Study Guide for a Master in Physics University of Zurich

Table of contents

Contents

1. Introduction

1.1 The University of Zurich and the department of physics

The University of Zurich was founded in the year 1833. It is renowned worldwide as a center for education and research. With 3500 faculty members working at approximately 140 institutes, about 26000 students and 4000 graduations per year the UZH is the largest university in Switzerland. The university is committed to the unity of education and research and maintains all areas of foundational scientific research. The university also provides scientific services.

Education and research in physics have played an important role in the scientific life of Zurich since its founding. Amongst the physics professors at the University of Zurich, we find well-known names such as Rudolf Clausius, Max von Laue (Nobel Prize 1914), Albert Einstein (Nobel Prize 1922), Peter Debye (Nobel Prize 1936), Ervin Schrödinger (Nobel Prize 1933), Gregor Wentzel, Walter Heitler, Hans H. Staub and K. Alex Müller (Nobel Prize 1987).

Today, both the institutes of physics www.physik.uzh.ch/ and the institute of computational science, www.ics.uzh.ch/ are located on the campus of the University of Zurich-Irchel. Currently, there are approximately 200 students (including PhD students) majoring in physics. 20 professors and about 100 assistants teach these students, along with students in other subjects (studying physics as a minor, as well as those studying biology, chemistry and medicine). On average, 80 students begin studying physics every year, which enables faculty to provide them with intensive individual assistance. Our flexible degree regulations allow students to adapt their course work to individual needs.

The employees of both physics institutes are involved actively in many different areas of foundational studies in physics. This includes experimental and theoretical physics, magnetism and superconductivity, surface science, bio- and nanophysics, astrophysics and cosmology. More detailed information about the work of individual research teams can be found on the aforementioned institute websites.

1.2 Equality in Physics

The Faculty of Mathematics and Natural Sciences (MNF) of the University of Zurich (UZH) considers gender equality and diversity among students, its academic and non-academic staff to be very valuable and is committed to implementing the UZH's Code of Conduct Gender Policy.
It is a fact that fewer women than men study physics, chemistry or engineering in Switzerland, while in other countries, such as Italy or France, their proportion is significantly higher.
Before 2000, the proportion of women among physics students was 10% and has been rising steadily since then; today it is 33% among new students. The proportion of women among doctoral students, scientific staff and professors has also risen steadily over the last 20 years.

The Department of Physics strives counteract any form of prejudice (whether conscious or unconscious) and to create family-friendly working conditions. Suggestions on how to improve working conditions for students are always welcome so that a pleasant climate can be achieved for all students.
Links
Gender and Diversity UZH (https://www.gleichstellung.uzh.ch/en.html)
Person of Trust(https://www.mnf.uzh.ch/en/fakultaet/vertrauenspersonen.html)
Psychological Counselling Services UZH (https://www.pbs.uzh.ch/en.html)

2. Studying physics at the University of Zurich

These guidelines summarize all information, including from higher-order regulations, which is relevant for studying physics at the University of Zurich (see chapter 5)

2.1 Overview

As of a few years, the university has been using the European Credit Transfer and Accumulation System (ECTS). A degree is composed of individual, thematically more or less independent units (modules), which each have some form of a performance assessment (this often means exams and grades). The structure of studies follows the Bologna-Model. The clear structuring encourages and eases the possibility for students to complete a portion of their degree at a different European University without delays.

In a master's program, students specialize in a current field of research. The program lasts 3 semesters if students select a minor it is 4 semesters. The main focus of the program is on a master thesis in form of a research project at an advanced level of scientific work. The MSc degree, "Master of Science UZH in Physics," qualifies you for academic work in physics and fulfils the scientific portion of a teaching degree for Swiss "Maturitätsschulen" (university-track secondary schools).

Following a MSc degree, you can complete a mentored, but continually more independent research project over 3 to 4 years to earn a doctoral degree, "Doctor scientiarum naturalium" (Dr.sc.nat. = Ph.D.). A Ph.D. is accepted worldwide as a qualification for independent research.

The time spent to acquire a degree specified above are based on a full-time investment. Extensions are possible if you for instance are also working part-time (see chapter 3).

2.2 Master's degree

During a master's program in physics at the University of Zurich, students may begin to specialize in a current field of research. The program begins in the fall and continues, under normal circumstances, for three semesters.
The department of physics at the UZH essentially has four different areas of research:

- Condensed Matter
- Particle Physics
- Astro(particle)physics and Cosmology
- Bio- and medical physics

You may find a summary of current research in annual reports at www.physik.uzh.ch/en/berichte.html and at the websites of each research team at www.physik.uzh.ch/en/forschung.html and www.ics.uzh.ch.

Graduates receive a degree of "Master of Science UZH in Physics". 90 credit points are necessary to obtain a master's degree. During the first and second semester, the program consists of lectures, practice sessions and labs in students' chosen area of specialization as well as an elective field of study.
In the master's program, lectures are taught in English.

Continuing on to a master's program with a major in Physics

With a "Bachelor of Science UZH in Physics" or a bachelor's degree in physics from any other Swiss university, you are automatically admitted to our master's program in physics. You must have successfully completed all compulsory and core elective modules (including your bachelor's thesis) to sign up for the master's program.
Depending on the concentration students select, as well as the modules completed during their bachelor's studies, they will need to complete certain modules (see below).
Students will receive credit towards their master's degree for at most 30 credit points from their bachelor's degree. Students may only begin work on their master's thesis once they have completed their bachelor's degree.

Faculty members individually evaluate bachelor's degrees from foreign universities. Any documents must be handed in together with the application for matriculation at the Dean's Office (Studiendekanat) or at the Admission's Office (Kanzlei) for Students with a Foreign Degree. Depending on what students have studied previously, they may be required to complete additional coursework during the master's program.

Continuing from a BSc180/BSc150 major in Physics to a consecutive master's program

Students with a BSc degree with a major in Physics for 180 or 150 ECTS credits can continue with a consecutive master's program without restrictions.
If the master specialisation **Astrophysics and Cosmology** requires the compulsory module: Introduction to Astrophysics (AST241). If this module is not taken in the Bachelor's program, the corresponding module must be completed in the Master's program, whereby crediting is possible in the elective area of the Master's program.

Continuing from a BSc120 major in Physics to a consecutive master's program

With a BSc degree majoring in Physics 120 CP, a transfer to the consecutive Master requires the following modules, which differ according to the Master's specialization. The corresponding modules are compulsory modules for the respective specialization.

- **Condensed Matter:**
  Solid State Physics (PHY210), Quantum mechanics I (PHY331)*
- **Particle Physics:**
  Nuclear and Particle Physics I (PHY211), Quantum mechanics I (PHY331)*
- **Astrophysics and Cosmology:**
  no additional requirements for 60 and 30 CP minors in Astrophysics, otherwise the additional requirement is Astrophysics (AST241)
- **Bio- and medical Physics:**
  Nuclear and Particle Physics I (PHY211)

* PHY 331 is only required for students starting with the master studies in autumn 21 or later.

Modules from this list, which were not completed in the bachelor's programme, must be completed in the master's programme.
In addition to these requirements, all students must discuss the courses they intend to complete with their master thesis advisor, who may set additional requirements.

Master's thesis and exam

The central focus of the master's program is a master's thesis. It consists of an independent research contribution within one of the research teams in physics at our university. The work required for a master's thesis along with the preparation for the module exam corresponds to 55 credit points, usually approximately 9 months of full time work. All master's theses must be documented in a written report, which will be graded.

Theses may also be completed with an external research team (for instance Biomedical Imaging, Medical Physics). Students must submit a written request along with a work outline to a faculty member in the UZH's physics department, who has to be willing to accept responsibility for the thesis and designate the courses the students should attend. Such a thesis must centre on a question within the field of physics. Theses with external research groups need to meet the requirements of a master's thesis in physics at the UZH in duration, quality, mentorship and grading. The corresponding credit points will therefore be counted as credit points earned at the University of Zurich.

The module exam for the master's thesis consists of two parts, which each take about 30 minutes and are both graded. Firstly, students present their master's thesis in a public presentation. In the second part, which is not open to the public, students must defend their thesis against a minimum of two lecturers. They are asked questions focusing on the field of the thesis.

The overall grade for a student's master's thesis is composed of a weighted average of their written report (2/3) and their module exam (1/3). A student must achieve at least a 4.0 for both the thesis and the exam.

Dates for the master's thesis and module exam are set individually in consultation with the responsible faculty member. The forms necessary to sign up can be found at http://www.physik.uzh.ch/en/study/studienberatung/formulare.html.

Research seminar

You are required to attend research seminars on the topic of your chosen field of research in all master's programs. The seminar organizer must confirm your attendance. Relevant forms may be found at http://www.physik.uzh.ch/en/study/studienberatung/formulare.html.

Choice of additional lecture modules

Besides following the regulations of each master's program, we recommend you seek a conversation with the various research teams before choosing your program of study. In special cases, it is possible and useful – in consultation with the responsible professors – to substitute modules of the master's program with specialized courses in your chosen field of research.

Minor

Students must earn 90 CP for a master's degree in Physics. A minor for 30 CP may be completed on a voluntary basis. See section 2.6.

Grading

Student's GPA for their master's degree is composed of a weighted average of the grades of all modules belonging to the master's program in accordance to how many credit point they each were worth.

2.2.1 Physics of Condensed Matter

Coordinator: Professor Andreas Schilling

This master's program offers an advanced education in experimental Condensed Matter. The first semester consists of lectures, which are accompanied by practice sessions and labs. In the second semester, students are required to spend less time in lectures. Therefore, they can begin work on their master's thesis once they have written a careful research proposal in direct consultation with a faculty member. The master's thesis is an independent research project, which takes 9 months under normal circumstances and is completed at the end of the third semester.

Compulsory modules

Table Compulsory modules for master in Condensed Matter Physics

Sem.	Nr.	Title	Class Time		Performance assessment	Grade	CP
			Lectures	Exercises			
1	PHY401	Condensed Matter	4	2	Module exam	Yes	10
1 or 2	PHY403	Master's Thesis Proposal			Report	No	2
2	PHY411	Solid State Theory	4	2	Module exam	Yes	10
2 semesters	PHY447	Research seminar	1.5		Participation	No	2
2 and 3	PHY448	Master's Thesis			thesis (2/3) and module exam (1/3)	Yes	50

Elective modules

The remaining credits needed to fulfill the requirement of 90 credit points must be earned in elective modules. At least 2/3 of the credit points for the remaining elective modules must come from subjects that are related to the topic of the Master's thesis. The remaining ECTS can also come from general topics related to physics, materials science or metrology.
If you have any questions, please discuss the program with the coordinator of the master's program (Christoph Aegerter) or the coordinator of the condensed matter specialisation.

Course contents for compulsory and core elective modules

PHY401 Condensed Matter
Phenomenology of

- energy bands and fermi areas
- optical properties
- supra-conduction
- di-electrics and ferro-electrics
- magnetic properties
- surface effects
- electron optics and applications of focussed electron radiation
- production of structures at the micro- and nanometer scale
- lithographic structuring methods
- mesoscopic physics

PHY403 Proposal for a master's thesis
Students must hand in their proposal before beginning with their master's thesis. It should be 2-5 pages long and be structured as follows: summary, motivation, how much you have researched, research plan (including measurement methods)

PHY447 Research seminar
Students are required to regularly attend a research seminar on a topic related to their thesis work during two semesters. Instead of attending a single seminar, students may also opt combined lectures from a variety of seminars (for instance from the Colloquium in Physics).

PHY411: Theory of Condensed Matter

- electrons and phonons
- spectra, band theory
- application of group theory
- second quantization
- Many-body-theory
- electron-phonon interactions
- supra-conduction
- magnetism

You can find a list of additional core elective and elective modules in the lecture catalogue with commentary at www.physik.uzh.ch/de/studium/vorlesungsunterlagen.html, “Physics of Condensed Matter.” You may receive credit for other independently selected modules as long as the coordinator of the master’s program has approved them.

2.2.2 Particle Physics

Coordinator: Professor M. Grazzini

This master’s program offers an advanced education in theoretical and experimental Particle Physics. Faculty members at the ETH and the UZH jointly offer courses in this program. After introductory lectures, practice sessions and labs, students begin their master’s thesis that should take 9 months.

Compulsory modules

Table Compulsory modules for master in Particle Physics

Sem.	Nr.	Title	Class Time		Performance assessment	Grade	CP
			Lectures	Exercises			
1	PHY452	Elementary particle theory	4	2	Module exam	Yes	10
2 semesters	PHY497	Research seminar	1.5		Participation	No	2
2	PHY451	Elementary Particle Physics	3	2	Module exam	Yes	8
2 and 3	PHY498	Master’s thesis			Thesis (2/3) module exam (1/3)	Yes	50

Elective modules

The remaining credits needed to fulfill the requirement of 90 credit points must be earned in elective modules. Students can also choose additional courses amongst the core elective listing. Every year, specialized lectures are offered on topics of current research. Credits earned in intensive courses for graduate education will also be counted as well as compulsory courses of other master concentrations in physics.
If you have any questions, please discuss the program with the coordinator of the master's program (Christoph Aegerter) or the coordinator of the particle physics specialisation.

Table Elective modules for master in Particle Physics

Sem.	Nr.	Title	Class Time			Performance	Grade	CP
			Lectures	Exercises	Lab			
1 or 2	PHY463	Research lab			4-6 weeks	Module exam	Yes	6
1	PHY461	Exp. Methoden and Inst.	2	2		Module exam	Yes	6
2	PHY568	Flavor Physics	2	1		Module exam	Yes	5
2	PHY465	Experimental astro particle physics	2	2		Module exam	Yes	6
3	PHY563	Electroweak Theory	2	1		Module exam	Yes	5
3	PHY564	QCD	2	1		Module exam	Yes	5
2	PHY552	Quantum field theory II	3	2		Module exam	Yes	8
3	PHY567	Higgs Physics	2	1		Module exam	Yes	5
3	PHY572	Advanced Topics in Field Theory	2	1		Module exam	Yes	5
3	PHY573	Quantum field theory III	2	1		Module exam	Yes	5

Course content of core elective and elective modules

PHY451/452 Phenomenology of Particle Physics I and II
(will be held jointly by theoreticians and experimentalists)

- Relativistic kinematics
- Cross sections and phase space
- Elements in quantum electrodynamics
- Unitary symmetries and QCD
- Electroweak interactions
- Physics of flavours
- Limits of the standard model (GUT and SUSY, etc.)

PHY551 Quantum Field Theory

- Relativistic wave functions
- Quantification of free fields
- Re-normalization
- Perturbation theory
-

PHY461 Experimental Methods and Instruments in Particle Physics

- Physics and structure of particle accelerators
- Foundations and concepts in particle detectors
- Trace and vortex detectors, calorimetry, particle identification
- Special applications such as Cerenkov detectors, air showers, direct detection of dark matter, emulsions
- Simulations methods, selection electronics, trigger and data measurement
- Examples and key experiments

PHY463 Research internship
This internship lasts for 4 to 6 weeks, during which students construct, conduct and evaluate an experiment using a particle radiation at CERN or PSI or some other research lab. For instance, you might do an internship at PSI, where you work in a group for three weeks planning and constructing an experiment that uses the PSI's secondary laser and conducting it jointly during shifts. Then you must evaluate your data and complete a report.

PHY552 Quantum Field Theory II
Advanced topics such as:

- Re-normalization groups
- Abel and non-Abel Eicht theories
- Standard model, Higgs mechanism
- Path integrals
- PHY568 Flavour Physics
- B-Penomenology
- Neutrino masses and oscillations
- CP violations in B^0_s

PHY497 Research seminar
Students are required to regularly attend a research seminar in Particle Physics during two semesters ("Current work in astrophysics and particle physics" or "theoretical physics").

2.2.3. Astrophysics and cosmology

Coordinator: Professor R. Helled

This master's program offers an advanced education in astrophysics and cosmology. After introductory lectures, practice sessions and labs, students begin with their master's thesis that should take 9 months.

Compulsory modules
Table Compulsory modules for master in Astrophysics and Cosmology

Sem.	Nr.	Title	Class Time		Performance assessment	Grade	CP
			Lectures	Exercises			
1	AST512	Theoretical Astrophysics	4	2	Module exam	Yes	10
2 semesters	AST547	Research seminar	1		Participation	No	2
2 and 3	AST548	Master's thesis			thesis (2/3) module exam (1/3)	Yes	50

Core Elective modules

At least 18 ECTS credits must be earned from elective modules.
PHY 511 and AST 513 are recommended for concentration in cosmology. AST 514 and AST 246 are recommended for concentration in astrophysics.

Table Core elective modules for master in Astrophysics and Cosmology

Sem.	Nr.	Title	Class Time		Performance assessment	Grade	CP
			Lectures	Exercises			
1	PHY511	General Relativity	4	2	Module exam	Yes	10
2	AST513	Physical Cosmology	4	2	Module exam	Yes	10
1	AST514	Planetary and Stellar Astrophysics	4	2	Module exam	Yes	10
1	AST246	Computational Astrophysics	2	lab	Module exam	Yes	10

Elective modules

The remaining credits needed to fulfill the requirement of 90 credit points must be earned in elective modules. For instance, we recommend: ESC411 Computational Science I, QTF1 (PHY551) or specialized astrophysics modules that take place every year (for instance, Stellar Structure and Evolution). Compulsory courses of other master concentrations in physics may also be chosen. If you have any questions, please discuss the program with the coordinator of the master's program (Christoph Aegerter) or the coordinator of the physics specialisation Astrophysics and Cosmology.

Course contents in the compulsory modules

PHY511 General Relativity

- repetition of special relativity
- principle of aequivalence
- motion in the gravitational field, gravitational red-shift
- tensors in Riemann-Space
- covariant derivative, parallel transport
- Riemann tensor, Bianchi-Identities
- Einstein's field equations
- Schwarzschild-solution
- precession of the perihelion, deflection of light
- geodesic precession
- gravitational waves
- black holes
- Friedman-Robertson-Walker universe

AST513 Physical Cosmology

- big bang and early universe
- nucleosynthesis
- inflation
- relativistic perturbation theory and growth of structure
- cosmic microwave background and large scale structure
- dark matter and dark energy

AST512 Theoretical Astrophysics

- radiative processes in the interstellar medium
- Star structure
- Star development
- Supernovae
- White dwarfs
- Neutron stars
- Black holes
- Planet formation

Research seminar
During two semesters, students are required to attend at least one seminar per week
http://www.ics.uzh.ch/en/seminars/

2.2.4. Bio- and medical Physics

Coordinator: Prof. J. Unkelbach

This master's program offers an advanced education in astrophysics and cosmology. After introductory lectures, practice sessions and labs, students begin with their master's thesis that should take 9 months.

Compulsory modules

Table Compulsory modules for master in Bio- and Medical Physics

Sem.	Nr.	Title	Class Time		Performance	Grade	CP
			Lectures	Exercises			
1	227-0385-10L (ETH)	Biomedical Imaging	3	2	Module exam	Yes	6
2 semesters	WBAT1377	Research seminar	1		Participation	No	2
2 and 3	PHY598	Master's thesis			thesis (2/3) and module exam (1/3)	Yes	50

Core elective modules
The modules, worth minimum 10 CP, are chosen from the list below depending on whether the focus is on biological or medical physics.

Table Core Elective modules for master in Bio- and Medical Physics

Sem.	Nr.	Title	Class Time		Performance	Grade	CP
			Lectures	Exercises			
1	PHY471	Physics and Mathematics of Radiotherapy Planning	2	2	Module exam	Yes	6
1	PHY401	Condensed matter	4	2	Module exam	Yes	10
2	PHY361	Physics against cancer: The Physics of Imaging and Treating Cancer	2	1	Module exam	Yes	5

Elective modules
The remaining credit points missing from the total of 90 must be earned through elective modules. Whether a module will be awarded credit is determined individually in consultation with the supervisor of the Master's thesis. For instance, we recommend: PHY461 Experimental Methods and Instruments, STA404 Clinical Biostatistics, ESC411 Computational Science I, PHY233 Numerical Methods I, PHY352 Continuum mechanics, BIO330 Modelling in Biology, BIO253 Experimental Techniques in Physical Biology, PHY431 Biology for Physicists.
Compulsory courses of other master concentrations in physics may also be chosen. If you have any questions, please discuss the program with the coordinator of the master's program (Christoph Aegerter) or the coordinator of the physics concentration Bio- and Medical Physics.

Course contents in the compulsory modules

227-0385-10L Biomedical Imaging
(is being offered by the Institute for Biomedical Engineering)
- Physikalische und technische Grundlagen der medizinischen Bildgebung
- Bildrekonstruktion
- Röntgenbildgebung
- Computertomographie (CT)
- Single Photon Emission Tomography (SPECT)
- Positron Emission Tomography (PET)
- Magnetresonanztomographie (MR)
- Ultraschall

PHY471 Physics and Mathematics of Radiotherapy planning
- Wechselwirkung von Strahlung im Gewebe
- Dosisberechnungsalgorithmen
- Bestrahlungsplanung
- Intensitätsmodulierte Strahlentherapie (IMRT)
- Mathematische Optimierungsmethoden in der IMRT Planung
- Bildregistrierung
- Grundlagen der klinischen Radioonkologie, Zielvolumendefinition, Fraktionierung

PHY361 Physics against cancer: The physics of imaging and treating cancer
- Radiation Physics
- Imaging for radiotherapy
- Imaging with protons and ions
- Radiotherapy with photons, electrons, protons and heavy ions
- Basics of radiobiology and bio-physical modelling for radiotherapy
- Organ motion management
- Special radiotherapy techniques

PHY401 Condensed Matter
Phenomenology of
- energy bands and fermi areas
- optical properties
- supra-conduction
- di-electrics and ferro-electrics
- magnetic properties
- surface effects
- electron optics and applications of focussed electron radiation
- production of structures at the micro- and nanometer scale
- lithographic structuring methods
- mesoscopic physics

PHY461 Experimental Methods and Instruments in Particle Physics
- Physics and structure of particle accelerators
- Foundations and concepts in particle detectors

- Trace and vortex detectors, calorimetry, particle identification
- Special applications such as Cerenkov detectors, air showers, direct detection of dark matter, emulsions
- Simulations methods, selection electronics, trigger and data measurement
- Examples and key experiments

STA404 Clinical biostatistics

- Confidence intervals for proportions,
- Analysis of diagnostic studies,
- Analysis of agreement,
- Randomized controlled trials,
- Hypothesis tests and sample size calculation,
- Randomization and blinding,
- Analysis of continuous and binary outcomes,
- Multiplicity,
- Subgroup analysis,
- Protocol deviations,
- Some special designs (crossover, equivalence, and clusters),
- Analysis of prognostic studies,
- Development and assessment of clinical prediction models.

ESC411 Computational Science I

- Ordinary differential equations
- Partial differential equations
- Monte-Carlo
- Inverse problems
- Signal-processing
- Optimization
- Visualization
- Combinatorial problems

PHY233 Numerical Methods I

- Floating point representation
- Solving systems of linear equations
- Matrix diagonalization algorithms
- Eigenvalue calculations
- Function interpolation and extrapolation
- Solving the differential equations with numerical methods

BIO330 Modelling in Biology

- Deterministic Reaction-Diffusion models
- Stochastic Reaction-Diffusion models
- Finite-element modelling
- Cell-based tissue models
- Image analysis

BIO253 Experimental Techniques in Physical Biology

- Biomechanics of tissue
- Force measurements
- Modern microscopy
- Scattering methods
- Nuclear magnetic resonance

PHY431 Biology for Physicists

- Constituents of Biomatter, DANN, RNA, Proteins
- Heredity and evolution
- Allometric scaling laws
- Morphogenesis
- Transcription of genes
- Neural Networks

Research seminar
Students are required to regularly attend a research seminar in bio- or medical physics during two semesters (e.g. at the department for radiooncology at the University Hospital, at the Paul-Scherrer Institute or at the Institute for Biomedical Engineering).

2.3. Examinations and performance assessments

The procedure of **module examinations** is regulated in the General Regulations and the Study Program Regulations at the Faculty of Science. The most important regulations are also listed in section 5.6 of these Study Regulations. Oral exams usually take 20 minutes, while written exams take 2 hours. At the beginning of the semester, the responsible faculty member in each module states what kind of examination there will be. This faculty member is also responsible for the content and conducting of the module exam and should be available for questions regarding the exam.

In case of failure the exam can be **repeated once**. Instead of taking the repetition examination, the entire module can also be repeated. In the case of modules whose performance assessment includes solving exercises, the exercises must also be repeated.

In addition to the exam, students may be required to complete further **records of performance** (such as completing practice problems). The responsible faculty member will determine these at the beginning of the semester.

In modules without a module exam, records of performance may be conducted during lecture periods such as an ungraded attendance exercise or a quiz.

2.4 Teaching degree for Swiss "Maturität" schools (university-track secondary schools)

The Institute of Gymnasial and Professional Pedagogy offers the necessary training for a teaching degree for "Maturität" schools. As the program is constantly being remodelled, it is best to look up detailed information at www.ife.uzh.ch/llbm.html.

The program covers 60 CP. You may choose whether to complete the degree in one or two subjects (i.e. to primarily teach physics, but have mathematics as a secondary subject).

The requirement for admission to a teaching program at "Maturität" schools is a master's degree in physics or an equivalent degree.

Compulsory elective modules in the area of subject specific didactic
A teaching degree in a high school subject requires the attendance of subject-specific courses that focus on teaching at "Maturität" schools. Up to 6 CP of the below modules count towards these courses upon request:

- AST241 Introduction to Astrophysics
- PHY250 Electronics
- PHY251 Electronics course
- PHY261 Tutorial
- PHY262 teaching assistant for Physics I
- PHY263 teaching assistant for Physics II
- PHY271 additional lab experiments
- PHY272 Semester project
- PHY291 Proseminar in experimental Physics
- PHY391 Proseminar in theoretical Physics

Physics as a 2nd subject for a teaching degree at "Maturität" schools
The coursework required for a degree in teaching physics as a 2nd subject involves 90 CP. This requirement can for instance be fulfils with a 60 CP BSc minor and a 30 CP MSc minor.

Mathematics as a 2nd subject for a teaching degree at "Maturität" school
Physicists who want to teach mathematics as their second subject must complete 90 CP worth of coursework. This requirement is usually fulfilled with a 60 CP BSc minor and a 30 CP MSc minor.

3. How to organize your studies

3.1 Duration of Studies

The standard duration of studies as described in these Study Regulations is six semesters. If students only complete their bachelor's thesis during the summer vacation, studies will take three full years. Obtaining a master's degree should take another three semesters, if no additional minor is completed. With a minor, the master's program lasts 4 semesters.

At most, students are allowed to take twice the amount of time as intended to complete the bachelor and master's program, counting from the start of the respective direction of study. Students who failed to fulfil the program in the anointed time period may no longer obtain a degree at the Faculty of Science. The Faculty may grant an extended period for study upon a well-founded request.

Departmental advisors are happy too assist in a sensible spreading out of the required course load over an extended duration of studies.

3.2 Personal mentoring, Advising

When students begin a program at the institute, they are each assigned a professor as an advisor. Advisors will help students at their request in questions concerning physics, their studies, and personal goals up until they earn their bachelor's degree. Once you have been assigned an advisor, you are asked to contact him or her independently.

3.3 Time commitment for your studies and a part-time job

The standard duration of studies is based on a full-time course load. Thanks to the flexibility of the Study Program Regulations, students can potentially keep a part-time job. However, even with a comparatively small part-time job, students should expect a slightly longer duration of studies.

Most modules require students to complete exercises and lab reports independently. This work usually takes as much time as actual class time. To be able to follow lectures, students will discover how important it is to work over material after class for, on average, one hour for every lesson.

Breaks are another opportunity to have a part-time job, though you must keep the scheduling of exams and intensive courses in mind (see section 2.2.5). We recommend that students discuss details carefully with the departmental advisors.

3.4 Research internships

Opportunities often arise for students to work with research teams in their labs, where they can get to know the current topics of research and the researchers. Students who are interested should address the team leaders directly or else contact the departmental advisors. In addition, the research centres at the CERN (Geneva), DESY (Hamburg) and PSI (Villigen in Kanton AG) offer programs for students over the summer, which involve practical work as well as theoretical education.

3.5 Military

Lectures and labs during the semester, intensive courses in the lecture-free period as well as dates for module exams may overlap with recruit schooling and other military training events. Therefore, we recommend students to complete their service before beginning their studies. If students do have to attend training events during their studies, they should be in touch with the departmental advisors. However, absence due to military service will never lead to a reduction of demands in a module exam or other controls of performance.

3.6 Mobility

At the university level, national as well as international projects and scholarships strongly encourage student mobility. A certain degree of mobility is expected of future academics in light of the growing

globalization in economics and technology. For instance, physicists should be well versed in English, since pretty much all primary literature and international conferences are in English.

We recommend for students to complete at least one semester of their studies at a university in a foreign country, so they can gain new experiences, widen their horizons and work together with people from different cultural backgrounds. Interested students must apply for admission to a foreign program independently. You can find further information on the university website or directly with the official mobility positions (www.uzh.ch/de/studies/mobility.html).

4 Addresses and Information Services

These guidelines: www.physiks.uzh.ch/de/studium.html

Information about the study of physics: www.physiks.uzh.ch

Homepages of the Physics Institute: www.physik.uzh.ch
Homepage of the Institute for Computational Science: http://www.ics.uzh.ch

Postal address: Physik-Institut der Universität, Winterthurerstr. 190, CH-8057 Zürich

Student Advisory Services:
Prof. C. Aegerter, Tel. 044 635 58 13, christof.aegerter@physik.uzh.ch, 36 K 86
Dr. Katharina Müller, Tel. 044 635 57 72, studium@physik.uzh.ch, 36 J 22

Course catalogue: www.studentservices.uzh.ch

Events at the UZH: www.agenda.uzh.ch

Regulations and information sheets for the Faculty of Science:
https://www.mnf.uzh.ch/en/studium/reglemente.html

Office of Student Affairs, for requests and general questions:
www.mnf.ch/de/studium/wie-studieren/beratung.html

5. Frequently asked questions and answers regarding a degree at the MNF

5.1 What documents contain the regulation of a degree at the MNF?

These Study Regulations are designed to be informative. However, we have included all information that is relevant to studying at the institute from the superordinate regulations, which have been listed bellow.

The binding superordinate regulations are (see https://www.mnf.uzh.ch/en/studium/reglemente.html)

a) Framework Regulations for studying in the bachelor and master's programs at the Faculty of Science at the University of Zurich.
b) Program Regulations for studying in the bachelor and master's programs at the Faculty of Science at the University of Zurich.
c) Regulations for Obtaining a Doctoral Degree

The Framework Regulations contains the general ordinances for the bachelor and master's programs. The Study Program Regulations describe each program's contents. The Doctorate Regulations regulates the doctoral program, which is not included in these Study Regulations.

These guidelines and the regulations a), b) and c) will be in effect for the foreseeable future. The Course Catalogue (www.studentservices.uzh.ch), which is put out every semester, contains more current information, such a detailed description of course offerings.

5.2 How is a program constructed? What academic degrees can I attain?

The various programs of study at the MNF are structured in levels. The first level leads to a bachelor's degree, the next level to a master's degree. The bachelor's program provides students with solid foundational knowledge and trains them in structured scientific thinking. The master's program then provides an advanced scientific education and trains students to work in the sciences independently.

The bachelor's program serves as a foundation for further studies at the master's level, be it in the same subject at our or a different university, or be it in a different subject. The Study Program Regulations determine under which conditions changing subjects between the bachelor and master's program is possible.

At the third level following a master's degree, students may begin doctoral studies, as long as they have found an advisor willing to oversee their dissertation. During doctoral studies in physics, the university usually provides students with financial support.

A master's degree provides the necessary training in a subject necessary to obtain a teaching degree for "Maturität" schools.

5.3 What is a minor?

A minor is a different subject from a major, in which students must earn either 30 or 60 credit points (see the following section). It will be listed in the bachelor and master's diploma.

5.4 How does the credit point system work?

All programs of study are planned according to the principles of the credit point system. This means that all academic performances with be awarded with credit points (cp) in conjunction with a control of performance (i.e. an exam or a paper). The system follows these principles:

- No credit points will be awarded without a control of performance.
- One credit point approximately corresponds to 30 hours of work. This time period should include class time as well as time needed for independent work (going over lectures, solving problems, writing papers and reports, preparing for exams, etc.).
- One semester of full-time study (including the lecture-free period) corresponds to 30 cp.

5.4.1 How many credit points do I need? How much time do I have?

180 CP are necessary for a bachelor's degree, an additional 90 CP (or 120 CP) are needed for a master's degree. This means that the bachelor's program will usually take six, the master's program three (potentially 4) additional semesters (the intended duration of study)

At most, students are allowed to take twice the intended duration of study to complete their degree, counting from the start of a specific direction of study. If a student fails to complete the requirements necessary for a bachelor's or master's degree in this time period, they will no longer be permitted to earn a degree at the Faculty of Science. The Faculty may permit an extended duration of study upon a well-founded request.

Therefore, part-time students in particular have the possibility of continuing their studies for, at most, twice the intended duration of study. On the other hand, with a bit of an extra effort, it may also be possible to earn the required credit points in less than the intended time period.

5.4.2 Can I compile my credit points freely?

No. Students may not choose the courses through which they earn credit points freely. These Study Regulations and the Study Program Regulations describe which courses are compulsory as well as where there is room for choice. For further information see section 5.5.

5.4.3 How can I find my credit point status?

Once per semester, students receive a transcript of the credit points they have thus far earned along with any grades received. Students are obliged to report any discrepancies to the dean's office within four weeks.

5.5 How is the degree structured? What are modules?

All program's of study are structured into modules. One module may consist of one or more courses. Credit points are only awarded for modules. At most, a module may extend over two semesters. Completion of a module may be dependent on the fulfilment of requirements; the Lecture Catalogue with Commentary provides further information on the matter (www.studentservices.uzh.ch/).

5.5.1 What types of modules are there?

We differentiate between three types of modules:

- Compulsory module: a module that all students in a specific program must complete.
- Core elective module: a module that must be chosen from a predetermined list of options.
- Elective module: a module that may be chosen freely from all the course offerings of one subject or group of subjects.

The Study Program Regulations of the MNF specifies the compulsory, core elective and elective modules of each program of study, including the corresponding credit points. The determination of elective and core elective modules may also be put out in the Lecture Catalogue with Commentary.

5.5.2 Who is responsible for modules (including examinations or other performance records)?

Each module has a responsible faculty member, who is listed in the Lecture Catalogue with Commentary.

5.5.3 How do I register for a module?

You may register for a module according to the general regulations of the UZH. You will find the current link for booking modules at www.students.uzh.ch/booking.html.

5.5.4 How do I earn my credit points?

Credit points are only awarded after controls of performance. Scheduling, form and breadth of these performance controls will be announced in the Lecture Catalogue with Commentary.

If students are discovered in an act of dishonesty at a performance control, the performance control will be recorded as having been failed.

5.6 What are module examinations? How are they conducted?

A module exam is a written or oral exam on the material covered in a module. The responsible faculty member decides whether the exam will be written or oral. Module exams are graded on the standard scale of 1 through 6 (half grades are possible). If the grade for the entire module is 4 or higher, students receive credit for the module. If the grade is lower than 4, students will not receive credit. The grade from a module exam is calculated into the final grade of your bachelor or master's diploma in proportion to how many credit points it was worth.

5.6.1 Do I have to register for individual module exams? Can I cancel my registration?

Once you have registered for a module, you are automatically signed up for the respective module exam. However, you may drop the module, including the exam, without explanation up until the cancellation deadline. The exact cancellation deadline is provided in the Course Catalogue.

