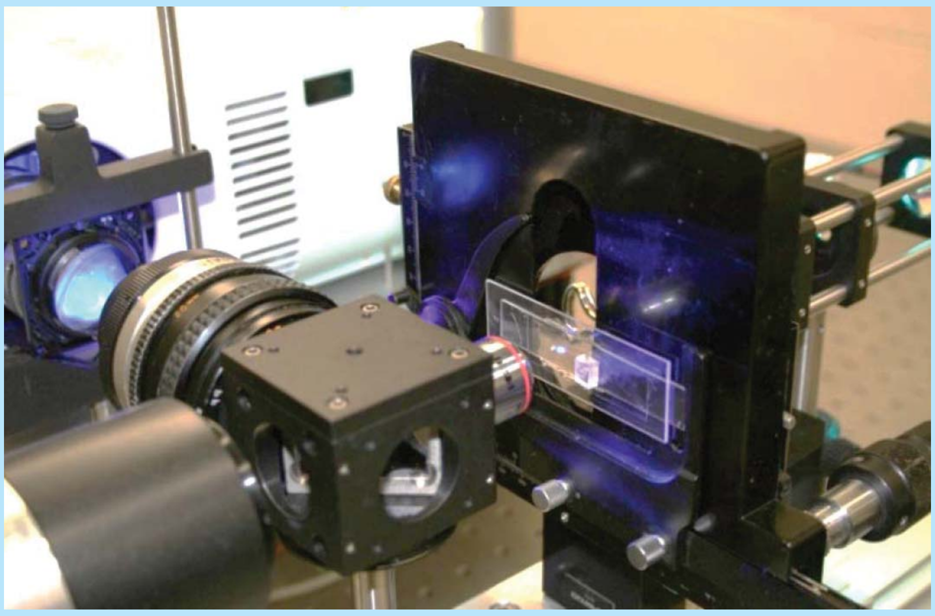
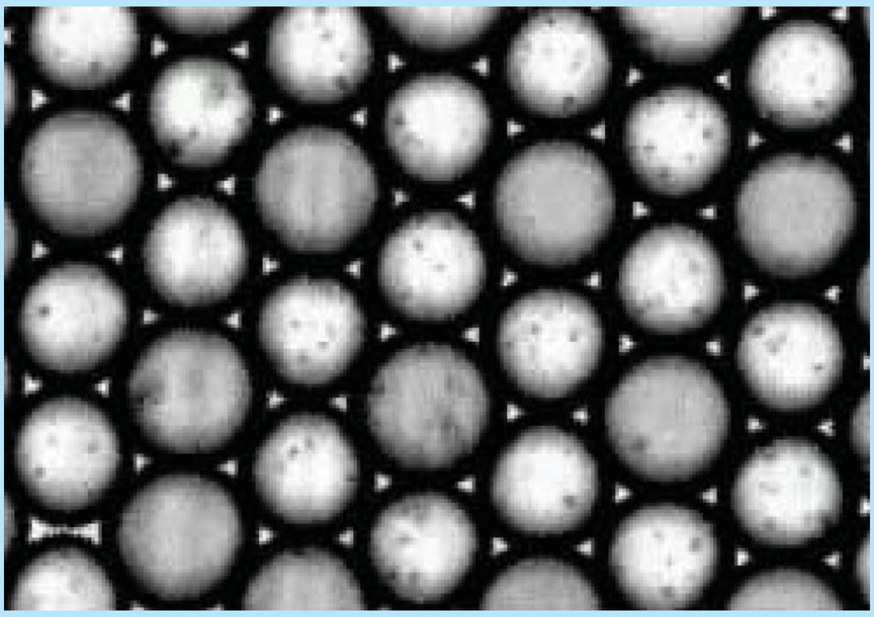
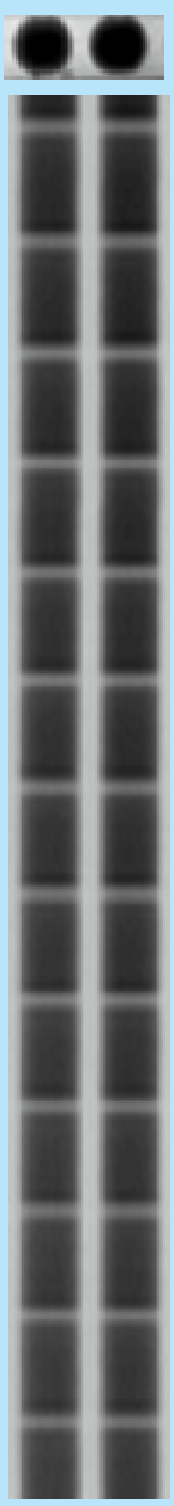
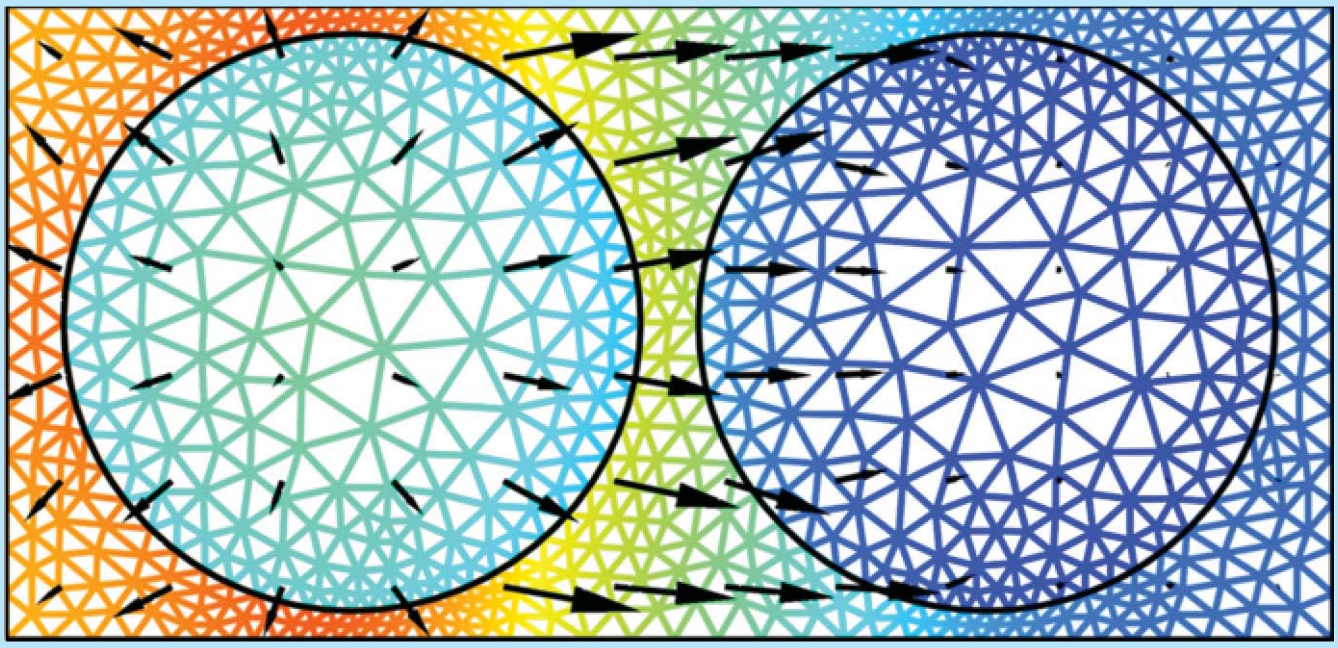
Physical Mathematics Seminar

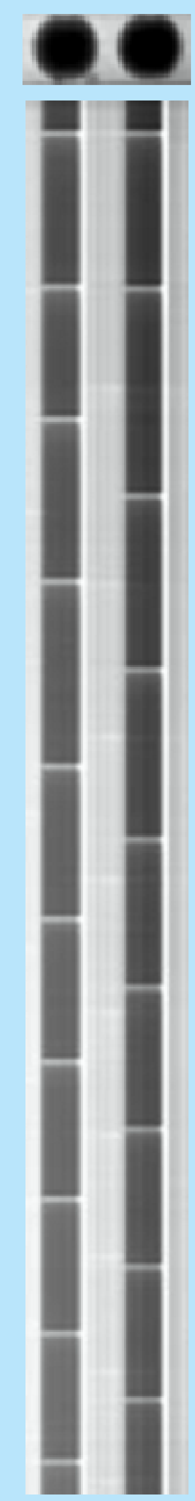
Testing Turing











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The *Chemical Basis of Morphogenesis*, published in 1952 by Alan Turing, described how, in circular arrays of identical biological cells and continuous rings of tissue, diffusion can interact with chemical reactions to generate up to six spatial-temporal periodic chemical structures. Here we report an experimental reaction-diffusion system ideally suited for testing Turing's ideas in synthetic "cells" consisting of microfluidically produced surfactant-stabilized emulsions in which aqueous droplets containing the Belousov-Zhabotinsky oscillatory chemical reactants are dispersed in oil. In contrast to biology, here the chemistry is understood, rate constants are known and interdrop coupling is purely diffusive. We explore a large set of parameters through control of concentrations, drop size, spacing, and spatial arrangement of the drops in lines and rings in one dimension and hexagonal arrays in two dimensions. The Turing model is regarded as a metaphor for morphogenesis in biology; useful for a conceptual framework and to guide modeling, but not for prediction. In this chemical system, we quantitatively assess the extent to which the Turing model predicts both pattern formation and temporal synchronization of chemical oscillators. Finally, we demonstrate that chemical morphogenesis drives physical differentiation in synthetic cells.

TUESDAY, DECEMBER 9, 2014
2:30 PM
Building E17, Room 122

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

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