(Quantum) systems in the open

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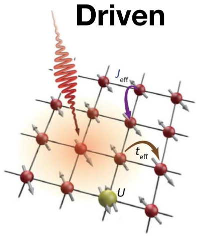
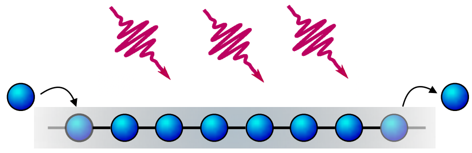
What we work on

We study **open systems**, in other words systems that exchange, for example, energy or particles through external drive or coupling to their environment. Understanding the effect of such system-bath coupling is crucial for future quantum-technology applications. Moreover, the exchange can lead to new and exciting phenomena that differ from those found in isolated systems.

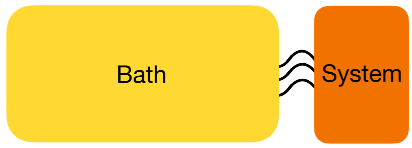
Driven



Markovian coupling

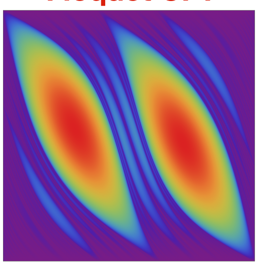


Full system-bath coupling



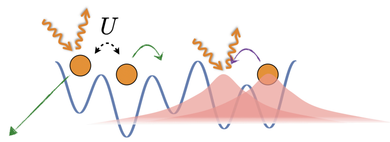
Quantumness

Floquet CFT



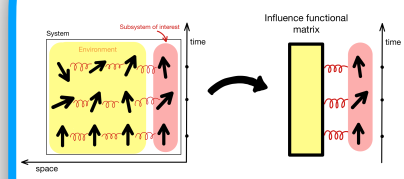
We study one-dimensional (quasi-)periodically **driven critical quantum systems,** whose effective low energy description can be solved using tools from **(conformal) field theory**, displaying rich phase diagram.

Lindbladian CFT



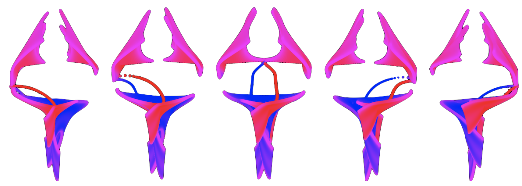
Adding dissipation to a system typically washes out the physical phenomena observed in the closed case. Using the **Lindblad formalism**, which assumes a memoryless bath, we study the fate of **many-body localization** in realistic cold-atom settings or periodically driven non-interacting systems that exchanges particles with a bath. Interestingly, we find that the physics in the latter case is robust to dissipation.

Influence matrix



The **influence-matrix formalism** allows to study non-equilibrium phenomena in many-body systems. It describes the effect of the system ('environment') on the dynamics of a local subsystem ('system') without using the Markov approximation.

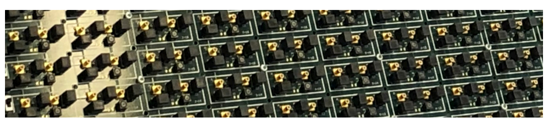
Exceptional topological insulators



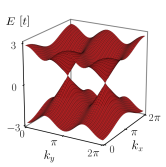
The dynamics or response of **open quantum systems** is often described by local **non-Hermitian operators**. In comparison to Hermitian operators, they may have drastically different properties with regards to their spectral stability against perturbations and topology. The **exceptional topological insulator** is an example of a non-Hermitian topological state of matter that features exotic surface states which can only exist within the 3D bulk embedding.

Topolectrical circuits

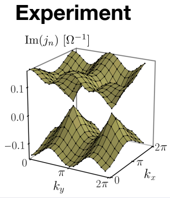
Electrical circuits provide a platform that emulates lattice models and topological band structures in the form of a periodic arrangement of resistors, capacitors, inductors and possibly more 'exotic' circuit elements.



Theory



Experiment



Electrical circuits allow to realize:

- lattice models with **hermitian** and **non-hermitian** couplings
- **linear** and **non-linear** regimes
- driven **Floquet dynamics**
- **local** and **non-local** couplings

Openness