SIGMA: The Segmented Inverted-coaxial GerMANium Detector

J Wright¹, L Harkness-Brennan², A Boston³, D Judson⁴, M Labiche⁵, P Nolan⁶, R Page⁷, F Pearce⁸, D Radford⁹, J Simpson¹⁰ and C Unsworth¹¹

¹,²,³,⁴,⁶,⁷,⁸,¹¹University of Liverpool, UK, ¹⁰STFC, UK, ⁹Oak Ridge National Laboratory, USA

The SIGMA detector is the next stage in γ-ray spectroscopy, providing unrivalled performance in both energy and position resolving capabilities. The combination of point contact technology in addition to a unique segmentation scheme enables SIGMA to be capable of sub-mm position resolution; possible only through the use of pulse shape analysis techniques. The long term objective is that detectors of this type will be deployed as part of the germanium array required for the DEPSEC experiment at the FAIR facility. Additionally, this detector will be ideally suited for use as a single detector γ-ray imaging device for commercial and industrial applications, revolutionising performance in such areas as nuclear decommissioning, security, environmental monitoring and medical imaging.

The unrivalled energy resolving capabilities of SIGMA will be realised due to low series noise on the point contact; a product of the reduced capacitance of said contact, an effect which will be increasingly evident at low energies. The design of the detector results in increased drift times for the primary charge carries, with drift times of up to 2 μs theorised. The relationship between drift times and interaction position has been studied and characterised through the use of detailed electric field and charge transport simulations. Furthermore, studies have been performed to increase understanding of the expected position resolution and imaging capabilities.