SFB 910 Symposium

"Open Floquet systems: Controlling quantum states by driving and dissipation"

Friday, 13th May 2022, 15:00 s.t.
H 3005 / via Zoom
For information on how to access the event, please contact:
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Technische Universität Berlin
Straße des 17. Juni 135, 10623 Berlin

15:00 **Classical resonances in quantum mechanics**
Martin Holthaus *(Universität Oldenburg)*

15:55 **Floquet-heating induced non-equilibrium Bose condensation in an open optical lattice**
Alexander Schnell (*TU Berlin)*

16:30 Coffee Break

17:00 **Dissipative Quantum Chaos in Floquet Systems**
Sergey Denisov *(Oslo Metropolitan University, Norway)*

17:55 **Cavity-based reservoir engineering for periodically driven quantum systems**
Francesco Petiziol *(TU Berlin)*

Guests are welcome!

Sabine Klapp André Eckardt Bernold Fiedler

http://www.itp.tu-berlin.de/sfb910/

Abstracts

Classical resonances in quantum mechanics

Prof. Dr. Martin Holthaus *(Universität Oldenburg)*

Some of the simplest, yet most effective strategies for endowing a periodically driven quantum system with properties which its undriven antecessor does not have involve the exploitation of resonances. In particular, in weakly anharmonic, strongly driven systems one encounters a systematic Floquet-state reordering which is explained by a quantum analog of the familiar classical pendulum approximation. In this talk I will briefly review this phenomenon, and some of its ramifications: For instance, a principal resonance effectuates a generalization of the pi-pulses known from two-level systems to multilevel ladder systems. Higher resonances allow one to generate subharmonic quantum motion and thus to break discrete time-translation symmetry in a manner reminiscent of Floquet time crystals, but without invoking many body localization.

Floquet-heating induced non-equilibrium Bose condensation in an open optical lattice

Dr. Alexander Schnell *(TU Berlin)*

Periodically driven quantum systems suffer from heating via resonant excitation. While such Floquet heating guides a generic isolated system towards the infinite temperature state, a driven open system, coupled to a thermal bath, will approach a non-equilibrium steady state, which is determined by the interplay of driving and dissipation. Here, we show that this interplay can give rise to the counterintuitive effect that Floquet heating can induce Bose condensation. We consider a one-dimensional Bose gas in an optical lattice of finite extent, which is coupled weakly to a three-dimensional thermal bath given by a second atomic species. The bath temperature T lies well above the crossover temperature, below which the majority of the system's particles form a (finite-size) Bose condensate in the ground state. However, when a strong local potential modulation is switched on, which resonantly excites the system, a non-equilibrium Bose condensate is formed in a state that decouples from the drive. Our predictions, which are based on a microscopic model that is solved using kinetic equations of motion derived from Floquet-Born-Markov theory, can be probed under realistic experimental conditions.

Dissipative Quantum Chaos in Floquet Systems

Prof. Dr. Sergey Denisov *(Oslo Metropolitan University, Norway)*

Dissipative Quantum Chaos is an emerging theory with the agenda to relate open quantum and classical dissipative systems and eventually provide us with a tool to determine whether the evolution of an open system is “chaotic” or “regular”. The spectral properties of the generators of the quantum Markovian evolution are important in this respect. So far the emphasis was put on the generators of the Gorini-Kossakowski-Sudarshan–Lindblad (GKS-L) form. Universal features were found and some new concepts, like the complex spacing ratio, were developed by using the GKS-L framework. However, stationary GKS-L generators do not provide a straightforward way to the semiclassical chaotic regime; therefore it is hard to relate open quantum and dissipative classical system with chaotic dynamics. I address another type of generator, a so-called Redfield generator, which emerges in Floquet-Markov theory and allows for a semiclassical transition. And I use a driven Duffing oscillator as a model to analyse the spectral properties of Redfield generators and to search for ‘chaos-regular dynamics’ transitions.

Cavity-based reservoir engineering for periodically driven quantum systems

Dr. Francesco Petiziol *(TU Berlin)*

We show that nonequilibrium quantum states can be prepared and stabilized by combining time-periodic driving (Floquet engineering) with synthetic quantum baths, as they can be realized in quantum simulators based on superconducting circuits. Considering lattices of periodically driven artificial atoms coupled to pumped-damped cavities, we characterize regimes, where, on the one hand, the periodic driving can produce effective Hamiltonians with desired properties while, on the other, the cavities induce controlled dissipation cooling the systems to the effective ground state. We will illustrate this mechanism in the robust preparation of non-trivial states such as chiral currents for interacting photons and Aharonov-Bohm cages, where quantum interference constrains the systems to localized states.