DY 23 Statistical Physics (general) II

Time: Tuesday 11:45–13:15 Room: SCH 251

DY 23.1 Tue 11:45 SCH 251

Strong disorder fixed point in the dissipative random transverse field Ising model — •GREGORY SCHEHR and HEIKO RIEGER — Theoretische Physik, Universität Saarbrücken

We study the zero temperature equilibrium properties of the random transverse Ising model (RTFIM) where each spin is coupled to an ohmic bath of harmonic oscillators. We propose a real space renormalization group (RG) procedure that we then study numerically. We determine the phase diagram and the critical exponents, which are foud to be independent of the dissipative strength. In addition we find some indication for a diverging dynamical exponent when approaching the transition, suggesting that the critical behavior is governed by a new infinite randomness fixed point, with "activated" scaling.

DY 23.2 Tue 12:00 SCH 251

Small Scale Anisotropy in Lagrangian Turbulence — •EBERHARD BODENSCHATZ [1,2], NICHOLAS OUELLETTE[2], HAITAO XU[2], and MICKAEL BURGOIN[2] — [1]MPI for Dynamics and Self-Organization, Goettingen — [2]Cornell University, Ithaca, NY

Intense turbulence is generally assumed to be statistically isotropic at small length and time scales regardless of the symmetries of the large scale flow. We have studied the effects of large scale anisotropy on small scale turbulent fluctuations via the second order Lagrangian velocity structure function and the Lagrangian velocity spectrum in an intensely turbulent laboratory flow using three dimensional optical particle tracking. We find that the asymmetries of the large scale flow are reflected in small scale statistical quantities, though with no change of the scaling exponents. In addition, we present new measurements of the Lagrangian structure function scaling constant \$C_0\$, which is of central importance to stochastic turbulence models as well as to the understanding of turbulent pair dispersion and scalar mixing, from both the structure function and the spectrum, and the two measurements are shown to agree. The scaling of \$C_0\$ with the turbulence level is also investigated, and found to be in agreement with an existing model.

DY 23.3 Tue 12:15 SCH 251

The order-disorder transition in the Coulomb glass lattice model — •ARNULF MÖBIUS and ULRICH RÖSSLER — IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Phase transitions in the Coulomb glass have been under controversial debate for two decades, from first numerical studies to recent analytical theory [1]. Here we numerically investigate lattices half-filled with localised particles interacting via the long-range Coulomb potential. For zero static disorder and finite temperature T, order-disorder transitions are observed for dimensions $d = 2$ and 3. Surprisingly, the critical properites are consistent with the Ising model with short-range interaction [2].

To study the influence of static disorder at $T = 0$, we developed an efficient procedure for the ground state search. It combines branch-and-bound type algorithms for complex relaxation steps, thermal cycling, flooding local minima, relaxation of cluster excitations, and renormalisation. Thus ground states of samples of up to 12^3 sites are found with high probability. Studying 2d and 3d lattices with a random on-site potential, rectangularly distributed between $-B/2$ and $B/2$, we observed an order-disorder transition for $d = 3$. Using finite-size scaling, we obtained $B_c = 0.375 \pm 0.015$ as critical disorder strength for lattice constant 1. This value exceeds the result of the nonlinear screening theory [1] by a factor of roughly 2. However, for $d = 2$, already arbitrarily small disorder seems to destroy the ordered phase.

[1] S. Pankov, V. Dobrosavljevic, Phys. Rev. Lett. **94**, 049402 (2005).
[2] A. Möbius, U.K. Rößler, cond-mat/0309001.

DY 23.4 Tue 12:30 SCH 251

Multi-Channel Transport in Disordered Medium under Generic Scattering Conditions: A Transfer Matrix Approach — •PRAGYA SHUKLA — Department of physics, IIT Kharagpur-721302, West Bengal, India

A variety of transport properties can be formulated in terms of the eigenvalues of transmission matrix of the region. The knowledge of the statistical behavior of transmission eigenvalues is therefore very useful in the statistical analysis of transport properties. This motivates us to study the joint probability distribution of transmission eigenvalues. Previous attempts in this direction have resulted in the well-known DMPK equation which describes the statistical evolution of transmission eigenvalues with respect to changing length of the medium. Various assumptions made in its derivation, however, restrict its applicability to quasi one dimensional systems or under specific scattering conditions. As the transport properties are also sensitive to other system parameters besides length e.g., boundary conditions, disorder strength and dimensionality, a generalization of DMPK equation for higher dimensions and under generic scattering conditions is required. The talk discusses our results obtained in this direction. Our results show that the evolution of transmission eigenvalues, due to changes in various physical parameters in a disordered region of arbitrary dimensions, is governed by a single complexity parameter; this implies a deep level of universality of transport phenomena through a wide range of disordered regions.

DY 23.5 Tue 12:45 SCH 251

Application of Zhangs Square Root Law and Herding to Financial Markets — •WAGNER FRIEDRICH — Institut für Theoretische Physik, Universität Kiel, Leibnizstr.15, D-24098 Kiel

We apply an asymmetric version of Kirman's herding model to volatile financial markets. In the relation between returns and agent concentration we use the square root law proposed by Zhang. This can be derived by extending the idea of a critical mean field theory suggested by Plerou et al. We show that this model is equivalent to the so called 3/2-model of stochastic volatility. The description of the unconditional distribution for the absolute returns is in good agreement with the DAX independent whether one uses the square root or a conventional linear relation. Only the statistic of extreme events prefers the former. The description of the autocorrelations are in much better agreement for the square root law. The volatility clusters are described by a scaling law for the distribution of returns conditional to the value at the previous day in good agreement with the data.

DY 23.6 Tue 13:00 SCH 251

The inverse scattering problem of traffic flow — •MARTIN TREIBER, ARNE KESTING, and DIRK HELBING — Technische Universität Dresden

We discuss one-dimensional stochastic driven multi-particle systems with asymmetric next-neighbour interactions such as traffic flow. Based on a Fokker-Planck approach, it is possible to approximatively calculate the stationary velocity and distance distributions among the elements (driver-vehicle units) as a function of the generalized interaction potential. The results relate to the ones known from Random Matrix Theory.

In this contribution, we propose a method to treat the inverse problem, i.e., determining the generalized interaction potential, the acceleration function, and the strength of the stochastic force from empirical single-vehicle data. We apply the method to data from a Dutch freeway and compare the resulting empirical acceleration function with that of popular car-following models.