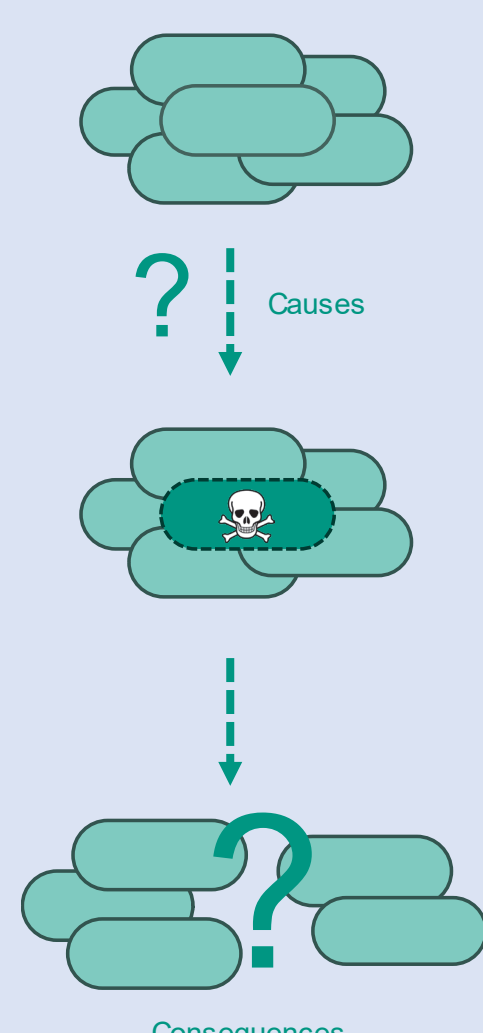


Investigation of cell death dynamics in bacterial clusters via microfluidic cultivation and advanced imaging techniques

Background of the overall project:

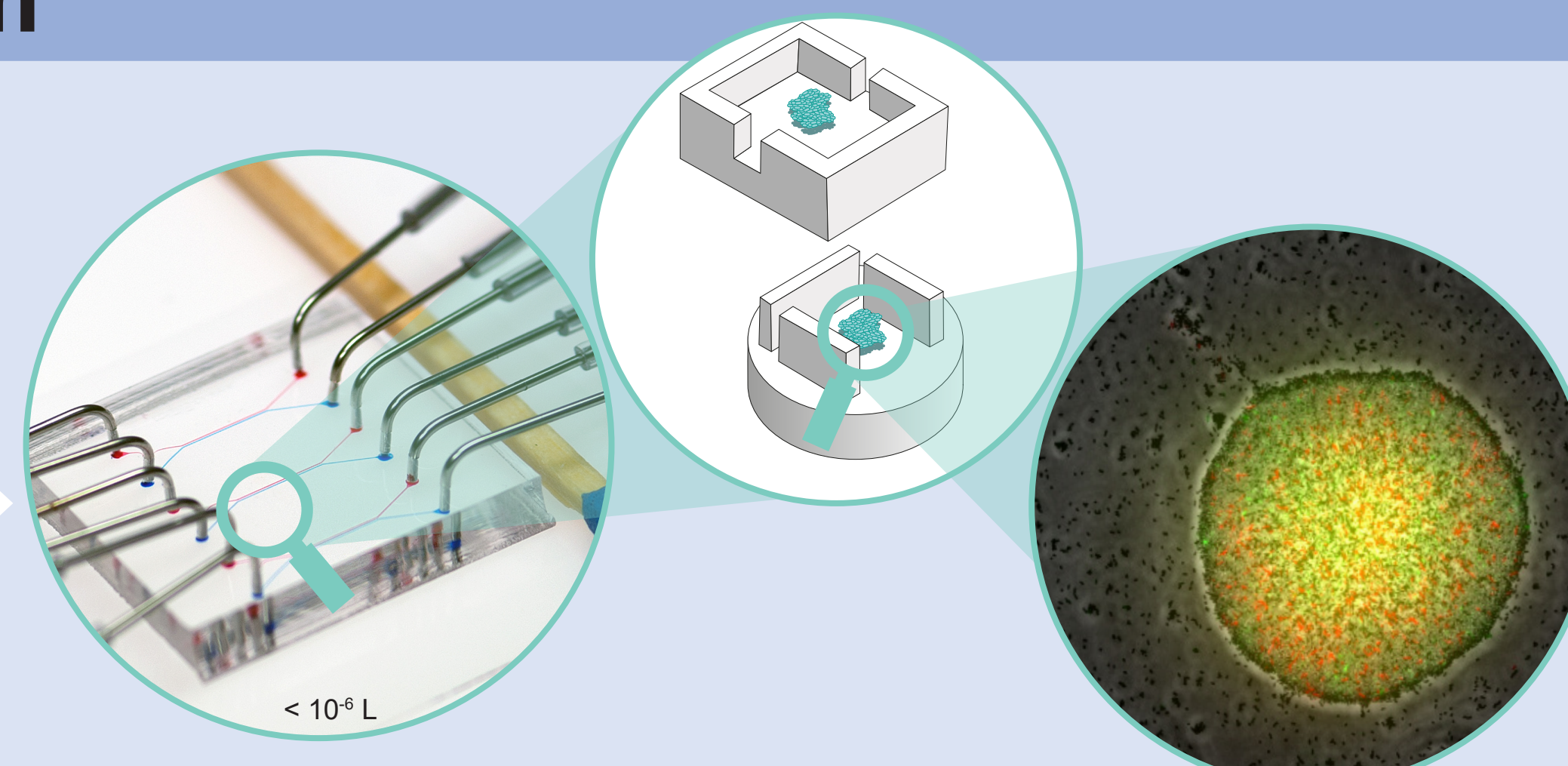
Motivation

The emergence of **multicellularity** was a significant event in the history of life, yet our understanding of it remains limited



- Crucial for the emergence is the **formation of groups** from previously single cells
- These exhibit behaviors such as the **altruistic suicide**
- The knowledge about the **causes and consequences** of this cell lysis are still rudimentary due to a lack of technology
- **Microfluidic platforms** offer promising solutions due to their precise environmental control and high temporal and spatial resolution

Aim



Development of the **microfluidic cultivation platform** and investigation of the **causes and consequences of the altruistic suicide** in bacterial multicellular groups

Bachelor / Master thesis:

Objective

The overarching goal of this thesis is to investigate the role of cell death in bacterial clusters cultivated in microfluidic systems. By employing live/dead staining methods and advanced image analysis pipelines, this work aims to: (1) Identify and quantify dead cells within bacterial clusters; (2) Understand the temporal and spatial dynamics of cell death events; (3) Elucidate factors that influence the initiation of cell death within these clusters.

Work packages

Literature review:

Aim: Understanding of the role of cell death in biofilm development.

- Review of current literature on live/dead staining techniques and role of cell death in biofilm formation
- Identification of key parameters which influence the bacterial cell death

Optimization of the live/dead staining on chip:

Aim: Establishment of a staining protocol for microfluidic long term cultivations.

- Validating staining protocols for end-term, repeated and continuous staining methods
- Optimization of staining protocols for continuous measurements during long term cultivations

Proof-of-concept (1): Analyzing the spatio-temporal dynamics of cell death in the clusters:

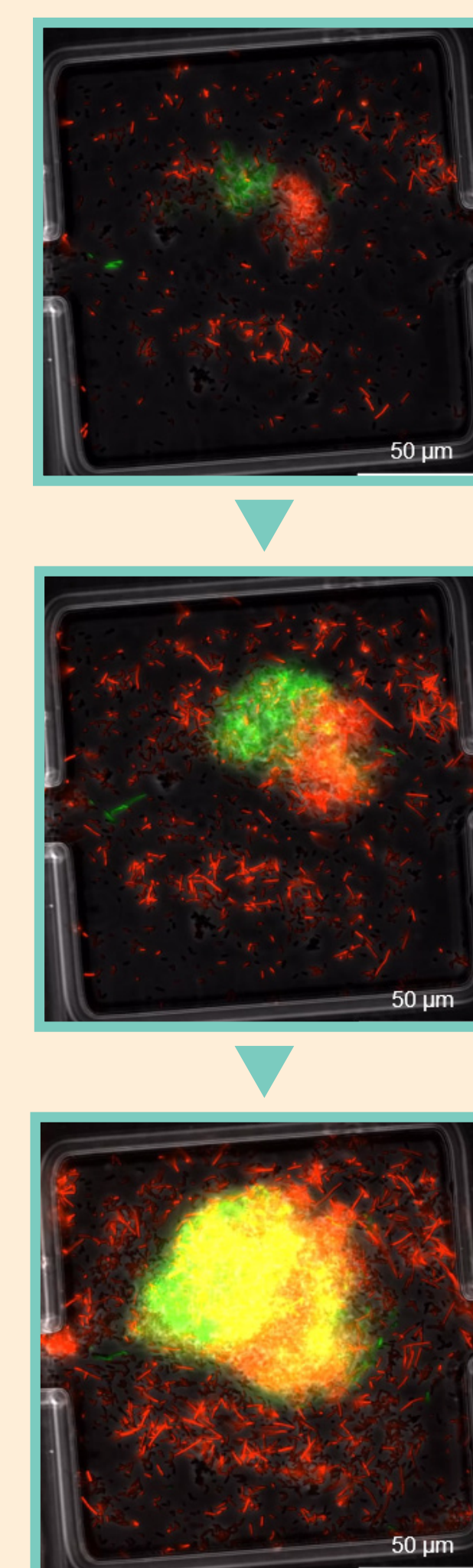
Aim: Quantitative analysis the spatio-temporal dynamics of cell death in clusters.

- Microfluidic cultivation of bacterial clusters with continuous staining
- Generation of high-resolution images for subsequent analysis
- Identifying the spatial and temporal appearance within the clusters

Proof-of-concept (2): Analyzing the different environmental factors on the appearance and role of cell death in the clusters

Aim: Quantitative analysis of the influence of parameters that effect the cell death in clusters.

- Microfluidic cultivation of bacterial clusters under different conditions with death cell staining
- Generation of high-resolution images for subsequent analysis



Expected results

This thesis provides a unique opportunity to explore the role of cell death in bacterial clusters while gaining hands-on experience in microfluidic cultivation techniques. The results will contribute to a deeper understanding of the early stages of bacterial biofilm formation.

General information:

Your Qualifications

- Background in bioengineering, biotechnology, biology or similar
- Knowledge of microbiological methods
- Interest in multidisciplinary research
- Structured, independent and meticulous working method

Application

- Apply now!
- Apply with: Curriculum vitae, transcript and proposal start date

Sent application to miriam.epping@kit.edu