Center for Fluid Mechanics, Division of Applied Mathematics
Fluids and Thermal Systems Group, School of Engineering
Joint Seminar Series

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Nonlinear Waves and Electrokinetic Shocks in Capillary Electrophoresis

Electrophoretic separation of a mixture of chemical species is a fundamental technique of great usefulness in analytical chemistry and the life sciences. In capillary electrophoresis, the sample migrates in a microcapillary in the presence of a background electrolyte. When the ionic concentration of the sample is sufficiently high, the signal is known to exhibit features reminiscent of nonlinear waves including sharp concentration 'shocks'. We show that under certain conditions, the concentration of the sample ion obeys a one dimensional nonlinear advection diffusion equation reducible to Burgers' equation in the weakly nonlinear limit. We show that this fact can be exploited to obtain exact formulas for useful quantities such as the migration speed, width and shape of sample peaks, thereby providing a framework for understanding experimental observations. In the presence of a zeta potential at the capillary wall, induced pressure gradients also cause Taylor dispersion of the sample ions, resulting in an effective axial diffusivity that is concentration dependent.

TUESDAY – OCTOBER 25, 2011
4:00 PM
Barus & Holley, Room 190