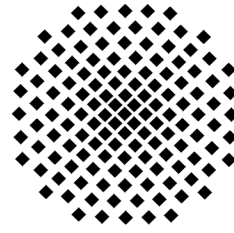


Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme*

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Dienstag, 18. Oktober 2011

17:15 Uhr

Hörsaal V 57.01

Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

Gastgeber: Prof. Martin Dressel, Universität Stuttgart, Telefon: 0711 - 685-64946

Light-Matter Interaction – from Strong to Ultrastrong Coupling in Superconducting Quantum Circuits

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Abstract

Superconducting quantum circuits implemented by nanostructured superconductors allow for the investigation of fundamental quantum phenomena on a macroscopic scale and the implementation of solid state quantum information systems. A big advantage of superconducting quantum two-level systems (qubits) over natural atoms is their design flexibility and wide tunability by means of external control parameters such as magnetic fields. We address the coupling of superconducting flux qubits [1,2] to on-chip microwave resonators, giving rise to the prospering field of superconducting circuit quantum electrodynamics (c-QED), which allows us to study the fundamental interaction between artificial solid state atoms and single microwave photons as the basis for communicating quantum information. Recently, we succeeded to realize for the first time c-QED systems operating in the **ultra-strong coupling regime**, where the atom-cavity coupling rate reaches a considerable fraction of the atom transition frequency [3]. In this regime new objects are formed consisting of matter and light. We present spectroscopy data on these new objects providing insight into novel phenomena that could not be studied in atom cavity-QED so far. We also address the interplay of multi-photon processes and symmetries in a qubit-resonator system by spectroscopically analyzing a superconducting qubit-resonator system under one- and two-photon driving [4].

[1] T. Niemczyk et al., Supercond. Sci. Techn. 22, 034009 (2009).

[2] F. Deppe et al., PRB 76, 214503 (2007); K. Kakuyanagi, et al., PRL 98, 047004 (2007).

[3] T. Niemczyk et al., Nature Physics 6, 772-776 (2010).

[4] F. Deppe et al., Nature Physics 4, 686 (2008); T. Niemczyk et al., arXiv:1107.0810v1 (2011).