Theoretical Femtosecond Physics Atoms And Molecules In Strong Laser Fields Graduate Texts In Physics

Graduate Programs in Physics, Astronomy and Related FieldsAdvances in Atomic, Molecular, and Optical PhysicsAtoms and Molecules Interacting with LightSpringer Handbook of Atomic, Molecular, and Optical PhysicsTheory of Atomic and Molecular ClustersExcitation of Atoms and Broadening of Spectral LinesTheoretical Femtosecond PhysicsR-Matrix Theory of Atomic CollisionsJournal of Experimental and Theoretical PhysicsFemtosecond Physics: Laser-Matter Interaction TheoryFemtosecond Laser SpectroscopyCoherent Dynamics of Complex Quantum SystemsPeterson's Guide to Graduate Programs in the Physical Sciences and Mathematics 1990Theoretical Femtosecond PhysicsSuper-Intense Laser-Atom PhysicsFemtosecond Laser FilamentationHigh Power Laser SystemsDynamics of Complex Quantum SystemsTrends in Atomic and Molecular PhysicsElements of Photoionization Quantum Dynamics MethodsFemtosecond Laser SpectroscopyAtomic and Molecular BeamsFemtosecond Laser PulsesAdvances in Atomic, Molecular, and Optical PhysicsPrecision Physics of Simple Atoms and MoleculesTheoretical Atomic PhysicsAtoms, Molecules, and LightFemtosecond Optical Frequency Comb: Principle, Operation and ApplicationsUltrafast Phenomena in Molecular SciencesQuantum Dynamic

ImagingColliderFemtosecond Laser-Matter InteractionCurrent Topics in Atomic, Molecular and Optical PhysicsIntroduction to Laser PhysicsAtoms in Intense Laser FieldsAtoms, Solids, and Plasmas in Super-Intense Laser FieldsUltrafast Dynamics Driven by Intense Light PulsesUltrafast Processes in SpectroscopyThe Kinetic Theory of Inert Dilute PlasmasAtoms, Molecules and Photons

Graduate Programs in Physics, Astronomy and Related Fields

This volume presents multidisciplinary treatments of important areas and new developments within precision physics. It concentrates on new topics and those not treated in the previous volumes about the precision physics of simple atoms, all published in LNP. For example, it concentrates on the proton structure and its effects on the energy levels, on simple molecules, on atoms somewhat more complicated than hydrogen (such as lithium), on exotic atoms and atoms with exotic nuclei.

Advances in Atomic, Molecular, and Optical Physics

This book constructs all the transport properties of the system within the framework of linear irreversible thermodynamics. This includes a systematic study of all possible cross effects as well as the famous H-theorem.

Atoms and Molecules Interacting with Light

The emergence and spectacularly rapid evolution of the field of atomic and molecular clusters are among the most exciting developments in the recent history of natural sciences. The field of clusters expands into the traditional disciplines of physics, chemistry, materials science, and biology, yet in many respects it forms a cognition area of its own. This book presents a cross section of theoretical approaches and their applications in studies of different cluster systems. The contributions are written by experts in the respective areas. The systems discussed range from weakly (van der Waals) bonded, through hydrogen- and covalently bonded, to semiconductor and metallic clusters. The theoretical approaches involve high-level electronic structure computations, more approximate electronic structure treatments, use of semiempirical potentials, dynamical and statistical analyses, and illustrate the utility of both classical and quantum mechanical concepts.

Springer Handbook of Atomic, Molecular, and Optical Physics

Theory of Atomic and Molecular Clusters

Over the last few years, there has been a convergence between the fields of ultrafast science, nonlinear optics, optical frequency metrology, and precision laser spectroscopy. These fields have been

developing largely independently since the birth of the laser, reaching remarkable levels of performance. On the ultrafast frontier, pulses of only a few cycles long have been produced, while in optical spectroscopy, the precision and resolution have reached one part in Although these two achievements appear to be completely disconnected, advances in nonlinear optics provided the essential link between them. The resulting convergence has enabled unprecedented advances in the control of the electric field of the pulses produced by femtosecond mode-locked lasers. The corresponding spectrum consists of a comb of sharp spectral lines with well-defined frequencies. These new techniques and capabilities are generally known as “femtosecond comb technology. ” They have had dramatic impact on the diverse fields of precision measurement and extreme nonlinear optical physics. The historical background for these developments is provided in the Foreword by two of the pioneers of laser spectroscopy, John Hall and Theodor Hänsch. Indeed the developments described in this book were foreshadowed by Hänsch’s early work in the 1970s when he used picosecond pulses to demonstrate the connection between the time and frequency domains in laser spectroscopy. This work complemented the advances in precision laser stabilization developed by Hall.

Excitation of Atoms and Broadening of Spectral Lines

Focusing on atom-light interactions and containing numerous exercises, this in-depth textbook prepares

students for research in a fast-growing field.

Theoretical Femtosecond Physics

Laser is one of the most applicable sources of energy and it can be used in a large variety of applications such as defense, industries and medicine. The special characteristics of this source of energy make it very interesting for different applications. This book includes an interesting and recent collection of relevant research on the development of high-powered laser systems. It includes topics such as using a variety of methods to generate laser pulses in the femtosecond and attosecond range with different wavelengths. This book includes 10 chapters. This book is a very relevant source for researchers as well as engineers working with high-powered laser systems around the world.

R-Matrix Theory of Atomic Collisions

This smooth introduction for advanced undergraduates starts with the fundamentals of lasers and pulsed optics. Thus prepared, the student is introduced to short and ultrashort laser pulses, and learns how to generate, manipulate, and measure them. Spectroscopic implications are also discussed. The second edition has been completely revised and includes two new chapters on some of the most promising and fast-developing applications in ultrafast phenomena: coherent control and attosecond pulses.

Journal of Experimental and Theoretical

Physics

Theoretical investigations of atoms and molecules interacting with pulsed or continuous wave lasers up to atomic field strengths on the order of 10^16 W/cm2 are leading to an understanding of many challenging experimental discoveries. This book deals with the basics of femtosecond physics and goes up to the latest applications of new phenomena. The book presents an introduction to laser physics with mode-locking and pulsed laser operation. The solution of the time-dependent Schrödinger equation is discussed both analytically and numerically. The basis for the non-perturbative treatment of laser-matter interaction in the book is the numerical solution of the time-dependent Schrödinger equation. The light field is treated classically, and different possible gauges are discussed. Physical phenomena, ranging from Rabi-oscillations in two-level systems to the ionization of atoms, the generation of high harmonics, the ionization and dissociation of molecules as well as the control of chemical reactions are presented and discussed on a fundamental level. In this way the theoretical background for state of the art experiments with strong and short laser pulses is given. The text is augmented by more than thirty exercises, whose worked-out solutions are given in the last chapter. Some detailed calculations are performed in the appendices. Furthermore, each chapter ends with references to more specialized literature.

Femtosecond Physics: Laser-Matter

Interaction Theory

A survey of elementary processes and mechanisms, presenting useful and relatively simple methods of approximation for calculating the effective cross sections, giving a number of approximate formulas. Extensive tables list cross sections and rate coefficients for various atoms and elementary processes. For this second edition several sections and formulas have been substantially revised, the tables recalculated using the updated version of ATOM and recent progress in the field has been added.

Femtosecond Laser Spectroscopy

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.

Coherent Dynamics of Complex Quantum Systems

This book gathers together a range of similar problems that can be encountered in different fields of modern quantum physics and that have common features with regard to multilevel quantum systems. The main motivation was to examine from a uniform standpoint various models and approaches that have been developed in atomic, molecular, condensed matter, chemical, laser and nuclear physics in various contexts. The book should help senior-level undergraduate, graduate students and researchers putting particular problems in these fields into a broader scientific context and thereby taking advantage of well-established techniques used in adjacent fields. This second edition has been expanded to include substantial new material (e.g. new sections on Dynamic Localization and on Euclidean Random Matrices and new chapters on Entanglement, Open Quantum Systems, and Coherence Protection). It is based on the author's lectures at the Moscow Institute of Physics and Technology, at the CNRS Aimé Cotton Laboratory, and

on other courses he has given over the last two decades.

Peterson's Guide to Graduate Programs in the Physical Sciences and Mathematics 1990

This volume presents and reviews trends and developments in the following active areas of research in atomic and molecular physics: Structure and properties of clusters: atomic dynamics in intense laser fields, (e, 2e) and photoionization processes, electron impact total ionization from atoms and molecules, electron excitation of autoionizing atoms and depopulation of Rydberg atoms, Quantum optical resonances; multiphoton and multistep laser ionization spectroscopy and life time measurement of NO2.

Theoretical Femtosecond Physics

The embryonic development of femtoscience stems from advances made in the generation of ultrashort laser pulses. Beginning with mode-locking of glass lasers in the 1960s, the development of dye lasers brought the pulse width down from picoseconds to femtoseconds. The breakthrough in solid state laser pulse generation provided the current reliable table-top laser systems capable of average power of about 1 watt, and peak power density of easily watts per square centimeter, with pulse widths in the range of four to eight femtoseconds. Pulses with peak power density reaching watts per square centimeter have

been achieved in laboratory settings and, more recently, pulses of sub-femtosecond duration have been successfully generated. As concepts and methodologies have evolved over the past two decades, the realm of ultrafast science has become vast and exciting and has impacted many areas of chemistry, biology and physics, and other fields such as materials science, electrical engineering, and optical communication. In molecular science the explosive growth of this research is for fundamental reasons. In femtochemistry and femtobiology chemical bonds form and break on the femtosecond time scale, and on this scale of time we can freeze the transition states at configurations never before seen. Even for n- reactive physical changes one is observing the most elementary of molecular processes. On a time scale shorter than the vibrational and rotational periods the ensemble behaves coherently as a single-molecule trajectory.

Super-Intense Laser-Atom Physics

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

Femtosecond Laser Filamentation

Coherent Dynamics of Complex Quantum Systems is aimed at senior-level undergraduate students in the areas of atomic, molecular, and laser physics, physical chemistry, quantum optics and quantum

informatics. It should help them put particular problems in these fields into a broader scientific context and thereby take advantage of the well-elaborated technique of the adjacent fields.

High Power Laser Systems

This established text contains an advanced presentation of quantum mechanics adapted to the requirements of modern atomic physics. The third edition extends the successful second edition with a detailed treatment of the wave motion of atoms, and it also contains an introduction to some aspects of atom optics that are relevant for current and future experiments involving ultra-cold atoms. Included: Various problems with complete solutions.

Dynamics of Complex Quantum Systems

This book documents the recent vivid developments in the research field of ultrashort intense light pulses for probing and controlling ultrafast dynamics. The recent fascinating results in studying and controlling ultrafast dynamics in ever more complicated systems such as (bio-)molecules and structures of meso- to macroscopic sizes on ever shorter time-scales are presented. The book is written by some of the most eminent experimental and theoretical experts in the field. It covers the new groundbreaking research directions that were opened by the availability of new light sources such as fully controlled intense laser fields with durations down to a single oscillation cycle, short-wavelength laser-driven attosecond pulses and

intense X-ray pulses from the upcoming free electron lasers. These light sources allowed the investigation of dynamics in atoms, molecules, clusters, on surfaces and very recently also in nanostructures and solids in new regimes of parameters which, in turn, led to the identification of completely new dynamics and methods for controlling it. Example topics covered by this book include the study of ultrafast processes in large molecules using attosecond pulses, control of ultrafast electron dynamics in solids with shaped femtosecond laser pulses, light-driven ultrafast plasmonic processes on surfaces and in nanostructures as well as research on atomic and molecular systems under intense X-ray radiation. This book is equally helpful for people who would like to step into this field (e.g. young researchers), for whom it provides a broad introduction, as well as for already experienced researchers who may enjoy the exhaustive discussion that covers the research on essentially all currently studied objects and with all available ultrafast pulse sources.

Trends in Atomic and Molecular Physics

This title covers the state of the art in this field both theoretically and experimentally. With contributions from leading researchers including several Nobel laureates, it represents a long-lasting source of reference on all aspects of fundamental research into or using atomic and molecular beams.

