Principles Of Nuclear Magnetic Resonance In One And Two Dimensions

The renowned Oxford Chemistry Primers series, which provides focused introductions to a range of important topics in chemistry, has been refreshed and updated to suit the needs of today's students, lecturers, and postgraduate researchers. The rigorous, yet accessible, treatment of each subject area is ideal for those wanting a primer in a given topic to prepare them for more advanced study or research. Moreover, cutting-edge examples and applications throughout the texts show the relevance of the chemistry being described to current research and industry. The learning features provided, including questions at the end of every chapter and online multiple-choice questions, encourage active learning and promote understanding. Furthermore, frequent diagrams, margin notes, and glossary definitions all help to enhance a student's understanding of these essential areas of chemistry. Nuclear Magnetic Resonance offers a concise and accessible introduction to the physical principles of liquid-state NMR, a powerful technique for probing molecular structures. Examples, applications, and exercises are provided throughout to enable beginning undergraduates to get to grips with this important analytical technique. Online Resource Centre The Online Resource Centre to accompany Nuclear Magnetic Resonance features: For registered adopters of the text: * Figures from the book available to download For students: * Multiple-choice questions for self-directed learning * Full worked solutions to the end-of-chapter exercises

Principles of Nuclear Magnetism has, over the years, established itself as the classic single volume treatise which gives a comprehensive account of all the concepts, theories, and results associated with the study of nuclear magnetism. Presents the basic principles of nuclear magnetic resonance for students and professionals with a knowledge of the natural and technical sciences at the lower-division level, and of calculus, matrix algebra, vectors, and complex numbers. Summarizes the quantum mechanics necessary. The topics include the magnetic properties of the nucleus, the motion of magnetization, the major methods and types of NMR, and relaxation. Annotation copyright by Book News, Inc., Portland, OR Nuclear Magnetic Resonance in Biochemistry: Principles and Applications focuses on the principles and applications of nuclear magnetic resonance (NMR) in biochemistry. Topics covered include experimental methods in NMR: the mechanisms of NMR relaxation; chemical and paramagnetic shifts; spin-spin splitting; the use of NMR in investigations of biopolymers and biomolecular interactions; and molecular dynamics in biological and biochemical systems. This text is comprised of eight chapters; the first of which gives an overview of NMR spectroscopy and its use in studies of biological systems. The n Nuclear magnetic resonance (NMR) spectroscopy is one of the most powerful and widely used techniques in chemical research for investigating structures and dynamics of molecules. Advanced methods can even be utilized for structure determinations of biopolymers, for example proteins or nucleic acids. NMR is also used in medicine for magnetic resonance imaging (MRI). The method is based on spectral lines of different atomic nuclei that are excited when a strong magnetic field and a radiofrequency transmitter are applied. The method is very sensitive to the features of molecular structure because also the neighboring atoms influence the signals from individual nuclei and this is important for determining the 3D-structure of molecules. This new edition of the popular classic has a clear style and a highly practical, mostly non-mathematical approach. Many examples are taken from organic and organometallic chemistry, making this book an invaluable guide to undergraduate and graduate students of organic chemistry, biochemistry, spectroscopy or physical chemistry, and to researchers using this well-established and extremely important technique. Problems and solutions are included. The first edition of this book was written in 1961 when I was Morris Loeb Lecturer in Physics at Harvard. In the preface I wrote: "The problem faced by a beginner today is enormous. If he attempts to read a current article, he often finds that the first paragraph refers to an earlier paper on which the whole article is based, and with which the author naturally assumes familiarity. That reference in turn is based on another, so the hapless student finds himself in a seemingly endless retreat. I have felt that graduate students or others beginning research in magnetic resonance needed a book which really went into the details of calculations, yet was aimed at the beginner rather than the expert. " The original goal was to treat only those topics that are essential to an understanding of the literature. Thus the goal was to be selective rather than comprehensive. With the passage of time, important new concepts were becoming so all-pervasive that I felt the need to add them. That led to the second edition, which Dr. Lotsch, Physics Editor of Springer-Verlag, encouraged me to write and which helped launch the Springer Series in Solid-State Sciences. Now, ten years later, that book (and its 1980 revised printing) is no longer available. Meanwhile, workers in magnetic resonance have continued to develop startling new insights. A multidisciplinary reference of engineering measurement tools, techniques, and applications "When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of science."

