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Large Scale Stochastic Dynamics

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Abstract. In focus are interacting stochastic systems with many components, ranging from stochastic partial differential equations to discrete systems as interacting particles on a lattice moving through random jumps. More specifically one wants to understand the large scale behavior, large in spatial extent but also over long time spans, as entailed by the characterization of stationary measures, effective macroscopic evolution laws, transport of conserved fields, homogenization, self-similar structure and scaling, critical dynamics, dynamical phase transitions, metastability, large deviations, to mention only a few key items.

Mathematics Subject Classification (2010): 60Gxx, 82-XX, 35-XX.

Introduction by the Organisers

"Large Scale Stochastic Dynamics" is at the crossroad of probability theory and statistical physics, the central theme being the stochastic evolution of a system with many interacting components. A prototypical example is the stochastic Ising model: at the sites of a regular lattice one has spins which take values ± 1. A specified spin flips at random times with a rate depending on the current neighboring spin configuration. Such a seemingly simple model has a very rich phenomenology. For example, let us impose that at the initial time the spin values are random according to a Bernoulli measure, whereas the dynamics runs at low temperatures forcing spins to align. Which laws govern the resulting spatial coarsening process? One may modify the dynamics by requiring the number of up spins (= particles) to be conserved, which is implemented by exchanging the spin values for a neighboring pair of spins. This model leads to a system of interacting symmetric random

walks. One can drive the system by a uniform force field making the random walks asymmetric. The variations are without bound. Mathematically one has to focus on a few central issues. In fact, at the conference interesting advance was reported on zero temperature dynamics of lozenges and on cuve shortening for zero temperature Glauber dynamics.

Our workshop is a snap-shot of the current activities. A partial list of topics reads

- random walks in random environments, including tree graphs
- low temperature Ising dynamics
- stochastic conservation laws with several components
- transport processes, mixing times, spectral gaps
- metastable systems
- condensation and coarsening phenomena
- hydrodynamic limits

We had 46 participants from 13 countries, mostly probabilists, but also experts from partial differential equations, numerical analysis, and statistical physics. They all enjoyed tremendously the unique and stimulating atmosphere at the Mathematische Forschungsinstitut Oberwolfach and hope to return some day.

Claudio Landim,
Stefano Olla,
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Workshop: Large Scale Stochastic Dynamics

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