Elements of Photoionization Quantum Dynamics Methods

Femtosecond Laser Spectroscopy

The breadth, scope and volume of research in atomic, molecular and optical (AMO) physics have increased enormously in the last few years. Following the widespread use of pulsed lasers, certain newly emerging areas as well as selected mature subfields are ushering in a second renaissance. This volume focuses on current research in these crucial areas: cold atoms and BoseOCoEinstein condensates, quantum information and quantum computation, and new techniques for investigating collisions and structure. The topics covered include: the multireference coupled cluster method in quantum chemistry and the role of electronic correlation in nanosystems; laser cooling of atoms and theories of the BoseOCoEinstein condensate; and quantum computing and quantum information transfer using cold atoms and shaped ultrafast pulses. Other articles deal with recent findings in heavy ion collisions with clusters, time-of-flight spectroscopy techniques, and a specific example of a chaotic quantum system. The contributions will greatly assist in the sharing of specialized knowledge among experts and will also be useful for postgraduate students striving to obtain an overall picture of the current research status in the areas covered. Sample Chapter(s). Chapter 1: Ultrafast Dynamics of Nano and Mesoscopic Systems Driven by Asymmetric Electromagnetic Pulses (1,314 KB). Contents: Ultrafast Dynamics of Nano and Mesoscopic Systems Driven by Asymmetric Electromagnetic Pulses (A Matos-Abiague et al.);

Experimenting with Topological States of BoseOCoEinstein Condensates (C Raman); PairOCoCorrelation in BoseOCoEinstein Condensate and Fermi Superfluid of Atomic Gases (B Deb); A FeynmanOCoKac Path Integral Study of Rb Gas (S Dutta); Quantum Information Transfer in AtomOCoPhoton Interactions in a Cavity (A S Majumder et al.); MRCPA: Theory and Application to Highly Correlating System (K Tanaka); Estimation of Ion Kinetic Energies from Time-of-Flight and Momentum Spectra (B Bapat); Study of AtomOCoSurface Interaction Using Magnetic Atom Mirror (A K Mohapatra); and other papers. Readership: Academics, researchers and research students in physics."

Atomic and Molecular Beams

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.

Femtosecond Laser Pulses

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.

Advances in Atomic, Molecular, and Optical Physics

Studying and using light or "photons" to image and then to control and transmit molecular information is among the most challenging and significant research fields to emerge in recent years. One of the fastest growing areas involves research in the temporal imaging of quantum phenomena, ranging from molecular dynamics in the femto (10-15s) time regime for atomic motion to the atto (10-18s) time scale of electron motion. In fact, the attosecond "revolution" is now recognized as one of the most important recent breakthroughs and innovations in the science of the 21st century. A major participant in the development of ultrafast femto and attosecond temporal imaging of molecular quantum phenomena

has been theory and numerical simulation of the nonlinear, non-perturbative response of atoms and molecules to ultrashort laser pulses. Therefore, imaging quantum dynamics is a new frontier of science requiring advanced mathematical approaches for analyzing and solving spatial and temporal multidimensional partial differential equations such as Time-Dependent Schroedinger Equations (TDSE) and Time-Dependent Dirac equations (TDDEs for relativistic phenomena). These equations are also coupled to the photons in Maxwell's equations for collective propagation effects. Inversion of the experimental imaging data of quantum dynamics presents new mathematical challenges in the imaging of quantum wave coherences on subatomic (subnanometer) spatial dimensions and multiple timescales from atto to femto and even nanoseconds. In Quantum Dynamic Imaging: Theoretical and Numerical Methods, leading researchers discuss these exciting state-of-the-art developments and their implications for R&D in view of the promise of quantum dynamic imaging science as the essential tool for controlling matter at the molecular level.

Precision Physics of Simple Atoms and Molecules

This book attempts to give a discussion of the physics and current and potential applications of the self-focusing of an intense femtosecond laser pulse in a tra- parent medium. Although self-focusing is an old subject of nonlinear optics, the consequence of self-focusing of intense femtosecond laser pulses is totally

new and unexpected. Thus, new phenomena are observed, such as long range lam- tation, intensity clamping, white light laser pulse, self-spatial ltering, self-group phase locking, self-pulse compression, clean nonlinear uorescence, and so on. Long range propagation at high intensity, which is seemingly against the law of diffraction, is probably one of the most exciting consequences of this new sub- eld of nonlinear optics. Because the intensity inside the lament core is high, new ways of doing nonlinear optics inside the lament become possible. We call this lamentation nonlinear optics. We shall describe the generation of pulses at other wavelengths in the visible and ultraviolet (UV) starting from the near infrared pump pulse at 800 nm through four-wave-mixing and third harmonic generation, all in gases. Remotely sensing uorescence from the fragments of chemical and biological agents in all forms, gaseous, aerosol or solid, inside the laments in air is demonstrated in the labo- tory. The results will be shown in the last part of the book. Through analyzing the uorescence of gas molecules inside the lament, an unexpected physical process pertaining to the interaction of synchrotron radiation with molecules is observed.

Theoretical Atomic Physics

This book presents the latest developments in Femtosecond Chemistry and Physics for the study of ultrafast photo-induced molecular processes. Molecular systems, from the simplest H2 molecule to polymers or biological macromolecules, constitute

central objects of interest for Physics, Chemistry and Biology, and despite the broad range of phenomena that they exhibit, they share some common behaviors. One of the most significant of those is that many of the processes involving chemical transformation (nuclear reorganization, bond breaking, bond making) take place in an extraordinarily short time, in or around the femtosecond temporal scale (1 fs = 10-15 s). A number of experimental approaches - very particularly the developments in the generation and manipulation of ultrashort laser pulses - coupled with theoretical progress, provide the ultrafast scientist with powerful tools to understand matter and its interaction with light, at this spatial and temporal scale. This book is an attempt to reunite some of the state-of-the-art research that is being carried out in the field of ultrafast molecular science, from theoretical developments, through new phenomena induced by intense laser fields, to the latest techniques applied to the study of molecular dynamics.

Atoms, Molecules, and Light

The embryonic development of femtoscience stems from advances made in the generation of ultrashort laser pulses. Beginning with mode-locking of glass lasers in the 1960s, the development of dye lasers brought the pulse width down from picoseconds to femtoseconds. The breakthrough in solid state laser pulse generation provided the current reliable table-top laser systems capable of average power of about

1 watt, and peak power density of easily watts per square centimeter, with pulse widths in the range of four to eight femtoseconds. Pulses with peak power density reaching watts per square centimeter have been achieved in laboratory settings and, more recently, pulses of sub-femtosecond duration have been successfully generated. As concepts and methodologies have evolved over the past two decades, the realm of ultrafast science has become vast and exciting and has impacted many areas of chemistry, biology and physics, and other fields such as materials science, electrical engineering, and optical communication. In molecular science the explosive growth of this research is for fundamental reasons. In femtochemistry and femtobiology chemical bonds form and break on the femtosecond time scale, and on this scale of time we can freeze the transition states at configurations never before seen. Even for n- reactive physical changes one is observing the most elementary of molecular processes. On a time scale shorter than the vibrational and rotational periods the ensemble behaves coherently as a single-molecule trajectory.

Femtosecond Optical Frequency Comb: Principle, Operation and Applications

A unified account of the rapidly developing field of high-intensity laser-atom interactions, suitable for both graduate students and researchers.

Ultrafast Phenomena in Molecular Sciences

This volume of Advances in Atomic, Molecular, and Optical Physics celebrates and honors the work and life of Professor Herbert Walther. Areas of emphasis include quantum optics, in general, and BEC, atomic coherence, quantum interference, etc. in particular. Pulls vast amount of information together in cohesive, easy to understand manner Written by people who know and are familiar with Herbert Walther's work Comprehensive articles New developments

Quantum Dynamic Imaging

This is the first comprehensive treatment of the interaction of femtosecond laser pulses with solids at nonrelativistic intensity. It connects phenomena from the subtle atomic motion on the nanoscale to the generation of extreme pressure and temperature in the interaction zone confined inside a solid. The femtosecond laser-matter interaction has al

Collider

Femtosecond Laser-Matter Interaction

Commencing with a self-contained overview of atomic collision theory, this monograph presents recent developments of R-matrix theory and its applications to a wide-range of atomic molecular and optical processes. These developments include the electron and photon collisions with atoms, ions and molecules which are required in the analysis of laboratory and astrophysical plasmas, multiphoton processes

required in the analysis of superintense laser interactions with atoms and molecules and positron collisions with atoms and molecules required in antimatter studies of scientific and technologial importance. Basic mathematical results and general and widely used R-matrix computer programs are summarized in the appendices.

Current Topics in Atomic, Molecular and Optical Physics

This volume is a collection of papers presented at the Ninth International Symposium on "Ultrafast Processes in Spectroscopy" (UPS '95) held at the International Centre for Theo retical Physics (ICTP), Trieste (Italy), October 30 -November 3, 1995. These meetings have become recognized as the major forum in Europe for discussion of new work in this rapidly moving field. The UPS'95 Conference in Trieste brought together a multidisciplinary group of researchers sharing common interests in the generation of ultrashort optical pulses and their application to studies of ultrafast phenomena in physics, chemistry, material science, electronics, and biology. It was attended by approximately 250 participants from 20 countries and the five-day program comprises more than 200 papers. The progress of both technology and applications in the field of ultrafast processes during these last years is truly remarkable. The advent of all solid state femtosecond lasers and the extension of laser wavelengths by frequency conversion techniques provide a large variety of high-performance light

sources for ultrashort pulses. With these sources ultrafast phenomena in physical, chemical and biological systems and in electronic de vi(:es are now studied extensively. Ultrafast technology is becoming one of the basic and common tools presently entering a wide variety of scientific fields not only for basic re search but also for promoting new applications in various areas. We feel that these pro ceedings vividly reflect the present status of the field.

Introduction to Laser Physics

The dynamics of quantum systems exposed to ultrafast (at the femtosecond time-scale) and strong laser radiation has a highly non-linear character, leading to a number of new phenomena, outside the reach of traditional spectroscopy. The current laser technology makes feasible the probing and control of quantum-scale systems with fields that are as strong as the interatomic Coulombic interactions and time resolution that is equal to (or less than) typical atomic evolution times. It is indispensable that any theoretical description of the induced physical processes should rely on the accurate calculation of the atomic structure and a realistic model of the laser radiation as pulsed fields. This book aims to provide an elementary introduction of theoretical and computational methods and by no means is anywhere near to complete. The selection of the topics as well as the particular viewpoint is best suited for early-stage students and researchers; the included material belongs in the mainstream of theoretical approaches albeit using simpler language without sacrificing

mathematical accuracy. Therefore, subjects such as the Hilbert vector-state, density-matrix operators, amplitude equations, Liouville equation, coherent laser radiation, free-electron laser, Dyson-chronological operator, subspace projection, perturbation theory, stochastic density-matrix equations, time-dependent Schrödinger equation, partial-wave analysis, spherical-harmonics expansions, basis and grid wavefunction expansions, ionization, electron kinetic-energy and angular distributions are presented within the context of laser-atom quantum dynamics.

Atoms in Intense Laser Fields

With the publication in 1994 of Atomic, Molecular, and Optical Science: An Investment in the Future (the FAMOS report), the National Research Council launched the series Physics in a New Era, its latest survey of physics. Each of the six area volumes in the survey focuses on a different subfield of physics, describing advances since the last decadal survey and suggesting future opportunities and directions. This survey culminated in 2001 with the publication of the seventh and final volume, Physics in a New Era: An Overview. Since the publication of the FAMOS report, the developments in atomic, molecular, and optical (AMO) science have been amazing. Significant advances in areas such as cooling and trapping, atom and quantum optics, single-atom and single-molecule detection, and ultrafast and ultra intense phenomena, along with the emergence of new applications, made it clear that an update of the FAMOS report was

needed. With support from the National Science Foundation and the Department of Energy, the Committee for an Updated Assessment of Atomic, Molecular, and Optical Science was formed. The committee's statement of task reads as follows: The committee will prepare a narrative document that portrays the advances in AMO science and its impact on society. This report highlights selected forefront areas of AMO science, emphasizing recent accomplishments and new opportunities, identifies connections between AMO science and other scientific fields, emerging technologies, and national needs, describes career opportunities for AMO scientists. To accomplish its task and at the same time reach a broad audience, the committee decided to present its report in the form of a brochure highlighting selected advances, connections, and impacts on national needs. An exhaustive assessment of the field, which will fall within the purview of the next decadal survey, was not the goal of the update. The committee would like to express its gratitude for the informative interactions it had with many scientists and policy makers. Many colleagues completed a questionnaire and suggested topics to be included in this report. The final selection of topics was made in accordance with the criteria set forth in the statement of task. While this report was still being written, the tragic events of September 11, 2001, occurred. AMO science and its applications have already played and will continue to play a central role in our nation's response to terrorist threats from conventional as well as chemical or biological weapons. Some of the technology discussed in this report in the chapter "AMO Science Enhancing National Defense" was used

successfully for the U.S. military response in Afghanistan-the Global Positioning System (GPS) and laser-guided munitions are just two examples. AMO science will also enable the development of early detection techniques that will help to neutralize the threat from biological and chemical agents.

