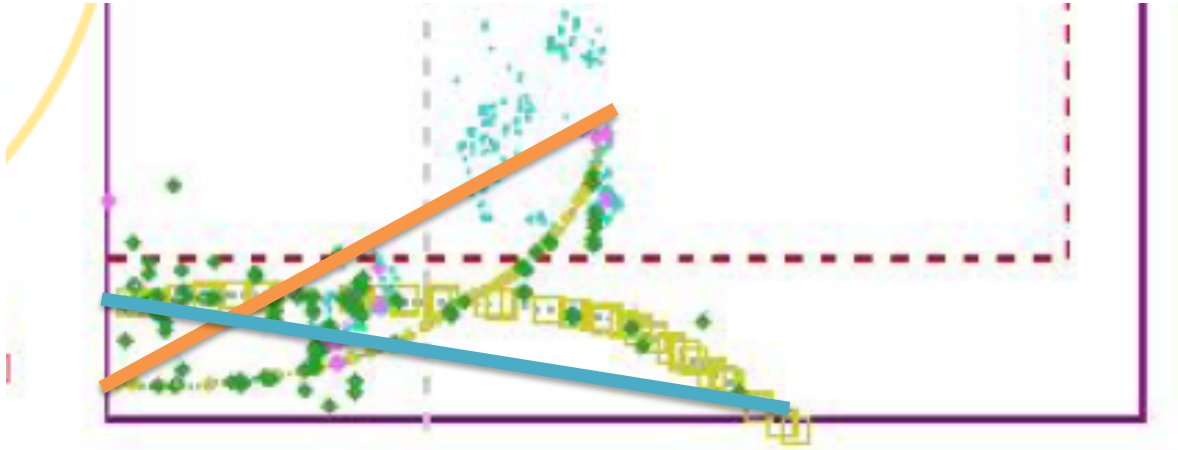
- Counter quantization is not a show-stopper here.



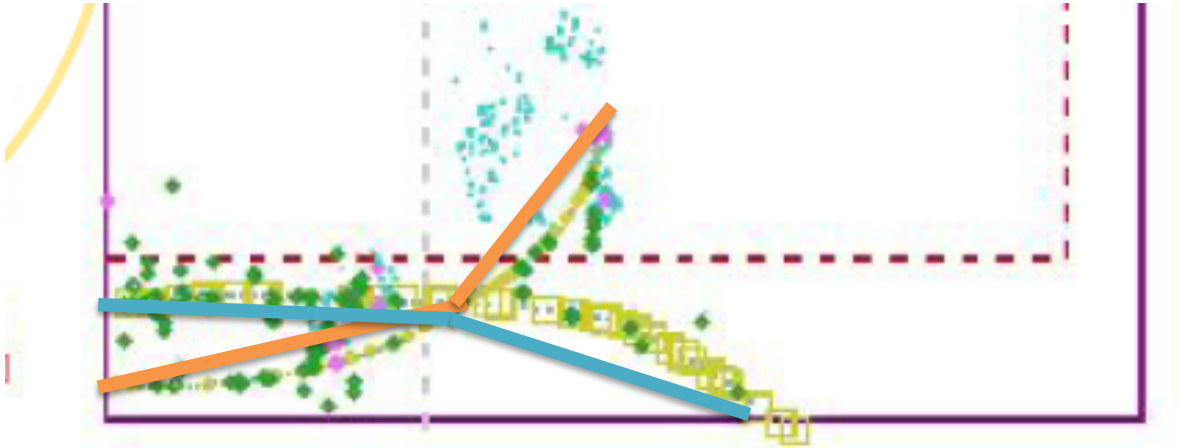


Charge Identification

- Tracks have opposite charge and they have opposite curvature. Just like they are supposed to.

