A reference Monte Carlo platform to assess radiation quality in hadrontherapy (protons and carbon ions)

Context of the recruitment

In the framework of the European Marie-Curie ITN programme "PARTNER", IBA will host 2 Early Stage Researchers for a 3 years period each. The researchers will be offered to participate in active training and, upon agreement with the secondary partners who support the projects, they will prepare a PhD thesis, while being considered as a full member of the IBA research team. As such they will be selected along with the regular IBA recruitment process and will benefit from an IBA employment contract. In order to guarantee that the candidate will fit with the PhD programme to be held with CREATIS, the responsible of the thesis will be involved in the recruitment process.

Scientific background

Due to complex processes during ion beam irradiation in biological tissues, it is necessary to have a thorough three-dimensional description not only of the total deposited dose but also of the radiation quality (particles, LET, processes, etc.) associated to this dose. This is particularly important in the perspective of calculating the biological dose. Moreover, this reference Monte Carlo (MC) platform will provide the basis to determine the different convolution kernels (e.g. in terms of particle types and LET...) used in superposition/analytical methods implemented for treatment planning. Such a platform could also be used to determine to what extent the dose depends on the stoichiometric calibration procedure, from CT Hounsfield units to material composition. The developed platform will based on Geant4. In a longer term perspective, but beyond the scope of this project, we also plan to tackle the issue of inverse treatment planning in hadrontherapy taking into account RBE modeling.

Specific goals in the PARTNER programme

The PARTNER program is entitled "Adaptive radiotherapy and treatment planning strategies for ion beam therapy". The goal is the evaluation of the robustness of ion treatment plans with respect to anatomical and topographical inter-fraction variations. A second objective is to quantify the irradiation products with Monte Carlo simulations to provide the information necessary to compute the biological dose.

Preliminary description of the PhD programme

The aim is to design Monte Carlo simulations for computing dose distributions from proton/carbon irradiation inside a patient and to compare the dose distributions obtained with the TPS and with MC simulation. The MC platform will be based on the framework developed at CREATIS (based on Geant4). Special attention will be given to target heterogeneity and physical properties of particle-matter interactions (radiation quality), especially for carbon ions, in order to provide the information needed to compute the biological dose. Validation of simulations will be performed against measurements on IBA machines and CMS treatment planning system.

Job Description

The successful candidate will join the research team of the IBA Particle Therapy department in Louvain-la-Neuve, Belgium. In the first stage of his/her activities at IBA, he/she will be familiarized with IBA protontherapy system, with the clinical environment and with the

ongoing new developments; this could include visits to existing IBA Proton Therapy facilities and contributions to local research activities.
The major aspect of his/her appointment is to contribute to the development of the MC platform as described above, sharing his/her time between IBA and the academic partner CREATIS in Lyon. In the perspective of sustaining a PhD thesis, he/she will follow the required academic programme according to CREATIS rules.
In the context of PARTNER programme, the candidate will participate to trainings, workshops and conferences organized within the network.

Profile

General considerations

- Graduated in Physics or Physics Engineer
- Brilliant scientist, able to enter rapidly into the technical details of a complex system
- Dynamic and proactive
- Experience in nuclear physics, in particular with Monte Carlo simulations
- Experience in radiotherapy (ideally in hadrontherapy) is an asset
- Interested in an international working environment, including frequent travels
- Interested in a scientific career with a dynamic company in an expanding field
- Fluent in English (spoken and written)

Specific considerations in the context of Marie-Curie European Programme

- Degree obtained within the 4 years prior their recruitment
- Not of Belgian nationality
- No permanent stay or regular activity in Belgium for more than 12 months in the 3 years immediately prior to their recruitment.