Wintersemester 2015/2016

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 2015

physics611 **Particle Physics**
Tu, Th 14-16, HS, HISKP

Instructor(s): B. Ketzer

Prerequisites:
BSc Vorlesung physik511 Physik V (Kerne und Teilchen)

Contents:
- Introduction: overview, notations
- Basics: kinematics, Lorentz systems, colliders and fixed target experiments
- Scattering processes: cross section and lifetime, Fermi's golden rule, phase space, 2- and 3-body decays, Mandelstam variables
- Dirac equation, spin and helicity, QED
- Interactions and fields
- e+e- annihilation
- Lepton-p scattering and the quark model
- Symmetries and conservation laws
- Strong interaction and QCD
- Weak interaction
- Electroweak unification and Standard Model tests
- The Higgs Boson

Literature:
The lecture does not follow a particular book but larger parts will be close to the new book by

M. Thomson, "Modern Particle Physics", Cambridge University Press

Further useful books are:

Halzen, Martin Quarks and Leptons
D. Perkins Introduction to High Energy Physics
C. Berger Elementarteilchenphysik
D. Griffith Introduction to Elementary Particles
P. Schmüser Feynman-Graphen und Eichtheorien für Experimentalphysiker

Comments:
This lecture is recommended as the first course for master students interested in (experimental) particle physics.

physics612 **Accelerator Physics**

We, Th 10-12, SR I, HISKP

Instructor(s): W. Hillert

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 der Aufbau des ca. 27 km langen, fast vollständig supraleitenden Large Hadron Colliders (LHC) am CERN / Genf oder des 1 Angström Röntgenlasers (XFEL) 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 construction of the 27 km, almost entirely superconducting Large Hadron Collider (LHC) at CERN / Geneva or the Angström X-ray laser (XFEL) 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 orbit 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/)

Condensed Matter Physics I
Tu 10:00-11:30, Th 12:00-13:30, SR, II. Physikalisches Institut, UKÖLN

Instructor(s): M. Grüninger

Prerequisites:

Contents:
Comprehensive introduction to the basic principles and experimental methods of condensed matter physics. Examples of current research will be discussed. The entire course (I & II, given in 2 semesters) covers the following topics:
crystal structure and binding, reciprocal lattice and diffraction, lattice dynamics,
electronic structure and Fermi surface, semiconductors and metals, transport,
magnetism, superconductivity, optical properties, and correlated electrons.

Literature:
Ashcroft/Mermin: Solid State Physics
Ibach/Lüth, Solid-State Physics
Gross/Marx: Festkörperphysik
Kittel: Introduction to Solid State Physics

Comments:

physics614 Laser Physics and Nonlinear Optics
Tu 10-12, Th 14-16, HS, IAP

Dozent(en): M. Weitz

Erforderliche Vorkenntnisse:
Optics, Atomic Physics, Quantum Mechanics

Inhalt:
- Propagation of Laser Beams, Resonators
- Atom Light Interaction
- Principles of Lasers, Laser Systems
- Properties of Laser Light
- Applications of Lasers
- Frequency Doubling, Sum and Difference Frequency Generation
- Parametric Processes, Four Wave Mixing

Literatur:
- P. Miloni, J. Eberly; Lasers (Wiley, New York, 1988)
- D. Meschede; Optik, Licht und Laser (Teubner, Wiesbaden, 2005)
- F. K. Kneubühl; Laser (Teubner, Wiesbaden, 2005)
- J. Eichler, H.J. Eichler; Laser (Springer, Heidelberg, 2003)
- R. Boyd; Nonlinear Optics (Academic Press, Boston, 2003)
- Y.-R. Shen; The principles of nonlinear optics (Wiley, New York, 1984)

Bemerkungen:
The Lecture is suitable for BSc Students beginning with the 5. Semester and for Master-Students.

physics620 **Advanced Atomic, Molecular and Optical Physics**
Tu 12-14, Th 10-12, HS, IAP

Instructor(s): D. Meschede

Prerequisites:
Quantum mechanics
Atomic Physics

Contents:
Part 1: Atomic and optical physics (Matter and light)
Introduction, overview of the course
Reminder of basic atomic structure (including relativistic corrections)
Atoms in external fields
Interaction of light and matter: electric dipole transitions, selection rules;
Magnetic resonance; Ramsey interferometry, atomic clocks,
Dissipative light-matter interaction
Light forces, optical potentials, Laser cooling
Quantisation of light, cavity-QED

Part 2: Quantum information processing
Basic ideas: qubits, gates
Entanglement and quantum algorithms
Ion traps

Part 3: Molecular Physics
Basic molecules: Hydrogen Molecule;
Molecular potentials, bound states, collisions
Feshbach resonances

Part 4: Quantum gases
Evaporative cooling
Bose-Einstein Condensation;
Fundamentals of many-body physics,
Optical lattices
Ultracold Fermi gases
BEC vs. BCS

Literature:
C. Foot, "Atomic Physics"
C. Pethick/H. Smith, "Bose-Einstein condensation in dilute atomic gases"
L. Pitaevskii/S. Stringari, "Bose-Einstein condensation"
L. Nielsen/I. Chuang "Quantum Computation and Quantum Information"

Comments:

physics615 **Theoretical Particle Physics**
Tu 16-18, Th 9, HS I, PI

Instructor(s): M. Drees

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

Contents:
Classical field theory,
Gauge theories for QED and QCD,
Higgs mechanism,
Standard model of strong and electroweak interactions,
Grand unification,
Nonperturbative aspects of the standard model
Physics beyond the standard model

Literature:
Aitchison and Hey, Gauge theories in particle physics
Cheng and Li, Gauge theories of elementary 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).

physics616 **Theoretical Hadron Physics**
We 14-17, SR I, HISKP

Instructor(s): C. Hanhart, A. Wirzba

Prerequisites:
Quantum Mechanics, Advanced Quantum Theory

Contents:

1. Introduction: brief overview of particle physics
2. Symmetries and Quarks: hadron spectra and interactions, hadron masses, light and heavy quarks, simple quark model,...
3. Hadron Structure: form factors and structure functions, unitarity and analyticity, vector meson dominance, dispersion relations,...
4. Introduction to QCD: QCD Lagrangian, asymptotic freedom,...
5. Chiral symmetry: spontaneous symmetry breaking, Goldstone theorem, hadron interactions at low energies,...

Literature:

- F. Halzen, A.D. Martin; Quarks and Leptons (Wiley 1984)
- D.H. Perkins; Introduction to High Energy Physics (Addison-Wesley 1987)
- J.F. Donoghue et al.; Dynamics of the Standard Model, 2nd ed. (Cambridge University Press 2014)
- A.W. Thomas, W. Weise; The Structure of the Nucleon (Wiley-VCH 2001)
- M.E. Peskin, D.V. Schroeder; An Introduction to Quantum Field Theory (Westview Press 1995)

Comments:
A basic knowledge of Quantum Field Theory is useful.

physics715 **Experiments on the Structure of Hadrons**
Mo 14-16, SR II, HISKP

Instructor(s): H. Schmieden

Prerequisites:
Bachelor in Physics
Quantum Mechanics
Physics IV & V (atomic, nuclear & particle)

Contents:
Key experiments for hadron structure over the last century to very recent.
Hadrons and their interactions.
Quarks and their interactions.
Baryon (in particular nucleon) and meson structure.

Literature:
will be discussed in the lecture

Comments:
Preliminary Discussion (Vorbesprechung) Monday, Oct 19, 14ct (SR II, HISKP)

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. We plan to replace this course by a module that covers all research areas. Projects in high energy physics will still be possible. For questions, please contact Lecturer E. von Törne, evt@physik.uni-bonn.de.

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 (Advanced Topics in High Energy Physics)**
block course, October 12th-16th, Konferenzraum II, PI 1.049, PI

Instructor(s): E. von Törne

Prerequisites:
For the exercises, basic knowledge of C would be good

Contents:
BCGS Intensive Week, "From Hits to Higgs" - a Discovery Simulation for Physics at the LHC
12-16. October, Conference room-II, Physikalisches Institut Bonn

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.

What does one need to know 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.

