Active and passive particles in Stokes regime: bacteria at interfaces and sedimentation through a cellular flow

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In this talk I will discuss two aspects of small particles hydrodynamic interactions in Stokes regime, first in the case of bacteria swimming close to complex interfaces, and then considering the problem of particle advection and sedimentation in a cellular flow. The locomotion of swimming microorganisms such as bacteria can be significantly altered by nearby boundaries. In particular, microorganisms using helical propulsion tend to swim in circles. Using an analytical model, we show how different complex interfaces affect a nearby bacterium and modify its swimming properties.

In the presence of an external flow, the sedimentation of small passive particles can be significantly modified, in particular in vortical or turbulent flows. In this work, we study the competition of the different terms involved in particle advection using a model experiment, where isolated particles can be tracked in a controlled quasi-2D cellular flow. We investigate the role of inertia on the settling rate and trajectories, for small spherical particles and slender rods.

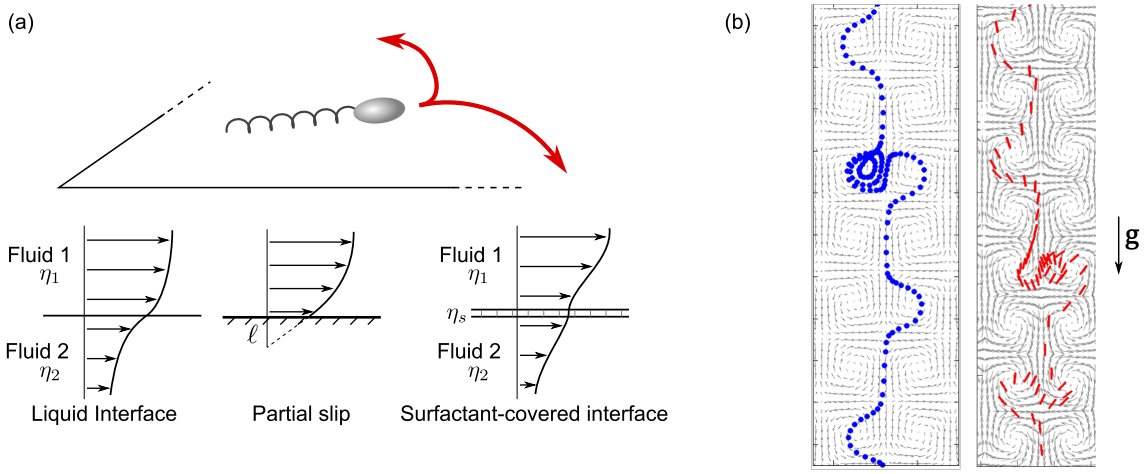

Figure 1: (a) Circular motion of bacterium E. Coli close to complex interfaces: how does interface rheology affect the rotation rate and direction? (b) Spherical particle and rigid rod settling through a cellular flow: experimental trajectories showing possible entrapment.