# 230859 - FAM - Atomic and Molecular Physics

**Coordinating unit:** 230 - ETSETB - Barcelona School of Telecommunications Engineering  
**Teaching unit:** 748 - FIS - Department of Physics  
**Academic year:** 2019  
**Degree:** MASTER'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2018). (Teaching unit Optional)  
**ECTS credits:** 4  
**Teaching languages:** English

## Teaching staff

**Coordinator:** Massignan, Pietro Alberto  
**Others:** Rey Oriol, Rosendo

## Opening hours

**Timetable:** By appointment

## Requirements

Mechanics, Probability and Statistics, Thermodynamics, Quantum Physics

## Teaching methodology

There will be six hours per week of lectures, addressing both theory and practical exercises.

## Learning objectives of the subject

- Know how to describe what an atom is, and how it can be treated quantum mechanically  
- Understand the behavior of atoms in electromagnetic fields  
- Know the reasons that lead to the appearance of the fine and hyperfine structures  
- Understand how the symmetries of the wave function and of the orbitals lead to the periodic table of the elements  
- Fundamentals of molecular physics  
- Approach to recent discoveries and state-of-the-art experimental techniques

## Study load

| Total learning time: 100h | Hours large group: 36h | 36.00%  
| Self study: 64h | 64.00% |
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Description:

- Introduction: the hydrogen atom
- Interaction between atoms and external fields (static, and oscillating)
- Fine and hyperfine structure
- Selection rules
- Symmetries of the wave function
- Atoms with many electrons (Thomas Fermi model, and Hartree-Fock method)
- Understanding the periodic table of the elements
- Molecular structure and degrees of freedom
- Advanced spectroscopy techniques: infra-red, Raman, and nuclear magnetic resonance
- Laser cooling and preparation of ultra-cold quantum gases of bosons and fermions

Qualification system

The final score will result from the weighted average of three marks (or "evaluation systems"):
- E1 (50%): written tests and/or homework assignments.
- E3 (30%): written report of a personal project.
- E2 (20%): oral presentation and defense of the aforementioned personal project.

Bibliography

Basic: