DY 21: Statistical Physics (General) II

Time: Tuesday 14:00–15:30 Location: H6

DY 21.1 Tue 14:00 H6

Ground state energy of noninteracting fermions with a random energy spectrum — •Hendrik Schawe[1], Alexander K. Hartmann[1], Satya M. Majumdar[2], and Grégory Schehr[2] — [1]Institut für Physik, Carl von Ossietzky Universität Oldenburg — [2]Laboratoire de Physique Théorique et Modèles Statistiques, Université de Paris-Sud

We study the distribution of the ground states of a toy model for K noninteracting fermions. In the spirit of Derrida's random energy model, we assume the N energy levels ε_i to be independently, identically distributed according to $p(\varepsilon)$. The ground state energy is the sum of the K smallest energy levels. While the single energy levels are independent, correlations arise due to the ordering. We derive analytically a universal form for the limit of $N \to \infty$ only dependent on the small ε behavior of $p(\varepsilon)$, which reduces in the $K = 1$ case to the well-known Weibull distribution. Further, we confirm this analytical limiting form with numerical data not only in the main region of the distribution but also including the very rare event tails of probabilities much smaller than 10^{-100}. In this talk we will focus on the numerical calculations necessary to reach this precision.

DY 21.2 Tue 14:15 H6

On the derivation of the escape rate of giant classical magnetic spins via an adaptation of the very low damping method of Kramers for particles — •Declan Byrne[1], William Coffey[1], Yuri Kalmykov[2], and Serguey Titov[3] — [1]Department of Electronic and Electrical Engineering, Trinity College, Dublin 2, Ireland — [2]Laboratoire de Mathématiques et Physique, Université de Perpignan Via Domitia, 54, Avenue Paul Alduy, F-66860 Perpignan, France — [3]Kotel'nikov Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Vvedenskii Square 1, Fryazino, Moscow Region, 141190, Russian Federation

It is demonstrated how the original perturbative Kramers' method (starting from the phase space coordinates only) [H.A. Kramers, Physica 7, 384 (1940)] of determining the energy-controlled-diffusion equation for Newtonian particles with separable and additive Hamiltonians may be easily modified to yield the energy-controlled diffusion equation and thus the very low damping escape rate (including spin-transfer torque) for classical giant magnetic spins with two degrees of freedom. These have dynamics governed by the magnetic Langevin and Fokker-Planck equations and thus are generally based on non-separable and non-additive Hamiltonians. The derivation of the VLD rate directly from the (magnetic) Fokker-Planck equation in the space of polar angles of the magnetization following from the Kramers method is much simpler than those previously used which involve inter alia transformation to energy and phase variables as well as the properties of multiplicative noise.

DY 21.3 Tue 14:30 H6

Chiral 1D Floquet topological insulators beyond rotating wave approximation — Dante M. Kennes[1], •Niclas Müller[2], Mikhail Pletyukhov[2], Clara Weber[2], Christoph Bruder[3], Fabian Hassler[4], Jelena Klinovaja[3], Daniel Loss[3], and Herbert Schoeller[2] — [1]Dahlem Center for Complex Quantum Systems and Fachbereich Physik, Freie Universität Berlin, 14195 Berlin, Germany — [2]Institut für Theorie der Statistischen Physik, RWTH Aachen, 52062 Aachen, Germany and JARA - Fundamentals of Future Information Technology — [3]Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056, Switzerland — [4]JARA-Institute Quantum Information, RWTH Aachen University, 52062 Aachen, Germany

We study one-dimensional (1D) Floquet topological insulators with chiral symmetry going beyond the standard rotating wave approximation. The occurrence of many anticrossings between Floquet replicas leads to a dramatic extension of phase diagram regions with stable topological edge states (TESs). We present an explicit construction of all TESs in terms of a truncated Floquet Hamiltonian in frequency space, prove the bulk-boundary correspondence, and analyze the stability of the TESs in terms of their localization lengths. We propose experimental tests of our predictions in curved bilayer graphene.

DY 21.4 Tue 14:45 H6

Mori-Zwanzig formalism for systems with time-dependent Hamiltonians* — •Michael te Vrugt and Raphael Wittkowski — Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, D-48149 Münster, Germany

The Mori-Zwanzig projection operator formalism is a powerful method for the derivation of mesoscopic and macroscopic theories based on known microscopic equations of motion. It has applications in a large number of areas including dynamical density functional theory and spin relaxation theory. In its present form, however, the formalism cannot be directly applied to systems with time-dependent Hamiltonians. Such systems are relevant in a lot of scenarios like, for example, NMR or driven soft matter.

We derive a generalization of the present Mori-Zwanzig formalism that is able to treat time-dependent Hamiltonians in both classical and quantum systems. Moreover, we develop a variety of approximation techniques that enhance the practical applicability of our formalism. Our method is demonstrated for the important case of spin relaxation in a time-dependent external magnetic field. The Bloch equations are derived together with microscopic expressions for the relaxation times.

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DY 21.5 Tue 15:00 H6

Influence of spin-orbit and spin-Hall effects on the spin Seebeck current beyond linear response — •Levan Chotorlishvili — Karl-Freiherr-von-Fritsch Str. 3 D-06120 Halle

We study theoretically the spin transport in heterostructures consisting of a ferromagnetic metallic thin film sandwiched between heavy-metal and oxide layers. The spin current in the heavy metal layer is generated via the spin Hall effect, while the oxide layer induces at the interface with the ferromagnetic layer a spin-orbital coupling of the Rashba type. Impact of the spin Hall effect and Rashba spin-orbit coupling on the spin Seebeck current is explored with a particular emphasis on nonlinear effects. Technically, we employ the Fokker-Planck approach and contrast the analytical expressions with full numerical micromagnetic simulations. We show that when an external magnetic field is aligned parallel (antiparallel) to the Rashba field, the spin-orbit coupling enhances(reduces) the spin pumping current. In turn, the spin Hall effect and the Dzyaloshinskii-Moriya interaction are shown to increase the spin pumping current.

DY 21.6 Tue 15:15 H6

Solving the quantum dimer and six vertex models one electric field line at a time — Inti Sodemann[1], Jonah Herzog-Arbeitman[2], and •Sebastián Felipe Mantilla Serrano[1] — [1]Max Planck Institute for the Physics of Complex Systems Dresden, Germany — [2]Princeton University, Princeton, USA

The phase diagram of the quantum dimer model in the square lattice has recently been challenged by Monte Carlo studies that question the existence of a resonant plaquette state neighboring the Rokhsar-Kivelson point (Phys. Rev. B 90, 245143 (2014) and Phys. Rev. B 98, 064302 (2018)). This model can be viewed as a U(1) lattice gauge theory with a finite density of fluctuating electric field lines. Here we take a different line of attack on this model and on the related six-vertex model (6VM), by exploiting the global conservation law of the number of electric field lines, which allows us to study an isolated fluctuating electric field line. In the case of the 6VM we map it onto the spin 1/2 XXZ chain which can be solved exactly. For the QDM the problem maps onto a two-leg spin 1/2 ladder which we solve using numerical exact diagonalization. Our findings are consistent with the existence of three distinct phases including a Luttinger liquid phase which is the 1D precursor to the fully 2Dplaquette phase. The uncanny resemblance of our single electric field line problem and the classic 2Dproblem suggests that much of the behaviour of the latter might be understood by thinking of it as a closely packed array of quasi-1D electric field lines which by themselves are undergoing non-trivial phase transitions