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THE UNIVERSITY of WISCONSIN MADISON

Department of Physics Colloquium

Friday, March 19, 2010 • 4:00 P.M. • 2241 Chamberlin Hall

cookies & coffee served at 3:30 p.m

Quantum Computer

Dream and Realization

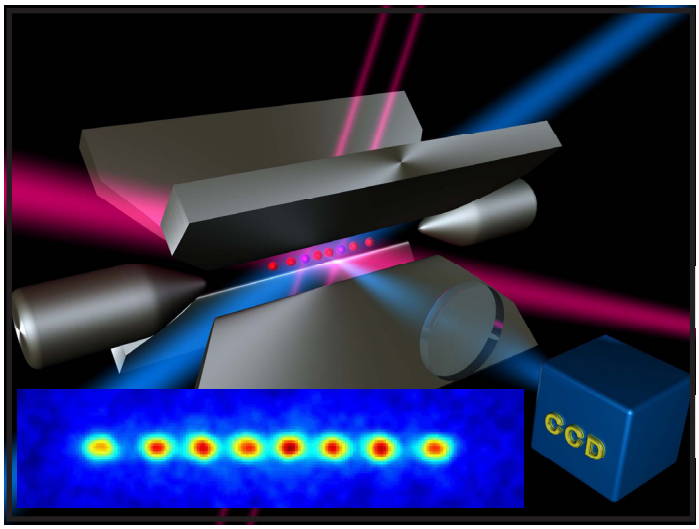
Rainer Blatt

Institute for Experimental Physics
University of Innsbruck

and

Institute for Quantum Optics and Quantum Information
Austrian Academy of Sciences

Computational operations always rely on real physical processes, which are data input, data representation in a memory, data manipulation using algorithms and finally, the data output. With conventional computers all the processes are classical processes and can be described accordingly. It is known for several years now that certain computations could be processed much more efficiently using quantum mechanical operations. Therefore, it would be desirable to build a quantum computer. This requires the implementation of quantum bits (qubits), quantum registers and quantum gates and the development of quantum algorithms. In this talk, several techniques for the implementation of a quantum computer will be briefly reviewed. In particular, an approach based on laser-cooled trapped ions will be highlighted in detail and experimental realizations of quantum registers and quantum gate operations using strings of trapped ions in a linear Paul trap will be discussed. In particular, the quantum way of doing computations will be illustrated by means of quantum algorithms for the creation of entangled states and their analysis using tomography measurements. More generally, applications of such states for quantum metrology will be presented.



Ion trap with laser beams and an image of the fluorescence from 8 ions.