



THE CHINESE UNIVERSITY OF HONG KONG

Department of Physics

COLLOQUIUM

Collective Motion and Density Fluctuations in Bacterial Colonies

by

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Date: April 9, 2010 (Friday)

Time: 4:00 - 5:00 p.m.

Place: L2, Science Centre, CUHK

(Light refreshments will be served 20 minutes prior to the colloquium.)

ALL INTERESTED ARE WELCOME

Abstract

The emergence of collective motion such as in bird flocks, fish schools, and insect swarms is a ubiquitous self-organization phenomenon. Such collective behavior plays an important role in a range of problems, such as spreading of diseases in animal or fish groups. Current models have provided a qualitative understanding of collective motion, but progress in quantitative modeling is hindered by the lack of experimental data.

Here we examine a model microscopic system, where we are able to measure simultaneously the positions, velocities, and orientations of up to a thousand bacteria (wild-type *Bacillus subtilis*) in a colony. The motile bacteria form closely-packed dynamic clusters within which they move cooperatively. Physical dimensions of clusters scale with the square-root of their sizes, defined as the number of the constituent bacteria. Cluster size exhibits a power-law distribution truncated by an exponential tail, and the probability of finding large clusters grows markedly as bacterial density increases. Mobile clusters cause anomalous fluctuations in bacterial density, as found in mathematical theories and numerical models. Our results demonstrate that bacteria are an excellent system to study general phenomena of collective motion.

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