UNIVERSITÀ DI TRENTO | Dipartimento di Fisica

MASTER'S DEGREE IN PHYSICS

0518H Fisica - 0527H Physics

MASTER'S DEGREE IN PHYSICS: HOW TO CHOOSE THE STUDY PLAN

Academic Year 2025/2026

Index

Contacts

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Frequently Asked Questions

1. What is a study plan?

A study plan lists all the teaching activities a student plans to take to achieve the degree. The study plan must comply with the rules detailed in the *Regolamento Didattico* and the *Manifesto degli Studi*.
Warning: you must check the *Regolamento* and *Manifesto* corresponding to your enrolment year.
Further info: https://corsi.unitn.it/en/physics-master/study/study-plan-submission.

2. How does a study plan look like?

The outline of a valid study plan is shown in Tab. 1. All the available courses and their classification (core, integrative, etc.) are listed in the *Manifesto degli Studi*.

Mandatory core courses See the *Manifesto degli Studi* Sec. 4.a, *corsi caratterizzanti obbligatori*. • Experimental Methods (FIS/01). • Advanced Quantum Mechanics (FIS/02).	**12 CFU**
Elective core courses See the *Manifesto degli Studi* Sec. 4.a, *corsi caratterizzanti*. • 1 core course listed as FIS/02. • 3 core courses listed as FIS/03 or FIS/04. • 1 core course among all those not selected (FIS/01-02-03-04).	**30 CFU**
Elective integrative courses See the *Manifesto degli Studi* Sec. 4.b, *corsi affini e integrativi a scelta vincolata.*	**24 CFU**
Free choice courses See the *Manifesto degli Studi* Sec. 4.e, *insegnamenti a scelta libera*.	**12 CFU**
Foreign language knowledge See the *Manifesto degli Studi* Sec. 4.f, *ulteriori competenze linguistiche*.	**3 CFU**
Thesis See the *Manifesto degli Studi* Sec. 6, *prova finale*.	**39 CFU**

Table 1. Outline of a study plan.

3. Where can I find the list of all the teaching activities?

The teaching activities proposed for the Master's degree in Physics for the present academic year are listed in the *Manifesto degli Studi* (see Sec. 4 of the MdS). *The Manifesto* reports also the course classification (SSD, *settore scientifico disciplinare*), the number of CFU and the corresponding teaching hours, and the teacher's name.
Further info: https://corsi.unitn.it/en/physics-master/study/program-guide-and-documents.

4. Who must present a study plan?

Every student enrolled in the Master's degree must present a study plan.

5. How can I upload my study plan?

Once prepared, the study plan must be uploaded through ESSE3 or via the other methods provided by the Students' Secretariat. In case of any issues, students must contact the Secretariat.

The study plan can be submitted only during given timeframes defined by the Students' Secretariat.
Further info: https://corsi.unitn.it/en/physics-master/study/study-plan-submission.

6. Can I modify my study plan?
Yes. The study plan can be modified by submitting the proper form within the given timeframes.
Further info: https://corsi.unitn.it/en/physics-master/study/study-plan-submission.

7. Who will review my study plan?
Study plans are approved by the Responsible for the Master's Degree in Physics. The review checks both the formal requirements and the coherence between the plan and the objectives of the Master's Degree in Physics.

8. What is a specialization area?
Specialisation areas provide a coarse description of the research fields in Physics that are actively investigated at the University of Trento. Every area is characterised by several study plans tailored to provide the background to start a research activity in that field. The specialisation areas are:

- **Physics of Fundamental Interactions**;
- **Physics of Matter**;
- **Physics Applied to Life Sciences, Environment and Cultural Heritage**;
- **Physical Science Communication and Teaching Methods**.

9. What if I do not like a suggested study plan?
Study plans can be personalised comply with the rules detailed in the *Regolamento Didattico* and the *Manifesto degli Studi*. Personalised study plans are reviewed and approved by the Responsible for the Master's Degree in Physics.
Further info: https://corsi.unitn.it/en/physics-master/study/program-guide-and-documents.

10. What if my scientific interests do not match any specialization area?
Specialisation areas provide only a coarse description of the present research in Physics, and the suggested study plans do not cover all the activities done in the Department or all the possible research fields. If you have specific interests, you can contact the Coordinator of the Teaching Activities or the Responsible for the Master's Degree in Physics to understand how they can fit within the Master's Degree and our Department.

Teaching activities

The following tables show the teaching activities for the a.y. 2025/2026 as published in the *Manifesto degli Studi*. This list is updated and approved every year by the Department Board.

