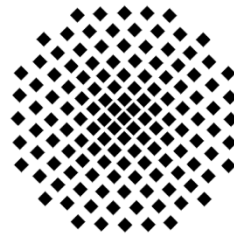


# Stuttgarter Physikalisches Kolloquium

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

Ansprechpartner: Prof. Harald Giessen  
E-Mail: giessen@physik.uni-stuttgart.de  
Telefon: 0711 - 685-65111



Dienstag, 23. April 2013

17:15 Uhr

Hörsaal V 57.01

Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

Gastgeber: Prof. Harald Gießen, Universität Stuttgart, Telefon: 0711 - 685-65110

## The Quantum Way of Doing Computations

### Rainer Blatt

Institute for Experimental Physics & Institute for Quantum Optics and Quantum Information,  
Innsbruck

### Abstract

Since the mid nineties of the 20<sup>th</sup> century it became apparent that one of the centuries' most important technological inventions, computers in general and many of their applications could possibly be further enormously enhanced by using operations based on quantum. This is timely since the classical roadmaps for the development of computational devices, commonly known as Moore's law, will cease to be applicable within the next decade due to the ever smaller sizes of the electronic components that soon will enter the quantum physics realm.

Computations, whether they happen in our heads or with any computational device, always rely on real physical processes, which are data input, data representation in a memory, data manipulation using algorithms and finally, the data output. Building a quantum computer then requires the implementation of quantum bits (qubits) as storage sites for quantum information, quantum registers and quantum gates for data handling and processing and the development of quantum algorithms.

In this talk, the basic functional principle of a quantum computer will be reviewed and a few technologies for their implementation will be highlighted. In particular, the quantum way of doing computations will be illustrated by showing how quantum correlations, commonly known as "entanglement" can enhance computational processes. Aside from their use for quantum computers, these quantum technologies open wide perspectives for applications in many technical areas. Examples such as quantum enhanced metrology and quantum simulations will be presented.