PHYSICAL MATHEMATICS SEMINAR

THERMO-CAPILLARY MOTION ABOUT A STATIONARY BUBBLE, AND A CONVECTIVE PCR MODEL

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ABSTRACT:

This talk will addresses two topics. The first entails thermo-capillary flow about a small stationary bubble, resulting from surface tension dependence upon temperature. Such flows, which are important in small scale devices and/or micro-gravity conditions, received significant attention in the (common) case of small, but non-zero, convection effects. A standard model usually comprises an unbounded fluid domain which is exposed to an externally-imposed temperature gradient. Surprisingly, it was found (Balasubramaniam & Subramanian 2004) that a straight-forward asymptotic expansion in the small Peclet number fails to satisfy the pertinent far-field condition. I will discuss the relation between the unbounded-domain problem and its bounded counterpart, where the gradient is generated by thermally manipulating an external boundary located at distance λ from the bubble. Specifically, the $\lambda \to \infty$ limit of the bounded model suggests how to obtain physically-meaningful quantities using an unbounded-domain asymptotic scheme.

In the second part of the talk I will describe a joint work with K. Dorfman and G. Ben-Dov: convection-reaction-diffusion model for PCR in a circulating flow driven by natural convection, such as occurs in a Raleigh-Bénard cell. The DNA transport is modelled using evolution equations that describe a three-state (single strand, annealed, and double strand) convection-diffusion-reaction process. By focusing on the exponential amplification stage, the governing equations are transformed into an eigenvalue problem, which is easily solved using spectral methods. The largest real eigenvalue, λ, is related to the "doubling time," and the corresponding eigenfunctions constitute the stationary concentration fields during this exponential amplification phase. Diffusion plays a non-trivial role in the overall rate of amplification.

TUESDAY, SEPTEMBER 13, 2005
2:30 PM
Building 1, Room 132

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

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