

2026 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Towards clinical implementation of carbon ion arc therapy for brain tumors

Helmholtz Centre and/or institute:

GSI Helmholtzzentrum für Schwerionenforschung

Project leader:

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Description of the project (max. 1 page):

Carbon ion therapy is a modern form of cancer radiation therapy, able to concentrate highly effective dose into the tumor. To even more increase the radiobiological effectiveness against radioresistant, potentially hypoxic tumors, carbon ion arc therapy delivered to an upright patient rotated in front of a horizontal beam has been under investigation in our lab and in several other research institutes. For the brain in particular, arcs can enable to move high-linear energy transfer (LET) regions, i.e., regions of dense radiation damages to the tissue, from the normal tissue into the target, thereby reducing potential toxicity and increasing tumor killing.

Within the project, existing implementations of carbon ion arc therapy in our treatment planning system TRiP98 shall be extended towards a clinically realizable form, considering constraints of both accelerators and delivery systems found in clinical facilities, such as the Shanghai Proton and Heavy Ion Centre. This includes energy and possibly field sequencing as well as precise dosimetry, as benchmarked against clinical software or measurements. For clinical realization, this also includes a synchronization of upright patient rotation with the beam delivery, aiming for an experimental deliverability of the developed planning strategy.

The endpoint of the project is a planning simulation study on clinical data, investigating potential benefits over conventional planning in LET distributions, Oxygen-Enhancement-Ratio, and possibly TCP/NTCP models. If feasible, the endpoint can be extended to experimental validation at the Chinese collaborating clinical institute.

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:

- PhD in Medical Physics, Engineering or informatics
- Experience with carbon ion therapy, treatment planning and programming
- Preferentially with coding experience for example in Python, C or C++
- Language requirement: English
- Prior knowledge on upright patient positioning would be a bonus