Quantum Information Theory Sommer Semester 2023

Contents

1. Basic notions on the universal quantum computer: Quantum gates, quantum circuits, universality and measurements.
2. Quantum algorithms: Deutsch-Jozsa, Shor and Grover.
3. Quantum communication: No-cloning theorem, quantum teleportation and superdense coding. Quantum key distribution.
4. Physical realizations: DiVincenzo criteria, Cirac Zoller quantum computer, Circuit QED.
5. Decoherence and open quantum systems.
6. Quantum error correction. Fault tolerant quantum computing.
7. Alternative quantum computing models: Adiabatic quantum computation.
8. Introduction to the theory of entanglement: Definition, criteria and measurement of entanglement, multipartite entanglement.

Qualification aims

In this course, we will study the basic concepts and theoretical tools in quantum information processing. The students will understand the concept of quantum algorithms and quantum circuits, learn to program a quantum computer, understand the functioning of important quantum algorithms, learn how to describe quantum channels and the principles of quantum error correction and entanglement theory. They will understand the most advanced concepts of physical realizations of quantum computers.

Prerequisites

The students should have taken the basic modules on Analysis and Linear Algebra.

Literature

- Nielsen and Chuang, "Quantum Computation and Quantum Information", link
- de Wolf, "Quantum Computing: Lecture Notes", link
- Preskill, "Quantum Computation. Lecture Notes", link