MINERvA reconstruction overview

Noë Roy
on behalf of the Reco & Sim Minerva 2x2 team

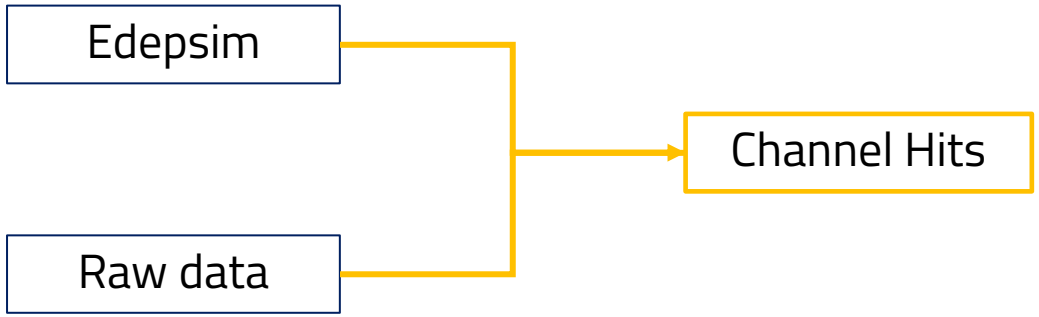
2x2 Workshop – 05/20/2023

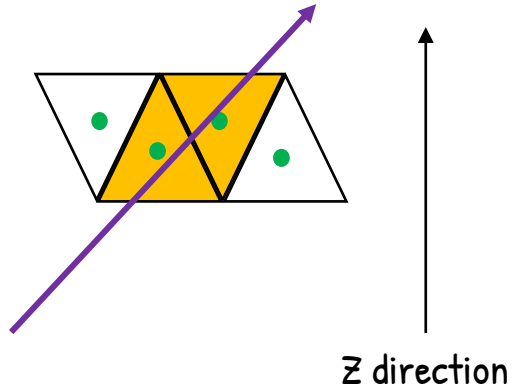
YORK U

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

ArgonCube

Basic MINERvA reconstruction





- **Channel hits: Electronic channel output from readout (simulated or from data). Strip, Module, pE…**

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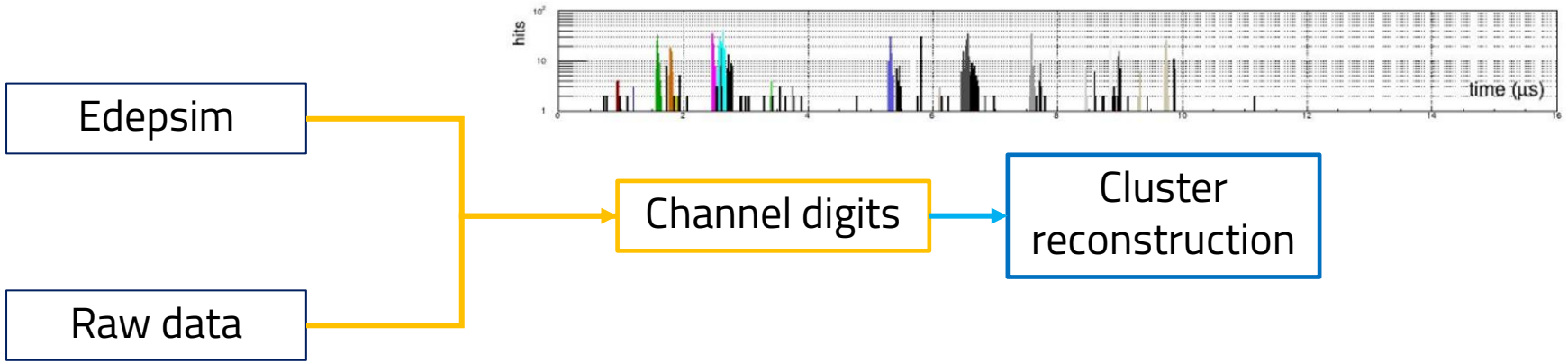
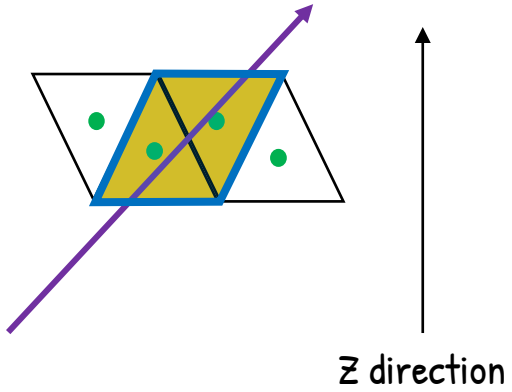
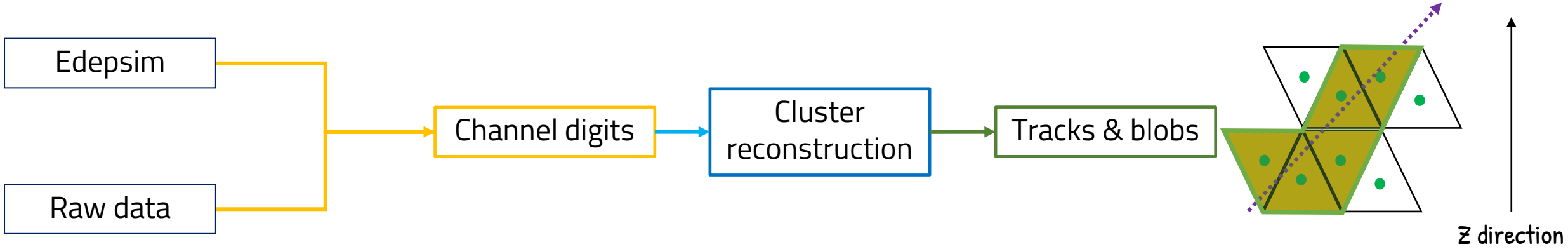




