

# ML reco: 2x2 simulation results

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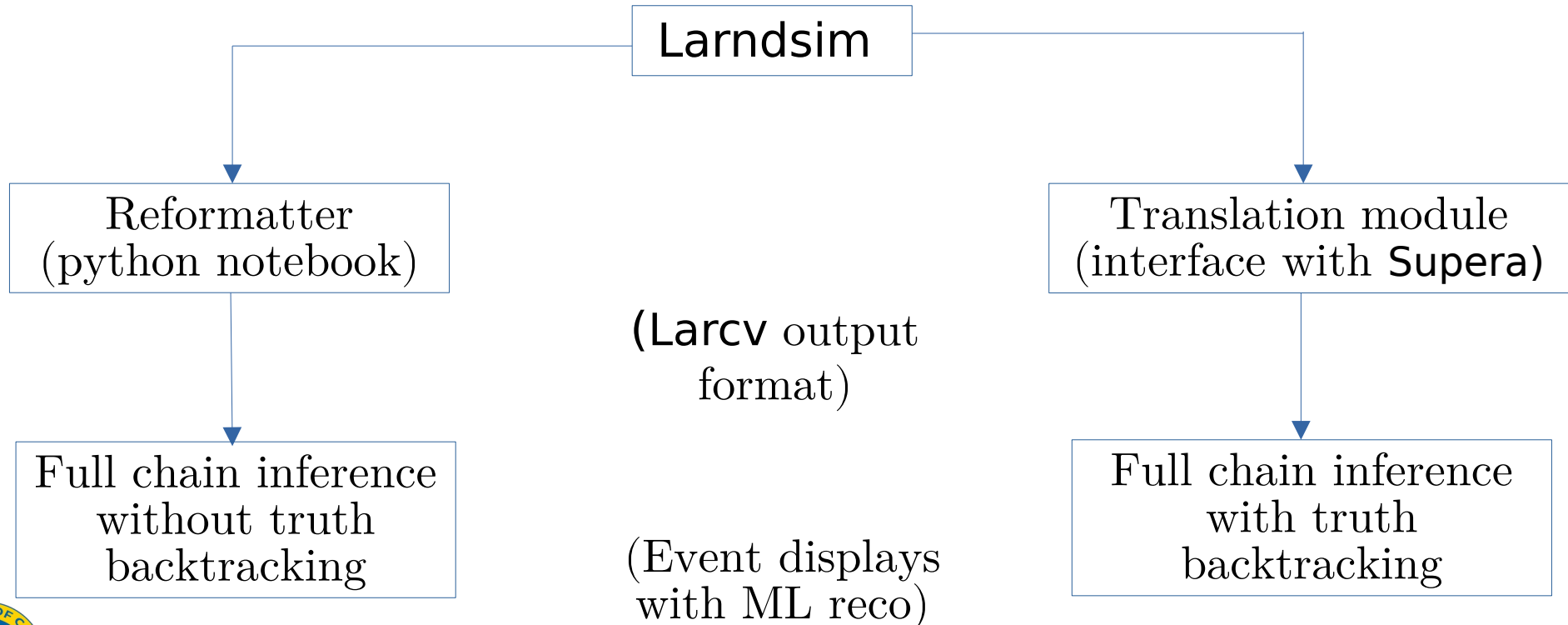
2x2 analysis workshop | 20<sup>th</sup> January, 2023



