

Subdivided Module Catalogue for the Subject

Physics International

as a Master's with 1 major with the degree "Master of Science" (120 ECTS credits)

Examination regulations version: 2020 Responsible: Faculty of Physics and Astronomy

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record 88|j44|-|-|H|2020

UNIVERSITÄT WÜRZBURG

Learning Outcomes

After having successfully completed their studies the graduates safulfil the following requirements:

- The graduates are highly skilled in abstract thinking, they are able to think analytically, they have a high problem-solving competence and are able to structure complex interrelations.
- The graduates have a wide overview of the different areas of physics and of connections to other sciences.
- They have profound knowledge of the mathematical and theoretical basics of physics as well as profound knowledge of the theoretical and experimental methods to gain new insights.
- They are able to transfer their abilities and expertise to research projects and know the current state of research in at least one speciality.
- With the help of primary literature, especially in English, they are able to become acquainted with the current state of research in a speciality .
- They have the ability to independently apply physical and mathematical methods to concrete experimental or theoretical physical tasks, to develop solutions and to interpret and assess the results.
- Even with incomplete information they are in a position to work independently on physical problems, applying scientific methods and following the rules of good scientific practice, and to present, assess and attend to the results and consequences of their work.
- They are able to discuss physical topics on the current state of research with other physicists and also to explain connections to physics to non-scientists.
- As physicists they are able to work in or even lead interdisciplinary and international teams with (natural) scientists and/or engineers in research, industry and economy.

Scientific qualification

- The graduates have profound knowledge of the mathematical, experimental and theoretical basics of physics
- The graduates can resort to profound knowledge of the theoretical and experimental methods to gain new insights
- The graduates have a wide overview of the different areas of physics
- The graduates know scientific areas adjacent to physics and realise interdisciplinary connections .
- The graduates have are highly skilled in abstract thinking, they are able to think analytically, they have a high problem-solving competence and are in a position to structure complex interrelations
- The graduates transfer their abilities and expertise to research projects and know the current state of research in at least one speciality .
- The graduates are able to discuss physical topics on the current state of research with other physicists.
- The graduates are in a position to independently apply physical and mathematical methods to concrete experimental or theoretical physical tasks, to develop solutions and to interpret and assess the results.
- With the help of primary literature, especially in English, the graduates are able to become acquainted with the current state of research in a speciality.

Qualification to start a job

- Even with incomplete information the graduates are in a position to work independently on physical problems, following the rules of good scientific practice, and to present, assess and attend to the results and consequences of their work.
- As physicists the graduates are able to work in or even lead interdisciplinary and international teams with (natural) scientists and/or engineers in research, industry and economy.

| Master's with 1 major Physics International (2020) | JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- | page 2 / 170 |
|--|--|--------------|
| | ta record Master (120 ECTS) Physics International - 2020 | |

- The graduates have the ability to independently apply physical and mathematical methods to concrete experimental or theoretical physical tasks, to develop solutions and to interpret and assess the results.
- The graduates are able to transfer their abilities and expertise to research projects and know the current state of research in at least one speciality.

Self-development

UNIVERSITÄT

WÜRZBURG

- Even with incomplete information the graduates are in a position to work independently on physical problems, and to present, assess and attend to the results and consequences of their work.
- The gradues know the rules of good scientific practice and take them into account

Qualification for social commitment

- The graduates are able to critically reflect scientific developments and to capture their impact on economy, society and environment. (technological impact assessment)
- The graduates have enlargened their knowledge concerning economic, social, natural scientific or cultural questions (to name but a few) and are able to attend to their views reasonably.
- The graduates are able to discuss physical topics on the current state of research with other physicists and also to explain physical correlations to non-scientists.
- The graduates have developped the willingness and ability to show their skills in participative processes and actively contribute to decisions.

Abbreviations used

Course types: \mathbf{E} = field trip, \mathbf{K} = colloquium, \mathbf{O} = conversatorium, \mathbf{P} = placement/lab course, \mathbf{R} = project, \mathbf{S} = seminar, \mathbf{T} = tutorial, $\ddot{\mathbf{U}}$ = exercise, \mathbf{V} = lecture

Term: **SS** = summer semester, **WS** = winter semester

Methods of grading: **NUM** = numerical grade, **B/NB** = (not) successfully completed

Regulations: **(L)ASPO** = general academic and examination regulations (for teaching-degree programmes), **FSB** = subject-specific provisions, **SFB** = list of modules

Other: **A** = thesis, **LV** = course(s), **PL** = assessment(s), **TN** = participants, **VL** = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

ASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

06-Feb-2020 (2020-16) 09-Jun-2021 (2021-63) 06-Sep-2022 (2022-55) 12-Jun-2024 (2024-75) 14-Nov-2024 (2024-97)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding.

| Master's with 1 major Physics International (2020) | JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- | page 4 / 170 |
|--|--|--------------|
| | ta record Master (120 ECTS) Physics International - 2020 | |



In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.

The subject is divided into

| Abbreviation | Module title | ECTS credits | Method of grading | page | | | |
|--|---|-----------------|-------------------|------|--|--|--|
| Electives Field (60 ECTS cr | edits) | | <u>.</u> | | | | |
| Subfield Physics (55 ECTS credits) | | | | | | | |
| Advanced Laboratory Courses (9 ECTS credits) | | | | | | | |
| 11-P-FM1-Int-201-m01 | Advanced Laboratory Course Master Part 1 | 3 | B/NB | 121 | | | |
| 11-P-FM2-Int-201-m01 | Advanced Laboratory Course Master Part 2 | 3 | B/NB | 122 | | | |
| 11-P-FM3-Int-201-m01 | Advanced Laboratory Course Master Part 3 | 3 | B/NB | 123 | | | |
| 11-P-FM4-Int-201-m01 | Advanced Laboratory Course Master Part 4 | 3 | B/NB | 124 | | | |
| Advanced Seminar (5 EC | TS credits) | | | | | | |
| 11-OSP-A-Int-201-m01 | Advanced Seminar Physics A | 5 | NUM | 119 | | | |
| 11-OSP-B-Int-201-m01 | Advanced Seminar Physics B | 5 | NUM | 120 | | | |
| Experimental Physics (1 | o ECTS credits) | | L | | | | |
| 11-BSV-Int-201-m01 | Image and Signal Processing in Physics | 6 | NUM | 58 | | | |
| 11-OHL-Int-201-m01 | Organic Semiconductors | 6 | NUM | 117 | | | |
| 11-PMM-Int-201-m01 | Physics of Advanced Materials | 6 | NUM | 127 | | | |
| 11-SPI-Int-201-m01 | Spintronics | 6 | NUM | 148 | | | |
| 11-FK2-Int-201-m01 | Solid State Physics 2 | 8 | NUM | 88 | | | |
| 11-FKS-Int-201-m01 | Solid State Spectrocopy | 6 | NUM | 90 | | | |
| 11-MAG-Int-201-m01 | Magnetism | 6 | NUM | 107 | | | |
| 11-HNS-Int-201-m01 | Optical Properties of Semiconductor Nanostructures | 6 | NUM | 97 | | | |
| 11-HPH-Int-201-m01 | Semiconductor Physics | 6 | NUM | 99 | | | |
| 11-QTR-Int-201-m01 | Quantum Transport | 6 | NUM | 138 | | | |
| 11-QIC-Int-201-m01 | Advanced Theory of Quantum Computing and Quantum Infor- | 6 | NUM | 134 | | | |
| A NOD Int and mad | mation | | NILIAA | | | | |
| 11-NOP-Int-201-m01 | Nano-Optics | 6 | NUM | 115 | | | |
| 11-PTS-Int-201-m01 | Phenomenology and Theory of Superconductivity | 6 | NUM | 128 | | | |
| 08-PCM4-161-m01 | Ultrafast spectroscopy and quantum-control | 5 | NUM | 13 | | | |
| 11-CSFM-Int-201-m01 | Advanced Topics in Solid State Physics | 6 | NUM | 68 | | | |
| 11-ASM-Int-201-m01 | Methods of Observational Astronomy | 6 | NUM | 49 | | | |
| 11-TPE-Int-201-m01 11-ASP-Int-201-m01 | Experimental Particle Physics | 6 | NUM | 164 | | | |
| | Introduction to Space Physics | 6 | NUM | 50 | | | |
| 11-MAS-Int-201-m01 | Multi-wavelength Astronomy | 6 | NUM | 110 | | | |
| 11-CSAM-Int-201-m01 | Advanced Topics in Astrophysics | 6 | NUM | 67 | | | |
| 11-MRI-Int-201-m01 | Advanced Magnetic Resonance Imaging | 6 | NUM | 112 | | | |
| 11-SSC-Int-201-m01 | Surface Science | 6 | NUM | 150 | | | |
| 11-BIC-Int-201-m01 | Basic Imaging Concepts | 6 | NUM | 55 | | | |
| 11-IRP-Int-201-m01 | Basic Imaging Reconstruction and Processing | 6 | NUM | 101 | | | |
| 11-CAP-Int-201-m01 | Contemporary Astrophysics | 6 | NUM | 62 | | | |
| 11-AAI-Int-201-m01 | Advanced Astro Imaging | 6 | NUM | 43 | | | |
| 11-CTA-Int-201-m01 | Advanced Computer Tomography | 6 | NUM | 69 | | | |
| 11-EIM-Int-201-m01 | Electron and Ion Microscopy | 6 | NUM | 71 | | | |
| 11-SPT-Int-201-m01 | Scanning Probe Technologies | 6 | NUM | 149 | | | |
| 11-FPA-Int-201-m01 | Visiting Research | 10 | NUM | 91 | | | |

Master's with 1 major Physics International (2020)

JMU Würzburg • generated 19-Apr-2025 • exam. reg. data record Master (120 ECTS) Physics International - 2020

page 6 / 170

| 11-EXE5-Int-201-m01 | Current Topics in Experimental Physics | 5 | NUM | 73 |
|--|---|----|------|---------|
| 11-EXE6-Int-201-m01 | Current Topics in Experimental Physics | 6 | NUM | 75 |
| 11-EXE7-Int-201-m01 | Current Topics in Experimental Physics | 7 | NUM | 76 |
| 11-EXE8-Int-201-m01 | Current Topics in Experimental Physics | 8 | NUM | 77 |
| 11-EXE6A-Int-201-m01 | Current Topics in Experimental Physics | 6 | NUM | 74 |
| 11-EXP6-Int-201-m01 | Current Topics in Physics | 6 | NUM | 80 |
| Theoretical Physics (10 I | ECTS credits) | | | |
| 11-QM2-Int-201-m01 | Quantum Mechanics II | 8 | NUM | 136 |
| 11-TQO-Int-221-m01 | Theoretical Quantum Optics | 8 | NUM | 169 |
| 11-RTT-Int-201-m01 | Theory of Relativity | 6 | NUM | 144 |
| 11-RMFT-Int-201-m01 | Renormalization Group Methods in Field Theory | 8 | NUM | 142 |
| 11-PKS-Int-201-m01 | Physics of Complex Systems | 6 | NUM | 125 |
| 11-0IC-Int-201-m01 | Advanced Theory of Quantum Computing and Quantum Infor- mation | 6 | NUM | 134 |
| 11-TFK-Int-201-m01 | Theoretical Solid State Physics | 8 | NUM | 162 |
| 11-TFK2-Int-201-m01 | Theoretical Solid State Physics 2 | 8 | NUM | 160 |
| 11-TEFK-Int-201-m01 | Topological Effects in Solid State Physics | 8 | NUM | 156 |
| 11-FFK-Int-201-m01 | Field Theory in Solid State Physics | 8 | NUM | 86 |
| 11-AKTF-Int-201-m01 | Selected Topics of Theoretical Solid State Physics | 6 | NUM | 46 |
| 11-CMS-Int-201-m01 | Computational Materials Science (DFT) | 8 | NUM | 63 |
| 11-KFT-Int-201-m01 | Conformal Field Theory | 6 | NUM | 105 |
| 11-KFT2-Int-201-m01 | Conformal Field Theory 2 | 6 | NUM | 103 |
| | Group Theory | 6 | NUM | 95 |
| | Particle Physics (Standard Model) | 6 | NUM | 165 |
| | Renormalization Group and Critical Phenomena | 6 | NUM | 65 |
| | Bosonisation and Interactions in One Dimension | 6 | NUM | 60 |
| 11-GGD-Int-201-m01 | Introduction to Gauge/Gravity Duality | 8 | NUM | 93 |
| | Cosmology | 6 | NUM | 45 |
| 11-AST-Int-201-m01 | Theoretical Astrophysics | 6 | NUM | 52 |
| | Introduction to Plasma Physics | 6 | NUM | 72 |
| | High-Energy Astrophysics | 6 | NUM | |
| | Computational Astrophysics | 6 | NUM | 47 |
| | Quantum Field Theory I | | | 114 |
| 11-QFT1-Int-201-m01 | Quantum Field Theory II | 8 | NUM | 130 |
| - | | 8 | NUM | 132 |
| | Theoretical Elementary Particle Physics | 8 | NUM | 158 |
| | Selected Topics of Theoretical Elementary Particle Physics | 6 | NUM | 54 |
| 11-BSM-Int-201-m01 | Models Beyond the Standard Model of Elementary Particle Physics | 6 | NUM | 56 |
| 11-STRG1-Int-201-m01 | String Theory 1 | 8 | NUM | 152 |
| 11-STRG2-Int-201-m01 | String Theory 2 | 6 | NUM | 154 |
| 11-RAI-Int-211-m01 | Radio Astronomical Interferometry | 6 | NUM | 140 |
| 11-SLQ-Int-241-m01 | Black Holes | 6 | NUM | 146 |
| 11-TPSM-Int-211-m01 | Particle Physics (Standard Model) | 8 | NUM | 167 |
| 11-FPA-Int-201-m01 | Visiting Research | 10 | NUM | 91 |
| 11-EXT5-Int-201-m01 | Current Topics of Theoretical Physics | 5 | NUM | 81 |
| 11-EXT6-Int-201-m01 | Current Topics of Theoretical Physics | 6 | NUM | 83 |
| Aaster's with 1 major Physics Internat | ional (2020) JMU Würzburg • generated 19-Apr-2025 • exam. re ta record Master (120 ECTS) Physics International | | page | 7 / 170 |

| 11-EXT7-Int-201-m01 | Current Topics of Theoretical Physics | 7 | NUM | 84 |
|---------------------------|--|----|------|-----|
| 11-EXT8-Int-201-m01 | Current Topics of Theoretical Physics | 8 | NUM | 85 |
| 11-EXT6A-Int-201-m01 | Current Topics of Theoretical Physics | 6 | NUM | 82 |
| 11-EXP6A-Int-201-m01 | Current Topics in Physics | 6 | NUM | 79 |
| 11-APM-Int-241-m01 | Astrophysics | 6 | NUM | 48 |
| 11-ATP-Int-241-m01 | Atmospheric Physics | 6 | NUM | 53 |
| 11-0QS-Int-241-m01 | Open Quantum Systems | 6 | NUM | 118 |
| Subfield Non-Physical Mi | nors | | | |
| 10-M-ORSaf-152-m01 | Operations Research for students of other subjects | 10 | NUM | 41 |
| 10-M-VAN-152-m01 | Advanced Analysis | 7 | NUM | 42 |
| 10-M=AAANin-152-m01 | Applied Analysis | 10 | NUM | 26 |
| 10-M=ADGMin-152-m01 | Differential Geometry | 10 | NUM | 27 |
| 10-M=AFTHin-152-m01 | Complex Analysis | 10 | NUM | 28 |
| 10-M=ALTHin-152-m01 | Lie Theory | 10 | NUM | 29 |
| 10-M=ATOPin-152-m01 | Topology | 10 | NUM | 30 |
| 10-M=AZTHin-152-m01 | Number Theory | 10 | NUM | 31 |
| 10-M=VGDSin-152-m01 | Groups and their Representations | 10 | NUM | 33 |
| 10-M=VGEMin-152-m01 | Geometrical Mechanics | 10 | NUM | 34 |
| 10-M=VNPEin-152-m01 | Numeric of Partial Differential Equations | 10 | NUM | 37 |
| 10-M=VDIMin-152-m01 | Discrete Mathematics | 5 | NUM | 32 |
| 10-M=VMPHin-152-m01 | Selected Topics in Mathematical Physics | 10 | NUM | 36 |
| 10-M=VPDPin-152-m01 | Partial Differential Equations of Mathematical Physics | 10 | NUM | 38 |
| 10-M=VPRGin-152-m01 | Pseudo Riemannian and Riemannian Geometry | 10 | NUM | 39 |
| 10-I=DB-161-m01 | Databases | 5 | NUM | 15 |
| 10-I=PA-161-m01 | Analysis and Design of Programs | 5 | NUM | 18 |
| 10-I-RAK-152-m01 | Computer Architecture | 5 | NUM | 24 |
| 10-I-APR-172-m01 | Advanced Programming | 5 | NUM | 20 |
| 10-I-BS-191-m01 | Operating Systems | 5 | NUM | 22 |
| 10-l=Kl1-161-m01 | Artificial Intelligence 1 | 5 | NUM | 16 |
| 08-FU-SAM-161-m01 | Sensor and Actor Materials - Functional Ceramics and Magne- tic Particles | 5 | NUM | 12 |
| 08-FU-EEW-152-m01 | Electrochemical Energy Storage and Conversion | 5 | NUM | 9 |
| 08-FU-MW-161-m01 | Structure and Properties of Modern Materials: Experiments vs. Simulations | 5 | NUM | 11 |
| 11-EXNP6-Int-201-m01 | Nonphysical Minor Subject | 6 | NUM | 78 |
| Master Project Modules (6 | o ECTS credits) | | | |
| 11-FS-P-Int-201-m01 | Professional Specialization Physics International | 15 | B/NB | 92 |
| 11-MP-P-Int-201-m01 | Scientific Methods and Project Management Physics Interna- tional | 15 | B/NB | 111 |
| 11-MA-P-Int-201-m01 | Master Thesis Physics International | 30 | NUM | 109 |
| | · | | | · |

| Module | | | | | Abbreviation | |
|---|----------------------|--|--|--|-----------------------|--------------|
| Electro | chemic | al Energy Storage and (| Conversion | | 08-FU-EEW-152-m0 | 1 |
| Module coordinator | | | | Module offered by | | |
| holder of the Chair of Chemical Technology of Material Syn- | | | | | echnology of Materi | al Synthesis |
| thesis | or the c | | ology of material syn | | centrology of materi | ar Synthesis |
| ECTS | Metho | d of grading | Only after succ. con | pl. of module(s) | | |
| 5 | | rical grade | | • • • • • | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 seme | ster | undergraduate | | | | |
| Conten | ts | | | | | |
| um and cal dou | l nickel Ible lay | application of: battery metal hydride, sodium er capacitors, redox-flov GaAs, organic and dye | sulphur, sodium nicke v batteries, fuel cell sy | el chloride, lithium ic /stems (AFC, PEMFC, | on accumulators), el | ectrochemi- |
| | | ning outcomes | | | | |
| | | developed a knowledg e to research problems. | | nergy storage and co | onversion and are al | ble to apply |
| Course | s (type, | number of weekly cont | act hours, language – | - if other than Germa | n) | |
| V (2) + | P (1) + I | Ξ (1) | | | | |
| | | essment (type, scope, l on on whether module o | | | tion offered — if not | every seme- |
| | ment o | ssessment: German and ffered: Once a year, sum I laces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 150 h | | | | | | |
| Teachi | | h | | | | |
| reaciili | ig tytl | <u>.</u> | | | | |
| Dofo | d t = ! | | ulations for to a bin | | | |
| Referre | a to in | LPOI (examination reg | ulations for teaching-o | legree programmes) | | |
| | | • | | | | |
| Module | | | - - - - - - - - - - - | > | | |
| | | gree (1 major) Nanostruc | | 5) | | |
| | - | ee (1 major) Physics (20 00 (1 major) Napostructu | | | | |
| | - | ee (1 major) Nanostructu ee (1 major) Functional N | | | | |
| | - | ee (1 major) Nanostructu | | | | |
| | - | ee (1 major) Physics (20) | | | | |
| | - | ee (1 major) Physics Inte | | | | |
| master | | | | | | |
| | 's degre | ee (1 major) Quantum Er | ngineering (2020) | | | |
| Master Bachel | or's deg | gree (1 major) Nanostruo | cture Technology (202 | o) | | |
| Master Bachel | or's deg | | cture Technology (202 | 0) | | |



Master's degree (1 major) Quantum Technology (2021)

| | e title | | | - | Abbreviation |
|---|--|--|--|--|---|
| Structu | ire and | Properties of Moderr | n Materials: Experiments | s vs. Simulations | 08-FU-MW-161-m01 |
| Module | e coord | linator | | Module offered by | / |
| | | | ktionswerkstoffe (Func- | | Technology of Material Synthesi |
| tional N | | | | | reennology of material synthesi |
| ECTS | Meth | od of grading | Only after succ. con | npl. of module(s) | |
| 5 | 1 | rical grade | | • • • • | |
| Duratio | on | Module level | Other prerequisites | ; | |
| 1 seme | ster | graduate | | | |
| Conten | ts | • | | | |
| Materia simulat | | erties of metals and c | eramics: correlation of s | tructure/property re | elations through experiments an |
| Intende | ed lear | ning outcomes | | | |
| mance | ceram pecial | ics. They are introduce | ed to measuring method | s and calculation m | uminium alloys and high-perfor- nethods using numerical simulat of materials and the resulting pr |
| Course | s (type | , number of weekly co | ontact hours, language – | - if other than Germ | ian) |
| V (2) + | | · · · · · | | | |
| Method | d of as | sessment (type scope | | | |
| | | | e, language — if other th | an German, examin | ation offered — if not every sem |
| ster, in | format | | e, language — if other th le can be chosen to earn | | ation offered — if not every sem |
| | | | | | ation offered — if not every sem |
| a) talk | (appro | ion on whether modul x. 30 minutes) or | | a bonus) | ation offered — if not every sem |
| a) talk b) oral c) oral | (appro examir examir | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua | (approz examir examir age of a | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess | (appro examir examir age of a ment o | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess | (appro examir examir age of a ment o | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess | (appro examir examir age of a ment o | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess Allocat | (appro examir examir age of a ment o ion of [| ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess Allocat | (appro examir examir age of a ment o ion of [| ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess Allocat Additio | (appro. examir examir age of a ment o ion of p onal inf | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral Langua Assess Allocat Additio Worklo | (appro. examir examir age of a ment o ion of p onal inf | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral d Langua Assess Allocat Additio Worklo 150 h | (appro. examir examir age of a ment o ion of p onal inf | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral d Langua Assess Allocat Additio Worklo 150 h | (appro. examir examir age of a ment o ion of p onal inf | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or | ation offered — if not every sem |
| a) talk b) oral c) oral d Langua Assess Allocat Additio Worklo 150 h Teachin | (appro. examir examir age of a ment o ion of p onal inf pad | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places formation | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester | a bonus) utes) or ites total) | |
| a) talk b) oral c) oral d Langua Assess Allocat Additio Worklo 150 h Teachin | (appro. examir examir age of a ment o ion of p onal inf pad | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places formation | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English | a bonus) utes) or ites total) | |
| a) talk b) oral c) oral d Langua Assess Allocat Worklo 150 h Teachin Referre | (appro. examir examir age of a ment o ion of p onal inf onal inf oad | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou sssessment: German a offered: Once a year, w places formation | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester | a bonus) utes) or ites total) | |
| a) talk (b) oral (c) oral (Langua Assess Allocat Modulio Teachin Referre Module | (appro. examir examir age of a ment o ion of p onal inf pad ng cycl ed to in | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places formation | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester | a bonus) utes) or ites total) | |
| a) talk (b) oral (c) oral (Langua Assess Allocat Morklo 150 h Teachin Referre Module | (appro. examir examir age of a ment o ion of onal inf onal inf onal inf ead ed to in e appea | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places formation ee LPO I (examination r ars in ee (1 major) Physics (compared to the second temperature of temperature of te | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester | a bonus) utes) or ites total) degree programmes | |
| a) talk b) oral c) oral d Langua Assess Allocat Additio Teachin Referre Module Master Master | (appro. examir examir age of a ment o ion of p onal inf onal inf oad ed to in e appea 's degr | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places formation ee LPO I (examination r ars in ree (1 major) Physics (a ree (1 major) Nanostru | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester regulations for teaching- 2016) cture Technology (2016) | a bonus) utes) or ites total) degree programmes | |
| a) talk b) oral c) oral d Langua Assess Allocat Additio 150 h Teachin Referre Module Master Master Master | (appro. examir examir age of a ment o ion of p onal inf onal inf i | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places formation ee (1 major) Physics (r ee (1 major) Functiona | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester regulations for teaching- 2016) cture Technology (2016) al Materials (2016) | a bonus) utes) or ites total) degree programmes | |
| a) talk (b) oral (c) oral (Langua Assess Allocat Additio Worklo 150 h Teachin Referre Master Master Master Master | (appro. examir examir age of a ment o ion of p onal inf onal inf i | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places formation ee (1 major) Physics (r ee (1 major) Functiona | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester regulations for teaching- 2016) cture Technology (2016) al Materials (2016) cture Technology (2020) | a bonus) utes) or ites total) degree programmes | |
| a) talk (b) oral (c) oral (Langua Assess Allocat Additio Worklo 150 h Teachin Referre Master Master Master Master Master | (appro. examir examir age of a ment o ion of onal inf onal inf ona | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou issessment: German a offered: Once a year, w places formation formation ee (1 major) Physics (ee (1 major) Physics (ee (1 major) Physics (ee (1 major) Functiona ee (1 major) Nanostru ee (1 major) Nanostru | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester egulations for teaching- 2016) cture Technology (2016) al Materials (2016) cture Technology (2020) 2020) | a bonus) utes) or ites total) degree programmes | |
| a) talk (b) oral (c) oral (Langua Assess Allocat Worklo 150 h Teachin Referre Master Master Master Master Master Master Master | (appro. examir examir age of a ment o ion of p onal inf onal inf onal inf onal inf oad ed to in 's degr 's degr 's degr 's degr 's degr | ion on whether modul x. 30 minutes) or nation of one candida nation in groups (grou assessment: German a offered: Once a year, w places formation ee (1 major) Physics (free (1 major) Physics (free ee (1 major) Physics (free (1 major) Physics (1 major) Physics (free (1 major) Physics (1 major) Physics (free (1 major) Physics (1 majo | le can be chosen to earn te each (approx. 20 minu ps of 2, approx. 30 minu and/or English vinter semester regulations for teaching- 2016) cture Technology (2016) al Materials (2016) cture Technology (2020) 2020) nternational (2020) | a bonus) utes) or ites total) degree programmes | |

| Module | e title | | | | Abbreviation |
|---------------------------|-------------------------------|--|------------------------|---------------------|--|
| Sensor | and A | ctor Materials - Functiona | l Ceramics and Mag | netic Particles | 08-FU-SAM-161-m01 |
| Module | e coord | inator | | Module offered by | |
| degree tional <i>N</i> | | mme coordinator Funktio als) | nswerkstoffe (Func- | Chair of Chemical | Technology of Material Synthesis |
| ECTS | Metho | od of grading | Only after succ. con | pl. of module(s) | |
| 5 | | rical grade | | • | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| | | | | | s piezoelectrics, shape memory logical fluids, magnetofluids. |
| Intende | ed lear | ning outcomes | | | |
| Studen | ts have | e developed fundamental | knowledge in the ar | ea of sensory and a | ctuatory materials. |
| | | , number of weekly conta | - | * | · · |
| V (2) + | | , | | | |
| Metho | d of ass | Sessment (type, scope, la ion on whether module ca | | | ation offered — if not every seme- |
| Langua Assess | ge of a ment o itable f | ation in groups (groups c ssessment: German and, ffered: Once a year, sum or bonus blaces | or English | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| Additio | | | | | |
| Worklo | | | | | |
| | au | | | | |
| 150 h | | | | | |
| Teachi | ig cycl | e | | | |
| D - f | | | 1 - 4 : . | | \ |
| Referre | a to in | LPOI (examination regu | lations for teaching-o | legree programmes |) |
| | | • | | | |
| Module | | | ~ | | |
| | - | ee (1 major) Physics (2010 | | | |
| | - | ee (1 major) Nanostructur ee (1 major) Functional M | | | |
| | - | ee (1 major) Nanostructur | | | |
| | - | ee (1 major) Physics (202 | | | |
| Master | 's degr | ee (1 major) Physics Inter | national (2020) | | |
| | | ee (1 major) Quantum Eng | | | |
| | - | ee (1 major) Quantum Teo | | | |
| | - | ee (1 major) Quantum Eng | | | |
| master | s uegr | ee (1 major) Physics Inter | national (2024) | | |

| Ultrafa | e title | | | Abbreviation | |
|--|--|--|--|------------------------|--------------|
| Ultrafast spectroscopy and quantum-control | | | | 08-PCM4-161-m01 | |
| Module coordinator | | | Module offered by | | |
| | | Matarialian" | · · · · | and Theoretical Ch | omictry |
| | r of the seminar "Nanoskalige | Materialien" Institute of Physical and Theoretical Chemistry Only after succ. compl. of module(s) | | | emistry |
| ECTS | Method of grading numerical grade | Unly after succ. con | ipi. of module(s) | | |
| 5 | | | | | |
| Duratio | | Other prerequisites | | | |
| 1 seme | | Prior completion of | modules o8-PCM1a a | and 08-PCM1D recom | nmended. |
| Conten | ts | | | | |
| | odule discusses advanced top ulses, time-resolved laser spe | | | control. It focuses of | n ultrashort |
| Intende | ed learning outcomes | | | | |
| plain th | ts are able to describe the ger ne theory of time-resolved lase les and applications of quantu | er spectroscopy and na | | | |
| Course | s (type, number of weekly con | tact hours, language – | - if other than Germa | n) | |
| S (2) + | Ü (1) | | | | |
| | e taught in: German or English | | | | |
| | d of assessment (type, scope, formation on whether module | | | tion offered — if not | every seme- |
| | en examination (approx. 90 m examination of one candidate | | ıtes) or | | |
| | (approx. 30 minutes) | | | | |
| | ge of assessment: German an | d/or English | | | |
| Allocat | ion of places | | | | |
| | | | | | |
| Additio | onal information | | | | |
| | | | | | |
| Worklo | | - | | | |
| | au | | | | |
| 150 h | | | | | |
| Teachir | ng cycle | | | | |
| | | | | | |
| | | | | | |
| | d to in LPO I (examination reg | gulations for teaching-o | legree programmes) | | |
| | ed to in LPO I (examination reg | gulations for teaching- | degree programmes) | | |
| Referre | ed to in LPO I (examination reg | gulations for teaching-o | degree programmes) | | |
| Referre Module | | | degree programmes) | | |
| Referre Module Master | e appears in | (2016) | degree programmes) | | |
| Referre Module Master' Master' | e appears in 's degree (1 major) Chemistry (| (2016) cs (2016) | degree programmes) | | |
| Referre Module Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct | (2016) cs (2016) 016) ure Technology (2016) | | | |
| Referre Module Master' Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio | (2016) cs (2016) 016) ure Technology (2016) onal Mathematics (201 | 6) | | |
| Referre Module Master' Master' Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun | (2016) cs (2016) 016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat | 6) ion PLUS, Elite Netwo | | 016) |
| Referre Master' Master' Master' Master' Master' Supple | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (20 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher | (2016) cs (2016) 016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite | 6) ion PLUS, Elite Netwo | | 016) |
| Referre Master' Master' Master' Master' Master' Supple Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher 's degree (1 major) Chemistry (| (2016) cs (2016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite (2018) | 6) ion PLUS, Elite Netwo Network Bavaria (EN | | 016) |
| Referre Master' Master' Master' Master' Master' Supple Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher 's degree (1 major) Chemistry ('s degree (1 major) Computatio | (2016) cs (2016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite (2018) onal Mathematics (201 | 6) ion PLUS, Elite Netwo Network Bavaria (EN | | 016) |
| Referre Master' Master' Master' Master' Master' Master' Master' Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher 's degree (1 major) Chemistry ('s degree (1 major) Computatio 's degree (1 major) Mathemati | (2016) cs (2016) o16) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite (2018) onal Mathematics (201 cs (2019) | 6) ion PLUS, Elite Netwo Network Bavaria (EN 9) | | 016) |
| Referre Master' Master' Master' Master' Master' Supple Master' Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (20 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Nanostruct | (2016) cs (2016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite (2018) onal Mathematics (201 cs (2019) ure Technology (2020) | 6) ion PLUS, Elite Netwo Network Bavaria (EN 9) | | 016) |
| Referre Master' Master' Master' Master' Master' Supple Master' Master' Master' Master' | e appears in 's degree (1 major) Chemistry ('s degree (1 major) Mathemati 's degree (1 major) Physics (2c 's degree (1 major) Nanostruct 's degree (1 major) Computatio 's teaching degree Gymnasiun mentary course MINT Teacher 's degree (1 major) Chemistry ('s degree (1 major) Computatio 's degree (1 major) Mathemati | (2016) cs (2016) ure Technology (2016) onal Mathematics (201 n MINT Teacher Educat Education PLUS, Elite (2018) onal Mathematics (201 cs (2019) ure Technology (2020) | 6) ion PLUS, Elite Netwo Network Bavaria (EN 9) | | 016) |



Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Functional Materials (2022) Master's degree (1 major) Mathematics (2022) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024) Master's degree (1 major) Computational Mathematics (2024)

| Inclample Institute of Computer Science Module coordinator Module offered by Institute of Computer Science Institute of Computer Science Institute of Computer Science Duration Module level Other prerequisites Inserting and complex SQL statements; database planning and normal forms, XML data modelling; transaction management. Intended learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Contents Contents <th col<="" th=""><th colspan="4">Module title</th><th>Abbreviation</th><th></th></th> | <th colspan="4">Module title</th> <th>Abbreviation</th> <th></th> | Module title | | | | Abbreviation | |
|--|---|--|------------------------------|---|------------------------|------------------------|---------------|
| Dean of Studies Informatik (Computer Science) Institute of Computer Science ECTS Method of grading Only after succ. compl. of module(s) 5 numerical grade | Databases | | | | | 10-I=DB-161-m01 | |
| ECTS Method of grading Only after succ. compl. of module(s) 5 num=rical grade Duration Module level Other prerequisites 1 semester graduate Contents Relational algebra and complex SQL statements; database planning and normal forms, XML data modelling; transaction management. Intended learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) written examination of approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 20 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination or hose ther examination of Places Additonal information For the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Vorkload <td< td=""><td>Module</td><td>e coord</td><td>inator</td><td></td><td colspan="3">Module offered by</td></td<> | Module | e coord | inator | | Module offered by | | |
| ECTS Method of grading Only after succ. compl. of module(s) 5 num=rical grade Duration Module level Other prerequisites 1 semester graduate Contents Relational algebra and complex SQL statements; database planning and normal forms, XML data modelling; transaction management. Intended learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) written examination of approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination in groups of 2 candidate (approx. 20 minutes) or an oral examination in groups of 2 candidate (approx. 10 minutes) or an oral examination or hose ther examination of Places Additonal information For the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Vorkload <td< td=""><td>Dean o</td><td colspan="3">n of Studies Informatik (Computer Science)</td><td>Institute of Comput</td><td>er Science</td><th></th></td<> | Dean o | n of Studies Informatik (Computer Science) | | | Institute of Comput | er Science | |
| 5 numerical grade Duration Module level. Other prerequisites 1 semester graduate Contents Relational algebra and complex SQL statements; database planning and normal forms, XML data modelling; transaction management. Intended Earning outcomes Thetaded Face Server (type, number of weekly contact hours, language — if other than German) V (2) + 0 Sourses (type, number of weekly contact hours, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) writter examination of one candidate each (approx. 20 minutes)). | | | · · · | | | | |
| Duration Module level Other prerequisites 1 semester graduate Contents Relational algebra and complex SQL statements; database planning and normal forms, XML data modelling; transaction management. Intended learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language – if other than German) V (2) + 0 (2) Wethod of assessment (type, scope, language – if other than German, examination offered – if not every semester, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Aldication of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><th></th></td<> | | | | | | | |
| 1 semester graduate | - | L | | Other prerequisites | | | |
| Relational algebra and complex SQL statements; database planning and normal forms; XML data modelling; transaction management. Intended learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German) V (2) + 0 (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | | | | | | |
| transaction management. Intendel learning outcomes The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German) V (2) + U (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | Conten | Its | | | | | |
| The students possess knowledge about data modelling and queries in SQL, transactions as well as about easy data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German) Y (2) + 0 (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 6o to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | - | - | statements; database | planning and norma | l forms, XML data mo | odelling; |
| data modelling in XML. Courses (type, number of weekly contact hours, language — if other than German) V(2) + 0 (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | Intend | ed learr | ning outcomes | | | | |
| V (2) + Ú (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | | | out data modelling and | l queries in SQL, trar | isactions as well as | about easy |
| V (2) + Ú (2) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | Course | s (type. | number of weekly cor | tact hours, language - | - if other than Germa | ın) | |
| ster, information on whether module can be chosen to earn a bonus) written examination (approx. 6o to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | | , | , | | , | |
| written examination (approx. 6o to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (ap- prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | | | | | ition offered — if not | every seme- |
| If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places | | | | | a bonus) | | |
| examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes) per candidates. Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | the written examina | tion may be replace | d by an oral |
| prox. 15 minutes per candidate). Separate written examination for Master's students. Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | | |
| Language of assessment: German and/or English creditable for bonus Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | 0 | |
| creditable for bonus Allocation of places Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | | |
| Allocation of places Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | - | - | | id/or English | | | |
| Additional information Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | | |
| Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO 1 (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Allocat | ion of p | olaces | | | | |
| Focuses available for students of the Master's programme Informatik (Computer Science, 120 ECTS credits): SE, IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO 1 (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Additio | nal inf | ormation | | | | |
| IS, HCI, GE. Workload 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | Master's programme l | nformatik (Compute | r Science. 120 ECTS (| credits): SE. |
| 150 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | IS, HCI, | , GE. | | | | | |
| Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Worklo | ad | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | 150 h | | | | | | |
| Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Teachi | ng cycl | e | | | | |
| Module appears in Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | | |
| Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Referre | ed to in | LPO I (examination re | gulations for teaching- | degree programmes) | | |
| Master's degree (1 major) Computer Science (2016) Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | | | | | | | |
| Master's degree (1 major) Physics (2016) Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Module | e appea | rs in | | | | |
| Master's degree (1 major) Digital Humanities (2016) Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Computer | Science (2016) | | | |
| Master's degree (1 major) Computer Science (2017) Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Physics (2 | 016) | | | |
| Master's degree (1 major) Computer Science (2018) Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Digital Hur | nanities (2016) | | | |
| Master's degree (1 major) Physics (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Computer | Science (2017) | | | |
| Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Computer | Science (2018) | | | |
| Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Physics (2 | 020) | | | |
| Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Physics Int | ernational (2020) | | | |
| Master's degree (1 major) Physics International (2024) | Master | 's degre | ee (1 major) Quantum E | Ingineering (2020) | | | |
| | Master | 's degre | ee (1 major) Quantum E | Engineering (2024) | | | |
| | Master | 's degre | ee (1 major) Physics Int | ernational (2024) | | | |
| Master's with 1 major Physics International (2020) JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- ta record Master (120 ECTS) Physics International - 2020 page 15 / 170 | Master's w | ith 1 major | Physics International (2020) | - | | - | page 15 / 170 |

| | | | | Abbreviation | | | |
|--|--|--|--|---|-----------------------|---------------|--|
| Artificial Intelligence 1 10-I=KI1-161-m01 | | | | | | | |
| Modul | e coord | inator | | Module offered by | l | | |
| 1 | nolder of the Chair of Computer Science VI | | | Institute of Computer Science | | | |
| ECTS | 1 | thod of grading Only after succ. compl. of module(s) | | | | | |
| 5 | 1 | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | | | | |
| 1 seme | | graduate | | | | | |
| Conter | Its | | | | | | |
| | | | euristic search, constra d inference, knowledge | | , search with partial | information, | |
| | | ning outcomes | | · · | | | |
| The stu | udents (| possess theoretical an | d practical knowledge a | about artificial intelli | gence in the area of | agents, | |
| | | | ess possible applicatio | | | . | |
| Course | s (type | , number of weekly cor | ntact hours, language – | - if other than Germa | n) | | |
| V (2) + | Ü (2) | | | | | | |
| | | | language — if other th | | tion offered — if not | every seme- | |
| | | | can be chosen to earn | a bonus) | | | |
| | | nation (approx. 60 to 1 | 20 minutes). eginning of the course, | the written examina | tion may be replace | d by an oral | |
| | | | (approx. 20 minutes) or | | | | |
| | | es per candidate). | арр. оли <u>– о</u> ассо) о. | | | | |
| Langua | age of a | ssessment: German ar | nd/or English | | | | |
| credita | ble for | bonus | | | | | |
| Allocat | ion of p | olaces | | | | | |
| | | | | | | | |
| Additio | onal inf | ormation | | | | | |
| Focuse AT,SE,I | | able for students of the | Master's programme l | nformatik (Compute | r Science, 120 ECTS (| credits): | |
| Worklo | ad | | | | | | |
| 150 h | | | | | | | |
| Teachi | ng cycl | e | | | | | |
| | | | | | | | |
| Referre | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | | | |
| | | | | | | | |
| Modul | e appea | urs in | | | | | |
| Master | 's degr | ee (1 major) Computer | Science (2016) | | | | |
| | - | ee (1 major) Mathemat | | | | | |
| | - | ee (1 major) Physics (2 | - | | | | |
| | - | - | ture Technology (2016) | | | | |
| | - | | onal Mathematics (201 | | | | |
| | | | n MINT Teacher Educat | | | 016) | |
| | | | Education PLUS, Elite | Network Bavaria (EN | B) (2016) | | |
| | - | ee (1 major) Computer | | | | | |
| | - | ee (1 major) Computer | | 0) | | | |
| | - | ee (1 major) Computati ee (1 major) Mathemat | onal Mathematics (201 ics (2010) | 9) | | | |
| | _ | - | - | | | | |
| Master's w | ith 1 majo | r Physics International (2020) | - | e generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 16 / 170 | |

Master's degree (1 major) Information Systems (2019)

Master's degree (1 major) Nanostructure Technology (2020)

Master's degree (1 major) Physics (2020)

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020)

Master's degree (1 major) Aerospace Computer Science (2020)

Master's degree (1 major) Physics International (2020)

Master's degree (1 major) Quantum Engineering (2020)

Master's degree (1 major) Quantum Technology (2021)

| Module title | | | | Abbreviation | | |
|--|--------------------------------|--|---|---|-----------------------|---------------|
| Analys | is and [| Design of Programs | | | 10-I=PA-161-m01 | |
| Module | e coordi | inator | | Module offered by | | |
| holder | of the C | hair of Computer Scien | nce II | Institute of Comput | er Science | |
| ECTS | Metho | d of grading | Only after succ. con | npl. of module(s) | | |
| 5 | numer | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | | | | |
| Conten | its | | | | | |
| Prograi | m analy | sis, model creation in | software engineering, p | program quality, test | of programs, proces | s models. |
| Intend | ed learr | ning outcomes | | | | |
| The stu quality | | are able to analyse prog | grams, to use testing fr | ameworks and metri | cs as well as to judg | e program |
| | | number of weekly con | tact hours, language – | - if other than Germa | n) | |
| V (2) + | | number of weekty con | | | | |
| | | • () | | <u> </u> | | |
| | | essment (type, scope, on on whether module | | | tion offered — if not | every seme- |
| lf anno examir prox. 1 Langua | unced b nation o 5 minut | nation (approx. 60 to 12 by the lecturer at the be f one candidate each (es per candidate). ssessment: German an bonus | eginning of the course, approx. 20 minutes) or | | | |
| Allocat | ion of p | laces | | | | |
| 71110 041 | | | | | | |
| Additio | onal info | ormation | | | | |
| Focuse SE,IS,E | | ble for students of the | Master's programme I | nformatik (Compute | Science, 120 ECTS o | credits): |
| Worklo | | | | | | |
| 150 h | | | | | | |
| | | | | | | |
| Teachi | ng cycle | <u>.</u> | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination reg | gulations for teaching-o | degree programmes) | | |
| | | | | | | |
| Module | e appea | rs in | | | | |
| Master | 's degre | ee (1 major) Computer S | Science (2016) | | | |
| | - | ee (1 major) Mathemati | | | | |
| | - | ee (1 major) Physics (20 | | | | |
| | - | ee (1 major) Nanostruct | •, • | | | |
| | - | ee (1 major) Computatio | | | | |
| | | ing degree Gymnasiun | | | | 016) |
| | | y course MINT Teacher | | Network Bavaria (EN | B) (2016) | |
| | - | ee (1 major) Computer S | | | | |
| | - | ee (1 major) Computer 9 | | `` | | |
| | | ee (1 major) Computati | | 9) | | |
| | - | ee (1 major) Mathemati | - | | | |
| Master | 's degre | ee (1 major) Information | 1 Systems (2019) | | | |
| Master's w | ith 1 major | Physics International (2020) | - | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 18 / 170 |

Master's degree (1 major) Nanostructure Technology (2020) Master's degree (1 major) Physics (2020) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Technology (2021) Master's degree (1 major) Computational Mathematics (2022) Master's degree (1 major) Mathematics (2022)

| Modul | e title | | | | Abbreviation | |
|--|---|--|--|---|--|--------------------------|
| Advan | ced Pro | gramming | | | 10-l-APR-172-m01 | |
| Modul | e coord | inator | | Module offered by | | |
| | | Chair of Computer Scienc | 0.11 | Institute of Comput | or Science | |
| ECTS | | od of grading | Only after succ. con | | | |
| 5 | 1 | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | | undergraduate | | | | |
| Conter | | | | | | |
| With th grams. and co | ne know If more de dup ensible | vledge of basic programm e complex problems are to licates occur. In this lectu structure. Also, further to | o be tackled, subopt ure, further knowledg | imal results like long te is to be conveyed o | , incomprehensible on how to give progr | functions ams and co- |
| Intend | ed lear | ning outcomes | | | | |
| then in | npleme | n advanced programming nted in multiple languag ng concepts are introduce | es and their efficienc | y measured using sta | andard metrics. In a | ddition, par- |
| Course | es (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (2) + | Ü (2) | | | | | |
| | | sessment (type, scope, la on on whether module ca | | | tion offered — if not | every seme- |
| lf anno examir prox. 1 Langua | ounced nation c 5 minut | nation (approx. 60 to 120 by the lecturer at the beg of one candidate each (ap res per candidate). ssessment: German and, bonus | inning of the course, oprox. 20 minutes) or | | | |
| Alloca | tion of p | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| 150 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination regu | lations for teaching- | degree programmes) | | |
| | Nr. 3 b) | | | <u> </u> | | |
| | e appea | ars in | | | | |
| | | gree (1 major) Computer S | Science (2017) | | | |
| | | gree (1 major) Computer S | | | | |
| Modul | e studie | es (Bachelor) Computer S | cience (2019) | | | |
| Master | r's degr | ee (1 major) Nanostructui | re Technology (2020) | | | |
| | - | ee (1 major) Physics (202 | | | | |
| | | ning degree Gymnasium I | | | | 020) |
| | | y course MINT Teacher E | | | B) (2020) | |
| | | gree (1 major) Business I | • | | am rag da | |
| master's w | nun 1 majoi | r Physics International (2020) | | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 20 / 170 |

UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Master's degree (1 major) Quantum Technology (2021) Bachelor's degree (1 major) Business Information Systems (2021) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Business Information Systems (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Bachelor's degree (1 major) Business Information Systems (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Bachelor's degree (1 major) Digital Business & Data Science (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Bachelor's degree (1 major) Games Engineering (2025)

| Modul | e title | | | | Abbreviation | |
|------------|-------------|--|---------------------------|---|------------------------|---------------|
| Operat | ting Sys | stems | | | 10-l-BS-191-m01 | |
| Modul | e coord | inator | | Module offered by | | |
| holder | of the (| Chair of Computer Scie | nce II | Institute of Comput | er Science | |
| ECTS | | od of grading | Only after succ. con | · · · · · · · · · · · · · · · · · · · | | |
| 5 | | rical grade | | , ,, | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | | undergraduate | | | | |
| Conter | nts | | | | | |
| | | o computer systems, d | | | | |
| | | ing systems, processes nt, device and file man | | | ition and communica | ation, memo- |
| Intend | ed lear | ning outcomes | | | | |
| The stu | udents | oossess knowledge an | d practical skills in bui | lding and using esse | ntial parts of operati | ing systems. |
| | | , number of weekly con | <u> </u> | | · · · | 0 , |
| V (2) + | | , | | |) | |
| | | t in: English | | | | |
| Metho | d of ass | essment (type, scope, on on whether module | | | tion offered — if not | every seme- |
| | | | | | | |
| | | nation (approx. 60 to 1: by the lecturer at the b | | the written examina | tion may be replaced | d by an oral |
| | | f one candidate each (| | | | |
| | | es per candidate). | | | | - |
| | | ssessment: German ar | id/or English | | | |
| | ble for | | | | | |
| Allocat | tion of p | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | _ | | | | | |
| Worklo | ad | | | | | |
| 150 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination reg | gulations for teaching- | degree programmes) | | |
| | | | | | | |
| Modul | e appea | ars in | | | | |
| Bachel | lor's de | gree (1 major) Compute | er Science (2019) | | | |
| | - | ee (1 major) Nanostruc | | | | |
| | - | ee (1 major) Physics (20 | | | | |
| | | gree (1 major) Business | • | (2020) | | |
| | - | ee (1 major) Physics Int | | | | |
| | - | ee (1 major) Quantum E gree (1 major) Aerospa | | 2020) | | |
| | | gree (1 major) Aerospa | | | | |
| | | ee (1 major) Quantum T | | ability (2021) | | |
| | - | gree (1 major) Guantum 1 | | (2021) | | |
| | | gree (1 major) Artificial | • | | | |
| | | | | | | |
| master's W | nui 1 majoi | Physics International (2020) | | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 22 / 170 |

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Bachelor's degree (1 major) Business Information Systems (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024)

| Modul | e title | | | | Abbreviation | |
|------------|----------------------|--|--|---|------------------------|---------------|
| Compu | iter Arc | hitecture | | | 10-I-RAK-152-m01 | |
| Modul | e coord | inator | | Module offered by | | |
| Dean c | of Studio | es Informatik (Compute | er Science) | Institute of Comput | ter Science | |
| ECTS | Metho | od of grading | Only after succ. cor | npl. of module(s) | | |
| 5 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | ; | | |
| 1 seme | ester | undergraduate | | | | |
| Conter | nts | | | | | |
| | | architectures, comma ector processors, mult | nd processing through i-core processors. | pipelining, statical | and dynamic instruc | tion schedu- |
| Intend | ed lear | ning outcomes | | | | |
| | | naster the most impor operating systems. | tant techniques to desi | ign fast computers a | s well as their intera | ction with |
| | | | ntact hours, language – | – if other than Germa | an) | |
| V (2) + | | , | | | , | |
| Metho | d of ass | | language — if other th can be chosen to earn | | ition offered — if not | every seme- |
| - | | nation (approx. 60 to 1 | | la Dollus) | | |
| | | | eginning of the course, | the written examina | tion may be replace | d by an oral |
| | | | (approx. 20 minutes) or | | | |
| | | es per candidate). | | | | |
| | age of a Ible for | ssessment: German ar | nd/or English | | | |
| | | | | | | |
| Alloca | tion of p | naces | | | | |
| | 1. 6 | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| 150 h | _ | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | 1 | |
| - | Nr. 3 b) | | | | | |
| | | Rechnerarchitektur | | | | |
| | e appea | | | | | |
| | | gree (1 major) Compute | | | | |
| | | gree (1 major) Mathem | - |) | | |
| | | - · · | ational Mathematics (2 ce Computer Science (2 | - | | |
| | | - · · | ing degree Gymnasium | - | 2015) | |
| | | ee (1 major) Physics (2 | | | 2013/ | |
| | - | | n MINT Teacher Educat | ion PLUS, Elite Netw | ork Bavaria (ENB) (2 | 016) |
| | | | ce Computer Science (2 | | | |
| Bachel | lor's de | gree (1 major) Compute | er Science (2017) | | | |
| | | gree (1 major) Compute | - | | | |
| Master | 's degr | ee (1 major) Physics (2 | 020) | | | |
| Master's w | ith 1 majo | Physics International (2020) | | • generated 19-Apr-2025 • ex r (120 ECTS) Physics Internat | - | page 24 / 170 |

UNIVERSITÄT WÜRZBURG

Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Supplementary course MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2020) Master's degree (1 major) Physics International (2020) Bachelor's degree (1 major) Aerospace Computer Science (2020) Bachelor's degree (1 major) Computer Science und Sustainability (2021) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2022) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2023) Bachelor's degree (1 major) Mathematics (2023) Master's degree (1 major) Physics International (2024) Bachelor's degree (1 major) Artificial Intelligence and Data Science (2024) Master's teaching degree Gymnasium MINT Teacher Education PLUS, Elite Network Bavaria (ENB) (2025) Bachelor's degree (1 major) Games Engineering (2025)

| Module | | | | | Abbreviation | |
|--|---|--|---|--|---|---------------------------|
| Applied | | | | | 10-M=AAANin-152-r | n01 |
| Module | e coord | nator | | Module offered by | | |
| | | es Mathematik (Mathem | | Institute of Mathem | atics | |
| ECTS | î | d of grading | Only after succ. con | npl. of module(s) | | |
| 10 | <u> </u> | rical grade | | | | |
| Duration | | Module level | Other prerequisites | | | |
| Conten | | graduate | | | | |
| In-dept theory particu theory Recom Familia | h study of Hilbe lar FEM of ellipt mendee rity wit | of functional analysis a ert spaces and Fourier a methods), principles o ic, parabolic and hyper d previous knowledge: h the contents of the mo | nalysis, spectral theor f functional analysis, f bolic partial differenti | y and quantum mech function spaces, emb al equations with me | nanics, numerical mo bedding theorems, co thods from function | ethods (in ompactness, |
| Intende | ed learr | ning outcomes | | | | |
| to esta | blish a | acquainted with the fur connection between his her natural and engine | s/her acquired skills a | | | |
| Course | s (type, | number of weekly cont | act hours, language – | - if other than Germa | n) | |
| V (4) + Module | | tin: English | | | | |
| | | essment (type, scope, l on on whether module | | | tion offered — if not | every seme- |
| b) oral c) oral Langua | examin examin Ige of a ment o | nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: English ffered: In the semester i bonus | each (approx. 20 minu of 2, 15 minutes per c | utes) or andidate) | bsequent semester | |
| Allocat | ion of p | laces | | | | |
| | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 300 h | | | | | | |
| Teachi | ng cycle | 9 | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination reg | ulations for teaching- | degree programmes) | | |
| | | | | | | |
| Module | e appea | rs in | | | | |
| Master Master Master Master Master | 's degre 's degre 's degre 's degre 's degre | ee (1 major) Mathematic ee (1 major) Physics Inte ee (1 major) Mathematic ee (1 major) Mathematic ee (1 major) Physics Inte ee (1 major) Mathematic Physics International (2020) | ernational (2020) is International (2021) is International (2022) ernational (2024) is International (2025) JMU Würzburg | generated 19-Apr-2025 • exa | - | page 26 / 170 |
| | | | ta record Maste | r (120 ECTS) Physics Internati | onal - 2020 | |

| Module | | | | | Abbreviation |
|--------------------------------|---|--|--|------------------------|---|
| Differe | ntial Ge | eometry | | | 10-M=ADGMin-152-m01 |
| Module | e coord | inator | | Module offered by | |
| Dean of | f Studi | es Mathematik (Mathema | atics) | Institute of Mathem | atics |
| ECTS | 1 | od of grading | Only after succ. com | npl. of module(s) | |
| 10 | nume | rical grade | | | |
| Duratio | Duration Module level Other prerequisites | | | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| folds. | | lvanced results in differe d previous knowledge: | ntial geometry, in pa | rticular about differe | ntiable and Riemannian mani- |
| | | lge from the modules "In s" is recommended. | troduction to Differer | ntial Geometry", "Intr | oduction to Topology" and "Geo- |
| Intende | ed lear | ning outcomes | | | |
| | | | | | ds or Riemannian manifolds, is al methods in differential geome- |
| Course | s (type | , number of weekly conta | ct hours, language — | - if other than Germa | n) |
| V (4) + Module | | t in: English | | | |
| | | s essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral c) oral e Langua | examir examin ge of a ment o | nination (approx. 90 to 1 lation of one candidate e ation in groups (groups c ssessment: English ffered: In the semester in bonus | ach (approx. 20 minu of 2, 15 minutes per c | ıtes) or andidate) | ıbsequent semester |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 300 h | | | , | | |
| Teachir | ng cvcl | e | | | |
| | | | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching- | legree programmes) | |
| | <u></u> | | | | |
| Module | annos | ore in | | | |
| | | ee (1 major) Mathematics | International (2015) | | |
| | - | ee (1 major) Physics Inter | | | |
| | - | ee (1 major) Mathematics | | | |
| | - | ee (1 major) Mathematics | | | |
| | | ee (1 major) Physics Inter | | | |
| Master | 's degr | ee (1 major) Mathematics | International (2025) | | |

| Module tit | le | | | Abbreviation | |
|---|---|---|-----------------------|---|--|
| Complex A | nalysis | | | 10-M=AFTHin-152-m01 | |
| Module co | ordinator | | Module offered by | | |
| Dean of Stu | udies Mathematik (Mathema | atics) | Institute of Mathem | atics | |
| | ethod of grading | Only after succ. con | npl. of module(s) | | |
| 10 nu | merical grade | | | | |
| Duration | | | | | |
| 1 semester | graduate | | | | |
| Contents | | | | | |
| geometric ons (e. g. e Recommen | In-depth study of mapping properties of analytic functions and their generalisations with modern analytic and geometric methods. Structural properties of families of holomorphic and meromorphic functions. Special functi- ons (e. g. elliptic functions). Recommended previous knowledge: Basic knowledge of the contents of the module "Introduction to Complex Analysis" is recommended. | | | | |
| Intended le | earning outcomes | | | | |
| The studen ticular the | nt is acquainted with the fund | ties of holomorphic f | unctions. He/She is | f higher complex analysis, in par- able to establish a connection ations in other subjects. | |
| Courses (ty | ype, number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + Ü (2 Module taı | e) ught in: English | | | | |
| | assessment (type, scope, la nation on whether module ca | | | tion offered — if not every seme- | |
| b) oral exa c) oral exar Language o | examination (approx. 90 to 1 mination of one candidate e mination in groups (groups o of assessment: English nt offered: In the semester in for bonus | ach (approx. 20 minu of 2, 15 minutes per c | utes) or andidate) | ıbsequent semester | |
| Allocation | of places | | | | |
| | | | | | |
| Additional | information | | | | |
| | | | | | |
| Workload | | | | | |
| 300 h | | | | | |
| Teaching c | zycle | | | | |
| | | | | | |
| Referred to | o in LPO I (examination regu | lations for teaching-o | degree programmes) | | |
| | | | | | |
| Module ap | pears in | | | | |
| Master's de Master's de Master's de | egree (1 major) Mathematics egree (1 major) Physics Inter egree (1 major) Mathematics egree (1 major) Mathematics egree (1 major) Physics Inter | national (2020) International (2021) International (2022) | | | |
| Master's d | egree (1 major) Mathematics | International (2025) | | | |

| Module | e title | | | | Abbreviation | |
|--|------------------------------|--|--|---|-------------------------|----------------|
| Lie The | eory | | | | 10-M=ALTHin-152-m | 101 |
| Module | e coord | inator | | Module offered by | | |
| Dean o | fStudie | es Mathematik (Mathen | natics) | Institute of Mathem | atics | |
| ECTS | 1 | od of grading | Only after succ. cor | npl. of module(s) | | |
| 10 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | i | | |
| 1 seme | ster | graduate | | | | |
| Conten | lts | | | | | |
| | - | ips and their Lie algebra olications, e.g. in physi | | on, structure and clas | ssification of Lie alge | ebras, classic |
| Basic k | nowlec d. Furth | d previous knowledge: lge of the contents of th nermore, basic knowled | | | | |
| Intend | ed learr | ning outcomes | | | | |
| | hese to | acquainted with the fu common problems, an | | | | |
| Course | s (type, | , number of weekly cont | tact hours, language – | – if other than Germa | n) | |
| V (4) + Module | | t in: English | | | | |
| | | essment (type, scope, | | | tion offered — if not | every seme- |
| ster, in | formati | on on whether module | can be chosen to earn | a bonus) | | |
| b) oral c) oral Langua Assess | examin examin age of a | nination (approx. 90 to ation of one candidate ation in groups (groups ssessment: English ffered: In the semester bonus | each (approx. 20 min of 2, 15 minutes per c | utes) or andidate) | ıbsequent semester | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 300 h | | | | | | |
| - | ng cycl | 6 | | | | |
| | 0 . 7 | - | | | | |
| Roforra | d to in | LPOI (examination reg | ulations for teaching. | degree programmes) | | |
| Referre | | | | | | |
| Modul | | re in | | | | |
| | e appea | | | | | |
| | - | ee (1 major) Mathematio ee (1 major) Physics Inte | | | | |
| | - | ee (1 major) Mathematic | | 1 | | |
| | - | ee (1 major) Mathematic | | | | |
| | - | ee (1 major) Physics Inte | | | | |
| Master | 's degre | ee (1 major) Mathematio | s International (2025) | | | |
| Master's w | ith 1 major | Physics International (2020) | - | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 29 / 170 |

| Module | title | | | | Abbreviation |
|--|--|---|--|----------------------|-----------------------------------|
| Topolo | gy | | | | 10-M=ATOPin-152-m01 |
| Module | coord | inator | | Module offered by | |
| Dean of | fStudie | es Mathematik (Mathema | atics) | Institute of Mathem | atics |
| ECTS | | od of grading | Only after succ. com | pl. of module(s) | |
| 10 | | rical grade | | | |
| Duratio | | Module level | Other prerequisites | | |
| 1 seme | | graduate | | | |
| Conten | | | | | |
| | | opology, topological inva ng spaces. | ariants (e. g. fundame | ental group, connect | ion), construction of topological |
| Intende | ed learr | ning outcomes | | | |
| | | acquainted with the fund non problems. | damental results, the | orems and methods | in topology and is able to apply |
| Course | s (type | , number of weekly conta | ct hours, language — | if other than Germa | n) |
| V (4) + I Module | • • | t in: English | | | |
| | | e ssment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral (c) oral (Langua | examin examin ge of a ment o | nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: English ffered: In the semester in bonus | ach (approx. 20 minu of 2, 15 minutes per ca | tes) or andidate) | ıbsequent semester |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 300 h | | | | | |
| Teachir | ng cycl | e | | | |
| | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching-d | legree programmes) | |
| | | | | | |
| Module | appea | rs in | | | |
| Master' Master' Master' Master' | s degre s degre s degre s degre | ee (1 major) Mathematics ee (1 major) Physics Inter ee (1 major) Mathematics ee (1 major) Mathematics ee (1 major) Physics Inter | national (2020) International (2021) International (2022) national (2024) | | |
| Master' | s degre | ee (1 major) Mathematics | International (2025) | | |

| Modul | | | | | Abbreviation | |
|--|--|---|---|---|-----------------------|---------------|
| Numbe | er Theor | у | | | 10-M=AZTHin-152-n | 101 |
| Modul | e coord | inator | | Module offered by | | |
| Dean o | of Studie | es Mathematik (Mathe | matics) | Institute of Mathem | natics | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 10 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | i | | |
| 1 seme | ster | graduate | | | | |
| Conter | Its | | | | | |
| applica overvie Recom Basic k | ations to ew of th mendeo knowled | o prime number distrib e development of mod d previous knowledge: lge of algebra and num | | equations; discussi , such as can be acq | on of the Riemann hy | pothesis, |
| Intend | ed learı | ning outcomes | | | | |
| structu | ires in n | | undamental methods o ws methods for the sol er theory. | | | |
| Course | s (type | , number of weekly cor | itact hours, language – | - if other than Germa | n) | |
| V (4) + Module | | t in: English | | | | |
| | | | language — if other th can be chosen to earn | | tion offered — if not | every seme- |
| b) oral c) oral Langua Assess | examin examin age of a | ation of one candidate ation in groups (group ssessment: English ffered: In the semester | o 120 minutes, usually e each (approx. 20 minu s of 2, 15 minutes per c in which the course is | utes) or andidate) | ıbsequent semester | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 300 h | | | | | | |
| Teachi | ng cycl | 9 | | | | |
| | | | | | | |
| Referre | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | | |
| | | | <u></u> | | | |
| Modul | e appea | rs in | | | | |
| | | | ics International (2015) | | | |
| | - | ee (1 major) Physics Int | | | | |
| | - | | ics International (2021) | | | |
| | - | | ics International (2022) |) | | |
| | - | ee (1 major) Physics Inf | | | | |
| | | | ics International (2025) | | | / |
| master's w | iin i majoi | Physics International (2020) | | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | • | page 31 / 170 |

| Discret | e title | | | | Abbreviation |
|--|--|--|---|-----------------------------------|----------------------------------|
| | te Math | iematics | | | 10-M=VDIMin-152-m01 |
| Module | e coord | inator | | Module offered by | <u> </u> |
| | | es Mathematik (Mat | nematics) | Institute of Mathem | natics |
| ECTS | 1 | od of grading | Only after succ. con | | lattes |
| 5 | | rical grade | | | |
|) Duratio | | Module level | Other prerequisites | 4 | |
| 1 seme | _ | graduate | | | |
| Conten | | 3.44440 | | | |
| graph t Recomi | theory of the mende | or combinatorics) d previous knowleds | ge: | | coding theory, cryptography, |
| | - | | of the module "Introduction | on to Discrete Mathe | matics" is required. |
| | - | ning outcomes | unneed require in a set of | ad topic in discust | mathematics |
| | | | vanced results in a select | • | |
| | | , number of weekly o | ontact hours, language – | - If other than Germa | in) |
| V (3) + I Module | | t in: English | | | |
| ster, ini a) writt b) oral c) oral Langua | format en exa examin examir age of a | ion on whether mode mination (approx. 6c nation of one candid nation in groups (gro | be, language — if other th ule can be chosen to earn to to 90 minutes, usually c ate each (approx. 15 minu ups of 2, approx. 10 minu | a bonus) hosen) or ites) or | ition offered — if not every sem |
| | | | ter in which the course is | | ubsequent semester |
| credita | ble for | ffered: In the semes bonus | | | ubsequent semester |
| credita | ble for | ffered: In the semes bonus | | | ubsequent semester |
| credita Allocat | ble for t ion of | ffered: In the semes bonus | | | ubsequent semester |
| credita Allocat | ble for t ion of | offered: In the semes bonus places | | | ubsequent semester |
| credita Allocat Additio | ble for ion of onal inf | offered: In the semes bonus places | | | ubsequent semester |
| credita Allocat Additio Worklo | ble for ion of onal inf | offered: In the semes bonus places | | | ubsequent semester |
| credita Allocat Additio Worklo 150 h | ble for ion of onal inf | offered: In the semes bonus places formation | | | ubsequent semester |
| credita Allocat Additio Worklo | ble for ion of onal inf | offered: In the semes bonus places formation | | | ubsequent semester |
| credita Allocat Additio Worklo 150 h Teachin | ble for ion of onal inf oad | offered: In the semes bonus places formation | | offered and in the su | |
| credita Allocat Additio Worklo 150 h Teachin | ble for ion of onal inf oad | offered: In the semes bonus places formation | ter in which the course is | offered and in the su | |
| credita Allocat Additio Worklo 150 h Teachin Referre | ble for ion of onal inf oad ng cycl | offered: In the semes bonus places formation e LPO I (examination | ter in which the course is | offered and in the su | |
| credita Allocat Additio Worklo 150 h Teachin Referre Master Master Master Master Master Master Master | ble for ion of onal inf oad ad ad ad ad ad ad ad ad ad | e E E E E E E E E E E E E E | ter in which the course is regulations for teaching- atics International (2015) International (2020) n Engineering (2020) atics International (2021) atics International (2022) n Engineering (2024) | offered and in the su | |

| Module | title | | | | Abbreviation |
|---------------------|-----------------------------|--|---|-----------------------|--|
| Groups | and th | eir Representations | ; | | 10-M=VGDSin-152-mo1 |
| Module | | instar | | Modulo offered by | |
| | | - | | Module offered by | |
| | | es Mathematik (Mat | (| Institute of Mathem | natics |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | |
| 10 | <u> </u> | rical grade | | | |
| Duratio | | Module level | Other prerequisites | | |
| 1 seme | | graduate | | | |
| Conten | | | | | |
| the S-ri Recom | ngs of nende nowled | Schur. d previous knowledg Ige of algebra is ass | ge: | | nd special techniques such as s "Introduction to Algebra" and |
| <u> </u> | | ning outcomes | | | |
| | | | | | the ability to work on contempo- y his/her skills to complex pro- |
| Course | s (type | , number of weekly o | ontact hours, language – | - if other than Germa | an) |
| V (4) + I Module | | t in: English | | | |
| | | | be, language — if other th ule can be chosen to earn | | ation offered — if not every seme- |
| c) oral e Langua | examin ge of a ment o | ation in groups (gro ssessment: English ffered: In the semes | ate each (approx. 20 mini ups of 2, 15 minutes per c ter in which the course is | andidate) | ubsequent semester |
| Allocat | | | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| AuditiO | natini | | | | |
| | - d | | | | |
| Worklo | a0 | | | | |
| 300 h | | | | | |
| Teachir | ıg cycl | e | | | |
| | | | | | |
| Referre | d to in | LPOI (examination | regulations for teaching- | degree programmes) | |
| Module | annos | urs in | | | |
| | | | atics International (2015) | | |
| | - | | International (2020) | | |
| | - | | atics International (2020) | | |
| | - | • | atics International (2022) | | |
| | - | | International (2024) | | |
| | - | | atics International (2025) |) | |
| | | | | | |

| Modul | e title | | | Abbreviation | |
|---|---|---|--|---|---------------|
| Geome | etrical Mechanics | | | 10-M=VGEMin-152-n | 101 |
| Nodul | e coordinator | | Module offered by | 1 | |
| Dean o | of Studies Mathematik (Mathe | ematics) | Institute of Mathen | natics | |
| ECTS | Method of grading | Only after succ. co | ompl. of module(s) | | |
| 10 | numerical grade | | | | |
| Durati | on Module level | Other prerequisite | 25 | | |
| 1 seme | | | | | |
| Conter | nts | I. | | | |
| tic geo phase Recom Advan Geome | odule builds on the topics com metry, cotangent bundles an space reduction, normal form mended previous knowledge ced knowledge of differential etry". Knowledge of the content heoretical mechanics can also | d other examples of sy ns, introduction to Pois : geometry is required, nts of the module "Intr | mplectic manifolds, s sson geometry. such as can be acquii | ymmetries and Noeth red in the module "Dif | ferential |
| ntend | ed learning outcomes | | | | |
| The stu He/Sh | udent is acquainted with sele e is able to establish a conne uestions in physics. | | | , . | |
| Course | es (type, number of weekly co | ntact hours, language | — if other than Germa | an) | |
| V (4) + Modul | Ü (2) e taught in: English | | | | |
| Metho | d of assessment (type, scope | , language — if other t | han German, examina | tion offered — if not e | every seme |
| | nformation on whether modul | | | | , |
| b) oral c) oral Langua Assess | ten examination (approx. 90 f examination of one candidat examination in groups (group age of assessment: English sment offered: In the semeste able for bonus | e each (approx. 20 mi os of 2, 15 minutes per | nutes) or candidate) | ubsequent semester | |
| Alloca | tion of places | | | | |
| | | | | | |
| Additi. | onal information | | | | |
| Auulti | | | | | |
| Workle | | | | | |
| | Udu | | | | |
| 300 h | | | | | |
| Teachi | ing cycle | | | | |
| | | | | | |
| Referre | ed to in LPO I (examination re | egulations for teaching | g-degree programmes) | | |
| | | | | | |
| Modul | e appears in | | | | |
| | r's degree (1 major) Mathema | | 5) | | |
| | r's degree (1 major) Physics Ir | | | | |
| | r's degree (1 major) Mathema | | | | |
| | r's degree (1 major) Mathema r's degree (1 major) Physics Ir | | 2) | | |
| waste | r's degree (1 major) Physics Ir | iternational (2024) | | | |
| | vith 1 major Physics International (2020) | | g • generated 19-Apr-2025 • ex | | page 34 / 170 |



