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Because of the favorable characteristics of solid-state lasers, they have become the preferred candidates for a wide range of applications in science and technology, including spectroscopy, atmospheric monitoring, micromachining, and precision metrology. Presenting the most recent developments in the field, Solid-State Lasers and Applications focuses on the design and applications of solid-state laser systems. With contributions from leading international experts, the book explores the latest research results and applications of solid-state lasers as well as various laser systems. The beginning chapters discuss current developments and applications of new solid-state gain media in different wavelength regions, including cerium-doped lasers in the ultraviolet range, ytterbium lasers near 1µm, rare-earth ion-doped lasers in the eye--safe region, and tunable Cr2+:ZnSe lasers in the mid-infrared range. The remaining chapters study specific modes of operation of solid-state laser systems, such as pulsed microchip lasers, high--power neodymium lasers, ultrafast solid-state lasers, amplification of femtosecond pulses with optical parametric amplifiers, and noise characteristics of solid-state lasers. Solid-State Lasers and Applications covers the most important aspects of the field to provide current, comprehensive coverage of solid-state lasers.

Ultrashort Laser Pulse Phenomena, Second Edition serves as an introduction to the phenomena of ultra short laser pulses and describes how this technology can be used to examine problems in areas such as electromagnetism, optics, and quantum mechanics. Ultrashort Laser Pulse Phenomena combines theoretical backgrounds and experimental techniques and will serve as a manual on designing and constructing femtosecond ("faster than electronics") systems or experiments from scratch. Beyond the simple optical system, the various sources of ultrashort pulses are presented, again with emphasis on the basic concepts and how they apply to the design of particular sources (dye lasers, solid state lasers, semiconductor lasers, fiber lasers, and sources based on frequency conversion). Provides an easy to follow guide through "faster than electronics" probing and detection methods THE manual on designing and constructing femtosecond systems and experiments Discusses essential technology for applications in micro-machining, femtochemistry, and medical imaging

This thesis offers a thorough and informative study of high-power, high-energy optical parametric chirped pulse amplifications systems, the foundation of the next generation of femtosecond laser technology. Starting from the basics of the linear processes involved and the essential design considerations, the author clearly and systematically describes the various prerequisites of the nonlinear optical systems expected to drive attosecond physics in the coming decade. In this context, he gives an overview of methods for generating the broadband and carrier-envelope-phase stable seed pulses necessary for producing controlled electric-field waveforms in the final system; provides a guide to handling the high-power, high-energy pump lasers required to boost the pulse energy to the desired operating range; describes the design of the nonlinear optical system used to perform the amplification, including modes of operation for ultra-broadband infrared-visible pulses or narrowband (yet still ultrafast) pulses tunable over multiple octaves; and finally presents a prospective high-energy field synthesizer based upon these techniques. As such, this work is essential reading for all scientists interested in utilizing the newest generation of ultrafast systems.

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.

The papers in this volume cover the major areas of research activity in the field of ultrafast optics at the present time, and they have been selected to provide an overview of the current state of the art. The purview of the field is the methods for the generation, amplification, and characterization of electromagnetic pulses with durations from the pieo-to the attosecond range, as well as the technical issues surrounding the application of these pulses in physics, chemistry, and biology. The contributions were solicited from the participants in the Ultrafast Optics IV Conference, held in Vienna, Austria, in June 2003. The purpose of the confer-

ence is similar to that of this book: to provide a forum for the latest advances in ultrafast optical technology. Ultrafast light sources provide a means to observe and manipulate events on the scale of atomic and molecular dynamics. This is possible either through appropriate shaping of the time-dependent electrie field, or through the ap plication of fields whose strength is comparable to the binding forces of the electrons in atoms and molecules. Recent advances discussed here include the generation of pulses shorter than two optical cycles, and the ability to measure and to shape them in all degrees of freedom with unprecedented 2 21 2 precision, and to amplify them to the Zettawatt/cm (10 W /cm) range.

This book gives a detailed overview on this new and exciting field at the boundary of physics and chemistry. Laser-induced ultrafast molecuar dynamics is presented for many textbook-like examples of model molecules and clusters. Experimental results on phenomena like wave packet propagation, ultrafast photodissociation and femtosecond structural redistribution are presented and described theoretically.

Over the past five years, there has been an enormous increase in the inter est in and understanding of electronic and optoelectronic devices operating in the picosecond (multigigahertz) range. This has been fueled in a sig nificant way by the spectacular advances in picosecond laser technology, electro optic sampling, III-V devices, and wideband fiber optic systems. Partly to address these advances, a new conference jointly sponsored by the IEEE Lasers and Electrooptics Society (IEEE (LEOS)) and the Op tical Society of America (OSA) was founded and its first meeting held in March 1985. The purpose of this meeting was to bring together work ers in the areas of electronics and optoelectronics who share a common interest in the physics and technology of picosecond solid-state electronic and optoelectronic devices, their multigigahertz applications, and ultrafast measurement techniques. Emphasis was placed on the interdisciplinary as pects of these areas, since each area is covered by its own topical meeting. This meeting was quite successful and led to a second meeting, of which this volume forms the proceedings.

This volume comprises a collection of invited and selected contributions presented at the 16th International Conference on Laser Spectroscopy in Palm Cove, Queensland, Australia, 13–18 July 2003. The papers report the latest and most exciting developments in laser spectroscopy and related areas: new ultra-precise spectroscopic measurements based on optical frequency combs including tests of the stability of the fundamental constants; the first realization of Bose–Einstein condensation in cesium and ytterbium; the behavior of ultra-cold bosons and fermions in optical lattices; the production of ultra-cold cesium, helium and fermionic lithium molecules; the production and coherent transport of ultra--cold atoms in microtraps on the surface of chips; the implementation of one- and two-qubit quantum algorithms and experiments towards a scalable quantum computer based on trapped ions; and new medical applications of laser spectroscopy. The proceedings have been selected for coverage in: • Index to Scientific & Technical Proceedings® (ISTP® / ISI Proceedings) • Index to Scientific & Technical Proceedings (ISTP CDROM version / ISI Proceedings) • CC Proceedings — Engineering & Physical Sciences Contents: Precision SpectroscopyUltrafast SpectroscopyQuantum Degenerate GasesCold Molecules and Cold collisionsAtom Optics and InterferometryCavity QEDQuantum Optics and Quantum InformationNovel Applications and New Laser SourcesMedical Applications Readership: Researchers and graduate students in the fields of laser spectroscopy, atomic and molecular physics, atom optics, quantum gases and quantum information. Keywords:Laser Spectroscopy;Precision Spectroscopy;Quantum Degenerate Gases;Quantum Information;Atom Optics;Quantum Optics

Advances in Atomic, Molecular, and Optical Physics, Volume 71 provides a comprehensive compilation of recent developments in a field that is in a state of rapid growth as new experimental and theoretical techniques are used on many problems, both old and new. Topics covered include related applied areas, such as atmospheric science, astrophysics, surface physics, and laser physics, with timely articles written by distinguished experts. Sample content covered in this release includes Attosecond generation and application from X-ray Free Electron Lasers. Presents the work of international experts in the field Contains comprehensive articles that compile recent developments in a field that is experiencing rapid growth, with new experimental and theoretical techniques emerging Ideal for users interested in optics, excitons, plasmas and thermodynamics Covers atmospheric science, astrophysics, and surface and laser physics, amongst other topics

Each generation yielded growths in brightness and time resolution that were unimaginable just a few years earlier. In particular, the progression from the 3rd to 4th generation is a true revolution; the peak brilliance of coherent soft and hard x-rays has increased by 7-10 orders of magnitude, and the image resolution has reached the angstrom (1 [symbol] = 10-10 meters) and femto-second (1 fs = 10-15 second) scales. These impressive capabilities have fostered fundamental scientific advances and led to an explosion of numerous possibilities in many important research areas including material science, chemistry, molecular biology and the life sciences. Even more remarkably, this field of photon source invention and development shows no signs of slowing down. Studies have already been started on the next generation of x-ray sources, which would have a time resolution in the atto-second (1 as = 10-18 second) regime, comparable to the time of electron motion inside atoms.

Recent rapid advances in femtosecond technology have had a great impact on its industrial applications, including ultrafast optoelectronic devices and optical. telecommunication systems, ultrashort-pulse lasers and measurement systems, and the development of novel materials for ultrafast functions. In this book, a wealth of knowledge covering requirements for applications as well as details of recent achievements in important technical areas is presented by internationally renowned authors in a concise, systematic form. As a whole, this is the first comprehensive book on the emerging field of femtosecond technology.

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.