# ML reco workflow

Current – temporary solution

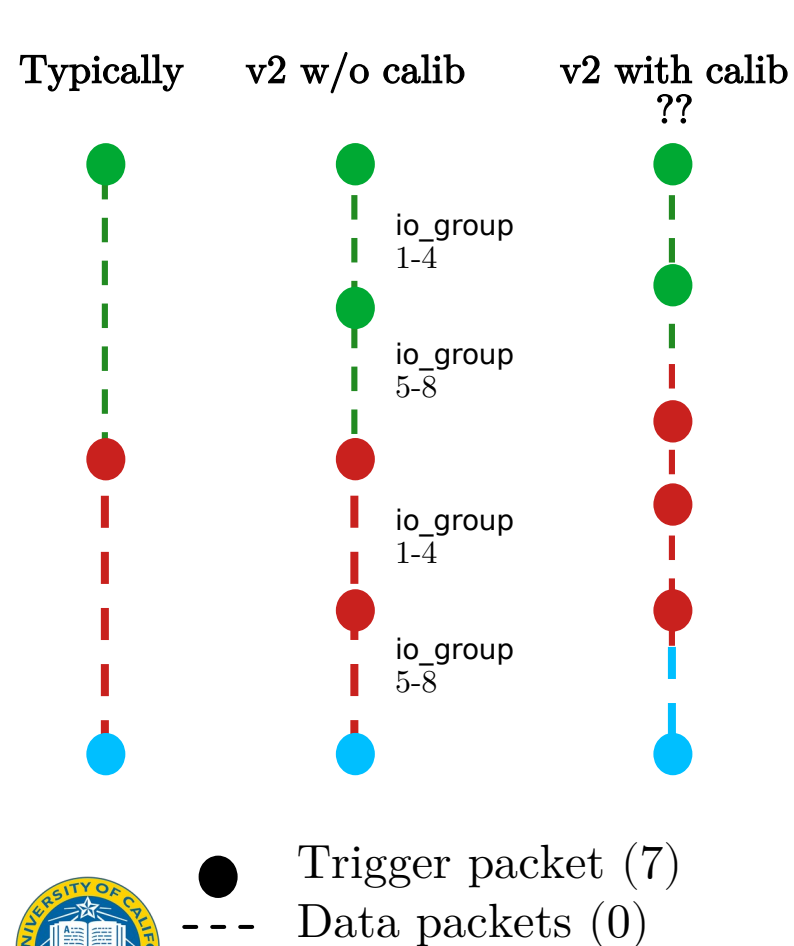
Future – permanent solution  
👉 this close to being ready



Note: ML reco still trained on edep-sim



## Event division in the reformatter/ translation module

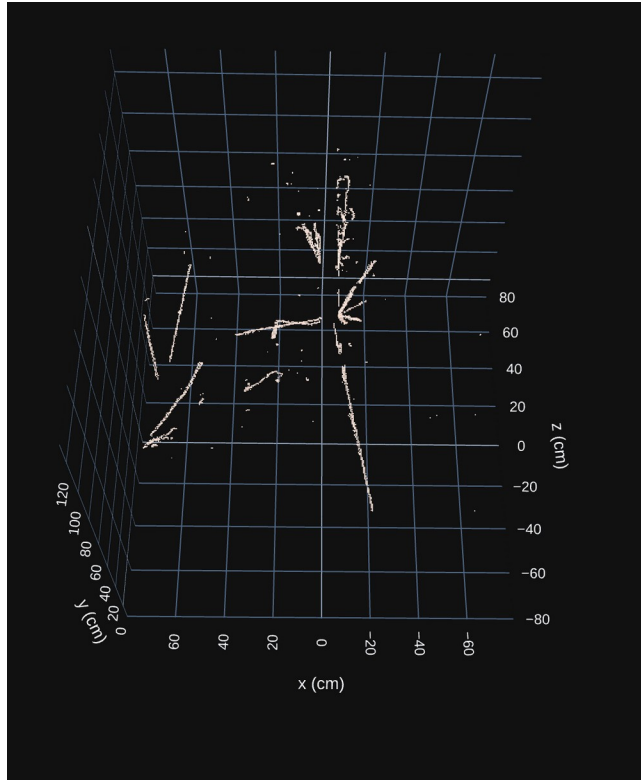


- Typically events are divided at the reco level based on trigger packets (left-most).
- Previous version of the file had a similar structure but double the amount of triggers due to io\_groups separation (middle) → events divided based on trigger packets + io\_group
- The latest version has a pattern of trigger + data packets that I don't understand (right-most). For now, events divided based on timestamps, data packets from a single spill are closer in time.
- Event division at reco level not needed anymore with the newly calibrated file since the events are already divided at the **larndsim** stage.  
To-do: modify reformatter/ translation module to accommodate this change.
- Event displays in the following slides are from the latest version (calibrated with truth info)

