Thoughts about diffusion mediated transport: can we study motion in small systems?

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Abstract

Diffusion mediated transport is implicated in the operation of many molecular level systems. These include some liquid crystal and lipid bilayer systems, and, especially, the motor proteins responsible for eukaryotic cellular traffic. All of these systems are extremely complex and involve subtle interactions on varying scales, as exemplified by the talks in the last workshop. The chemical/mechanical transduction in motor proteins is, by contrast to many materials microstructure situations, quite distant from equilibrium. These systems function in a dynamically metastable range.

Our plan is tolook at the relationship of the Monge–Kantorovich mass transfer problem to models for conventional kinesin type motors and their relatives. These concepts permit us to establish consistent thermodynamical dissipation principles from which evolution equations follow, and thus the connection to the Calculus of Variations. What properties are necessary for transport? What is the role of diffusion? What is the role of other elements of the system and how can dissipation be exploited to understand this?

How successful are we?

This is a review of joint work with *M. Chipot, J. Dolbeault, S. Hastings, M. Kowalczyk,* and *J. B. McLeod.*