PhD project advert – Alexander Mietke

Institute Affiliation: Applied Mathematics

Research Themes: Soft Matter, Non-equlibrium physics, Biological physics

Project Description: **Active Matter in Complex Environments**

Biological organisms develop their body geometry through a sequence of shape changes, a processes called morphogenesis. This dynamics often takes place within challenging mechanical environments, provided for example by surrounding material with complex mechanical properties or by spatial constraints from rigid enclosures. Such interactions with the environment have a profound impact on the dynamics, which can be captured within the paradigmatic theoretical framework of active 'living matter'.

In this project, the effects of external forces on active matter will be studied theoretically in minimal models and in experimental collaborations. The goal is to understand how mechanical interactions with the environment may guide self-organized symmetry breaking and patterning processes in non-equilibrium systems and, ultimately, in developing organisms.

Tools that can be used to tackle this question include the continuum mechanics of surfaces, numerical approaches for active matter in complex geometries and topologies, as well as model inference techniques that can directly be applied to experimental data.

References: A. Mietke *et al.*, Minimal model of cellular symmetry breaking, PRL (2019)
A. Mietke *et al.*, Self-organized shape dynamics of active surfaces, PNAS (2019)
L. Pimpale *et al.*, Cell lineage-dependent chiral actomyosin flows drive cellular rearrangements in early *C. elegans* development, eLife (2020)
N. Romeo *et al.*, Learning developmental mode dynamics from single-cell trajectories, eLife (2021)

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