TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Wednesday, 18 October 2017, 4:00 p.m.
Room 617 Wachman Hall

(refreshments and social at 3:45 p.m)

Life in Complex Fluids

by Paulo E. Arratia
Department of Mechanical Engineering and Applied Mechanics
University of Pennsylvania

Abstract. Many microorganisms evolve in media that contain (bio)-polymers and/or solids; examples include cervical mucus, intestinal fluid, wet soil, and tissues. These so-called complex fluids often exhibit non-Newtonian rheological behavior such as shear-thinning viscosity and elasticity. In this talk, I will discuss recent experiments on the effects of fluid elasticity on the swimming behavior of microorganisms. Two main microorganisms are used, the green algae *C. reinhardtii* (a puller-type swimmer) and the bacterium *E. coli* (a pusher-type swimmer). For the case of pullers (*C. reinhardtii*), we find that fluid elasticity hinders the cells overall swimming speed but leads to an increase in the cells flagellum beating frequency. The beating kinematics and flagellum waveforms are also significantly modified by fluid elasticity. For the case of pushers (*E. coli*), the presence of even small amount of polymers in the medium suppresses the bacteria run-and-tumble mechanism. The bacteria spend more time in ballistic mode and swim faster as well. Single molecule experiments using fluorescently labeled DNA show that the flow fields generated by *E. coli* are able to stretch initially coiled polymer molecules and thus induce elastic stresses in fluid. These results demonstrate the intimate link between swimming kinematics and fluid rheology and that one can control the spreading and motility of microorganisms by tuning fluid properties.