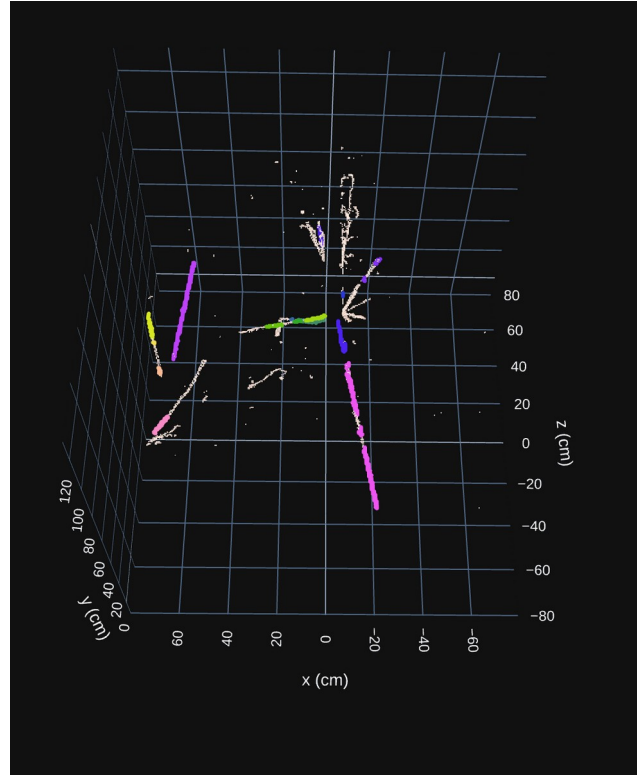


# Event display – event 0

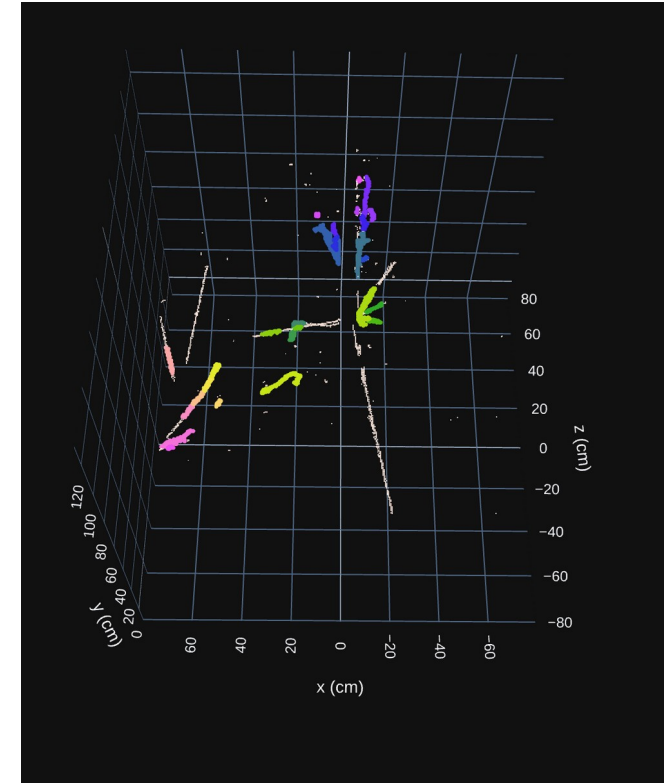
Energy deposits



Regrouped tracks

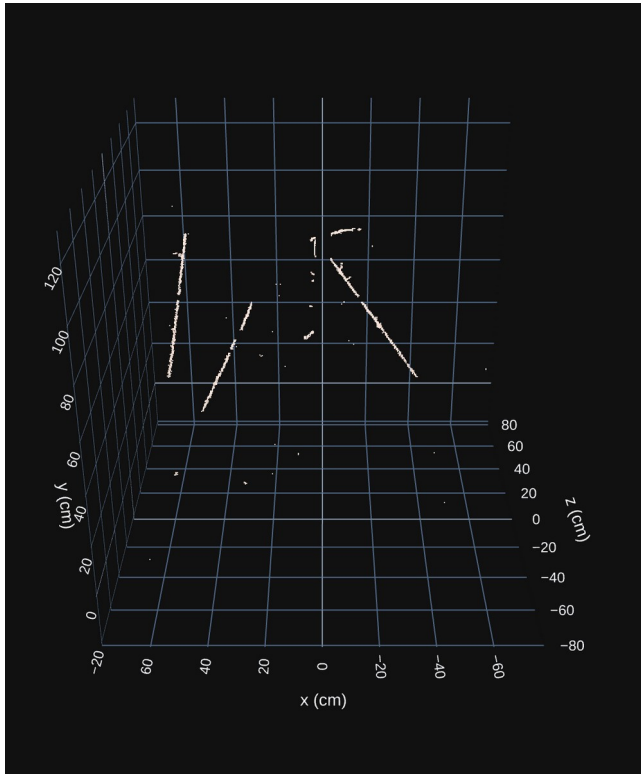


Regrouped showers

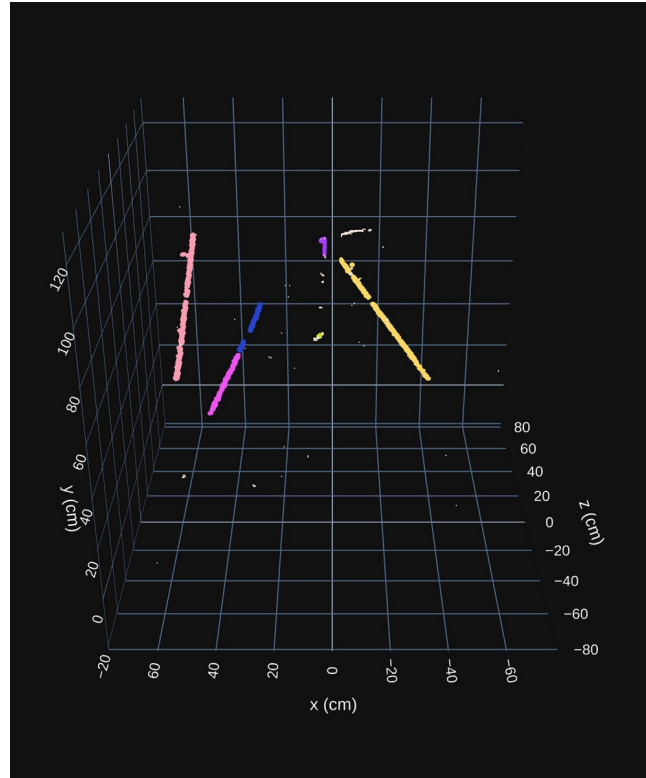


