

Quantum optics and quantum information (3 ECTS)

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The "quantum optics and quantum information" option deals with various aspects of quantum optics and opens the door to problems in quantum information. The electromagnetic field, an ideal tool for the study of quantum physics, is at the heart of this course. Over the past twenty years, research in quantum optics has focused on the realization of non-classical states of radiation (single photons, entangled states) and their application to quantum information protocols (cryptography, teleportation, quantum computation).

Objectives : Understand the basic concepts of quantum information and implement them in concrete physical systems.

Content :

Sessions 1 and 2 : Field states, seminal experiments

We'll review the consequences of electromagnetic field quantization, the usual states encountered in quantum optics and the experiments that have demonstrated them.

Sessions 2 and 3 : Entanglement

We'll introduce the concept of entanglement, its mathematical characterization and the notion of entanglement witnesses, in particular Bell's inequalities.

Sessions 3 and 4: Basic quantum information protocols

We'll demonstrate the principles of a few simple protocols for quantum communication and computation.

Sessions 4 and 5 : Quantum Technologies

We will present experiments that enable the generation of non-classical states with small numbers of photons.

Sessions 6 and 7 : Continuous variables

We will present quantum information protocols and experiments in the domain of continuous variables.

Place : Jussieu