Raw and deconvoluted signal shapes: Zero suppression

DUNE 35-ton
Simulation and Reconstruction

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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

Procedure

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

Longitudinal (beam)

Transverse (drift)

10 kt workspace
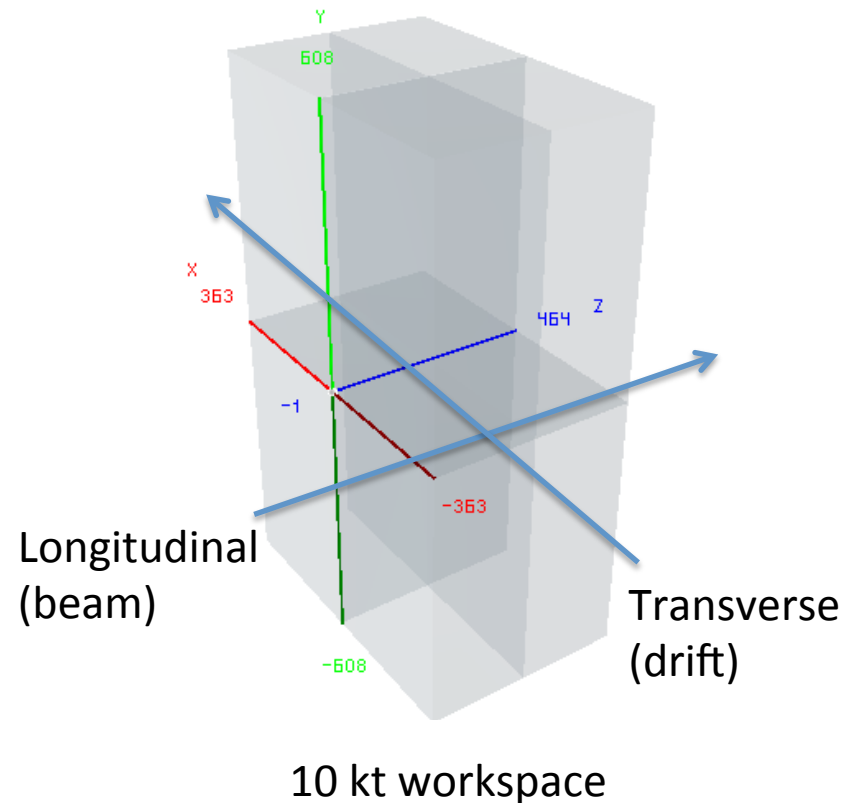
New results

The following slides show some new results

- Same procedure as earlier talks except
  - Random seeds are now reproducible
    - So I can look at the same events with different releases or configuration
  - Now show both with and without ZS (zero suppression)
    - fcl: physics.producers.daq.CompressionType: "none"
    - SimChannel should not be (and is not) affected
    - Raw includes ZS and is affected
    - Deconvoluted is derived from raw and so is affected
- Transverse muons are used
- FD workspace detector
- SimChannel, raw and deconvoluted shown for event 1
- Raw are shown for a few more events
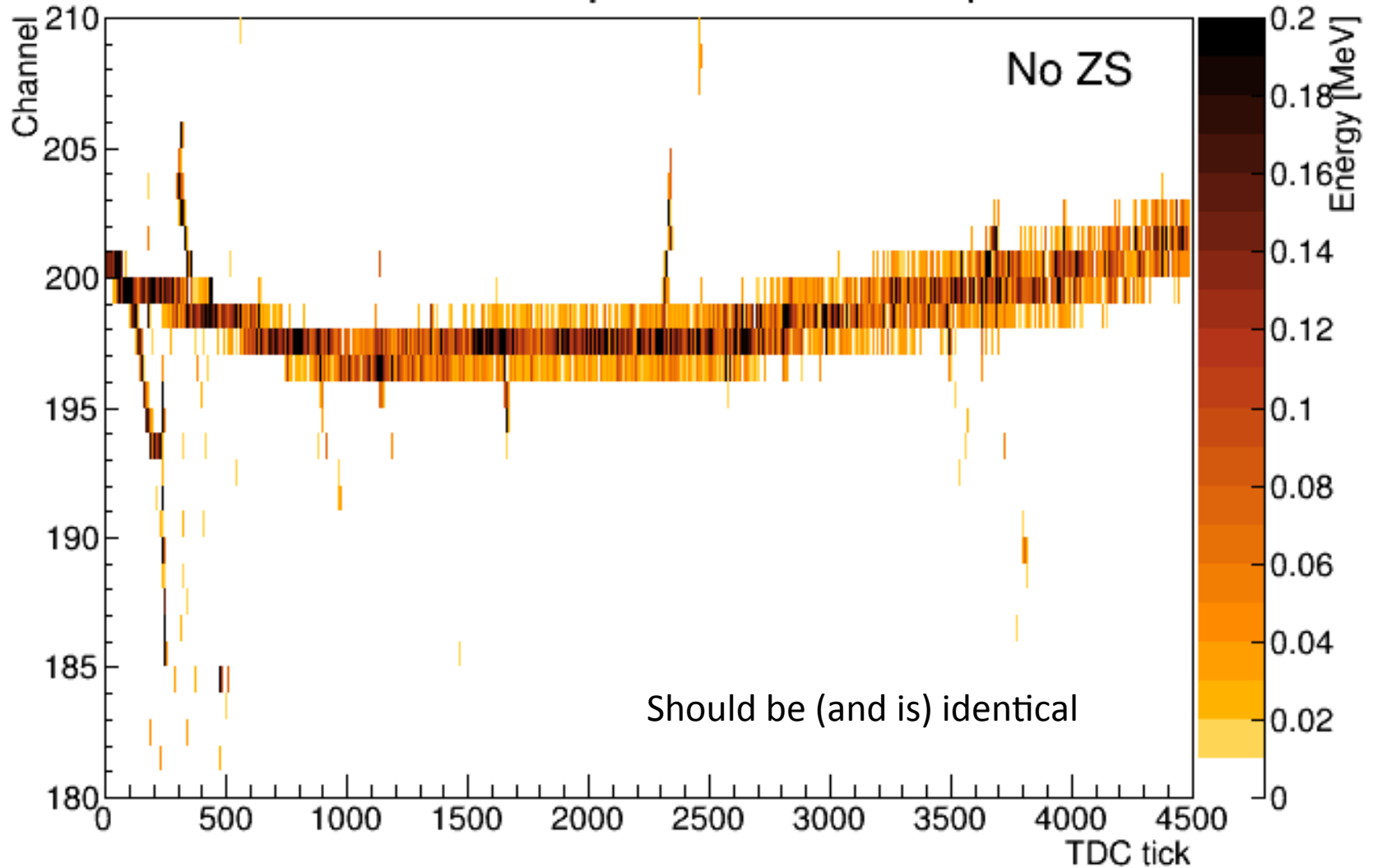- Note that a threshold of 5 ADC counts is now used for the raw spectra
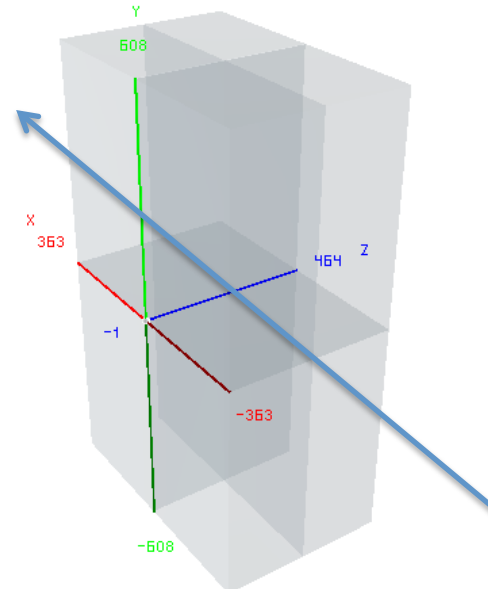
SimChannel with ZS
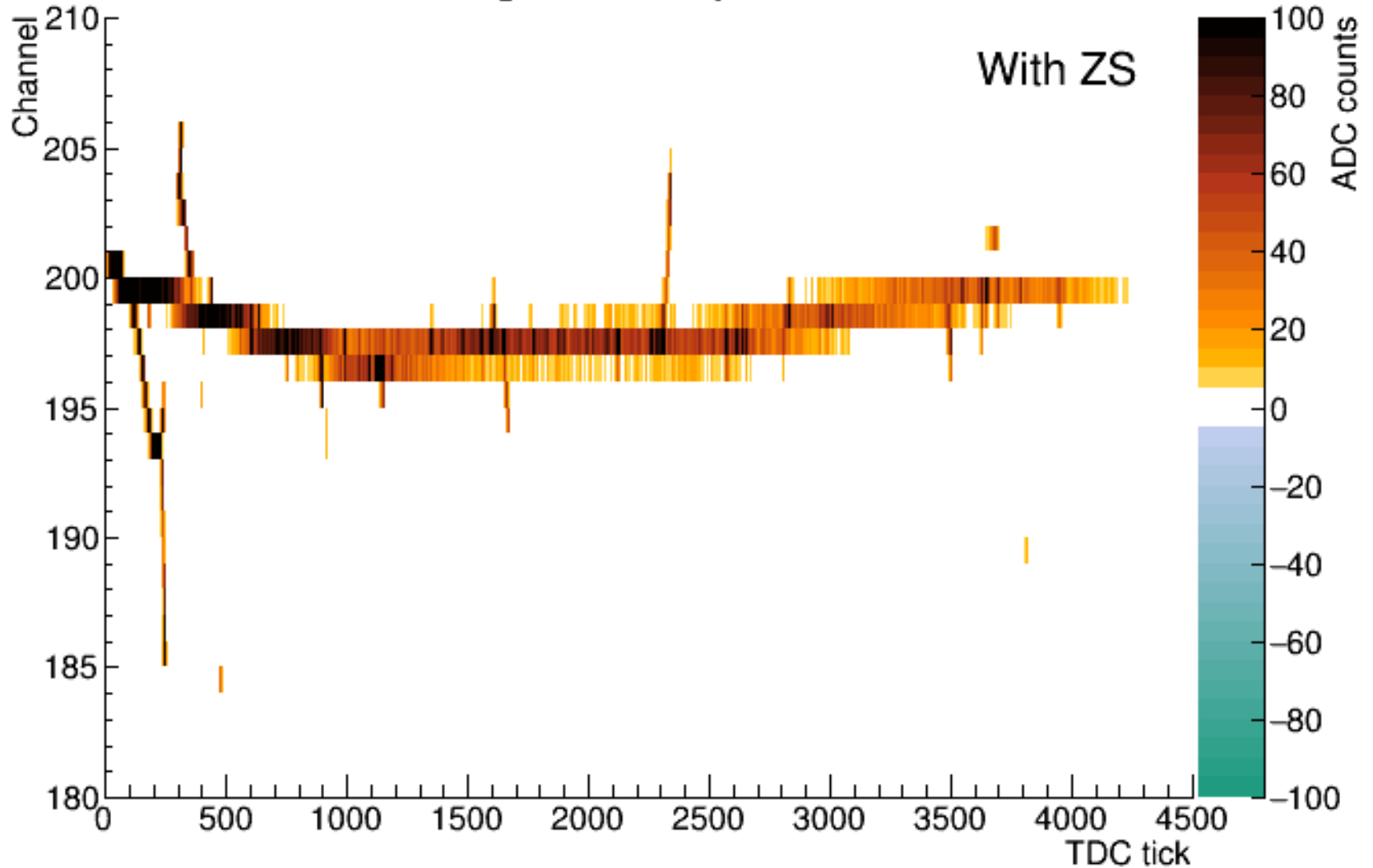

