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Hydrodynamics of actin-based propulsion ALEXANDER LESHANSKY — Actin polymerization is a key element in the motility of many cells and bacteria. The motility of bacterium Listeria monocytogenes, self-propelled inside cells by growing of a soft elastic comet made of a filamentous actin network, considered as a model system for understanding motile functions involving actin polymerization. While biochemical aspects of comet growth are now well understood, the underlying physical mechanism of motion is still under debate. Recently proposed biomimetic systems have provided a significant advance in the understanding of the actin-based propulsion. In these experiments, the bacteria are replaced by microparticles (solid beads, vesicles or drops) covered with actin polymerization promoters. The microparticles submerged into cell extracts closely mimic the natural phenomena of actin comet formation and self-locomotion. A direct measurement of the forces generated during actin-based propulsion in micromanipulation experiments suggests that hydrodynamic forces may not play an important role in motility. On the other hand, for microparticles with actin tails that are not anchored, the hydrodynamics, in fact, controls the speed of the microparticle displacement. I develop a simple hydrodynamic theory of the actin-based propulsion. The working hypothesis is that the growing filaments act as a force dipole, whereas the propulsive force is determined by the balance of dissociated and attached filaments. We show that the theory agrees well with resent experimental observations concerning propulsion speed of microparticles of different shapes.

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