Institut de Physique Nucléaire de Lyon
UMR 5822 Université Lyon 1 CNRS/IN2P3

Internship offer – Year 2014-2015

Internship level:	**M2**
Duration :	4-6 months
For M2 internship:	
	- **Possibility of opening to a thesis : Yes**
	- **Type of funding proposed:LabEx PRIMES**

Supervisor :	Michaël Beuve
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Address :	**IPNL – Bureau V14** **Domaine Scientifique de la Doua – Bât. P. Dirac** **4 rue Enrico Fermi – 69622 Villeurbanne Cedex - France**
Team coaching :	**CAS/PHABIO**

Title of the internship : [2]

Biophysical modeling for innovative therapy

Summary of work required :

Motivation and Scientific Background

Developing innovative radiotherapies for the cancer treatment is one of the two main applicative fields that federate the research activities undertaken within the LabEx PRIMES. This covers hadrontherapy, which uses light-ion beams (mainly protons and carbon ions) ; the uses of heavy elements (PAT-Z) or nano-particles in combination with standard X-rays, X-rays produced by synchrotron or hadrontherapy ; and microbeam of X-rays produced by synchrotrons.

The optimization of the treatment parameters relies on the prediction of the biological effects of these new therapies. Because the benefit of almost all these therapies is attributed to the microscopic physical, and possibly physico-chemical, initial processes, physics-based models needed to be developed in collaboration with biologists.

Project description

We are developing a new biophysical model (Nanox) to predict the biological consequences of radiations in terms of cell-killing. This model is based on the outcomes of our simulations, which describes at nanoscale, the physical and physic-chemical processes induced by the impact of radiations into water, as a representation of cell medium. The theoretical framework of this model has been set-up, the results obtained with a first version of the related computing code are very promising for calculating cell-killing induced by fast ions.

The modhadron(*) project is starting to couple nanox model to Geant4/Gate simulation tool-kits, extending cellular scale to patient scale for hadrontherapy. This project includes also an experimental part to measure biological data to parameterize and challenge nanox model for several tumor cell-lines, in particular using the platform RADIOGRAAFF we are developing for radiobiology studies at the Institute for Nuclear Physics of Lyon.

In parallel, in the framework of the Biohydra(*) project, we are improving our simulations of the microscopic processes to include the effect of heavy elements and nanoparticles on the physical and physic-chemical processes. The purpose is not only to better understand the fundamental mechanisms, but also to

extend nanox predictions to innovative radiotherapies other than hadrontherapy.

The purpose of this proposition is thus to contribute to the development of nanox model in the context of innovative radiotherapies and by interacting with some members of our group and of the LabEx PRIMES

(*) funded by the "Plan Physique Cancer" (INCa/INSERM)

Expected Profile

Physicists with skills in computing and simulations

- **Experience or motivation for modeling, simulations**
- **Skill in programming, Numerical methods, mathematics**
- **Expected knowledge in: Interaction of particles with matter, biophysics**
- **Interest for physics and its medical applications**

Location: IPNL (Campus de la Doua, Lyon, France)

Contact: send CV and letters by email to michael Beuve michael.beuve@univ-lyon1.fr
`https://www.ipnl.in2p3.fr/`
`Home > Research areas > Interdisciplinary activities > CAS-PhaBIO`

Team members:
IPNL: M. Beuve (PR UCBL), E. Testa (MCF, UCBL), M. Cunha (PhD Student, CNRS), C. Monini (Post-Doc, UCBL), A. Ipatov (Post-Doc, CNRS)
Strong interactions with other members of the LabEx PRIMES (Physicists, Biologists and Computing scientists)