

Atomic And Molecular Clusters

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Atomic and Molecular Clusters

Cluster physics is the foundation of the increasingly important field of nanotechnology. Clusters, ranging in size from a few to many millions of atoms, constitute a fascinating field of research in physics, chemistry and materials science. They are formed by most of the elements of the Periodic Table, and the types of bonding and the resultant clusters are equally as varied. This book introduces atomic clusters, ranging from weakly-bonded clusters of argon to strongly-bonded carbon clusters and metal nano-particles. It includes worked examples to enable lecturers and students to gauge their understanding and progress. Atomic and Molecular Clusters describes the experimental generation, detection and interrogation of clusters and theoretical approaches developed to aid understanding of their physical properties. It classifies clusters according to their bonding types and gives examples of present and possible future applications of clusters in electronic, optical and magnetic devices.

Theory of Atomic and Molecular Clusters

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

Atomic and Molecular Clusters

The last fifteen years have seen a veritable explosion of clusters research brought about by two relatively new experimental advances - supersonic jet expansions creating cold high density atomic

and molecular beams, and laser (mass and optical) spectroscopy. The success and power of these two techniques, taken together and applied to the study of atomic and molecular clusters, are described in this volume. The field of cluster study is a very broad one, propelled by both the potential application of cluster results to many bulk systems and interest in clusters as systems in their own right. The eclectic nature of the collection of chapters in this book reflects well the diverse nature of this area of chemical physics. The book begins with one of the most surprising and controversial of recent cluster studies - those for the carbon system. As with bulk and molecular carbon chemistry, the chemistry of carbon clusters seems to be unique. Nonmetallic main group clusters also form a very interesting set of systems and their structure and chemistry are as fascinating as they are varied. Diatomic/atomic clusters and small polyatomic clusters demonstrate an incredible amount of spectroscopic detail and thus structure, dynamics and, in some instances, chemistry can be characterized for them. Clusters of larger molecules also yield information on structure, dynamics and chemistry but can in addition give information on changes in molecular structure with degree of solvation. As clusters become larger they begin to assume the properties of bulk systems. Finally, some chapters discuss the nucleation and growth of clusters, each from its own unique perspective and point of view. Current efforts involve following these processes from the formation of a two-molecule cluster to liquid drop. Atomic and Molecular Clusters provides the researcher with a survey of the current status of the field and will also be of interest to the student who may discover a new and exciting area of investigation.

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Atomic and Molecular Clusters

This book describes the experimental generation, detection, and interrogation of clusters. They are classified according to their bonding types, and theoretical models are presented which account for their respective properties. Examples are given of present and possible future applications in electronic, optical, and magnetic devices.

Atomic and Molecular Cluster Research

The physics of atomic and molecular clusters is interesting from many points of view. These systems bridge the domains of atomic and molecular physics on one side and condensed matter physics on the other. Their properties may be dominated by their large surface-to-volume ratio, giving a unique opportunity to study the interplay between surface and volume effects. They may exhibit a discrete spectroscopy because of their finite size. A major thrust in the development of high-tech materials can be described as atomic-scale engineering. In this process, materials are assembled on an almost atom by atom basis in order to obtain useful properties not found in naturally-occurring substances.

Clusters of Atoms and Molecules II

Cluster science studies the transition from atomic, and molecular physics or chemistry to the science and technology of condensed matter. Two main topics from this large field will be emphasized in this second volume of Atomic and Molecular Clusters. After an Introduction, Chap. 2 deals mainly with molecular clusters, how they react to positive or negative charges (Sect. 2.1 to 2.5), how they decompose and how they can be charged (Sect. 2.6 and 2.7), and how one can do chemistry with them (2.8 and 2.9). Clusters in contact with a macroscopic medium are treated in Chap. 3. It is from this domain that one can expect possible new applications of cluster science. The optical spectra of silver clusters in a dielectric medium are discussed in Sect. 3.1. Their properties have since long been used unknowingly to stain glass windows. Large clusters floating in an ambient pressure gas are called aerosols (Sect. 3.2). Their properties can be used to monitor air pollution. Development

of a photographic film is due to supported silver clusters in a liquid environment (Sect. 3.3). Large semiconductor clusters, also called "quantum dots"