Master's degree (1 major) Mathematics International (2025)

| Module title | | | | | Abbreviation |
|--|--|--|--|--------------------------|---|
| Selected Topics in Mathematical Physics | | | | | 10-M=VMPHin-152-m01 |
| Module coordinator | | | | Module offered by | |
| Dean of Studies Mathematik (Mathemat | | | matics) | Institute of Mathematics | |
| ECTS Method of grading | | - 1 - ¹ | . compl. of module(s) | | |
| 10 | | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| terial so Recomr Depenc | ciences mende ling on | s, geometric field theo d previous knowledge | ry, advanced topics in q : d advanced knowledge | uantum theory. | uid dynamics, mathematical ma- of analysis is required. In case of |
| | | ning outcomes | | | |
| The student is acquainted with an advanced topic in mathematical physics. He/She is able to establish a connection between his/her acquired skills and other branches of mathematics and questions in physics. | | | | | |
| Courses (type, number of weekly contact hours, language — if other than German) | | | | | |
| V (4) + I Module | | t in: English | | | |
| | | | , language — if other the e can be chosen to earn | | ation offered — if not every seme- |
| b) oral (c) oral (Langua | examir examin ge of a ment o | nation of one candidat ation in groups (group ssessment: English ffered: In the semeste | o 120 minutes, usually o e each (approx. 20 minu os of 2, 15 minutes per c r in which the course is | utes) or andidate) | ubsequent semester |
| Allocati | ion of _l | olaces | | | |
| | | | | | |
| Additional information | | | | | |
| | | | | | |
| Worklo | ad | | | | |
| 300 h | | | | | |
| Teachir | ıg cvcl | e | | | |
| | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | <u></u> | | |
| Module | annes | ars in | | | |
| | | | ics International (2015) | | |
| Master's degree (1 major) Mathematics International (2015) Master's degree (1 major) Physics International (2020) | | | | | |
| | Master's degree (1 major) Mathematics International (2021) | | | | |
| | Master's degree (1 major) Mathematics International (2022) | | | | |
| | - | ee (1 major) Physics In | | | |
| Master' | laster's degree (1 major) Mathematics International (2025) | | | | |

| Module | e title | | | | Abbreviation |
|---|---------------------------------------|--|---|---|----------------------------------|
| Numeric of Partial Differential Equations | | | ons | | 10-M=VNPEin-152-m01 |
| Module coordinator | | | | Module offered by | |
| Dean o | f Studi | es Mathematik (Mathem | natics) | Institute of Mathem | natics |
| ECTS | | od of grading | Only after succ. com | | |
| 10 | | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | _ | | |
| (numer discont Recom We reco | ical me inuous mende ommer | ethods for elliptic, parab 6 Gelerkin finite element d previous knowledge: 1d basic knowledge of fu | oolic and hyperbolic pa is method, finite differ unctional analysis and | ntial differential equ ences and finite volu partial differential e | quations, such as can be acqui- |
| | | dules "Introduction to Fu | Inctional Analysis" and | a "Applied Analysis" | · |
| | | ning outcomes | | | |
| | | acquainted with advan | | | |
| | | , number of weekly cont | act hours, language — | if other than Germa | in) |
| V (4) + Module | | t in: English | | | |
| | | sessment (type, scope, lion on whether module) | | | tion offered — if not every seme |
| b) oral c) oral e Langua | examir examin ge of a ment o | mination (approx. 90 to nation of one candidate nation in groups (groups ssessment: English ffered: In the semester i bonus | each (approx. 20 minu of 2, 15 minutes per c | ites) or andidate) | ubsequent semester |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 300 h | | | | | |
| Teachir | ng cvcl | e | | | |
| | <u> </u> | | | | |
| Referre | d to in | LPOI (examination reg | | legree programmes) | |
| | | | | | |
| Module | e appea | ars in | | | |
| Master | 's degr | ee (1 major) Mathematic | s International (2015) | | |
| Master' | 's degr | ee (1 major) Physics Inte | ernational (2020) | | |
| | - | ee (1 major) Mathematio | | | |
| | - | ee (1 major) Mathematic | | | |
| | - | ee (1 major) Physics Inte | | | |
| Master | 's degr | ee (1 major) Mathematio | s International (2025) | | |

| Module | e title | | · · · · · · · · · · · · · · · · · · · | Abbreviation | | |
|--|--|--|--|-------------------------------------|---------------|--|
| Partial | Differential Equations of Ma | thematical Physics | | 10-M=VPDPin-152-1 | m01 | |
| Modul | e coordinator | | Module offered by | | | |
| Dean of Studies Mathematik (Mathematics) | | ematics) | Institute of Mathem | atics | | |
| ECTS | Method of grading | Only after succ. con | | | | |
| 10 numerical grade | | | | | | |
| Duratio | on Module level | Other prerequisites | | | | |
| 1 seme | ester graduate | | | | | |
| Contents | | | | | | |
| Elliptic, parabolic, and hyperbolic equations; Laplace equation, heat equation and wave equation as standard examples; initial and boundary value problems; well-posed and ill-posed problems; solution methods; extensi- ons and generalisations; Hilbert space methods; Sobolev spaces and Fourier transforms. Recommended previous knowledge: Basic knowledge from the modules "Ordinary Differential Equations" and "Introduction to Partial Differential Equations" is recommended, as well as basic knowledge of functional analysis. | | | | | | |
| | ed learning outcomes | 0 | , | | | |
| equation between | udent is acquainted with func ons, as well as standard exar en his/her acquired skills and es (type, number of weekly co | nples from mathematica I other branches of mati | al physics. He/She is nematics and question | able to establish a ons in physics. | | |
| V (4) + | | | | | | |
| | e taught in: English | | | | | |
| a) writt b) oral c) oral Langua Assess | formation on whether modul ten examination (approx. 90 examination of one candidat examination in groups (group age of assessment: English sment offered: In the semester able for bonus | to 120 minutes, usually re each (approx. 20 minutes of 2, 15 minutes per c | chosen) or utes) or andidate) | ıbsequent semester | | |
| Allocat | tion of places | | | | | |
| | | | | | | |
| Additic | onal information | | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| 300 h | | | | | | |
| Teachi | ng cycle | | | | | |
| | | | | | | |
| Referre | ed to in LPO I (examination r | egulations for teaching- | degree programmes) | | | |
| | | | | | | |
| | e appears in | | | | | |
| Module | Master's degree (1 major) Mathematics International (2015) Master's degree (1 major) Physics International (2020) Master's degree (1 major) Mathematics International (2021) Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Physics International (2024) | | | | | |
| Master Master Master Master Master | r's degree (1 major) Physics Ir r's degree (1 major) Mathema r's degree (1 major) Mathema r's degree (1 major) Physics Ir | tics International (2021) tics International (2022) Iternational (2024) |) | | | |
| Master Master Master Master Master | r's degree (1 major) Physics Ir r's degree (1 major) Mathema r's degree (1 major) Mathema | tics International (2021) tics International (2022) Iternational (2024) tics International (2025) |) | | page 38 / 170 | |

| Modul | e title | | | Abbreviation | |
|---|--|---|--|---|--|
| Pseude | o Riemannian and Riemannia | n Geometry | | 10-M=VPRGin-152-r | n01 |
| Modul | e coordinator | | Module offered by | | |
| Dean of Studies Mathematik (Mathematics) | | matics) | Institute of Mathematics | | |
| ECTS Method of grading Only after succ. compl. of module(s) | | | | | |
| 10 | numerical grade | | | | |
| Duration Module level Other prerequisites | | | | | |
| 1 semester graduate | | | | | |
| Conter | nts | | | | |
| nian ar map, Ja Laplac theory. Recom | mended previous knowledge: | olds, Levi-Civita connec rems in Riemannian ge of Lorenz manifolds, Eir | tion and curvature, g ometry, submanifolc ostein equations and | geodesics and the ex Is, integration, d'Ale I applications in gen | xponential mbert and eral relativity |
| Geome | ced knowledge of differential ; etry". Knowledge of the conten eory" is also recommended. | | | | |
| | ed learning outcomes | | | | |
| manifo | udent is acquainted with adva olds. He/She is able to establi tics and questions in physics. | | | | |
| Course | es (type, number of weekly cor | ntact hours, language – | - if other than Germa | an) | |
| V (4) + | | | | | |
| | e taught in: English | | | | |
| | d of assessment (type, scope, iformation on whether module | | | ition offered — if not | every seme- |
| | ten examination (approx. 90 to | | | | |
| | examination of one candidate examination in groups (group | | | | |
| | age of assessment: English | 5 01 2, 15 minutes per e | | | |
| | sment offered: In the semester | r in which the course is | offered and in the s | ubsequent semester | |
| | able for bonus | | | | |
| Allocat | tion of places | | | | |
| | | | | | |
| Additio | onal information | | | | |
| | | | | | |
| Worklo | Jau | | | | |
| 300 h | | | | | |
| | ng cycle | | | | |
| Referre | ed to in LPO I (examination re | gulations for teaching- | degree programmes) | | |
| Modul | e appears in | | | | |
| Master | r's degree (1 major) Mathemat r's degree (1 major) Physics In r's degree (1 major) Mathemat | ternational (2020) | | | |
| | vith 1 major Physics International (2020) | JMU Würzburg | generated 19-Apr-2025 • ex r (120 ECTS) Physics Internat | | page 39 / 170 |
| | | ta recoru maste | (120 LCIS) FILYSICS IIILEITIAL | ional - 2020 | |



Master's degree (1 major) Mathematics International (2022) Master's degree (1 major) Physics International (2024) Master's degree (1 major) Mathematics International (2025)

| Module | e title | | | | Abbreviation |
|---|----------------|---|------------------------|-----------------------|--|
| Operations Research for students of other subjects | | | ther subjects | | 10-M-ORSaf-152-m01 |
| Module coordinator | | | | Module offered by | |
| Dean o | f Studie | es Mathematik (Mathema | atics) | Institute of Mathem | natics |
| ECTS | | od of grading | Only after succ. com | | |
| 10 | | rical grade | | • | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | undergraduate | | | |
| Conten | ts | | | | |
| Linear | prograr | nming, duality theory, tra | insport problems, inte | egral linear program | ming, graph theoretic problems. |
| Intende | ed learı | ning outcomes | | | |
| for solv | ving ma | | pecially in economics | | h, as required as a central tool apply these methods to practical |
| Course | s (type | , number of weekly conta | ct hours, language — | if other than Germa | an) |
| V (4) + | Ü (2) | | | | |
| | | e ssment (type, scope, la on on whether module ca | | | ation offered — if not every seme- |
| Assess credita Allocat | ble for | | which the course is | offered and in the su | ubsequent semester |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 300 h | | | | | |
| Teachi | ng cycl | e | | | |
| | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching-c | legree programmes) | |
| | | | | | |
| Module | e appea | in in | | | |
| Bachelor's degree (1 major) Computer Science (2015) Master's degree (1 major) Physics (2016) Bachelor's degree (1 major) Computer Science (2017) Bachelor's degree (1 major) Computer Science (2019) Master's degree (1 major) Physics (2020) | | | | | |
| | - | ee (1 major) Physics Inter gree (1 major) Computer S | | hility (2021) | |
| Dachel | | gree (1 major) Computers | Science und Susidilla | ionity (2021) | |

| Module | e title | | Abbreviation | | |
|--|------------------------------|---|---|---------------------|-----------------------------------|
| Advanc | ed Ana | lysis | 10-M-VAN-152-m01 | | |
| Module | e coord | inator | | Module offered by | |
| Dean of Studies Mathematik (Mathematics) | | | atics) | Institute of Mathem | atics |
| ECTS | Metho | od of grading | Only after succ. com | pl. of module(s) | |
| 7 | nume | rical grade | | | |
| Duratio | on | Module level | Other prerequisites | | |
| 1 seme | ster | undergraduate | | | |
| Conten | its | | | | |
| Continu | uation o | of analysis in several vari | ables, integration the | eorems. | |
| Intende | ed learı | ning outcomes | | | |
| | | acquainted with advanc understand the construct | | | of the Lesbegue integral, he or |
| | | | • | | ``` |
| | | , number of weekly conta | ct nours, language — | f other than Germa | n) |
| V (4) + | · · · | | | | |
| | | s essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral c) oral | examin examin age of a | nination (approx. 90 to 1 ation of one candidate e ation in groups (groups c ssessment: German and/ bonus | ach (15 to 30 minutes of 2, 10 to 15 minutes | s) or | |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 210 h | | | | | |
| Teachi | ng cvcl | 6 | | | |
| | | - | | | |
| Referre | ed to in | LPO I (examination regu | lations for teaching-d | legree programmes) | |
| | | <u></u> | | | |
| Module | annes | ors in | | | |
| | | gree (1 major) Mathemati | cs (2015) | | |
| | | gree (1 major) Mathemati | - | | |
| | | gree (1 major) Computatio | | 015) | |
| | | gree (1 major) Mathemati | | | |
| | | ee (1 major) Physics (2010 | • | | |
| | - | ee (1 major) Nanostructur | | | |
| | - | ee (1 major) Nanostructur | •, · · | | |
| | - | ee (1 major) Physics (202 | | | |
| | - | ee (1 major) Physics Inter | | | |
| | - | ee (1 major) Quantum Eng | | | |
| | | ee (1 major) Quantum Teo | | | |
| | - | • | | | |
| Bachelor's degree (1 major) Mathematics (2023) | | | | | |

| Module title | | | | Abbreviation | |
|--|--|--|---|---|---|
| | | ro Imaging | | | 11-AAI-Int-201-m01 |
| Module coordinator | | | | Module offered by | |
| | Managing Director of the Institute of Theoretical Physics and Astrophysics | | | Faculty of Physics and Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | numei | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| ric Tran Detecto 2) Imag c) Basio | smissio or Types ge Proce c Metho | on: Ground Based vs. Sp s and CCD Properties; e) essing: a) Data Formats a | ace Based Imaging; o Imaging in Other Ban nd Imaging Software | c) Observing Techniq Ids of the Electromag r; b) Basic Methods: | Eye to the Detector; b) Atmosphe- ues and Instruments; d) Optical gnetic Spectrum Pixel Operations and Statistics; aging in Color f) Image Processing |
| try; e) M 4) Outlo | nced P Aaximu bok: a) | m Entropy Methods; f) In | terferometry; g) Imag tific Questions / Inst | ge Classification, Ma | Analysis; d) Speckle Interferome- chine Learning Methods essing; b) Future Facilities Radio |
| | | ning outcomes | | | |
| dern as re the fe analysi | tronom ollowin s, appl | ny, incorporating measur g qualifications: ability t | ements from ground- o process and interp : of processing algori | and space-based in ret raw-image data, t | thods using examples from mo- struments. The students acqui- o perfom data reduction, image and methods are not limited to |
| Course | s (type, | number of weekly conta | ct hours, language – | - if other than Germa | n) |
| V (3) + I Module | | t in: English | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| | | | | | |

Workload

180 h

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020) exchange program Physics (2023)

Master's degree (1 major) Physics International (2024)

| Module title | | | | Abbreviation | | |
|--|---|--|---|--|--|--|
| Cosmol | ogy | | | | 11-AKM-Int-201-m01 | |
| Module | coord | inator | | Module offered by | | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | eoretical Physics | Faculty of Physics and Astronomy | | |
| ECTS | | od of grading | Only after succ. con | pl. of module(s) | | |
| 6 | | rical grade | | - · · · | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | | | | |
| Conten | ts | | | | | |
| Matter, | Expanding Space-Time, Friedmannian Cosmology, Basics of General Relativity, The Early Universe, Inflation, Dark Matter, Primordial Nucleosynthesis, Cosmic Microwave Background, Structure Formation, Galaxies and Galaxy Clusters, Intergalactic Medium, Cosmological Parameters | | | | | |
| Intende | ed learn | ning outcomes | | | | |
| | | lge of cosmology. Knowle ions. Insight into current | | | logy and the ability to relate tho- cientific questions. | |
| Course | s (type, | , number of weekly conta | ct hours, language – | - if other than Germa | ın) | |
| V (3) + I Module | | t in: English | | | | |
| ster, inf | formati | essment (type, scope, la on on whether module ca nination (approx. 90 to 1 | an be chosen to earn | | tion offered — if not every seme- | |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua | examin examin ect repo entatio ten exa ake the ssmen date at ge of a | ation of one candidate e ation in groups (groups c ort (approx. 8 to 10 pages n/talk (approx. 30 minute amination was chosen as form of an oral examination | ach (approx. 30 minu of 2, approx. 30 minu) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa is about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachir | ng cycl | e | | | | |
| | | | | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching- | degree programmes) | | |
| | | | | | | |
| Module | appea | rs in | | | | |
| exchan | ge prog | ee (1 major) Physics Inter gram Physics (2023) | | | | |
| master | Master's degree (1 major) Physics International (2024) | | | | | |

| Modul | e title | | | | Abbreviation | |
|---|---|--|--|--|--|--------------|
| Select | ed Topi | cs of Theoretical Solid | State Physics | | 11-AKTF-Int-201-mo | 1 |
| Module | e coord | inator | | Module offered by | | |
| | | ector of the Institute of T | heoretical Physics | Faculty of Physics a | nd Astronomy | |
| and As | | | neoretical inysies | | ind Astronomy | |
| ECTS | Meth | od of grading | Only after succ. cor | npl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | ; | | |
| 1 seme | ster | graduate | | | | |
| Conten | nts | | | | | |
| ments | to brin | , selected topics of cong g the students in touch quantum matter. | | | | |
| Intend | ed lear | ning outcomes | | | | |
| theore | tical po | learn how to describe co int of view. This happer ssover of these students | is on the basis of anal | ytical and numerical | methods. Therefore, | |
| | | , number of weekly con | act hours, language – | - if other than Germa | n) | |
| V (3) + Module | • • | t in: English | | | | |
| | | sessment (type, scope, ion on whether module | | | tion offered — if not | every seme- |
| e) pres If a wri stead t of asse nation Langua | entatic tten ex take the essmen date at age of a | ort (approx. 8 to 10 page on/talk (approx. 30 minu amination was chosen a e form of an oral examin t is changed, the lecture t the latest. assessment: English offered: In the semester | ites). Is method of assessm ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the or | If the metho |
| Allocat | tion of | places | | | | |
| | | | | | | |
| Additic | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| | | | | | | |
| 180 h | | | | | | |
| 180 h Teachi | ng cycl | e | | | | |
| Teachi | | | | | | |
| Teachi | | e LPOI (examination reg | ulations for teaching- | degree programmes) | | |
| Teachi Referre | ed to in | LPOI (examination reg | ulations for teaching- | degree programmes) | | |
| Teachi Referre Module | ed to in e appea | LPOI (examination reg | | degree programmes) | | |
| Teachi Referre Module Master Master Master | ed to in e appe a 's degr 's degr 's degr | LPO I (examination reg ars in ee (1 major) Physics Into ee (1 major) Quantum E ee (1 major) Quantum E | ernational (2020) ngineering (2020) ngineering (2024) | degree programmes) | | |
| Teachi Referre Module Master Master Master | ed to in e appe a 's degr 's degr 's degr | LPO I (examination reg ars in ee (1 major) Physics Inte ee (1 major) Quantum E | ernational (2020) ngineering (2020) ngineering (2024) | degree programmes) | | |

| Module title | | | | | Abbreviation | |
|---|--|---|----------------------|-----------------------|------------------------------------|--|
| | | strophysics | | | 11-APL-Int-201-m01 | |
| Module | e coordi | inator | | Module offered by | | |
| Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics | | | | | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | numei | rical grade | | | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | | | | |
| Conten | ts | | | | | |
| celerati | Astrophysical sources of high-energy emission, radiative processes, interaction of light with matter, particle-ac- celeration processes, pair creation, nuclear processes, pion production, astrophysical shock waves, kinetic equations | | | | | |
| Intende | ed learr | ning outcomes | | | | |
| | | ains knowledge in fundar adiative processes in ast | | gy astrophysics, such | n as particle acceleration and | |
| Course | s (type, | number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (3) + I Module | | t in: English | | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | |
| | | nination (approx. 90 to 1 | | | | |
| | | ation of one candidate e | | ites) or | | |
| | | ation in groups (groups o | | - | r | |
| | | ort (approx. 8 to 10 pages | | | | |
| | | n/talk (approx. 30 minut | | ant this may be char | nged and assessment may in- | |
| | | | | | mination in groups. If the method | |
| | | | | | weeks prior to the original exami- | |
| | | the latest. | | | | |
| - | - | ssessment: English ffered: In the semester in | which the course is | offered and in the cu | ub cogulant comostor | |
| | | | which the course is | onered and in the su | | |
| Allocat | ion of p | liaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| Worklo | | | | | | |
| 180 h | au | | | | | |
| Teachir | | a | | | | |
| Teaciiii | ig cycu | 5 | | | | |
| Referro | d to in | LPO I (examination regu | lations for teaching | legree programmec) | | |
| | | | | | | |
| Module | 20023 | rs in | | | | |
| | | ee (1 major) Physics Inter | national (2020) | | | |
| | - | gram Physics (2023) | national (2020) | | | |
| | | ee (1 major) Physics Inter | national (2024) | | | |
| | | | | | | |

| Module | Module title | | | Abbreviation | |
|---|--|---|---|--|---|
| Astrophysics | | | | 11-APM-Int-241-m01 | |
| Module | coord | inator | | Module offered by | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | eoretical Physics | Faculty of Physics and Astronomy | |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | | Module level | Other prerequisites | | |
| 1 semes | ster | graduate | | | |
| Conten | ts | | | | |
| Telesco Mediun tive Gal | pes an n, Mole actic N | d Detectors, Stellar Struc cular Clouds, Structure o uclei, Large-Scale Structu | ture and Atmospher f the Milky Way, the | es, Stellar Evolution | oplanets, Astronomical Scales, and their End Stages, Interstellar Expanding Universe, Galaxies, Ac- |
| | | ning outcomes | | | |
| of astro | physic | | ole to plan and interp | oret his/her own obse | s the methods and instruments ervations. He/She is familiar with 's and galaxies. |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) |
| V (2) + I Module | | t in: English | | | |
| | | e ssment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asses nation e Langua | examin examin ect repo entatio ten exa ake the ssmen date at ge of a | form of an oral examinat | ach (approx. 30 minu of 2, approx. 30 minu) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa is about this by four y | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocati | ion of p | olaces | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachir | ng cycl | e | | | |
| | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching- | degree programmes) | |
| | | - | | | |
| Module | appea | irs in | | | |
| Master' | s degre | ee (1 major) Physics Inter | national (2020) | | |
| Master' | Master's degree (1 major) Physics International (2024) | | | | |

| Mother | Module title | | | | | Abbreviation | |
|--|---|---|---|---|---|--------------------------------|--|
| Methods of Observational Astronomy | | | / | | 11-ASM-Int-201-mo | 1 | |
| Module | o coord | inator | | Module offered by | | | |
| | | | Theoretical Physics | Faculty of Physics a | and Astronomy | | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | | | | | |
| ECTS | Meth | od of grading | Only after succ. cor | npl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | on | Module level | Other prerequisites | 5 | | | |
| 1 seme | 1 semester graduate | | | | | | |
| Conten | ts | | | | | | |
| | | oservational Astronomy om radio, optical, X-ray a | | | action and reduction | n of observa- | |
| | | ning outcomes | | • | | | |
| (radio, | optical | r the methods used in ol I, X-ray and gamma-ray e luct astronomical obser | energies). Knowledge | | | | |
| Course | s (type | , number of weekly cont | tact hours, language - | – if other than Germa | in) | | |
| V (3) + Module | | t in: English | | | | | |
| | | sessment (type, scope, ion on whether module | | | tion offered — if not | every seme- | |
| e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the metho of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exam nation date at the latest. Language of assessment: English | | | | | | | |
| Langua | date at ige of a | t is changed, the lecture the latest. | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua | date at ige of a ment o | t is changed, the lecture the latest. ssessment: English ffered: In the semester | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua Assess | date at ige of a ment o | t is changed, the lecture the latest. ssessment: English ffered: In the semester | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua Assess Allocat | date at ige of a ment o ion of J | t is changed, the lecture the latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua Assess Allocat | date at ige of a ment o ion of J | t is changed, the lecture the latest. ssessment: English ffered: In the semester | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the methoo riginal exami | |
| Langua Assess Allocat | date at age of a ment o ion of p | t is changed, the lecture the latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the methoo riginal exami | |
| Langua Assess Allocat Additio Worklo | date at age of a ment o ion of p | t is changed, the lecture the latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the methoo riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h | date at age of a ment o ion of p onal inf | t is changed, the lecture t he latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo | date at age of a ment o ion of p onal inf | t is changed, the lecture t he latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen | e each or an oral exa ts about this by four | mination in groups. weeks prior to the o | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin | date at age of a ment o ion of p onal inf pad | t is changed, the lecture t he latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen in which the course is | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin | date at age of a ment o ion of p onal inf pad | t is changed, the lecture t he latest. Issessment: English Iffered: In the semester places | ation of one candidat er must inform studen in which the course is | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin | date at age of a ment o ion of p onal inf bad | t is changed, the lecture t the latest. Issessment: English offered: In the semester places formation e LPO I (examination reg | ation of one candidat er must inform studen in which the course is | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module | date at age of a ment o ion of p onal inf onal info onal info info onal info info info info info info info info | t is changed, the lecture t the latest. Issessment: English offered: In the semester places formation ee LPOI (examination reg ars in ee (1 major) Physics Inte | ation of one candidat er must inform studen in which the course is unable of the course is gulations for teaching- | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master | date at age of a ment o ion of p onal inf onal inf onal inf onal inf oad ad ad ad ad ad ad ad ad ad ad ad ad a | t is changed, the lecture t the latest. Issessment: English offered: In the semester places formation e LPO I (examination reg ars in ee (1 major) Physics Inte ee (1 major) Quantum E | ation of one candidat er must inform studen in which the course is unable of the course is gulations for teaching- | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the methor riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master exchan | date at age of a ment o ion of p onal inf ad ad ed to in 's degr 's degr ge prog | t is changed, the lecture t the latest. Issessment: English offered: In the semester places formation e LPO I (examination reg ars in ee (1 major) Physics Inte ee (1 major) Quantum Ei gram Physics (2023) | ation of one candidat er must inform studen in which the course is gulations for teaching- ernational (2020) ngineering (2020) | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the methor riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin Referre Module Master Master Master Master | date at age of a ment o ion of p onal inf onal info onal info info info onal info info info info info info info info | t is changed, the lecture t the latest. Issessment: English Iffered: In the semester places formation e LPO I (examination reg ars in ee (1 major) Physics Inte eg (1 major) Quantum En gram Physics (2023) ee (1 major) Quantum En | ation of one candidat er must inform studen in which the course is ulations for teaching- ernational (2020) ngineering (2024) | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the method riginal exami | |
| Langua Assess Allocat Additio Worklo 180 h Teachin Referre Master Master Master Master Master Master | date at age of a ment o ion of p onal inf onal i | t is changed, the lecture t the latest. Issessment: English offered: In the semester places formation e LPO I (examination reg ars in ee (1 major) Physics Inte ee (1 major) Quantum Ei gram Physics (2023) | ation of one candidat er must inform studen in which the course is ulations for teaching- ernational (2020) ngineering (2024) ernational (2024) | e each or an oral exa ts about this by four offered and in the su | mination in groups. weeks prior to the o ubsequent semester | If the metho riginal exam | |

| Module title | | | | Abbreviation | | | |
|--|---|--|---|--|--|--|--|
| Introdu | ction t | o Space Physics | | | 11-ASP-Int-201-m01 | | |
| Module coordinator | | | | Module offered by | | | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | eoretical Physics | Faculty of Physics and Astronomy | | | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | | | | |
| 1 seme | ster | graduate | | | | | |
| Conten | ts | | | | | | |
| 2. Dyna 3. Elem 4. The s 5. Acce | Overview Dynamics of charged particles in magnetic and electric fields Elements of space physics The sun and heliosphere Acceleration and transport of energetic particles in the heliosphere Instruments to measure energetic particles in extraterrestrial space | | | | | | |
| | | ning outcomes | | | | | |
| Basic k | nowlec and the | lge in space physics, in p heliosphere. Knowledge | | | namics of charged particles in al concepts and the methods of | | |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | | |
| V (3) + I Module | | t in: English | | | | | |
| | | | | | tion offered — if not every seme- | | |
| | | on on whether module ca | | a bonus) | | | |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua | examin examin ect repo entatio ten exa ake the ssmen date at ge of a ment o | form of an oral examina t is changed, the lecturer the latest. ssessment: English ffered: In the semester in | ach (approx. 30 minu of 2, approx. 30 minu o) or es) method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa ts about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocat | ion of p | olaces | | | | | |
| | | | | | | | |
| Additio | nal inf | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 180 h | | | | | | | |
| Teachir | ng cycl | e | | | | | |
| | | | | | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching- | degree programmes) | | | |
| | | | | | | | |
| Module | appea | urs in | | | | | |
| Master' | Master's degree (1 major) Physics International (2020) | | | | | | |

