DOCTORAL SCHOOL OF PHYSICS

Discipline: Science
Form of education: Doctor of Philosophy (PhD) training
Objectives: acquire the academic degree training and the skills necessary in research, development, innovation, and higher-level education
Length of training: 8 semesters
Training type: regular school
Financing: state-sponsored or tuition-fee based
Entrance requirements: MSc and a successful entrance exam
Language requirements: a type „C" secondary (or equivalent) language exam (preferrable in English) recognized by the state (entrance requirement) and a basic level second language exam (exit requirement)
Training phases: First two years (period I): 120 ECTS credits, finished with a complex exam
Last two years (period II): 120 ECTS credits, finished with an absolutorium
Number of ECTS credits required: 240
Moduls of ECTS credits:
Progams I-III and V: study credits (48), research credits in the first two years (72), in the last two years (120)
Program IV (Physics education): study credits (80), research credits in the first two years (52), in the last two years (120)

Person responsible for the training: Dr. Jenő Gubicza, professor of physics, head of the PhD school

TRAINING MODULE

Program I: Materials Science and Solid State Physics
Head of the program: Dr. István Groma

FIZ/1/001 Nanophase metals
6 credit, theory, optional, no repetition
FIZ/1/004 The finite element method and applications in material science
6 credit, theory, optional, no repetition
FIZ/1/005 Liquid crystals, polymers
6 credit, theory, optional, no repetition
FIZ/1/006 Pattern formation in complex systems
6 credit, theory, optional, no repetition
FIZ/1/009 Micro- and nanotechnology I.
6 credit, theory, optional, no repetition
FIZ/1/014 Analytical electron microscopy
6 credit, theory, optional, no repetition
FIZ/1/015 Physical materials science I.
6 credit, theory, optional, no repetition

FIZ/1/016 Physical materials science II.
6 credit, theory, optional, no repetition
FIZ/1/018 Nuclear solid state physics I.
6 credit, theory, optional, no repetition
FIZ/1/019 Nuclear solid state physics II.
6 credit, theory, optional, no repetition
FIZ/1/021 Transmission electron microscopy and electron diffraction
6 credit, theory, optional, no repetition
FIZ/1/022 Advanced Material Physics
6 credit, theory, optional, no repetition
FIZ/1/023 Solid state theory
6 credit, theory, optional, no repetition
FIZ/1/024 Lattice defects I.
6 credit, theory, optional, no repetition
FIZ/1/025 Lattice defects II.
6 credit, theory, optional, no repetition
FIZ/1/029 Solid state research I.
6 credit, theory, optional, no repetition
FIZ/1/030 Solid state research II.
6 credit, theory, optional, no repetition
FIZ/1/031 Technology of materials (intensive course)
6 credit, theory, optional, no repetition
FIZ/1/032 Nanomagnetism
6 credit, theory, optional, no repetition
FIZ/1/036 Composite materials
6 credit, theory, optional, no repetition
FIZ/1/037 Amorphous alloys
6 credit, theory, optional, no repetition
FIZ/1/038 Diffraction methods in Materials Science I.
6 credit, theory, optional, no repetition
FIZ/1/039 Diffraction methods in Materials Science II.
6 credit, theory, optional, no repetition
FIZ/1/040 Bulk nanostructured materials
6 credit, theory, optional, no repetition
FIZ/1/041 Quantum bits in solids
6 credit, theory, optional, no repetition
FIZ/1/042 Topological insulators I.
6 credit, theory, optional, no repetition
FIZ/1/043 Topological insulators II.
6 credit, theory, optional, no repetition
FIZ/1/044 Micro and nanotechnology II.
6 credit, theory, optional, no repetition
FIZ/1/045 Low temperature plasma physics
6 credit, theory, optional, no repetition
FIZ/1,3/013 Quantum chaos in mesoscopic systems
6 credits, theory, optional, no repetition
FIZ/1,3/015 Carbon Nanostructures
6 credits, theory, optional, no repetition
FIZ/1,3/016 Macromolecules
6 credits, theory, optional, no repetition

