Atoms In Intense Laser Fields

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Atoms in Electromagnetic Fields Springer Science & Business Media
Atoms in strong radiation fields are interesting objects for study, and the research field that concerns itself with this study is a comparatively young one. For a long period after the ~scovery of the photoelectric effect. it was not possible to generate electro magnetic fields that did more than perturb the atom only slightly, and (first-or~er) perturbation theory could perfectly explain what was going on at those low intensities. The development of the pulsed laser bas changed this state of affairs in a rather dramatic way, and fields can be applied that really have a large, or even dominant influence on atomic structure. In the latter case, w~ speak of super-intense fields. Since the interaction between atoms and electromagnetic waves is characterized by many parameters other than the light intensity, such as frequency, iQnization potential, orbit time, etc., it is actually quite difficult to define what is exactly meant by the term 'super-intense'. Obviously the term does not have an absolute meaning, and intensity should always be viewed in relation to other properties of the system. An atom in a radiation field can thus best be described in terms of various ratios of the quantities involved. The nature of the system sometimes drastically changes if the value of one of these parameters exceeds a certain critical value, and the new regime could be called super-intense with respect to that parameter.
Progress in Ultrafast Intense Laser Science XIV Springer
Comprises a comprehensive reference source that unifies the entire fields of atomic molecular and optical (AMO) physics, assembling the principal ideas, techniques and results of the field. 92 chapters written by about 120 authors present the principal ideas, techniques and results of the field, together with a guide to the primary research literature (carefully edited to ensure a uniform coverage and style, with extensive cross-references). Along with a summary of key ideas, techniques, and results, many chapters offer diagrams of apparatus, graphs, and tables of data. From atomic spectroscopy to applications in comets, one finds contributions from over 100 authors, all leaders in their respective disciplines. Substantially updated and expanded since the original 1996 edition, it now contains several entirely new chapters covering current areas of great research interest that barely existed in 1996, such as Bose-Einstein condensation, quantum information, and cosmological variations of the fundamental constants. A fully-searchable CD- ROM version of the contents accompanies the handbook.
Super-Intense Laser—Atom Physics Springer Science & Business Media
Multiphoton Processes in Atoms in intense laser-light fields is gaining ground as a spectroscopic diagnostic tool. The authors present descriptions of processes occurring in atoms under the action of strong electromagnetic radiation, in particular, the shift, broadening, and mixing of atomic states. The topics include tunneling ionization, above-threshold ionization, ionization of multiply charged ions, resonance-enhanced ionization, super-intense radiation fields, and properties of Rydberg states strongly perturbed by laser radiation.
Intense Laser Phenomena and Related Subjects Springer Science & Business Media
The development of lasers capable of producing high-intensity pulses has opened a new area in the study of light-matter interactions. The corresponding laser fields are strong enough to compete with the Coulomb forces in controlling the dynamics of atomic systems and give rise to multiphoton processes. This book presents a unified account of this rapidly developing field of physics. The first part describes the fundamental phenomena occurring in intense laser-atom interactions and gives the basic theoretical framework to analyze them. The second part contains a detailed discussion of Floquet theory, the numerical integration of the wave equations and approximation methods for the low- and high-frequency regimes. In the third part, the main multiphoton processes are discussed: multiphoton ionization, high harmonic and attosecond pulse generation, and laser-assisted electron-atom collisions. Aimed at graduate students in atomic, molecular and optical physics, the book will also interest researchers working on laser interactions with matter.
Springer Handbook of Atomic, Molecular, and Optical Physics World Scientific
Proceedings of the 30th Course of the International School of Quantum Electronics on Atoms, Solids and Plasmas in Super-Intense Laser Fields, held 8-14 July, in Erice, Sicily
High-Resolution Experiments on Strong-Field Ionization of Atoms and Molecules Springer
It is a great pleasure that we are now publishing the fourth volume of the series on PUILS, through which we have been introducing the progress in ultrafast intense laser science, the frontiers of which are rapidly expanding, thanks to the progress in ultrashort and high-power laser technologies. The interdisciplinary nature of this research ?eld is attracting researchers with di?erent expertise and backgrounds. As in the previousvolumeson PUILS, each chapter in the presentvolume, which is in the range of 15 – 25 pages, begins with an introduction in which a clear and concise account of the signi?cance of the topic is given, followed by a description of the authors ' most recent research results. All the chapters are peer-reviewed. The articles of this fourth volume cover a diverse range of the interdisciplinary research ?eld, and the topics may be grouped into four categories: strong ?eld ionization of atoms (Chaps. 1 – 2), excitation, ioni- tion and fragmentation of molecules (Chaps. 3 – 5), nonlinear intense optical phenomena and attosecond pulses (Chaps. 6 – 8), and laser solid interactions and photoemissions (Chaps. 9 – 11).
Multiphoton Processes in Atoms Springer
This book covers a broad range of topics from the interdisciplinary research field of ultrafast intense laser science, focusing on atoms and molecules interacting with intense laser fields, laser-induced filamentation, high-order harmonics generation, and high power lasers and their applications. This sixteenth volume features contributions from world-renowned researchers, introducing the latest reports on probing molecular chirality with intense laser fields, and the most recent developments in the Shanghai Superintense Ultrafast Laser Facility project. The PUILS series delivers up-to-date reviews of progress in this emerging interdisciplinary research field, spanning atomic and molecular physics, molecular science, and optical science, which has been stimulated by the recent developments in ultrafast laser technologies. Each volume compiles peer-reviewed articles authored by researchers at the forefront of each of their own subfields of ultrafast intense laser science. Every chapter opens with an overview of the topics to be discussed, so that researchers unfamiliar to the subfield, especially graduate students, can grasp the importance and attractions of the research topic at hand; these are followed by reports of cutting-edge discoveries.
Muonic Atoms in Super Intense Laser Fields Springer Science & Business Media
In studying the radiation-matter interaction, one can take two different approaches. The first is typical of spectroscopy: one considers the interaction between radi ation and a single atom, i. e. , one studies those phenomena in which the presence of other atoms is irrelevant. The other attitude consists, in contrast, in studying those phenomena which arise just from the simultaneous presence of many atoms. In fact, all the atoms interact with the same electromagnetic field; under suitable conditions, this situation creates strong atom-atom correlations, which in turn give rise to a cooperative behavior of the system as a whole. Cooperative means that the overall behavior is quite different from the superposition of the effects arising from single atoms and is completely unpredictable if one neglects the coup ling between the atoms induced by their common electromagnetic field. This book contains five complete and up-to-date contributions on the theory and experiments of three coherence effects in radiation-matter interaction: resonance fluorescences, optical bistability, and superfluorescence. They have raised in creasing interest in recent years from both a fundamental and an applicative view point. Even if their phenomenology appears completely different, these effects be long in the same book because they are striking examples of open systems driven far from thermal equilibrium, as those considered in Haken's synergetics and in Prigogine's theory of dissipative structures. This aspect is discussed in the in troducting chapter, in which we outline the basic physics and the essential features which unify these three effects.
Advances Of Atoms And Molecules In Strong Laser Fields Springer Science & Business Media
A unified account of the rapidly developing field of high-intensity laser-atom interactions, suitable for both graduate students and researchers.
Multiphoton Processes in Atoms Springer
Probing and controlling electrons and nuclei in matter at the attosecond timescale became possible with the generation of attosecond pulses by few-cycle intense lasers, and has revolutionized our understanding of atomic structure and molecular processes. This book provides an intuitive approach to this emerging field, utilizing simplified models to develop a clear understanding of how matter interacts with attosecond pulses of light. An introductory chapter outlines the structure of atoms and molecules and the properties of a focused laser beam. Detailed discussion of the fundamental theory of attosecond and strong-field physics follows, including the molecular tunnelling ionization model (MO-ADK theory), the quantitative rescattering (QRS) model, and the laser induced electronic diffraction (LIED) theory for probing the change of atomic configurations in a molecule. Highlighting the cutting-edge developments in attosecond and strong field physics, and identifying future opportunities and challenges, this self-contained text is invaluable for students and researchers in the field.
Progress in Ultrafast Intense Laser Science: Stabilization of atoms in a strong laser field Cambridge University Press
The proceedings of a May 1991 workshop in Hamilton, Ontario. The 35 papers reflect the expansion of the interest in how atoms behave in laser fields to include molecules, and suggest that advancing laser technology is pushing toward the frontier of nonlinear photochemistry and photophysics, so that
Coherence Phenomena in Atoms and Molecules in Laser Fields Springer
The PUILS series delivers up-to-date reviews of progress in Ultrafast Intense Laser Science, a newly emerging interdisciplinary research field spanning atomic and molecular physics, molecular science, and optical science, which has been stimulated by the recent developments in ultrafast laser technologies. Each volume compiles peer-reviewed articles authored by researchers at the forefront of each their own subfields of UILS. Every chapter opens with an overview of the topics to be discussed, so that researchers unfamiliar to the subfield, as well as graduate students, can grasp the importance and attractions of the research topic at hand; these are followed by reports of cutting-edge discoveries. This tenth volume covers a broad range of topics from this interdisciplinary research field, focusing on electron scattering by atoms in intense laser fields, atoms and molecules in ultrashort pulsed EUV and X-ray light fields, filamentation induced by intense laser fields, and physics in super-intense laser fields.
Attosecond and Strong-Field Physics Springer Science & Business Media
This book presents a collection of papers, written during the last 33 years by Claude Cohen-Tannoudji and his collaborators, on various physical effects which can be observed on atoms interacting with electromagnetic fields. It consists of a personal selection of review papers, lectures given at schools, as well as original experimental and theoretical papers. Emphasis is put on physical mechanisms and on general approaches, such as the dressed atom approach, having a wide range of applications. Various topics are discussed, such as light shifts, level crossing resonances, multiphoton processes, resonance fluorescence in intense laser fields, photon correlations, quantum jumps, radiative corrections, laser cooling and trapping.This volume includes short introductions by the author. Each paper presented in the volume is preceded by a short commentary giving its motivations, explaining how it fits with the general evolution of the research field, and pointing out connections existing between works done at different periods.
Classical Trajectory Perspective of Atomic Ionization in Strong Laser Fields World Scientific
This volume offers theoretical investigations of atoms and molecules interacting with pulsed or continuous wave lasers. Theoretical background is included, and the text incorporates several exercises. Additional calculations are performed in the appendices.
Interaction of Atoms with Intense Laser Fields and Ultrashort Pulses Springer
A thorough introduction to the subject, covering theory and experiments, for graduates and researchers.
Atoms in Intense Laser Fields CRC Press
This book covers a diverse cross section of this interdisciplinary research field, with contributions grouped into four categories: laser-induced filamentation; atoms and molecules in a laser field; interaction of solid materials with a coherent light field; and ion acceleration and ionization of atoms in super intense laser fields. This book series presents up-to-date reviews of advances in this interdisciplinary research field, spanning atomic and molecular physics, as well as molecular and optical science, which have been stimulated by the recent developments in ultrafast laser technologies. Each book compiles peer-reviewed articles by researchers at the forefront of their particular subfields. All the chapters include an overview to allow graduate students and researchers unfamiliar with the subfield to grasp the importance and attractions of the topic covered, followed by reports of cutting-edge discoveries.
Coherence Phenomena in Atoms and Molecules in Laser Fields Toronto ; New York : Academic Press
This volume presents the latest advancements and future perspectives of atomic, molecular and optical (AMO) physics and its vital role in modern sciences and technologies. The chapters are devoted to a wide range of quantum systems, with an emphasis on the understanding of ionization, high-harmonic generation, molecular orbital imaging and coherent control phenomena originating from light-matter interactions. The book overviews current research landscape and highlight major scientific trends in AMO physics interfacing with interdisciplinary sciences. It may be particularly interesting for young researchers working on establishing their scientific interests and goals.
