Wintersemester 2012/2013
Winter Term

Kommentiertes Vorlesungsverzeichnis Physik-Astronomie

Veranstaltungen des Masterstudiums, von den Dozenten/innen kommentiert

Annotated Course Catalogue Physics-Astronomy

a list of advanced courses, with comments by the instructors

Herausgeber: Fachgruppe Physik-Astronomie Oktober 2012

physics612 **Accelerator Physics**
We 10-12, Th 10-12, SR I, HISKP
Diplom: WPVANG, VANG

Instructor(s): W. Hillert, A. Lehrach, R. Maier

Prerequisites:
Mechanics, Electrodynamics

Contents:
Die neuere experimentelle Physik basiert zum Teil auf dem Einsatz von Teilchenbeschleunigern, insbesondere im Bereich der Hochenergiephysik, der Materialforschung und der Erforschung der Substruktur der Atomkerne und der Hadronen. Durch die aktuellen wissenschaftlichen Fragestellungen wurden und werden auch weiterhin ständig gesteigerte Herausforderungen an den Betrieb und die Entwicklung von Teilchenbeschleunigern gestellt, was zum Einsatz modernster Technologien aus einer Vielzahl von physikalischen Bereichen führte (als Beispiele mögen hier die Realisierung einer ca. 27 km langen, fast vollständig supraleitenden Anlage am CERN / Genf oder der Aufbau eines mehr als 3 Kilometer langen 1-Angström Röntgenlasers am DESY / Hamburg dienen). Im Zuge dieser Entwicklungen und systematischen Untersuchungen der physikalischen Vorgänge in Beschleunigern entstand die Beschleunigerphysik als eigenständiger Fachbereich der angewandten Physik.

Die vorliegende Vorlesung ist eine Einführung in die Beschleunigerphysik. Sie gibt einen Überblick über die verschiedenen Funktionsweisen unterschiedlicher Beschleunigertypen und führt, neben einer physikalischen Behandlung der wichtigsten Subsysteme (Teilchenquellen, Magnete, Hochfrequenzresonatoren), in die transversale und longitudinale Strahldynamik ein.

More recent experimental physics is partly based on the use of particle accelerators, especially in high energy physics, materials research and exploration of the substructure of atomic nuclei and hadrons. Due to the current scientific questions, more and more demanding challenges have been and still are posed to the operation and development of particle accelerators, thus leading to the use of state-of-the-art high technology taken from a multitude of fields in physics (as examples may be cited the realisation of a 27 km, almost entirely superconducting facility at CERN / Geneva or the construction of a more than 3 kilometers long 1 Angström X-ray laser at DESY / Hamburg). In the course of these developments and systematic investigation of the physical processes in particle accelerators, particle accelerator physics emerged as a stand-alone field of applied physics.

The present lecture is meant as an introduction into particle accelerator physics. It provides an overview of the various functional principles of different accelerator types and provides, alongside a physical treatment of the most important subsystems (particle sources, magnets, resonant cavities), an introduction into transversal and longitudinal beam dynamics.

Inhaltsverzeichnis / Table of Contents:

Literature:

H. Wiedemann, Particle Accelerator Physics I,
3rd edition, Springer 2007, Berlin, ISBN 978-3-540-49043-2

F. Hinterberger, Physik der Teilchenbeschleuniger und Ionenoptik, 2. Ausgabe, Springer 2008, Berlin, ISBN 978-3-540-75282-0

K. Wille, Physik der Teilchenbeschleuniger und Synchrotronstrahlungsquellen, 2. überarb. und erw. Aufl., Teubner 1996, Stuttgart, ISBN 3-519-13087-4

K. Wille, The physics of particle accelerators, Oxford Univ. Press 2005, Oxford, ISBN 0-19-850550-7

S. Y. Lee, Accelerator Physics, 3rd edition, World Scientific, New Jersey 2012, ISBN 978-981-4374-94-1 (pbk)

D.A. Edwards, M.J. Syphers, An Introduction to the Physics of High Energy Accelerators, Wiley & Sons 1993, New York, ISBN 0-471-55163-5

...

Comments:
Es ist vorgesehen, den Lernstoff durch detaillierte Besichtigungen und praktische Studien an der Beschleunigeranlage ELSA des Physikalischen Instituts sowie Exkursionen zu anderen Beschleunigeranlagen zu veranschaulichen und zu vertiefen.

Zu dieser Vorlesung wird ein Script im Internet (pdf-Format, Englisch) zur Verfügung gestellt. (http://www-elsa.physik.uni-bonn.de/~hillert/Beschleunigerphysik/)

The opportunity will be offered to exemplify and deepen the subject matter by detailed visits and practical studies at the institute of physics'

accelerator facility ELSA and excursions to other accelerator facilities.

Accompanying the lecture, a script (pdf-format, english) will be provided on the internet. (http://www-elsa.physik.uni-bonn.de/~hillert/Beschleunigerphysik/)

physics614 **Laser Physics and Nonlinear Optics**
Tu 8-10, Th 16-18, HS, IAP
Diplom: WPVEXP, VEXP

Instructor(s): F. Vewinger

Prerequisites:
Bachelor in Physics or "Physik-Vordiplom"

Contents:
The course will cover the fundamentals needed for the understanding of the operation of continuous and pulsed laser systems. We will discuss basic properties of the emitted radiation (coherence, linewidth, profile) for different types of lasers, properties of both stable and unstable resonators (mode profile, bandwidth) and the dynamics of the laser output and the atomic population. Different methods for the production of short and ultrashort pulses will aslo be presented, as well as applications of lasers.

In the second part of the course basic concepts of nonlinear optics and their role in laser development will be discussed. These include frequency doubling, Raman lasing, Harmonic generation, to name just a few.

Literature:
Original literature will be given in the lecture. As a textbook, basically any book on laser physics covers the topics of the lecture. Here is a short list:

Laser Physics:
Hooker/Webb, Laser physics (Oxford University Press,Oxford 2010)
Svelto, Principles of lasers (Plenum Press New York 1998)
Silfvast, Laser fundamentals (Cambridge University Press 1996)
Siegman, Lasers (Univ. Science Books 1986)
Milonni/Eberly, Lasers (John Wiley & Sons 1988)

Nonlinear Optics:
Boyd, Nonlinear optics (Academic Press 2003)
Powers, Fundamentals of nonlinear optics (CRC Press 2011)
Butcher/Cotter, The elements of nonlinear optics (Cambridge Universtiy Press 2003)
Mills, Nonlinear optics (Springer Berlin (u.a.) 1991)
Shen, The principles of nonlinear optics (Wiley New York (u.a.) 1984)

Laser Physics & Nonlinear Optics:
Menzel, Photonics (Springer Berlin 2001)
Saleh/Teich, Fundamentals of Photonics (John Wiley & Sons 1991)
Yariv/Yeh, Photonics (Oxford University Press 2007)

Demtröder, Laser spectroscopy (Springer 2008)
Meschede, Optics, light and lasers (Wiley-VCH 2003)

Comments:

physics620 **Advanced Atomic, Molecular and Optical Physics**
Tu 14-16, Th 10-12, HS, IAP
Diplom: WPVEXP, VEXP

Instructor(s): D. Meschede

Prerequisites:

Contents:
see ecampus

Literature:

Comments:

physics615 **Theoretical Particle Physics**
Mo 10-12, Th 13, HS I, PI
Diplom: WPVTHE, VTHE

Instructor(s): M. Drees

Prerequisites:
Relativistic quantum mechanics. Introductory courses in particle physics and quantum field theory are helpful, but not essential.

Contents:
Deriving Feynman rules in the wave function formalism
QED
QCD
Electroweak interactions, completing the standard model of particle physics, including the recent discovery of (most likely) the (or at least a) Higgs boson.

Literature:
Aitchison and Hey: Gauge Theories in Particle Physics
Halzen and Martin: Quarks and Leptons
Peskin and Schroeder: An Introduction to Quantum Field Theory

Comments:
The course (both lectures and tutorials) are in English.
A condition for participation in the final exam is that 50% of the homework of this class have been solved (not necessarily entirely correctly).

physics717 **High Energy Physics Lab**
4 to 6 weeks on agreement

Instructor(s): E. von Törne

Prerequisites:

Contents:
This course offers students in their first year of their Master studies the opportunity to participate in research activities.

Literature:

Comments:
The students join one of the high energy physics groups groups and conduct their own small research project for typically 4 weeks. We recommend to participate in a project during term break (either in spring or summer/ early fall) but projects during the semester are also possible. More information here: http://heplab.physik.uni-bonn.de/

physics719 **BCGS intensive week (Detectors and Physics of Higgs Discovery Machines)**
24.09.2012 - 28.09-2012

Instructor(s): E. von Törne

Prerequisites:

Contents:
This course will of interest both for students starting their master studies, students who start their master project soon, Ph.D. students from other fields of physics who wish to broaden their horizon. The BCGS intensive week aims at providing a detailed insight of an LHC detector and the experiments that are done with them to address important questions of fundamental physics today. Emphasis is put on the recent discovery of a new particle by the ATLAS and CMS experiments which is probably the Higgs boson.

