PHYSICAL MATHEMATICS SEMINAR

PACK & SWIM: FLUID MECHANICS AT THE MICRON SCALE

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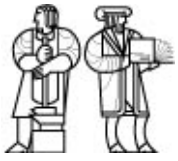
ABSTRACT:

When length scales in fluid mechanical systems are sufficiently small, many physical effects are relevant in addition to viscous stresses. We present two phenomena, involving surface effects and long range hydrodynamic interactions, that take place at the scale of a few microns. First, we introduce the topic of self-assembly and present a theory of the experiments of Manoharan et al. (2003, Science, vol. 301), where a small number of colloidal micro-particles at the surface of a drying droplet, driven by capillary forces, form unique clusters. We show that the geometrical constraints during the drying process are sufficient to determine the unique final configurations. Next, we turn to the swimming behavior of bacteria (E. coli) near solid surfaces, where it has been observed that they do not swim in a straight line but in circles. We offer a mechanical model for such behavior and show that the hydrodynamic interactions between the bacteria and the nearby surface are sufficient to induce a clockwise motion (when viewed from above) as in the experiments. We predict the radii of the circular paths and their rotational frequencies, and compare with experimental data.

TUESDAY, MARCH 8, 2005
2:30 PM
Building 2, Room 338

Refreshments at 3:30 PM in Building 2, Room 349.



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