Sim channels for apa1z2 event 1 MC particle 1
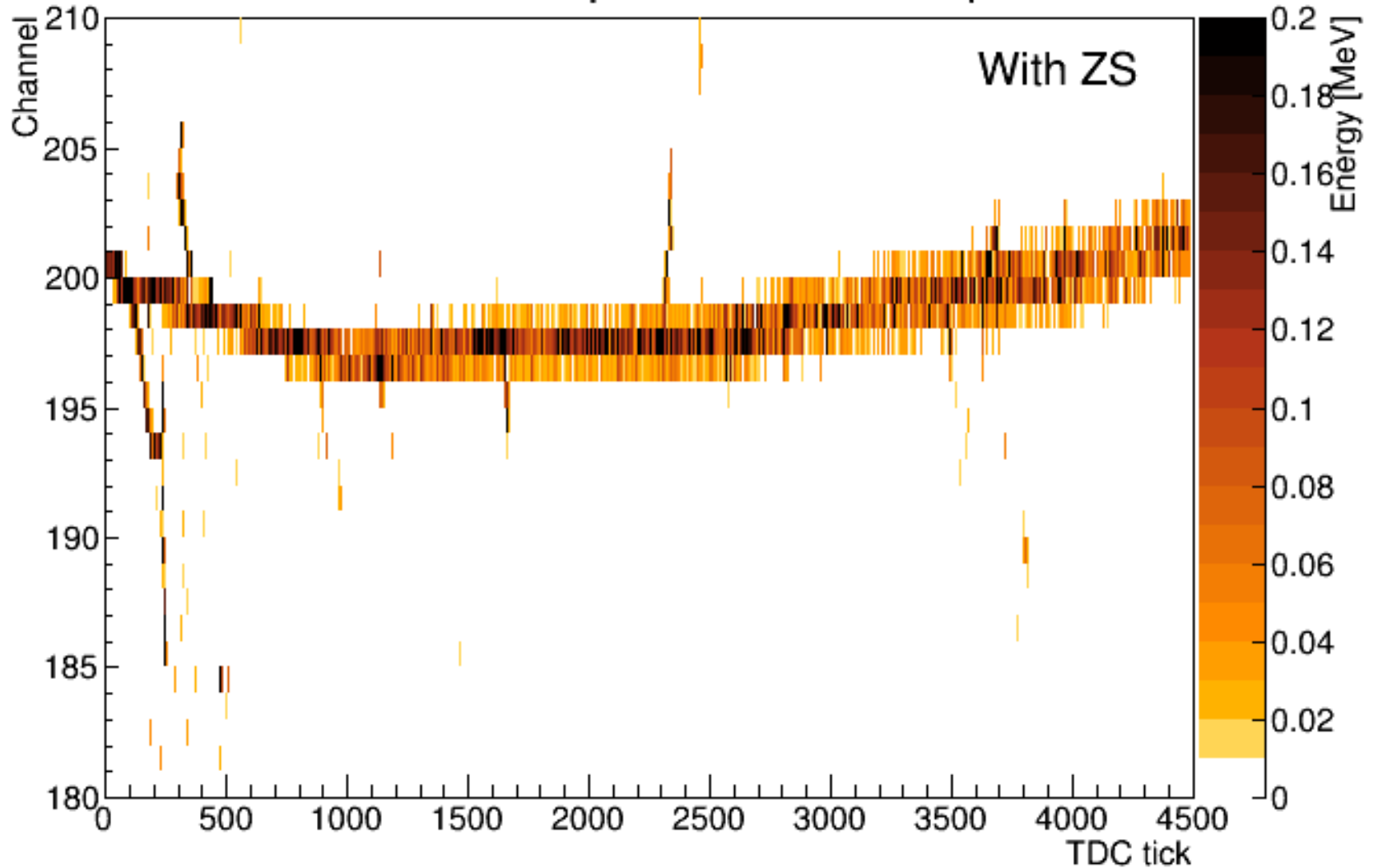
With ZS

SimChannel w/o ZS

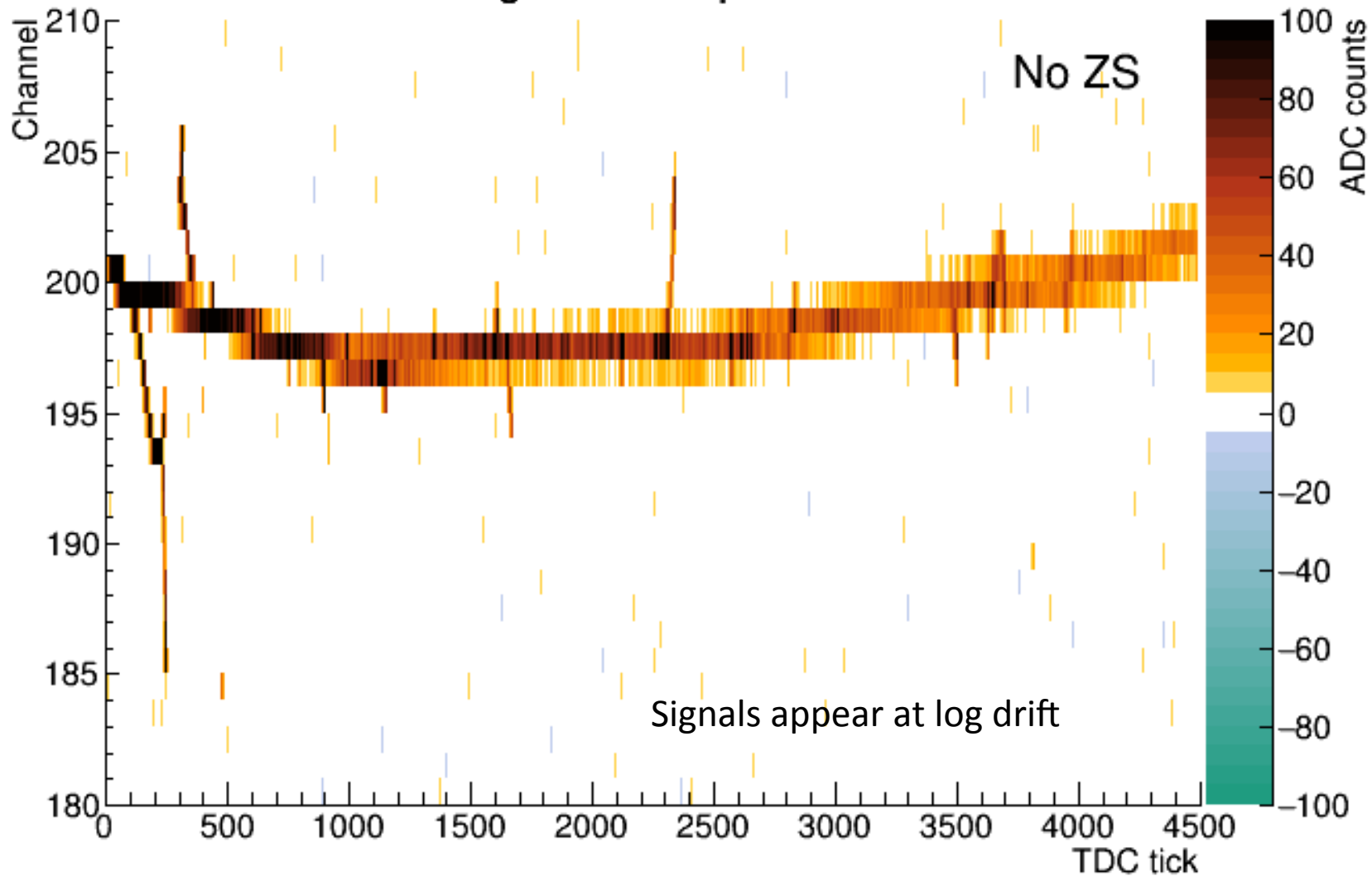Sim channels for apa1z2 event 1 MC particle 1

