Study plan

Name of study plan: Experimentální jaderná a částicová fyzika

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Applications of Natural Sciences
Type of study: Follow-up master full-time
Required credits: 94
Elective courses credits: 26
Sum of credits in the plan: 120
Note on the plan:

Name of the block: Compulsory courses of the specialization
Minimal number of credits of the block: 94
The role of the block: PO

Code of the group: NMSEJCFPP1
Name of the group: NMSEJCF - povinné předměty 1. ročník
Requirement credits in the group: In this group you have to gain at least 44 credits
Requirement courses in the group: In this group you have to complete at least 11 courses
Credits in the group: 44
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
02EXK	**Excursion**	Z	1	1týd.	L	PO
02EMJF	**Experimental Methods of Nuclear Physics** ***Jan Čepila***	ZK	3	2+0	Z	PO
02EMSF	**Experimental Methods of Subnuclear Physics** ***Jan Čepila***	ZK	2	2+0	L	PO
02FAJ	**Physics of Atomic Nuclei** *Jiří Adam, Petr Veselý* ***Jiří Adam*** *Jiří Adam (Gar.)*	ZK	4	4+0	L	PO
02KTPE1	**Quantum Field Theory 1**	Z	5	3+1	Z	PO
02QFT1	**Quantum Field Theory 1** ***Jan Čepila***	Z,ZK	7	4+2		PO
02QFT2	**Quantum Field Theory 2** ***Jan Čepila***	Z,ZK	5	3+1		PO
02KTPE2	**Quantum Field Theory 2**	Z,ZK	5	3+1	L	PO
02NF	**Neutron Physics** ***Jan Čepila***	Z,ZK	4	2+2	L	PO
02PPRA1	**Project Practicum 1**	Z	2	0+2	Z	PO
02PPRA2	**Project Practicum 2**	KZ	4	0+4	L	PO
02VUEF1	**Research Project 1**	Z	6	6	Z,L	PO
02VUEF2	**Research Project 2**	KZ	8	8	L,Z	PO

Characteristics of the courses of this group of Study Plan: Code=NMSEJCFPP1 Name=NMSEJCF - povinné předměty 1. ročník

02EXK	Excursion	Z	1
One week excursion on any experimental workplace in the Czech Republic (INP AS CR Řež etc.) or abroad (JINR DUBNA, CERN etc).			
02EMJF	Experimental Methods of Nuclear Physics	ZK	3
The lecture describes basic physical processes, methods and equipment used in experimental nuclear physics and in some practical applications.			
02EMSF	Experimental Methods of Subnuclear Physics	ZK	2
The lecture describes the methods, detectors and set-ups used in experiments in subnuclear physics.			
02FAJ	Physics of Atomic Nuclei	ZK	4
Nucleon-nucleon(NN) interaction, few-body systems, G matrix, nuclear properties, nuclear models (single-particle model, collective motion, Hartree-Fock approximation, TDA method, RPA method, pairing, quasi-particles, nuclear deformations), electromagnetic and weak processes in nuclei, nuclear reactions (kinematics and mechanisms of nuclear reactions)			
02KTPE1	Quantum Field Theory 1	Z	5
Relativistic quantum mechanics for particles with spin 0, 1/2 a 1. Perturbative solution for one-particle equations in external field. Feynman rules, observables in tree approximation.			

02QFT1	Quantum Field Theory 1	Z,ZK	7
Relativistic quantum mechanics for particles with spin 0, 1/2 a 1. Perturbative solution for one-particle equations in external field. Feynman rules, observables in tree approximation.			
02QFT2	Quantum Field Theory 2	Z,ZK	5
Symmetries, gauge fields, spontaneous symmetry breaking, quantization of relativistic fields, reduction formulas for S-matrix elements, perturbative series, Wick theorem, radiative corrections, renormalization.			
02KTPE2	Quantum Field Theory 2	Z,ZK	5
Symmetries, gauge fields, spontaneous symmetry breaking, quantization of relativistic fields, reduction formulas for S-matrix elements, perturbative series, Wick theorem, radiative corrections, renormalization.			
02NF	Neutron Physics	Z,ZK	4
Basic properties of neutron, radionuclide neutron sources, accelerator based neutron sources, nuclear research reactors, neutron induced reactions, fission, neutron detection, neutron diffraction, neutron interaction with matter, slowing down and absorption of neutrons, macroscopic description of neutron transport, neutron shielding, physical principles of nuclear facilities for energy production.			
02PPRA1	Project Practicum 1	Z	2
Experimental project is a two-semestral course that represents the final degree of practical education of students in the experimental nuclear physics. Project has a form of a work on designated project and the topic of the project is chosen such that it is complementary to the theoretical knowledge in experimental nuclear physics. Students are encouraged to form work-groups and each of them solves a particular task on this project. Finally, students attempt to propose and build and perform the experiment and then process the results to scientific output. The goal of the first semester is to familiarize with the experiment, make theoretical calculations, and realize simulations for proposing particular properties of the apparatus. A document summarizing the proposal of the apparatus is a final result of this course.			
02PPRA2	Project Practicum 2	KZ	4
Experimental project is a two-semestral course that represents the final degree of practical education of students in the experimental nuclear physics. Project has a form of a work on designated project and the topic of the project is chosen such that it is complementary to the theoretical knowledge in experimental nuclear physics. Students are encouraged to form work-groups and each of them solves a particular task on this project. Finally, students attempt to propose and build and perform the experiment and then process the results to scientific output. The goal of the second semester is to build the apparatus according to the proposal, perform the experiment and analyze the data. Technical design report of the apparatus is the final result of this course.			
02VUEF1	Research Project 1	Z	6
Research project on selected topic under supervisors guidance.			
02VUEF2	Research Project 2	KZ	8
Research project on selected topic under supervisors guidance.			

Code of the group: NMSEJCFPP2
Name of the group: NMSEJCF - povinné předměty 2. ročník
Requirement credits in the group: In this group you have to gain at least 50 credits
Requirement courses in the group: In this group you have to complete at least 7 courses
Credits in the group: 50
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
02DPEF1	**Master Thesis 1**	Z	10	10	Z,L	PO
02DPEF2	**Master Thesis 2**	Z	20	20	L,Z	PO
02JSP	**Nuclear Spectroscopy** *Vladimír Wagner Vladimír Wagner (Gar.)*	Z,ZK	5	2+2	L	PO
02SEMI1	**Seminar 1**	Z	2	0+2		PO
02SEMI2	**Seminar 2**	Z	3	0+2		PO
02ZQCD	**Quantum Chromodynamics** *Jana Bielčíková* ***Jan Čepila*** *Jana Bielčíková (Gar.)*	Z,ZK	6	3+2	Z	PO
02ZESI	**Fundamentals of Electroweak Theory**	Z,ZK	4	2+2	L	PO

Characteristics of the courses of this group of Study Plan: Code=NMSEJCFPP2 Name=NMSEJCF - povinné předměty 2. ročník

02DPEF1	Master Thesis 1	Z	10
Master´s thesis on chosen topic under supervisor's guidance			
02DPEF2	Master Thesis 2	Z	20
Master´s thesis on chosen topic under supervisor's guidance.			
02JSP	Nuclear Spectroscopy	Z,ZK	5
Nuclear spectroscopy comprises several experimental techniques which are of ultimate importance for experimental nuclear physics and various applications as well. Lecture will be devoted to fundamentals of X- and gamma- ray, charged particle and neutron spectroscopy.			
02SEMI1	Seminar 1	Z	2
Participation on faculty and institute seminars according to the topic of diploma thesis.			
02SEMI2	Seminar 2	Z	3
Participation on faculty and institute seminars according to the topic of diploma thesis.			
02ZQCD	Quantum Chromodynamics	Z,ZK	6
The goal of these lectures is to acquire knowledge about basic principles of strong interaction starting from the constituent quark model and SU(3) flavour symmetry, studies of nucleon structure in deep inelastic scattering of leptons on nucleons and parton model to basics of Quantum Chromodynamics and its practical applications in the context of current experiments in high energy physics and physics of ultra-relativistic heavy-ion collisions.			
02ZESI	Fundamentals of Electroweak Theory	Z,ZK	4
The path to the phenomenological V-A theory of the weak interactions. The idea of unification of weak and electromagnetic interactions. Nonabelian gauge fields and the Higgs mechanism. The Glashow-Weinberg-Salam standard model of electroweak interactions.			

Name of the block: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

Code of the group: NMSEJCFVP
Name of the group: NMSEJCF - volitelné předměty
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
02AQCD	**Applied Quantum Chromodynamics at High Energies** *Ján Nemčík* ***Ján Nemčík*** *Ján Nemčík (Gar.)*	ZK	2	2+0		v
02DRI	**Path Integral** ***Jan Čepila***	Z,ZK	3	2+1	Z	v
02ETSM	**Experimental Tests of the Standard Model** ***Jan Čepila***	ZK	2	2+0	Z	v
02ESH	**Extreme States of Matter**	Z	2	2+0	Z	v
02FCI1	**Functional Integral 1** ***Jan Čepila***	Z	2	2+0	Z	v
02FCI2	**Functional Integral 2** ***Jan Čepila***	Z	2	2+0	L	v
02RFTI	**Physics of Ultra-Relativistic Nuclear Collisions** ***Jan Čepila***	Z,ZK	3	2+1	Z	v
02GR	**Groups and Representations** *Goce Chadzitaskos, Lenka Motlochová* ***Lenka Motlochová*** *Goce Chadzitaskos (Gar.)*	Z,ZK	3	2+1	Z	v
02EMBS	**Embedded Systems in Nuclear Experiments**	Z	2	2+2	Z	v
02JAS	**Nuclear Astrophysics** ***Jan Čepila***	ZK	2	2+0	Z	v
02KZ	**Cosmic Rays** ***Jan Čepila***	ZK	2	2+0		v
02LIAG	**Lie Algebras and Lie Groups** ***Jan Čepila***	Z,ZK	6	3+2	L	v
02MAT	**Materials for Experimental Nuclear Physics** *Libor Škoda Libor Škoda (Gar.)*	ZK	2	2+0		v
18MMC	**Monte Carlo Method** *František Gašpar, Miroslav Virius*	Z	4	2+2	Z	v
17PRE	**Computer Control of Experiments** *Martin Kropík* ***Martin Kropík***	Z,ZK	3	2+1	Z	v
17PLP	**Programmable Logic Arrays**	ZK	2	2	L	v
02NVKM1	**Numerical Calculations in Quantum Mechanics 1**	Z	3	0+3	Z	v
02NVKM2	**Numerical Calculations in Quantum Mechanics 2** ***Jan Čepila***	Z	3	0+3	L	v
02RQGP3	**Seminar on Quark-Gluon Plasma 3**	Z	1	2+0		v
02RQGP4	**Seminar on Quark-Gluon PLasma 4**	Z	1	2+0		v
02RQGP5	**Seminar on Quark-Gluon Plasma 5**	Z	1	2+0		v
02RQGP6	**Seminar on Quark-Gluon Plasma 6**	Z	1	2+0		v
02SFHIC	**Statistical Physics in Nucleus-Nucleus Collisions**	Z,ZK	2	2+1	Z	v
02SSD	**Statistical data analysis**	Z,ZK	4	2+2		v
02SSD2	**Statistical Data Analysis 2**	Z,ZK	4	2+2		v
02UC	**Particles Accelerators** ***Miroslav Krůs***	ZK	2	2+0		v
02UC2	**Particle Accelerators 2** *Miroslav Krůs* ***Miroslav Krůs*** *Miroslav Krůs (Gar.)*	ZK	2	2+0		v
02EJFS2	**Workshop on Experimental Nuclear Physics 2**	Z	1	5dní	Z	v
02EJFS3	**Workshop on Experimental Nuclear Physics 3**	Z	1	5dní	Z	v
01ZPB1	**Introduction to Computer Security 1** *Petr Vokáč* ***Petr Vokáč*** *Petr Vokáč (Gar.)*	Z	2	1+1		v
01ZPB2	**Introduction to Computer Security 2** *Petr Vokáč* ***Petr Vokáč*** *Petr Vokáč (Gar.)*	Z	2	1+1		v

16ZJT	**Nuclear Technology Devices** *Tomáš Čechák, Kamil Augsten* ***Kamil Augsten*** *Tomáš Čechák (Gar.)*	ZK	2	2+0	1	V

Characteristics of the courses of this group of Study Plan: Code=NMSEJCFVP Name=NMSEJCF - volitelné předměty

02AQCD	Applied Quantum Chromodynamics at High Energies	ZK	2
This lecture is oriented to provide basic applications of quantum chromodynamicks that corresponds to understanding of the dynamics of processes in particle physics at high energies on proton and nuclear targets that are currently measured by experiments at RHIC and LHC colliders. Complementary informations to lectures of Basics of quantum chromodynamics will be provided.			
02DRI	Path Integral	Z,ZK	3
The lecture covers the following topics; Evolution kernel, Trotter product formula and configuration-space path integral, elementary properties of path integrals and simple solutions (e.g., free particle, harmonic oscillator, Bohm-Aharonov effect), semiclassical time-evolution amplitude (WKB approximation) and its application to the anharmonic oscillator, variational perturbation theory and its application to the double well potential, Green functions and the Feynman-Kac formula, phase-space path integrals, coherent state representation and Klauder's path integral, Wick rotation and Euclidean path integrals, simple applications in statistical physics.			
02ETSM	Experimental Tests of the Standard Model	ZK	2
The experimental tools for the study of the deep inelastic scattering of leptons on nucleons. The determination of the structure functions of nucleons, the verification of the quantum chromodynamics, the measurement of the coupling constant of the strong interactions.			
02ESH	Extreme States of Matter	Z	2
Lectures will provide basics in states of matter in extreme conditions. It deals with broad spectra of phenomena from electromagnetic plasma through phases of nuclear matter at high temperatures or densities to highly speculative forms of matter that may be responsible for initialy accelerated expansion of the Universe in its early stages (inflation) or for its current acceleration (dark energy). Lectures may also serve as a brief introduction to parts of modern cosmology connected to nuclear and particle physics.			
02FCI1	Functional Integral 1	Z	2
The lecture provides an introduction into quantum field theory. The actual treatment is provided by means of functional integrals. Central part of the lecture revolves around particle physics. In this connection, the quantization of simple systems (scalar fields, fermionic fields and gauge fields) is outlined and the corresponding perturbation treatment of Green's function is discussed via Feynman integrals. We further cover topics such as quantum field theory at finite temperature, renormalization group methods and spontaneous breakdown of symmetry. Essential part of the lecture consists of the problem solving. Handouts are provided.			
02FCI2	Functional Integral 2	Z	2
The lecture can serve as a convenient foundation in further study of exactly solvable systems, nuclear physics or supersymmetric quantum field theory. The actual treatment is provided by means of functional integrals. Central part of the lecture revolves around particle physics. In this connection, the quantization of abelian and non-abelian gauge fields will be outlined and the corresponding perturbation treatment of Green's function is discussed via Feynman integrals. We further cover topics such as quantum field theory at finite temperature, renormalization group methods and spontaneous breakdown of symmetry. Essential part of the lecture consists of the problem solving. Handouts are provided.			
02RFTI	Physics of Ultra-Relativistic Nuclear Collisions	Z,ZK	3
The goal of this subject is to introduce students the principles of physics of heavy-ion collisions at large energies. Students will gain insight into phases of a nuclear collision, properties of the created matter (quark-gluon plasma (QGP)), probes which contain information about the QGP and other phases of the collision, and knowledge that these signals brought to us based on the recent measurements at present experiments.			
02GR	Groups and Representations	Z,ZK	3
The aim of the lectures is to acquaint students with the basic concepts of discrete group theory and their representations. The student will be thoroughly acquainted with the methods of classification of finite groups, decomposition of groups into direct and semidirect products, and with the properties of reducible and irreducible representations.			
02EMBS	Embedded Systems in Nuclear Experiments	Z	2
Subject Embedded Systems in Nuclear Experiments is an introductory course in fully programmable logical arrays and digital signal processors which are widely used in experimental equipment for particle and nuclear physics experiments.			
02JAS	Nuclear Astrophysics	ZK	2
Nuclear processes in the Universe and stars, relic radiation, nucleosynthesis and neutrinos as a fingerprint of these processes. Experimental facts on cosmic rays, ideas on their origin and their detection at the Earth.			
02KZ	Cosmic Rays	ZK	2
Experimental facts on cosmic rays, ideas on their origin and their detection at the Earth. Properties of cosmic rays, phenomenology, origin, acceleration and propagation. Gamma rays in Universe. Detection techniques of cosmic rays, cosmic ray interaction with the Earth atmosphere, extended air showers.			
02LIAG	Lie Algebras and Lie Groups	Z,ZK	6
Definitions and properties of Lie groups and Lie algebras. Different types of Lie algebras, root systems and classification of complex simple Lie algebras. Introduction to theory of representations.			
02MAT	Materials for Experimental Nuclear Physics	ZK	2
This lecture is designed for students of experimental nuclear physics. The lecture gives the overview of materials physics with respect to materials frequently used in the experimental nuclear physics, particularly their construction properties and influence of the ionizing radiation on their properties and possible use in experiment.			
18MMC	Monte Carlo Method	Z	4
This courseis devoted to the numerical method Monte Carlo and to its selected applications.			
17PRE	Computer Control of Experiments	Z,ZK	3
Lectures provide information about standard interfaces of personal computers - parallel, serial, USB, LAN and special interface cards; about standalone equipment that communicate with computers via serial lines or GPIB (IEEE488) interface, further about measuring systems with VME, VXI and LXI interfaces, discuss their advantages and disadvantages. Next, lectures deal with programming of measuring systems - special dedicated software, problems of use of high programming languages and especially use of graphical oriented development tools (Agilent VEE ane LabView); data acquisition and evaluation. Finally, students prepare individual software project for data acquisition and evaluation.			
17PLP	Programmable Logic Arrays	ZK	2
Lecture provides information about digital circuits, data representation in digital systems, combinational and sequential/ logic, Boolean algebra, SPLD, CPLD and FPGA chips. Next, lecture is devoted to HDL and VHDL programming languages and development tool ISP Expert Lattice Semiconductors for programming and testing of SPLD and CPLD chips. Finally, students prepare individual design of a CPLD.			
02NVKM1	Numerical Calculations in Quantum Mechanics 1	Z	3
Introduction to Quantum Mechanics in Mathematica. Introduction to the numerical methods as well as to the basics of a few programming languages. Calculation of basic systems - particle in a box and a square-well potential.			
02NVKM2	Numerical Calculations in Quantum Mechanics 2	Z	3
Advanced methods to solve quantum-mechanical problems. Solution of the Lippmann-Schwinger equation for real potential - bound states and scattering. Presentation of some tools useful in the calculation in Quantum Field Theory.			
02RQGP3	Seminar on Quark-Gluon Plasma 3	Z	1
Seminar deals with theoretical work related to problems of quark-gluon plasma.			
02RQGP4	Seminar on Quark-Gluon PLasma 4	Z	1
Recent experimental measurements of the properties of the QGP.			

02RQGP5	Seminar on Quark-Gluon Plasma 5	Z	1
Recent experimental measurements of the properties of the QGP.			
02RQGP6	Seminar on Quark-Gluon Plasma 6	Z	1
Recent experimental measurements of the properties of the QGP.			
02SFHIC	Statistical Physics in Nucleus-Nucleus Collisions	Z,ZK	2
Special course of statistical physics focused on application in heavy ion physics. Summary of basics concepts of statistical physics, quantum statistics with focuse on ultrarelativistic boson, fermi and hagedorn gasses.			
02SSD	Statistical data analysis	Z,ZK	4
The course is primarily focussed on practical application of methods of experimental data analysis. Students obtain knowledge of different statistical methods and their usage, fitting methods, and testing of hypothesis.			
02SSD2	Statistical Data Analysis 2	Z,ZK	4
Individual work will include implementation and testing of a program for analysis of generated data sample. Results are reviewed during the exam			
02UC	Particles Accelerators	ZK	2
The basic methods of accelerating and driving beams. Linear and cyclic accelerators. Colliding beams.			
02UC2	Particle Accelerators 2	ZK	2
Introduction to physics and technology of modern and next generation accelerators based on laser and plasma technology.			
02EJFS2	Workshop on Experimental Nuclear Physics 2	Z	1
Students of the 3-th and 4-th course will present on this workshop status of their Bachelor and Research works. At the same time they will obtain an overview of the scientific program of the department of physics in direction of experimental nuclear physics and related fields.			
02EJFS3	Workshop on Experimental Nuclear Physics 3	Z	1
Students of the advanced course will present on this workshop status of their research works. At the same time they will obtain an overview of the scientific program of the department of physics in direction of experimental nuclear physics and related fields.			
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2
16ZJT	Nuclear Technology Devices	ZK	2
Basic scheme of nuclear reactor and nuclear power plant, chain fission reaction development, factors influencing reactivity, internal fuel cycle, main components of nuclear energetic reactor, most important reactor types, linear high-voltage accelerators, linear high-frequency accelerators, accelerators based on cyclotron, microtron, betatron, electron and proton synchrotrons, electron and ion sources for accelerators, targets.			

List of courses of this pass:

Code	Name of the course	Completion	Credits
01ZPB1	Introduction to Computer Security 1	Z	2
01ZPB2	Introduction to Computer Security 2	Z	2
02AQCD	Applied Quantum Chromodynamics at High Energies	ZK	2
This lecture is oriented to provide basic applications of quantum chromodynamicks that corresponds to understanding of the dynamics of processes in particle physics at high energies on proton and nuclear targets that are currently measured by experiments at RHIC and LHC colliders. Complementary informations to lectures of Basics of quantum chromodynamics will be provided.			
02DPEF1	Master Thesis 1	Z	10
Master´s thesis on chosen topic under supervisor's guidance			
02DPEF2	Master Thesis 2	Z	20
Master´s thesis on chosen topic under supervisor's guidance.			
02DRI	Path Integral	Z,ZK	3
The lecture covers the following topics; Evolution kernel, Trotter product formula and configuration-space path integral, elementary properties of path integrals and simple solutions (e.g., free particle, harmonic oscillator, Bohm-Aharonov effect), semiclassical time-evolution amplitude (WKB approximation) and its application to the anharmonic oscillator, variational perturbation theory and its application to the double well potential, Green functions and the Feynman-Kac formula, phase-space path integrals, coherent state representation and Klauder's path integral, Wick rotation and Euclidean path integrals, simple applications in statistical physics.			
02EJFS2	Workshop on Experimental Nuclear Physics 2	Z	1
Students of the 3-th and 4-th course will present on this workshop status of their Bachelor and Research works. At the same time they will obtain an overview of the scientific program of the department of physics in direction of experimental nuclear physics and related fields.			
02EJFS3	Workshop on Experimental Nuclear Physics 3	Z	1
Students of the advanced course will present on this workshop status of their research works. At the same time they will obtain an overview of the scientific program of the department of physics in direction of experimental nuclear physics and related fields.			
02EMBS	Embedded Systems in Nuclear Experiments	Z	2
Subject Embedded Systems in Nuclear Experiments is an introductory course in fully programmable logical arrays and digital signal processors which are widely used in experimental equipment for particle and nuclear physics experiments.			
02EMJF	Experimental Methods of Nuclear Physics	ZK	3
The lecture describes basic physical processes, methods and equipment used in experimental nuclear physics and in some practical applications.			
02EMSF	Experimental Methods of Subnuclear Physics	ZK	2
The lecture describes the methods, detectors and set-ups used in experiments in subnuclear physics.			
02ESH	Extreme States of Matter	Z	2
Lectures will provide basics in states of matter in extreme conditions. It deals with broad spectra of phenomena from electromagnetic plasma through phases of nuclear matter at high temperatures or densities to highly speculative forms of matter that may be responsible for initialy accelerated expansion of the Universe in its early stages (inflation) or for its current acceleration (dark energy). Lectures may also serve as a brief introduction to parts of modern cosmology connected to nuclear and particle physics.			

02ETSM	Experimental Tests of the Standard Model	ZK	2
The experimental tools for the study of the deep inelastic scattering of leptons on nucleons. The determination of the structure functions of nucleons, the verification of the quantum chromodynamics, the measurement of the coupling constant of the strong interactions.			
02EXK	Excursion	Z	1
One week excursion on any experimental workplace in the Czech Republic (INP AS CR Řež etc.) or abroad (JINR DUBNA, CERN etc).			
02FAJ	Physics of Atomic Nuclei	ZK	4
Nucleon-nucleon(NN) interaction, few-body systems, G matrix, nuclear properties, nuclear models (single-particle model, collective motion, Hartree-Fock approximation, TDA method, RPA method, pairing, quasi-particles, nuclear deformations), electromagnetic and weak processes in nuclei, nuclear reactions (kinematics and mechanisms of nuclear reactions)			
02FCI1	Functional Integral 1	Z	2
The lecture provides an introduction into quantum field theory. The actual treatment is provided by means of functional integrals. Central part of the lecture revolves around particle physics. In this connection, the quantization of simple systems (scalar fields, fermionic fields and gauge fields) is outlined and the corresponding perturbation treatment of Green's function is discussed via Feynman integrals. We further cover topics such as quantum field theory at finite temperature, renormalization group methods and spontaneous breakdown of symmetry. Essential part of the lecture consists of the problem solving. Handouts are provided.			
02FCI2	Functional Integral 2	Z	2
The lecture can serve as a convenient foundation in further study of exactly solvable systems, nuclear physics or supersymmetric quantum field theory. The actual treatment is provided by means of functional integrals. Central part of the lecture revolves around particle physics. In this connection, the quantization of abelian and non-abelian gauge fields will be outlined and the corresponding perturbation treatment of Green's function is discussed via Feynman integrals. We further cover topics such as quantum field theory at finite temperature, renormalization group methods and spontaneous breakdown of symmetry. Essential part of the lecture consists of the problem solving. Handouts are provided.			
02GR	Groups and Representations	Z,ZK	3
The aim of the lectures is to acquaint students with the basic concepts of discrete group theory and their representations. The student will be thoroughly acquainted with the methods of classification of finite groups, decomposition of groups into direct and semidirect products, and with the properties of reducible and irreducible representations.			
02JAS	Nuclear Astrophysics	ZK	2
Nuclear processes in the Universe and stars, relic radiation, nucleosynthesis and neutrinos as a fingerprint of these processes. Experimental facts on cosmic rays, ideas on their origin and their detection at the Earth.			
02JSP	Nuclear Spectroscopy	Z,ZK	5
Nuclear spectroscopy comprises several experimental techniques which are of ultimate importance for experimental nuclear physics and various applications as well. Lecture will be devoted to fundamentals of X- and gamma- ray, charged particle and neutron spectroscopy.			
02KTPE1	Quantum Field Theory 1	Z	5
Relativistic quantum mechanics for particles with spin 0, 1/2 a 1. Perturbative solution for one-particle equations in external field. Feynman rules, observables in tree approximation.			
02KTPE2	Quantum Field Theory 2	Z,ZK	5
Symmetries, gauge fields, spontaneous symmetry breaking, quantization of relativistic fields, reduction formulas for S-matrix elements, perturbative series, Wick theorem, radiative corrections, renormalization.			
02KZ	Cosmic Rays	ZK	2
Experimental facts on cosmic rays, ideas on their origin and their detection at the Earth. Properties of cosmic rays, phenomenology, origin, acceleration and propagation. Gamma rays in Universe. Detection techniques of cosmic rays, cosmic ray interaction with the Earth atmosphere, extended air showers.			
02LIAG	Lie Algebras and Lie Groups	Z,ZK	6
Definitions and properties of Lie groups and Lie algebras. Different types of Lie algebras, root systems and classification of complex simple Lie algebras. Introduction to theory of representations.			
02MAT	Materials for Experimental Nuclear Physics	ZK	2
This lecture is designed for students of experimental nuclear physics. The lecture gives the overview of materials physics with respect to materials frequently used in the experimental nuclear physics, particularly their construction properties and influence of the ionizing radiation on their properties and possible use in experiment.			
02NF	Neutron Physics	Z,ZK	4
Basic properties of neutron, radionuclide neutron sources, accelerator based neutron sources, nuclear research reactors, neutron induced reactions, fission, neutron detection, neutron diffraction, neutron interaction with matter, slowing down and absorption of neutrons, macroscopic description of neutron transport, neutron shielding, physical principles of nuclear facilities for energy production.			
02NVKM1	Numerical Calculations in Quantum Mechanics 1	Z	3
Introduction to Quantum Mechanics in Mathematica. Introduction to the numerical methods as well as to the basics of a few programming languages. Calculation of basic systems - particle in a box and a square-well potential.			
02NVKM2	Numerical Calculations in Quantum Mechanics 2	Z	3
Advanced methods to solve quantum-mechanical problems. Solution of the Lippmann-Schwinger equation for real potential - bound states and scattering. Presentation of some tools useful in the calculation in Quantum Field Theory.			
02PPRA1	Project Practicum 1	Z	2
Experimental project is a two-semestral course that represents the final degree of practical education of students in the experimental nuclear physics. Project has a form of a work on designated project and the topic of the project is chosen such that it is complementary to the theoretical knowledge in experimental nuclear physics. Students are encouraged to form work-groups and each of them solves a particular task on this project. Finally, students attempt to propose and build and perform the experiment and then process the results to scientific output. The goal of the first semester is to familiarize with the experiment, make theoretical calculations, and realize simulations for proposing particular properties of the apparatus. A document summarizing the proposal of the apparatus is a final result of this course.			
02PPRA2	Project Practicum 2	KZ	4
Experimental project is a two-semestral course that represents the final degree of practical education of students in the experimental nuclear physics. Project has a form of a work on designated project and the topic of the project is chosen such that it is complementary to the theoretical knowledge in experimental nuclear physics. Students are encouraged to form work-groups and each of them solves a particular task on this project. Finally, students attempt to propose and build and perform the experiment and then process the results to scientific output. The goal of the second semester is to build the apparatus according to the proposal, perform the experiment and analyze the data. Technical design report of the apparatus is the final result of this course.			
02QFT1	Quantum Field Theory 1	Z,ZK	7
Relativistic quantum mechanics for particles with spin 0, 1/2 a 1. Perturbative solution for one-particle equations in external field. Feynman rules, observables in tree approximation.			
02QFT2	Quantum Field Theory 2	Z,ZK	5
Symmetries, gauge fields, spontaneous symmetry breaking, quantization of relativistic fields, reduction formulas for S-matrix elements, perturbative series, Wick theorem, radiative corrections, renormalization.			

02RFTI	Physics of Ultra-Relativistic Nuclear Collisions	Z,ZK	3
The goal of this subject is to introduce students the principles of physics of heavy-ion collisions at large energies. Students will gain insight into phases of a nuclear collision, properties of the created matter (quark-gluon plasma (QGP)), probes which contain information about the QGP and other phases of the collision, and knowledge that these signals brought to us based on the recent measurements at present experiments.			
02RQGP3	Seminar on Quark-Gluon Plasma 3	Z	1
Seminar deals with theoretical work related to problems of quark-gluon plasma.			
02RQGP4	Seminar on Quark-Gluon PLasma 4	Z	1
Recent experimental measurements of the properties of the QGP.			
02RQGP5	Seminar on Quark-Gluon Plasma 5	Z	1
Recent experimental measurements of the properties of the QGP.			
02RQGP6	Seminar on Quark-Gluon Plasma 6	Z	1
Recent experimental measurements of the properties of the QGP.			
02SEMI1	Seminar 1	Z	2
Participation on faculty and institute seminars according to the topic of diploma thesis.			
02SEMI2	Seminar 2	Z	3
Participation on faculty and institute seminars according to the topic of diploma thesis.			
02SFHIC	Statistical Physics in Nucleus-Nucleus Collisions	Z,ZK	2
Special course of statistical physics focused on application in heavy ion physics. Summary of basics concepts of statistical physics, quantum statistics with focuse on ultrarelativistic boson, fermi and hagedorn gasses.			
02SSD	Statistical data analysis	Z,ZK	4
The course is primarily focussed on practical application of methods of experimental data analysis. Students obtain knowledge of different statistical methods and their usage, fitting methods, and testing of hypothesis.			
02SSD2	Statistical Data Analysis 2	Z,ZK	4
Individual work will include implementation and testing of a program for analysis of generated data sample. Results are reviewed during the exam			
02UC	Particles Accelerators	ZK	2
The basic methods of accelerating and driving beams. Linear and cyclic accelerators. Colliding beams.			
02UC2	Particle Accelerators 2	ZK	2
Introduction to physics and technology of modern and next generation accelerators based on laser and plasma technology.			
02VUEF1	Research Project 1	Z	6
Research project on selected topic under supervisors guidance.			
02VUEF2	Research Project 2	KZ	8
Research project on selected topic under supervisors guidance.			
02ZESI	Fundamentals of Electroweak Theory	Z,ZK	4
The path to the phenomenological V-A theory of the weak interactions. The idea of unification of weak and electromagnetic interactions. Nonabelian gauge fields and the Higgs mechanism. The Glashow-Weinberg-Salam standard model of electroweak interactions.			
02ZQCD	Quantum Chromodynamics	Z,ZK	6
The goal of these lectures is to acquire knowledge about basic principles of strong interaction starting from the constituent quark model and SU(3) flavour symmetry, studies of nucleon structure in deep inelastic scattering of leptons on nucleons and parton model to basics of Quantum Chromodynamics and its practical applications in the context of current experiments in high energy physics and physics of ultra-relativistic heavy-ion collisions.			
16ZJT	Nuclear Technology Devices	ZK	2
Basic scheme of nuclear reactor and nuclear power plant, chain fission reaction development, factors influencing reactivity, internal fuel cycle, main components of nuclear energetic reactor, most important reactor types, linear high-voltage accelerators, linear high-frequency accelerators, accelerators based on cyclotron, microtron, betatron, electron and proton synchrotrons, electron and ion sources for accelerators, targets.			
17PLP	Programmable Logic Arrays	ZK	2
Lecture provides information about digital circuits, data representation in digital systems, combinational and sequential/ logic, Boolean algebra, SPLD, CPLD and FPGA chips. Next, lecture is devoted to HDL and VHDL programming languages and development tool ISP Expert Lattice Semiconductors for programming and testing of SPLD and CPLD chips. Finally, students prepare individual design of a CPLD.			
17PRE	Computer Control of Experiments	Z,ZK	3
Lectures provide information about standard interfaces of personal computers - parallel, serial, USB, LAN and special interface cards; about standalone equipment that communicate with computers via serial lines or GPIB (IEEE488) interface, further about measuring systems with VME, VXI and LXI interfaces, discuss their advantages and disadvantages. Next, lectures deal with programming of measuring systems - special dedicated software, problems of use of high programming languages and especially use of graphical oriented development tools (Agilent VEE ane LabView); data acquisition and evaluation. Finally, students prepare individual software project for data acquisition and evaluation.			
18MMC	Monte Carlo Method	Z	4
This courseis devoted to the numerical method Monte Carlo and to its selected applications.			

For updated information see http://bilakniha.cvut.cz/en/FF.html
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