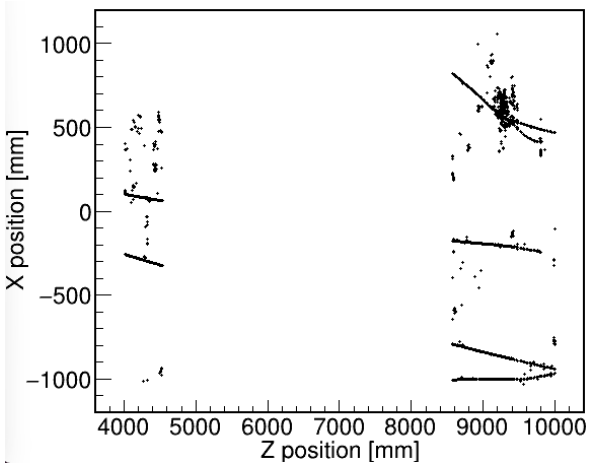
- **Channel hits: Electronic channel output from readout (simulated or from data). Strip, Module, pE…**
- **Clusters: During the same time slice, gathering of neighboring hits in a plane. Time given by higher energy hit; position derived from charged weighted average.**
  - Characterization of clusters according to energy & repartition of the charges.

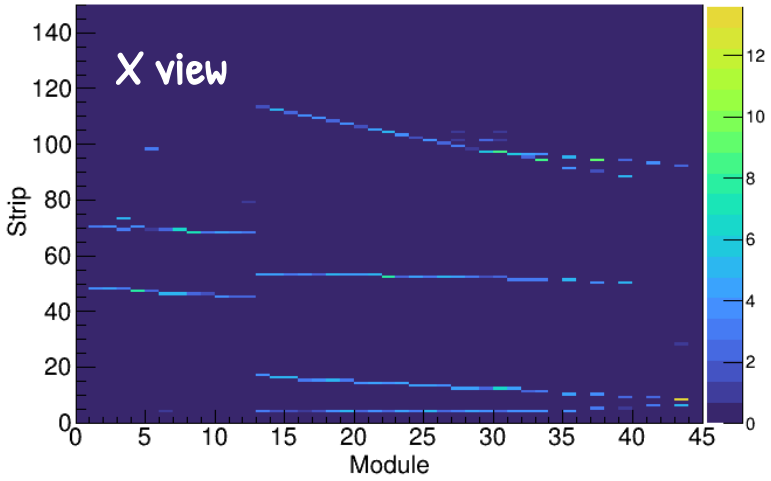
Basic MINERvA reconstruction

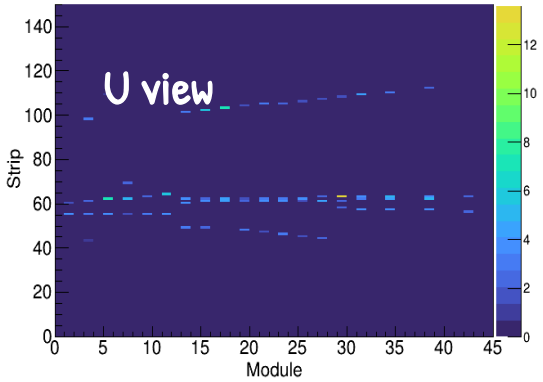


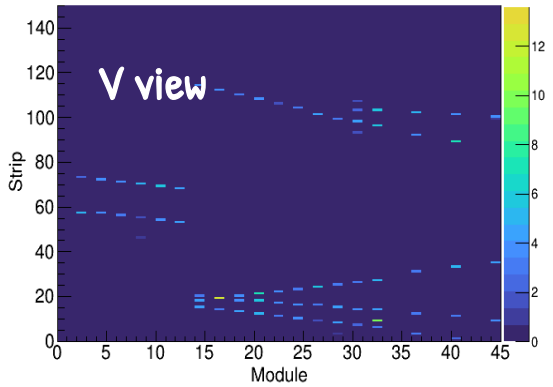
- **Channel hits: Electronic channel output from readout (simulated or from data). Strip, Module, pE…**
- **Clusters: During the same time slice, gathering of neighboring hits in a plane. Time given by higher energy hit; position derived from charged weighted average.**
- **Shower and Tracks are reconstructed through the succession of neighboring clusters in several planes in the same time slice with pattern recognition algorithms.**
  - For Tracks, only « trackable clusters » are used : Cluster with at least 1 MeV energy + average energy of each digits between 1-8 MeV + no digits > 12 MeV. Narrow region to select MIPs