FIZ/1,3/020 Experimental metods in solid state physics I.
6 credit, theory, optional, no repetition
FIZ/1,3/022 Mesoscopic superconductors
6 credits, theory, optional, no repetition
FIZ/1,3/023 Physics of mesoscopic systems II.
6 credits, theory, optional, no repetition
FIZ/1,3/025 Trapped atomic systems
6 credits, theory, optional, no repetition
FIZ/1,3/028 Computer simulations in statistical physics
6 credits, theory, optional, no repetition
FIZ/1,3/032 Phase transitions
6 credits, theory, optional, no repetition
FIZ/1,3/035 Many-body problem I.
6 credits, theory, optional, no repetition
FIZ/1,3/040 Mesoscopic Systems I.
6 credits, theory, optional, no repetition
FIZ/1,3/041 Trapped atomic systems II.
6 credits, theory, optional, no repetition
FIZ/1,3/042 Cooling and trapping of neutral atoms
6 credits, theory, optional, no repetition
FIZ/1,3/050 Many-body problem II.
6 credit, theory, optional, no repetition
FIZ/1,3/052 Experimental metods in solid state physics II.
6 credit, theory, optional, no repetition
FIZ/1,3/054 Universality classes in non-equilibrium systems
6 credits, theory, optional, no repetition
FIZ/1,3/060 Quantum information theory
6 credits, theory, optional, no repetition
FIZ/1,3/062 Superconductivity
6 credits, theory, optional, no repetition
FIZ/1,3/065 Synchrotron radiation and applications
6 credits, theory, optional, no repetition
FIZ/1,3/066 Theories of open quantum systems
6 credits, theory, optional, no repetition
FIZ/1,3/068 Green's functions in nanophysics
6 credits, theory, optional, no repetition
FIZ/1,3/073 Group theory in solid state research
6 credits, theory, optional, no repetition
FIZ/1,3/074 Introduction to superconductivity
6 credits, theory, optional, no repetition
FIZ/1,3/076 Entanglement in quantum many-body systems
6 credits, theory, optional, no repetition
FIZ/1,3/079 Stochastic processes
6 credits, theory, optional, no repetition
FIZ/1,3/082 Dynamical phenomena in soft materials
6 credits, theory, optional, no repetition
FIZ/1,3/083 Advanced neutron techniques of material characterization
6 credits, theory, optional, no repetition

FIZ/SZ Free credits (max. credits: 6/semester)

FIZ/VB Final report credits (maximum 60 credits at the end of the 6th semester and maximum 30 credits at the end of the 7th semester)

Research module

FIZ/K18 Guided research work (1,2,3,4. semester)
18 credit, research, optional, repeatable
FIZ/K5 Guided research work (5,6,7,8. semester)
5 credit, research, optional, repeatable
FIZ/K10 Guided research work (5,6,7,8. semester)
10 credit, research, optional, repeatable
FIZ/K15 Guided research work (5,6,7,8. semester)
15 credit, research, optional, repeatable

Teaching module (max. credits: 4/semester)

FIZ/OKT/2 Teaching activity
2 credits, practice, optional, can be repetaed
FIZ/OKT/4 Teaching activity
4 credits, practice, optional, can be repeated

Program II: Particle and Nuclear Physics
Head of the program: Dr. Zoltán Trócsányi

FIZ/2/001 Advanced field theory
6 credit, theory, optional, no repetition
FIZ/2/002 Standard model
6 credit, theory, optional, no repetition
FIZ/2/003 Beyond the standard model
6 credit, theory, optional, no repetition
FIZ/2/004 Experimental methods of particle physics II
6 credit, theory, optional, no repetition
FIZ/2/005 String Theory I
6 credit, theory, optional, no repetition
FIZ/2/007 Lattice field theory I.
6 credit, theory, optional, no repetition
FIZ/2/008 Solitons and instantons I.
6 credit, theory, optional, no repetition
FIZ/2/009 Solitons and instantons II.
6 credit, theory, optional, no repetition
FIZ/2/015 Inflationary cosmology
6 credit, theory, optional, no repetition
FIZ/2/016 Finite temperature quantum field theory and astrophysical applications
6 credit, theory, optional, no repetition
FIZ/2/017 Discrete gauge symmetries
6 credit, theory, optional, no repetition
FIZ/2/018 Conform field theories

