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Simulating the position sensitivity of the segmented iThemba LABS HPGe detector

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The iThemba LABS detector is made up of four end-closed coaxial, front tapered, electrically segmented n-type germanium crystals, packed closely together in one cryostat. The dimensions of each crystal are: 60 mm width before shaping and 90 mm long. The cathode of each crystal is electrically segmented into 8 contacts with depth segmentation at 35 mm, implying that the back segments are 55 mm long. This results in a total of 36 electronic channels of which 32 are associated with the outer contacts and 4 with the inner core contacts of the detector. The inner core contacts provide high resolution measurements of gamma-ray energy deposition for each crystal whilst the outer contacts provide information about the locations of the gamma-ray interaction inside the detector.
The position sensitivity of this segmented iThemba LABS HPGe detector is investigated through simulation using the Multi-Geometry Simulation code. This code simulates the electric potential, electric field, drift velocity, weighting potential and generate the expected pulse shape from an arbitrary gamma-ray interaction's position within the germanium detector volume. When the charge sensitive pre-amplifier response for the segmented iThemba LABS HPGe detector is convoluted with the total current produced by the MGS, the resulting charge pulse is effectively slowed and smoothed. Using this code, the pulse shape response at the inner and outer contacts has been generated changing the radius, angle and depth of gamma-ray interaction positions within the germanium detector volume. Changes in the pulse shapes reflecting changes in the position of the interaction point were observed. This confirms that the detector is sensitive to the exact position of the gamma-ray interaction. The details about the simulated position sensitivity of the segmented iThemba LABS HPGe detector will be discussed.

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