2x2 Chicago Meeting

February 26, 2024

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Agenda

1. Paper Update
2. Update on impact of dead space between modules
3. Update on physics advantages of 3D reconstruction

2x2 Paper Update

Link to Overleaf Draft:
https://www.overleaf.com/8458358216drvhjgctvqpr#7b24bd

Status:

- General Structure Forming
- emailed Callum and James at LBNL: no response
  - Will send follow-up (on Slack)

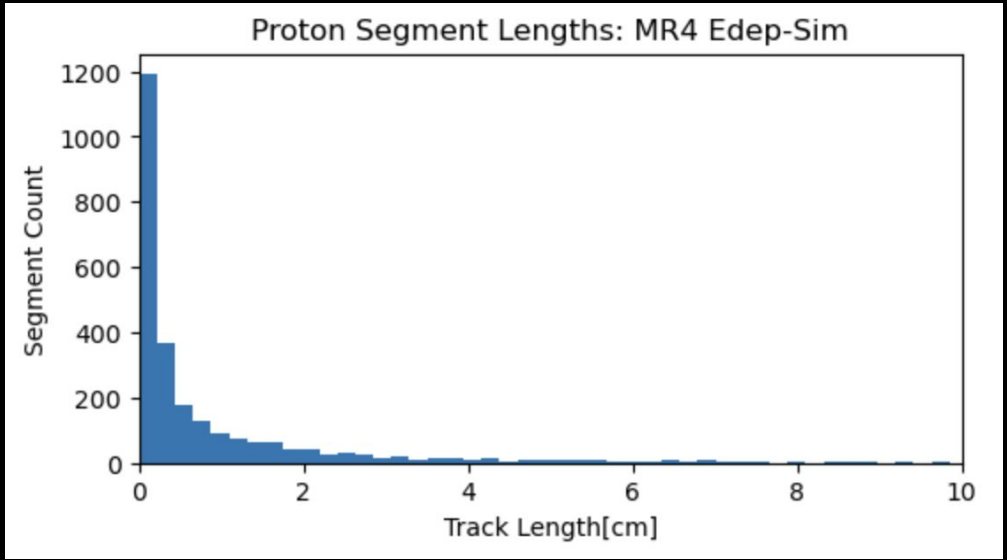
To Do:

- Establish plan for **2 complimentary papers**
  - **1st** is 2x2 first events: simple, released immediately (we lead)
  - **2nd** is detailed technical paper with more complex analysis (they lead)

Dead Space Between Modules: n-LAr XS

Main Issue: **Losing proton tracks**

- **Proton is the main topological identifier for event**
- **Tracks will be short**



Dead Space Between Modules

Zach Hulcher:

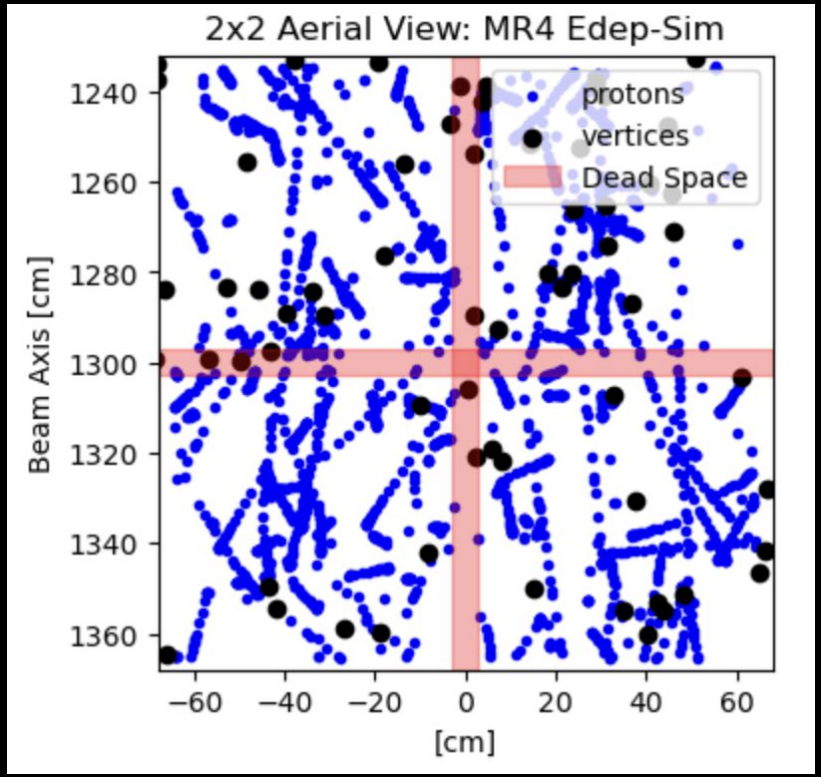
- 5cm dead space

“Vertex” = vertex of a ν interaction

“Proton” = energy dep. hit from proton

In 1 edep-sim file:

- 2.50% protons in dead space
- 13.46% vertices in dead space
  - Can mitigate w/ muon track or fiducial cuts



Dead Space b/w Modules: ν-Ar Cross Sections

Implications near dead space:

Lost hits in/near dead space:

a. Incomplete dE/dx
b. Could mess with Particle ID
c. Can't match between vertex and decay/scattered neutral daughter

Solutions:

1. Restrict fiducial volume for accepted vertices to center of module
2. Improve TPC-to-TPC matching

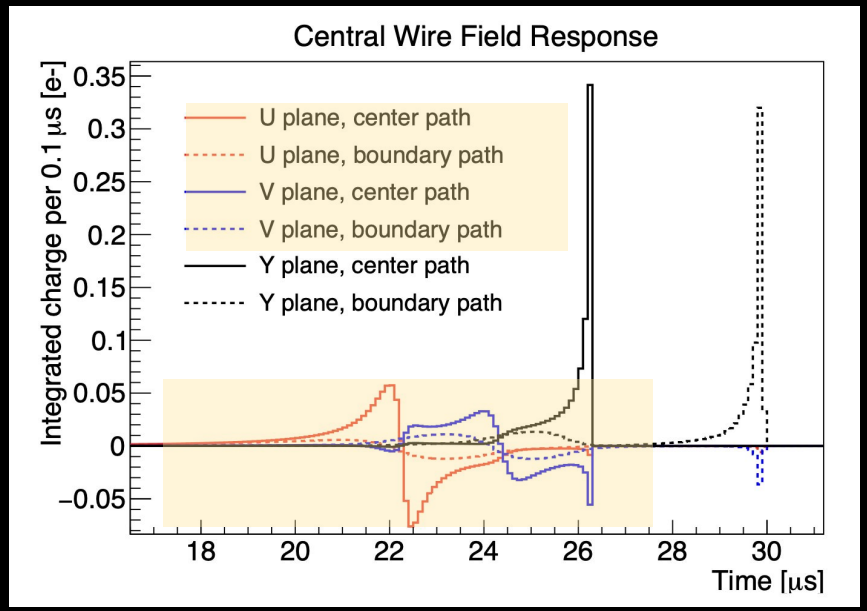
Advantages of 3D Reconstruction

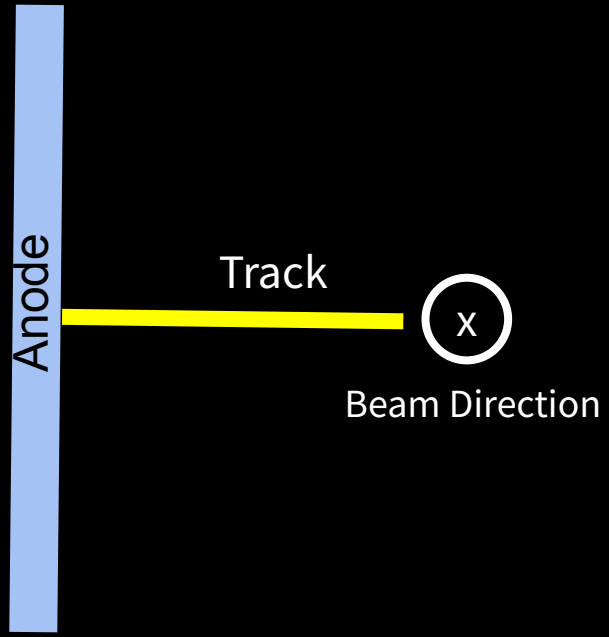
Three main cases where 3D reconstruction >> 2D reconstruction:

1.) Tracks roughly perpendicular to anode plane
2.) Tracks roughly parallel to the anode plane and nearly parallel to wire orientation
3.) Instances of high pileup

3D Reco: Perpendicular Tracks

- Induction plane bipolar signal → signal cancellation for high inclination tracks
- Thus, charge extraction on induction planes is often inefficient in these cases

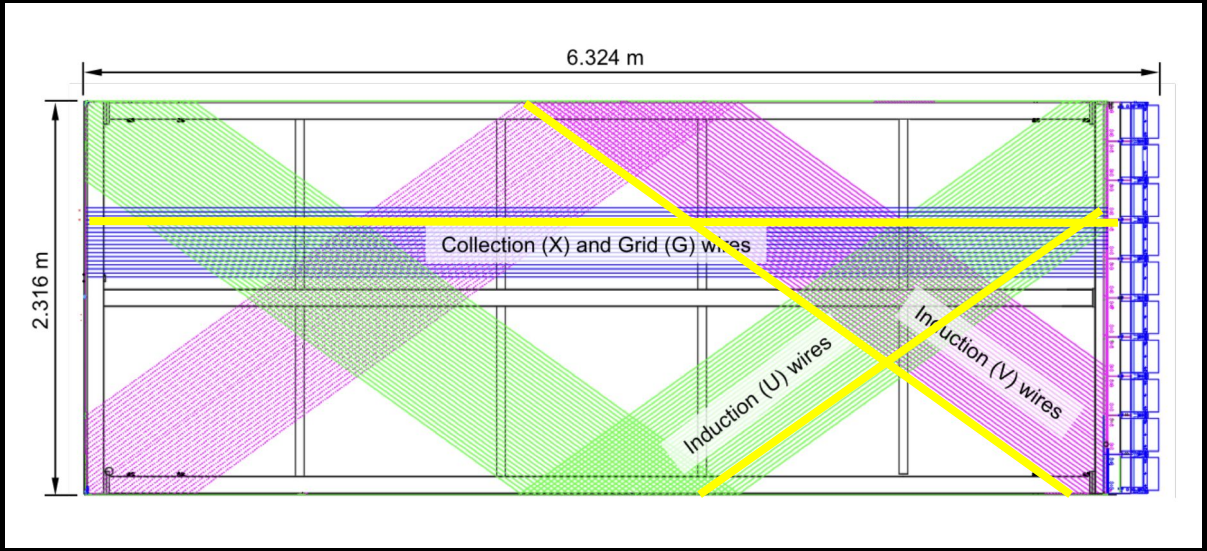




arXiv:1802.08709

3D Reco: Parallel Tracks + High Pileup Regions

True signal location can be obscured in events with high pileup or tracks parallel to individual wires



** Modularity will also improve reconstruction in high pileup environments **

arXiv:2007.06722

Advantages of 3D Reconstruction

Overall, events where daughter particles have either very high or very low transverse momentum are most improved with pixel-based vs. wire-based readout