6 credit, theory, optional, no repetition

FIZ/2/019 Field theories with boundaries
6 credit, theory, optional, no repetition

FIZ/2/020 Algebraic field theory I.
6 credit, theory, optional, no repetition

FIZ/2/021 Introduction to general relativity I.
6 credit, theory, optional, no repetition

FIZ/2/022 Experimental methods of nuclear physics
6 credit, theory, optional, no repetition

FIZ/2/023 Jet physics in hadron hadron and in heavy ion collisions
6 credit, theory, optional, no repetition

FIZ/2/024 The phase diagram of strongly interacting matter
6 credit, theory, optional, no repetition

FIZ/2/043 Introduction to supersymmetry
6 credit, theory, optional, no repetition

FIZ/2/049 Experimental high energy physics: data analysis
6 credit, theory, optional, no repetition

FIZ/2/050 Perturbative conformal field theory
6 credit, theory, optional, no repetition

FIZ/2/052 Algebraic field theory II.
6 credit, theory, optional, no repetition

FIZ/2/053 String theory II.
6 credit, theory, optional, no repetition

FIZ/2/054 String Theory III.
6 credit, theory, optional, no repetition

FIZ/2/055 Lattice field theory II.
6 credit, theory, optional, no repetition

FIZ/2/057 Introduction to general relativity II.
6 credit, theory, optional, no repetition

FIZ/2/077 Introduction to Quantum Integrable Models
6 credit, theory, optional, no repetition

FIZ/2/078 The algebraic Bethe Ansatz and its applications
6 credit, theory, optional, no repetition

FIZ/2/081 Weak interaction
6 credit, theory, optional, no repetition

FIZ/2/083 Quantum chromodynamics
6 credit, theory, optional, no repetition

FIZ/2/084 Integrable field theories
6 credit, theory, optional, no repetition

FIZ/2/086 Solitons and instantons III.
6 credit, theory, optional, no repetition

FIZ/2/094 High energy heavy ion physics and the perfect quark fluid
6 credit, theory, optional, no repetition

FIZ/2/104 Integrable methods in gauge/gravity duality I
6 credit, theory, optional, no repetition

FIZ/2/109 Integrability methods in gauge/gravity duality
6 credit, theory, optional, no repetition

FIZ/2/110 Statistical field theory
6 credit, theory, optional, no repetition

FIZ/2/113 Quantum world

6 credit, theory, optional, no repetition

FIZ/2/117 Selected chapters from experimental high energy physics
6 credit, theory, optional, no repetition

FIZ/2/132 Particle Astrophysics
6 credits, theory, optional, no repetition

FIZ/2/136 Nuclear physics with radioactive beams
6 credit, theory, optional, no repetition

FIZ/2/137 Strong interaction at low energies
6 credit, theory, optional, no repetition

FIZ/2/138 Experimental methods in particle physics
6 credit, theory, optional, no repetition

FIZ/2/139 Neutrino Physics
6 credit, theory, optional, no repetition

FIZ/2/140 Methods of Computing Feynman integrals
6 credit, theory, optional, no repetition

FIZ/2/141 Lie group in physics
6 credit, theory, optional, no repetition

FIZ/2/142 Renormalization
6 credit, theory, optional, no repetition

FIZ/SZ Free credits (max. credits: 6/semester)

FIZ/VB Final report credits (maximum 60 credits at the end of the 6th semester and maximum 30 credits at the end of the 7th semester)

Research module

FIZ/K18 Guided research work (1,2,3,4. semester)
18 credit, research, optional, repeatable

FIZ/K5 Guided research work (5,6,7,8. semester)
5 credit, research, optional, repeatable

FIZ/K10 Guided research work (5,6,7,8. semester)
10 credit, research, optional, repeatable

FIZ/K15 Guided research work (5,6,7,8. semester)
15 credit, research, optional, repeatable

Teaching module (max. credits: 4/semester)

FIZ/OKT/2 Teaching activity
2 credits, practice, optional, can be repetaed

FIZ/OKT/4 Teaching activity
4 credits, practice, optional, can be repeated

Program III: Statistical Physics, Biological Physics and Physics of Quantum Systems
Head of the program: Dr. Gábor Horváth

