MASTERS of SCIENCE AND TECHNOLOGY

MAJOR : PHYSICS

SPECIALTY : RADIATION PHYSICS, DETECTORS, INSTRUMENTATION AND IMAGING (PRIDI)

General description of the degree :

This degree provides the knowledge needed to design new instruments of detection focusing on medical imaging and the challenges raised in the fields of Biology and Medicine.

Access and recruitment :

- **Entry level :** 3rd year Bachelor (L3) of Physics from the University of Strasbourg.
- **Other candidates :** admission after examining their application*.
- **Duration of degree :** 2 years.
- **Registration :** Application via https://ecandidat.unistra.fr or Campus France.

* It is possible to recruit candidates directly in MASTERS 2nd year (M2), after obtaining their M1 or equivalent from another institution.

Acquired skills :

- Interact with Biologists, Medical Doctors and Chemists to design/develop tools to meet their needs in clinical or preclinical imaging.
- Work in a multidisciplinary team and carry out projects within the interdisciplinary field of physics, chemistry and biology.
- Master the main imaging techniques used on human and animal subjects: ultrasound, X-ray tomography, single-photon emission tomography, positron emission tomography (PET), magnetic resonance imaging (MRI)...
- Acquire knowledge on the basics of cellular and molecular biology, mammalian physiology and radiolabelling (visible, g and b+).
- Acquire knowledge of the physics principles behind the main components of detectors communly used in the field and how to operate them.
- Obtaining and processing data from photon detectors to construct 3D images.
- Acquire knowledge of the interaction between radiation and matter, focusing particularly on the subsequent biological effects.
- Acquire knowledge in dosimetry preparing the candidate for the DQPRM national contest (Diploma of qualification in radiology and medical physics), the terms of the contest can be found here : www-instn.cea.fr.

Job opportunities and further studies :

- **Main job title :** PhD student, academic, engineer with a focus on the interdisciplinary physics and biology fields, medical physicist, R&D engineer...
- **Sectors :** Industries specialised in the field of imaging, detectors and measurement systems, higher education, colleges, high schools, hospitals and analysis laboratories after passing the DQPRM contest
- **The second year (M2 level) is open to the 3rd year undergraduates** of the TPS engineering school, providing a double degree in engineering and MASTERS in Science.

Associated institutes :

Institut pluridisciplinaire Hubert-Curien (IPHC), Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie (Icube) and the Institut Régional du Cancer.

Partnership :

General Electric and Ecole universitaire de Recherche (QMat) : Quantum science and nanomaterials.

Radiation physics, detectors, instrumentation and imaging

Subjects :

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

1st Semester

- 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.

* UE : "Unite d'Enseignement" or Teaching Unit, composed of several courses.

2nd Semester

- 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, Introduction 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 :

- Basics of cellular and molecular biology for physicists (54h).
- Signal processing (32h).
- Interaction of radiation with matter and its biological effects (18h).
- Detectors and instrumentation (30h).
- Physics basis of medical imaging (18h).
- Markers and tracers for imaging (18h).
- Computer Science for Physics (18h).
- 1 free UE + 2 optional courses (36h): Nuclear magnetic resonance, New techniques in optical microscopy of living matter, Imaging using ionizing radiation, Image processing, Dosimetry.

Internship :

An internship of 15 weeks takes place in semester 4 (the second semester of M2) to initiate the candidates for research activities. It must be carried out in a laboratory, in industry or research institutions. This internship must allow the student to develop his skills facing a new problem that might require new solving approaches or techniques.

Examples of internship topics :

- Development of a new imaging technique: Cerenkov imaging (IPHC).
- Design of a linear counter to measure the kinetics of new radiopharmaceuticals (IPHC).
- Contribution to the clinical evaluation of a gamma operating camera in a hospital setting (IPHC).
- Time-resolved study of fluorescence, within the nanosecond-scale, induced in scintillating ionic liquids excited by protons of 1 to 4 MeV (IPHC).

Scholarships :

PhD scholarships are available in M2 to those who wish to apply, academic results will be taken into consideration.

Contacts / information :

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