Specialized course for Master students:

Platforms for Quantum Technologies

Lecturers:

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Aims of the course:

Recently, elusive concepts of quantum mechanics such as superposition and entanglement – which have long been regarded as curiosities of quantum mechanics with no practical purposes – have become the key elements of several technological applications. These fledgling quantum technologies define a new field of physics and engineering, and may be roughly structured into quantum communication, quantum sensing, quantum simulations, and, last but not least, quantum computing. This lecture will give an overview of the most promising platforms and first applications, following up on a crisp introduction to the basic theoretical concepts needed for their understanding. The course is organized in the framework of the Cluster of Excellence Matter and Light for Quantum Computing (ML4Q).

Contents of the course:

- Basics of quantum information processing:
  qubits, quantum operations, measurements, circuit model, quantum teleportation, Deutsch and Grover algorithms, quantum error correction
- AMO (atomic, molecular, optical) platforms:
  cavity quantum electrodynamics: single photon sources, implementation of phase gates;
  quantum simulators: gases of cold atoms, optical lattices, ground state and excitation dynamics
- Solid state platforms:
  charge and electron spin qubits; superconducting qubits; qubit dynamics and control; decoherence; quantum supremacy
- Topological platforms:
  topological insulators and superconductors; braiding;
  Majorana qubit design; topological surface code

Registration:

The course is aimed at Master students in Physics with a knowledge in quantum mechanics and basic knowledge of condensed matter physics. For organizational reasons, registration is mandatory.
Please register via e-mail to ml4q-office@uni-koeln.de by February 27, 2020.

Examination:

There will be a (graded) written exam in the final week of the semester break. Successful participants will receive Credit Points according to the regulations at the corresponding university.

www.ml4q.de

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