INFORMATION QUANTIQUE

PHYSICS FOR INFORMATION TECHNOLOGY

Lecturers: Anne-Segolene CALLARD

| Lecturers : 16.0 | TC : 0.0 | PW : 4 | Autonomy : 0.0 | Study : 8 | Project : 0.0 | Language : FR

Objectives

Over the past two decades, the rapid evolution of quantum systems engineering has paved the way to new forms of processing and transmission of information. At the crossroads of quantum mechanics, computer science, information theory and engineering, the development of quantum computers allows to consider solutions to problems that seemed impossible to solve with a classical approach. The objective of the course aims at understanding the challenges linked to the developments of quantum information and at perceiving in what extent they can modify the current landscape of information processing.

Keywords : Qubit, superposition, entanglement, quantum cryptography, teleportation, quantum computer, photons, superconducting junctions.

Programme

1. Introduction, complexity of an algorithm, class of a problem, promises of quantum information, limits. Quantum superiority. What can we solve with a quantum calculator?
2. Quantum mechanics, postulates, notion of Qubit, Cryptography
3 Two-Qubit system, intricacies-correlations, EPR paradox
4. Teleportation, indistinguishability, decoherence, limits.
5. Calculations: quantum gates
6. Quantum algorithms
7. Physical implementations: the qubit photon
8. The superconducting qubit, today's quantum computer today

Learning outcomes

- Explain the concept of quantum superiority and identify the advantages of quantum computing, its limits
- Describe the main platforms envisaged to implement qubits,
- Explain the principles of the main quantum algorithms and their interests.
- Describe the evolution of a qubits system through a quantum logic gate.

Independent study

Objectifs : 1TP Single photon sources
1 BE quantum calculations (IBM simulators)
1 BE A bibliographic research work of your choice with oral restitution in pairs.

Méhodes : bibliographic research work of your choice with oral restitution in pairs.

Core texts

M. A. NIELSEN and I. L. CHUANG, *QUANTUM COMPUTATION AND QUANTUM INFORMATION*, Cambridge University Press, 2016
Pascal Degiovanni, Natacha Portier, Clément Cabart, Alexandre Feller et Benjamin Roussel *PHYSIQUE QUANTIQUE, INFORMATION ET CALCUL*, EDP Sciences - Collection : Savoirs Actuels, 2020

Assessment

Score = 50% knowledge + 50% know-how
Knowledge score = final exam
Know-how score = 40% TP mark + 60% BE mark (oral presentation).