

# PHYSICAL MATHEMATICS SEMINAR

## Fluid Flows Created by Swimming Bacteria Drive Self-Organization in Confined Domains

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### AGENDA

Concentrated suspensions of swimming microbes and other forms of active matter are known to display intricate, self-organized spatiotemporal patterns on scales larger than those of the individual motile units. The collective dynamics of swimming microorganisms exhibits a complex interplay with the surrounding fluid: the motile cells stir the fluid, which in turn can reorient and advect them. This feedback loop can result in long-range interactions between the cells. We present a computational model that takes into account these cell-fluid interactions and cell-cell forces and that predicts counterintuitive cellular order driven by long-range flows. The predictions are confirmed by experiments with *Bacillus Subtilis* bacteria which measure the flagella bundle orientation and tracks the cells in the self-organized state. Simulations and experiments show that if the micro-swimmers are confined inside thin cylindrical chambers the suspension self-organizes into a stable swirling vortex. If the micro-swimmers are confined in thin racetracks, a persistent unidirectional stream can be observed. Both these phenomena emerge as a result of the complex interplay between the swimmers, the confining boundaries and the fluid flow. The study highlights the importance of models and simulations of micro-swimmers needing to correctly include both steric and hydrodynamic interactions in order to capture the dynamics observed in experiments. Collaborators: Hugo Wioland and Raymond Goldstein, DAMTP, University of Cambridge, UK.

**TUESDAY, SEPTEMBER 30, 2014**

**2:30 PM**

**Building E17, Room 122**

*Reception following in Building E17, Room 401A  
(Math Dept. Common Room)*

<http://math.mit.edu/pms/>