Atoms, Solids, and Plasmas in Super-Intense Laser Fields

This series, established in 1965, is concerned with recent developments in the general area of atomic, molecular and optical physics. The field is in a state of rapid growth, as new experimental and theoretical techniques are used on many old and new problems. Topics covered include related applied areas, such as atmospheric science, astrophysics, surface physics and laser physics. Articles are written by distinguished experts who are active in their research fields. The articles contain both relevant review material and detailed descriptions of important recent developments.

Ultrafast Dynamics Driven by Intense Light Pulses

Most of the texts available on lasers deal with laser engineering and laser applications, only a few of them treating theoretical aspects of the laser at an advanced level. Introduction to Laser Physics provides an introduction to the essential physics of quantum electronics and lasers. Fundamental topics in modern optics, the applicability of various theoretical

approaches, and the physical meaning of laser-related phenomena are carefully described. Experimental results and properties of practical lasers are interwoven, thereby allowing an explicit demonstration of the rate equation approach and the semiclassical treatment. The basic concepts of nonlinear optical devices and laser spectroscopy are intro- duced. The second edition includes additional information on optical resonators, minor improvements of the text and several new problems, completed with solutions.

Ultrafast Processes in Spectroscopy

Femtosecond Physics: Laser-Matter Interaction Theory examines various theories related to femtosecond physics including an extensive overview of interaction theory and related concepts. It includes definitions of time-dependent schrödinger equation, field-matter interaction in quantum two-level systems and atoms and molecules. Provides the reader with insights into the development of its knowledge, so as to understand the different theories and applications of femtosecond physics.

The Kinetic Theory of Inert Dilute Plasmas

An accessible look at the hottest topic in physics and the experiments that will transform our understanding of the universe The biggest news in science today is the Large Hadron Collider, the world's largest and most powerful particle-smasher, and the anticipation

of finally discovering the Higgs boson particle. But what is the Higgs boson and why is it often referred to as the God Particle? Why are the Higgs and the LHC so important? Getting a handle on the science behind the LHC can be difficult for anyone without an advanced degree in particle physics, but you don't need to go back to school to learn about it. In Collider, award-winning physicist Paul Halpern provides you with the tools you need to understand what the LHC is and what it hopes to discover. Comprehensive, accessible guide to the theory, history, and science behind experimental high-energy physics Explains why particle physics could well be on the verge of some of its greatest breakthroughs, changing what we think we know about quarks, string theory, dark matter, dark energy, and the fundamentals of modern physics Tells you why the theoretical Higgs boson is often referred to as the God particle and how its discovery could change our understanding of the universe Clearly explains why fears that the LHC could create a miniature black hole that could swallow up the Earth amount to a tempest in a very tiny teapot "Best of 2009 Sci-Tech Books (Physics)"-Library Journal "Halpern makes the search for mysterious particles pertinent and exciting by explaining clearly what we don't know about the universe, and offering a hopeful outlook for future research."-Publishers Weekly Includes a new author preface, "The Fate of the Large Hadron Collider and the Future of High-Energy Physics" The world will not come to an end any time soon, but we may learn a lot more about it in the blink of an eye. Read Collider and find out what, when, and how.

Atoms, Molecules and Photons

This introduction to Atomic and Molecular Physics explains how our present model of atoms and molecules has been developed during the last two centuries by many experimental discoveries and from the theoretical side by the introduction of quantum physics to the adequate description of micro-particles. It illustrates the wave model of particles by many examples and shows the limits of classical description. The interaction of electromagnetic radiation with atoms and molecules and its potential for spectroscopy is outlined in more detail and in particular lasers as modern spectroscopic tools are discussed more thoroughly. Many examples and problems with solutions should induce the reader to an intense active cooperation.

ROMANCE ACTION & ADVENTURE MYSTERY & THRILLER BIOGRAPHIES & HISTORY CHILDREN'S YOUNG ADULT FANTASY HISTORICAL FICTION HORROR LITERARY FICTION NON-FICTION SCIENCE FICTION