DKFZ Clinician Scientist Fellowships 2023

dkfz. GERMAN CANCER RESEARCH CENTER IN THE HELMHOLTZ ASSOCIATION

Research for a Life without Cancer

Abstract for a DKFZ project at the DKFZ

Name of DKFZ research division/group:	**Division of Medical Physics in Radiation Oncology (E040)**
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Group homepage: Please visit our website for further information on our research and recent publications.	https://www.dkfz.de/en/medphys/index.php

RESEARCH PROFILE AND PROJECT TOPICS

We focus on research in image guided, adaptive radiotherapy (ART), concentrating on optimization of efficient, AI-based workflows for ART and novel optimization strategies. In 2022 we will initiate a novel treatment machine (ETHOS) for fast CBCT-based ART at DKFZ and start several projects with our clinical partners: a multi-centric, translational oncology project, funded by DKH, on *ART for locally advanced lung cancer,* comparing the potential of MR and CBCT guidance; a feasibility trail will investigate ART for cervical carcinoma and we will investigate sim-and-treat at the ETHOS (CBCT-based treatment planning). We also contribute to projects on MR-guided particle therapy and the MR-Linac at the University hospital and continue to explore the radiobiology of ion beams at HIT. We envisage a strong clinical contribution of a clinician scientist in the following areas:

The group **Computational Patient Models** is developing **digital patient twins** for RT, meaning the creation of digital copies to stand in as proxies for computerized patient-tailored plan optimizers and as treatment monitors for accumulated dose and image-extracted early effect predictors.
Potential projects involve:
- DL(deep learning)-driven, but guideline conformal target volume delineation
- ML(machine learning)-driven, but motion-insensitive MR-to-CT image translators
- ML(machine learning)-driven 4D motion predictors guided by 2D cine imaging

The group **Radiotherapy Optimization** investigates new methods to optimize RT treatment plans, including incorporation of uncertainty or outcome models into classical planning, as well as novel treatment strategies like mixed-beam therapy.
Potential projects:
- Towards clinically acceptable jointly optimized mixed-modality treatments

- Improving ML-based treatment outcome models addressing the bias from treatment plan design

The group **Applied Medical Radiation Physics** performs radiobiological studies in animals to investigate the differential effectiveness of ions compared to photons in normal tissues and tumors. This includes the experimental determination of RBE for comparison with model predictions and diagnostic imaging studies as well as histological and molecular analysis of tissue samples obtained from the irradiation experiments.
Potential Projects are related to the investigation of:
- late effects in rat spinal cord after photon, proton and ion irradiations
- response of hypoxic and normoxic tumors after photon, proton and ion irradiations.