UNIVERSITÉ DU LUXEMBOURG

# Physics Colloquium

**14th of October, 2019 at 1:00 pm**
**Coffee at 12:45 pm**

**Campus Limpertsberg**
**Bâtiment des Sciences – room BS 2.04**

**Talk by Prof. Jörn Dunkel**
Massachusetts Institute of Technology

*Invited by Physics Research Unit.*

## Understanding & controlling bacterial dynamics: from swimming and swarming to biofilm formation

Bacteria are among the most abundant forms of life on Earth and play important roles in various biological, ecological and industrial processes. In this talk, I will summarize our recent efforts to understand better the essential physical mechanisms and forces that govern individual and collective bacterial dynamics. After looking at the hydrodynamic flow fields generated by individual bacteria [1], we will demonstrate how collective bacterial swimming in dense suspensions [2] can be controlled through suitably designed microfluidic structures [3]. In the second part, we will discuss how recent advances in microscopy techniques enable the study of bacterial swarming [4] and biofilm formation [5] at single-cell resolution over an enormous range of length and time scales -- and which theoretical challenges and opportunities arise from this unprecedented wealth of data.

[1] Drescher et al, PNAS 108(27): 10940-10945, 2011
[2] Dunkel et al, Phys Rev Lett 110: 228102, 2013
[3] Wioland et al, Nature Physics 12: 341-345, 2016
[4] Jeckel et al, PNAS 116(5): 1489-1494, 2019
[5] Hartmann et al, Nature Physics 15: 251-256, 2019

**Biography:**

Jörn Dunkel is Associate Professor of Physical Applied Mathematics at MIT. He studied Physics (2004) and Mathematics (2005) at the Humboldt University Berlin, and completed his PhD at the University of Augsburg (2008). After two years of postdoctoral research at the Rudolf-Peierls Centre for Theoretical Physics in the University of Oxford, he spent three years as a Research Associate at DAMTP in the University of Cambridge. Working at the intersection of statistical and biological physics, Jörn's current research focuses on how physical properties of individual cells or microorganisms determine self-organization, development and biological function in multicellular systems. To this end, his group is developing and investigating mathematical models that describe dynamical behavior and structure formation in active and soft matter. Jörn was elected to a Junior Research Fellowship in Physics at Mansfield College, University of Oxford in 2008, and was named Research Fellow at Murray Edwards College, University of Cambridge in 2011. He is the recipient of the 2011 Gustav Hertz Prize of the German Physical Society. Jörn was awarded an Alfred P Sloan Research Fellowship in 2015 and received a Complex Systems Scholar Award from the James S. McDonnell Foundation in 2016.

UNIVERSITÉ DU
LUXEMBOURG