DY 3: Quantum Dynamics, Decoherence and Quantum Information II

Time: Monday 15:00–17:00 Location: H39

DY 3.1 Mon 15:00 H39

Many-body localization and thermalization in the full probability distribution function of observables — •Elena Canovi[1], Davide Rossini[2], Rosario Fazio[2], Giuseppe Santoro[3,4,5], and Alessandro Silva[3,4] — [1]Institut für Theoretische Physik III, Universität Stuttgart — [2]NEST, Scuola Normale Superiore, and Istituto Nanoscienze-CNR, Piazza dei Cavalieri 7, I-56126 Pisa, Italy — [3]SISSA, Via Bonomea 265, I-34136 Trieste, Italy — [4]International Centre for Theoretical Physics (ICTP), PO Box 586, I-34014 Trieste, Italy — [5]CNR-IOM Demoscritos National Simulation Center, Via Bonomea 265, I-34136 Trieste, Italy

We investigate the relation between thermalization following a quantum quench and many-body localization in quasiparticle space in terms of the long-time full distribution function of observables. In particular we focus on the long-time behavior of an integrable XXZ chain subject to an integrability- breaking perturbation. We study the effect of integrability-breaking on the asymptotic state after a quench of the anisotropy parameter, looking at the behavior of the full probability distribution of the transverse and longitudinal magnetization of a subsystem. We compare the resulting distributions with those obtained in equilibrium at an effective temperature set by the initial energy. We find that, while the long time distribution functions appear to always agree qualitatively with the equilibrium ones, quantitative agreement is obtained only when integrability is fully broken and the relevant eigenstates are diffusive in quasi-particle space.

DY 3.2 Mon 15:15 H39

The Hows and Whys of Multidimensional Instantons: Tunnelling effects in gas- and condensed-phase systems — •Jeremy O. Richardson[1,2], Stuart C. Althorpe[1], and Michael Thoss[2] — [1]Department of Chemistry, University of Cambridge, UK — [2]Institut für Theoretische Physik und Interdisziplinäres Zentrum für Molekulare Materialien, Friedrich-Alexander-Universität Erlangen-Nürnberg, Staudtstraße 7/B2, D-91058 Erlangen

We describe a simple method for locating semiclassical instantons in multidimensional systems [1]. Using steepest-descent integration of a discretized form of Feynman's path integral, these instantons can be used to compute chemical reaction rates in the deep-tunnelling regime and the energy-level splitting pattern resulting from tunnelling between degenerate potential wells [2]. Applications are shown for systems in full dimensionality using *ab initio* potential-energy surfaces including proton-transfers and water cluster rearrangements [3].

The discretized instantons are closely related to the method of ring-polymer molecular dynamics [4], which explains why the latter is able to obtain reaction rates so reliably in the deep-tunnelling regime [1]. An extension to simulate nonadiabatic quantum dynamics using the mapping representation [5] in ring-polymer form is discussed.

[1] J. O. Richardson and S. C. Althorpe, *J. Chem. Phys.* **131**, 214106 (2009). [2] *ibid.* **134**, 054109 (2011). [3] J. O. Richardson, S. C. Althorpe and D. J. Wales **135**, 124109 (2011). [4] I. R. Craig and D. E. Manolopoulos, *J. Chem. Phys.* **123**, 034102 (2005). [5] G. Stock and M. Thoss, *Phys. Rev. Lett.* **78**, 578 (1997).

DY 3.3 Mon 15:30 H39

Creation and protection of entangled states through local operations and a non-Markovian environment — •Rebecca Schmidt, Jürgen T. Stockburger, and Joachim Ankerhold — Institut für Theoretische Physik, Universität Ulm, Albert Einstein-Allee 11, 89069 Ulm

Local operations alone cannot create entanglement. Dissipation normally has a destructive effect on entangled states. Suprisingly, the *combined* effect of local operations and dissipation can create and preserve entanglement for suitably chosen protocols. Building on recent techniques for the optimal control theory of open quantum systems [1], we show how to entangle two noninteracting harmonic oscillators under the influence of local operations and a 'mutual drag' induced by the environment. Even though the latter effect inevitably exposes the system to reservoir noise (mandated by the fluctuation-dissipation theorem), entanglement is created and maintained. Our use of stochastic Liouville-von Neumann equations [2] for the reduced system dynamics guarantees consistency with a physical reservoir model for arbitrarily strong/fast driving.

