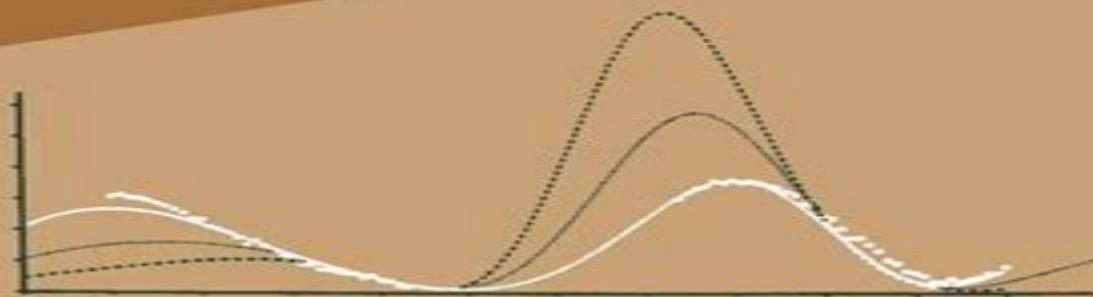


Harald Friedrich

# Theoretical Atomic Physics



Springer-Verlag

# Theoretical Atomic Physics

**Niels Bohr**



## **Theoretical Atomic Physics:**

**Theoretical Atomic Physics** Harald Friedrich, 2017-05-10 This expanded and updated well established textbook contains an advanced presentation of quantum mechanics adapted to the requirements of modern atomic physics. It includes topics of current interest such as semiclassical theory, chaos, atom optics and Bose-Einstein condensation in atomic gases. In order to facilitate the consolidation of the material covered, various problems are included together with complete solutions. The emphasis on theory enables the reader to appreciate the fundamental assumptions underlying standard theoretical constructs and to embark on independent research projects. The fourth edition of *Theoretical Atomic Physics* contains an updated treatment of the sections involving scattering theory and near threshold phenomena manifest in the behaviour of cold atoms and molecules. Special attention is given to the quantization of weakly bound states just below the continuum threshold and to low energy scattering and quantum reflection just above. Particular emphasis is laid on the fundamental differences between long ranged Coulombic potentials and shorter ranged potentials falling off faster than  $1/r^2$  at large distances  $r$ . The new sections on tunable near threshold Feshbach resonances and on scattering in two spatial dimensions also address problems relevant for current and future research in the field of cold and ultra cold atoms. Graduate students and researchers will find this book a valuable resource and comprehensive reference alike.

*Theoretical Atomic Physics* Harald Siegfried Friedrich, 2013-03-09 Atomic physics is a pioneering discipline at the forefront of theoretical and experimental physics. It has played a major role in advancing our understanding of chaotic systems. The 1997 Nobel Prize in Physics was awarded for progress in cooling atoms to extremely low temperatures. This new edition of *Theoretical Atomic Physics* takes into account recent developments and includes sections on semiclassical periodic orbit theory, scaling properties for atoms in external fields, threshold behaviour of ionization cross sections, classical and quantum dynamics of two electron atoms and Bose-Einstein condensation of atomic gases. Moreover, for students there are 48 problems with complete solutions which makes this course the most thorough introduction to the field available.

**Theoretical Atomic Physics** Harald Siegfried Friedrich, 2005-12-27 level and a good understanding of the links to classical mechanics is almost always helpful. The aim of *Theoretical Atomic Physics* remains to provide the reader with a solid foundation of this sort of advanced quantum mechanics. In preparing the third edition I have again tried to do justice to the rapid development of the field. I have included references to important new work whenever this seemed appropriate and easy to do. Chapter 1 now includes a section on processes involving wave packets of continuum states and also an expanded treatment of the semiclassical approximation. Chapter 3 begins with a section illuminating the characteristic differences in the near threshold properties of long ranged and shorter ranged potentials and the first section of Chap 4 contains a more elaborate discussion of scattering lengths. As a further special topic in Chap 5 there is a section describing some aspects of atom optics including discussions of the interactions of atoms with material surfaces and with light fields. The appendix on special mathematical functions has been slightly

expanded to accommodate a few results that I repeatedly found to be useful I am grateful to many colleagues who continue to inspire me with numerous discussions involving atomic physics quantum mechanics and semiclassical connections in particular Robin Coté at the University of Connecticut Manfred Kleber at the Technical University Munich and Jan Michael Rost at the Max Planck Institute for Complex Systems in Dresden

**Relativistic Quantum Theory of Atoms and Molecules** Ian P Grant, 2007-04-15 This book is intended for physicists and chemists who need to understand the theory of atomic and molecular structure and processes and who wish to apply the theory to practical problems As far as practicable the book provides a self contained account of the theory of relativistic atomic and molecular structure based on the accepted formalism of bound state Quantum Electrodynamics The author was elected a Fellow of the Royal Society of London in 1992

**Handbook of Theoretical Atomic Physics** Miron Amusia, Larissa Chernysheva, Victor Yarzhevsky, 2012-07-23 The aim of this book is to present highly accurate and extensive theoretical Atomic data and to give a survey of selected calculational methods for atomic physics used to obtain these data The book presents the results of calculations of cross sections and probabilities of a broad variety of atomic processes with participation of photons and electrons namely on photoabsorption electron scattering and accompanying effects Included are data for photoabsorption and electron scattering cross sections and probabilities of vacancy decay formed for a large number of atoms and ions Attention is also given to photoionization and vacancy decay in endohedrals and to positron atom scattering The book is richly illustrated The methods used are one electron Hartree Fock and the technique of Feynman diagrams that permits to include many electron correlations This is done in the frames of the Random Phase approximation with exchange and the many body perturbation theory Newly obtained and previously collected atomic data are presented The atomic data are useful for investigating the electronic structure and physical processes in solids and liquids molecules and clusters astronomical objects solar and planet atmospheres and atomic nucleus Deep understanding of chemical reactions and processes is reached by deep and accurate knowledge of atomic structure and processes with participation of atoms This book is useful for theorists performing research in different domains of contemporary physics chemistry and biology technologists working on production of new materials and for experimentalists performing research in the field of photon and electron interaction with atoms molecules solid bodies and liquids

**Theoretical Atomic Spectroscopy** Zenonas Bronislavovich Rudzikas, 1997-12-04 This monograph presents a complete guide to the theory of modern spectroscopy of atoms Atomic spectroscopy continues to be one of the most important subjects of contemporary physics The book describes the contemporary state of the theory of many electron atoms and ions the peculiarities of their structure and spectra the processes of their interaction with radiation and some of the applications of atomic spectroscopy It contains a large number of new results which have been published mainly in Russian and are therefore almost unknown to western scientists Primarily a reference for researchers and graduate students in atomic physics and physical chemistry this work will also be of value to physicists and chemists in other areas

who use spectroscopy in their work *Atomic Physics* Max Born, Roger John Blin-Stoyle, J. M. Radcliffe, 1989-06-01 Nobel Laureate's lucid treatment of kinetic theory of gases elementary particles nuclear atom wave corpuscles atomic structure and spectral lines much more Over 40 appendices bibliography **Atomic Physics and Human Knowledge** Niels Bohr, 2017-01-12 This collection of articles which were first published in 1958 and written on various occasions between 1932 and 1957 forms a sequel to Danish physicist Niels Bohr's earlier essays in *Atomic Theory and the Description of Nature* 1934 The theme of the papers is the epistemological lesson which the modern development of atomic physics has given us and its relevance for analysis and synthesis in many fields of human knowledge The articles in the previous edition were written at a time when the establishment of the mathematical methods of quantum mechanics had created a firm foundation for the consistent treatment of atomic phenomena and the conditions for an unambiguous account of experience within this framework were characterized by the notion of complementarity In the papers collected here this approach is further developed in logical formulation and given broader application [Atomic Physics 3](#) Stephen Smith, 2012-12-06 Session A Status of QED Experiments Status of Quantum Electrodynamics Theory Atomic Physics and Quantum Electrodynamics in the Infinite Momentum Frame Theories of the Fine Structure Constant  $g_j$   $H$   $g_S$   $e$  Determination Preliminary Results Session B Exotic Atoms Highly Excited States of Helium and Neon Theoretical Study of Atomic Rydberg States Inner Shell Ionization by Heavy Charged Particles Fine Structure and Hyperfine Structure of the Helium Negative Ion Statistical Theory of Atom and Ion Polarizabilities Session C Ab Initio Calculations of Atomic Energy Spectra **Atomic Structure** Colm T. Whelan, 2018-05-03 A knowledge of atomic theory should be an essential part of every physicist's and chemist's toolkit This book provides an introduction to the basic ideas that govern our understanding of microscopic matter and the essential features of atomic structure and spectra are presented in a direct and easily accessible manner Semi-classical ideas are reviewed and an introduction to the quantum mechanics of one and two electron systems and their interaction with external electromagnetic fields is featured Multielectron atoms are also introduced and the key methods for calculating their properties reviewed [Atomic and Quantum Physics](#) Hermann Haken, Hans C. Wolf, 2012-12-06 Atomic physics and its underlying quantum theory are the point of departure for many modern areas of physics astrophysics chemistry biology and even electrical engineering This textbook provides a careful and eminently readable introduction to the results and methods of empirical atomic physics The student will acquire the tools of quantum physics and at the same time learn about the interplay between experiment and theory A chapter on the quantum theory of the chemical bond provides the reader with an introduction to molecular physics Plenty of problems are given to elucidate the material The authors also discuss laser physics and nonlinear spectroscopy incorporating latest experimental results and showing their relevance to basic research Extra items in the second edition include solutions to the exercises derivations of the relativistic Klein Gordon and Dirac equations a detailed theoretical derivation of the Lamb shift a discussion of new developments in the spectroscopy of inner

shells and new applications of NMR spectroscopy for instance tomography New Directions in Atomic Physics: Theory Edward Uhler Condon,1972 Theoretical Atomic Physics Code Development Joseph Abdallah,Los Alamos National Laboratory,1988 *Theoretical Atomic Physics for Fusion* ,1992 The understanding of electron ion collision processes in high temperature plasmas remains a key factor in the ultimate development of nuclear fusion as a viable energy source for the nation Our 1990 1992 research proposal delineated 3 main areas of research in electron ion scattering theory Summaries our 1992 efforts in each of these research areas are presented **Works on Atomic Physics, 1912-1917** Niels Bohr,1982-01 New Directions in Atomic Physics: Theory Oktay Sinanoglu,1972 *Essays 1958-1962 on Atomic Physics and Human Knowledge* Niels Bohr,1987 **Theoretical Atomic Physics Code Development IV Lines** J. Abdallah,R. E. H. Clark,1988 **Theoretical Atomic Physics Code Development at Los Alamos** ,1989 We have developed a set of computer codes for atomic physics calculations at Los Alamos These codes can calculate a large variety of data with a minimum of effort on the part of the user In particular differential cross sections and electron impact coherence parameters can be readily obtained for arbitrary ions or atoms Currently the theory consists of non relativistic Hartree Fock structure calculations and non relativistic distorted wave approximation or first order many body theory collisional calculations 12 refs 2 figs 5 tabs *Semiclassical Theory of Atoms* Berthold-G. Englert,2014-08-23 Semiclassical Theory of Atoms presents a novel approach to theoretical atomic physics The fundamental quantity in this new powerful formalism is the effective potential not the density The starting point is the highly semiclassical approximation known as the Thomas Fermi model It is studied in great detail and then refined in three steps by adding quantum corrections successively according to their importance First the strongly bound electrons are treated in detail Second the bulk of electrons is better described by introducing quantum corrections to the Thomas Fermi treatment and by including the exchange interaction At this stage predicted binding energies for instance are correct to within a small fraction of a percent Third shell effects are introduced The improved semiclassical treatment is then sufficiently refined to reproduce the systematics of the Periodic Table It addresses the graduate student with a good knowledge of elementary quantum mechanics

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