Life Sciences Seminar

Collective functionality in intelligent active matter: Bridging multi-scale biology with the physics of solids, fluids and information

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Host: Edouard Hannezo

Biological systems flourish through collective functionality, by self-assembling into cells, tissues, flocks and parliaments. Understanding this multi-scale organization also lies at the heart of modern engineering and medicine: Pathologies can arise from deficiencies in collective functionality, while active and adaptive materials can be designed from controlling systems out of equilibrium. In this talk, I will overview our recent work on building first-principle theories, numerical tools, and experiments for studying the fascinating physics of life. We will first focus on reliable communication in ultra-fast biology, exemplified by the discovery of hydrodynamic trigger waves [1]. Second, we will discuss bacterial contamination dynamics, which is enhanced by the ability of cells to swim against flows [2]. Third, we consider the role of topology in biofunctionality, especially in active carpets like ciliary arrays [3]. These insights open up exciting new avenues towards unravelling synthetic and biological active matter, through collective functionality, together. BIO: Arnold completed his MSci in theoretical physics at University College London (2012), where he was named Best Overall Undergraduate and 30 under 30 by Scientific American. He then joined the group of Julia Yeomans FRS for his DPhil at the University Oxford (2016), specialising in biological physics, specifically in the hydrodynamics and non-equilibrium statistical physics of active matter. This work was awarded the Sir Sam Edwards PhD Thesis Prize. Supported by an HFSP cross-disciplinary fellowship, he moved to the lab of Manu Prakash at Stanford University, where he currently works on the physics of pathogens and ultra-fast biology. Outside the lab, Arnold is very enthusiastic about science communication. He worked as editor and editor-in-chief of a student-led magazine, and now he frequently organises family events, school visits and science hikes. Please join! 1.Mathijssen AJTM, Culver J, Bhamla MS, Prakash M, Collective intercellular communication through ultra-fast hydrodynamic trigger waves, Nature 571, 560-564 (2019)2.Mathijssen AJTM, Figueroa-Morales N, Junot G, Lindner A, Clement E, Zttl A, Oscillatory surface rheotaxis of swimming E. coli bacteria, Nat. Comm. 10, 3434 (2019)3.Ramirez-San Juan G, Mathijssen AJTM, He M, Jan L, Marshall WF, Prakash M, Multi-scale heterogeneity enhances mucus clearance in mouse airways, under review at Nat. Phys.

Tuesday, February 11, 2020 09:00am - 10:00am

Mondi Seminar Room 2, Central Building

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