UNI FREIBURG

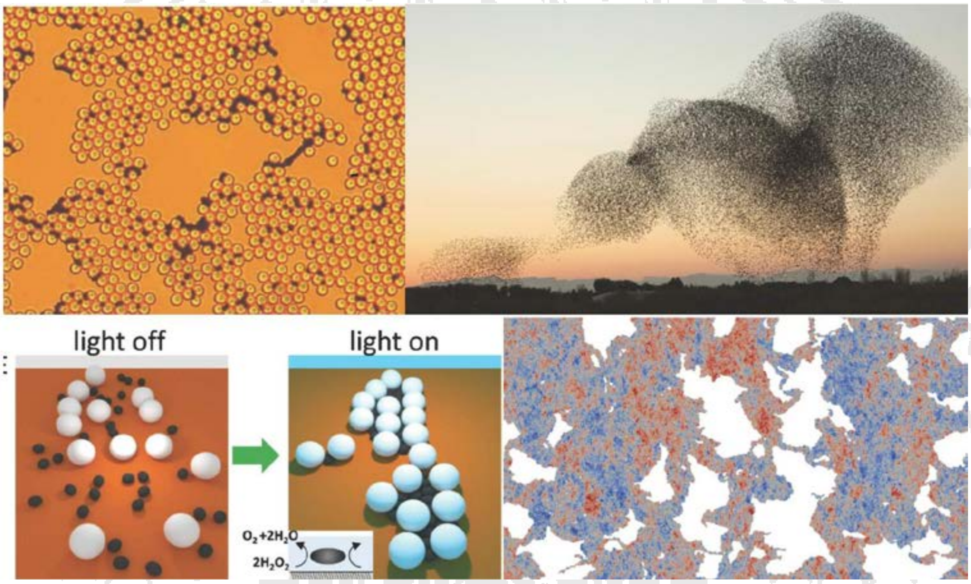
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

Physikalisches Institut

PHYSIKALISCHES KOLLOQUIUM

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

IM GROßEN HÖRSAAL



ACTIVE MATTER AND ACTIVE MATERIALS: EMERGING BEHAVIOR IN INSTRINSICALLY OUT OF EQUILIBRIUM SYSTEMS

PROF. DR. IGNACIO PAGONABARRAGA

CECAM, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (EPFL),
LAUSANNE, SWITZERLAND

Flocks of birds, schools of fishes, or bacterial colonies constitute examples of living systems that coordinate their motion. In all these systems their constituent elements generate motion due to energy consumption and can exchange information or react sensitively to chemical cues in order to move together or to react collectively to external signals. Artificial systems, such as nanorobots, exploit the heterogeneous compositions of their surface to displace as a result of the heterogeneous chemical processes that take place in the presence of appropriate chemical substances.

All these systems are intrinsically out of equilibrium in the absence of any external driving, and their collective properties result as a balance between their direct interactions and the indirect coupling to the medium in which they displace. The mechanical balance that determines the states they develop spontaneously make these systems very versatile and have a natural tendency to for large scale aggregates. An understanding on the basic principles underlying the emergence and self-assembly on active systems poses fundamental challenges: How do the relevant entities interact with each other? Can we identify universal, generic principles associated to the main features in the self-assembly and emergent behavior of intrinsically out of equilibrium systems? Are there mechanisms that can be shared by living systems and synthetic, active materials?

I will consider simple statistical models to address fundamental aspects of active systems and will analyze the implications that self-propulsion has in the emergence of structures in suspensions of model self-propelled particles. I will discuss the potential of schematic models to address fundamental questions that still remain open, such as the connection of the effective phase diagram and pressure with effective equilibrium concepts. These approaches allow to understand the transformations that characterize these systems as effective phase transitions out of equilibrium.