

Submodule

Interaction of high-energy radiation with matter

Thomas Stöhlker

supported by Renate Martin and Günter Weber



http://web-docs.gsi.de/~stoe_exp/lectures/WS2013/lectures.php

Prof. Dr. Thomas Stöhlker

Web Pages

Jena

<http://www.ioq.uni-jena.de/atomphysik.html>

http://www.helmholtz.de/forschung/forschung_foerdern/helmholtz_institute/helmholtz_institut_jena/

GSI

http://www-linux.gsi.de/~stoe_exp/

Web Page / Lecture

http://web-docs.gsi.de/~stoe_exp/lectures/WS2013/lectures.php

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Number	
Name	Interaction of high-energy radiation with matter
Coordinator	Prof. Th. Stöhlker
Learning objectives	The course introduces the basic interaction processes of high-energy photon and particle beams with matter. The course covers recent developments of high intensity radiation sources, such as Free Electron Lasers and modern particle accelerators.
Content	<ul style="list-style-type: none"> - Fundamental interaction processes - Scattering, absorption and energy loss - Detection methods - Particle creation - Application and biology and medicine
Course type	lectures: 2h/week exercises: 1h/week
ECTS credits	4
Category	submodule which can be elected out of the list of offered submodules in module Specialization II according to the student's education objectives
Usability	this submodule is part of the module Specialization II in the 3 rd semester of the Master of Photonics program
Frequency of offer	winter semester
Duration	1 semester
Work load	lectures: 30h exercises: 15h self-study: 75h total work load: 120h
Language	English
Prerequisites	none
Exam prerequisites	regular participation in lectures and exercises
Requirements to complete this submodule	Presentation and oral examination
Used media	electronic presentations, blackboard
Literature	<ul style="list-style-type: none"> - Leo, Techniques for Nuclear and Particle Physics Experiments - Haken-Wolf, Atom- und Quantenphysik



Ankündigung Vorlesung

Wechselwirkung hochenergetischer Teilchen- und Photonenstrahlung mit Materie

Dozent: Prof. Dr. Thomas Stöhlker (IOQ und Helmholtz-Institut Jena)

Die Anwendungen moderner Teilchenbeschleuniger reichen von der Erforschung der fundamentalen Bausteine und Kräfte in der Natur bis hin zum Einsatz in der Biologie und Medizin. In diesem Kontext gewinnen Hochintensitätslaser zur Erzeugung hochenergetischer Teilchen und deren Einsatz als intensive Strahlungsquellen zunehmend an Bedeutung.

Der thematische Schwerpunkt der Vorlesung konzentriert sich auf die physikalischen Prozesse und begleitenden Phänomene, die bei der Wechselwirkung hochenergetischer Teilchen mit Materie auftreten.

So werden beispielhaft folgende Themen behandelt:

- elementare Wechselwirkungsprozesse
- Streuung, Absorption und Energieverlust
- Teilchenerzeugung
- Nachweismethoden
- Anwendungen in der Biologie und Medizin.

Studiengang: Master of Physics, Master of Photonics

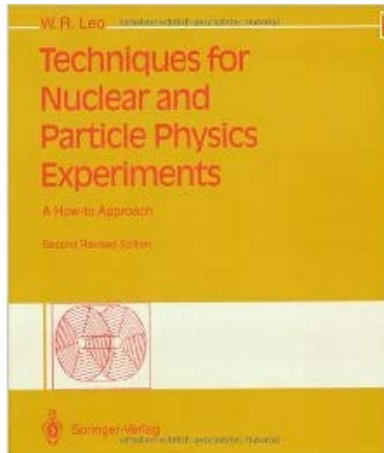
2 Stunden und 1 Std. Seminar/Übung (Englisch)

Mittwochs zwischen 10:00 - 12:00

Seminarraum 205, Helmholtz-Institut, Fröbelstieg 3

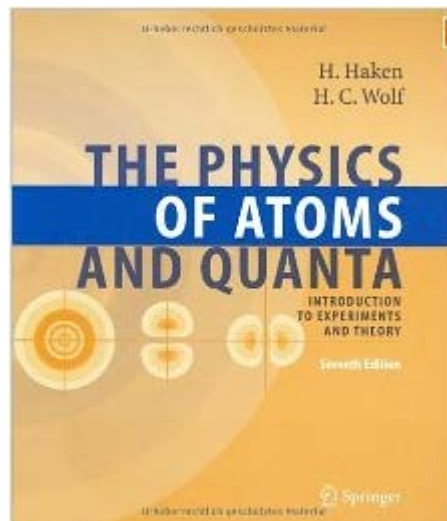


Literature: Main sources



W.R. Leo

“Techniques for Nuclear and Particle Physics Experiments”



H. Haken and H.C. Wolf

“The Physics of Atoms and Quanta”

Additional and Comprehensive Literature

General

H. Bethe and E. Salpeter
“Quantum Mechanics of One- and Two-Electron Systems”

H. Haken and H. C. Wolf
“Atom- und Quantenphysik Einführung in die experimentellen und theoretischen Grundlagen”

W. Demtröder
“Experimentalphysik 3: Atome, Moleküle und Festkörper”

K. Bethge, G. Gruber and Th. Stöhlker
“Physik der Atome und Moleküle”

Experimental/Statistics

K. Kleinknecht
„Detektoren für Teilchenstrahlung“



Sources in the Internet

General

<http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html>

NIST

Physical Reference Data

<http://www.nist.gov/pml/data/>

X-ray Emission Lines

<http://www.nist.gov/pml/data/xraytrans/index.cfm>

Berkeley National Laboratory

Table of Isotopes

<http://ie.lbl.gov/education/isotopes.htm>

Atomic Data

<http://ie.lbl.gov/atomic/atom.htm>

Elemental Physical Properties

<http://ie.lbl.gov/elem/elem.htm>

CODATA Internationally recommended values of the Fundamental Physical Constants

<http://physics.nist.gov/cuu/Constants/index.html>

Institute of Chemistry, Free University Berlin

Fundamental Physical Constants

http://www.chemie.fu-berlin.de/chemistry/general/constants_en.html

Conversion of Units

http://www.chemie.fu-berlin.de/chemistry/general/units_en.html

Periodic tables (professional edition)

<http://www.webelements.com/>

Korea Atomic Energy Research Institute

Table of Nuclides

<http://atom.kaeri.re.kr/ton/nuc6.html>

Center for Synchrotron Radiation Research and Instrumentation, Chicago, United States

Periodic Table of Elements - X-ray properties

<http://www.csrri.iit.edu/periodic-table.html>

Let`s hope, the US will solve their problem

National Institute of
Standards and Technology

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

NIST Closed, NIST and Affiliated Web Sites Not Available

Due to a lapse in government funding, the National Institute of Standards and Technology (NIST) is closed and most NIST and affiliated web sites are unavailable until further notice. We sincerely regret the inconvenience.

The [National Vulnerability Database](#) and the [NIST Internet Time Service](#) web sites will continue to be available. A limited number of other web sites may also be available.

Notice will be posted here (www.nist.gov) once operations resume. You may also get updates on NIST's operating status by calling (301) 975-8000.

Conferences and other events scheduled during the shutdown are postponed or cancelled. Even after NIST reopens, some NIST events may need to be rescheduled. Once access to NIST Web sites resumes, please see the [Conferences and Events](http://www.nist.gov/allevts.cfm) (<http://www.nist.gov/allevts.cfm>) list for updated information on specific events.

X-Ray Data Booklet

UPDATE October 2009

A new version of the booklet is now available!
Please visit the [CXRO](http://xdb.lbl.gov) web site to obtain your copy.

[X-Ray Data Booklet \(October 2009\)\[pdf\]](#)

● [Introduction](#)

● [X-Ray Properties of Elements](#)

- [Electron Binding Energies](#)
- [X-Ray Energy Emission Energies](#)
- [Fluorescence Yields for K and L Shells](#)
- [Principal Auger Electron Energies](#)
- [Subshell Photoionization Cross-Sections](#)
- [Mass Absorption Coefficients](#)
- [Atomic Scattering Factors](#)
- [Energy Levels of Few Electron Ions](#)
- [Periodic Table of X-Ray Properties](#)

● [Synchrotron Radiation](#)

- [Characteristics of Synchrotron Radiation](#)
- [History of X-rays and Synchrotron Radiation](#)
- [Synchrotron Facilities](#)

● [Scattering Processes](#)

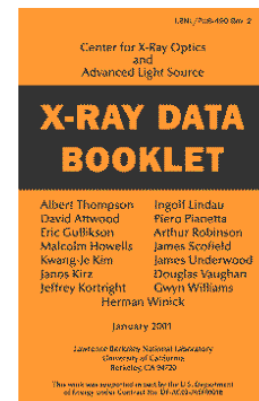
- [Scattering of X-rays from Electrons and Atoms](#)
- [Low-Energy Electron Ranges in Matter](#)

● [Optics and Detectors](#)

- [Crystal and Multilayer Elements](#)
- [Specular Reflectivities for Grazing](#)
- [Gratings and Monochromators](#)
- [Zone Plates](#)
- [X-Ray Detectors](#)

● [Miscellaneous](#)

- [Physical Constants](#)
- [Physical Properties of the Elements](#)
- [Electromagnetic Relations](#)
- [Radioactivity and Radiation Protection](#)
- [Useful Formulas](#)



To view the X-Ray Data Booklet,
you need [Adobe Reader](#).

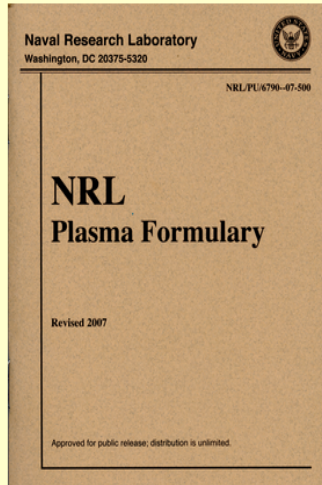
<http://xdb.lbl.gov/>

NRL Plasma Formulary

2007 Revised Edition

The NRL Plasma Formulary has been the mini-Bible of plasma physicists for the past 25 years. It is an eclectic compilation of mathematical and scientific formulas, and contains physical parameters pertinent to a variety of plasma regimes, ranging from laboratory devices to astrophysical objects.

Any questions, suggestions, comments, etc. should be directed to (ppdweb@ppd.nrl.navy.mil).



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There is no charge for the NRL Plasma Formulary Booklets (i.e., they're free).

<http://wwwppd.nrl.navy.mil/nrlformulary/>

Our “road map”

Lectures

- 1 16.10.2012 Preliminary Discussion / Introduction

Basics concepts, Dirac sea, Creation of Particles

- 2 23.10.2013 Dirac Theory
- 3 30.10.2013 Atomic Decay Modes and Radiation Properties
- 4 06.11.2013 Interaction of Photons with Matter
- 5 13.11.2013 Interaction of Charged Particles with Matter
- 6 20.11.2013 Key Experiments

Sources of High Energetic Radiation

- 7 27.11.2013 Nuclei and their Decay Modes
- 8 04.12.2013 Cosmic Radiation

Detectors

- 9 11.12.2013 Photon-, x-ray-, gamma-detectors
- 10 18.12.2013 Particle Detectors

Applications

- 11 08.01.2014 Radiation and their Biological Effectiveness
- 12 15.01.2014 Application of Charged Particle to Cancer Therapy

Novel Accelerators

- 13 22.01.2014 Novel Photon Sources
- 14 29.01.2014 Modern Accelerators for Ions and Exotic Nuclei

Summary

- 15 05.02.2014

Exercises

Basics concepts, Dirac sea, Creation of Particles

- 1 31.10.2013
- 2 14.11.2013
- 3 28.11.2013

Sources of High Energetic Radiation

- 4 12.12.2013

Detectors

- 5 09.01.2014

Applications

- 6 23.01.2014

Novel Accelerators

- 7 06.02.2014