Unresolved Issues with Pixel-based Readout

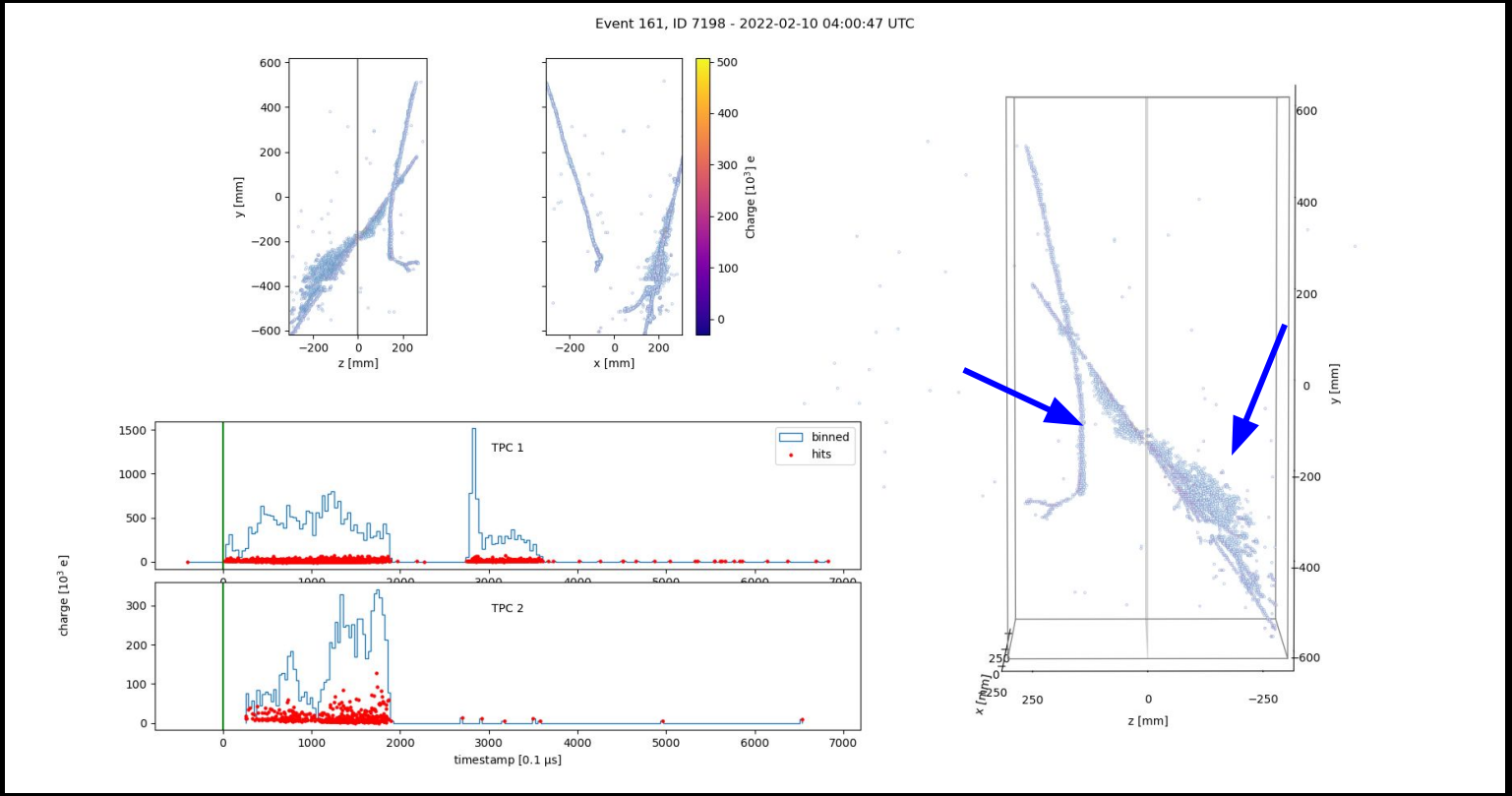
Currently, pixel-based readout has its own challenges:

1.) Shadowing/lobing channel pre-triggers
2.) Vertex blurring
3.) Non-physical pre-trigger gap (hit “fuzziness”)