Cluster reconstruction



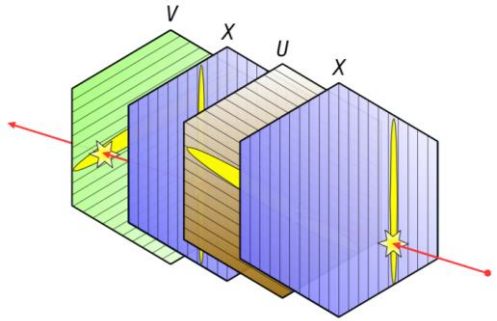




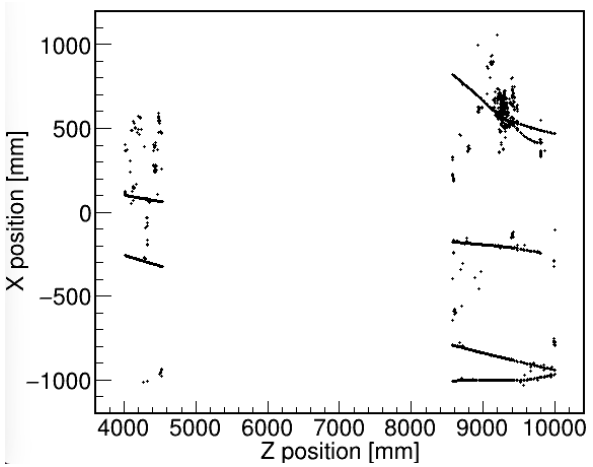


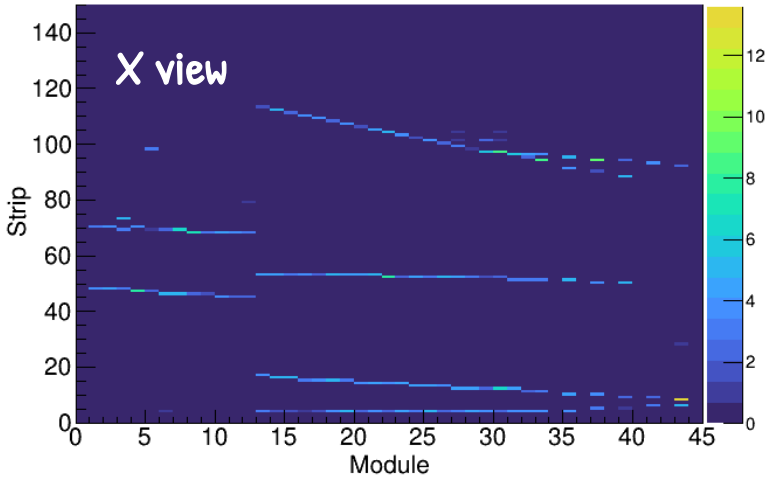
Cluster reconstruction for the 3 different views.
X view has 2 times more planes than U and V, hence the gaps in the 2 other views.

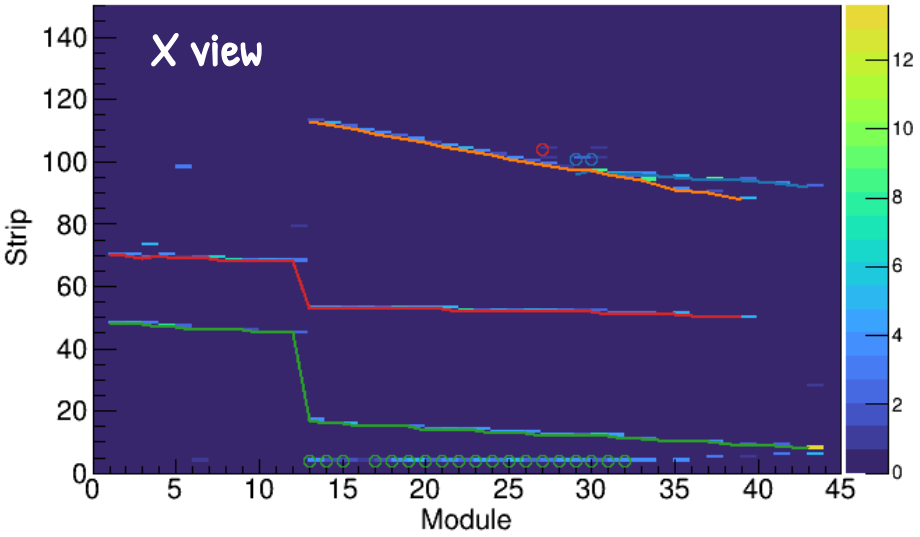
Clear tracks can be seen on the clusters.



Cluster reconstruction X view







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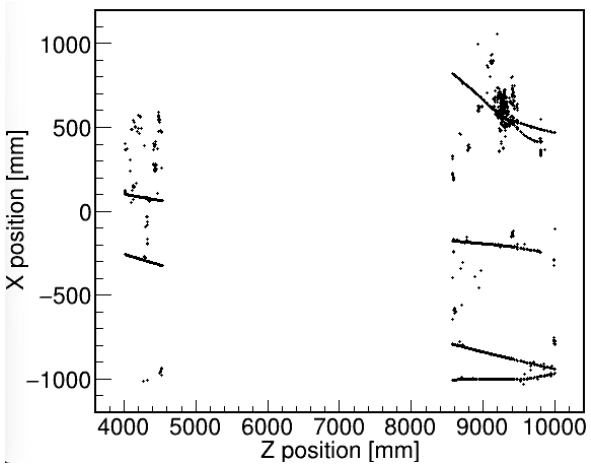
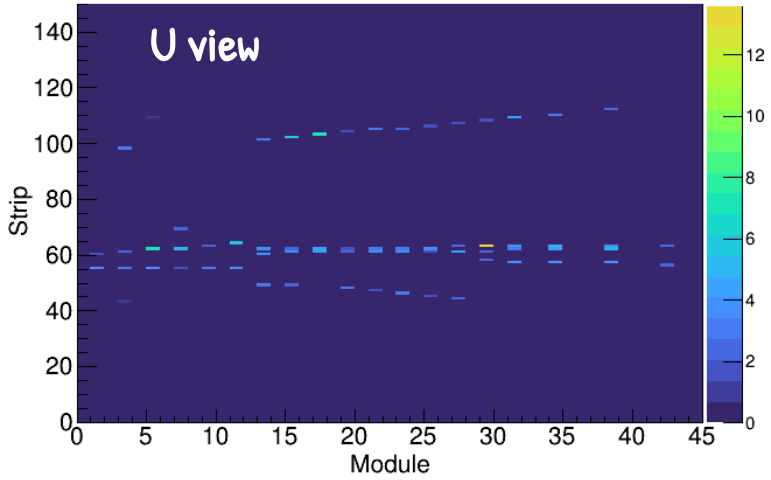
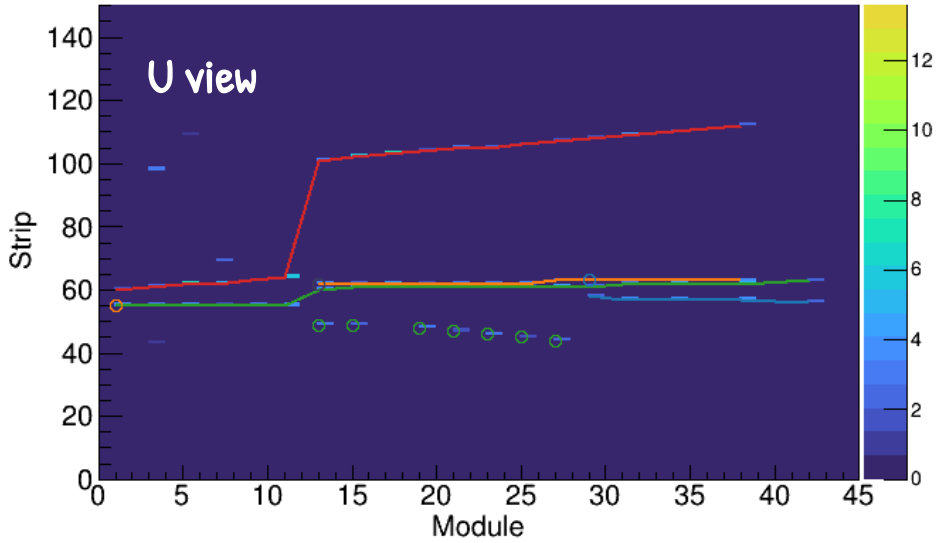
Tracks reconstructed on the identified clusters.
-> depending on the cluster composition of the tracks, some are actually reconstructed into blobs on few occurrences.