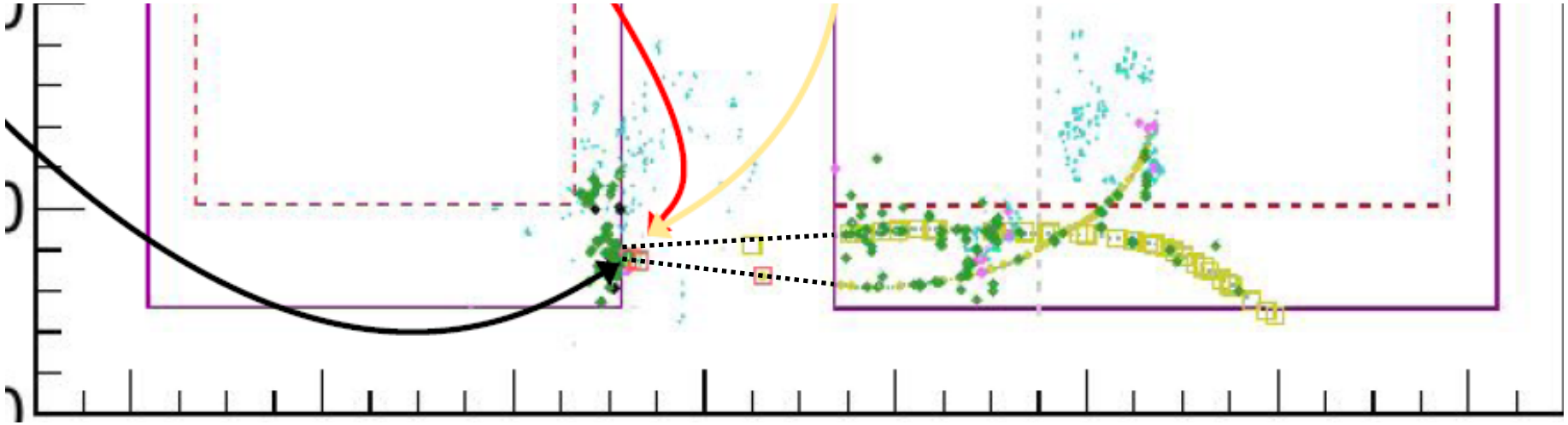


- If the tracks get split at the intersection point, the four half-tracks still have the right curvature and can be matched
  - However, the charge identification for short, energetic tracks is not so good.



Projecting Back

- Extending either muon track into the argon gives a plausible solution consistent with the vertex
- This is accidental for the decay in flight muon – but sometimes it happens



Why Do I Care?

- So what if there are two muons? We identified them both, and got the DIS one correct.

- What if this were a NC event?
  - We'd call it a CC event (and a $\bar{\nu}$ to boot)
  - This messes up our understanding of beam composition
  - This also messes up any measurement of $\sin^2 \theta_W$ we might want to do.

- What handles do we have?
  - Look at the vertex z in LAr: pions are less penetrating
  - Look at the μ charge ratio: DIF is more democratic
  - Look at TMS muons entering from very wide angles

This is an area where physics needs impact detector requirements. It would be good to get a better handle on this.

(Yes, I am suggesting a study)

More on Back Projection

- Uncertainty on track projection depends on several factors
  - Position uncertainty from counter width (W = 3.5 cm)
  - Projection uncertainty from the track fit – proportional to W
    - Extrapolation distance comparable to track length → projection comparable to W
  - Multiple scattering exiting LAr
    - Requires full simulation, but ballpark number is a few centimeters
  - Multiple scattering entering TMS
    - Also requires full simulation, but ballpark number is a few centimeters

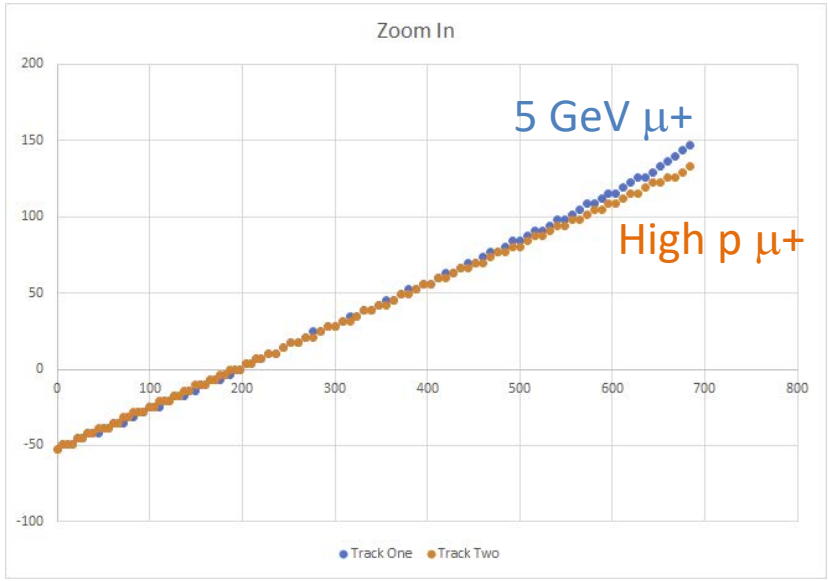
- This is complicated by the fact that we track in u & v, but the multiple scattering is direction-agnostic.
  - Projection in y will be worse than x

The short answer is that we can expect the TMS can back-track to identify vertices, but not identify individual tracks.

