3D Directionality in DRIFT-II

CYGNUS Workshop, Boulby Mine

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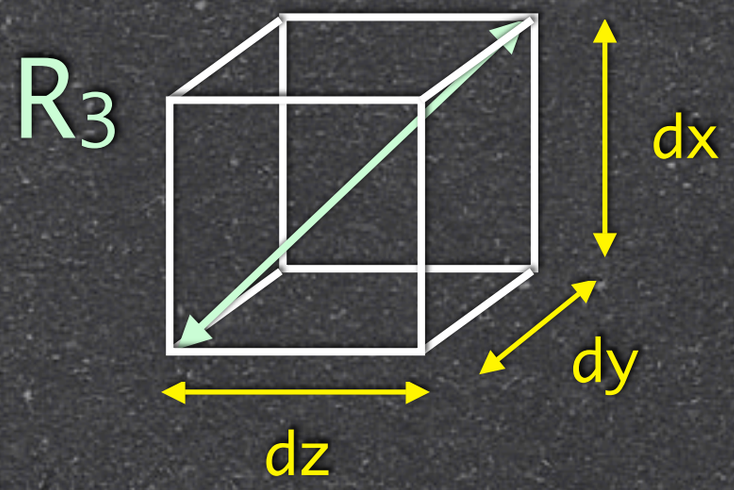
Is DRIFT Directional in 3D?

- Pawel Majewski's Simulation
  - 250 keV S recoil
  - drift distance (z) = 50 cm
  - full diffusion
  - passes through electronics
  - result: standard DRIFT data files

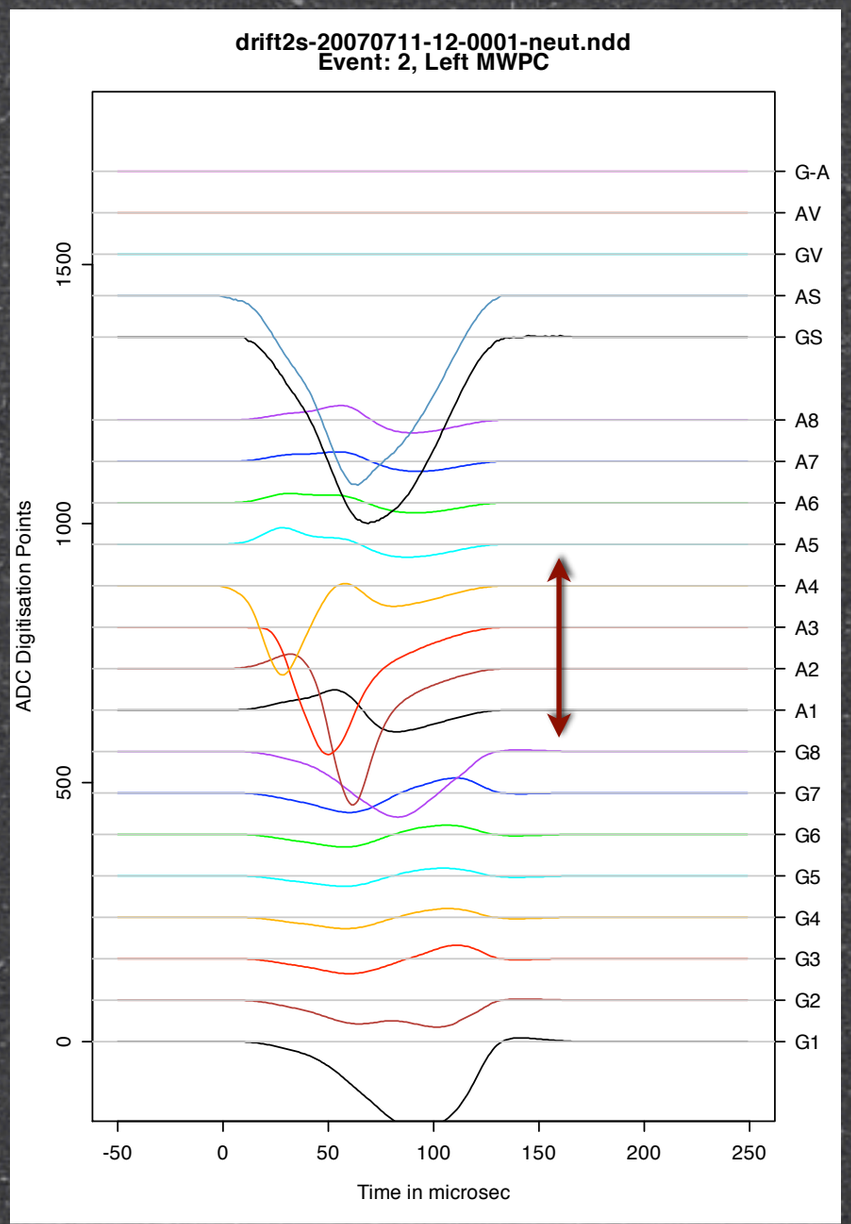
Is DRIFT Directional in 3D?

MINIMUM CUBOID AROUND TRACK

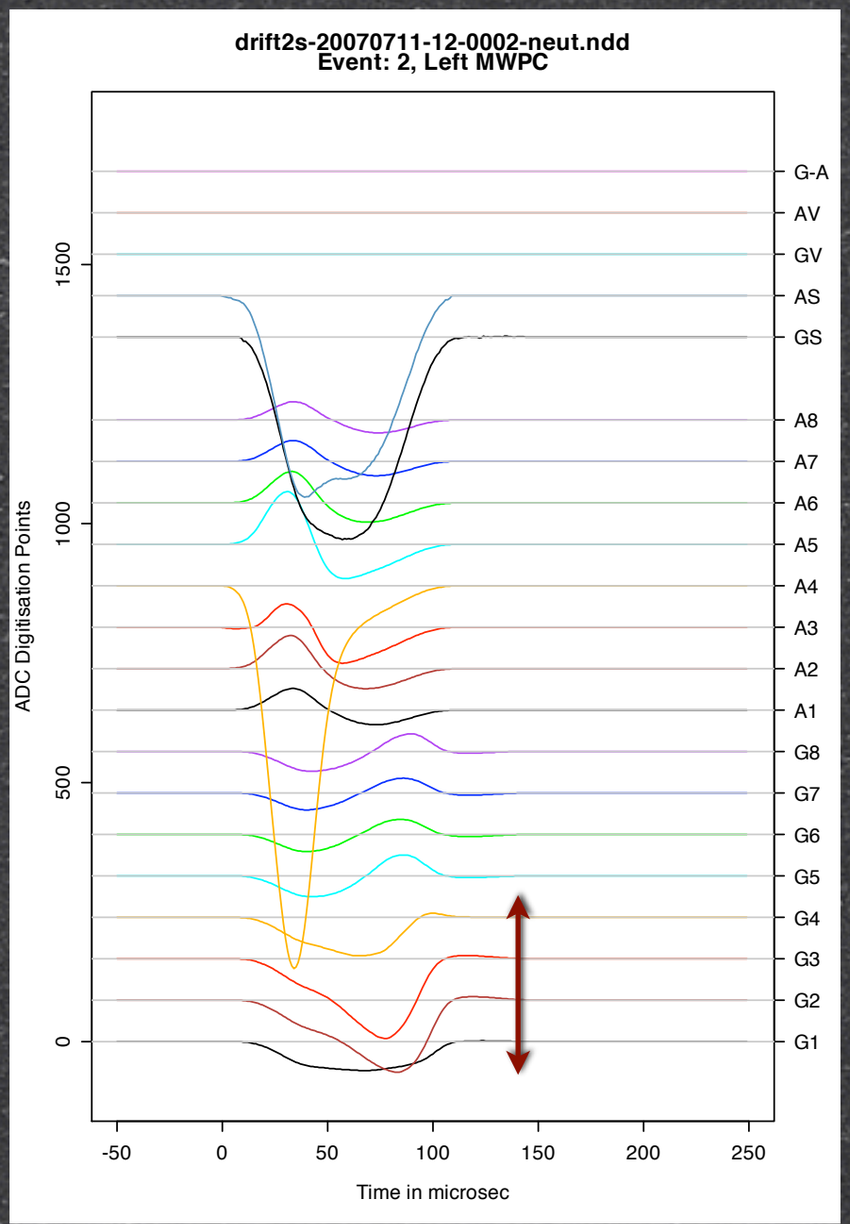


- dx, dy, dz of simulated track "cloud" measured before drifting to MWPC
- All events analysed with standard 3D reconstruction code
- theta, phi measured
- 3 directed runs (x, y, z)

