SPECIAL ISSUE:

STATISTICAL MECHANICS OF IRREVERSIBLE STOCHASTIC MODELS

This Special Issue is devoted to a topic that has stimulated great interest and activity in Brazil and around the world: nonequilibrium statistical physics, in particular, stochastic models exhibiting phase transitions, scale invariance, or other nonequilibrium scaling phenomena. Such systems, introduced as models of phase transformation dynamics, populations, traffic flow, and catalysis, among other examples, have taken on a life of their own as workers have tried to delineate their scaling behavior and universal properties via exact analyses, scaling arguments, and computer simulations.

As in equilibrium statistical mechanics, where simple lattice models (Ising, Potts, XY,...) have proved a mainstay in understanding phase transitions, the range of surprising and complex behavior shown by seemingly simple models continues to fascinate theorists. The key concepts of scaling and universality, developed in the study of equilibrium critical phenomena, find new application in the nonequilibrium context.

While the field of nonequilibrium phase transitions is too broad to allow a complete survey in a single volume, we do hope that the present issue provides an in-depth look at several facets of this rapidly growing area. Since there are few pedagogical references in this field, we encouraged the authors to write articles that would be useful for students curious about nonequilibrium phase transitions.

Nonequilibrium processes are, of course, irreversible. Irreversibility can arise due to a far-from-equilibrium initial condition, or from intrinsically non-reversible transitions. (In the latter case, which applies to the majority of the problems studied here, the model is defined by a set of transition probabilities, not by a Hamiltonian.) Some examples of intrinsically irreversible dynamics are: spin systems coupled to two or more heat baths, at different temperatures; lattice gases with biased hopping; birth-and-death processes in which the zero-population state is absorbing (allows no escape). Many of these processes exhibit steady states, but due to the absence of detailed balance, the stationary probability distribution cannot be written as a Gibbs measure. Of particular interest are phase transitions between different steady states, and the scaling behavior describing the approach to the stationary state.

We are very pleased that many of the world leaders in nonequilibrium phase transitions have agreed to contribute. Our thanks to all of the authors for providing very interesting, well written articles in a timely fashion! We are grateful to Prof. Sílvio Salinas for suggesting this special issue.

Tânia Tomé and Ronald Dickman,
Guest Editors