No ZS

Should be (and is) identical

Raw signals with ZS

Raw signals for apa1z2 event 1

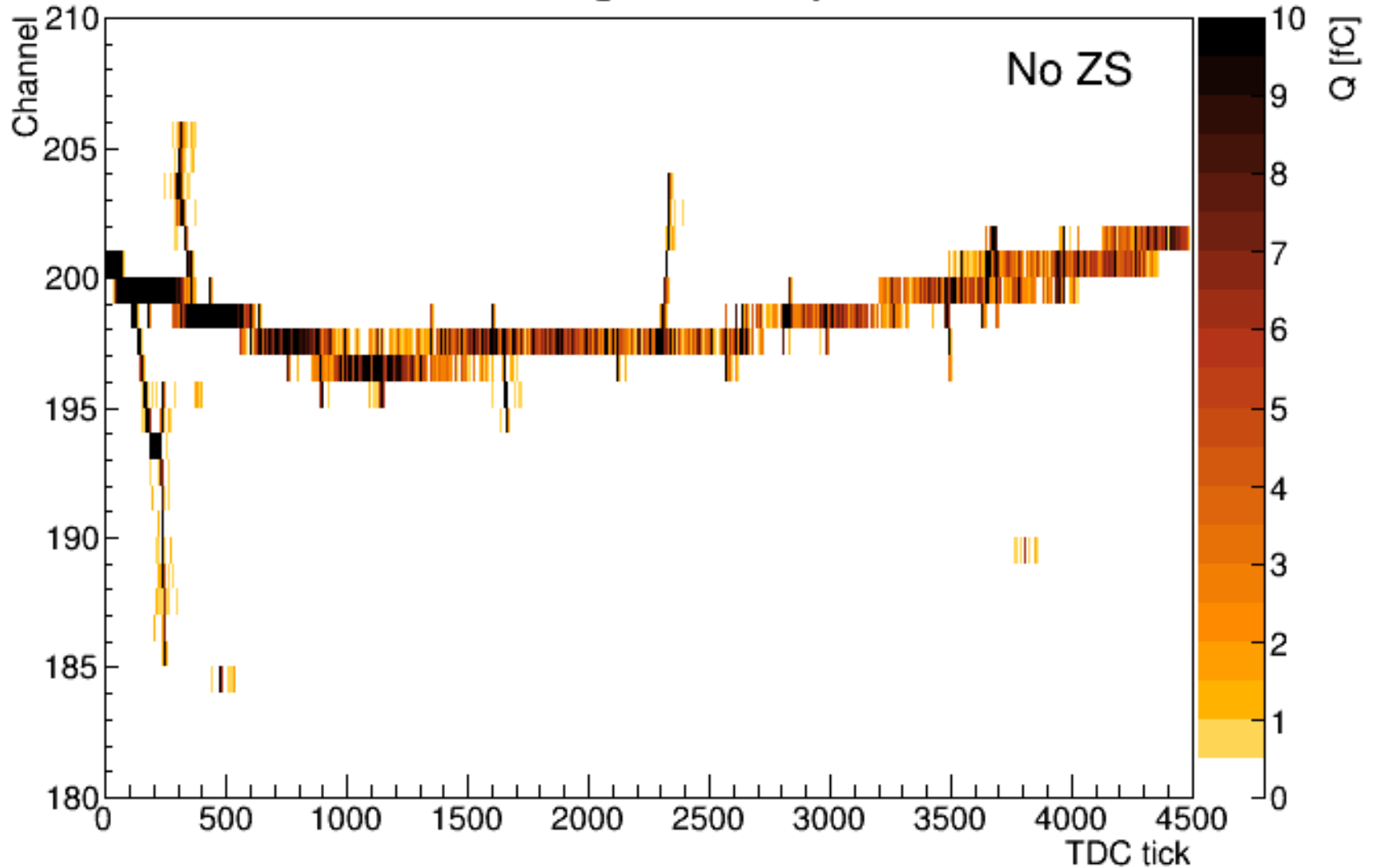# Raw signals w/o ZS

Raw signals for apa1z2 event 1

No ZS

Signals appear at log drift

Deconvoluted with ZS
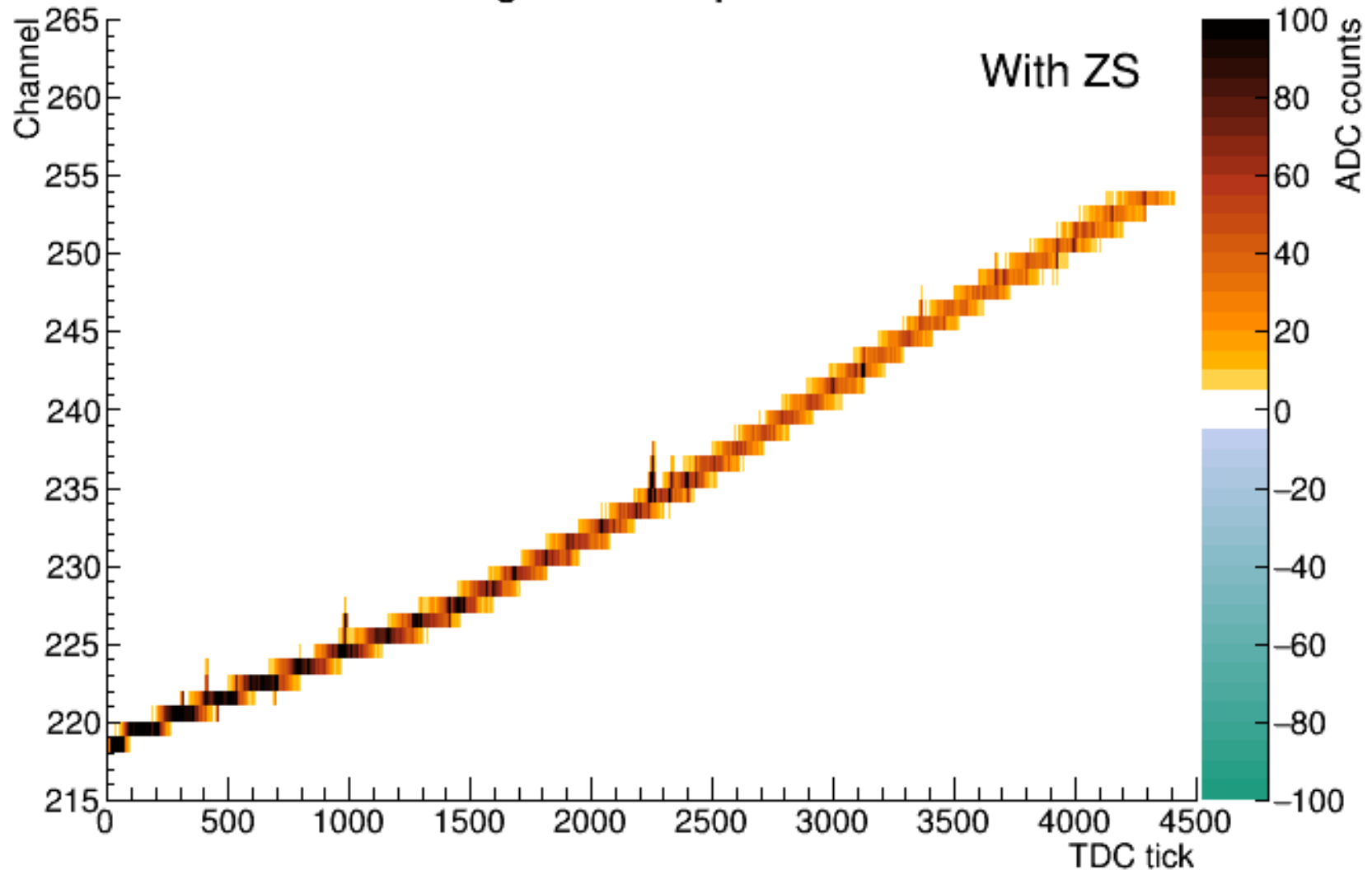

Deconvoluted signals for apa1z2 event 1
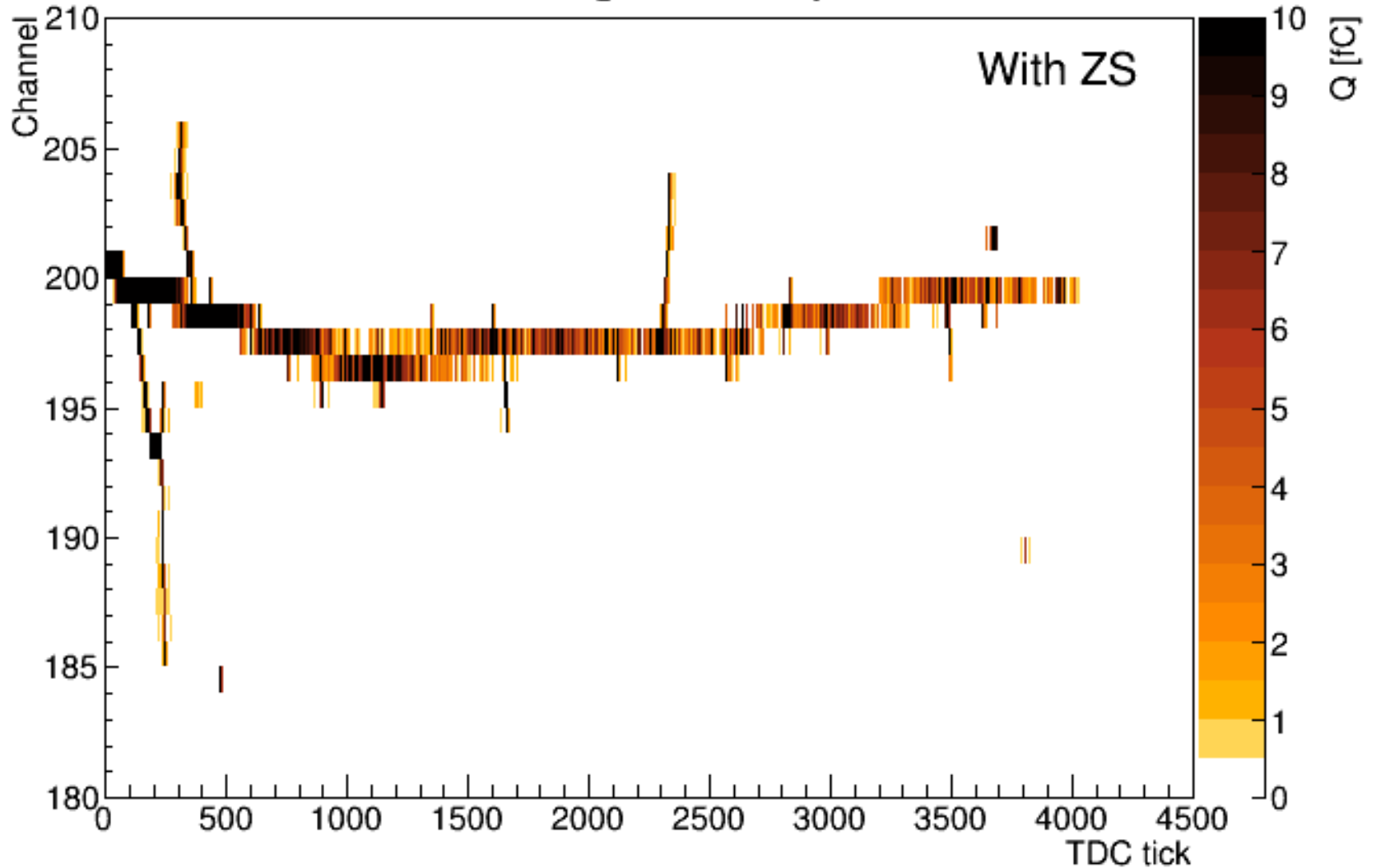
Deconvoluted w/o ZS

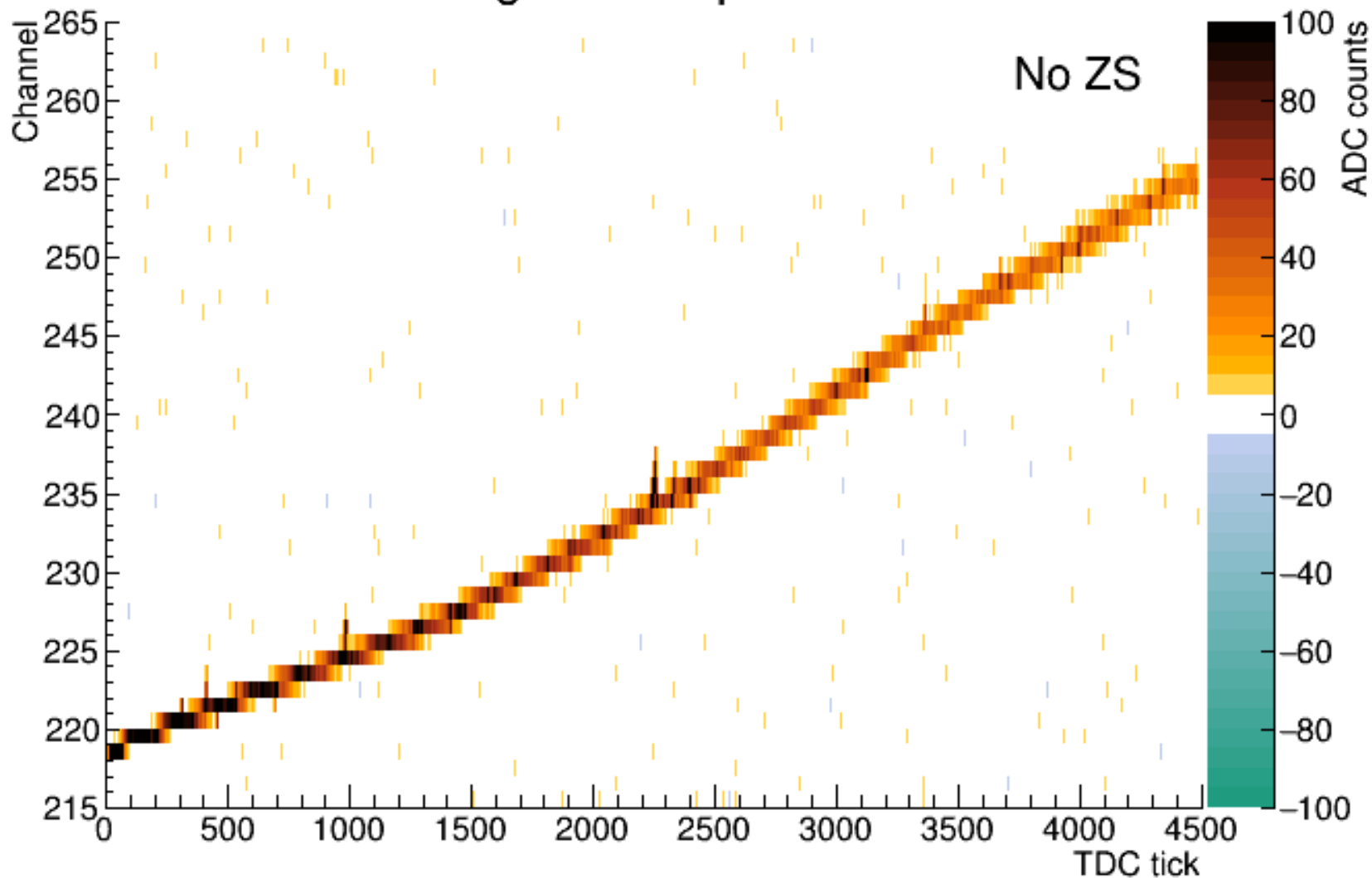Deconvoluted signals for apa1z2 event 1

No ZS
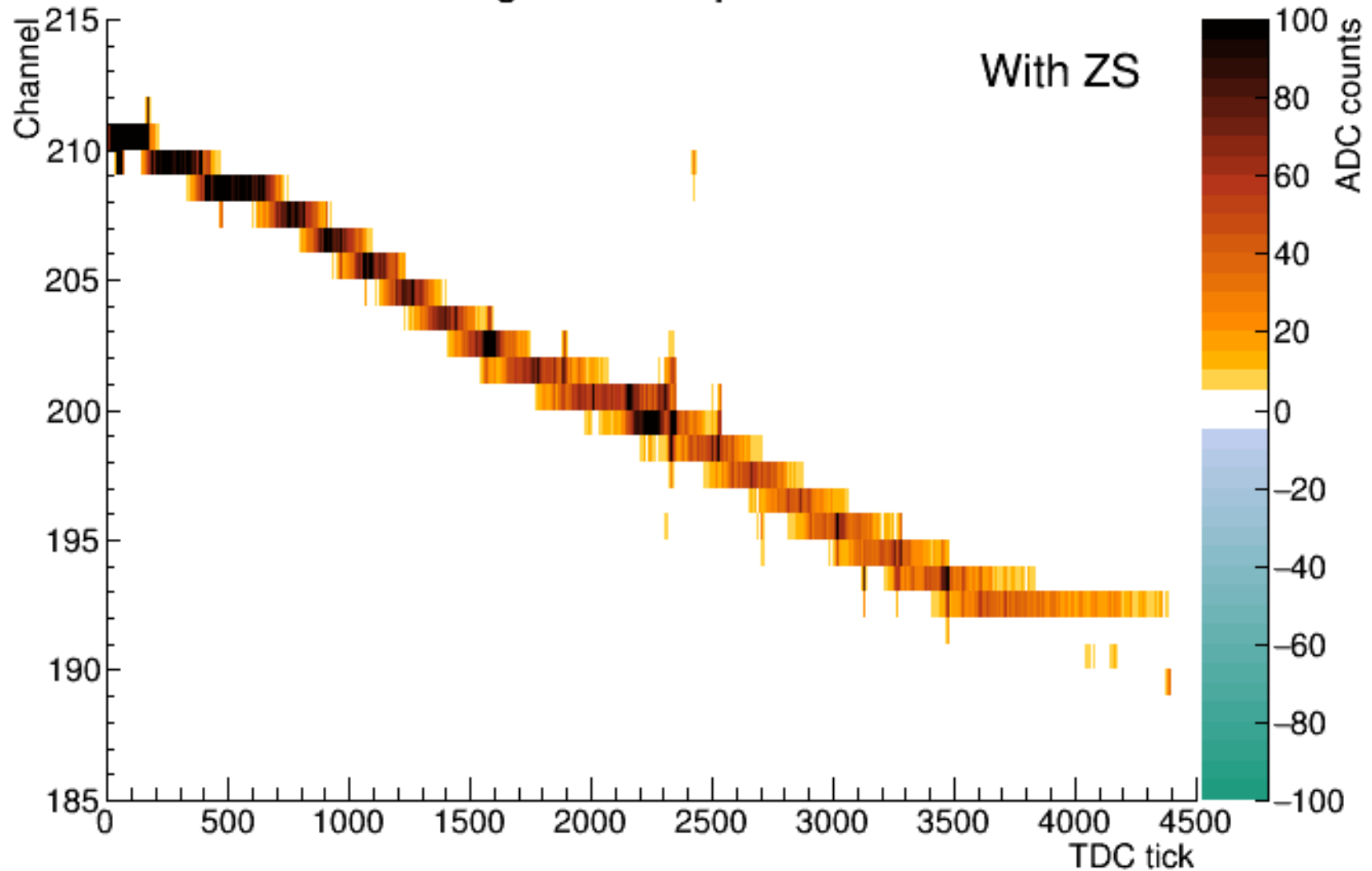
Raw signals with ZS event 2

Raw signals for apa1z2 event 2

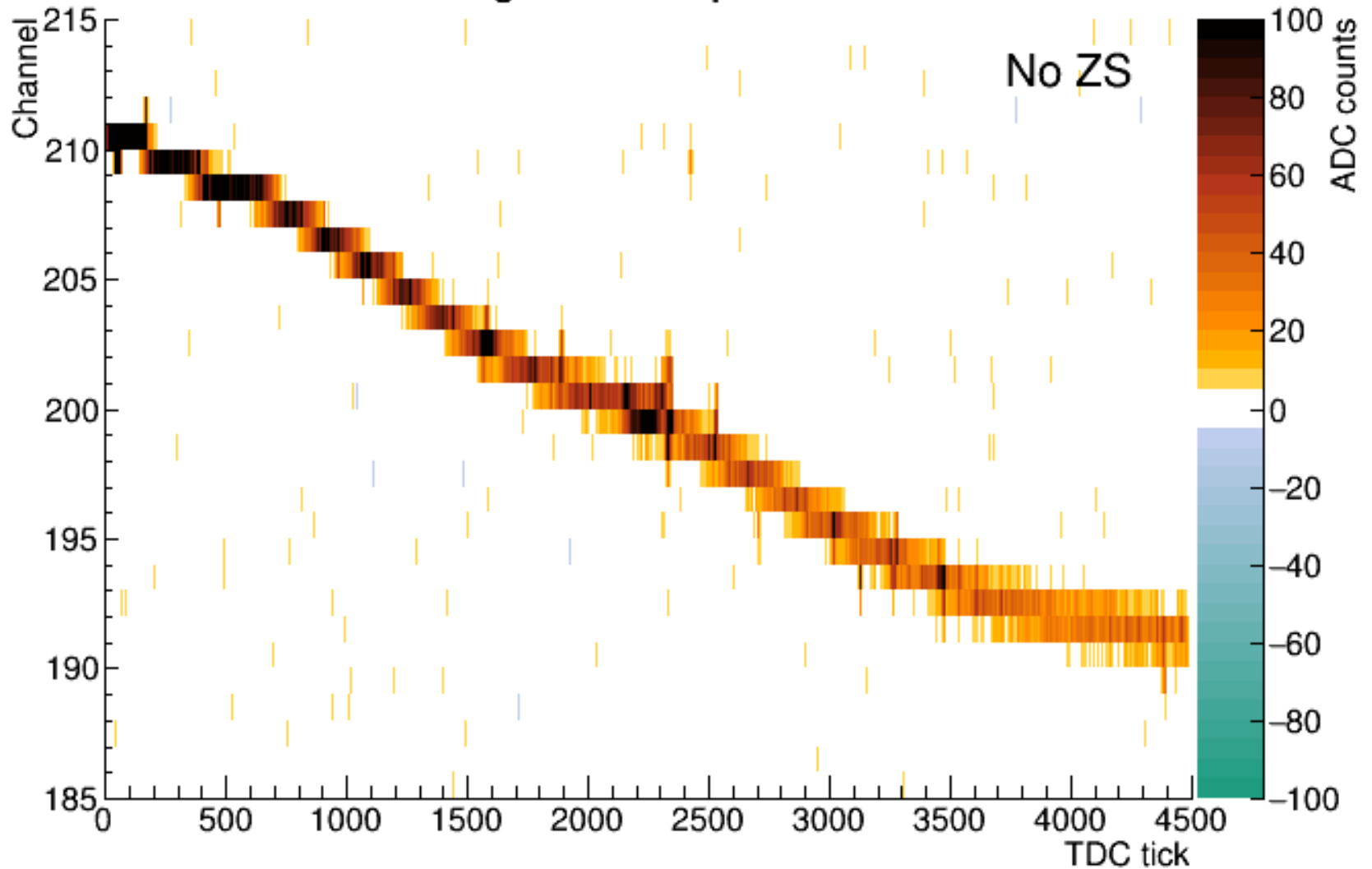# Raw signals w/o ZS event 2

Raw signals for apa1z2 event 2

No ZS

Raw signals with ZS event 3

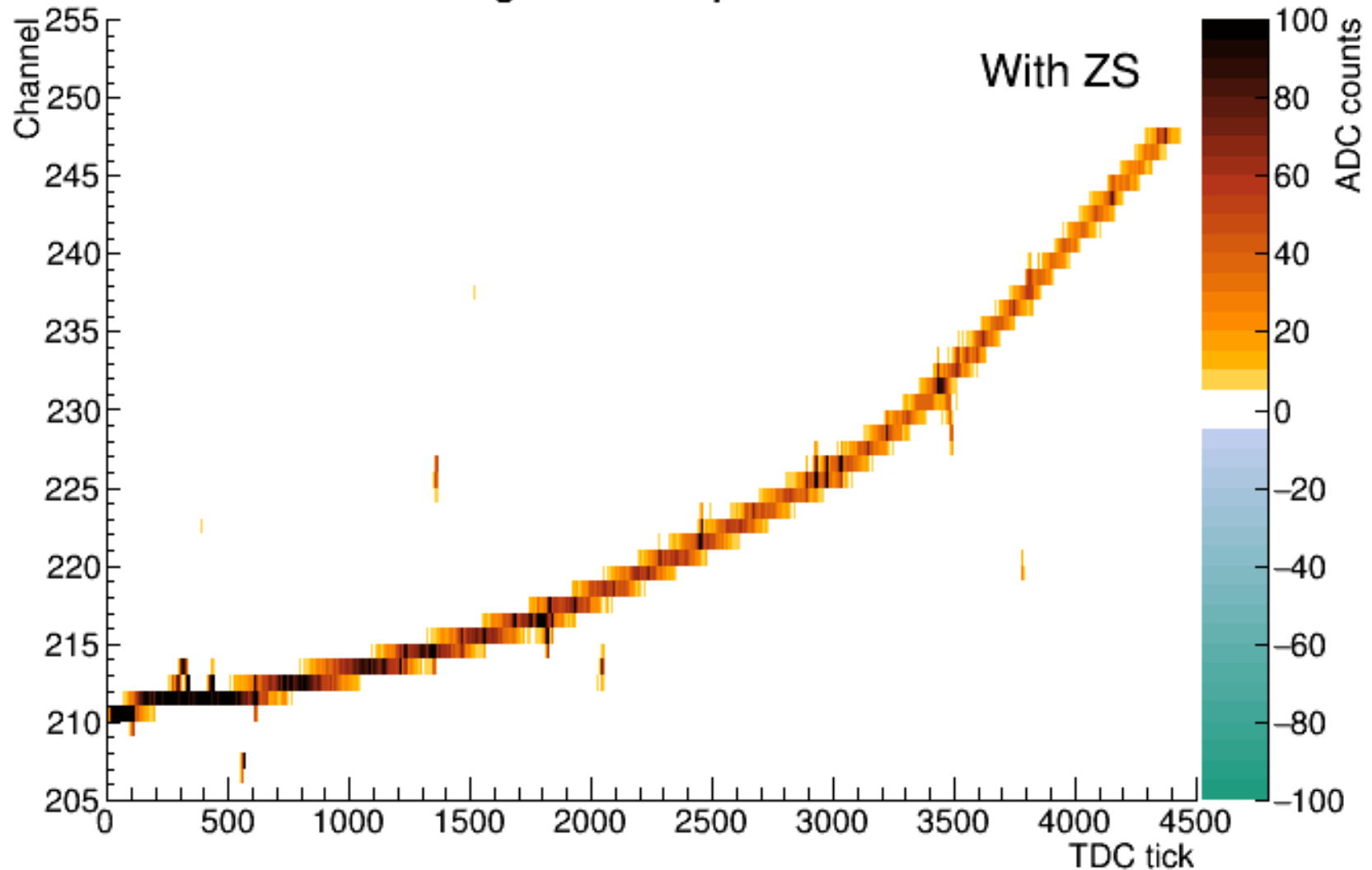Raw signals for apa1z2 event 3

With ZS

Raw signals w/o ZS event 3
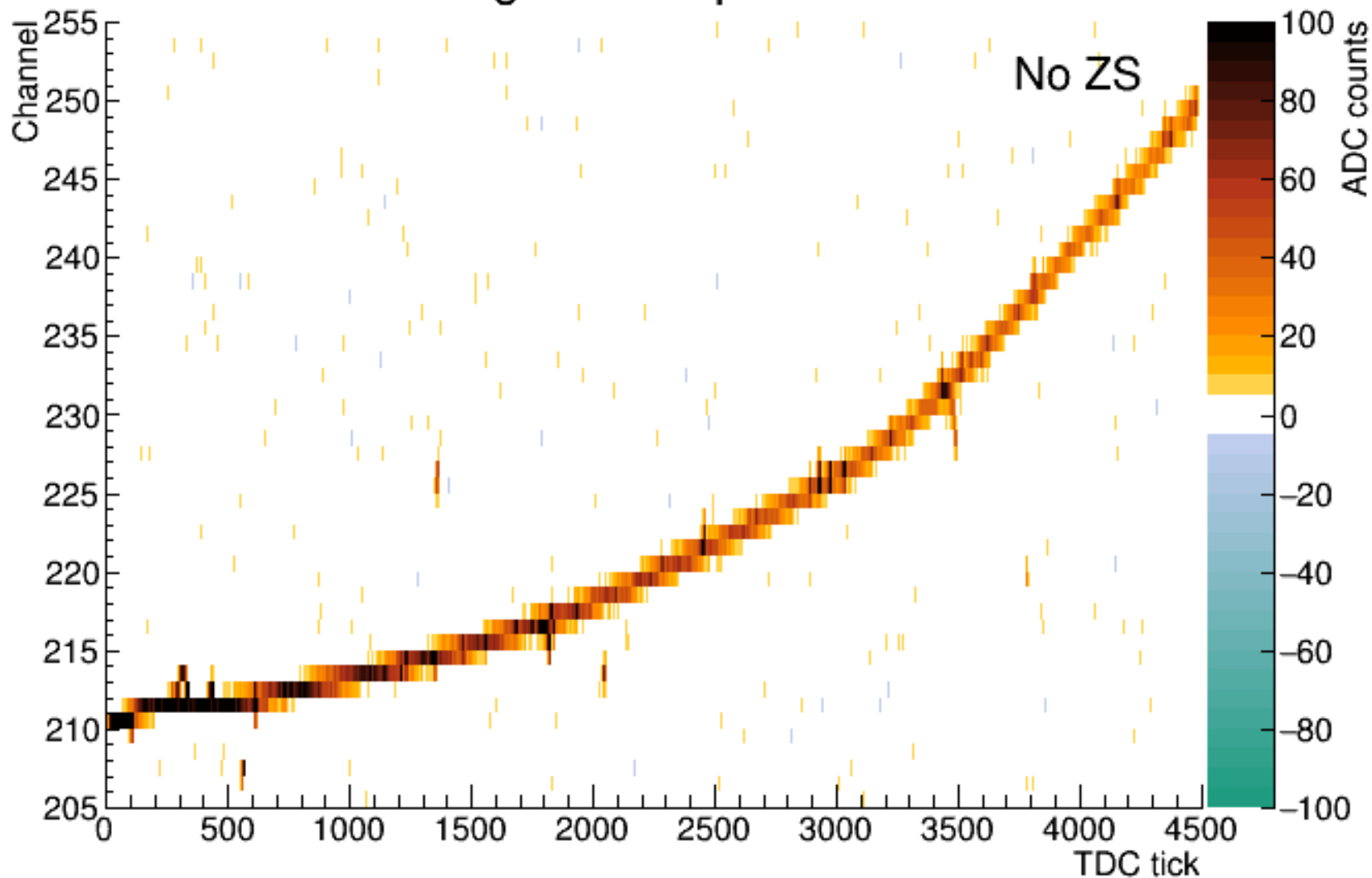

Raw signals for apa1z2 event 3

Raw signals with ZS event 4

Raw signals for apa1z2 event 4

Raw signals w/o ZS event 4

Raw signals for apa1z2 event 4

Comments

Without zero suppression

- Raw signals now look OK, i.e. similar to SimChannel
- Deconvoluted disappear in adjacent TPC ticks
  - But the peak tick is consistent with the raw spectrum

With zero suppression

- As reported earlier, the raw signals disappear for long drift
- Suspicious that problem appears only for ticks larger than one drift in the 35 ton detector
  - Software defect?
  - Or am I missing some FCL parameter change

Conclusion

- My two issues with simulation and disappearing sign in deconvolution are both from a problem with zero suppression

Extras
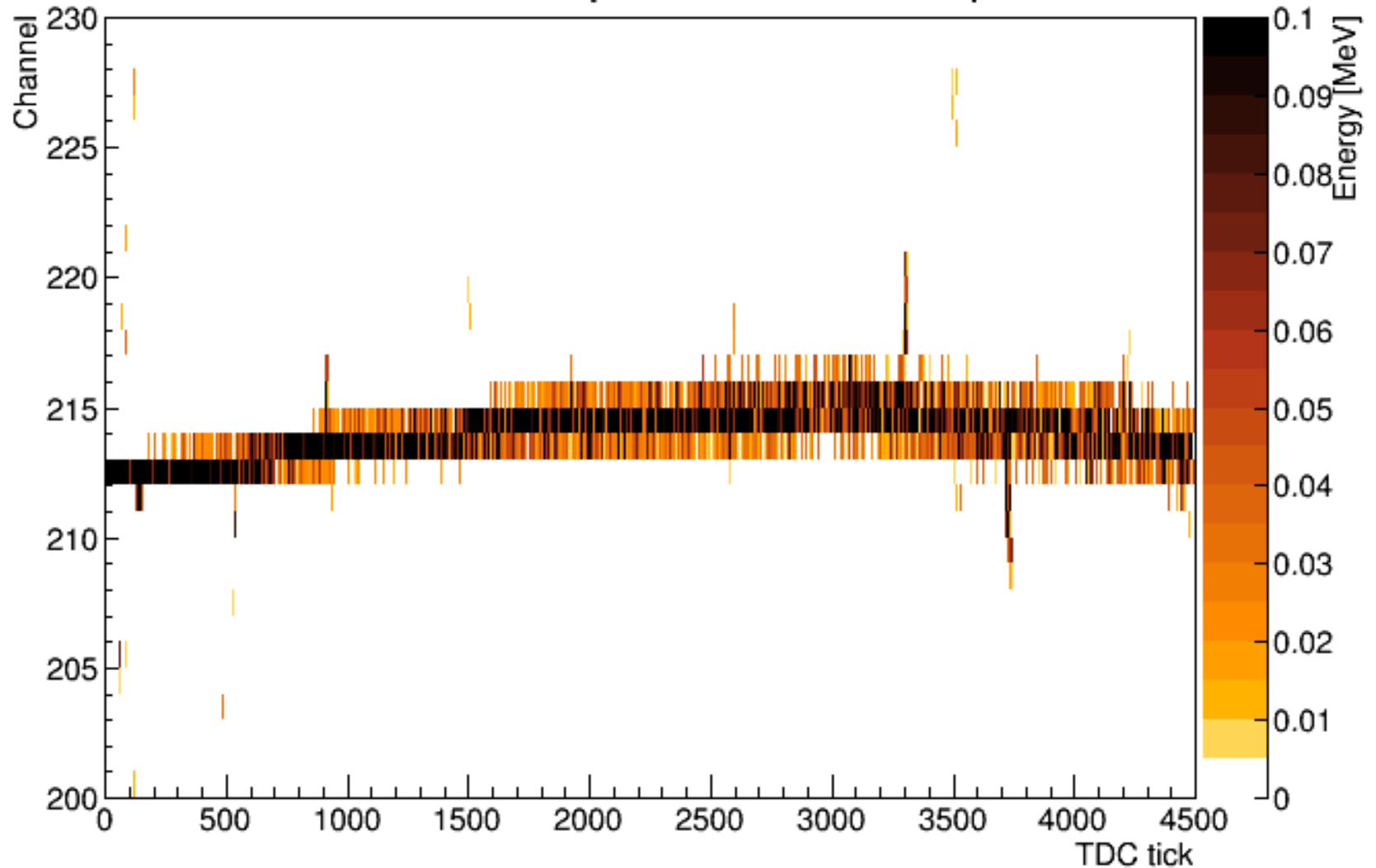
Original results

- SimChannel

- Raw

- Deconvoluted
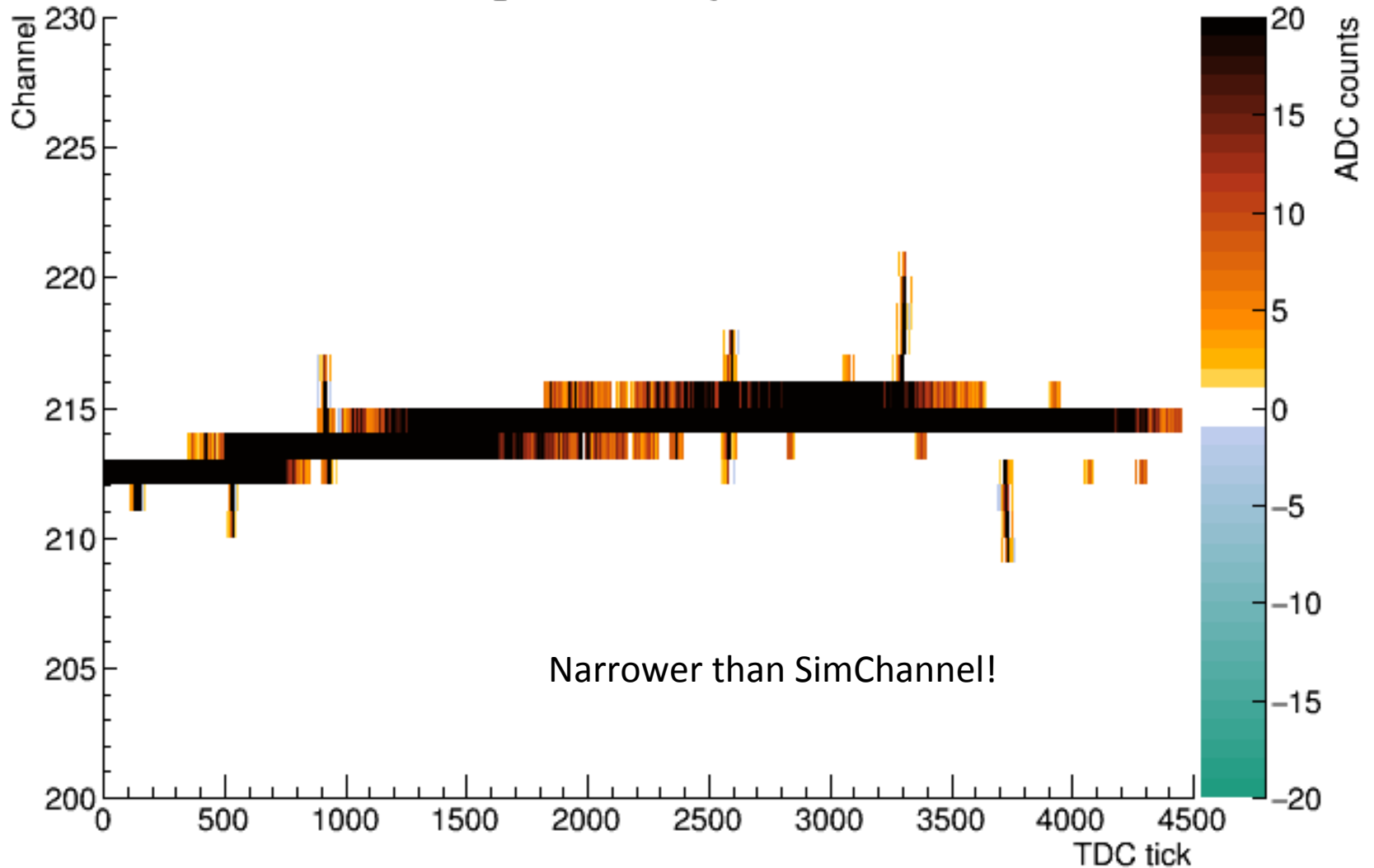
Detector displays

- Made with draw_detector

SimChannel channel vs. tick
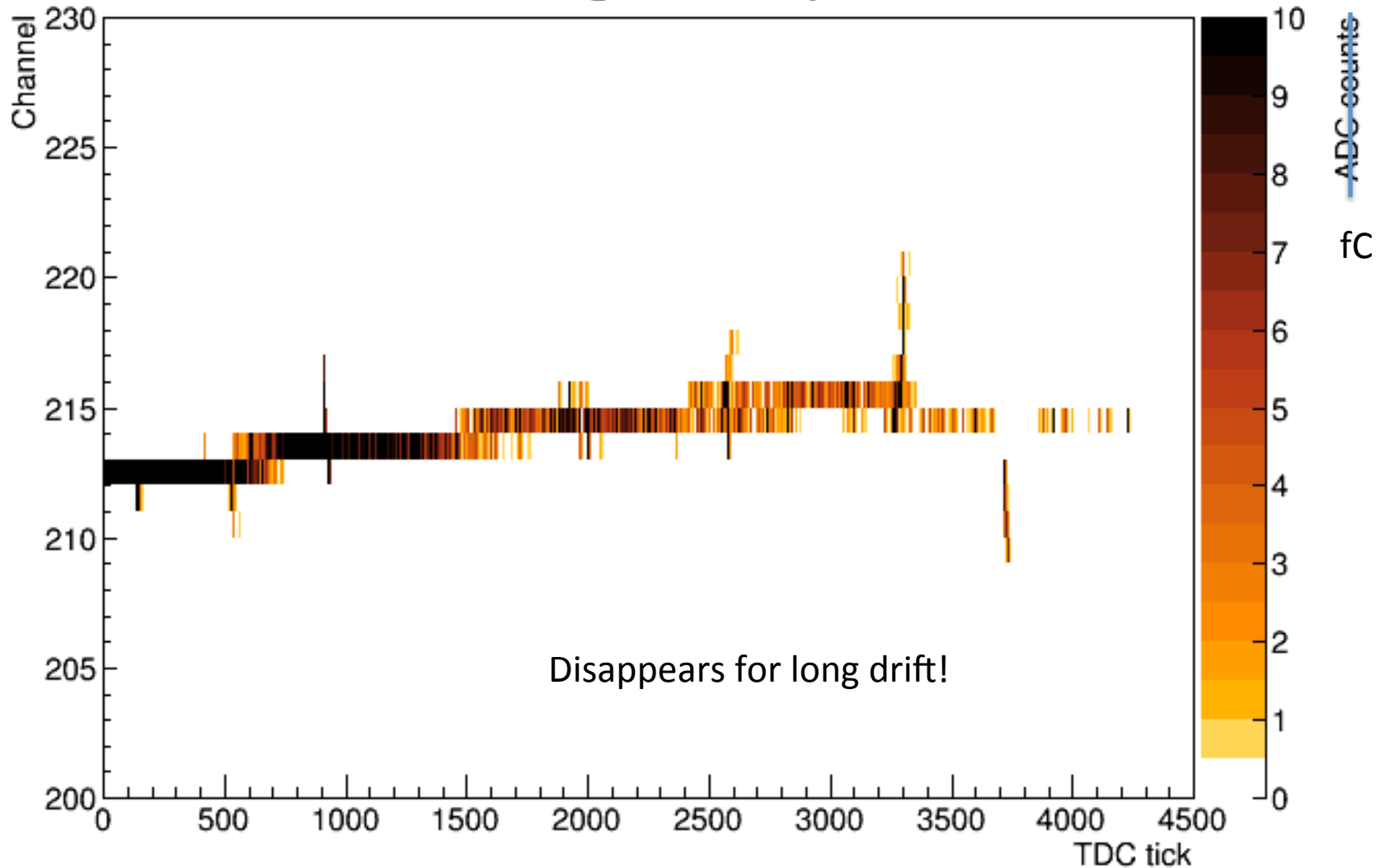

Sim channels for apa1z2 event 4 MC particle 1