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module | <u>title</u> | | | | Abbreviation |
|---|--|--|---|---|--|
| Theore | tical As | strophysics | | | 11-AST-Int-201-m01 |
| Module | coord | inator | | Module offered by | |
| Managi and Ast | - | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS | | od of grading | Only after succ. con | pl. of module(s) | |
| 6 | | rical grade | | • • • • | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| | | retical astrophysics such jets, shock waves, radiat | | | olack holes, supernovae, pulsars, |
| Intende | ed learr | ning outcomes | | | |
| Knowle | dge of | basic processes and met | hods of theoretical a | strophysics. Ability t | to formulate theoretical models. |
| Course | s (type, | , number of weekly conta | ct hours, language – | - if other than Germa | n) |
| V (2) + Module | | t in: English | | | |
| | | s essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| c) oral e d) proje e) prese If a writ stead ta of asse nation Langua | examin ect repo entatio ten exa ake the ssmen date at ge of a | form of an oral examina | of 2, approx. 30 minu) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa s about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocat | | | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachir | ng cycl | e | | | |
| | | | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching- | degree programmes) | |
| | | | | | |
| Module | e appea | irs in | | | |
| Master | 's degre | ee (1 major) Physics Inter | national (2020) | | |
| | | gram Physics (2023) | | | |
| Master | 's degre | ee (1 major) Physics Inter | national (2024) | | |

| Module | e title | | | | Abbreviation | |
|-------------------|-------------------|---|---|---|------------------------|---------------|
| Atmosp | oheric l | Physics | | | 11-ATP-Int-241-m01 | |
| Module | coord | inator | | Module offered by | | |
| | | ector of the Institute of Th | poorotical Physics | Faculty of Physics a | nd Astronomy | |
| and Ast | trophys | sics | , 1 | | | |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | I | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | | graduate | | | | |
| Conten | ts | | | | | |
| mics. R and Ru | adiativ naway. | atmospheres. Planetary a re transfer and radiative b Physics of clouds. Electr mic rays. Atmospheres o | balance. Fluid mecha ic and magnetic field | nics. Greenhouse eff | ect. Climate Models | : Equilibrium |
| Intende | ed lear | ning outcomes | | | | |
| | | e knowledge of the physic | | | | |
| | | e. They are able to use the | | | | |
| | | lanets. They are able to n al warming. | nodel the physical m | echanisms of the ter | restrial climate and i | nterpret the |
| | | , number of weekly conta | oct hours language - | - if other than Germa | n) | |
| V (2) + | | | | n other than defind | 11) | |
| | | t in: English | | | | |
| | | sessment (type, scope, la | inguage — if other th | an German, examina | tion offered — if not | every seme- |
| | | on on whether module c | | | | , |
| a) writte | en exai | mination (approx. 90 to 1 | 20 minutes) or | | | |
| | | ation of one candidate e | | | | |
| | | ation in groups (groups o | | tes per candidate) o | r | |
| | • | ort (approx. 8 to 10 pages n/talk (approx. 30 minut | - | | | |
| | | amination was chosen as | | ent this may be chai | nged and assessmer | nt may in- |
| | | e form of an oral examina | | | | |
| | | t is changed, the lecturer | | | | |
| | | the latest. | | ,,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, , | | 0 |
| Langua | ge of a | ssessment: English | | | | |
| Assess | ment o | ffered: In the semester ir | which the course is | offered and in the su | ibsequent semester | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachir | ng cycl | e | | | | |
| | | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching- | degree programmes) | | |
| | | | | | | |
| Module | appea | ars in | | | | |
| Master' | 's degr | ee (1 major) Physics Inter | national (2020) | | | |
| | | ee (1 major) Physics Inter | | | | |
| Master's wi | ith 1 majo | r Physics International (2020) | | e generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | | page 53 / 170 |

| Module | title | | | | Abbreviation |
|---|--|---|---|--|--|
| Selecte | d Topi | cs of Theoretical Element | tary Particle Physics | | 11-ATTP-Int-201-m01 |
| Module | coord | inator | | Module offered by | |
| | ng Dire | ector of the Institute of Th | neoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS | | od of grading | Only after succ. cor | npl. of module(s) | |
| 6 | | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | ; | |
| 1 seme | ster | graduate | | | |
| 1. Adva 2. Phen 3. Higgs 4. Top-(| tion of nced T omenc s Physi Quark I | | Calculations of Scatte | | |
| gy. Kno | wledge | e of current trends in part | icle physics phenom | enology. | of particle physics phenomenolo- |
| | | , number of weekly conta | ict hours, language – | - if other than Germa | n) |
| V (3) + I | | t in: English | | | |
| ster, inf a) writte | formati en exai | sessment (type, scope, la on on whether module ca mination (approx. 90 to 1 nation of one candidate e | an be chosen to earn 20 minutes) or | a bonus) | tion offered — if not every seme- |
| c) oral e d) proje e) prese If a writ stead ta of asse nation o Langua Assess | examin ect repo entatio ten exa ake the ssmen date at ge of a ment o | ation in groups (groups of ort (approx. 8 to 10 pages n/talk (approx. 30 minut amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: English ffered: In the semester in | of 2, approx. 30 minus) or es). method of assessm tion of one candidate must inform studen | ites per candidate) o ent, this may be chan e each or an oral exa ts about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | _ | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachir | ıg cycl | e | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching- | degree programmes) | |
| Module | appea | urs in | | | |
| | | ee (1 major) Physics Inter | national (2020) | | |
| | - | ee (1 major) Physics Inter | | | |

| Module | | | | | Abbreviation | |
|---|--|--|--|---|---|---|
| Basic I | maging | Concepts | | | 11-BIC-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | <u>.</u> | |
| Manag | ing Dire | ctor of the Institute of | Applied Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | nume | ical grade | | | | |
| Duratio | | Module level | Other prerequisites | i | | |
| 1 seme | | graduate | | | | |
| Conten | | | | | | |
| across tion, ce spread vanced | all ima entral-s functic I metho | ging modalities, incluc ice- theorem), 3) the s n, modulation transfe ds for image acquisitio | epts and physical images ling 1) the concept of For ystem theory of imagin r function, spatial resol on will be covered and a and astrophysics will | burier imaging, 2) tor g systems, and 4) iss ution, contrast, nois a comprehensive ove | nography (Radon-Tra sues of image quality e). During the course | ansforma- y (point- e different ad- |
| Intende | ed learr | ing outcomes | | | | |
| | | | ndations of imaging me re able to explain the di | | | |
| Course | s (type | number of weekly con | ntact hours, language – | - if other than Germa | n) | |
| V (3) + Module | | t in: English | | | | |
| | | | , language — if other th e can be chosen to earn | | tion offered — if not | every seme- |
| b) oral c) oral of d) projection e) pression lf a write stead to of assemination Langua | examin examin ect repo entatio tten exa ake the essment date at ige of a | ation in groups (group ort (approx. 8 to 10 pag n/talk (approx. 30 min mination was chosen form of an oral exami is changed, the lectu the latest. ssessment: English | e each (approx. 30 minu s of 2, approx. 30 minu ges) or | tes per candidate) o ent, this may be char e each or an oral exa ts about this by four | nged and assessmen mination in groups. weeks prior to the or | If the method riginal exami- |
| Allocat | ion of p | laces | | | | |
| | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | 9 | | | | |
| Teachir | ng cycle | e: every year, after ann | ouncement | | | |
| Referre | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | | |
| | | | | | | |
| Module | e appea | rs in | | | | |
| exchan | ige prog | ee (1 major) Physics In gram Physics (2023) ee (1 major) Physics In | | | | |
| | | Physics International (2020) | JMU Würzburg | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 55 / 170 |

| Module | title | | | | Abbreviation | |
|--|--|---|--|---|--|---------------------------------|
| | - | d the Standard Model | of Elementary Particle | Physics | 11-BSM-Int-201-mo | 1 |
| Module | coord | inator | | Module offered by | - | |
| Managi and Ast | | ector of the Institute of sics | Theoretical Physics | Faculty of Physics a | ind Astronomy | |
| ECTS | Metho | od of grading | Only after succ. co | mpl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | n | Module level | Other prerequisites | 5 | | |
| 1 seme | ster | graduate | | | | |
| Conten | ts | | | | | |
| 2. Tests 3. Neut 4. Higgs | s of the rino Ph s Physi | | v Energy Experiments a | and at High Energy Co | olliders | |
| • P • E • <i>N</i> • S | article xtende lodels upersy | enology of Experiment Cosmology d Gauge Theories with Extended Higgs S mmetry with Extra Dimension c | ectors | | | |
| Intende | ed learr | ning outcomes | | | | |
| particle | phenc and un | h tests of the standard omenology, in particula derstand how to test th | r Higgs and neutrino p | hysics. Ability to con | struct extensions of | the standard |
| Course | s (type, | , number of weekly cor | itact hours, language - | – if other than Germa | ın) | |
| V (3) + I | R (1) | t in: English | | | | |
| | | e ssment (type, scope, on on whether module | | | tion offered — if not | every seme- |
| b) oral e c) oral e d) proje e) prese If a writ stead ta of asse nation e Langua | examin examin ect repo entatio ten exa ake the ssmen date at ge of a | nination (approx. 90 to ation of one candidate ation in groups (group ort (approx. 8 to 10 pag n/talk (approx. 30 min amination was chosen form of an oral examin t is changed, the lectur the latest. ssessment: English ffered: In the semester | e each (approx. 30 min s of 2, approx. 30 minu res) or utes). as method of assessm nation of one candidat rer must inform studen | utes per candidate) o ent, this may be cha e each or an oral exa ts about this by four | nged and assessmer mination in groups. weeks prior to the or | If the method riginal exami- |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Master's wi | th 1 major | Physics International (2020) | - | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | - | page 56 / 170 |

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

| Module title | | | | Abbreviation | |
|---|---|--|--|--|---------------|
| | Signal Processing in Physic | :5 | | 11-BSV-Int-201-m01 | |
| Module coo | ordinator | | Module offered by | | |
| Managing D | Director of the Institute of Ap | oplied Physics | Faculty of Physics a | nd Astronomy | |
| | thod of grading | Only after succ. com | pl. of module(s) | | |
| 6 nun | nerical grade | | | | |
| Duration | Module level | Other prerequisites | | | |
| 1 semester | graduate | | | | |
| Contents | | | | | |
| of the digita rem, correla | d aperiodic signals; basic p al signal and image process ation and energy considerat nkel and Radon transformat | ing; discretization of ion; statistical signal | signals/Shannon sa | mpling theorem; Pa | rsival theo- |
| Intended le | arning outcomes | | | | |
| processing | nowledge about digital ima and various methods of sig olying them to tomography. | | | | |
| Courses (ty | pe, number of weekly conta | ict hours, language — | if other than Germa | n) | |
| V (2) + Ü (2) Module tau | ght in: English | | | | |
| | assessment (type, scope, la ation on whether module c | | | tion offered — if not | every seme- |
| c) oral exam d) project re e) presenta lf a written of stead take to of assessmention date Language o | nination of one candidate e nination in groups (groups of eport (approx. 8 to 10 pages tion/talk (approx. 30 minut examination was chosen as the form of an oral examina ent is changed, the lecturer at the latest. f assessment: English t offered: In the semester in | of 2, approx. 30 minutes) or es). method of assessme tion of one candidate must inform student | tes per candidate) or ent, this may be char e each or an oral exar s about this by four v | nged and assessmer mination in groups. weeks prior to the or | If the method |
| Allocation o | of places | | | | |
| | | | | | |
| Additional i | information | | | | |
| | | | | | |
| Workload | | | | | |
| 180 h | | | | | |
| Teaching cy | /cle | | | | |
| | , | | | | |
| Referred to | in LPO I (examination regu | lations for teaching-o | legree programmes) | | |
| | | | | | |
| Module app | pears in | | | | |
| Master's de exchange p | gree (1 major) Physics Inter gree (1 major) Quantum En rogram Physics (2023) gree (1 major) Quantum En | gineering (2020) | | | |
| Master's with 1 m | ajor Physics International (2020) | | generated 19-Apr-2025 • exa (120 ECTS) Physics Internation | - | page 58 / 170 |
| | | ta record MaStel | (120 LCT3) Physics Internatio | σπαι - 2020 | |



Master's degree (1 major) Physics International (2024)

| Module title | | | | Abbreviation |
|---|---|--|---|---|
| Bosonisation and Intera | actions in One [| Dimension | | 11-BWW-Int-201-m01 |
| Module coordinator | | | Module offered by | |
| | e Institute of Th | eoretical Physics | Faculty of Physics a | and Astronomy |
| Managing Director of the and Astrophysics | e msulule of Th | EUTERICAL PHYSICS | | and Astronomy |
| ECTS Method of grad | ing | Only after succ. cor | npl. of module(s) | |
| 6 numerical grade | | | • • • | |
| Duration Module l | evel | Other prerequisites | 5 | |
| 1 semester graduate | | | | |
| Contents | | | | |
| malization group, and th The below mentioned to 3. Interacting fermions o 4. Bethe ansatz 5. Spin-1/2 chains 6. Disordered systems 7. Non-abelian bosonisa lodchikov equation, app | and Luttinger l he sine-Gordon opics will be pre on a lattice (Hub ation and the W olications of the omes uliarities of one ally relevant fea | iquids (spinless ferr model). sented in different y obard model, t/J mod ZW model (Kac-Moo WZW model) -dimensional (1D) el tures including disc | vears: del, transport proper ody algebras, Sugawa ectron systems. Acquirder effects and tran | ara construction, Knizhnik-Zamo- uisition of the theoretical tools to sport in 1D. |
| V (3) + R (1) | of weekly conta | ct nours, language - | – II other than Germa | 411) |
| Module taught in: Englis | sh | | | |
| | (type, scope, la | | | ation offered — if not every seme- |
| stead take the form of a of assessment is change nation date at the latest Language of assessmen Assessment offered: In t | ne candidate e roups (groups c x. 8 to 10 pages prox. 30 minute was chosen as n oral examinat ed, the lecturer :. it: English | ach (approx. 30 min f 2, approx. 30 minu) or es). method of assessm ion of one candidat must inform studen | utes per candidate) o ent, this may be cha e each or an oral exa ts about this by four | nged and assessment may in- mination in groups. If the methoo weeks prior to the original exami |
| Allocation of places | | | | |
| | | | | |
| Additional information | | | | |
| | | | | |
| Workload | | | | |
| 180 h | | | | |
| Teaching cycle | | | | |
| | | | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

| Module | e title | | | | Abbreviation | |
|--|---|--|--|---|--|---------------------------------|
| Conten | nporary | Astrophysics | | | 11-CAP-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | l | |
| - | - | ector of the Institute of | Theoretical Physics | Faculty of Physics a | and Astronomy | |
| and Ast ECTS | <u> </u> | od of grading | Only after succ. cor | nnl of modulo(c) | | |
| <u>6</u> 6 | | rical grade | | | | |
| Duratio | L | Module level | Other prerequisites | | | |
| 1 seme | | graduate | | - | | |
| Conten | ts | | | | | |
| Telesco Mediur | opes an n, Mole | onomy, Coordinates ar Id Detectors, Stellar Str cular Clouds, Structure luclei, Large-Scale Stru | ructure and Atmospher e of the Milky Way, the | es, Stellar Evolution | and their End Stage | s, Interstellar |
| Intende | ed lear | ning outcomes | | | | |
| of astro | ophysic | familiar with the mode al research. He/She is ad evolution of the mos | able to plan and interp | oret his/her own obs | ervations. He/She is | |
| Course | s (type | , number of weekly cor | ntact hours, language - | – if other than Germa | un) | |
| V (3) + Module | | t in: English | | | | |
| | _ | sessment (type, scope, | language — if other th | an German, examina | ition offered — if not | every seme- |
| | | on on whether module | | | | , |
| c) oral (d) proje e) press If a writ stead t of asse nation Langua | examin ect repo entatio tten exa ake the essmen date at uge of a | ation of one candidate ation in groups (group ort (approx. 8 to 10 pag n/talk (approx. 30 min amination was chosen form of an oral examin t is changed, the lectur the latest. ssessment: English ffered: In the semester | s of 2, approx. 30 minu ges) or utes). as method of assessm nation of one candidat rer must inform studen | ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four | nged and assessme mination in groups. weeks prior to the o | If the method riginal exami- |
| Allocat | | | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| Teachir | ng cycle | e: every year, after ann | ouncement | | | |
| | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | | |
| Module | e appea | irs in | | | | |
| | | ee (1 major) Physics Int | ernational (2020) | | | |
| | | gram Physics (2023) ee (1 major) Physics Int | ernational (2024) | | | |
| Master's wi | ith 1 majo | Physics International (2020) | - | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | - | page 62 / 170 |
| | | | | | | |

| Module title | | | | Abbreviation |
|--|--|--|---|---|
| Computational Mater | rials Science (DFT) | | | 11-CMS-Int-201-m01 |
| Module coordinator | | | Module offered by | |
| Managing Director of and Astrophysics | the Institute of Th | eoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS Method of gra | ading | Only after succ. con | pl. of module(s) | |
| 8 numerical gra | ade | | | |
| Duration Module | le level | Other prerequisites | | |
| 1 semester gradua | ate | | | |
| Contents | | | | |
| liarity with DFT softwa ctions by projecting D tions of the AIM and e based on exact diago stency equations. | and localized bas ion of topological i static mean-field th ds for solid state p model (AIM) and l eld theory (DMFT) ds for realistic mod d electrons tcomes t of the above topi are packages such DFT results onto at explore some of its onalization or cont | invariants heory hysics Kondo physics deling of solids cs complemented by as VASP or Wien2k omic orbitals using v s limiting cases such inuous-time quantur | and construction of r vannier90. Knowledg as the Kondo regime n Monte Carlo for the | to be held in the CIP-Pool. Fami- maximally localized Wannier fun- ge how to obtain many-body solu- e. Ability to use impurity solvers e solution of the DMFT self-consi- |
| Courses (type, number V (4) + R (2) | | ct hours, language – | - if other than Germa | n) |
| Module taught in: Eng | - | 10 | | |
| Method of assessmer ster, information on w | | | | tion offered — if not every seme- |
| stead take the form of | of one candidate ea n groups (groups o prox. 8 to 10 pages (approx. 30 minute on was chosen as of an oral examinat nged, the lecturer est. nent: English | ach (approx. 30 minu of 2, approx. 30 minu) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa s about this by four y | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocation of places | | | | |
| | | | | |
| Additional informatio | on | | | |
| | | | | |
| Workload | | | | |
| 240 h | | | | |

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

| Module | | | | | Abbreviation |
|--|--|---|--|---|--|
| Renorm | nalizati | on Group and Critical Ph | enomena | | 11-CRP-Int-201-m01 |
| Module | coord | inator | | Module offered by | · |
| Managi and Ast | | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | ind Astronomy |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| 4. Phas 5. Pertu 6. Low- | n field t concep e diagi irbatioi dimens | | | | |
| - | | ning outcomes | | | |
| Profour sics. Ur | nd knov ndersta | wledge of the principles of | | | on group (RG) in statistical phy- theories in both statistical and |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | in) |
| | taugh | t in: English | | | |
| | | Sessment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua | examir examin ect repo entatio ten exa ake the ssmen date at ge of a | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate must inform student | tes per candidate) o ent, this may be char e each or an oral exa is about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocat | ion of p | olaces | | | |
| | | | - | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachir | ng cycl | e | | | |
| | 5 2 9 3 4 | - | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching. | legree programmes) | |
| | a .o iii | | | | |
| Module | annos | urs in | | | |
| Mouule | apped | | | | |

Master's with 1 major Physics International (2020)

| Module | e title | | | | Abbreviation |
|---|---|--|---|--|---|
| Advand | ed Top | oics in Astrophysics | | | 11-CSAM-Int-201-m01 |
| Module | e coord | linator | | Module offered by | |
| Manag and As | - | | of Theoretical Physics | Faculty of Physics a | and Astronomy |
| ECTS | <u> </u> | od of grading | Only after succ. cor | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | on | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | Approval from exan | nination committee r | equired. |
| Conten | ts | | | | |
| are rele dynam | evant to ics, he | o the following topics | : Stellar structure, star for cesses of the interstellar | ormation and develop | physics will be conveyed which oment, radiation transport, gas histry, accretion and jets, galaxy |
| Intend | ed lear | ning outcomes | | | |
| | | | urrent topics of astrophy quainted with current res | | pphysics. |
| Course | s (type | , number of weekly c | ontact hours, language - | – if other than Germa | an) |
| V (3) + | | | | | |
| | | t in: English | | | |
| | | | e, language — if other th Ile can be chosen to earr | | ation offered — if not every seme- |
| b) oral c) oral d) proje e) pres lf a write stead t of assess nation | examir examir ect repe entatio tten exa ake the essmen date at | nation in groups (grou ort (approx. 8 to 10 p on/talk (approx. 30 m amination was chose e form of an oral exan | ate each (approx. 30 min ups of 2, approx. 30 minu ages) or inutes). n as method of assessm nination of one candidat | ites per candidate) o ent, this may be cha e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocat | ion of | places | | | |
| | | | | | |
| Additio | onal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachi | ng cycl | e | | | |
| | | | | | |
| Referre | ed to in | LPOI (examination | regulations for teaching- | degree programmes) | |
| | | | | | |
| Module | e appea | ars in | | | |
| | - | ee (1 major) Physics ee (1 major) Physics | | | |

| Advanc | <u>e title</u> | | | | Abbreviation |
|---|--|---|--|--|--|
| | ed Top | ics in Solid State Physic | CS | | 11-CSFM-Int-201-m01 |
| Module | coord | inator | | Module offered by | |
| | _ | ector of the Institute of T | hoorotical Dhucica | Faculty of Physics | and Astronomy |
| and Ast | - | | neoretical Physics | | and Astronomy |
| ECTS | Methe | od of grading | Only after succ. co | mpl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | Approval from exar | nination committee I | required. |
| Conten | ts | | | | |
| vered in | n any o | | ese topics may relate | | anced courses on topics not co- arch developments or to subjects |
| | | ning outcomes | • | | |
| | | | ng of an advanced to | pic in condensed ma | tter physics. Insight into the inter |
| | | teaching and research. | | | |
| Course | s (type | , number of weekly cont | act hours, language - | – if other than Germa | an) |
| V (3) + | | | | | |
| Module | e taugh | t in: English | | | |
| a) writt b) oral | en exa examir | ion on whether module of mination (approx. 90 to nation of one candidate | 120 minutes) or | | |
| | | | of 2, approx. 30 minu | - | pr |
| d) proje e) prese If a writ stead ta of asse nation | ect repo entatio tten exa ake the ssmen date at | ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a e form of an oral examina | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- mination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation | ect repo entatio ten exa ake the ssmen date at ge of a | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a form of an oral examina t is changed, the lecture the latest. issessment: English | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- mination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua | ect repo entatio ten exa ake the ssmen date at ge of a | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a form of an oral examina t is changed, the lecture the latest. issessment: English | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat | ect repe entatio ten exa ake the ssmen date at ge of a ion of j | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a form of an oral examina t is changed, the lecture the latest. issessment: English | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- amination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat | ect repe entatio ten exa ake the ssmen date at ge of a ion of j | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- amination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat | ect rep entatio ten exa ake the ssmen date at ge of a ion of j | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- mination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat Additio | ect rep entatio ten exa ake the ssmen date at ge of a ion of j | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- mination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat Additio 180 h | ect rep entatio ten exa ake the ssmen date at ge of a ion of p nal inf ad | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- amination in groups. If the metho |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat Additio | ect rep entatio ten exa ake the ssmen date at ge of a ion of p nal inf ad | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | s) or tes). s method of assessm ation of one candidat | utes per candidate) o nent, this may be cha ne each or an oral exa | nged and assessment may in- amination in groups. If the metho |
| d) proje e) prose If a writ stead ta of asse nation Langua Allocat Additio 180 h Teachin | ect rep entatio ten exa ake the ssmen date at ge of a ion of j mal inf ad | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places ormation | is) or tes). s method of assessm ation of one candidat in must inform studen | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exam |
| d) proje e) prese If a writ stead ta of asse nation Langua Allocat Additio 180 h Teachin | ect rep entatio ten exa ake the ssmen date at ge of a ion of j mal inf ad | ort (approx. 8 to 10 page in/talk (approx. 30 minu amination was chosen a e form of an oral examina t is changed, the lecture the latest. issessment: English places | is) or tes). s method of assessm ation of one candidat in must inform studen | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exami |
| d) proje e) press If a writ stead ta of asse nation Langua Allocat Additio 180 h Teachin Referre | ect rep entatio ten exa ake the ssmen date at ge of a ion of p mal inf ad | e LPOI (examination reg | is) or tes). s method of assessm ation of one candidat in must inform studen | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exam |
| d) proje e) prese If a writ stead ta of asse nation (Langua Allocat Additio 180 h Teachin Referre Module | ect repentation entation aten exa ake the ssmen date at ge of a ion of p mal inf ad ad ad ad ad ad ad | e LPOI (examination reg | is) or tes). s method of assessm ation of one candidat or must inform studen ulations for teaching- | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exam |
| d) proje e) prese If a writ stead ta of asse nation (Langua Allocat Additio 180 h Teachin Referre Module | ect rep entatio ten exa ake the ssmen date at ge of a ion of p mal inf ad ad ad ad ad ad ad ad ad ad ad ad ad | e e (1 major) Physics Integration | rnational (2020) | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exam |
| d) proje e) press If a writ stead ta of asse nation Langua Allocat Additio 180 h Teachin Referre Master Master | ect rep entatio ten exa ake the ssmen date at ge of a ion of j mal inf ad ad ad ad ad ad ad ad ad ad ad ad ad | e LPOI (examination reg | rnational (2020) | utes per candidate) of nent, this may be cha re each or an oral exa ts about this by four | inged and assessment may in- amination in groups. If the metho weeks prior to the original exam |

| Module title | Abbreviation | | | | | |
|--|--|--|--|---|--|--|
| Advanced Computer Tomography 11-CTA-Int-201-m01 | | | | | | |
| Module coordinator | | | Module offered by | | | |
| Managing Director of the Institute of Ap | | plied Physics Faculty of Physics and Astronomy | | | | |
| ECTS Method of gradir | ng | Only after succ. compl. of module(s) | | | | |
| 6 numerical grade | | | | | | |
| Duration Module level | | Other prerequisites | | | | |
| 1 semester graduate | | | | | | |
| Contents | | | | | | |
| medical and industrial im on to various tasks in eng ting the Radon transform ty of standard recording g gebraic reconstruction te ny these methods. Stude ror sources as well as the images. Finally the most watersheds, labelling and Intended learning outcor The student know the con basic inverse problem por solutions, based on Four | naging applica gineering and ". Starting with geometries (pa echniques (ART ents will have t e correspondin common tools d fiber orienta mes ncept of Comp osed by this te ier analysis an | tions. In addition to t medical science, this h the simple Filtered arallel, fan, cone, heli) along with many ty he opportunity to see g correction scheme for volume image ar tion analysis. uted tomography (CT chnique the students d/or based on proba | the technicalities of blecture emphasizes Back Projection met ix) the advanced cou- pes of regularization how Radon data is s influence the outco halysis are presented alysis are presented and its application are able to derive s ibility theory. Most in | (CT), which is employed both in CT systems and their applicati- is on the mathematics of "inver- hod which is applied to a varie- urse lays out the strategies for al- schemes which may accompa- recorded and how different er- ome of the reconstructed volume d, such as distance transforms, es. From the formulation of the trategies for different numerical mportantly the students have a errors in CT which can impede | | |
| any well-prepared recons | struction. | | | · | | |
| V (3) + R (1) Module taught in: English | · · · · | | | | | |
| | type, scope, la | | | tion offered — if not every seme- | | |
| stead take the form of an of assessment is change nation date at the latest. | ne candidate e bups (groups c . 8 to 10 pages brox. 30 minute was chosen as 1 oral examinat d, the lecturer | ach (approx. 30 minu of 2, approx. 30 minu) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be char e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | |
| Allocation of places | | | | | | |
| | | | | | | |
| Additional information | | | | | | |
| | | | | | | |
| | | | | | | |
| Workload | | | | | | |
| 180 h | | | | | | |
| Teaching cycle | | | | | | |
| Teaching cycle: every year, after announcement | | | | | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

| Module title | | | Abbreviation | | | | | |
|--|-----------------|------------------------------|--|--|------------------------|---------------------------------|--|--|
| Electron and Ion Microscopy | | | 11-EIM-Int-201-m01 | | | | | |
| Module coordinator | | | | Module offered by | | | | |
| Managing Director of the Institute of Applied | | | Applied Physics | Faculty of Physics and Astronomy | | | | |
| ECTS | | od of grading | | y after succ. compl. of module(s) | | | | |
| 6 | | rical grade | | • | | | | |
| Duratio | n | Module level | Other prerequisites | 5 | | | | |
| 1 seme | ster | graduate | | | | | | |
| Conten | ts | | | | | | | |
| Theoretical Foundations. Electron and ion sources, optics of charged particles, interaction of matter with elec- trons and charged particles, detectors, measurement principles: SEM, STEM, TEM, sample preparation, advan- ced contrast mechanisms: EBSD, EELS, EDS, cathodoluminescence. | | | | | | | | |
| Intende | ed learr | ning outcomes | | | | | | |
| and ins | trumer | Ital basics and princip | ed knowledge in elect les of detectors and co ations. He/she knows | ntrast mechanisms. | He/she knows differ | | | |
| Course | s (type, | , number of weekly cor | ntact hours, language – | – if other than Germa | n) | | | |
| V (3) + Module | | t in: English | | | | | | |
| | | | language — if other th can be chosen to earn | | ition offered — if not | every seme- | | |
| d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes) If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | If the method riginal exami- | | |
| Allocation of places | | | | | | | | |
| | | | | | | | | |
| Additio | nal info | ormation | | | | | | |
| Workload | | | | | | | | |
| 180 h | | | | | | | | |
| Teaching cycle | | | | | | | | |
| Teaching cycle: annually, after announcement | | | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | | |
| | | | | | | | | |
| Module appears in | | | | | | | | |
| | | ee (1 major) Physics Int | ternational (2020) | | | | | |
| exchange program Physics (2023) | | | | | | | | |
| Master's degree (1 major) Quantum Engineering (2024) | | | | | | | | |
| Master's degree (1 major) Physics International (2024) | | | | | | | | |
| Master's wi | ith 1 major | Physics International (2020) | | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | - | page 71 / 170 | | |

| Module title | | | | | Abbreviation | | |
|--|---|---|---|--|--|--|--|
| Introduction to Plasma Physics | | | | | 11-EPP-Int-201-m01 | | |
| Module coordinator | | | | Module offered by | <u> </u> | | |
| Managing Director of the Institute of Theoretical Physics | | | Theoretical Physics | Faculty of Physics and Astronomy | | | |
| and As | - | | | | and Astronomy | | |
| ECTS | | | | npl. of module(s) | | | |
| 6 | I | rical grade | | | | | |
| Duration Module level | | | Other prerequisites | | | | |
| 1 seme | | graduate | | | | | |
| Transp thin the | a Astrop ort equ e solar | ations for energetic par | ticles, Properties of ma ion via shock waves a | agnetic turbulence, I nd via interaction wi | elds, Magnetohydrodynamics, Propagation of solar particles wi- th plasma turbulence, Particle ad diation. | | |
| Intend | ed lear | ning outcomes | | | | | |
| Knowle | edge of | fundamental processes | s in plasma astrophysi | cs. | | | |
| Course | s (type | , number of weekly con | tact hours, language – | - if other than Germa | an) | | |
| V (2) + | | | | | | | |
| | _ | t in: English | | | ation offered — if not every seme | | |
| ster, in a) writt b) oral | format en exa examir | ion on whether module mination (approx. 90 to nation of one candidate | can be chosen to earn 120 minutes) or each (approx. 30 minu | a bonus) utes) or | | | |
| d) proje e) pres If a writ stead t of asse nation Langua Assess | ect rep entatio tten ex ake the essmen date at age of a ment o | e form of an oral examin t is changed, the lecture t the latest. ssessment: English ffered: In the semester | es) or utes). as method of assessmu ation of one candidate er must inform student | ent, this may be cha e each or an oral exa ts about this by four | nged and assessment may in- mination in groups. If the metho weeks prior to the original exam | | |
| Allocat | ion of | places | | | | | |
| | | | | | | | |
| Additio | onal inf | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 180 h | | | | | | | |
| Teachi | ng cycl | e | | | | | |
| | | | | | | | |
| Referre | ed to in | LPOI (examination reg | gulations for teaching- | degree programmes) | | | |
| | | | | | | | |
| Module | e appea | ars in | | | | | |
| | | ee (1 major) Physics Inte | ornational (2020) | | | | |
| | σe nro | | emational (2020) | | | | |
| | | gram Physics (2023) ee (1 major) Physics Inte | | | | | |

| Module | e title | | | | Abbreviation | |
|---|---|--|---|---|---|--|
| Current | t Topics | s in Experimental Physics | 5 | | 11-EXE5-Int-201-m01 | |
| Module coordinator | | | | Module offered by | | |
| | | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. com | · · · · | , | |
| 5 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee r | equired. | |
| Conten | ts | | | | | |
| Current study a | | in experimental physics | Credited academic a | achievements, e.g. iı | n case of change of university or | |
| Intende | ed learr | ning outcomes | | | | |
| suring a link the | and eva e learnt s (type, | | are necessary to acqu elds of application. | ire this knowledge. | physics and insight into the mea- He/She is able to classify and to an) | |
| | | t in: English | | | | |
| | | sessment (type, scope, la on on whether module ca | | | ation offered — if not every seme- | |
| b) oral c) oral of d) projection e) press lf a write stead to of asseen to the stead to the stead | examin examin ect repo entatio tten exa ake the ssment date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be cha e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 150 h | | | | | | |
| Teaching cycle | | | | | | |
| | | | | | | |
| Referre | d to in | LPO I (examination regu | lations for teaching-o | legree programmes) |) | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) | | | | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module | e title | | | | Abbreviation | |
|---|---|--|---|---|---|--|
| Current | t Topics | s in Experimental Physics | 5 | | 11-EXE6A-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | | |
| | | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. com | · · · · | , | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee r | equired. | |
| Conten | ts | | | | | |
| Current study a | | in experimental physics | , credited academic a | chievements, e.g. ir | n case of change of university or | |
| Intende | ed learr | ning outcomes | | | | |
| suring a link the | and eva e learnt s (type, | | are necessary to acqu elds of application. | ire this knowledge. | physics and insight into the mea- He/She is able to classify and to an) | |
| | | t in: English | | | | |
| | | essment (type, scope, la on on whether module ca | | | ation offered — if not every seme- | |
| b) oral c) oral of d) projection e) press lf a write stead to of asseen to the stead to the stead | examin examin ect repo entatio tten exa ake the ssment date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be cha e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching-o | legree programmes) | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) | | | | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module | e title | | | | Abbreviation | |
|---|---|---|---|---|---|--|
| Current | t Topics | s in Experimental Physics | 5 | | 11-EXE6-Int-201-m01 | |
| Module coordinator | | | | Module offered by | | |
| | | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. com | · · · · | , | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee r | equired. | |
| Conten | ts | | | | | |
| Current study a | | in experimental physics. | Credited academic a | achievements, e.g. in | n case of change of university or | |
| Intende | ed learr | ning outcomes | | | | |
| suring a link the | and eva | | are necessary to acquelds of application. | ire this knowledge. | physics and insight into the mea- He/She is able to classify and to | |
| V (3) + | R (1) | t in: English | | | | |
| | | sessment (type, scope, la on on whether module ca | | | ation offered — if not every seme- | |
| b) oral c) oral of d) projection e) press lf a write stead to of asseen to the stead to the stead | examin examin ect repo entatio tten exa ake the ssment date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be cha e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teaching cycle | | | | | | |
| | | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching-c | legree programmes) | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) | | | | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module | e title | | | | Abbreviation | |
|---|--|---|---|---|---|--|
| Curren | t Topics | s in Experimental Physic | 5 | | 11-EXE7-Int-201-m01 | |
| Module coordinator | | | | Module offered by | | |
| chairpe | erson o | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. con | · · · · | , | |
| 7 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | Approval from exam | ination committee r | equired. | |
| Conten | nts | | | | | |
| | t topics abroad. | in experimental physics | . Credited academic a | achievements, e.g. iı | n case of change of university or | |
| Intend | ed lear | ning outcomes | | | | |
| Master suring link the | 's level and eva e learnt | . He/She commands kno aluation methods which a . He/She knows about fie | wledge in a current fi are necessary to acqu elds of application. | eld in experimental uire this knowledge. | ule in experimental physics on physics and insight into the mea- He/She is able to classify and to | |
| | | , number of weekly conta | ci nours, language – | - ir other than Germa | 111) | |
| V (3) + Module | | t in: English | | | | |
| | | | nguage — if other tha | an German, examina | ation offered — if not every seme- | |
| | | ion on whether module c | | | ·····,···, | |
| b) oral c) oral d) projetion e) press lf a write stead to fassee nation | examir examin ect repo entatio tten exa cake the essmen date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be cha e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | tion of p | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 210 h | | | | | | |
| Teaching cycle | | | | | | |
| | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | | |
| | Module appears in | | | | | |
| | Master's degree (1 major) Physics International (2020) | | | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module | e title | | | | Abbreviation | |
|--|--|---|---|--|---|--|
| Curren | t Topics | s in Experimental Physics | 5 | | 11-EXE8-Int-201-m01 | |
| Module coordinator | | | | Module offered by | | |
| | | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | 1 | od of grading | Only after succ. com | | and hotomotiny | |
| 8 | 1 | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | Approval from exam | ination committee re | equired. | |
| Conten | nts | | | | | |
| | t topics abroad. | in experimental physics. | Credited academic a | achievements, e.g. ir | n case of change of university or | |
| Intend | ed lear | ning outcomes | | | | |
| Master suring link the | 's level and eva e learnt | . He/She commands kno | wledge in a current fi are necessary to acqu elds of application. | eld in experimental ire this knowledge. | ule in experimental physics on physics and insight into the mea- He/She is able to classify and to an) | |
| V (4) + Module | | t in: English | | | | |
| | | sessment (type, scope, la on on whether module ca | | | ition offered — if not every seme- | |
| b) oral c) oral d) proju- e) press If a writ stead t of asse nation | examir examin ect repo entatio tten exa cake the essmen date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be chan e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | tion of p | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | oad | | | | | |
| 240 h | 240 h | | | | | |
| Teachi | Teaching cycle | | | | | |
| | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| Modul | Modulo appears in | | | | | |
| | Module appears in Macter's degree (a major) Deusics International (2020) | | | | | |
| | Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | |
| master s'degree (1 major) i hystes international (2024) | | | | | | |

