Curriculum for the master's programme in Physics (2018 version)

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§ 1 Objectives and qualification profile

(1) Based on the comprehensive general education in the field of physics during the bachelor's programme, the master's programme in Physics at the University of Vienna allows students to choose an emphasis and specialisation, and introduces them to the practice of academic research and writing. The master's programme in Physics is based on the research profile of the Faculty of Physics at the University of Vienna. Students demonstrate that they can meet this educational objective by means of a master's thesis and a public defence.

(2) Beyond a bachelor's qualification, graduates of the master's programme in Physics at the University of Vienna are qualified to observe complex phenomena in nature and technology by means of experiments and to describe these in a theoretical and mathematical way or to simulate and model these aided by computers. They have profound knowledge of and are able to apply modern research methods in their discipline. Through their profound academic education and their ability to think analytically in research, graduates are qualified to work independently and methodologically and develop problem-solving competences in a variety of different areas. Accordingly, the job profile of physicists is diverse and includes activities at universities and non-university research institutions, in industry (research and development, management), in the health sector, in the public service sector as well as in service institutions (banks, insurance companies, business consulting). During their professional activity, graduates of the master's programme benefit of the English language skills practised through their research work.

(3) The knowledge and skills acquired during the master's programme in Physics also prepare students for further degree programmes.

(4) The language of instruction is English. Language proficiency in English corresponding to level B2 of the Common European Framework of Reference is required.

§ 2 Duration and scope

(1) The workload for the master's programme in Physics comprises 120 ECTS credits. This is equivalent to a degree programme duration of four semesters.

(2) The programme is deemed completed if 60 ECTS credits as defined in the provisions on compulsory modules, 30 ECTS credits as defined in the provisions on elective modules, 27 ECTS credits as defined in the provisions on the master's thesis and 3 ECTS credits as defined in the provisions on the master's examination have been obtained.

§ 3 Entry requirements

(1) To be admitted to the master's programme in Physics students must have completed an eligible bachelor's programme or an eligible degree programme at the same level of university education at a recognised Austrian or foreign post-secondary educational institution.

(2) The bachelor's programme in Physics at the University of Vienna is certainly eligible.

(3) To compensate for significant disciplinary differences, supplementary examinations can be stipulated, which have to be completed until the end of the second semester of the master's programme. The Rectorate may specify which supplementary examinations are a prerequisite for taking examinations specified in the Curriculum of the master's programme.

(4) If the significant disciplinary differences according to para. 3 exceed the extent of 30 ECTS credits, this is not considered an eligible degree programme and the student is not admitted to the master's programme.

(5) The master's programme is held in English. Therefore, students must have English language proficiency corresponding to level B2 (Common European Framework of Reference for Languages).

§ 4 Academic degree

Graduates of the master's programme in Physics are awarded the degree "*Master of Science*", abbreviated as *MSc*. Where the academic degree is stated this must be after the name.

§ 5 Structure – Modules with allocated ECTS credits

(1) Overview

The master's programme in Physics consists of a group of elective modules comprising 30 ECTS credits in total and 4 compulsory modules comprising 60 ECTS credits in total.

- The group of elective modules Core comprising 30 ECTS credits allows students to acquire profound knowledge of several disciplines at the Faculty of Physics.

- In the alternative compulsory module Specialisation in Current Research Topics A (10 ECTS credits) students can choose if they would like to further acquire knowledge of an additional advanced discipline and complete an additional module from the group of elective modules Core (M-VAF A 1), or if they already familiarise themselves with a current research topic at the Faculty of Physics (M-VAF A 2).

- The compulsory module Specialisation in Current Research Topics B (20 ECTS credits) serves the consolidation and specialisation in a current field of research at the Faculty of Physics. In advanced practical laboratory courses and research internships, students should learn how to apply modern research methods and acquire profound knowledge of independent experimental work or independent use of modern computational methods to address concrete physical questions in the research areas of the Faculty.

- The compulsory module Extension comprising 20 ECTS credits can be used as an extension in topics outside the discipline and/or as a consolidation of related topics with a relation to natural sciences, technology, mathematics or computer science at the University of Vienna or other universities.

- The compulsory module Specialisation comprising 10 ECTS credits gives students the opportunity to prepare for the master's thesis in research groups and to familiarise themselves with the methods and devices required for their master's thesis. Subsequently, students should write their master's thesis.

(1.1) Group of elective modules: Core: 30 ECTS credits

Students must complete 3 modules comprising 30 ECTS credits from the group of elective modules Core. This group of elective modules includes the following modules:

	Elective modules	ECTS credits
M-CORE 1	Advanced Computational Physics	10
M-CORE 2	Advanced Electronic Structure	10
M-CORE 3	Advanced Particle Physics	10
M-CORE 4	Advanced Physics of Nuclei and Isotopes	10
M-CORE 5	Advanced Quantum Mechanics	10
M-CORE 6	Advanced Statistical Physics and Soft Matter Physics	10
M-CORE 7	General Theory of Relativity and Cosmology	10
M-CORE 8	Atmospheric Aerosol Physics	10
M-CORE 9	Experiments in Quantum Optics and Quantum Information	10
M-CORE 10	Condensed Matter Physics	10
M-CORE 11	Scattering, Microscopy and Spectroscopy	10
M-CORE 12	Theory of Quantum Optics and Quantum Information	10

(1.2) Alternative compulsory modules: Specialisation in Current Research Topics A: 10 ECTS credits

Students must select one module comprising 10 ECTS credits from the alternative compulsory modules Specialisation in Current Research Topics A. In the alternative compulsory module Specialisation in Current Research Topics A 1 (M-VAF A 1), students may also choose a module they did not already complete from the group of elective modules Core.

	Alternative compulsory modules	ECTS credits
M-VAF A 1	Specialisation in Current Research Topics A 1	10
M-VAF A 2	Specialisation in Current Research Topics A 2	10

(1.3) Compulsory modules: Specialisation in Current Research Topics B: 20 ECTS credits

The courses offered in the compulsory module Specialisation in Current Research Topics B are aimed at the consolidation and specialisation in a current field of research at the Faculty of Physics and at the introduction to independent academic work. For this purpose, courses with 5/10 ECTS credits are offered as well as advanced practical laboratory courses and research internships comprising 10 ECTS credits each depending on availability. The courses offered in this compulsory module may be adjusted to the demand of the students and the development of current interdisciplinary key research areas at the Faculty of Physics. The University is not obliged to offer each course of this module in every academic year or in every cycle.

	Compulsory module	ECTS credits
M-VAF B	Specialisation in Current Research Topics B	20

(1.4) Compulsory module: Extension: 20 ECTS credits

Students must obtain 20 ECTS credits in the compulsory module Extension. Students can take courses from the master's programme in Physics that they did not already complete or courses from other bachelor's or master's curricula of the University of Vienna (or other Austrian or foreign universities) with a

subject relation (technology, mathematics, natural sciences or computer science). No more than 5 ECTS credits may be from courses not related to the subject (other courses at the University of Vienna or at other universities.

	Compulsory module	ECTS credits
M-ERG	Extension	20

(1.5) Compulsory module: Specialisation: 10 ECTS credits

	Compulsory module	ECTS credits
M-SPEZ	Specialisation	10

(1.6) Master's thesis: 27 ECTS credits

(1.7) Public defence: 3 ECTS credits

(2) Module descriptions

(2.1) Group of elective modules: Core: 30 ECTS credits

Students must complete 3 modules from the group of elective modules Core. This group of elective modules includes the following modules:

M-CORE 1	**Advanced Computational Physics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended pre-requisite	It is recommended that students only choose this module if they know the basics of quantum mechanics and if they have completed the module WPF 1 Computational Physics in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire profound knowledge of concepts, models and methods in the practical application of modern computer simulation methods in the area of statistical mechanics and are able to apply it to disciplinary practical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include: Monte Carlo simulations, molecular dynamics, long-range interactions, entropy and free energy, rare events. The skills and abilities acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	<u>In preparation for the module examination:</u> VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 2	**Advanced Electronic Structure** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended pre-requisite	Quantum mechanics	

Module outcomes	Students acquire profound knowledge of the concepts, models and methods in modern electronic structure theory. They can apply these to disciplinary physical problems and acquire abilities in using disciplinary tools to solve problems. The contents include: Modern electronic structure methods for solid bodies and molecules (linear combination of plane waves and atomic orbitals); density-functional theory, Hartree Fock and configuration interaction method; many-body perturbation theory, second quantisation, introduction to quantum field theory, Feynman diagrammatic methods. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

M-CORE 3	**Advanced Particle Physics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they have completed the modules WP 6 Introduction to Particle Physics and WPF 7 Introduction to the Theory of Relativity in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire profound knowledge of the concepts, models and methods in particle physics. They acquire abilities in using mathematical tools to solve problems in the area of theoretical and mathematical physics. The contents include: Methods in quantum field theory applied to simple processes of particle physics; the standard model and its potential extensions. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 4	**Advanced Physics of Nuclei and Isotopes** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they have completed the module WP 8 Introduction to Nuclear Physics in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire profound knowledge of the concepts, models and methods in the area of nuclear physics and are able to apply it to disciplinary physical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include:	

	Nuclear reactions and their description in quantum mechanics; experimental nuclear physics; Accelerators and detectors; ion beam physics, technical realisation and physical basics of nuclear fusion and nuclear fission (energy, weapons, accidents); applications in medicine; material analysis; use of radionuclides with long half-lives in environmental sciences and geosciences; nuclear astrophysics. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

M-CORE 5	**Advanced Quantum Mechanics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Module outcomes	Students acquire profound knowledge of the concepts and methods in the area of theoretical quantum mechanics and are able to apply it to disciplinary physical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include: A selection of advanced topics in quantum mechanics: Mathematical foundations of quantum mechanics, symmetries, perturbation theory, scattering theory, many-body systems and second quantisation, path integrals, electromagnetic interactions in quantum field theory, relativistic quantum theory. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 6	**Advanced Statistical Physics and Soft Matter Physics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	Thermodynamics and Statistical Physics	
Module outcomes	Students acquire profound knowledge of the concepts, models and methods in theoretical statistical mechanics, either in the area of 'phase transitions and critical phenomena', or 'statistical mechanics of non-equilibrium systems' or 'soft matter physics'. They can apply these to disciplinary physical problems and acquire abilities in using disciplinary tools to solve problems. The contents on phase transitions and critical phenomena include: A selection of: Landau theory and Landau-Ginzburg theory; critical phenomena and renormalisation group; universality and critical exponents; Kosterlitz-Thouless transition, vortices, supraconductors, suprafluidity. The contents on statistical mechanics of non-equilibrium systems include:	

SSt (Semesterstunde): hour per week per semester.
pi (prüfungsimmanent): continuous assessment.
npi (nicht prüfungsimmanent): non-continuous assessment.
Course types and their abbreviations: see § 9.

	A selection of: Brownian motion and Langevin equations; Fokker-Planck equations; theory of linear response; irreversibility and fluctuation-dissipation theorem; kinetic gas theory, molecular hydrodynamics; fluid mechanics. The contents on soft matter physics include: A selection of: Polymer structures (ideal chains, self-avoiding chains, solvent effects); concentrated and semi-dilute polymer solutions, melting; dynamics of polymers (Rouse model and Zimm model); colloids and colloidal interactions; steric stabilisation and charge stabilisation; colloidal self-organisation. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

M-CORE 7	**General Theory of Relativity and Cosmology** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they have completed the module WP 7 Introduction to the Theory of Relativity in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire knowledge of the concepts and models in the General Theory of Relativity and their application to phenomena of astrophysics and cosmology. They acquire abilities in using mathematical tools to solve problems in the area of theoretical and mathematical physics. The contents include: Physical basics of the General Theory of Relativity, introduction to differential geometry and Riemannian geometry, Schwarzschild metric, tests of the General Theory of Relativity, relativistic star models, relativistic cosmology, linearised gravitational theory and gravitational waves. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 8	**Atmospheric Aerosol Physics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they have completed the module WP 9 Aerosol Physics in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire profound knowledge of the concepts and methods in the area of atmospheric aerosol physics and are able to apply it to disciplinary practical problems. They acquire abilities in using disciplinary tools for solving problems.	