# Event display – event 1

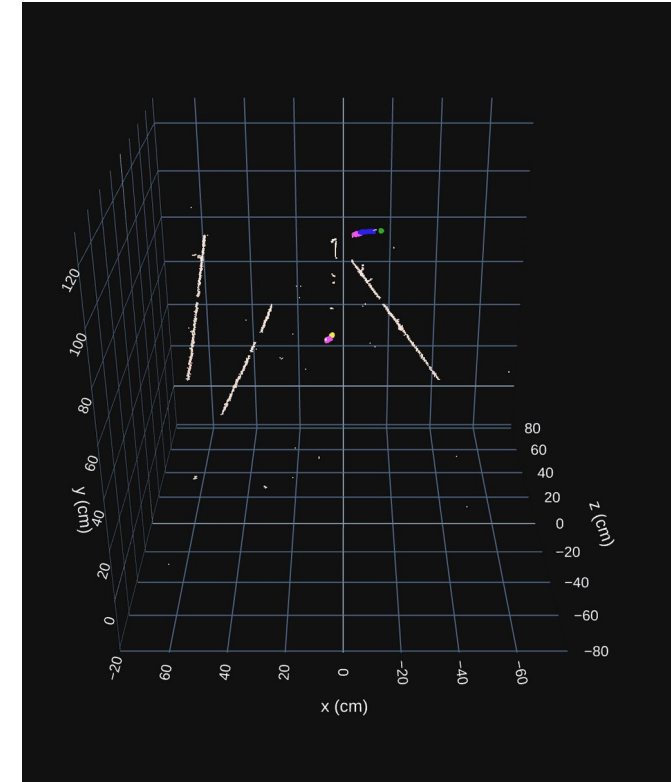
## Energy deposits



## Regrouped tracks

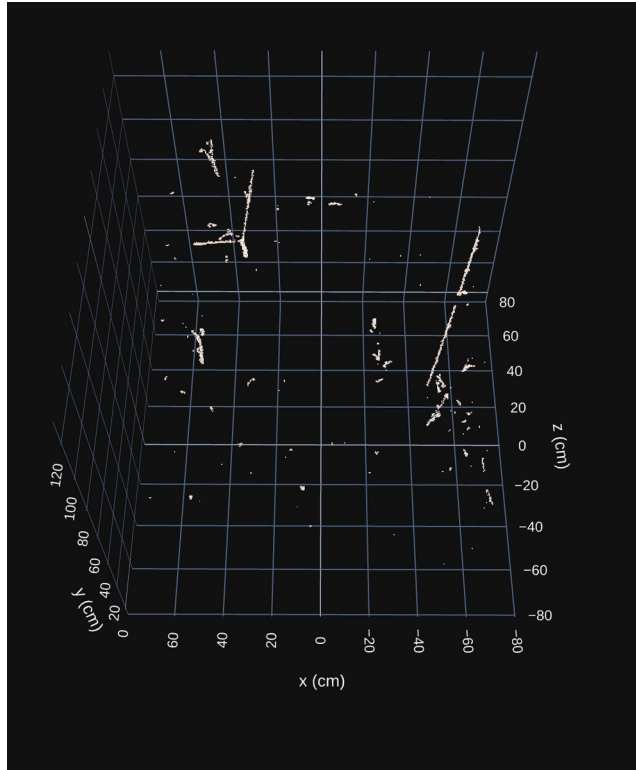


## Regrouped showers

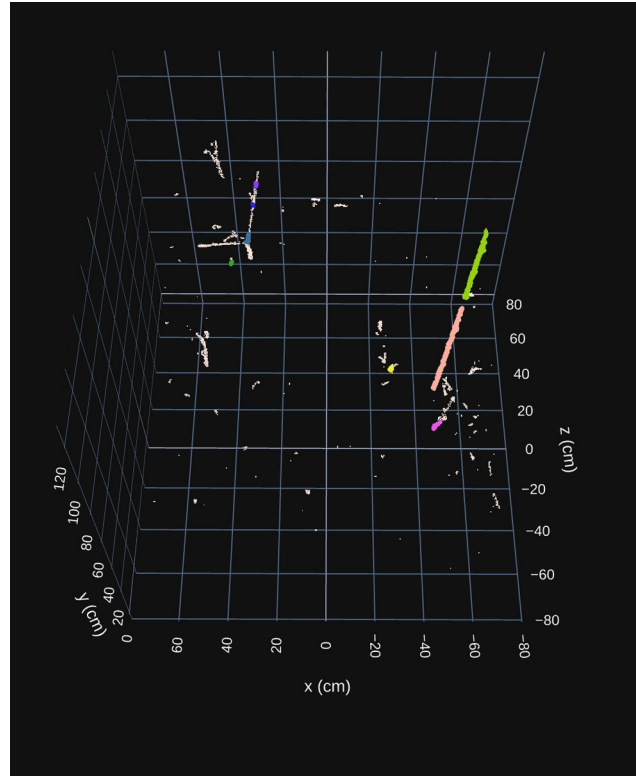


# Event display – event 2

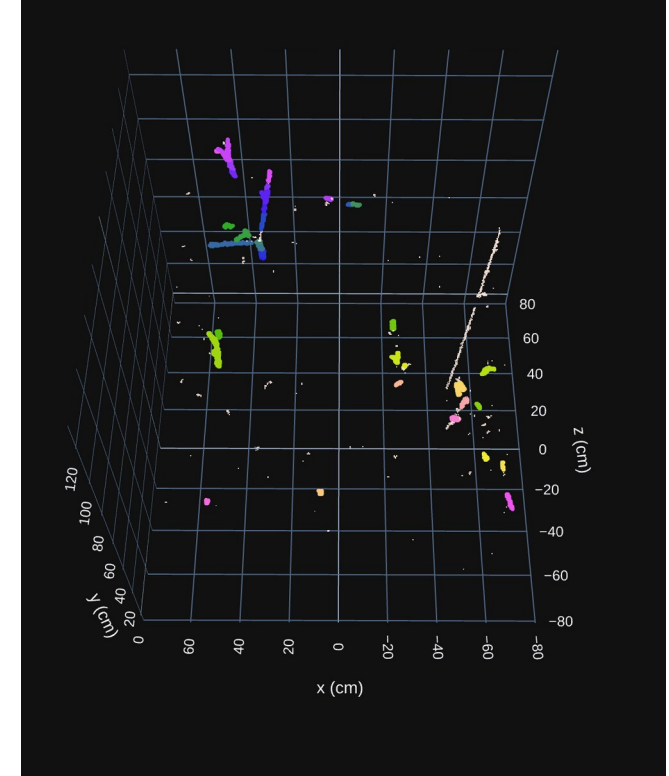
