Physics Courses offered in English

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Courses on basic level – cycle 1

FYSB01 Introduction to quantum mechanics

Introduktion till kvantmekanik
7,5hp
Språk: E
Level: T2
Study period: HT1 and VT1
Pace: 100%
Contact Person(s): Tomas Brage (046-222 77 24) Tomas.Brage@fysik.lu.se
Description in English: *This course is a first introduction to quantum mechanics. It contains the following parts: experimental foundation of quantum physics, wave functions, dynamical variables and operators, Schrodinger Equation for infinite boxes, harmonic oscillator.*
Literature: McMurry: Quantum Mechanics.
Note: This course is a part of FYSA21
Homepage : http://utbildning.fysik.lu.se/fysa21

FYSB02 Quantum mechanics and computations

Kvantmekanik och beräkningar
15ECTS
Language: S/E
Study period: HT and VT
Study pace: 50%
Contact(s): Tomas Brage (046-222 77 24) Tomas.Brage@fysik.lu.se
Homepage : http://utbildning.fysik.lu.se/FYSA21

FYSA31 Physics 3, Modern Physics

Fysik 3, Modern Fysik
30 ECTS
Language: E
Study period: HT, VT
Pace: 100%
Contact Person(s): Tomas Brage (222 77 24) Tomas.Brage@fysik.lu.se
Description in English: *The course consists of the physics of free and bound atoms, nuclear and particle physics. Applications of quantum mechanics is a central part of the course. An introductory course in quantum mechanics is therefore a prerequisite. The atomic physics part deals with hydrogen, helium and multielectronsystems, together with the interaction of atoms with electromagnetic fields. The physics of the bound atom includes solid state physics and molecular physics. The nuclear physics part treats models of atomic nuclei and reactions. The particle physics contains a review of the*

elementary particles, in the form of leptons and hadrons. Quarks and the standardmodel for interaction between leptons and quarks are treated. Astrophysics and cosmology are used as applications of both atomic, nuclear and particle physics.
Description in Swedish: *I kursen ingår fria och bundna atomers fysik samt kärn-och partikelfysik. Kvantmekaniken från fysik 2 tillämpas på de olika avsnitten. I atomfysiken behandlas väteatomen, heliumatomen och flerelektronsystem samt atomers växelverkan med fält. Den bundna atomens fysik avser främst fasta tillståndets fysik men molekylfysik ingår också. I kärnfysiken behandlas modeller för atomkärnor och kärnreaktioner. I partikelfysiken ingår en översikt över elementarpartiklarna: leptoner och hadroner samt kvarkar och det som vanligen kallas standardmodellen för växelverkan mellan leptoner och kvarkar. Astrofysik och kosmologi, inklusive elementsyntes, kan ses som en tillämpning på moment som ingår i såväl atomfysik som kärn-och partikelfysik. .*
Literature:
Atomic Physics: Thorne, Litzén and Johansson: Spectrophysics, ISBN: 3-540-65117-9
Nuclear Physics: Krane: Introduction to nuclear physics
High Energy Physics: Material sold by the department
Solid State Physics: Ibach: Solid State Physics.
Homepage: http://utbildning.fysik.lu.se/fysa31

FYSB03, Nuclear Physics

FYSB03 Kärnfysik
7.5 ECTS
Language: E
Study period: HT1, VT1
Pace: 50%
Contact Person(s): Tomas Brage (222 77 24) Tomas.Brage@fysik.lu.se
Description in English: Nuclear Physics part of FYSA31
Kursens hemsida : http://utbildning.fysik.lu.se/fysa31

FYSB04, Atomic and Molecular Physics

Atom- och Molekylfysik, 9 ECTS
Language: E
Study period: HT1, VT1
Pace: 50%
Contact Person(s): Tomas Brage (222 77 24) Tomas.Brage@fysik.lu.se
Description in English: Atomic/Molecular Physics part of FYSA31
Kursens hemsida : http://utbildning.fysik.lu.se/fysa31

FYSB05 High Energy Physics

Högenergifysik, 6 ECTS
Language: E
Study period: HT2, VT2
Pace: 50%

Contact Person(s): Tomas Brage (222 77 24) Tomas.Brage@fysik.lu.se
Description in English: Nuclear Physics part of FYSA31
Kursens hemsida : http://utbildning.fysik.lu.se/fysa31

FYSB06 High Energy Physics

Fasta Tillståndets Fysik, 9 ECTS

Language: E
Study period: HT2, VT2
Pace: 50%
Contact Person(s): Tomas Brage (222 77 24) Tomas.Brage@fysik.lu.se
Description in English: Solid State Physics part of FYSA31
Kursens hemsida : http://utbildning.fysik.lu.se/fysa31

Advanced courses: General courses (FYSM01) - Introduction to Advanced Studies in Physics

FYSN11 Experiments in research and society

Fysikexperiment i forskning och samhälle
FYSN11 7,5hp

Language: E
Study period: HT1
Pace: 50%
Contact Person(s):
Anders Oskarsson (046/2227707) anders.oskarsson@hep.lu.se; Jesper Andersen (046/2224153) jesper.andersen@sljus.lu.se
Description in English: *What defines a physics experiment and how does one choose an experiment or a measuring technique to study a specific problem in research or in daily life? The course aims at answering these questions by means of linking generic physical principles to a wide range of experimental cases – for example, 'scattering' is used in macroscopic studies of materials as well as in the microcosmos to derive information on Nature's fundamental forces. Following a given theory or hypothesis, the experimental investigation is first broken down into certain subprocesses, which are to be checked in the laboratory. Highly sensitive experimental techniques are discussed in view of fundamental concepts. Commonalities of experiments from microcosmos to makrocosmos are stressed. An experimental analysis for physical characterisation of a sample starts by disturbing it by some radiation of suitable wavelength. To observe the effect that this disturbance causes means interaction of radiation with the detector material. Interaction of radiation with matter is thus an important course element. The effect in a detector results in an electrical response from the detector, a response that can be quantified electronically. The electronic data acquisition latter is covered in FYSN15 "Experimental tools".*
Literature: W.R. Leo Techniques for Nuclear and Particle physics experiments. Springer Verlag. Don't buy it before the introductory meeting. There are probably copies available.
Homepage : http://kasper.pixe.lth.se/fysn11/login.asp
Official course description (English) :
http://www.hep.lu.se/staff/oskarsson/kurser/FYSN11_en.doc
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fysn11sw.pdf

FYSN13 Electromagnetism

Elektromagnetism
FYSN13 7,5hp

Language: E
Study period: HT2
Pace: 50%
Contact Person(s):
Andreas Wacker (046-2223012) Andreas.Wacker@fysik.lu.se
Description in English: *The course shall provide central knowledge in advanced electrodynamics relevant for a variety of fields in physics. Course contents: Maxwell's equations, conservation laws, and electromagnetic potentials; Wave propagation in media; Optical waveguides; Radiating systems; Selected advanced topics, such as relativistic formulation, synchrotron radiation or quantum optics*
Description in Swedish: *Kursinnehåll: Maxwells ekvationer, konserveringslagar och elektromagnetiska potentialer; Vågutbredning i material; Vågledare; Strålande system; Utvalda avancerade ämnen, såsom relativitisk formulering, synkrotronstrålning eller kvantoptik*
Literature: John D. Jackson: Classical Electrodynamics, 3rd Edition, (Wiley 1998). [Note that earlier editions did not use SI units and are therefore not recommended.] To get started we will also use the on-line textbook Classical Electrodynamics by Bo Thidé http://www.plasma.uu.se/CED/Book/
Homepage : http://www.teorfys.lu.se/FYSN13/
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fysn13sw.pdf