FIZ/3/003 Statistical physics of biological sytems
6 credit, theory, optional, no repetition
FIZ/3/004 Fractal growth
6 credit, theory, optional, no repetition
FIZ/3/005 Theoretical evolutionary biology
6 credit, theory, optional, no repetition
FIZ/3/008 Pattern formation in complex systems
6 credit, theory, optional, no repetition
FIZ/3/009 Liquid crystals and polymers
6 credit, theory, optional, no repetition
FIZ/3/010 Sensory biophysics
6 credit, theory, optional, no repetition
FIZ/1,3/013 Quantum chaos in mesoscopic systems
6 credit, theory, optional, no repetition
FIZ/1,3/015 Carbon Nanostructures
6 credit, theory, optional, no repetition
FIZ/1,3/016 Macromolecules
6 credit, theory, optional, no repetition
FIZ/3/017 Physics of environmental flows
6 credit, theory, optional, no repetition
FIZ/3/018 Application of chaos theory
6 credit, theory, optional, no repetition
FIZ/3/019 Modeling traffic in communication networks
6 credit, theory, optional, no repetition
FIZ/1,3/020 Experimental metods in solid state physics I.
6 credit, theory, optional, no repetition
FIZ/3/021 Statistical physics of polymers and membranes
6 credit, theory, optional, no repetition
FIZ/1,3/022 Mesoscopic superconductors
6 credit, theory, optional, no repetition
FIZ/1,3/023 Physics of mesoscopic systems II.
6 credit, theory, optional, no repetition
FIZ/1,3/025 Trapped atomic systems
6 credit, theory, optional, no repetition
FIZ/3/027 Extreme statistics and their applications
6 credit, theory, optional, no repetition
FIZ/1,3/028 Computer simulations in statistical physics
6 credit, theory, optional, no repetition
FIZ/3/029 Introduction to quantum optics
6 credit, theory, optional, no repetition
FIZ/3/030 Coherent control of quantum systems
6 credit, theory, optional, no repetition
FIZ/1,3/032 Phase transitions
6 credit, theory, optional, no repetition
FIZ/3/033 Non-equilibrium statistical physics
6 credit, theory, optional, no repetition
FIZ/3/034 Mathematical methods in quantum chemistry I.
6 credit, theory, optional, no repetition
FIZ/1,3/035 Many-body problem I.

6 credit, theory, optional, no repetition

FIZ/3/037 Environmental fluid hydrodynamics II. EA
6 credit, theory, optional, no repetition

FIZ/3/039 Statistical properties of chaos
6 credit, theory, optional, no repetition

FIZ/1,3/040 Mesoscopic Systems I.
6 credit, theory, optional, no repetition

FIZ/1,3/041 Trapped atomic systems II.
6 credit, theory, optional, no repetition

FIZ/1,3/042 Cooling and trapping of neutral atoms
6 credit, theory, optional, no repetition

FIZ/3/044 New experiments in quantum mechanics
6 credits, theory, optional, no repetition

FIZ/3/045 Sensory biophysics II: Bioacoustics
6 credit, theory, optional, no repetition

FIZ/3/048 Dynamical critical phenomenas
6 credit, theory, optional, no repetition

FIZ/1,3/050 Many-body problem II.
6 credit, theory, optional, no repetition

FIZ/3/051 Fundamentals of the Physics of Solids II.
6 credit, theory, optional, no repetition

FIZ/1,3/052 Experimental metods in solid state physics II.
6 credit, theory, optional, no repetition

FIZ/1,3/054 Universality classes in non-equilibrium systems
6 credit, theory, optional, no repetition

FIZ/3/055 Systems biology: quantitative analysis of intracellular signal transduction networks
6 credit, theory, optional, no repetition

FIZ/3/056 Quantitative models of mechanisms in developmental biology
6 credit, theory, optional, no repetition

FIZ/3/059 Evolutionary game theory
6 credit, theory, optional, no repetition

FIZ/1,3/060 Quantum information theory
6 credit, theory, optional, no repetition

FIZ/1,3/062 Superconductivity
6 credit, theory, optional, no repetition

FIZ/3/063 Graphs in bioinformatics
6 credit, theory, optional, no repetition

FIZ/3/064 Clustering with networks
6 credit, theory, optional, no repetition

FIZ/1,3/065 Synchrotron radiation and applications
6 credit, theory, optional, no repetition

