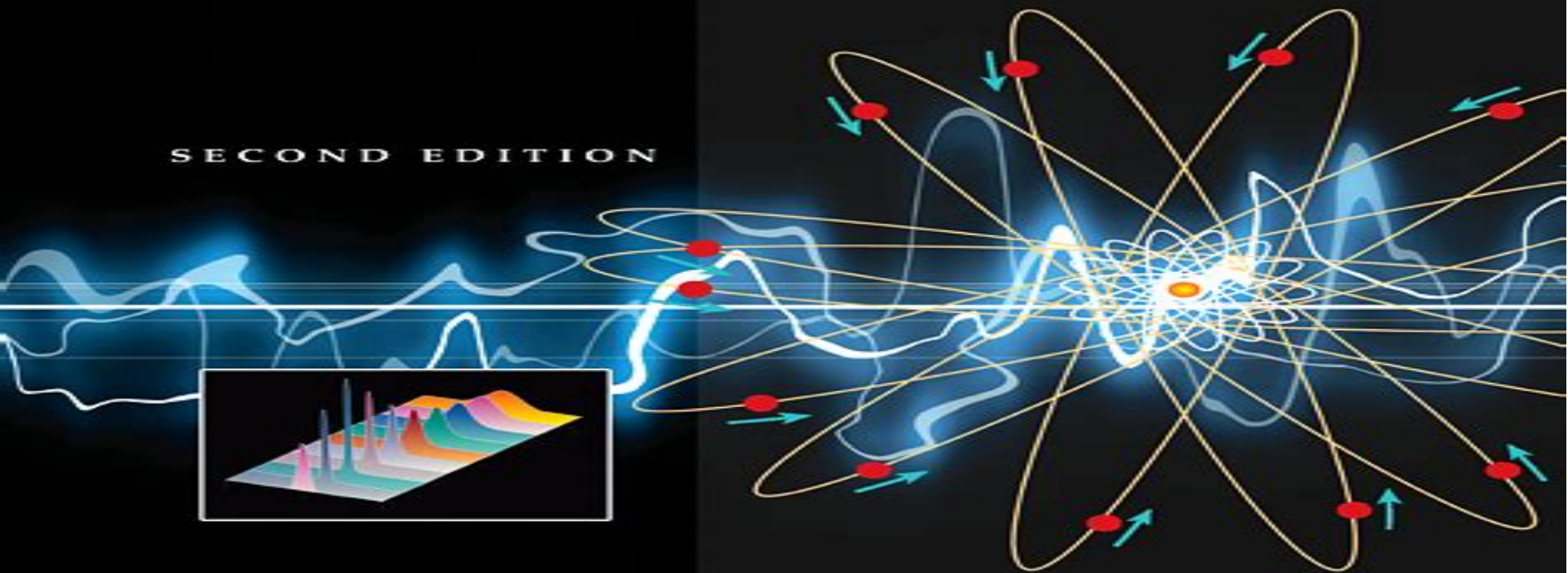


Ultrashort Laser Pulse Phenomena

*Fundamentals, Techniques,
and Applications on a
Femtosecond Time Scale*

SECOND EDITION



Jean-Claude Diels
Wolfgang Rudolph

Ultrashort Laser Pulse Phenomena

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Ultrashort Laser Pulse Phenomena Ultrashort Laser Pulse Phenomena:

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Fundamentals, Techniques, and Applications on a Femtosecond Time Scale Jean-Claude Diels, Wolfgang Rudolph, 2006-09 Ultrashort Laser Pulse Phenomena 2e 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 **Ultrashort laser pulse**

phenomena ... Diels, 1996 **Ultrashort Laser Pulse Phenomena** Jean-Claude Diels, Wolfgang Rudolph, 2014-07-15 Ultrashort Laser Pulse Phenomena balances theory and applications of ultrafast optical pulses with detailed descriptions of experimental configurations and surveys of relevant data from the literature demonstrating how the technology can be applied in areas such as spectroscopy medical imaging electromagnetism optics and quantum physics The third edition streamlines the discussion of ultrashort pulse fundamentals and their main application fields Nonlinear optics is revised and re organized from most general transient concepts leading through successive approximations to the classical concepts of nonlinear susceptibility Sections on recent developments such as comb spectroscopy attosecond science and corresponding laser sources have been added or considerably extended Showing how abstract models can be put into practice this book is an easy to understand guide to designing and constructing femtosecond and attosecond systems and applications suitable for

engineers and scientists working in the areas of optics spectroscopy optical imaging photochemistry and ultrafast science and engineering 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 the essential technology for applications in micro machining femtochemistry medical imaging and attosecond science Elegant theoretical formulations in conjunction with experimental discussions on practical implementation and field applications of nonlinear and ultrafast optics Insightful presentation of measurement techniques with numerous examples of ultrafast processes in assorted materials Key Features of this edition Chapters 3 and 4 re written and combined into a single chapter starting with general concepts of coherent interaction evolving by approximations to the traditional concepts of nonlinear optics New chapter 4 on High Fields interactions to include High Harmonic Generation attosecond phenomena and particle accelerators New section on the synthesis of frequency combs cascade of Raman lines or of harmonics to create ultrashort pulses chapter 5 VECSEL lasers chapter 6 OPCPA Dazzler and Fazzler Chapter 8 Add comb spectroscopy and molecular spectroscopy in Chapter 10 Chapters 11 through 13 completely re written and updated

Ultrashort Laser Pulse Phenomena J.-c Diels, 2006 **Ultrashort Laser Pulse Phenomena, 2nd Edition** Jean-Claude Diels, Wolfgang Rudolph, 2006 Ultrashort Laser Pulse Phenomena serves as an introduction to the phenomena of ultrashort laser pulses and describes how this technology can be applied in areas such as spectroscopy medical imaging electromagnetism optics and quantum physics Combining the principles with experimental techniques the book serves as a guide to designing and constructing femtosecond systems The second edition has updated and expanded its content and includes more examples of ultrashort sources and a more comprehensive fundamentals chapter Diagnostic techniques and applications involving sensors mode locked lasers and imaging have been fully revised to include current technologies Written in a tutorial style this book is suitable for senior undergraduate and graduate students as well as engineers and scientists working in the areas of optics spectroscopy optical imaging photochemistry and ultrafast science and engineering 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

Coherence and Ultrashort Pulse Laser Emission F. J. Duarte, 2010-12-30 In this volume recent contributions on coherence provide a useful perspective on the diversity of various coherent sources of emission and coherent related phenomena of current interest These papers provide a preamble for a larger collection of contributions on ultrashort pulse laser generation and ultrashort pulse laser phenomena Papers on ultrashort pulse phenomena include works on few cycle pulses high power generation propagation in various media to various applications of current interest Undoubtedly Coherence and Ultrashort Pulse Emission offers a rich and practical perspective on this rapidly evolving field

Coherence and Ultrashort Pulse Laser Emission F. J. Duarte, 2010-12-30 In this volume recent contributions on coherence provide a useful perspective on the diversity of various

coherent sources of emission and coherent related phenomena of current interest These papers provide a preamble for a larger collection of contributions on ultrashort pulse laser generation and ultrashort pulse laser phenomena Papers on ultrashort pulse phenomena include works on few cycle pulses high power generation propagation in various media to various applications of current interest Undoubtedly Coherence and Ultrashort Pulse Emission offers a rich and practical perspective on this rapidly evolving field *Laser Spectroscopy* Wolfgang Demtröder, 2013-06-29 Keeping abreast of the latest techniques and applications this new edition of the standard reference and graduate text on laser spectroscopy has been completely revised and expanded While the general concept is unchanged the new edition features a broad array of new material e g frequency doubling in external cavities reliable cw parametric oscillators tunable narrow band UV sources more sensitive detection techniques tunable femtosecond and sub femtosecond lasers X ray region and the attosecond range control of atomic and molecular excitations frequency combs able to synchronize independent femtosecond lasers coherent matter waves and still more applications in chemical analysis medical diagnostics and engineering Fundamentals of Photonics Bahaa E. A. Saleh, Malvin Carl Teich, 2020-03-04 Fundamentals of Photonics A complete thoroughly updated full color third edition Fundamentals of Photonics Third Edition is a self contained and up to date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics Featuring a blend of theory and applications coverage includes detailed accounts of the primary theories of light including ray optics wave optics electromagnetic optics and photon optics as well as the interaction of light and matter Presented at increasing levels of complexity preliminary sections build toward more advanced topics such as Fourier optics and holography photonic crystal optics guided wave and fiber optics LEDs and lasers acousto optic and electro optic devices nonlinear optical devices ultrafast optics optical interconnects and switches and optical fiber communications The third edition features an entirely new chapter on the optics of metals and plasmonic devices Each chapter contains highlighted equations exercises problems summaries and selected reading lists Examples of real systems are included to emphasize the concepts governing applications of current interest Each of the twenty four chapters of the second edition has been thoroughly updated

Laser Pulses Igor Peshko, 2012-10-17 This book discusses aspects of laser pulses generation characterization and practical applications Some new achievements in theory experiments and design are demonstrated The introductory chapter shortly overviews the physical principles of pulsed lasers operation with pulse durations from seconds to yoctoseconds A theory of mode locking based on the optical noise concept is discussed With this approximation all paradoxes of ultrashort laser pulse formation have been explained The book includes examples of very delicate laser operation in biomedical areas and extremely high power systems used for material processing and water purification We hope this book will be useful for engineers and managers for professors and students and for those who are interested in laser science and technologies

Generation and Parametric Amplification of Few-Cycle Light Pulses at Relativistic Intensities Alexander

Kessel, 2018-06-28 This book reports on the development of a pioneering light source architecture of the so called Petawatt Field Synthesizer PFS system which is based on short pulse pumped optical parametric chirped pulse amplification OPCPA driven by a homemade 1 ps diode pumped Yb YAG At a few cycle pulse duration of the amplified pulses this architecture yields record levels of peak power and temporal contrast the latter boasting a 100 times faster rise time from the noise level to peak intensity of the pulse compared to conventional laser systems This allows investigation of the true laser solid interaction without premature plasma expansion and without lossy pulse cleaning by e g plasma mirrors The book describes several concepts for the generation of broadband high energy and high contrast seed pulses as well as the OPCPA development few cycle pulse compression and contrast characterization in a concise and insightful manner The theory chapter serves as an excellent and accessible primer on OPCPA and other nonlinear interactions while the experimental parts provide an excellent description of the challenges of developing such a novel architecture and some of the innovative solutions to overcome them

Pulsed Fiber Lasers Peter Adel, 2004

Laser Spectroscopy and Laser Imaging Helmut H. Telle, Ángel González Ureña, 2018-04-17 a very valuable book for graduate students and researchers in the field of Laser Spectroscopy which I can fully recommend Wolfgang Demtröder Kaiserslautern University of Technology How would it be possible to provide a coherent picture of this field given all the techniques available today The authors have taken on this daunting task in this impressive groundbreaking text Readers will benefit from the broad overview of basic concepts focusing on practical scientific and real life applications of laser spectroscopic analysis and imaging Chapters follow a consistent structure beginning with a succinct summary of key principles and concepts followed by an overview of applications advantages and pitfalls and finally a brief discussion of seminal advances and current developments The examples used in this text span physics and chemistry to environmental science biology and medicine Focuses on practical use in the laboratory and real world applications Covers the basic concepts common experimental setups Highlights advantages and caveats of the techniques Concludes each chapter with a snapshot of cutting edge advances This book is appropriate for anyone in the physical sciences biology or medicine looking for an introduction to laser spectroscopic and imaging methodologies Helmut H Telle is a full professor at the Instituto Pluridisciplinar Universidad Complutense de Madrid Spain Ángel González Ureña is head of the Department of Molecular Beams and Lasers Instituto Pluridisciplinar Universidad Complutense de Madrid Spain

Solid-State Lasers and Applications Alphan Sennaroglu, 2017-12-19 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 1 μ m 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

Stimulated Raman Scattering Microscopy Ji-Xin Cheng, Wei Min, Yasuyuki Ozeki, Dario Polli, 2021-12-04 Stimulated Raman Scattering Microscopy Techniques and Applications describes innovations in instrumentation data science chemical probe development and various applications enabled by a state of the art stimulated Raman scattering SRS microscope Beginning by introducing the history of SRS this book is composed of seven parts in depth including instrumentation strategies that have pushed the physical limits of SRS microscopy vibrational probes which increased the SRS imaging functionality data science methods and recent efforts in miniaturization This rapidly growing field needs a comprehensive resource that brings together the current knowledge on the topic and this book does just that Researchers who need to know the requirements for all aspects of the instrumentation as well as the requirements of different imaging applications such as different types of biological tissue will benefit enormously from the examples of successful demonstrations of SRS imaging in the book Led by Editor in Chief Ji Xin Cheng a pioneer in coherent Raman scattering microscopy the editorial team has brought together various experts on each aspect of SRS imaging from around the world to provide an authoritative guide to this increasingly important imaging technique This book is a comprehensive reference for researchers faculty postdoctoral researchers and engineers Includes every aspect from theoretic reviews of SRS spectroscopy to innovations in instrumentation and current applications of SRS microscopy Provides copious visual elements that illustrate key information such as SRS images of various biological samples and instrument diagrams and schematics Edited by leading experts of SRS microscopy with each chapter written by experts in their given topics

Manipulating Quantum Structures Using Laser Pulses Bruce W. Shore, 2011-09-29 The use of laser pulses to alter the internal quantum structure of individual atoms and molecules has applications in quantum information processing the coherent control of chemical reactions and in quantum state engineering This book presents the underlying theory of such quantum state manipulation for researchers and graduate students The book provides the equations and approaches for their solution which can be applied to complicated multilevel quantum systems It also gives the background theory for application to isolated atoms or trapped ions simple molecules and atoms embedded in solids Particular attention is given to the ways in which quantum changes can be displayed graphically to help readers understand how quantum changes can be controlled

[Handbook of Laser Technology and Applications](#) Chunlei Guo, Subhash Chandra Singh, 2021-06-23 This comprehensive handbook gives a fully updated guide to lasers and laser technologies including the

complete range of their technical applications This third volume covers modern applications in engineering and technology including all new and updated case studies spanning telecommunications and data storage to medicine optical measurement defense and security nanomaterials processing and characterization Key Features Offers a complete update of the original bestselling work including many brand new chapters Deepens the introduction to fundamentals from laser design and fabrication to host matrices for solid state lasers energy level diagrams hosting materials dopant energy levels and lasers based on nonlinear effects Covers new laser types including quantum cascade lasers silicon based lasers titanium sapphire lasers terahertz lasers bismuth doped fiber lasers and diode pumped alkali lasers Discusses the latest applications e g lasers in microscopy high speed imaging attosecond metrology 3D printing optical atomic clocks time resolved spectroscopy polarization and profile measurements pulse measurements and laser induced fluorescence detection Adds new sections on laser materials processing laser spectroscopy lasers in imaging lasers in environmental sciences and lasers in communications This handbook is the ideal companion for scientists engineers and students working with lasers including those in optics electrical engineering physics chemistry biomedicine and other relevant areas

Thermal Processes Using Attosecond Laser Pulses Mirosław Kozłowski, Janina Marciak-Kozłowska, 2006-09-27 This book is based on the results of our interest in the field of ultrashort laser pulses interaction with matter The aim of our monograph was to build the balanced description of the thermal transport phenomena generated by laser pulses shorter than the characteristic relaxation time In the book we explore the matter on the quark nuclear as well atomic scales Also on the cosmic scale Planck Era the thermal disturbance shorter than the Planck time creates the new picture of the Universe The mathematics especially PDE are the main tool in the description of the ultrashort thermal phenomena Two types of the PDE parabolic and hyperbolic partial differential equations are of special interest in the study of the thermal processes We assume a moderate knowledge of basic Fourier and d'Alembert equations The scope of the book is deliberately limited to the background of the quantum mechanics equations Schrödinger and Klein Gordon In this book the attosecond laser pulses are the main source of the disturbance of the thermal state of the matter Recently the attosecond laser pulses constitute a novel tool for probing processes taking place on the time scale of electron motion inside atoms The research presented in this book appears to provide the basic tools and concepts for attosecond thermal dynamics Nevertheless much research is still needed to make this emerging field routinely applicable for a broad range of processes on atomic and subatomic scales

A New Generation of High-Power, Waveform Controlled, Few-Cycle Light Sources Marcus Seidel, 2019-02-01 This thesis presents first successful experiments to carrier envelope phase stabilize a high power mode locked thin disk oscillator and to compress the pulses emitted from this laser to durations of only a few optical cycles Moreover the monograph introduces several methods to achieve power scalability of compression and stabilization techniques All experimental approaches are compared in detail and may serve as a guideline for developing high power waveform controlled few cycle light sources which offer tremendous potential to exploit extreme

nonlinear optical effects at unprecedentedly high repetition rates and to establish table top infrared light sources with a unique combination of brilliance and bandwidth As an example the realization of a multi Watt multi octave spanning mid infrared femtosecond source is described The thesis starts with a basic introduction to the field of ultrafast laser oscillators It subsequently presents additional details of previously published research results and establishes a connection between them It therefore addresses both newcomers to and experts in the field of high power ultrafast laser development

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