| Nonph | Module title | | | | Abbreviation |
|---|--|--|--|-----------------------|--|
| Nonphysical Minor Subject | | | | | 11-EXNP6-Int-201-m01 |
| Module coordinator | | | | Module offered by | |
| chairpe | erson o | f examination committee | ! | Faculty of Physics a | and Astronomy |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | on | Module level | Other prerequisites | | |
| 1 seme | ester | graduate | Approval from exam | ination committee r | required. |
| Conten | nts | | | | |
| Non-te | chnical | minor. Crediting for acad | demic achievements, | e.g. from university | change or study abroad |
| Intend | ed lear | ning outcomes | | | |
| | | osseses advanced know cal minor subject (mathe | | | irements of a module in the field). |
| Course | s (type | , number of weekly conta | act hours, language – | - if other than Germa | an) |
| V (3) + Module | | t in: English | | | |
| | | essment (type, scope, la on on whether module c | | | ation offered — if not every seme- |
| c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. | | | | | |
| stead t of asse nation | tten exa ake the essmen date at | amination was chosen as form of an oral examina t is changed, the lecture the latest. | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua | tten exa ake the essmen date at age of a | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua | tten exa ake the essmen date at | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat | tten exa cake the essmen date at age of a t ion of j | amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: English blaces | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat | tten exa cake the essmen date at age of a t ion of j | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Additic | tten exa cake the essmen date at age of a tion of p | amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: English blaces | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Additio Worklo | tten exa cake the essmen date at age of a tion of p | amination was chosen as form of an oral examina t is changed, the lecturer the latest. ssessment: English blaces | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Additic Worklo 180 h | tten exa cake the essmen date at age of a tion of p onal inf | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Additic Worklo 180 h | tten exa cake the essmen date at age of a tion of p | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Additic Worklo 180 h | tten exa cake the essmen date at age of a tion of p onal inf | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places | es). s method of assessme tion of one candidate | e each or an oral exa | nged and assessment may in- imination in groups. If the method |
| stead t of asse nation Langua Allocat Morklo 180 h Teachi | tten exa cake the essmen date at age of a tion of p onal inf pad | amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places | es). s method of assessme tion of one candidate must inform student | e each or an oral exa | inged and assessment may in- amination in groups. If the method weeks prior to the original exami- |
| stead t of asse nation Langua Allocat Additic 180 h Teachi | tten exa cake the essmen date at age of a tion of p onal inf pad | e form of an oral examina t is changed, the lecture the latest. ssessment: English blaces ormation | es). s method of assessme tion of one candidate must inform student | e each or an oral exa | inged and assessment may in- amination in groups. If the method weeks prior to the original exami |
| stead t of asse nation Langua Allocat Morklo 180 h Teachi Referre | tten exa cake the essmen date at age of a tion of p onal inf pad | e e Pormation was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places ormation e LPO I (examination regu | es). s method of assessme tion of one candidate must inform student | e each or an oral exa | inged and assessment may in- amination in groups. If the method weeks prior to the original exami- |
| stead t of asse nation Langua Allocat Additio Worklo 180 h Teachi Referre Modulo | tten exa ake the essmen date at age of a tion of p onal inf oad ng cycl ed to in e appea | e e Pormation was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English places ormation e LPO I (examination regu | es). s method of assessmo tion of one candidate must inform student lations for teaching-o | e each or an oral exa | inged and assessment may in- amination in groups. If the method weeks prior to the original exami- |

| Module title | | Abbreviation | | | | | |
|---|--|--|--|--|--|--|--|
| Current Topics in Physics | | 11-EXP6A-Int-201-m01 | | | | | |
| Module coordinator | | Module offered by | | | | | |
| chairperson of examination committee | 2 | Faculty of Physics a | nd Astronomy | | | | |
| ECTS Method of grading | Only after succ. compl. of module(s) | | | | | | |
| 6 numerical grade | | | | | | | |
| Duration Module level | Other prerequisites | | | | | | |
| 1 semester graduate | Approval from exam | ination committee re | equired. | | | | |
| Contents | | | | | | | |
| Current topics in experimental or theor university or study abroad. | retical physics. Credit | ed academic achiev | ements, e.g. in case of change of | | | | |
| Intended learning outcomes | | | | | | | |
| The student posseses advanced know physics on Master's level in the study a current field in physics and insight in this knowledge. He/She is able to clas | programme Nanostru nto the measuring and sify and to link the le | cture Technology. He d calculating method arnt. He/She knows | e/She commands knowledge in Is which are necessary to acquire about fields of application. | | | | |
| Courses (type, number of weekly conta | act hours, language – | - if other than Germa | n) | | | | |
| V (3) + R (1) Module taught in: English | | | | | | | |
| Method of assessment (type, scope, la ster, information on whether module c | | | tion offered — if not every seme- | | | | |
| a) written examination (approx. 90 to a b) oral examination of one candidate e c) oral examination in groups (groups d) project report (approx. 8 to 10 pages) e) presentation/talk (approx. 30 minut) If a written examination was chosen as stead take the form of an oral examination date at the latest. Language of assessment: English | each (approx. 30 minu of 2, approx. 30 minu s) or ees). s method of assessme ition of one candidate | tes per candidate) o ent, this may be char e each or an oral exa | nged and assessment may in- mination in groups. If the method | | | | |
| Allocation of places | | | | | | | |
| | | | | | | | |
| Additional information | | | | | | | |
| | | | | | | | |
| Workload | | | | | | | |
| 180 h | | | | | | | |
| Teaching cycle | | | | | | | |
| | - | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| | Master's degree (1 major) Physics International (2020) | | | | | | |
| Master's degree (1 major) Quantum En | | | | | | | |
| Master's degree (1 major) Quantum En | gineering (2024) | | | | | | |
| Master's degree (1 major) Physics Inte | rnational (2024) | | | | | | |

| Module title | | | | | Abbreviation | | |
|--|--|--|---|--|--|--|--|
| Curren | Current Topics in Physics 11-EXP6-Int-201-m01 | | | | | | |
| Modul | e coord | inator | | Module offered by | | | |
| chairp | erson o | f examination committee | | Faculty of Physics a | nd Astronomy | | |
| ECTS Method of grading Only after succ. compl. of module(s) | | | | | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | on | Module level | Other prerequisites | | | | |
| 1 seme | ester | graduate | Approval from exam | ination committee re | equired. | | |
| Conter | nts | | | | | | |
| | | in experimental or theor tudy abroad. | etical physics. Credit | ed academic achieve | ements, e.g. in case of change of | | |
| Intend | ed lear | ning outcomes | | | | | |
| physic a curre this kn | s on Ma nt field owledg | aster's level in the study p in physics and insight in | programme Nanostru to the measuring and sify and to link the le | cture Technology. He d calculating method arnt. He/She knows | ule in theoretical or experimental e/She commands knowledge in Is which are necessary to acquire about fields of application. n) | | |
| V (3) + | | , , | , <u> </u> | | · | | |
| ster, in a) writt b) oral | formati ten exa examir | ion on whether module ca mination (approx. 90 to 1 nation of one candidate e | an be chosen to earn 20 minutes) or ach (approx. 30 minu | a bonus) Ites) or | tion offered — if not every seme- | | |
| d) proj e) pres If a wri stead t of asse nation | ect repo entatio tten exa cake the essmen date at | e form of an oral examina | i) or es). method of assessme tion of one candidate | ent, this may be char e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocat | tion of p | olaces | | | | | |
| | | | | | | | |
| Additio | onal inf | ormation | | | | | |
| | | | | | | | |
| Worklo | oad | | | | | | |
| 180 h | | | | | | | |
| Teachi | ng cycl | e | | | | | |
| | <u></u> | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | 3 | | | | |
| Modul | | | | | | | |
| Master | Master's degree (1 major) Physics International (2020) | | | | | | |
| 1 | - | ee (1 major) Quantum Eng ee (1 major) Quantum Eng | | | | | |
| | - | | | | | | |
| muster | Master's degree (1 major) Physics International (2024) | | | | | | |

| Module title | | Abbreviation | | | | |
|--|--|--|--|---|--|--|
| Current Topic | s of Theoretical Physics | | | 11-EXT5-Int-201-m01 | | |
| Module coor | linator | | Module offered by | | | |
| chairperson o | of examination committee | | Faculty of Physics a | nd Astronomy | | |
| | od of grading | Only after succ. com | pl. of module(s) | | | |
| 5 num | erical grade | | | | | |
| Duration | Module level | Other prerequisites | | | | |
| 1 semester | graduate | Approval from exam | ination committee re | equired. | | |
| Contents | | | | | | |
| Current topic study abroad | | redited academic ach | ievements, e.g. in c | ase of change of university or | | |
| Intended lea | rning outcomes | | | | | |
| ster's level. H sters the resp | le/She commands advand pective methods. He/She | ed technical knowled is able to apply these | lge in a current field methods to current | ule in theoretical physics on Ma- in theoretical physics and ma- problems in theoretical physics. | | |
| | e, number of weekly conta | ict hours, language — | if other than Germa | in) | | |
| V (2) + R (2) Module taug | nt in: English | | | | | |
| | sessment (type, scope, la tion on whether module ca | | | tion offered — if not every seme- | | |
| b) oral exami c) oral exami d) project rep e) presentation If a written existent take the of assessment of assessment of assessment of at each of a take the of assessment of at each of a take the of a take take the of a take take take take take take take ta | e form of an oral examina nt is changed, the lecturer | ach (approx. 30 minu of 2, approx. 30 minut 5) or es). 5 method of assessme tion of one candidate | tes per candidate) o ent, this may be char each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocation of | places | | | | | |
| | | | | | | |
| Additional in | formation | | | | | |
| | | | | | | |
| Workload | | | | | | |
| 150 h | 150 h | | | | | |
| Teaching cyc | Teaching cycle | | | | | |
| | | | | | | |
| Referred to in | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | | |
| אומגובו ג עבצובב (ב ווומוטו) דוויגונג ווונרוומנוטוומו (2024) | | | | | | |

| Module | e title | | | | Abbreviation | | |
|---|--|---|---|--|---|--|--|
| Current Topics of Theoretical Physics | | | | | 11-EXT6A-Int-201-m01 | | |
| Module coordinator | | | | Module offered by | | | |
| chairpe | erson o | f examination committee | | Faculty of Physics a | nd Astronomy | | |
| ECTS | | od of grading | Only after succ. com | pl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee r | equired. | | |
| Conten | ts | | | | | | |
| Current study a | • | in theoretical physics. C | redited academic ach | ievements, e.g. in c | ase of change of university or | | |
| Intende | ed learr | ning outcomes | | | | | |
| ster's le sters th | evel. He | e/She commands advance ective methods. He/She i | ed technical knowled s able to apply these | dge in a current field methods to current | ule in theoretical physics on Ma- in theoretical physics and ma- problems in theoretical physics. | | |
| Course | s (type, | , number of weekly conta | ct hours, language — | if other than Germa | in) | | |
| V (3) + Module | | t in: English | | | | | |
| | | e ssment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | | |
| b) oral c) oral d) proje e) pres lf a write stead t of assess nation | examin examin ect repo entatio tten exa ake the essment date at | form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minut) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be char each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocat | ion of p | olaces | | | | | |
| | | | | | | | |
| Additio | onal info | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 180 h | | | | | | | |
| Teachi | ng cycl | 9 | | | | | |
| | | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| | Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | | |
| | | | | | | | |

| Module title | | | | | Abbreviation | | |
|--|--|---|--|--|---|--|--|
| Current Topics of Theoretical Physics | | | | | 11-EXT6-Int-201-m01 | | |
| Module coordinator | | | | Module offered by | | | |
| chairpe | erson of | examination committee | | Faculty of Physics a | ind Astronomy | | |
| ECTS | Metho | od of grading | Only after succ. com | pl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee re | equired. | | |
| Conten | ts | | | | | | |
| Current study a | | in theoretical physics. C | redited academic ach | ievements, e.g. in c | ase of change of university or | | |
| Intende | ed learr | ning outcomes | | | | | |
| ster's le sters th | evel. He | e/She commands advance ective methods. He/She i | ed technical knowled is able to apply these | dge in a current field methods to current | ule in theoretical physics on Ma- in theoretical physics and ma- problems in theoretical physics. | | |
| | | number of weekly conta | ct hours, language — | if other than Germa | in) | | |
| V (3) + Module | | t in: English | | | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | | |
| b) oral c) oral d) proje e) pres lf a write stead te of assentiation | examin examin ect repo entatio tten exa ake the ssment date at | form of an oral examinat | ach (approx. 30 minu of 2, approx. 30 minut o) or es). method of assessme tion of one candidate | tes per candidate) o ent, this may be char each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocat | ion of p | olaces | | | | | |
| | | | | | | | |
| Additio | nal info | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 180 h | | | | | | | |
| Teachi | ng cycl | 9 | | | | | |
| | | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| | Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | | |
| | master s degree (r major) i hysics memational (2024) | | | | | | |

| Module | title | | | | Abbreviation | | |
|---|--|---|---|---|---|--|--|
| Current Topics of Theoretical Physics | | | | | 11-EXT7-Int-201-m01 | | |
| Module | coord | inator | | Module offered by | | | |
| chairpe | rson of | examination committee | | Faculty of Physics a | ind Astronomy | | |
| ECTS | Metho | od of grading | Only after succ. com | pl. of module(s) | | | |
| 7 | nume | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | | | | |
| 1 semes | ster | graduate | Approval from exam | ination committee re | equired. | | |
| Conten | ts | | | | | | |
| Current study a | • | in theoretical physics. C | redited academic ach | ievements, e.g. in c | ase of change of university or | | |
| Intende | ed learr | ning outcomes | | | | | |
| ster's le sters th | evel. He | e/She commands advance ective methods. He/She i | ed technical knowled s able to apply these | lge in a current field methods to current | ule in theoretical physics on Ma- in theoretical physics and ma- problems in theoretical physics. | | |
| | | number of weekly conta | ct hours, language — | if other than Germa | in) | | |
| V (3) + I Module | | t in: English | | | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | | |
| b) oral o c) oral o d) proje e) prese If a writ stead ta of asses nation o | examin examin ect repo entatio ten exa ake the ssment date at | form of an oral examinat | ach (approx. 30 minu of 2, approx. 30 minut) or es). method of assessme tion of one candidate | es per candidate) o ent, this may be chan each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | | |
| Allocati | ion of p | olaces | | | | | |
| | | | | | | | |
| Additio | nal info | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 210 h | | | | | | | |
| Teachir | ng cycle | 9 | | | | | |
| | | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| Master' | Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024) | | | | | | |
| musici | יומסובי ס עבצובב (ד וומסטו) דוויסונס ווונבווומנוטוומו (2024) | | | | | | |

| Module | title | | | | Abbreviation |
|---|--|--|---|---|---|
| Current Topics of Theoretical Physics | | | | | 11-EXT8-Int-201-m01 |
| Module | coordi | nator | | Module offered by | <u> </u> |
| chairper | son of | examination committee | | Faculty of Physics a | nd Astronomy |
| | | d of grading | Only after succ. com | pl. of module(s) | |
| 8 | numer | ical grade | | | |
| Duratior | | Module level | Other prerequisites | | |
| 1 semes | ter | graduate | Approval from exam | ination committee re | equired. |
| Content | s | | | | |
| Current study ab | • | in theoretical physics. C | redited academic ach | ievements, e.g. in c | ase of change of university or |
| Intende | d learn | ing outcomes | | | |
| ster's lev sters the | vel. He e respe | e/She commands advance ective methods. He/She i | ed technical knowled is able to apply these | dge in a current field methods to current | ule in theoretical physics on Ma- in theoretical physics and ma- problems in theoretical physics. |
| Courses | (type, | number of weekly conta | ct hours, language — | if other than Germa | in) |
| V (4) + R Module | | : in: English | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral e c) oral e d) projection e) prese lf a writte stead ta of assess nation d | xamin xamin ct repo ntation en exa ke the sment ate at | form of an oral examinat | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate | tes per candidate) of ent, this may be chan each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |
| Allocatio | | | | | |
| | | | | | |
| Addition | nal info | ormation | | | |
| | | | | | |
| Workloa | d | | | | |
| 240 h | | | | | |
| Teaching cycle | | | | | |
| | | | | | |
| Referred | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | |
| | | | | | |
| Module | appea | rs in | | | |
| Master's | s degre | ee (1 major) Physics Inter | national (2020) | | |
| Master's | s degre | ee (1 major) Physics Inter | national (2024) | | |

| Module title | | | | | Abbreviation | |
|--|---|---|----------------------|-----------------------|-----------------------------------|--|
| Field Theory in Solid State Physics | | | | | 11-FFK-Int-201-m01 | |
| Module | coord | inator | | Module offered by | | |
| Managi and Ast | | ector of the Institute of Th ics | eoretical Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 semes | ster | graduate | | | | |
| Conten | ts | | | | | |
| Green's An outli 1. Singl 2. Revie 3. Diagn 4. Diagn 5. Land 6. Supe 7. One-o Intende Working ties of F sential | This will usually be a course on quantum many particle physics approached by the perturbative methods using Green's functions An outline could be: 1. Single-particle Green's function 2. Review of second quantization 3. Diagrammatic method using many particle Green's functions at temperature T=0 4. Diagrammatic method for finite T 5. Landau theory of Fermi liquids 6. Superconductivity 7. One-dimensional systems and bosonization Intended learning outcomes Working knowledge of the methods of quantum field theory in a non-relativistic context. Ability to study proper- ties of Fermi liquids (and bosonic systems) beyond the one-particle picture. Acquisition of methods which are es- sential for the understanding the effects of interactions, including superconductivity and the Kondo effect. | | | | | |
| V (4) + I | | number of weekly conta | ci nours, language – | - II other than Germa | II) | |
| | | t in: English | | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e Langua Assessi | a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocation of places | | | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | | | | |
| Teachir | ig cycle | 9 | | | | |
| | | | | | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title | | | | | Abbreviation | |
|---|---|--|--|------------------------|--------------------------------------|--|
| | Solid State Physics 2 11-FK2-Int-201-m01 | | | | | |
| Module coordinator Module off | | | Module offered by | | | |
| Manag | ing Dire | ctor of the Institute of Ap | plied Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Metho | d of grading | Only after succ. con | npl. of module(s) | | |
| 8 | numer | ical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | Approval from exam | ination committee re | equired. | |
| Conten | its | | | | | |
| a. Elect b. Bloc c. Elect 2. Sem a. Elect b. Ferm c. Elect d. Boltz 3. The c a. Mact b. Pola plasmo c. Ferro 4. Sem a. Char b. Intrin c. Dope d. Phys e. Hete 5. Mag a. Atom b. Dia- c. Ferro 6. Supe a. Pher b. Mod | trical an h theore trons i-classic trical tra i surfac trical tra zmann-e dielectri roscopic rizability ons, inte omagnet iconduc racteristi nsic sem ed semio sics and prostruct netism nic dia-a and par omagnet ercondu nomena lels of su | cal models of dynamic pro- nsport in partially and co- es; measurement technin nsport in external magne- equations of transport c function and ferroelect c electrodynamics and m y of solids, of lattices, of r-band transitions, Wann ism tors ics niconductors conductors applications of p-n junc- ures and paramagnetism amagnetism in metals ism | rocesses ompletely filled band ques etic fields trics icroscopic theory valence electrons ar nier-Mott excitons | | ns; optical phonons, polaritons, | |
| Intende | ed learn | ing outcomes | | | | |
| | - | effects, concepts and mo applications of experim | | lid state physics. Far | niliarity with the theoretical prin- | |
| Course | s (type, | number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + Module | | in: English | | | | |
| | Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | |
| ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method | | | | | | |

UNIVERSITÄT WÜRZBURG

of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

Additional information

Workload

240 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023)

Mastarla darrea (majar) Quantum Fra

Master's degree (1 major) Quantum Engineering (2024)

| | | | | Abbreviation | | |
|--|--|--|--|---|--|--|
| Solid S | Solid State Spectrocopy 11-FKS-Int-201-m01 | | | | | |
| Module | e coord | inator | | Module offered by | | |
| Manag | ing Dire | ector of the Institute of Ap | plied Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | 1 | od of grading | Only after succ. con | pl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | | graduate | | | | |
| Conten | ts | | | | | |
| - | | ny particle picture of elec X-ray spectroscopies. | ctrons in solids, Light | t-matter interaction, | Optical spectroscopy, Electron | |
| Intende | ed learr | ning outcomes | | | | |
| | their a | | | | rent methods of spectrosco- rn developments in the related | |
| Course | s (type, | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (3) + Module | | t in: English | | | | |
| Metho | d of ass | essment (type, scope, la | nguage — if other tha | an German, examina | tion offered — if not every seme- | |
| ster, in | formati | on on whether module ca | an be chosen to earn | a bonus) | | |
| b) oral c) oral d) projetion e) pression lf a write stead to a st | examin examin ect repo entatio tten exa ake the essment date at age of a | form of an oral examinat | ach (approx. 30 minu of 2, approx. 30 minu o) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa s about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | |
| Module appears in | | | | | | |
| | - | ee (1 major) Physics Inter | | | | |
| | - | ee (1 major) Quantum Eng | gineering (2020) | | | |
| | | gram Physics (2023) ee (1 major) Quantum Eng | gineering (2024) | | | |
| | - | | | | | |
| | Master's degree (1 major) Physics International (2024) | | | | | |

| Module title | | | | Abbreviation | |
|--|--|---|-----------------------|-----------------------|--|
| Visiting Research | | | | | 11-FPA-Int-201-m01 |
| Modul | e coord | inator | | Module offered by | <u> </u> |
| chairp | erson o | f examination committee | | Faculty of Physics a | and Astronomy |
| ECTS | | od of grading | Only after succ. con | · · · · | |
| 10 | | rical grade | | | |
| Durati | on | Module level | Other prerequisites | ; | |
| | | graduate | | nination committee r | required. |
| Conter | nts | | | | |
| analys | | documentation of the res | | | sics. Experimental work including visits to other universities or re- |
| Intend | ed lear | ning outcomes | | | |
| | | h current research topics yze and document scient | • | heoretical physics. V | Vithin experimental physics, the |
| Course | es (type | , number of weekly conta | ct hours, language – | - if other than Germa | an) |
| R (o) Modul | e taugh | t in: English | | | |
| | | sessment (type, scope, la ion on whether module ca | | | ation offered — if not every seme- |
| | | (approx. 10 to 20 pages) ssessment: English | | | |
| Alloca | tion of | places | | | |
| | | | | | |
| Additio | onal inf | ormation | | | |
| | | | | | |
| Worklo | oad | | | | |
| 300 h | | | | | |
| Teachi | ing cycl | e | | | |
| | | | | | |
| Referre | ed to in | LPOI (examination regu | lations for teaching- | degree programmes |) |
| | | | | | |
| Modul | e appea | ars in | | | |
| Master | r's degr | ee (1 major) Physics Inter | national (2020) | | |
| Master's degree (1 major) Quantum Engineering (2020) | | | | | |
| | Master's degree (1 major) Quantum Engineering (2024) | | | | |
| Master | r's degr | ee (1 major) Physics Inter | national (2024) | | |

| Module title | e | | | Abbreviation | |
|--|--|----------------------|-----------------------|---|--|
| | al Specialization Physics In | ternational | | 11-FS-P-Int-201-m01 | |
| Module coo | ordinator | | Module offered by | | |
| | n of examination committee | | Faculty of Physics a | and Astronomy | |
| | thod of grading | Only after succ. con | | | |
| | t) successfully completed | | | | |
| Duration | Module level | Other prerequisites | | | |
| 1 semester | graduate | | | | |
| Contents | | | | | |
| for the envi pics. | saged topic of the master th | | | s that are of particular relevance quired underlying fundamental to- | |
| | arning outcomes | | | | |
| for the mas | | | | of relevance to the topic chosen bility to present and convey this | |
| Courses (ty | pe, number of weekly conta | ct hours, language — | - if other than Germa | in) | |
| S (4) Module tau | ght in: English | | | | |
| | assessment (type, scope, la ation on whether module ca | | | tion offered — if not every seme- | |
| | scussion (30 to 45 minutes) If assessment: English | | | | |
| Allocation of | of places | | | | |
| | | | | | |
| Additional | information | | | | |
| | | | | | |
| Workload | | | | | |
| 450 h | | | | | |
| Teaching cy | /cle | | | | |
| | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | |
| Module app | pears in | | | | |
| Master's de | egree (1 major) Physics Inter | national (2020) | | | |
| Master's de | egree (1 major) Physics Inter | national (2024) | | | |

| Module title | | | | Abbreviation |
|---|---|---|--------------------|--------------------|
| Introduction | to Gauge/Gravity Duality | / | | 11-GGD-Int-201-m01 |
| A4 - J. 1 | | | | |
| Module coordinator | | | Module offered by | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | Faculty of Physics | and Astronomy |
| ECTS Met | hod of grading | Only after succ. co | mpl. of module(s) | |
| 8 num | erical grade | | | |
| Duration | Module level | Other prerequisite | s | |
| 1 semester | graduate | | | |
| Contents | | | | |
| Quant Interact Renorn Gauge Confor Large Super 2. Elements Manife Riema Maxim Black 3. Elements Open String Type II D-Brar 4. The AdS/0 Staten Near-f Field-oc Tests of Hologi Hologi Hologi Hologi Finite Quant Black Hologi Transp 7. Application Finite Quant Hologi Hologi Entang 8. Application Graviti Graviti | malisation Group Fields mal Symmetry N expansion symmetry of gravity olds, coordinate covariand nn curvature hally symmetric spacetime holes of string theory and closed strings in background fields B String Theory tes CFT correspondence nent of the correspondence of the correspondence of the correspondence: Co of the correspondence: Co of the correspondence: Co of the correspondence co caphic principle s to non-conformal theori caphic C-Theorem ins I: Thermo- and hydrod um field theory at finite te | es prrelation functions onformal anomaly es pup ynamics emperature malism scosity and conductiv physics her-Nordström black | | |

Intended learning outcomes

Thorough understanding of the foundations of gauge/gravity duality and the ability to carry out basic tests. Working knowledge of essential applications. Knowledge of quantum mechanics and classical electrodynamics is a prerequisite for this course. Knowledge of quantum field theory and general relativity will be useful, however is not a prerequisite.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + R (2)

Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 120 minutes) or

b) oral examination of one candidate each (approx. 30 minutes) or

c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or

d) project report (approx. 8 to 10 pages) or

e) presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

--

Additional information

Workload

240 h

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020)

exchange program Physics (2023)

| Module title | | | | | Abbreviation | | |
|---|---|---|--|--|--|--------------------------------|--|
| Group | Theory | | | | 11-GRTM-Int-201-mc |)1 | |
| Modul | e coord | inator | | Module offered by | Nodule offered by | | |
| | ging Dire strophys | ector of the Institute of Th sics | neoretical Physics | Faculty of Physics a | and Astronomy | | |
| ECTS | Metho | od of grading | Only after succ. cor | npl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Durati | | Module level | Other prerequisites | | | | |
| 1 seme | ester | graduate | Approval from exam | nination committee r | equired. | | |
| Conter | nts | | | | | | |
| Germa | n conte | ents available but not trar | nslated yet. | | | | |
| | entheor Idunger | ie. Endliche Gruppen. Lie າ | e-Gruppen. Lie-Algeb | ren. Darstellungen. T | ensoren. Klassifikati | onstheorem. | |
| Intend | ed lear | ning outcomes | | | | | |
| Germa | n inten | ded learning outcomes a | vailable but not trans | slated yet. | | | |
| der La | ge, Prob | den beherrschen die Gru plemstellungen der Grupp ruppentheorie zur Formul | pentheorie zu erkenn | en und mit Hilfe der | erlernten Methoden | | |
| Course | es (type | , number of weekly conta | act hours, language – | - if other than Germa | ın) | | |
| V (3) + | | | | | | | |
| | _ | t in: English | | | | | |
| | | sessment (type, scope, la ion on whether module c | | | ition offered — if not | every seme- | |
| b) oral c) oral d) proj e) pres lf a wri stead to f asse nation Langua | examin examin ect repo sentatio tten exa take the essmen date at age of a | mination (approx. 90 to 1 nation of one candidate e lation in groups (groups of ort (approx. 8 to 10 pages in/talk (approx. 30 minut amination was chosen as e form of an oral examina t is changed, the lecturer the latest. Issessment: English iffered: In the semester in | each (approx. 30 minu of 2, approx. 30 minu s) or es). 5 method of assessm tion of one candidate r must inform student | tes per candidate) o ent, this may be cha e each or an oral exa ts about this by four | nged and assessmer mination in groups. I weeks prior to the or | If the method iginal exami- | |
| Alloca | tion of _l | places | | | | | |
| | | | | | | | |
| Additi | onal inf | ormation | | | | | |
| | | | | | | | |
| Worklo | oad | | | | | | |
| 180 h | | | | | | | |
| Teaching cycle | | | | | | | |
| | | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| Maste | r's degr | ee (1 major) Physics Inter | mational (2020) | | | | |
| Master's w | /ith 1 majo | r Physics International (2020) | - | • generated 19-Apr-2025 • exa r (120 FCTS) Physics Internati | - | page 95 / 170 | |



exchange program Physics (2023) Master's degree (1 major) Physics International (2024)

| | e title | | | | Abbreviation |
|--|--|--|---|---|--|
| Optical Properties of Semiconductor Nanostructures | | | tor Nanostructures | | 11-HNS-Int-201-m01 |
| Module coordinator | | | | Module off | ered by |
| | | ector of the Institute | of Applied Physics | | Physics and Astronomy |
| ECTS | | od of grading | Only after succ. | | · · · · · · · · · · · · · · · · · · · |
| 6 | | rical grade | | • | |
| Duratio | n | Module level | Other prerequisi | tes | |
| 1 seme | ster | graduate | | | |
| Conten | ts | | | | |
| ging the tures of with a f of nove for qua | eir size f varyin ocus o el optoe ntum c | . The lecture addres g dimensions (2D, 1 n optical properties lectronic and quant | ses technological chal D, oD). It provides the and light-matter coupl | lenges in the p basic theoretic ing. Moreover, based on such r | es can be systematically tailored via chan reparation of semiconductor nanostruc- al concepts to describe their properties, it discusses the challenges and concepts nanostructures, including building blocks |
| founda | tions. k | | • | | ctures as well as with their theoretical structures, and of their applications to |
| Course | s (type | , number of weekly o | contact hours, languag | e — if other tha | n German) |
| V (3) + Module | | t in: English | | | |
| | | | pe, language — if other ule can be chosen to e | | examination offered — if not every seme- |
| b) oral c) oral c d) proje e) prese If a writ stead ta of asse nation Langua | examin examin ect repo entatio ten exa ake the ssmen date at ge of a | ation in groups (gro ort (approx. 8 to 10 p n/talk (approx. 30 n amination was chose form of an oral exa t is changed, the lec the latest. ssessment: English | ate each (approx. 30 m ups of 2, approx. 30 m pages) or ninutes). en as method of asses mination of one candic turer must inform stud | inutes per canc sment, this ma late each or an ents about this | lidate) or y be changed and assessment may in- oral examination in groups. If the metho by four weeks prior to the original exami in the subsequent semester |
| Allocat | ion of p | olaces | | | |
| Additional information | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachi | ng cycl | e | | | |
| | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | |
| Module | | rc in | | | |

Master's with 1 major Physics International (2020)

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title | | | | | Abbreviation | | |
|--|---|--|---|--|--|---------------------------------|--|
| | Semiconductor Physics 11-HPH-Int-201-m01 | | | | | | |
| Module c | | | | | Module offered by | | |
| | | ctor of the Institute of | | Faculty of Physics a | nd Astronomy | | |
| | | d of grading | Only after succ. con | npl. of module(s) | | | |
| | | ical grade | | | | | |
| Duration 1 semeste | | Module level graduate | Other prerequisites | | | | |
| Contents | | giaduate | | | | | |
| The lecture, structure, tronic pro studies h | The lecture deals with the fundamental properties of semiconductors. It begins with an analysis of the crystal structure, leading to methods for describing band structures. These form a basis for discussing optical and electronic properties of monolithic semiconductors. It then turns to examining semiconductor heterostructures, and studies how these can be used to modify and design optical and electrical properties, especially in the case of lowered dimensionality systems. Examples are selected from current research activities. | | | | | | |
| Intended | learn | ing outcomes | | | | | |
| and band | d struc | | g knowledge semicond rical and optical prope n the program. | | | | |
| Courses (| (type, | number of weekly con | tact hours, language – | - if other than Germa | n) | | |
| V (3) + R (Module ta | | in: English | | | | | |
| | | | language — if other th can be chosen to earn | | tion offered — if not | every seme- | |
| c) oral ex. d) project e) presen lf a writte stead tak of assess nation da Language | amina t repo ntatior en exa ke the sment ate at e of as | ation in groups (group) rt (approx. 8 to 10 pag n/talk (approx. 30 min mination was chosen form of an oral examin is changed, the lectur the latest. ssessment: English | | tes per candidate) of ent, this may be char e each or an oral exa ts about this by four | nged and assessmer mination in groups. weeks prior to the or | If the method riginal exami- | |
| Allocatio | | | | | | | |
| | | | | | | | |
| Additiona | al info | rmation | | | | | |
| | | | | | | | |
| Workload | d | | | | | | |
| 180 h | | | | | | | |
| Teaching | g cycle | 1 | | | | | |
| | | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | |
| | | | | | | | |
| Module a | Module appears in | | | | | | |
| Master's | Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) | | | | | | |
| Master's with | 1 major | Physics International (2020) | - | e generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 99 / 170 | |



Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title | | | | | Abbreviation | | |
|--|---|---|---|---|---|-----------------------|--|
| Basic Imaging Reconstruction and Processing | | | | 11-IRP-Int-201-m01 | | | |
| Module | e coord | inator | | Module offered by | - | | |
| Manag | ing Dire | ector of the Institute of | | Faculty of Physics a | nd Astronomy | | |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | | | |
| 6 | nume | rical grade | | | | | |
| Duratio | on | Module level | Other prerequisites | | | | |
| 1 seme | | graduate | | | | | |
| Conten | | | | | | | |
| duced i ging ap code. In cessing in the f CT data | This training course uses the fundamentals of modern signal processing and imaging concepts, which are intro- duced in the corresponding lecture. Starting with the different categories of signals and transferring them to ima- ging applications, the students can test Fourier transform properties first hand by developing Matlab or Python code. Image convolution and de-convolution techniques are addressed in particular with respect to image pro- cessing tasks in modern physics (e.g. denoising). The Radon-Transform, which takes an outstanding im-portance in the field of computed tomography is demonstrated by the three-dimensional image reconstruction from real CT data whereby different sources of error can be tested. The theoretical part on discrete signals and their Fouri- er transform properties as well as different ways of image compression will also be further developed during this | | | | | | |
| | | ning outcomes | | | | | |
| respect probler | t to ima ms, suc | ging applications. The h as image reconstruc | re firm with the theoret y are able to devise a s tion, denoising, Fourier culate appropriate figu | trategy /toolchain fo analysis and freque | r basic and advance ncy decomposition. | d imaging By using | |
| Course | s (type, | number of weekly cor | ntact hours, language – | - if other than Germa | n) | | |
| V (3) + Module | | t in: English | | | | | |
| | | | language — if other the can be chosen to earn | | tion offered — if not | every seme- | |
| b) oral c) oral of d) projection e) pression lf a write stead to of assentiation | ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English | | | | | | |
| Allocat | ion of p | olaces | | | | | |
| | | | | | | | |
| Additional information | | | | | | | |
| | | | | | | | |
| Workload | | | | | | | |
| 180 h | | | | | | | |
| Teachi | Teaching cycle | | | | | | |
| Teachir | ng cycle | e: every year, after ann | ouncement | | | | |
| | | | gulations for teaching- | degree programmes) | | | |
| | | | | | | | |
| Master's wi | ith 1 major | Physics International (2020) | - | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 101 / 170 | |

Module appears in

Master's degree (1 major) Physics International (2020) exchange program Physics (2023)

| | | | | Abbreviation | |
|---|----------|------------------------------------|----------------------|----------------------|-----------------------------------|
| | | d Theory 2 | | | 11-KFT2-Int-201-m01 |
| Module | coordi | nator | | Module offered by | |
| Managi and Ast | | ctor of the Institute of Th ics | eoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | numer | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 seme | ster | graduate | | | |
| Conten | | | | | |
| Contents 5 Minimal models (critical statistical mechanics models (Ising, tricritical Ising, 3 state Potts model, restricted so- lid-on-solid models), correlation functions of the critical Ising model, fusion rules and the Verlinde algebra, Land- au-Ginzburg description of minimal models, modified Coulomb gas method and its application to the Ising mo- del, superconformal models) 6 Free bosons and fermions (mode expansions, twist fields, fermionic zero modes and fermion parity) 7 Free fermions on the torus (operator implementation of the partition function, vacuum energies, representati- ons of Virasoro algebra, the modular group and fermionic spin structures, Virasoro characters, critical Ising mo- del on the torus, Jacobi theta function identities) 8 Free bosons on the torus (Lagrangian formulation of the partition function, fermionization, orbifolds in general, S1/Z2 orbifold, Gaussian and Askhin-Teller models, duality between original and orbifold theories, marginal ope- rators, the space of c=1 theories) Intended learning outcomes Acquisition of both practical and conceptional familiarity with the methods of conformal field theory. Basic un- derstanding of critical phenomena, quantum field theory, and functional integration. Enhanced level of under- standing in particular for students of theoretical physics by exposure to an ambitious method with significant ap- plications in contemporary condensed matter physics. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) | | | | | |
| Method | l of ass | | | | tion offered — if not every seme- |
| ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocat | ion of p | laces | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024)

| Module | e title | | Abbreviation | | | | | | |
|---|---------------------|---------------------------------|--------------------------------------|----------------------------------|--|----------------|--|--|--|
| Confor | mal Fie | ld Theory | 11-KFT-Int-201-m01 | | | | | | |
| Module | e coord | inator | | Module offered by | | | | | |
| | | | Theoretical Physics | Faculty of Physics and Astronomy | | | | | |
| Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics | | | | | | | | | |
| | | Only after succ. con | Only after succ. compl. of module(s) | | | | | | |
| 6 | nume | rical grade | | | | | | | |
| Duration Module level Other prerequis | | | Other prerequisites | 25 | | | | | |
| 1 seme | 1 semester graduate | | | | | | | | |
| Conten | ts | | | | | | | | |
| Conformal field theory (CFT), as developed in the 1980s, finds immediate applications in string theory and two- dimensional statistical mechanics, where critical exponents and correlation functions for many models (Ising, tricritical Ising, 3-state Potts, etc.) can be calculated exactly. The physical idea is that the principle of scale inva- riance is elevated from a global to a local invariance, which for reasons of consistency amounts to invariance un- der conformal transformations. This, in turn, yields a rich and fascinating mathematical structure for two dimen- sional systems (either two space or one time and one space dimension). CFT has become relevant to many in- teresting areas of condensed matter physics, including Abelian and non-Abelian bosonization, quantized Hall states (where the bulk wave function is described in terms of conformal correlators, and the edge in terms 1+1 di- mensional CFTs), the two-channel Kondo effect, fractional topological insulators, and in particular fault-tolerant topological quantum computing involving non-Abelian anyons (Ising and Fibonacci anyons, for example, owe their names to the fusion rules of the associated conformal fields.) A potential syllabus for the first term of the course is: 0 Introduction (scale and conformal invariance, critical exponents, the transverse Ising model at the self-dual point) 1 Conformal theories in D=2 (primary fields and correlation functions, quantum field theory, canonical quantiza- tion and Noether's theorem, radial quantization and Polyakov's theorem, time ordering and functional integrati- on, the free boson and vertex operators, conformal Ward identities) 3 The central charge and the Virasoro algebra (central charge, the Schwarzian derivative, the free fermion, (Abe- lian) bosonization, mode expansions and the Virasoro algebra, the cylinder geometry and the Casimir effect, in- and out-states, highest weight states, descendant fields and operator product expansions, conformal blocks, duality and the bootstrap) 4 Kac determinant and u | | | | | | | | | |
| Intended learning outcomes | | | | | | | | | |
| Acquisition of both practical and conceptional familiarity with the methods of conformal field theory. Basic un- derstanding of critical phenomena, quantum field theory, and functional integration. Enhanced level of under- standing in particular for students of theoretical physics by exposure to an ambitious method with significant ap- plications in contemporary condensed matter physics. | | | | | | | | | |
| Courses (type, number of weekly contact hours, language — if other than German) | | | | | | | | | |
| V (3) + R (1) Module taught in: English | | | | | | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method Master's with 1 major Physics International (2020) JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- | | | | | | | | | |
| waster's W | ini i majo | r Filysics international (2020) | | r (120 ECTS) Physics Internati | | page 105 / 170 | | | |

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

--

Additional information

--

Workload

180 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020)

exchange program Physics (2023)

| Module title | | Abbreviation | | | | | | | |
|---|-----------------------|---|--------------------|----------------|--|--|--|--|--|
| Magnetism | | | 11-MAG-Int-201-m01 | | | | | | |
| Module coordinator | | Module offered by | | | | | | | |
| Managing Director of the Institute of A | pplied Physics | Faculty of Physics and Astronomy | | | | | | | |
| ECTS Method of grading | Only after succ. con | pl. of module(s) | | | | | | | |
| 6 numerical grade | | | | | | | | | |
| Duration Module level | Other prerequisites | | | | | | | | |
| 1 semester graduate | | | | | | | | | |
| Contents | | | | | | | | | |
| Dia- and paramagnetism, Exchange interaction, Ferromagnetism, Antiferromagnetism, Anisotropy, Domain struc- ture, Nanomagnetism, Superparamagnetism, Experimental methods to measure magnetic properties. Kondo ef- fect. | | | | | | | | | |
| Intended learning outcomes | | | | | | | | | |
| Knowledge of the basic terminology, concepts and phenomena of magnetism and the experimental methods to measure them. Skills in constructing simple models and describing the mathematical formalism, and the ability to apply these skills to the mentioned fields of magnetism. Competence to independently solve problems in these fields. Capability of assessing the precision of observations and of their analysis. | | | | | | | | | |
| Courses (type, number of weekly contact hours, language — if other than German) | | | | | | | | | |
| V (3) + R (1) Module taught in: English | | | | | | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | | | | |
| Allocation of places | | | | | | | | | |
| | | | | | | | | | |
| Additional information | | | | | | | | | |
| | | | | | | | | | |
| Workload | | | | | | | | | |
| 180 h | | | | | | | | | |
| Teaching cycle | | | | | | | | | |
| | _ | | | | | | | | |
| Referred to in LPO I (examination regu | lations for teaching- | legree programmes) | | | | | | | |
| | | | | | | | | | |
| Module appears in | | | | | | | | | |
| Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) | | | | | | | | | |
| Master's degree (1 major) Quantum En | gineering (2024) | | | | | | | | |
| Master's with 1 major Physics International (2020) | - | generated 19-Apr-2025 • exa (120 ECTS) Physics Internation | - | page 107 / 170 | | | | | |



| Modul | Module title Abbreviation | | | | | |
|--|---|--|---------------------------------------|-----------------------|---|--|
| Maste | Master Thesis Physics International 11-MA-P-Int-201-m01 | | | | | |
| Module coordinator Module offered by | | | | | | |
| chairp | erson o | f examination committee | | Faculty of Physics a | and Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 30 | nume | rical grade | | | | |
| Durati | on | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | | | | |
| Conter | nts | | | | | |
| | | work on an experimental nd according to scientific | | | s, in particular using state-of-the- | |
| Intend | ed lear | ning outcomes | | | | |
| | | pendently work on an ex hods and scientific aspec | | | in particular according to state- tten final thesis. | |
| Course | es (type | , number of weekly conta | ct hours, language – | · if other than Germa | ın) | |
| | | | | | | |
| | | essment (type, scope, la on on whether module ca | | | ition offered — if not every seme- | |
| | | is (750 to 900 hours total ssessment: English |) | | | |
| Alloca | tion of _l | olaces | | | | |
| | | | | | | |
| Additi | onal inf | ormation | | | | |
| Time to | o compl | ete: 6 months | | | | |
| Workle | - | | | | | |
| 900 h | | | · · · · · · · · · · · · · · · · · · · | | | |
| | ing cycl | e | | | | |
| | _ , | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) | | | | | | |
| | Master's degree (1 major) Physics International (2024) | | | | | |

| Module title Abbreviation | | | | | | | |
|---|--|---|--|---|--|--|--|
| Multi-wavelength Astronomy 11-MAS-Int-201-m01 | | | | | | | |
| Module coor | Module coordinator Module offered by | | | | | | |
| Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics | | | | | | | |
| | nod of grading | Only after succ. con | npl. of module(s) | | | | |
| 6 num | erical grade | | | | | | |
| Duration | Module level | Other prerequisites | | | | | |
| 1 semester | graduate | | | | | | |
| Contents | | | | | | | |
| 2. Jet-emissi 3. VLBI obse 4. High-ener 5. Multimess | nology of active galactic nu on processes rvations of jets gy observations of jets senger signatures of jets | iclei and extragalacti | c jets | | | | |
| | rning outcomes | | | | | | |
| | | | | e galactic nuclei and their extra- n writing an observing proposal | | | |
| Courses (typ | e, number of weekly conta | ect hours, language – | - if other than Germa | n) | | | |
| V (3) + R (1) Module taug | ht in: English | | | | | | |
| | ssessment (type, scope, la tion on whether module c | | | tion offered — if not every seme | | | |
| b) oral exam c) oral exam d) project regeling e) presentation lf a written estead take the of assessmention date as Language of | ne form of an oral examina nt is changed, the lecturer | each (approx. 30 minu of 2, approx. 30 minu s) or es) s method of assessm tion of one candidate r must inform student | tes per candidate) of ent, this may be char e each or an oral exa ts about this by four y | nged and assessment may in- mination in groups. If the metho weeks prior to the original exam | | | |
| Allocation of | places | | | | | | |
| | | | | | | | |
| Additional in | formation | | | | | | |
| | | | | | | | |
| Workload | | | | | | | |
| 180 h | | | | | | | |
| Teaching cycle | | | | | | | |
| | | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | |
| | | | | | | | |
| Module appears in | | | | | | | |
| | | national (2020) | | | | | |
| - | Master's degree (1 major) Physics International (2020) exchange program Physics (2023) | | | | | | |
| | gree (1 major) Physics Inter | mational (2024) | | | | | |
| Master's with 1 ma | jor Physics International (2020) | - | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internation | | | | |

| Scientific Methods and Project Management Physics International 11-MP-P-Int-201-m01 Module correlation committee Faculty of Physics and Astronomy Conternation committee Faculty of Physics and Astronomy ECTS Module for any of module(s) Introduction for the organing Only after succ. compl. of module(s) Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project planning within a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis, Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to present the project in seminar talk. Converse (type, number of weekly contact hours, language — if other than German) R (a) Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) Language Language - if other than German, examination offered — if not every seme ster, information Language Language - if other than German, examination offered — if not every seme ster, information Language Language - if other than German, examina | Module title Abbreviation | | | | | Abbreviation |
|---|--|-------------------|-----------------------------|-----------------------|-----------------------|------------------------------------|
| chairperson of examination committee Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 15 (not) successfully completed Duration Module level Other prerequisites 1 semester graduate Contents Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intendel learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (4) Module taught in: English Method of sacessment (type, scope, language — if other than German, examination offered — if not every seme ster, information Language of assessment: English Allocation of places < | Scienti | ific Met | thods and Project Manag | ement Physics Interr | national | 11-MP-P-Int-201-m01 |
| ECTS Method of grading Only after succ. compl. of module(s) 15 (not) successfully completed Duration Module level Other prerequisites 1 semester graduate Contents Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intended learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (4) Module taught in: English Method of assessment: (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) Language of assessment: English Allocation of places | Modul | e coord | linator | | Module offered by | |
| 15 (not) successfully completed | chairpe | erson o | f examination committee | | Faculty of Physics a | and Astronomy |
| Duration Module level Other prerequisites 1 semester graduate Contents Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intendel learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (a) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Workload 450 h Teaching cycle Module appears in Module appears in Module for playsics International (2020) | ECTS | | | Only after succ. con | npl. of module(s) | |
| 1 semester graduate Contents Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intended learning outcomes Intended learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (a) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places 404 Workload Module taught in: English Additional information Morkload - | 15 | (not) | successfully completed | | | |
| Contents Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intended learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (a) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Workload 450 h | Duratio | on | | Other prerequisites | | |
| Introduction to the scientific approach and practice, including project planning within a current experimental or theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intended learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theoretical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (a) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | 1 seme | ester | graduate | | | |
| theoretical research topic in physics. Establishment of a scientific project plan for the planned master thesis. Intended learning outcomes Knowledge of the scientific approach and practice, including project planning in a current experimental or theo- retical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (4) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | Conter | nts | | | | |
| Knowledge of the scientific approach and practice, including project planning in a current experimental or theo- retical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (4) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| retical research topic of relevance to the topic chosen for the master thesis. Ability to establish a research plan for the master thesis, and to plan the required experimental or theoretical work. Ability to present the project in seminar talk. Courses (type, number of weekly contact hours, language — if other than German) R (4) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | Intend | ed lear | ning outcomes | | | |
| R (4) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | retical for the | researc master | ch topic of relevance to th | e topic chosen for th | e master thesis. Abi | ility to establish a research plan |
| Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Mostler's degree (1 major) Physics International (2020) | Course | es (type | , number of weekly conta | ct hours, language – | - if other than Germa | an) |
| ster, information on whether module can be chosen to earn a bonus) talk with discussion (30 to 45 minutes) Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | e taugh | it in: English | | | |
| Language of assessment: English Allocation of places Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | | | | | ation offered — if not every seme- |
| Additional information Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | Allocat | tion of | places | | | |
| Workload 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | Additio | onal inf | ormation | | | |
| 450 h Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | Worklo | bad | | | | |
| Teaching cycle Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | 450 h | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) Module appears in Master's degree (1 major) Physics International (2020) | | ng cvcl | e | | | |
| Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| Module appears in Master's degree (1 major) Physics International (2020) | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| Module appears in Master's degree (1 major) Physics International (2020) | | | | | | |
| Master's degree (1 major) Physics International (2020) | | e appez | ars in | | | |
| | | | | national (2020) | | |
| masier s uegree (1 major) r mysics miemanonal (2024) | | | | | | |

| Module title Abbreviation | | | | | Abbreviation | | | |
|--|--|--|--|--|--|--|--|--|
| Advanc | ed Mag | gnetic Resonance Imag | ging | | 11-MRI-Int-201-m01 | | | |
| Module coordinator Module offered by | | | | | <u> </u> | | | |
| Manag | ing Dire | ector of the Institute of | Applied Physics | Faculty of Physics a | and Astronomy | | | |
| ECTS | | od of grading | Only after succ. co | | · | | | |
| 6 | | | | | | | | |
| Duratio | Duration Module level Other prerequisites | | | | | | | |
| 1 seme | 1 semester graduate | | | | | | | |
| Conten | ts | | | | | | | |
| imaging the fun course 1) the N 2) the p and me 3) the c 4) the p | g (MRI) damen covers IMR sig principl easurer concept physica | , has played a major ro tals of nuclear magnet gnal theory and signal of es of spatial encoding, nent parameters, t of k-space and Fourie | ole in the revolution in ic resonance (resonan evolution (Bloch equat , magnetic resonance r imaging, technical possibilities | medical imaging ove ce principle, relaxatio tions) imaging (MRI) and co and limitations of M | r, through magnetic resonance r the last 30 years. Starting from on times, chemical shift) this rresponding imaging sequences RI. Finally, typical application | | | |
| | | ning outcomes | | ion-destructive testin | g will be covered. | | | |
| tical-th on/ima plinary | eoretic ige-pro relatio | al description and the cessing principles. The ns and applications. | physical basics of mo students gain a deep | dern MRI, MRI-instrun insight into the area | d MRI including the mathema- nentation and image-formati- of modern MRI and its interdisci- | | | |
| Course | s (type | , number of weekly cor | ntact hours, language | — if other than Germa | an) | | | |
| V (3) + Module | | t in: English | | | | | | |
| | | | | | tion offered — if not every seme- | | | |
| b) oral c) oral of d) projetion e) pression lf a write stead to of asset nation | ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. | | | | | | | |
| - | - | ssessment: English ffered: In the semester | r in which the course is | s offered and in the si | ibsequent semester | | | |
| Allocat | | | | | | | | |
| | | | | | | | | |
| Additio | Additional information | | | | | | | |
| | | | | | | | | |
| Worklo | ad | | | | | | | |
| 180 h | | | | | | | | |
| Teaching cycle | | | | | | | | |
| Teachi | ng cvcl | e | | | | | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Compu | Module title Abbreviation | | | | | | | | | | | |
|--|---|---|--|--|--|--|--|--|--|--|--|--|
| Computational Astrophysics 11-NMA-Int-201-m01 | | | | | 11-NMA-Int-201-mo | 1 | | | | | | |
| Module coordinator Module offered by | | | | | | | | | | | | |
| - | ing Dire trophys | ector of the Institute of | Theoretical Physics | Faculty of Physics a | nd Astronomy | | | | | | | |
| ECTS | <u> </u> | od of grading | Only after succ. cor | npl. of module(s) | | | | | | | | |
| 6 | | rical grade | | | | | | | | | | |
| Duratio | on | Module level | Other prerequisites | ; | | | | | | | | |
| 1 seme | ster | graduate | | | | | | | | | | |
| Conten | Its | | | | | | | | | | | |
| rithms Lattice | (tree- a -Boltzm | ods used in astrophysic nd polynomial codes). nann). Hyperbolic conse s of high-performance o | Particle-mesh method ervation laws (fluid dyr | s (particle-in-cell met namics, finite differen | hods). Vlasow meth ce method, Rieman | nods (e.g., n solver, | | | | | | |
| Intend | ed lear | ning outcomes | | | | | | | | | | |
| | | e problems and equatic s. Capability to choose | | | | | | | | | | |
| Course | s (type | , number of weekly con | tact hours, language - | - if other than Germa | n) | | | | | | | |
| V (3) + Module | | t in: English | | | | | | | | | | |
| | | sessment (type, scope, on on whether module | | | ion offered — if not | every seme- | | | | | | |
| | | mination (approx. 90 to lation of one candidate | | utes) or | | | | | | | | |
| | | | | ites per candidate) or | | | | | | | | |
| a) proje | | | | | | c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or | | | | | | |
| e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. | | | | | | | | | | | | |
| If a writ stead t of asse nation Langua | tten exa ake the essmen date at age of a | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the methoriginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess | tten exa ake the essmen date at age of a ment o | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the methor riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess | tten exa ake the essmen date at age of a ment o | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the methor riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat | tten exa ake the essmen date at age of a ment o ion of p | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat | tten exa ake the essmen date at age of a ment o ion of p | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio | tten exa ake the essmen date at age of a ment o ion of p | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio Worklo | tten exa ake the essmen date at age of a ment o ion of p | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio Worklo 180 h | tten exa ake the essmen date at age of a ment o ion of p onal info | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio Worklo 180 h | tten exa ake the essmen date at age of a ment o ion of p onal info | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm ation of one candidat er must inform studen | e each or an oral exar ts about this by four v | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Morklo 180 h Teachin | tten exa ake the essmen date at age of a ment o ion of p onal info pad | amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces ormation | as method of assessm lation of one candidat er must inform studen in which the course is | e each or an oral exar ts about this by four v offered and in the su | nination in groups. veeks prior to the or | If the methor riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Morklo 180 h Teachin | tten exa ake the essmen date at age of a ment o ion of p onal info pad | amination was chosen a form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester blaces | as method of assessm lation of one candidat er must inform studen in which the course is | e each or an oral exar ts about this by four v offered and in the su | nination in groups. veeks prior to the or | If the method riginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Worklo 180 h Teachin Referre | tten exa ake the essmen date at age of a ment o ion of p onal info pad | amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester places ormation e LPOI (examination reg | as method of assessm lation of one candidat er must inform studen in which the course is | e each or an oral exar ts about this by four v offered and in the su | nination in groups. veeks prior to the or | If the methoriginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio 180 h Teachin Referre Module | tten exa ake the essmen date at age of a ment o ion of p onal info pad ad ed to in e appea | e EPOI (examination reg | as method of assessm lation of one candidat er must inform studen in which the course is gulations for teaching- | e each or an oral exar ts about this by four v offered and in the su | nination in groups. veeks prior to the or | If the methoriginal exami | | | | | | |
| If a writ stead t of asse nation Langua Assess Allocat Additio 180 h Teachin Referre Module Master exchan | tten exa ake the essmen date at age of a ment o ion of p onal info pad ad ad ad ad ad ad ad ad ad ad ad ad a | amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester places ormation e LPOI (examination reg | as method of assessm lation of one candidat er must inform studen in which the course is gulations for teaching- | e each or an oral exar ts about this by four v offered and in the su | nination in groups. veeks prior to the or | If the methoriginal exami | | | | | | |

| Nano-Optics 11-NOP-Int-201-m01 Module control the institute of Applied Physics Faculty of Physics and Astronomy ECTS Methed of the institute of Applied Physics Faculty of Physics and Astronomy ECTS Methed of the institute of Applied Physics Faculty of Physics and Astronomy Duration Module tevel Other prerequisites of module(s) Duration Module tevel Other prerequisites of module(s) Contents semestr graduate | Module title Abbreviation | | | | | | |
|---|--|--|---|---|--|--|--|
| Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 num=rical grade Duration Module level Other prerequisites 1 semester graduate Contents The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical microscopy are discussed. In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in 20, 10 and o dimensions are introduced and discussed in detail. This finally leads to the concept of optical antennas. Intended learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx, 90 to 120 minutes) or | | | | | | | |
| ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussed on of the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in 2D, 1D and 0 dimensions are introduced and discussed in detail. This finally leads to the concept of optical an-tennas. Intended learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R () Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) o) a) written examination of one candidate each (approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) b) oral examination in scolesen as method of assessment, this may be | Module coord | inator | | Module offered by | | | |
| 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Contents Daration Module level Discussed In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in abos, publications of nano-optics as relinted uced and their light emission in nano-environments is derived. Plasmons in and publications of nano-optics as well as the current developments of the topic. Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) and examination in groups. If the method of assessment the assessment may instead take the form of an oral examination of one candidate each oran oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examinatio | | | | | | | |
| Duration Module level Other prerequisites 1 semester graduate Contents The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical microscopy are discussed. In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and discussed in detail. This finally leads to the concept of optical antennas. Intended learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 9 on inutes). If a written examination on schease as method of assessment, this may be changed and assessment may instead take the form of an oral | | | Only after succ. con | npl. of module(s) | | | |
| 1 semester graduate | 6 nume | rical grade | | | | | |
| Contents The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical micros-copy are discussed. In the following, the near-field optical microscopy is introduced and discussed and their light emission in nano-environments is derived. Plasmons in 2D, 1D and o dimensions are introduced and discussed in detail. This finally leads to the concept of optical antennas. Intended learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or o) oral examination of nor candidate each (approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or for project report (approx. 8 to 10 pages) or f a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination of places if a written examination was chosen as m | | | Other prerequisites | | | | |
| The lecture conveys theoretical fundamentals, experimental techniques, and applications of nano-optics starting from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical micros- copy are discussed. In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in 2D, 1D and o dimensions are introduced and discussed in detail. This finally leads to the concept of optical an- tennas. Intendel learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) oral examination must inform students about this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecture must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Additional information | | graduate | | | | | |
| from the discussion of the focusing of light. Based on this, the fundamentals of modern far-field optical micros- copy are discussed. In the following, the near-field optical microscopy is introduced and discussed. As a further basis, quantum emitters are introduced and their light emission in nano-environments is derived. Plasmons in 2D, 1D and o dimensions are introduced and discussed in detail. This finally leads to the concept of optical an- tennas. Intended learning outcomes Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 90 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Morkload 180 h | | | | | | | |
| Specific and in-depth knowledge of the topic of nano-optics. Familiarity with the basic theoretical description and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Morkload 180 h | from the discu copy are discu basis, quantu 2D, 1D and o d | ussion of the focusing o ussed. In the following, m emitters are introduc | f light. Based on this, t the near-field optical r ed and their light emis | he fundamentals of nicroscopy is introdu sion in nano-enviror | modern far-field opt iced and discussed. iments is derived. Pl | ical micros- As a further lasmons in | |
| and applications of nano-optics as well as the current developments of the topic. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 80 to 120 groups). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Additional information Workload 180 h | Intended lear | ning outcomes | | | | | |
| V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Morkload 180 h | | | | | | escription | |
| Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Additional information Workload 180 h | Courses (type | , number of weekly con | act hours, language – | - if other than Germa | n) | | |
| ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Additional information Workload 180 h | | t in: English | | | | | |
| b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places Additional information Workload 180 h | | | | | tion offered — if not | every seme- | |
| Additional information Workload 180 h | b) oral examin c) oral examin d) project repu- e) presentatio If a written exa- stead take the of assessmen nation date at Language of a | nation of one candidate nation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a e form of an oral examin t is changed, the lecture t the latest. Issessment: English | each (approx. 30 minu of 2, approx. 30 minu es) or ites). is method of assessme ation of one candidate er must inform student | tes per candidate) of ent, this may be char e each or an oral exa s about this by four y | nged and assessmer mination in groups. weeks prior to the or | If the method riginal exami- | |
| Workload 180 h | Allocation of | places | | | | | |
| Workload 180 h | | | | | | | |
| 180 h | Additional inf | ormation | | | | | |
| 180 h | | | | | | | |
| | Workload | | | | | | |
| | 180 h | | | | | | |
| Teaching cycle | | | | | | | |
| | | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | |
| | | | | | | | |
| Module appears in | Module appea | ars in | | | | | |
| Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) | | | | | | | |
| Master's with 1 major Physics International (2020) JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- ta record Master (120 ECTS) Physics International - 2020 page 115 / 170 | Master's with 1 majo | r Physics International (2020) | - | | - | page 115 / 170 | |



Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title Abbreviation | | | | | Abbreviation | |
|--|---|---|--|--|--|--|
| Organi | Organic Semiconductors 11-OHL-Int-201-m01 | | | | | |
| Module coordinator Module offered by | | | | | | |
| Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy | | | ind Astronomy | | | |
| ECTS | Meth | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | | | | |
| Conter | nts | | | | | |
| Fundaı ons. | mentals | s of organic semiconducto | ors, molecular and po | olymer electronics ar | nd sensor technology, applicati- | |
| Intend | ed lear | ning outcomes | | | | |
| In-dep | th knov | vledge of the properties o | f organic semicondu | ctor materials and th | neir applications. | |
| | | , number of weekly conta | - | | | |
| V (3) + | | ,, | | | | |
| - | | t in: English | | | | |
| | | s essment (type, scope, la ion on whether module ca | | | tion offered — if not every seme- | |
| d) proj e) pres If a wri stead t of asse nation Langua Assess | ect rep entatio tten ex ake the essmen date at age of a | e form of an oral examina t is changed, the lecturer t the latest. ssessment: English offered: In the semester in |) or es) method of assessm tion of one candidate must inform student | ent, this may be char e each or an oral exa s about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| | | A | | | | |
| Teaching cycle | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | |
| Module appears in | | | | | | |
| | •• | ee (1 major) Physics Inter | national (2020) | | | |
| | - | ee (1 major) Quantum Eng | | | | |
| | - | gram Physics (2023) | | | | |
| | - | ee (1 major) Quantum Eng | · | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module title Abbreviation | | | | Abbreviation | | |
|---|--|--|--|--|--|--|
| Open Quantum Systems 11-0QS-Int-241-mo1 | | | | | 11-OQS-Int-241-m01 | |
| Module | Module coordinator Module offered by | | | | | |
| Managi and Ast | | ector of the Institute of Th ics | eoretical Physics | Faculty of Physics a | nd Astronomy | |
| | | od of grading | Only after succ. con | pl. of module(s) | | |
| | | rical grade | | - - | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 semes | ster | graduate | | | | |
| Content | s | | | | | |
| density cesses | matrix | theory, stochastic proce | sses in Hilbert space | , non-Markovian pro | cesses, relativistic quantum pro- | |
| Intende | d learı | ning outcomes | | | | |
| develop | ment | of a theoretical understa | nding of quantum sys | stem coupled to their | r environment | |
| Courses | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (3) + F Module | | t in: English | | | | |
| | | e ssment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | |
| d) proje e) prese If a writt stead ta of asses nation o Languag | ect repo entatio ten exa ake the ssmen date at ge of a ment o | form of an oral examina t is changed, the lecturer the latest. ssessment: English ffered: In the semester in |) or es). method of assessme tion of one candidate must inform student | ent, this may be char e each or an oral exa s about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Workloa | ad | | | | | |
| 180 h | | | | | | |
| Teaching cycle | | | | | | |
| | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master' | Master's degree (1 major) Physics International (2020) | | | | | |
| Master' | Master's degree (1 major) Physics International (2024) | | | | | |

| Module co Managing ECTS M | Director of the Institute of <i>i</i> ethod of grading imerical grade | Applied Physics Only after succ. con | Module offered by Faculty of Physics a | 11-OSP-A-Int-201-m01 | |
|---|---|---|--|-------------------------------------|--|
| Managing ECTS M 5 nu Duration 1 semeste | Director of the Institute of <i>i</i> ethod of grading imerical grade | <u>'</u> | | | |
| ECTSM5ntDuration1 semeste | ethod of grading Imerical grade | <u>'</u> | Faculty of Physics a | | |
| 5 nu Duration 1 semeste | Imerical grade | Only after succ. con | | and Astronomy | |
| Duration 1 semeste | | | npl. of module(s) | | |
| 1 semeste | A4 - J. J. 1 - 1 1 | | | | |
| | Module level | Other prerequisites | | | |
| Contents | r graduate | | | | |
| | | | | | |
| Seminar o | n current topics in theoretic | al and experimental p | hysics | | |
| Intended | earning outcomes | | | | |
| | nowledge about a current t marizing them and present | | | Ability to read scientific publica- | |
| Courses (t | ype, number of weekly con | tact hours, language – | - if other than Germa | an) | |
| Method of | | | | ation offered — if not every seme- | |
| | mation on whether module | | a bonus) | | |
| | liscussion (30 to 45 minute of assessment: English | s) | | | |
| Allocation | of places | | | | |
| | | | | | |
| Additiona | linformation | | | | |
| | | | | | |
| Workload | | | | | |
| 150 h | | | | | |
| Teaching | cycle | | | | |
| | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | |
| Module appears in | | | | | |
| Master's degree (1 major) Physics International (2020) | | | | | |
| exchange program Physics (2023) Master's degree (1 major) Physics International (2024) | | | | | |

| Modul | Module title Abbreviation | | | | | |
|--|--|--|-----------------------|-----------------------|---------------------------------------|--|
| Advanced Seminar Physics B 11-OSP-B-Int-201-mc | | | | | 11-OSP-B-Int-201-m01 | |
| Module coordinator Module offered by | | | | | | |
| Manag | ing Dir | ector of the Institute of Ap | oplied Physics | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. con | | , | |
| 5 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | | | | |
| Conter | nts | | | | | |
| Semina | ar on ci | irrent topics in theoretica | l and experimental p | hysics. | | |
| Intend | ed lear | ning outcomes | | | | |
| | | | | | . Ability to read scientific publica- | |
| tions, s | summa | rizing them and presentir | ng them to a peer auc | lience. | | |
| Course | es (type | , number of weekly conta | ct hours, language – | - if other than Germa | in) | |
| S (2) | | | | | | |
| Modul | e taugh | t in: English | | | | |
| | | sessment (type, scope, la ion on whether module ca | | | tion offered — if not every seme- | |
| talk wi | th disc | ussion (30 to 45 minutes) | | | | |
| Langua | age of a | ssessment: English | | | | |
| Allocat | tion of | olaces | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| 150 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | |
| Modul | Module appears in | | | | | |
| | Master's degree (1 major) Physics International (2020) | | | | | |
| exchar | exchange program Physics (2023) | | | | | |
| Master | r's degr | ee (1 major) Physics Inter | national (2024) | | | |

