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*OLD: Comparison of Multi-Parallel Slit and Knife-Edge Slit Prompt Gamma Cameras in the context of hadrontherapy verification*

NEW: Analytical and Monte-Carlo modelling of Multi-Parallel Slit and Knife-Edge Slit Prompt Gamma Cameras.

Proton range monitoring with prompt-gamma coming from nuclear reactions between the beam and the patient is currently investigated with various detector systems, such as the Multi-Parallel Slit (MPS) and Knife-Edge Slit (KES) prompt gamma cameras. Camera performance is mainly characterized by a compromise between spatial resolution and detection efficiency. However, during camera design, modifications of geometrical parameters, such as collimator-crystal distance and collimator pitch or depth, often lead to improvement of one of these criteria and deterioration of the other.

In order to compare the performance of different camera types and configurations, we derived an analytical model for two models, MPS and KES, that roughly but easily predict camera performance. The models allow to estimate variation in performance according to variation in geometrical parameters. Monte-Carlo (MC) simulations were performed to evaluate the model and perform deeper comparisons between the two camera systems.

As a result, the spatial resolution and efficiency estimated by the analytical models match the MC simulations to within a factor of two. The efficiencies are slightly better than predicted (MPS prediction and MC: 4.18e-5, 2.22e-5, KES: 6.67e-5, 3.96e-5), while for the the spatial resolution the prediction is a bit too optimistic for the MPS (14.52 mm, MC: 17.35 mm) and for the KES on point (13.5 mm, MC: 12.94 mm).

The comparison between MPS and KES fall-off retrieval performance shows that MPS provides between 0.5-1.5 (1σ) precision for one spot at 1e9 protons and KES between 1.0-5.5 mm, which indicates that the role off the efficiency may be larger than that of the spatial resolution, when it comes to choosing a collimator design.