Canberra SAGe Well Coincidence Measurements

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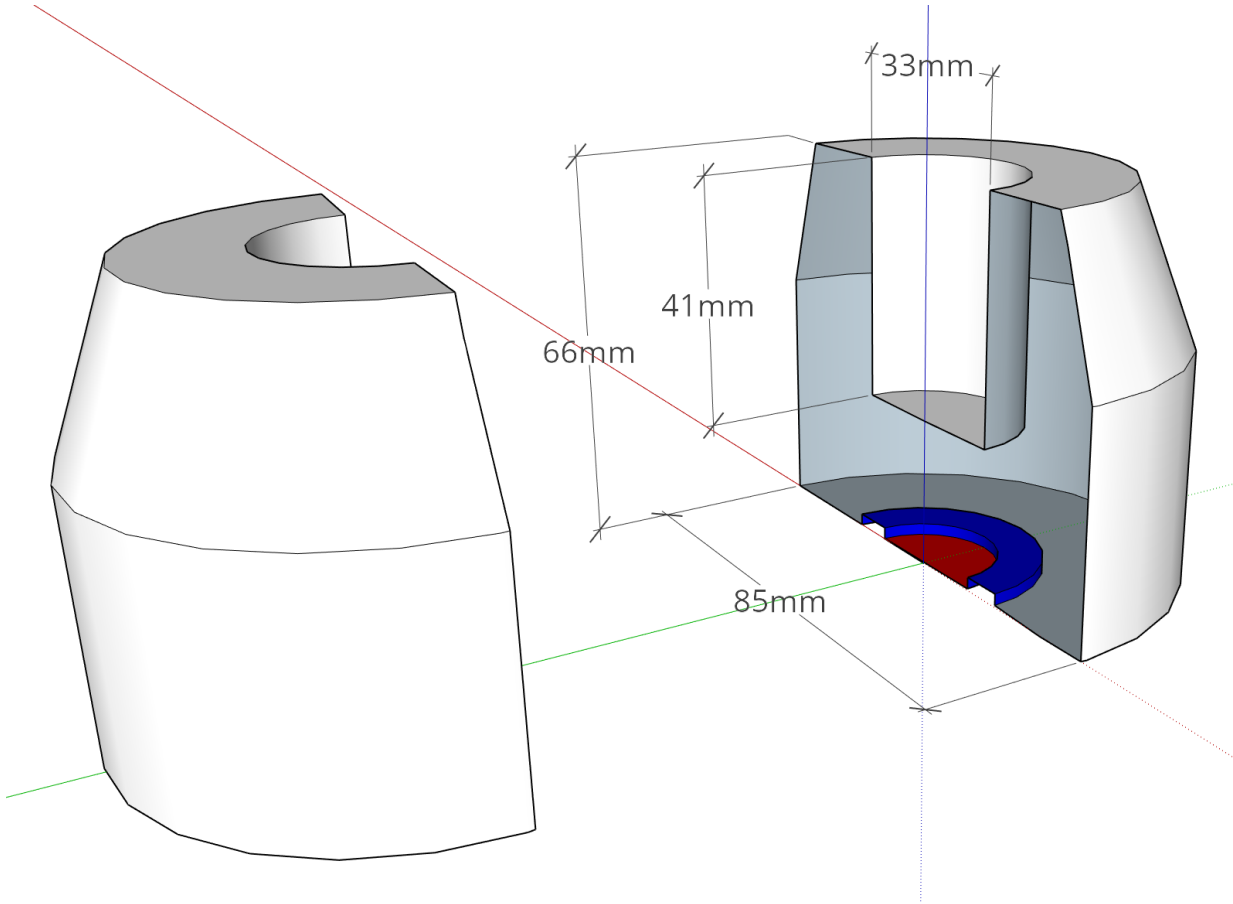
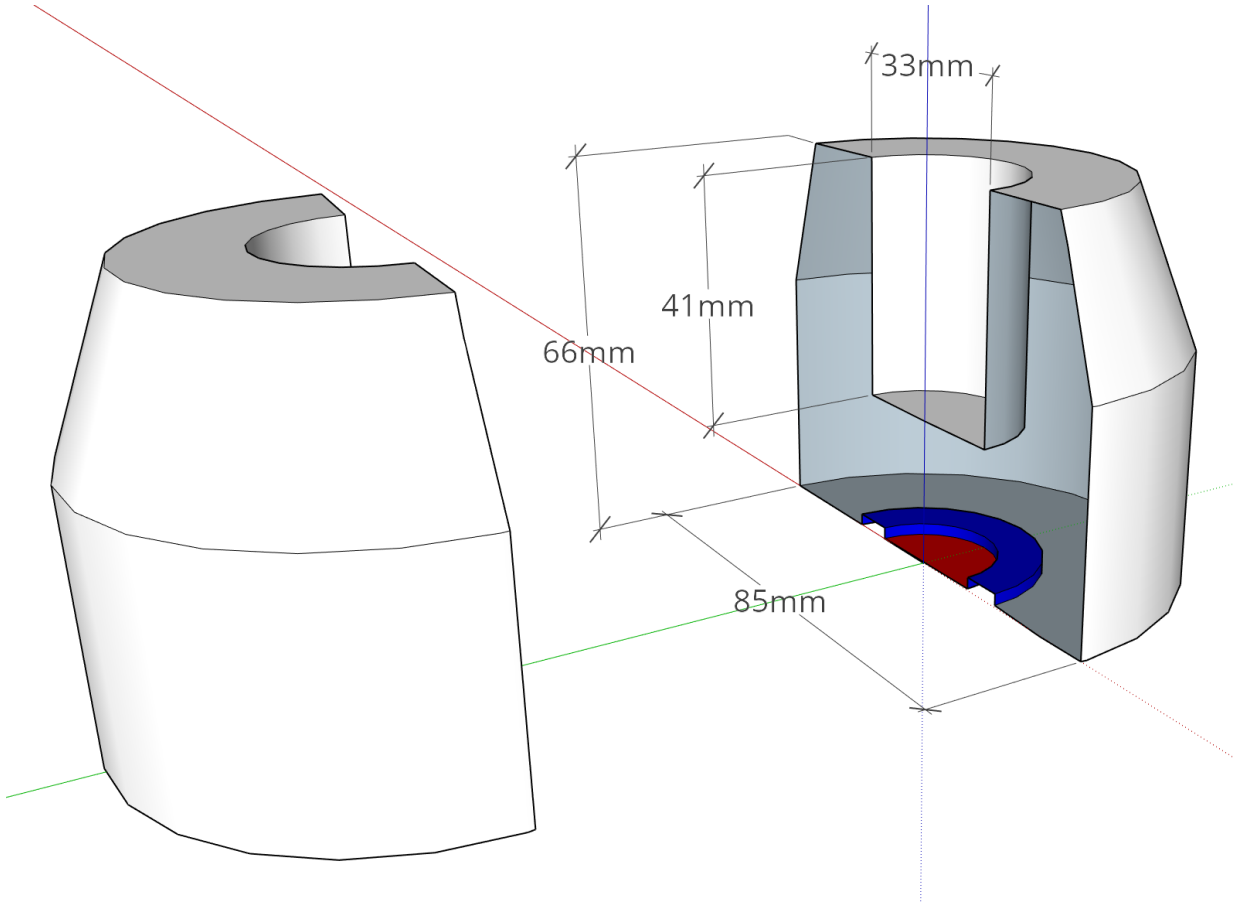
Canberra SAGe Well GSW275

