PHYSICAL MATHEMATICS SEMINAR

Interfacial Fluid Phenomena

PEDRO J. SÁENZ

Massachusetts Institute of Technology

ABSTRACT:

Surface tension plays a crucial role in a wide range of biological (e.g. insect propulsion), geophysical (e.g. lava flow dynamics), environmental (e.g. disease transmission), technological (e.g. microfluidics) and every-day (e.g. tears of wine) phenomena. In this talk, I will illustrate three different problems dealing with interfacial phenomena that find motivation in markedly diverse areas. First, I will discuss the kinetics and flow dynamics of non-spherical sessile drops undergoing phase change. In a vast variety of real-life situations spherical sessile drops are the exception rather than the rule, yet the intricacy of the physical mechanisms involved has constrained the study of this problem to spherical configurations. By considering a range of sessile drops with canonical, non-spherical shapes, we demonstrate a number of new geometry-induced effects and deduce a scaling law for the evaporation rate of any drop shape. Second, I will illustrate the potential of variable bottom topography to excite specific wave modes in the free surface of a vibrating fluid bath, which may be exploited to direct the motion of self-propelled drops 'walking' on the vibrated free surface. Specifically, we show that a submerged circular well may drive the walking drop to excite specific eigenmodes in the bath that result in drastic changes in the particle's motion. We thus demonstrate how variations in topography may be used to generate topographically induced potentials acting on walking drops. Finally, I will discuss the realignment of a Janus drop (double-emulsion drop formed by two immiscible fluids) in response to an externally-imposed temperature gradient due to the Marangoni effect. Depending on the angle between the interior interface and the direction of the temperature gradient, asymmetries in the thermocapillary flow may lead to spontaneous drop rotation. We characterize theoretically the hydrodynamic response and flow during this thermally-driven realignment process and discuss how such effect may be exploited for the development of dynamically reconfigurable microlenses.

TUESDAY, FEBRUARY 27, 2018
2:30 PM
Building 2, Room 136

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

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

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