

Update on 3D reconstruction

2024-02-28

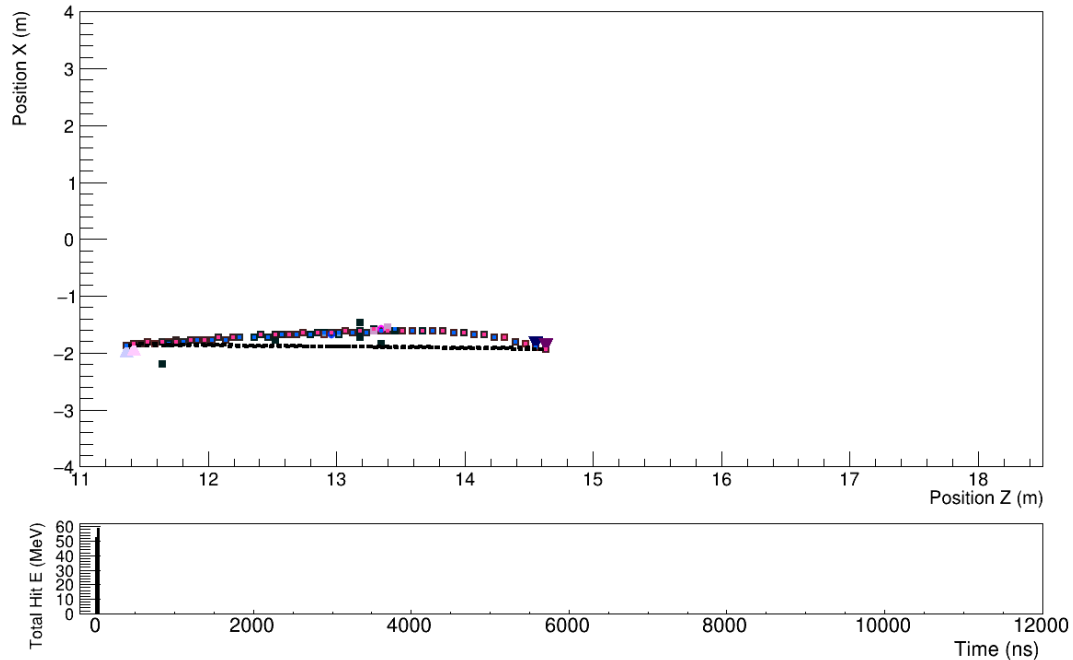
Asa Nehm





Reminder: Last status

- Looked into different issues in 2D reconstruction
- Fixed issues with 'missing' hits at end/start of tracks → extrapolation





Towards 3D matching

Initial idea for matching

- Match ends of tracks if close enough (space + time)
- Put all hits of both tracks into one new
- Optional
 - Add adjacent hits to new track?
 - Combined 3D line from Hough transform or calculate from combined lines?
 - Kalman filter?





Towards 3D matching: Refine plan

Idea for matching

- Match ends of tracks if close enough (space + time)
- Put all hits of both tracks into one new

~~Optional~~



Not for now

- ~~- Add adjacent hits to new track?~~
- ~~- Combined 3D line from Hough transform or calculate from combined lines?~~
- ~~- Kalman filter?~~



Towards 3D matching: Refine plan

Idea for matching

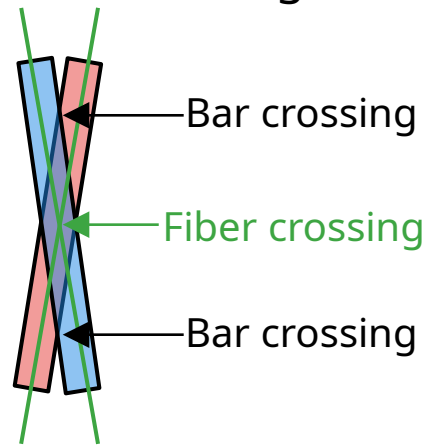
- Match ends of tracks if close enough (space + time)
 - **Close enough at start and end:** ± 1 plane number(!) and within 10 bars
 - **Close enough in time:** in same time slice and within 30 ns
- Put all hits of both tracks into one new
 - Copy hits from both tracks into **new 3D track class** (\rightarrow Liam)
 - Can contain: hit positions, start hit, end hit, direction of track, length of track, energy deposit, energy range, time
 - **Calculate y coordinate** per plane number pair (if possible, handle exemptions)