- Canberra SAGe Well "inverted coaxial" detector studied at Liverpool.
- Mechanically cooled by Canberra CP5-plus.
- Excellent energy resolution due to low capacitance of small electrode.



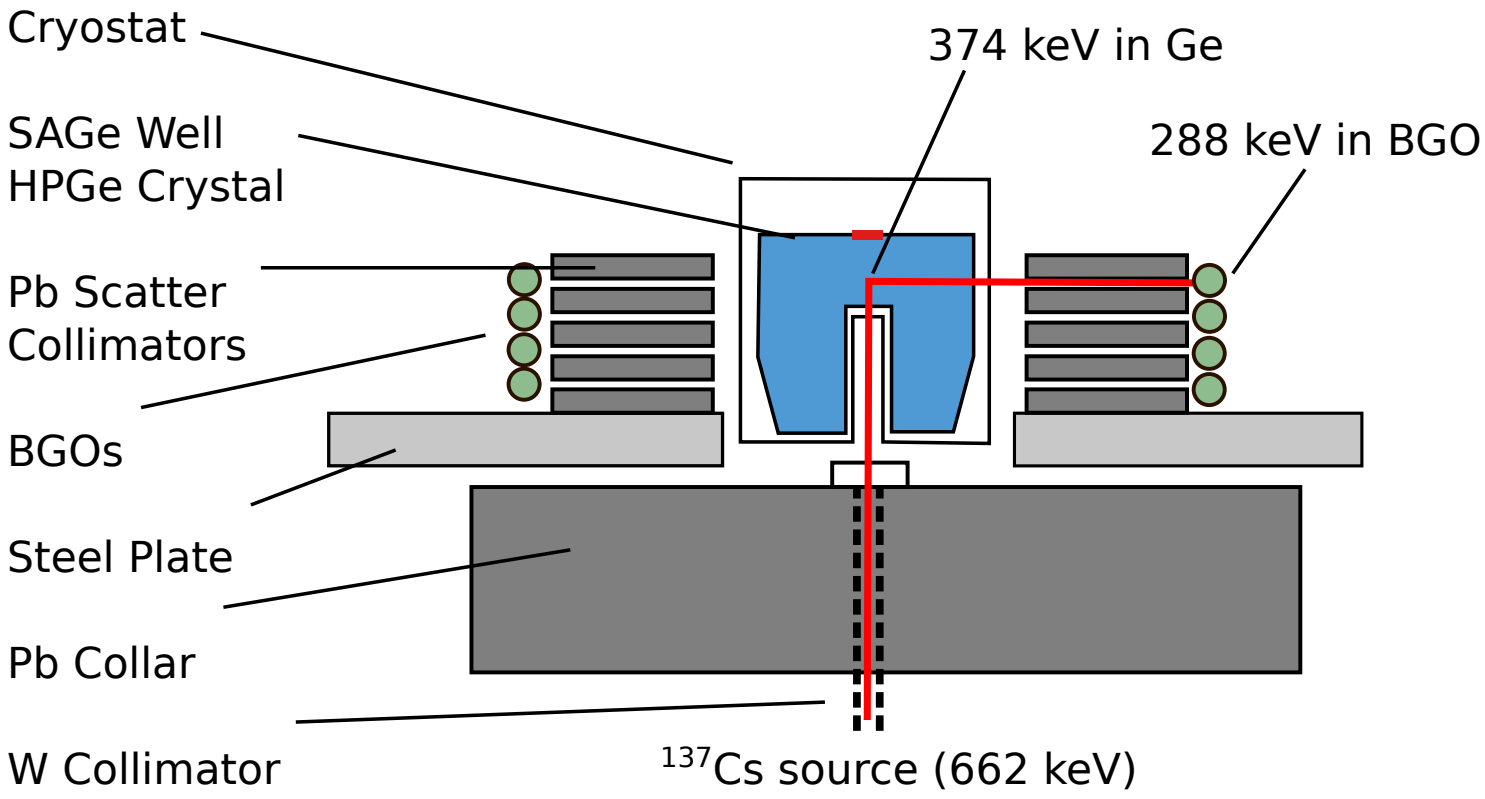
Canberra SAGe Well GSW275

- Holes collected at small electrode.
- Very long charge collection times (up to $1.6\mu s$).
- ADL field simulations optimised to match experimental signals.



