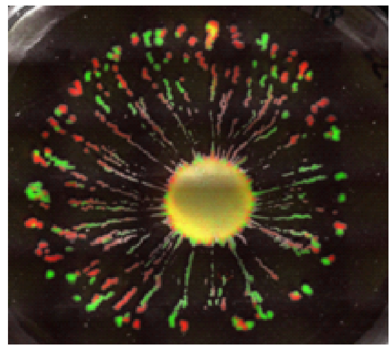
Physical Math Seminar

Active Antagonism:
Reproducing Microorganisms and Fluid Flows



DAVID R. NELSON

Departments of Physics and of Molecular and Cellular Biology

Harvard University

ABSTRACT:

The growth and evolution of microbial populations is often subject to advection by fluid flows in spatially extended environments, with immediate consequences for spatial population genetics in marine ecology, planktonic diversity and fixation times. We review recent progress made in understanding this rich problem in the simplified setting of two competing genetic microbial strains subjected to fluid flows. We first review microbial range expansion experiments on liquid substrates and then move on to discuss antagonism, i.e., two killer microorganism strains, each secreting toxins that impede the growth of their competitors (competitive exclusion), both with and without stationary fluid flows. Recent experiments that reveal the presence of a genetic line tension are described. Coupled reaction-diffusion equations that include advection by simple steady cellular flows composed of characteristic flow motifs in two dimensions reveal how local flow shear and compressibility effects can interact with selective advantage to have a dramatic influence on genetic competition and fixation in spatially distributed populations. We analyze a variety of 1d and 2d flow geometries including sources, sinks, vortices and saddles, and show how simple analytical models of the dynamics of the genetic interface can be used to shed light on the nucleation, coexistence and flow-driven instabilities of genetic drops.

TUESDAY, SEPTEMBER 19, 2023
2:30 PM – 3:30 PM
Building 2, Room 449

http:math.mit.edu/seminars/pms

Massachusetts Institute of Technology