PHYSICAL MATHEMATICS SEMINAR

Flagellar synchronisation through direct hydrodynamic interactions

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ABSTRACT:

Microscale fluid flows generated by ensembles of beating eukaryotic flagella are crucial to fundamental processes such as development, motility and sensing. Despite significant experimental and theoretical progress, the underlying physical mechanisms behind this striking coordination remain unclear. We describe a novel series of experiments in which the flagellar dynamics of two micropipette-held somatic cells of *Volvox carteri*, with measurably different intrinsic beating frequencies, are studied by high-speed imaging as a function of their mutual separation and orientation. From analysis of beating time series, we find that the interflagellar coupling, which is constrained by the lack of chemical and mechanical connections between the cells to be purely hydrodynamical, exhibits a spatial dependence that is consistent with theoretical predictions. At close spacings it produces robust synchrony which can prevail for thousands of flagellar beats, while at increasing separations this synchrony is systematically degraded by stochastic processes. Manipulation of the relative cell orientation reveals the existence of both in-phase and antiphase synchronised states, consistent with dynamical theories. Through dynamic flagellar tracking with exquisite precision, we quantify the associated waveforms and show that they are significantly different in the synchronised state. This study unequivocally reveals that flagella coupled only through a fluid medium are capable of exhibiting robust synchrony despite significant differences in their intrinsic properties.

TUESDAY, FEBRUARY 18, 2014

2:30 PM

Different location: → **Building 66, Room 144**

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

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

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