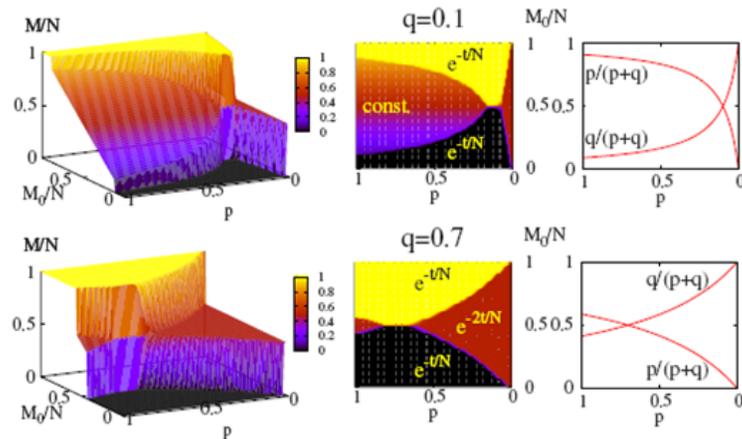


Statistical Mechanics of Systems far from Equilibrium

Beate Schmittmann and Royce K.P. Zia

Virginia Tech DMR-0705152

Networks, from power grids and transportation to communication and social ones, became a subject of great interest to statistical physicists recently. Both static properties, such as the distribution of links connected to the various nodes, and dynamic behavior, such as the changes in the states of a node due to its interactions via its links to other nodes, have been studied. In one of the projects supported by this grant, we investigate the dynamics of an *adaptive* network, in which the links themselves are also dynamic, evolving according to the states of the nodes at either end. In our simple model, each node represents an individual with just two opinions (e.g., voting for two political parties, colored as yellow and black in the figure). Starting with M_0 nodes (amongst a total of N) voting yellow and a random distribution of links, a nodes evolves by a simple rule: it assumes the color of the majority of those connected to it. Then the links are updated. A link between nodes of the same [opposite] color is established with probability p [q]. With these simple rules, a variety of final states emerged: full consensus (all of one color), polarization (50-50, red in figure), or frozen at the initial partition (region around $M_0/N=p=0.5$).



From *Physical Review E* 79, 046104 (2009) by I.J. [Benczik](#), S.Z. [Benczik](#), B. Schmittmann, and R.K.P. Zia

Then the links are updated. A link between nodes of the same [opposite] color is established with probability p [q]. With these simple rules, a variety of final states emerged: full consensus (all of one color), polarization (50-50, red in figure), or frozen at the initial partition (region around $M_0/N=p=0.5$). The “phase diagrams” for two cases ($q=0.1$ and 0.7) are shown at left. We formulated a theory which allows all these features to be understood intuitively and predicted quantitatively.

Statistical Mechanics of Systems far from Equilibrium

Beate Schmittmann and Royce K.P. Zia

Virginia Tech DMR-0705152

Education and outreach:

Our projects involves a wide spectrum of techniques, so that younger scientists, as well as established researchers, can easily participate. Postdocs, graduate and undergraduate students, as well as summer interns form an integral component of our research. In addition, we bring many national and international visitors to foster their networking. As an example, this grant supported a mini-workshop in December 2008. All the invited speakers are recent PhD's.

In the synergy between junior scientists and senior researchers, we often find that the former excel in discovering new phenomena, through e.g., computer simulations of simple models. Frequently, these discoveries are quite unexpected and, the analytic experiences of the latter play crucial roles in their understanding.

Workshop on
Non-equilibrium Statistical Mechanics:
a bridge from physics to biology

Physics Department, Virginia Tech, Blacksburg, VA, USA
December 11th, 2008 Robeson 210

8:50 Royce Zia: *Welcome*

9:00 [Rosemary Harris](#) (Queen Mary, London, UK)
[Traffic of cytoskeletal motors with disordered attachment rates](#)

9:45 [Leah Shaw](#) (William and Mary, Williamsburg, VA)
[Epidemic Spread on Adaptive Social Networks](#)

10:30 *coffee/tea break*

Chair: Beate Schmittmann

10:45 [Sumedha](#) (Brandeis, Waltham, MA)
[A thermodynamic mechanism for the agglomeration of DNA-looping proteins](#)

11:30 Jay Mettetal (Systems Biology Group, [Pfizer](#), Cambridge, MA)
[Stochastic switching as a survival strategy in fluctuating environments](#)

12:15 *lunch*

Chair: Rosemary Harris

1:45 [Thierry Platini](#) (Virginia Tech)
[Out of equilibrium bosons on a one-dimensional optical random lattice](#)

2:30 [Jijia Deng](#) (Hankline, St. Paul, MN)
["Edge effects" in TASEP and insights from mean-field approaches](#)

3:15 *coffee/tea break*

3:30 Short talks (PhD candidates at Virginia Tech): Chair: Leah Shaw
Yen Chou, Jon Cook, Sven Dorosz, Tao Jia, Sayak Mukherjee, Matt Raum, ...

6:00 Beate Schmittmann: *Closing remarks and... dinner*

sponsored in part by

