Introduction to Quantum Information [Level 4] 2015-16

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Aims:

This course aims to introduce you to the fundamental principles and applications of quantum information and their realisation.

By the end of this course you should be able to:

Dynamics of qubits

- Construct the dynamics of a single or two qubits, as induced by a Hamiltonian.
- Understand the effect of a projective measurement on a single or two qubits.
- Understand the no-cloning theorem

Single qubits and the Bloch sphere

- Represent the state of qubits and their dynamics on the Bloch sphere.
- Understand dissipative dynamics on the Bloch sphere.

Decoherence and error correction

- Understand qualitatively the concept of decoherence.
- Describe the dynamics of one or more qubits in terms of quantum channels.
- Construct error correction codes for given errors.

Protocols

- Understand the teleportation protocol with and without imperfections.
- Understand the Deutsch Jozsa algorithm.
- Understand the Grover algorithm.

Entangled states

- Understand the Bell theorem.
- Understand the concept of entangled states, both for pure and for mixed states.
- Determine if a state of two qubits is entangled or not.
- Construct quantum channels that change the entanglement of a state in a desired fashion, and understand when this is possible.