Extreme Thouless effect in an exactly soluble one dimensional spin model with long range interactions

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The common classification of phase transitions distinguishes between first order and continuous (second order and higher) transitions. While continuous transitions are characterized by a continuously varying order parameter and a diverging length scale, and hence exhibit scale invariance and universality, first order transitions usually display a discontinuous order parameter and no diverging length scale, and in general are non-universal.
However, there are known exceptions for this dichotomy, such as certain glass models, models of DNA denaturation and others where transitions of mixed nature have been observed. In particular these systems display phase transitions which are characterized by
a diverging length scale and a discontinuous order parameter. Such transitions are sometimes referred to as of order 1.5.

A rather intriguing model of this kind is the one dimensional Ising ferromagnet with $1/r^2$ interactions. Although the model is not exactly soluble it has been demonstrated that it displays a diverging length scale and a discontinuity of the order parameter at the transition a phenomenon termed the Thouless effect.

Here we define and analyze a somewhat modified model which can be exactly solved. We show that it exhibits an extreme Thouless effect, namely, that while the transition is critical with a diverging length scale, the magnetization jumps at the transition from 0 to $pm 1$. We also show, through the exact solution as well as through an RG analysis, that the model exhibits a line of phase transitions of mixed nature with continuously varying critical exponents which depend on the interaction parameters. We also discuss the relation of our model to condensation models, such as Zero Range Process (ZRP) and the Poland Scheraga (PS) model of DNA denaturation.

Moderate deviations of the density in driven models with reversed bias

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The poster deals with stochastic one-dimensional systems with oppositely directly bulk and boundary drive, studied for instance in the context of Brownian motors. The probability to observe a rare macroscopic density profile in such systems decays as e^{-L^2}, where L is the length of the system. Their dynamics is governed, however, by moderate deviations of the density, whereby a finite number of particles climbs a macroscopic number of steps against the bulk drive. The probability of such moderate deviations scales as $e^$.
We study the corresponding rate function in a system composed of two oppsitely driven asymmetric simple exclusion processes. Using the
matrix product representation the rate function is shown to be given by a sum of single particle excitations. The rate function exhibits a nonalaticity, which is similar to that observed in many nonequilibrium systems. Similar results are expected to be found in a large class of oppositely driven systems.

Extinction in four species cyclic competition

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When four species compete stochastically in a cyclic way, the formation of two teams of mutually neutral partners is observed. In this paper we study through numerical simulations the extinction processes that can take place in this system both in the well mixed case as well as on different types of lattices. The different routes to extinction are revealed by the probability distribution of the domination time, i.e. the time needed for one team to fully occupy the system. If swapping is allowed between neutral partners, then the probability distribution is dominated by very long-lived states where a few very large domains persist, each domain being occupied by a mix of individuals from species that form one of the teams. Many aspects of the possible extinction scenarios are lost when only considering averaged quantities as for example the mean domination time.

Order by disorder in frustrated oscillators

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We consider classical nonlinear oscillators on regular topologies. When the couplings are chosen to be repulsive in a way that bonds are frustrated, we observe a proliferation of coexisting stationary states. Which state is approached depends on the initial conditions. The states of our interest differ by their degree of synchronization and their patterns of phase-locked motion. When disorder is introduced into the system by additive or multiplicative Gaussian noise, we observe noise intervals with less synchronized oscillators succeeded by intervals with more synchronized oscillators, while the noise intensity is monotonically increased. In the latter case noise has induced a higher degree of order in the sense of a larger number of coinciding phases. This order-by-disorder effect is reminiscent to the analogous effect that is known from spin systems. Surprisingly, the alternating behavior with less and more order is observed not only for a single interval of intermediate noise strength, but repeatedly as a function of increasing noise intensity.

Melting of an Ising quadrant

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We investigate the two-dimensional Ising ferromagnet endowed with zero-temperature single spin-flip dynamics. Starting with a quadrant of one phase in the sea of the opposite phase, the former shrinks in volume with time. We study how the area of the melted region grows, in particular its fluctuations. There is a direct correspondence with the relaxation of a one dimensional symmetric simple exclusion process starting from a step density profile where the area is related to the net displacement of all particles. We show how the fluctuations of the later, and in turn that of the area can be computed in the hydrodynamical limit using the macroscopic theory proposed by Bertini, De Sole, Gabrielli, Jona-Lasinio and Landim.

How to quantify the degree of autonomous Maxwell's demon

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We study the fundamental properties of autonomous Maxwell's demons that performs measurement and feedback control on stochastic thermodynamic systems. We propose a general criterion to quantitatively determine the amount of "demonity," which quantifies how much mutual information is used in autonomous dynamics to decrease the entropy of subsystem (i.e., how the dynamics can be regarded as an autonomous demon) [1]. We also give a simple autonomous model that is a perfect Maxwell's demon on the basis of the proposed criterion.

[1] Naoto Shiraishi and Takahiro Sagawa, in preparation.