The long answer will take simulation.

TMS Momentum Range

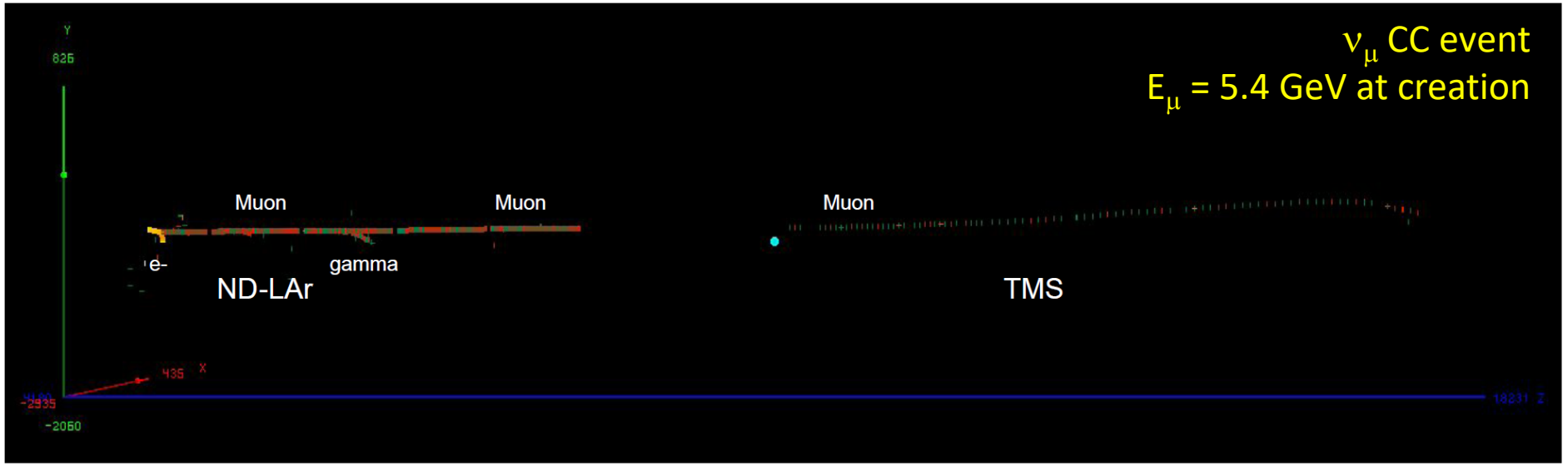
- Last week's DUNE meeting made clear to me that there were some misconceptions on what the TMS momentum range is. So, from first principles:
  - The TMS has the equivalent thickness of 3.2m of iron – 3m iron, 1m scintillator, Al covers…
    - This ranges out muons up to about 5.0 GeV (dE/dx = 1.57 MeV g^{-1} cm^2, from Groom et al. We are slightly (8%) above minimum ionizing since we are slightly on the relativistic rise.
    - This is where the **nominal 5.0 GeV** comes from
  - On top of this we have
    - An additional 500 MeV obtained from where the track starts to curve
      - We can tell 5 from ∞ but probably not 5½ from ∞
    - An additional 0-1.2 MeV from dE/dx in the liquid argon
    - An additional 0-800 MeV from the geometric secant(ψ) factor



- So the nominal 5.0 GeV is actually a **range between 5.5-7.5 GeV**
  - Probably the most representative number is 6 GeV
  - It's a soft turn-off and not a cliff
  - There is a "bad spot" for high momentum tracks dead center.

TMS Event Displays

- Also shown at last week's meeting (by Herilala Soamasina Razafinime, Cincinnati) was this:



- I really like this – it shows the idea(s) behind TMS in a single picture
  - It would be a good figure for the TDR, various talks, etc.
- Things I would change:
  - More visible TMS hits
  - A more typical event – lower energy and more centered in the argon TPC

Questions?