



## Quantum Optics with Superconducting Circuits

Since the initial demonstrations that superconducting circuits based on Josephson junctions can be considered as qubits, there has been remarkable progress in the field. Superconducting quantum circuits have realized basic quantum gates and demonstrated proof of principle quantum algorithms like error correction. Design, control and measurement of these man-made, solid-state quantum systems has increased tremendously in the last couple of years. Many state of the art experiments employ the concept of a „quantum bus,“ where qubits couple via superconducting high-quality cavities. A byproduct of this architecture is, that it is perfectly suited for quantum optics experiments using microwave photons. These, so called circuit quantum electrodynamics systems have been used for the preparation and detection of single gigahertz photons, as well as other highly non-classical states of microwave light. Due to the high coupling strength and improved coherence times it is now possible to enter new regimes in quantum optics and observe new quantum effects.

In this talk I will attempt to give an overview of some of the key concepts of circuit QED and describe the recent development of a 3D architecture for superconducting circuits. Furthermore I want to show recent experiments demonstrating nonlinear quantum optics effects and the creation of, up to 100 photon, Schrödinger cat states. Finally I want to point out some possible directions for the future in this field.

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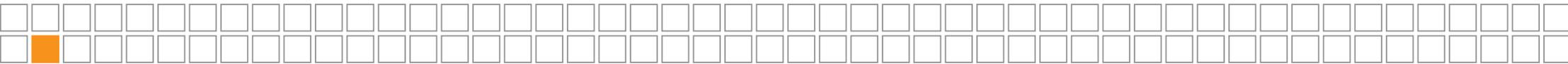
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**Einladung**  
 zur Antrittsvorlesung

**Quantum Optics**  
**with Superconducting Circuits**

von  
**Univ.-Prof. Dr. Gerhard Kirchmair**

Dienstag, 5. November 2013, 17:15 Uhr  
 Hörsaal C, Viktor Franz Hess Haus  
 Technikerstr. 25



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**Gerhard Kirchmair**



Gerhard Kirchmair was born in 1981 in Hall i.T., Austria. He studied physics at the University of Innsbruck and did his diploma thesis in the group of Prof. Rainer Blatt, on building a laser for precision spectroscopy on Calcium ions. For his PhD work he continued in the group of Prof. Rainer Blatt working on realizing quantum information protocols and quantum simulation experiments with calcium ions in a linear Paul trap. He received his PhD in 2010, sub auspiciis, on the subject "Quantum non-demolition measurements and quantum simulation". From 2010 on, he joined the group of Prof. Robert Schoelkopf as a post-doctoral associate at Yale

University. He was working on superconducting circuits coupled to Josephson junction qubits with a focus on implementing quantum optics experiments. Gerhard is now professor for experimental physics at the University of Innsbruck and junior research director at the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences. His research group works on superconducting circuits for quantum simulation and on interfacing microwave circuits with other quantum systems to build hybrid devices.

**Programm:**

Begrüßung und Vorstellung  
durch den Dekan der Fakultät für Mathematik, Informatik und Physik  
**Univ.-Prof. Dr. Günther Specht**

Grußworte des Rektors  
**Univ.-Prof. Dr. Dr. h.c. mult. Tilmann Märk**

Im Anschluss laden wir zu einem kleinen Buffet ein.  
Wir freuen uns auf Ihr Kommen.