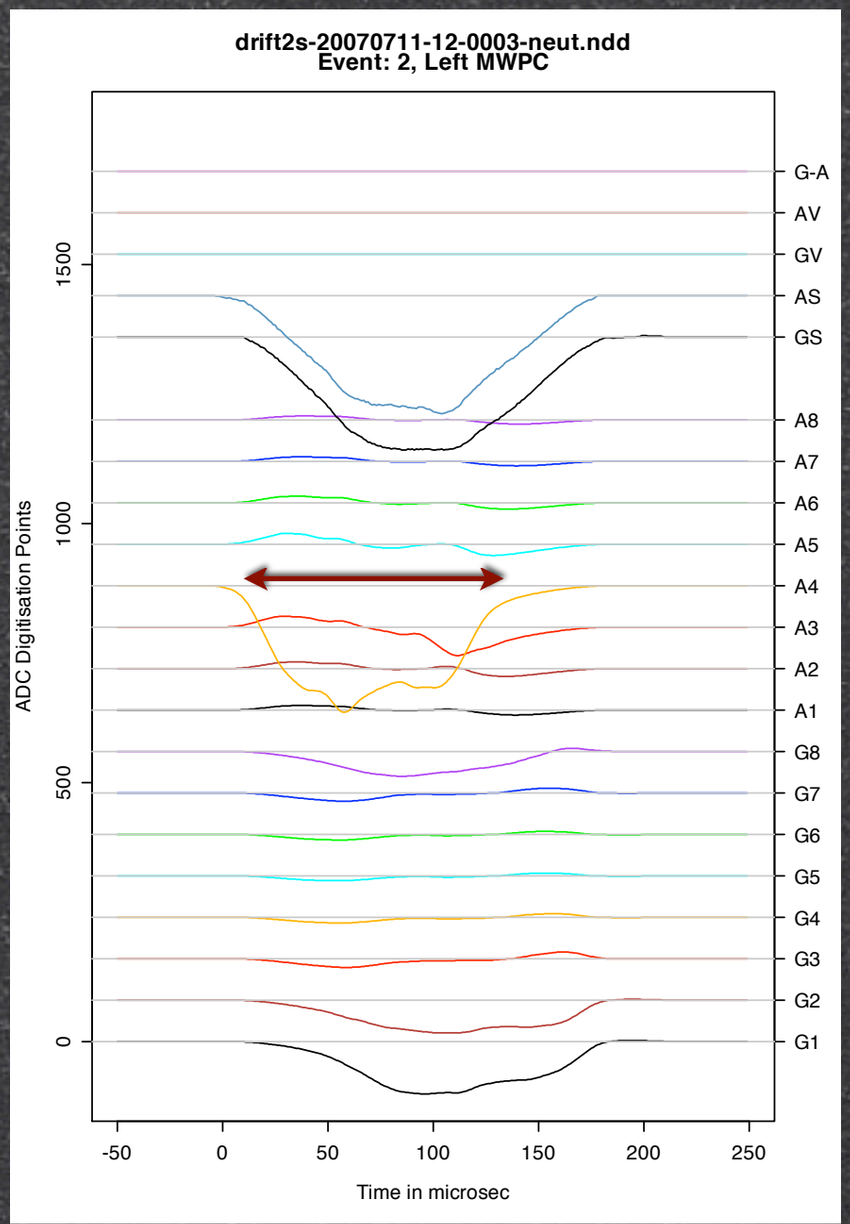
Simulated Events



HIGH DX

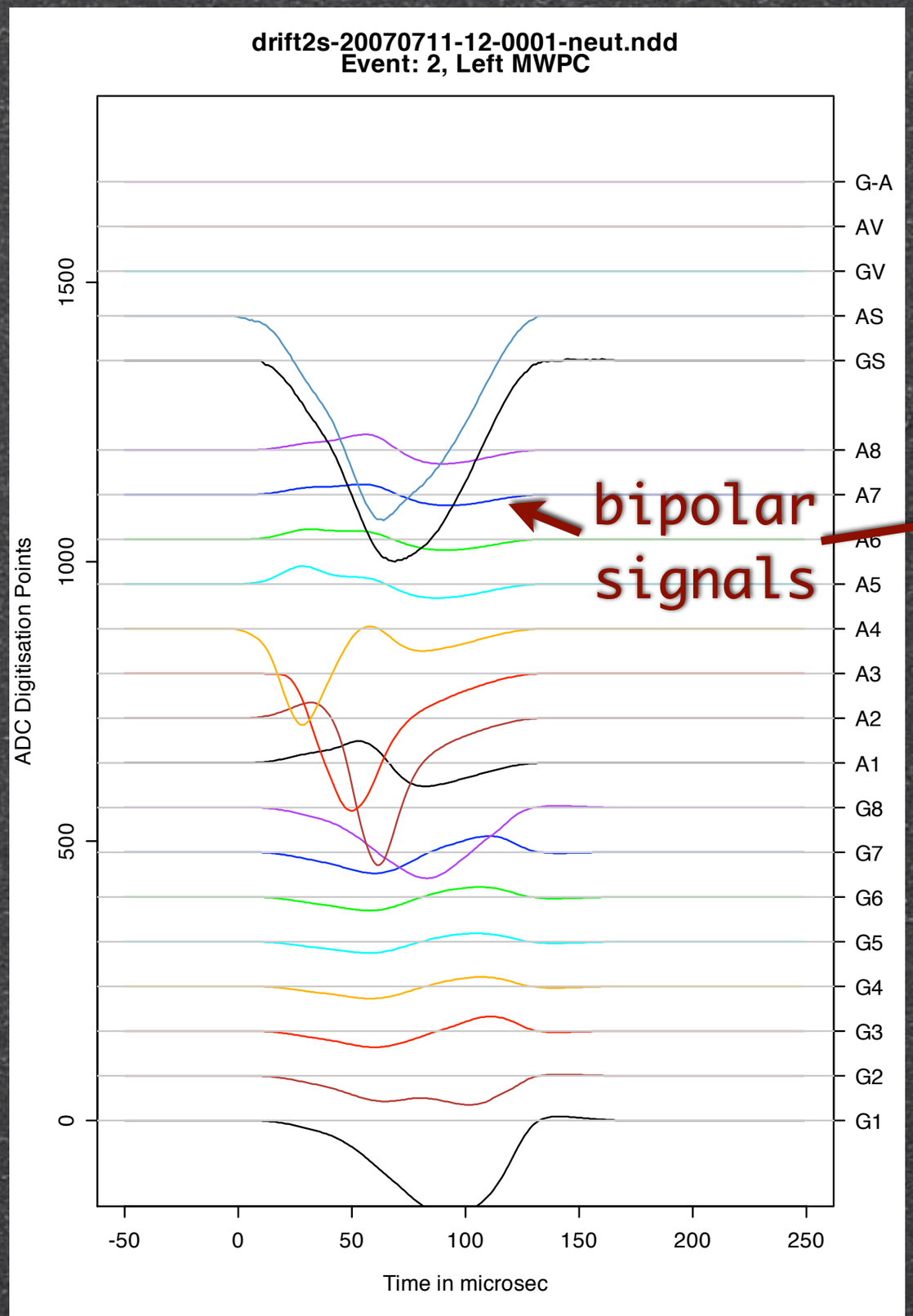


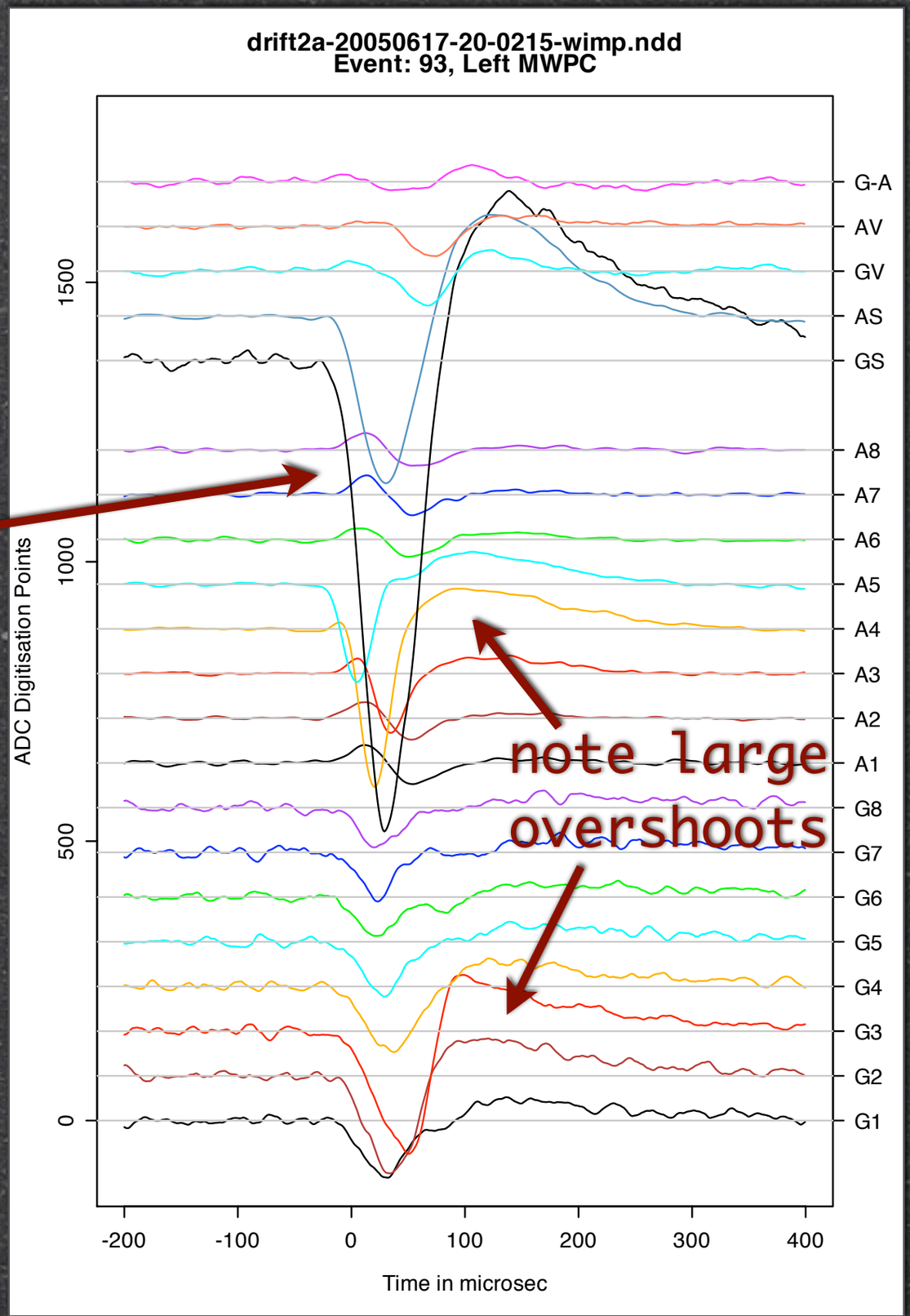
HIGH DY



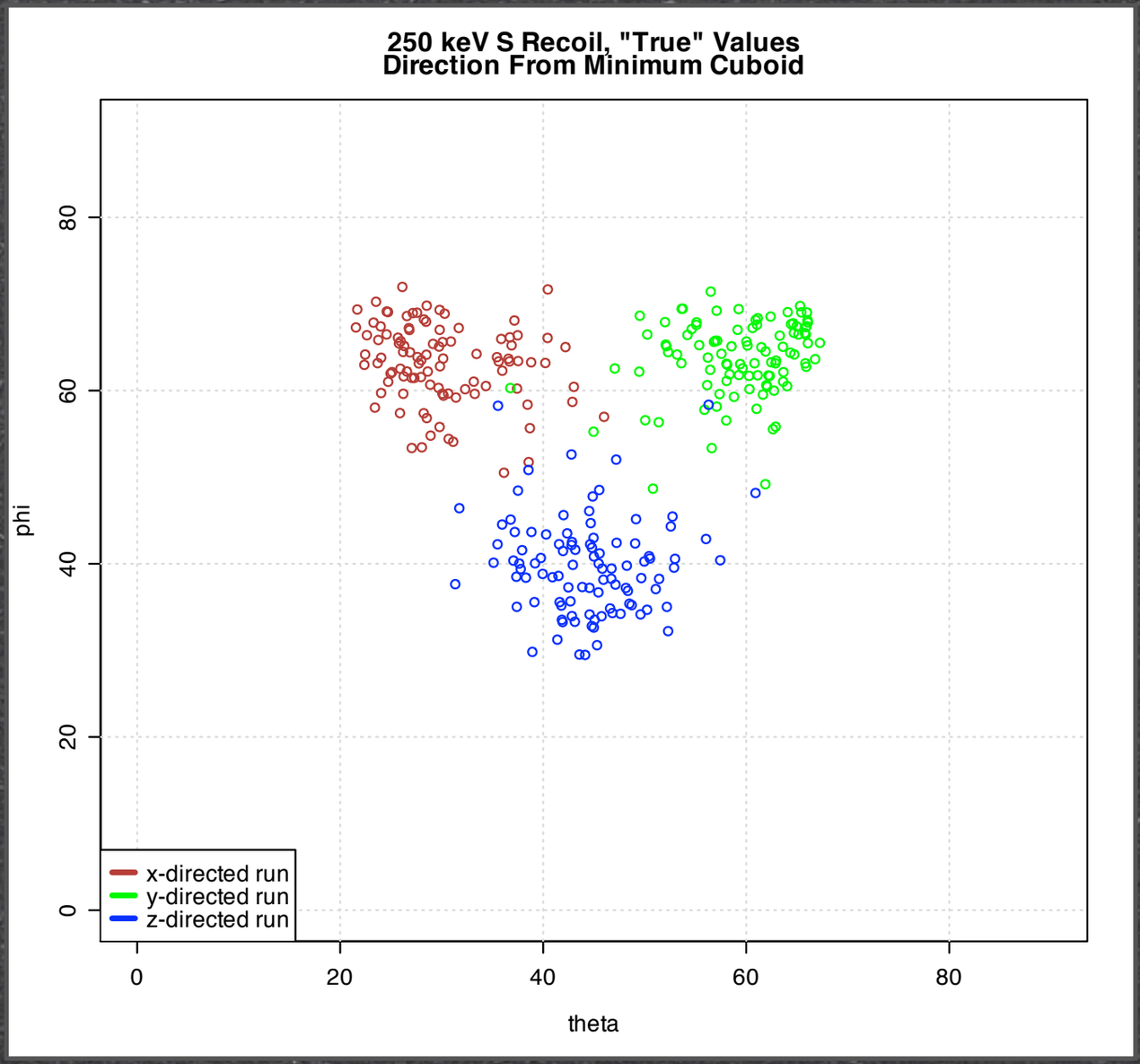
HIGH DZ

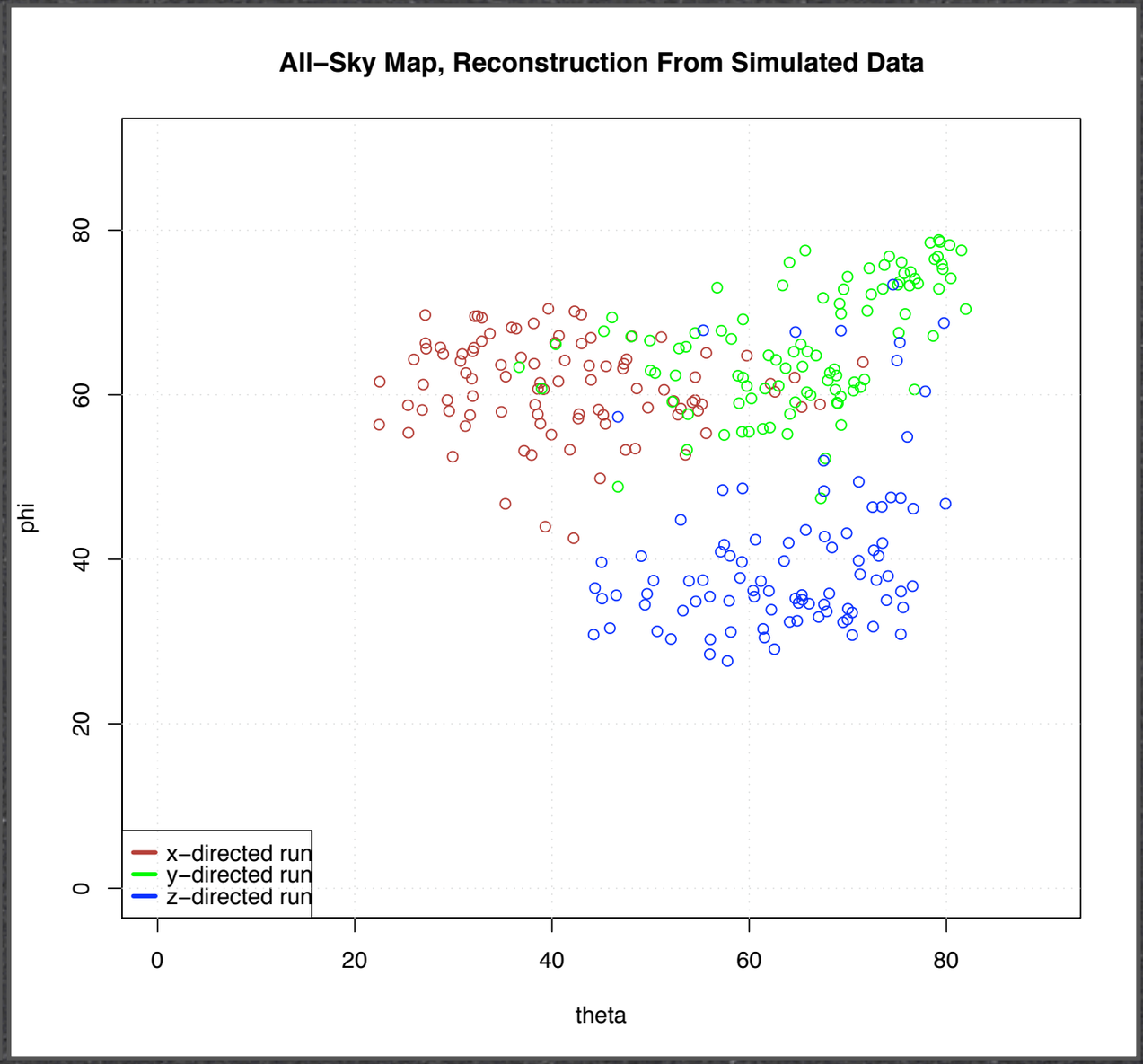