Energy deposits



Regrouped tracks

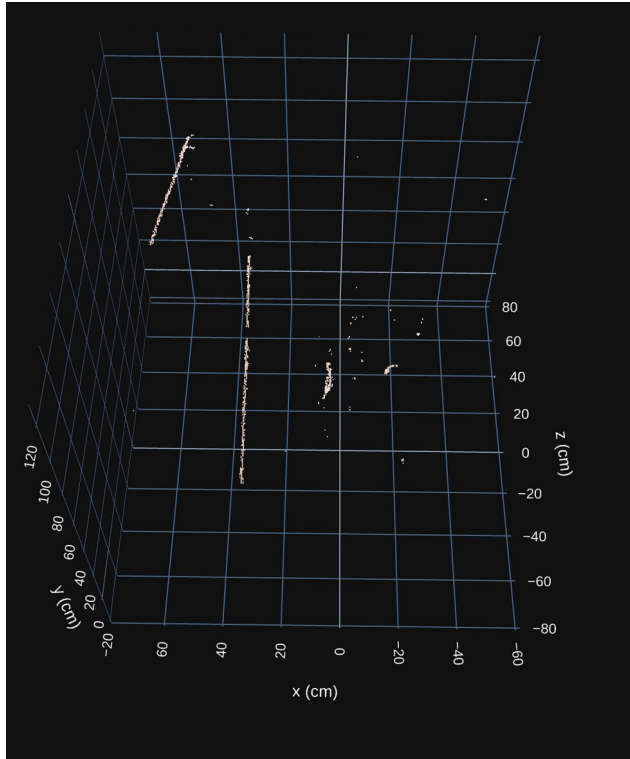


Regrouped showers

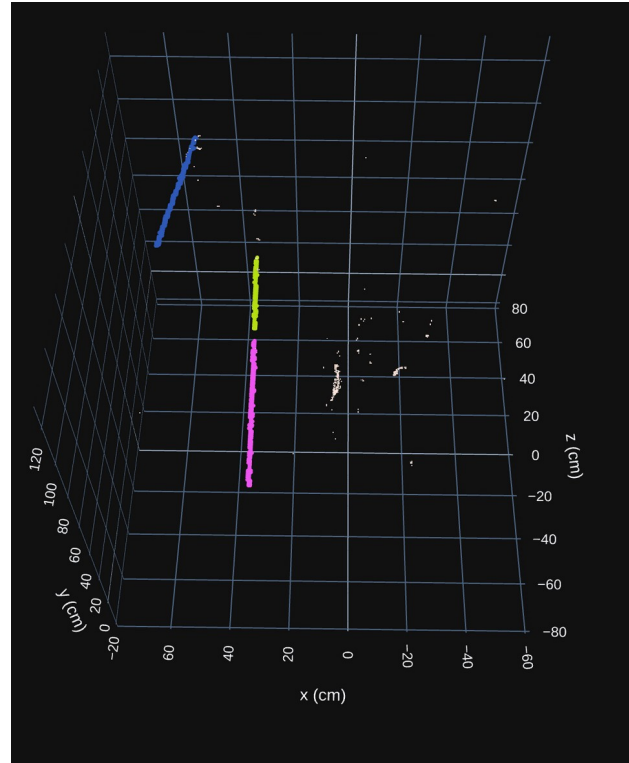


# Event display – event 3

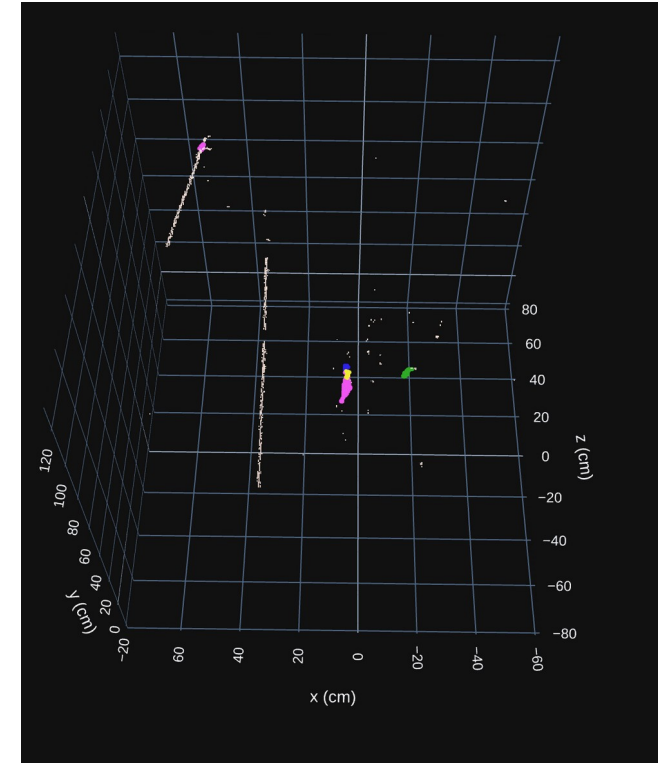
Energy deposits



Regrouped tracks



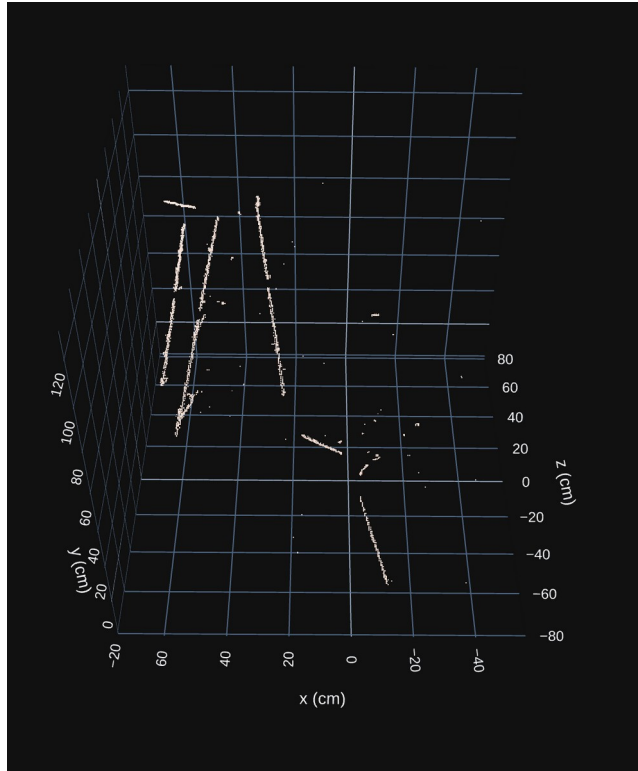