These effects are currently under investigation …

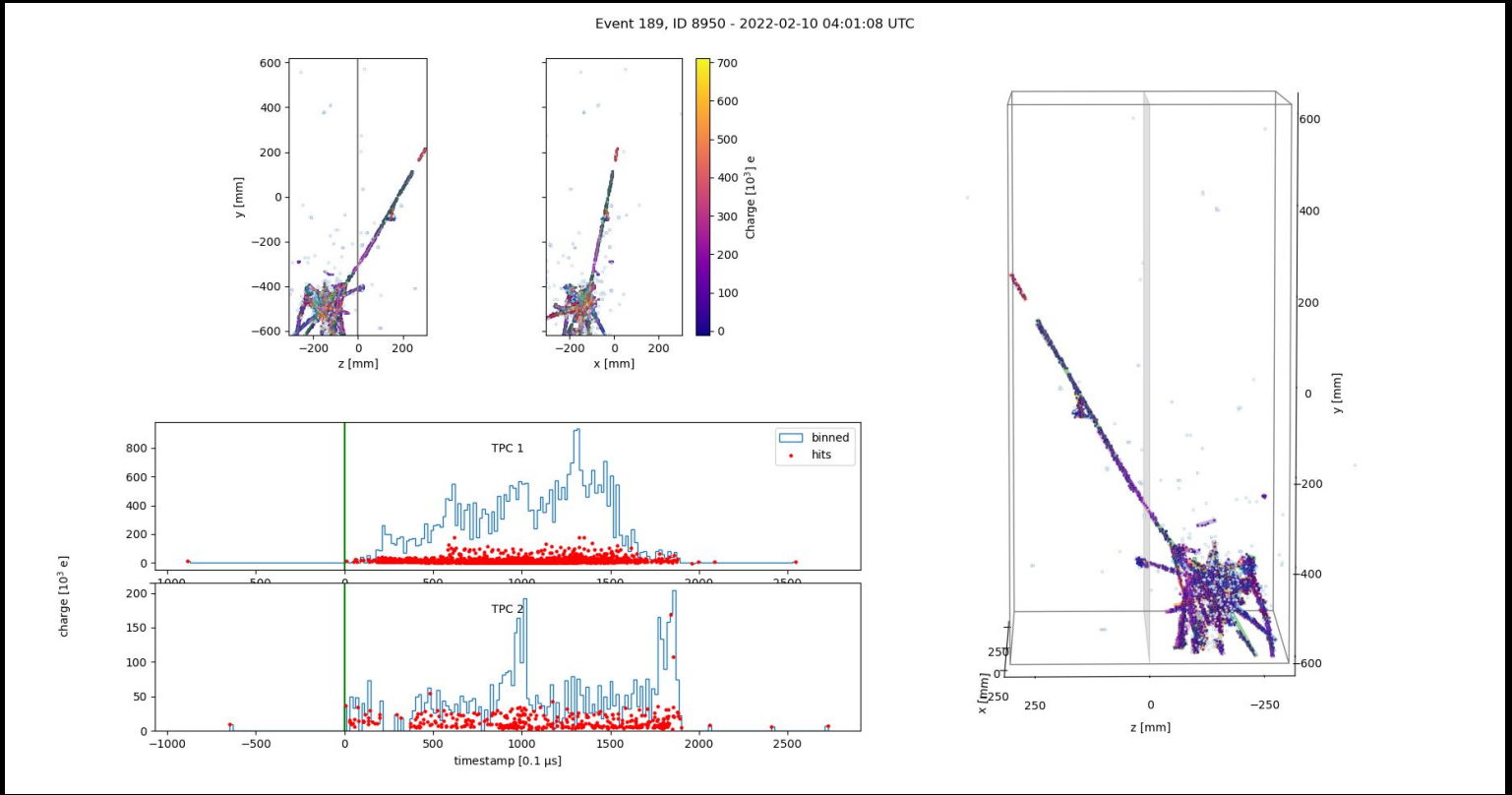
Unresolved Issues with Pixel-based Readout

Shadowing/Lobing



Unresolved Issues with Pixel-based Readout

Vertex Blurring



Unresolved Issues with Pixel-based Readout

Non-physical pre-trigger gap (hit “fuzziness”)