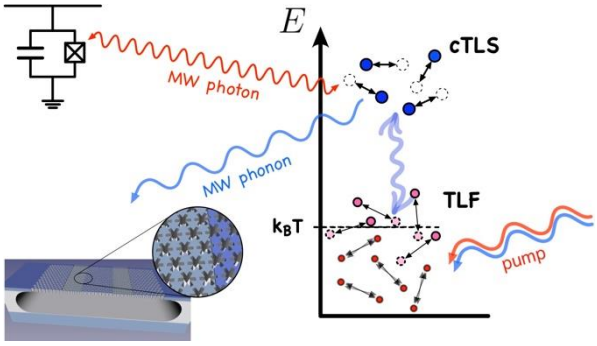
Scientific Area	SA1 Quantum Electronics
Topic title	Understanding and engineering microscopic sources of noise in solid-state quantum devices
Main host institution	IBM Research – Zurich https://www.zurich.ibm.com
Supervisor/institution	Clemens Müller https://researcher.watson.ibm.com/researcher/view.php?person=zurich-clm
Co-Supervisor/institution	tbd
Mentor[1]/institution	Christoph Bruder / University of Basel
Secondment institution	University of Basel

Topic description



Solid-state quantum devices are rapidly maturing towards useful technology, promising advances in a variety of fields ranging from computation to chemistry and communication. Their performance is currently typically limited by noise, causing loss of information and decoherence. One particular source of noise relevant to solid-state are ensembles of microscopic two-level systems interacting with the devices. These are thought to reside on surfaces as well as inside oxide layers, but their exact microscopic origin is not yet understood.

In this project we will theoretically investigate the microscopic origin of decoherence in solid-state quantum devices and work together with experiments to test and refine our understanding of TLS. Special focus here will be on understanding the interactions between microscopic noise sources and their host devices, as well as the interactions of the TLS with their own noisy environments. The ultimate aims are to (i) develop schemes to suppress TLS induced decoherence in solid-state quantum devices through bath engineering and (ii) develop a better understanding of the formation of TLS and the origin of their interactions with their host devices. The project is theoretical in nature, with a strong focus on direct collaboration with experiments, performed directly at IBM Zurich and in the labs of other collaborators.

Recommended applicant's profile

The candidate should have a solid background in quantum mechanics, quantum optics and quantum information theory, ideally with previous experience in the theory of open quantum system. The candidate must be curious to learn and expand her/his expertise on quantum circuit design, condensed matter physics, materials science, surface chemistry, and experimental data analysis. Excellent coding skill and a working knowledge of Mathematica are desired, Python experience is optional.

[1] Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the ESR, including career matters with an external perspective and provide mediation in the case of disputes.

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