[1] R. Schmidt, A. Negretti, J. Ankerhold, T. Calarco and J.T. Stockburger, PhysRevLett **107**,130404(2011)
[2] J.T. Stockburger and H. Grabert, PhysRevLett **88**,170407(2002)

DY 3.4 Mon 15:45 H39

Genuine three-qubit entanglement from coupling to a heat bath — •Christopher Eltschka[1], Daniel Braun[2,3], and Jens Siewert[4,5] — [1]Institut für Theoretische Physik, Universität Regensburg, D-93040 Regensburg, Germany — [2]Université de Toulouse, Laboratoire de Physique Théorique (IRSAMC), F-31062 Toulouse, France — [3]CNRS, LPT (IRSAMC), F-31062 Toulouse, France — [4]Departamento de Química Física, Universidad del País Vasco UPV/EHU, 48080 Bilbao, Spain — [5]Ikerbasque, Basque Foundation for Science, 48011 Bilbao, Spain

Initially unentangled qubits which do not interact which each other can become entangled by interacting with a common heat bath [1]. But with more than two qubits, there exist several inequivalent types of entanglement [2]. Therefore it is an important question which types of entanglement can be generated. While exactly determining and quantifying the entanglement for mixed states of more than two qubits is an unsolved problem, recent advancements [3] based on the Greenberger-Horne-Zeilinger symmetry [4] allow to determine a good lower bound for the entanglement. By using those methods we show that for three qubits coupled to the same heat bath indeed all types of entanglement can be generated for almost all separable initial states.

[1] D. Braun, Phys. Rev. Lett. **89**, 277901 (2002).
[2] W. Dür, G. Vidal, and J.I. Cirac, Phys. Rev. A **62**, 062314 (2000).
[3] C. Eltschka and J. Siewert, to be published in Scientific Reports.
[4] C. Eltschka and J. Siewert, Phys. Rev. Lett. **108**, 020502 (2012).

15 min. break.

DY 3.5 Mon 16:15 H39

Nonequilibrium Quantum Phase Transitions in the Ising Model — •Victor Manuel Bastidas Valencia, Clive Emary, Gernot Schaller, and Tobias Brandes — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We establish a set of nonequilibrium quantum phase transitions in the Ising model driven under monochromatic nonadiabatic modulation of the transverse field. We show that besides the Ising-like critical behavior, the system exhibits a novel anisotropic transition which is absent in equilibrium. The novel nonequilibrium quantum phases correspond to states which are synchronized with the external control in the long-time dynamics. A preprint including our results is available under the arXiv Reference: arXiv:1207.5242v1

DY 3.6 Mon 16:30 H39

Statistical mechanics for a periodically driven closed quantum system — •Achilleas Lazarides, Arnab Das, and Roderich Moessner — Max Planck Institute for the Physics of Complex Systems

We study closed quantum systems in the presence of periodic driving, that is, isolated systems not in contact with a bath. We find that the system reaches a periodic steady state which is well-described by an appropriate modification of standard statistical mechanical concepts.

DY 3.7 Mon 16:45 H39

The Casimir companion X — •Frank Boldt[1], James D. Nulton[2], Bjarne Andresen[3], Peter Salamon[2], and Karl Heinz Hoffmann[1] — [1]Institute of Physics, Chemnitz University of Technology - D-09107 Chemnitz, Germany — [2]Department of Mathematical Science, San Diego State University - San Diego, California, 92182, USA — [3]Niels Bohr Institute, University of Copenhagen, Universitetsparken 5, DK-2100 Copenhagen , Denmark

In this talk a new invariant of motion for Hamiltonian systems is presented: the Casimir companion. For systems with simple dynamical algebras (e.g., coupled spins, harmonic oscillators) our new invariant is useful in problems that consider adiabatically varying the parameters in the Hamiltonian. In particular, it has proved useful in optimal control of changes in these parameters. The Casimir companion also allows simple calculation of the entropy of non-equilibrium ensembles.