SFB/TRR 21 - Colloquium

19. Mai 2017, Stuttgart

Michael Knap

(Technische Universität München)

Collective Quantum Dynamics: From ergodicity to many-body localization

It has been the believe that generic quantum many-body systems necessarily approach thermal equilibrium after a long time evolution. As a consequence any quantum information encoded in the initial state is lost in the course of the dynamics. However, recently the generality of this assumption of ergodic evolution has been put into question. In this talk, we will discuss how ergodicity - and with that fundamental concepts of statistical mechanics - can break down in a disordered many-body system by the phenomenon of many-body localization. Many-body localization describes an exotic phase of matter in which quantum information can prevail for infinitely long times even at finite temperatures. We will analyze the generic phase diagram of such systems, which consist of an ergodic phase at weak disorder and a many-body localized phase at strong disorder. Furthermore, we demonstrate how the peculiar properties of the many-body localization transition can be characterized in experiments and what the consequence of long-range interactions are on many-body localization.

Relevant papers:

- Interferometric probes of many-body localization. Phys. Rev. Lett. 113, 147204 (2014). - Many-body Localization with Dipoles. Phys. Rev. Lett. 113, 243002 (2014).
- Anomalous diffusion and Griffiths effects near the many-body localization transition Phys. Rev. Lett. 114, 160401 (2015).
- Rare region effects and dynamics near the many-body localization transition. Annalen der Physik, 1600326 (2017).
- Probing Slow Relaxation and Many-Body Localization in Two-Dimensional Quasi-Periodic Systems. [arXiv:1704.03063].

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Universität Stuttgart, NWZII, Raum 2.136
Pfaffenwaldring 57, 70569 Stuttgart

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