

From Self-Organization to Function: Mechanically Driven Morphogenesis in Organoids

📅 11:00 am - 12:30 pm, 7 May 2026 (Thursday)

📍 P4704, 4/F, Yeung Kin Man Acad Building, CityUHK

Abstract

A central challenge in biomedicine is the development of physiologically relevant in vitro systems that faithfully recapitulate tissue architecture and function, while enabling reliable assessment of drug responses and cytotoxicity. At the core of this challenge lies the fundamental property of living matter to self-organize into higher-order structures across molecular, cellular, organ, and organismal scales. Conventional two-dimensional cultures and simplified models fail to capture these emergent processes, particularly the interplay between mechanical cues, cellular organization, and dynamic collective behaviors, thereby limiting their predictive power for translational applications. Collective motion driven by active transport processes and mechanical cues have emerged as a key mechanisms underlying such order formation across these length scales. Here, I present recent results on structure formation in organoid systems, demonstrating how mechanical feedback between extracellular matrix, proliferation, and cell migration governs morphogenetic processes in these multicellular model systems. I will present findings on the developmental phases of mammary gland organoids, pancreatic ductal adenocarcinoma organoids, and epiblastoid development. Notably, we identify the formation of cardiac shell organoids as a key finding, representing a structurally organized and functional in vitro model with emergent tissue-level organization.

These results directly address key biomedical challenges by providing more physiologically relevant and tunable model systems for studying development and disease. The structural and functional complexity of the organoids enhances their applicability for drug screening and disease modeling, while cytotoxicity assays confirm high biocompatibility and minimal adverse effects on cell viability. Together, this approach helps bridge the gap between simplified in vitro systems and in vivo physiology, enabling more predictive and reliable platforms for biomedical research and therapeutic testing.

Biography

Prof. Andreas Bausch is the Founding Director of the Center of Organoid Systems and the Center for Functional Protein Assemblies at the Technical University of Munich (TUM), Germany. In July 2025, he was awarded the endowed Hein Heinz Nixdorf Chair Professorship in Biophysical Engineering of Living Matter at TUM.

He studied physics at TUM and the Université de Montréal and received his doctorate from TUM in 1999. An Emmy Noether Fellowship allowed him to work at Harvard University under Prof. D. Weitz. After receiving several global invitations, he accepted the Chair of Cellular Biophysics at TUM in 2008 and is currently a member of the Senate and the Academic Board of Trustees at TUM. Internationally recognized for his contributions, Prof. Bausch has received multiple honors and held leadership roles at major academic institutions and events, including a Visiting Scholarship at Harvard in 2021 and the Visiting Miller Professor Appointment at the University of California, Berkeley, in 2015. Since 2019, he has been a Fellow of the Max Planck School Matter to Life.

Prof. Bausch conducts research on structure formation in biological systems, focusing on the mechanical properties of the cytoskeleton and the self-organization of organoid structures. His transdisciplinary approach has led to significant breakthroughs reaching from our understanding cytoskeletal function, cell mechanics, biosensors up to the complex branching morphogenesis in organoids.

Utilizing advanced technologies such as microfluidics, multimodal imaging, AI-guided microscopy, magnetic and optical tweezers, and atomic force microscopy, his research team aims to uncover the fundamental principles driving organoid development, contributing to advancements in developmental biology and tissue engineering. His recent efforts focus on translating these findings into biotechnological applications.



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