SSt (Semesterstunde): hour per week per semester.
pi (prüfungsimmanent): continuous assessment.
npi (nicht prüfungsimmanent): non-continuous assessment.
Course types and their abbreviations: see § 9.

	The contents include: A selection of: Structure and composition of the atmosphere, dynamic and optical phenomena in the atmosphere, description, physical properties and transport of atmospheric aerosols, condensation processes in the atmosphere, new formation of aerosol particles through nucleation, formation of fog and clouds, atmospheric radiation balance, greenhouse effect and climate change, aerosol measurement technique. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

M-CORE 9	**Experiments in Quantum Optics and Quantum Information** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they know the basics of quantum mechanics and if they have completed the module WPF 2 Classical Optics and Quantum Optics as well as WPF 3 Quantum Information in the bachelor's programme in Physics at the University of Vienna.	
Module outcomes	Students acquire profound knowledge of the concepts, models and methods in the area of experimental quantum optics and quantum information and are able to apply it to disciplinary practical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include: A selection of: Photonic quantum optics, physics of matter waves from neutrons to molecules; elementary quantum grids with photons, atoms, ions, molecules and solid bodies; supraconducting circuits. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 10	**Condensed Matter Physics** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	Basics of Solid State Physics	
Module outcomes	Students acquire profound knowledge of the concepts, methods and materials in the area of solid state physics and are able to apply it to disciplinary practical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include:	

	Electronic properties of solid bodies: free electron gas, band structure, density of states, effective mass, Fermi surfaces, plasmons, quantum oscillations; dielectric and ferro-electric properties of solid bodies, semiconductors, supraconductors; magnetism: Hund's rules, Stoner model, paramagnetism, diamagnetism and ferromagnetism; mechanical properties of solid bodies, biomaterials; structure determination of non-crystalline solid bodies and of hybrid materials; modern experimental methods for structure determination and for measuring electrical phenomena and quantum transport phenomena; small angle X-ray scattering; presentation of current research areas in the field of solid state physics. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

M-CORE 11	**Scattering, Microscopy and Spectroscopy** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	Basics of Solid State Physics	
Module outcomes	Students acquire profound knowledge of concepts and methods to examine materials, especially to determine their structure and electronic properties, and they are able to apply it to disciplinary practical issues. They acquire abilities in using disciplinary tools for solving problems. The contents include: Light scattering, X-ray scattering, electronic scattering and neutron scattering, Bragg scattering, diffuse scattering, small-angle scattering, holography and neutron interferometry, scattering at atoms and crystalline solid bodies, kinematic and dynamic scattering theory; microscopic procedures and devices; aberrations, angular resolution, image generation with matter waves; methods in spectroscopy, especially electronic transport, tunnelling spectroscopy, electron energy loss spectroscopy, as well as different procedures in spectroscopy with photons (optical or X-ray-based). The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-CORE 12	**Theory in Quantum Optics and Quantum Information** (elective module)	**10 ECTS credits**
Prerequisites	None	
Recommended prerequisite	It is recommended that students only choose this module if they know the basics of quantum mechanics and if they have completed the module WPF 2 Classical Optics and Quantum Optics as well as WPF 3 Quantum	

	Information in the bachelor's programme in Physics at the University of Vienna.
Module outcomes	Students acquire profound knowledge of concepts and methods in the area of theoretical quantum optics and quantum information and are able to apply it to disciplinary physical problems. They acquire abilities in using disciplinary tools for solving problems. The contents include: Quantisation of the electromagnetic field; quantum mechanical description of light (states, transformations, observation/measurement); representation theory and quasi-probability distribution; linear optics; basics of quantum information processing with quantised light; non-linear processes; interaction between light and matter. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)
Proof of performance	Written module examination (10 ECTS credits)

(2.2) Alternative compulsory modules: Specialisation in Current Research Topics A: 10 ECTS credits

Students must select one module comprising 10 ECTS credits from the alternative compulsory modules Specialisation in Current Research Topics A.