Regrouped showers



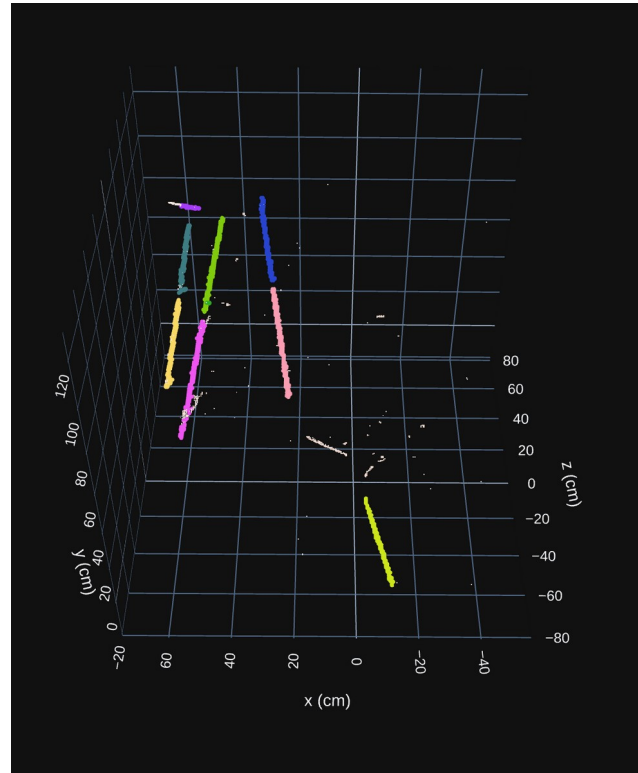


# Event display – event 4

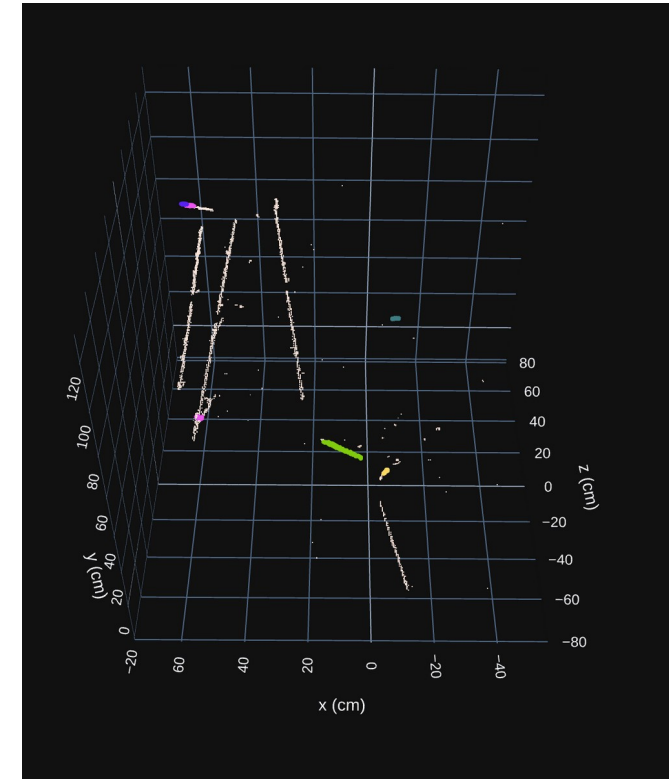
## Energy deposits



## Regrouped tracks



## Regrouped showers





# Progress with issues

## 1) Timestamp issue in older versions → fixed now!

time < event trigger time → weird x values (around 5-20% of packets)

## 2) Event division:

The issue is that the trigger packet structure is different in different versions. Not needed anymore at reco level due to the new calibrated version.

