THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Online Undergraduate Analysis and PDE Seminar

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Zoom

Moving boundary problems for evaporating fluids

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Abstract. Many challenging problems in fluid dynamics and partial differential equations involve boundaries that move in response to the dynamics of the solution. In fluid mechanics, moving interfaces define the evolving shapes of bodies of fluids. For problems where the mass of the fluid is changing due to evaporation, the interaction of the phase change with other effects can yield interesting behaviors.

In the first part of the presentation, Jeong, Jiang, and Zhang examine how evaporation can compete with influences of diffusion and deposition in a particle-ladened fluid. For diffusion-dominated problems, PDE and stochastic models for particle transport were studied to observe deposition behavior on solid boundaries produced in different parameter regimes. Problems for the Fokker-Planck equation with varying boundary conditions were considered in one and two dimensions, using both SDE and PDE approaches. Computationally scaled 2D models were then simulated to obtain the temporal evolution of the particle concentration and deposition patterns in a rectangular pore and also for sessile drops on flat solids

In the second part of the presentation, Witelski will describe the interfacial dynamics that can occur in lubrication models for thin layers of viscous fluids on water repellent solids. The longwave PDE model is a fourth order nonlinear parabolic PDE with a non-conservative flux representing a one-sided model of fluid evaporation or condensation. Stability analysis for the PDE shows how phase change can drive fluid films to break up into sets of droplets. In one parameter regime, it is shown that the intermediate dynamics can play a deciding role in tipping the system to long-time evaporation- or condensation-dominated behavior.