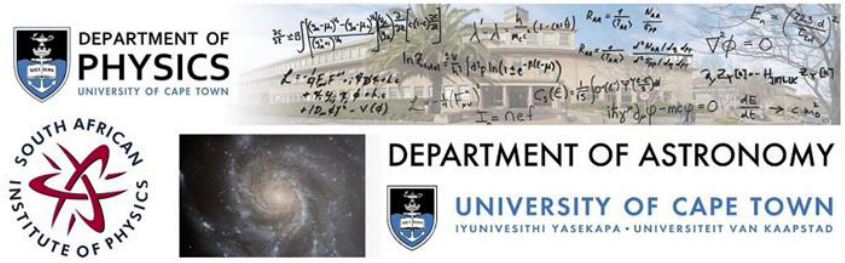

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Performance characterisation for Positron Emission Particle Tracking at “PEPT Cape Town”

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Abstract content
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Since 2009, the Department of Physics at the University of Cape Town has run a dedicated facility, “PEPT Cape Town”, for developing and applying the technique of Positron Emission Particle Tracking (PEPT). It is based at iThemba LABS, South Africa, and is one of only two such institutions in the world. Developed at Birmingham University, UK, PEPT has become one of the most powerful visualisation and characterisation techniques for investigating particle dynamics within opaque and often aggressive industrial environments.

The facility operates an ECAT Exact3D “HR++” positron camera manufactured by Siemens medical systems. It was designed to achieve high sensitivity and a wide field of view through an increased number of detector elements compared to standard medical PET devices. Recently we have acquired an ADAC Vertex camera similar in design to the current flagship Birmingham system. This offers the opportunity for studying larger systems than can be accommodated within the HR++ ring system and for validating experimental results from both institutions.

This paper presents an overview of the PEPT Cape Town facility, radiotracer production routes and initial performance characteristics of the positron camera systems. These data suggest the possible dynamic range in which PEPT can be performed. Under typical experimental conditions, a level of performance comparable to published metrics from Birmingham was achieved with the ADAC Vertex, in general locating particles at kHz rates and with millimetre accuracy in 3 dimensions. For the HR++, a greatly enhanced performance was measured, with particle location rates approaching 50 kHz whilst retaining similar location accuracy. The high sensitivity of this system offers the unprecedented tracking of low activity, or conversely of small, tracer particles in fast flowing systems, and extends the potential viability of PEPT. Exemplar applications in mixing, separation, fluidisation, and other particle phenomena are given to illustrate the power and range of the technique.

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