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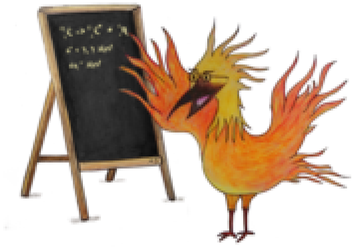

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Development of a portable gamma imaging system for absorbed radiation dose control in targeted radionuclide therapy

Targeted radionuclide therapy is still a developing area among the different treatment modalities against cancer but is one of the most used in the treatment of malign and benign diseases of thyroid. The large heterogeneity of absorbed doses in patients and the range of effects observed, both in terms of toxicity and response, demonstrate that an individualized dosimetry is essential for optimizing this therapy [1]. In clinical practice, patient-specific dosimetry relies on the quantification of radiopharmaceutical uptake as a function of time, which is obtained both from pre-therapy tracer studies and measurements made with a counting probe during treatment [2]. However, the best way to reach a real dose quantification, especially free of the influence of the stunning effect [3], would be to perform imaging during treatment. Conventional gamma cameras are not suited for this kind of applications both in terms of performances (very high activity, high energy), ergonomics (use in the isolation room of the patient) and availability, that should be compatible with an accurate temporal sampling of the kinetics of the tracer. The aim of the project is to strengthen the control of the dosed delivered to organs during targeted radionuclide therapy of thyroid, developing a novel mobile gamma imaging device specifically dedicated to semi-quantitative measurements of the bio-distribution and kinetics of the radio-tracer for both benign and malign thyroid disease. The device will be op- timized, in terms of energy and spatial responses, to meet the specific needs of absorbed radiation dose control during thyroid therapy and its ergonomics will be suited for using it at the patients bedside. The final purpose is to develop a 10x10 cm2 field of view camera suited to the size of the thyroid. The camera will consist of a parallel-hole high- energy tungsten collimator, made with 3D printing, coupled to a continuous inorganic scintillator, readout by a recent and well-suited technology based on arrays of Silicon Photomul- tiplier (SiPMs) detectors [4]. We report here the preliminary study aiming to optimize the detection head of the camera, by using both experimental data and theoretical approaches. Experimental characterizations is focused on the choice of the best scintillator-photodetector assembly, in terms of spatial and energy performances. The theoretical studies rely both on the design of the collimator with analytical models,and on the optimization of the overall camera, with Monte Carlo simulations, for the dosimetry of thyroid diseases.

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