

Specialty CONDENSED MATTER AND NANOPHYSICS (MCN)

Presentation of training curriculum:

This experimental and theoretical training program by, and for research, aims to train graduate students in Physics of Condensed Matter. It is conceived to attain a specialized know-how on the elaboration and characterization of both solid-state and soft condensed matter materials, particularly at the nanometric scale. This area of research is thriving at present, due to the growing importance of nano-physics. The electronic, magnetic, and optical properties, as well as their combination, constitute the core of the teaching and research contents of the program, which is strongly oriented towards the study novel phenomena at the small-size scales.



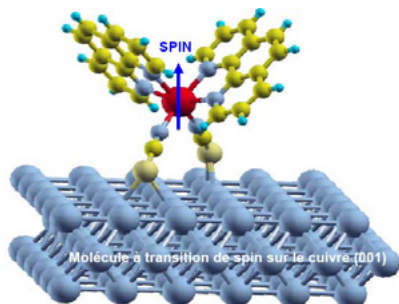
Topcon microscope

Access and recruitment:

- ♦ **Entry level:** bachelor degree or equivalent (French or foreign "licence") in physics or applied physics. The direct admission to the M2 level is possible for students with strong academic records that have the M1 level.
- ♦ **Duration of training:** 2 years.
- ♦ **Enrollment procedure:** <https://ecandidat.unistra.fr> or Campus France.

Targeted skills:

- ♦ Basic skills in the Physics of Condensed Matter, as well as in advanced techniques of instrumentation and scientific programming.
- ♦ Transverse skills: an ease to work in an English environment (the M2 lectures are conducted in English), introduction to a research activity carried out at the international level, numerical methods for data treatment and simulations.



Job opportunities:

- ♦ **Functions:** researcher, university professor, research engineer (after a PhD).
- ♦ **Relevant branches of activity:** basic or applied research, technology development and management of large technical projects in the public and private sectors; universities, CNRS, CEA, IRSN, EDF, ANDRA, AREVA, companies developing sensors, measurement systems and simulation tools.

Partnership:

In association with the Ecole universitaire de Recherche (QMat): [Quantum science and nanomaterials](#).

Condensed matter and nanophysics

Courses:

M1: (common to all specialties, taught in English)



Semestre 1

- Quantum mechanics and statistical mechanics (112h).
- Programming and actual research (58h).
- Experimental physics (60h).
- 1 free UE + 2 optional courses (56h): Mechanics of continuous medias (*in French*), Astrophysical objects and their observations, Group theory, Ionizing radiation and detection methods, General relativity, Direction of time & Advanced statistical mechanics, Variational principles and analytical mechanics, Elements of quantum theory of collisions, Project, Photonics for quantum science and technology, Soft condensed matter.

Semestre 2

- Nuclear physics and elementary particles-Solid state physics (112h).
- Computer programming and numerical simulations (22h).
- Laboratory physics (16 days).
- 1 free UE + 1 optional course (56h): Particles and astroparticles, Stellar physics, Atomic and molecular physics, Intro. to physics of living systems, Relativistic quantum mechanics, Numerical methods in physics, Project, Electronics for quantum science and technology, Critical phenomena and non-equilibrium statistical physics.

M2:

- Advanced quantum mechanics: applications to condensed matter (42h).

- Advanced statistical mechanics: out-of-equilibrium processes (42h).
- Radiation-matter interaction: applications to condensed matter (42h).
- 1 free UE + 4 optional courses (72h): Magnetism and magnetic nanostructures, Spintronics, Electronic properties of low dimensionality systems, Theory and modeling of electronic structure of materials, Many-body Physics applied to condensed matter, Open quantum systems, Electron dynamics: charges and spins, Local spectroscopies, Surfaces and interfaces in soft matter, Dynamical properties of complex systems, Biophysics, Computational project, Optical microscopies, Scattering techniques for condensed matter, Electronic microscopies

Laboratory internship:

The introduction to research is a preliminary step to a PhD thesis. In semester 4, a full-time laboratory training of at least 3 months will allow the student to test his/her ability to integrate into a research team, to confront the problems of research, synthesize the results of the performed research and assess his/her degree of autonomy. The topic can be chosen among proposals from local laboratories, as well as French and international laboratories or companies performing research.

Local laboratories:

Institute of physics and chemistry of materials of Strasbourg (IPCMS), Institute Charles-Sadron (ICS), Institute of science and supramolecular engineering (ISIS), Electronic department of the solid-systems and photonics (D-ESSP), Sciences laboratory of engineering, computing and imaging (ICube), and Laboratory physical and electronic spectroscopy (LPSE, Mulhouse).

Contacts / information:

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