Nonperturbative Theory of Single/multiphoton Processes in Atoms and Molecules Induced by Intense Laser Fields World Scientific Publishing Company
This volume contains the lectures and communications presented at the NATO Advanced Research Workshop (NATO ARW

900857) which was held May 5-10, 1991 at McMaster University, Hamilton, Ontario, Canada. A scientific commitee made up of P.P. Lambropoulos (USC & Crete), P.8. Corkum (NRC, Ottawa), and H. B. vL. van den Heuvell (FOM, Amsterdam) guided the organizers, A.D. Bandrauk (Sherbrooke) and S.C. Wallace (Toronto) in preparing a programme which would cover the latest advances in the field of atom and molecule laser interactions. Since the last meeting held in July 1987 on "Atomic and Molecular Processes with Short Intense Laser Pulses", NATO ASI vol 1718 (Plenum Press 1988), considerable progress has been made in understanding high intensity effects on atoms and the concomitant coherence effects. After four years, the emphasis is now shifting more to molecules. The present volume represents therefore this trend with four sections covering the main interests of research endeavours in this area: i) Atoms in Intense Laser-Fields ii) Molecules in Intense Laser Fields iii) Atomic Coherences iv) Molecular Coherences The experience developed over the years in multiphoton atomic processes has been very useful and is the main source of our understanding of similar processes in molecules. Thus ATI (above threshold ionization) has been found to occur in molecules as well as a new phenomenon, ATD (above-threshold dissociation). Laser-induced avoided crossings of molecular electronic surfaces is also now entering the current language of high intensity molecular processes.

Progress in Ultrafast Intense Laser Science Cambridge University Press

The study of atomic systems exposed to super-intense laser fields de fines an important area in atomic, molecular and optical physics. Although the concept of super-intense field has no absolute meaning, it is now usual to call an electromagnetic field super-intense when it exceeds the atomic binding field. In the case of the simplest atomic system, hydrogen in its 16 2 ground state, this occurs above an intensity of 3. 5 x 10 Wattfcm which is the atomic unit of intensity. Presently at the laboratory scale and in ex tremely short and tightly focussed laser pulses, the electric field strength 16 18 2 reaches peak values which are of the order of 10 - 10 Wattfcm in the infrared frequency regime, the prospect being that such peak intensities may be reached within a few years in a regime of much higher frequencies (XUV or even X). The interaction of such electromagnetic fields with an atomic system has a highly non-linear character which has led to the observation of to tally unexpected phenomena. There are three fundamental processes which have marked the beginning of an intensive research in the field of super intense laser-atom physics (SILAP). These processes which only involve one atomic electron are (i) the so-called above-threshold ionisation i. e.

Progress in Ultrafast Intense Laser Science Cambridge University Press

The ionization of atoms and molecules in strong laser fields is an active field in modern physics and has versatile applications in such as attosecond physics, X-ray generation, inertial confined fusion (ICF), medical science and so on. Classical Trajectory Perspective of Atomic Ionization in Strong Laser Fields covers the basic concepts in this field and discusses many interesting topics using the semiclassical model of classical trajectory ensemble simulation, which is one of the most successful ionization models and has the advantages of a clear picture, feasible computing and accounting for many exquisite experiments quantitatively. The book also presents many applications of the model in such topics as the single ionization, double ionization, neutral atom acceleration and other timely issues in strong field physics, and delivers useful messages to readers with presenting the classical trajectory perspective on the strong field atomic ionization. The book is intended for graduate students and researchers in the field of laser physics, atom molecule physics and theoretical physics. Dr. Jie Liu is a professor of Institute of Applied Physics and Computational Mathematics, China and Peking University.