## SERVICE DE METROLOGIE NUCLEAIRE

## PARTICLES-MATTER INTERACTIONS: Nuclear medicine and radiotherapy

(in collaboration with Jules Bordet Institute)

### 2. Comparing quantitative $^{177}$Lu SPECT with scintillation or semiconductor Gamma-Cameras

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**Background:**

Nuclear medicine examination requires delivery of a gamma-emitting radiopharmaceutical product into the patient, normally through injection into the bloodstream. The pharmacokinetics of the radiopharmaceutical in an organ allows studying the biology or the functionality of the considered organ. The pharmacokinetic is obtained by image quantification of the administered radiopharmaceutical.

$^{177}$Lu is a radioisotope used to produce radiopharmaceutical products for therapeutic purpose because it emits beta particles, but as it also emits gamma rays the treatment could be imaged through gamma-cameras. Single-photon emission computed tomography (SPECT) is a tomographic imaging technique based on the detection of the gamma rays emitted by the radiopharmaceutical product. These gamma rays are conventionally detected through scintillation Gamma-Cameras to acquire multiple 2-D images (also called projections) from multiple angles. Software is then used to apply a tomographic reconstruction algorithm to the multiple projections, yielding the 3-D data set (SPECT).

A new generation of Gamma-Camera combining a new type of detectors made of semiconductor and a new type of geometry (ring shape) is now available. This new type of Gamma-Camera is very promising but still needs to be evaluated. (https://www.youtube.com/watch?v=TJzmTjdAMH8). The Jules Bordet Institute has just acquired the two last generations of these two types of Gamma-Cameras allowing $^{177}$Lu imaging, leading to a unique opportunity to directly compare their capabilities.

**Goal:**

The goal of this master thesis is to compare the efficiency in term of resolution and sensitivity of both systems. First, the Master student will study the available literature on the subject. Secondly, based on literature findings and discussion with the medical physics team, the student will determine a list of experiments to conduct. Thirdly she/he will prepare and acquire phantoms (plastic objects that mimic the human abdomen) containing activity of $^{177}$Lu, with activities and geometries corresponding to the previous decisions. Then the student will reconstruct all the acquired phantoms with each predefined reconstruction parameters and will perform image quality analysis. Finally, based on these analyses, the student will compare the two systems.