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Sub-Millimetre Particle Tracking Using PEPT with the PolarisJ Semiconductor Array

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The Positron Emission Particle Tracking (PEPT) technique has been in development in Cape Town since 2009, and allows one to track a 1mm positron-emitting point source travelling at 1m/s to within 1mm, 1000 times a second. Typically, this utilises a large, high efficiency scintillation detector like BGO. However, recent experiments have shown that high resolution, relatively high efficiency semiconductor (CdZnTe) detectors, which are usually used in prompt gamma-ray detection during proton radiotherapy, are able to track particles down to sub-millimetre precision. We have been using the PolarisJ detectors to develop the PEPT technique, and hope to use them to track particles in micro-scale fluid dynamics applications. Initial measurements have been able to locate a ^{22}Na button source in three-dimensional space with an uncertainty of 0.11mm and a signal-to-noise ratio of 85%. This is a promising first step towards tracking micrometre-sized particles with sub-millimetre accuracy.

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