LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
FACULTY OF PHYSICS
CHAIR OF EXPERIMENTAL PHYSICS
MEDICAL PHYSICS
PROF. DR. KATIA PARODI

The Chair of Medical Physics of Ludwig-Maximilians-University Munich (LMU) is offering

1 Postdoctoral position (TVL-E13 100%, 2 years) (m,f,d) on

"Integrating prompt gamma range verification and relative biological effectiveness in multicriterial proton treatment planning"

Proton therapy is an increasingly widespread cancer treatment option which allows to tightly confine high dose to the tumor and spare organs at risk, because the dose maximum is deposited at the end of the range, so-called Bragg peak. Two aspects however make the planning and delivery for proton therapy challenging: 1) The Bragg peak position is sensitive to anatomical variations and uncertainties in the knowledge of the tissue stopping properties, and 2) the relative biological effectiveness (RBE) of protons is variable.

The issue of Bragg peak positioning is currently addressed in clinical practice at the planning stage by careful choice of beam directions, generous safety margins around the tumour, and robust optimization approaches, at the cost of sacrificing dose conformity. Moreover, during delivery, prompt gamma (PG) emissions induced by the irradiation are being considered a promising tool for in-vivo range verification, enabling to monitor the Bragg peak position, ideally in real-time. The variable RBE is currently disregarded by assuming a constant value of 1.1, but possible implications of a variable RBE scheme are subject of increasing attention.

The overarching goal of this project is to develop models and algorithms which incorporate PG range verification and biological effectiveness in terms of linear energy transfer (LET) and RBE as new criteria in a research proton planning system based on multicriteria optimization (MCO). This MCO system shall be ideally suited to study the trade-offs of conflicting planning goals, and it will be used to gain novel insights into the clinical potential of adding PG range verification and LET/RBE considerations to standard dose metrics of target coverage and normal tissue sparing. The benefits of the augmented planning abilities will be investigated in a final in-silico planning study addressing the trade-offs between tumor dose, organ at risk sparing, LET/RBE variations, and suitability for PG monitoring. Hence, with this project, we aim at the development of a new treatment planning platform which could provide a paradigm shift in proton beam therapy, combining for the first time range verification considerations and biological effectiveness at the stage of treatment planning. The final goal is to promote a better utilization of the advantageous properties of proton radiotherapy to improve clinical outcome for cancer patients.

This research will be carried out in a multi-disciplinary project funded by the German Research Foundation (DFG), which unites physicists at LMU (LMU, PI: Prof. Dr. Katia Parodi), mathematicians at the Fraunhofer-Institut für Techno- und Wirtschaftsmathematik in Kaiserslautern (ITWM, PI: Prof. Dr. Karl-Heinz Küfer) and clinicians at the LMU University Hospital (KUM, PI: PD Dr. Dr. Christian Thieke).

Your tasks

- Building upon existing tools, establish a research platform for fast calculations of proton dose, LET, RBE and PG distributions in realistic clinical scenarios.
- Refine selection criteria for pencil beam positions with the best potential for PG range verification and assess the monitoring quality of the resulting plan by simulating the expected PG image for a number of possible detector setups.
- Support integration of PG and variable LET/RBE maps in the prototype MCO system together with the colleagues at ITWM.
- Support clinical evaluation of the augmented prototype MCO system for a number of representative tumour entities and sites together with the colleagues at KUM, to elucidate the interdependencies between PG monitoring quality, biological effectiveness and doses to the tumor and organs at risk.

Our requirements

- PhD or similar qualification in physics or engineering, ideally with a background in medical physics or biomedical engineering
- Understanding of radiation transport and radiation therapy, with focus on proton beam therapy
- Experience in coding and documentation standards, programming languages (preferably C/C++, Python) and Linux and Windows OS
- Proficiency in treatment planning, Monte Carlo simulations and/or in-vivo range verification (ideally with prompt gamma) would be desirable
- Motivation to work with multi-disciplinary teams
- Ability to pursue independent research and to guide co-workers
- High level of creativity
- Fluent English knowledge (spoken and written)

The LMU Chair of Medical Physics offers a multi-disciplinary environment and works on various core topics of ion beam therapy. The working place will be at the Forschungszentrum Garching, which is well connected to the city of Munich by public transportation. Disabled candidates are preferentially considered in case of equal qualification. Applications from women and minorities are strongly encouraged.

The position will be initially for 2 years at the TVL-E13 100% level. If you are interested in this offer, please send us your application (letter of motivation, CV, last school certificate, university degree including grades, publication list, references, other qualification certificates like TOEFL) via email (less than 5 MB) to

Katia.Parodi@lmu.de and Andrea.Leinthaler@physik.uni-muenchen.de. Please indicate your earliest possible entry date.

Deadline for your application is 19th of February 2022.