Raw and deconvoluted signal shapes

DUNE Far Detector Simulation and Reconstruction

David Adams

BNL

October 21, 2015

Introduction

I have been looking at LAr TPC signal spectra

Inspired by talk by Michelle at Oct. 13 FD physics meeting

- https://indico.fnal.gov/conferenceDisplay.py?confId=10567

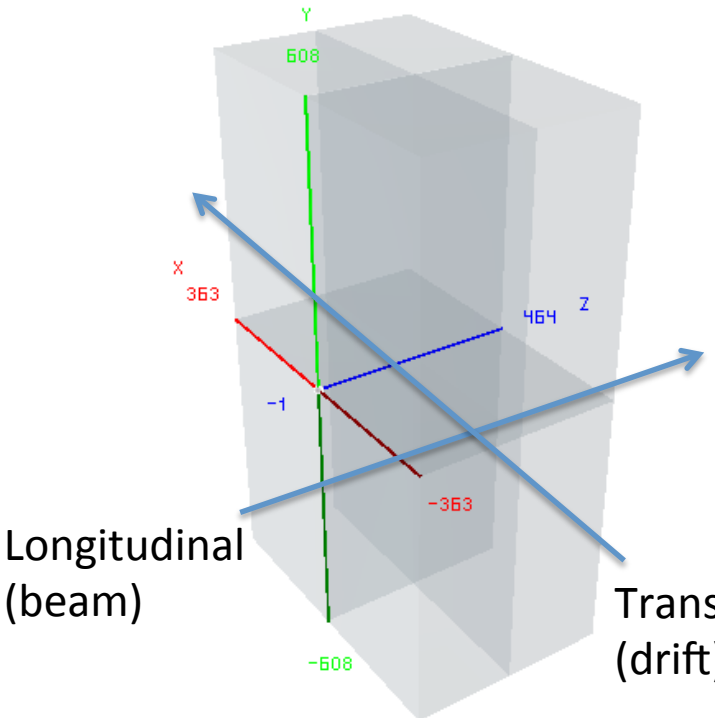
See my talk at the last 35 ton sim/reco meeting

- https://indico.fnal.gov/conferenceDisplay.py?confId=10604
- Strange results for detector simulation
  - Raw signal is narrower in channels than SimChannel signal
- And I see some issues with the deconvolution
  - Negative tails on the deconvoluted signal
  - Width large compared to SimChannel for short drift
  - Signal disappears at long drift for very wide signals
- Issue of deconvolution normalization now understood to be due to calibration: ADC count -> fC
  - I have not (yet) checked that the normalization is as expected

Introduction

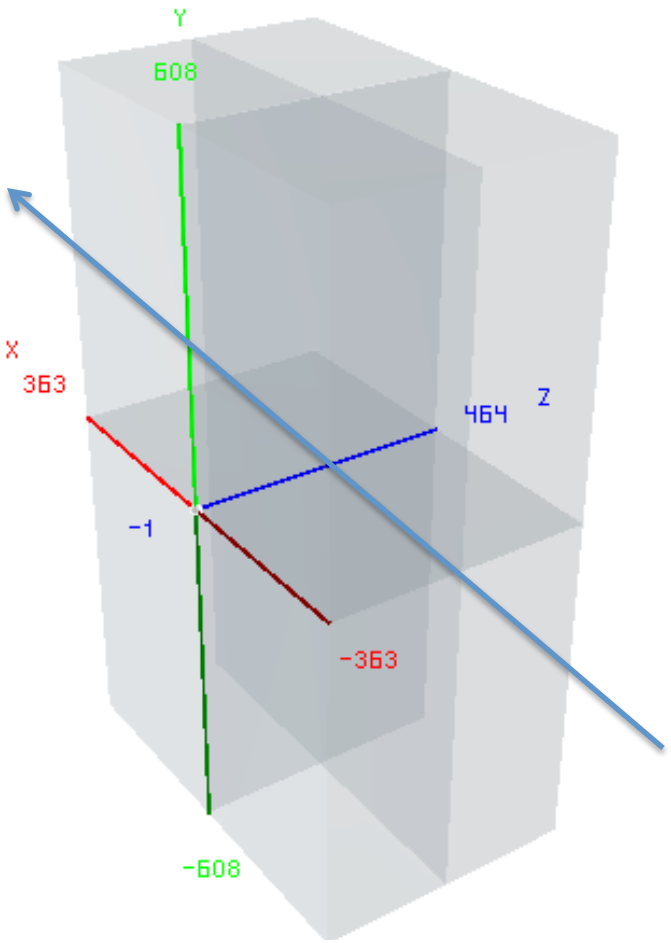
Simulation studies

- Throw horizontal single muons at 35t or FD workspace detector
- Transverse muons (along *x*)
  - Perpendicular to wire plane
  - To study signal shape as a function of channel
- Longitudinal muons (along *z*)
  - Parallel to wire plane
  - To study signal shape as a function of TDC tick
- Select ticks or channels by hand where signal is
  - in expected direction
    - not scattered
  - and narrow
    - no delta rays