Simulated vs Real Data





Simulated Data, Reconstructed

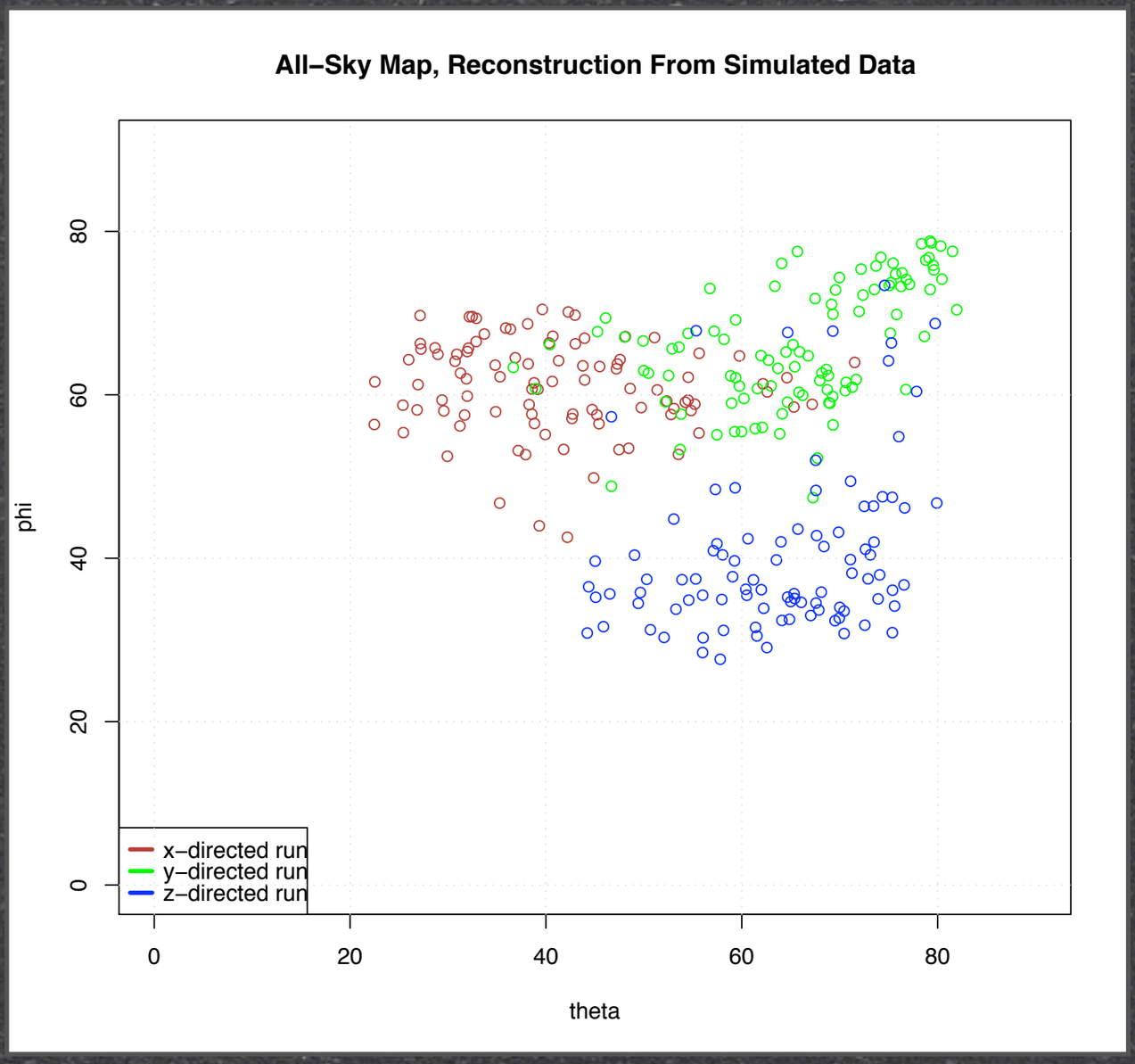


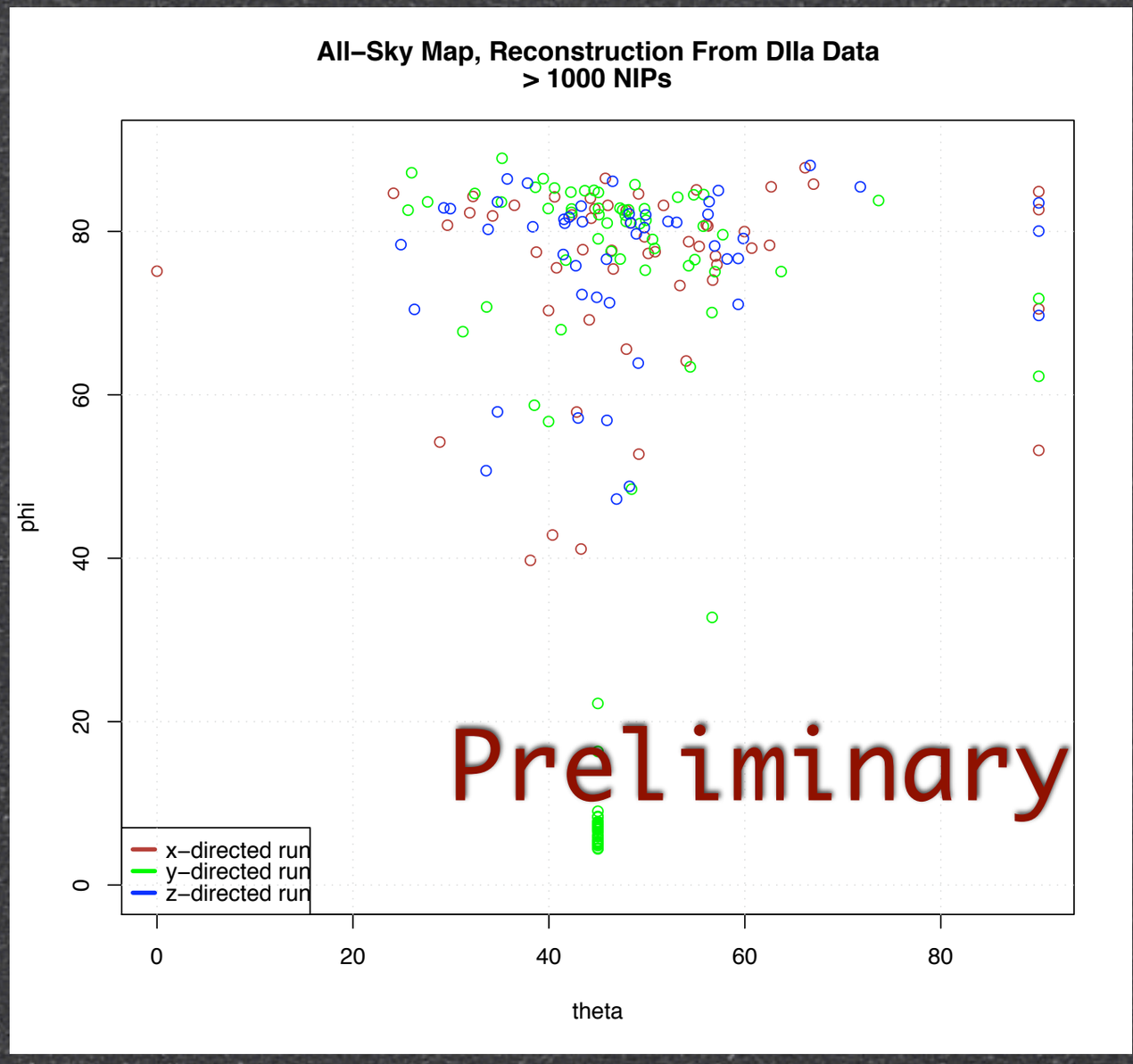


Directionality from Simulation

	mean dx	mean dy	mean dz
x run	4.20 ± 0.01	3.60 ± 0.01	3.11 ± 0.01
