

Group Dynamics in Phototaxis

Doron Levy¹

Microbes live in environments that are often limiting for growth. They have evolved sophisticated mechanisms to sense changes in environmental parameters such as light and nutrients, after which they swim or crawl into optimal conditions. This phenomenon is known as "chemotaxis" or "phototaxis." Using time-lapse video microscopy we have monitored the movement of phototactic bacteria, i.e., bacteria that move towards light. These movies suggest that single cells are able to move directionally but at the same time, the group dynamics is equally important. Following these observations, in this talk we will present a hierarchy of mathematical models for phototaxis: a stochastic model, an interacting particle system, and a system of PDEs. We will discuss the models, their simulations, and our theorems that show how the system of PDEs can be considered as the limit dynamics of the particle system. Time-permitting, we will overview our recent results on particle, kinetic, and fluid models for phototaxis. This is a joint work with Devaki Bhaya (Department of Plant Biology, Carnegie Institute), Tiago Requeijo (Math, Stanford), and Seung-Yeal Ha (Seoul, Korea).

¹ Department of Mathematics and Center for Scientific Computation and Mathematical Modeling (CSCAMM), University of Maryland, College Park, MD 20742