FIZ/1,3/066 Theories of open quantum systems
6 credit, theory, optional, no repetition

FIZ/1,3/068 Green's functions in nanophysics
6 credit, theory, optional, no repetition

FIZ/3/070 Quantum electrodynamics in resonator
6 credit, theory, optional, no repetition

FIZ/3/071 Molecular and biophysical mechanisms of cell motion
6 credit, theory, optional, no repetition

FIZ/1,3/073 Group theory in solid state research
6 credit, theory, optional, no repetition
FIZ/1,3/074 Introduction to superconductivity
6 credit, theory, optional, no repetition
FIZ/3/075 Extremes, Records, and Order-Statistics in Nature
6 credit, theory, optional, no repetition
FIZ/1,3/076 Entanglement in quantum many-body systems
6 credit, theory, optional, no repetition
FIZ/3/077 Imaging techniques in modern biology
6 credit, theory, optional, no repetition
FIZ/3/078 Fronts and Patterns
6 credit, theory, optional, no repetition
FIZ/1,3/079 Stochastic processes
6 credit, theory, optional, no repetition
FIZ/3/082 Preclinical models in cancer research
6 credit, theory, optional, no repetition
FIZ/3/083 Python programming and networks
6 credit, theory, optional, no repetition
FIZ/1,3/083 Advanced neutron techniques of material characterization
6 credits, theory, optional, no repetition
FIZ/3/084 Data mining and machine learning
6 credits, theory and practice, optional, no repetition
FIZ/3/085 Data exploration and visualization
6 credits, theory and practice, optional, no repetition
FIZ/3/086 Data Models and Databases in Science
6 credits, theory and practice, optional, no repetition
FIZ/3/087 Data science computer lab
6 credits, practice, optional, no repetition
FIZ/3/088 Advanced statistics and modelling
6 credits, theory and practice, optional, no repetition
FIZ/3/089 Deep learning and machine learning in natural sciences
6 credits, theory optional, no repetition
FIZ/3/090 Scientific modelling computer lab
6 credits, practice, optional, no repetition
FIZ/3/091 Computional Studies of Electron Systems
6 credits, practice, optional, no repetition
FIZ/3/092 New results in machine learning
6 credits, theory and practice, optional, no repetition
FIZ/3/093 Advanced machine learning lab
6 credits, theory and practice, optional, no repetition
FIZ/3/094 X-ray and YUV physics and spectroscopy
6 credits, theory, optional, no repetition
FIZ/3/095 Electromagnetic waves in plasmas
6 credits, theory, optional, no repetition
FIZ/3/096 Foundations of Quantum Mechanics
6 credits, theory, optional, no repetition
FIZ/3/097 Classical and Quantum Optimization
6 credits, theory, optional, no repetition

FIZ/SZ Free credits (max. credits: 6/semester)

FIZ/VB Final report credits (maximum 60 credits at the end of the 6th semester and maximum 30 credits at the end of the 7th semester)

Research module

FIZ/K18 Guided research work (1,2,3,4. semester)
18 credit, research, optional, repeatable
FIZ/K5 Guided research work (5,6,7,8. semester)
5 credit, research, optional, repeatable
FIZ/K10 Guided research work (5,6,7,8. semester)
10 credit, research, optional, repeatable
FIZ/K15 Guided research work (5,6,7,8. semester)
15 credit, research, optional, repeatable

Teaching module (max. credits: 4/semester)

FIZ/OKT/2 Teaching activity
2 credits, practice, optional, can be repetaed
FIZ/OKT/4 Teaching activity
4 credits, practice, optional, can be repeated