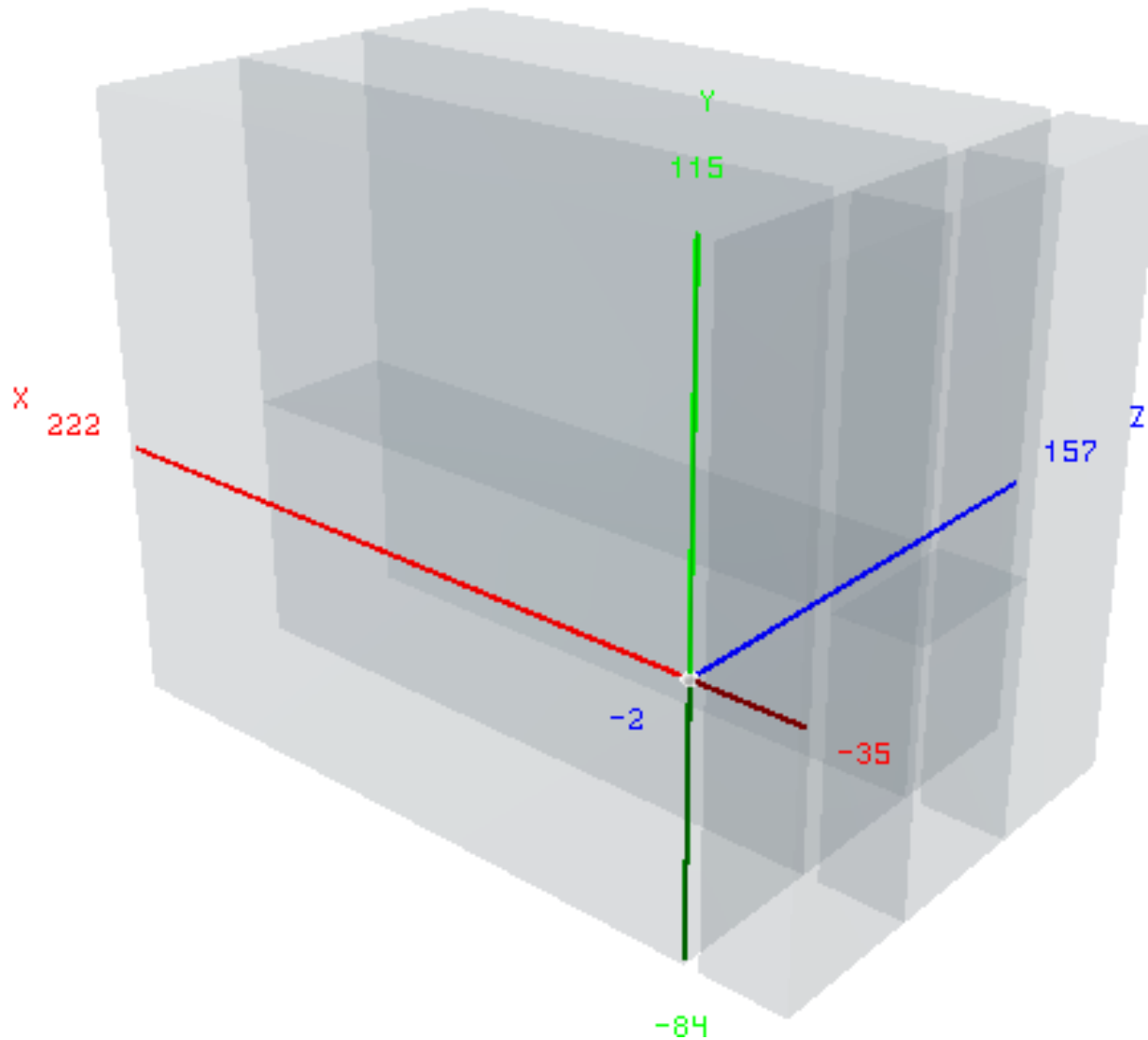# Raw channel vs. tick
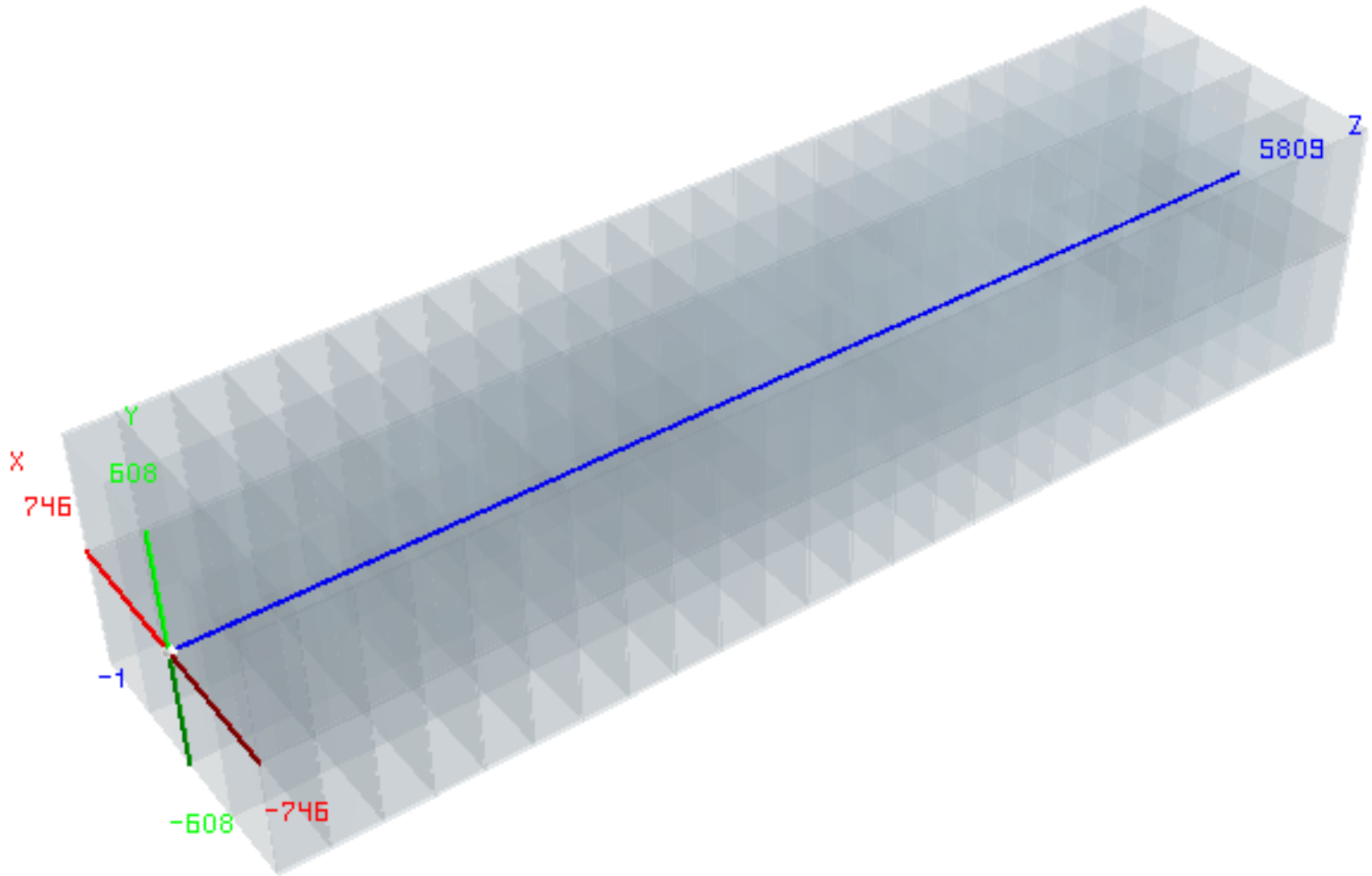

Raw signals for apa1z2 event 4

Narrower than SimChannel!

Deconvoluted channel vs. tick

Deconvoluted signals for apa1z2 event 4

Disappears for long drift!

dune35t4apa_v5

dune10kt_v1

dune10kt_v1_workspace