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A modular positron camera for positron emission particle tracking in harsh environments

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By detecting the back-to-back gamma ray emissions from a positron emitting tracer particle high speed and accurate tracking can be achieved as it moves throughout the field of view of a positron camera; this forms the basis of the technique Positron Emission Particle Tracking (PEPT), developed at Birmingham for over 25 years. The ability to track either particles or neutrally buoyant flow followers (in the case of liquid systems) enables the use of the PEPT technique for studying a wide range of particulate systems, granular dynamics and multiphase flows. We have previously described the development of a modular positron camera used for PEPT which has proven to have considerable benefit as the field of view and hence the sensitivity can be custom tailored to the application in question. Further, the camera is transportable and can be operated in remote or industrial environments.

One of the recent successes for the modular camera has been in the study of liquid metal casting at the foundry on the University campus. This has proved challenging as the camera is operated in a harsh high temperature environment with a significant amount of gamma ray scattering and attenuating material present. Tracer particles which are used for PEPT have been developed which can survive the conditions found in liquid aluminium. Investigations into the camera performance for PEPT experiments involved in the study of liquid metals, including measurements of sensitivity and location precision, gamma ray attenuation and scattering properties of the materials involved, are reported in this paper. Example particle trajectories from these experiments will be given to illustrate the applicability of PEPT to an increasing range of applications.

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