



2023 Helmholtz – OCPC – Programme for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

AI-driven treatment plan optimization for carbon ion eye therapy

Helmholtz Centre and/or institute:

GSI Helmholtzzentrum für Schwerionenforschung

Project leader:

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Description of the project (max. 1 page):

Particle therapy for tumours located in the eye are highly successful. Carbon ion beam therapy could help to sharpen the treatment field and further improve therapy. Due to the small size of the target, sharp field gradient are advisable, and a collimator greatly facilitates delivery.

Current treatment planning systems for carbon ion beams cannot correctly consider collimators close to the patient, as pencil beam algorithms are insufficient and Monte Carlo engines too slow for iterative optimization. Delivery is thus typically performed with an open beam, relying on the comparably sharp gradients of carbon. Still, a collimator could improve conformity and safety for the patient. This project therefore aims to train an existing AI framework on eye treatment plans including a collimator to derive a fast and accurate method for eye treatment planning.

An existing AI framework trained for the prediction of patient-individual pencil beams in lung and H&N cancer will be adapted to the specific scenario of eye therapy. To this end, Monte Carlo simulations of RBE-weighted carbon ion plans for eye tumours including a collimator will be conducted, both for full fields and individual pencil beams. The AI model will be trained on this data, with the endpoint of predicting a pencil beam dose profile for a new patient anatomy and collimator. Monte Carlo simulations take in the order of 10-60 min, while the AI prediction for



each beam is available in some ms, leading to the possibility for iterative plan optimization with the quality of a Monte Carlo simulation but at the speed of a pencil beam algorithm.

The candidate will conduct both Monte Carlo simulations and adapt the AI model to the small collimated fields. Training and verification will be conducted on a patient cohort to be prepared by the candidate.

The endpoint is non-inferiority of the AI-plans in comparison to an MC re-calculation in a test dataset. This topic is of high clinical relevance and of scientific interest for several carbon ion centers in China, but also other Asian and European countries that started carbon ion eye treatment recently.

Description of existing or sought Chinese collaboration partner institute (max. half page):

We are looking either for an operating carbon ion facility, or for a research institute with a strong research focus on particle therapy.

Required qualification of the postdoc:

We are looking for an excellent postdoc with a degree in a related field, and with a strong background in treatment planning and IT topics, if possible with experience in AI.

- PhD in Medical Physics, Engineering or informatics
- Experience with carbon ion therapy, treatment planning and programming
- Additional skills in design and training of AI models, preferably in TensorFlow
- Language requirement – English