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Atoms and Molecules Experiments Using Ice, Salt, Marbles, and More Adventures with Atoms and Molecules Adventures with Atoms and Molecules, Book II XUV Pump-Probe Experiments on Diatomic Molecules Adventures with Atoms and Molecules, Book III Comparison of Ab Initio Quantum Chemistry with Experiment for Small Molecules Simple Machine Experiments Using Seesaws, Wheels, Pulleys, and More Experiments in Molecular Cell Biology Experiments in Molecular Biology Cold Molecules High-Resolution Experiments on Strong-Field Ionization of Atoms and Molecules Molecular Electronics Laser Experiments with Small Molecules Molecules in Interaction with Surfaces and Interfaces Perfect/Complete Scattering Experiments Multiple-Photon Excitation and Dissociation of Polyatomic Molecules Molecular Spectroscopy—Experiment and Theory Magnetism Laser-Induced Processes in Molecules Models, Mysteries, and Magic of Molecules Methods and Mechanisms for Producing Ions from Large Molecules The Origin of Chirality in the Molecules of Life Tunnelling in Molecules Gas-Phase IR Spectroscopy and Structure of Biological Molecules Maxwell on Molecules and Gases Low Temperatures and Cold Molecules Coherence Phenomena in Atoms and Molecules in Laser Fields Lasers, Molecules, and Methods Many-body Theory of Molecules, Clusters, and Condensed Phases Guidelines for Research Involving Recombinant DNA Molecules Experiments with Trapped RbCs Molecules Experiments with Stark-decelerated and Trapped Molecules Polymer Physics Experiments with Single DNA Molecules Physical Chemistry of Cold Gas-Phase Functional Molecules and Clusters Energy Storage and Redistribution in Molecules Clusters of Atoms and Molecules Spintronics with Individual Metal-organic Molecules Dissociative Recombination of Molecular Ions with Electrons Optical, Electric and Magnetic Properties of Molecules Rotational Spectroscopy of Diatomic Molecules

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This book provides an interdisciplinary review of one of the great unsolved mysteries that has fascinated scientists for over 150 years: the origin of chirality in biomolecules. Current advances in fields as diverse as space exploration, prebiotic chemistry and high-energy physics may help to provide an answer. Important pieces of information will come from observations at the two frontiers of science: outer space and the subatomic world. Observation of distant planets, galaxies, and even actual sampling of celestial objects from beyond the solar system are projects currently underway. At the other end of the spectrum, there are experiments that study the elemental properties of matter, such as symmetry, and interactions with the fundamental forces. Completely revised and updated this new edition once again unifies all the theories of the origin of biomolecular homochirality together in a single source. This complete, interdisciplinary review of an intriguing subject condenses a large and disparate range of contributions from journals in almost every scientific field. The various theories have been organized, interrelated and explained in a unified way. It is fundamental, comprehensive and structured to be accessible for educational purposes. Nuclear Quantum Effects from Bio to Physical Chemistry This book celebrates the career and scientific accomplishments of Professor David Buckingham, who is due to retire from his Chair at Cambridge University in 1997. The adopted format comprises reprints of a number of David Buckingham's key scientific papers, each one or two of these preceded by a review of the corresponding area of David's wide-ranging research interest. Each reviewer is recognised as an expert in that field of interest and has some close association with David Buckingham, as a scientific colleague and/or a former research student. The book should serve as a distinctive reference source, both retrospective and prospective, for the field of chemical physics with which the name A.D. Buckingham is associated. The editors opted to reprint a majority of early classic Buckingham papers, balanced by some of David Buckingham's more recent publications. Reprinted papers have been placed into a general scientific context that covers prior influences on, and later impacts by, the work nominated for review. Dissociative Recombination of Molecular Ions with Electrons is a comprehensive collection of refereed papers describing the latest developments in dissociative

recombination research. The papers are written by the leading researchers in the field. The topics covered include the use of microwave afterglows, merged beams and storage rings to measure rate coefficients and to identify the products and their yields. The molecules studied range in size from the smallest, H2+, to bovine insulin ions. The theoretical papers cover the important role of Rydberg states and the use of wave packets and quantum defect theory to deduce cross sections, rate constants and quantum yields. Several theoretical and experimental papers address the controversial topic of H3+ dissociative recombination and its importance in the interstellar medium. Dissociative recombination studies of other molecular ions in the interstellar medium and in cometary and planetary atmospheres are covered. Ionization is an important competitive process to dissociative recombination and its competition with predissociation and its role in the reverse process of the association of neutral species is presented. Dissociative attachment, in which an electron attaches to a neutral molecule, has many similarities to dissociative recombination. The topics covered include the accurate calculation of electron affinities, attachment to molecules, clusters, and to species absorbed on solid surfaces and electron scattering by a molecular anion. Describes experiments involving simple machines that follow the scientific method, explores the use of levers to control motion and lift, and shows how the steepness of inclined planes affects the force needed to move something. -- Chemistry experiments that can be done at home or in the classroom using easily obtained and inexpensive materials. Now available in paperback! -- Includes step-by-step instructions for thirty experiments that demonstrate the scientific method. 1. The birth of molecular electronics. 1.1. Why molecular electronics?. 1.2. A brief history of molecular electronics. 1.3. Scope and structure of the book -- 2. Fabrication of metallic atomic-size contacts. 2.1. Introduction. 2.2. Techniques involving the scanning electron microscope (STM). 2.3. Methods using atomic force microscopes (AFM). 2.4. Contacts between macroscopic wires. 2.5. Transmission electron microscope. 2.6. Mechanically controllable break-junctions (MCBJ). 2.7. Electromigration technique. 2.8. Electrochemical methods. 2.9. Recent developments. 2.10. Electronic transport measurements. 2.11. Exercises -- 3. Contacting single molecules: Experimental techniques. 3.1. Introduction. 3.2. Molecules for molecular electronics. 3.3. Deposition of molecules. 3.4. Contacting single molecules. 3.5. Contacting molecular ensembles. 3.6. Exercises -- 4. The scattering approach to phase-coherent transport in nanocontacts. 4.1. Introduction. 4.2. From mesoscopic conductors to atomic-scale junctions. 4.3. Conductance is transmission : heuristic derivation of the Landauer formula. 4.4. Penetration of a potential barrier : tunnel effect. 4.5. The scattering matrix. 4.6. Multichannel Landauer formula. 4.7. Shot noise. 4.8. Thermal transport and thermoelectric phenomena. 4.9. Limitations of the scattering approach. 4.10. Exercises -- 5. Introduction to Green's function techniques for systems in equilibrium. 5.1. The Schrodinger and Heisenberg pictures. 5.2. Green's functions of a

noninteracting electron system. 5.3. Application to tight-binding Hamiltonians. 5.4. Green's functions in time domain. 5.5. Exercises -- 6. Green's functions and Feynman diagrams. 6.1. The interaction picture. 6.2. The time-evolution operator. 6.3. Perturbative expansion of causal Green's functions. 6.4. Wick's theorem. 6.5. Feynman diagrams. 6.6. Feynman diagrams in energy space. 6.7. Electronic self-energy and Dyson's equation. 6.8. Self-consistent diagrammatic theory : the Hartree-Fock approximation. 6.9. The Anderson model and the Kondo effect. 6.10. Final remarks. 6.11. Exercises -- 7. Nonequilibrium Green's functions formalism. 7.1. The Keldysh formalism. 7.2. Diagrammatic expansion in the Keldysh formalism. 7.3. Basic relations and equations in the Keldysh formalism. 7.4. Application of Keldysh formalism to simple transport problems. 7.5. Exercises -- 8. Formulas of the electrical current : exploiting the Keldysh formalism. 8.1. Elastic current : microscopic derivation of the Landauer formula. 8.2. Current through an interacting atomic-scale junction. 8.3. Time-dependent transport in nanoscale junctions. 8.4. Exercises -- 9. Electronic structure I: Tight-binding approach. 9.1. Basics of the tight-binding approach. 9.2. The extended Huckel method. 9.3. Matrix elements in solid state approaches. 9.4. Slater-Koster two-center approximation. 9.5. Some illustrative examples. 9.6. The NRL tight-binding method. 9.7. The tight-binding approach in molecular electronics. 9.8. Exercises -- 10. Electronic structure II : density functional theory. 10.1. Elementary quantum mechanics. 10.2. Early density functional theories. 10.3. The Hohenberg-Kohn theorems. 10.4. The Kohn-Sham approach. 10.5. The exchange-correlation functionals. 10.6. The basic machinery of DFT. 10.7. DFT performance. 10.8. DFT in molecular electronics. 10.9. Exercises -- 11. The conductance of a single atom. 11.1. Landauer approach to conductance: brief reminder. 11.2. Conductance of atomic-scale contacts. 11.3. Conductance histograms. 11.4. Determining the conduction channels. 11.5. The chemical nature of the conduction channels of oneatom contacts. 11.6. Some further issues. 