Proposition de stages et mémoires

2019-2020

Le Service de Métrologie Nucléaire poursuit des activités dans les domaines de la proton thérapie et de la physique des accélérateurs avec plusieurs partenaires incluant Ion Beam Applications (IBA), le SCK-CEN, Royal Holloway (University of London), et le CERN. Les mémoires suivants sont proposés dans le cadre de ces collaborations aux étudiants de MA2 pour l'année académique 2019-2020.

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4. Study of the rf cavities for proton bunching in laser-based proton therapy

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Proton therapy is an advanced form of radiation therapy, with lower secondary effects compared to conventional gamma ray techniques. Current systems, including those of Belgian market leader IBA, use particle accelerators (cyclotrons or synchrotrons) to generate the proton beam. This implies a very high cost that is the main obstacle for a widespread deployment of this advanced therapy.

Recently, research for new particle accelerators has led to the investigation of a new technique in which an intense laser beam is sent on a target, creating a plasma from which charged particles can be extracted. The whole acceleration happens on a scale of a few micrometers, instead of several meters for equivalent accelerators. The beam produced is, however, very different in composition, energy spectrum and divergence, and new methods are needed to clean the particle spectrum depending on the application in need. Our startup, HIL Applied Medical, carries the ambition to use this new technology in order to dramatically reduce the cost of a proton therapy center. HIL currently has a 5 TW laser facility that will be upgraded with a 200 TW laser around the end of 2020.

In this work, we are interested in reducing the energy spread by bunching the protons in an RF cavity. The purpose of the thesis is to study the impact of several RF cavity designs on the energy spectrum and on the beamline efficiency. After some work on the existing applications and limitation of RF bunchers, the student will be asked to model the beam transport through the cavity and come up with an optimal design. An analysis of the technical feasibility of the solution (energy consumption, cooling requirements, space requirements) is also expected. The student will be part of an international collaboration between HIL, ULB and Hebrew University. HIL is a fast-growing startup with ambitious targets, and further research/R&D opportunities will open in several fields (magnets, beam transport, dosimetry, shielding) after the master.