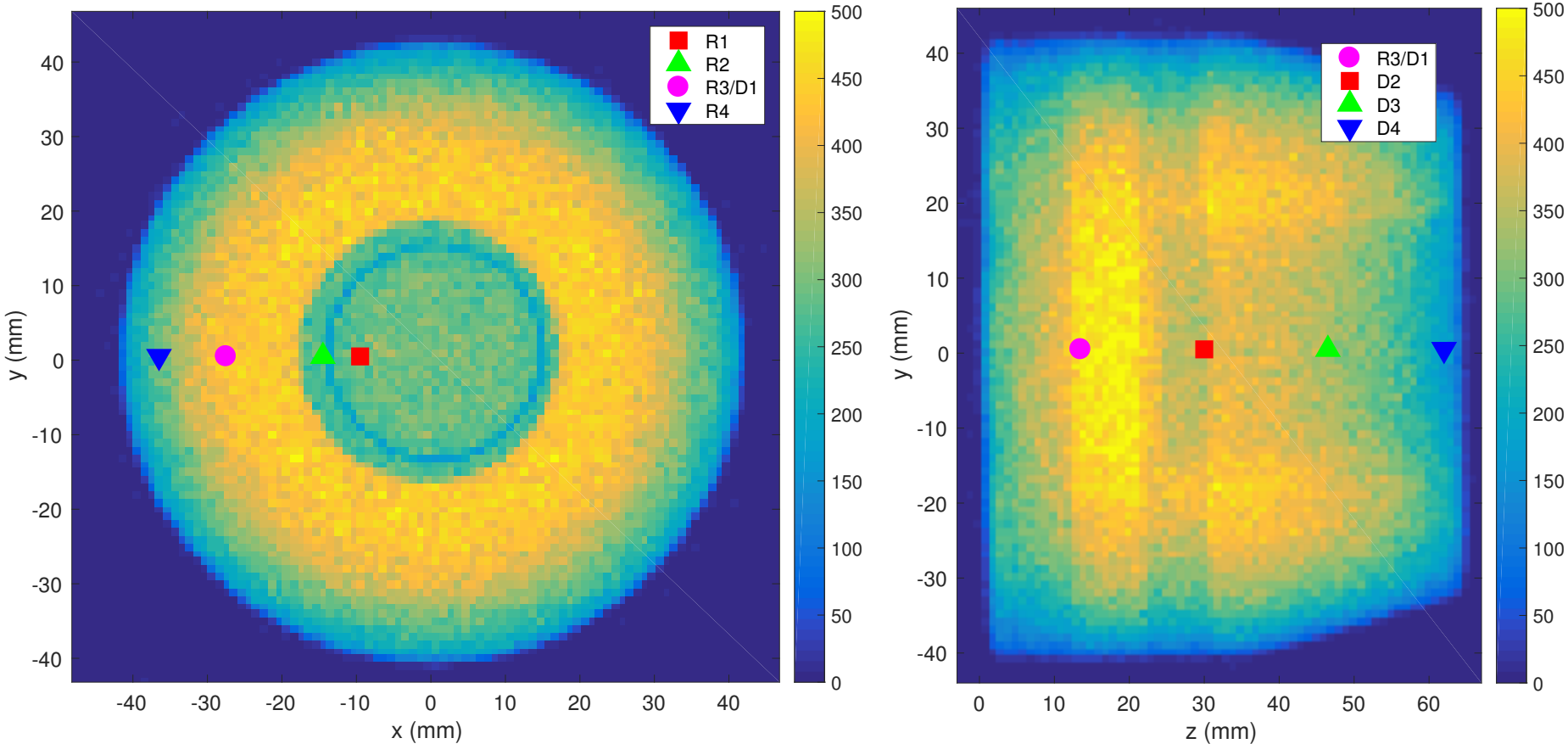
Scanning System

- Liverpool scanning system familiar to AGATA group from early measurements.
- New Scionix BGO detectors and CAEN 1724 digitisers.
- Energy gates and mutual similarity used to select events for mean signal formation.



