2019 HGF – GSI – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

Title of the project:

Motion mitigation for lung cancer ion beam therapy under clinical conditions

Helmholtz Centre and institute:

GSI

Project leader:

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Description of the project (max. 1 page)**:**

The Shanghai Proton and Heavy Ion Center (SPHIC) is one of the few particle therapy centers treating lung cancer patients with scanned beam delivery. First data on the highly promising clinical outcome were recently published (Chen et al, 2019).
It is well known that scanned particle therapy of moving targets is challenged by motion-induced range changes and the so-called interplay effect. The GSI biophysics has a long history of investigating 4D-ion beam therapy, including treatment planning simulations, 4D-dose reconstruction and developing and implementing motion compensation strategies. A good example of a clinical collaboration of GSI is the 4D-dose reconstruction of liver irradiations at HIT Heidelberg, where 4D-doses of each fraction was assessed based on 4DCT data, motion traces and beam records.
In the proposed project, a postdoc will investigate clinical data from SPHIC lung cancer patients using GSI's 4D treatment planning software TRiP4D. The implemented motion mitigation strategies can be assessed by patient-individual dose reconstructions including the interplay effect. Any observed residual motion effects can be associated to clinical outcome, gathering data on clinical importance for example of dose errors in single fractions that average out over the course of therapy.

In a second step, based on the gathered data, possible improvements in the delivery strategy can be investigated, simulated and eventually also verified experimentally. Different scenarios will be devised, taking into account technical and legal constraints of the medical product. A three stage simulation approach will include a scenario possible at the unchanged facility, a second one with minor changes to the medical product – as agreed upon with SPHIC, and finally a hypothetical case simulating state of the art motion mitigation regardless of current technical feasibility.

The outcome of this project consists of a) a retrospective clinical analysis of the influence of residual motion effects on patient outcome, and b) a set of scenarios describing a range of possible motion mitigation strategies that could be implemented for future lung cancer therapies

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

The Shanghai Proton and Heavy Ion Center (SPHIC) or a physics/technical institute associated with SPHIC
The proposed project would require an exchange of patient data from SPHIC, requiring adherence to relevant ethical and legal standards

Required qualification of the post-doc:

- PhD in Physics, Medical Physics or related
- Experience with ion beam therapy, treatment planning software
- Additional skills in data analysis, experimental validation, programming in C
- Language requirement: English