M-VAF A 1	**Specialisation in Current Research Topics A 1** (alternative compulsory module)	**10 ECTS credits**
Prerequisites	None	
Module outcomes	Students acquire profound knowledge of concepts and methods in the core areas at the Faculty of Physics and are able to apply it to disciplinary physical problems. They acquire abilities in using disciplinary tools for solving problems. Students choose a module they did not already complete from the group of elective modules Core (M-CORE 1 to 12).	
Module structure	In preparation for the module examination: VO: 6 ECTS credits, 4 SSt. (npi) PUE: 4 ECTS credits, 2 SSt. (pi)	
Proof of performance	Written module examination (10 ECTS credits)	

M-VAF A 2	**Specialisation in Current Research Topics A 2** (alternative compulsory module)	**10 ECTS credits**
Prerequisites	None	
Module outcomes	Students have the opportunity to consolidate their knowledge of individual topics of current research at the Faculty of Physics according to their choice. In addition, students acquire profound knowledge of independent experimental work or independent use of modern computational methods to address concrete physical questions in the disciplines of the Faculty. Experiments are conducted and analysed with modern research devices / in modern laboratories of the Faculty of Physics. Students may also take advanced practical laboratory courses and conduct independent project work. Subject to availability, students select:	

	Courses (pi, npi) from the areas of aerosol physics and environmental physics, computational physics, computational materials physics, gravitational physics, nuclear physics, isotope physics, mathematical physics, quantum optics and quantum information, condensed matter physics and physics of low-dimensional solids, soft matter physics and physics of fluids and particle physics.
Module structure	Subject to availability, students choose lectures, seminars, combined lectures and exercises comprising 10 ECTS credits in total. VO 5 ECTS credits each, 3 SSt. (npi) and/or SE 5 ECTS credits each, 2 SSt. (pi) and/or VU 5/10 ECTS credits each, 3/6 SSt. (pi) or LP 10 ECTS credits each, 6 SSt. (pi)
Proof of performance	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (10 ECTS credits in total)

(2.3) Compulsory module: Specialisation in Current Research Topics B: 20 ECTS credits

Students must obtain 20 ECTS credits from the compulsory module Specialisation in Current Research Topics B (M-VAF B):

M-VAF B	**Specialisation in Current Research Topics B** (compulsory module)	**20 ECTS credits**
Prerequisites	None	
Module outcomes	Students have the opportunity to consolidate their knowledge of individual topics of current research at the Faculty of Physics according to their choice. In addition, students acquire profound knowledge of independent experimental work or independent use of modern computational methods to address concrete physical questions in the disciplines of the Faculty. Experiments are conducted and analysed with modern research devices / in modern laboratories of the Faculty of Physics. Students may also take advanced practical laboratory courses and conduct independent project work. <u>Subject to availability, students select:</u> Courses (pi, npi) from the areas of aerosol physics and environmental physics, computational physics, computational materials physics, gravitational physics, nuclear physics, isotope physics, mathematical physics, quantum optics and quantum information, condensed matter physics and physics of low-dimensional solids, soft matter physics and physics of fluids and particle physics. <u>Research internships (Forschungspraktika, PR Forschung):</u> In this module, students also have the opportunity to complete research internships. Students acquire profound knowledge of independent experimental work or independent use of modern computational methods to address concrete physical questions focussing on research activities in the disciplines of the Faculty. Experiments are conducted and analysed with modern research devices / in modern laboratories of the Faculty or foreign universities/research institutions.	
Module structure	Subject to availability, students choose lectures, seminars, combined lectures and exercises, practical laboratory courses and/or research internships comprising 20 ECTS credits in total: VO 5 ECTS credits each, 3 SSt. (npi) and/or SE 5 ECTS credits each, 2 SSt. (pi) and/or VU 5/10 ECTS credits each, 3/6 SSt. (pi) and/or LP 10 ECTS credits each, 6 SSt. (pi) and/or	

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npi (nicht prüfungsimmanent): non-continuous assessment.
Course types and their abbreviations: see § 9.

	PR Forschung 10 ECTS credits each (pi) For the recognition of research internships at external research institutions, students must obtain approval from the Physics Directorate of Studies in advance. The student requesting prior approval must enclose a recommendation by a teacher from the Faculty of Physics as part of local quality assurance.
Proof of performance	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (20 ECTS credits in total). For PR Forschung: The scope of the research internship is 10 ECTS credits, for which the institution at which the student completed the research internship must provide a written proof of performance, including 250 hours of research-related work.

