



HE384 Jan. 3:0

Quantum Computation

Instructor

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Email:

Department: Centre for High Energy Physics

Course Time:

Lecture venue:

Detailed Course Page:

Announcements

Brief description of the course

This is an introductory course on quantum computation.

It is taught at the graduate level, though many undergraduates take it.

The topics covered in the course are: Quantum circuits, quantum algorithms, quantum correlations, quantum complexity, quantum error correction codes.

Prerequisites

Familiarity with basics of quantum mechanics and computer science.

Syllabus

Foundations of quantum theory. States, observables, measurement and unitary evolution. Qubits versus classical bits, spin-half systems and photon polarisations. Pure and mixed states, density matrices.

Extension to positive operator valued measures and superoperators.

Decoherence and master equations. Quantum entanglement and Bell's theorems.

Introduction to classical information theory and generalisation to quantum

information. Dense coding, teleportation and quantum cryptography.

Turing machines and computational complexity. Reversible computation.

Universal quantum logic gates and circuits. Quantum algorithms: database

search, FFT and prime factorisation. Quantum error correction and fault

tolerant computation. Physical implementations of quantum computers.

Course outcomes

Students would learn the framework of quantum computation,

and how that may be useful for future quantum technologies.

Grading policy

50% for assignments, 50% for final exam.

Assignments

Resources