SECONDARY PARTICLES MEASUREMENTS FOR HADRONTHERAPY

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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, the DeSIS team is involved in measurements of secondary particles produced during hadrontherapy through two distincts projects: the FOOT collaboration and the CLINM project. The FOOT collaboration aims at measuring double differential cross sections (azimuthal angle and energy) of carbon fragmentation on different targets, while the goal of the CLINM project is to correlate the physical properties of secondary particles with their chemical effects (such as radiolysis of molecules). A significant number of measurement campaigns were already carried out at CNAO facility (Pavia), and the data still need to be analyzed and compared to Monte Carlo simulations. Furthermore, new experimental campaign will be performed in spring 2026 at CNAO for the CLINM experiment with ^{4}He and ^{16}O ion beams.

The master student recruited for this internship will take part in the analysis of existing data from both CLINM and FOOT, and will also be involved in the preparation and the realization of the in-beam experiment at CNAO. During experiments, she/he could get familiar with the setup and with the experimental conditions during data taking. The measured physical properties of secondary particles (energy, charge) produced by ions in matter will be compared to the results obtained with the Geant4 simulation tool. This comparison will assess or not the obtained results with Geant4.