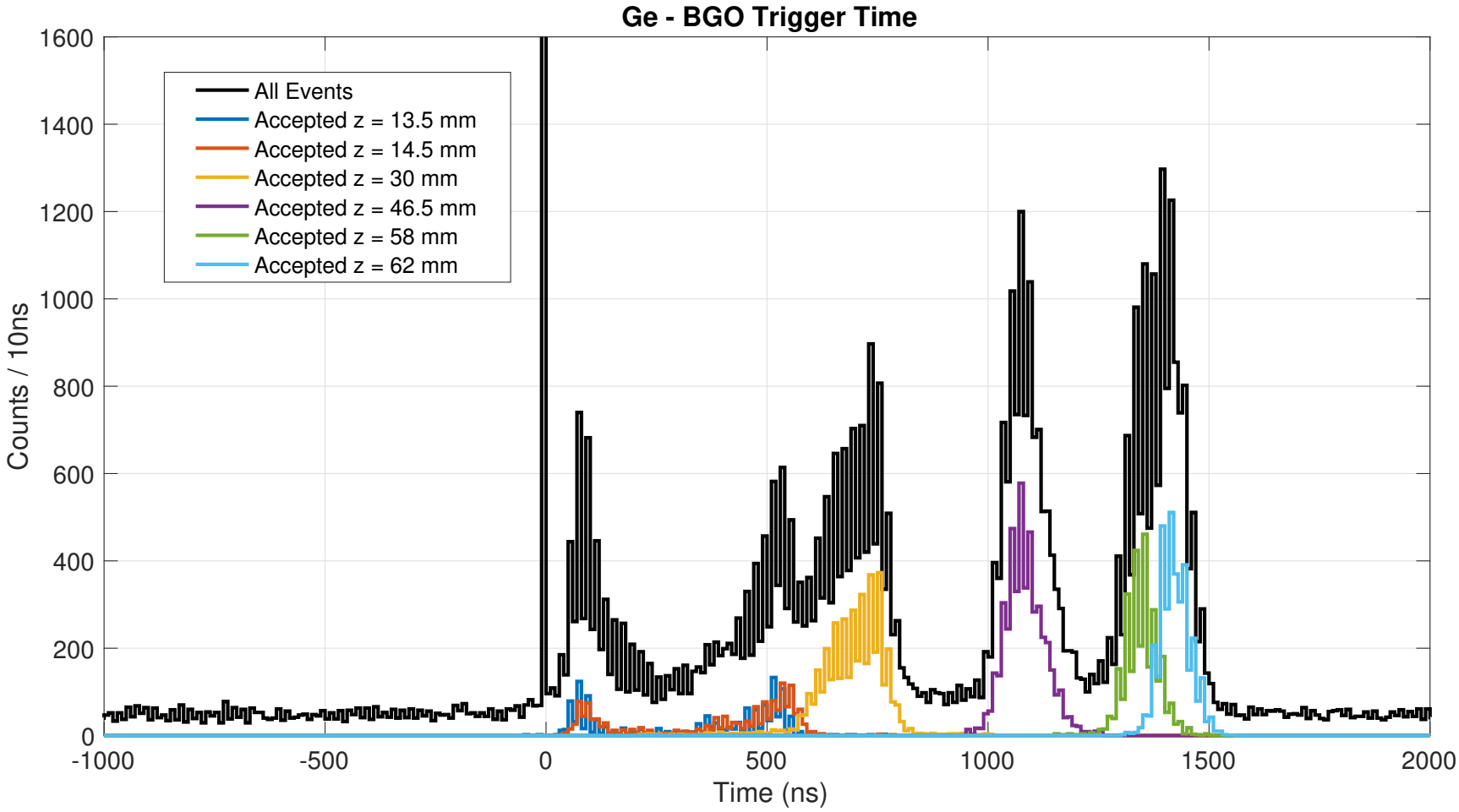
Singles Scan

- Singles scan photopeak intensity reveals detector location and orientation.
- Markers show coincidence scan example positions, discussed later.
  - Line of points along radius at $z = 13mm$.
  - Line of points through depth at $r = 25mm$.



