

# GS\_Quantum\_UE\_Many-body quantum mechanics



Level  
Baccalaureate  
+4



ECTS  
3 credits



Component  
UFR PhITEM  
(physique,  
ingénierie, terre,  
environnement,  
mécanique)



Semester  
Printemps

- > **Teaching language(s):** English
- > **Open to exchange students:** Yes
- > **Code d'export Apogée:** PAX8NQA

## Presentation

### Description

This course gives an introduction to the concepts of many-body quantum mechanics. It describes the quantum statistics of bosons and fermions, and the quantum properties of systems composed of many identical particles. The main theoretical ingredient for this purpose is the creation and annihilation operators of quantum particles, in what is sometimes called the "second quantization formalism".

#### Content

- **Chapter 1: Quantum statistics and theoretical tools in quantum mechanics**
  - Density operator
  - Bosons, Fermions, quantum statistics
  - Quantum states of identical particles
- **Chapter 2: Bosons and light-matter interactions**
  - Electromagnetic field quantization, field creation and annihilation operators
  - Fock states, coherent states
  - Jaynes-Cummings Hamiltonian and vacuum Rabi oscillations
  - Bose-Einstein condensation and Gross-Pitaevski equation
- **Chapter 3: Fermionic systems**
  - Introduction to fermionic creation and annihilation operators

Fermi sea: electrons and holes  
Hartree-Fock approximation  
Hubbard model  
Cooper pairs, Bogoliubov transformation

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## Course parts

CM	Lectures (CM)	26h
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**Period :** Semester 8

## Useful info

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### Campus

› [Grenoble - University campus](#)