y run	2.08 ± 0.01	4.71 ± 0.01	2.30 ± 0.01
z run	1.98 ± 0.01	3.99 ± 0.01	5.56 ± 0.02

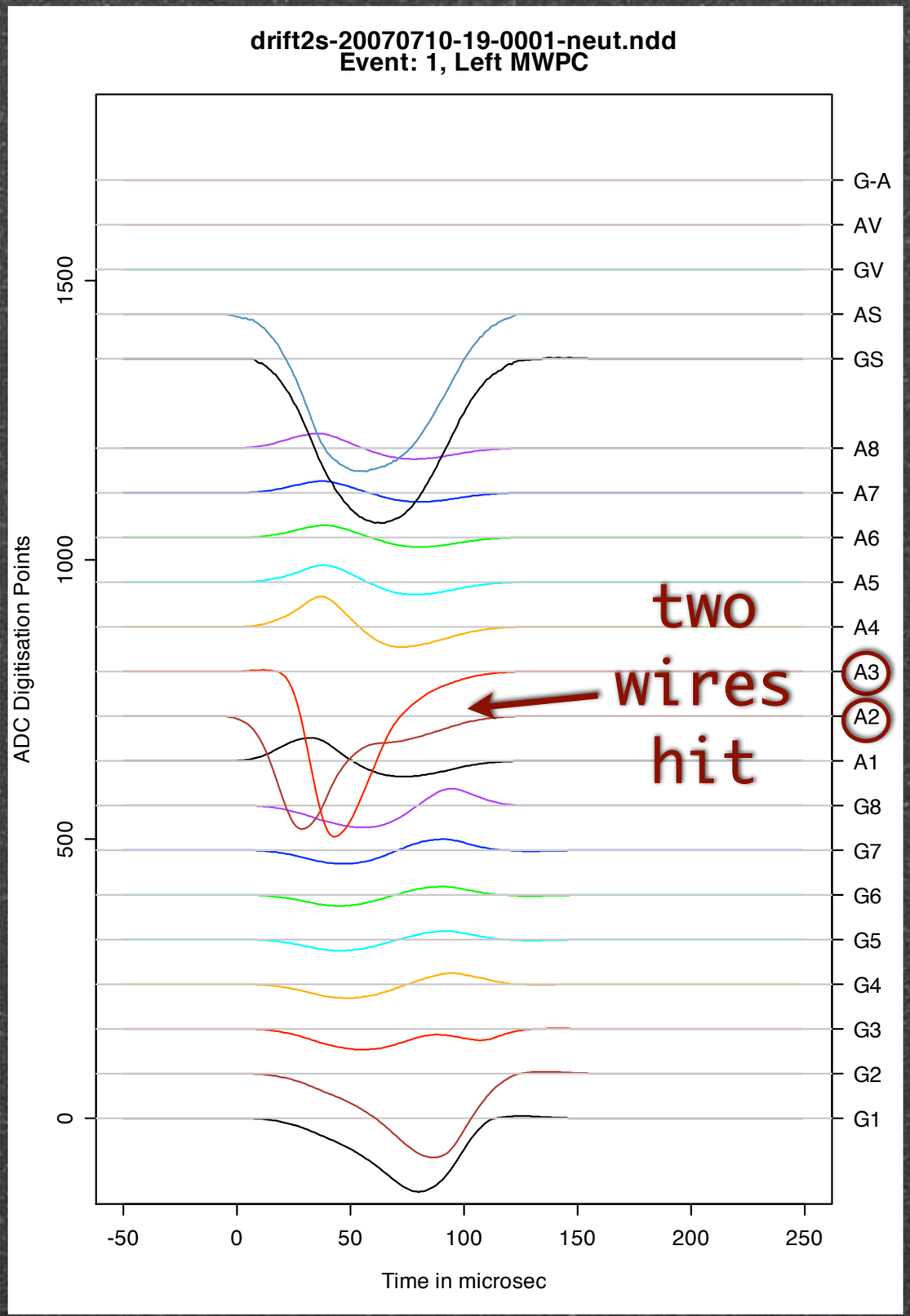
Simulated vs Real Data





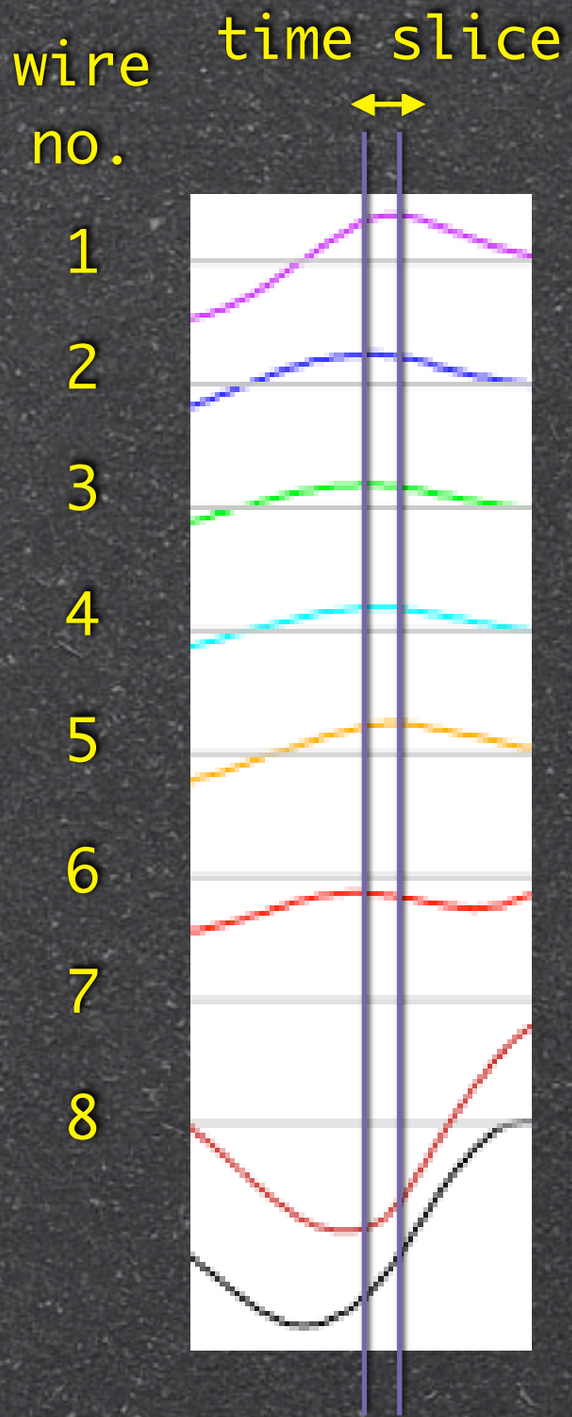
Tunable parameters need tuning for real data