| Module title | | | | Abbreviation | |
|--|---|---|--|--|--|
| Advanced La | boratory Course Master P | art 1 | | 11-P-FM1-Int-201-m01 | |
| Module coordinator | | | Module offered by | | |
| Managing Di | rector of the Institute of A | pplied Physics | Faculty of Physics a | and Astronomy | |
| | od of grading | Only after succ. cor | · · · · · | , | |
| 3 (not) | successfully completed | | E | | |
| Duration | Module level | Other prerequisites | 5 | | |
| 1 semester | graduate | Preparation and sat | fety briefing. | | |
| Contents | | | | | |
| solid state pr tic resonance | operties, surfaces and int | erfaces. Experiments | s covering the topics | nents and correlated systems, x-ray radiation, nuclear magne- ith visible light, Hall effect, super- | |
| Intended lea | rning outcomes | | | | |
| ledge of how ge of experim | to prepare a scientific pu | blication and use sta scientific publication | te-of-the-art analysis s, of performing and | perimental outcome. Basic know- s systems and software. Knowled- evaluating an experiment, and | |
| Courses (type | e, number of weekly conta | act hours, language - | – if other than Germa | an) | |
| P (3) Module taug | ht in: English | | | | |
| | | | | tion offered if not around a second | |
| | tion on whether module c | | | ition offered — if not every seme- | |
| fic publicatio successfully regulations a | st successfully prepare, p n) an experiment to be co | nsidered to have suc s to be considered to | ccessfully completed have successfully c | aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed | |
| Allocation of | places | | | | |
| | | | | | |
| Additional in | formation | | | | |
| | | | | | |
| Workload | | | | | |
| 90 h | | | | | |
| Teaching cyc | le | | | | |
| | | | | | |
| Referred to in | LPOI (examination regu | lations for teaching- | degree programmes) | | |
| | Ū. | | | | |
| Module appe | ars in | | | | |
| | ree (1 major) Physics Inter | rnational (2020) | | | |
| - | ree (1 major) Quantum En | | | | |
| - , | ogram Physics (2023) | | | | |
| - | Master's degree (1 major) Quantum Engineering (2024) | | | | |
| Master's degree (1 major) Physics International (2024) | | | | | |

| Module title | | | | Abbreviation | | |
|--|--|---|---|---|---|--|
| Advanced Laboratory Course Master Part 2 | | | | | 11-P-FM2-Int-201-m01 | |
| Module coordinator | | | | Module offered by | | |
| Manag | ing Dir | ector of the Institute of Ap | oplied Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Meth | od of grading | Only after succ. con | npl. of module(s) | | |
| 3 | (not) | successfully completed | | | | |
| Duratio | on | Module level | Other prerequisites | 5 | | |
| 1 seme | ster | graduate | Preparation and saf | ety briefing. | | |
| Conten | ts | | | | | |
| solid st tic reso | tate pro onance | operties, surfaces and int | erfaces. Experiments | s covering the topics | nents and correlated systems, x-ray radiation, nuclear magne- th visible light, Hall effect, super- | |
| Intende | ed lear | ning outcomes | | | | |
| ledge o ge of ex presen | of how t xperim ting an | to prepare a scientific pu ental methods, of using s d discussing the results i | blication and use sta cientific publication n the form of a scien | te-of-the-art analysis s, of performing and tific publication | perimental outcome. Basic know- s systems and software. Knowled- evaluating an experiment, and | |
| | s (type | , number of weekly conta | ict hours, language – | - if other than Germa | n) | |
| P (3) Module | e taugh | t in: English | | | | |
| | | sessment (type, scope, la ion on whether module c | | | tion offered — if not every seme- | |
| Studen fic pub succes regulat | its mus licatior sfully c ions ar | n) an experiment to be co | nsidered to have suc s to be considered to | cessfully completed have successfully co | aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed | |
| Allocat | ion of | places | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 90 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | , | | | | |
| Module | | ars in | | | | |
| | | ee (1 major) Physics Inter | national (2020) | | | |
| | - | ee (1 major) Quantum En | | | | |
| | - | gram Physics (2023) | _ · · · | | | |
| | Master's degree (1 major) Quantum Engineering (2024) | | | | | |
| Master | Master's degree (1 major) Physics International (2024) | | | | | |

| Module title | | | | Abbreviation |
|---|---|---|--|--|
| Advanced Laboratory Course Master Part 3 | | | | 11-P-FM3-Int-201-m01 |
| Module coordinator | | | Module offered by | |
| Managing Dir | ector of the Institute of A | pplied Physics | Faculty of Physics a | and Astronomy |
| | od of grading | Only after succ. cor | | |
| 3 (not) | successfully completed | | | |
| Duration | Module level | Other prerequisites | 6 | |
| 1 semester | graduate | Preparation and sat | fety briefing. | |
| Contents | | | | |
| solid state pr tic resonance | operties, surfaces and int | erfaces. Experiments | s covering the topics | nents and correlated systems, x-ray radiation, nuclear magne- ith visible light, Hall effect, super- |
| Intended lear | ning outcomes | | | |
| ledge of how ge of experim | to prepare a scientific pu | blication and use sta scientific publication | te-of-the-art analysis s, of performing and | perimental outcome. Basic know- s systems and software. Knowled- evaluating an experiment, and |
| Courses (type | e, number of weekly conta | act hours, language - | – if other than Germa | an) |
| P (3) Module taugi | nt in: English | | | |
| | | anguage — if other th | an German examina | tion offered — if not every seme- |
| | ion on whether module c | | | alon oncica in not every senie |
| fic publicatio successfully regulations a | st successfully prepare, p n) an experiment to be co | nsidered to have suc s to be considered to | ccessfully completed have successfully c | aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed |
| Allocation of | places | | | |
| | • | | | |
| Additional in | formation | | | |
| | | _ | | |
| Workload | | | | |
| 90 h | | | | |
| Teaching cyc | le | | | |
| | | | | |
| Referred to in | LPOI (examination regu | llations for teaching- | degree programmes) | |
| | <u> </u> | | | |
| Module appe | ars in | | | |
| | ree (1 major) Physics Inter | rnational (2020) | | |
| - | ree (1 major) Quantum En | | | |
| | gram Physics (2023) | | | |
| - | ree (1 major) Quantum En | | | |
| Master's deg | Master's degree (1 major) Physics International (2024) | | | |

| Module title | | Abbreviation | | |
|--|--|---|--|--|
| Advanced Laboratory Course Master Part 4 | | | 11-P-FM4-Int-201-m01 | |
| Module coordinator | | | Module offered by | |
| Managing Dir | rector of the Institute of A | pplied Physics | Faculty of Physics a | and Astronomy |
| | od of grading | Only after succ. cor | | |
| 3 (not) | successfully completed | | | |
| Duration | Module level | Other prerequisites | 5 | |
| 1 semester | graduate | Preparation and sat | fety briefing. | |
| Contents | | | | |
| solid state pr tic resonance | operties, surfaces and int | erfaces. Experiments | s covering the topics | nents and correlated systems, x-ray radiation, nuclear magne- ith visible light, Hall effect, super- |
| Intended lear | rning outcomes | | | |
| ledge of how ge of experim presenting ar | to prepare a scientific pu nental methods, of using s and discussing the results | blication and use sta scientific publication in the form of a scien | te-of-the-art analysis s, of performing and tific publication. | perimental outcome. Basic know- s systems and software. Knowled- evaluating an experiment, and |
| | e, number of weekly conta | act hours, language - | – if other than Germa | an) |
| P (3) Module taugi | nt in• Englich | | | |
| | | | on Cormon oversing | tion offered if not even come |
| | tion on whether module c | | | ition offered — if not every seme- |
| fic publicatio successfully regulations a | st successfully prepare, p n) an experiment to be co | nsidered to have suc s to be considered to | ccessfully completed have successfully c | aluate (in the form of a scienti- this experiment. Students must ompleted this module. Detailed |
| Allocation of | places | | | |
| | - | | | |
| Additional in | formation | | | |
| | | | | |
| Workload | | | | |
| 90 h | | | | |
| Teaching cyc | le | | | |
| | | | | |
| Referred to in | LPOI (examination regu | llations for teaching- | degree programmes) | |
| | | | | |
| Module appe | ars in | | | |
| Master's deg | ree (1 major) Physics Inter | rnational (2020) | | |
| - | ree (1 major) Quantum En | gineering (2020) | | |
| | ogram Physics (2023) | | | |
| - | ree (1 major) Quantum En | | | |
| Master's degree (1 major) Physics International (2024) | | | | |

| Module title Abbreviation | | | Abbreviation | | |
|---|--|---|------------------------|-----------------------|--|
| Physics | s of Cor | nplex Systems | | | 11-PKS-Int-201-m01 |
| Module | coord | inator | | Module offered by | |
| Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics | | | | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 semes | ster | graduate | | | |
| Conten | ts | | | | |
| 2. Intro 3. Entro 4. Phas 5. Unive 6. Spin | ductior py pro- e trans ersality glasse | | equilibriumt | | |
| | | ning outcomes | | | |
| In-dept na in co univers | h know omplex ality. A | ledge of concepts and m many-body systems. The | orough understandin | g of the concepts of | nding of collective phenome- entropy, entropy production and o perform research tasks in the |
| Courses | s (type, | number of weekly conta | ct hours, language – | - if other than Germa | n) |
| V (2) + I Module | | t in: English | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asse nation e | a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English | | | | |
| Allocati | | | | | |
| | | | | | |
| Additio | nal info | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 180 h | | | | | |
| Teachir | ig cycle | 9 | | | |
| | 3 - 9 - 61 | - | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching- | degree programmes) | |
| | | | interest to teaching (| | |
| l | | | | | |

Module appears in

| Module title | | | | Abbreviation | | |
|---|--|--|---|--|--|--|
| | Physics of Advanced Materials 11-PMM-Int-201-m01 | | | | | |
| Modul | e coord | inator | | Module offered by | | |
| Manag | ing Dire | ector of the Institute of Ap | oplied Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | ester | graduate | | | | |
| Conter | nts | | | | | |
| als and | d super | | eterostructures and s | | d polymers; magnetic materi- ls to characterize these material | |
| Intend | ed learı | ning outcomes | | | | |
| Familia | arity wit | h the properties and cha | racterization method | s of various groups o | of modern materials. | |
| | | , number of weekly conta | | | | |
| V (3) + | R (1) | t in: English | | | · · | |
| | | | nguage — if other th | an German, examina | tion offered — if not every seme- | |
| | | on on whether module ca | | | | |
| c) oral d) proj e) pres If a wri stead t of asse nation Langua Assess | examin ect repo entatio tten exa take the essmen date at age of a | form of an oral examina t is changed, the lecturer the latest. ssessment: English ffered: In the semester in | of 2, approx. 30 minu) or es). method of assessme tion of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa is about this by four | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Alloca | | Jaces | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | bad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | |
| | | | | | | |
| Modul | Module appears in | | | | | |
| Master | r's degr | ee (1 major) Physics Inter | national (2020) | | | |
| | - | ee (1 major) Quantum Eng | gineering (2020) | | | |
| | | gram Physics (2023) | | | | |
| | - | ee (1 major) Quantum Eng | | | | |
| Master's degree (1 major) Physics International (2024) | | | | | | |

| Module title | | | | | Abbreviation | |
|--|--|---|--|---|---|---|
| Phenor | nenolo | gy and Theory of Super | conductivity | | 11-PTS-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | | |
| - | ing Dire | ector of the Institute of A ector of the Institute of T sics | | Faculty of Physics a | and Astronomy | |
| ECTS | 1 | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | i | | |
| 1 seme | 1 semester graduate | | | | | |
| Conten | ts | | | | | |
| materia vention superco grams a des, ph of the H | al scien nal and onduct and fur nase flu liggs m | es of Superconductors a tice for calculating tempe unconventional superco ors. Extension of Ginzbu nctional integrals. Theor actuations, and coupling nechanism. Interplay of research topics and pers | erature profiles in sup onductivity. Review of urg-Landau theory to a etical formalism of Wa g to the electromagnet magnetism and conve | erconductors. Overvi BCS theory and its a quantum field theor ard identities and res ic field. Interpretatio ntional/unconventio | iew of the phenomer applicability for diffe ry formalism using Fo sponse functions. Go n of the Meissner ef anal superconductivi | nology of con- rent types of eynman dia- oldstone mo- fect in terms |
| Intende | ed lear | ning outcomes | | · | | |
| derstar arch. K as well tors an | nding o nowlec as the d their | basic knowledge about f unconventional supero lge of BCS mean-field th Meissner effect and the fascinating connection , number of weekly cont | conductivity and its in eory, the quantum-fie Higgs mechanism. Ba with competing magn | terplay with magneti ld theory methods n asic understanding o etic phases. | sm in the context of ecessary to extend E of unconventional su | current rese- BCS theory, |
| V (3) + | | , number of weekly cont | | | (11) | |
| Module | e taugh | t in: English | | | | |
| | | sessment (type, scope, l ion on whether module (| | | ition offered — if not | every seme- |
| b) oral c) oral d d) proje e) pres If a writ stead t of asse nation | a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English | | | | | |
| Allocat | ion of _l | olaces | | | | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| | Teaching cycle | | | | | |
| | | | | | | |
| Master's wi | ith 1 majo | r Physics International (2020) | - | 9 generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 128 / 170 |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title Abbreviation | | | Abbreviation | | | |
|---|--|--|--|-----------------------|---|--|
| | | 1 Theory I | | | 11-QFT1-Int-201-m01 | |
| Module | coord | inator | | Module offered by | | |
| Managi and Ast | | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | n | Module level | Other prerequisites | | | |
| 1 semes | ster | graduate | Approval from exam | nination committee re | equired. | |
| Conten | ts | | | | | |
| Lagra Field Asym Gaug Pertu Feyni Quar Radia Ren | Symmetries. Lagrange formalism for fields. Field quantisation. Asymptotic states, scattering theory and S-matrix Gauge principle and interaction. Perturbation theory. Feynman rules. Quantum elektrodynamical processees in Born approximation. Radiative corrections (optional) Renormalisation (optional). | | | | | |
| | | ning outcomes | | | | |
| They kn process | iow hov ses in t | w to use perturbation the | ory and how to apply n electrodynamics in | y Feynman rules. The | ivistic quantum field theories. y are able to calculate basics over, they have a basic under- | |
| Courses | s (type, | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + I | | the French l | | | | |
| | | t in: English | | | | |
| | | sessment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | |
| b) oral e c) oral e d) proje e) prese If a writ stead ta of asses nation e Langua | a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English | | | | | |
| Allocati | | ffered: In the semester in | | | | |
| Allocal | | παιεσ | | | | |
| | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | - | | | |
| Teachir | ng cycl | e | | | | |
| | | | | | | |
| | | | | | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

| Module title Abbreviation | | | | | Abbreviation | |
|---|---|---|---|---|--|--|
| Quantu | Quantum Field Theory II 11-QFT2-Int-201-m01 | | | | | |
| Module | coord | inator | | Module offered by | | |
| Managi and Ast | | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | | od of grading | Only after succ. con | npl. of module(s) | | |
| 8 | | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 semes | | graduate | | | | |
| Conten | ts | | | | | |
| 2. Path 3. Reno 4. Reno 5. Gaug 6. Spon | Integra rmaliza rmaliza e theo itaneou | ation ation group | | | | |
| | | ning outcomes | | | | |
| In-dept zation a | h know and of § | ledge of the concepts an | | | ding the principles of renormali- ory and to solve them using the | |
| Courses | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + I Module | | t in: English | | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- | |
| b) oral e c) oral e d) proje e) prese lf a writ stead ta of asses nation e Langua | examin examin ect repo entatio ten exa ake the ssment date at ge of a | form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu) or es). method of assessmution of one candidate must inform student | tes per candidate) of ent, this may be char e each or an oral exa s about this by four y | nged and assessment may in- mination in groups. If the method weeks prior to the original exami- | |
| Allocati | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | | | | |
| Teachir | ng cycl | e | | | | |
| | | | | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching- | degree programmes) | | |
| Module | appea | irs in | | | | |
| | | | | | | |

Master's with 1 major Physics International (2020)

| Module title Abbreviation | | | | | | |
|---|--|--|--|--|--|----------------------------------|
| Advanc | ed The | ory of Quantum Compu | ting and Quantum Inf | ormation | 11-QIC-Int-201-mon | L |
| Module coordinator | | | | Module offered by | Module offered by | |
| Managing Director of the Institute of Theoretical Physics Faculty of Physics and Astronomy and Astrophysics | | | | | | |
| ECTS Method of grading Only after succ. compl. of module(s) | | | | | | |
| 6 | 1 | rical grade | | • | | |
| Duratio | n | Module level | Other prerequisites | 5 | | |
| 1 seme | ster | graduate | | | | |
| Conten | ts | | | | | |
| 2. Quar 3. Com 4. Enta 5. Quar 6. Quar | ntum th posite ngleme ntum oj ntum ga | ary of classical informat neory seen from the pers systems and the Schmid ent measures perations, POVMs, and t ates and quantum comp | pective of information It decomposition the theorems of Kraus puters | | | |
| | | the theory of decohere | nce | | | |
| | | ning outcomes | | | | |
| Knowle depth ι | dge of underst f quan | ve understanding of qua handling tensor produc canding of the phenome tum information theory. | ts and dealing with qu non of entanglement. | uantum effects in m Knowledge of the fi | ultipartite quantum s undamental mathem | systems. In- atical con- |
| Course | s (type | , number of weekly cont | act hours, language - | – if other than Germ | an) | |
| V (3) + | R (1) | | | | | |
| | | t in: English | | | | |
| | | essment (type, scope, l on on whether module | | | ation offered — if no | t every seme- |
| b) oral c) oral d d) proje e) press If a writ stead ta of asse nation Langua | examir examin ect repo entatio ten exa ake the ssmen date at ge of a | mination (approx. 90 to nation of one candidate ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minu amination was chosen a e form of an oral examin t is changed, the lecture the latest. ssessment: English ffered: In the semester i | each (approx. 30 min of 2, approx. 30 minues) or tes). s method of assessm ation of one candidater must inform studen | ites per candidate) of ent, this may be cha e each or an oral exa ts about this by four | anged and assessme amination in groups. r weeks prior to the o | If the method original exami- |
| Allocat | | | | | · | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| Auuitio | natini | | | | | |
| \\\\c =l=l | | | - | | | |
| Worklo | aa | | | | | |
| 180 h | | | | | | |
| Teachiı | ng cycl | e | | | | |
| Doforro | d to in | IPOL (ovamination to | ulations for toaching | dograa programmas |) | |
| Referre | a to in | LPO I (examination reg | utations for teaching- | uegree programmes |) | |
| Naster's wi | | | | | | |
| | in i majo | | - | er (120 ECTS) Physics Interna | - | page 134 / 170 |
| | | | | | | |

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module title Abbreviation | | | | | Abbreviation | |
|---|--|--|--|---|---|--|
| | | hanics II | | | 11-QM2-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | | |
| Managi and Ast | | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | ster | undergraduate | | | | |
| Conten | ts | | | | | |
| program to be co 1. Seco 2. Banc 3. Angu 4. Scatt 5. Relat of atom 6. Quar | "Quantum mechanics 2" constitutes the central theoretical course to be taken within the international Master's program in physics. While the specific emphasis can be adjusted individually, the core topics that are supposed to be covered should include: 1. Second quantization: fermions and bosons 2. Band structures of particles in a crystal 3. Angular momentum, symmetry operators, Lie Algebras 4. Scattering theory: potential scattering, partial wave expansion 5. Relativistic quantum mechanics: Klein-Gordon equation, Dirac equation, Lorentz group, fine structure splitting of atomic spectra 6. Quantum entanglement 7. Canonical formalism | | | | | |
| · · · · · · · · · · · · · · · · · · · | | | hanna an an h-an i an Than | | f the mostly mostly and the sur- | |
| tical co mathen sically. | ncepts natical The co | of the listed topics. Abili ly, to solve problems ana | ty to describe or moo lytically or using app uent theory courses i | del problems of mod proximation methods in astrophysics, high | of the mathematical and theore- ern theoretical quantum physics and to interpret the results phy- energy physics and condensed | |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + I Module | | t in: English | | | | |
| | | | | | tion offered — if not every seme- | |
| a) writte b) oral e c) oral e d) proje e) prese If a writ stead ta of asse nation e | ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. | | | | | |
| | Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | | | | |
| | | | | | | |

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020)

exchange program Physics (2023)

Master's degree (1 major) Quantum Engineering (2024)

Master's degree (1 major) Physics International (2024)

| Module | Module title Abbreviation | | | | | | |
|--|---|---|--|---|--|---------------------------------|--|
| Quantı | Quantum Transport 11-QTR-Int-201-m01 | | | | | | |
| Module | e coord | inator | | Module offered by | | | |
| Manag | ing Dire | ctor of the Institute of | Applied Physics | Faculty of Physics a | ind Astronomy | | |
| ECTS | · | od of grading | Only after succ. con | npl. of module(s) | | | |
| 6 | L | rical grade | | | | | |
| Duratio | | Module level | Other prerequisites | ; | | | |
| 1 seme | | graduate | | | | | |
| action as well the qua of supe Low din vant m | The lecture addresses the fundamental transport phenomena of electrons in solids where Electron-electron inter- action and the wave nature are the determining factors. This includes the diffusive and ballistic transport regime as well as the Coulomb blockade. Observations of electron interference effects, conductance quantization and the quantum Hall effect will be discussed. Thermoelectric properties of electronic system and the phenomenon of superconductivity will be examined as well. Low dimensional electron systems and its quantum mechanical description are the basis of this lecture. Rele- vant material systems are semiconductor heterostructures as well as topological insulators, topological semime- tals, and topological superconductors. The content will be guided by actual research results. | | | | | | |
| Intend | ed learr | ing outcomes | | | | | |
| | | ledge of basic transpo ults critical. | rt experiments, its ana | lysis and its interpre | tation which enables | s the student | |
| Course | s (type, | number of weekly con | tact hours, language – | - if other than Germa | ın) | | |
| V (3) + Module | | t in: English | | | | | |
| | | | language — if other th can be chosen to earn | | tion offered — if not | every seme- | |
| b) oral c) oral d) proje e) press lf a write stead t of assess nation Langua | examin examin ect repo entatio tten exa ake the essment date at age of a | ation in groups (group) ort (approx. 8 to 10 pag n/talk (approx. 30 min mination was chosen form of an oral examin is changed, the lectur the latest. ssessment: English | e each (approx. 30 minu s of 2, approx. 30 minu es) or | ites per candidate) o ent, this may be cha e each or an oral exa ts about this by four | nged and assessmer mination in groups. weeks prior to the or | If the method riginal exami- | |
| Allocat | ion of p | laces | | | | | |
| | | | | | | | |
| Additio | onal info | ormation | | | | | |
| | | | | | | | |
| Worklo | ad | | | | | | |
| 180 h | | | | | | | |
| Teachi | Teaching cycle | | | | | | |
| | | | | | | | |
| Referre | ed to in | LPOI (examination re | gulations for teaching- | degree programmes) | | | |
| | | | | | | | |
| Module | e appea | rs in | | | | | |
| | | ee (1 major) Physics Int | ernational (2020) | | | | |
| Master's w | ith 1 major | Physics International (2020) | - | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 138 / 170 | |

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Module | Module title Abbreviation | | | | | | | |
|---|--|---|-----------------------|--|--------------------|----------------|--|--|
| Radio / | Radio Astronomical Interferometry | | | | 11-RAI-Int-211-m01 | | | |
| Module | a coord | instor | Module offered by | | | | | |
| | | | | | and Actroneur | | | |
| and As | - | | neoretical Physics | Faculty of Physics a | and Astronomy | | | |
| ECTS | <u> </u> | od of grading | Only after succ. con | nnl of module(s) | | | | |
| 6 | | | | | | | | |
| Duratio | | Module level | Other prerequisites | - | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Conten | | | | | | | | |
| | | and Background | | | | | | |
| | a) History of radio astronomy | | | | | | | |
| | | d development of radio | | . f | | | | |
| | | s of radio interferometry | | or special interest | | | | |
| | | f important concepts in al Concepts | iaulo astronomy | | | | | |
| 1. Fouri | | • | | | | | | |
| | | t of telescope aperture | | | | | | |
| | | n and Fourier Theorems | | | | | | |
| | | scopes as spatial filters | | | | | | |
| 2. Inter | | | | | | | | |
| | | son interferometer | | | | | | |
| | | ement interferometer | | | | | | |
| | | y function | | | | | | |
| | | ce of limited bandwidth | e) Spatial frequencie | s in interferometry | | | | |
| | | systems | | | | | | |
| | | nthesis by Radio Interfer | ometric Arrays | | | | | |
| | | t of (u ,v) coverage figurations and transit a | rrayic | | | | | |
| | | rays and Earth-rotation s | | | | | | |
| d) VLBI | - | | yiitiiesis | | | | | |
| | | parations and geometry | | | | | | |
| 4.Rece | | | | | | | | |
| - | | frequency conversion | | | | | | |
| | | eter sensitivity | | | | | | |
| c) Sam | pling, v | veighting, gridding | | | | | | |
| | | smearing | | | | | | |
| c) Calib | | | | | | | | |
| | | struction | | | | | | |
| - | | alternative imaging algo | oritrims | | | | | |
| b) Imag c) Seif | | | | | | | | |
| , | | mforming | | | | | | |
| - | | plications and Challeng | es | | | | | |
| • | | d Wide-Field Imaging | | | | | | |
| | - | Baseline Interferometry | | | | | | |
| | - | py in Radio Interferomet | ry | | | | | |
| d) Polarisation in Radio Interferometry | | | | | | | | |
| | | in Science in Radio Inter | - | | | | | |
| | | ncy Challenges Interferor | netry | | | | | |
| | | Radio Interferometry | | | | | | |
| | | etry and Geodesy | Incoming Dadia Inter | foromotors | | | | |
| | | realization: Current and ncy arrays: LOFAR, GMRT | - | | | | | |
| | 1. Low-frequency arrays: LOFAR, GMRT, ASKAP, APERTIF/WSRT, LWA, MWA Naster's with 1 major Physics International (2020) JMU Würzburg • generated 19-Apr-2025 • exam. reg. da- | | | | | | | |
| naster S W | itir i niaj0 | r mysics international (2020) | - | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | - | page 140 / 170 | | |



2. Centimeter-Band Arrays: JVLA, MERLIN, ATCA, MeerKAT, VLBA, EVN, LBA, JVN, VERA, AVN

3. (Sub-) Mill imeter Arrays: ALMA, NOEMA, GMVA, EHT

4. The Future: SKA

Intended learning outcomes

The goal of the course is the transfer of knowwledge and competence in the radio interferometrical method, providing a foundation for independent research.

Concepts are taught in connection to practical examples from modern astronomy including recent measurements of radio interferometers.

Students shall gain the following specific competences: Understanding of the concept of radio interferometrical observations and their calibration.

Processing and interpretation of raw data. data reduction and analysis, applications and understanding of established algorithms.

Handling of large data volumes. The course makes use of general concepts and teaches special programming concepts that are of wide use beyond astronomy.

Courses (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 120 minutes) or

b) oral examination of one candidate each (approx. 30 minutes) or

c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or

d) project report (approx. 8 to 10 pages) or

e) presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Language of assessment: English

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

--

Additional information

Workload

180 h

Teaching cycle

Teaching cycle: every year, after announcement

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

| Module title Abbreviation | | | | | Abbreviation | |
|---|--|---|-----------------------|-----------------------|------------------------------------|--|
| Renorm | nalizati | on Group Methods in Fie | eld Theory | | 11-RMFT-Int-201-m01 | |
| Module | Module coordinator | | | Module offered by | | |
| | ng Dire | ector of the Institute of Th | neoretical Physics | Faculty of Physics a | and Astronomy | |
| ECTS | | od of grading | Only after succ. cor | npl. of module(s) | | |
| 8 | 8 numerical grade | | | | | |
| Duratio | n | Module level | Other prerequisites | 5 | | |
| 1 seme | ster | graduate | | | | |
| Conten | ts | | | | | |
| lation of stems, the court 1. Wilson 2. Path 3. Beth 4. RG flu 5. Composition 6. RG flu Intende | This course is complementary to the discussion of Wilson's renormalizationg group (RG) as covered in the cour- se "Renormalization Group and Critical Phenomena" (11-CRP). This course focuses on the diagrammatic formu- lation of RG flow equations and its relation to diagrammatic perturbation expansions. For interacting fermion sy- stems, this is of particular relevance in the context of the functional renormalization group. A possible outline of the course is: 1. Wilson's RG 2. Path integral formulation of interacting fermions 3. Bethe-Salpeter-equation 4. RG flow equations for the one-particle and the two-particle vertex 5. Comparison of flow equations with diagrammatic resummation schemes (such as the "random phase approxi- mation") 6. RG flow equations for spin systems Intended learning outcomes Familiarity with modern diagram based techniques for interacting many-body systems. In-depth understanding | | | | | |
| conduc | tivity, o | charge and spin density v | waves, and nematic i | nstabilities. | · · · | |
| V (4) + | | , number of weekly conta | ici nours, ianguage - | – ii other than Germa | all <i>)</i> | |
| | | t in: English | | | | |
| | | essment (type, scope, la on on whether module c | | | ation offered — if not every seme- | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: Once a year as announced | | | | | | |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | - | | | |
| 240 h | | | | | | |

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

| Module title | | | | | Abbreviation | |
|---|-----------|------------------------------|----------------------|---|--------------|----------------|
| Theory of Relativity 11-RTT-Int-201-m01 | | | | | | |
| Module coordinator | | | | Module offered by | | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | | Faculty of Physics and Astronomy | | |
| | | | Only after succ. con | ompl. of module(s) | | |
| 6 | nume | rical grade | | | | |
| Duration Module level Other prerequisit | | | Other prerequisites | s | | |
| 1 semester graduate | | | - | | | |
| Contents | | | | | | |
| Mathematical Foundations Differential forms Brief Summary of the special relativity Elements of differential geometry Electrodynamics as an example of a relativistic gauge theory Field equations of the fundamental structure of general relativity Stellar equilibrium and other astrophysical applications Introduction to cosmology | | | | | | |
| Intended learning outcomes | | | | | | |
| Familiarity with the basic physical and mathematical concepts of general relativity. Mathematical understanding of the formulation in terms of differential forms. Understanding of the formal similarity between electrodynamics and the theory of general relativity, viewing both of them as gauge theories. Application of the theory to simple models of stellar equilibrium. First contact with elements of cosmology. | | | | | | |
| Courses (type, number of weekly contact hours, language — if other than German) | | | | | | |
| V (3) + R (1) Module taught in: English | | | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | |
| Allocation of places | | | | | | |
| | | | | | | |
| Additional information | | | | | | |
| | | | | | | |
| Workload | | | | | | |
| 180 h | | | | | | |
| Teaching cycle | | | | | | |
| | | | | | | |
| Performed to in LPOL (examination regulations for teaching degree programmer) | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| | | | | | | |
| Master's wi | th 1 majo | Physics International (2020) | - | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 144 / 170 |

Master's degree (1 major) Physics International (2020) exchange program Physics (2023) Master's degree (1 major) Physics International (2024)

| Module | | | | | Abbreviation |
|---|---|---|--|--|---|
| Black H | oles | | | | 11-SLQ-Int-241-m01 |
| Module | e coord | inator | | Module offered by | |
| Managi and Ast | - | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 6 | nume | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | i | |
| 1 semester graduate | | | | | |
| Conten | ts | | | | |
| PART 1 - Classical solutions 1. Vacuum solutions of Einstein's equation - the Schwarzschild solution, Birkhoff's theorem, the Eddington-Finkelstein coordinates, Kruskal extension and eternal black holes, the Penrose diagram, conformal compactification and Carter-Penrose diagram 2. Gravitational collapse - the Oppenheimer-Snyder solution 3. Charged and rotating black holes - Cauchy horizons, ergosphere 4. ADM formalism - energy and angular momentum 5. Black hole thermodynamics PART 2 - Astrophysical observations of black holes 1. Spin and mass measurements of black holes 2. Black hole electromagnetism 3. Gravitational waves and their measurement PART 3 - Quantum aspects of black hole 1. Introduction to QFT on curved spacetime: Rindler spacetime, Unruh effect 2. Derivation of Hawking radiation 3. Hawking's original formulation of the information paradox 4. The "holography of information" - information paradox in AdS/CFT, the Page curve and Islands 5. Firewall, fuzzball, complementarity - possible resolutions of information paradox | | | | | |
| | | and the factorization puz | zzle | | |
| | | ning outcomes | | | |
| ons in t Througl connec | he fiel h this c tion wi | ds of Astronomy, Astroph course, the students will g | ysics, General Relati gain sufficient comm this area. This in turr | vity, String Theory ar ands over the applic n will motivate them | se and the active research directi- nd Gauge/Gravity Duality. ations of general relativity in to pursue careers as a researcher r and PhD projects. |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | in) |
| V (3) + I Module | | t in: English | | | |
| Method | l of ass | sessment (type, scope, la | | | tion offered — if not every seme- |
| · · · · | | ion on whether module ca | | a bonus) | |
| b) oral o c) oral o d) proje e) prese If a writ stead ta of asse nation o | examir examin ect repo entatio ten exa ake the ssmen date at | e form of an oral examina | ach (approx. 30 minu of 2, approx. 30 minu of or es). method of assessm tion of one candidate | tes per candidate) o ent, this may be char e each or an oral exa | r nged and assessment may in- mination in groups. If the method weeks prior to the original exami- |

Assessment offered: In the semester in which the course is offered and in the subsequent semester