(2.4) Compulsory module: Extension: 20 ECTS credits

Students must complete courses comprising 20 ECTS credits from the compulsory module Extension.

M-ERG	**Extension** (elective module)	**20 ECTS credits**
Prerequisites	None	
Module outcomes	According to their choice, students acquire profound knowledge in disciplines that complement their degree programme in a meaningful way.	
Module structure	Subject to availability, students choose courses with continuous assessment (pi) and/or courses with non-continuous assessment (npi) comprising 20 ECTS credits in total. Students may select: - Courses not already completed from the master's programme in Physics at the University of Vienna. - Courses from other bachelor's or master's curricula of the University of Vienna (or other Austrian or foreign universities) with a subject relation (technology, mathematics, natural sciences or computer science). - No more than 5 ECTS credits from topics not related to the subject (other courses at the University of Vienna or at other universities) if they have been approved by the Physics Directorate of Studies in advance.	
Proof of performance	Passing of all course examinations (npi) and/or continuous assessment courses (pi) specified in the module (20 ECTS credits in total)	

(2.5) Compulsory module: Specialisation: 10 ECTS credits

Students must obtain 10 ECTS credits in the compulsory module Specialisation.

M-SPEZ	**Specialisation** (compulsory module)	**10 ECTS credits**
Prerequisites	None	
Module outcomes	Students acquire highly specialised knowledge and abilities that are required for preparing and writing a master's thesis in the relevant research area upon completion of this module.	
Module structure	KU: 10 ECTS credits, 2 SSt. (pi)	
Proof of performance	Passing of the course (10 ECTS credits)	

§ 6 Master's thesis

(1) The purpose of the master's thesis is to demonstrate the student's ability to achieve adequate standards of content and methodology when independently addressing academic topics. The assignment for the master's thesis must be chosen in a way that the student can reasonably be expected to complete it within six months.

(2) The topic of the master's thesis must be taken from one of the compulsory modules and/or elective modules. If a different topic is selected or if there is uncertainty regarding allocation of the selected topic, the competent body responsible for study matters should decide on whether or not it is admissible.

(3) The master's thesis comprises 27 ECTS credits.

§ 7 Master's examination

(1) To be admitted to a master's examination the student must have successfully passed all required modules and examinations and the master's thesis must have been positively assessed.

(2) The master's examination is a public defence. This form of examination consists of a defence and an examination on the academic disciplines related to the master's thesis. Grading will be conducted as stipulated in the Statutes of the University of Vienna.

(3) The master's examination comprises 3 ECTS credits.

§ 8 Mobility during the master's programme

The completion of modules abroad is permitted. The competent body responsible for study matters is responsible for the recognition of academic achievements completed abroad.

§ 9 Course classification

(1) All courses with non-continuous assessment (npi) have to be offered as one of the following types of courses:

Lectures (*Vorlesungen*, VO) [non-continuous assessment] serve the purpose of imparting knowledge primarily through lectures by a teacher that can be combined with interactive elements. Lecturers answer comprehension questions. Students must consolidate the course contents beyond the classes through self-study. Instructions for self-study and/or supplementary literature facilitate continuous and detailed learning. In lectures, the proof of performance is a written or an oral examination.

(2) All courses with continuous assessment (pi) have to be offered as one of the following types of courses:

Combined lectures and exercises (*Vorlesungen verbunden mit Übungen*, VU) [continuous assessment] are courses with continuous assessment that combine the acquisition of subject-specific knowledge and/or methodological knowledge in the lecture part with their application in the exercise part. A VU is a lecture (VO) accompanied by exercises. The lecturer decides on the temporal sequence of lecture-type and exercise-type parts as needed. The lecture part and the exercise part must be completed simultaneously. Achieving the learning outcomes of a VU also requires independent study outside the designated course hours. The proof of performance is based on multiple written or oral student assignments during the course or on independently completing and submitting assignments as well as on a final written or oral examination.

