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SONDERKOLLOQUIUM

zur Ausschreibung – W2-Professur für theoretische Quanten-Vielteilchenphysik

2. Juni 2025 um 9:00 Uhr

BCTP, Wegelerstraße 10, Seminarraum I (2.019)

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Prof. Patrick Potts

Universität Basel, Schweiz

Dissipation as a resource - Active reservoir engineering and coherent feedback

Quantum features including superposition and entanglement are fragile and usually detrimentally affected by the surrounding environment which induces dissipation. In the last decades, it has been realized that dissipation is not always a nuisance but may be leveraged to induce useful behavior. Examples are provided by reservoir engineering and feedback control. In reservoir engineering, a structured environment enables for instance the preparation of entangled states as well as the design of unidirectional amplifiers. Using feedback control, measurements on the environment can be used to manipulate the system dynamics. This is particularly relevant for quantum optics, where the light leaking out of a system can be measured. Applications include state preparation and quantum error correction.

In this talk, I will present two emerging paradigms for leveraging the environment: active reservoir engineering and coherent feedback. In active reservoir engineering, control over a small quantum system is used to manipulate the state of the environment. In this way, the two-level systems surrounding a superconducting qubit can be cooled and the magnetization of nuclear spins surrounding a semiconducting quantum dot can be manipulated. This has the potential to induce a paradigm shift, where the best strategy for protecting a quantum system is no longer to isolate it, but to bring its environment in a more favorable state. In coherent feedback, the light leaking out of a quantum system is coherently manipulated and fed back to the system. Since no measurement is performed, the imprecision vs backaction trade-off can be circumvented. I will present experimental and theoretical results where a mechanical resonator is cooled close to the ground state using coherent feedback.

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