PHYS-454

Quantum optics and quantum information

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Ing.-phys	MA2, MA4	Opt.
Photonics minor	E	Opt.
Photonics		Obl.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Fully quantum theory of the light-matter interaction. Study of interacting quantum systems. Introduction to a few modern problems in quantum optics. Introduction to quantum information. Quantum cryptography and quantum computing.

Content

5. Fully quantum theory of the light-matter interaction, and of the laser.
Jaynes-Cummings model and spontaneous emission. Master equation for system-reservoir interaction within the Born-Markov approximation. Fully quantum theory of the laser: photon statistics and laser linewidth.
6. Introduction to many-body effects in semiconductors. Microcavities.
Semiconductor Bloch equations. Excitons. « Incoherent » relaxation terms. Correlation phenomena in atoms and quantum boxes. Microcavities, strong coupling and polaritons.
7. Mechanical effects in the light-matter interaction.
Radiation pressure. Casimir effect.
8. Introduction to quantum theory of information.
The quantum bit. Entangled states and Bell inequalities. Quantum cryptography, Quantum teleportation, Quantum simulation and quantum computers.

Learning Outcomes

By the end of the course, the student must be able to:

- Master the calculational techniques

Assessment methods

oral (75%), presentation in a team of two of a scientific article (25%)