Program IV: Physics Education
Head of the program: Dr. Nguyen Quang Chinh

FIZ/T/001 Physics education I
5 credit, theory, optional, no repetition
FIZ/T/002 Foundation of the theory of relativity
5 credit, theory, optional, no repetition
FIZ/T/003 Physics of environmental flows
5 credit, theory, optional, no repetition
FIZ/T/005 Chaotic mechanics
5 credit, theory, optional, no repetition
FIZ/T/006 Versatile use of computers in pyhsics education
5 credit, theory, optional, no repetition
FIZ/T/007 Physics of elementary particles
5 credit, theory, optional, no repetition
FIZ/T/009 Physics education II (Classical physics, electromagnetism, optics)
5 credit, theory, optional, no repetition
FIZ/T/010 Physics education III (Modern physics: atomic physics, molecular and nuclear physics)
5 credit, theory, optional, no repetition
FIZ/T/011 Physics education IV (Modern physics: statistical physics, relativity, material science, nonlinear phenomena)
5 credit, theory, optional, no repetition
FIZ/T/013 Hystorically relevant experiments of Physics

5 credit, theory, optional, no repetition

FIZ/T/016 Energetics and environment
5 credit, theory, optional, no repetition

FIZ/T/020 Cooperative phenomena, interdisciplinary aspects
5 credit, theory, optional, no repetition

FIZ/T/021 Physics in biology
5 credit, theory, optional, no repetition

FIZ/T/022 Physics in chemistry
5 credit, theory, optional, no repetition

FIZ/T/023 Recent results in astronomy and space science
5 credit, theory, optional, no repetition

FIZ/T/024 Plausible quantum theory
5 credit, theory, optional, no repetition

FIZ/SZ Free credits (max. credits: 6/semester)

FIZ/VB Final report credits (maximum 60 credits at the end of the 6th semester and maximum 30 credits at the end of the 7th semester)

Research module

FIZ/K4/16 Guided research work (in semesters: 1, 2, 3, 4)
4, 16, 16, 16, credits/semester, research, optional, repeatable

FIZ/K5 Guided research work (5,6,7,8. semester)
5 credits, research, optional, repeatable

FIZ/K10 Guided research work (5,6,7,8. semester)
10 credits, research, optional, repeatable

FIZ/K15 Guided research work (5,6,7,8. semester)
15 credits, research, optional, repeatable

Teaching module (max. credits: 4/semester)

FIZ/OKT/2 Teaching activity
2 credits, practice, optional, can be repetaed

FIZ/OKT/4 Teaching activity
4 credits, practice, optional, can be repeated

Program V: Astronomy and Space Physics
Head of the program: Dr. Kristóf Petrovay

FIZ/5/001 [034] Observational methods in astrophysics
6 credits, theory, optional, no repetition

FIZ/5/002 [129] Astronomy with ESO instrumentation
6 credits, theory, optional, no repetition

FIZ/5/003 [026] Astrostatistics I.
6 credits, theory, optional, no repetition

FIZ/5/004 [059] Astrostatistics II.
6 credits, theory, optional, no repetition

FIZ/5/005 [075] Working with astronomical databases
6 kredit, gyakorlat, választható, nem ismételhető

FIZ/5/006 [119] Data mining in astronomy
6 credits, theory, optional, no repetition
FIZ/5/007 [031] Advanced infomation technology in astronomy I.
6 credits, theory, optional, no repetition
FIZ/5/008 [064] Advanced infomation technology in astronomy II.
6 credits, theory, optional, no repetition
FIZ/5/009 [032] Radio astronomy I.
6 credits, theory, optional, no repetition
FIZ/5/010 [065] Radio astronomy II.
6 credits, theory, optional, no repetition
FIZ/5/011 [038] Astrophysical turbulence, dynamos and reconnection 1. LCT
6 credits, theory, optional, no repetition
FIZ/5/012 [067] Astrophysical turbulence, dynamos and reconnection II. LCT
6 credits, theory, optional, no repetition
FIZ/5/013 [039] Astronomy from space I.
6 credits, theory, optional, no repetition
FIZ/5/014 [072] Astronomy from space II.
6 kredit, egyéni kutatás, választható, nem ismételhető
FIZ/5/015 [040] Infrared Astronomy I
6 credits, theory, optional, no repetition
FIZ/5/016 [068] Infrared Astronomy II. GY
6 kredit, gyakorlat, választható, nem ismételhető
FIZ/5/017 [076] Chapters from moder astronomy and cosmology
6 kredit, előadás, választható, nem ismételhető
FIZ/5/018 [107] N-body simulations in astrophysics and cosmology
6 credits, theory, optional, no repetition
FIZ/5/019 [126] Cosmology
6 credits, theory, optional, no repetition
FIZ/5/020 [074] The distant universe
6 kredit, előadás, választható, nem ismételhető
FIZ/5/021 [127] Gravitational wave astrophysics
6 credits, theory, optional, no repetition
FIZ/5/022 [118] High energy astrophysics
6 credits, theory, optional, no repetition
FIZ/5/023 [122] The physics of black holes
6 credits, theory, optional, no repetition
FIZ/5/024 [123] Selected chapters from the study of the structure of compact stars
6 credits, theory, optional, no repetition
FIZ/5/025 [080] The structure of compact stars
6 kredit, előadás, választható, nem ismételhető
FIZ/5/026 [121] Active galactic nuclei
6 credits, theory, optional, no repetition
FIZ/5/027 [027] Dynamics of stellar systems I.
6 credits, theory, optional, no repetition
FIZ/5/028 [060] Dynamics of stellar systems II.
6 credits, theory, optional, no repetition
FIZ/5/029 [120] Stellar and galaxy populations
6 credits, theory, optional, no repetition
FIZ/5/030 [037] Current research results in interstellar matter and star formation I.
6 credits, theory, optional, no repetition

FIZ/5/031 [025] The physics of interstellar matter I.
6 credits, theory, optional, no repetition
FIZ/5/032 [058] The physics of interstellar matter II.
6 credits, theory, optional, no repetition
FIZ/5/033 [070] Accretion processes in star formation
6 kredit, gyakorlat, választható, nem ismételhető
FIZ/5/034 [093] Light variations in young stellar objects
6 credits, theory, optional, no repetition
FIZ/5/035 [033] Stellar activity – active stars I.
6 credits, theory, optional, no repetition
FIZ/5/036 [066] Stellar activity – active stars II.
6 credits, theory, optional, no repetition
FIZ/5/037 [115] Pulsating variables and their observation I.
6 credits, theory, optional, no repetition
FIZ/5/038 [116] Pulsating variables and their observation II.
6 credits, theory, optional, no repetition
FIZ/5/039 [114] Pulsation theory
6 credits, theory, optional, no repetition
FIZ/5/040 [101] Exoplanetary research
6 credits, theory, optional, no repetition
FIZ/5/041 [099] Chapter sfrom the theory and observations of multiple stellar and planetary systems I.
6 credits, theory, optional, no repetition
FIZ/5/042 [100] Chapter sfrom the theory and observations of multiple stellar and planetary systems II.
6 credits, theory, optional, no repetition
FIZ/5/043 [130] (Exo)planetary atmospheres seminar I.
6 credits, theory, optional, no repetition
FIZ/5/044 [131] (Exo)planetary atmospheres seminar II.
6 credits, theory, optional, no repetition
FIZ/5/045 [103] The formation of planets and planetary systems
6 credits, theory, optional, no repetition
FIZ/5/046 [098] Small and microscopic Solar System bodies
6 credits, theory, optional, no repetition
FIZ/5/047 [133] At the edge of the Solar System 1
6 credits, theory, optional, no repetition
FIZ/5/048 [134] At the edge of the Solar System 2
6 credits, theory, optional, no repetition
FIZ/5/049 [102] Dwarf planets in the Solar System
6 credits, theory, optional, no repetition
FIZ/5/050 [105] Chaos detection methods in Hamiltonian systems. - Applications in celestial mechanics
6 kredit, gyakorlat, választható, nem ismételhető
FIZ/5/051 [029] Perturbation methods in celestial mechanics I.
6 credits, theory, optional, no repetition
FIZ/5/052 [062] Perturbation methods in celestial mechanics II.
6 credits, theory, optional, no repetition
FIZ/5/053 [125] Chapters from modern celestial mechanics
6 credits, theory, optional, no repetition
FIZ/5/054 [073] Lineáar and nonlinear MHD waves

6 kredit, előadás, választható, nem ismételhető

FIZ/5/055 [082] Solar System plasma physics
6 kredit, előadás, választható, nem ismételhető

FIZ/5/056 [095] Physics of the heliosphere
6 credits, theory, optional, no repetition

FIZ/5/057 [128] Solar physics
6 credits, theory, optional, no repetition

FIZ/5/058 [071] Physics of the solar atmosphere
6 kredit, gyakorlat, választható, nem ismételhető

FIZ/5/059 [135] Space weather and space climate
6 credits, theory, optional, no repetition

FIZ/SZ Free credits (max. credits: 6/semester)

FIZ/VB Final report credits (maximum 60 credits at the end of the 6th semester and maximum 30 credits at the end of the 7th semester)

Research module

FIZ/K18 Guided research work (1,2,3,4. semester)
18 credit, research, optional, repeatable

FIZ/K5 Guided research work (5,6,7,8. semester)
5 credit, research, optional, repeatable

FIZ/K10 Guided research work (5,6,7,8. semester)
10 credit, research, optional, repeatable

FIZ/K15 Guided research work (5,6,7,8. semester)
15 credit, research, optional, repeatable

Teaching module (max. credits: 4/semester)

FIZ/OKT/2 Teaching activity
2 credits, practice, optional, can be repetaed

FIZ/OKT/4 Teaching activity
4 credits, practice, optional, can be repeated

List of complex examination topics

In Programs I-III and V one can choose the *main topics* from the following list:

Astrophysics, Space Physics and Planetary Systems, Biophysics, Material science, Quantum mechanics, Atomic and molecular physics, Nuclear physics, Optics, Particle Physics, Statistical physics, Solid state physics, Network theory,

In Program IV the main topics is Physics education.

Secondary topics in Programs I-III and V (all optional):

Solar Physics, Physics of the Solar System, Celestial mechanics, Galactic astronomy, Stellar astrophysics, Physics of the interstellar medium, Extragalactic astronomy, Cosmology, High energy astrophysics, Physics of exoplanets and exoplanetary systems, Signal processing. Data-intensive and machine learning methods. Molecular biophysics, Bioinformatics, Methods of physics in biology, Evolution theory, Environmental physics, Mathematical foundations of relativistic quantum theory, Renormalization and the renormalization group, Optical and particle spectroscopy, Plasma physics, Heavy ion physics, Reactor physics and radiation protection, Applications of nuclear methods, Theory of gravitation, Quantum information, Experimental quantum mechanics, Quantum optics and lasers, Quantum electrodynamics, Low energy hadron physics and nonperturbative quantum chromodynamics, Quantum chromodynamics, Phenomena and theory of electroweak interaction, Experimental methods and data processing in particle physics, Chaotic systems, Growth phenomena and pattern formation, Phase transitions and critical phenomena, Computational methods in statistical physics, Hydrodynamics, Defects in metals and insulators, Mechanical properties of solids, Experimetal methods in solid state research and material science, Liquid crystals, Magnetic properties of condensed matter, Optical properties of condensed matter, Many-body problem, Mesoscopic electron systems, Carbon nanostructures, **Topological insulators,** Computational methods in material science and solid state physics, Physics of amorf materials and nanostructures, Physics of membranes and macromolecules; Nuclear astrophysics; Standard model of particle interactions; Beyond the standard model; Particle astrophysics

Secondary topics in Program IV can be chosen by merging two topics of the following list:

Hystorically relevant experiments of Physics, Foundation of the theory of relativity Plausible quantum theory, Physics of elementary particles, Energetics and environment, Physics of environmental flows, Chaotic mechanics, Versatile use of computers in pyhsics education, Cooperative phenomena, interdisciplinary aspects, Physics in biology, Physics in chemistry, Recent results in astronomy and space science

Evaluation and control

Fulfilment of the requirements of a given course is evaluated and recorded in the transcript by the lecturer on a five-point scale (1-2-3-4-5, 1: failed .. 5: excellent). Research activities are evaluated and recorded in the transcript by the supervisor on a three-point scale (excellent – acceptable – failed). Credits are approved by the program directors. Outstanding research achievements, proved by scientific publications, books or books chapters, can be honored by a maximum of 60 ECTS credits. A request for such credits should be submitted by the student and approved by the Council of the PhD School.