UNIVERSITY OF CAMBRIDGE

DEEP UNDERGROUND NEUTRINO EXPERIMENT

2x2 Simulation Challenge: Pandora

Leigh Whitehead (for the Pandora Team)

20th January 2023

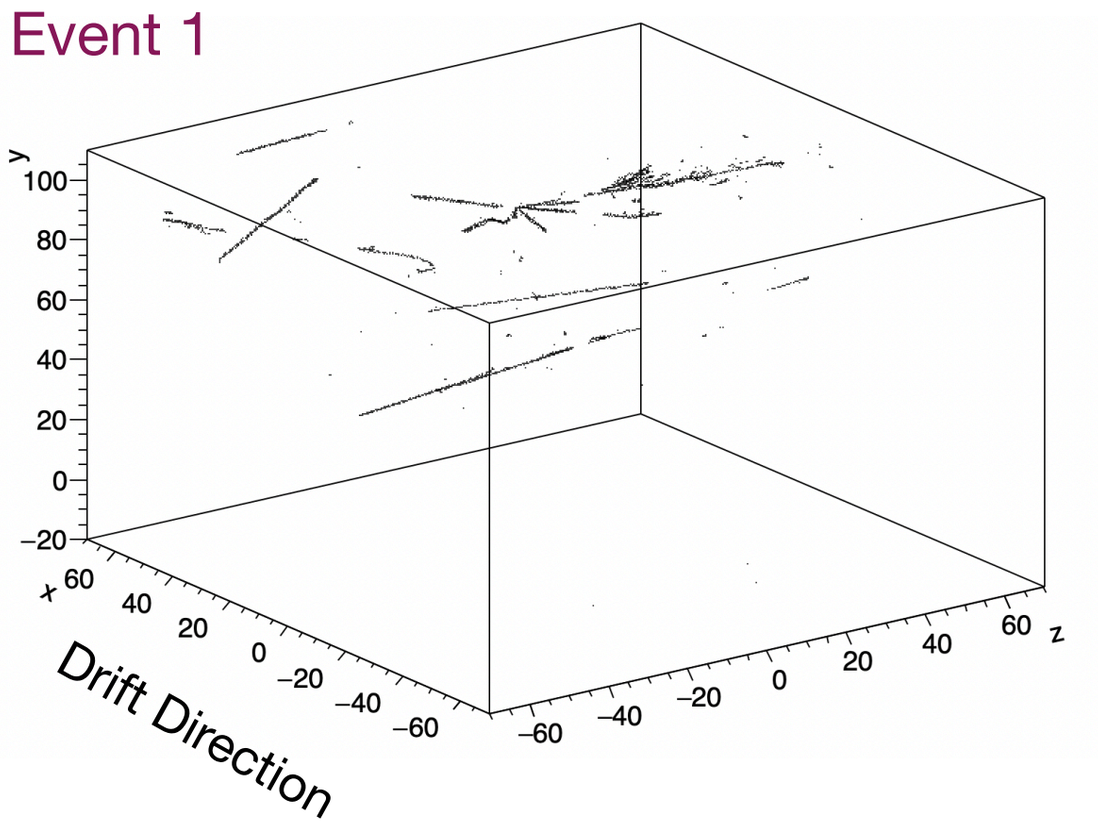
Bern ND-LAr Workshop 2023

Introduction

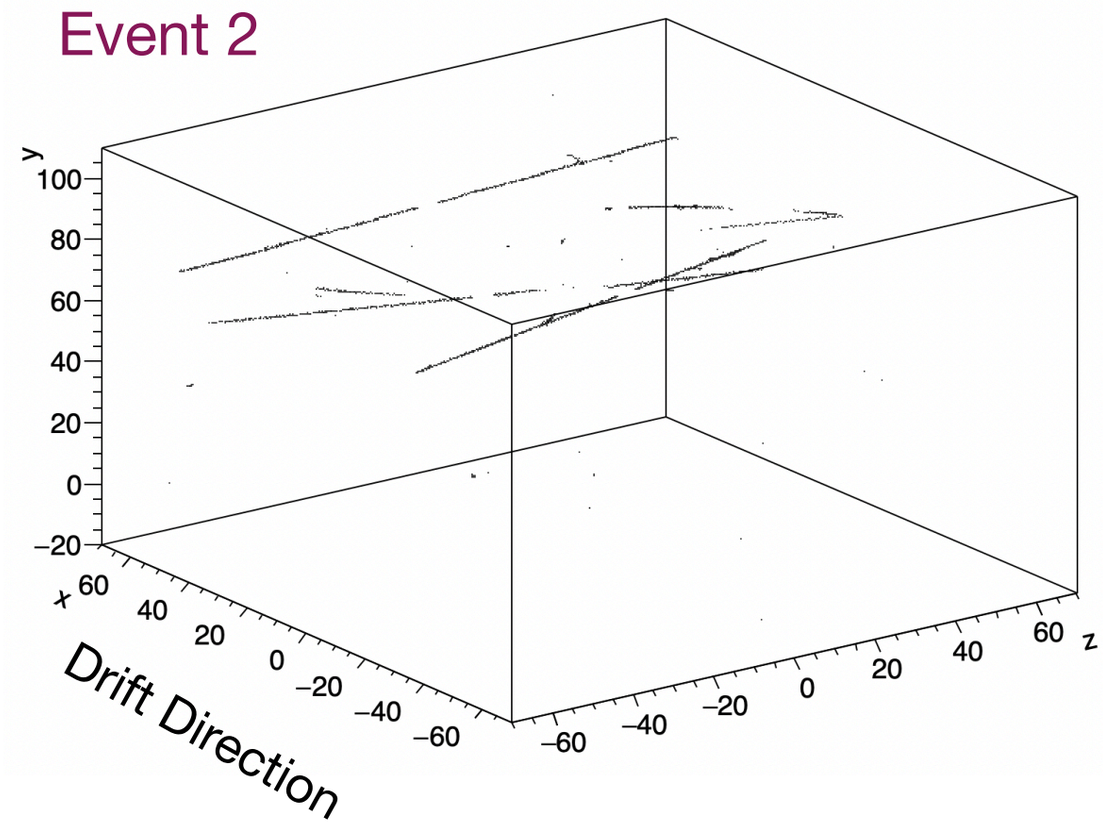
- Richie has processed Kevin's latest file to get it in the format we are currently using in Pandora

- Found five events, as expected

Event 1



Event 2



Hits before reading into Pandora

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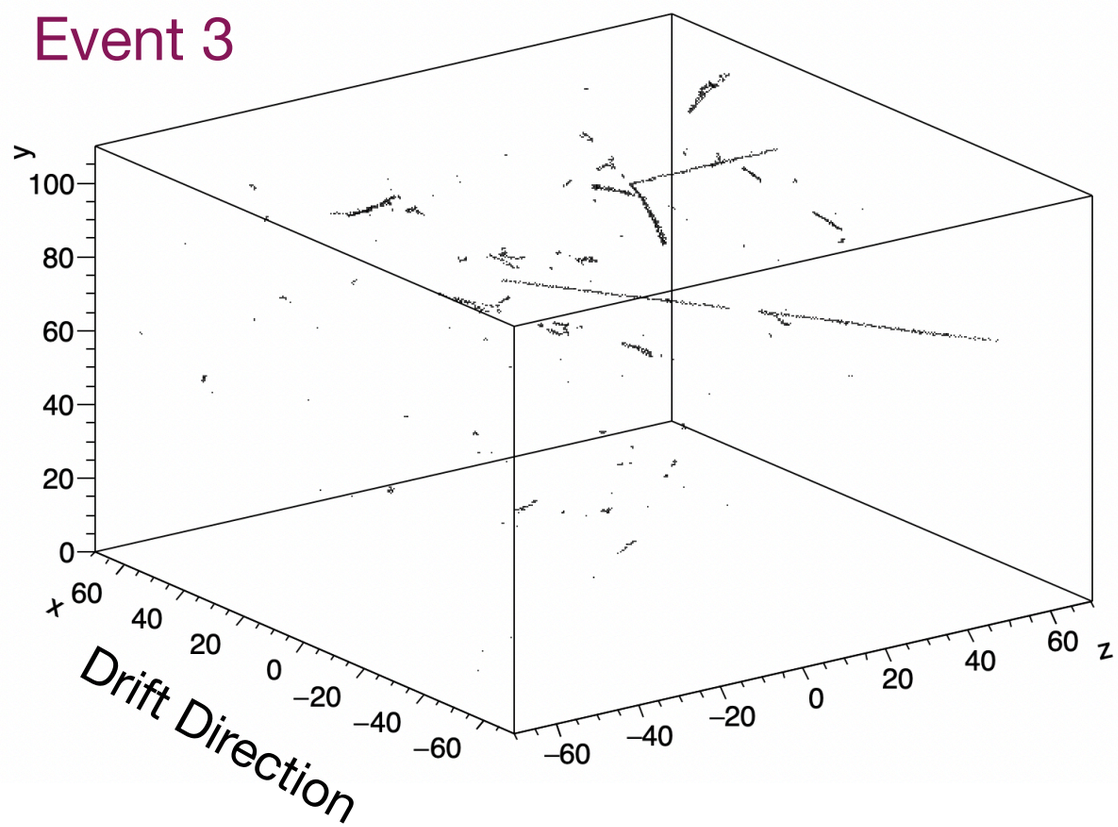
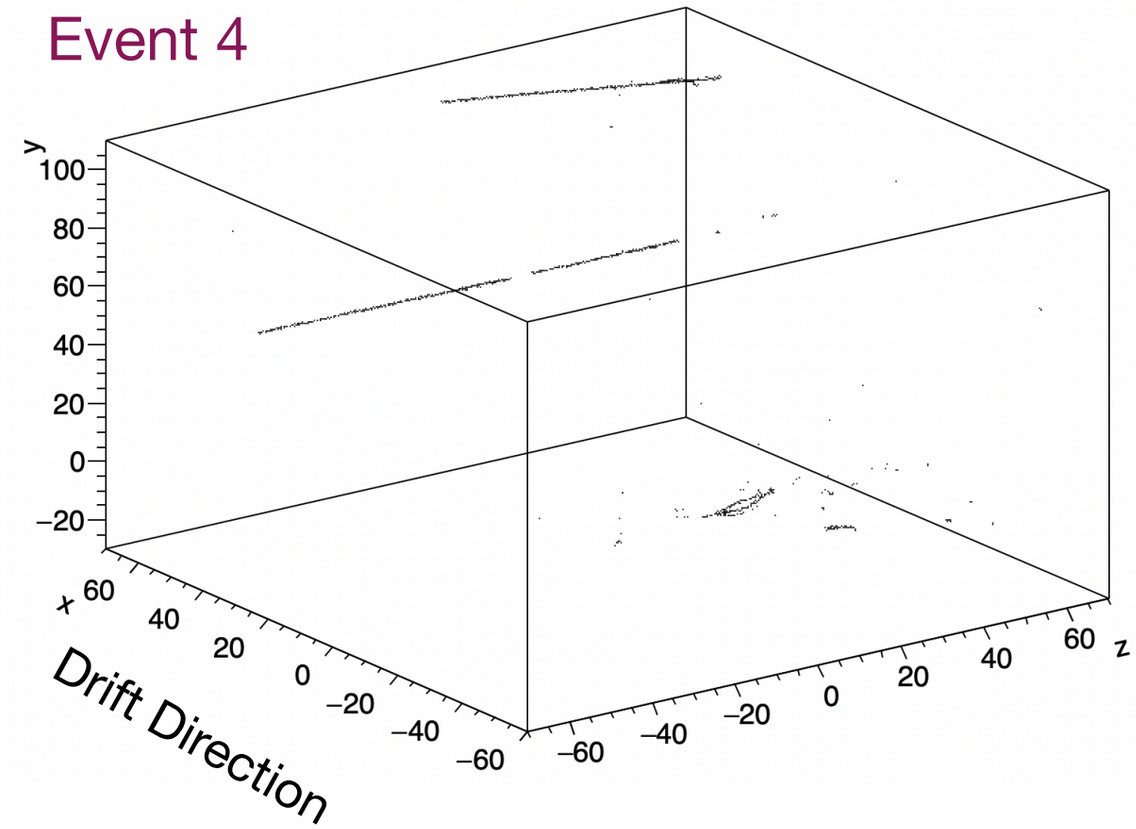