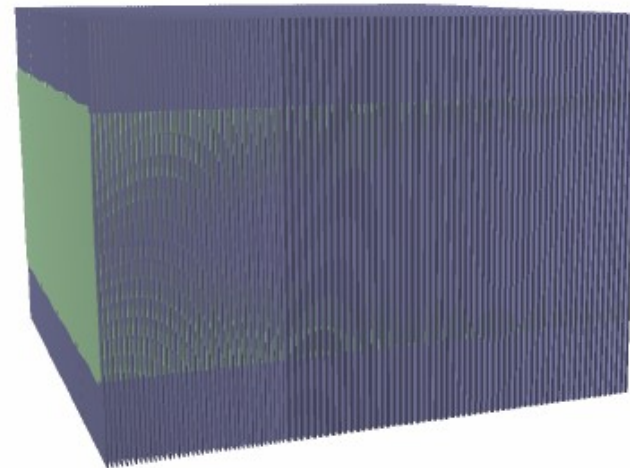
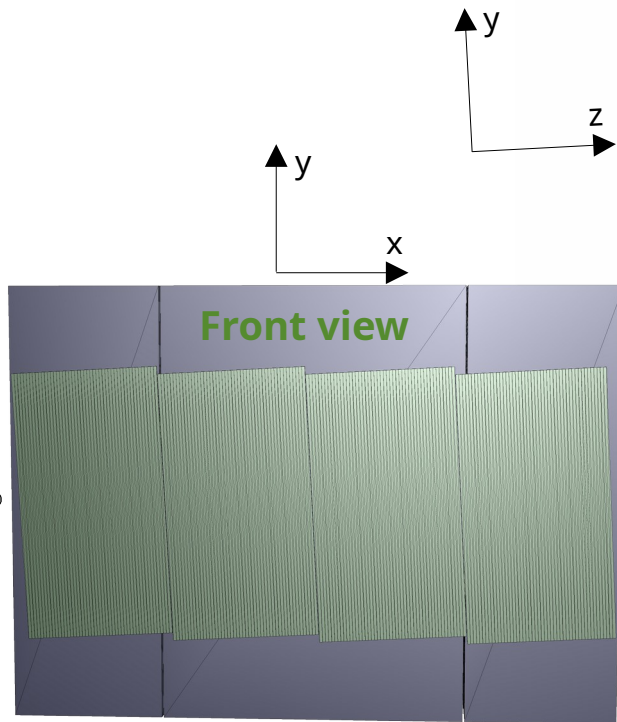
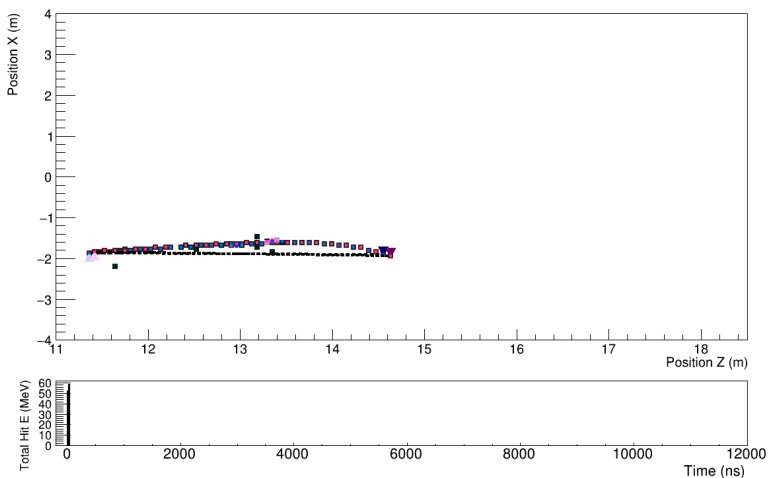
How to calculate y coordinate?