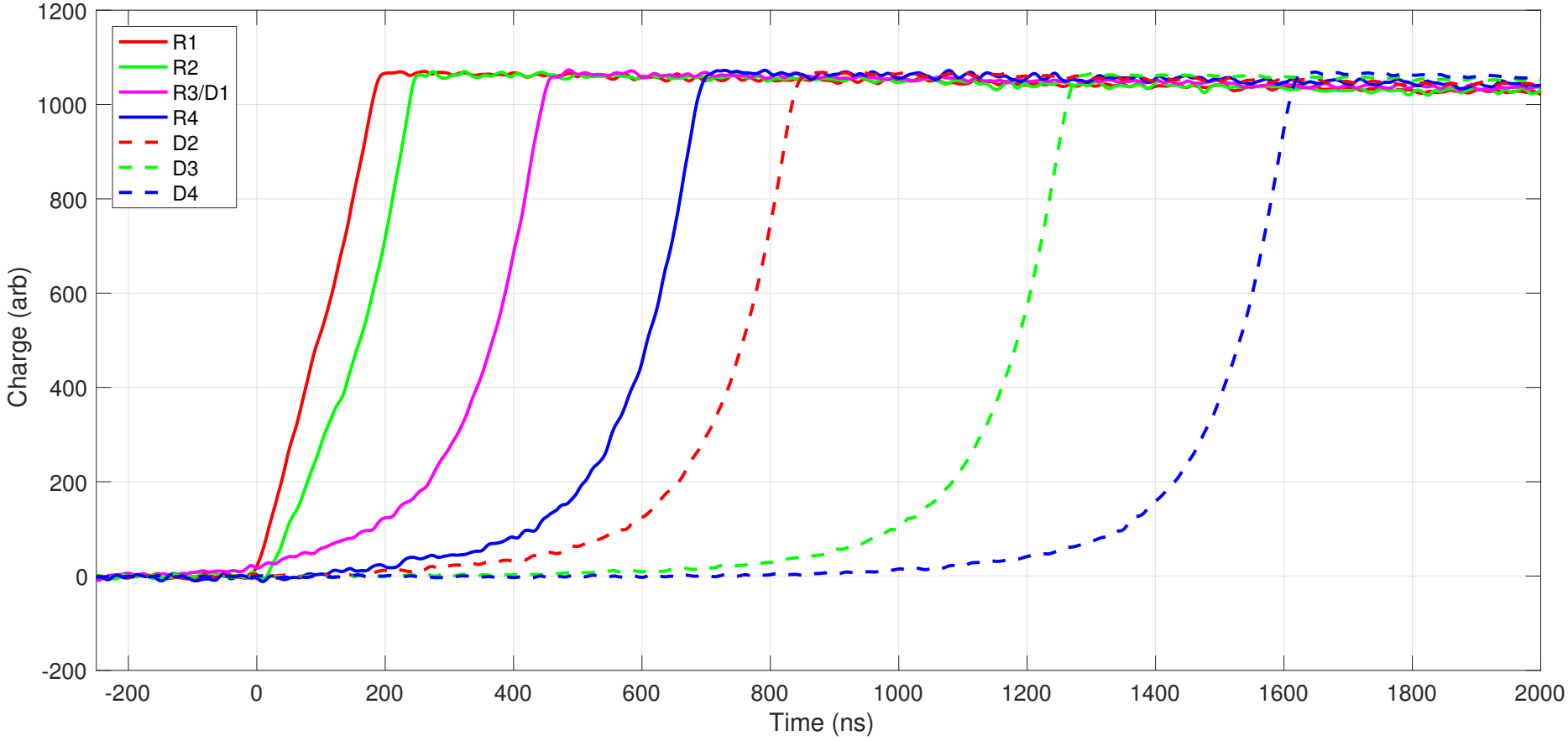
Coincidence Scan

- T_{2-98} of SAGe signals up to $600ns$.
- SAGe-BGO time differences reveal full charge collection time can be much longer.



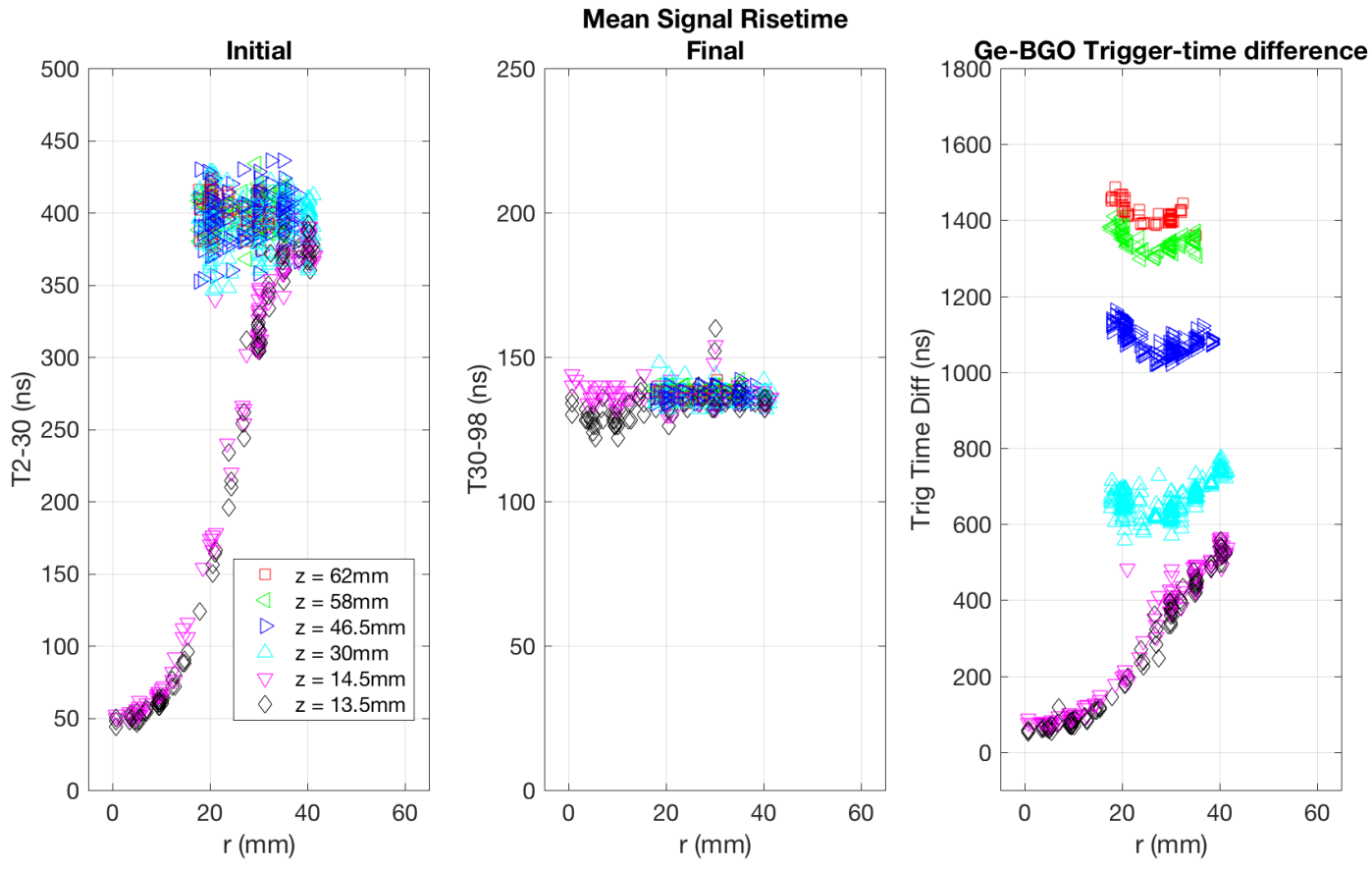
Coincidence Scan

- Signals from different positions shifted according to SAGe-BGO time difference.
- For signals of similar shape this produces the correct relative time alignment.



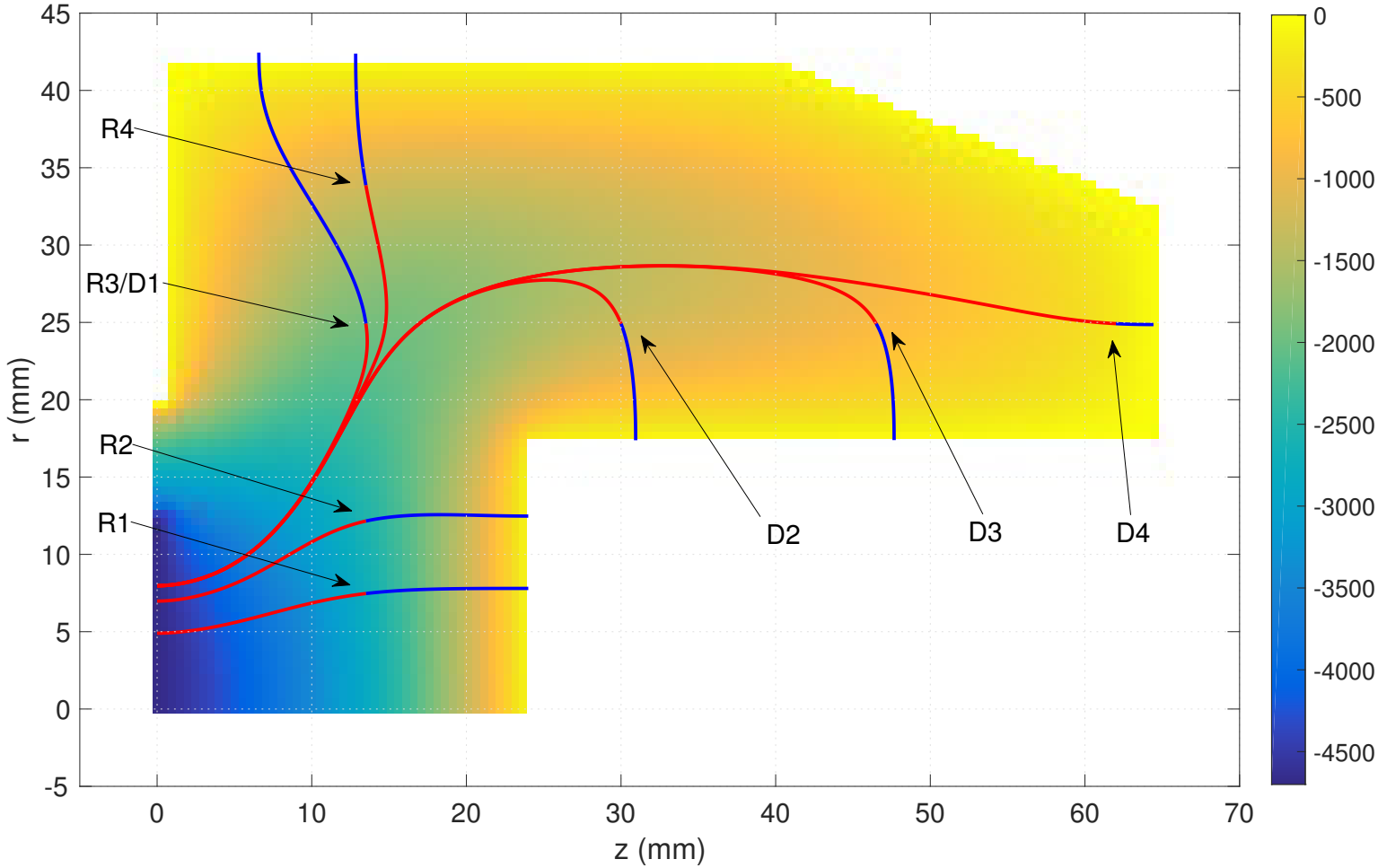
Coincidence Scan

- Close to the electrode there is significant variation in the shape of the induced signal.
- Elsewhere in the detector induced signals show little variation.
- SAGe-BGO time differences show detailed charge collection behaviour.



