Physical Mathematics Seminar

Shear-induced unmixing in bacterial suspensions

JEFFREY GUASTO
Department of Mechanical Engineering
Tufts University

ABSTRACT:

Motile bacteria play integral roles in biophysical processes ranging from biogeochemical cycling in the oceans to the spread of infections in the human body. Their ability to seek out nutrients and chemical signals for survival is conferred through swimming using long, thin, actuated flagella. However, these processes can be disrupted by the ubiquitously dynamic fluid environments in which they live. In this seminar, we will discuss microfluidic experiments using video microscopy to uncover transport mechanisms that lead to bacterial unmixing in flowing fluids. In particular, hydrodynamic shear produces striking spatial heterogeneity in suspensions of motile bacteria, characterized by up to 70% cell depletion from low-shear regions due to cell 'trapping' in high-shear regions. A Langevin model reveals that trapping arises from the competition between the alignment of elongated bacteria with the flow and the stochasticity in their swimming orientation. Finally, we show that shear-induced trapping directly impacts bacterial survival strategies, suppressing chemotaxis by hampering directional motility and more than doubling surface attachment by increasing the transport of bacteria towards surfaces.

TUESDAY, APRIL 1, 2014
2:30 PM
Building E17, Room 136

Reception following in Building E17, Room 401A
(Math Dept. Common Room)

http://math.mit.edu/pms/

Massachusetts Institute of Technology