FYSN14 Lasers

Lasrar
FYSN14/FAFN01 7,5hp

Language: E
Study period: HT2
Contact Person(s): Anne L'Huillier (222 7661) anne.lhuillier@fysik.lth.se
Description in English: *This course provides both theoretical and hands on experience of lasers. It includes three laboratory exercises and a series of theoretical exercises. It treats resonators, mode structure, gaussian beams, continuous and pulsed laser operation, laser light properties.*
Description in Swedish: *Kursens mål är att ge studenterna fördjupad kunskap om modern laserfysik. Den är både experimentell, med tre laborationer, och teoretisk, med att antal övningar. Den inkluderar resonatorer, gaussiska strålar, kontinuerlig och pulsad laserverkan, laserljusegenskaper.*
Literature: Fundamental of Photonics, second edition B. E. A. Saleh and M. C. Teich

Wiley Series in Pure and Applied Optics, John Wiley & sons, inc. Chapters 3,10, 12-15 This book will be used during the following courses: Optics and optical design, Lasers, Photonics and Optical communication, Advanced Optics and Lasers of the Photonics program. It will be available at KFS. For the students that only want to read one course of the Photonics program, it will be possible to buy at a reduced price (300 SEK) a copy of the chapters included in that course.
Course structure: Course content: · Beam optics · Resonator optics · Photon optics · Photon and Atoms · Laser amplifiers · Lasers There will be three laboratory exercises: He-Ne laser, YAG-laser, Diod-laser and a project including ray tracing. We will use a modern ray tracing program FRED.
Homepage : http://www.photonics.fysik.lth.se/lasers.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAFN01.htm

FYSN15 Experimental tools

Fysik: Experimentella verktyg
FYSN15 7,5hp

Language: E
Study period: HT2
Pace: 50%
Contact Person(s):
Anders Oskarsson N-stud (046/2227707) anders.oskarsson@hep.lu.se
Per Kristiansson LTH-stud (046/2227627)
Description in English: *The student will learn to understand and apply generic experimental tools and techniques used in the natural sciences and in particular in physics. An orientation about contemporary, large-scale infrastructure for physics research like accelerators and other sources of radiation of different wavelength. The course element dedicated to electronics aims at the understanding of signal processing and data acquisition in modern experiments. These are described in viewof modern electronics and digital media common in society. Examples are taken from every-day life, such as digital recording and playing of music. Once data has been acquired, it has to be analysed and presented in diagram form such as to clarify the effects. Statistical evaluation to reveal the significance of the results is a mandatory final step of an experimental investigation which is covered in the course.*
Homepage : http://kasper.pixe.lth.se/fysn15/login.asp
Official course description (English) :
http://www.hep.lu.se/staff/oskarsson/kurser/FYSN15_en.doc
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fysn15sw.pdf

FYSN17 Quantum Mechanics

Kvantmekanik
FYSN17 7,5hp

Language: E
Study period: HT1 and VT1

Pace: 50%
Contact Person(s):
Ulf von Barth (2229069) barth@teorfys.lu.se; Carl-Olof Almbladh (148396) coa@teorfys.lu.se
Description in English: *This course deals with the formulation of Quantum mechanics in terms of operators and state vectors. It treats, among other things, identical particles, continuous spectra, Schrödinger equation, Heissenberg formalism, angular momenta and symmetries, and approximation methods. Applications are picked from simple systems - two-level systems and systems in external fields.*
Description in Swedish: *Denna kurs behandlar kvantmekanikens formulering i termer av operatorer och tillståndsvektorer. Bl. a. behandlas identiska partiklar, kontinuerliga spektra, Schrödingerekvationen, Heisenbergformalismen, rörelsemängdsmoment och symmetrier, samt approximationsmetoder. Tillämpningar görs på enkla system, tvånivåsystem och system i externa fält.*
Literature: B. H. Bransden, Quantum Mechanics, Longman, New Jersey, UK 2000 ISBN 0582356911 Rekommederad fördjupningslitt: J. Sakurai, Modern Quantum Mechanics, Addison-Wesley 1994;:A. Messiah, Quantum Mechanics 1-2, North-Holland Amsterdam 1964-65, Dover, New York 1999.
Homepage : http://www.teorfys.lu.se/FYSN17/index.html
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fysn17sw.pdf

FYTN02 Statistical Mechanics
Statistisk mekanik
FYTN02 7,5hp

Language: S/E
Study period: HT2
Pace: 50%

Contact Person(s): Gösta Gustafson (046/2229068) Gosta.Gustafson@thep.lu.se
Homepage :
http://www.thep.lu.se/English/education/courses/statistical_mechanics/

FYTN03 Computational Physics
Beräkningsfysik
FYTN03 7,5hp

Language: S/E
Study period: HT1
Pace: 50%
Contact Person(s):
Leif Lönnblad (222 7780) leif.lonnblad@thep.lu.se;
Anders Irbäck (222 3493) anders@thep.lu.se
Homepage :
http://www.thep.lu.se/English/education/courses/computational_physics/

Advanced Courses: Elective Courses in Physics – Department of Physics

FYSD12 Fundamental Combustion

Grundläggande förbränning
(FBR012) 7,5hp

Language: S/E
Study period: VT2
Pace: 50%
Contact Person(s):
Per-Erik Bengtsson (046 2223109) per-erik.bengtsson@forbrf.lth.se
Description in English: *This course aims at providing the basics for understanding combustion phenomena. This includes thermodynamics, chemical kinetics, ignition, fluid dynamics and the formation of pollutants. From the knowledge in these areas it is possible to reach an understanding for energy related and environmental problems connected to real life combustion.*
Description in Swedish: *Kursen är ämnad att ge de grundläggande betingelserna för förbränningsfenomen, och inkluderar termodynamik, kemisk kinetik, självantändningsprocesser, värme- och masstransport, och hur vissa luftburna föroreningar bildas ur förbränning. Med detta som grund skapas en förståelse för hur energirelaterade problem och miljöproblem är till förbränning som den sker i normala förbränningsanläggningar.*
Literature: Course material produced by the division
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FBR012.html

FYST11 Theoretical nuclear physics

Teoretisk kärnfysik
FYST11 7,5hp

Language: E

Study period: HT2
Pace: 50%
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst11sw.pdf

FYST13 Chaos for science and technology

Kaos, naturvetenskap och teknik
FYST13 7,5hp

Language: E
Study period: HT1
Pace: 50%
Contact Person(s): Gunnar Ohlén Gunnar.Ohlen@matfys.lth.se

FYST14 Atomic and molecular spectroscopy

Atom- och molekylspektroskopi
FYST14 7,5hp

Language: E
Study period: HT1
Pace: 50%
Introduktionsmöte: September 02, 20078 08:15 am, Group Room, Atomic Physics, A Building, 2nd floor
Contact Person(s): Sune Svanberg (222 7650) Sune.Svanberg@fysik.lu.se
Description in English: *This course combines theory and laboratory exercises providing extensive knowledge and familiarity with modern equipment and methods for spectroscopy and spectroscopy applications. Special emphasis is given to the area of laser spectroscopy. Modern and up to date research equipment is used in the laboratory exercises.*
Literature: Sune Svanberg, Atomic and Molecular Spectroscopy – Basic Aspects and Practical Applications, 4th edition; Springer-Verlag, Heidelberg 2004; Lab-instr.
Course structure: Laborationer: Fouriertransformspektroskopi, Nivåkorsningsspektroskopi, Tillämpad molekylär laserspektroskopi, Högupplösande laserspektroskopi Demonstrationer: Synkrotronstrålning (MAX-lab), astrofysikalisk spektroskopi, kärnspinnresonans, femtokemi, förbränningsdiagnostik, laserradar Examination: Skriftlig tentamen
Homepage : http://kurslab-atom.fysik.lth.se/FKAtommol/index.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAF080.html

FYST15 Semiconductor Physics

Halvledarfysik
FYST21 7,5hp

Language: S/E
Study period: HT1
Contact Person(s): Günter Grossmann (222 97 65) Gunter.Grossmann@ftf.lth.se