About half of the course is devoted to hand-on projects. Students have the choice between two topics:
- C++ in high energy physics
- FPGA (hardware-near programming)

What does one need to know to built such detectors and to analyse LHC data? While following these lines, particular emphasis is given to
- the scientific and technical requirements of LHC detectors
- the physics of tracking and energy detectors
- the theoretical background of LHC physics (Standard Model + Higgs physics)
- the experimental methods to address these physics questions

Of course, not all topics can be addressed to depth within one week. Thus an effort is made that students will receive an overview and understand the most important mechanisms.

Literature:

Comments:
see web page http://www.uni-bonn.de/~etoerne/teaching/intensive-week12/
The course is an all-day workshop 24.-28. September, starting at 9:15. Studnets from Cologne: There is a regional train at 8:38 from Köln-Süd that would bring you to Bonn in time for the lecture. This train is free with the student ticket.

physics732 **Optics Lab**
4 to 6 weeks on agreement

Instructor(s): F. Vewinger, S. Linden, D. Meschede, M. Weitz

Prerequisites:
BSc

Contents:
The Optics Lab is a 4-6 week long practical training/internship in one of the research groups in Photonics and Quantum Optics, which can have several aspects:
- setting up a small experiment
- testing and understanding the limits of experimental components
- simulating experimental situations

Credit points can be obtained after completion of a written report.

Literature:
Will be given by the supervisor

Comments:

physics740 **Hands-on Seminar: Experimental Optics and Atomic Physics**

Dozent(en): M. Weitz u.M.

Erforderliche Vorkenntnisse:
Optik- und Atomphysik Grundvorlesungen, Quantenmechanik

Inhalt:
Diodenlaser
Optische Resonatoren
Akustooptische Modulatoren
Spektroskopie
Radiofrequenztechnik
Spannungsdoppelbrechung
und vieles mehr

Literatur:
wird gestellt

Bemerkungen:
Vorbesprechung am Montag, den 15.10.12, 9 c.t.,
Konferenzraum IAP, 3. Stock Wegelerstr. 8

Seminartermine ab 22.10.12

physics751 **Group Theory**
We 14-17, SR I, HISKP
Diplom: VTHE, WPVTHE

Instructor(s): S. Krewald, B. Kubis, A. Wirzba

Prerequisites:
quantum mechanics, some knowledge of linear algebra

Contents:

1. Finite groups
2. Group representations and character theory
3. Permutation group and Young tableaux
4. Lie groups and algebras
5. SU(2), SU(3) and the Poincaré group

Literature:

- H.F. Jones, Groups, representations and physics, 2nd ed. (Taylor & Francis, New York, 1998)
- P. Ramond, Group Theory - A Physicist's Survey, (Cambridge University Press, Cambridge, 2010)
- H. Georgi, Lie algebras in particle physics, 2nd ed. (Perseus, Reading, Mass., 1999)
- F. Stancu, Group theory in subnuclear physics (Clarendon, Oxford, 1996)
- M. Hamermesh, Group theory and its application to physical problems (Dover, New York, 1989)

Comments:

physics771 **Environmental Physics**
Th 13-15, HS 118, AVZ I

Instructor(s): B. Diekmann

Prerequisites:
Bachelor (Prediploma for diploma students)
basics in thermodynamics would be helpful

Contents:
time schedule (very preliminary)
Thur 11.10 Introduction
18.10 Introduction continued
25.10 Measurement techniques, .. errors
8.11 Thermodynamics
15.11 Environmental Aspects of use of fossile energy sources
22.11 Greenhouse warming
29.11 Env. asp's of nuclear energy (radioactivity) I
6.12 Env. asp's of nuclear energy (reactors, fuel chain) II
13.12 Environmental aspects of renewable energies
20.12 Ozone Depletion
10.1 Odour propagation & detection
17.1 Physics of sounds & noise
24.1 Elektromagnetic waves & smog smog“
30.1 Summary & Prep seminar SS13 Examinations

Special emphasis will be on environmental aspects of energy use (*)
but also environmental consequences of daily life like electromagnetic smogs
or simply noise:
basic physic's mechanism's, consequences and efficiencies of counteracting mechanisms are discussed in detail
(*) Espt. those from use of nuclear energy after Fukushima will be a main issue (a) worldwide and (b) in germany after 'switch off' decision

Literature:
Diekmann,B., Heinloth,K.: Physikalische Grundlagen der Energieerzeugung, Teubner 1997,
Diekmann,Lodomez, Rosenthal, Energie, in preparation
(from author, on availability)
Boeker, Grendelle, Environmental Physics
Mc Kay, Sustainable Energy without hot Air
more from www.http://withouthotair.com/
Schiffer Energiemarkt Deutschland TÜV Verlag
Have a look into previous courses via 'ecampus' with an acces given
by Bernd Diekmann on authorized request

Comments:

For Diploma students, the lecture is not yet foreseen as VANG lecture.
If necessary the lecture can be upgraded by an additional exercise lecture immediately after the main course. A final examination is foreseen in february.

physics772 **Physics in Medicine I: Fundamentals of Analyzing Biomedical Signals**
Mo 10-12, We 12, SR I, HISKP
Diplom: VANG, WPVANG

Instructor(s): K. Lehnertz

Prerequisites:
Vordiplom, Bachelor

Contents:
Introduction to the theory of nonlinear dynamical systems
- regularity, stochasticity, deterministic chaos, nonlinearity, complexity, causality, (non-)stationarity, fractals
- selected examples of nonlinear dynamical systems and their characteristics (model and real world systems)
- selected phenomena (e.g. noise-induced transition, stochastic resonance, self-organized criticality)
Time series analysis
- linear methods: statistical moments, power spectral estimates, auto- and cross-correlation function, autoregressive modeling
- univariate and bivariate nonlinear methods: state-space reconstruction, dimensions, Lyapunov exponents,
entropies, determinism, synchronization, interdependencies, surrogate concepts, measuring non-stationarity
Applications
- nonlinear analysis of biomedical time series (EEG, MEG, EKG)

Literature:
M. Priestley: Nonlinear and nonstationary time series analysis, London, Academic Press, 1988.

H.G. Schuster: Deterministic chaos: an introduction. VCH Verlag Weinheim; Basel; Cambridge, New York, 1989

E. Ott: Chaos in dynamical systems. Cambridge University Press, Cambridge UK, 1993

H. Kantz, T. Schreiber T: Nonlinear time series analysis. Cambridge University Press, Cambridge UK, 2nd ed., 2003

A. Pikovsky, M. Rosenblum, J. Kurths: Synchronization: a universal concept in nonlinear sciences. Cambridge University Press, Cambridge UK, 2001

Comments:
Beginning: Mon, Oct 8, 10:00 ct

physics774 **Electronics for Physicists**
We 9, Fr 10-12, SR I, HISKP

Instructor(s): P.-D. Eversheim

Prerequisites:
Practical course in electronics

Contents:
One of the "classic" abilities of an experimentalist is to build those instruments himself he needs but can not get otherwise. In this context the knowledge of electronics - in view of the growing electronics aided acquisition and control of experiments - becomes a key skill of an experimentalist.
The intention of this lecture is to enable the students by means of exemplary experiments to work out concepts to solutions for given problems. It will be shown that many of these solutions or concepts to solutions, respectively, are used in other fields of physics too (quantum mechanics, optics, mechanics, acoustics, . . .). At the end of this lecture, the student should:
i) have an overview over the most common parts in electronics.
ii) be concious about the problems of handling electronic parts and assemblies.
iii) understand the concepts that allow an analysis and synthesis of the dynamic properties of systems.

Literature:
1) The Art of Electronics by Paul Horowitz and Winfield Hill,
Cambridge University Press
- "The practitioners bible" -
2) Elektronik für Physiker by K.-H. Rohe,
Teubner Studienbücher
- A short review in analogue electronics -
3) Laplace Transformation by Murray R. Spiegel,
McGraw-Hill Book Company
- A book you really can learn how to use and apply Laplace Transformations -
4) Entwurf analoger und digitaler Filter by Mildenberger,
Vieweg
- Applications of Laplace Transformations in analogue electronics -
5) Aktive Filter by Lutz v. Wangenheim,
Hüthig
- Comprehensive book on OP-Amp applications using the Laplace approach -
6) Mikrowellen by A.J.Baden Fuller,
Vieweg
- The classic book on RF and microwaves basics -
7) Physikalische Grundlagen der Hochfrequenztechnik by Meyer / Pottel
Vieweg
- An interesting approach to explain RF behaviour by acoustic analogies -

Comments:

physics652 **Seminar on Advanced Topics in Photonics and Quantum Optics**
Fr 10-12, HS, IAP
Diplom: SEXP, WPSEXP

Instructor(s): S. Linden, F. Vewinger

Prerequisites:

Contents:
The seminar has two goals: To provide in-depth knowledge about selected key experiments in the field of atomic, molecular and optical physics, and to provide practical training in preparing and presenting excellent talks. During the first meeting the organizers will present a list of topics from which each active participant of the seminar can select one. A preliminary list of topics can be found at http://www.vewinger.iap.uni-bonn.de/index.php?id=152 . Early birds can already book a topic in the lecture-free time.

For each topic literature will be provided. Starting with this material the active participants of the seminar will familiarize themselves with the content. This will be done by discussions as well as by further literature search. Based on the accumulated knowledge an outline for each talk will be made and finally the viewgraphs will be prepared. Then the talk will be presented in the seminar. Typical duration of the talk is 45-60 minutes. After the talk there will be a discussion about the content. And, as a second part of the discussion, technical issues of the talk will be analyzed. Finally, a short written summary of the talk will be prepared and distributed.

Preparation of the talk is a serious amount of work. It is highly recommended to start already at the beginning of the lecture time to familiarize yourself with the content.

Literature:
Will be given by the supervisor.

Comments:
A first meeting will take place Friday, October 12th, in the IAP lecture hall at 10:15, where the available topics will be detailed. However, interested students can contact the organizers also in advance to get already a topic for an own talk.

physics655 **Seminar on Advanced Topics in Surface Analysis Methods**
We 14-16, HS, IAP
Diplom: SANG, WPSEXP

Instructor(s): E. Soergel

Prerequisites:

Contents:
Surface analysis tool with high lateral resolution are basically scanning probe methods. Those comprise:
SXM (= scanning "X" microscopy whereby "X" stands for tunneling, force, Kelvin probe, magnetic force, nearfield-optical, ...)
SEM (scanning electron microscopy) and related techniques.

A mixture of subjects will be proposed for talks

Literature:
Own Literature search, help will be provided.

Comments:
October 10'th: Distribution of the subjects

Basic requirements for a successful participance:
45 min talk and a 3-pages summary

physics656 **Computer-Theoretikum und -Seminar über Analyse biomedizinischer Signale / Computational Physics Seminar on Analyzing Biomedical Signals (D/E)**
Start: October 15th
Mo 14-16, SR II, HISKP
Diplom: SANG, WPSEXP

Instructor(s): K. Lehnertz, B. Metsch

Prerequisites:
Vordiplom, BSc, basics of programming language (e.g., Fortran, C, C++, Pascal)

Contents:
- time series: chaotic model systems, noise, autoregressive processes, real world data
- generating time series: recursive methods, integration of ODEs
- statistical properties of time series: higher order moments, autocorrelation function, power spectra, corsscorrelation function
- state-space reconstruction (Takens theorem)
- characterizing measures: dimensions, Lyapunov-exponents, entropies, testing determinism (basic algorithms, influencing factors, correction schemes)
- testing nonlinearity: making surrogates, null hypothesis tests, Monte-Carlo simulation
- nonlinear noise reduction
- measuring synchronisation and interdependencies

Literature:
- H. Kantz, T. Schreiber T: Nonlinear time series analysis. Cambridge University Press, Cambridge UK, 2nd ed., 2003
- A. Pikovsky, M. Rosenblum, J. Kurths: Synchronization: a universal concept in nonlinear sciences. Cambridge University Press, Cambridge UK, 2001
- WH. Press, BP. Flannery, SA. Teukolsky, WT. Vetterling: Numerical Recipes: The Art of Scientific Computing. Cambridge University Press
- see also: http://www.mpipks-dresden.mpg.de/~tisean/ and http://www.nr.com/

Comments:

6929 **Komplexe Systeme / Complex Systems (D/E)**
Do 16-18, Seminarraum II, HISKP

Instructor(s): G. Schütz

Prerequisites:
Thermodynamics, Quantum Mechanics I

Contents:
Random walks, Stochastic Interacting particle systems, Introduction to the modelling of biological processes (DNA denaturation, Kinetics of protein synthesis) and, if time permits, also socio-economic systems (accumulation of wealth, traffic flow)

Literature:
1) G. Schütz, Exactly solvable models for many-body systems far from equilibrium, vol. 19 of Phase Transitions and Critical Phenomena. (Academic Press, London, 2001)

2) A. Schadschneider, D. Chowdhury, K. Nishinari: Stochastic Transport in Complex Systems: From Molecules to Vehicles (Elsevier 2010) (Table of Contents: http://www.thp.uni-koeln.de/~as/Mypage/toc_book.pdf)

Comments:
Lecture will be held in German or English, depending on the audience. First lecture: 18/10/2012

6816 **Praktikum in der Arbeitsgruppe: Theorie der kondensierten Materie und der nanoskopischen Physik**
http://thp.uni-bonn.de/kroha/
für Studierende im Bachelor-Studiengang,
pr, ganztägig, Dauer nach Vereinb., PI/AVZ

Instructor(s): J. Kroha

Prerequisites:
Quantenmechanik I

Contents:
Bearbeitung kleiner Teilprobleme der Theorie von Vielteilchensystemen in der Festkörperphysik, der nanoskopischen Physik oder der Physik ultrakalter Gase in Zusammenarbeit mit Doktoranden der Gruppe.

Literature:

Comments:

6818 **Praktikum in der Arbeitsgruppe: Polarisiertes Target / Laboratory in the Research Group: Polarized Target (D/E)**
http://polt05.physik.uni-bonn.de
pr, ganztägig, Dauer n. Vereinb., PI

Instructor(s): H. Dutz, S. Goertz u.M.

Prerequisites:
Basics in Thermodynamics, Quantum Mechanics and Solid State Physics.

Contents:
The intention is to provide an overview about the research topics of the working group to the participating students within 4 weeks.

Introduction to the following research activities:

Development of dedicated target cryostats, development of new types of so called internal superconducting magnets, research and diagnostics on new polarizable target materials, improvements in the field of NMR techniques for polarization measurement.
Students will have the oportunity to work on a small research project by their own and to give a final report to the group members.

Literature:
The lectures does not follow a particular text book. Recommendations on background literature will be provided during the course.

Comments:

6821 **Research Internship / Praktikum in der Arbeitsgruppe (SiLab): Semiconductor pixel detector development and materials, FPGAs and ASIC Chips (Design and Testing) (D/E)**
(http://hep1.physik.uni-bonn.de),
whole day, ~4 weeks, preferred during off-teaching terms, by appointment, PI

Instructor(s): F. Hügging, H. Krüger, E. von Törne, N. Wermes u.M.

Prerequisites:
Lectures on detectors and electronics lab course

Contents:
Research Internship:

Students shall receive an overview into the activities of a research group:

here: Development of Semiconductor Pixel Detectors and Micro-Electronics

Literature:
will be handed out

Comments:
early aplication necessary

6822 **Research Internship / Praktikum in der Arbeitsgruppe: Proton-Proton-Collisions at the LHC (D/E) (http://hep1.physik.uni-bonn.de)**
lab, whole day, ~4 weeks, preferred during off-teaching terms, by appointment, PI

Instructor(s): E. von Törne, N. Wermes u.M.

Prerequisites:
Lectures on Particle Physics

Contents:
Within 4 weeks students receive an overview/insight of the research carried out in our research group.

Topics: Analyses of data taken with the ATLAS Experiment at the LHC
especially: Higgs and Top physics, tau-final states and b-tagging

The exact schedule depends on the number of applicants appearing at the same time.

Literature:
will be handed out

Comments:
Early application is required
Contacts: E. von Törne, M. Cristinziani, J. Kroseberg, N. Wermes

6824 **Praktikum in der Arbeitsgruppe: Detektorentwicklung und Teilchenphysik an einem Elektron-Positron-Linearcollider / Laboratory in the Research Group: Detector Development and Particle Physics at an Electron-Positron Linear Collider (D/E)**
pr, ganztägig, ca. 4 Wochen n. Vereinb., vorzugsweise in den Semesterferien, PI

Instructor(s): K. Desch, P. Bechtle

Prerequisites:
Vorlesungen über Teilchenphysik

Contents:
In einem 4 wöchigen Praktikum wird den Studierenden die Möglichkeit gegeben

anhand eines eigenen kleinen Projektes einen Einblick in die Arbeitsweise

der experimentellen Hochenergiephysik zu bekommen.

Themen werden bei der Vorbesprechung vereinbart.

Möglichkeiten (Beispiele):

- Simluation von Prozessen am International Linear Collider

- Messungen an einer Zeitprojektionskammer

Literature:
wird ausgegeben

Comments:
Eine frühe Anmeldung ist erwünscht bei Prof. Desch, Dr. P. Bechtle oder Dr. J. Kaminski

6826 **Praktikum in der Arbeitsgruppe: Neurophysik, Computational Physics, Zeitreihenanalyse**
pr, ganztägig, ca. 4 Wochen, n. Vereinb., HISKP u. Klinik für Epileptologie

Instructor(s): K. Lehnertz u.M.

Prerequisites:
basics of programming language (e.g. C, C++, Pascal)

Contents:
This laboratory course provides insight into the current research activities of the Neurophysics group.

Introduction to time series analysis techniques for biomedical data, neuronal modelling, cellular neural networks. Opportunity for original research on a topic of own choice, with concluding presentation to the group.

Literature:
Working materials will be provided.

Comments:
Contact:

Prof. Dr. K. Lehnertz

email: klaus.lehnertz@ukb.uni-bonn.de

6834 **Praktikum in der Arbeitsgruppe: Vorbereitung und Durchführung optischer und atomphysikalischer Experimente, Mitwirkung an Forschungsprojekten der Arbeitsgruppe / Laboratory in the Research Group: Preparation and conduction of optical and atomic physics experiments, Participation at research projects of the group (D/E)**
pr, ganztägig, 2-6 Wochen n. Vereinb., IAP

Instructor(s): M. Weitz u.M.

Prerequisites:
Optik und Atomphysik Grundvorlesungen, Quantenmechanik

Contents:
Studenten soll frühzeitig die Möglichkeit geboten werden, an aktuellen Forschungsthemen aus dem Bereich der experimentellen Quantenoptik mitzuarbeiten: Ultrakalte atomare Gase, Bose-Einstein-Kondensation, kollektive photonische Quanteneffekte. Die genaue Themenstellung des Praktikums erfolgt nach Absprache.

Literature:
wird gestellt

Comments:
Homepage der Arbeitsgruppe:

http://www.iap.uni-bonn.de/ag_weitz/Bonn_AG_Quantenoptik.html

astro841 **Radio astronomy: tools, applications, and impacts**
Di 16, Do 16-18, Raum 0.012, AIfA
Exercises arranged by appointment

Instructor(s): U. Klein

Prerequisites:
electrodynamics, interstellar medium

Contents:

1. Introduction
history
astrophysics and radio astronomy

2. Single-dish telescopes
Cassegrain and Gregory foci
geometries and ray tracing
antenna diagrams
antenna parameters

3. Fourier optics
Fourier transform
aperture – farfield relations
spatial frequencies and filtering
power pattern
convolution and sampling
resolving power

4. Influence of earth's atmosphere
ionosphere, troposphere
plasma frequency
Faraday rotation
refraction, scintillation
absorption / emission
radiation transport

5. Receivers
total-power and heterodyne systems
system temperature
antenna temperature, sensitivity
Dicke-, correlation receiver
amplifiers
hot-cold calibration

6. Wave propagation in conductors
coaxial cables, waveguides
matching, losses
quasi optics

7. Backend
continuum, IF-polarimeter
spectroscopy
filter spectrometer
autocorrelator
acousto-optical spectrometer
pulsar backend

8. mm and submm techniques
telescope parameters and observables
atmosphere, calibration, chopper wheel
error beam
SIS receivers
bolometers

9. Single-dish observing techniques
on-off, cross-Scan, Raster
continuous mapping, OTF, fast scanning
frequency-switching, wobbling technique

10. Data analysis
sampling theorem
spectroscopy
multi-beam observations
image processing, data presentation

11. Interferometry basics
aperture - image plane
complex visibility
delay tracking
fringe rotation
sensitivity

12. Imaging
Fourier inversion
cleaning techniques
self-calibration
zero-spacing correction

13. VLBI
station requirements
processor

calibration and imaging
retarded baselines
geodesy

14. Spectroscopy
XF and FX correlation
data cubes

15. Polarimetry
cross dipoles
circular feeds
spurious polarization

16. Future developments and science
projects, telescopes
LOFAR, SKA, ALMA, SOFIA, Planck
impacts: ISM, IGM, cosmology ...

Literature:
Lecture Notes (for free; fully spelled out)

Tools of Radio Astronomy
Kristen Rohfs, Thomas L. Wilson
Springer

Radio Astronomy
John D. Kraus
Cygnus-Quasar Books

The Fourier Transform and its Applications
Ronald N. Bracewell
McCraw-Hill Book Company

Comments:

astro853 **The physics of dense stellar systems**
Mo 15-17, Raum 3.010, AIfA

Instructor(s): P. Kroupa

Prerequisites:
Vordiploma or BSc in physics

Contents:
Stars form in groups or clusters that are far denser than galactic fields. Understanding the dynamical processes within these dense stellar systems is therefore important for understanding the properties of stellar populations of galaxies. The contents of this course are:

Fundamentals of stellar dynamics: distribution function, collisionless Boltzmann equation, Jeans equations, Focker-Planck equation, dynamical states,
relaxation, mass segregation, evaporation, ejection, core collapse.
Formal differentiation between star clusters and galaxies.
Binary stars as energy sinks and sources.
Star-cluster evolution.
Cluster birth, violent relaxation.
Birth of dwarf galaxies.

Literature:
1) Lecture notes will be provided.
2) J. Binney, S. Tremaine: Galactic Dynamics (Princeton University Press 1988)
3) D. Heggie, P. Hut: The gravitational million-body problem (Cambridge University Press 2003)
4) Initial Conditions for Star Clusters:
http://adsabs.harvard.edu/abs/2008LNP...760..181K
5) The stellar and sub-stellar IMF of simple and composite populations:
http://adsabs.harvard.edu/abs/2011arXiv1112.3340K
6) The universality hypothesis: binary and stellar populations in star clusters and galaxies:
http://adsabs.harvard.edu/abs/2011IAUS..270..141K

Comments:
Aims: To gain a deeper understanding of stellar dynamics, the birth, origin and properties of stellar populations and the fundamental building blocks of galaxies.

This course corresponds to course astro853 in the M.Ap. programme.

