The TIGRESS 32-fold segmented HPGe clover array - position sensitivity from pulse shape characterisation and simulation

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The TRIUMF-ISAC Gamma-Ray Escape-Suppressed Spectrometer (TIGRESS) is a 32-fold segmented HPGe clover array which will be installed at the ISAC-II radioactive ion beam facility [1] at TRIUMF in Vancouver, Canada. The array will consist of 12 detectors, each comprising four $\sim 40\%$ relative efficiency HPGe crystals. The outer contact of each crystal is segmented longitudinally into four sections, and transversely into two sections, creating 8 segments per crystal in addition to the central full-volume contact.

Due to Doppler broadening, the energy resolution of such large-volume detectors is significantly reduced compared with the intrinsic high resolution of germanium when detecting gamma-rays emitted from recoiling nuclei. This broadening is proportional to the opening angle subtended by the detector, resulting in a trade-off between detection efficiency which favours a close-packed configuration and energy resolution which favours a high granularity. This trade-off can be compensated for by obtaining more precise information on the first interaction point of a gamma-ray within the detector volume. The localisation of the first interaction point is obtained by analysing the pulse shapes and heights of the signal in the charge-collecting segment and the induced transient signals in the remaining segments of the crystal, and comparing them with a library of such signals collected as a function of first interaction position. To create this library from experimental data is prohibitively time consuming, so the final goal is to create the library from simulations following the Ramo theorem [2], tuned by selected experimental data.

This presentation will focus on the progress of the development of the TIGRESS array. Results from coincidence-scanning measurements will be presented, and compared with initial results from FEMLAB simulations. The challenges of the ongoing development of a device which is at the forefront of germanium detector technology will be discussed. First results from a recent Coulomb excitation experiment at the ISAC-I facility will be presented, highlighting the performance of a subset of the final array in a real-world experimental situation.

[1] R. E. Laxdal, Nucl. Instr. and Meth. **B 204**, 400 (2003).
[2] S. Ramo, Currents induced by electron motion. Proc. IRE, **27**, 584 (1939).