Description in English: *The course introduces the basic physical principles of semiconductor devices. It is assumed that the student is familiar with the basic topics of Solid State Physics as they are covered in introductory courses, i.e. lattice vibrations, bonding and electronic structure, and electrical and optical properties. A review of semiconductors in equilibrium - intrinsic and extrinsic semiconductors, electrons and holes, and charge carrier concentrations - is followed by a discussion of generation, recombination, injection, and transport of non-equilibrium carriers. Next, the static and dynamic properties of the p-n junction are discussed, and subsequently the bipolar junction transistor. The unipolar devices, presented next, include the metal-semiconductor junction and contacts, the metal-oxide-semiconductor structure, and the metal-semiconductor field-effect transistor. The course concludes with a summary of photonic devices and a short introduction to integrated circuits and their fabrication processes. The laboratory exercises cover Photonic effects in semiconductors, Deep-Level Transient Spectroscopy, and computer simulations of MOSFETs and bipolar junction transistors.*
Description in Swedish: *Kursen avser att presentera de grundläggande fysikaliska principerna som behövs för att förstå halvledarkomponenter och deras funktion. Det förutsätts att studenterna är förtrogna med grundläggande avsnitt ur fasta tillståndets fysik enligt inledande kurser såsom gittervibrationer, bindning och elektronstruktur, och elektriska och optiska egenskaper. Efter en kortfattad repetition av dessa avsnitt och en diskussion av halvledare i jämvikt - intrinsiska och extrinsiska halvledare, elektroner och hål, laddningsbärarkoncentrationer - följer en genomgång av excitations- och rekombinationsmekanismer och injektion av laddningsbärare. Därefter behandlas pn-övergången följt av den bipolära transistorn. Bland de unipolära komponenterna behandlas metall-halvledarövergången och kontakter, metal-oxid-halvledar- strukturen och transistorn och metal-halvledar-fälteffekttransistorn. Kursen slutar med en översikt över optiska komponenter och en introduktion till integrerade kretsar och deras tillverkningsprocesser. Laborationerna ägnas åt fotoeffekter och generations- och rekombinationsmekanismer samt datorsimuleringar av fälteffekt och bipolära transistorer.*
Literature: Sze, S. M.: Semiconductor Devices, Physics and Technology, 2nd ed., John Wiley & Sons, 2002
Course structure: 38 tim föreläsning, 16 tim looaborationer, inlämningsuppgifter och muntlig tentamen
Homepage : http://www-gu.ftf.lth.se/HTMLTestgg/InfoFFF021Vertical.html
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FFF021.html

FYST16 Modern Subatomic Physics

Modern subatomär fysik (FKF070) 7,5hp

Language: E
Study period: VT2
Pace: 50%
Contact Person(s): Per Kristiansson per.kristiansson@nuclear.lu.se; Joakim Cederkall Joakim.Cederkall@nuclear.lu.se
Description in English: *Modern subatomic physics is a very active and diverse research field, ranging from photon-induced reactions to the search for the quark-gluon plasma. By following a number of current research projects (all with*

connections to Lund) from their conception, through experiment and data analysis, to their final interpretation and comparisons with theory, the course aims at presenting and illustrating models and nuclear reactions commonly used today to describe the fundamental building blocks of matter.
Description in Swedish: *Modern subatomär fysik är ett mycket brett och aktivt forskningsområde som omfattar allt mellan fotoninducerade reaktioner till frågan om kvark-gluonplasmats påvisbarhet. För att illustrera de modeller och kärnreaktioner som används i dagens subatomära forskning följer vi under kursens gång några aktuella projekt (med anknytning till Lund) från planeringsstadiet, via experiment och dataanalys till den slutliga uttolkningen och jämförelser med teorin.*
Literature: Materials (texts, articles etc.) handed out during the course. Krane's book is a good preparatory text.
Course structure: A block of 27 45-min lectures, with accompanying problem sets ("inlämninsuppgifter"), is followed by work on an individual literature project. The project is then presented both in a written report and as an 20-min oral presentation.
Homepage : http://jack.pixe.lth.se/kfgu/kurser.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FKF070.html

FYST17 Modern Experimental Particle Physics

Modern Experimentell Partikelfysik (FKF050) 7,5hp

Language: E
Study period: VT1
Pace: 50%
Contact Person(s): Oxana Smirnova (222 7699) oxana.smirnova (at) hep.lu.se
Description in English: *Theory: the building blocks of matter, the quark model for hadrons, forces of nature: QED, the weak interaction, the strong interaction; the Higgs mechanism. Experiments: accelerators, detector systems, particle identification, relativistic kinematics. Resent research at accelerators and in space.*
Description in Swedish: *Kursen avser att ge grundläggande kunskaper om den moderna elementarpartikelfysiken. En sammanfattning av kvarkar och leptoner inleder kursen. Sambandet mellan symmetrier och naturlagar beskrivs, liksom hadroner och deras kvanttal. Den teoretiska huvudvikten läggs på standardmodellen. Kursen ger också en översikt av experimentella metoder: acceleratorer, detektor system, partikelidenfikation, och relativistisk kinematik.*
Literature: Martin, B.R. & Shaw, G.: "Particle Physics" 2nd edition, John Wiley & Sons, 1997 (358 pages)
Course structure: Three 2-hour lectures a week. A few weekly hand-in exercises with three problem-solution sessions. Presentations about current high-energy physics experiments, and 2-3 sessions during which students will give presentations on selected topics (LU students only, ca. 20 min each).
Homepage : http://www.hep.lu.se/education.html

FYST18 Applied subatomic physics

Tillämpad subatomär fysik
(FKFN01) 7,5hp

Language: S
Study period: VT1
Pace: 25%
Introduktionsmöte: 15/1 2007 kl 8.15
Contact Person(s): Jan Pallon (222 7637) jan.pallon@nuclear.lu.se; Kristina Stenström (222 7643) kristina.stenstrom@nuclear.lu.se
Description in English: *The course has an introductory part about accelerator in general that is followed by three experimental project. The projects are performed at the three accelerator facilities, MAX-lab, the Nuclear Microprobe accelerator and at the AMS-facility, which are all used for development and applications of analytical techniques. They are all different (synchrotron radiation, ion beam analysis and accelerator mass spectroscopy) regarding both accelerator technique and application areas. Basic: Accelerators, ion sources, vacuum technique, ion optics. Application techniques: AMS, synchrotron radiation, ion-beam analysis.*
Description in Swedish: *Kursen omfattar en inledande, grundläggande del om acceleratorer som följs av tre projekt med laborativa inslag. Projekten genomförs vid våra tre acceleratoranläggningar, MAX-laboratoriet, Mikroacceleratorn och AMS-faciliteten där forskning bedrivs kring användning och tillämpning av analysmetoder. Dessa skiljer sig mycket från varandra (synkrotronljus, jonstråleanalys respektive acceleratormasspektrometri), både i fråga om acceleratorteknologi och tillämpningsområden. Grundläggande: Accelerator, jonkällor, vakuumteknik, jonoptik. Användning: AMS, Synkrotronljusfysik, Jonstråleanalys*
Literature: Krane, K.S.: Introductory Nuclear Physics. John Wiley & Sons 1988. ISBN 0-471-80553-X Instititutionen: Kompendium i acceleratorfysik Material utdelat i samband med projekt.
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FKFN01.html