Clusters of Atoms and Molecules II

It is widely recognized that an understanding of the physical and chemical properties of clusters will give a great deal of important information relevant to surface and bulk properties of condensed matter. This relevance of clusters for condensed matter is one of the major motivations for the study of atomic and molecular clusters. The changes of properties with cluster size, from small clusters containing only a few atoms to large clusters containing tens of thousands of atoms, provides a unique way to understand and to control the development of bulk properties as separated units are brought together to form an extended system. Another important use of clusters is as theoretical models of surfaces and bulk materials. The electronic wavefunctions for these cluster models have special advantages for understanding, in particular, the local properties of condensed matter. The cluster wavefunctions, obtained with molecular orbital theory, make it possible to relate chemical concepts developed to describe chemical bonds in molecules to the very closely related chemical bonding at the surface and in the bulk of condensed matter. The applications of clusters to phenomena in condensed matter is a cross-disciplinary activity which requires the interaction and collaboration of researchers in traditionally separate areas. For example, it is necessary to bring together workers whose background and expertise is molecular chemistry with those whose background is solid state physics. It is also necessary to bring together experimentalists and theoreticians.

Cluster Models for Surface and Bulk Phenomena

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 discussed 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.

Clusters of Atoms and Molecules

Advances in the Theory of Atomic and Molecular Systems, is a collection of contributions presenting recent theoretical and computational developments that provide new insights into the structure, properties, and behavior of a variety of atomic and molecular systems. This volume (subtitled "Dynamics, Spectroscopy, Clusters, and Nanostructures") deals with the topics of "Quantum Dynamics and Spectroscopy", "Complexes and Clusters", and "Nanostructures and Complex Systems". This volume is an invaluable resource for faculty, graduate students, and researchers interested in theoretical and computational chemistry and physics, physical chemistry and chemical physics, molecular spectroscopy, and related areas of science and engineering.

Advances in the Theory of Atomic and Molecular Systems

This comprehensive book on Nanoclusters comprises sixteen authoritative chapters written by leading researchers in the field. It provides insight into topics that are currently at the cutting edge of cluster science, with the main focus on metal and metal compound systems that are of particular interest in materials science, and also on aspects related to biology and medicine. While there are numerous books on clusters, the focus on clusters as a bridge across disciplines sets this book apart from others. Delivers cutting edge coverage of cluster science Covers a broad range of topics in physics, chemistry, and materials science Written by leading researchers in the field

Nanoclusters

This book provides an introduction to many-body methods for applications in quantum chemistry. These methods, originating in field-theory, offer an alternative to conventional quantum-chemical approaches to the treatment of the many-electron problem in molecules. Starting with a general introduction to the atomic and molecular many-electron problem, the book then develops a stringent formalism of field-theoretical many-body theory, culminating in the diagrammatic perturbation expansions of many-body Green's functions or propagators in terms of Feynman diagrams. It also introduces and analyzes

practical computational methods, such as the field-tested algebraic-diagrammatic construction (ADC) schemes. The ADC concept can also be established via a wave-function based procedure, referred to as intermediate state representation (ISR), which bridges the gap between propagator and wave-function formulations. Based on the current rapid increase in computer power and the development of efficient computational methods, quantum chemistry has emerged as a potent theoretical tool for treating ever-larger molecules and problems of chemical and physical interest. Offering an introduction to many-body methods, this book appeals to advanced students interested in an alternative approach to the many-electron problem in molecules, and is suitable for any courses dealing with computational methods in quantum chemistry.

Many-Body Methods for Atoms, Molecules and Clusters

This book is an in-depth review of experiment and theory on electric-dipole polarizabilities. It is broad in scope, encompassing atomic, molecular, and cluster polarizabilities. Both static and dynamic polarizabilities are treated (in the absence of absorption) and a full tensor picture of the polarizability is used. Traditional experimental techniques for measuring electric polarizabilities are described in detail. Recently developed experimental methods, including light forces, position-sensitive time-of-flight deflection, and atom interferometry, are also extensively discussed. Theoretical techniques for calculating polarizabilities are reviewed, including a discussion on the use of Gaussian basis sets. Many important comparisons between theory and experiment are summarized in an extensive set of tables of polarizabilities of important atoms, molecules, and clusters. Applications of polarizabilities to many areas of chemistry and physics are described, including optics, chemical structure, interactions of gases and particles with surfaces, and the interaction of molecules with light. The emphasis is on a lucid presentation of the ideas and results with up-to-date discussions on important applications such as optical tweezers and nanostructure fabrication. This book provides an excellent overview of the importance of polarizabilities in understanding the physical, electronic, and optical properties of particles in a regime that goes from free atoms to condensed-phase clusters.

Electric-dipole Polarizabilities of Atoms, Molecules, and Clusters

With the central importance of electric polarizability and hyperpolarizability for a wide spectrum of activities, this book charts the trends in the accurate theoretical determination of these properties in specialized fields. The contributions include reviews and original papers that extend from methodology to applications in specific areas of primary importance such as cluster science and organic synthesis of molecules with specific properties.

Atoms, Molecules and Clusters in Electric Fields

Clusters can be viewed as solids at the nano-scale, yet molecular cluster chemistry and solid state chemistry have traditionally been considered as separate topics. This treatment has made it conceptually difficult to appreciate commonalities of structure and bonding between the two. Using analogous models, this is the first book to form a connecting bridge. Although the focus is on clusters, sufficient attention is paid to solid-state compounds at each stage of the development to establish the interrelationship between the two topics. Comprehensive coverage of cluster types by composition, size and ligation, is provided, as is a synopsis of selected research. Written in an accessible style and highly illustrated to aid understanding, this book is suitable for researchers in inorganic chemistry, physical chemistry, materials science, and condensed matter physics.

Atomic and Molecular Clusters in Intense Laser Pulses

Recent advances in experimental techniques now enable researchers to produce in a laboratory clusters of atoms of desired composition from any of the elements of the periodic table. This has created a new area of research into novel materials since clusters cannot be regarded either as a "large" molecule or as a fragment of the bulk. Both experimental and theoretical studies are revealing unusual properties that are not observed in solid state environments. The structures of micro-clusters are found to be significantly distorted from the most symmetric arrangement, some even exhibiting pentagonal symmetry commonly found in icosahedric structures. The unusual stability of certain clusters, now described as "magic number species"

Atomic Clusters: Theory & Experiments

Not merely a discussion of small particles or clusters of atoms, molecules, but also the systems they constitute. The goal is to analyse the properties of such finite aggregates and their behaviour in gases and plasmas, and to investigate processes that involve such clusters, based on lectures and seminar problems for graduates. The main part of the book includes more than 200 problems, covering collisions, charge transfer, chemical reactions, condensed systems and their structures, kinetics of cluster growth, excited clusters, the transition from clusters to bulk particles, and small particles, dust, and aerosols in plasmas. Reference data for corresponding parameters of systems under consideration is given in the appendices. Of interest to physicists, astrophysicists, and chemists.

Molecular Clusters

This book presents a "snapshot" of the most recent and significant advances in the field of cluster physics. It is a comprehensive review based on contributions by the participants of the 2nd International Symposium on Atomic Cluster Collisions (ISACC 2007) held in July 19–23, 2007 at GSI, Darmstadt, Germany. The purpose of the Symposium is to promote the growth and exchange of scientific information on the structure and properties of nuclear, atomic, molecular, biological and complex cluster systems studied by means of photonic, electronic, heavy particle and atomic collisions. Particular attention is devoted to dynamic phenomena, many-body effects taking place in cluster systems of a different nature — these include problems of fusion and fission, fragmentation, collective electron excitations, phase transitions, etc. Both the experimental and theoretical aspects of cluster physics, uniquely placed between nuclear physics on the one hand and atomic, molecular and solid state physics on the other, are discussed. Contents: Clustering Phenomena at Nuclear and Subnuclear Scales Structure and Properties of Atomic Clusters Electron, Photon and Ion Cluster Collisions Clusters on a Surface Phase Transitions, Fusion, Fission and Fragmentation in Finite Systems Clusters in Laser Fields Clustering Phenomenon in System of Various Degrees of Complexity Structure and Dynamics of Biomolecules- From Biomolecules to Cells and System Biology Readership: Researchers in physics, chemistry, biophysics, and materials science, both academic and professional. Keywords: Atomic Clusters; Biomolecules; Nanophysics; Nanoparticles; Collisions; Cluster Deposition; Fission and Fusion Processes; Phase Transitions Key Features: Provides an overview of the traditional tools of the atomic, nuclear, molecular and biological physics applied to atomic clusters Emphasizes collisions with electrons, photons, heavy particles and atoms, as well as fusion and fission Utilizes an interdisciplinary approach that joins many very different branches of physics, chemistry and mathematics

Physics and Chemistry of Small Clusters

This book completes the physical foundations and experimental techniques described in volume 1 with an updated review of the accessory equipment indispensable in molecular beam experiments. It extends the subject to cluster beams and beams of hyperthermal and subthermal energies.

Clusters and Small Particles

This volume of the Enrico Fermi Summer School proceedings is concerned with the chemical physics of atomic and molecular clusters of medium and large size which are defined as clusters too large to yield rotationally resolved spectra. In practice this means from trimers and tetramers up. By limiting the field a separation is made between the study of systems of well-known structures (for which the position of each of their fragments is well known) from systems that, because of their dynamical or "fluid" status or because of the too large number of components, have to be studied with methods which are intrinsically more statistic.

Latest Advances in Atomic Cluster Collisions

Numerous experiments and calculations have shown that isolated metal clusters possess many interesting features, quite different from those known from surface and solid-state physics or from atomic and molecular physics. The technological exploitation of these new properties, e.g. in miniature electronic or mechanical components, requires the cluster to be brought into an environment such as an encapsulating matrix or a surface. Due to the interaction with the contact medium, the properties of the clusters may change or even disappear. Thus the physics of cluster-on-surface systems -- the main subject of this book -- is of fundamental importance. The book addresses a wide audience, from the newcomer to the expert. Starting from fundamental concepts of adsorbate-surface interactions, the modification of electronic properties through electron confinement, and concepts of cluster production, it elucidates the distinct properties of the new metallic nanostructures.

Atom, Molecule, and Cluster Beams II

Few-body physics covers a rich and wide variety of phenomena, ranging from the very lowest energy scales of atomic and molecular physics to high-energy particle physics. The papers contained in the present volume provide an aperçu of recent progress in the field from both the theoretical and experimental perspectives and are based on work presented at the "22nd International Conference on Few-Body Problems in Physics". This book is geared towards academics and graduate students involved in the study of systems which present few-body characteristics and those interested in the related mathematical and computational techniques.

The Chemical Physics of Atomic and Molecular Clusters

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.

Metal Clusters at Surfaces

This volume contains the invited papers and selected contributed papers presented at the biennial International Symposium on ELECTRON COLLISIONS WITH MOLECULES, CLUSTERS AND SURFACES held at Royal Holloway, University of London from 29th to 30th July, 1993. This Symposium was a Satellite Meeting of the XVIII International Conference on the Physics of Electronic and Atomic Collisions (ICPEAC) and follows a 16 year tradition of Satellite Conferences in related areas of collisions held in association with previous ICPEAC's. In the past each of these electron-molecule symposia covered the broad field of electron-molecule scattering at rather low energies, but also included hot topics. This time as well as covering the whole field, well defined electron collisions with clusters and with particles in the complex potential of a surface were emphasized. Not many details are known about such collisions, although they become more and more important in surface characterisation, plasma-wall interactions, electron induced desorption and reorganisation of adsorbed particles. Recently, much work, theoretical and experimental, has been devoted to electron collisions with rather large carbon, silicon and halogen containing molecules. These problems are of relevance in plasma assisted thin film formation and etching of surfaces and can now be approached with advanced theoretical methods and experimental equipment.

Recent Progress in Few-Body Physics

Cluster chemistry is one of the recent, exciting areas of Inorganic Chemistry. The occurrence of molecular clusters, like fullerene C₆₀, constitutes a fundamental feature midway between the chemistry

of isolated chemical compounds and that of the elements. Main features of the Cluster Chemistry of both main group and transition metal elements are treated in this book. The author highlights aspects related to the synthesis, the structure, the special bonding and the reactivity of these species. The book is written as a textbook for senior undergraduate and postgraduate students. References in tables and illustrations permit the reader to reach relevant original information. Professor Gonzalez-Moraga fills a demand for a publication appropriate for dissemination and specially for teaching this exciting subject. From the Contents: Current Concepts in Modern Chemistry - Transition Metal Cluster Chemistry - Main Group-Transition Metal Mixed Clusters - Cluster Compounds of the Main Group Elements - Synthetic Analogues of the Active Sites of Iron-Sulfur Proteins.

Physical Chemistry of Cold Gas-Phase Functional Molecules and Clusters

This book comprises selected peer-reviewed papers presented at the 7th Topical Conference of the Indian Society of Atomic and Molecular Physics, jointly held at IISER Tirupati and IIT Tirupati, India. The contributions address current topics of interest in atomic and molecular physics, both from the theoretical and experimental perspective. The major focus areas include quantum collisions, spectroscopy of atomic and molecular clusters, photoionization, Wigner time delay in collisions, laser cooling, Bose-Einstein condensates, atomic clocks, quantum computing, and trapping and manipulation of quantum systems. The book also discusses emerging topics such as ultrafast quantum processes including those at the attosecond time-scale. This book will prove to be a valuable reference for students and researchers working in the field of atomic and molecular physics.

Electron Collisions with Molecules, Clusters, and Surfaces

Atomic clusters are aggregates of atoms containing a few to several thousand atoms. Due to the small size of these pieces of matter, the properties of atomic clusters in general are different from those of the corresponding material in the macroscopic bulk phase. This monograph presents the main developments of atomic clusters and the current status of the field. The book treats different types of clusters with very different properties: clusters in which the atoms or molecules are tied by weak van der Waals interactions, metallic clusters, clusters of ionic materials, and network clusters made of typical covalent elements. It includes methods of experimental cluster synthesis as well as the structural, electronic, thermodynamic and magnetic properties of clusters, covering both experiments and the theoretical work that has led to our present understanding of the different properties of clusters. The question of assembling nanoclusters to form solids with new properties is also considered. Having an adequate knowledge of the properties of clusters can be of great help to any scientist working with objects of nanometric size. On the other hand, nanoclusters are themselves potentially important in fields like catalysis and nanomedicine.

Cluster Chemistry

This comprehensive volume surveys the general aspects of atomic cluster science and outlines some of its important new challenges. It begins by detailing the recent advances in the understanding of structure and the essential properties of selected atomic cluster systems, fullerenes and confined atoms. Recent advances in the field of photo processes involving atomic clusters and fullerenes are discussed, and an entire chapter is devoted to the problem of fission dynamics of atomic clusters, presenting parallels with similar processes in nuclear physics. The book goes on to describe the problems of electron-cluster collisions with special emphasis on polarization and collective excitation effects. The important area of the behavior of atomic clusters in laser fields is considered; the ionization, collective dynamics of electrons in the system in the presence of the laser field, and the laser induced dynamics of molecules and clusters are thoroughly described. Finally, a broad spectrum of problems in the area of ionic collisions with fullerenes and metal clusters is covered — from both experimental and theoretical points of view — and the results of the most recent measurements are reported. The concluding chapter takes a careful look at the interaction of an atomic cluster with a surface. The problems of cluster deposition and formation at a surface as well as collision processes involving clusters deposited at a surface are considered through a number of illustrative examples./a

Quantum Collisions and Confinement of Atomic and Molecular Species, and Photons

In these days of specialization it is important to bring together physicists working in diverse areas to exchange and share their ideas and excitement. This leads to cross-fertilization of ideas, and it enriches, as in biological systems, a specialized field with new strength, development and direction derived from

another area. Although this might be an uncommon thing, it is an important step in our understanding of the physical world around us, which is, after all, the main purpose of physics. The seed for this conference was really sowed when one of us (MB) and Mr. Manngård showed some a-scattering data at backward angles to FBM one summer about four years ago. That occasion led to a long research collaboration between the Abo Akademi physicists and other scientists in several countries. The actual idea to explore the possibility of holding a conference, however, crystallized in the summer of 1989 during a visit of FBM to Abo Akademi. The final decision to organize a conference was made after MB visited Professor Ben Mottelson in Copenhagen and Professor Anagnostatos in Athens. At this point it was recognized that there are similarities as well as differences between clustering phenomena in nuclei and systems consisting of atoms. It was therefore conjectured that it could be very stimulating to bring together these groups to exchange their ideas and to learn from each other's fields. A conference along these lines, we hoped, would contribute to an increased mutual understanding.

Atomic, Molecular and Cluster Physics

Contemporary research in atomic and molecular physics concerns itself with studies of interactions of electron, positron, photons, and ions with atoms, molecules, and clusters; interactions of intense ultrashort laser interaction with atoms, molecules, and solids; laser assisted atomic collisions, optical, and magnetic traps of neutral atoms to produce ultracold and dense samples; high resolution atomic spectroscopy and experiments by using synchrotron radiation sources and ion storage rings. In recent years, important advances have been made in the experimental as well as theoretical understanding of atomic and molecular physics. The advances in atomic and molecular physics have helped us to understand many other fields, like astrophysics, atmospheric physics, environmental science, laser physics, surface physics, computational physics, photonics, and electronics. XII National Conference on Atomic and Molecular Physics was held at the Physics Department, M. 1. S. University, Udaipur from 29th Dec. 1998 to 2nd Jan. 1999 under the auspices of the Indian Society of Atomic and Molecular Physics. This volume is an outcome of the contributions from the invited speakers at the conference. The volume contains 24 articles contributed by the distinguished scientists in the field. The contributors have covered a wide range of topics in the field in which current research is being done. This also reflects the trend of research in this field in Indian universities and research institutes. We are grateful to the national programme committee, national, and local organizing committees, and members of the Physics Department and Computer Centre, M. 1.

Structure and Properties of Atomic Nanoclusters

Since the early days of modern physics spectroscopic techniques have been employed as a powerful tool to assess existing theoretical models and to uncover novel phenomena that promote the development of new concepts. Conventionally, the system to be probed is prepared in a well-defined state. Upon a controlled perturbation one measures then the spectrum of a single particle (electron, photon, etc.) emitted from the probe. The analysis of this single particle spectrum yields a wealth of important information on the properties of the system, such as optical and magnetic behaviour. Therefore, such analysis is nowadays a standard tool to investigate and characterize a variety of materials. However, it was clear at a very early stage that real physical compounds consist of many coupled particles that may be excited simultaneously in response to an external perturbation. Yet, the simultaneous (coincident) detection of two or more excited species proved to be a serious technical obstacle, in particular for extended electronic systems such as surfaces. In recent years, however, coincidence techniques have progressed so far as to image the multi-particle excitation spectrum in an impressive detail. Correspondingly, many-body theoretical concepts have been put forward to interpret the experimental findings and to direct future experimental research. This book gives a snapshot of the present status of multi-particle coincidence studies both from a theoretical and an experimental point of view. It also includes selected topical review articles that highlight the achievements and the power of coincident techniques.

Latest Advances In Atomic Clusters Collisions: Fission, Fusion, Electron, Ion And Photon Impact

With the central importance of electric polarizability and hyperpolarizability for a wide spectrum of activities, this book charts the trends in the accurate theoretical determination of these properties in specialized fields. The contributions include reviews and original papers that extend from methodology to applications in specific areas of primary importance such as cluster science and organic synthesis of molecules with specific properties.

Clustering Phenomena in Atoms and Nuclei

This series is concerned with recent developments in the general area of atomic, molecular, and optical physics. The field is in a state of rapid growth, as new experimental and theoretical techniques are put to bear on many old and new problems. Such problems range from studies of the fundamental properties of radiation and matter, through studies of hitherto inaccessible states of ordinary and exotic atoms and molecules, the control of atoms and molecules by light, the behaviour of atoms and molecules in intense radiations fields, the detailed structure of such systems, including complex molecules and molecular clusters, and a wide range of interaction phenomena among atoms, molecules, and their constituent parts and fields. Topics covered also include related applied areas, such as atmospheric science, astrophysics, surface physics, and laser physics.

Physics and Chemistry of Small Clusters

The aim of this brief is to present, in sufficient detail, a non-perturbative technique for calculating optical hyperpolarizabilities. The ability to efficiently compute hyperpolarizabilities, for a variety of different molecular systems, makes this brief invaluable for those engaged in the computational design of new electro-optical materials. The resulting computation is very predictable and suitable for automation, in contrast to perturbative methods that typically rely on iterative methods. The methodology which is wholly applicable to atoms, molecules, clusters (and with some modifications) to condensed matter, is described and illustrated at a level that is accessible to theoreticians and supplemented with details that should be of interest to practitioners.

Trends in Atomic and Molecular Physics

Many-Particle Spectroscopy of Atoms, Molecules, Clusters, and Surfaces