Event 4



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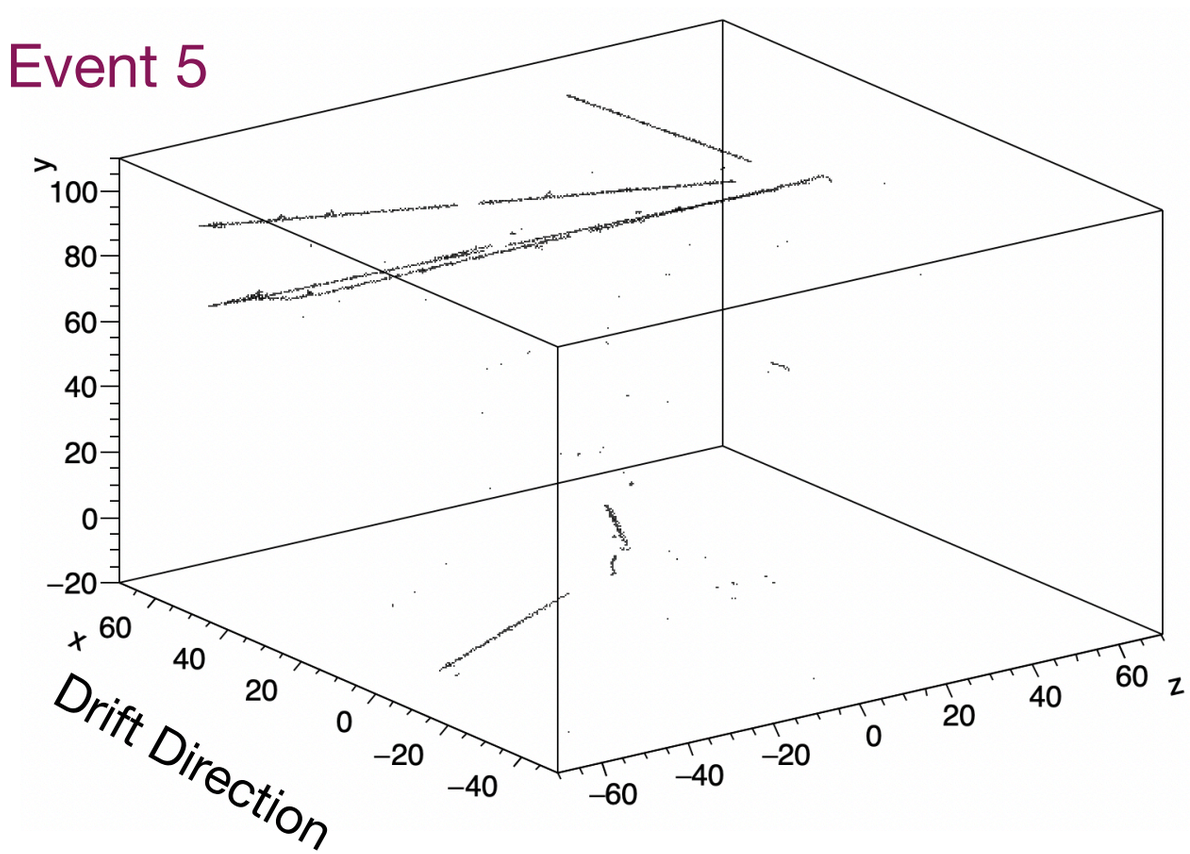
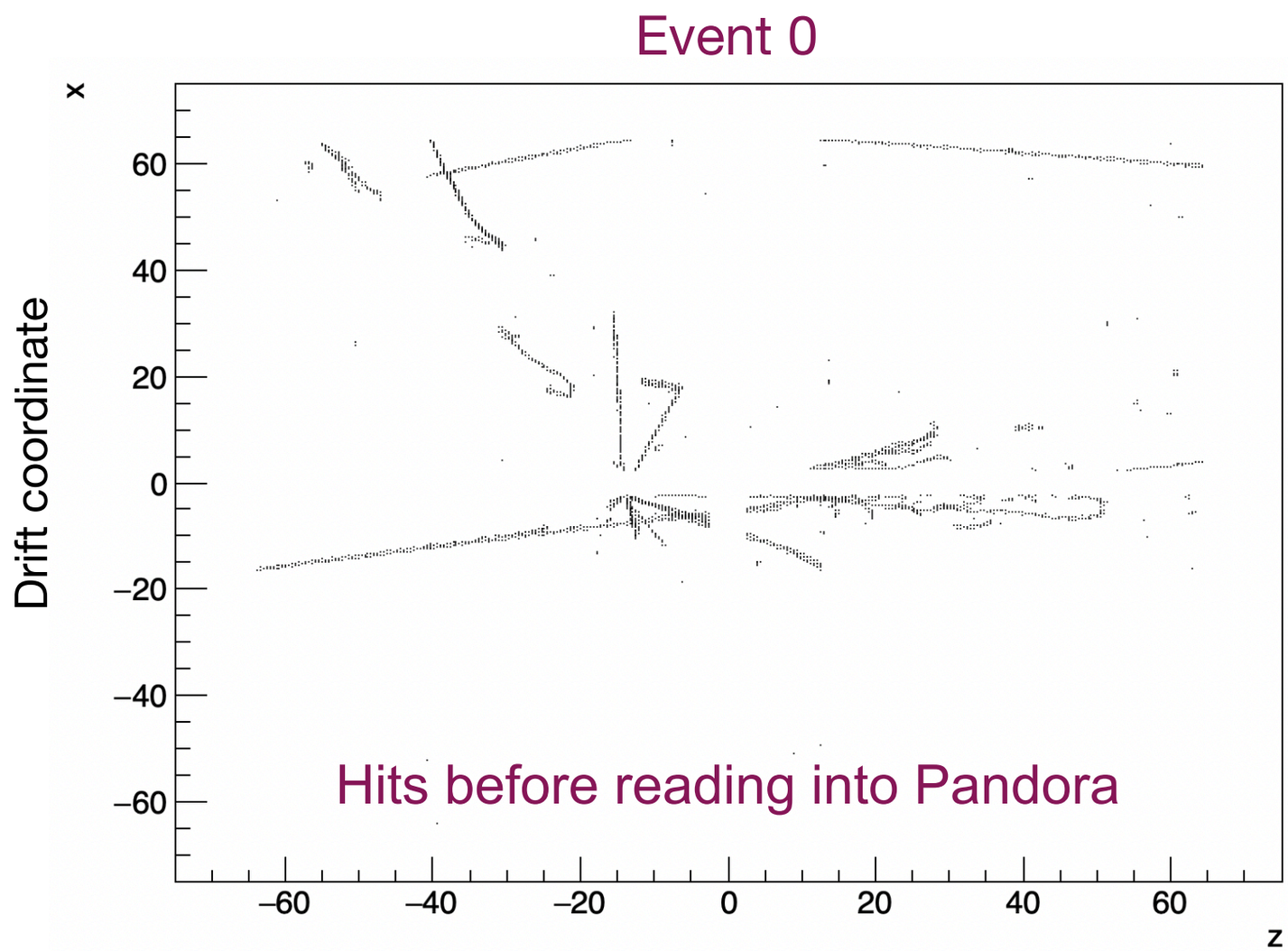


Hits before reading into Pandora

Introduction

- The tracks all look a bit fuzzy[1]
  - This is clearest in 2D projections with the drift direction (we call it x)



