Quantum Engineering and Emerging Technologies

ECTS credits
8 credits

Semester
Spring

In brief

Course langage: English, French

Presentation

Prerequisites

Basics of optics and quantum physics (1A course); basics of probability/statistics (1A course)

Learning objectives

This module aims to present the theoretical basis for understanding emerging technologies from the field of quantum physics, and to provide a current overview of the application areas of quantum engineering.

Description of the programme

Lectures and tutorials.

-Introduction to quantum optics: Historical aspects; From EM field quantization to compressed states of light and quantum photocounting statistics; Generation of compressed states of the field; Application to imaging and detection of gravitational waves (VIRGO/LIGO speaker to be defined) (JF),

-Analogy between geometrical/physical optics and classical/quantum mechanics (Hamilton versus de Broglie MA),

-Coherence and classical/quantum Wigner distribution (MA),

-Quantum tomography (TD),

-Fundamental aspects of gps (atomic clocks, quantum metrology TD),

-Quantum metrology based on cold atoms/trapped ions (speaker C. Champenois PIIM),

-Quantum plane, quantum computer, quantum information (TD),

-Quantum telecommunications (external speakers)

Practical work/projects

-Refresher course in quantum physics with numerical exercises (black box approach) (TD),

-Decoherence and quantum erasure (TD plus demo. in optical platform TD and JF),

-New applications related to polarization (MA) (among other things TP with the Thorlabs quantum cryptography kit TD and JF).

Generic central skills and knowledge targeted in the discipline

-for projects: soft skills, conducting a bibliographic work, situating a problem in a general scientific and applicative context

-for the written CC: ability to solve simple problems related to the course, such as exercises seen in class and to understand the theory (example: answer questions from the course)

-for practical work: involvement and participation, ability to observe and analyze

How knowledge is tested

Evaluation of table-based assignments, TP reports, personal work presentations resulting from bibliographic/modeling/simulation work, projects.

CC1 = 4 written papers of one hour each = 60

CC2 = TP reports = 10

CC3 = Presentations = 10%.

CC4 = Projects = 20

Bibliography

specific biblio still to be specified.

Teaching team

Thomas Durt

Quantum Engineering and Emerging Technologies

Julien Fade

Miguel Alonso

Caroline Champenois (AMU)

Other speakers to be defined

Total des heures		**100h**
CM	Master class	50h
TD	Directed work	24h
TP	Practical work	10h
PJ		10h
AU		6h

Useful info

Name responsible for EU

Lead Instructor

Thomas Durt

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