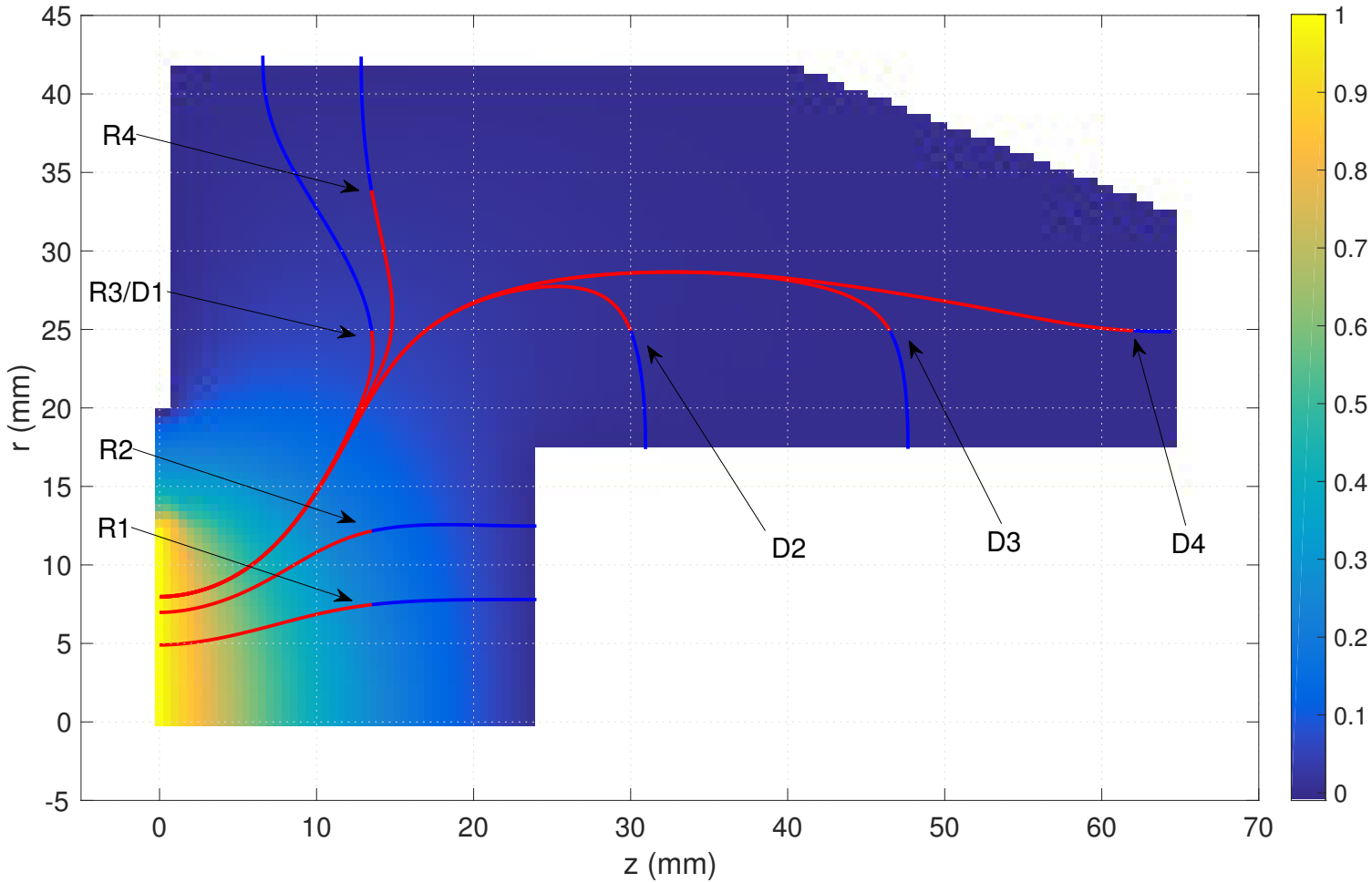
ADL Simulations

- Calculated electric field in detector.
- Hole paths shown in red, electron paths in blue.
- Fields were checked against those calculated at Canberra.