Preparatory exercises for exams (*prüfungsvorbereitende Übungen*, PUE) [continuous assessment] serve the application of already acquired knowledge and the consolidation of skills that are required for understanding the course contents. Students work independently or as a team on concrete tasks and issues. Students are supervised in small groups. Lecturers are mainly tasked with guiding

and monitoring students' work and implementing a sophisticated feedback culture. PUEs prepare students for the module examination and are courses with continuous assessment. The ECTS credits specified for these are not part of the 120 ECTS credits specified for this master's programme. The proof of performance necessary for the modules is to pass the module examination. The skills acquired during preparation exercises for examinations are a central element of the module outcomes and are inherently checked in the module examination.

Seminars *(Seminare,* SE*)* [continuous assessment] serve to induce academic debate. Seminars aim at giving students the ability to gain detailed knowledge of a problem of physics through the study of specialist literature and data sources. Students also learn to present their findings in an intelligible manner in an oral presentation. Students are assessed on the basis of multiple written or oral assignments during the course.

Courses (*Kurse*, KU) [continuous assessment] serve the purpose of acquiring knowledge of and consolidating selected themes, academic problems and solutions or acquiring basic, intermediate and specialised knowledge and knowledge of methods or addressing special topics. Courses aim at giving students the ability to gain detailed knowledge of a problem of physics instructed by the lecturer through the study of current specialist literature and data sources. Students also learn to present their findings in an intelligible manner in an oral presentation. The assessment is based on multiple oral contributions by the participants during the course.

Practical laboratory courses (*Laborpraktika,* LP) [continuous assessment] are courses that complement lectures and seminars and aim at consolidating practical skills and knowledge. Students are assessed on the basis of multiple written or oral assignments during the course.

Research internships (*Praktika Forschung,* PR Forschung) [continuous assessment] allow students to get an insight into the academic work of researchers of research groups at the Faculty of Physics or at non-university research institutions. This can take the form of participation in a current research project or a small student project using the used measuring instruments, programmes, etc. Research internships may take no longer than 6 months and are assessed only with "participated with success"/ or "participated without success". The scope of the research internship is 10 ECTS credits, for which the institution at which the student completed the research internship must provide a written proof of performance, including 250 working hours. For the recognition of research internships at external research institutions or other universities, students must obtain approval from the directorate of studies in advance. The student requesting prior approval must enclose a recommendation by a teacher from the Faculty of Physics as part of local quality assurance.

§ 10 Courses with a limited number of participants and registration procedures

Students may participate in courses with continuous assessment subject to availability of places. The following general limits on the number of students apply in the different courses:

Combined lectures and exercises (*Vorlesung verbunden mit Übungen,* VU)	15
Preparatory exercises for exams (*prüfungsvorbereitende Übungen*, PUE)	25
Seminars (*Seminare*, SE)	15
Advanced practical laboratory courses (*vertiefende Laborpraktika*, LP)	4
Courses from the compulsory module Specialisation (KU)	2
Research internships (*Forschungspraktika*, PR Forschung)	1

(2) Modalities concerning the registration for courses and examinations as well as the allocation of places in the courses are governed by the stipulations of the Statutes of the University of Vienna.

§ 11 Examination regulations

(1) Proof of performance in courses
The lecturer of a course is responsible for making the necessary announcements according to the stipulations in the Statutes.

(2) Content of examinations
The examination content relevant to preparing and holding examinations must be in line with the required number of ECTS credits. This also applies to module examinations.

(3) Examination procedure
The examination procedure is subject to the stipulations in the Statutes of the University of Vienna.

(4) No double recognition and no dual use
Courses taken and examinations passed in the three-year bachelor's programme, which constitute entry requirements for the master's programme, cannot be recognised again in the master's programme. Courses taken and examinations passed from another compulsory or elective module of the degree programme cannot be recognised within another module within the same degree programme. This also applies to recognition procedures.

(5) Examination results must be allocated to the relevant module by the stated ECTS figure and must not be allocated to different proofs of performance.

§ 12 Entry into force

(1) This Curriculum will enter into force upon announcement in the University Gazette of the University of Vienna as of 1 October 2018.

(2) The amendment to the Curriculum as stated in the University Gazette of the University of Vienna on 26 June 2020, 26th edition, number 139 as amended enters into force on 1 October 2022.

§ 13 Transitional provisions

(1) This Curriculum applies to all students who commence their degree programme as of the winter semester of 2018/2019.

(2) If, at a later stage of the degree programme, courses are no longer offered which were compulsory under the original curricula, the competent body responsible for study matters decides ex officio (equivalence regulation) or at the request of the doctoral candidate which courses and examinations have to be completed instead.

(3) Students who have started the master's programme in Physics before that date may voluntarily accept the provisions of this Curriculum by simple confirmation.

(4) Students who started the master's programme, which entered into force prior to this Curriculum (University Gazette of 21 June 2007, 30th edition, number 151 as amended) are entitled to complete their degree programme by 30 April 2021.

(5) The competent body responsible for study matters will be entitled to determine in general or on a case-by-case basis which of the courses taken and examinations passed will be recognised for this Curriculum.

Appendix:

Semester path for the master's programme in Physics

To complete the master's programme in Physics in the specified study period, it is recommended that students follow the following semester path:

<table>
<tr><th>1st semester</th><th>2nd semester</th><th>3rd semester</th><th>4th semester</th></tr>
<tr><th>30 ECTS credits</th><th>30 ECTS credits</th><th>30 ECTS credits</th><th>30 ECTS credits</th></tr>
<tr><td rowspan="3">3 elective modules from the group of elective modules Core
M-CORE 1-12
(30 ECTS credits)</td><td>Specialisation in Current Research Topics A
M-VAF A 1 or M-VAF A 2
(10 ECTS credits)</td><td>Specialisation in Current Research Topics B
M-VAF B
(10 ECTS credits)</td><td rowspan="2">Master's Thesis
(27 ECTS credits)</td></tr>
<tr><td>Specialisation in Current Research Topics B
M-VAF B
(10 ECTS credits)</td><td>Extension
M-ERG
(10 ECTS credits)</td></tr>
<tr><td>Extension
M-ERG
(10 ECTS credits)</td><td>Specialisation
M-SPEZ
(10 ECTS credits)</td><td>Public Defence
(3 ECTS credits)</td></tr>
</table>

English translation of the module titles:

German	**English**
Advanced Computational Physics (Wahlmodul)	Advanced Computational Physics (elective module)
Advanced Electronic Structure (Wahlmodul)	Advanced Electronic Structure (elective module)
Advanced Particle Physics (Wahlmodul)	Advanced Particle Physics (elective module)
Advanced Physics of Nuclei and Isotopes (Wahlmodul)	Advanced Physics of Nuclei and Isotopes (elective module)
Advanced Quantum Mechanics (Wahlmodul)	Advanced Quantum Mechanics (elective module)
Advanced Statistical Physics and Soft Matter Physics (Wahlmodul)	Advanced Statistical Physics and Soft Matter Physics (elective module)
Allgemeine Relativitätstheorie und Kosmologie (Wahlmodul)	General Theory of Relativity and Cosmology (elective module)
Atmosphärische Aerosolphysik (Wahlmodul)	Atmospheric Aerosol Physics (elective module)
Experiments in Quantum Optics & Quantum Information (Wahlmodul)	Experiments in Quantum Optics and Quantum Information (elective module)
Physik der kondensierten Materie (Wahlmodul)	Condensed Matter Physics (elective module)
Streuung, Mikroskopie und Spektroskopie (Wahlmodul)	Scattering, Microscopy and Spectroscopy (elective module)
Theory of Quantum Optics & Quantum Information (Wahlmodul)	Theory of Quantum Optics and Quantum Information (elective module)
Vertiefung in aktuelle Forschungsthemen A 1 (alternatives Pflichtmodul)	Specialisation in Current Research Topics A 1 (alternative compulsory module)
Vertiefung in aktuelle Forschungsthemen A 2 (alternatives Pflichtmodul)	Specialisation in Current Research Topics A 2 (alternative elective module)
Vertiefung in aktuelle Forschungsthemen B (Pflichtmodul)	Specialisation in Current Research Topics B (compulsory module)

SSt (Semesterstunde): hour per week per semester.
pi (prüfungsimmanent): continuous assessment.
npi (nicht prüfungsimmanent): non-continuous assessment.
Course types and their abbreviations: see § 9.

Ergänzung (Pflichtmodul)	Extension (compulsory module)
Spezialisierung (Pflichtmodul)	Specialisation (compulsory module)