Cluster reconstruction U view







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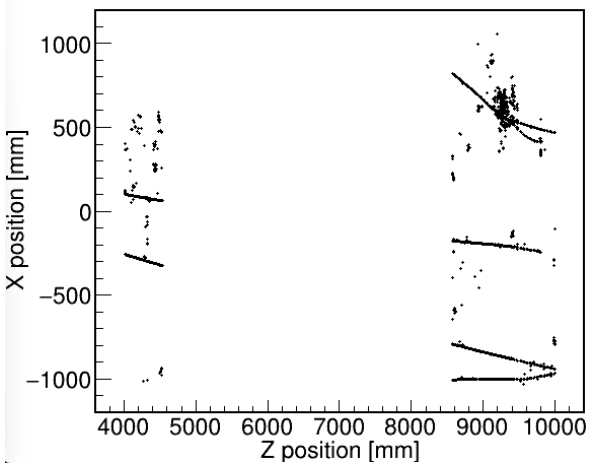
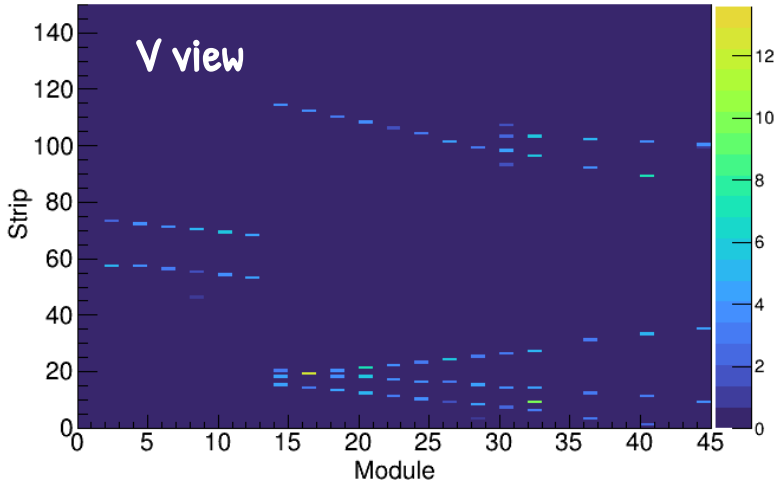
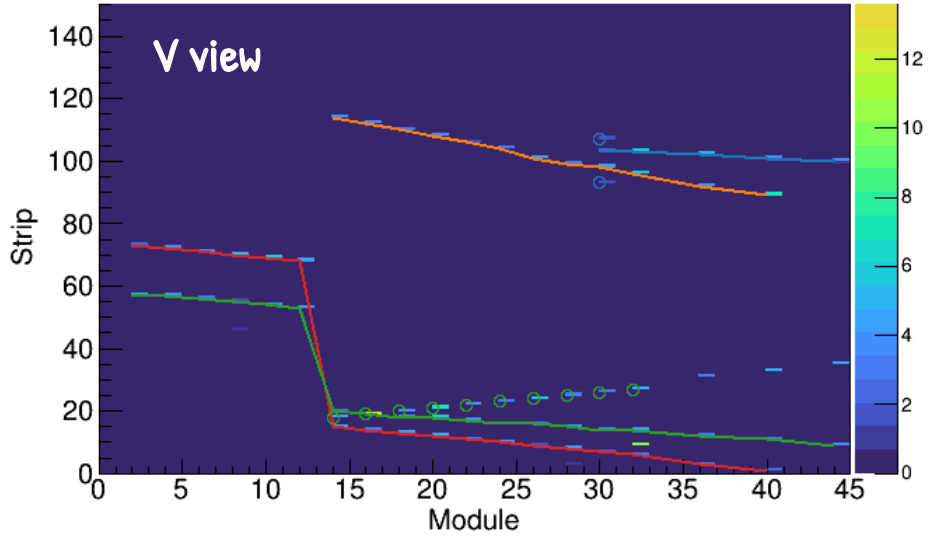
Cluster reconstruction V view







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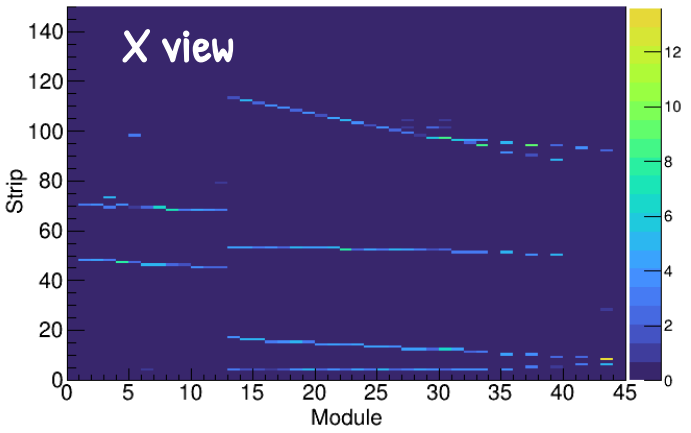
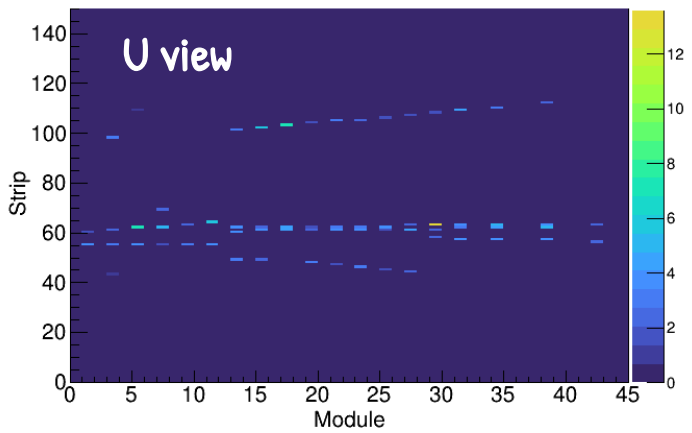
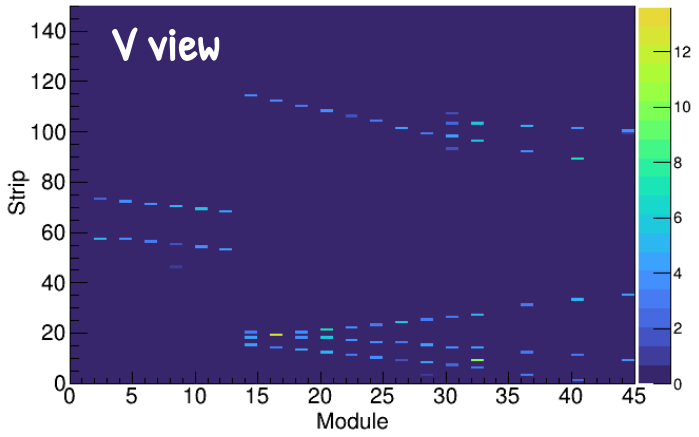
Output for other reconstruction







-> We store each clusters Strip, Module, Plane position, energy, timing, associated true MC deposits.

-> From Jessie's description of ML-Reco needs (sorry to be late on that regard): We have nearly everything.

Last point to figure out is the 2D position conversion between Strip+Module & usual coordinates.

-> For X planes it's quite easy:

-> For U and V planes it's more subtle as U,V position is a combination between X and Y

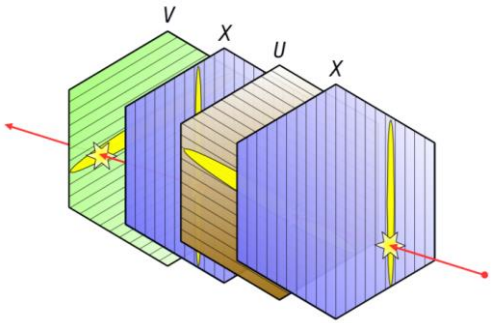
-> **1st output could just be X planes deposits (still got the interaction shape + easy 2D conversion) ?**

In the HDF5 file:

List of simulated channels outputs (cluster positions + energy and timing)

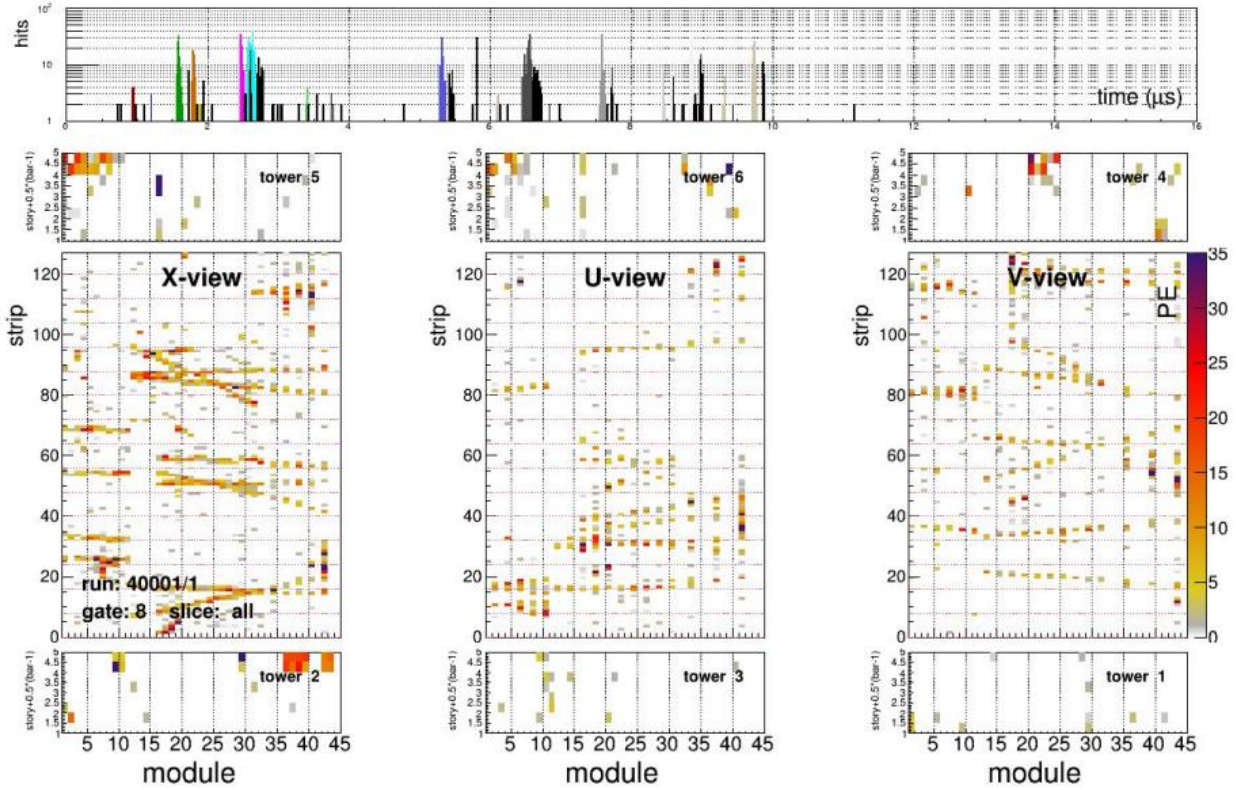
List of true particle contributing (start, end, pid, parent particle)