Reconstructing X



- 2mm pitch
- count number of anode wires hit
- dx = (wires hit −1) × 2 ± 1 (mm)
- resolution is coarse

Reconstructing Y

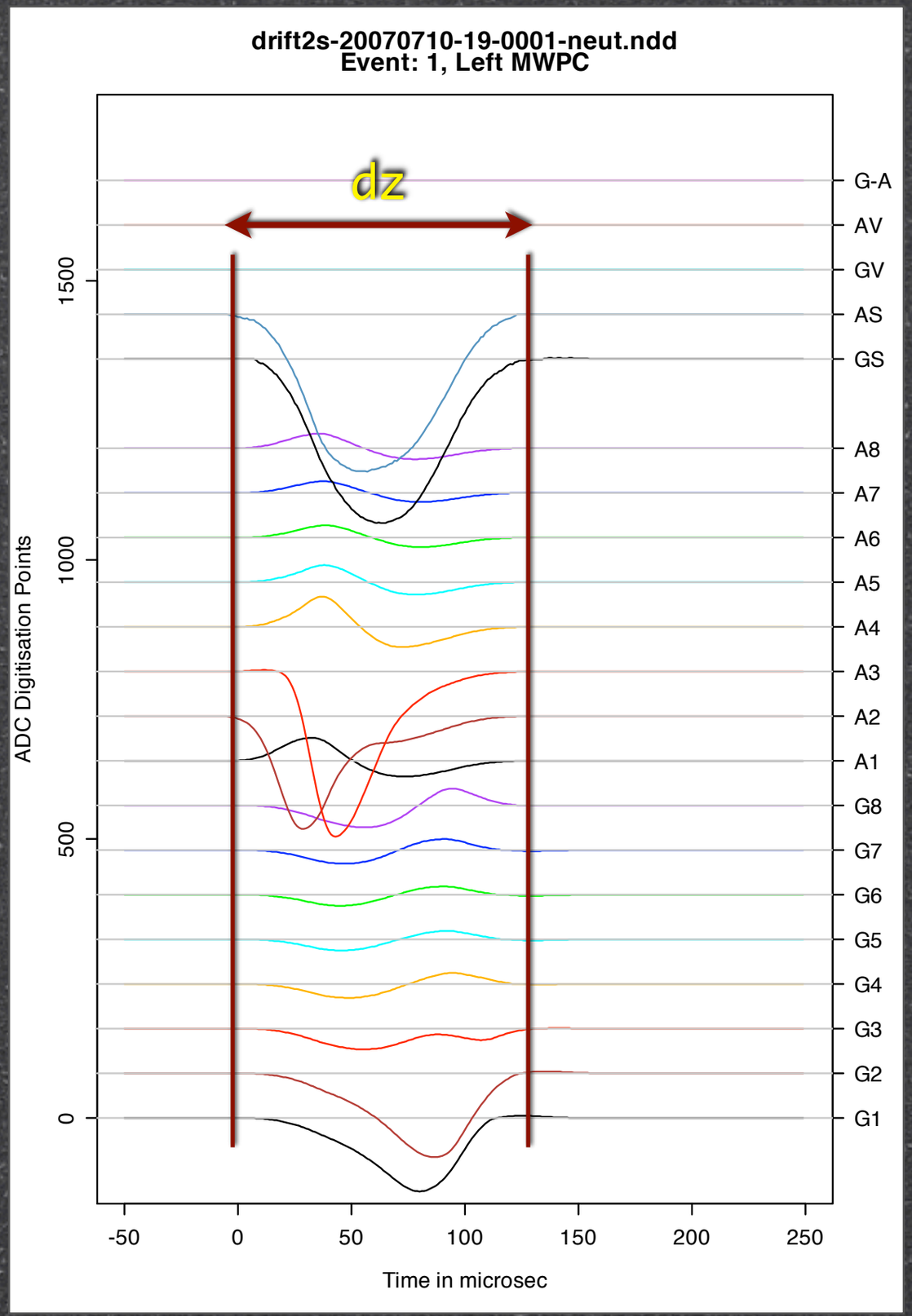


- Time slices are taken over time of track (~5μs)
- Mean charge measured at each wire per time slice
- Each wire weighted by factor:

  |mean/standard dev|

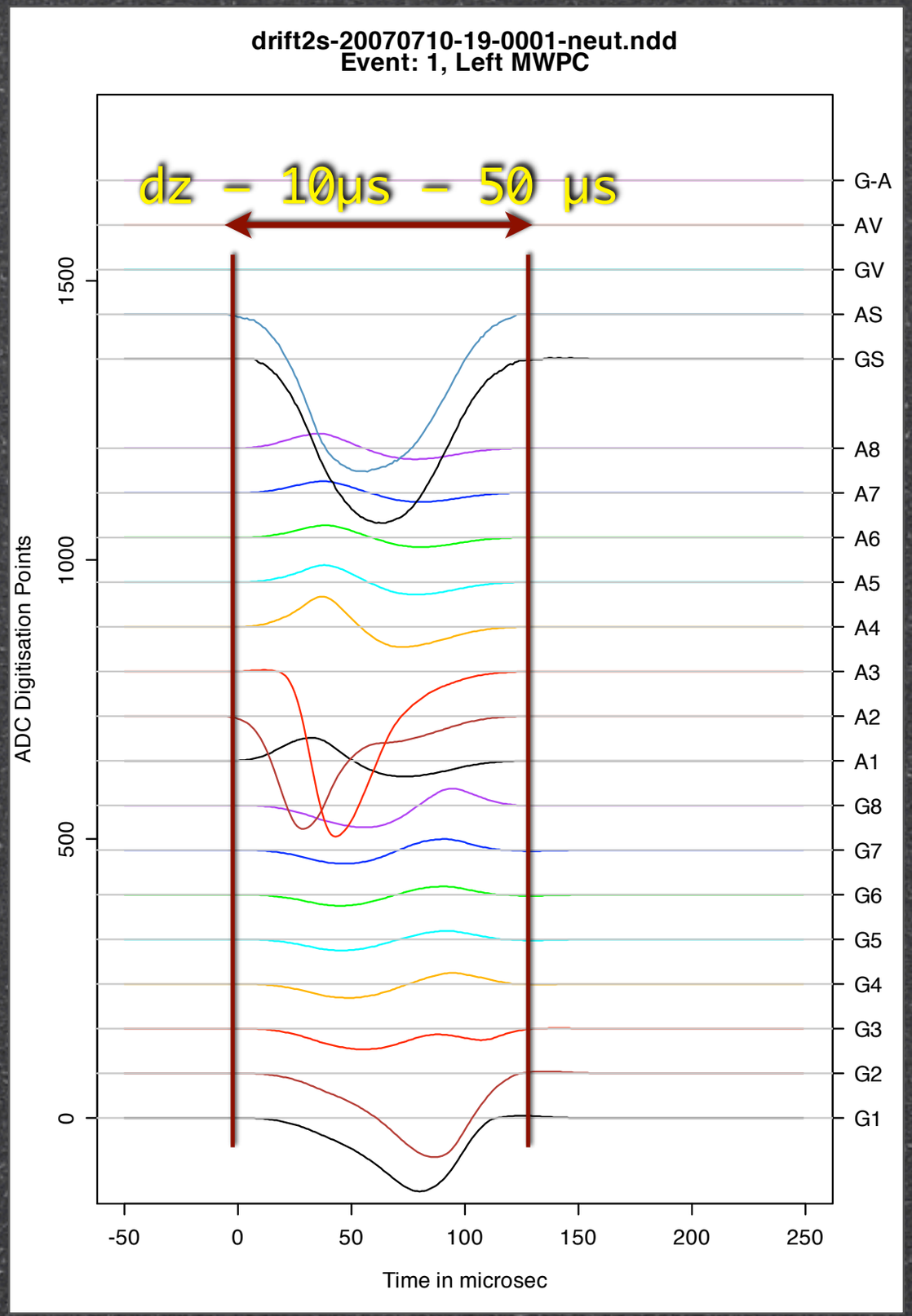
  over extent of track
- Mean wire number calculated via circular statistics
- Resolution high due to high (1μs) sampling rate

