

### 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 solid-state objects and polymers, 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.



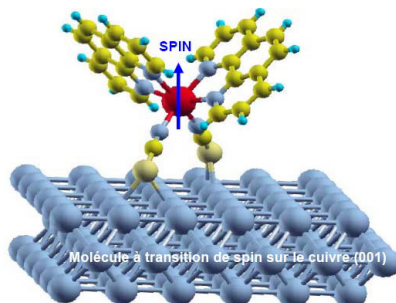
Topcon microscope

#### 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:** see [www.physique-ingenierie.unistra.fr](http://www.physique-ingenierie.unistra.fr)

#### 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 «Quantum Nanomaterials and Nanoscience».

# Condensed matter and nanophysics

## Courses:

**Master 1:** (common to all specialties, mainly taught in English) 

### Semestre 1

- Quantum mechanics and statistical physics (112 h).
- Programming and actual research (58 h).
- Experimental Physics (60 h).
- 1 free UE + 2 optional courses (56 h): Mechanics of Continuous medias, Objects of the universe and Their observation, Group Theory, Ionizing Radiation and Detection Methods, General Relativity, Nanostructures and nanophysics, Elements of quantum theory of collisions, Critical phenomena and non-equilibrium statistical physics, Tutored project, Time arrow & Advanced Statistical Physics, Variational Principles and analytical mechanics.

### Semestre 2

- Nuclear material, elementary particles and condensed matter physics (112 h).
- Programming and numerical simulation (22 h).
- Laboratory physics (16 days).
- 1 free UE + 2 optional courses (56 h): Particles and Astroparticles, Physics of the stars, Atomic and molecular physics, Introduction to the physics of life, soft matter Physics, relativistic quantum mechanics, Optics and Photonics, Digital Applications in Physics, Tutored Project.

**Master 2:** (taught in English) 

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

- Advanced statistical mechanics: out-of-equilibrium processes (42 h).
- Radiation-matter interaction: applications to condensed matter (42 h).
- 1 free UE + 4 optional courses (72 h): Magnetism, spintronics, electronic properties of low dimensionality systems, theory and modeling of electronic structure of solids, many-body Physics applied to condensed matter, open quantum systems, electron dynamics: charges and spins, local spectroscopies, surfaces and interfaces in soft matter, computational physics, scattering techniques for condensed matter, interaction in soft condensed matter, dynamical properties of complex systems, optical and 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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