Note

- Some courses can be attended alternatively in the first or second year.
- Core courses not already selected can be taken among the elective integrative ones.

Mandatory core courses

Course code	Course title	Lecturer	SSD	CFU	Hours	Year/ semester
145164	Experimental Methods	Leonardo Ricci	FIS/01	6	60	1/II
146268	Advanced Quantum Mechanics	Alessandro Roggero	FIS/02	6	48	1/I

Elective core courses

Course code	Course title	Lecturer	SSD	CFU	Hours	Year/ semester
145648	Experimental Physics	Riccardo Checchetto	FIS/01	6	60	1/II
145177	Statistical Mechanics	Raffaello Potestio	FIS/02	6	48	1/I
145646	Quantum Field Theory I	Albino Perego	FIS/02	6	48	1/II
145649	Computational Physics	Francesco Pederiva	FIS/02	6	48	1/II
145511	Atomic Physics	Gabriele Ferrari	FIS/03	6	48	1/I
145650	Physics of disordered systems	Marco Zanatta	FIS/03	6	48	1/II
145651	Quantum Theories for Multiparticle Systems [1]	Pier Luigi Cudazzo	FIS/03	6	48	1/II
145653	Solid State Physics I [1]	Giacomo Baldi	FIS/03	6	48	1/I
145854	Condensed Matter Theory [1]	Matteo Calandra Buonaura	FIS/03	6	56	1/I
146110	Antimatter Physics	Sebastiano Mariazzi	FIS/03	6	48	2/I
146201	Physics and Chemistry of Semiconductor Materials	Michele Orlandi	FIS/03	6	48	2/I
145645	Nuclear and Subnuclear Physics	Francesco Pederiva	FIS/04	6	48	1/II
145775	Astroparticle Physics [2]	Roberto Battiston	FIS/04	6	48	2/I
146269	Particle Physics [2]	Roberto Iuppa	FIS/04	6	56	1/II

146270	General Relativity	Massimiliano Rinaldi	FIS/02	6	48	1/I

[1] The following order is strongly suggested: Solid State Physics I, Condensed Matter Theory, and Quantum Theories for Multiparticle Physics.
[2] The following order is strongly suggested: Particle Physics; Astroparticle Physics.

Elective integrative courses

Course code	Course title	Lecturer	SSD	CFU	Hours	Year/ semester
145171	Optoelectronics	Lorenzo Pavesi	FIS/01	6	48	1/II
145175	Quantum Optics	Iacopo Carusotto	FIS/03	6	48	1/II
145338	Bio-Medical Imaging	Albrecht Haase	FIS/07	6	48	1/II
145347	Groups and Representations for Physics	Mauro Spreafico	FIS/02	6	48	1/II
145654	Solid State Physics II	Roberto S. Brusa	FIS/03	6	48	1/II
145889	Multi-scale Methods in Soft Matter Physics	Raffaello Potestio	FIS/03	6	48	1/II
146271	Quantum Computing and Quantum Simulation	Philipp H.J. Hauke	FIS/02	6	48	1/II
146288	Quantum Gases	Giacomo Lamporesi	FIS/03	6	48	1/II
145230	Laboratory of Advanced Electronics	Leonardo Ricci	FIS/07	6	56	2/I
145231	Laboratory of Condensed Matter	Marco Zanatta	FIS/01	6	56	2/I
145232	Laboratory of Energy Conversion Processes	Paolo Tosi	FIS/01	6	56	2/I
145235	Molecular and Cellular Biophysics	Marina Scarpa	BIO/10	6	48	2/I
145282	Photonics	Stefano Azzini	FIS/01	6	48	2/I
145283	Laboratory of Advanced Photonics	Paolo Bettotti	FIS/01	6	56	2/I
145285	Statistical Field Theory	Stefano Giorgini	FIS/02	6	48	2/II
145512	Nanoscience	Marina Scarpa	FIS/01	6	48	2/I
145647	Quantum Field Theory II	Dionysios Triantafyllopoulos	FIS/02	6	48	2/I
145882	Relativistic and Multimessenger Astrophysics	Albino Perego	FIS/05	6	48	2/I

145891	Medical Biophysics	Francesco Tommasino	FIS/07	6	48	2/II
145892	Gravitational Wave Astronomy and Multimessenger Observations	Giovanni Andrea Prodi	FIS/05	6	48	2/I
146281	Laboratory of Optics for Quantum Sciences and Technologies	Gabriele Ferrari	FIS/03	6	56	2/I
146358	Laboratory of Nuclear and Subnuclear Physics	Francesco Nozzoli	FIS/04	6	56	2/II
146364	Modern Cosmology	Sunny Vagnozzi	FIS/05	6	48	2/II
146365	Physics of Semiconductors	This course will be not taught in 2025/2026	FIS/03	6	48	2/I
146360	Superconducting Quantum Nanosystems, Circuits and Devices	Federica Mantegazzini & Gianluca Rastelli	FIS/03	6	48	2/II
140531	Introduction to Meteorology and Climatology [1]	Simona Bordoni	FIS/06	12	60	1/I
140571	Atmospheric Boundary Layer and Turbulence [1]	Dino Zardi	FIS/06	6	60	1/II
140607	Introduction to Climate Change [1]	Simona Bordoni	FIS/06	6	60	1/II
145153	Experimental Physics Laboratory at High School Level I [2]	Pasquale Onorato	FIS/08	6	56	1/I
145537	Physics Education: Theoretical and Experimental Approaches [2]	Pasquale Onorato	FIS/08	6	56	1/II
145907	Mathematical Physics - Quantum Relativistic Theories [2]	Valter Moretti	MAT/07	6	63	1/II
140534	Environmental Physical Chemistry [1]	Daniela Ascenzi	CHIM/03	6	60	2/I
140575	Tropical Meteorology and Climate [1]	Simona Bordoni	FIS/06	6	60	2/II
145546	Computational Biophysics [3]	Gianluca Lattanzi & Luca Tubiana	FIS/02 e FIS/03	6	96	2/I
145605	Renewable Energy and Meteorology [4]	Lorenzo Giovannini	FIS/06	6	60	2/II

145734	Air pollution modelling [1]	To be defined	FIS/06	6	60	2/II
146119	Atmospheric Physics and Modelling [5]	Lorenzo Giovannini	FIS/06	6	60	2/I
146214	Markov Decision Processes and Reinforcement Learning [2]	Francesco Giuseppe Cordoni	MAT/06	9	48	2/I

[1] From the Master's Degree in Environmental Meteorology.
[2] From the Master's Degree in Matematica.
[3] From the Master's Degree in Quantitative and Computational Biology.
[4] From the Master's Degree in Ingegneria per l'Ambiente e il Territorio.
[5] From the Master's Degree in Ingengeria Energetica.

Foreign language courses

Course code	Course title	CFU
145852	Scientific Writing and Presentations in English (B2a)	3
145328	Further Language Knowledge (English C1)	3
145582	Further Language Knowledge (German B2)	3
145584	Further Language Knowledge (Spanish B2)	3
145583	Further Language Knowledge (French B2)	3

Physics of Fundamental Interactions

Nuclei, Particles, Gravitation and Astrophysics

Contacts: Prof. **Massimiliano Rinaldi**
Prof. **Francesco Pederiva**

Within this study plan, a student is expected to gain a broad and solid knowledge about the physics background and the methods used in theoretical physics, including the development and the application of advanced computational methods, both in the classical and in the quantum computing paradigm. The main areas of investigation are:

- **Gravitation and Cosmology** for the study of fundamental interactions, black holes and cosmological open problems, using general relativity and quantum field theory;
- **Nuclei and Nuclear Matter** for the description of nuclear structure and reactions, neutron star matter, and collective neutrino oscillations;
- **Relativistic and Nuclear Astrophysics** for the investigation of extreme events in the Universe, like the mergers of neutron stars and black holes, or the gravitational collapse of massive stars;
- **Quantum Gases and Quantum Information** for the study of superfluids of bosons, fermions and their mixtures, open quantum systems, synthetic quantum systems with atoms and photons, and their use for novel quantum technologies.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145649 – Computational Physics (FIS/02)
145646 – Quantum Field Theory I (FIS/02)
145651 – Quantum Theories for Multiparticle Systems (FIS/03)
145645 – Nuclear and Subnuclear Physics (FIS/04)
145775 – Astroparticle Physics (FIS/04)
146269 – Particle Physics (FIS/04)
146270 – General Relativity (FIS/02)

Elective integrative courses

145647 – Quantum Field Theory II
145285 – Statistical Field Theory
145347 – Groups and Representations for Physics
145882 – Relativistic and Multimessenger Astrophysics
145892 – Gravitational Wave Astronomy and Multimessenger Observation
146358 – Laboratory of Nuclear and Subnuclear Physics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Example of study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - General Relativity - Quantum Field Theory I - Computational Physics - Particle Physics - Nuclear and Subnuclear Physics

2nd year	- Astroparticle Physics
	- *Two courses among:*
	  - Quantum Field Theory II
	  - Statistical Physics
	  - Statistical Field Theory
	- *One courses between:*
	  - Relativistic and Multimessenger Astrophysics
	  - Groups and Representations for Physics
	- *Foreign language knowledge and two free choice exams in the I or II year*
	- Master thesis project

Physics of Fundamental Interactions

Particle and Astroparticle physics

Contact person: Prof. **Roberto Battiston**

Astroparticle and Particle Physics studies the fundamental laws of the universe using advanced space probes and particle accelerators using big-data analysis techniques. LM students at Trento have access to two leading space borne Astroparticle Physics experiments, AMS on the International Space Station for the search of matter and dark matter in Cosmic Rays, and the constellation of CSES satellites observing the Earth and the Universe from the magnetosphere. Theses are also available for experiments at CERN accelerators, ATLAS at the LHC, and AMBER for the study of rare nuclear cross sections. Big-data analysis using AI and Deep Learning techniques are widely studied at Trento as well as the development of new radiation detectors for nanosatellites, in collaboration with FBK and the Space@TN program. In addition to research, training offered in this LM course offers opportunities in the industrial sector, taking into account the current strong development of Space Economy both in Italy as well as internationally.

Suggested courses

Elective core courses

145645 – Nuclear and Subnuclear Physics (FIS/04)
145646 – Quantum Field Theory I (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145775 – Astroparticle Physics (FIS/04)
146110 – Antimatter Physics (FIS/03)
146269 – Particle Physics (FIS/04)

NB: Particle Physics is preparatory for Astroparticle Physics.

Elective integrative courses

145230 – Laboratory of Advanced Electronics
145283 – Laboratory of Advanced Photonics
145882 – Relativistic and Multimessenger Astrophysics
145892 – Gravitational Wave Astronomy and Multimessenger Observations
146214 – Markov Decision Processes and Reinforcement Learning
146270 – General Relativity
146358 – Laboratory of Nuclear and Subnuclear Physics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Recommended free choice courses are:
145062 – Machine learning

145718 – Deep learning Lab
145688 – Machine learning

Examples of study plan

Experiments

1st year	- Experimental Methods - Advanced Quantum Mechanics - Laboratory of Advanced Electronics - Particle Physics - Computational Physics - Experimental Physics - Experimental Techniques in Nuclear and Subnuclear Physics - Nuclear and Subnuclear Physics
2nd year	- Astroparticle Physics - Gravitational Wave Astronomy and Multimessenger Observations - Laboratory of Advanced Photonics - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Data analysis

1st year	- Experimental Methods - Advanced Quantum Mechanics - Quantum field theory I - Particle Physics - Computational Physics - Experimental Physics - Experimental Techniques in Nuclear and Subnuclear Physics - Nuclear and Subnuclear Physics
2nd year	- Astroparticle Physics - Relativistic and multimessenger astrophysics - Gravitational Wave Astronomy and Multimessenger Observations - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Physics of Fundamental Interactions

Experimental Gravitation and Cosmology

Contacts: Prof. **Giovanni Andrea Prodi**
Prof. **William Weber**

The field of Experimental Gravitation and Cosmology encompasses several possible careers and specializations in the science of detectors, measurement devices and observations. At Trento, the students can access cutting edge research on Gravitational Waves, a science in rapid expansion, and become actively engaged in stimulating international endeavours. In fact, Trento offers opportunities both in present and future earth-based observatories, within the LIGO-Virgo-Kagra and Einstein Telescope collaborations, as well as in the space-born observatory LISA. Theses can address fundamental physics by means of diverse technological challenges, spanning from e.g. quantum optics, advanced interferometric techniques, adaptive control of complex systems, realization of free fall and data analysis methods. The training offered can be tailored according to the students' interests and prepares for the participation to PhD programs as well as for a carrier oriented to industrial research.

Suggested courses

Elective core courses

145511 – Atomic Physics (FIS/03)
145646 – Quantum Field Theory I (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145650 – Physics of disordered systems (FIS/03)
145775 – Astroparticle Physics (FIS/04)
145653 – Solid State Physics I (FIS/03)
146269 – Particle Physics (FIS/04)

Elective integrative courses

145892 – Gravitational Wave Astronomy and Multimessenger Observations
146270 – General Relativity
145175 – Quantum Optics
145882 – Relativistic and Multimessenger Astrophysics
145230 – Laboratory of Advanced Electronics
146281 – Laboratory of Optics for Quantum Sciences and Technologies
146095 – Optoelectronics and quantum devices for sensing and automation
146214 – Markov Decision Processes and Reinforcement Learning

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Example of study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Laboratory of Advanced Electronics - Solid state I - General Relativity - Quantum Field Theory I - Particle Physics - Experimental Physics
2nd year	- Astroparticle Physics - Gravitational Wave Astronomy and Multimessenger Observations - Laboratory of optics for quantum sciences and technologies - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

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Physics of Matter

Quantum Gases and Quantum information

Contacts: Prof. **Gabriele Ferrari**
Prof. **Philipp Hauke**

This study plan is aimed at training physicists skilled in the field of many-particle systems governed by quantum mechanics, such as gases and fluids of bosons and fermions, made of atoms, molecules, or other particles, including photons. The curriculum is designed for students interested in undertaking both experimental and theoretical research; in fact, in this area the interplay between theory and experiments is typically strong, which is reflected in the possibility of formulating flexible curricula between the two approaches. Students will learn to use ultracold atoms and, more generally, quantum systems as useful platforms both for the study of fundamental laws of physics and for the realization of devices for applications in the fields of quantum information and quantum simulation, photonics, precision measurements and metrology, and more. Those who choose this path will be able to join the activities of the Pitaevskii BEC Center for their thesis.
Further info: https://bec.science.unitn.it.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145511 – Atomic Physics (FIS/03)
145653 – Solid State Physics I (FIS/03)
145854 – Condensed Matter Theory (FIS/03)
145651 – Quantum Theories for Multiparticle Systems (FIS/03)
145645 – Nuclear and Subnuclear Physics (FIS/04)
145648 – Experimental Physics (FIS/01)
145653 – Quantum Field Theory I (FIS/02)
145649 – Computational Physics (FIS/02)

Elective integrative courses

145175 – Quantum Optics
145887 – Quantum Gases
146271 – Quantum Computing and Quantum Simulation
145285 – Statistical Field Theory
146281 – Laboratory of Optics for Quantum Sciences and Technologies

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)
We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Examples of study plans

Experiments

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Atomic Physics - Experimental Physics - Quantum Optics - Quantum Gases
2nd year	- Laboratory of Optics for Quantum Sciences and Technologies - Nanoscience - Statistical Field Theory - Quantum Computing and Quantum Simulations - *Foreign language knowledge and two exams at choice in the I or II year* - Master thesis project

Theory

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Atomic Physics - Quantum Optics - Quantum Gases - Quantum Field Theory I - Computational Physics
2nd year	- Statistical Field Theory - Quantum Computing and Quantum Simulations - Condensed Matter Theory - *Foreign language knowledge and two exams at choice in the I or II year* - Master thesis project

Physics of Matter

Quantum Physics of Matter: Materials, Energy and Environment

Contacts: Prof. **Giacomo Baldi**
Prof. **Matteo Calandra**

The physics of matter is the field of physics devoted to the study of the microscopic and macroscopic properties of the condensed phases of matter. It is one of the widest fields of research in the physical sciences, involving many researchers worldwide. The research activities span from the investigation of the fundamental laws governing the complex behaviour of atoms and electrons to the development of materials tailored to specific applications.
The proposed study plan is designed to give a detailed overview of condensed matter physics and material science, including theory, numerical simulations, and experimental methods. The study plan is sufficiently flexible to adapt to students that are more inclined to the laboratory activity or to those that prefer to go deeper in the theoretical foundations or in the numerical methods. Moreover, the interested student will have the opportunity to practice for the first time the research activities in the field, within one of the research groups of the department, that offer both basic research lines and more applied ones.
The research at the Physics Department spans a wide range of topics, including plasma physics, disordered systems, simulation of biological and soft matter, materials for energy and the environment.
Further info: https://qpm.physics.unitn.it/.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145653 – Solid State Physics I (FIS/03)
145650 – Physics of Disordered Systems (FIS/03)
145854 – Condensed Matter Theory (FIS/03)
145890 – Physics and Chemistry of Semiconductor Materials (FIS/03)

Elective integrative courses

140534 – Environmental Physical Chemistry
145231 – Laboratory of Condensed Matter
145232 – Laboratory of Energy Conversion Processes
145512 – Nanoscience
145175 – Quantum Optics
145654 – Solid State Physics II
145889 – Multiscale Methods in Soft Matter Physics
145651 – Quantum Theories for Multiparticle Systems

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Examples of study plans

Experiments

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Solid State Physics I - Physics and Chemistry of Semiconductor Materials - Experimental Physics - Physics of Disordered Systems - Multi-scale methods in Soft Matter Physics
2nd year	- Laboratory of Condensed Matter - Laboratory of Energy Conversion Processes - Condensed Matter Theory - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Theoretical/computational study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Solid State I - Condensed Matter Theory - Quantum Theories for Multiparticle Systems - Quantum Field Theory I - Computational Physics
2nd year	- Statistical Mechanics - Quantum Computing and Quantum Simulation - Physics of Disordered Systems - Multiscale methods in soft matter - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

NB: for a theoretical/computational study plan, it is strongly suggested to take Solid State Physics I, Condensed Matter Theory, and Quantum Theory of Many Particle Systems in this order, being the first two preparatory to the last one.

Physics of Matter
Nanophotonics

Contact: Prof. **Lorenzo Pavesi**

The Nanophotonics study plan encompasses two primary tracks: Photonics and Nanomaterials, and Quantum Photonics. In both, the central theme revolves around photonics, which is the science of light. Here, we delve into fundamental concepts related to light generation, detection, shaping, and utilization, leading to novel phenomena and applications. Photonics has become a pivotal enabling technology, finding applications across diverse fields such as the internet, manufacturing, automotive, medicine, and energy. Additionally, we explore various material platforms where photonics is realized. This encompasses integrated photonic circuits as well as nanomaterials, spanning both inorganic and natural organic materials. For those with a keen interest, a focus on quantum photonics is also feasible. In this area, we investigate quantum phenomena associated with light, uncovering their applications in security, computing, and sensing.
These topics serve as the foundation for research conducted in the Nanoscience Laboratory. Here the mission is to generate new knowledge, foster understanding, and translate physical phenomena related to photons and their interactions with matter – especially in nanostructured contexts – into practical applications.
Further info: http://nanolab.physics.unitn.it/

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145650 – Physics of disordered systems (FIS/03)
145653 – Solid State Physics I (FIS/03)
145511 – Atomic Physics (FIS/03)
145854 – Condensed matter theory (FIS/03)

Elective integrative courses

145283 – Laboratory of Advanced Photonics
145171 – Optoelectronics
145512 – Nanoscience
145282 – Photonics
145175 – Quantum Optics
145230 – Laboratory of Advanced Electronics
145654 – Solid State Physics II

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)
We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Recommended free choice courses are:
145231 – Laboratory of Condensed Matter
145235 – Molecular and Cellular Biophysics
145890 – Physics and Chemistry of Semiconductor Materials
146271 – Quantum Computing and Quantum Simulations
146112 – Experimental Methods in Cell Physics

Examples of study plan

Photonics and Nanoscience

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Solid State Physics I - Experimental Physics - Optoelectronics - *Two elective core courses in FIS/03*
2nd year	- Laboratory of Advanced Photonics - Nanoscience - Photonics - *Foreign language knowledge and one free choice exam in the I or II year* - Master thesis project

Quantum photonics

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Solid State Physics I - Experimental Physics - Optoelectronics - *Two elective core courses in FIS/03*
2nd year	- Photonics - Quantum Computing - Quantum Optics - *Foreign language knowledge and one free choice exam in the I or II year* - Master thesis project

Physics Applied to Life Sciences, Environment and Cultural Heritage

Atmospheric and Climate Physics

Contacts: Prof. **Simona Bordoni**
Prof. **Dino Zardi**

The study plan in Atmospheric and Climate Physics offers several courses related to atmosphere and climate processes, also covering different environmental applications, and introducing a variety of approaches, including experimental techniques, theoretical analysis and numerical simulations.
The topics covered are strictly connected with the research activities of the lecturers, including the use and development of weather and climate models, the evaluation of atmospheric boundary-layer processes with experimental field campaigns and applications in different fields, such as weather forecasts, evaluation of climate change effects, pollutant dispersion, support to agricultural practices, estimation of renewable energy sources.
The knowledge and skills learned in this study plan provides graduates with a sound background for a variety of jobs where expertise in weather and climate is needed (e.g. weather forecasts, climate services), also to provide support to other professionals or decision makers (e.g. air quality, renewable energy, agriculture, transports), or to proceed to higher levels of education.
Further info: https://meteo.unitn.it

Suggested courses

Elective core courses

145648 – Experimental Physics (FIS/01)
145177 – Statistical Mechanics (FIS/02)
145649 – Computational Physics (FIS/02)
145854 – Condensed matter theory (FIS/03)
145511 – Atomic Physics (FIS/03)
145650 – Physics of disordered systems (FIS/03)
145653 – Solid State Physics I (FIS/03)
145890 – Physics and Chemistry of Semiconductor Materials (FIS/03)
146269 – Particle Physics (FIS/04)

Elective integrative courses

140531 – Introduction to meteorology and climatology [1]
146119 – Atmospheric Physics and Modelling
145605 – Renewable Energy and Meteorology
140607 – Introduction to climate change [2]
140571 – Atmospheric boundary layer and turbulence [2]
140575 – Tropical Meteorology and Climate [2]
145734 – Air pollution modelling [3]

[1] Contents are similar to those of “Fondamenti di Meteorologia e Climatologia”.
[2] Prerequisite: “Introduction to Meteorology and Climatology” or “Fondamenti di Meteorologia e Climatologia”.
[3] Prerequisite: “Atmospheric Boundary Layer and Turbulence”.

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Suggested study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Introduction to meteorology and climatology - Computational Physics - Particle physics - Atmospheric Physics and Modelling - Introduction to climate change - Renewable Energy and Meteorology
2nd year	- Solid State Physics I - Atmospheric Physics and Modelling - Physics of Disordered Systems - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Physics Applied to Life Sciences, Environment and Cultural Heritage

Biophysics

Contact: Prof. **Gianluca Lattanzi**

Biophysics consists in the application of physical methods to the investigation of problems of biological relevance. The field is strongly transdisciplinary and multidisciplinary: it needs to be approached from different points of view and with different techniques. It is important to acquire a good knowledge of theoretical physics (statistical mechanics and non-equilibrium thermodynamics), experimental physics (at least to grasp the techniques that are widely employed in biophysics) and computational physics (both for data analysis and simulations of specific systems). Job opportunities are widely available in different contexts, including research in academia and/or R&D in industrial biotech companies.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145650 – Physics of Disordered Systems (FIS/03)
145651 - Quantum Theories for Multiparticle Systems (FIS/03)
145653 – Solid State Physics I (FIS/03)
145854 – Condensed Matter Theory (FIS/03)

Elective integrative courses

145231 – Laboratory of Condensed Matter
145235 – Molecular and Cellular Biophysics
145338 – Bio-Medical Imaging
145512 – Nanoscience
145546 – Computational Biophysics
145889 – Multi-scale methods in soft matter physics
145891 – Medical Biophysics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Suggested study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical Mechanics - Solid State Physics I - Molecular and Cellular Biophysics - Bio-Medical Imaging - *One exam between:* • Physics of disordered systems • Quantum Theories for Multiparticle Systems - *One exam between:* • Experimental Physics • Computational Physics - *One exam between:* • Medical Biophysics • Multiscale Methods in Soft Matter Physics
2nd year	- Computational Biophysics - Nanoscience - *One exam beetween:* • Condensed matter theory • Physics and Chemistry of Semiconductor Materials - *Foreign language knowledge and one free choice exam in the I or II year* - Master thesis project

Physics Applied to Life Sciences, Environment and Cultural Heritage

Medical Physics

Contact: Prof. **Francesco Tommasino**

The study track in Medical Physics aims at providing to the student a solid background in the field of physics applied to medical and biological problems, with a special focus on the applications associated with charged particle beams. This represents an interdisciplinary research field, requiring the obvious understanding of physical processes, complemented by chemical and biological concepts.
In our Department, the Bio-Medical Radiation Physics group is active in this field. The group operates in strong collaboration with the CIBIO Department, with INFN as well as with the local Proton Therapy Center (APSS).
Students who choose this study plan typically continue their formation starting a PhD (about 30%) or joining a post-lauream school in Health Physics (about 30%), which paves the way for a clinical job. The remaining fraction is distributed among jobs in the industry, mainly as data analyst, and school teaching.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145645 – Nuclear and Subnuclear Physics (FIS/04)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145650 – Physics of disordered systems (FIS/03)
145653 – Solid State Physics I (FIS/03)
145854 – Condensed matter theory (FIS/03)
146110 – Antimatter Physics (FIS/04)
146269 – Particle Physics (FIS/04)

Elective integrative courses

145235 – Molecular and Cellular Biophysics
145338 – Bio-Medical Imaging
145890 – Physics and Chemistry of Semiconductor Materials
145891 – Medical Biophysics
145894 – Experimental Techniques in Nuclear and Subnuclear Physics
146112 – Experimental Methods in Cell Physics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)

We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.
Suggested free choice course:
146260 - Medical Imaging Laboratory

Suggested study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - *One exam between:* • Statistical Mechanics • Computational Physics - Solid State Physics I - Medical Biophysics - Molecular and Cellular Biophysics - Bio-Medical Imaging - Nuclear and subnuclear Physics - Experimental Physics
2nd year	- *One exam between:* • Antimatter Physics • Particle Physics - Experimental Techniques in Nuclear and Subnuclear Physics - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Physics Applied to Life Sciences, Environment and Cultural Heritage

Nonlinear Systems and Electronics

Contact: Prof. **Leonardo Ricci**

The study plan "Nonlinear systems and electronics" encompasses fundamental and interdisciplinary topics of physics and provides the student with expertise to address physical problems in many challenging contexts of research, including applications of physics to science and technology.
While linear phenomena are largely understood and predictable, nonlinearity is the basic ingredient of a huge class of fascinating complex systems, ranging from the brain to the climate. Learning how to analyze the signals generated by these systems and interpret them, for example by relying on the information-theoretical notion of entropy, allows the investigation of the underlying mechanisms and the improvement of predictability.
Besides addressing physical problems, the student will learn how to deal with complex systems and signals by means of advanced software and hardware techniques. For example, fast digital and analog electronics is among the expertise cultivated within the study plan.