Allocation of places

Additional information

Workload

180 h

Teaching cycle

--

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024)

| Module | e title | | | | Abbreviation | |
|---|---|------------------------------|--|---|-----------------------|----------------|
| Spintro | onics | | | | 11-SPI-Int-201-m01 | |
| Module | e coord | inator | | Module offered by | | |
| Manag | ing Dire | ector of the Institute of | Applied Physics | Faculty of Physics a | ind Astronomy | |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 | numei | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | | | |
| 1 seme | ster | graduate | | | | |
| Conten | its | | | | | |
| giant n | In this lecture, the basic principles of spin transport are taught, with a particular emphasis on the phenomena of giant magnetoresistance and tunnel magnetoresistance. New phenomena from the fields of spin dynamics and current-induced spin phenomena are discussed. | | | | | |
| Intend | ed learr | ning outcomes | | | | |
| | . Overvi | | n transport models and e-art findings in this fie | | | |
| Course | s (type, | number of weekly cor | itact hours, language – | - if other than Germa | ın) | |
| V (3) + Module | | t in: English | | | | |
| | | | language — if other th can be chosen to earn | | tion offered — if not | every seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | |
| | ion of p | | | | | |
| | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycle | 9 | | | | |
| | <u> </u> | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | |
| Referred to in LPOT (examination regulations for teaching-degree programmes) | | | | | | |
| Module | e appea | rs in | | | | |
| | | ee (1 major) Physics Int | ernational (2020) | | | |
| | - | ee (1 major) Quantum I | | | | |
| | - | gram Physics (2023) | J | | | |
| | | ee (1 major) Quantum I | Engineering (2024) | | | |
| | - | ee (1 major) Physics Int | | | | |
| Master's w | ith 1 major | Physics International (2020) | - | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 148 / 170 |
| | | | | | | , |

| Module | | | | | Abbreviation | |
|---|--|--|------------------------|---|------------------------|----------------|
| | | e Technologies | | | 11-SPT-Int-201-m01 | |
| Module | e coord | nator | | Module offered by | | |
| | | ctor of the Institute of A | <u> </u> | Faculty of Physics a | and Astronomy | |
| ECTS | <u> </u> | d of grading | Only after succ. con | npl. of module(s) | | |
| 6 | · | rical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | ! | graduate | | | | |
| Basic tl surface engine basic p | Basic theoretical principles of scanning force, tunneling, and near-field optical microscopy; basic principles of surface science; tip-sample interactions; design principles and material considerations; fundamentals of control engineering; measurement modes, e.g., contact and non-contact, Kelvin probe, friction force microscopy, etc; basic principles of processing and presenting microcopy data; measurement techniques and their application: lock-in, phase-lock loop, etc. | | | | | |
| | | ning outcomes | | | | |
| les, is a | aware o | res specific knowledge f basic design principle contrast mechanisms, a | s, knows pros and cor | ns of various materia | ls, and is familiar of | measure- |
| Course | s (type | number of weekly cont | act hours, language – | - if other than Germa | ın) | |
| V (3) + Module | | t in: English | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester Allocation of places | | | | | | |
| Additio | onal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | | | | |
| Teachi | ng cycl | 9 | | | | |
| Teaching cycle: every year, after announcement | | | | | | |
| Referre | ed to in | LPOI (examination reg | ulations for teaching- | degree programmes) | | |
| | | | | | | |
| Module | e appea | rs in | | | | |
| | - | ee (1 major) Physics Inte | ernational (2020) | | | |
| | | gram Physics (2023) ee (1 major) Physics Inte | ernational (2024) | | | |
| | | Physics International (2020) | JMU Würzburg | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | | page 149 / 170 |

| Module | e title | | | | Abbreviation | |
|---|---|--|---------------------------------------|---|-----------------------|----------------|
| | Scien | | | | 11-SSC-Int-201-m01 | |
| Module | e coordi | nator | | Module offered by | | |
| | <u> </u> | ctor of the Institute of A | · · · · · · · · · · · · · · · · · · · | Faculty of Physics a | nd Astronomy | |
| ECTS | | d of grading | Only after succ. con | Only after succ. compl. of module(s) | | |
| 6 | L | ical grade | | | | |
| Duratio | | Module level | Other prerequisites | | | |
| 1 seme | I | graduate | | | | |
| Relevan Atomic surface | Relevance of surfaces and interfaces, distinction from bulk phases, classical description, continuum models, Atomic structure: reconstructions and adsorbates, surface orientation and symmetries, Microscopic processes at surface, thermodynamics, adsorption and desorption, Experimental characterization, Electronic structure of sur- faces, chemical bonding, surface states, spin-orbit coupling, Rashba effects, topological surface states, magne- tism | | | | | |
| Intende | ed learr | ing outcomes | | | | |
| charact | The students have an overview over the diverse aspects of surface science and they are familiar with the physical characteristic of surfaces and interfaces. The students know the most important experimental techniques for the investigation of surfaces, as well as their specific fields of application. | | | | | |
| Course | s (type, | number of weekly cont | act hours, language – | - if other than Germa | n) | |
| V (3) + Module | | : in: English | | | | |
| | | essment (type, scope, on on whether module | | | tion offered — if not | every seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | |
| Allocat | | | | | | |
| | P | | | | | |
| Additio | nal info | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 180 h | | | _ | | | |
| Teachi | | | | | | |
| reacini | is cycli | • | | | | |
| Poforro | d to in | LPO I (examination reg | ulations for teaching | degree programmes) | | |
| | | | | | | |
| Module | e appea | rs in | | | | |
| Master Master | 's degre 's degre | ee (1 major) Physics Inte ee (1 major) Quantum E gram Physics (2023) | | | | |
| Master's w | ith 1 major | Physics International (2020) | - | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internation | - | page 150 / 170 |



Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| | Module title Abbreviation | | | | | |
|--|--|-------------------------------------|--------------------------|--|-----------------------|----------------|
| String | String Theory 1 11-STRG1-Int-201-m01 | | | | | 01 |
| Module | e coord | inator | | Module offered by | | |
| Manag and As | | ector of the Institute of T sics | Theoretical Physics | Faculty of Physics and Astronomy | | |
| ECTS | Meth | od of grading | Only after succ. cor | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | ; | | |
| 1 seme | ster | graduate | | | | |
| Conten | Contents | | | | | |
| action, dimens Conforr ty. | Classical and quantum theory of the relativistic bosonic string, in particular the Nambu-Goto action and Polyakov action, Quantization of the closed bosonic string and emergent graviton, Quantum Lorentz invariance and critical dimension, Quantization of the open bosonic string, D-Branes, Gauge Fields and Yang-Mills Theories, Relativistic Conformal Field Theory, String Path Integral, BRST Quantization, String Interactions, Effective Actions and Gravi- ty. | | | | | |
| Intende | ed lear | ning outcomes | | | | |
| Familiarity with the classical and quantum theory of relativistic bosonic strings, in particular with the two classical actions for relativistic bosonic strings, the Nambu-Goto action and the Polyakov action. Ability to quantize the closed bosonic string and to understand the emergence of the massless graviton in the spectrum of the closed bosonic string. Knowledge of the the quantum Lorentz anomaly and the derivation of the critical dimension of the bosonic string quantization and the spectrum of massless gauge fields, as well as of Yang-Mills fields for coincident branes. In-depth knowledge of relativistic conformal field theory, the string path integral and its BRST quantization and the emergence of Einstein gravity. Courses (type, number of weekly contact hours, language — if other than German) | | | | | | |
| | | , number of weekly con | act nours, language – | – If other than Germa | in) | |
| V (4) + Module | | t in: English | | | | |
| | | sessment (type, scope, | language if other th | an German examina | tion offered — if not | avary sama- |
| | | | | | | every serie |
| b) oral c) oral d) proje e) pres If a writ stead t of asse nation Langua | ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocation of places | | | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | | | | |
| Teachi | ng cvcl | e | | | | |
| | 0.95 | | | | | |
| Master's w | ith 1 majo | r Physics International (2020) | - | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | - | page 152 / 170 |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) exchange program Physics (2023) Master's degree (1 major) Physics International (2024)

| String Theory a 11:STRG2-Int-201-m01 Module coordinator Module offered by Managing Director of the Institute of Theoretical Physics and Astrophysics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 Als Superstrings, the Glizozi-Scherck-Olive Projection and Space-Time Supersymmetry in 10 dimensions, the type 1 superstring theories, anomaly cancellation and restrictions on gauge groups, dualities between the five superstring theories and M Theory, Familiarity with the main features of boso- nic string theory, as well as with the theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theorew. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Superstring. Understanding of the emergence of type II A/B Superstring theories and the restrictions it imposes on the allowed gauge groups. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understand | Module | title | | | | Abbreviation |
|--|---|--|---------------------------------------|----------------------|-----------------------|-----------------------------------|
| Managing Director of the institute of Theoretical Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade - Duration Module level Other prerequisites 1 semester graduate - Contents Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, hetpe 1 Superstring, theetories as well as their relation to M Theory in 110, D-Branes and supersymmetric gauge theories, supergravity and the AdS/CFT Correspondence. Indepth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of bosonic string theories as well as with the theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Superstrings, theories as well as their relation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories and the supersymmetry in 10. Guards and the supersymmetry in 10. Familiarity with the type 1 and heterotic superstring theories as well as with anomaly cancellation in these theories and the supersymmetry in 10. To. Moved due of the propredites of | | - | | | | 11-STRG2-Int-201-m01 |
| and Astrophysics Method of grading Only after succ. compl. of module(s) 6 numerical grade - Duration Module level Other prerequisites 1 semester graduate - Contents Superstring, Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of cilfford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the Glozzi-Scherck-Olive Projection and Space-Time Supersymmetry in 10 dimensions, the type 1 superstring, heterolic string theories, anomaly cancellation and restrictions on gauge groups, dualities between the five superstring theories as well as their relation to M Theory in 11D, D-Branes and supersymmetric gauge theories, supergravity and the AdS/CFT Correspondence. Intendel learning outcomes In-depth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of bosonic string theory, as well as within theory of fermionic fields and representations of Clifford algebra in different dimensions, as relevant for the understanding of supersymmetry in two and higher dimensions, as relevant for the understanding of supersymmetry in two and higher dimensions, as relevant for the understranding of supersymmetry in two and higher dimensions, as relevant for the understranding of supersymmetry in two and higher dimensions, as relevant for the understranding of the emergence of type I A/B Superstring theories and the restrictions in theory in 10. Knowledge of the | Module | coordi | inator | | Module offered by | |
| 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the clioizzi-Scherck-Olive Projection and Space-Time Supersymmetry in to dimensions, the type 1 Superstring, theories, anomaly cancellation and restrictions on gauge groups, dualities between the five superstring theories and M Theory. In 11D, D-Branes and supersymmetric gauge theories, supergravity and the AdS/CFT Correspondence. Intended learning outcomes | | | | eoretical Physics | Faculty of Physics a | and Astronomy |
| Duration Module level Other prerequisites 1 semester graduate Contents Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of Clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the Gliozzi-Scherck-Olive Projection and Space-Time Supersymmetry in to dimensions, the type 1 superstring, heterotic string theories, anomaly cancellation and restrictions on gauge groups, dualities between the five superstring theories as well as their relation to M Theory in 1D, D-Branes and supersymmetric gauge theories, supergravity and the AdS/CFT Correspondence. Intended learning outcomes Indepth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of bosonic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theories, as well as with anomaly cancellation in these theories and the extrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 1D. Familiarity with the type 1 and heterotic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories and the super-symmetry in two Advecaus Schwarz Superstring theories as well as their relation to M Theory in 1D. Knowledge of the properties | ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 1 semester graduate | 6 | numer | rical grade | | | |
| Contents Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fermionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the closzic-Scherck-Olive Projection and Space-Time Supersymmetry in to dimensions, the type 1 Superstring, theterotic string theories, anomaly cancellation and restrictions on gauge groups, dualities between the five superstring theories as well as their relation to M Theory. Familiarity with the main features of bosonic string theories, supergravity and the AdS/CFT Correspondence. Indepth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of bosonic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theory. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Schwarz Superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories and the supersymmetry in 100. Familiarity with the super-symmetry in 200. Familiarity with the superstring theories and the super-symmetry in 200. Familiarity with the superadition of the and proteet of type II A/B Superstring | Duratio | n | Module level | Other prerequisites | | |
| Superstring Theories and M Theory, in particular a short introduction to bosonic string theory, the theory of fer- mionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the filoziz-Scherck-Olive Projection and Space-Time Supersymmetry in a 0 dimensions, the ty- pe 1 Superstring, the terotic string theories, anomaly cancellation and restrictions on gauge groups, dualities bet- ween the five superstring theories as well as their relation to M Theory in 11D, D-Branes and supersymmetric gau- ge theories, supergravity and the AdS/CFT Correspondence. Intended learning outcomes In-depth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of boso- nic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theory. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Su- perstring. Understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Supersymmetry in 10D. Familiarity with the type 1 and hetero- tic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 11D. Knowledge of the properties of D-Branes in type I and II superstring theories and the super- symmetric gauge theories they carry, of the supergravity actions in ten and eleven dimensional space-time and of the AdS/CFT Correspondence. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessme | 1 semes | ster | graduate | | | |
| mionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the filozzi-Scherek-Olive Projection and Space-Time Supersymmetry in to dimensions, the ty- pe 1 Superstring theories as well as their relation to M Theory in 11D, D-Branes and supersymmetric gau- ge theories, supergravity and the AdS/CFT Correspondence. Intended learning outcomes In-depth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of boso- nic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theory. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Suu- perstring. Understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Supersymmetry in 10D. Familiarity with the type 1 and hetero- tic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 11D. Knowledge of the properties of D-Branes in type I and II superstring theories and the super- symmetric gauge theories they carry, of the supergravity actions in ten and eleven dimensional space-time and of the AdS/CFT Correspondence. Courses (type, number of weekly contact hours, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination in groups (groups of 2, approx. 30 minutes) or c) oral examination of one candidate each (approx. 30 minutes) or d) project report (approx. 90 to 120 minutes) or d) | Conten | Contents | | | | |
| Intended learning outcomes In-depth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of bosonic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring. Understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Supersymmetry in 10D. Familiarity with the type 1 and heterotic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 11D. Knowledge of the properties of D-Branes in type I and II superstring theories and the supersymmetric gauge theories they carry, of the supergravity actions in ten and eleven dimensional space-time and of the AdS/CFT Correspondence. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or c) oral examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of | mionic and hig A/B Sup pe 1 Su ween th | mionic fields and representations of clifford algebra in diverse dimensions, a review of supersymmetry in two and higher dimensions, the classical and quantum version of the Ramond-Neveau-Schwarz Superstring, type 2 A/B Superstrings, the Gliozzi-Scherck-Olive Projection and Space-Time Supersymmetry in 10 dimensions, the ty- pe 1 Superstring, heterotic string theories, anomaly cancellation and restrictions on gauge groups, dualities bet- ween the five superstring theories as well as their relation to M Theory in 11D, D-Branes and supersymmetric gau- | | | | |
| In-depth knowledge of supersymmetric string theories and M Theory. Familiarity with the main features of boso- nic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theory. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Su- perstring. Understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Supersymmetry in 10D. Familiarity with the type 1 and hetero- tic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 11D. Knowledge of the properties of D-Branes in type I and II superstring theories and the super- symmetric gauge theories they carry, of the supergravity actions in ten and eleven dimensional space-time and of the AdS/CFT Correspondence. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language | | | · · · · · · · · · · · · · · · · · · · | <u></u> | | |
| V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | nic string theory, as well as withthe theory of fermionic fields and representations of Clifford algebra in different dimensions. Knowledge of supersymmetry in two and higher dimensions, as relevant for the understanding of superstring theory. Working knowledge of the classical and quantum version of the Ramond-Neveau-Schwarz Superstring. Understanding of the emergence of type II A/B Superstrings upon imposing the Gliozzi-Scherck-Olive Projection, which in particular enforces Space-Time Supersymmetry in 10D. Familiarity with the type 1 and heterotic superstring theories, as well as with anomaly cancellation in these theories and the restrictions it imposes on the allowed gauge groups. Knowledge of dualities between the five superstring theories as well as their relation to M Theory in 11D. Knowledge of the properties of D-Branes in type I and II superstring theories and the super-symmetric gauge theories they carry, of the supergravity actions in ten and eleven dimensional space-time and of the AdS/CFT Correspondence. | | | | | |
| Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | , number of weekly conta | ct hours, language – | - if other than Germa | in) |
| ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | Module | taught | | | | |
| b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | tion offered — if not every seme- |
| | a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| <u></u> | | | | | | |
| Additional information | Additio | nal info | ormation | | | |
| | | | | | | |

Workload

180 h

Teaching cycle

Referred to in LPO I (examination regulations for teaching-degree programmes)

--

Module appears in

Master's degree (1 major) Physics International (2020) exchange program Physics (2023)

Master's degree (1 major) Physics International (2024)

| Module | e title | | | | Abbreviation | |
|---|---|--|---|---|--|---------------------------------|
| Topolo | gical El | fects in Solid State Phy | sics | | 11-TEFK-Int-201-mo | 1 |
| Module | e coord | inator | | Module offered by | | |
| Managi and Ast | | ector of the Institute of T sics | heoretical Physics | Faculty of Physics and Astronomy | | |
| ECTS | Metho | od of grading | Only after succ. cor | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | n | Module level | Other prerequisites | ; | | |
| 1 seme | ster | graduate | | | | |
| Conten | Contents | | | | | |
| Geometric phase in quantum systems Mathematical basics of topology Time-reversal symmetry Hall conductance and Chern numbers Bulk-boundary correspondence Graphene (as a topological insulator) Quantum Spin Hall insulators Z2 invariants Topological superconductors Intended learning outcomes | | | | | | |
| stems. | Ability | retical understanding of to connect their knowled Würzburg University. | | | | |
| Course | s (type | , number of weekly conta | act hours, language – | - if other than Germa | ın) | |
| V (4) + | R (2) | | | | | |
| | | t in: English | | | | |
| | | essment (type, scope, la on on whether module o | | | tion offered — if not | every seme- |
| b) oral c) oral of d) projection e) pressed lf a write stead ta of assed nation Langua | examir examin ect repo entatio tten exa ake the ssmen date at ge of a | mination (approx. 90 to aation of one candidate of ation in groups (groups ort (approx. 8 to 10 page n/talk (approx. 30 minur amination was chosen as form of an oral examina t is changed, the lecture the latest. ssessment: English ffered: In the semester i | each (approx. 30 minu of 2, approx. 30 minu s) or tes). s method of assessm ation of one candidate r must inform studen | ites per candidate) of ent, this may be char e each or an oral exa ts about this by four | nged and assessmer mination in groups. weeks prior to the or | If the method riginal exami- |
| Allocat | ion of p | olaces | | | | |
| | | | | | | |
| Additio | nal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| 240 h | | | | | | |
| Teachi | ng cycl | e | | | | |
| | | | | | | |
| Referre | d to in | LPO I (examination reg | ulations for teaching- | degree programmes) | | |
| Master's wi | ith 1 majo | r Physics International (2020) | | • generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 156 / 170 |

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Modul | Module title Abbreviation | | | | | |
|---|--|---|-------------------------|--|---------------------------|----------------|
| Theore | Theoretical Elementary Particle Physics 11-TEP-Int-201-m01 | | | | | |
| Modul | e coord | inator | | Module offered by | | |
| | ing Dire | ector of the Institute of sics | Theoretical Physics | Faculty of Physics and Astronomy | | |
| ECTS | | od of grading | Only after succ. cor | npl. of module(s) | | |
| 8 | nume | rical grade | | | | |
| Duratio | on | Module level | Other prerequisites | 5 | | |
| 1 seme | ester | graduate | | | | |
| Conter | Contents | | | | | |
| Fundamental Forces and Particles Groups and Symmetries Quark Model of Hadrons Parton Model and Deep Inelastic Scattering Basics of Quantum Field Theory Gauge Theories Spontaneous Symmetry Breaking Electro-Weak Standard Model Quantum Chromo Dynamics | | | | | | |
| 10. Ext | ension | s of the Standard Mode | | | | |
| Intend | ed lear | ning outcomes | | | | |
| Familiarity with the mathematical methods of elementary particle physics. Understanding of the structure of the standard model and its construction from symmetry principles and experimental observations. Knowledge of the calculational methods for scattering and decay processes, tests of the standard models and there are limitations. Familiarity with the basics of extended theories. | | | | | | |
| | | , number of weekly cor | llact nours, language - | - II other than Germa | (1) | |
| V (4) + Module | | t in: English | | | | |
| | | sessment (type, scope, ion on whether module | | | ition offered — if not ev | very seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | |
| Allocation of places | | | | | | |
| | | | | | | |
| Additio | onal inf | ormation | | | | |
| | | | | | | |
| Worklo | ad | | | | | |
| | | | | | | |
| 240 h | | | | | | |
| Teachi | ing cycl | e | | | | |
| | | | | | | |
| Master's w | ith 1 majo | r Physics International (2020) | - | • generated 19-Apr-2025 • exa er (120 ECTS) Physics Internati | | page 158 / 170 |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) exchange program Physics (2023) Master's degree (1 major) Physics International (2024)

| Module | e title | | | | Abbreviation |
|---|---|--|----------------------|-----------------------|-----------------------------------|
| Theore | tical So | olid State Physics 2 | | | 11-TFK2-Int-201-m01 |
| Module | e coord | inator | | Module offered by | |
| Managi and Ast | | ector of the Institute of Th sics | eoretical Physics | Faculty of Physics a | nd Astronomy |
| ECTS | Metho | od of grading | Only after succ. con | npl. of module(s) | |
| 8 | nume | rical grade | | | |
| Duratio | n | Module level | Other prerequisites | | |
| 1 semester graduate | | | | | |
| Conten | Contents | | | | |
| A possible continuation of "11-TFK" is the following syllabus: 5. Advanced topics of the theory of superconductivity (Bogoliubov-de Gennes equations, effective field theory, Anderson-Higgs description of the Meissner effect) 6. Unconventional superconductors (e.G. copper-oxide high-Tc superconductors) 7. Green's function methods and Feynman diagrammatic technique 8. The Kondo Effect (Anderson's "poor mans scaling", renormalization group) | | | | | |
| | | • | | manzation group) | |
| Advanc ty to ap | Intended learning outcomes Advanced knowledge of the topics listed above. In-depth understanding of both the concepts involved and abili- ty to apply the methods listed. This provides a thorough working knowledge of a large number of topics treated in the standard textbooks on theoretical solid state physics. | | | | |
| Course | s (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) |
| V (4) + Module | | t in: English | | | |
| | | essment (type, scope, la on on whether module ca | | | tion offered — if not every seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocat | ion of p | olaces | | | |
| | | | | | |
| Additio | nal inf | ormation | | | |
| | | | | | |
| Worklo | ad | | | | |
| 240 h | | | | | |
| Teachir | ng cycl | e | | | |
| | -3 -9 -1 | - | | | |
| Referre | d to in | LPOI (examination regu | lations for teaching | degree programmoc) | |
| Referre | | | | active programmes) | |
| •• | | | | | |
| Module | | | | | |
| Master | 's degr | ee (1 major) Physics Inter | national (2020) | | |

Master's with 1 major Physics International (2020)



exchange program Physics (2023) Master's degree (1 major) Physics International (2024)

| Module title | | | | Abbreviation | |
|---|--|-----------------------|---|--------------------------|----------------|
| Theoretical Solid State Physics 11-TFK-Int-201-m01 | | | | | |
| Module coord | inator | | Module offered by | | |
| | | enretical Physics | Faculty of Physics a | nd Astronomy | |
| Managing Director of the Institute of Theoretical Physics and Astrophysics | | | Faculty of Fligsles a | nu Astronomy | |
| ECTS Methe | od of grading | Only after succ. con | npl. of module(s) | | |
| 8 nume | rical grade | | | | |
| Duration Module level Other prerequisites | | | | | |
| 1 semester | graduate | | | | |
| Contents | | | | | |
| The contents of this two-term course will depend on the choice of the lecturer, and may include parts of the syllabus which could alternatively be offered as "Quantum Many Body Physics" (11-QVTP). A possible syllabus may be: 1. Band structure (Sommerfeld theory of metals, Bloch theorem, k.p approach and effective Hamiltonians for to- pological insulators (TIs), bulk-surface correspondence, general properties of TIs) 2. Electron–electron interactions in solids (path integral method for weakly interacting fermions, mean field theory, random phase approximation (RPA), density functional theory) 3. Application of mean field theory and the RPA to magnetism 4. BCS theory of superconductivity | | | | | |
| Intended lear | ning outcomes | | | | |
| apply the met | vledge of the topics listed hods listed. This provide books on theoretical solid | s a thorough working | | | |
| Courses (type | , number of weekly conta | ct hours, language – | - if other than Germa | n) | |
| V (4) + R (2) | | | | | |
| Module taugh | t in: English | | | | |
| | s essment (type, scope, la ion on whether module ca | | | tion offered — if not ev | /ery seme- |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocation of | places | | | | |
| | | | | | |
| Additional information | | | | | |
| | | | | | |
| Workload | | | | | |
| 240 h | | | | | |
| Teaching cycl | e | | | | |
| | | | | | |
| Poforrad to in | IPOL (ovamination real | lations for toaching | dogroo programmes) | | |
| Referred to IN | LPO I (examination regu | iations for teaching- | aegree programmes) | | |
| | | | | | |
| waster's with 1 majo | r Physics International (2020) | | generated 19-Apr-2025 • exa r (120 ECTS) Physics Internation | | oage 162 / 170 |

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) exchange program Physics (2023) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)

| Experimental Particle Physics 11-TPE-Int-201-m01 Module offered by Module offered by Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 sem seter graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes | Module title | | | | Abbreviation | |
|--|---|--|---|-----------------------|------------------------------------|--|
| Managing Director of the Institute of Applied Physics Faculty of Physics and Astronomy ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) are axmination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes). f a written examination was chosen as method | Experimenta | al Particle Physics | | | 11-TPE-Int-201-m01 | |
| ECTS Method of grading Only after succ. compl. of module(s) 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 9 to 120 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or a) oral examination in groups (groups of 2, approx. 30 minutes) or a) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, | Module coo | rdinator | | Module offered by | | |
| 6 numerical grade Duration Module level Other prerequisites 1 semester graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) or al examination of one candidate each (approx. 30 minutes) or b) or al examination of one candidate each (approx. 30 minutes) or c) areaxmination in groups (groups of 2, approx. 30 minutes) or b) or al examination in groups (or 2, or approx. 30 minutes). f a written examination was chosen as method of assessment, this may be changed and assessment may in- | Managing D | irector of the Institute of Ap | plied Physics | Faculty of Physics a | nd Astronomy | |
| Duration Module level Other prerequisites 1 semester graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination was chosen as method of assessment, this may be changed and assessment may in- | | | Only after succ. con | pl. of module(s) | | |
| 1 semester graduate Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) and examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or b) oral examination in groups (groups of 2, approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or b) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be | 6 num | nerical grade | | | | |
| Contents Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. Determination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 9 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | Duration | | Other prerequisites | | | |
| Physics with modern particle physics detectors at the LHC and at the Tevatron. Discovery of the Higgs Boson. De- termination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for phy- sics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data ana- lysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertain- ties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | 1 semester | graduate | | | | |
| termination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for physics beyond the standard model. Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | Contents | Contents | | | | |
| Intended learning outcomes Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | termination | termination of the W boson and Top Quark mass. Measurement of standard model parameters. Search for phy- | | | | |
| Familiarity with the basic questions studied with a modern particle physics detector, and with modern data analysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | | | | | | |
| lysis techniques in particle physics. Ability to put results into context and to assess their systematic uncertainties. Courses (type, number of weekly contact hours, language — if other than German) V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | | | | | | |
| V (3) + R (1) Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | lysis technic | | | | | |
| Module taught in: English Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | Courses (typ | oe, number of weekly conta | ct hours, language – | · if other than Germa | n) | |
| ster, information on whether module can be chosen to earn a bonus) a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | | ght in: English | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | | | | | tion offered — if not every seme- | |
| b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may in- | | | | a bonus) | | |
| If a written examination was chosen as method of assessment, this may be changed and assessment may in- | b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or | | | | | |
| stead take the form of an oral examination of one candidate each or an oral examination in groups. If the method | If a written e stead take t | examination was chosen as he form of an oral examination | method of assessme tion of one candidate | each or an oral exa | mination in groups. If the method | |
| of assessment is changed, the lecturer must inform students about this by four weeks prior to the original exami- nation date at the latest. Language of assessment: English | nation date | at the latest. | must inform student | s about this by four | weeks prior to the original exami- | |
| Assessment offered: In the semester in which the course is offered and in the subsequent semester | Assessment | offered: In the semester in | which the course is | offered and in the su | Ibsequent semester | |
| Allocation of places | Allocation o | f places | | | | |
| | | | | | | |
| Additional information | Additional in | nformation | | | | |
| | | | | | | |
| Workload | Workload | | | | | |
| 180 h | 180 h | | | | | |
| Teaching cycle | Teaching cy | cle | | | | |
| - | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | Referred to | in LPO I (examination regu | lations for teaching-o | legree programmes) | | |
| | | | | | | |
| Module appears in | | | | | | |
| Master's degree (1 major) Physics International (2020) | | | national (2020) | | | |
| exchange program Physics (2023) Masteria degrees (constant) Physical International (2023) | | | | | | |
| Master's degree (1 major) Physics International (2024) | master's de | gree (1 major) Physics Inter | national (2024) | | | |

| Module title | | | | Abbreviation | |
|---|---|-------------------------|--------------------------------|--------------------|----------------|
| Particle Physi | cs (Standard Model) | | | 11-TPSM-Int-201-mc | 01 |
| Module coord | inator | | Module offered by | <u> </u> | |
| | ectors of the Institute o f Theoretical Physics a | | Faculty of Physics a | and Astronomy | |
| ECTS Metho | od of grading | Only after succ. con | npl. of module(s) | | |
| 6 nume | rical grade | | | | |
| Duration | Module level | Other prerequisites | | | |
| 1 semester | graduate | Approval from exam | nination committee re | equired. | |
| Contents | | | | | |
| Theoretical description of the Standard Model Electroweak symmetry breaking through the Higgs mechanism parity Violation Bhabha scattering Z-Line Shape and forward / reverse asymmetry Higgs production and decay Experimental setup and results of key experiments to test the Standard Model and for determining its parame- ters | | | | | |
| Search for the | | | | | |
| | ning outcomes | | | 1 1.1 1 | |
| Students know the theoretical fundamental laws of the standard model of particle and the key experiments that have established and confirmed the standard model. They have basic knowledge in order to interpret experimental or theoretical results in the framework of the standard model can and knows its significance and limitations. | | | | | |
| Courses (type | , number of weekly cor | ntact hours, language – | - if other than Germa | ın) | |
| V (3) + R (1) | | | | | |
| Module taugh | t in: English | | | | |
| | Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | |
| Allocation of | olaces | | | | |
| | | | | | |
| Additional inf | ormation | | | | |
| | | | | | |
| Workload | | | | | |
| 180 h | | | | | |
| Teaching cycl | e | | | | |
| | | | | | |
| Referred to in | IPOI (examination ro | gulations for teaching- | degree programmoc) | | |
| Referred to III | | | | | |
| | r Physics International (2020) | IA11 \\//:: | • generated 19-Apr-2025 • exa | am rog da | page 165 / 176 |
| master s with 1 mdJ0 | i ingoleo international (2020) | - | r (120 ECTS) Physics Internati | - | page 165 / 170 |

Master's degree (1 major) Physics International (2020) exchange program Physics (2023)

| Module title | | Abbreviation | | | | | | |
|---|---------------------------------|-----------------------|---|----------|----------------|--|--|--|
| Particle Phys | ics (Standard Model) | 11-TPSM-Int-211-mc | 01 | | | | | |
| Module coordinator | | | Module offered by | | | | | |
| Managing Directors of the Institute of Applied Physics and | | | Faculty of Physics and Astronomy | | | | | |
| the Institute of Theoretical Physics and Astrophysics | | | | | | | | |
| ECTS Method of grading Only after succ. co | | | mpl. of module(s) | | | | | |
| 8 nume | erical grade | | | | | | | |
| Duration | Module level | Other prerequisites | | | | | | |
| 1 semester | graduate | Approval from exam | ination committee re | equired. | | | | |
| Contents | | | | | | | | |
| Theoretical description of the Standard Model Electroweak symmetry breaking through the Higgs mechanism parity Violation Bhabha scattering Z-Line Shape and forward / reverse asymmetry Higgs production and decay Experimental setup and results of key experiments to test the Standard Model and for determining its parame- ters Search for the Higgs boson | | | | | | | | |
| Intended lear | ning outcomes | | | | | | | |
| Students know the theoretical fundamental laws of the standard model of particle and the key experiments that have established and confirmed the standard model. They have basic knowledge in order to interpret experimental or theoretical results in the framework of the standard model can and knows its significance and limitations. | | | | | | | | |
| Courses (type | e, number of weekly conta | act hours, language – | - if other than Germa | n) | | | | |
| V (4) + R (2) | | | | | | | | |
| Module taug | nt in: English | | | | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | | | |
| Allocation of places | | | | | | | | |
| | | | | | | | | |
| Additional information | | | | | | | | |
| | | | | | | | | |
| Workload | | | | | | | | |
| 240 h | | | | | | | | |
| Teaching cycle | | | | | | | | |
| | | | | | | | | |
| Referred to in LPO I (examination regulations for teaching-degree programmes) | | | | | | | | |
| | | | <u> </u> | | | | | |
| Master's with 1 majo | or Physics International (2020) | - | 9 generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 167 / 170 | | | |

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Physics International (2024)

| Module title | | | | | Abbreviation | | | |
|---|----------------|--------------------------------|------------------------|---|--------------------|----------------|--|--|
| Theoretical Quantum Optics | | | | | 11-TQO-Int-221-mo1 | L | | |
| Module coordinator | | | Module offered by | | | | | |
| Managing Director of the Institute of Theoretical Phys and Astrophysics | | | Theoretical Physics | Faculty of Physics and Astronomy | | | | |
| | | | Only after succ. con | ompl. of module(s) | | | | |
| 8 | | rical grade | | - | | | | |
| Duratio | on | Module level | Other prerequisites | Other prerequisites | | | | |
| 1 seme | ster | graduate | | | | | | |
| Contents | | | | | | | | |
| Semi-classical atom-field interactions Interaction of atoms with quantized light fields and dressed-atom model Master equation and open systems Coherence and interference effects Coherent light propagation in resonant media Photon statistics and correlations Quantum optics of many-body systems | | | | | | | | |
| | | ning outcomes | | | | | | |
| Comprehensive understanding of phenomena involving light and its interaction with atoms at the microscopi- cal level. Knowledge of density matrix formalism for quantum systems and the related mathematical concepts. In-depth understanding of quantum properties of light and their experimental signatures, including photon sta- tistics and correlations. Knowledge of the theory of open systems and master equation description involving Lindblad superoperators. Understanding and modeling the role of coherence and interference in light propagati- on effects in resonant atomic media. Knowledge of cooperative effects in many-body systems: super- and subra- diance, collective light shifts and their applications. | | | | | | | | |
| Course | s (type | , number of weekly cor | tact hours, language – | - if other than Germa | ın) | | | |
| V (4) + R (2) Module taught in: English | | | | | | | | |
| Method of assessment (type, scope, language — if other than German, examination offered — if not every seme- ster, information on whether module can be chosen to earn a bonus) | | | | | | | | |
| a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes). If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest. Language of assessment: English Assessment offered: In the semester in which the course is offered and in the subsequent semester | | | | | | | | |
| Allocation of places | | | | | | | | |
| | | | | | | | | |
| Additional information | | | | | | | | |
| | | | | | | | | |
| Workload | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Teaching cycle | | | | | | | | |
| | | | | | | | | |
| Master's w | ith 1 majo | r Physics International (2020) | - | e generated 19-Apr-2025 • exa r (120 ECTS) Physics Internati | - | page 169 / 170 | | |

Referred to in LPO I (examination regulations for teaching-degree programmes)

Module appears in

Master's degree (1 major) Physics International (2020) Master's degree (1 major) Quantum Engineering (2020) Master's degree (1 major) Quantum Engineering (2024) Master's degree (1 major) Physics International (2024)