FYST19 Physics and Chemistry of Surfaces

Ytors fysik och kemi
7,5hp

Language: E
Study period: VT2
Pace: 50%
Contact Person(s): Jesper Andersen (046 222 4153)
Jesper.Andersen@sljus.lu.se; Anders Mikkelsen (046 222 9627)
anders.mikkelsen@sljus.lu.se
Description in English: *The goal of this course is to give an introduction to the specific problems and challenges related to surfaces and how these are addressed experimentally. These problems are of fundamental importance in a wide range of*

subjects such as heterogenous catalysis, corrosion, printing, dyeing, detergency and adhesion. Further in the field of nanoscience surfaces plays a prominent role as nanosized objects inherently have large surface to bulk ratios – in the extreme case such as carbon nanotubes the object is a surface. In the course an introduction to surfaces and their fundamental importance in physics, chemistry, nanoscience and biology will first be given. Then the basic description of surfaces structure, adsorption, reactions and growth on surfaces will be discussed. In particular it will be discussed how the physics and chemistry of the surfaces (and 2D gasses of the surfaces) can differ fundamentally from their 3D counterparts. In the remaining (main) part of the course we will discuss the experimental measurements of surface structure, chemistry and morphology using: Scanning Probe Microscropies (STM, AFM, MFM), Spectrocopy (AES, XPS), Diffraction (LEED, SXRD) and microscopy methods based on XPS, LEED, SXRD
Course structure: The course will be problem based, with a few overview lectures. At the end of the course the students will carry out individual projects, which should result in a written report and a student presentation.
Homepage : http://www.sljus.lu.se/staff/achim/Ytfysik2007_2006.html
Official course description (Swedish) :
http://kurslab.fysik.lu.se/Kurser/kursplaner/fyst19sw.pdf

FYST20 Spectroscopy and the quantum description of matter
Spektroskopi och materiens kvantmekaniska beskrivning
FYST20 7,5hp

Language: E
Study period: VT1
Pace: 50%
Contact Person(s): Joachim Schnadt (046-2220469)
joachim.schnadt@sljus.lu.se
Description in English:
The course is concerned with the application of spectroscopy to the development of a quantum mechanical understanding of the physical characteristics of matter. Such an understanding is of fundamental importance for many applications in basic and applied science within atomic, molecular, and condensed matter physics as well as materials science and chemistry.

Atoms, molecules, and condensed matter can be described using the same principles, and it is the electronic structure (i.e., the distribution and dynamics of the electron density) which plays a decisive role for the structural and chemical characteristics of matter. The electronic structure can be measured using spectroscopic methods typically used in atomic, molecular, and solid state physics. In this course you will learn how the quantum mechanical description of matter is connected to the spectra measured using some of the most important spectroscopic techniques. By this way one can obtain a deeper understanding for the quantum mechanical principles. Particular weight will be put on electron spectroscopy. Moreover, we will treat the connection between spectroscopy and microscopy in those microscopic techniques that mirror the electronic structure.

Description in Swedish:
Kursen behandlar hur man kan använda spektroskopi för att förstå materiens

egenskaper från ett kvantmekaniskt perspektiv. En sådan förståelse är av grundläggande betydelse för många användningsområden i såväl grund- som tillämpad forskning inom atom-, molekyl- och den kondenserade materiens fysik samt all materialforskning och kemi.

Atomer, molekyler och fasta material kan beskrivas utgående från samma principer, och det är den elektroniska strukturen (alltså fördelningen av och dynamiken i elektrontätheten) som spelar en avgörande roll för deras strukturella och kemiska egenskaper. Just elektronstrukturen avspeglas i resultaten från spektroskopimetoderna som man använder inom atom-, molekyl- och den kondenserade materiens fysik. I denna kurs lär man sig därför hur man kvantmekaniskt beskriver den elektroniska strukturen i molekyler och fasta material och hur denna hänger ihop med spektren från några av de viktigaste spektroskopiska metoderna. Särskilt stor vikt fästs vid elektronspektroskopi. Därutöver behandlas sammanhanget mellan spektroskopi och mikroskopi hos de mikroskopitekniker som främst avbildar den elektroniska strukturen.

Kursen innehåller följande moment:

- *kemiska bindningar i molekyler och den kvantmekaniska beskrivningen av molekyler*
- *kemiska bindningar i fast materia och den kvantmekaniska beskrivningen av fast materia*
- *spektroskopi för mätningar på materiens elektronstruktur, framförallt elektronspektroskopi och sveptunnelspektroskopi*
- *mikroskopimetoder som mäter den elektroniska strukturen i materia.*

Literature: Handouts and scientific literature provided during the course.
Homepage : http://www.utbildning.fysik.lu.se/fyst20/
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst20sw.pdf

FYST21 Light-Matter Interaction

Ljus-materia växelverkan
FYST21/FAFN05 7,5hp

Language: E
Study period: VT1
Pace: 50%
Contact Person(s): Anne l'Huiller Anne.lhuiller@fysik.lu.se
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAFN05.html

FYST22 Tissue Optics

Medicinsk optik

FYST22/FAF150 7,5hp

Language: E
Nivå: T4
Kurskategorier: A; FU;
LTH utbildning/år: D3, E3, F3, N3, Pi3
Tidpunkt: Varje år vårterminen
Study period: VT2
Pace: 50%
Introduktionsmöte: Monday March 31, 2008, 8.15-10.00 in H322
Contact Person(s): Stefan Andersson-Engels (23121) Stefan.Andersson-Engels@fysik.lth.se
Description in English: *This course provides the basic knowledge of light propagation it strongly scattering media. This is particularly important for medical laser applications. Initially an overview of various laser applications in medicine is given. Then follows a theoretical treatment of light propagation in strongly scattering materials based on the transport equations. The theoretical treatment is supported by laborative excercises. This is a project oriented course and at the end the participants carries out a theoretical project treating light propagation in tissue.*
Literature: Lecture notes and literature covering the subject of the project chosen.
Course structure: Laboratory exercises: Optical integrating sphere measurements of tissue optical properties, time-resolved measurements f tissue optical properties
Computer exercises: Calculation of light transport in tissue using the diffusion equation, Monte Carlo simulations of light transport in tissue, Calculation of temperature distribution in tissue following laser irradiation using the bioheat equation
Examination: Satisfactory presentation of the project, both in written form and as an oral presentation, written examination for higher grades
Homepage : http://www-atom.fysik.lth.se/MedOpt/
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAF150.html

FYST23 Experimental Biophysics

Biofysik, experimentell inriktning
FYST23/TNF060 15hp

Language: E
Nivå: T4
Kurskategorier: A; FU;
Tidpunkt: 2006 vårterminen
Study period: VT1-2
Pace: 50%
Contact Person(s): Jonas Tegenfeldt (28063) jonas.tegenfeldt@ftf.lth.se
Description in English: *The course consists of three main parts: a) bioanalytical applications of micro and nanotechnology, b) physics in biosystems, c) energy states in biomolecules.*
Description in Swedish: *Kursen består av tre huvudmoment: a) bioanalytiska tillämpningar av mikro- och nanotechnology, b) fysik i biosystem, c) energitillstånd hos biomolekyler.*
Literature: Recent scientific articles and excerpts from books.

Course structure: The course is divided into three parts: (1) Core concepts are presented during lectures and discussed in depth during seminars. Recent scientific papers are used as the basis for the discussions. (2) Laborative exercises are used to gain hands-on experience with selected important topics. (3) At the end of the course, a topic is chosen for further study. The result is presented in a written report and in a seminar.
Anmärkningar: Förkunskapskrav: FYSA31 eller motsvarande.
Homepage : http://nanobio.ftf.lth.se/~biokurs/
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst23sw.pdf

FYST24 The Physics of Low-dimensional Structures

Fysiken för låg-dimensionella strukturer
FYST24/FFF042 7,5hp
Language: E
Study period: VT2
Contact Person(s): Lars Samuelson lars.samuelson@ftf.lth.se; Dan Hessman dan.hessman@ftf.lth.se
Homepage : http://www-gu.ftf.lth.se HTTP/1.1 200 OK 9802
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst24sw.pdf

