Seminar/Talk

Energetics of a resonantly driven transmon qubit: measurement backaction and information fueled amplification

Benjamin Huard

Ecole Normale Superieure de Lyon | France

Host: Johannes Fink

Qubits are physical, a quantum gate thus not only acts on the information carried by the qubit but also on its energy. What is then the corresponding flow of energy between the qubit and the controller that implements the gate? In this talk, we exploit a superconducting platform to answer this question in the case of a quantum gate realized by a resonant drive field. During the gate, the superconducting qubit becomes entangled with the microwave drive pulse so that there is a quantum superposition between energy flows. We measure the energy change in the drive field conditioned on the outcome of a projective qubit measurement. We demonstrate that the drive's energy change associated with the measurement backaction can exceed by far the energy that can be extracted by the qubit. This can be understood by considering the qubit as a weak measurement apparatus of the driving field. The second part of the talk discusses engines exploiting non-classical resources. While a handful of experiments have investigated the inner dynamics of engines fueled by measurement backaction, powering a useful task by such an engine is missing. Here we demonstrate the amplification of microwave signals by an engine fueled by repeated quantum measurements of a superconducting transmon qubit. Using feedback, the engine acts as a quantum Maxwell demon operating without a hot thermal source. Measuring the gain of this amplification constitutes a direct probing of the work output of the engine, in contrast with inferring the work by measuring the qubit state along its evolution. Observing a good agreement between both work estimation methods, our experiment validates the accuracy of the indirect method.

Monday, August 18, 2025 01:00pm - 02:00pm
Office Bldg West / Ground floor / Foyer seminar room (I21.EG.128)

This invitation is valid as a ticket for the ISTA Shuttle from and to Heiligenstadt Station. Please find a schedule of the ISTA Shuttle on our webpage: https://ista.ac.at/en/campus/how-to-get-here/ The ISTA Shuttle bus is marked ISTA Shuttle (#142) and has the Institute Logo printed on the side.