PHYSICAL MATHEMATICS SEMINAR

A tale of swimming, steering, and synchronization

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ABSTRACT:

Motile cilia and flagella represent a best-seller of nature: their regular bending waves propel e.g. sperm cells; collections of cilia pump fluid in our airways and our brain. Our group investigates the physical mechanisms by which mechanical and chemical signals control the function of cilia and flagella. They represent an ideal model system to address the general question: what makes nonlinear feedback loops robust in the presence of active biological noise?

In a first part, I will introduce the synchronization of biological oscillators and show how mechanical self-stabilization leads to flagellar synchronization in a swimming green alga [1]. By mapping flagellar bending waves on a limit cycle, we can precisely measure how beating flagella change the speed of their beat in response to mechanical forces [2]. This turns out to be important also for the emergence of metachronal 'Mexican' waves in cilia carpets. A shorter second part will demonstrate how decision making improves sperm chemotaxis in the presence of noise [3].

[1] Geyer et al. PNAS 110, 2013
[2] G.S. Klindt et al. Phys. Rev. Lett. 117, 2016
[3] J.A. Kromer et al. PLoS Comp. Biol. 14, 2018

TUESDAY, SEPTEMBER 17, 2019
2:30 PM – 3:30 PM
Building 2, Room 131

Reception following in Building 2, Room 290
(Math Dept. Common Room)

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

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