Reconstructing Z

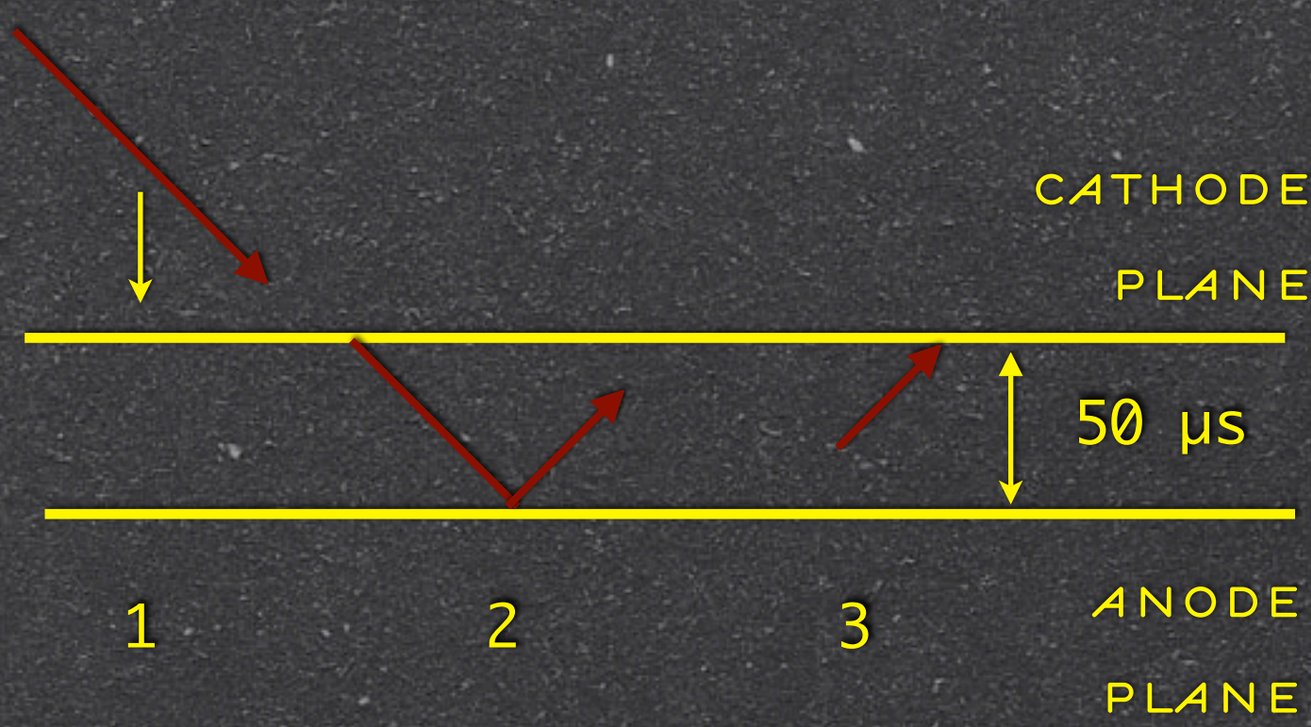


- multiply track extent in time by drift velocity (~60 m/s) to get dz in mm
- dz measured from baseline crossing to baseline crossing on either anode or grid sum (too much)
- dz measured from fwhm of first anode pulse to fwhm of last anode pulse (too small)

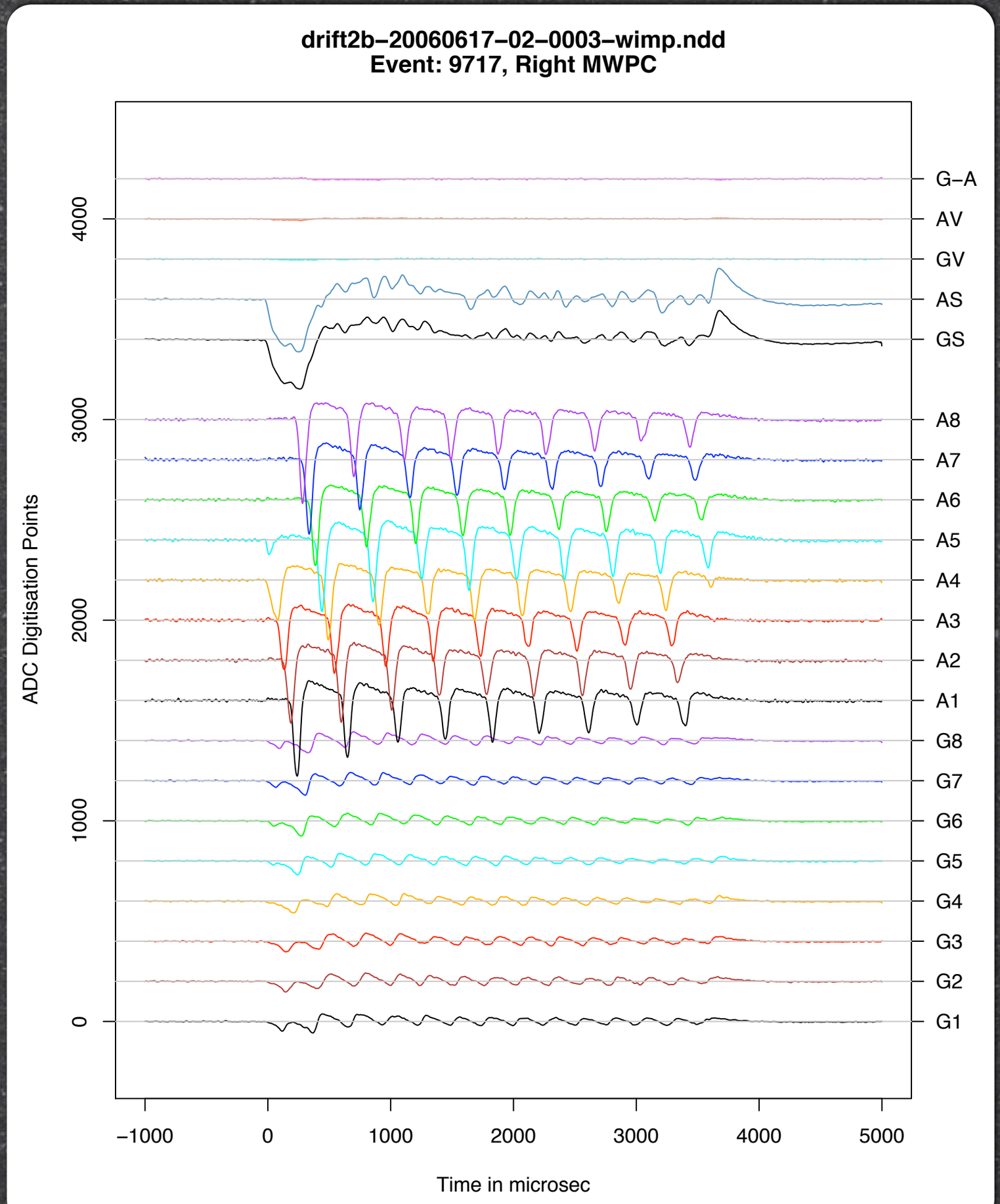
Reconstructing Z



- Pawel's simulation suggest dz be measured from sum readout – shaping time (10µs) – 50µs.

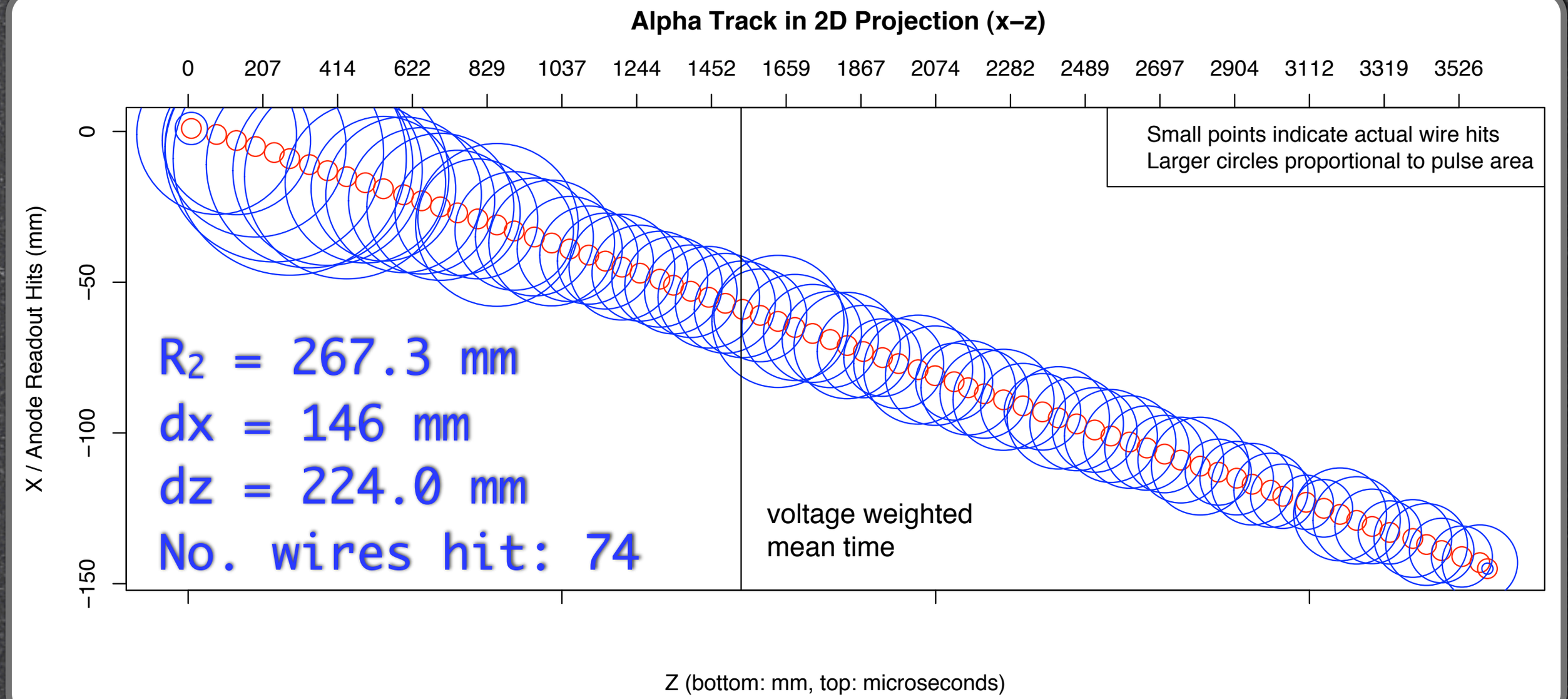


ALPHA TRACK



74 wires crossed
(146 mm in x)

