# Master internship: Assessment of Compton Camera imaging applied to Targeted Radionuclide Therapy

## Context

Targeted Radionuclide Therapy (TRT) is a promising technique for cancer therapy [1]. It is based on administering radionuclides that travel through the bloodstream of the patient reaching specifically target diseased cells, killing the cancer cells. In the common practice, the dosimetry is based on the activity per unit body weight approach. However, a personalized internal dosimetry is needed in order to deliver the required dose and monitor the effects.

SPECT or PET imaging is frequently employed to recover the spatial distribution of these tracers when they also have diagnostic capabilities [2, 3]. Nevertheless, this typically results in poor spatial resolution due to the emitted high energy gamma rays and the generated bremsstrahlung photons when using therapeutic radioisotopes which makes quantitative image challenging. Compton camera (CC) imaging devices may be good candidates for TRT monitoring due to the electronic collimation being able to provide high efficiency together with high spatial resolution and significantly extend the range of radiotracers that can be investigated [4].

## Objective

The purpose of this master internship is to assess the potential application of CC to the TRT and perform a comparative study with SPECT imaging technique. To this end, Monte Carlo simulations based on realistic patient data will be performed using GATE simulation toolkit.

## Tasks

- Identify possible therapeutic radionuclides that can be imaged with Compton Cameras.
- Develop Monte Carlo simulations of the radiotracer bio-distribution using a patient geometry.
- Study the simulated data obtained with both imaging systems.
- Evaluate and compare efficiency and spatial resolution between both imaging systems.

## Required skills

- **Education**: master student in particle/nuclear physics, medical physics, computer science or image processing.
- **Scientific interests**: medical imaging, nuclear medicine, Monte Carlo simulations.
- **Programming skills**: C++, ROOT or Python.
- **Experience**: development of Monte Carlo simulations with GATE would be a plus.
- **Languages**: command of English required, French optional.

## Practical information

- **Supervision**: Ane Etxebeste, David Sarrut and Etienne Testa.
- **Location**: Centre Léon Bérard and IPNL laboratory, Lyon, France.
- **Period**: 2019 (duration: 6 months).
- Please send a CV, master marks and a brief statement of interest by email to:
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  David Sarrut (david.sarrut@creatis.insa-lyon.fr)
  Etienne Testa (testa@ipnl.in2p3.fr)

## References


[1] Tiantian Li, Edwin CI Ao, Bieke Lambert, Boudewijn Brans, Stefaan Vandenberghe, and Greta SP Mok. Quantitative imaging for targeted radionuclide therapy dosimetry-technical review. *Theranostics*, 7(18):4551, 2017.

[2] M Ljungberg and K Sjögreen Gleisner. Three-dimensional image-based dosimetry in radionuclide therapy. *IEEE Transactions on Radiation and Plasma Medical Sciences*, 2018.

[3] Michael Ljungberg. Absolute quantitation of spect studies. In *Seminars in nuclear medicine*. Elsevier, 2018.

[4] T Conka Nurdan, K Nurdan, AB Brill, and AH Walenta. Design criteria for a high energy compton camera and possible application to targeted cancer therapy. *Journal of Instrumentation*, 10(07):C07018, 2015.