  - For hits at a given z, we see a spread of hits in the drift direction

[1] At least compared to what we see from the wire-based LArTPCs

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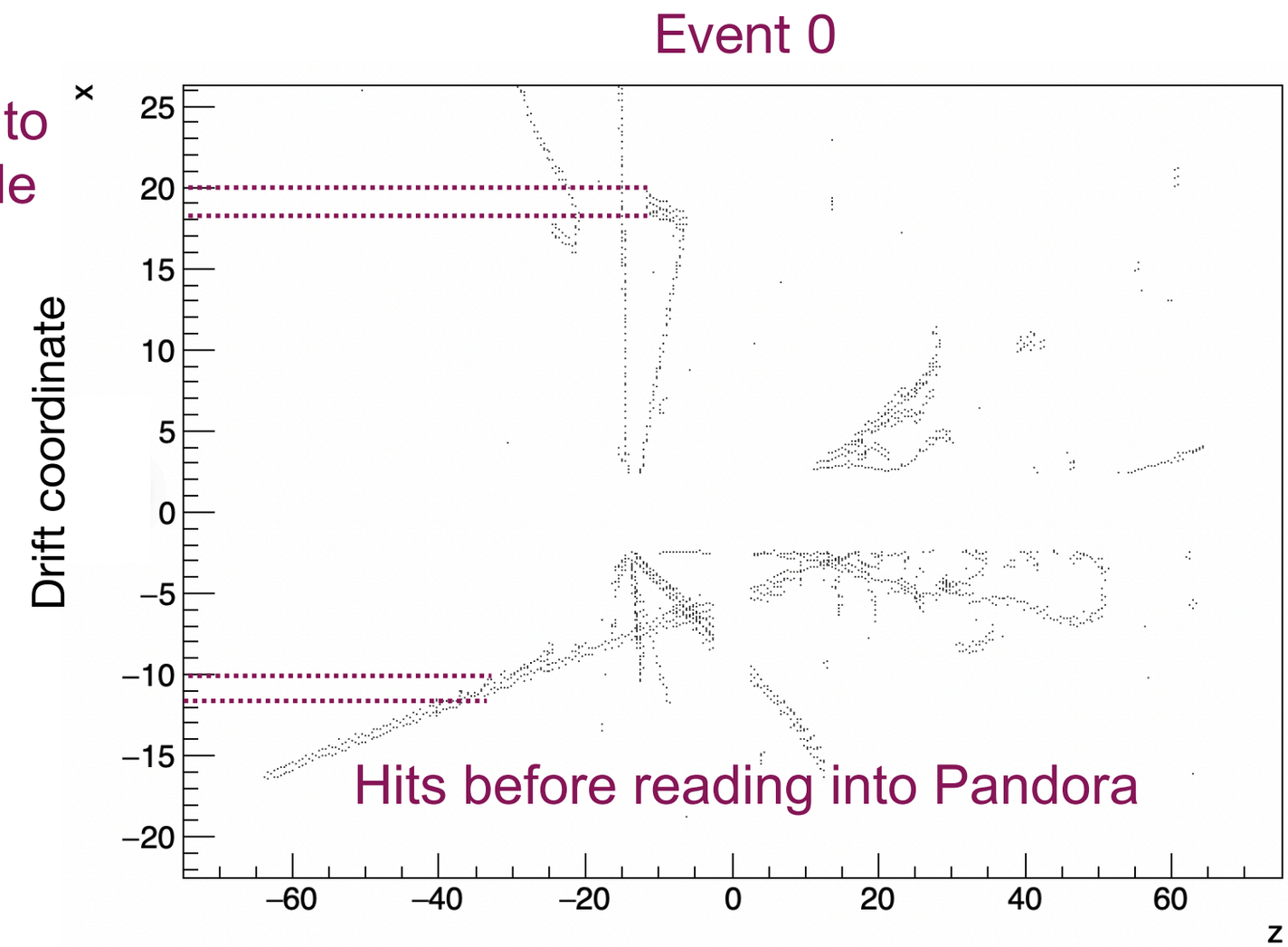
Tracks appear to be ~1-2cm wide in the drift direction



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Comment on the input file

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  - This is clearest in 2D projections with the drift direction (we call it x)
  - For hits at a given z, we see a spread of hits in the drift direction

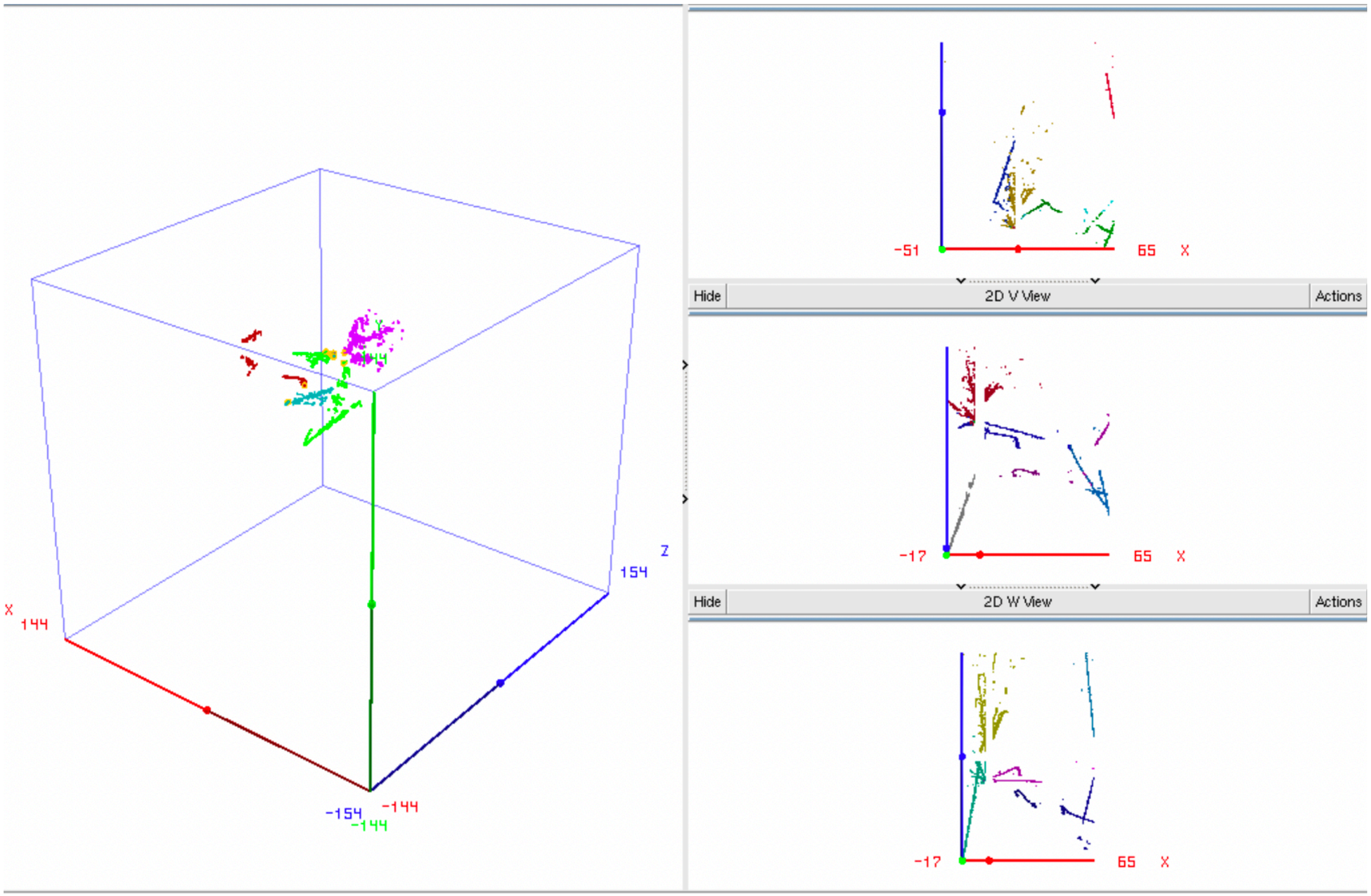
- We will see that this causes a problem for Pandora
  - (Most) tracks in wire-readout LArTPCs don't have this effect
  - More likely to reconstruct as a shower than a track

- I will show the five events reconstructed in two ways
  - The standard MicroBooNE chain with 3 x 2D projections
  - As above, but with initial clustering performed in 3D to ensure the projected 2D clusters are consistent across views, and with input 3D hits assigned to the fully reconstructed particles instead of 3D hit creation

