MAR06-2005-006421

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Elasticity, adhesion and actin based propulsion[1]

AJAY GOPINATHAN[2], University of California Santa Barbara

When a cells crawls, its shape re-organizes via polymerization and depolymerization of actin filaments. The growing ends of the filaments are oriented towards the outside of the cell, and their polymerization pushes the cell membrane forwards. The same mechanism comes into play when the bacterial pathogen Listeria monocytogenes infects a cell. The bacterium hijacks the host cell's actin machinery to create an actin network (the actin comet tail) that propels the bacterium through cells and into neighboring cells. We propose a mechanism for how polymerization gives rise to motility that incorporates the effects of inhomogeneous polymerization. We treat the actin comet tail as an elastic continuum tethered to the rear of the bacterium. The interplay of polymerization and tethering gives rise to inhomogeneous stresses calculated with a finite element analysis. We quantitatively reproduce many distinctive features of actin propulsion that have been observed experimentally, including stepped motion, hopping, tail shape and the propulsion of flat surfaces.

[1]This work was supported by NSF-DMR-0503347 and NSF-CHE-0096492

[2]In collaboration with Andrea J. Liu