CARL VON OSSIETZKY universität OLDENBURG Institut für PHYSIK

P H Y S I K A L I S C H E S   K O L L O Q U I U M

E I N L A D U N G

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speaks

Prof. Dr. Rudolf Gross

Walther-Meißner-Institute for Low Temperature Research,

Bavarian Academy of Sciences and Humanities,

Chair for Technical Physics,

Technische Universität München, Germany

about

„ Solid State Circuits Go Quantum"

Within the last decade it has been shown that deliberately engineered solid state circuits behave quantum mechanically: they show a discrete level structure and quantum coherence up to time scales of milliseconds. The application of such circuits in fundamental quantum experiments has opened the fascinating new field of ***circuit quantum electrodynamics*** (circuit-QED) – the analog of cavity QED in atom quantum optics. Moreover, they pave the way for interesting new applications in quantum information technology and quantum metrology.

I will show how the combination of superconducting microwave cavities with superconducting, mechanical or magnetic nanosystems leads to the fascinating field of superconducting hybrid quantum systems [1-5], allowing the study of a rich variety of interesting phenomena. In particular, the strong and ultra-strong coupling regime, where excitations can be coherently exchanged between the different subsystems, can be achieved [1]. In ***circuit nano-electromechanics*** [3,4], the parametric coupling of electromagnetic and mechanical degrees of freedom gives rise to a host of electro-mechanical phenomena such as quantum-limited displacement measurements, sideband cooling or amplification of mechanical motion. In ***superconducting-magnetic circuit QED systems*** the strong coupling regime between a ferromagnetic insulator and a microwave cavity can be reached [5], allowing for the coherent exchange of the quantized excitations (magnons and photons). Such systems are key ingredients for solid state based hybrid quantum systems, where specific advantages of the subsystems are used for processing, storing and transfer of quantum information.

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[1] T. Niemczyk et al., Nature Physics **6**, 772 (2010).

[2] E.P. Menzel et al., Phys. Rev. Lett. **109**, 250502 (2012)

[3] Xiaoqing Zhou et al., Nature Physics **9**, 179-184 (2013).

[4] Fredrik Hocke et al., New J. Phys. **14**, 123037 (2012); see also APL **105**, 123106 (2014); APL **105**, 133102 (2014).

[5] H. Huebl et al., Phys. Rev. Lett. **111**, 127003 (2013).

All interested persons are cordially invited.

Gez. Prof. Dr. Joachim Peinke