DFD10-2010-020030

Abstract for an Invited Paper
for the DFD10 Meeting of
the American Physical Society

E. coli swimming over agar in a thin aqueous film

HOWARD BERG, Harvard University

When cells of Escherichia coli are grown in a rich medium over somewhat soft agar (0.45%) they elongate, produce more flagella, and swarm (or flock). Their behavior is dominated by collisions: an individual cell's velocity is randomized in about 0.2 s [1]. However, cells do not swim in spirals, as they do when in a thick layer of fluid near a solid boundary [2]. This suggests that the surface of the swarm is stationary, i.e., that the cells swim in a thin film of fluid between two fixed surfaces. We showed that this is the case by following the motion of MgO smoke particles deposited at the fluid-air interface [3]. By visualizing flagella of cells in swarms, we found that cells can escape from a confined environment by swimming back through the flagellar bundle, without changing the orientation of the cell body. This maneuver involves normal-to-curly and curly-to-normal polymorphic transformations [4]. These phenomena will be illustrated.

[1] Darnton NC, Turner L, Rojevsky S, & Berg HC (2010) Dynamics of bacterial swarming. Biophys. J. 98:2082-2090.
[2] Lauga E, DiLuzio WR, Whitesides GM, & Stone HA (2006) Swimming in circles: motion of bacteria near solid boundaries. Biophys. J. 90:400-412.
[3] Zhang R, Turner L, & Berg HC (2010) The upper surface of an Escherichia coli swarm is stationary. Proc. Natl. Acad. Sci. USA 107:288-290.
[4] Turner L, Zhang R, Darnton NC, & Berg HC (2010) Visualization of flagella during bacterial swarming. J. Bacteriol. 192:3259-3267.