PHENIICS doctoral school **PhD thesis subject proposal 2017**

Laboratory/research team:

Laboratoire Leprince-Ringuet, École polytechnique / Médical (PEPITES project).

Title:

Development of an ultra-thin monitor for charged particle beams.

Overview of the research:

Proton therapy dose delivery requires a continuous and precise measurement of beam properties, intensity, position and profile. When crossing the monitor material thicknesses, the beam undergoes a dispersion that should lead to a maximum submillimeter lateral spreading at the patient to be tolerable. For monitors located a few meters upstream of the patient, this constraint leads to a material budget lower than 15-micrometer water equivalent thickness (WET).

The continuous presence of the monitor in the line also requires good resistance to radiation. If the intensities of the beams used in the medical field are relatively low (a few nA) the exposure time results in integrated doses of some 10^6 à 10^8 Gy per year.

Initially motivated by the needs of proton therapy, the LLR team is developing a solution based on thin film techniques that may have a range of applications that is well beyond the foreseen framework.

Thesis project:

The thesis project is to obtain a fully working ultra-thin monitor prototype able to permanently operate on mid-energy (O(100 MeV)) charged particle accelerators. The project proposes to carry out a complete prototype. The objective is to ascertain the proof of principle of the approach and establish the performance of such a system.

The following studies will have to be conducted:

- Beam tests with basic prototype
    - Signal generation in the therapeutic energy range (70 – 230 MeV with protons)
    - Beam intensities dynamic range
    - Low beam energies (O(10 MeV)) and high beam energies (O(1 GeV)),

    - Radiation hardness
- Beam tests with full prototype
    - Full proof of concept

The feasibility of such a monitor would actually demonstrate more widely the interest of the approach, and it may be declined in many ways. Complementary studies to exploit this potential by proposing various beam monitor configurations will have to be carried out also.

Master and doctoral school:

- Master 2 in particle physics
- PHENIICS doctoral school – Université Paris-Saclay

Local team:

Medical applications group (resp. Marc VERDERI).

Contact:

Marc VERDERI verderi@in2p3.fr
Christophe THIEBAUX thiebaux@llr.in2p3.fr