

Atomic And Molecular Spectroscopy Basic Concepts And Applications

The Book Has 15 Chapters In All. The First Two Chapters Are Related To Atomic Structure And Atomic Spectra. The Next Chapter Is Devoted To Nature Of Chemical Bonds As Looked Upon Through Quantum Mechanics, Followed By All Types Of Spectroscopy. Every Aspect Is Explained With Some Typical Spectra. The Underlying Theory So Developed Will Help Students To Carry Out Spectral Analysis. Only Simple Quantum Mechanics Relevant To Simple Molecular Structure Has Been Given. Attempt Has Been Made To Relate The Characteristic Chemical Behavior Of These Molecules With Its Mo And Thus To Molecular Spectra. One Will Not Find Such Relationship In Any Book, But This Will Make Chemistry, As Such, Still More Interesting. Application Of Infrared And Ultra-Violet Spectroscopy, Nmr And Mass Spectra In Structure Determination Of Organic Molecules Are Very Elegantly Presented. In The Fourteenth Chapter, Lasers And Their Applications To Various Types Of Second, Third, And Fourth Order Scattering Spectroscopy Have Been Developed. The Book Has Minimum But Essential Mathematics With Very Easy Format In Its Text. Such An Approach Will Give A Clear Understanding Of The Subject And Provides Knowledge To Excel At Any Level University Examination, Competitive Examination, And Before Interview Boards. Designed to serve as a textbook for postgraduate students of physics and chemistry, this second edition improves the clarity of treatment, extends the range of topics, and includes more worked examples with a view to providing all the material needed for a course in molecular spectroscopy—from first principles to the very useful spectral data that comprise figures, charts and tables. To improve the conceptual appreciation and to help students develop more positive and realistic impressions of spectroscopy, there are two new chapters—one on the spectra of atoms and the other on laser spectroscopy. The chapter on the spectra of atoms is a detailed account of the basic principles involved in molecular spectroscopy. The chapter on laser spectroscopy covers some new experimental techniques for the investigation of the structure of atoms and molecules. Additional sections on interstellar molecules, inversion vibration of ammonia molecule, fibre-coupled Raman spectrometer, Raman microscope, supersonic beams and jet-cooling have also been included. Besides worked-out examples, an abundance of review questions, and end-of-chapter problems with answers are included to aid students in testing their knowledge of the material contained in each chapter. Solutions manual containing the complete worked-out solutions to chapter-end problems is available for instructors.

This Comprehensive Text Clearly Explains Quantum Theory, Wave Mechanics, Structure Of Atoms And Molecules And Spectroscopy. The Book Is In Three Parts, Namely, Wave Mechanics; Structure Of Atoms And Molecules; And Spectroscopy And Resonance Techniques. In A Simple And Systematic Manner, The Book Explains The Quantum Mechanical Approach To Structure, Along With The Basic Principles And Application Of

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Spectroscopic Methods For Molecular Structure Determination. The Book Also Incorporates The Electric And Magnetic Properties Of Matter, The Symmetry, Group Theory And Its Applications. Each Chapter Includes Many Solved Examples And Problems For A Better Understanding Of The Subject. With Its Exhaustive Coverage And Systematic Approach, This Is An Invaluable Text For B.Sc. (Hons.) And M.Sc. Chemistry Students.

The book includes various spectroscopic techniques including atomic spectroscopy, pure rotational spectroscopy, vibrational spectroscopy of diatomic and polyatomic molecules, Raman spectroscopy and electronic spectroscopy. Solved and unsolved exercises are provided throughout the book for easy understanding and better assessment.

Basic Concepts and Instrumentation

Fundamentals of Molecular Spectroscopy

Chemical Bonds

Modern Spectroscopy

Molecular Physics

This is the first volume of textbooks on atomic, molecular and optical physics, aiming at a comprehensive presentation of this highly productive branch of modern physics as an indispensable basis for many areas in physics and chemistry as well as in state of the art bio- and material-sciences. It primarily addresses advanced students (including PhD students), but in a number of selected subject areas the reader is lead up to the frontiers of present research. Thus even the active scientist is addressed. This volume 1 provides the canonical knowledge in atomic physics together with basics of modern spectroscopy. Starting from the fundamentals of quantum physics, the reader is familiarized in well structured chapters step by step with the most important phenomena, models and measuring techniques. The emphasis is always on the experiment and its interpretation, while the necessary theory is introduced from this perspective in a compact and occasionally somewhat heuristic manner, easy to follow even for beginners.

This textbook offers an introduction to the foundations of spectroscopic methods and provides a bridge between basic concepts and experimental applications in fields as diverse as materials science, biology, solar energy conversion, and environmental science. The author emphasizes the use of time-dependent theory to link the spectral response in the frequency domain to the behavior of molecules in the time domain, strengthened by two brand new chapters on nonlinear optical spectroscopy and time-resolved spectroscopy. Theoretical underpinnings are presented to the extent necessary for readers to understand how to apply spectroscopic tools to their own interests.

Molecular Symmetry and Spectroscopy deals with the use of group theory in quantum mechanics in relation to problems in molecular spectroscopy. It discusses the use of the molecular symmetry group, whose elements consist of permutations of identical nuclei with or without inversion. After reviewing the permutation groups, inversion operation, point groups, and representation of groups, the book describes the use of representations for labeling molecular

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energy. The text explains an approximate time independent Schrödinger equation for a molecule, as well as the effect of a nuclear permutation or the inversion of E^* on such equation. The book also examines the expression for the complete molecular Hamiltonian and the several groups of operations commuting with the Hamiltonian. The energy levels of the Hamiltonian can then be symmetrically labeled by the investigator using the irreducible representations of these groups. The text explains the two techniques to change coordinates in a Schrödinger equation, namely, (1) by using a diatomic molecule in the rovibronic Schrödinger equation, and (2) by a rigid nonlinear polyatomic molecule. The book also explains that using true symmetry, basis symmetry, near symmetry, and near quantum numbers, the investigator can label molecular energy levels. The text can benefit students of molecular spectroscopy, academicians, and investigators of molecular chemistry or quantum mechanics.

The richly illustrated book comprehensively explains the important principles of diatomic and polyatomic molecules and their spectra in two separate, distinct parts. The first part concentrates on the theoretical aspects of molecular physics, such as the vibration, rotation, electronic states, potential curves, and spectra of molecules. The different methods of approximation for the calculation of electronic wave functions and their energy are also covered. The introduction of basics terms used in group theory and their meaning in molecular physics enables an elegant description of polyatomic molecules and their symmetries. Molecular spectra and the dynamic processes involved in their excited states are given its own chapter. The theoretical part then concludes with a discussion of the field of Van der Waals molecules and clusters. The second part is devoted entirely to experimental techniques, such as laser, Fourier, NMR, and ESR spectroscopies, used in the fields of physics, chemistry, biology, and material science. Time-resolved measurements and the influence of chemical reactions by coherent controls are also treated. A list of general textbooks and specialized literature is provided for further reading. With specific examples, definitions, and notes integrated within the text to aid understanding, this is suitable for undergraduates and graduates in physics and chemistry with a knowledge of atomic physics and familiar with the basics of quantum mechanics.

Atomic Spectroscopy and Radiative Processes

Theoretical Principles and Experimental Methods

Molecular Symmetry and Spectroscopy

Basic Atomic and Molecular Spectroscopy

Molecular Spectroscopy: Modern Research, Volume III is a collection of papers presented at the 40th Annual Molecular Spectroscopy Symposium, held at the Ohio State University. The contributors of this seven-chapter text cover the significant advances in molecular spectroscopic research and their application in chemistry. Chapters 1 and 2 discuss first the higher-order vibration-rotation interactions in molecules and then present formulas and an insight into the direction being taken in theoretical pursuits. Chapter 3 provides an extensive compilation of published intensity and collision broadening parameters

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derived from infrared spectra. This chapter also contains a detailed discussion using consistent notation of some of the methods commonly applied to extract such information from laboratory spectra. Chapter 4 examines a variety of laser systems and their application in investigations involving triatomic free radicals and ions, while chapter 5 considers the developments in the microwave spectroscopic studies on nonpolar molecules when their symmetry is reduced by isotopic substitution. Chapter 6 emphasizes the quasi-linear molecular problem to develop an appreciation of the symptoms of quasi-linearity and theoretical treatments thereof. This chapter also examines the increasing role of highly resolved spectra in the interpretation of various large-amplitude motions in molecules. Lastly, Chapter 7 describes the electric multipolar moments of hydrogen and its isotopes. Spectroscopists, chemists, and researchers will find this work invaluable.

This work has been selected by scholars as being culturally important and is part of the knowledge base of civilization as we know it. This work is in the public domain in the United States of America, and possibly other nations. Within the United States, you may freely copy and distribute this work, as no entity (individual or corporate) has a copyright on the body of the work. Scholars believe, and we concur, that this work is important enough to be preserved, reproduced, and made generally available to the public. To ensure a quality reading experience, this work has been proofread and republished using a format that seamlessly blends the original graphical elements with text in an easy-to-read typeface. We appreciate your support of the preservation process, and thank you for being an important part of keeping this knowledge alive and relevant.

This introduction to Atomic and Molecular Physics explains how our present model of atoms and molecules has been developed over the last two centuries both by many experimental discoveries and, from the theoretical side, by the introduction of quantum physics to the adequate description of micro-particles. It illustrates the wave model of particles by many examples and shows the limits of classical description. The interaction of electromagnetic radiation with atoms and molecules and its potential for spectroscopy is outlined in more detail and in particular lasers as modern spectroscopic tools are discussed more thoroughly. Many examples and problems with solutions are offered to encourage readers to actively engage in applying and adapting the fundamental physics presented in this textbook to specific situations. Completely revised third edition with new sections covering all actual developments, like photonics, ultrashort lasers, ultraprecise frequency combs, free electron lasers, cooling and trapping of atoms, quantum optics and quantum information.

This book describes the basic physical principles of atomic spectroscopy and the absorption and emission of radiation in astrophysical and laboratory plasmas. It summarizes the basics of electromagnetism and thermodynamics and then describes in detail the theory of atomic spectra for complex atoms, with emphasis on astrophysical applications. Both equilibrium and non-equilibrium phenomena in plasmas are considered. The interaction between radiation and matter is described, together with various types of radiation (e.g., cyclotron, synchrotron, bremsstrahlung, Compton). The basic theory of polarization is explained, as is the theory of radiative transfer for astrophysical applications. Atomic Spectroscopy and Radiative Processes bridges the gap between basic books on atomic spectroscopy and the very specialized publications for the advanced researcher: it will provide under- and postgraduates with a clear in-depth description of theoretical aspects, supported by practical examples of applications.

Springer Handbook of Atomic, Molecular, and Optical Physics

An Introduction to Modern Molecular Spectroscopy

Introduction to Atomic and Molecular Spectroscopy

Atomic And Molecular Spectroscopy

An Introduction to Molecular Spectroscopy

A wide-ranging review of modern techniques in atomic and molecular spectroscopy. A brief description of atomic and molecular structure is followed by the relevant energy structure expressions. A discussion of radiative properties and the origin of spectra leads into coverage of X-ray and photoelectron spectroscopy, optical

spectroscopy, and radiofrequency and microwave techniques. The treatment of laser spectroscopy investigates various tunable sources and a wide range of techniques characterized by high sensitivity and high resolution. Throughout this book, the relation between fundamental and applied aspects is shown, in particular by descriptions of applications to chemical analysis, photochemistry, surface characterisation, environmental and medical diagnostics, remote sensing and astrophysics.

This profusely illustrated book, by a world-renowned chemist and award-winning chemistry teacher, provides science students with an introduction to atomic and molecular structure and bonding. (This is a reprint of a book first published by Benjamin/Cummings, 1973.) The main aim of this unique book is to introduce the student to spectroscopy in a clear manner which avoids, as far as possible, the mathematical aspects of the subject. It is thus intended for first or second year undergraduates, particularly those with minimal mathematics qualifications. After explaining the theory behind spectroscopy, the book then goes on to look at the different techniques, such as rotational, vibrational and electronic spectroscopy. It encompasses both high resolution (structural) and low resolution (analytical) spectroscopy, demonstrating their close interrelationship. The many worked problems make this book particularly appealing for independent study.

*"Authoritative and clearly written."—Applied Optics The direct observation of short-lived free radicals and the consequent study of their structure and reactions have led to important developments in almost every branch of chemistry as well as in other areas. This volume by a Nobel laureate offers an excellent introduction to the essentials of molecular spectroscopy. The introductory chapter discusses experimental methods and illustrates the observed spectra of various molecules and free radicals. Subsequent chapters explore rotational, vibrational, and electronic energy levels of diatomic molecules and ions; radiative transitions; linear and nonlinear polyatomic radicals and ions; continuous and diffuse spectra; predissociation and pre-ionization; and recombination. The well-illustrated text features more than 100 figures and spectra. A distilled version of the author's monumental three-volume study, *Molecular Spectra and Molecular Structure*, it constitutes a superb resource for anyone wishing a concise but complete treatment of the fundamentals of molecular spectroscopy.*

Astronomical Spectroscopy: An Introduction To The Atomic And Molecular Physics Of Astronomical Spectra (2nd Edition)

An Introduction to Atomic and Molecular Structure

Basic Aspects and Practical Applications

Atoms, Molecules and Optical Physics 1

The Theory of Infrared and Raman Vibrational Spectra

Introduce your students to the latest advances in spectroscopy with the text that has set the standard in the field for more than three decades: **INTRODUCTION TO SPECTROSCOPY, 5e**, by Donald L. Pavia, Gary M. Lampman, George A. Kriz, and James R. Vyvyan. Whether you use the book as a primary text in an upper-level spectroscopy course or as a companion book with an organic chemistry text, your students will receive an unmatched, systematic introduction to spectra and basic theoretical concepts in spectroscopic methods. This acclaimed resource features up-to-date spectra; a modern presentation of one-dimensional nuclear magnetic resonance (NMR) spectroscopy; an introduction to biological molecules in mass spectrometry; and coverage of modern techniques alongside DEPT, COSY, and HECTOR. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Aimed primarily at an undergraduate audience, this book introduces the reader to a wide range of spectroscopies.

Discusses one electron system, vector representation of momenta and vector coupling approximations, atomic spectra of hydrogen atom, alkali metal atoms, helium and two valence electron systems, X-ray spectroscopy, hyperfine structure and isotope shifts, linewidths, effect of external fields on atoms, and more.

For beginners and specialists in other fields: the Nobel Laureate's introduction to atomic spectra and their relationship to atomic structures, stressing basics in a physical, rather than mathematical, treatment. 80 illustrations.

Introduction to Spectroscopy

The Spectra and Structures of Simple Free Radicals

Rotational Spectroscopy of Diatomic Molecules

Molecular Vibrations

Laser Spectroscopy

The impact of lasers on spectroscopy can hardly be overestimated. Lasers represent intense light sources with spectral energy densities which may exceed those of incoherent sources by several orders of magnitude. Furthermore because of their extremely small bandwidth, single-mode lasers allow a spectral resolution which far exceeds that of conventional spectrometers. Many experiments which could not be done before the application of lasers because of lack of intensity or insufficient resolution are readily performed with lasers. Now several thousands of laser lines are known which span the whole spectral range from the vacuum-ultraviolet to the far-infrared region. Of particular interest are the continuously tunable lasers which may in many cases replace wavelength-selecting elements, such as spectrometers or interferometers. In combination with optical frequency mixing,

techniques such continuously tunable monochromatic coherent light sources are available at nearly any desired wavelength above 100 nm.

The latest edition of this highly acclaimed title introduces the reader to a wide range of spectroscopies, and includes both the background theory and applications to structure determination and chemical analysis. It covers rotational, vibrational, electronic, photoelectron and Auger spectroscopy, as well as EXAFs and the theory of lasers and laser spectroscopy. * A revised and updated edition of a successful, clearly written book * Includes the latest developments in modern laser techniques, such as cavity ring-down spectroscopy and femtosecond lasers * Provides numerous worked examples, calculations and questions at the end of chapters

Nearly all information about the Universe comes from the study of light as it reaches us. However, understanding the information contained in this light requires both telescopes capable of resolving it into its component colours and a detailed knowledge of the quantum mechanical behaviour of atoms and molecules. This book, which is based on a third-year undergraduate course taught by the author at University College London, presents the basic atomic and molecular physics necessary to understand and interpret astronomical spectra. It explains how and what kind of information can be extracted from these spectra. Contemporary astronomical spectra are used extensively to study the underlying atomic physics and illustrate the results.

A non-mathematical introduction to molecular spectroscopy. This revision includes: a chapter on the spectroscopy of surfaces and solids, new diagrams and problems, spectra that has been re-recorded on modern instruments, and enhanced applications of Fourier transform principles.

Microwave Spectroscopy

Introduction to Molecular Spectroscopy

Spectra of Atoms and Molecules

Molecular Spectroscopy: Modern Research

An Introduction to Atomic-, Molecular- and Quantum Physics

Pedagogical classic and essential reference focuses on mathematics of detailed vibrational analyses of polyatomic molecules, advancing from application of wave mechanics to potential functions and methods of solving secular determinant.

A wide-ranging review of modern spectroscopic techniques such as X-ray, photoelectron, optical and laser spectroscopy, and radiofrequency and microwave techniques. On the fundamental side the book focuses on physical principles and the impact of spectroscopy on our understanding of the building blocks of matter, while in the area of applications particular attention is given to those in chemical analysis, photochemistry, surface characterisation, environmental and medical diagnostics, remote sensing and astrophysics. The Fourth Edition also provides the reader with an update on laser cooling and trapping, Bose-Einstein condensation, ultra-fast spectroscopy, high-power laser/matter interaction, satellite-based astronomy and

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spectroscopic aspects of laser medicine.

It is still the only available text that presents from a consistent theoretical perspective an introduction both to classical atomic and molecular spectroscopy and to the spectroscopic advances made possible by modern optics, particularly laserbased methods.

Atomic and Molecular Processes describes radiative and collisional processes involving atoms or molecules. Organized into 21 chapters, this book emphasizes the developments in these processes stimulated by the growth of interest in space science, astrophysics, and plasma physics. The book initially discusses the general theory of magnetic dipole and electric quadrupole radiation and the calculations and observations on individual atoms, as well as the forbidden transitions. The text then explores general topics on forbidden and allowed lines and bands; photoionization; photodetachment; recombination and attachment; elastic and inelastic scattering of electron; and energy loss by slow electrons. Discussions on collision broadening of spectral features and encounters between atomic systems including range, energy loss, excitation, ionization, detachment, charge transfer, elastic scattering, mobility, diffusion, relaxation in gases, and chemical reactions are provided in other chapters. A chapter is devoted to the use of high-temperature shock waves, and accounts of other main experimental methods are given.

Atomic and Molecular Processes

Atomic and Molecular Spectroscopy

Molecular Spectroscopy and Quantum Dynamics

Atomic Spectra and Atomic Structure

MOLECULAR STRUCTURE AND SPECTROSCOPY

Comprises a comprehensive reference source that unifies the entire fields of atomic molecular and optical (AMO) physics, assembling the principal ideas, techniques and results of the field. 92 chapters written by about 120 authors present the principal ideas, techniques and results of the field, together with a guide to the primary research literature (carefully edited to ensure a uniform coverage and style, with extensive cross-references). Along with a summary of key ideas, techniques, and results, many chapters offer diagrams of apparatus, graphs, and tables of data. From atomic spectroscopy to applications in comets, one finds contributions from over 100 authors, all leaders in their respective disciplines. Substantially updated and expanded since the original 1996 edition, it now contains several entirely new chapters covering current areas of great research interest that barely existed in 1996, such as Bose-Einstein condensation, quantum information, and cosmological variations of the fundamental constants. A fully-searchable CD-ROM version of the contents accompanies the handbook.

Introduction to Quantum Mechanics, Second Edition presents an accessible, fully-updated introduction on the principles of quantum mechanics. The book outlines the fundamental concepts of quantum theory, discusses how these arose from classic experiments in chemistry and physics, and presents the quantum-

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mechanical foundations of many key scientific techniques. Chapters cover an introduction to the key principles underpinning quantum mechanics, differing types of molecular structures, bonds and behaviors, and applications of quantum mechanical theory across a number of important fields, including new chapters on Density Functional Theory, Statistical Thermodynamics and Quantum Computing. Drawing on the extensive experience of its expert author, this book is a reliable introduction to the principles of quantum mechanics for anyone new to the field, and a useful refresher on fundamental knowledge and latest developments for anyone more experienced in the field. Presents a fully updated accounting that reflects the most recent developments in Quantum Theory and its applications Includes new chapters on Special Functions, Density Functional Theory, Statistical Thermodynamics and Quantum Computers Presents additional problems and exercises to further support learning

Table of contents

The Fundamentals of Atomic and Molecular Physics is intended as an introduction to the field for advanced undergraduates who have taken quantum mechanics. Each chapter builds upon the previous, using the same tools and methods throughout. As the students progress through the book, their ability to use these tools will steadily increase, along with their confidence in their efficacy. The book treats the two-electron atom as the simplest example of the many-electron atom—as opposed to using techniques that are not applicable to many-electron atoms—so that it is unnecessary to develop additional equations when turning to multielectron atoms, such as carbon. External fields are treated using both perturbation theory and direct diagonalization and spontaneous emission is developed from first principles. Only diatomic molecules are considered with the hydrogen molecular ion and neutral molecule treated in some detail. This comprehensive coverage of the quantum mechanics of complex atoms and simple diatomic molecules, developed from the very basic components, is extremely useful for students considering graduate studies in any area of physics.

Introduction to Quantum Mechanics

Molecules and Radiation

The Fundamentals of Atomic and Molecular Physics

Fundamentals of Molecular Spectroscopy.

Atomic And Molecular Spectroscopy, 4E

Two Nobel Laureates present a systematic, comprehensive account of the theory, techniques, experimental data, and interpretation involved in the study of microwave spectroscopy. Ideal as reference or text. 1955 edition.

Molecular Spectroscopy and Quantum Dynamics, an exciting new work edited

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by Professors Martin Quack and Roberto Marquardt, contains comprehensive information on the current state-of-the-art experimental and theoretical methods and techniques used to unravel ultra-fast phenomena in atoms, molecules and condensed matter, along with future perspectives on the field. Contains new insights into the quantum dynamics and spectroscopy of electronic and nuclear motion Presents the most recent developments in the detection and interpretation of ultra-fast phenomena Includes a discussion of the importance of these phenomena for the understanding of chemical reaction dynamics and kinetics in relation to molecular spectra and structure The latest in the 'Tutorial Chemistry Texts' series, 'Basic Atomic and Molecular Spectroscopy' contains chapters on quantization in polyelectronic atoms, molecular vibrations and electronic spectroscopy.

1. Introduction. 1.1. Waves, Particles, and Units. 1.2. The Electromagnetic Spectrum. 1.3. Interaction of Radiation with Matter. 1.3a. Blackbody Radiation. 1.3b. Einstein A and B Coefficients. 1.3c. Absorption and Emission of Radiation. 1.3d. Beer's Law. 1.3e. Lineshape Functions. 1.3f. Natural Lifetime Broadening. 1.3g. Pressure Broadening. 1.3h. Doppler Broadening. 1.3i. Transit-Time Broadening. 1.3j. Power Broadening. 2. Molecular Symmetry. 2.1. Symmetry Operations. 2.1a. Operator Algebra. 2.1b. Symmetry Operator Algebra. 2.2. Groups. 2.2a. Point Groups. 2.2b. Classes. 2.2c. Subgroups. 2.3.

Atoms and Spectroscopy

Molecular Spectroscopy

Atoms, Molecules and Photons

Frontiers of Molecular Spectroscopy

Atomic and Molecular Spectroscopy Basic Aspects and Practical

Applications Springer Science & Business Media

Much of what we know about atoms, molecules, and the nature of matter has been obtained using spectroscopy over the last one hundred years or so. In this book we have collected together twenty chapters by eminent scientists from around the world to describe their work at the cutting edge of molecular spectroscopy. These chapters describe new methodology and applications, instrumental developments, and theory which is taking spectroscopy into new frontiers. The range of topics is broad. Lasers are utilized in much of the research, but their applications range from sub-femtosecond spectroscopy to the study of viruses and also to the investigation of art and archeological artifacts. Three chapters discuss work on biological systems and three others represent laser physics. The recent advances in cavity ringdown spectroscopy (CRDS), surface enhanced Raman spectroscopy (SERS), two-dimensional correlation spectroscopy (2D-COS), and microwave techniques are all covered. Chapters on electronic excited states, molecular dynamics, symmetry applications, and neutron scattering are also included and demonstrate the wide utility of spectroscopic techniques. * provides comprehensive coverage of present spectroscopic investigations * features 20 chapters written by leading

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researchers in the field * covers the important role of molecular spectroscopy in research concerned with chemistry, physics, and biology