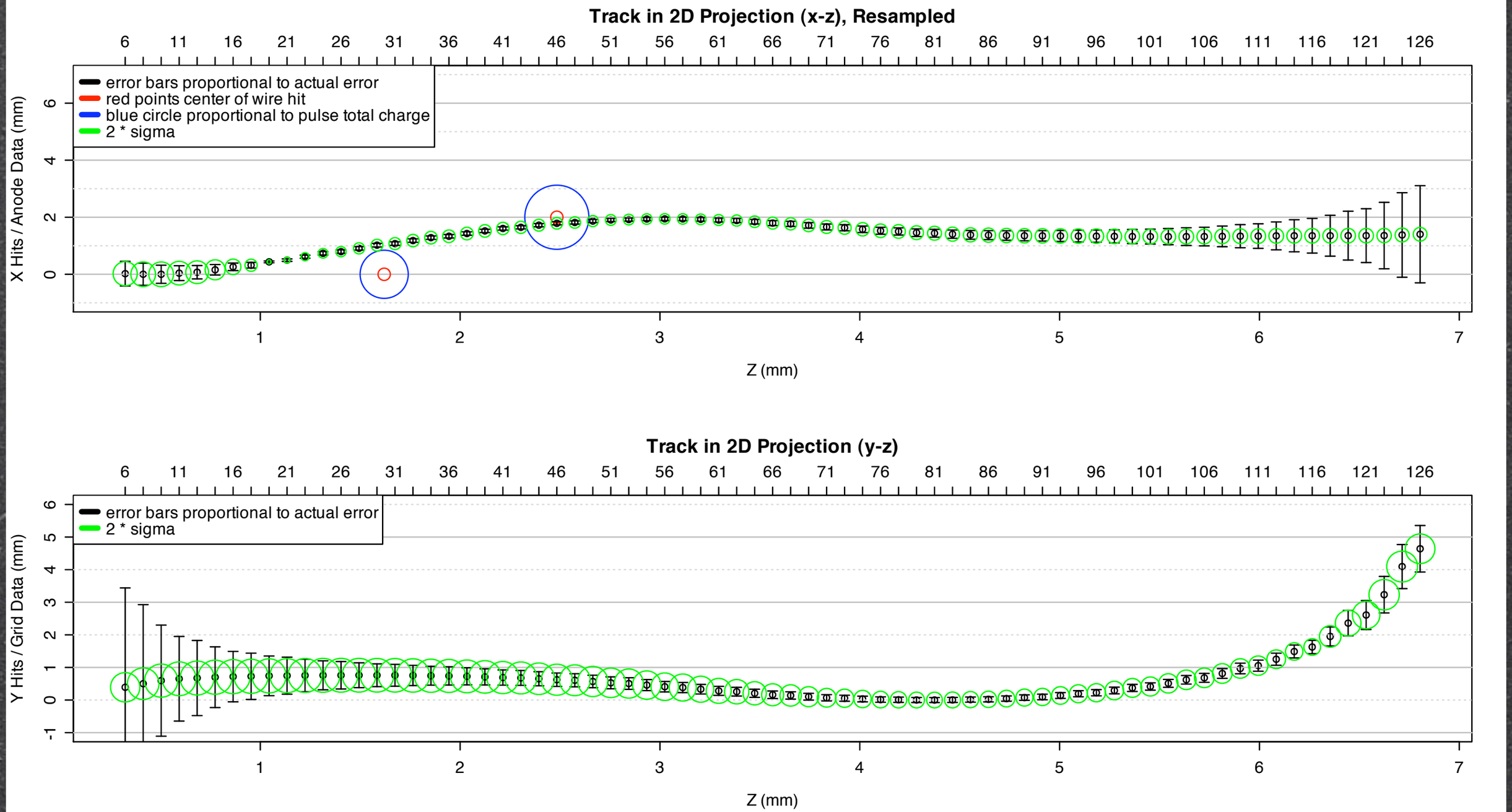
Alpha Reconstructed



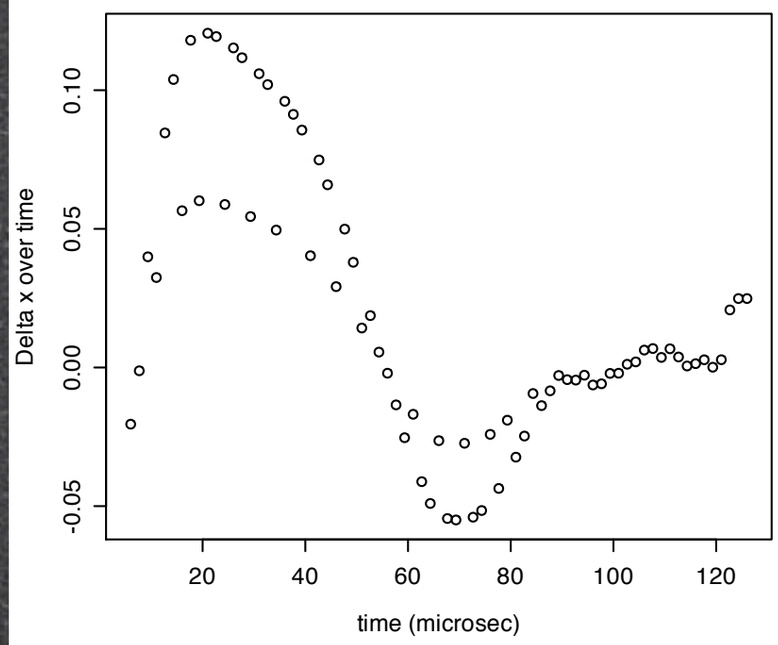
Neutron Reconstruction

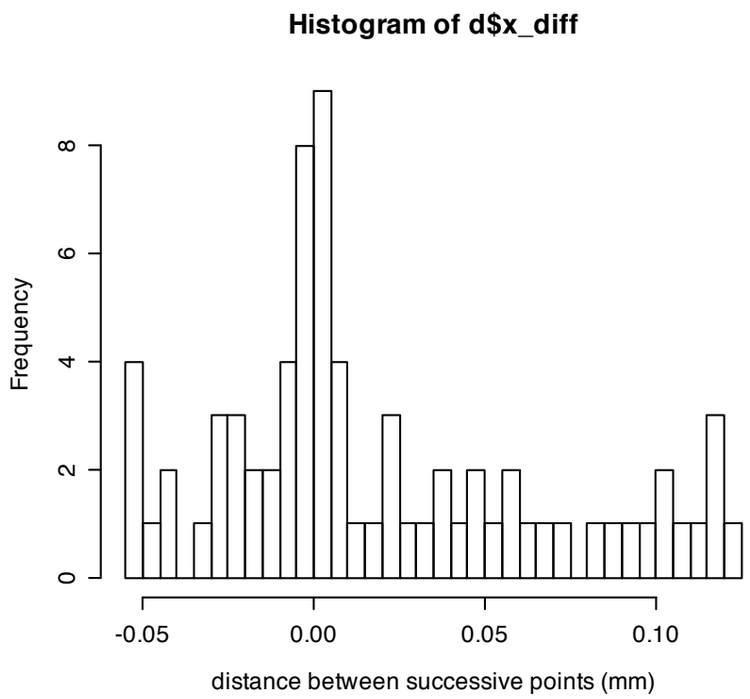
- Large tracks (alphas) can be reconstructed by simply interpolating a line between anode hits.
- This begins to fail for smaller tracks since the extent of this line in x is largely dependent on the angle the track hit the MWPC.
- X is now being reconstructed using time slices as the Y direction.