Association cluster <-> G4 particle



What about Data ?

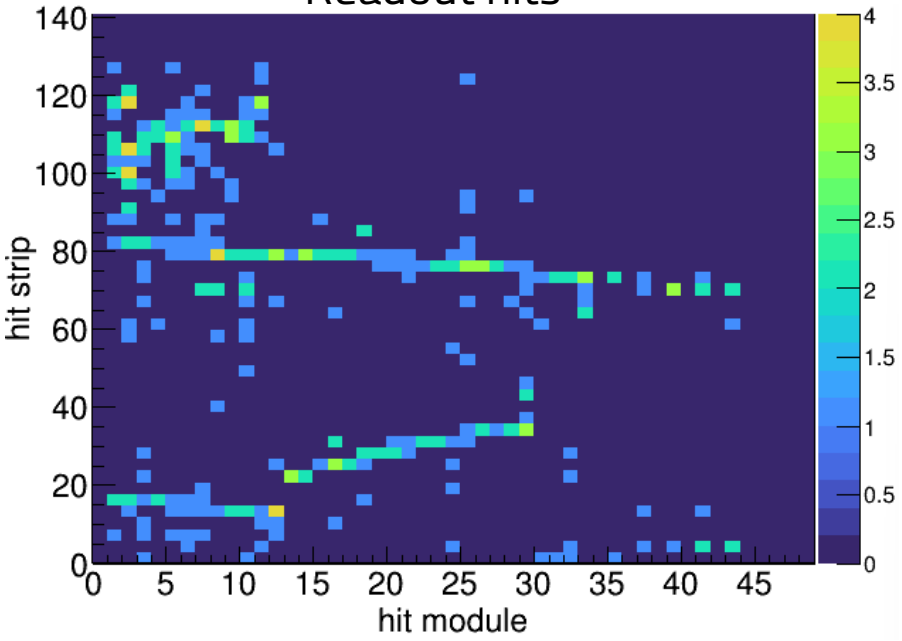
- VERY (**Very**) preliminary reco run on Data.
- Thanks to the hard work from everyone at Fermilab that installed and revived MINERvA planes, we actually have data to run the reconstruction!



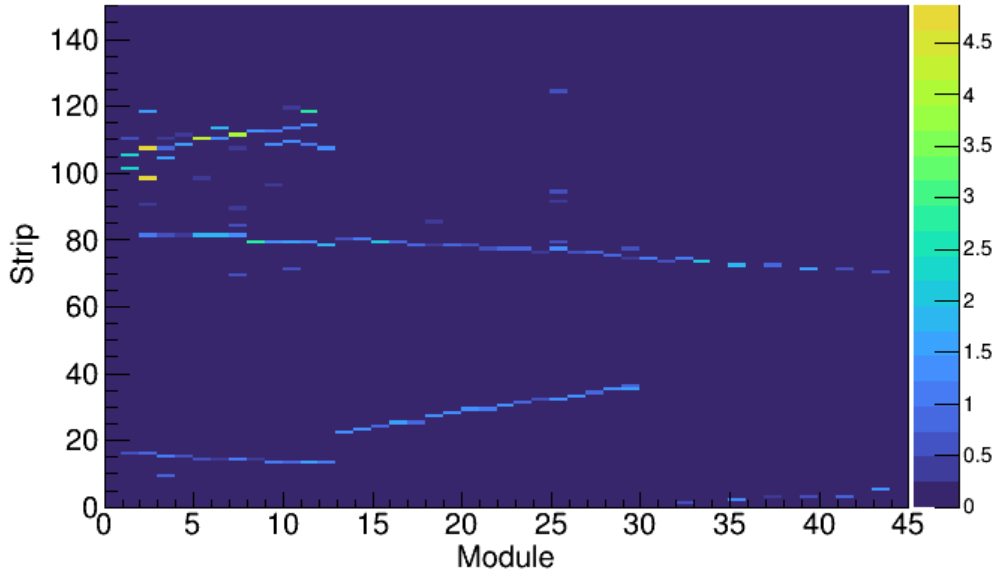
From Carlos' talk yesterday

What happens when we try to reconstruct data ?

Readout hits



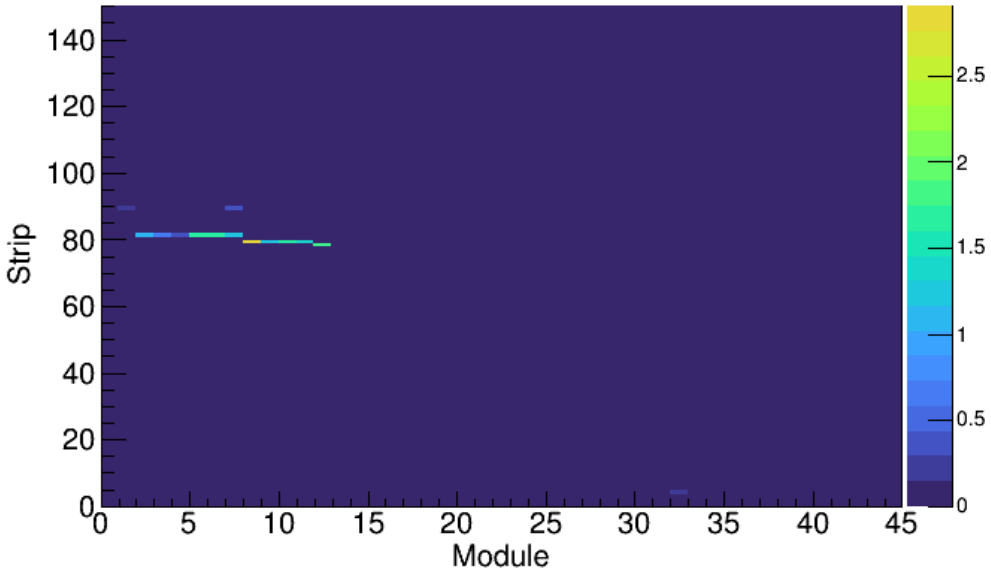
Cluster reconstruction



We have tried to run the MINERvA reconstruction on those readout hits.
1st achievement, nothing crashed and we do recover something that makes sense!

Selection of the 1 time slice :

Readout digits



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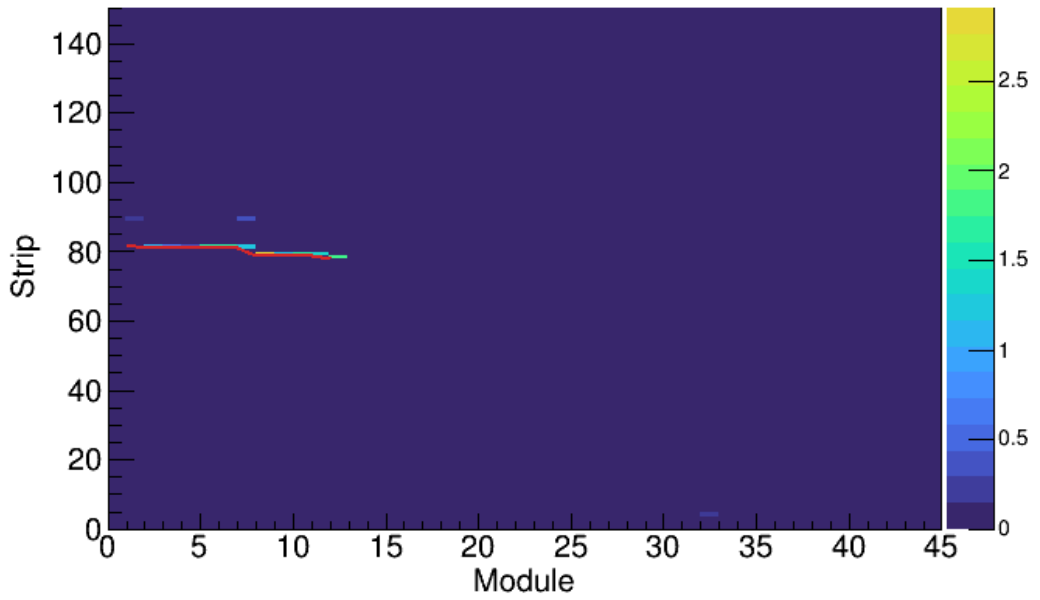
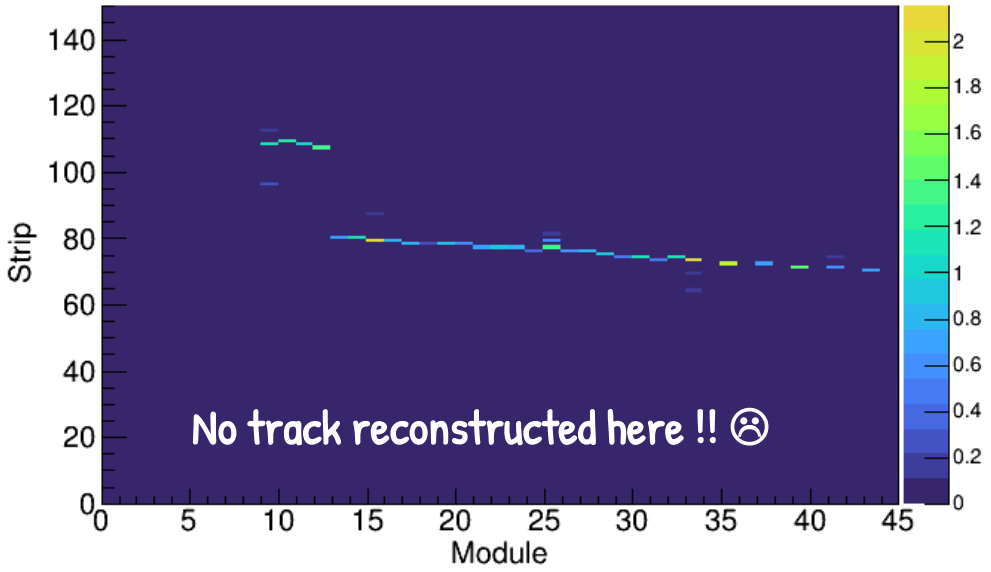


Actually only track that we reconstructed in this event.

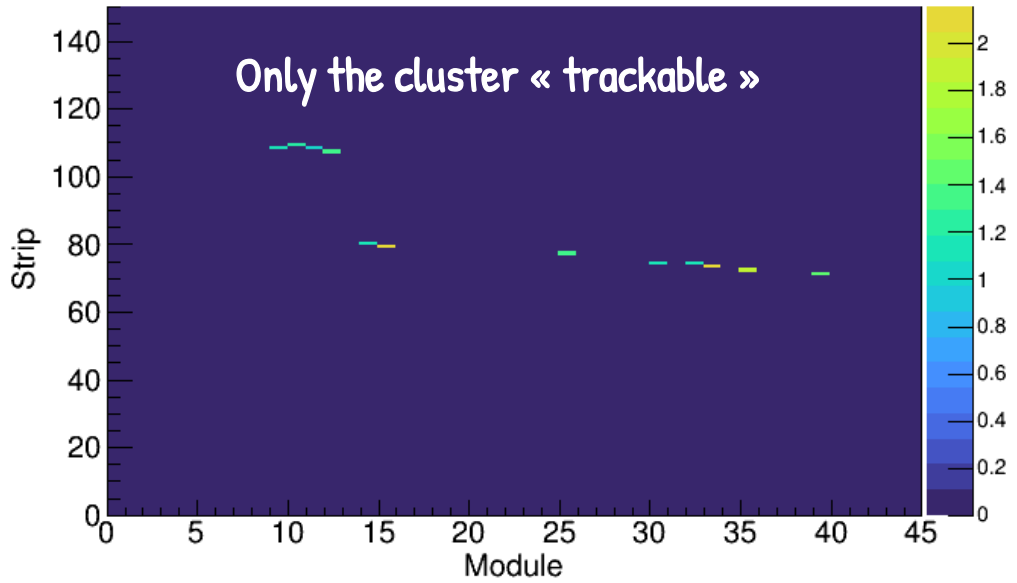
So we did technically reconstruct a track in MINERVA-2x2 but…

What about the other tracks ? On another time slice

Readout digits



Cluster reconstruction



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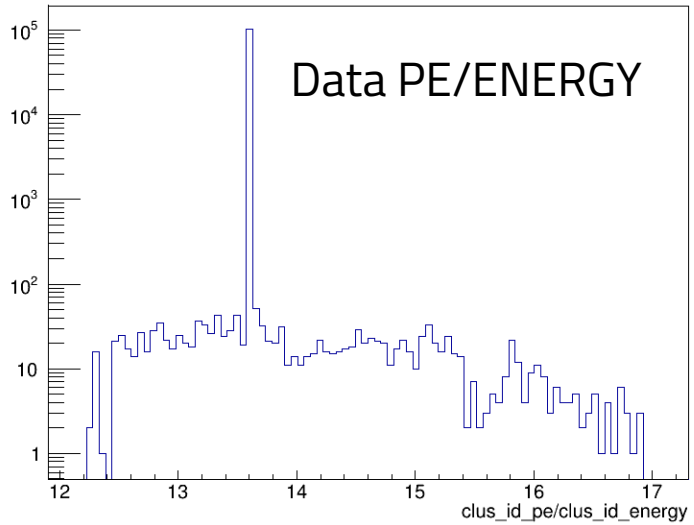
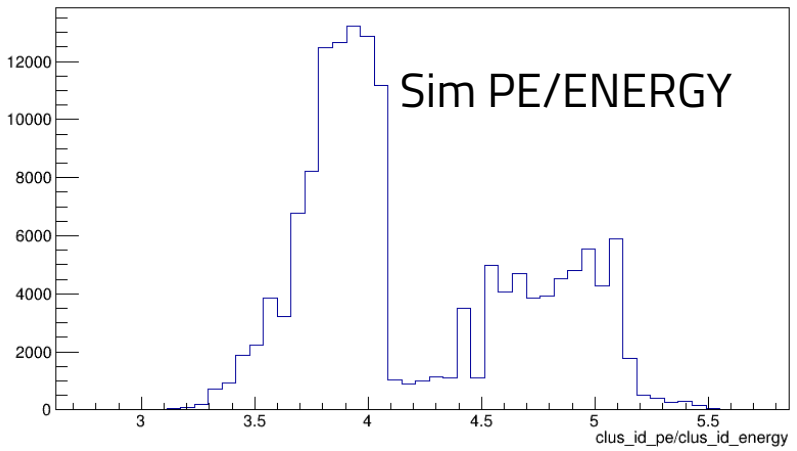
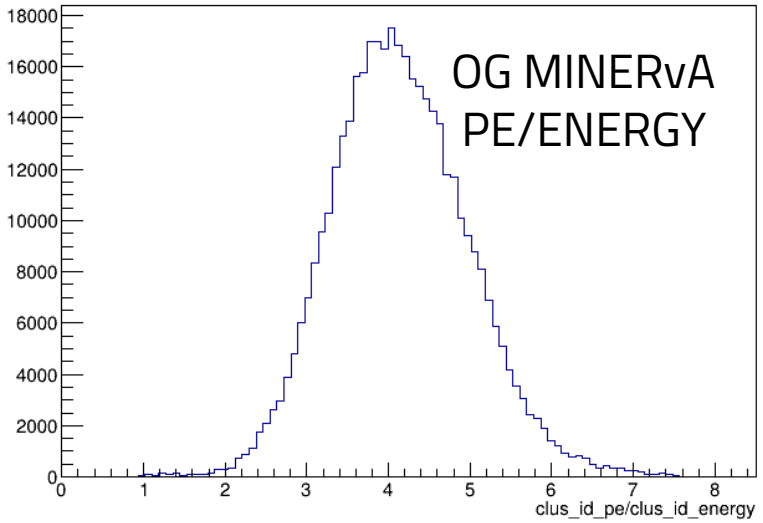
Seem to come from PE <-> Energy conversion







Ratio PE/Energy seem to be too high (and with a strange shape) for current data reco -> leads to lower energy clusters -> Not tracked.

Primary suspect on the tracking issue.

Conclusion and outlook

- We've got a reconstruction that runs properly on simulation
  - Still need to end the module to get the dst outputs to ML reco
- We are to produce tracks and blobs for CAFs
- Reco runs on data. Might be some energy conversion effect that is not applied correctly
- **Run on all MINIRUN3 dataset with 1st version of Sim&reco software. No clear running issue, validation in process**