This book presents advances in biomedical imaging analysis and processing techniques using time dependent medical image datasets for computer aided diagnosis. The analysis of time-series images is one of the most widely appearing problems in science, engineering, and business. In recent years this problem has gained importance due to the increasing availability of more sensitive sensors in science and engineering and due to the widespread use of computers in corporations which have increased the amount of time-series data collected by many magnitudes. An important feature of this book is the exploration of different approaches to handle and identify time dependent biomedical images. Biomedical imaging analysis and processing techniques deal with the interaction between all forms of radiation and biological molecules, cells or tissues, to visualize small particles and opaque objects, and to achieve the recognition of biomedical patterns. These are topics of great importance to biomedical science, biology, and medicine. Biomedical imaging analysis techniques can be applied in many different areas to solve existing problems. The various requirements arising from the process of resolving practical problems motivate and expedite the development of biomedical imaging analysis. This is a major reason for the fast growth of the discipline.

This book covers the physics, technology and applications of short pulse laser sources that generate pulses with durations of only a few optical cycles. The basic design considerations for the different systems such as lasers, parametric amplifiers and external compression techniques which have emerged over the last decade are discussed to give researchers and graduate students a thorough introduction to this field. The existence of these sources has opened many new fields of research that were not possible before. These are UV and EUV generation from table-top systems using high-harmonic generation, frequency metrology enabling optical frequency counting, high-resolution optical coherence tomography, strong-field ultrafast solid-state processes and ultrafast spectroscopy, to mention only a few. Many new applications will follow. The book attempts to give a comprehensive, while not excessive, introduction to this exciting new field that serves both experienced researchers and graduate students entering the field. The first half of the book covers the current physical principles, processes and design guidelines to generate pulses in the optical range comprising only a few cycles of light. Such as the generation of relatively low energy pulses at high repetition rates directly from the laser, parametric generation of medium energy pulses and high-energy pulses at low repetition rates using external compression in hollow fibers. The applications cover the revolution in frequency metrology and high-resolution laser spectroscopy to electric field synthesis in the optical range as well as the emerging field of high-harmonic generation and attosecond science, high-resolution optical imaging and novel ultrafast dynamics in semiconductors. These fields benefit from the strong electric fields accompanying these pulses in solids and gases during events comprising only a few cycles of light.

Covering high-energy ultrafast amplifiers and solid-state, fiber, and diode lasers, this reference examines recent developments in high-speed laser technology. It presents a comprehensive survey of ultrafast laser technology, its applications, and future trends in various scientific and industrial areas. Topics include: micromachining applications for metals, dielectrics, and biological tissue; advanced electronics and semiconductor processing; optical coherence tomography; multiphoton microscopy; optical sampling and scanning; THz generation and imaging; optical communication systems; absolute phase control of optical signals; and more.

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.

Proceedings of SPIE present the original research papers presented at SPIE conferences and other high-quality conferences in the broad-ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.

Volume 55 of the Advances in Atomic, Molecular, and Optical Physics Series contains seven contributions, covering a diversity of subject areas in atomic, molecular and optical physics. In their contribution, Stowe, Thorpe, Pe'er, Ye, Stalnaker, Gerginov, and Diddams explore recent developments in direct frequency comb spectroscopy. Precise phase coherence among successive ultrashort pulses of a frequency comb allows one to probe fast dynamics in the time domain and high-resolution structural information in the frequency domain for both atoms and molecules. The authors provide a detailed review of some of the current applications that exploit the unique features of frequency comb spectroscopy and discuss its future directions. Yurvsky, Olshanii and Weiss review theory and experiment of elongated atom traps that confine ultracold gases in a quasi-one-dimensional regime. Under certain conditions, these quasi-one-dimensional gases are well-described by integrable one-dimensional many-body models with exact quantum solutions. Thermodynamic and correlation properties of one such model that has been experimentally realized are reviewed. DePaola, Morgenstein and Andersen discuss magneto-optical trap recoil ion momentum spectroscopy (MOTRIMS), exploring collisions between a projectile and target resulting in charged target fragments. MOTRIMS combines the technology of laser cooling and trapping of target atoms with the momentum analysis of the charged fragments that recoil from the target. The authors review the different MOTRIMS experimental approaches and the spectroscopic and collisional investigations performed so far. Safronova and Johnson give an overview of atomic many--body perturbation theory and discuss why extensions of the theory are needed. They present "all-order results based on a linearized version of coupled cluster expansions and apply the theory to calculations of energies, transition matrix elements and hyperfine constants. Another contribution on atomic theory, authored by Fischer, explores the advantages of expanding the atomic radial wave functions in a B-spline basis. The differential equations are replaced by non-linear systems of equations and the problems of orthogonality requirements can be dealt with using projection operators. Electron-ion collisional processes are analyzed by Mueller, including descriptions of the experimental techniques needed to obtain cross section data and typical values for these cross sections. The present status of the field is discussed in relation to the detailed cross sections and rate coefficients that are needed for understanding laboratory or astrophysical plasmas. Finally, Duan and Monroe review ways to achieve scalable and robust quantum communication, state engineering, and quantum computation. Using radiation and atoms, ions, or atomic ensembles, they show that they can construct scalable quantum

networks that are inherently insensitive to noise. Progress in experimental realization of their proposals is outlined. International experts Comprehensive articles New developments