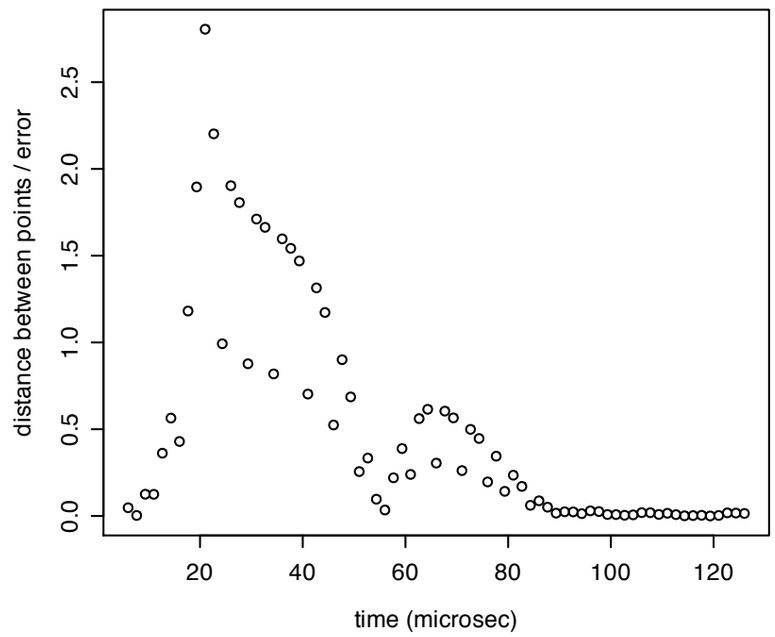
3D Reconstruction

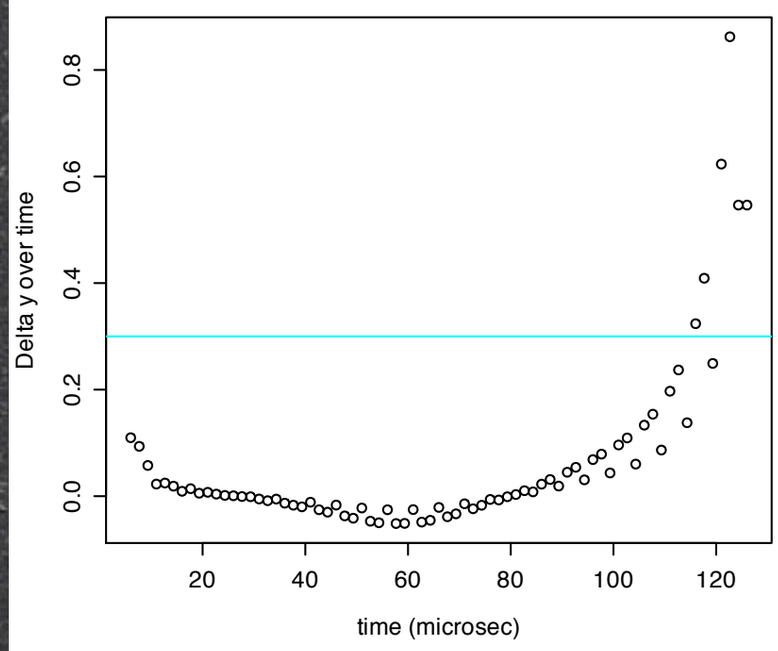


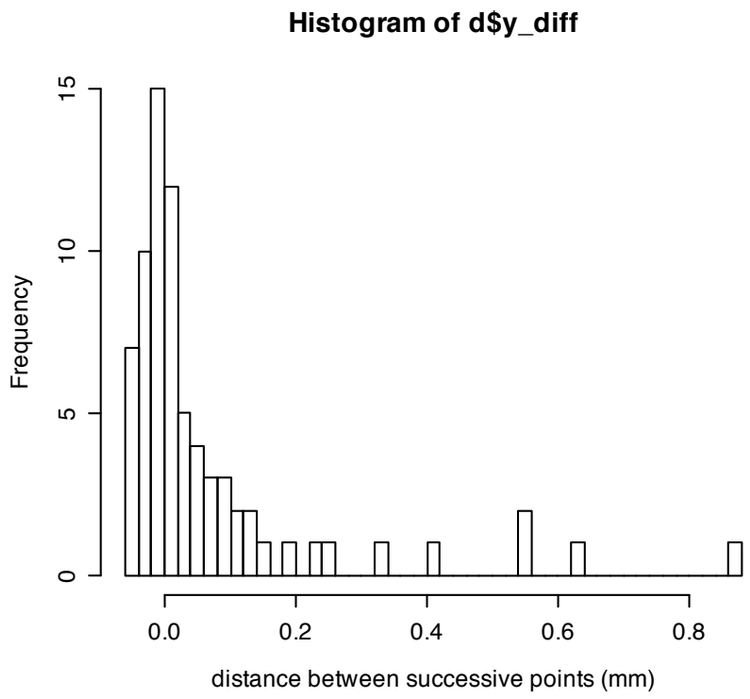
Error plots & Statistics

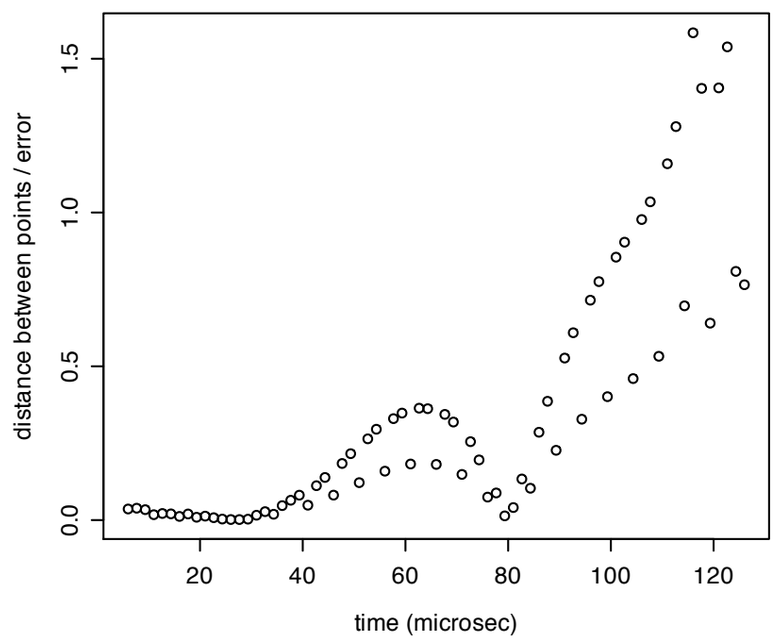






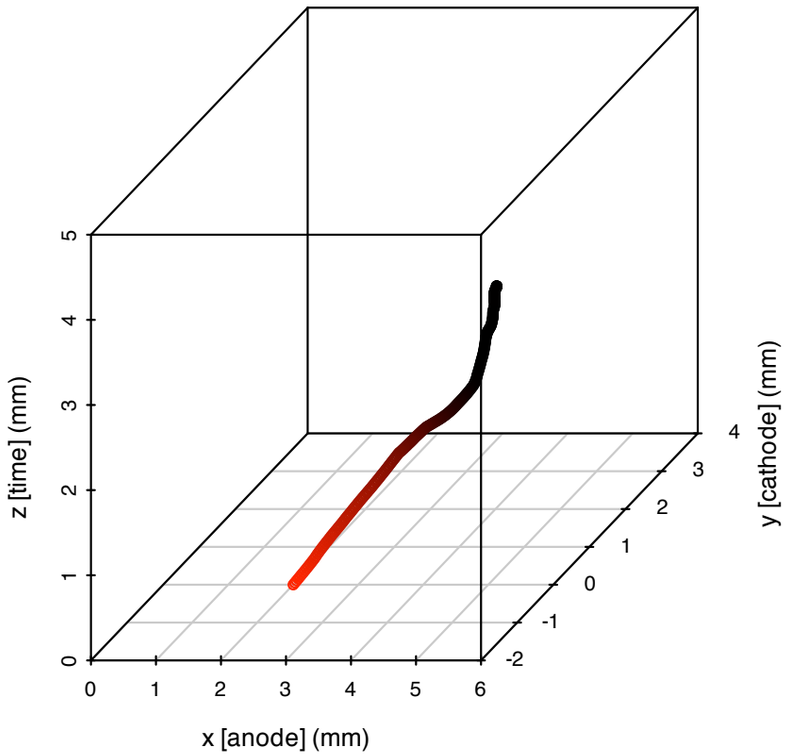




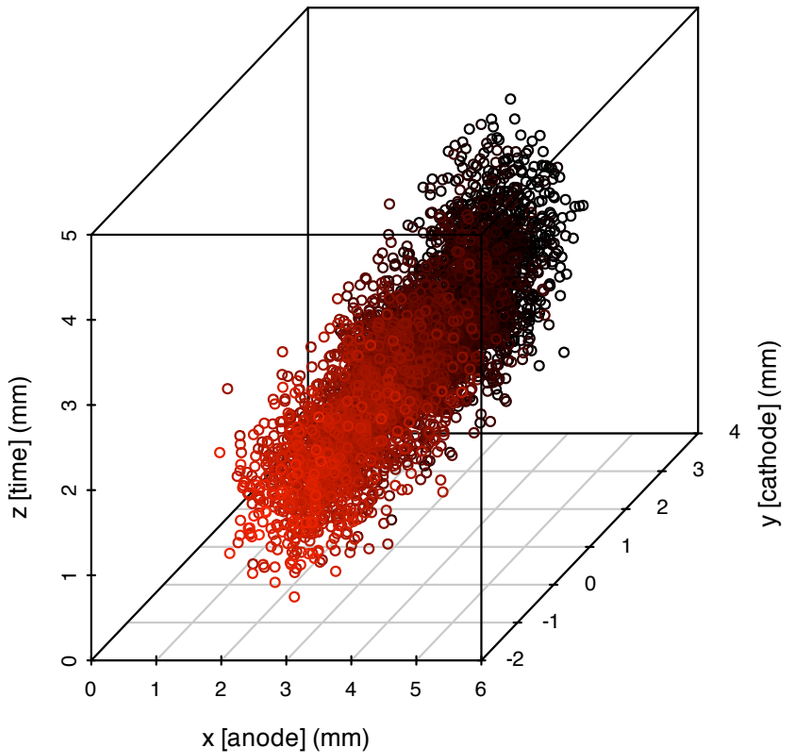


3D Reconstruction

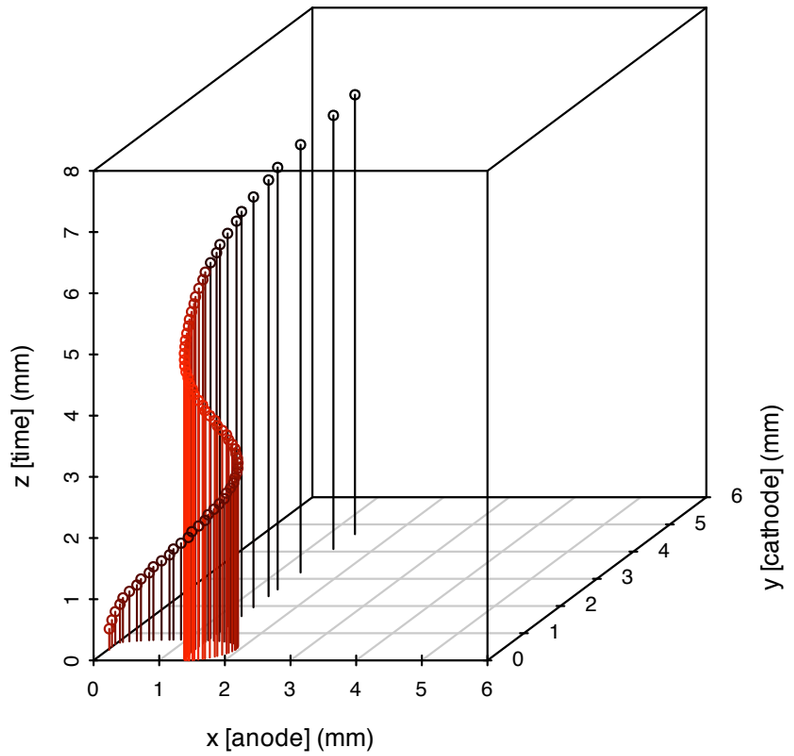
200 keV S Recoil, Original Track



200 keV S Recoil, Diffused Track



200 keV S Recoil, Reconstructed Track



Conclusions & Future Work

- 3D track reconstruction looks very promising
- Useful for discrimination – simulations show for RPRs have dx ≈ dy ≈ dz
- Electronics change may greatly improve directionality
- Need to investigate data taken with new electronics (sans shapers)