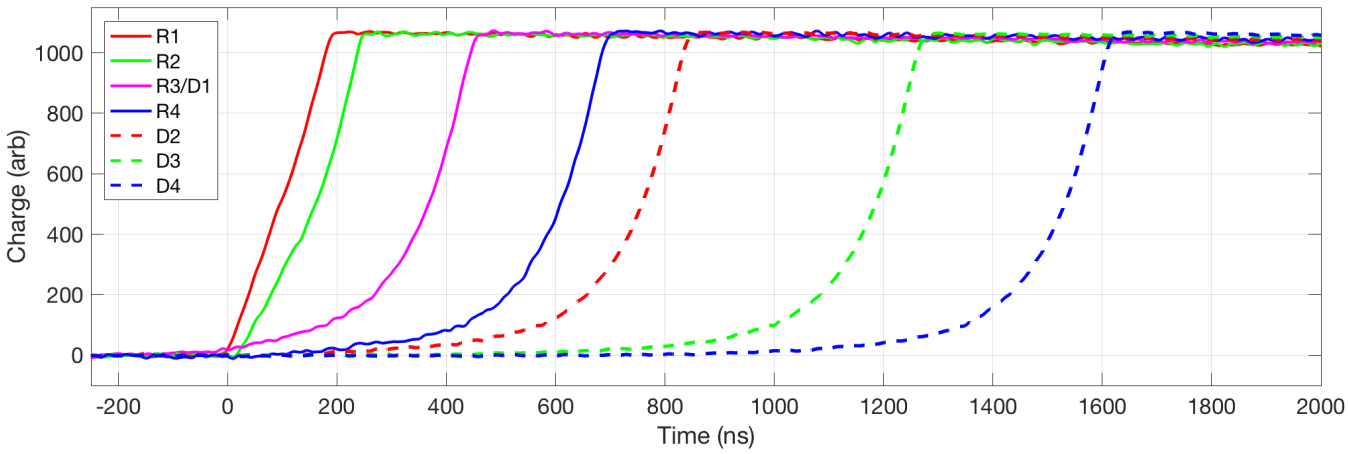
ADL Simulations

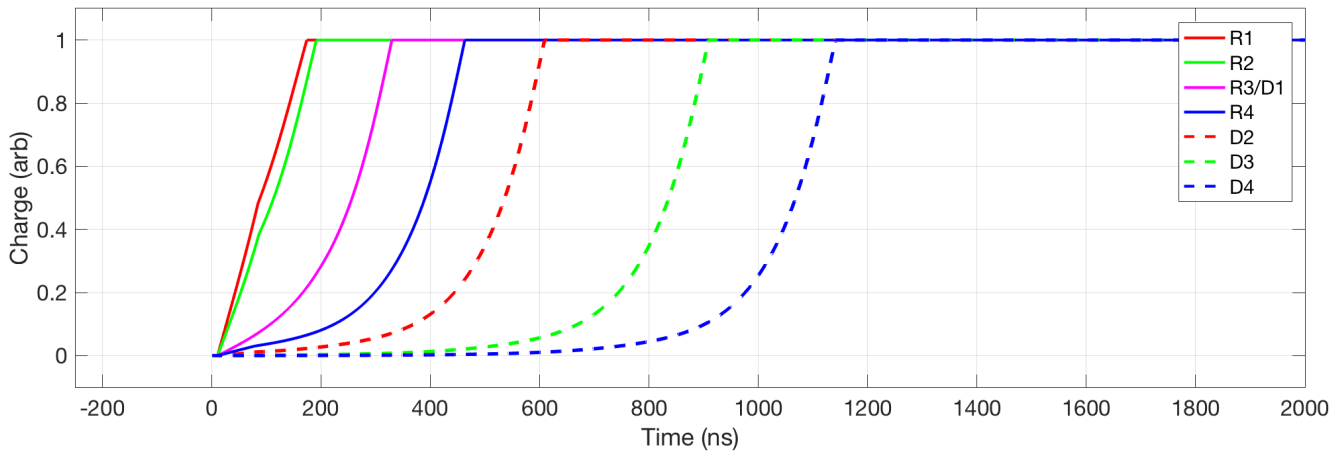
- Weighting potential map shows why induced signals show such uniformity.
- Induced signal very small until holes approach the electrode.



Comparing Signals

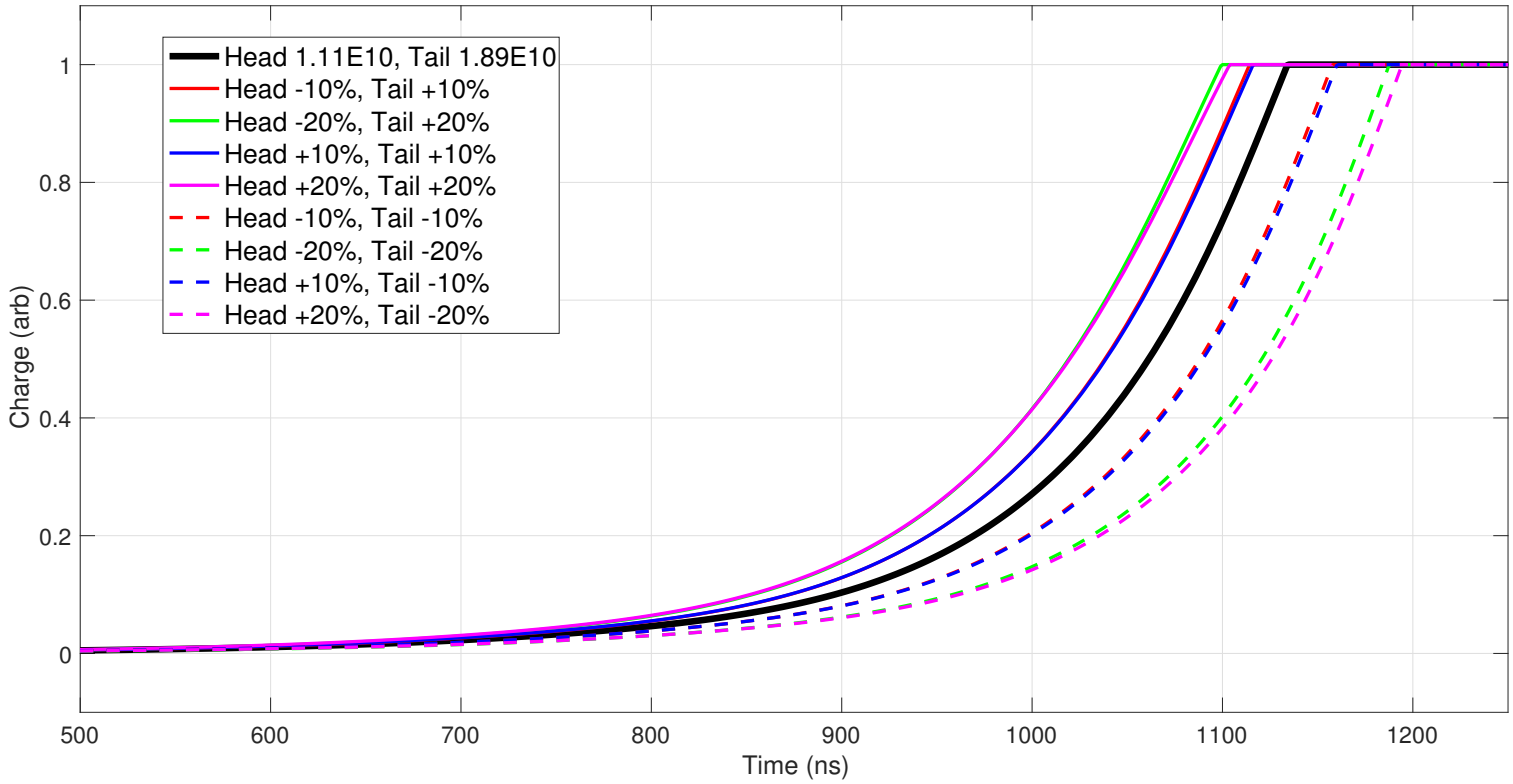
- Calculated signals show much faster charge collection than observed.
- Mobilities taken from ADL/Bart Bruyneel model. (Characterization of large volume HPGe detectors. Part I and II, NIM A, 2006)





Impurity Concentration

- Simulated signal from point D4 for a selection of impurity distributions.
- Uncertainty of 20% on impurity concentrations not sufficient to explain observed charge collection times.



Hole Mobility

- Temperature of CP5-cooled crystal significanly higher than that of typical LN2 cooled devices.
- Temperature scaling of $T^{-2.6}$ produces charge collection times very close to those seen in experiment.
- $\approx$ 30% when temperature increases from 98 K to 113 K.