FYST25 Solid State Theory

Fasta tillståndets teori
FYST25/FFF051 7,5hp

Language: E
Study period: VT1
Pace: 50%
Contact Person(s): Andreas Wacker (2223012) Andreas.Wacker@fysik.lu.se
Description in English: *Bandstructure. Transport properties. Magnetism. Electron-electron interactions within the Hartree-Fock approximation. Dielectric and optical properties. Electron-phonon interaction and BCS superconductivity.*
Description in Swedish: *Bandstruktur. Transportegenskaper. Magnetism. Elektron-elektron växelverkan inom Hartree-Fock approximationen. Dielektriska och optiska egenskaper. Elektron-fonon växelverkan och BCS supraledning.*
Literature: Alternatively, the following books can be used: David W. Snoke: Solid State Physics (Addison Wesley, 2008), C. Kittel: Introduction to Solid State Physics (John Wiley & Sons, 1996), or H. Ibach and H. Lüth: Solid State Physics (Springer 2003) These are complemented by lecture notes which focus on more theoretical aspects.
Homepage : http://www.teorfys.lu.se/FYS234/
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst25sw.pdf

FYST27 The electronic structure of solids and their surfaces

Elektronstrukturen hos fasta ämnen och ytor
7,5hp

Language: S/E
Study period: VT2
Pace: 50%
Contact Person(s): Ulf von barth (222 9069) barth@teorfys.lu.se; Carl-Olof Almbladh (148396) coa@teorfys.lu.se
Description in English: *This course is about how one can treat the complicated many-body broblem in real molecules and solids. It is explained how this problem can be mapped on to a much simpler one-electron problem. Baisc physical concepts like molecular binding, energy surfaces, exchange, correlation and screening are introduced and illuminated. The calculation of excitation energies are described. Most of the course is devoted to practical exercises consisting in using computers for solving a set of successively more advanced models of real physical systems. At the end of the course the participants are taught to handle one of the standard computer codes for studying the elctronic structure of real surfaces.*
Description in Swedish: *Denna kurs behandlar mångpartikelteori med begreppen utbyte och korrelation, täthetsfunktionalteori för molekyler och fasta kroppar, samt kemisk bindning i molekyler, fasta ämnen och adsorbater. Begreppen kvasipartiklar och deras självenergier diskuteras, liksom olika metoder att lösa enpartikelekvationer. I kursen ingår datorlaborationer där studenten på egen hand löser förenklade modellproblem liksom laborationer där färdiga program används för att studera realistiska elektronstrukturproblem.*
Literature: Utdelat kursmaterial. www.abinit.org/package/?text=4_4_4 Richard M. Martin, Electronic Structure, Basic Theory and Practical Methods, Cambridge University Press, 2004
Anmärkningar: Regular lectures are given with a minimum of six paricipants.

FYST28 Laser-based Combustion Diagnostics

Laserbaserad förbränningsdiagnostik
7,5hp

Language: E
Kurskategorier: A; FU;
LTH utbildning/år: F4
Tidpunkt: Varje år vårterminen
Study period: VT1
Pace: 50%
Introduktionsmöte: Vecka 3, 2007
Contact Person(s): Joakim Bood (046 2223928) joakim.bood@forbrf.lth.se
Description in English: *The course is aimed at providing knowledge about the possibilities and limitations for using laser diagnostic techniques for determining species concentrations, temperatures, velocities and particle size distributions in combustion processes.*
Description in Swedish: *Kursen syftar till att ge en grundläggande fysikalisk förståelse för laserdiagnostiska teknikers möjlighet att mäta parametrar såsom temperatur och ämneskoncentrationer i förbränningsprocesser. Centrala inslag i*

kursen är växelverkan mellan strålning och materia, lasrar och deras egenskaper, optik, optisk detektion, molekylspektroskopi, och förbränning.
Literature: A.C Eckbreth: Laser Diagnostics for Combustion Temperatur and Species, Gordon and Breach, 1996, och utdelat material.
Course structure: Kursen består av ca 15 lektioner, två övningar, och två laborationer. Dessutom finns det obligatoriska inlämningsuppgifter och ett miniprojekt som innebär att studenten ska läsa en kort vetenskaplig artikel som redovisas inför kursgruppen.
Anmärkningar: Länken till kursplanen kommer förhoppningsvis att fungera snart. Kursen har fått ny kurskod och LTH ska snart lägga in den i sitt system. Kontakta kursansvarig för frågor.
Official course description (Swedish) :
http://kurslab.fysik.lu.se/kurser/kursplaner/fyst28sw.pdf

FYST29 Multi-spectral Imaging
Multispektral avbildning
7,5hp

Language: E
Study period: HT2
Pace: 100%
Contact Person(s): Sune Svanberg (222 7650) Sune.Svanberg@fysik.lth.se
Description in English: *This course describes how information about the physical and chemical status and nature of an object can be obtained by recording images of the object in different spectral intervals. This is a technique with a variety of different applications, e.g. in medical diagnostics, industrial quality inspection, microscopy, satellite-based remote sensing and astronomy. The course includes several laboratory exercises and visits to different research divisions at the Lund University.*
Literature: Sune Svanberg, Multispectral Imaging - From microscopy to astronomy -from radiowaves to gammarays, Kompendium 2008, Laborationsinstruktioner
Course structure: Labs: Digital imaging, Medical fluorescence imaging, Analysis of satellite images Guest lectures/demonstrations: Astronomical imaging, PIXE imaging, Scanning probe microscopy, Magnetic resonance imaging, Animal vision Project: 1.5 ECT Examination: Written examination
Homepage : http://photonics.fysik.lth.se/MultispectralImaging.htm
Official course description (English) :
http://photonics.fysik.lth.se/MultispectralImaging.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAF141.html

FYST30 Quantum information
Kvantinformation
7,5hp

Language: E
Study period: Every second year
Pace: 50%
Contact Person(s): Stefan Kröll and Peter Samuelsson

FYST31 Advanced processing of nanostructures

Avancerad framställning av nanostrukturer
(FFFN01) 7,5hp

Language: E
Study period: VT2
Pace: 50%
Contact Person(s): Dr. Ivan Maximov, ivan.maximov@ftf.lth.se
Description in English: *The aim of the course is to give a deep knowledge of fabrication and characterization of nanostructures, which can be used in both nanoelectronics and life sciences. The focus will be put on modern material processing techniques, which are used today in nanotechnology, for example, electron beam lithography, scanning electron microscopy, etching etc. Practical laboratory work (in the form of a project work) in our modern clean room is aimed at giving practical knowledge of some important technological methods used in semiconductor nanotechnology. Since it is very important to use a cleanroom environment in nanofabrication, a special attention will be put on cleanroom design, safety and practical work in the cleanroom.*
Homepage : http://www.teknisknanovetenskap.lth.se

FYST32 Advanced optics and lasers

Avancerade laser- och optiksystem
(FAFN10) 7,5hp

Language: E
Study period: VT2
Pace: 50%
Contact Person(s): Stefan Kröll Stefan.Kroll@fysik.lth.se; Anne l'Huillier Anne.LHuillier@fysik.lth.se
Description in English: The course aims at providing knowledge about basic as well as advanced techniques for manipulating and controlling laser light and laser pulses. This involves controlling intensity, frequency distribution, temporal profiles in order to design advanced optical systems for specialised tasks in industry as well as research.
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAFN10.html

FYST33 Electron Transport in Nanostructures

Elektrontransport i nanostrukturer
(FFFN10) 7,5hp

Language: E
Study period: VT1
Pace: 50%
Contact Person(s): Prof. Hongqi Xu, Hongqi.Xu@ftf.lth.se

Description in English: *The aim of the course is to give a deep knowledge of fabrication and characterization of nanostructures, which can be used in both nanoelectronics and life sciences. The focus will be put on modern material processing techniques, which are used today in nanotechnology, for example, electron beam lithography, scanning electron microscopy, etching etc. Practical laboratory work (in the form of a project work) in our modern clean room is aimed at giving practical knowledge of some important technological methods used in semiconductor nanotechnology. Since it is very important to use a cleanroom environment in nanofabrication, a special attention will be put on cleanroom design, safety and practical work in the cleanroom.*
Homepage : http://www.teknisknanovetenskap.lth.se