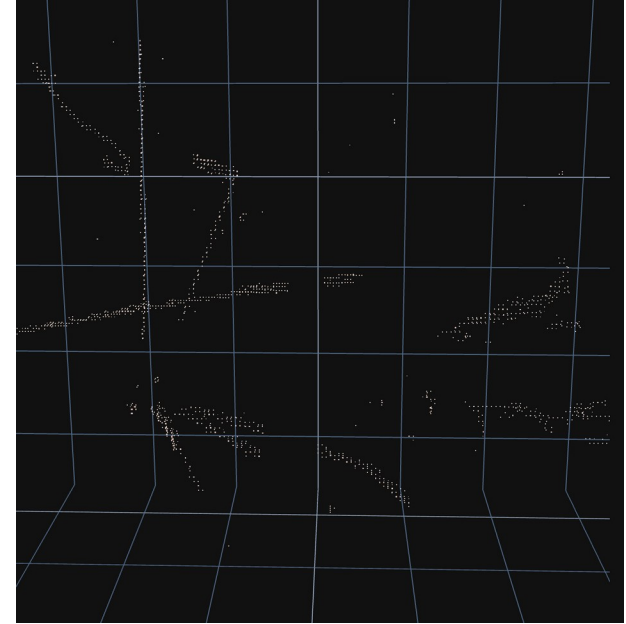
## 3) Fuzzy lines: feature not a bug?

rerun the simulation with a higher larpix threshold?

## 4) Event display of last event:

(ML reco related)

couldn't produce display of last event due to a bug in sequential sampling in `lartpc_mlreco3d`. Bug will be fixed in the next release, temporary solution adopted for now.



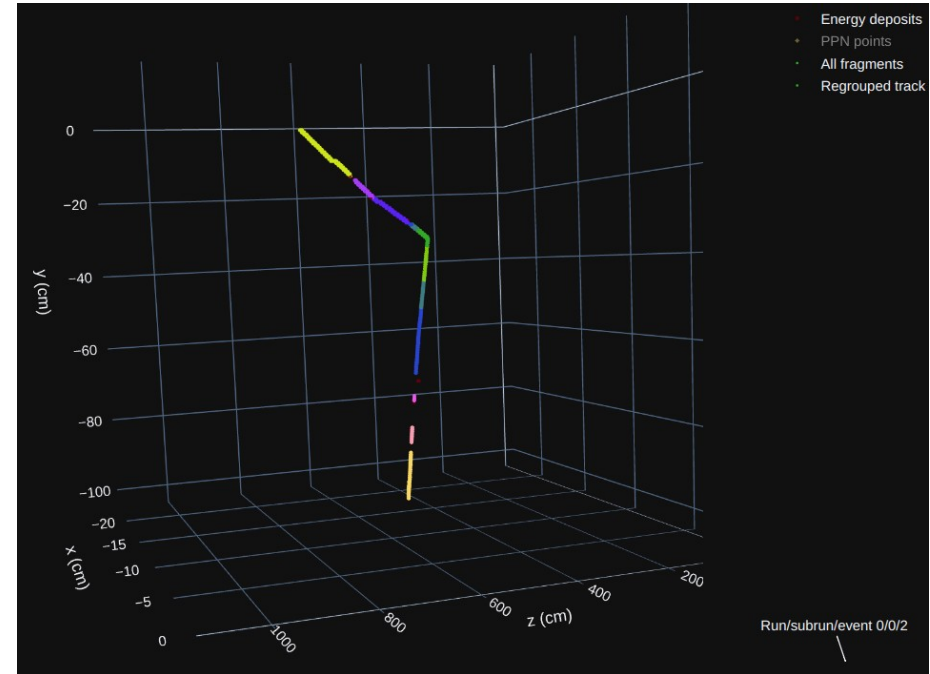
# Translation module status

- Updated translation module in-progress
- Shiny new features:
  - Truth backtracking
  - Importable python module
  - Interface with **edep2supera** for maintainability
  - Using new **LarpixParser** for charge packet position and energy
- Status:
  - Module now runs to completion and produces an output file (which is a first!)
  - Bug in truth backtracking: a particle-level truth parameter is not saving correctly and causing bugs when trying to plot event displays with truth information



# Translation module status

- For now, we can treat the output of the translation module as data (no truth backtracking) to get event displays (also a first!)
- Testing on 1mulp “particle bomb” events (not neutrino simulation)
- Using an old training model trained on edep-sim output
- Charge scale is not calibrated here, hence too many groups
- Next step is to fix the truth-backtracking bug



## Summary and to-do

- ML reco event displays obtained from the temporary reformatter
- Some issues that we ran into in the earlier versions of the simulation are fixed now
- Lot of progress with the new translation module (thanks Andrew!)
- To-do:
  - Fix truth backtracking bug in the new translation module.
  - Modify the reformatter/ translation module slightly to use the already divided events instead of performing event division.
  - Check regrouping of tracks and showers as they are not correctly regrouped