- Layers are tilted against each other by 3°
 - Use x position of the hit scintillator bars \rightarrow calculate geometry y position
 - $y = \text{'Anchor point' in } y - \frac{1}{2} \tan(90^\circ - 3^\circ) | X_{\text{bar1}} - X_{\text{bar2}} |$ (fiber crossing)
- The true hit can be anywhere in the crossing area though
 - From fiber crossing to top of bar crossing: ~ 34 cm \rightarrow uncertainty



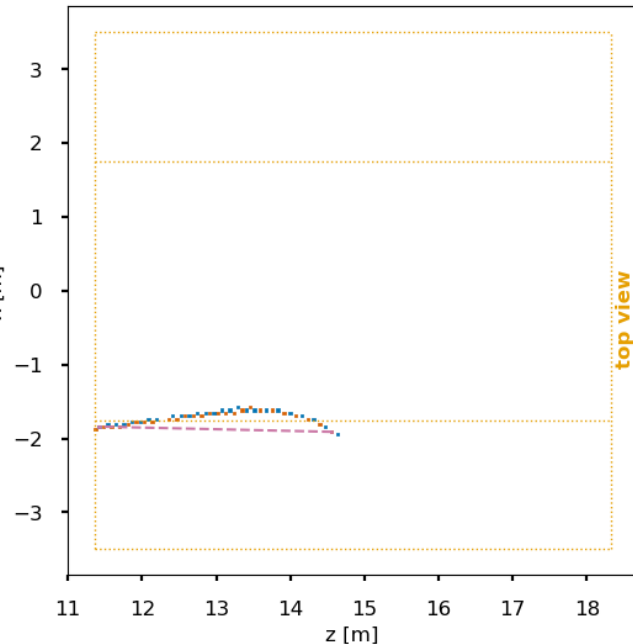
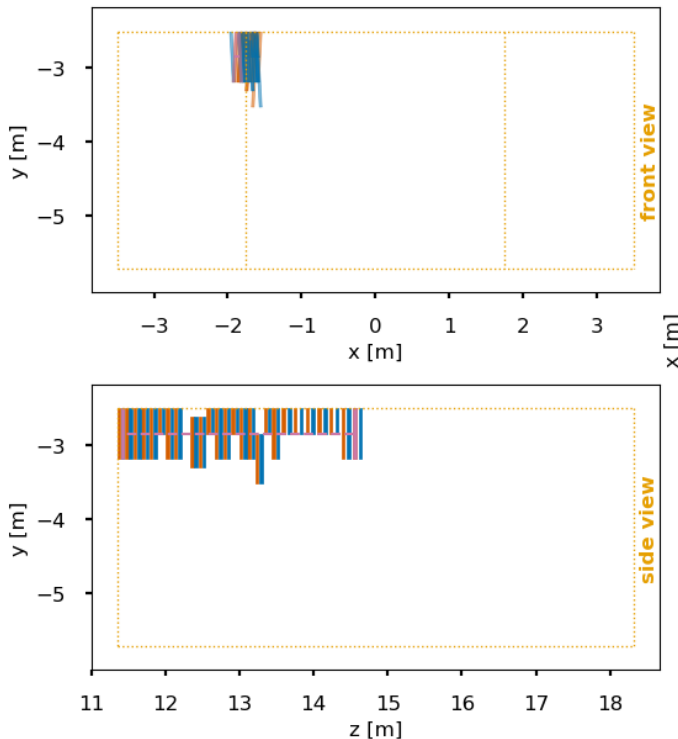
How to display this now?

- Event display so far only takes x and z coordinates
- Need to develop new event display for 3D tracks



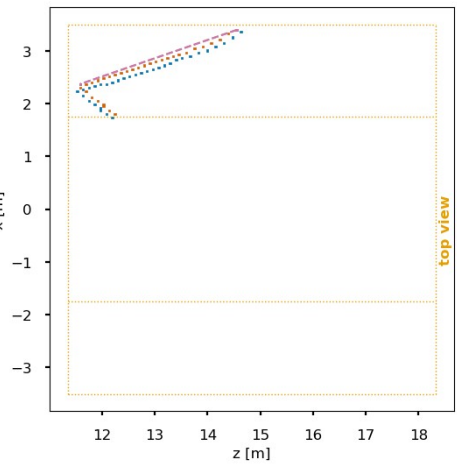
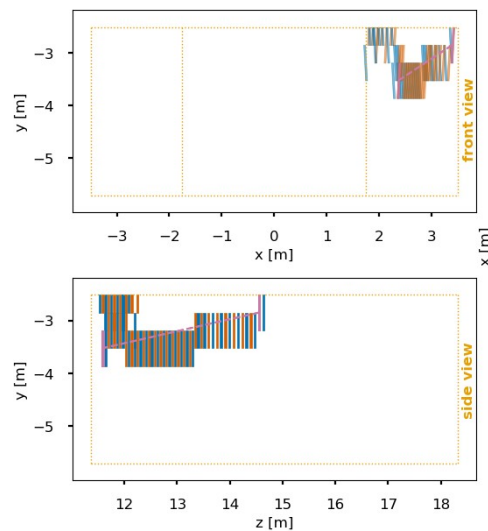
2D projections of the 3D tracks

