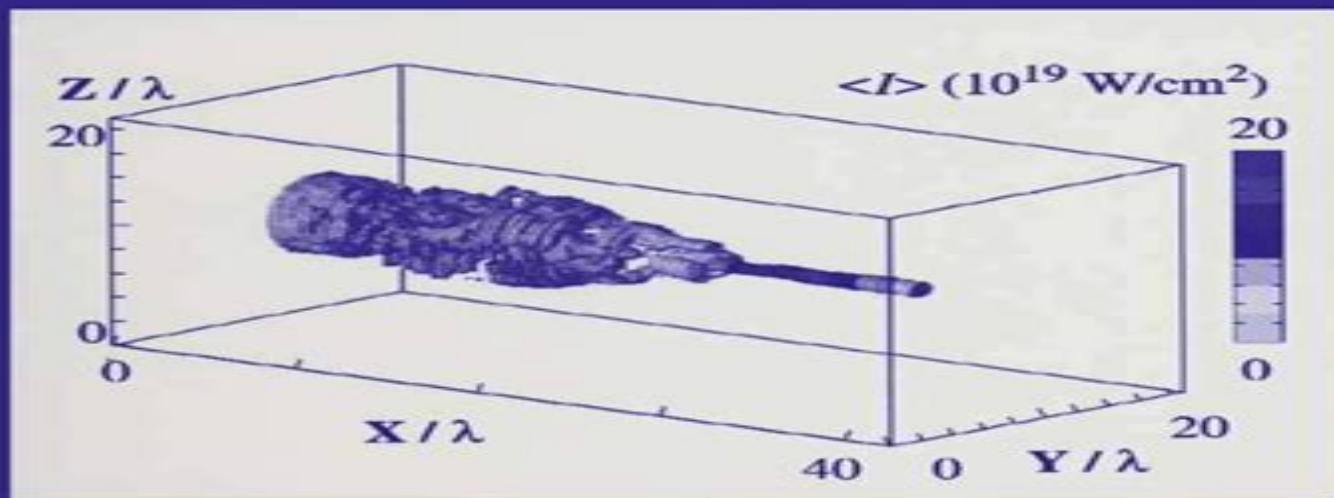


Atoms, Solids, and Plasmas in Super-Intense Laser Fields



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Dimitri Batani, Charles J. Joachain,
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Atoms Solids And Plasmas In Super Intense Laser Fields

**See Leang Chin, Pierre
Agostini, Gaetano Ferrante**



Atoms Solids And Plasmas In Super Intense Laser Fields:

Atoms, Solids, and Plasmas in Super-Intense Laser Fields Dimitri Batani, 2001-09-30 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

Atoms, Solids, and Plasmas in Super-Intense Laser Fields Dimitri Batani, Charles J. Joachain, S. Martellucci, Arthur N. Chester, 2012-12-06 The recent development of high power lasers delivering femtosecond pulses of 10^{20} intensities up to 10^{14} W cm has led to the discovery of new phenomena in laser interactions with matter At these enormous laser intensities atoms and molecules are exposed to extreme conditions and new phenomena occur such as the very rapid multi photon ionization of atomic systems the emission by these systems of very high order harmonics of the exciting laser light the Coulomb explosion of molecules and the acceleration of electrons close to the velocity of light These phenomena generate new behaviour of bulk matter in intense laser fields with great potential for wide ranging applications which include the study of ultra fast processes the development of high frequency lasers and the investigation of the properties of plasmas and condensed matter under extreme conditions of temperature and pressure In particular the concept of the fast ignitor approach to inertial confinement fusion ICF has been proposed which is based on the separation of the compression and the ignition phases in laser driven ICF The aim of this course on Atom Solids and Plasmas in Super Intense Laser fields was to bring together senior researchers and students in atomic and molecular physics laser physics condensed matter and plasma physics in order to review recent developments in high intensity laser matter interactions The course was held at the Ettore Majorana International Centre for Scientific Culture in Erice from July 8 to July 14 2000

Atoms in Intense Laser Fields C. J. Joachain, N. J. Kylstra, R. M. Potvliege, 2012 A unified account of the rapidly developing field of high intensity laser atom interactions suitable for both graduate students and researchers

[Laser Interactions with Atoms, Solids and Plasmas](#) Richard M. More, 2013-11-21 The aim of this NATO Advanced Study Institute was to bring together scientists and students working in the field of laser matter interactions in order to review and stimulate development of fundamental science with ultra short pulse lasers New techniques of pulse compression and colliding pulse mode locking have made possible the construction of lasers with pulse lengths in the femtosecond range Such lasers are now in operation at several research laboratories in Europe and the United States These laser facilities present a new and exciting research direction with both pure and applied science components In this ASI the emphasis is on fundamental processes occurring in the interaction of short laser pulses with atoms molecules solids and plasmas In the case of laser atom molecule interactions high power lasers provide the first access to extreme high intensity conditions above 10^{18} Watts cm a new frontier for nonlinear interaction of photons with atoms and molecules New phenomena observed include multiphoton ionization processes atomic collisions in the presence of a strong laser field Coulomb explosion following rapid ionization of a molecule and the production of high harmonics of the laser source Another important topic reviewed in this ASI is the

lasercooling of atoms **Atoms and Plasmas in Super-intense Laser Fields** Dimitri Batani, Charles Jean Joachain, S. Martellucci, 2004 **Relativistically Intense Laser-Microplasma Interactions** Tobias Ostermayr, 2019-07-16 This dissertation covers several important aspects of relativistically intense laser microplasma interactions and some potential applications A Paul trap based target system was developed to provide fully isolated well defined and well positioned micro sphere targets for experiments with focused peta watt laser pulses The laser interaction turned such targets into microplasmas emitting proton beams with kinetic energies exceeding 10 MeV The proton beam kinetic energy spectrum and spatial distribution were tuned by variation of the acceleration mechanism reaching from broadly distributed spectra in relatively cold plasma expansions to spectra with relative energy spread as small as 20% in spherical multi species Coulomb explosions and in directed acceleration processes Numerical simulations and analytical calculations support these experimental findings and show how microplasmas may be used to engineer laser driven proton sources In a second effort tungsten micro needle targets were used at a peta watt laser to produce few keV x rays and 10 MeV level proton beams simultaneously both measured to have only few m effective source size This source was used to demonstrate single shot simultaneous radiographic imaging with x rays and protons of biological and technological samples Finally the dissertation discusses future perspectives and directions for laser microplasma interactions including non spherical target shapes as well as thoughts on experimental techniques and advanced quantitative image evaluation for the laser driven radiography

Progress in Ultrafast Intense Laser Science I See Leang Chin, Pierre Agostini, Gaetano Ferrante, 2006-10-03 This is the first of a series of books on Ultrafast Intense Laser Science a newly emerging interdisciplinary research field that spans atomic and molecular physics molecular science and optical science It covers intense VUV laser cluster interaction resonance and chaos assisted tunneling and the effects of the carrier envelope phase on high order harmonic generation *Progress in Ultrafast Intense Laser Science III* See Leang Chin, Pierre Agostini, Gaetano Ferrante, 2008-01-23 The PUILS series presents Progress in Ultrafast Intense Laser Science This third volume in the series covers a diverse range of disciplines focusing on such topics as strong field ionization of atoms ionization and fragmentation of molecules and clusters generation of high order harmonics and attosecond pulses filamentation and laser plasma interaction and the development of ultrashort and ultrahigh intensity light sources **Laser Pulse Phenomena and Applications** F. J. Duarte, 2010-12-30 Pulsed lasers are available in the gas liquid and the solid state These lasers are also enormously versatile in their output characteristics yielding emission from very large energy pulses to very high peak power pulses Pulsed lasers are equally versatile in their spectral characteristics This volume includes an impressive array of current research on pulsed laser phenomena and applications Laser Pulse Phenomena and Applications covers a wide range of topics from laser powered orbital launchers and laser rocket engines to laser matter interactions detector and sensor laser technology laser ablation and biological applications *Advances in Solid State Lasers* Mikhail Grishin, 2010-02-01 Invention of the solid state laser has initiated the

beginning of the laser era Performance of solid state lasers improved amazingly during five decades Nowadays solid state lasers remain one of the most rapidly developing branches of laser science and become an increasingly important tool for modern technology This book represents a selection of chapters exhibiting various investigation directions in the field of solid state lasers and the cutting edge of related applications The materials are contributed by leading researchers and each chapter represents a comprehensive study reflecting advances in modern laser physics Considered topics are intended to meet the needs of both specialists in laser system design and those who use laser techniques in fundamental science and applied research This book is the result of efforts of experts from different countries I would like to acknowledge the authors for their contribution to the book I also wish to acknowledge Vedran Kordic for indispensable technical assistance in the book preparation and publishing

Laser-Plasma Interactions Dino A. Jaroszynski, R.A. Bingham, R.A Cairns, 2009-03-27 A Solid Compendium of Advanced Diagnostic and Simulation Tools Exploring the most exciting and topical areas in this field Laser Plasma Interactions focuses on the interaction of intense laser radiation with plasma After discussing the basic theory of the interaction of intense electromagnetic radiation fields with matter the book covers three ap

Optical Chemical Sensors F. Baldini, A.N. Chester, J. Homola, S. Martellucci, 2006-04-19 This book covers optical chemical sensing by means of optical waveguides from the fundamentals to the most recent applications The book includes a historical review of the development of these sensors from the earliest laboratory prototypes to the first commercial instrumentations The book reprints a lecture by the Nobel Laureate Charles Townes on the birth of maser and laser which lucidly illustrates the development of new science and new technology

Super-Intense Laser-Atom Physics IV H.G. Muller, M.V. Fedorov, 1996-05-31 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 discovery of the photoelectric effect it was not possible to generate electro magnetic fields that did more than perturb the atom only slightly and first order perturbation theory could perfectly explain what was going on at those low intensities The development of the pulsed laser has 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 we 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 ionization 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

Laser Wakefield Electron Acceleration Karl Schmid, 2011-05-18 This thesis covers the few cycle laser driven acceleration of electrons in a laser generated plasma This process known as laser wakefield acceleration LWFA relies

on strongly driven plasma waves for the generation of accelerating gradients in the vicinity of several 100 GV m a value four orders of magnitude larger than that attainable by conventional accelerators This thesis demonstrates that laser pulses with an ultrashort duration of 8 fs and a peak power of 6 TW allow the production of electron energies up to 50 MeV via LWFA The special properties of laser accelerated electron pulses namely the ultrashort pulse duration the high brilliance and the high charge density open up new possibilities in many applications of these electron beams

Fundamentals of Time-Dependent Density Functional Theory Miguel A.L. Marques, Neepea T. Maitra, Fernando M.S. Nogueira, E.K.U. Gross, Angel Rubio, 2012-01-20

There have been many significant advances in time dependent density functional theory over recent years both in enlightening the fundamental theoretical basis of the theory as well as in computational algorithms and applications This book as successor to the highly successful volume Time Dependent Density Functional Theory Lect Notes Phys 706 2006 brings together for the first time all recent developments in a systematic and coherent way First a thorough pedagogical presentation of the fundamental theory is given clarifying aspects of the original proofs and theorems as well as presenting fresh developments that extend the theory into new realms such as alternative proofs of the original Runge Gross theorem open quantum systems and dispersion forces to name but a few Next all of the basic concepts are introduced sequentially and building in complexity eventually reaching the level of open problems of interest Contemporary applications of the theory are discussed from real time coupled electron ion dynamics to excited state dynamics and molecular transport Last but not least the authors introduce and review recent advances in computational implementation including massively parallel architectures and graphical processing units Special care has been taken in editing this volume as a multi author textbook following a coherent line of thought and making all the relevant connections between chapters and concepts consistent throughout As such it will prove to be the text of reference in this field both for beginners as well as expert researchers and lecturers teaching advanced quantum mechanical methods to model complex physical systems from molecules to nanostructures from biocomplexes to surfaces solids and liquids From the reviews of LNP 706 This is a well structured text with a common set of notations and a single comprehensive and up to date list of references rather than just a compilation of research articles Because of its clear organization the book can be used by novices basic knowledge of ground state DFT is assumed and experienced users of TD DFT as well as developers in the field Anna I Krylov Journal of the American Chemical Society Vol 129 21 2007 This book is a treasure of knowledge and I highly recommend it Although it is a compilation of chapters written by many different leading researchers involved in development and application of TDDFT the contributors have taken great care to make sure the book is pedagogically sound and the chapters complement each other It is highly accessible to any graduate student of chemistry or physics with a solid grounding in many particle quantum mechanics wishing to understand both the fundamental theory as well as the exponentially growing number of applications In any case no matter what your background is it is a must read and an excellent reference to have on your shelf Amazon com

October 15 2008 David Tempel Cambridge MA X-Ray Lasers 2004 J Zhang, 2005-06-15 X Ray Lasers 2004 comprises invited contributed and poster papers presented at the 9th International Conference on X Ray Lasers ICXRL2004 held in Beijing in May 2004 Some 120 participants from 13 countries and regions met in Beijing to compare results and exchange views on future developments in x ray lasers and related fields The book covers the following topics overviews of x ray lasers research collisionally pumped x ray lasers capillary discharge pumped x ray lasers OFI and photo pumped x ray lasers high order harmonics XUV radiation grazing incidence pumping x ray lasers theory and simulations of x ray lasers and plasma media free electron lasers and accelerator based x ray sources alternative pumping schemes for x ray lasers applications of x ray lasers and other bright x ray sources x ray optics and instrumentation investigations of x ray laser media and developments of x ray laser drivers X Ray Lasers 2004 provides not only an overview and an up to date progress report on this fast moving field but also important reference material on which future work can be built **Free Electron Lasers**

2002 K.-J. Kim, S.V. Milton, E. Gluskin, 2012-12-02 This book contains the Proceedings of the 24th International Free Electron Laser Conference and the 9th Free Electron Laser Users Workshop which were held on September 9-13 2002 at Argonne National Laboratory Part I has been reprinted from Nucl Instr and Meth A 507 2003 Nos 1-2 *Time-Dependent Density-Functional Theory* Carsten A. Ullrich, 2011-12-22 Time dependent density functional theory TDDFT describes the quantum dynamics of interacting electronic many body systems formally exactly and in a practical and efficient manner TDDFT has become the leading method for calculating excitation energies and optical properties of large molecules with accuracies that rival traditional wave function based methods but at a fraction of the computational cost This book is the first graduate level text on the concepts and applications of TDDFT including many examples and exercises and extensive coverage of the literature The book begins with a self contained review of ground state DFT followed by a detailed and pedagogical treatment of the formal framework of TDDFT It is explained how excitation energies can be calculated from linear response TDDFT Among the more advanced topics are time dependent current density functional theory orbital functionals and many body theory Many applications are discussed including molecular excitations ultrafast and strong field phenomena excitons in solids van der Waals interactions nanoscale transport and molecular dynamics *Super-Intense Laser-Atom Physics* Bernard Pirau, Kazimierz Rzazewski, 2001-03-31 The study of atomic systems exposed to super intense laser fields defines 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 $1s$ ground state this occurs above an intensity of $3.5 \times 10^{16} \text{ W/cm}^2$ which is the atomic unit of intensity Presently at the laboratory scale and in extremely short and tightly focussed laser pulses the electric field strength $1.6 \times 10^{12} \text{ V/m}$ reaches peak values which are of the order of 10^{10} W/cm^2 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 totally 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 **Atomic Processes in Plasmas** David R. Schultz, Fred W. Meyer, Fay Ownby, 2002-10-10 The APS Topical Conference on Atomic Processes in Plasmas brings together researchers working in atomic physics and in plasma science emphasizing the strong and synergistic overlap of these fields The latest developments in atomic physics reported are recent advances in plasma science such as in magnetic or inertial confinement fusion Z pinches astrophysics and technical plasma processing

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