FYST34 High-Speed Devices
Höghastighetselektronik
(FFF115) 7,5hp

Language: S
Study period: HT2
Contact Person(s): Lars-Erik Wernersson Lars-Erik.Wernersson@ftf.lth.se
Description: Modern electronics like mobile- and satellite-based communication systems are based on the design of high-speed devices. This course covers the fundamental design of the heterostructures in key devices within established and emerging technologies. It contains basic modelling of DC and AC properties for HBTs and FETs, but also specific nano electronic applications such as tunnel diodes and ballistic FETs. The lectures are based on a mathematical description of the transport properties within the devices, while state-of-the-art performance devices will be presented as examples
Homepage : http://www-gu.ftf.lth.se
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FFF115.html

FYST35 Crystal Growth and Semiconductor Epitaxy
Kristalltillväxt och halvledarepitaxi
(FAFN15) 7,5hp

Language: S/E
Study period: HT2
Contact Person(s): Jonas Johansson, jonas.johansson@ftf.lth.se
Description: In this course we will carefully treat the fundamental aspects of crystal growth. We will study the thermodynamic prerequisites for crystal growth, such as chemical potential, construction of binary phase diagrams, supersaturation, and nucleation. Further on, we will discuss surface energies, surface diffusion, and Wulff's theorem. In the course section on epitaxial growth we will discuss surface reconstructions, lattice mismatch, and dislocations, as well as characterization – both *in*- and *ex-situ*. We will also deal with growth techniques and reactor models. During the course, the various moments will be illuminated by examples from modern research, especially research on epitaxy of nanostructures.
Homepage : http://www-gu.ftf.lth.se

FYST36 Molecular Physics

Molekylfysik
(FBR030) 7,5hp

Language: S/E
Study period: HT2
Contact Person(s): Frederik Ossler (46-46-2224832) frederik.ossler@forbrf.lth.se
Description in English: *The course in Molecular Physics, is supposed to provide the student with the basic concepts and methods for theoretical and practical spectroscopy of molecules. The methods give the possibility to describe, evaluate and reconstruct molecular spectra. Different types of spectra in the microwave-, infrared-, and visible-ultraviolet regions are described. The main focus is on molecules in gas phase, with a more detailed description of diatomic molecules and some special types of polyatomic systems. Quantities such as force constants, moments of inertia, bond length, atomic masses and nuclear spin are included in the equations that govern molecular spectra and can therefore be retrieved from spectra to some extent. Temperature is another important physical quantity in the description.*
Description in Swedish: *Kursen i Molekylfysik är tänkt at ge de grundläggande begreppen och metodiken inom teori och praktik för att kunna beskriva, tolka och rekonstruera molekylspektra. Kursen ger en beskrivning av de typer av spektra som orsakas av växelvekan mellan molekylen och mikrovågor, infraröd, synlig och ultraviolett elekromagnetisk strålning. Den största inriktningen är mot molekyler i gasfas, där man mer detaljerat kommer att titta på diatomära molekyler, men också vissa typer av polyatomära molekyler. Man komer också att gå igenom hur molekylära storheter som, tex, kraftkonstanter, tröghetsmoment, bindningsavstånd,atommassor och kärnspinn, kommer in i molekylbeskrivningen. Temperaturen visar sig vara en viktig fysikalisk storhet.*
Literature: C.N. Banwell and E. McCash, Fundamentals of Molecular Spectroscopy, Mc-Graw-Hill, 1994, och utdelat material
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FBR030.html

FYST37 Advanced Quantum Mechanics

Avancerad kvantmekanik
7,5hp

Language: E
Pace: 50%
Contact person: Ingemar Ragnarsson, Ingemar.ragnarsson@matfys.lth.se
Description in English: *We offer a new advanced course on quantum mechanics aimd for PhD students and for undergraduate students at LTH and N-faculty. The contents are:*

- *Fundamental concepts and quantum dynamics*
- *Theory of Angular moment: rotations, commutation relations, SO(3), SU(2) and Euler rotations, representations of rotation operator, spherical harmonics as rotation matrices, angular momentum addition, Bell's inequality, tensor operators, Wigner-Eckart theorem.*
- *Symmetries in quantum mechanics: Parity, lattice translations, time-reversal.*

- *Approximate methods: interaction picture, time-dependent perturbation theory.*
- *Many-particle theory and second quantization: identical particles, many-particle states, bosons, fermions, field operators.*
- *Scattering theory: Lippmann-Schwinger equation, Born approximation, optical theorem, partial waves, resonance scattering, symmetry considerations, time-dependent formulation.*

FYST38 Environmental Measurement Technology

Miljömätteknik
(FKF100) 7,5hp

Language: S/E
Study period: VT1-VT2
Pace: 25%
Contact Person(s): Erik Swietlicki (046/2229680) erik.swietlicki@nuclear.lu.se
Description in English: *The course primarily is aimed at advanced measurement technology applied to the air environment, some insights to measurement strategies and basic understanding of problems associated with air pollution. The course presents various problems in the air environment, measurement strategies, physical measurement methods and chemical analytical methods applied to environmental issues.*
Description in Swedish: *Kursens mål är främst att förmedla kunskaper i avancerad mätteknik speciellt applicerad på luftmiljön, samt insikter i mätstrategi. Undervisningen syftar även till att ge grundläggande kunskap om problemen knutna till luftföroreningar. Kursen omfattar presentation av olika allmänna luftmiljöproblem, strategier för mätning, fysikaliska mätmetoder samt metoder för kemisk analys applicerade på miljöfrågeställningar.*
Literature: Copied material collected in a file.
Course structure: The teaching includes lectures, demonstrations, laboratory exercises and a project, where environmental measurement data are interpreted and presented. In the laboratory exercises you will use advanced research equipment.
Homepage : http://www.fysik.lu.se/eriksw/fkf100/fkf100.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FKF100.html

FYST39 Nanoelectronics

Nanoelektronik
(FFF160) 7,5hp

Language: E
Study period: VT2
Contact Person(s): Lars-Erik Wernersson lars-erik.wernersson@ftf.lth.se
Homepage : http://www-gu.ftf.lth.se
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FFF160.html

FYST40 Nanomaterials – Thermodynamics and Kinetics

Nanomaterial – Termodynamik och Kinetik
(FFFN05) 7,5hp

Language: E
Study period: VT2
Contact Person(s): Dr. Kimberly Dick, kimberly.dick@ftf.lth.se
Homepage : http://www-gu.ftf.lth.se
Literature: DeHoff, R.: Thermodynamics in Materials Science. CRC, 2nd edition, 2006. ISBN: 0849340659

FYST41 Photonics and Optical Communication

Fotonik och optiskt kommunikation
(FAF095) 7,5hp

Language: S/E
Study period: VT1
Pace: 50%
Contact Person(s): Stefan Andersson-Engels (222 3121) stefan.andersson-engels@fysik.lth.se; Dan Hessman dan.hessman@ftf.lth.se
Description in English: *Aim The course aims at providing basic knowledge for designing the hardware side of optical communication systems. This is achieved by providing knowledge about optical fibres, optical detectors and light sources and how these components are integrated into optical communication systems. Knowledge and understanding After the student has passed the course, he/she should be able • To understand light propagation in wave guides and optical fibres • To understand the principles and calculate the performance of optical detectors and diode laser sources. • To understand the physics behind and operational principles for diodes and diode lasers. Application and judgment After the student has passed the course, he/she should be able • Choose appropriate detectors and light sources for various signal transmission or signal detection tasks • Design and theoretically evaluate the performance of simple optical communication systems Ability to communicate After the student has passed the course, he/she should • have an increased competence for presenting in writing an accomplished project. • have an increased experience for working in groups of two or four persons towards a common goal. Ability to learn and acquire information After the student has passed the course, he/she should be able to • Search and acquire knowledge from a reference English book*
Description in Swedish: *Mål Kursen syftar till att lära ut grundläggande och avancerad optik. Dessutom syftar kursen till att ge grundläggande kunskaper i hur optiska kommunikationssystem fungerar. Kunskapsmål Efter kursen skall kursdeltagarna ha tillägnat sig förmåga att förstå hur många olika slag av optiska komponenter fungerar och hur man mäter med ljus förstå begränsningarna i optiska system vad gäller upplösning, spektral transmission och överföringshastighet förstå hur man kan använda optiska komponenter för att bygga optiska system och vilka komponenter som behövs i ett optiskt kommunikationssystem. Färdighetsmål Efter kursen skall kursdeltagarna ha tillägnat sig förmåga att ställa upp optiska system med lasrar och optiska komponenter grundläggande färdigheter för att kunna göra mätningar i optiska system och bygga ett fiberoptiskt system grundläggande optisk kunskap för att förstå vad som händer i ett optiskt kommunikationssystem utökad*

färdighet i skriftlig framställning av observationer och beräkningar. Attitydmål Stimulera ett nyfiket förhållningssätt till optiska problem speciellt inom avancerad optik och inom optisk kommunikation Innehåll Föreläsningar: Ljusutbredning, detektorer, optiska material, modulation av ljus, fiberoptik, integrerad optik, WDM, Bragg-fibrer, fourieroptik, mönsterigenkänning, optisk mätteknik, digital holografi, optisk datalagring. Demonstrationer: Studiebesök och aktuell forskning. Laborationer: Bildkvalité i digitala och analoga optiska system, optisk kommunikation I, fourieroptik och bildbehandling, digital holografi och informationslagring i kristaller.
Literature: Fundamental of Photonics B. E. A. Saleh and M. C. Teich Wiley Series in Pure and Applied Optics, John Wiley & sons, inc. Kap. 7,8,9,16-18,23,24 + labinstructions available at the course homepage.
Course structure: The course is lectured four hours per week. There is in addition two hours of excercises to train problem solving and two hours for questions. Compulsary laboratory exercises and turn-in assignments are part of the course. The course is ended by a written examination.
Homepage : http://photonics.fysik.lth.se/PhotonicsOpticalCommunication.htm
Official course description (English) :
http://photonics.fysik.lth.se/PhotonicsOpticalCommunication.htm
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAF095.html

FYST42 Scanning Probe Microscopy
Svepspetsmikroskopi
FAF085 7,5hp

Language: S/E
Study period: VT2
Contact Person(s): Mikael K.-J. Johansson
Homepage : http://www-gu.ftf.lth.se/
Official course description (Swedish) :
http://www.ka.lth.se/kursplaner/arets/FAF085.html

FYST43 Optics and Optical Design
Optik och Optisk Design
(FAFF01) 7,5hp

Language: S/E
Study period: VT2
Contact Person(s): Mikael K.-J. Johansson
Description in English: *The course teaches the basic principles of optics and gives practical knowledge on optical design, with the help of a ray tracing program.*
Course content:
· *Ray optics, including matrix-formulation*

- *Wave optics*
- *Fourier Optics*
- *Electromagnetic optics*
- *Polarization*

There will be three laboratory exercises: Interferometry, Fourier Optics, and Light Polarization and a project including ray tracing.
Homepage : http://www.photonics.fysik.lth.se/Optics&OpticalDesign.htm

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Elective Courses in Physics – Department of Theoretical Physics

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FYTN01Mathematical Methods of Physics

Fysikens matematiska metoder
FYTN01 7,5hp

Language: S/E
Study period: HT2
Pace: 50%
Contact Person(s): Anders Irbäck (222 3493) anders@thep.lu.se
Homepage :
http://www.thep.lu.se/English/education/courses/mathematical_methods_of_physics/

FYTN04 Theoretical Particle Physics

Teoretisk partikelfysik
FYTN04 7,5hp

Language: S/E
Study period: HT2
Pace: 50%
Contact Person(s): Leif Lönnblad (222 77 80) leif.lonnblad@thep.lu.se; Johan Bijnens (222 04 47) bijnens@thep.lu.se
Homepage :
http://www.thep.lu.se/English/education/courses/theoretical_particle_physics/

FYTN05 Theoretical Biophysics

Teoretisk biofysik
FYTN05/TEK267 7,5hp

Language: S/E
Study period: HT1
Pace: 50%
Contact Person(s): Anders Irbäck (222 3493) anders@thep.lu.se
Homepage :

http://www.thep.lu.se/English/education/courses/theoretical_biophysics/

FYTN06 Artificial Neural Networks

Artificiella neurala nätverk
FYTN06 7,5hp

Language: S/E
Study period: VT2
Pace: 50%
Contact Person(s): Mattias Ohlsson (046 2227782) Mattias.Ohlsson@thep.lu.se
Homepage :
http://www.thep.lu.se/English/education/courses/artificial_neural_networks/

FYTN07 Systems Theory

Systemteori
FYTN07 7,5hp

Language: S/E
Study period: VT1
Pace: 50%
Contact Person(s): Bo Söderberg (046-222 90 72) Bo.Soderberg@thep.lu.se
Homepage : http://www.thep.lu.se/English/education/courses/systems_theory/

FYTN08 General Relativity

Allmän relativitetsteori
FYTN08 7,5hp

Language: S/E
Study period: VT2
Pace: 50%
Contact Person(s):
Johan Bijnens (046-2220447) bijnens@thep.lu.se
Literature: B.F. Schutz, A first course in general relativity, Cambridge University Press1985, ISBN 0-521-27703-5
Homepage : http://www.thep.lu.se/English/education/courses/general_relativity/

Elective Courses in Physics – Lund Observatory

ASTM13 Dynamical Astronomy

Dynamisk Astronomi
7,5hp

Language: S/E
Study period: HT2
Contact Person(s):
Description in English: *The course consists of: Newtonian gravitation and dynamics. Reference systems and units. Galactic coordinates. Astrometry and the determination of the distances, motions and distribution of stars. The HR diagram and the colours, luminosities and ages of stars. Stellar kinematics. The solar motion and the Local Standard of Rest. The rotation curve, differential galactic rotation and Oort's constants. Non-circular motions. The galactic potential and galactic orbits. The phase space, collisionless Boltzmann equation and Jeans' equations. Dynamical determination of masses and mass densities.*
Homepage :

Extragalactic Astronomy

Extragalaktisk Astronomi
7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English:
Homepage :

Planetary Systems

Planetsystem
7,5hp

Language: S/E
Study period: HT
Contact Person(s):
Description in English:
Homepage :

ASTM11 Statistical and Numerical Tools in Astrophysics

Statistiska och Numeriska Metoder i Astronomi

7,5hp

Language: S/E
Study period: HT2
Contact Person(s):
Description in English: *The course consists of: Techniques in structured programming. Elementary probability theory and statistics. Noise in astronomical data. Fitting models to data and assessment of the fit. Graphical display of data. Numerical solution of ordinary differential equations. Numerical evaluation of integrals. Analysis of real astronomical data.*
Homepage :

ASTM14 Stellar Structure and Evolution

Stjärnstruktur och -utveckling

7,5hp

Language: S/E
Study period: HT1
Contact Person(s):
Description in English: *The course contents are among others a review of the phases of stellar evolution, the equations of stellar structure, energy transport, nuclear reactions, stellar models, star formation and the evolution of low-mass and high-mass stars.*
Homepage :

Astrobiology

Astrobiologi

7,5hp

Language: S/E
Study period: HT1
Contact Person(s):
Description in English:.
Homepage :

ASTM12 High Energy Astrophysics

Högenergiastrofysik

7,5hp

Language: S/E

Study period: HT1
Contact Person(s):
Description in English: *The course consists of: A review of the evolution of massive stars. Core-collapse supernovae. Type Ia supernovae and their use as standard candles in cosmology. Mass transfer in binaries. X-ray binaries. Radio pulsars and millisecond pulsars. The formation of compact binaries. Hypernovae and gamma-ray bursts. Galactic nuclei. Gravitational radiation.*
Homepage :

