Recommended study pathways

Applied Physics in Medicine - Physics Applied to the Environment

MSc in Physics · Curriculum B: Particle Physics and Applied Physics

The pathways are examples intended to help students build a coherent study plan.

How the recommended pathways are structured

Curriculum B combines experimental/applied, theoretical and microphysics training with related and elective courses.

Core · Experimental & Applied

- 22 ECTS
- Laboratory of Nuclear and Subnuclear Measurements I + II (16 ECTS)
- One 6-ECTS course specific to the pathway

Core · Theoretical

- 6 ECTS
- Statistical Mechanics
- Provides a common theoretical foundation

Core · Microphysics

- 12 ECTS
- Two 6-ECTS courses
- Connects the pathway to matter, radiation and instrumentation

Related + Elective

- 18 ECTS related/supplementary
- 12 ECTS elective
- Room to adapt the plan to thesis interests

1 ECTS = 1 CFU

Applied Physics in Medicine

A pathway centred on radiation, imaging, detectors, data analysis and medical applications.

Core · Experimental & Applied · 22 ECTS

- Laboratory of Nuclear and Subnuclear Measurements I — 10 ECTS
- Laboratory of Nuclear and Subnuclear Measurements II — 6 ECTS
- Applications of Physics to Medicine – Medical Physics — 6 ECTS

Core · Foundations & Microphysics · 18 ECTS

- Statistical Mechanics — 6 ECTS
- Optical Microscopy — 6 ECTS
- Rivelatori di Radiazioni — 6 ECTS

Related / Supplementary · 18 ECTS

- Machine Learning Applications — 6 ECTS
- Radioattività — 6 ECTS
- Statistics and Data Analysis — 6 ECTS

Electives · 12 ECTS · choose 2

- Application of Neutron Physics — 6 ECTS
- Biophotonics — 6 ECTS
- Monte Carlo Simulation of Radiation Detectors — 6 ECTS
- Nanobiotecnologie — 6 ECTS
- Radiazioni elettromagnetiche non ionizzanti — 6 ECTS

Examples of thesis topics for Applied Physics in Medicine

These are general indications of possible research areas for thesis work. Please contact individual professors or representatives for further details.

Detector development for diagnostics

- Radiation detectors and scintillators for medical imaging (e.g. PET, SPECT)
- Photodetector and sensor design and characterisation
- Measurements at external accelerator or clinical facilities

Clinical data processing & AI in imaging

- AI applied to medical image analysis (e.g. segmentation, classification)
- Optimisation of variables and models used in diagnostic AI
- Quantitative image analysis for medical-physics applications

Simulation & dosimetry

- Monte Carlo modelling of detectors and dose distributions (e.g. Geant4)
- Simulation of particle/radiation transport in tissue-like media
- Comparison of simulations with clinical or irradiation measurements

These activities are often carried out in collaboration with advanced research centres and hospitals.

Physics Applied to the Environment

A pathway centred on energy, radiation, environmental monitoring and quantitative data analysis.

Core · Experimental & Applied · 22 ECTS

- Laboratory of Nuclear and Subnuclear Measurements I — 10 ECTS
- Laboratory of Nuclear and Subnuclear Measurements II — 6 ECTS
- Sostenibilità Energetica — 6 ECTS

Core · Foundations & Microphysics · 18 ECTS

- Statistical Mechanics — 6 ECTS
- Energy Physics — 6 ECTS
- Rivelatori di Radiazioni — 6 ECTS

Related / Supplementary · 18 ECTS

- Non-ionizing Electromagnetic Radiation — 6 ECTS
- Radioattività — 6 ECTS
- Statistics and Data Analysis — 6 ECTS

Electives · 12 ECTS · choose 2

- Application of Neutron Physics — 6 ECTS
- Applied Electronics — 6 ECTS
- Biophotonics — 6 ECTS
- Machine Learning Applications — 6 ECTS
- Monte Carlo Simulation of Radiation Detectors — 6 ECTS
- Processi a basso impatto ambientale — 6 ECTS

Examples of thesis topics for Physics Applied to the Environment

These are general indications of possible research areas for thesis work. Please contact individual professors or representatives for further details.

Detector development for monitoring

- Radiation detectors, electronics and sensing for field use
- In-situ gamma and neutron spectroscopy
- Radiometric measurements, incl. airborne monitoring

Energy & environmental sustainability

- Environmental modelling
- Energy efficiency and optimisation
- Low-level radioactivity and contamination assessment (e.g. water, soil, air)

Simulation & radiation transport

- Monte Carlo modelling of radiation transport in environmental matrices
- Simulation of detector response for environmental monitoring
- Comparison of simulations with radioactive contamination measurements

These activities are carried out in collaboration with national and international research centres (e.g., INFN, LENA), research infrastructures, industrial partners, and high-technology companies in environmental monitoring.