# ***INTERNSHIP PROPOSAL***

*(One page maximum)*

Laboratory name: Institute of Physics of the 2 Infinities of Lyon (IP2I)
CNRS identification code: UMR 5822
Internship director'surname: ALCOCER, Mario; TESTA, Étienne
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Internship location: Institute of Physics of the 2 Infinities of Lyon
Campus LyonTech la Doua, bâtiment Dirac
4 rue Enrico Fermi, 69622 Villeurbanne

Thesis possibility after internship: **YES**/NO
Funding: **YES**/NO If YES, which type of funding: LABEX or PICTURE project

**Title** "Modeling cell irradiations with low-energy ions: cell survival calculations with NanOx"

**Summary**
In France, more than half of all cancer patients are treated with radiotherapy (RT). Some innovative RTs optimize the dose of radiation delivered to the tumor, while limiting the exposure of healthy tissue. This is the case, for example, with hadrontherapy, which uses high-energy ion beams to effectively treat tumors that are radioresistant or require very precise ballistics. Other innovative RTs, such as Targeted Alpha Therapy (TAT), or Boron Neutron Capture Therapy (BNCT) use low-energy ions to selectively irradiate tumors from inside the body. One of the advantages of both techniques is that they enable targeted, systemic irradiation of metastatic lesions. Biophysical models are developed to predict the biological dose to tumors during treatment with these innovative RTs. In this context, the NanOx (NANodosimetry and OXidative stress) biophysical model was developed at the IP2I. NanOx was initially designed for hadrontherapy, and has recently been adapted to irradiation with low-energy ions, with the aim of also applying it to BNCT and TAT. In these therapies, the distribution of therapeutic agents (boron compounds or radiopharmaceuticals) can have a major impact on the dose received by tumor cells and, more generally, on the treatment as a whole. What is more, in the specific case of BNCT, the short path length of the ions may prevent them from reaching the nucleus to deposit their energy in the DNA. It is therefore important to study the consequences of partial cell irradiation on the biological effects. The aim of this internship is to explore this question in greater detail, using Monte Carlo simulation tools coupled to the NanOx model. During this internship, the student will use codes developed by our team to simulate the irradiation of cells with low-energy ions and calculate cell survival fractions. The student will then improve the simulations to include realistic cell geometries and algorithms to take into account new radiation targets in order to assess their impact on the overall biological effect.

Skills required:
- Good knowledge of ionizing radiation physics and interest in topics at the interface of physics, biology and health.
- C++ (essential) and Python (desirable) programming skills.
- Knowledge of Monte Carlo simulations (GATE / Geant4).
- A good level of English.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/**NO** Soft Matter and Biological Physics: **YES**/NO
Quantum Physics: YES/**NO** Theoretical Physics: YES/**NO**