PhD position in instrumental nuclear physics

3-dimensional scintillation dosimetry for small irradiation fields control in protontherapy

Radiotherapy is an important modality in treatment cancer. In this domain, proton beams have ballistic superiority against photon beams. Nevertheless, the use of protontherapy to treat small volume tumors (typically less than 27 cm^3) is limited because of the lack of well adapted dosimetry tools for small irradiation fields quality assurance. To answer this issue, an innovative dosimetry system has been developed. It is based on a scintillating block of 10 × 10 × 10 cm^3, a mirror and an ultra-fast camera recording the scintillation from different points of view. The system can be used to perform beam assurance quality (verification of the beam characteristics: position, energy, intensity), or treatment assurance quality (verification of the delivered dose distribution).
The system has already shown very good performance for beam assurance quality and is very promising for 3-dimensional dosimetry
The objective of this PhD thesis will be to develop numerical methods to convert the scintillation maps into dose maps. This includes the study of the energy dependence of the scintillation yield with proton beams, methods of image treatment and the development of calibration methods.
After the development of appropriate reconstruction methods, the detector will be evaluated and compared to reference dosimeter and treatment plans.
This project will be done at GANIL in collaboration with the LPC Caen from experimental acquisitions performed at the Cyclhad proton therapy center in 2021 and the first semester of 2022. It will involve the analysis and treatment of the scintillation acquisitions as well as Monte Carlo simulation.

Expected skills:

The student must have a formation in nuclear physics with a good knowledge of the detection of radiations and their interactions with matter. Knowledge in radiotherapy and dosimetry would be a plus.
The student will participate to the analysis and the treatment of the scintillation images to achieve 3-dimensional dosimetry. The candidate must thus have strong interest for data analysis and simulation, and will have to develop skill in image manipulation, programming and Monte Carlo simulations.
The candidate will need to be able to work in an interdisciplinary domain with people from other research fields such as biology, medical physics or medicine.

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