Project abstract

Name of DKFZ research division/group:	***mRNA Cancer Immunotherapies (D194)***
Contact person:	***Prof. Dr. Ugur Sahin*** ***d194@dkfz-heidelberg.de*** ***Dr. Alexandra Alves Duarte*** ***alexandra.alvesduarte@dkfz-heidelberg.de***
Group homepage: Please visit our website for further information on our research and recent publications.	***mRNA Cancer Immunotherapies - German Cancer Research Center***

PROJECT PROPOSAL

The mRNA Cancer Immunotherapies division at HI-TRON Mainz focuses on the systematic reprogramming of the cancer-immunity cycle through two convergent synthetic immunology strategies. We utilize nanoparticle technology for the functional programming of effector populations, specifically engineering T and NK cells with enhanced tumor infiltration, antigen recognition, and metabolic persistence. In parallel, we develop targeted mRNA interventions to modulate the tumor microenvironment (TME), neutralizing local immunosuppressive barriers that drive therapeutic resistance. By integrating high-dimensional multi-omics discovery with high-fidelity human model systems, we aim to develop a modular, programmable toolkit for precision oncology. Our mission is to bridge the gap between computational target discovery and functional validation in human-centric systems to improve clinical outcomes in solid malignancies.

Project 1 - Spatial Multi-Omics in Gastrointestinal Cancer

In this project, you will lead the implementation of ML-based digital pathology tools to decode the spatial organization of GI cancers, focusing on architectures associated with immune suppression. By integrating deep-learning outputs with genomics and transcriptomics, you will contribute to a clinical-computational framework to identify novel immunotherapy targets and refine predictive biomarker profiles. Your clinical background will be essential for grounding these models in diagnostic and histopathological logic. Supported by our bioinformatics team and a network of clinical experts at UCT Mainz leveraging AI-driven pathology analysis, you will gain advanced proficiency in Python-based deep learning and

spatial omics analysis. This role offers a unique opportunity to elevate your scientific profile at the vanguard of digital medicine and molecular oncology.

Project 2: Advanced Tumor Models for TME Reprogramming

This project leverages deep phenotyping of patient specimens using multiplex 3D imaging approaches, enabled by advanced in-house high-resolution confocal and spectral imaging platforms, to map the immune landscape of GI cancers in their native spatial context. These high-dimensional tissue insights will guide the development of 3D-bioprinted in vitro models that capture key immunosuppressive architectures, serving as a complementary system alongside patient-derived ex vivo tumor explants. These advanced human tissue models will support the functional validation of targeted mRNA interventions designed to modulate immunosuppressive cell populations. Your clinical expertise will be essential for connecting imaging-derived phenotypes to histopathological and disease biology. Working with a multidisciplinary team, you will integrate advanced imaging, bioengineering, and computational analysis to advance translational cancer research.