Lasers and electro-optics is a field of research leading to constant breakthroughs. Indeed, tremendous advances have occurred in optical components and systems since the invention of laser in the late 50s, with applications in almost every imaginable field of science including control, astronomy, medicine, communications, measurements, etc. If we focus on lasers, for example, we find applications in quite different areas. We find lasers, for instance, in industry, emitting power level of several tens of kilowatts for welding and cutting; in medical applications, emitting power levels from few milliwatt to tens of Watt for various types of surgeries; and in optical fibre telecommunication systems, emitting power levels of the order of one milliwatt. This book is divided in four sections. The book presents several physical effects and properties of materials used in lasers and electro-optics in the first chapter and, in the three remaining chapters, applications of lasers and electro-optics in three different areas are presented

This book explores recent developments and advances in femtosecond beam science, making these more accessible through contributions from leaders in the field. Each contribution aims to make the particular area of femtosecond beam science accessible through explaining the particular field, reviewing recent advances worldwide, and featuring important results and possible future uses of femtosecond pulses in the field. Femtosecond beam science is expected to lead to the development of technology realizing dynamic microscopy, that is, the visualization of atomic motions, chemical reactions, protein dynamics and other microscopic dynamics. Advances have enabled the visualizations of phonons, thermal expansion and shock-wave propagation by advanced time-resolved X-ray diffraction, at a time resolution of 10 picoseconds. These achievements will extend to the development of femtosecond X-ray sources and fourth generation synchrotron light sources. Dynamic microscopy promises to be one of the most important issues in dynamic nanotechnology in the future. As a result, the overview of femtosecond beam science provided by this book will be useful. Contents: Femtosecond Beam GenerationDiagnosis and SynchronizationApplications Readership: Researchers, engineers, technicians, graduate students and postdoctoral researchers. Key Features:Provides a useful overview of femtosecond beam science which makes the subject accessible to readers with varying interest in the subjectKeywords:Femtosecond Beam;Magnetic Pulse Compression;Laser Plasma Acceleration;Femtosecond Electron Pulse Diagnosis;Synchronization;Pump-and-Probe Analysis;Pulse-Radiolysis;Time-Resolved X-Ray Diffraction

This text presents a range of applications and disciplines in the fields of lasers and electro-optics. The 400 papers present advances in the field on topics including fusion, ultrafast electronics and lightwave communications.

Advances in Quantum Chemistry presents surveys of current developments in this rapidly developing field. With invited reviews written by leading international researchers, each presenting new results, it provides a single vehicle for following progress in this interdisciplinary area. Publishes articles, invited reviews and proceedings of major international conferences and workshops Written by leading international researchers in quantum and theoretical chemistry Highlights important interdisciplinary developments "The First International Meeting on Pulsed Plasma Laser Ablation, PPLA2003, was held in Messina and Catania on 18 and 19 September 2003"--Pref.

This volume features 11 papers presented by senior scientists at the 1st Asian Summer School on Laser Plasma Acceleration and Radiation held in August 2006 in Beijing, China. Plasma physicists, accelerator physicists, astrophysicists, and laser physicists will gain a detailed overview of the state of the science in laser--plasma acceleration and radiation along with its many emerging applications.

This volume comprises a collection of invited and selected contributions presented at the 16th International Conference on Laser Spectroscopy in Palm Cove, Queensland, Australia, 13OCo18 July 2003. The papers report the latest and most exciting developments in laser spectroscopy and related areas: new ultra-precise spectroscopic measurements based on optical frequency combs including tests of the stability of the fundamental constants; the first realization of BoseOCoEinstein condensation in cesium and ytterbium; the behavior of ultra-cold bosons and fermions in optical lattices; the production of ultra-cold cesium, helium and fermionic lithium molecules; the production and coherent transport of ultra-cold atoms in microtraps on the surface of chips; the implementation of one- and two-qubit quantum algorithms and experiments towards a scalable quantum computer based on trapped ions; and new medical applications of laser spectroscopy. The proceedings have been selected for coverage in: . OCo Index to Scientific & Technical Proceedings- (ISTP- / ISI Proceedings). OCo Index to Scientific & Technical Proceedings (ISTP CDROM version / ISI Proceedings). OCo CC Proceedings OCo Engineering & Physical Sciences."