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Slip, Swim, Mix, Pack: Fluid Mechanics at the Micron Scale ERIC LAUGA, Massachusetts Institute of Technology — This talk summarizes my thesis work which was advised by Michael P. Brenner and Howard A. Stone at Harvard University and is devoted to fluid behavior at the micrometer length scale. We consider four different problems. We first address the topic of the no-slip boundary condition in Newtonian liquids. After briefly reviewing the field, we (1) present models for apparent slip in three distinct experimental settings, (2) propose a new method to probe slip and (3) show that slip has virtually no influence on the non-modal stability of shear flows. The second problem we consider addresses mixing in micro-devices. We show that microchannels which are obtained with a single step of microfabrication (that is, have constant height) are able to generate fully three-dimensional flows. The third problem we present proposes a mechanical model for the motion of the bacterium E. coli near solid boundaries. It has been observed that, near a solid surface, E. coli does not swim in a straight line but in clockwise circles, which we show is a consequence of the hydrodynamic interactions between the free-swimming bacterium and the surface. The final problem we consider addresses self-assembly of micro- particles. We show that when spherical particles located on a liquid droplet are forced to come together by evaporation of the droplet, the geometrical and mechanical constraints arising during the process lead to unique final clusters.

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