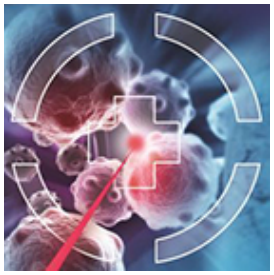

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The role of image reconstruction and processing in image-based range verification for particle therapy: A Review

To fully exploit the advantages of therapeutic ion beams, on-line monitoring of the dose deposition would be highly desirable. At present, several methods have been proposed to determine the beam range using the secondary radiation originating from the interactions between the therapeutic beam and the tissues. Two main techniques are prompt gamma imaging (PGI) and positron emission tomography (PET). Among PGI approaches, tomographic imaging using Compton cameras (CC) have been proposed.

Both CC-based PGI and PET are aimed to reconstruct the measured data into a tridimensional image which describes the distribution of the secondary radiation sources. This process corresponds to solve an inverse problem under very adverse conditions, e.g., very low rates of useful events, background noise, geometrical constraints and subsequent data truncation, etc. In this work, we aim to provide an insight of current techniques, possibilities and challenges which affect the precision and accuracy of CC and PET based range estimations. We focus on the role of the system response model, the type of reconstruction algorithm, possible data selection and use of a-priori information, etc. The way image reconstructed images are further processed can also affect the estimation of the distal fall-off, which is often the piece of information used to identify possible range deviations.

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