Quantum optics

Titulaires
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Mnémonique du cours
PHYS-F474

Crédits ECTS
5 crédits

Langue(s) d'enseignement
Anglais

Période du cours
Deuxième quadrimestre

Campus
Plaine

Contenu du cours

Quantum optics is the study of light and its interaction with matter at the level of single photons and single atoms. Applications of quantum optics include the theory of lasers, the manipulation of single atoms (for quantum clocks, for creating ultra-cold atoms), quantum communication (quantum key distribution), quantum computing (quantum logic gates), and fundamental topics such as entanglement. Progress in quantum optics continues to be fast and exciting.

The aim of the course is to provide an overview of the theory of quantum optics, and its uses both for fundamental physics experiments and applications.

In the first part of the course we will study the different states of light: thermal states, coherent states emitted by lasers, squeezed states, single photon states, entangled states. We will study the associated notions of coherence, the corresponding statistical distributions, and how they can be measured.

The second part of the course is devoted to light-matter interaction at the quantum level. Applications include: optical forces, optical cooling, quantum computing with ions.

The third part of the course will be devoted to sources of single photons and of photon pairs, and their applications.

The fourth part of the course will be devoted to contemporary topics in quantum optics, including quantum computing, teleportation, quantum key distribution, quantum memories for light, super resolution.

Objectifs (et/ou acquis d'apprentissages spécifiques)

Introduce quantum optics, from fundamentals to applications.

Introduce contemporary topics in quantum optics.

Pré-requis et co-requis

Connaissances et compétences pré-requises

A strong background in quantum mechanics (e.g. PHYS-F-302 - Quantum Mechanics 2) is necessary.

A basic introduction to field theory, and to atomic physics are useful but not necessary.

Méthodes d'enseignement et activités d'apprentissages

Ex-cathedra course; commented slides (podcast); exercise sessions.

Références, bibliographie et lectures recommandées

Quantum Optics: An Introduction by Mark Fox

The Quantum Theory of Light by Rodney Loudon

Introductory Quantum Optics by C. Gerry and P. Knight

Support(s) de cours

Podcast et Université virtuelle

Autres renseignements

Lieu(x) d'enseignement

Plaine

Contact(s)

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Méthode(s) d'évaluation

Examen oral

Méthode(s) d'évaluation (complément)

Oral Exam.

Langue(s) d'évaluation principale(s)

Anglais

Autre(s) langue(s) d'évaluation éventuelle(s)

Français

Programmes

Programmes proposant ce cours à la faculté des Sciences

MA-PHYS | Master en sciences physiques | finalité Approfondie/ bloc 1 et finalité Didactique/bloc 1