CROSS-SECTION MEASUREMENTS FOR HADRONTHERAPY WITH THE FOOT EXPERIMENT

SUPERVISORS : CHRISTIAN FINCK
INSTITUT PLURIDISCIPLINAIRE HUBERT CURIEN (IPHC)
23, RUE DU LOESS, BP 28 - 67037 STRASBOURG CEDEX 2
TEL : 03 88 10 65 89
E-MAIL : christian.finck@iphc.cnrs.fr

Cancer represents the leading cause of death in France, ahead of cardiovascular diseases and drugs. It actually corresponds to nearly 30% of deaths. The decline in mortality rates per 100,000 inhabitants has accelerated over the past 10 years (-16% among men and -8% among women). It results from several factors, such as the decrease in the incidence of certain cancers and better overall access to early diagnosis, but also the progress made in the care provided to patients. This decrease can also be explained by the appearance of new treatment modalities, such as hadrontherapy, which uses proton or carbon or even alpha particles as beam. In order to fully exploit the potential of hadrontherapy, it is necessary to understand the underlying physical processes of charged particles in tissues in order to correctly compute the dose in the tumor and in surrounding healthy tissues. It is therefore important to measure the cross-sections of the nuclear reactions taking place between the incident beam and the tissues.

Since 2008, we have been involved in measurements of double differential cross sections (azimuthal angle and energy) of carbon fragmentation on different targets. Although a significant number of measurement campaigns were already carried out, data on cross-sections are still lacking in certain energy ranges. The PhD subject is related to such measurements for beams of carbon, but also of oxygen, on different tissue equivalent targets (C, O H). We are part of the FOOT (FragmentatiOn Of Target) international collaboration which aims to measure cross-sections at different energies, target materials and beams. We have, already, participated in several campaigns, at GSI (Germany) 2019, 2021 and more recently at the treatment center of CNAO (Italy) in November last year. More than 15 million events were collected with the full experimental setup, including for the first time, the inner tracker system and the permanent magnet.

The student will take part in the data analysis. In a first step, all the tracking systems will be characterized, in order to estimate the track efficiency for charged particles. Subsequently, the global tracks will be reconstructed in order to identify the different isotopes resulting from the beam fragmentation. Thus, it will be possible to estimate the double differential cross-sections. These will be compared to the results obtained with the Geant4 simulation tool. This comparison will assess or not the obtained results with Geant4. Moreover, several other campaigns are already foreseen at CNAO in the next years, the student will have the opportunity to participate in the experiments. She/he could get familiar with the setup and with the experimental conditions during data taking.