Lecture

Quantum Systems for Information Technology

fall term (HS) 2008

Lecturer:
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ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Basic Structure of Course

- Part I: Introduction to Quantum Information Processing (QIP)
  - basic concepts
  - qubits, qubit control, measurement, gate operations
  - circuit model of quantum computation
  - examples of quantum algorithms
- Part II: Superconducting Quantum Electronic Circuits for QIP
  - qubit realizations, characterization, decoherence
  - qubit/photon interface: cavity quantum electrodynamics
  - physical realization of qubit control, tomography and qubit/qubit interactions
- Part III: Implementations
  - electrons and spins in semiconductor quantum dots
  - ions and neutral cold atoms
  - photons and linear optics
  - spins in nuclear magnetic resonance

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Guest Lectures

- Ion Trap Quantum Computing (1.12.2008),
  Hartmut Haeffner (University of Innsbruck, Austria)
- Quantum Communication (date to be confirmed)
  Mikael Afzelius (University of Geneva)
- Error Correction (to be confirmed)
  Guido Burkhard (University of Konstanz, Germany)
  or Sasha Shnirman (University of Karlsruhe, Germany)

Exercise Classes

- part I & II (week 2 - 8)
  - discuss and practice topics of lecture
- part III (week 9 - 13)
  - student presentations
- teaching assistants:
  - Stefan Filipp (filipp@phys.ethz.ch)
  - Peter Leek (peterleek@phys.ethz.ch)

Reading

- Quantum computation and quantum information
  Michael A. Nielsen & Isaac L. Chuang
  Cambridge : Cambridge University Press, 2000
  676 S.
  ISBN 0-521-63235-8

- additional reading material will be provided throughout the lecture and on the web page:
  qudev.ethz.ch/content/courses/coursesmain.html

Credit (Testat) Requirements

- active contribution to lectures and discussions

- successfully prepare and present a talk on one of the physical implementations of quantum information processing

Student Presentations

- Topics: implementations of quantum information processing
- Goal: present key features of implementation and judge its prospects
- Material: research papers and review articles will be provided
- Preparation: teams of two students, 10 slots for teams available, advice and support by TAs
- Duration: presentation + discussion (30+15 minutes)
- Presentation: blackboard, transparencies, powerpoint …

Exam & Credits

- aural exam (20 mins) during summer or winter exam session
- exam dates as required by your program of study
- 8 credit points (KP) can be earned successfully completing this class

Time and Place

- lecture: Monday (15-17), 14:45 – 16:30, HCI H 2.1
- exercises: Monday (11-13), 10:45 – 12:30, HCI H 8.1

- are there timing conflicts with other lectures?
  - TBD

- potential alternative time slots:
  - TBD

Registration & Contact Information

your registration and contact information

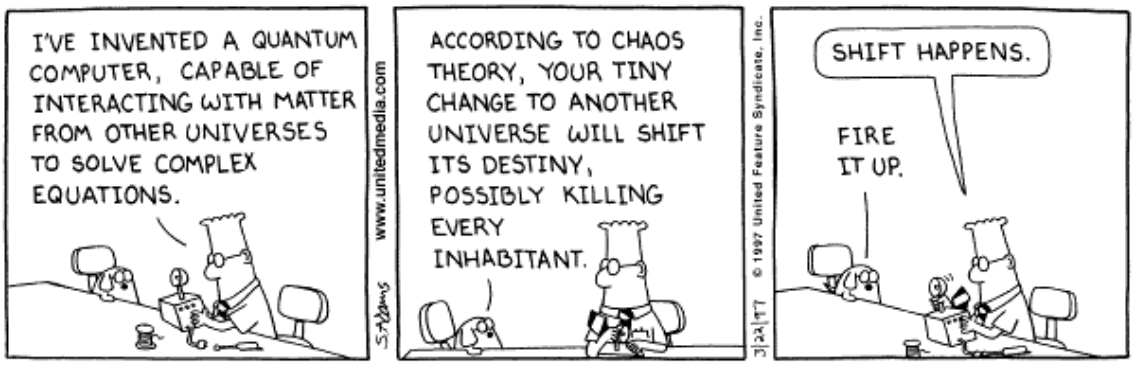
- please register online for the class

- in this way we can contact you

our contact information

- qsit-lecture@phys.etzh.ch
- www.qudev.ethz.ch/content/courses/coursesmain.html
  (will be updated)

Let's get started!



What is this lecture about?

Quantum Mechanics and its Applications in Information Processing

Questions:

- What are the fundamental concepts of quantum computation and quantum information?
- How did these concepts develop?
- How can one make use of these concepts?
- How does one go about actually building a quantum information processor?

Is it really interesting?

Even fashion models talk about it!

You do not believe it?

Watch this!

Why one should care about Quantum Mechanics

And quantum physics is featured in popular talk shows!

Watch Conan O'Brien and Jim Carrey on the 'Late Night' show.