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Department of Physics
SEMINAR

Bacteria-driven Flows in a Thin Fluid Film

by

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Place: 106 Y.C. Liang Hall, CUHK

ALL INTERESTED ARE WELCOME

Abstract

Swarms of flagellated bacteria are covered by a thin layer of fluid. The motion of this fluid is essential for the spreading and the physiology of swarms. However, the fluid is only ~ 1 micron in thickness, posing unexpected challenges to probe its motion. We developed a novel method for making micron-sized bubbles that can serve as tracers of thin-film flows. Using these microbubbles, we discovered an extensive stream (or river) flowing clockwise (when viewed from above) along the swarm edge, which provides an avenue for long-range communication between cells. By simultaneously visualizing the flows in phase-contrast and the flagellar motion in fluorescence, we found that the river is generated by the action of counterclockwise rotating flagella of cells stuck to the substratum. We also investigated how the swarm fluid spreads, by mapping large-scale flows within the body of the swarm. A complex pattern of fluid drifts were revealed: as the swarm spreads outwards, the fluid flows inwards near the outer edge of the swarm and outwards farther inside, creating a traveling water reservoir at the outer rim of the swarm. Fluorescence measurement of cell growth rates suggested that the fluid drift is driven by cell growth. With a simple fluid-balance model, we suggest a mechanism of how cell growth and flagellar motility together drive swarm spreading. The studies provide new insights to flagellar hydrodynamics and surface motility, and pave the road for further investigations of fundamental aspects of the surface-associated microbial life.