Suggested courses

Elective core courses

145511 – Atomic Physics (FIS/03)
145177 – Statistical Mechanics (FIS/02)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145653 – Solid State Physics I (FIS/03)
145854 – Condensed matter theory (FIS/03)
146269 – Particle Physics (FIS/04)

Elective integrative courses

145171 – Optoelectronics
145175 – Quantum Optics
145230 – Laboratory of Advanced Electronics
145283 – Laboratory of Advanced Photonics
145338 – Bio-Medical Imaging
145546 – Computational Biophysics
145889 – Multi-scale methods in soft matter physics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)
We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Recommended free choice courses are:
146271 – Quantum Computing and Quantum Simulations;
145231 – Laboratory of Condensed Matter;

145890 – Physics and Chemistry of Semiconductor Materials.

Suggested study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical mechanics - Laboratory of Advanced Electronics - Atomic physics - Particle physics - Experimental Physics - Multi-scale methods in soft matter physics
2nd year	- Solid State Physics I - Quantum optics - Laboratory of Advanced Photonics - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project

Physical Science Communication and Teaching Methods

Contact: Prof. **Stefano Oss**

The physical science communication laboratory is active in the field of physics education research. In this area, we deal with many topics in which, in addition to being interested in specific content -- classical physics: mechanics, thermodynamics, electromagnetism, optics; quantum physics: fundamentals, properties of matter, numerical modelling, the complex issues related to techniques and tools used in the design, testing and implementation of new teaching approaches, at various school levels, are addressed. The thesis proposals are many and range from issues related to the use of the physical sciences in scientific literacy (science education and sustainability), to questions considering the appropriateness of addressing quantum physics studies at non-university school levels, to the design of kits and, more in general, experiments that can be used in schools, to the discussion of new ways of organizing educational paths in the area of thermodynamics, to the critical study of telematic and multimedia tools, as well as AI, in laboratories and classrooms, and much more.

Suggested courses

Elective core courses

145177 – Statistical Mechanics (FIS/02)
145511 – Atomic Physics (FIS/03)
145645 – Nuclear and Subnuclear Physics (FIS/04)
145648 – Experimental Physics (FIS/01)
145649 – Computational Physics (FIS/02)
145646 – Quantum Field Theory I (FIS/02)
145650 – Physics of disordered systems (FIS/03)
145651 – Quantum Theories for Multiparticle Systems (FIS/03)
145653 – Solid State Physics I (FIS/03)
145775 – Astroparticle Physics (FIS/04)
145854 – Condensed matter theory (FIS/03)
146110 – Antimatter Physics (FIS/03)
146201 - Physics and Chemistry of Semiconductor Materials (FIS/03)
146269 – Particle Physics (FIS/04)
146269 – General Relativity (FIS/02)

Elective integrative courses

140531 – Introduction to meteorology and climatology
145153 – Experimental Physics Laboratory at High School Level I
145230 – Laboratory of Advanced Electronics
145232 – Laboratory of Energy Conversion Processes
145537 – Physics education: theoretical and experimental approaches
145654 – Solid State Physics II
146119 – Atmospheric Physics and Modelling
146358 – Laboratory of Nuclear and Subnuclear Physics

Foreign language knowledge (3 CFU)

Elective modules at free choice (12 CFU)
We suggest choosing two courses from those in the above lists, if not yet selected, or from the full list of active courses in the Master of Science in Physics. Students who want to choose courses different from those ones, must send a specific request to the Responsible of the LM in Physics.

Suggested study plan

1st year	- Experimental Methods - Advanced Quantum Mechanics - Statistical mechanics - Solid state physics I - Experimental Physics Laboratory at High School Level I - Physics of Disordered Systems - Nuclear and subnuclear physics - Experimental Physics - Physics education: theoretical and experimental approaches
2nd year	- Introduction to meteorology and climatology - Laboratory of energy conversion processes - *Foreign language knowledge and two free choice exams in the I or II year* - Master thesis project