[1] At least compared to what we see from the wire-based LArTPCs

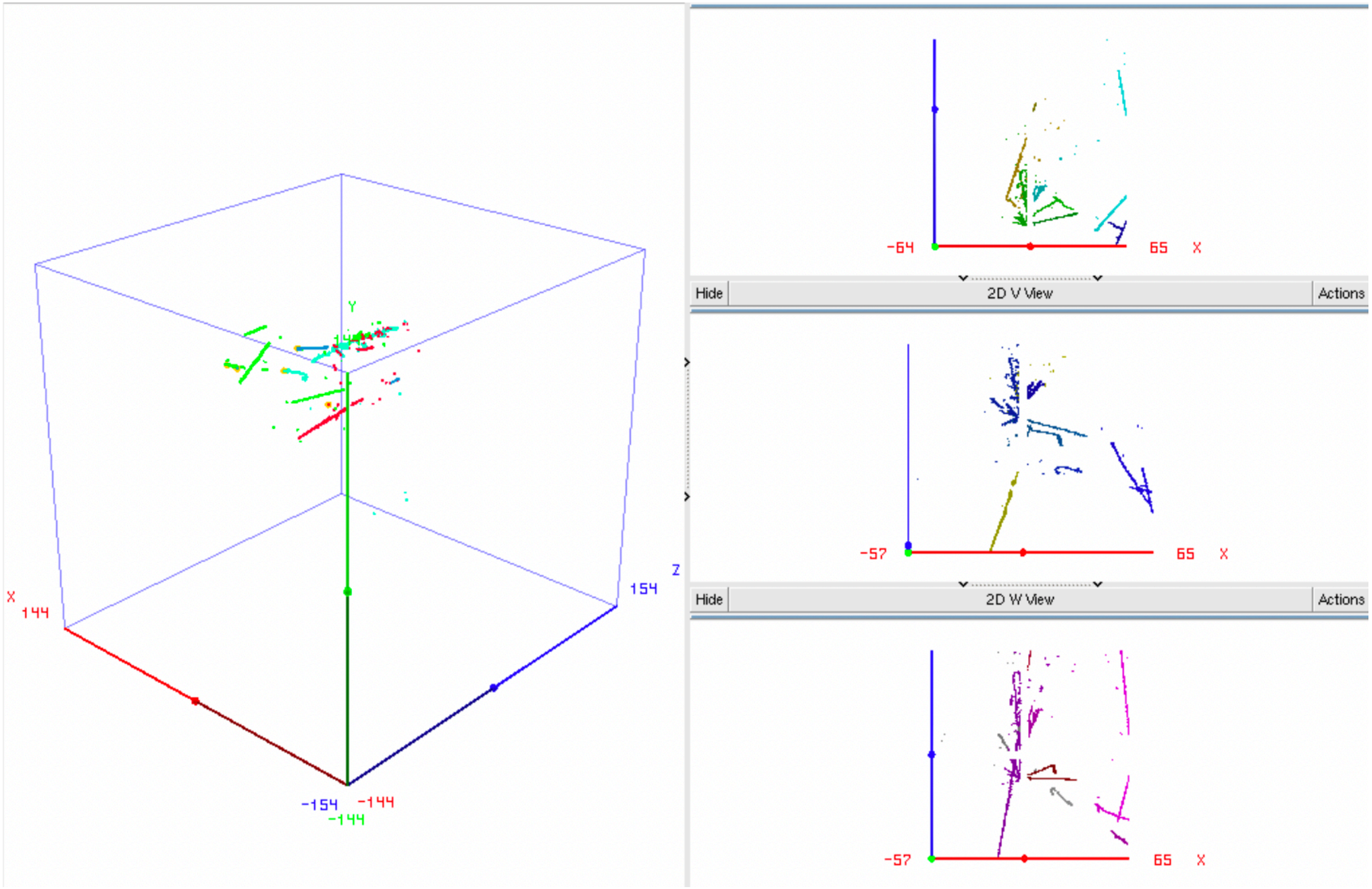
Reconstruction in Pandora

- Event 1: 2D-projection reco



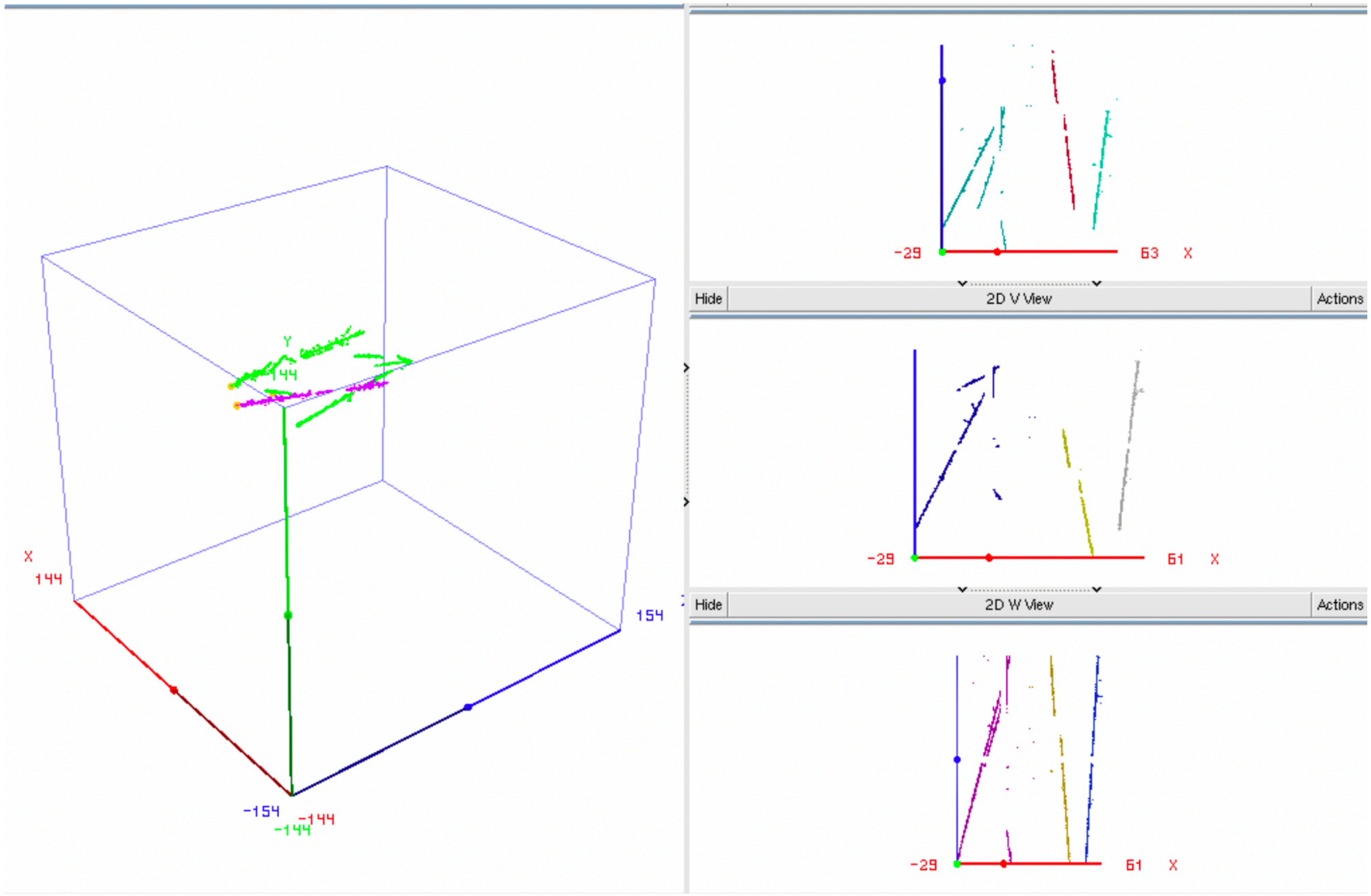
Reconstruction in Pandora

- Event 1: 2D-projection reco + initial 3D reco steps



Reconstruction in Pandora

- Event 2: 2D-projection reco



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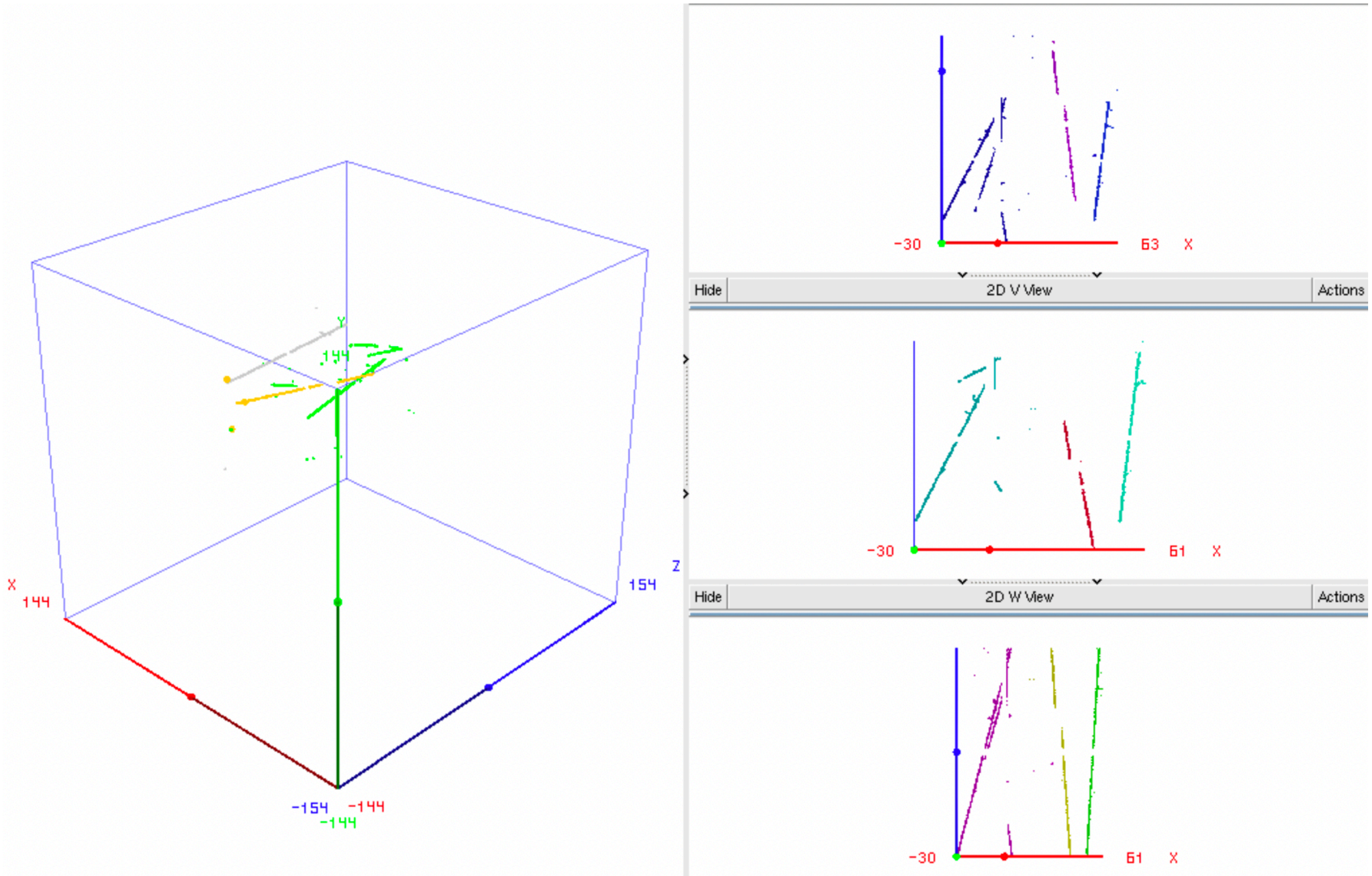
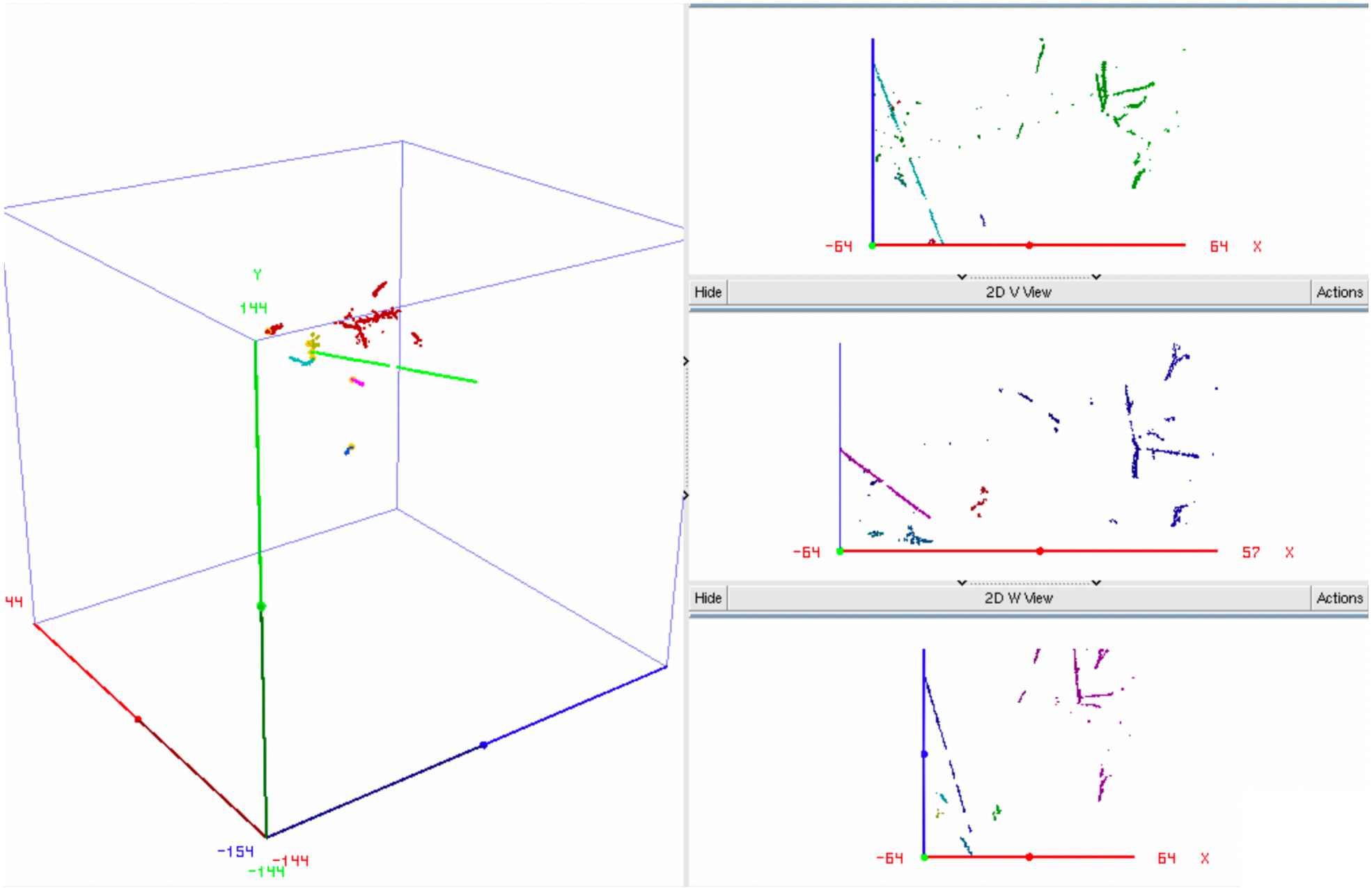