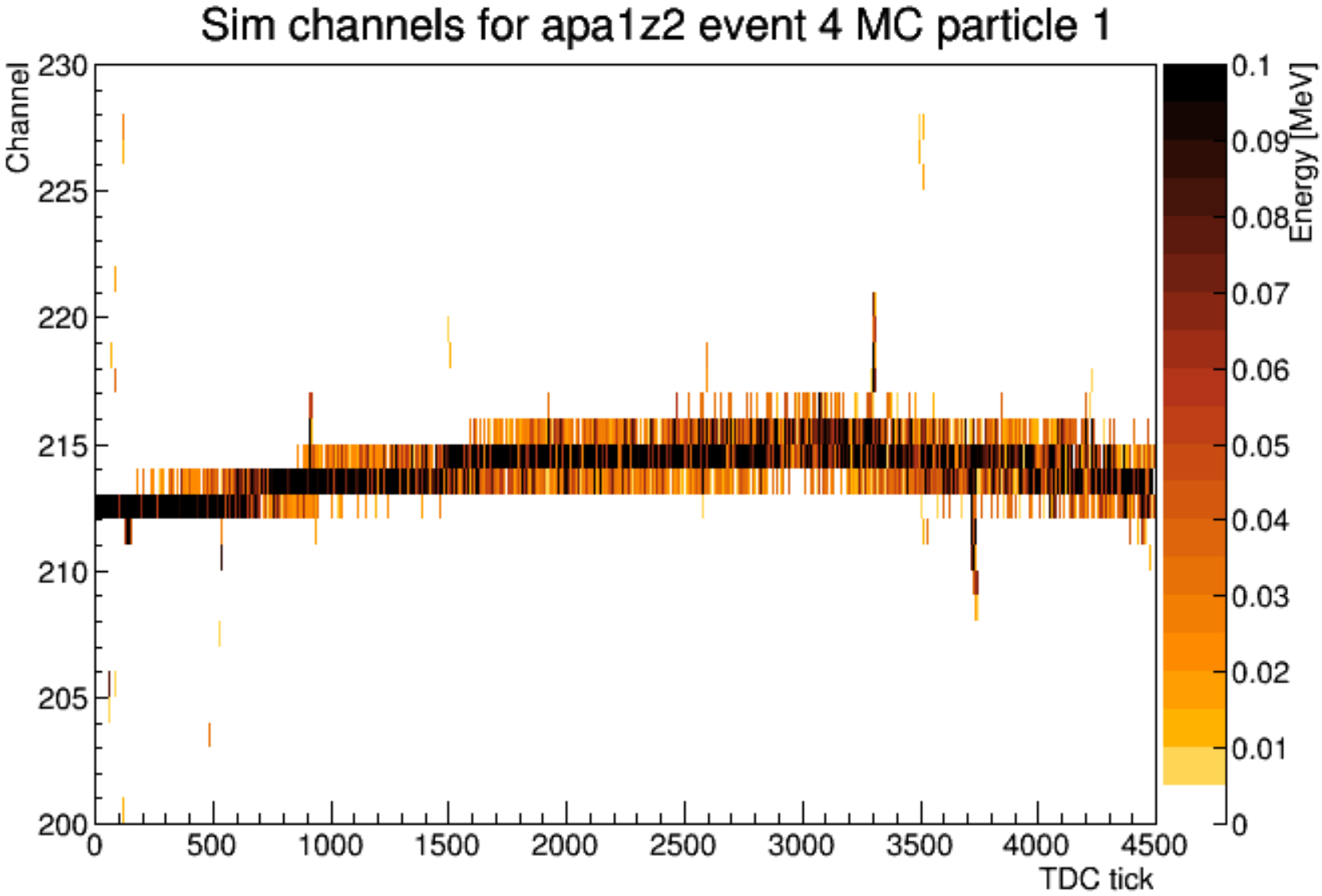


10 kt workspace

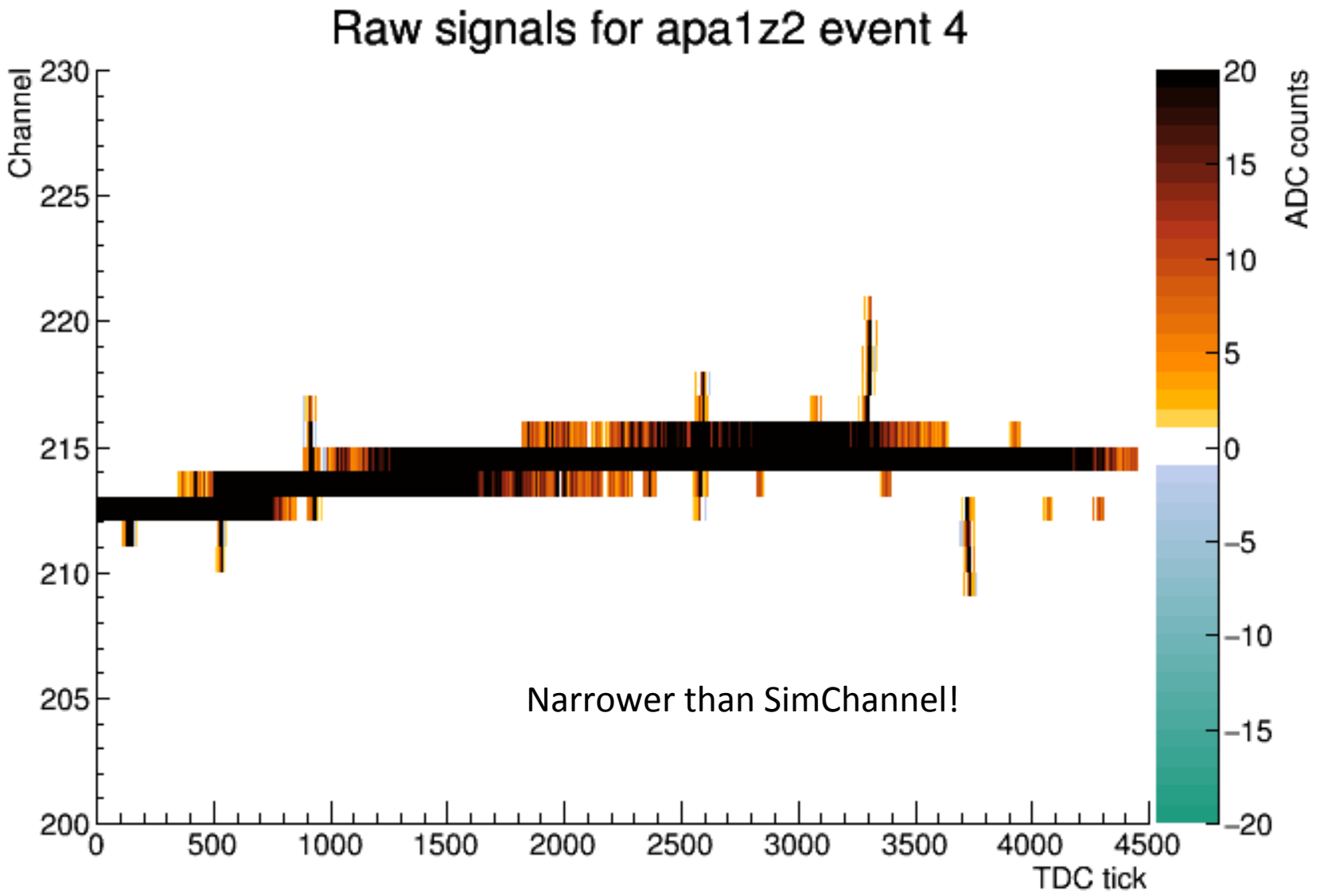
Transverse muons



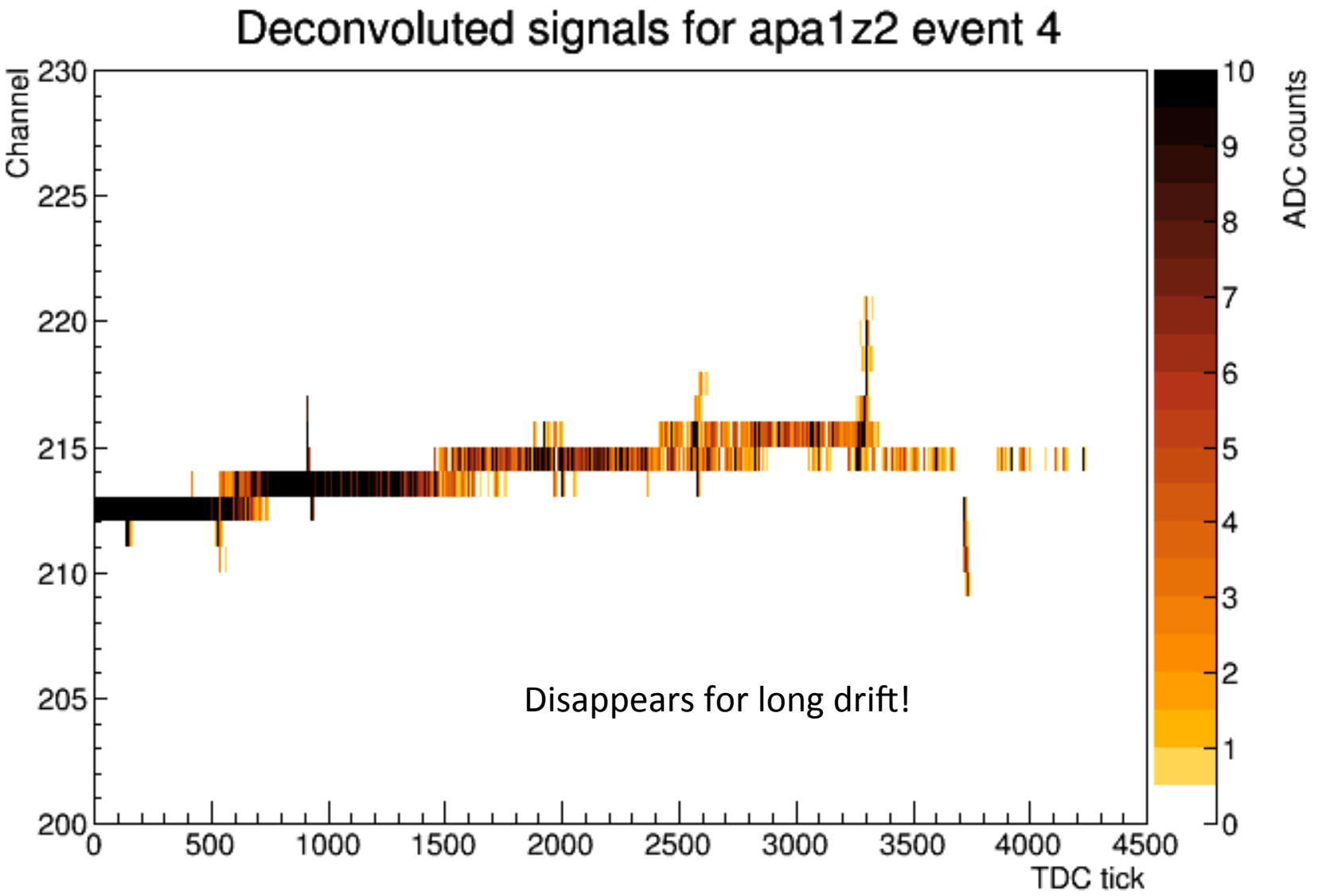
SimChannel channel vs. tick



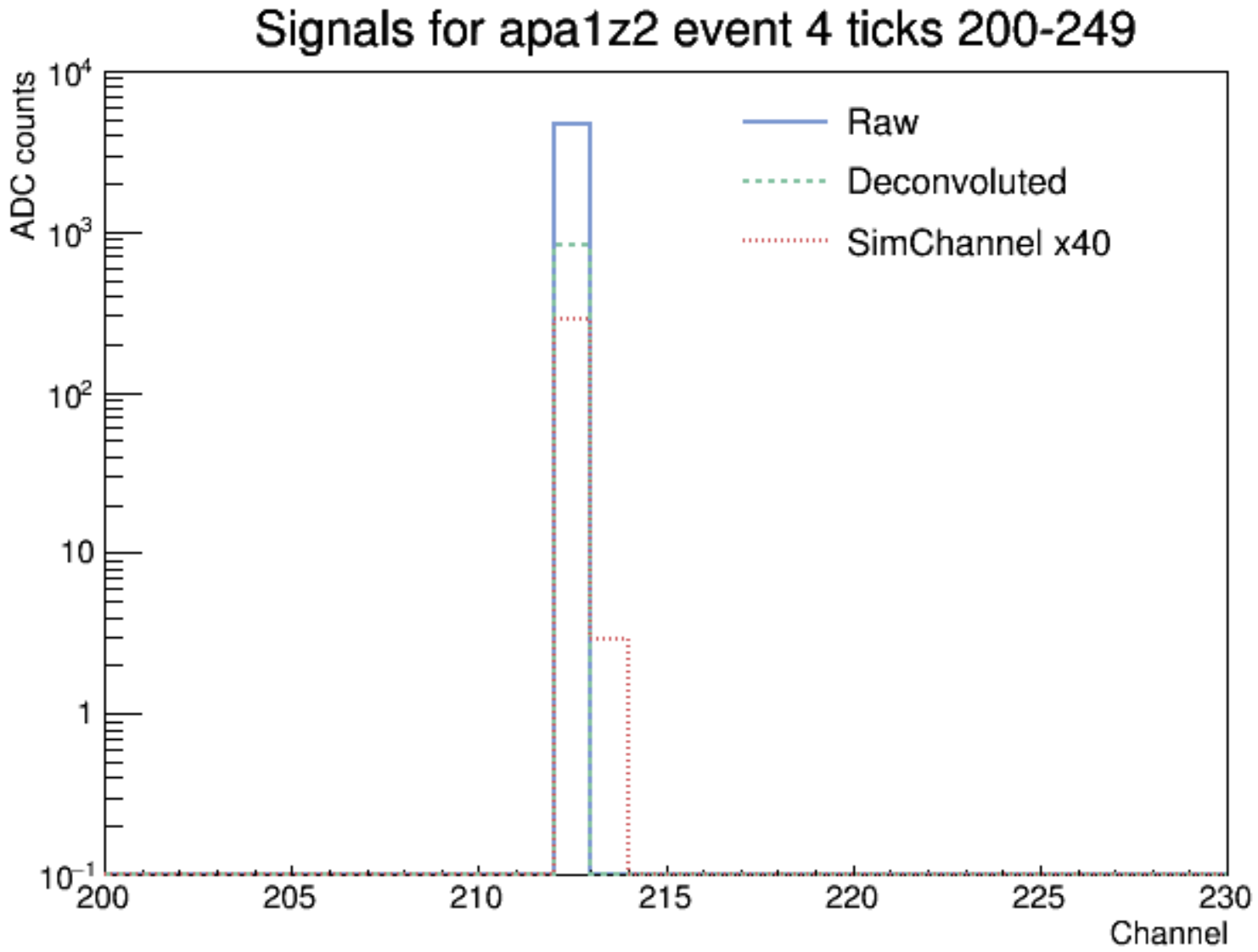
Raw channel vs. tick



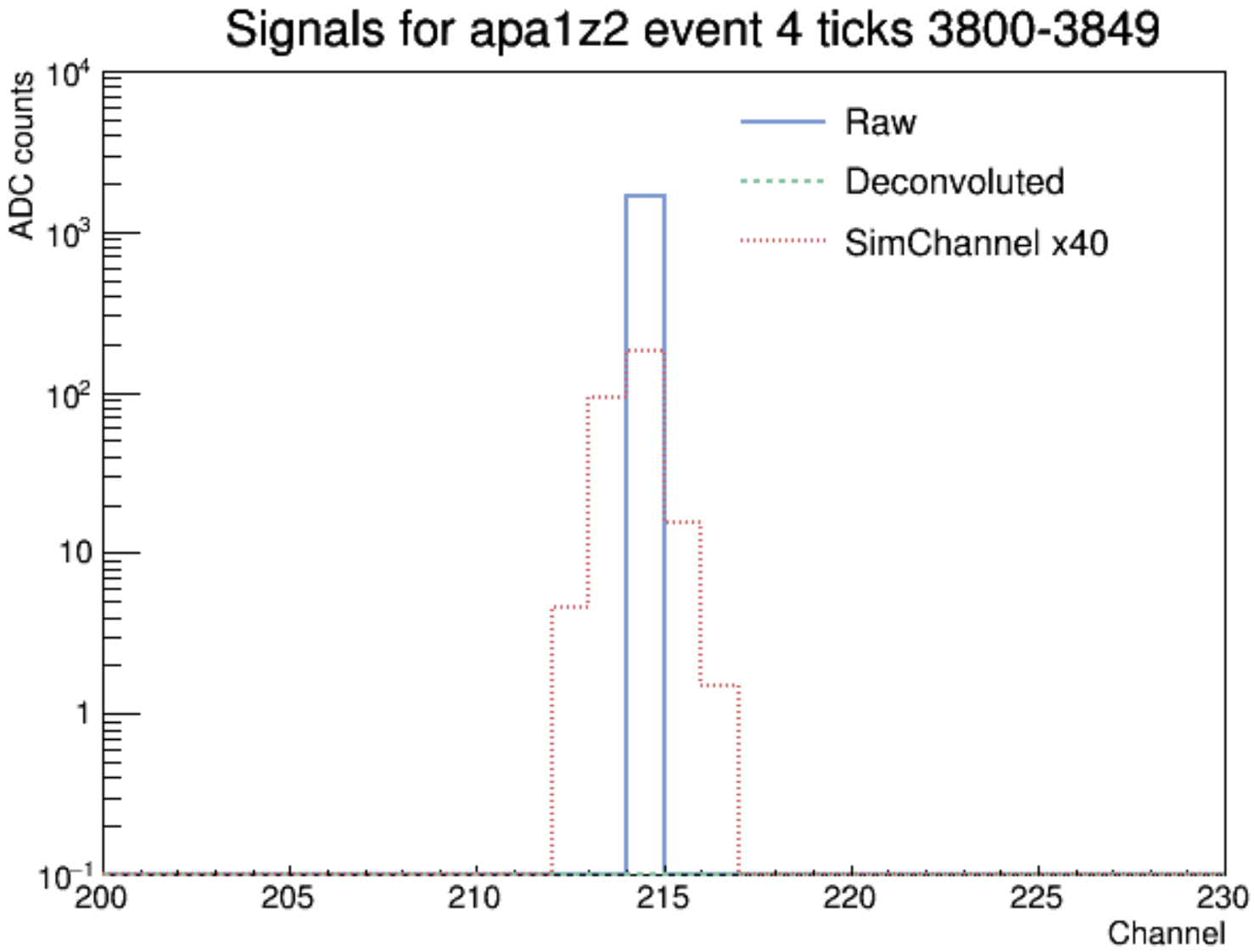
Deconvoluted channel vs. tick



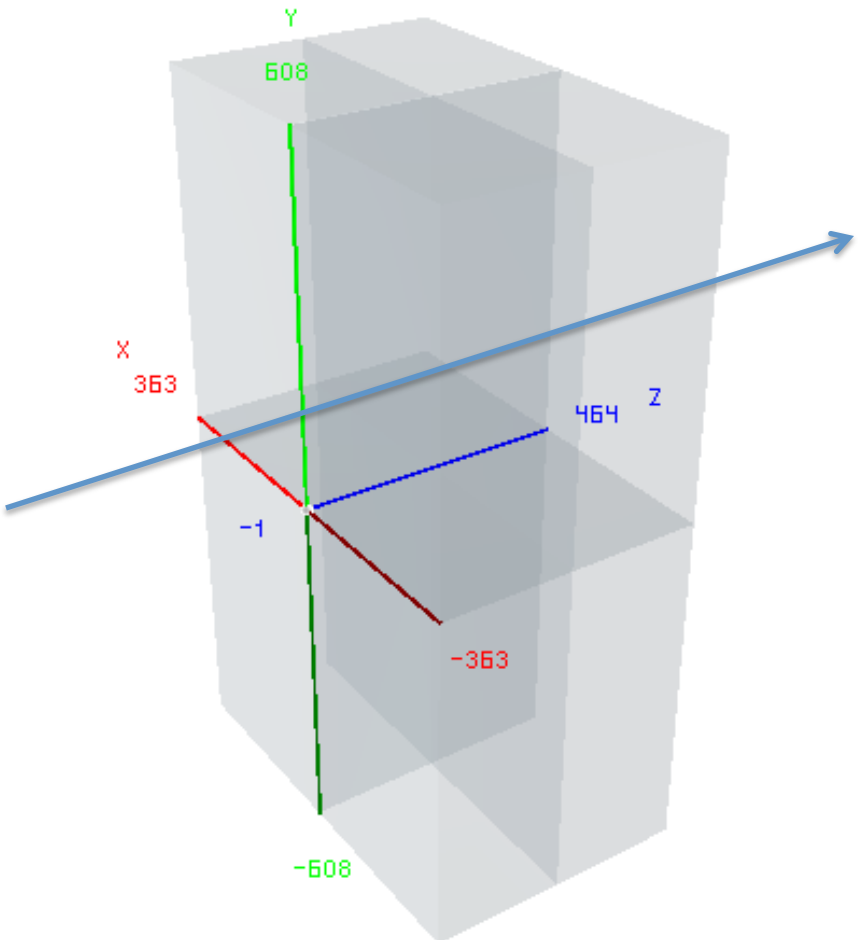
Channel signal shapes: short drift



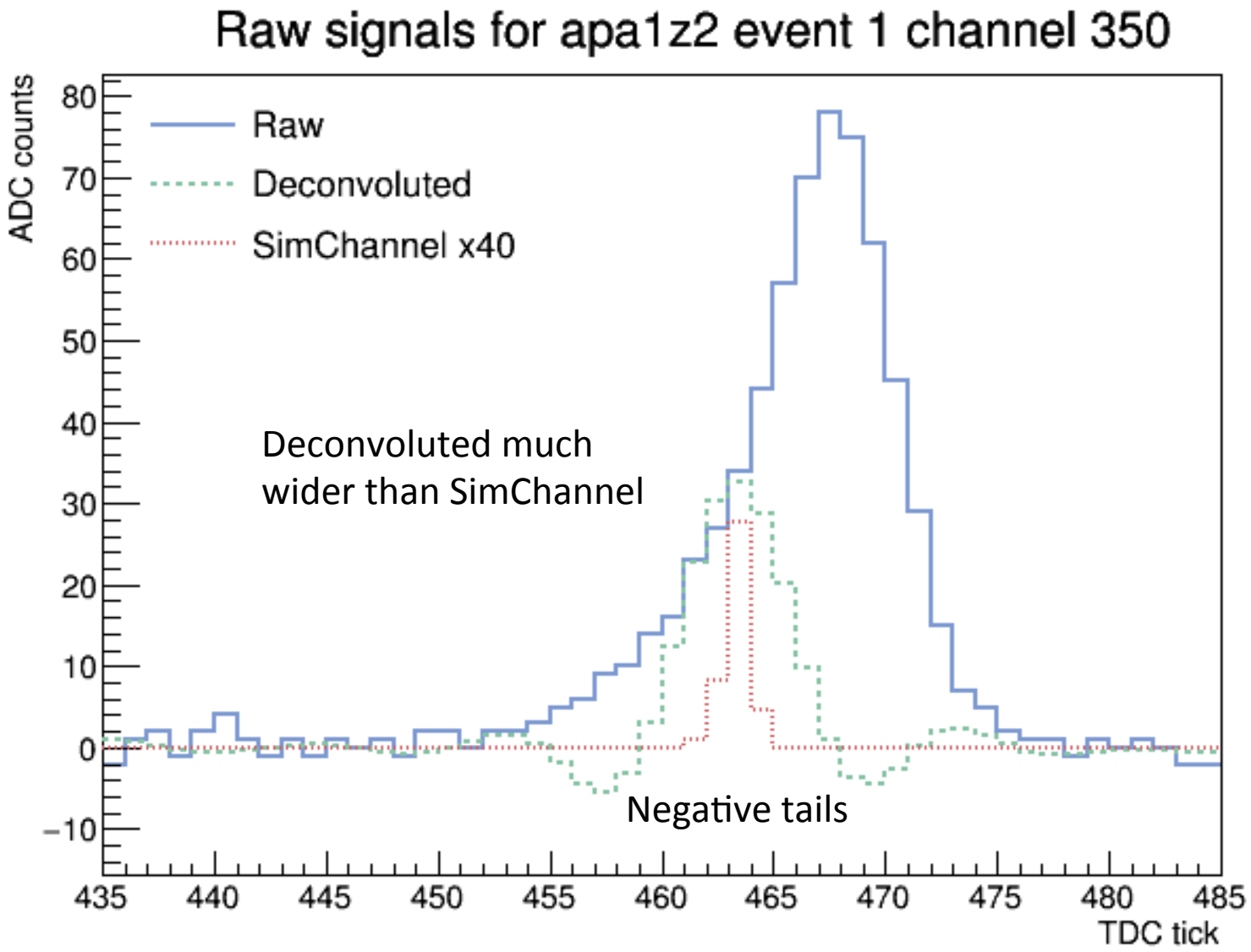
Channel signal shapes: long drift



Longitudinal muons



TDC signal shapes for 10 ktw: short drift



Comments

Simulation

- How can raw signal be narrower (in channels) than SimChannel?
  - Raw is derived from SimChannel
  - Zero suppression keeps neighboring channels
  - Signal is well above a single ADC count

Deconvolution

- Negative tails evident
  - Make me worry about resolution
    - different response for different signal widths
  - Removing tails might improve two-track separation
- Very long signal (perp to wire plane) disappears at long drift
  - Due to low-frequency filter? If so, why filter?
- Deconvoluted signal is much wider than the (very narrow) SimChannel at short drift
  - Maybe deconvolute as a function of drift?
  - To obtain better time resolution for short drifts

Conclusions

Number of issues raised for simulation and deconvolution

- See preceding page

I will continue to study these

- Now have a standalone (i.e. no art framework) example making use of the 35 ton deconvolution service
- This was crashing but problem tracked to issue of histogram management
  - Both and DUNE were deleting a histogram
  - Plan to protect DUNE against this
  - Although problem does not manifest in normal DUNE running (with art)
- Likely will make a standalone program that reads raw histograms and runs deconvolution on them

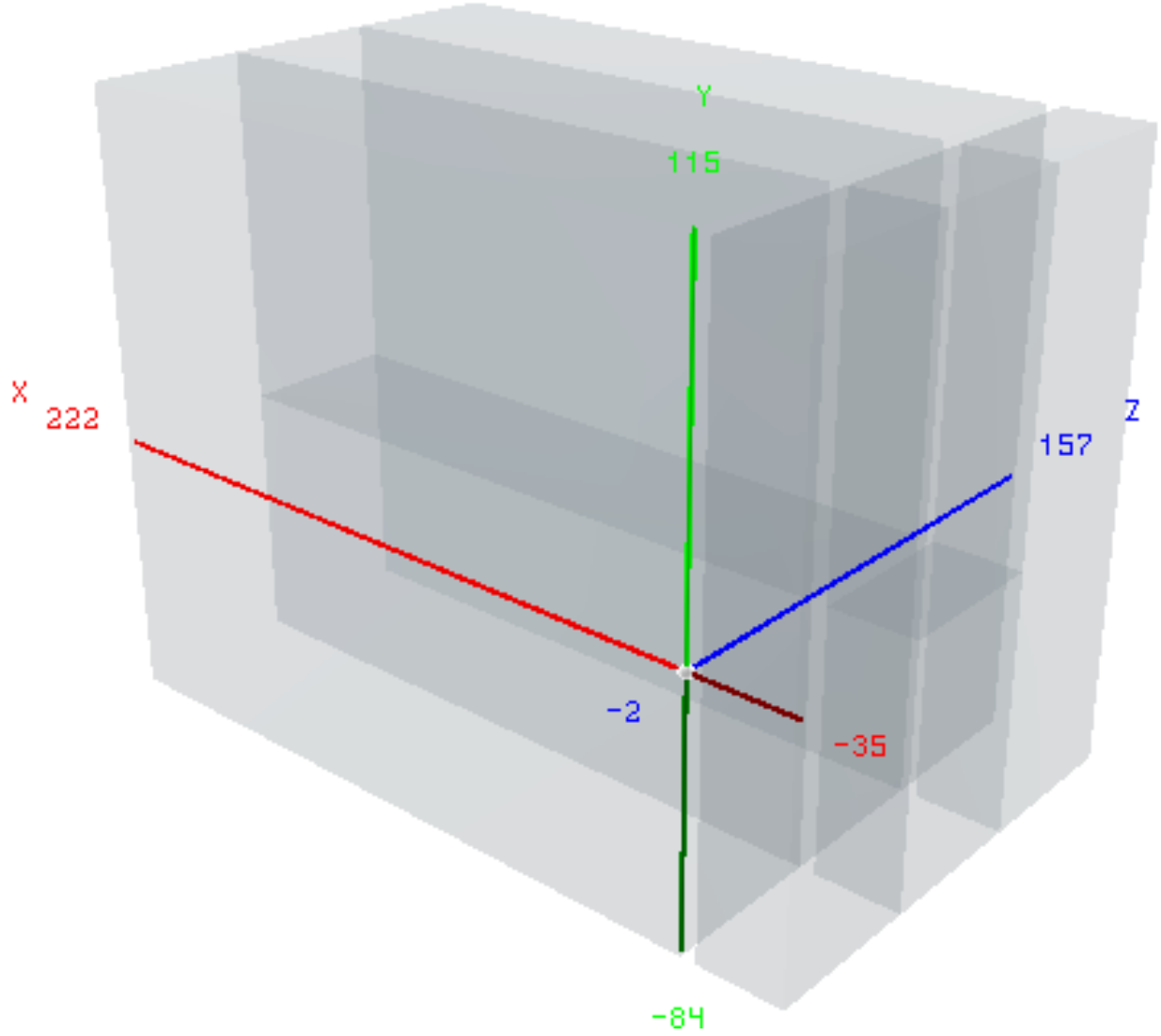
Extras

Other issues

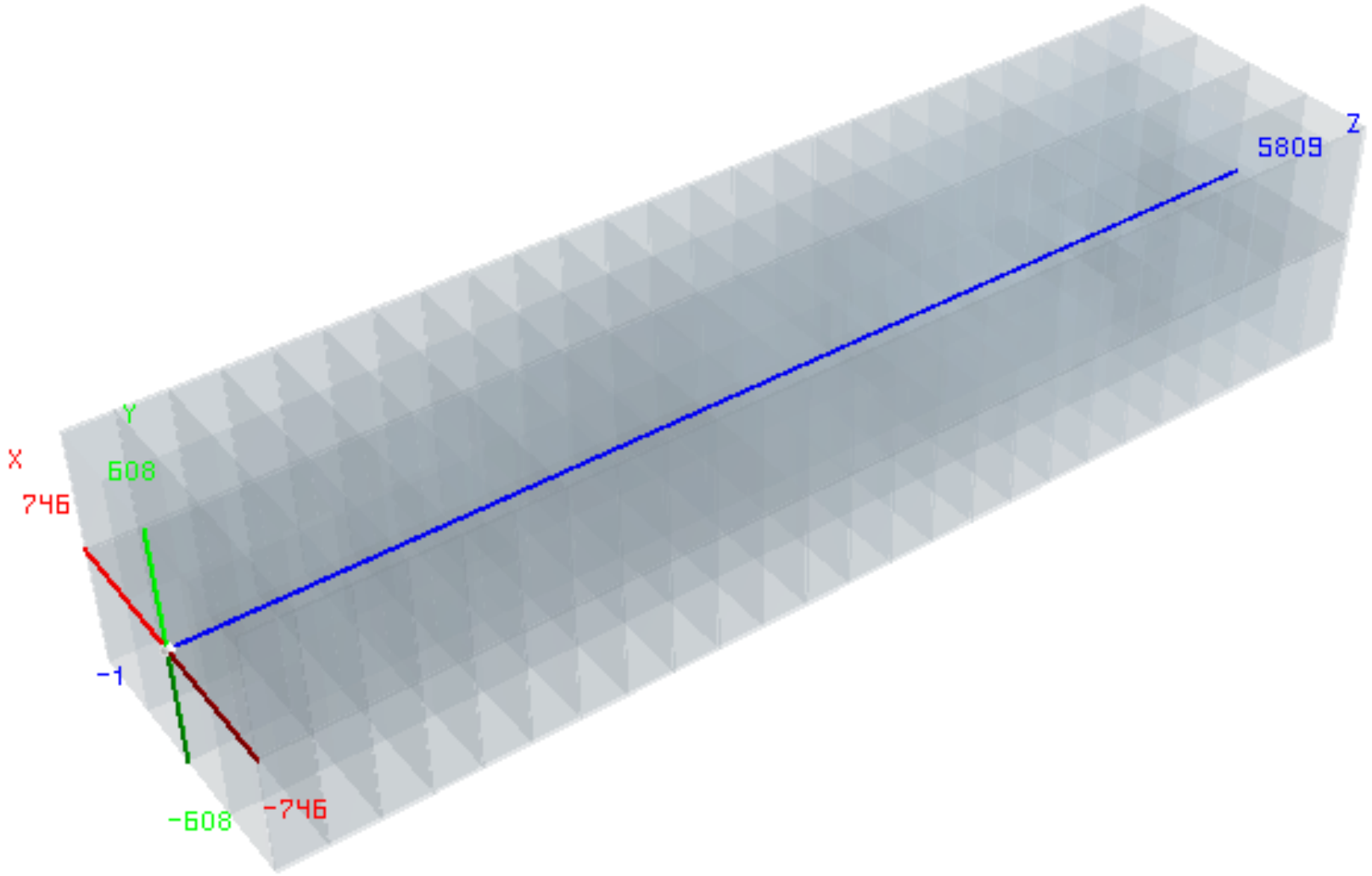
Detector displays

- Made with draw_detector

dune35t4apa_v5



dune10kt_v1



dune10kt_v1_workspace