5.6.2 Will I receive an invitation for each of my module examinations?

Not necessarily. You will not receive an invitation to written exams. The responsible faculty member will provide the necessary information for written exams. The responsible faculty member must also announce the time and date of oral module examinations. In addition, the administration at the physics institutes will send you an invitation to oral module exams at the physics institute.

5.6.3 When are the module examinations held?

The first exams of the fall semester will be held in the calendar weeks (CW) 51 and 2 to 6.
The first exams of the spring semester will be held in the calendar weeks 22 to 28.
Repeat exams are not necessarily held during the exam periods. Usually they are scheduled during CW 35 to 37.
The calendar weeks for individual module exams are listed in the guidelines or the program regulations. The exact dates of module exams are coordinated by the Office of Student Affairs and their date, time and location will be published in the course catalogue.

5.6.4 How and when will I receive the results of my module examinations?

Following every exam period, a commission of faculty members validates results. Students can view their results on a personal account prior to this.

5.6.5 What are my possibilities for repetition?

A module exam that was not passed can be taken over once, but only once. If a student does not pass a module exam for a compulsory module on the second try, he or she will be barred from continuing studies in any program for which this module is compulsory. If a student does not receive a passing grade for an elective module on the second try, the course may be replaced once with a different module. Elective modules can always be replaced with a different module after repetition.

If you should not pass a module exam, you will receive a registration form for the repeat exam along with your results. The registration form will inform you of the date by when you must enter a binding registration for the exam. If you do not register in time, you will have to retake the whole module and may repeat the exam only once more.

5.6.6 What happens if I fail to attend an exam or a repetition exam? What should I do in this case?

Anyone who fails to attend a module exam will fail the module. The Faculty may allow for exceptions where there are good reasons or a doctor’s attestation. If this is the case, you must hand in a written request including necessary papers or attestations with the dean’s office at latest five days after the exam.

In general, you will need to retake you exam on the date for repetition exams of the respective module.

5.6.7 How are performance controls conducted in modules for which no exam is intended?

In this case, the responsible faculty member is in charge of the situation. Their choice will be recorded in the Lecture Catalogue with Commentary. Even without an exam performance may be graded.

If you are prevented from attending such a performance control because of your health or another important reason, you must contact the responsible faculty member without delay. The responsible faculty member should then determine a date for repetition.

If a performance control is not completed successfully, the regulations for the repetition of an exam apply.

If you do not fulfil the requirements of a performance control, you will be given the opportunity to do them over. Depending on the type of performance control, this may mean that you will have to retake the entire module.

5.7 What do we need to know about bachelor or master's thesis?

A bachelor's thesis in physics involves working within a research team. Students present their results in a written report and an oral presentation. The bachelor's thesis is graded.

A master's thesis is expected to take 9 months of work. The thesis consists of advanced research, of which the results must be presented in a written report. The results must also be presented during a presentation within a seminar. The master's thesis and the presentation will be graded.

You may make a second attempt at a thesis with a new topic, but only once. The report must be written in German or English, or with the permission of your advisor in French or Italian.

5.8 Will I receive a bachelor's or master's degree automatically if I fulfil the necessary requirements?

No. These degrees are not awarded automatically when the necessary credit points have been earned. First, you must submit a request for completion of the bachelor or master's program. You will find the necessary forms at www.physik.uzh.ch/en/study/studeinberatung/formulare. If you have fulfilled all requirements, the Faculty will award you your title at the next gathering of the Faculty, as long as you submitted the request three weeks beforehand. Otherwise, you will receive your title at the next gathering.

5.9 How will my diploma look?

The diploma is written out in both German and English. It will also contain a grade, which is calculated according to the Study Program Regulations from the grades you received over the course of your studies. Grades in your major and minor will be recorded separately. In addition to your diploma, you will receive an academic record of all completed modules with their respective credit point values, as well as a diploma supplement, which contains general information about program's of study in Switzerland, especially at the University of Zurich.

5.10 Can I switch university every semester?

Yes. In general, credit points will be counted at all universities as long as they also follow the ECTS credit point system. A new university is however allowed to determine certain requirements for a program of study if their program of study is significantly different from the one at the UZH. However, if you wish to receive a bachelor's degree from the MNF, you will have to earn at least 90 of the 180 necessary credit points at the University of Zurich, though the Faculty may make exceptions upon request.

6. Glossary and Abbreviations

MNF	Faculty of Science: an organizational entity at the University of Zurich, which contains all natural sciences and mathematics.
CP	Credit points, ECTS points
ECTS	European Credit Transfer and Accumulation System
MSc	Master of Science
BSc	Bachelor of Science

SWH	Semester week hours (amount of hours per week per semester)
Dean	Head of the Faculty
Office of Student Affairs	Administrative office of the Faculty, at the Uni Irchel in Building Y-10
FS	Fall semester
SS	Spring semester
Student Administration Office	Administrative office of the entire university, in the main building at the university center.
lfp	Lecture-free period
MP	Mathematics for Physics students
KTI/II	Nuclear and Particle Physics I and II
QM	Quantum Mechanics
ED	Electrodynamics
FK	Solid State Physics