Reconstruction in Pandora

- Event 3: 2D-projection reco



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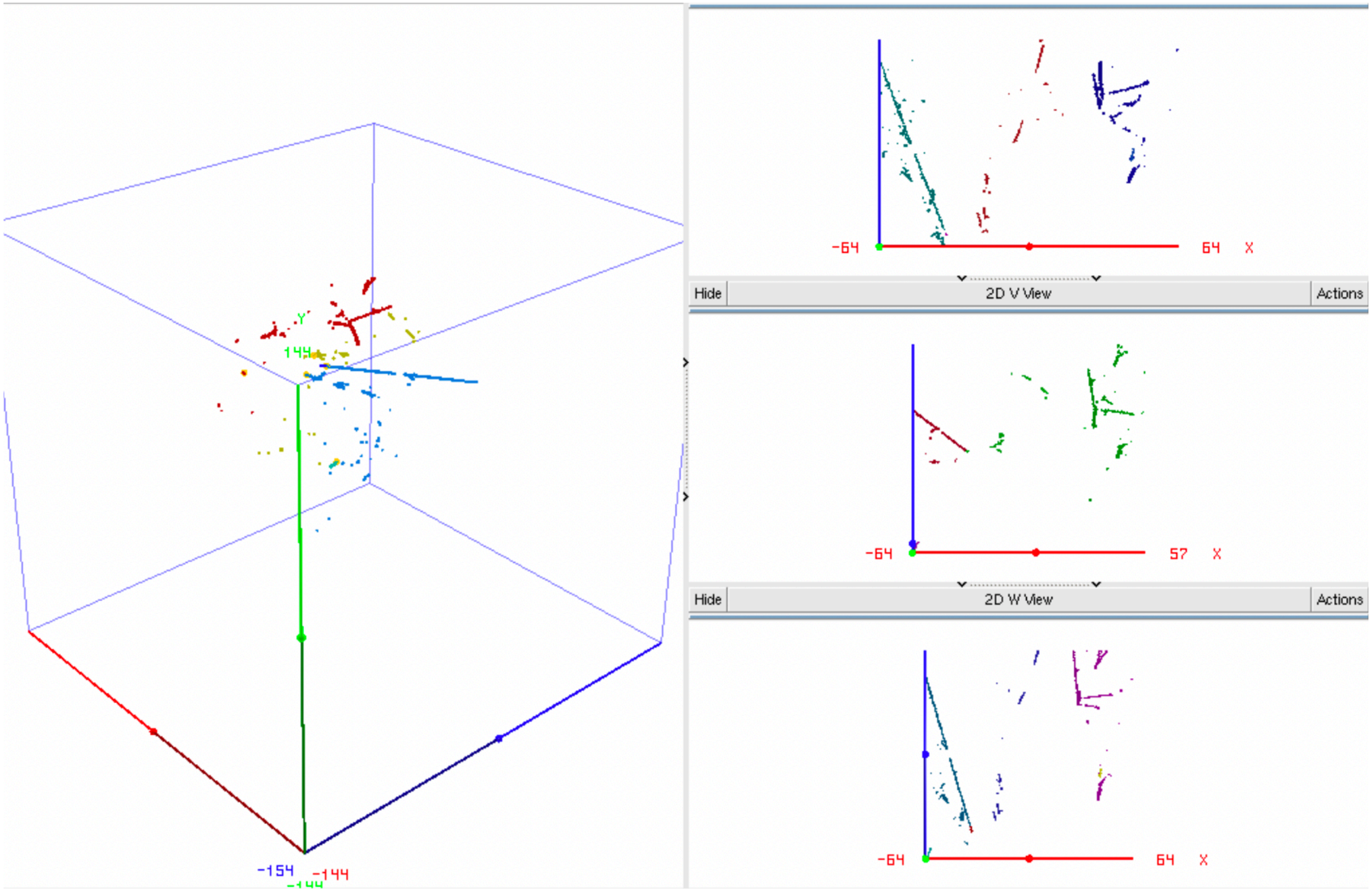
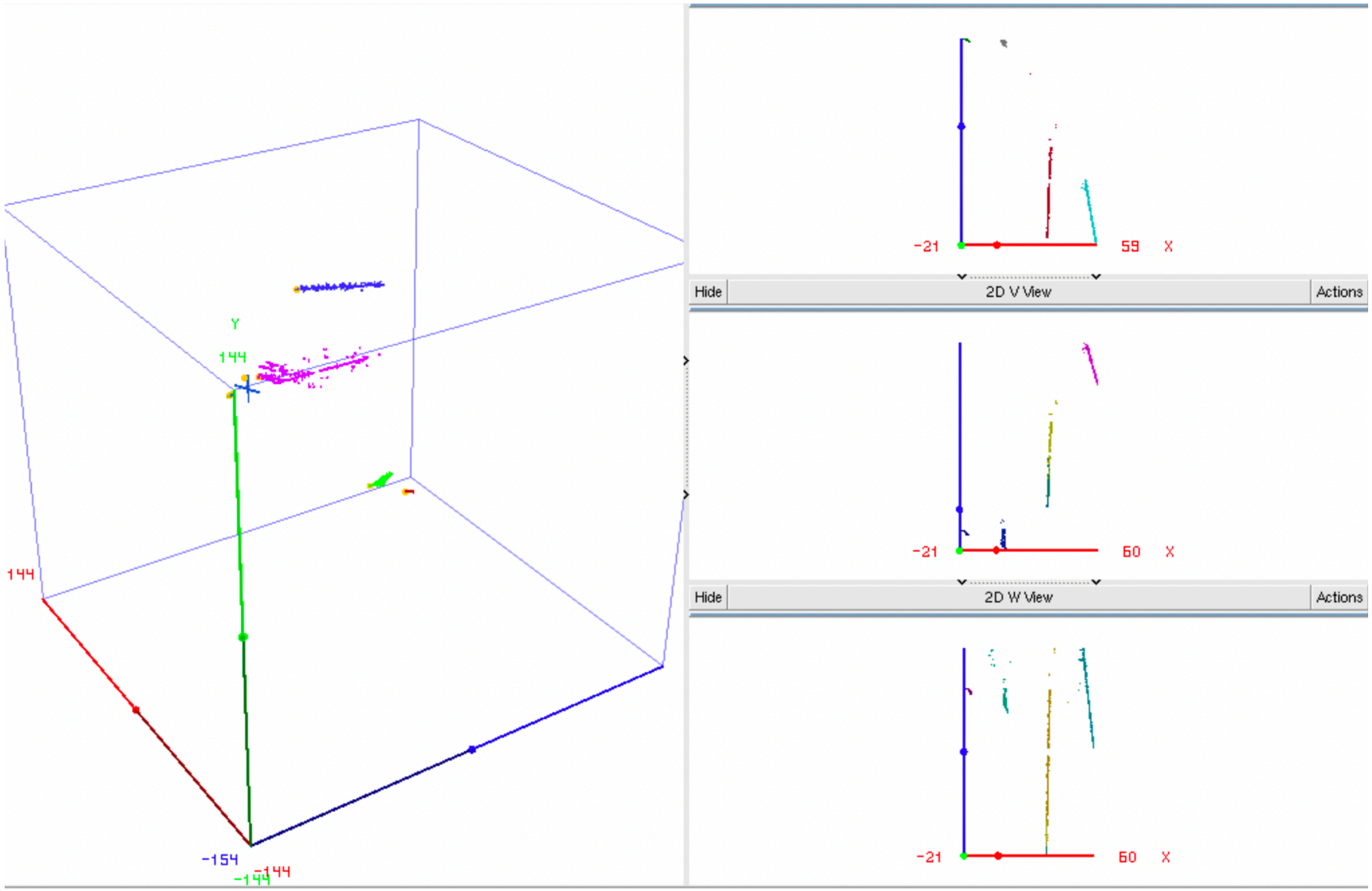


