Who we are:

EBG MedAustron is a cancer treatment and research centre in Wiener Neustadt that is unique in Austria. MedAustron uses ion therapy, an innovative form of radiation therapy, in the fight against cancer.

We offer a unique working environment built around the particle accelerator used for therapy and research with protons and carbon ions. We have set ourselves the goal of prolonging the lives of cancer patients and improving their quality of life.

Passionate about Medical Physics and fascinated by Monte Carlo Simulation and carbon ion therapy?

Join us for a **Master's thesis that goes beyond research**. By contributing to the advancement of innovative cancer treatments, you can **help improve the quality of life and future prospects of cancer patients.**

Master Thesis Project: Monte Carlo-based independent dose calculation for carbon ions with IDEAL/Gate-RTion v2

EBG MedAustron

from January 2027

Wiener Neustadt

6 - 9 months

Background of the topic:

In particle therapy, before a treatment plan can be delivered to the patient, it must undergo quality assurance. This is referred to as Patient Specific Quality Assurance (PSQA). Originally, PSQA consisted in measuring the delivered dose for the plan in water. Today, at MedAustron, PSQA is mostly performed in silico, by re-calculating the treatment plan's dose with an independent Monte Carlo (MC) engine. Independent Dose Calculation (IDC) for carbon ion therapy at MedAustron is based on the software IDEAL v1. IDEAL takes the DICOM files from the treatment plan, sets up MC simulations with Gate/Geant4, and writes the dose results back in DICOM format, ready to be compared against the plan doses.

The IDEAL version used in the clinics can only simulate physical dose, for carbon ions. However, the treatment plan is optimized in biological dose, which is the physical dose corrected to account for the damage the radiation produces on the cell's DNA.

IDEAL v2, featuring a new Gate version, offers the possibility to calculate the biological dose and Linear Energy Transfer (LET) distributions, on top of the physical dose. At MedAustron, we are working on the validation of IDEAL v2, with the goal of bringing this version into clinical use.

Project Proposal:

For your Master's thesis you will collaborate with the Monte Carlo and Beam Delivery groups from our Medical Physics department to validate the new features of IDEAL v2 and test clinically relevant scenarios.

The project has the following objectives:

- *Clinical commissioning for ~10 patients (physical dose)*
    - PSQA in water: validation against measurements and benchmark IDEAL v2 against IDEAL v1 and Treatment Planning System (TPS)
    - IDC in patient CT (physical dose): benchmark IDEAL v2 against IDEAL v1 and TPS
- *Advanced clinical commissioning:*
    - Discrepancies were observed between TPS and IDEAL v1 in the head cases.
        - Acquire measurements in anthropomorphic phantom with the Matrix detector
        - Compare TPS, IDEAL v1 and IDEAL v2 doses against measurements
- *IDEAL v2 specific features for clinical usage:*
    - Evaluate RBE-weighted dose for the same patient set against TPS
- *Additional research topics:*
    - Benchmark two different implementation of biological dose calculation in Gate.
    - Evaluate and optimize MC simulations parameters
    - Benchmark LET in IDEAL v2 against TPS for the same patient set

Your academical background:

- Ongoing Master's studies with focus on Medical Physics, Physics, Biomedical Engineering or related studies
- Strong interest in Medical Physics
- Python bases are strongly recommended
- Excellent command of spoken and written English
- Enjoyment of working with an international and interdisciplinary team

In return for completing the Master's thesis, we can offer a two-month paid internship with a gross monthly salary of €2,700 (on a full-time basis). The remaining months will be organised as an unpaid volunteer agreement.

Ready to write your Master's thesis with us and dive into the world of carbon ion therapy?

Take the next step and send us your application documents using our online application tool.

EBG MedAustron is committed to equal treatment and diversity. We welcome applications from all qualified people.

Apply now

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