- Display **hits** in the **size** that they actually are
 - add in **air gaps** between steel and scintillator for visible hits
- Use **uncertainty** of hit position **in y** for hit areas
- Different **views in scale**



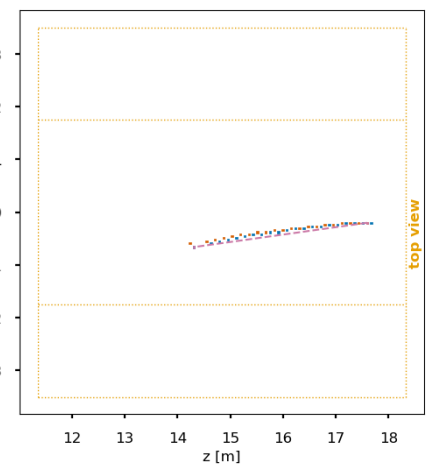
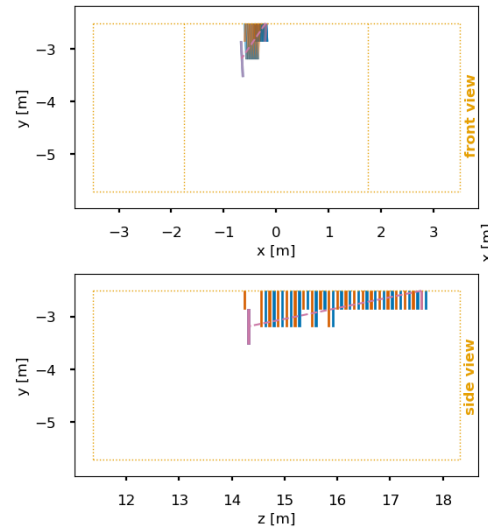
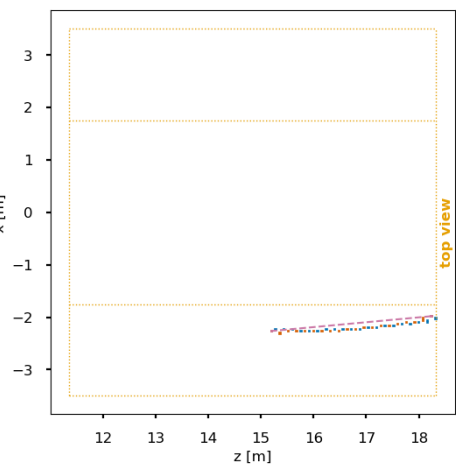
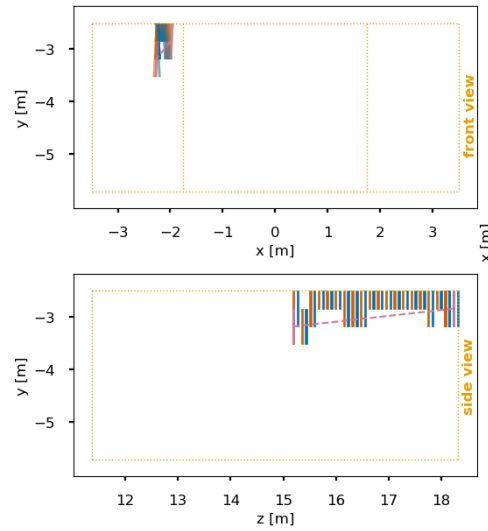


More examples



Need to **check** that everything is **correct** now

Then make **pull request** in dune-tms to merge `nehm_3D_reconstruction` branch onto main





Updates from others (studies meeting)



New people (both only got started)

- **Kate Hildebrandt** (PhD student)
 - Reco track matching with CAFs between ND-LAr and TMS
 - Supervisor: Andrew Furmanski
- **Magnus Handley** (PhD student)
 - Generating different detector geometries
 - Supervisor: Melissa Uchida



Time of studies meeting changed to Friday 11am CT



Update from Sushil on magnetic field simulation

- Study of muon behavior in the following cases
 - Standard magnetic field (1T)
 - Magnetic field when it is switched off
 - Mag field map: In this particular case → make smaller magnetic map field files and study muon's behavior
- Trying to answer
 - Muon resolution vs. true muon energy
 - Muon sign selection purity vs. true muon energy (started on)
 - Muon resolution vs. true muon angle