11.7. Conductance fluctuations. 11.8. Atomic chains : parity oscillations in the conductance. 11.9. Concluding remarks. 11.10. Exercises -- 12. Spin-dependent transport in ferromagnetic atomic contacts. 12.1. Conductance of ferromagnetic atomic contacts. 12.2. Magnetoresistance of ferromagnetic atomic contacts. 12.3. Anisotropic magnetoresistance in atomic contacts. 12.4. Concluding remarks and open problems -- 13. Coherent transport through molecular junctions I : basic concepts. 13.1. Identifying the transport mechanism in single-molecule junctions. 13.2. Some lessons from the resonant tunneling model. 13.3. A two-level model. 13.4. Length dependence of the conductance. 13.5. Role of conjugation in [symbol]-electron systems. 13.6. Fano resonances. 13.7. Negative differential resistance. 13.8. Final remarks. 13.9. Exercises -- 14. Coherent transport through molecular junctions II : test-bed molecules. 14.1. Coherent transport through some test-bed molecules. 14.2. Metal-molecule contact : the role of anchoring groups. 14.3. Tuning chemically the conductance : the role of side-groups. 14.4. Controlled STM-based single-

molecule experiments. 14.5. Conclusions and open problems -- 15. Single-molecule transistors : Coulomb blockade and Kondo physics. 15.1. Introduction. 15.2. Charging effects in transport through nanoscale devices. 15.3. Single-molecule three-terminal devices. 15.4. Coulomb blockade theory : constant interaction model. 15.5. Towards a theory of Coulomb blockade in molecular transistors. 15.6. Intermediate coupling : cotunneling and Kondo effect. 15.7. Single-molecule transistors : experimental results. 15.8. Exercises -- 16. Vibrationally-induced inelastic current I : experiment. 16.1. Introduction. 16.2. Inelastic electron tunneling spectroscopy (IETS). 16.3. Highly conductive junctions : point-contact spectroscopy (PCS). 16.4. Crossover between PCS and IETS. 16.5. Resonant inelastic electron tunneling spectroscopy (RIETS). 16.6. Summary of vibrational signatures -- 17. Vibrationally-induced inelastic current II : theory. 17.1. Weak electron-phonon coupling regime. 17.2. Intermediate electron-phonon coupling regime. 17.3. Strong electron-phonon coupling regime. 17.4. Concluding remarks and open problems. 17.5. Exercises -- 18. The hopping regime and transport through DNA molecules. 18.1. Signatures of the hopping regime. 18.2. Hopping transport in molecular junctions : experimental examples. 18.3. DNA-based molecular junctions. 18.4. Exercises -- 19. Beyond electrical conductance : shot noise and thermal transport. 19.1. Shot noise in atomic and molecular junctions. 19.2. Heating and heat conduction. 19.3. Thermoelectricity in molecular junctions -- 20. Optical properties of current-carrying molecular junctions. 20.1. Surface-enhanced Raman spectroscopy of molecular junctions. 20.2. Transport mechanisms in irradiated molecular junctions. 20.3. Theory of photon-assisted tunneling. 20.4. Experiments on radiation-induced transport in atomic and molecular junctions. 20.5. Resonant current amplification and other transport phenomena in ac driven molecular junctions. 20.6. Fluorescence from current-carrying molecular junctions. 20.7. Molecular optoelectronic devices. 20.8. Final remarks. 20.9. Exercises -- 21. What is missing in this book? The series Topics in Current Chemistry presents critical reviews of the present and future trends in modern chemical research. The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology, medicine and materials science. The goal of each thematic volume is to give the non-specialist reader, whether in academia or industry, a comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience. Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole. The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed. The coverage is not intended to be an exhaustive summary of the field or include large quantities of data, but should rather be conceptual, concentrating on the methodological thinking that will allow the non-specialist reader to understand the information presented. Contributions also offer an outlook on potential future developments in the field. Review articles for the individual volumes are invited by

the volume editors. Readership: research chemists at universities or in industry, graduate students. In this work two ideas of using individual metal organic molecules in applications for data storage are presented. On the one hand, metal-free phthalocyanine is used to form a GMR contact consisting of one single molecule leading to the world smallest magnetic sensor. On the other hand, chromium acetylacetonate was used to study the properties of magnetic molecules adsorbed on surfaces in order to build magnetic bits for date storage. This book reviews various aspects of molecular spectroscopy and its application in materials science, chemistry, physics, medicine, the arts and the earth sciences. Written by an international group of recognized experts, it examines how complementary applications of diverse spectroscopic methods can be used to study the structure and properties of different materials. The chapters cover the whole spectrum of topics related to theoretical and computational methods, as well as the practical application of spectroscopic techniques to study the structure and dynamics of molecular systems, solid-state crystalline and amorphous materials, surfaces and interfaces, and biological systems. As such, the book offers an invaluable resource for all researchers and postgraduate students interested in the latest developments in the theory, experimentation, measurement and application of various advanced spectroscopic methods for the study of materials. This book describes advanced research on the structures and photochemical properties of polyatomic molecules and molecular clusters having various functionalities under cold gas-phase conditions. Target molecules are crown ethers, polypeptides, large size protonated clusters, metal clusters, and other complex polyatomic molecules of special interest. A variety of advanced frequency and time-domain laser spectroscopic methods are applied. The book begins with the principle of an experimental setup for cold gas-phase molecules and various laser spectroscopic methods, followed by chapters on investigation of specific molecular systems. Through a molecular-level approach and analysis by quantum chemical calculation, it is possible to learn how atomic and molecular-level interactions (van der Waals, hydrogen-bonding, and others) control the specific properties of molecules and clusters. Those properties include molecular recognition, induced fitting, chirality, proton and hydrogen transfer, isomerization, and catalytic reaction. The information will be applicable to the design of new types of functional molecules and nanoparticles in the broad area that includes applied chemistry, drug delivery systems, and catalysts. This book brings together, for the first time, the results of recent research in areas ranging from the chemistry of cold interstellar clouds (10-20 K), through laboratory studies of the spectroscopy and kinetics of ions, radicals and molecules, to studies of molecules in liquid helium droplets, to attempts to create molecular (as distinct from atomic) Bose-Einstein condensates. Based on a symposium on lasers, molecules, and methods held at the Los Alamos Center for Nonlinear Studies held in July 1986. Contributors present recent advances in theoretical and experimental research on a diversity of dynamical and optical phenomena resulting

from the interactions of laser beams with molecules. They describe the predictive results of sophisticated mathematical models, the equipment involved in experiments, and reveal new insights into molecular structure and behavior. The definitive text on the rotational spectroscopy of diatomic molecules. This volume contains the lectures and communications presented at the NATO Advanced Research Workshop (NATO ARW 900857) which was held May 5-10, 1991 at McMaster University, Hamilton, Ontario, Canada. A scientific commitee made up of P.P. Lambropoulos (USC & Crete), P.8. Corkum (NRC, Ottawa), and H. B. vL. van den Heuvell (FOM, Amsterdam) guided the organizers, A.D. Bandrauk (Sherbrooke) and S.C. Wallace (Toronto) in preparing a programme which would cover the latest advances in the field of atom and molecule laser interactions. Since the last meeting held in July 1987 on "Atomic and Molecular Processes with Short Intense Laser Pulses", NATO ASI vol 1718 (Plenum Press 1988), considerable progress has been made in understanding high intensity effects on atoms and the concomitant coherence effects. After four years, the emphasis is now shifting more to molecules. The present volume represents therefore this trend with four sections covering the main interests of research endeavours in this area: i) Atoms in Intense Laser-Fields ii) Molecules in Intense Laser Fields iii) Atomic Coherences iv) Molecular Coherences The experience developed over the years in multiphoton atomic processes has been very useful and is the main source of our understanding of similar processes in molecules. Thus ATI (above threshold ionization) has been found to occur in molecules as well as a new phenomenon, ATD (above-threshold dissociation). Laser-induced avoided crossings of molecular electronic surfaces is also now entering the current language of high intensity molecular processes. James Clerk Maxwell (1831-1879) is generally considered the most importantmathematical physicist in the period between Newton and Einstein. His work, like theirs, exhibitsrange as well as depth and extends from his grand synthesis of electrical, magnetic, and opticalphenomena in the theory of electromagnetic fields to his contributions to the kinetic theory ofgases and its generalization into statistical mechanics.Maxwell on Saturn's Rings (The MIT Press,1983) focused on the early work that confirmed Maxwell's scientific promise. The present volumedeals with the evolution of Maxwell's overview of atomic and statistical physics and with his workon the kinetic theory of transport phenomena in gases. It includes 92 documents and papers spanningthe years 1859-1879. Among these are previously unpublished notes, drafts, and calculations andcorrespondence with Peter Guthrie Tait, William Thomson (Lord Kelvin), Herbert Spencer, GeorgeGabbriel Stokes, Simon Newcomb, and others.The reader can trace Maxwell's insights from theirinception to their fruition in the fully worked-out formal papers and shorter communications toNature that are also included. The documents reveal the stages through which key concepts passed -such as the idea that diffusion, viscosity, and heat conduction in gases are parallel dynamicalprocesses expressed in terms of the transfer of mass, momentum,

and energy - and show Maxwell'sskill in balancing abstract philosophical generalization with concrete practical detail.The editorshave provided a comprehensive introduction that places the material in historical context. Aforthcoming volume on thermodynamics and statistical mechanics will conclude their presentation ofMaxwell's scientific development.Elizabeth Garber and Stephen G. Brush are historians of scienceaffiliated with the State University of New York at Stony Brook and the University of Maryland,respectively. C. W. F. Everitt is a physicist and historian of science associated with StanfordUniversity. Do your students wait until the last minute to get started on Science projects? No problem. Each experiment in this resource follows the scientific method, and can be completed in an hour or less. Readers will model a chemical reaction, discover how small a molecule is, and find out what happens when atoms jump from one molecule to another. Most experiments also include ideas for science fair projects in case your readers have extra time. In the early 1970s, researchers in Canada, the Soviet Union and the United States discovered that powerful infrared laser pulses are capable of dissociating mole cules such as SiF4 and SF6' This result, which was so unexpected that for some time the phenomenon of multiple-photon dissociation was not recognized in many cir cumstances in which we now know that it occurs, was first publicized at a time when the possibility of using lasers for the separation of isotopes had attracted much attention in the scientific community. From the mid-1970s to the early 1980s, hun dreds of experimental papers were published describing the multiple-photon absorp tion of C02 laser pulses in nearly every simple molecule with an absorption band in the 9 - 11 jJm region. Despite this impressive volume of experimental results, and despite the efforts of numerous theorists, there is no agreement among re searchers in the field on many fundamental aspects of the absorption of infrared laser light by polyatomic molecules. This book is devoted to reviells of the experimental and theoretical research that provides the foundations for our current understanding of molecular multiple photon exc itat i on, and to rev i ews of research that is pert i nent to the 1 aser sep aration of isotopes. The main goal of this book is to elucidate what kind of experiment must be performed in order to determine the full set of independent parameters which can be extracted and calculated from theory, where electrons, photons, atoms, ions, molecules, or molecular ions may serve as the interacting constituents of matter. The feasibility of such perfect' and-or ˋcomplete' experiments, providing the complete quantum mechanical knowledge of the process, is associated with the enormous potential of modern research techniques, both, in experiment and theory. It is even difficult to overestimate the role of theory in setting of the complete experiment, starting with the fact that an experiment can be complete only within a certain theoretical framework, and ending with the direct prescription of what, and in what conditions should be measured to make the experiment ˋcomplete'. The language of the related theory is the language of quantum mechanical amplitudes and their relative phases. This book captures the spirit of research in the

direction of the complete experiment in atomic and molecular physics, considering some of the basic quantum processes: scattering, Auger decay and photo-ionization. It includes a description of the experimental methods used to realize, step by step, the complete experiment up to the level of the amplitudes and phases. The corresponding arsenal includes, beyond determining the total cross section, the observation of angle and spin resolved quantities, photon polarization and correlation parameters, measurements applying coincidence techniques, preparing initially polarized targets, and even more sophisticated methods. The `complete' experiment is, until today, hardly to perform. Therefore, much attention is paid to the results of state-of-the-art experiments providing detailed information on the process, and their comparison to the related theoretical approaches, just to mention relativistic multi-configurational Dirac-Fock, convergent close-coupling, Breit-Pauli R-matrix, or relativistic distorted wave approaches, as well as Green's operator methods. This book has been written in honor of Herbert Walther and his major contribution to the field but even to stimulate advanced Bachelor and Master students by demonstrating that obviously nowadays atomic and molecular scattering physics yields and gives a much exciting appreciation for further advancing the field. The Indaba 5 meeting, held in South Africa during August 2006, examined the progress being made to achieve first-principle understanding of molecular science and confirmed the need to better understand the mysteries and magic of molecules. This book explores the common ground to guide chemists, biologists, crystallographers, spectroscopists and theorists towards painting a holistic picture of scientific endeavor. Clusters of Atoms and Molecules I is devoted to theoretical concepts and experimental techniques important in the rapidly expanding field of cluster science. Cluster properties are dicussed for clusters composed of alkali metals, semiconductors, transition metals, carbon, oxides and halides of alkali metals, rare gases, and neutral molecules. The book contains several well-integrated treatments, all prepared by experts. Each contribution starts out as simple as possible and ends with the latest results, so that the book can serve as a text for a course, an introduction into the field, or as a reference book for the expert. The study of the interaction of molecules with surfaces and interfaces is of great importance for the understanding of adsorption and catalysis on solid surfaces, the complex properties of molecules on fluid interfaces and the relationship between structure and functionality in macromolecular biological systens. It is the aim of this volume to present and analyse in a comprehensive and accesible way the methodical achievements and the recent proress in this field. The broadness of both scope and selection of the topics should help in particular non-expert readers to become familiar with this exciting field of research. This conference on both the physics and chemistry of laser-induced processes in molecules was organized by the Quantum Electronics Divisional Board of the European Physical Society whose membership is given on p.367. The confer ence aim, to mix physicists and chemists interested in this exciting field both

from Europe and further afield, was well fulfilled by the attendance of around 250 participants and the submission of about 100 papers, which dre presented here. Numerous people at both the Physics Department, Heriot-Watt University, Edinburgh, and at the Projektgruppe fUr Laserforschung, MPI, Garching, con tributed hard work to the organization; in addition to Dr. Bob Harrison, who bore the biggest burden with conspicuous success, we particularly thank Hugh MacKenzie, Richard Dennis and last but not least Miss Joanne Askham and the secretaries in Edinburgh together with Frau Doris Maischberger and the secretaries in Garching. December 1978 K.L. Kompa S.D. Smith Conren~ Part I. Study of Lasers and Related Techniques Suitable for Applications in Chemistry and Spectroscopy Rare Gas Halogen Lasers and Photochemical Applications. By S.D. Rockwood ... 3 Group VI Molecular Photolytic Dissociation Studies Using Rare Gas Halide Lasers. By M.C. Gower, A.J. Kearsley, and C.E. Webb ... 8 Broadly Tunable UV Source Based on Stimulated Raman Scattering. This book provides a comprehensive review of seminal as well as recent results in the theory of condensed phases, including liquid metals, quantum liquids and Wigner crystals, along with selected applications, especially in the physical chemistry of molecules and clusters. A large part of this work is dedicated to The Thomasndash;Fermi semiclassical approximation for molecules and condensed phases, and its extension to inhomogeneous electron liquids and liquid metals. Correlation effects in quantum liquids and Wigner crystallization are other areas of focus of this work, with an emphasis towards the effect of low dimensionality and magnetic fields. The volume is a collection of reprints by N H March and collaborators over five decades. This book explores the relaxation dynamics of inner-valence-ionized diatomic molecules on the basis of extreme-ultraviolet pump-probe experiments performed at the free-electron laser (FEL) in Hamburg. Firstly, the electron rearrangement dynamics in dissociating multiply charged iodine molecules is studied in an experiment that made it possible to access charge transfer in a thus far unexplored quasimolecular regime relevant for plasma and chemistry applications of the FEL. Secondly the lifetime of an efficient non-radiative relaxation process that occurs in weakly bound systems is measured directly for the first time in a neon dimer (Ne2). Interatomic Coulombic decay (ICD) has been identified as the dominant decay mechanism in inner-valence-ionized or excited van-der-Waals and hydrogen bonded systems, the latter being ubiquitous in all biomolecules. The role of ICD in DNA damage thus demands further investigation, e.g. with regard to applications like radiation therapy. Chemistry experiments for home or school demonstrate the properties and behavior of various kinds of atoms and molecules. Combining the contemporary knowledge from widely scattered sources, this is a much-needed and comprehensive overview of the field. In maintaining a balance between theory and experiment, the book guides both advanced students and specialists to this research area. Topical reviews written by the foremost scientists explain recent trends and advances, focusing on the

*correlations between electronic structure and magnetic properties. The book spans recent trends in magnetism for molecules -- as well as inorganic-based materials, with an emphasis on new phenomena being explored from both experimental and theoretical viewpoints with the aim of understanding magnetism on the atomic scale. The volume helps readers evaluate their own experimental observations and serves as a basis for the design of new magnetic materials. Topics covered include: * Metallocenium Salts of Radical Anion Bis-(dichalcogenate) metalates * Chiral Molecule-Based Magnets * Cooperative Magnetic Behavior in Metal-Dicyanamide Complexes * Lanthanide Ions in Molecular Exchange Coupled Systems * Monte Carlo Simulation * Metallocene-Based Magnets * Magnetic Nanoporous Molecular Materials A unique reference work, indispensable for everyone concerned with the phenomena of magnetism. We characterize an isolated molecule by its compos~t~on, i.e. the number and types of atoms forming the molecule, its structure, i.e. the geometrical arrangement of the composite atoms with respect to each other, and its possible, i.e. quantum mechanically allowed, stationary energy states. Conceptually we separate the latter, being aware that this is an approximation, into electronic, vibrational and rotational states, including fine and hyperfine structure splittings. To be sure, there is an intimate relation between molecular structure and molecular energy states, in fact it is this relation we use, when we obtain structural information through spectroscopy, where we determine transitions between various stationary states of the molecule. The concepts above have proven extremely useful in chemistry and spectroscopy, however, the awareness of the limitations of these concepts has grown in recent years with the increasing recognition of (i) fluctional molecules, (ii) multiphoton absorption processes and (iii) influences due to the surroundings on "isolated" molecules. -- Chemistry experiments that can be done at home or in the classroom using easily obtained and inexpensive materials. Now available in paperback! -- Includes step-by-step instructions for thirty experiments that demonstrate the scientific method. A NATO Advanced Research Workshop on Methods and Mechanisms for Producing Ions from Large Molecules was held at Minaki Lodge, Minaki, Ontario, Canada, from 24 to 28 June 1990. The workshop was hosted by the time-of-flight group of the Department of Physics at the University of Manitoba, and was attended by 64 invited participants from around the world. Twenty-nine invited talks were given and 19 papers were presented as posters. Of the 48 contributions, 38 are included in these proceedings. The conference was organized to study the rapidly changing field of mass spectrometry of biomolecules. Particle-induced desorption (especially with MeV particles) has been the most effective method of producing molecular ions from biomolecules. An important part of the workshop was devoted to recent developments in this field, particularly to progress in understanding the fundamentals of the desorption process. In this respect, the meeting was similar to previous conferences in Marburg, FRG (1978); Paris, F (1980); Uppsala, S (1981); College Station, USA (1983,1984);*

Wangerooge, FRG (1986); Orsay, F (1988); Spiekeroog, FRG (1989); and to the IFOS series of meetings at Munster, FRG (1981,1983,1985,1987) and L6vAnger, S (1989). As in the most recent of these meetings, there was some emphasis on new developments, particularly cluster bombardment. A departure from the concentration on particle bombardment processes at this conference was inspired by the dramatic results obtained with two new methods for producing molecular ions from large molecules: matrix-assisted laser desorption and electrospray. The First Book on Ultracold MoleculesCold molecules offer intriguing properties on which new operational principles can be based (e.g., quantum computing) or that may allow researchers to study a qualitatively new behavior of matter (e.g., Bose-Einstein condensates structured by the electric dipole interaction). This interdisciplinary book discusse In this thesis, the ionization of atoms and small molecules in strong laser fields is experimentally studied using a reaction microscope. The population of autoionizing doubly excited states in the laser fields is proven and a possible connection to the well-known dielectronic recombination processes is discussed. The fundamental process of tunnel ionization in strong laser fields is subject of investigation in a pump-probe experiment with ultrashort laser pulses. A coherent superposition of electronic states in singly charged argon ions is created within the first, and subsequently tunnel-ionized with the second pulse. This gives access to state-selective information about the tunneling process and allows to test common models. Moreover, the ionization of krypton and argon at different wavelengths is studied, from the multiphoton to the tunneling regime. The wavelength-dependent investigations are furthermore extended to molecular hydrogen. In addition to ionization, this system might undergo different dissociative processes. Channel-selective electron momentum distributions are presented and compared to each other. At the American Chemical Society meeting in Philadelphia, Pennsylvania, U.S.A., a symposium was organized entitled, "Comparison of Ab Initio Quantum Chemistry with Experiment: State-of-the-Art." The intent of the symposium was to bring together forefront experimen talists, who perform the types of clean, penetrating experiments that are amenable to thorough theoretical analysis, with inventive theore ticians who have developed high accuracy ab initio methods that are capable of competing favorably with experiment, to assess the current applicability of theoretical methods in chemistry. Contributions from many of those speakers (see Appendix A) plus others selected for their expertise in the subject are contained in this volume. Such a book is especially timely, since with the recent develop ment of new, more accurate and powerful ab initio methods coupled with the exceptional progress achieved in computational equipment, ab initio quantum chemistry is now often able to offer a third voice to resolve experimental discrepancies, assist essentially in the interpre tation of experiments, and frequently, provide quantitatively accurate results for molecular properties that are not available from experiment. Research in the field of molecular biology has progressed at a fascinating rate in recent years. Much of this

progress results from the development of new laboratory techniques that allow very precise fractionation and analysis of nucleic acids and proteins, as well as the construction of recom binant DNA molecules that can then be cloned and expressed in host cells. Progress has been so rapid that there has been a shortfall in the training of appropriately qualified staff. Many existing laboratory workers require retraining, and many educational institutions have had difficulty incor porating the new molecular biology techniques into their teaching programs. Although there are several manuals currently available that describe laboratory techniques in molecular biology, they are principally written for the indivi dual research worker and are not intended for use in the design of practical classes for students. The aim of this book is to provide just such a series of pro tocols for the teaching of practical molecular biology. The idea arose following the success of several Workshops in Molecular Biology, organized and taught by staff in the Biol ogy Department of the Hatfield Polytechnic. Gradually, the protocols used in the workshops have been incorporated into the Hatfield undergraduate and postgraduate teaching pro grams and have now been collected together to form a book.

- *Molecular Spectroscopy Experiment And Theory*
- *Magnetism*
- *Laser Induced Processes In Molecules*
- *Models Mysteries And Magic Of Molecules*
- *Methods And Mechanisms For Producing Ions From Large Molecules*
- *The Origin Of Chirality In The Molecules Of Life*
- *Tunnelling In Molecules*
- *Gas Phase IR Spectroscopy And Structure Of Biological Molecules*
- *Maxwell On Molecules And Gases*
- *Low Temperatures And Cold Molecules*
- *Coherence Phenomena In Atoms And Molecules In Laser Fields*
- *Lasers Molecules And Methods*
- *Many body Theory Of Molecules Clusters And Condensed Phases*
- *Guidelines For Research Involving Recombinant DNA Molecules*
- *Experiments With Trapped RbCs Molecules*
- *Experiments With Stark decelerated And Trapped Molecules*
- *Polymer Physics Experiments With Single DNA Molecules*
- *Physical Chemistry Of Cold Gas Phase Functional Molecules And Clusters*
- *Energy Storage And Redistribution In Molecules*
- *Clusters Of Atoms And Molecules*
- *Spintronics With Individual Metal organic Molecules*
- *Dissociative Recombination Of Molecular Ions With Electrons*
- *Optical Electric And Magnetic Properties Of Molecules*
- *Rotational Spectroscopy Of Diatomic Molecules*