About half of the course is devoted to a hand-on project which will be organized as a simulation game (planspiel). Participants will use toy data to reconstruct proton proton collisions. Starting from uncalibrated hits we will create our own algorithms and finally search for new physics at the LHC. Students will learn several aspects of C++ and its applications in high energy physics.

Literature:

Comments:
see web page http://pi.physik.uni-bonn.de/~evt/teaching/intensiveweek15/
The course is an all-day workshop, starting on October 12 at 9:15. Students from Cologne: There is a regional express train at 8:38 from Köln-Süd that brings you to Bonn in time for the lecture. This train is free with your student ticket.

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

Instructor(s): F. Vewinger, M. Köhl, 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:
For arranging the topic and time of the internship, please contact the group leader of the group you are interested in directly. Please note that a lead time of a few weeks may occur, so contact the group early. In case you are unsure if/where you want to do the optics lab, please contact Frank Vewinger for information.

physics740 **Hands-on Seminar: Experimental Optics and Atomic Physics**
Mo 9-11, IAP

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 19.10.15, 9 c.t.,
Konferenzraum IAP, 3. Stock Wegelerstr. 8

Seminartermine ab 26.10.15

physics742 **Ultracold Atomic Gases: Experiment and Theory**
We 11-13, Fr 9-11, HS, IAP

Instructor(s): M. Köhl

Prerequisites:
Atomic physics (e.g. phys411); Quantum mechanics (e.g. phys420)

Contents:
Almost hundred years ago, in 1924, A. Einstein and S.N. Bose predicted the existence of a new state of matter, the so-called Bose-Einstein condensate. It took 70 years to successfully realize this macroscopic quantum state in the lab using ultracold atomic gases (Nobel prize 2001). The main challenge was to achieve cooling to Nanokelvin temperatures, the coolest temperatures ever reached by mankind.
Nowadays, ultracold gases are exciting systems to study a broad range of quantum phenomena. These phenomena range from the direct observation of quantum matter waves and superfluidity over the creation of artificial crystal structures as analogous to solids, to the realization of complex quantum phase transitions of interacting atoms, e.g. the formation of a bosonic Mott-insulator or the BCS superconducting state for Fermions. In this lecture we will discuss both the experimental and theoretical concepts of ultra-cold atomic gases.
Outline: Introduction and revision of basic concepts, Fundamentals of atom-laser interaction
Laser cooling & trapping, Bose-Einstein condensation of atomic gases.
Dynamics of Bose-Einstein condensates
Optical lattices: strongly interacting atomic gases and quantum phase transitions
The crossover of Fermi-gases between a BCS superconducting state and a Bose-Einstein condensate of molecules.

Literature:
C. J. Pethick and H. Smith, Bose-Einstein Condensation in Dilute Gases (Cambridge University Press)

Comments:

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

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 19, 10:00 ct

physics774 **Electronics for Physicists**
Tu 12-14, Th 13, HS, 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 control of experiments and data-acquisition - 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. A focus of this lecture is to show 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 Photonics/Quantum Optics**
We 14-16, HS, IAP

Instructor(s): F. Vewinger

Prerequisites:
BSc

Contents:
The seminar will cover "recent" advances in the field of quantum optics, including for example Bose-Einstein condensation, Ultracold Fermi gases, Quantum Information & Communication, Schrödinger Cats etc.

Modern physics builds on a few key experiments which started a new field or settled a long standing debate. Especially the "newer" experiments are not covered in the Bachelor studies, as they require a broad theoretical background.
The seminar has two goals: To provide in-depth knowledge about selected key experiments in the field of quantum optics, 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.

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 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 posted in the internet.

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.

A list of topics is available on ecampus.

Literature:
Will be given in the first seminar.

Comments:
A first meeting will take place wednesday, October 21st, in the IAP lecture hall at 14:15, 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.

physics654 **Seminar on Topics in Advanced Quantum Field Theory**
Th 14-16, Seminarrraum bctp 1

Instructor(s): H. Dreiner, B. Kubis, H.-P. Nilles

Prerequisites:
*) Quantum Field Theory I

Contents:
Possible seminar topics include:
*) Gauge anomalies
*) Monopols
*) Higgs mechanism
*) constructing a supersymmetry Lagrangian
*) SU(5) grand unified theory
*) Strong CP problem, axion

Literature:
A. Zee: Quantum Field Theory in a Nut Shell
Cheng & Lee: Gauge Field Theories

Comments:
* The first meeting will take place on Thursday, Oct. 22nd, 2015 at 2:15pm. The meeting as well as the seminar talks will take place in the large seminar room: in the Bethe Center, on the 3rd floor of Wegelerstrasse 10.

* The seminars will consist of 60min blackboard talks.

physics655 **Computational Physics Seminar on Analyzing Biomedical Signals**
Mo 14-16, SR I, HISKP

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

Prerequisites:
Vordiplom, Bachelor, 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:
Location: Seminarraum I, HISKP
Time: Mo 14 - 16 and one lecture to be arranged
Beginning: Mo October 19 (preliminary discussion)

physics657 **Seminar on Advanced Topics in Surface Science Physics**
Mo 16-18, HS, IAP

Instructor(s): E. Soergel

Prerequisites:

Contents:
Kick-off meeting 19. October 2015

Maximum 12 attendees

Early birds:
Subjects & dates for the talks upon request via email to
soergel@uni-bonn.de

Literature:

Comments:

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

Instructor(s): J. Kroha

Prerequisites:
Quantenmechanik I

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

Literature:

Comments:

6821 **Research Internship / Praktikum in der Arbeitsgruppe (SiLab): Detector Development: Semiconductor pixel detectors, pixel sensors, 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): L. Gonella, F. Hügging, H. Krüger, E. von Törne, N. Wermes u.M.

Prerequisites:
Lecture on detectors and electronics lab course (E-Praktikum)

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 application 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): M. Cristinziani, J. Kroseberg, E. von Törne, N. Wermes

Prerequisites:
Lecture(s) 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, T. Lenz, 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, Python)

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:

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6833 **Praktikum in der Arbeitsgruppe: Aufbau und Test optischer und spektroskopischer Experimente, Erstellung von Simulationen / Laboratory in the Research Group: Setup and Testing of Optical and Spectroscopical Experiments, Simulation Programming (D/E)**
pr, ganztägig, Dauer ca. 4-6 Wochen, n. Vereinb., IAP

Instructor(s): D. Meschede u.M.

Prerequisites:
Two years of physics studies (undergraduate/ bachelor program)

Contents:
Practical training in the research group can have several aspects:

--- setting up a small experiment
--- testing and understanding the limits of experimental components
--- simulating experimental situations
--- professional documentation

The minimum duration is 30 days, or 6 weeks.

Literature:
will be individually handed out

Comments:
Projects are always available. See our website.

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

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

Erforderliche Vorkenntnisse:
Optik und Atomphysik Grundvorlesungen, Quantenmechanik

Inhalt:
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.

Literatur:
wird gestellt

Bemerkungen:
Homepage der Arbeitsgruppe:

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

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

Instructor(s): U. Klein, N. Ben Bekhti, H. Junklewitz

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 ...

<u>Literature:</u>
Lecture Notes (fully spelled-out text, for free, handed out in the class)

<u>Comments:</u>

astro853 **The physics of dense stellar systems**
Mo 15-18, Raum 3.010, AIfA
Exercises arranged by appointment

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.
Galactic field populations.

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, and of the birth, origin and properties of stellar populations and the fundamental building blocks of galaxies. See the webpage for details.

Start: Monday, 19.10.2015, 15:15

astro856 **Quasars and microquasars**
Th 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.

1. Microquasars and Quasars
   Definitions
   Stellar evolution, white dwarf, neutron star, BH

2. 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 ?

3. X-ray observations
   Temperature of the accretion disc and inner radius
   Spectral states
   Quasi Periodic Oscillations (QPO)

4. Radio observations
   Single dish monitoring and VLBI
   Superluminal motion (review, article)
   Doppler Boosting
   Synchrotron radiation
   Plasmoids and steady jet

5. AGN

Literature:

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

astro893 **Seminar on stellar systems: star clusters and dwarf galaxies**
Tu 16:15-17:45, Raum 3.010, AIfA

Instructor(s): 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 either from P.Kroupa or 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.