Reconstruction in Pandora

- Event 4: 2D-projection reco



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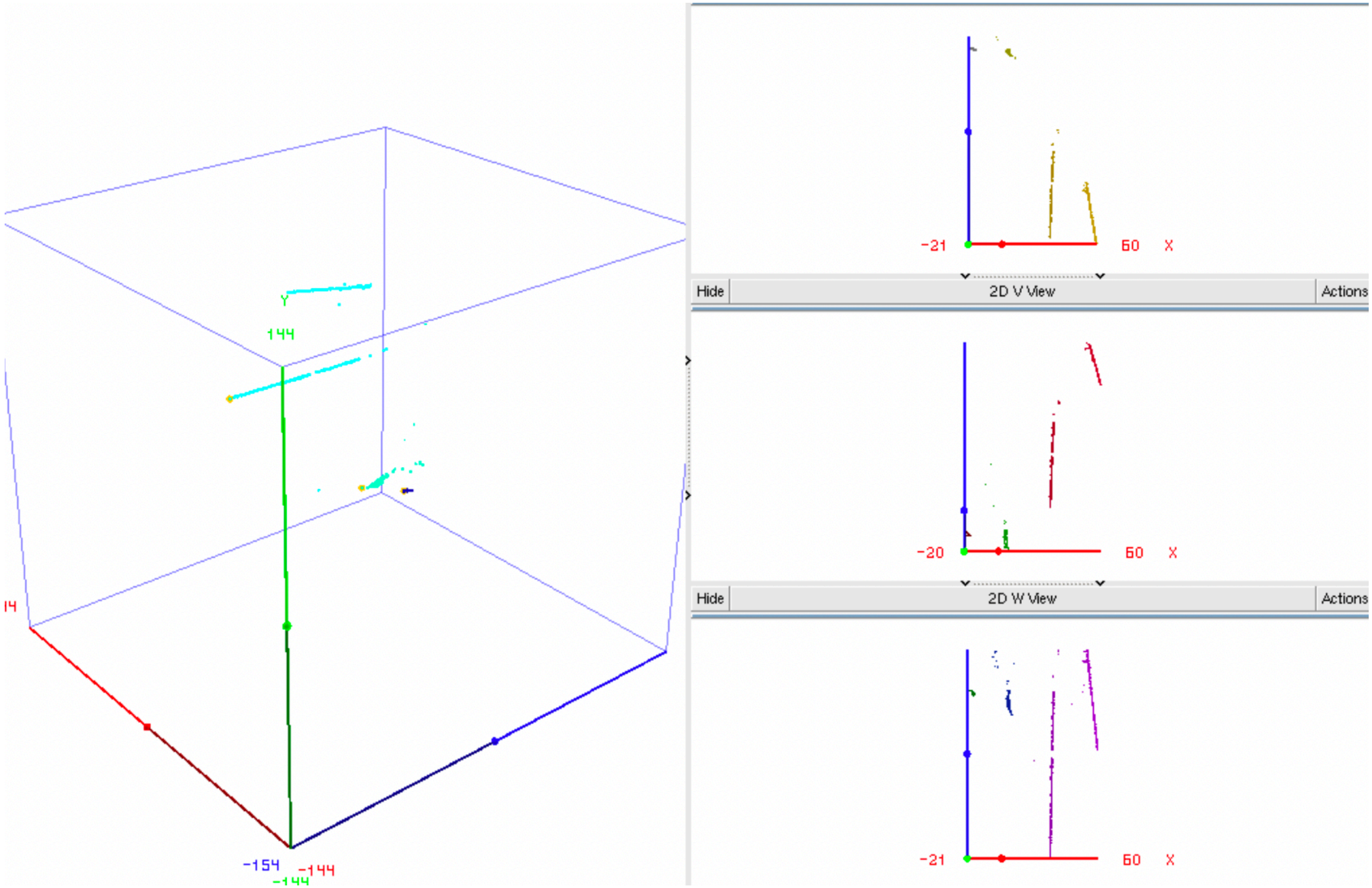
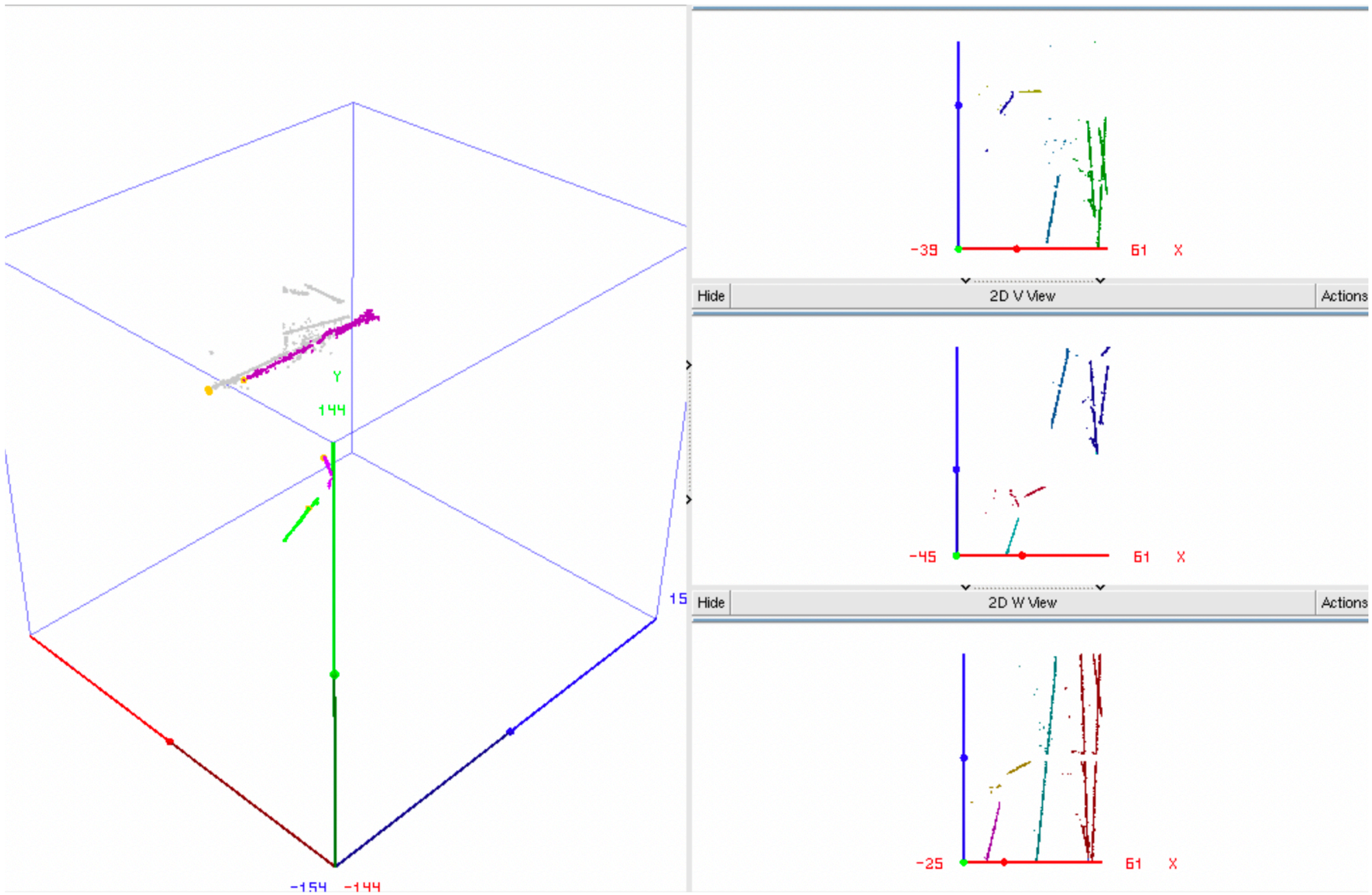
- Event 4: 2D-projection reco + initial 3D reco steps



Reconstruction in Pandora

- Event 5: 2D-projection reco



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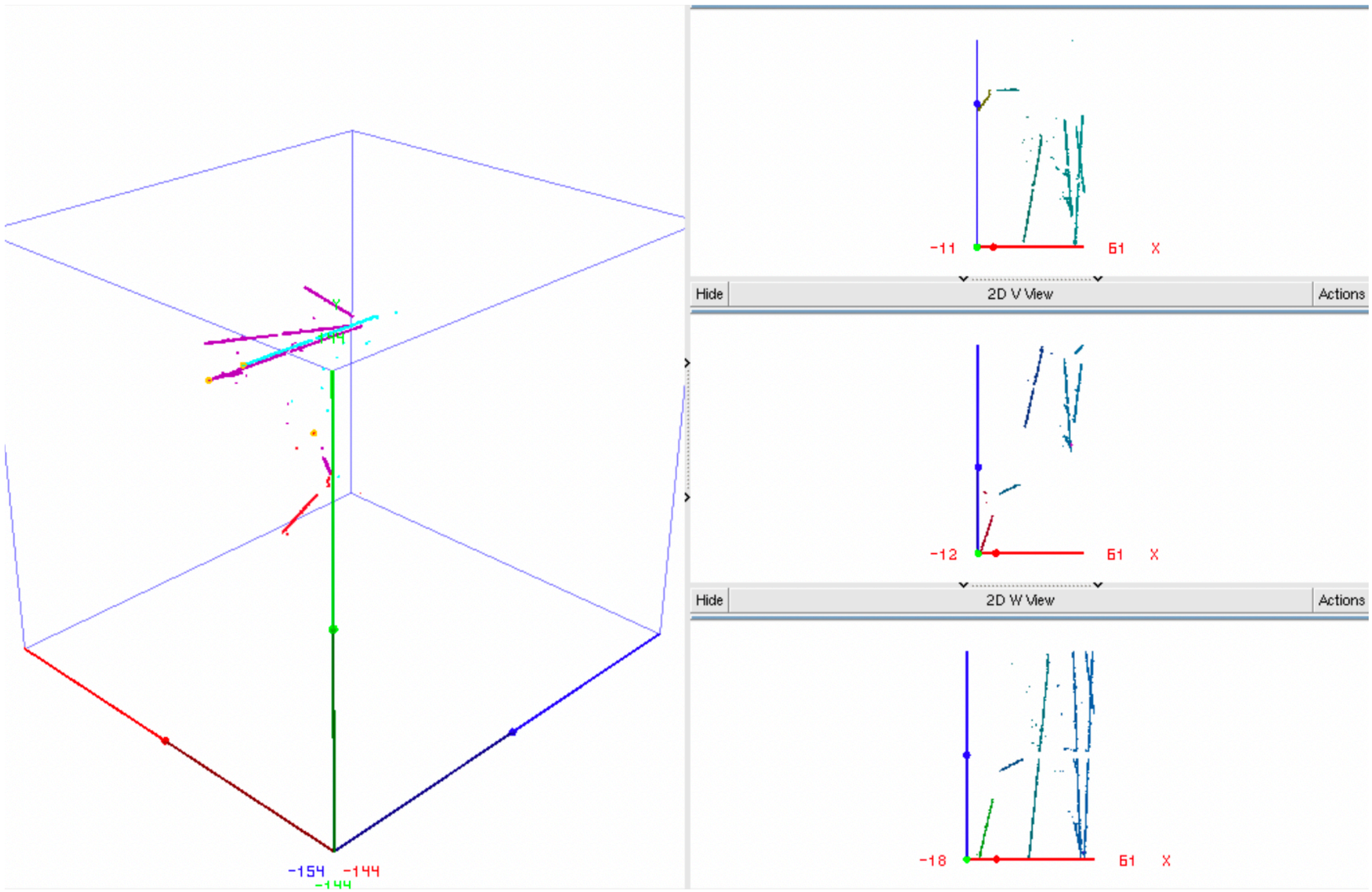
- Event 5: 2D-projection reco + initial 3D reco steps



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- We will see that this causes a problem for Pandora
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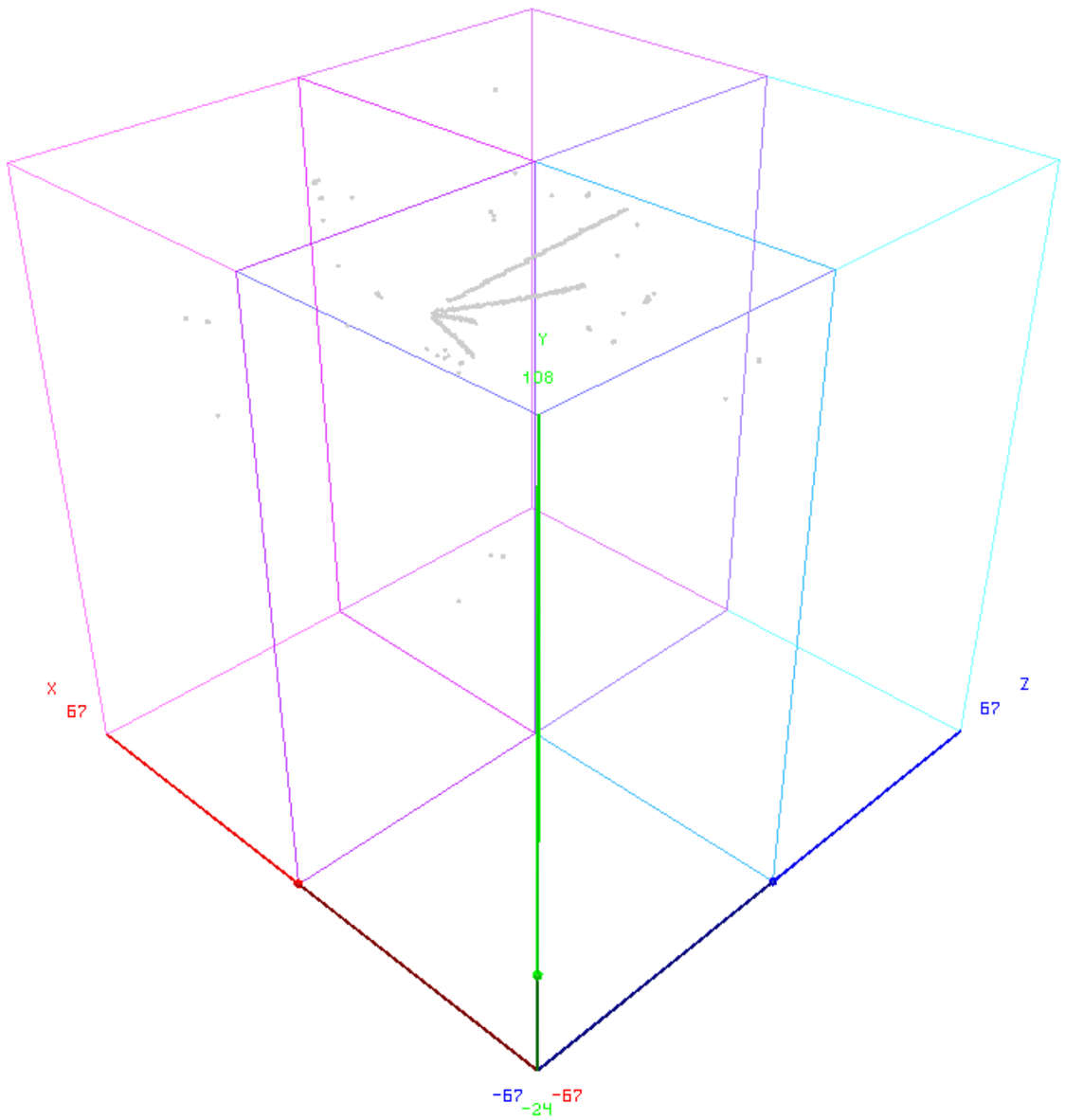
  - More likely to reconstruct as a shower than a track

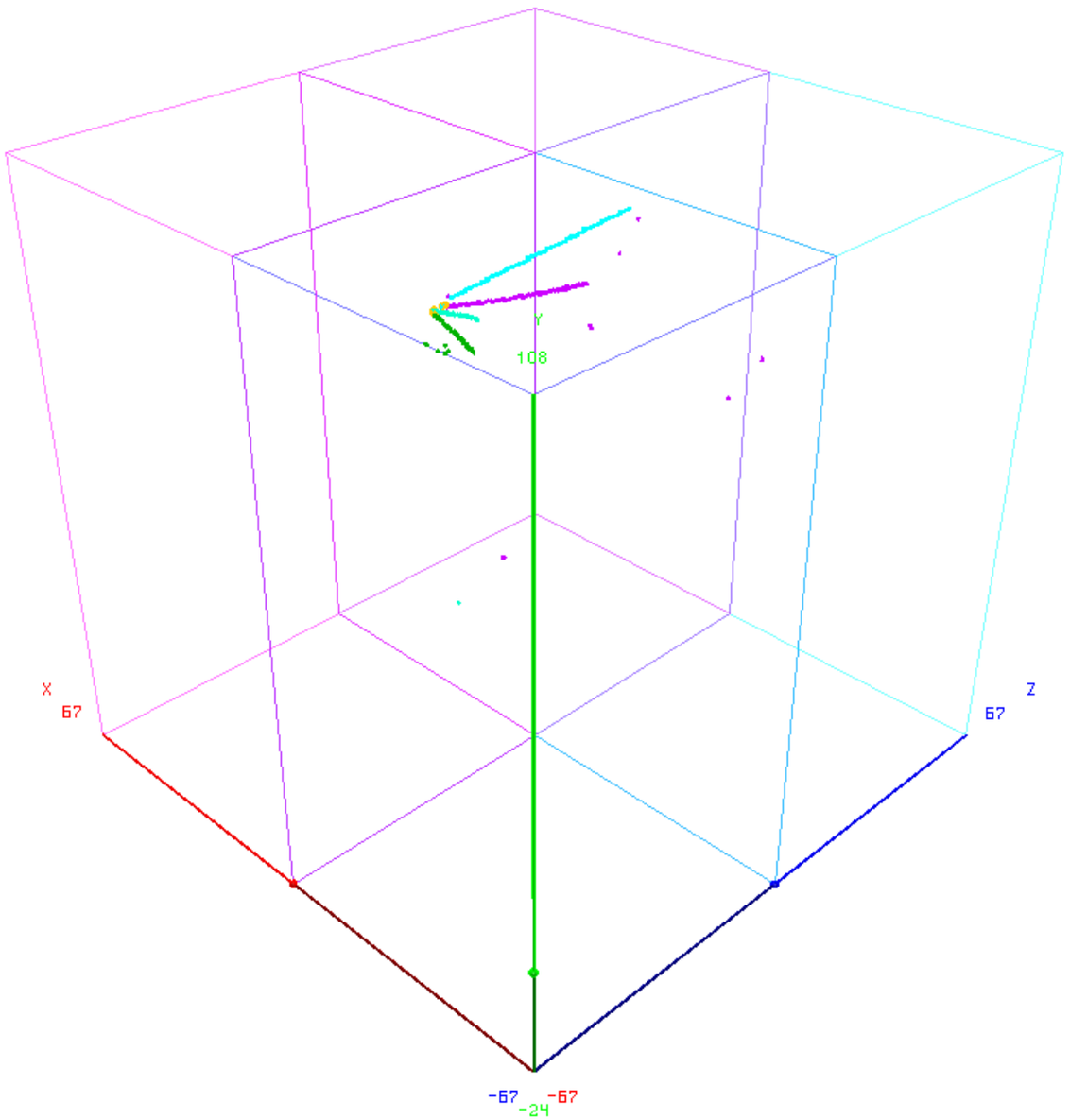
- See a similar effect in the module-0 data

- We may need to merge these hits together to ensure better reconstruction
  - Would mean the position resolution is worse in the drift direction (though, the fuzziness implies that this is true anyway?)

