

Dissertation press release

22.05.2020

Tunable environments for quantum circuits

Title of the dissertation	Photon-assisted tunneling and charge transport in hybrid circuits
Contents of the dissertation	<p>Physical systems always interact with their environment. In certain superconducting circuits, this interaction leads to signal dissipation, for instance the loss of quantum information, or increased noise for example in a charge sensor. The dissertation investigates hybrid microwave circuits in which the interaction between the physical system and its environment is tunable and demonstrates different applications of this property. Such a system can be used to produce an accurate calibration signal, or can be employed as a reset component in a scalable superconducting quantum processor. In the presented circuits, tunneling quasiparticles in a tunnel junction exhibit the tunable environment that can absorb and emit microwave photons to a superconducting coplanar waveguide resonator. The photon absorption and emission rates are driven by the potential difference between the two electrodes of the tunnel junction.</p> <p>Single-electron pumps create electric current by transferring elementary charge one-by-one. As the ampere has been redefined in May 2019, the demand increased for a reliable current standard which operates according to the new definition. Thus, electron pumps are potential candidates for being the hardware realizing the new quantum ampere. This thesis also investigates the charge noise in a sensitive electrometer that is integrated next to a single-electron pump as a proposal for a self-calibrating electric current source.</p>
Field of the dissertation	Engineering Physics
Doctoral candidate	Máté Jenei, MSc.
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Opponent	Professor Thomas Markus Ihn, ETH Zürich, Switzerland
Custos	Professor Mikko Möttönen, Aalto University School of Science, Department of Applied Physics
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