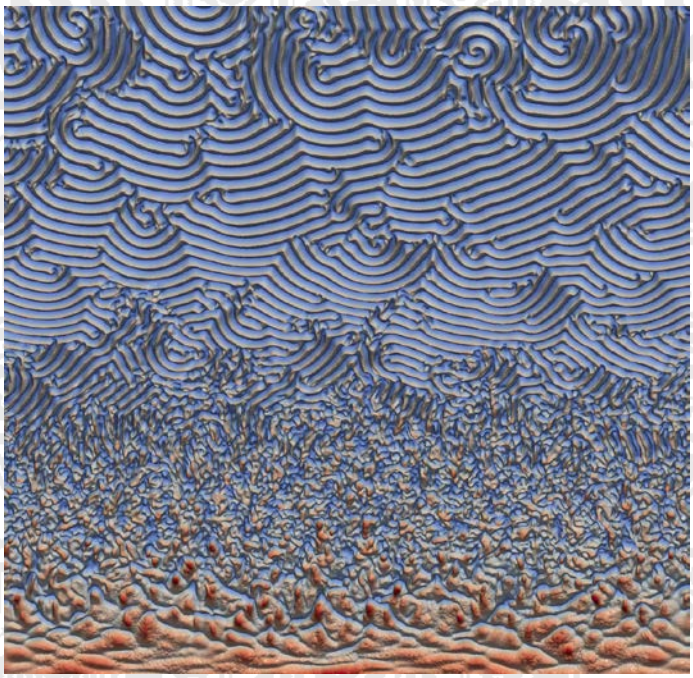
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg
Physikalisches Institut

PHYSIKALISCHES KOLLOQUIUM

AM 28. OKTOBER 2019 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



EMERGENCE AND SELF-ORGANISATION IN BIOLOGICAL SYSTEMS

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Isolated systems tend to evolve towards thermal equilibrium, a special state that has been a research focus in physics for more than a century. By contrast, most processes studied in biological systems are driven and far from thermal equilibrium. A fundamental overarching hallmark of all these processes is the emergence of structure, order, and information, and we are facing the major challenge to identify the underlying physical principles. Two particular exciting problems are the self-organised formation of functional spatio-temporal patterns in cells and the robust self-assembly of complex structures. In both fields there are recent advances in understanding the underlying physics that will be reviewed in this talk. In reaction-diffusion systems, it has been shown that the essential dynamics is the spatial redistribution of the conserved quantities which leads to moving equilibria. This has led to new insights into the robustness and evolvability of biochemical networks driving biological patterns. Efficient self-assembly of macromolecules and protein clusters is a vital challenge for living organisms: Not only are resources limited but also are malfunctioning aggregates a substantial threat to the organism itself. We will discuss recent advances in this field, in particular the role of stochastic effects and broken detailed balance.