Reconstruction in Pandora

- For comparison, the previous EDepSim events look like this:

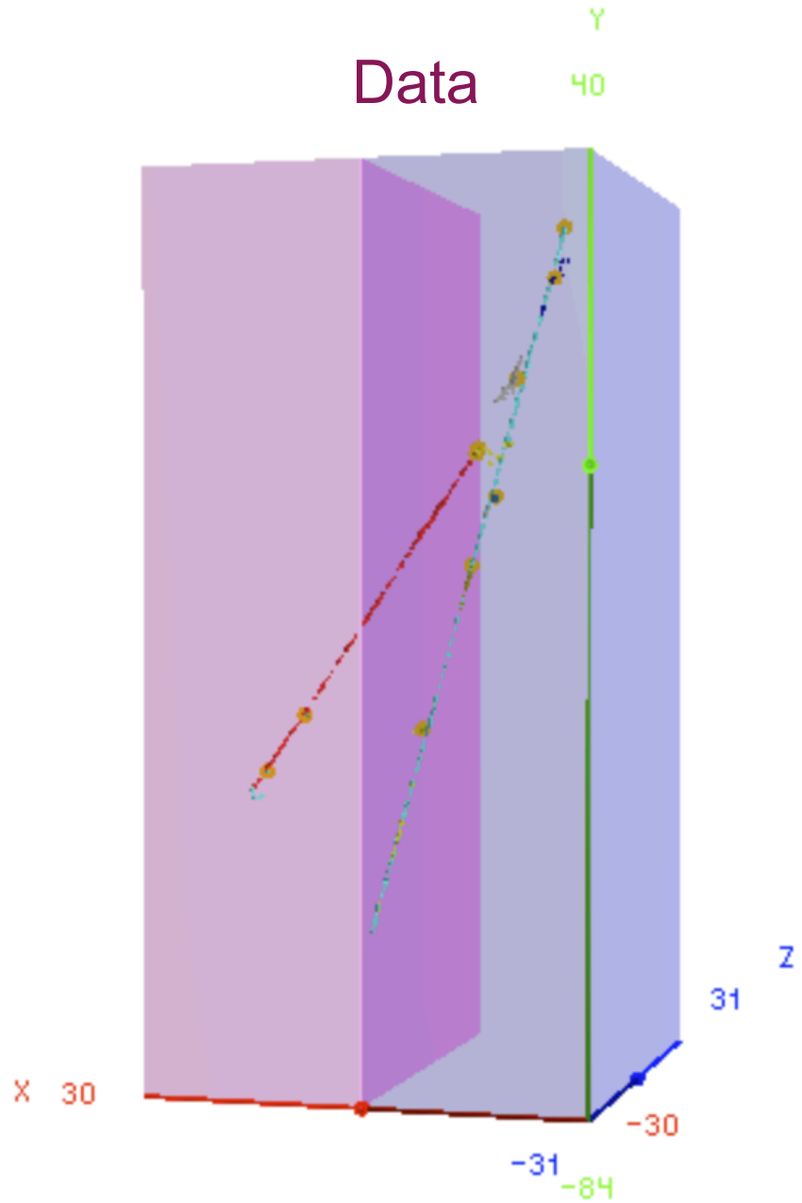




Reconstruction in Pandora

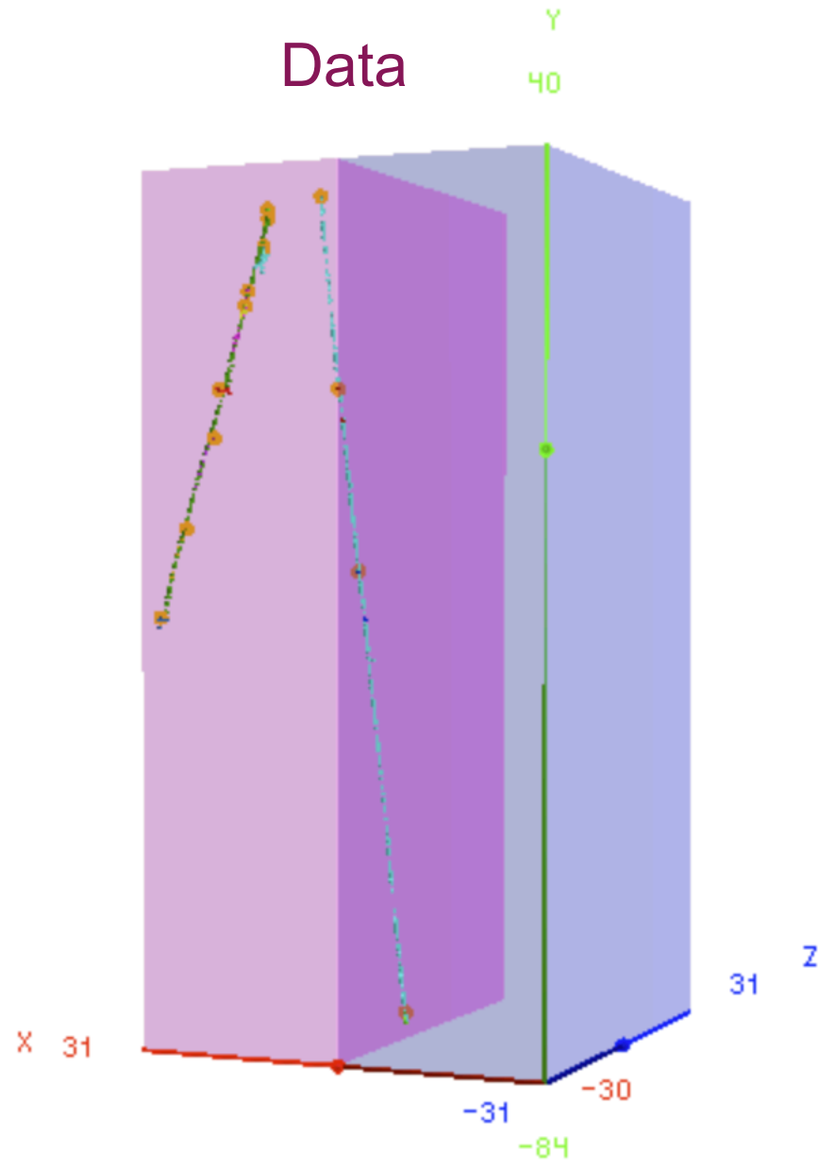
- Couple of examples from module-0

Data

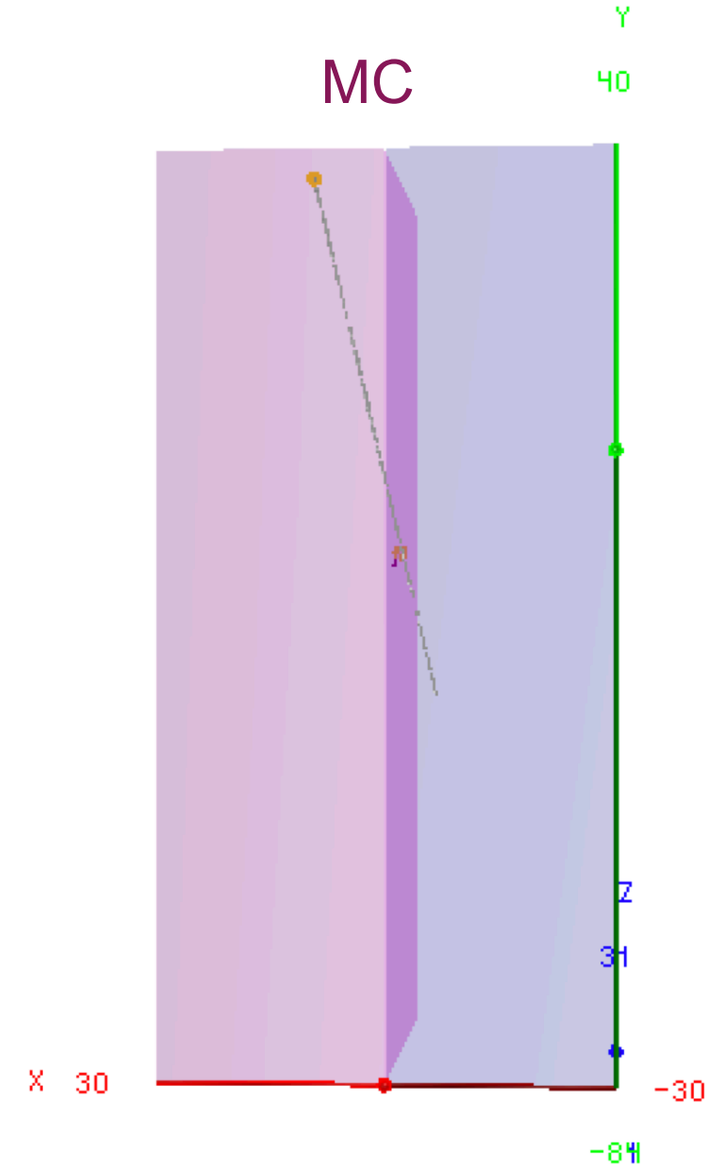


Two track event, with one “out of time” track stitched across the cathode

Data



MC



Forced cosmic reco on all events: forces objects to be reconstructed as tracks

Summary

- We’ve decoded the new version of the simulation challenge file
- We can read this information into Pandora and the objects are reconstructed to some level
- The spread of hits in the drift direction is limiting the performance
  - Means we are much more likely to reconstruct particles as showers instead of tracks
- The implementation of some simple native 3D algorithms has improved things, definitely for the final positions of the 3D hits