Start: Monday, 08.10.2012, 15:15

astro856 **Quasars and microquasars**
Do 13-15, Raum 0.01, MPIfR

Instructor(s): M. Massi

Prerequisites:

Contents:

Stellar-mass black holes in our Galaxy mimic many of the phenomena seen in quasars but at much shorter timescales. In these lectures we present and discuss how the simultaneous use of multiwavelength observations has allowed a major progress in the understanding of the accretion/ejection phenomenology.

Topics:

- Stellar evolution, white dwarf, neutron star, BH
- Accretion power in astrophysics
- Nature of the mass donor: Low and High Mass X-ray Binaries
- Accretion by wind or/and by Roche lobe overflow
- Eddington luminosity
- Mass function: neutron star or black hole ?
- X-ray observations
- Temperature of the accretion disc and inner radius
- Spectral states
- Quasi Periodic Oscillations (QPO)
- Radio observations
- Single dish monitoring and VLBI
- Superluminal motion
- Doppler Boosting
- Synchrotron radiation
- Plasmoids and steady jet
- AGN

Literature:

Comments:
http://www3.mpifr-bonn.mpg.de/staff/mmassi/#microquasars1

astro893 **Seminar on stars, stellar systems, and galaxies**
Di 16-17:30, Raum 3.010, AIfA

Instructor(s): R. Izzard, P. Kroupa, J. Pflamm-Altenburg

Prerequisites:
Vordiplom or Bachelor in physics;
The lecture "Stars and Stellar Evolution" (astro811);
The lecture "Astrophysics of Galaxies" (astro821)

Contents:
The newest literature (e.g. papers from the electronic pre-print server) relevant to research on stars, stellar populations, galaxies and dynamics;
current and preliminary research results by group members and guests on the above topics.

Literature:
Latest astro-ph pre-prints, or recently published research papers.

Comments:
This course is worth 4 credit points. The corresponding certificate ("Schein") is awarded if the student (a) attends the seminar and (b) holds a presentation. The certificate can be picked up in the office of the secretary on the third floor (AIfA) at the end of the semester.

The students will be introduced to the newest state of knowledge in the field of stellar astrophysics, star clusters, galaxies and dynamics. They will familiarise themselves with open questions and acquire knowledge on the newest methods in research.

astro894 **Seminar on astronomy and astrophysics**
Mo 14.00-15:30, Raum 0.012, AIfA

Instructor(s): F. Bertoldi, J. Kerp, U. Klein, M. Kramer, N. Langer, M. Massi, K. Menten, C. Porciani, T. Reiprich, P. Schneider

Prerequisites:
Lectures: Introduction to astronomy I and II.

Contents:
Current research papers on astrophysical problems (e.g. planet formation, stellar evolution, star clusters,
galaxies, galaxy clusters, quasars, cosmology).

Literature:
Current research papers.

Comments:
This is the main seminar for Master of Astrophysics students. It is worth 4 credit points. The corresponding certificate ("Schein" for diploma students) is awarded if the student
(a) attends the seminars of the other students and
(b) gives a successful presentation.
The certificate can be picked up in the office of Ms. Ellen Vasters (room 3.004) at the end of the semester (only diploma students need to pick one up).

The students will learn to hold a formal but pedagogical presentation about a subject of current international research.

The possible topics will be presented on the first lecture day.

6935 **Practical radio interferometry**
Mi 13-16, Raum 0.008, AIfA

Instructor(s): F. Bertoldi, F. Alves, M. Maercker, S. Mühle

Prerequisites:
None, though basic radioastronomy would be a plus.

Contents:
This lecture series is intended for all Master-level or PhD students, postdocs and grown-up astronomers

who are interested to learn more about the practical issues involved in reducing radio-interferometric data. After basic introduction lectures, the course will consist of specialized lectures and practical sessions that use several data analysis tools (AIPS and CASA).

Literature:
"Synthesis Imaging in Radio Astronomy II" (ASP Conference Series, V. 180, 1998), Editors: Taylor, Carilli,
Perley

Interferometry and Synthesis in Radio Astronomy (Wiley 2001), by Thompson, Moran, Swenson

Comments:

6940 **Physics of supernovae and gamma-ray bursts**
Mi 13.30 - 15.00, Raum 0.012, AIfA

Instructor(s): S. Yoon

Prerequisites:
Some knowledge on stellar evolution is desirable, but not required.

Contents:
In this course, the following topics will be addressed:
- Basic physics on stellar death
- Type Ia supernova, and its application to cosmology
- Core collapse supernova: observation and theory
- Gamma-ray bursts: observation and theory
- Supernova nucleosynthesis and chemical evolution of galaxies
- Probe of the early universe with supernovae and gamma-ray bursts

Literature:
Key references will be given for each course, while some courses will be based on "Introduction to High-Energy Astrophysics" by Stephan Rosswog & Marcus Brueggen, (Cambridge Univ. Press). See the lecture homepage for more details.

Comments: