Temple University Mathematics Colloquium

Leonid Berlyand

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will speak on

PDE/ODE models of motility in active biosystems

ABSTRACT: In the first part of the talk we present a review of our work on PDE models of swimming bacteria. First we introduce a stochastic PDE model for a dilute suspension of self-propelled bacteria and obtain an explicit asymptotic formula for the effective viscosity (E.V.) that explains the mechanisms of the drastic reduction of E.V.. Next, we introduce a model for semi-dilute suspensions with pairwise interactions and excluded volume constraints. We compute E.V. analytically (based on a kinetic theory approach) and numerically. Comparison with the dilute case leads to a phenomenon of stochasticity arising from a deterministic system. We develop a ODE/PDE model that captures the phase transition, an appearance of correlations and large scale structures due to interbacterial interactions.

In the second part of the talk we consider a system of two parabolic PDEs arising in modeling of motility of eukaryotic cells on substrates. The two key properties of this system are (i) presence of gradients in the coupling terms (gradient coupling) and (ii) mass (volume) preservation constraints. We derive the equation of the motion of the cell boundary, which is the mean curvature motion perturbed by a novel nonlinear term and prove that the sharp interface property of initial conditions is preserved in time.

Monday, January 27, 2014
Lecture at 4:00 pm
Coffee, tea, and refreshments from 3:40 pm
Room 617, Wachman Hall
Department of Mathematics