Introduction to Astrophysics
Introduktion till Astrofysik
7,5hp

Language: S/E
Study period: HT1
Contact Person(s):
Description in English: *This course is mandatory if you have not previously taken any astronomy courses. The course gives a general overview of modern astronomy, its scientific methods and results. Some of the areas covered are: Observational Techniques and Instrumentation, properties of stars, the formation and evolution of stars, the solar system and its formation, the Milky Way and other galaxies and theories for the evolution of the Universe as a whole.*
Homepage :

ASTM15 Laboratory Astrophysics
Laboratorieastrofysik
7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English: *The course treats areas in atomic physics that are needed for analysis of astrophysical spectra, from which the chemical composition of stars and the interstellar medium can be determined and from which information about different atomic processes in cosmical plasmas can be extracted. The course also treats the physical basis for model atmospheres of stars and models of other cosmical plasmas. From the content: Atomic structure and spectra of atoms and ions with several valence electrons. Experimental and theoretical determination of different atomic parameters of astrophysical relevance. Radiative transitions. Excitation and de-excitation, ionization and recombination. Acquisition and analysis of stellar spectra. Influence of observational and physical parameters. Determination of stellar parameters. Construction of a*

synthetic stellar spectrum based on a stellar atmosphere in thermal equilibrium. Interpretation of different types of spectra and spectral lines.
Homepage :

ASTM18 Observational Techniques and Instrumentations

Observationsteknik och instrument

7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English: *The course contains: Electromagnetic radiation and non-photonic astronomy. The influence of the atmosphere on observations. Detectors for optical and infrared radiation. Detectors for radio waves. Noise characteristics of detectors. Signal-to-noise ratio, quantum efficiency, and detectable quantum efficiency. Light collecting and imaging instruments. adaptive optics and extremely large telescopes. Space observatories. Spatial resolution and MTF. interferometry, visibility, UV-plane and interferometric imaging. Photometry, photometric systems and photometric reduction methods. Spectroscopy, grating, echelle and fourier transform spectrometers. Astrometry from earth and from space. Polarimetry and determination of Stokes vector.*
Homepage :

ASTM17 Statistical and Numerical Methods in Astrophysics II

Statistiska och Numeriska Metoder i Astrofysik II

7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English: *The course consists of: Introduction to computational astrophysics. Numerical algorithms and libraries. The N-body problem. Smoothed Particle Hydrodynamics. Numerical solution of partial differential equations in astrophysics. Introduction to astronomical data analysis. Multidimensional random variables. Time series analysis. Hypothesis testing. Monte Carlo and re-sampling techniques. Convolution, deconvolution and inverse problems in astronomy.*
Homepage :

Elective Courses in Physics – The MAX-laboratory

MAXM06 Introduction to Synchrotron Radiation Based Science

7,5hp

Language: S/E
Study period: HT
Contact Person(s):
Description in English:
Homepage :

MAXM07 Introductions to Acceleratos and Free Electron Lasers

7,5hp

Language: S/E
Study period: HT
Contact Person(s):
Description in English:
Homepage :

MAXM16 Experimental Methods and Instrumentations for Synchrotron Radiation

7,5hp

Language: S/E
Study period: HT
Contact Person(s):
Description in English:
Homepage :

MAXM17 Project in Synchrotron Radiation Based Research

7,5hp

Language: S/E
Study period: HT
Contact Person(s):
Description in English:
Homepage :

MAXM05 Acceleratos and FEL II

7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English:
Homepage :

MAXM04 Experimental X-ray Physics

7,5hp

Language: S/E
Study period: VT
Contact Person(s):
Description in English:
Homepage :

Directions within the Master's Programme

As a Masterstudent of Physics in Lund, you have a large freedom of choice. You can combine the courses as you like, together with your mentors. But we also point to some directions or specializations, representing areas where we are particularl strong. Below we list some of these specializations and the courses recommended if you like to follow them.

1. Mathematical or Theoretical Physics

FYSN13 Electromagnetism
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYST11 Theoretical nuclear physics
FYST13 Chaos for science and technology
FYST30 Quantum information
FYST33 Electron transport in nanostructures
FYST37 Advanced Quantum Mechanics
FYST38 Environmental Measurement Technology
FYTN01Mathematical Methods of Physics
FYTN04 Theoretical Particle Physics
FYTN05 Theoretical Biophysics
FYTN06 Artificial Neural Networks
FYTN07 Systems Theory
FYTN08 General Relativity

2. Synchrotron Radiation Physics

FYSN11 Experiments in research and society
FYSN13 Electromagnetism
FYSN15 Experimental tools
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYST19 Physics and Chemistry of Surfaces
FYST20 Spectroscopy and the quantum description of matter
FYST21 Light-Matter Interaction
FYST27 The electronic structure of solids and their surfaces
FYST36 Molecular Physics
FYST37 Advanced Quantum Mechanics
FYST42 Scanning Probe Microscopy
+ all MAX-lab courses

3. Nanophysics

FYSN11 Experiments in research and society
FYSN13 Electromagnetism
FYSN15 Experimental tools
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYST15 Semiconductor Physics
FYST19 Physics and Chemistry of Surfaces
FYST20 Spectroscopy and the quantum description of matter
FYST24 The Physics of Low-dimensional Structures
FYST27 The electronic structure of solids and their surfaces
FYST31 Advanced processing of nanostructures
FYST33 Electron transport in nanostructures
FYST34 High-Speed Devices
FYST35 Crystal Growth and Semiconductor Epitaxy
FYST37 Advanced Quantum Mechanics
FYST39 Nanoelectronics
FYST40 Nanomaterials – Thermodynamics and Kinetics
FYST42 Scanning Probe Microscopy
FYTN01Mathematical Methods of Physics

4. Combustion Physics

FYSN11 Experiments in research and society
FYSN13 Electromagnetism
FYSN14 Lasers
FYSN15 Experimental tools
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYSD12 Fundamental Combustion
FYST14 Atomic and molecular spectroscopy
FYST20 Spectroscopy and the quantum description of matter
FYST21 Light-Matter Interaction
FYST28 Laser-based Combustion Diagnostics
FYST29 Multi-spectral Imaging
FYST36 Molecular Physics
FYST37 Advanced Quantum Mechanics
FYST41 Photonics and Optical Communication
FYST43 Optics and Optical Design
FYTN01Mathematical Methods of Physics

5. Subatomic Physics

FYSN11 Experiments in research and society
FYSN13 Electromagnetism
FYSN15 Experimental tools
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYST11 Theoretical nuclear physics
FYST13 Chaos for science and technology
FYST16 Modern Subatomic Physics
FYST17 Modern Experimental Particle Physics
FYST18 Applied subatomic physics
FYST37 Advanced Quantum Mechanics
FYST38 Environmental Measurement Technology
FYTN01Mathematical Methods of Physics
FYTN04 Theoretical Particle Physics
FYTN08 General Relativity

6. Photonics and Lasers

FYSN11 Experiments in research and society
FYSN13 Electromagnetism
FYSN14 Lasers
FYSN15 Experimental tools
FYSN17 Quantum Mechanics
FYTN02 Statistical Mechanics
FYTN03 Computational Physics
FYSD12 Fundamental Combustion
FYST14 Atomic and molecular spectroscopy
FYST21 Light-Matter Interaction
FYST22 Tissue Optics
FYST28 Laser-based Combustion Diagnostics
FYST29 Multi-spectral Imaging
FYST32 Advanced optics and lasers
FYST36 Molecular Physics
FYST37 Advanced Quantum Mechanics
FYST41 Photonics and Optical Communication
FYST43 Optics and Optical Design
FYTN01Mathematical Methods of Physics

Explanations of descriptions

Language:
S = Swedish
E = English
S/E = English if needed

Study period:
HT1 = September 1-October
HT2 = November-January 18
VT1 = January 19-end of March
VT2 = end of March-beginning of June

Pace:
Pace of course, where 100% implies that you should only take this course during the period, 50% that you should take two courses in parallel and so on.