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Characterisation of small electrode HPGe detectors

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Canberra BEGe and SAGe Well are high-purity germanium detectors designed for gamma-ray spectroscopy featuring small p+ readout electrodes which provide reduced electronic noise and allow for unrivalled energy resolution, particularly at low gamma-ray energy. A series of characterisation studies has been carried out on a number of detectors at the University of Liverpool to investigate the use of pulse shape analysis (PSA) techniques. This has allowed gamma-ray interactions near to the detector surface to be identified. This information can then be used for improved sensitivity at low gamma-ray energy.

A coincidence scanning method with a highly collimated ^{137}Cs source has been used to identify single-site interactions at a range of known positions in the detectors. The small readout electrode results in extremely long charge collection times of up to 1.6μs typically leading to poor time resolution. In this work the interaction time has been precisely determined by coincidence with an array of BGO scintillation detectors allowing accurate measurement of charge drift times through the detector.

The results have been used to inform the development of algorithms for the suppression of Compton scatter events based on their interaction location in the detector. A number of source tests have examined the background rejection performance for low energy gamma rays in the presence Compton scatter background from ^{137}Cs and ^{60}Co.

Due to the extremely long charge collection times, comparisons between measured charge drift velocity and that predicted by electric field simulations have provided a sensitive test of mobility parameters for holes in germanium.

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