Master Thesis

Development of a Monte Carlo dose calculation reference tool for ion beam therapy

Division of Medical Radiation Physics, Department of Radiotherapy

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Motivation for the project

Ion beam therapy exploits the physical properties of charged ions to create highly conformal dose distributions for treatment, thereby reducing side effects. The high precision leads to an increased sensitivity towards changes within the patients' anatomy, making robust and accurate treatment planning challenging. This is an important research field for the development of new therapeutic concepts. In clinical practice a wide variety of dose calculation approaches exists, ranging from fast analytic algorithms to precise full Monte Carlo dose calculation.

At the new Austrian particle therapy facility MedAustron the treatment planning system (TPS) RayStation (Raysearch Laboratories, Sweden) allows treatment planning with protons and carbon ions. At the PEG MedAustron researchers have the possibility to use a research version of this TPS including novel tools that are not used released for clinical use.

Physical background

In order to evaluate these novel tools and to use the TPS output for further Monte Carlo simulation projects an independent evaluation and verification is required. Therefore, the independent full Monte Carlo simulation toolkit GATE will be used as reference tool.

Aim and concept of the master thesis

Aim of this thesis is to adapt the existing Monte Carlo GATE toolkit in order to achieve a good agreement with the output of the TPS RayStation, e.g. including the MedAustron beam model as implemented in RayStation and a correct electron density Hounsfield unit calibration.

MSc Thesis outline

- Modeling of the MedAustron beamline in Gate/Geant4
- Test and ensure CT electron density Hounsfield unit conversion
- Calculate and compare treatment plans with GATE and Raystation

Duration: 6-8 months, the position is open immediately

Qualification:

- Student of physics, biomedical engineering or computer science
- Good working knowledge in any programming language preferentially C++, Python or Matlab

Institute The project is conducted in the frame of the Christian Doppler Laboratory for Medical Radiation Research in collaboration with MedAustron under the supervision of Prof. Dr. Dietmar Georg

Keywords Monte Carlo Simulations, Ion Beam Therapy, Treatment Planning

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