PHYSICAL MATHEMATICS SEMINAR

DROP COALESCENCE IN STOKES FLOWS

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ABSTRACT:

Drop coalescence has been the focus of many studies because of its relevance to a broad range of engineering processes where the control of a drop size distribution is important. Nevertheless there remain many poorly understood aspects of this familiar problem. In general, drop coalescence involves body-forces or an ambient flow to bring pairs of drops into close contact, as well as short-range molecular forces (e.g., van der Waals attraction) to rupture the thin liquid film that separates drop interfaces prior to confluence. In many systems, the rate-limiting step for drop coalescence is associated with squeezing fluid out of the thin elm, before molecular forces become significant. Drainage of the thin-film between drops with tangentially-immobile interfaces is a well-understood problem, and the classical theory that describes this problem has been extended in an attempt to describe the behavior of drops with tangentially-mobile interfaces. However, there are important qualitative differences that have been overlooked in the current theories.

According to the classical theory, the thin film region between drops with tangentially-immobile interfaces is hydrostatic (except at the edges), and the ambient flow field has no influence on film drainage aside from the hydrodynamic pushing force that it provides. The current theories assume that these two features also apply to drops with tangentially-mobile interfaces. In fact, both assumptions are incorrect. It turns out that the film profile between drops with tangentially-mobile interfaces minimizes tangential stresses rather than pressure gradients, and ambient flow conditions can qualitatively affect film drainage, and in some cases even arrest film drainage (i.e., prevent coalescence).

TUESDAY, DECEMBER 12 2006
2:30 PM
Building 4, Room 270

Refreshments at 3:30 PM in Building 2, Room 349
(Applied Math Common Room)

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