— Lord Kelvin Measurement is at the heart of any engineering and scientific discipline and job function. Whether engineers and scientists are attempting to state requirements quantitatively and demonstrate compliance; to track progress and predict results; or to analyze costs and benefits, they must use the right tools and techniques to produce meaningful data. The Handbook of Measurement in Science and Engineering is the most comprehensive, up-to-date reference set on engineering and scientific measurements—beyond anything on the market today. Encyclopedic in scope, Volume 3 covers measurements in physics, electrical engineering and chemistry; Laser Measurement Techniques Magnetic Force Images using Capacitive Coupling Effect Scanning Tunneling Microscopy Measurement of Light and Color The Detection and Measurement of Ionizing Radiation Measuring Time and Comparing Clocks Laboratory-Based Gravity Measurement Cryogenic Measurements Temperature-Dependent Fluorescence Measurements Voltage and Current Transducers for Power Systems Electric Power and Energy Measurement Chemometrics for the Engineering and Measurement Sciences Liquid Chromatography Mass Spectroscopy Measurements of Nitrotyrosine-Containing Proteins Fluorescence Spectroscopy X-Ray Absorption Spectroscopy Nuclear Magnetic Resonance (NMR) Spectroscopy Near Infrared (NIR) Spectroscopy Nanomaterials Properties Chemical Sensing Vital for engineers, scientists, and technical managers in industry and government, Handbook of Measurement in

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Science and Engineering will also prove ideal for academics and researchers at universities and laboratories. The revolutionary impetus of the NMR methods in organic chemistry has parallels in the field of boron chemistry. IIB NMR spectroscopy provided a basis for the elucidation of structures and reactions of the boron hydrides. However, although many studies have been carried out with the higher boranes, carboranes, metalloboranes, etc., and although certain patterns have emerged, the correlation between the observed chemical shift and the assigned structural unit is still not fully understood. Therefore, predictions in this area are still rather limited, and semi-quantitative interpretations are not yet possible. Several years ago Eaton and Lipscomb summarized the status in this field in their book “NMR Studies of Boron Hydrides and Related Compounds” and a plethora of new data has accumulated since then. The book also contained material on simple borane derivatives, but they were not discussed in any detail. On the other hand many systematic studies, both synthetic and spectroscopic, have been conducted on these simple boron materials in the last decade. Thus a large amount of NMR information is available, not only on IIB but also on 1 H, 13 C, and 14 N. However, this information is widely scattered in the literature, and often the data are not discussed at all. It see med appropriate, therefore, to collect these data and to present them in one volume.

Combines clear and concise discussions of key NMR concepts with succinct and illustrative examples. Designed to cover a full course in Nuclear Magnetic Resonance (NMR) Spectroscopy, this text offers complete coverage of classic (one-dimensional) NMR as well as up-to-date coverage of two-dimensional NMR and other modern methods. It contains practical advice, theory, illustrated applications, and classroom-tested problems; looks at such important ideas as relaxation, NOEs, phase cycling, and processing parameters; and provides brief, yet fully comprehensible, examples. It also uniquely lists all of the general parameters for many experiments including mixing times, number of scans, relaxation times, and more. Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods, 2nd Edition begins by introducing readers to NMR spectroscopy - an analytical technique used in modern chemistry, biochemistry, and biology that allows identification and characterization of organic, and some inorganic, compounds. It offers chapters covering: Experimental Methods; The Chemical Shift; The Coupling Constant; Further Topics in One-Dimensional NMR Spectroscopy; Two-Dimensional NMR Spectroscopy; Advanced Experimental Methods; and Structural Elucidation. Features classical analysis of chemical shifts and coupling constants for both protons and other nuclei, as well as modern multi-pulse and multi-dimensional methods. Contains experimental procedures and practical advice relative to the execution of NMR experiments. Includes a chapter-long, worked-out problem that illustrates the application of nearly all current methods. Offers appendices containing the theoretical basis of NMR, including the most modern approach that uses product operators and coherence-level diagrams. By offering a balance between volumes aimed at NMR specialists and the structure-determination-only books that focus on synthetic organic chemists, Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods, 2nd Edition is an excellent text for students and post-graduate students working in analytical and bio-sciences, as well as scientists who use NMR spectroscopy as a primary tool in their work.

NMR of Paramagnetic Molecules: Principles and Applications is a compendium of papers that discusses the physical principles behind the technique of nuclear magnetic resonance, as well as evaluates the scope and limitation of the applications of NMR in chemistry and biology. These papers emphasize the applications of the technique in chemistry and biochemistry where it is widely used, particularly in experiments in the liquid state. Some papers describe the theoretical factors governing the resonance position and linewidth, and then also interpret magnetic parameters in terms of electronic structure. Another paper investigates the gap between the mathematical complexities of earlier experiments and the operational aspects of chemical information from the spectra. Examples show studies in biochemical molecules and process in events where contact interactions are present either as a result of intrinsic molecular paramagnetism or are just induced through the addition of suitable paramagnetic probes. One paper presents the definitive and controversial results involving stereochemistry and deuterium NMR. This collection of papers will prove useful for nuclear physicists, researchers, and academicians in the field of nuclear physics. Nuclear magnetic resonance spectroscopy is presently going through an explosive phase of development. This has been brought about largely on account of the advent of Fourier transform NMR spectrometers linked to powerful microcomputers which have opened up a whole new world for structural chemists and biochemists. This is exemplified by a host of publications, especially on new pulse sequences, which continue to provide new exciting modifications for recording two-dimensional NMR. Moreover, NMR is no longer confined to structural chemists but has moved firmly into the area of medicine as a powerful nondestructive body scanning technique. With this background, I felt that there was need for a text which would provide a fairly comprehensive account of the important features of 1H- and 13C-NMR spectroscopy in one book, as well as make available an up-to-date account of recent developments of new pulse sequences, with particular reference to 2D-NMR spectroscopy. Since this book is written for students of chemistry and biochemistry as well as for biology students who have chemistry as a subsidiary, it was decided to avoid a complex mathematical treatment and to present, as far as possible without oversimplification, a qualitative account of 1H- and 13C-NMR spectroscopy as it is today. I hope that the book satisfactorily meets these objectives. Solid State NMR: A thorough and comprehensive textbook covering the theoretical background, experimental approaches, and major applications of solid-state NMR spectroscopy. Nuclear Magnetic Resonance (NMR) spectroscopy is a powerful non-destructive technique capable of providing information about the molecular structure and dynamics of molecules. Alongside solution-state NMR, a well-established technique to study chemical structures and investigate physico-chemical properties of molecules in solutions, solid-state NMR (SSNMR) offers many exciting possibilities for the analysis of solid and soft materials across scientific fields. SSNMR shows unique capabilities for a detailed investigation of structural and dynamic properties of materials over wide space and time ranges. For this reason, and thanks to significant advances in the past several years, the application of SSNMR to materials is rapidly increasing in disciplines such as chemistry, physics, and materials and life sciences. Solid State NMR: Principles, Methods, and Applications offers a systematic introduction to the theory, methodological concepts, and major experimental methods of SSNMR spectroscopy. Exploring the unique potential of SSNMR for the structural and dynamic characterization of soft and either amorphous or crystalline solid materials, this comprehensive textbook provides foundational knowledge and recent developments of SSNMR, covering physical and theoretical background, experimental methods, and applications to pharmaceuticals, polymers, inorganic and hybrid materials, liquid crystals, and model membranes. Written by two expert authors to ensure a clear and consistent...
presentation of the subject, this textbook: Includes a brief introduction to the historical aspects and broad theoretical background of solid-state NMR spectroscopy Provides helpful illustrations to explain the various SSNMR concepts and methods Features accessible descriptive text with self-consistent use of quantum mechanics Covers the experimental aspects of SSNMR spectroscopy and in particular a description of many useful pulse sequences Contains references to relevant literature Solid State NMR: Principles, Methods, and Applications is the ideal textbook for university courses on SSNMR, advanced spectroscopies, and a valuable single-volume reference for spectroscopists, chemists, and researchers in the field of materials. Nine chapters cover: fundamental principles; experimental methods; the chemical shift; coupling of nuclear spins; nuclear relaxation and chemical rate processes; two-dimensional nuclear magnetic resonance spectroscopy; macromolecules; NMR of solids; special topics. Annotation copyrighted by Book News, Inc.; Portland, OR

The applications of nuclear magnetic resonance (NMR) to petroleum exploration and production have become more and more important in recent years. The development of the NMR logging technology and the NMR applications to core analysis and formation evaluation have been very rapid and extensive. The scope of this book covers a wide range of NMR related petrophysical measurements on cores including brief descriptions of recent applications of Magic Angle Spinning (MAS) NMR and the basics of NMR imaging of cores. In the discussion of NMR logging applications various schemes of using NMR logs to obtain necessary information for formation evaluation are outlined, such as irreducible water saturation determination, hydrocarbon typing, oil viscosity estimation, and permeability prediction. The principles of these applications are discussed using schematic diagrams for illustration. A unique aspect of the book is that it provides a detailed account of the basic principles of spin diffusion and relaxation in porous media. Another important area that is covered is the inversion of NMR data into a distribution of amplitudes associated with relaxation time which provides the basic information needed to interpret the NMR measurements obtained from logging.

Written by one of the world's leading NMR research teams, this monograph presents the most comprehensive and up-to-date treatment of nuclear magnetic resonance spectroscopy available. In the course of the last two decades, nuclear magnetic resonance spectroscopy has undergone a dramatic renaissance, and the authors provide a unified review of the entire field, covering basic principles and techniques for the study of solutions and solids, with emphasis placed on methods of one- and two-dimensional spectroscopy. The material is presented in an intuitive manner, with a large number of illustrations and a rigorous mathematical framework that should satisfy a wide audience.

Spin Resonance Spectroscopy: Principles and Applications presents the principles, recent advancements and applications of nuclear magnetic resonance (NMR) and electron paramagnetic resonance (EPR) in a single multi-disciplinary reference. Spin resonance spectroscopic techniques through NMR and EPR are widely used by chemists, physicists, biologists and medicinal chemists. This book addresses the need for new spin resonance spectroscopy content while also presenting the principles, recent advancements and applications of NMR and EPR simultaneously. Ideal for researchers and students alike, the book provides a single source of NMR and EPR applications using a dynamic, holistic and multi-disciplinary approach. Presents a highly interdisciplinary approach by including NMR and EPR applications in chemistry, physics, biology and biotechnology Addresses both NMR and EPR, making its concepts and applications implementable in multiple resonance environments and core scientific disciplines Features a broad range of methods, examples and illustrations for both NMR and EPR to aid in retention and underscore key concepts

This book provides a comprehensive review of modern nuclear magnetic resonance approaches to biomedical problems in vivo using state-of-the-art techniques. It devotes equal attention to the methods and applications of NMR and addresses the potential of each of the techniques discussed. The volume includes late-breaking areas such as functional imaging, flow imaging, bioreactor spectroscopy, and chemical shift imaging. All chapters are written in a “current concepts” style that renders information accessible to readers at all levels. Contributors are known experts in the field, lending the book an international perspective.

The book is devoted to the description of the fundamentals in the area of magnetic resonance. The book covers two domains: radiospectroscopy and quantum radioelectronics. Radiospectroscopy comprises nuclear magnetic resonance, electron paramagnetic resonance, nuclear quadrupolar resonance, and some other phenomena. The radiospectroscopic methods are widely used for obtaining the information on internal (nano, micro and macro) structure of objects. Quantum radioelectronics, which was developed on the basis of radiospectroscopic methods, deals with processes in quantum amplifiers, generators and magnetometers. We do not know analogues of the book presented. The book implies a few levels of the general consideration of phenomena, that can be useful for different groups of readers (students, PhD students, scientists from other scientific branches: physics, chemistry, physical chemistry, biochemistry, biology and medicine).

The power of nuclear magnetic resonance, NMR, for characterizing molecules dissolved in solution is widely acknowledged and NMR forms an essential component of undergraduate chemistry degrees. However, the application of NMR to the solid state is much less well appreciated. This text sets out the fundamental principles of solid-state NMR, explaining how NMR in solids differs from that in solution, showing how the various interactions of NMR can be manipulated to yield high-resolution spectra and to give information on local structure and dynamics in solids. This book aims to take some of the mystique out of solid-state NMR by providing a comprehensible discussion of the methodology, including the basic concepts and a practical guide to implementation of the experiments. A basic knowledge of solution-state NMR is assumed and is only briefly covered. The text is intended for those in academia and industry expecting to use solid-state NMR in their research and looking for an accessible introduction to the field. It will also be valuable for non-experts interested in learning how NMR can be usefully applied to solid systems. Detailed mathematical treatments are delayed to a chapter at the mid-point of the text and can be skipped. Introductions to experiments and numerical simulations are provided to help link NMR results to experimental practice. The different aspects of solid-state NMR, from basic pulse-and-acquire experiments to sophisticated techniques for the measurement of anisotropy information are presented. Examples illustrate the wide variety of applications of the technique and its complementarity to other solid-state characterization techniques such as X-ray diffraction. Various aspects of NMR crystallography are covered as are topics of motion in solids.

NMR in Molecular Biology provides an introduction to the basic concepts and principles of nuclear magnetic resonance (NMR) that are essential to a critical evaluation of experimental data. It also aims to acquaint readers in some detail with those prototype experiments in which a definite, biologically relevant answer has been obtained. The book opens with a chapter on the
historical development of NMR technology. Separate chapters follow on the fundamental principles of NMR; paramagnetic perturbations of NMR spectra; time scales, chemical exchange, and problems of exchange; and characteristics of NMR spectra through investigations of compounds such as amino acids and peptides; and nucleic acid bases, nucleosides, and nucleotides. Subsequent chapters deal with protein NMR spectra, protein-ligand interactions, and the structure and dynamics of membranes. This book is intended for the student or practicing scientist wishing to gain a critical understanding of the applications of NMR to a wide range of problems in molecular biology.

Techniques of solid state nuclear magnetic resonance (NMR) spectroscopy are constantly being extended to a more diverse range of materials, pressing into service an ever-expanding range of nuclides including some previously considered too intractable to provide usable results. At the same time, new developments in both hardware and software are being introduced and refined. This book covers the most important of these new developments. With sections addressed to non-specialist researchers (providing accessible answers to the most common questions about the theory and practice of NMR asked by novices) as well as a more specialised and up-to-date treatment of the most important areas of inorganic materials research to which NMR has application, this book should be useful to NMR users whatever their level of expertise and whatever inorganic materials they wish to study. This is the second edition of a useful introductory book on a technique that has revolutionized neuroscience, specifically cognitive neuroscience. Functional magnetic resonance imaging (fMRI) has now become the standard tool for studying the brain systems involved in cognitive and emotional processing. It has also been a major factor in the consilience of the fields of neurobiology, cognitive psychology, social psychology, radiology, physics, mathematics, engineering, and even philosophy. Written and edited by a clinician-scientist in the field, this book remains an excellent user's guide to

Protein NMR Spectroscopy, Second Edition combines a comprehensive theoretical treatment of NMR spectroscopy with an extensive exposition of the experimental techniques applicable to proteins and other biological macromolecules in solution. Beginning with simple theoretical models and experimental techniques, the book develops the complete repertoire of theoretical principles and experimental techniques necessary for understanding and implementing the most sophisticated NMR experiments. Important new techniques and applications of NMR spectroscopy have emerged since the first edition of this extremely successful book was published in 1996. This updated version includes new sections describing measurement and use of residual dipolar coupling constants for structure determination, TROSY and deuterium labeling for application to large macromolecules, and experimental techniques for characterizing conformational dynamics. In addition, the treatments of instrumentation and signal acquisition, field gradients, multidimensional spectroscopy, and structure calculation are updated and enhanced. The book is written as a graduate-level textbook and will be of interest to biochemists, chemists, biophysicists, and structural biologists who utilize NMR spectroscopy or wish to understand the latest developments in this field. Provides an understanding of the theoretical principles important for biological NMR spectroscopy Demonstrates how to implement, optimize and troubleshoot modern multi-dimensional NMR experiments Allows for the capability of designing effective experimental protocols for investigations of protein structures and dynamics Includes a comprehensive set of example NMR spectra of ubiquitin provides a reference for validation of experimental methods

Nuclear Magnetic Resonance in Biochemistry: Principles and Applications focuses on the principles and applications of nuclear magnetic resonance (NMR) in biochemistry. Topics covered include experimental methods in NMR; the mechanisms of NMR relaxation; chemical and paramagnetic shifts; spin-spin splitting; the use of NMR in investigations of biopolymers and biomolecular interactions; and molecular dynamics in biological and biochemical systems. This text is comprised of eight chapters; the first of which gives an overview of NMR spectroscopy and its use in studies of biological systems. The next two chapters discuss the theoretical basis for NMR applications in biochemistry, with emphasis on Bloch equations, quantum mechanics, correlation function and correlation time, double resonance, and chemical exchange. The reader is then introduced to the basis for chemical shifts and spin-spin splitting, along with several examples of the use of these NMR parameters in studies of small molecule interactions and structure. The experimental apparatus and procedures employed in NMR studies, Fourier transform NMR, and NMR spectral parameters of small molecules interacting with macromolecules are also considered. The book highlights the information obtainable from the spectra of biopolymers, and then concludes with a chapter on NMR investigations of the state of motion of lipids in membranes and model membranes; water in macromolecular and cellular systems; and sodium ion in biological tissues. This book is intended primarily for chemists, biochemists, biophysicists, and molecular biologists, as well as graduate students. This volume provides the basic principles of nuclear magnetic resonance and magnetic relaxation, with the aim of helping students and researchers in various fields of science and technology to obtain a deeper understanding of the subject. It reviews the nature of spin operators and the commutation relationship between them, the behaviour of nuclear magnetism in a static field, and describes the basic theory of the resonance absorption spectrum. The book evaluates Kubo and Tomita's theory which correlates NMR lineshape with the spin Hamiltonian. It also reviews the relationship between magnetic relaxation and molecular motion and deals briefly with recently developed high resolution NMR techniques for studying solid matter. This work will prove to be an indispensable source of information for students and graduate students in chemistry and physics, and for researchers working in the field of NMR.

Taking the reader through the underlying principles of molecular translational dynamics, this book outlines the ways in which magnetic resonance, through the use of magnetic field gradients, can reveal those dynamics. The measurement of diffusion and flow, over different length and time scales, provides unique insight regarding fluid interactions with porous materials, as well as molecular organisation in soft matter and complex fluids. The book covers both time and frequency domain methodologies, as well as advances in scattering and diffraction methods, multidimensional exchange and correlation experiments and orientational correlation methods ideal for studying anisotropic environments. At the heart of these new methods resides the ubiquitous spin echo, a phenomenon whose discovery underpins nearly every major development in magnetic resonance methodology. Measuring molecular translational motion does not require high spectral resolution and so finds application in new NMR technologies concerned with 'outside the laboratory' applications, in geophysics and petroleum physics, in horticulture, in food technology, in security screening, and in environmental monitoring.
Nuclear Magnetic Resonance (NMR) has been a fundamental player in the studies of superconducting materials for many decades. This local probe technique allows for the study of the static electronic properties as well as of the low energy excitations of the electrons in the normal and the superconducting state. On that account it has also been widely applied to Fe-based superconductors from the very beginning of their discovery in February 2008. This dissertation comprises some of these very first NMR results, reflecting the unconventional nature of superconductivity and its strong link to magnetism in the investigated compounds LaO1–xFxFeAs and LiFeAs.

A comprehensive overview of the current state of development in magnetic resonance angiography (MRA). After an initial outline of the basic principles of the technique and a general description of flow phenomena, the individual chapters are devoted to a full range of technical considerations. Practical recommendations for typical examination protocols of different vascular areas and lesions are given to facilitate correct application of the procedure. The advantages and drawbacks of MRA are discussed in comparison with other imaging techniques, and a catalogue of generally accepted indications is provided. To complete the picture, the book looks at possible future developments.

Precended by Magnetic resonance imaging: physical principles and sequence design / E. Mark Haacke ... [et al.]. c1999.

Nuclear magnetic resonance (NMR) is having an enormous impact on biomedical research both at the basic science and clinical levels. In order to appreciate the elegance and power of this technology a historical perspective is in order. In 1924 Pauli suggested that hydrogen nuclei might possess a magnetic moment. This was in fact confirmed by Ruben in 1939 who demonstrated that a beam of hydrogen molecules in the presence of a magnetic field could be deflected by radio frequency fields resonating at the Larmor frequency. The first successful NMR experiments in condensed matter were independently conducted in late 1945 by Purcell, Torrey and Pound and by Bloch, Hansen and Packard. The Purcell group detected proton NMR in solid paraffin and the Bloch group detected proton in liquid water. Bloch and Purcell received the Nobel Prize in physics in 1952 for these observations. Until about 1952, studies of liquids and solids with broad resonance lines dominated the field of NMR. However, the reports of 31P NMR chemical shifts in several compounds in 1949 by Knight, of 14N resonances in several ions by Proctor and Yu in 1950, and of 19F resonances in several compounds in 1950 by Dickinson led to the development of high resolution NMR in liquids. Since the molecular motions in liquids result in very narrow lines compared to those in solids, much smaller chemical shifts could be detected.

Spin Dynamics: Basics of Nuclear Magnetic Resonance, Second Edition is a comprehensive and modern introduction which focuses on those essential principles and concepts needed for a thorough understanding of the subject, rather than the practical aspects. The quantum theory of nuclear magnets is presented within a strong physical framework, supported by figures. The book assumes only a basic knowledge of complex numbers and matrices, and provides the reader with numerous worked examples and exercises to encourage understanding. With the explicit aim of carefully developing the subject from the beginning, the text starts with coverage of quarks and nucleons and progresses through to a detailed explanation of several important NMR experiments, including NMR imaging, COSY, NOESY and TROSY. Completely revised and updated, the Second Edition features new material on the properties and distributions of isotopes, chemical shift anisotropy and quadrupolar interactions, Pake patterns, spin echoes, slice selection in NMR imaging, and a complete new chapter on the NMR spectroscopy of quadrupolar nuclei. New appendices have been included on Euler angles, and coherence selection by field gradients. As in the first edition, all material is heavily supported by graphics, much of which is new to this edition. Written for undergraduates and postgraduate students taking a first course in NMR spectroscopy and for those needing an up-to-date account of the subject, this multi-disciplinary book will appeal to chemical, physical, material, life, medical, earth and environmental scientists. The detailed physical insights will also make the book of interest for experienced spectroscopists and NMR researchers. • An accessible and carefully written introduction, designed to help students to fully understand this complex and dynamic subject • Takes a multi-disciplinary approach, focusing on basic principles and concepts rather than the more practical aspects • Presents a strong pedagogical approach throughout, with emphasis placed on individual spins to aid understanding • Includes numerous worked examples, problems, further reading and additional notes

Principles of Nuclear Magnetic Resonance MicroscopyOxford University Press on Demand

This book is intended as a text/reference for students, researchers, and professors interested in physical and biomedical applications of Magnetic Resonance Imaging (MRI). Both the theoretical and practical aspects of MRI are emphasized. The book begins with a comprehensive discussion of the Nuclear Magnetic Resonance (NMR) phenomenon based on quantum mechanics and the classical theory of electromagnetism. The first three chapters of this book provide the foundation needed to understand the basic characteristics of MR images, e.g., image contrast, spatial resolution, signal-to-noise ratio, common image artifacts. Then MRI applications are considered in the following five chapters. Both the theoretical and practical aspects of MRI are emphasized. The book ends with a discussion of instrumentation and the principles of signal detection in MRI. Clear progression from fundamental physical principles of NMR to MRI and its applications Extensive discussion of image acquisition and reconstruction of MRI Discussion of different mechanisms of MR image contrast Mathematical derivation of the signal-to-noise dependence on basic MR imaging parameters as well as field strength In-depth consideration of artifacts in MR images Comprehensive discussion of several techniques used for rapid MR imaging including rapid gradient-echo imaging, echo-planar imaging, fast spin-echo imaging and spiral imaging Qualitative discussion combined with mathematical description of MR techniques for imaging flow

This book provides an introduction to the general principles of nuclear magnetic resonance and relaxation, concentrating on simple models and their application. It includes an introduction to the ideas and applications of nuclear magnetic resonance and emphasizes the concepts of relaxation and the time domain. Some relatively advanced topics are treated, but the approach is graduated and all points of
potential difficulty are carefully explained. An introductory classical discussion of relaxation is followed by a quantum-mechanical treatment. A selection of case studies is considered in depth, providing applications of the ideas developed in the text. There are a number of appendixes, including one on random functions. This treatment of one of the most important experimental techniques in modern science will be of great value to final-year undergraduates, graduate students and researchers using nuclear magnetic resonance, particularly physicists, and especially those involved in the study of condensed matter physics.

The book presents principles of electron magnetic resonance from a chemist's point-of-view, covering g-tensor theory, isotropical hyperfine structure, anisotropical hyperfine structure and fine structure of spectrum, and relaxation theory. Detailed explanations on quantitative determination of paramagnetic species are given to address readers' difficulties. Written as a physical chemistry graduate textbook, it is also suitable for industry users.

This highly successful book, details the underlying principles behind the use of magnetic field gradients to image molecular distribution and molecular motion, providing many examples by way of illustration.

Following excellent reviews of the hardback edition the book is now available in paperback.

Nuclear magnetic resonance spectroscopy, which has evolved only within the last 20 years, has become one of the very important tools in chemistry and physics. The literature on its theory and application has grown immensely and a comprehensive and adequate treatment of all branches by one author, or even by several, becomes increasingly difficult. This series is planned to present articles written by experts working in various fields of nuclear magnetic resonance spectroscopy, and will contain review articles as well as progress reports and original work. Its main aim, however, is to fill a gap, existing in literature, by publishing articles written by specialists, which take the reader from the introductory stage to the latest development in the field. The editors are grateful to the authors for the time and effort spent in writing the articles, and for their invaluable cooperation. The Editors Contents c. W. Hilbers and C. MacLean NMR of Molecules Oriented in Electric Fields.

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