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BOOK REVIEWS

Magnetic Properties of Low-dimensional Systems II : New Developments
(Springer Proceedings in Physics, Vol 50)
(Proceedings of the Second Workshop, San Luis Potosi, Mexico, May 23-26, 1989)
edited by L M Falicov, F Mejia-Lira and J L Moran-Lopez
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo-Hong Kong, 1990
ix + 247 pages, 119 figures; price . DM 98.00 (Hard cover); ISBN 3-540-52353-7

The book under review is the proceedings of the 2nd workshop with the same name held at San Luis Potosi, Mexico from May 23 to May 26, 1989. The theme of the meeting has become a major driving force in pure and applied science, and a major component of high-technological industrial applications such as magnetic recording, information storage and retrieval.

This book contains 27 articles divided into 7 parts. The subject matters of the articles are truly interdisciplinary. They cover many diverse areas of theoretical, experimental and engineering disciplines such as micromagnetics, surfaces and overlayers, magnetic superlattices, statistical mechanics of low dimensional magnetism, magnetic clusters, order-disorder and magnetic superconductors. To review such a book with so many interdisciplinary subjects one should make a chapter wise review.

We know that the magnetic energy is minimised in bulk solids by the formation of domain walls known as Block wall. But in the presence of a surface such as in thin films this Block wall is converted to Néel wall in order to reduce the magnetic stray field energy of the ferromagnetic system. This phenomenon can be observed experimentally from the Scanning electron microscopy with polarisation (SEMPA). This interesting phenomenon is the subject matter of the first article where the authors presented and analysed beautiful pictures taken from SEMPA. From the analysis they found that the surface Néel wall widths in bulk samples are at least twice those of interior Bloch walls. Many other interesting phenomena have been explained, with the help of SEMPA which has now become a powerful means of experimental investigation of surface magnetic structures. This article is very helpful to the research students in this line.

Part II contains 10 articles under the heading of 'Atomic-scale structure of magnetic surfaces and overlayers'. These articles mostly deal with measurement on ultrathin magnetic films with many of the most modern techniques such as, surface magneto-optic Kerr effect (SMOKE), spin polarized photoelectron diffraction, spin polarized photoemission and many more conventional techniques. These studies are very important both for the pure and applied science. The first article studies the existence of mono layer magnetism and surface

magnetic anisotropy of epitaxial film of Fe deposited on Cu(100), Ru(0001) and Pol(100) by the use of magneto-optic Kerr effect which was introduced only in 1985. These studies provide insights into three topics of interest : (i) the quest for monolayer magnetism : (ii) the nature of the surface magnetic anisotropy; and (iii) critical phenomena in two dimensional magnetic systems.

A number of articles in this section studies ultrathin magnetic layers through the use of spin-polarised photoelectron diffraction technique.

Part III contains 4 articles which deal with the magnetic superlattices. With the development of sophisticated techniques to prepare thin films, the physical properties of ultrathin ferromagnetic films, just a few monolayer thick have recently been studied in some detail with help a variety of experimental techniques such as Mössbaur Spectroscopy, squid and Kerr magnetometry, anomalous Hall effect, ferromagnetic resonance and various electron microscopy. These studies also include antiferromagnetic thin films. Moreover, because of low dimensionality of the above systems, scale dependence and superconductivity also comes into these studies. The various articles in part III mainly deals with the above problems.

Part IV contains 5 theoretical articles dealing with the statistical mechanics of low dimensional magnetism. The first two articles give brief account of effects of surfaces on critical phenomena and surface induced disorder and surface melting. They contain discussion of both static properties like the phase diagram, surface critical exponents as well as scaling and of the dynamical behaviour of various correlation functions. These two articles are presented in a very compact form and only people having sufficient knowledge of field theoretic methods can be benefitted. Another important article worth mentioning is by J Mathon who deals with the theory of spin waves in magnetic multilayers.

Part V deals with the theoretical studies on clusters and one dimensional magnetic systems such as quantum Heisanberg Chains and transition metal clusters. Chapter VII deals with the very important subject of co-existance of magnetism and superconductivity. This chapter has only one article although I would have preferred more articles in this subject.

The articles of this book deal generally with state of the art subjects which are now-a-days drawing the attention of the leading physicists of the world. As with all reports of workshop and symposium the articles lack many of the details which would have been much beneficial to research workers in general. But they contain enough references, which may help the research students. The book, as it stands now, is a very good addition to research workers engaged in research work in low dimensional system.

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Nonlinear Coherent Structures (Lecture Notes in Physics, Vol 353)
(Proceedings of the 6th International Workshop on Nonlinear Coherent Structures in Physics, Mechanics and Biological Systems held at Montpellier, France, June 21-23, 1990)
edited by M Barthes and J Leon

Springer-Verlag : Berlin-Heidelberg-New York-London-Paris Tokyo-Hong Kong, 1990
x + 280 pages; price . DM 55.00 (Hard cover), ISBN 3-540-52240-9

Springer-Verlag has done a commendable job by publishing the proceedings of the 6th International Workshop on nonlinear coherent structures in physics, mechanics and biological systems held at Montpellier, France in 1989 in this book-form. This will indeed be very useful to many scientists interested in nonlinear coherent structures who could not attend the workshop.

In the introduction, Remoissenet presents an overview of the experimental signatures of nonlinear waves in quasi-one-dimensional systems such as optical fibres and electrical transmission lines for nontopological solitons and in Josephson transmission lines, magnetic chains and synthetic polymers for topological solitons.

The book comprise three parts. In the first part nonlinear excitations in molecules and the hydrogen-bonded chains have been treated in eight papers. Five papers constitute the second part of the book and deals with solitary waves in solid state materials. Numerical and theoretical studies of nonlinear wave propagation is the subject matter of the third and the most expansive part of the book spread over eleven papers. In part 1, Scott in his article discusses nonlinearity arising from nonlinear force constants in molecular bonds and nonlinear phonon interactions in molecular cyrstals. Peyrard and Bishop report their investigation on the formation of large amplitude nonlinear excitation leading to the denaturation of DNA molecule. Barthes, Almairac, Sauvajol and Moret present incoherent neutron scattering measurements of the vibrational density of states in the hydrogen bonded molecules. NMR studies of nonlinear excitations in polypeptide like ACN molecule is reported by Masin, Gusman, Broekaert and Maerschalk. Kapor, Skrinjar and Stojanovic in their article asserts that the Frenkel excitons are Paulions and they apply the concept to derive finite temperature behaviour of the exciton bound states in compressible molecular chains. Pulse like solitary waves on a one dimensional diatomic lattice with alternating interactions is discussed by Merten and Hochstrasser. Studies on the longitudinal and transverse collective dynamics of protons in a zig zag hydrogen bonded system is presented by Pnevmatikos, Savin and Zolotaryuk. Christiansen, Lomdahl and Muto introduce a transverse degree of freedom in Toda lattice or a chain with nonlinear spring and mass.

In part II, Aubry and his coworkers in thier article analyse the limits of the validity of charge density wave model and extended Cooper pair model in superconducting phase transition.

Saint-Gregoire and Janovec have applied the theory of symmetry for exact solution of the nonlinear equations representing atomic displacements in quartz-like crystals in incommensurate phase. A lattice model is proposed by Pouget in view of studying nonlinear dynamics of microstructure patterns made of elastic domains involved in ferroelastic-martensitic transformations. Gaveau, Boucher, Regnault and Henry presents results of their NMR studies of quasi-two dimensional $BaNi_2(PO_4)_2$ crystal and bring out the role of nonlinear excitations in low dimensional magnetism. Kapor and his collaborators in their second article apply well known Boson techniques to study quantum corrections to classical magnetic solitons in various Heisenberg models.

In part III, the nucleation and the stability of the defects resulting from the localised modulation of the phase in nonlinear waves are numerically simulated by the appropriate Landau-Ginsburg-Newell model by Joets and Ribotta in their article. Bilbault and Remoissenet report theoretical and numerical study of the properties of monochromatic waves in a nonlinear electrical transmission lines whose capacitance has a periodic spatial variation. Reinisch, Devoret and their group show the existence of a stable two dimensional isoperimetar solitonic mode propagating simutaneously along the two diagonals of a square Josephson junction of intermediate length using energy consideration and numerical simulation. In a second article they demonstrate the existence of phase locked cycles in inhomogeneously driven sine-Gordon system and point out their possible experimental verification by Josephson devices. Seegar and his coworkers in an article report their studies on the behaviour of breather solutions of the sine-Gordon equation under the action of a constant external force. Spatschek, Taki and Eickermann analyse the spatial and the temporal behaviour of possible solutions of driven and damped nonlinear Schrodinger and sine-Gordon quations. Leon, Boiti and Pempinelli in their paper focus attention on the spectral transform of some measured field and show that the problem is to solve an integral equation in one or two dimension. In a paper Sanchez and Vazquez describe some techniques for study of stochastic ϕ^4 modes and apply these to a certain perturbation of the ϕ^4 potential. Feix and Goedert use a modification of Carleman embedding method to find invariants for the generalised Lotka-Volterra system.

The present reviewer found the article of Kenkre on slow relaxation effects in the evolution of nonlinear quantum system fascinating as it deals with strong interactions between a quasi-particle which moves in lattice (exciton or the like) in keeping with a quantum evolution equation and oscillators (phonons) whose displacements modulate the quasiparticle parameter such as site energy. These results bear significant relevance in energy transfer in molecular crystals and photosynthetic systems.

The range of topics that fall under the rubric of nonlinear coherent structure is diverse and publication of this inspired set of papers as lecture notes in a single volume will indeed be appreciated. I warmly recommend this book to the scientists and researchers

interested in the subject. This volume indeed assured us that the subject of 'nonlinear coherent structures is in a state of healthy growth'.

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Space-Time Organization in Macromolecular Fluids (Springer Series in Chemical Physics, Vol 51)
(Proceedings of the Eleventh Taniguchi International Symposium, Hakone, Japan, November 7-12, 1988)
edited by F Tanaka, M Doi and T Ohta
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris Tokyo-Hong Kong, 1989
xiv + 270 pages, 76 figures; price DM 80.00 (Hard cover), ISBN 3 540 51720-0

The Proceedings of the Taniguchi Symposium, 1988 contains twenty three papers organised in five different parts : Dynamics of Macro- and Microphase Separation; Structure Formation in Gels; Dynamics of Entangled Polymers; Polymer Adsorption and Chain conformation in Stiff-Polymer Solutions; each concentrating on a particular aspect of a general theme which may be termed self-organisation of macromolecular fluids.

In recent years the investigation of the physics of macromolecules in the liquid state in terms of structure and dynamics had led to considerable insight into the phenomenon of self organisation of this state of matter and has modified the standard statistical chain description by inclusion of intra and inter polymer forces that may now hopefully find applications in systems of practical interest. This significant progress has been achieved on the one hand due to accumulation of very precise experimental data produced by techniques of light scattering, thermal neutron scattering and many other like thermal and rheological measurements on polymers in liquid state. Concurrently new theoretical concepts of statistical mechanics, renormalisation group method, functional integral approach and others help to correlate and systematise the existing data and also suggest new experiments that are in the process of being verified. In part I the mean field type theories with and without fluctuation effects have been considered to study the dynamics of macro and microphase separation in block copolymers and homopolymer mixtures. The fluctuation effects have been found to be extremely important in the microphase separation and under certain conditions may give rise to non-Ising type transition behaviour usually found in polymer blends. The time resolved light scattering experiments have given the time evolution of the

structure function in the late stage of the phase separation in certain polymer blends that have features that cannot be explained with the existing theories. The late stage of spinodal decomposition has been studied by employing a mean field approach based on the interface dynamics which seems to be consistent with the exponent obtained from computer simulation experiments, although experiments yield values some of which are close to the mean field result while others are greater than this. The concluding work in this part introduces field theoretic approach to spinodal decomposition and shows potentiality of the method in studying unstable critical dynamics below the critical temperature.

Part II includes topics on gelation and pattern formation in polymeric materials. In order to interpret the data on complex modulus for some well characterised branched polymers near the gel point a dynamic scaling law based on the Rouse model appears to be quite successful. Several topics covering dynamics as well as rheological aspects of different types of polymers have been presented. The phenomenon of ion complexation and the competition between the consequent interaction with other existing ones leading to phase separation in gel phases has been qualitatively interpreted in terms of a simple theoretical model of polymer-ion complexation. The swelling of cross-linked polymer gels in solvent has shown many new features that cannot be explained within the Flory scheme. The elastic anisotropy seems to radically alter the nature of the phase transition of gels that are affinely deformed. Invoking the model of a highly compressible elastic body several aspects of pattern formation and critical dynamic behaviour of gels have been treated. Several computer simulation of pattern formation in bulk gels in 2-dimension have been presented which seem to have a bearing on metastable domain formation in actual gels.

The reptation model of polymer chain in concentrated solution has contributed significantly to our understanding of the behaviour of such states. In part III new results have been reported for wormlike surfactant micelles in which the reptation model has been extended to incorporate the effect of reversible breakage and recombination of micelles which suggests an explanation among others for the observed single exponential relaxation time. The paper on gel electrophoresis invites attention to development of both new experimental technique and models based on reptation theory for pulsed electric field which is sure to deliver new results in this exciting field. An alternative approach to the entanglement effect of rod like polymers has been developed using the Green function formalism to treat diffusion phenomenon. This calculation for rotational diffusion of entangled polymers compares favourably with the dynamic electric birefringence data over the entire concentration range. The concluding article in this section reviews the dynamics of macromolecules trapped inside porous random media. Preliminary simulation experiments seem to indicate that the exponents and their interrelations may be quite different from that of a single particle in a random media.

In part IV quantitative data on polymer adsorption in solid surfaces have been

provided in particular for copolymers and some conclusive evidence has been produced that large polymer chains are preferentially adsorbed over small ones. Finally some static properties of polymers have been discussed in terms of the well known two-dimensional dimer and six vertex models.

Part V discusses the application of Kratky-Porod model to stiff polymers, the possibility of Suzuki's coherent anomaly method to polymers and disclinations in Nematic liquid crystal.

The collection of articles in the book provides an up-to-date account of certain aspects of macromoles in liquid state and seeks to correlate structure and dynamics for which the reviewer feels only a real beginning has been made.

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Refractive Nonlinearity of Wide-band Semiconductors and Applications
(Laser Science and Technology, an International Handbook, Vol 9)
edited by A A Borshch, M Brodin and V Volkov
Harwood Academic · Chur-London-Paris-New York Melbourne, 1990
141 pages; price . $ 70 00, ISBN 3-7186-4971-3

During the last decade laser science and technology have developed very fast. In recent times there have been enormous progress in several areas of laser science and technology. The book "Refractive nonlinearity of wide-band semiconductors and applicatuons" contains the various aspects of the above rapidly growing interdisciplinary areas. It presents valuable and self-contained discussions on the refractive nonlinearity of wide band semiconductors. There is also a concise information on the latest achievements in these areas.

The basic mechanism of the nonlinearity in semiconductors has been presented here in a very convincing way so that general readers, who wish to know about the most important aspects of laser science, will find the book very interesting. Nonlinear refraction, in fact, depends on the physical parameters of the material such as structure, band gap and effective mass. The search for new material is of immense importance for the future developments in the field of laser science. These various aspects of laser science and technology have been discussed in the present volume alongwith the most recent achievements. This will surely serve as a ready reference to the researchers, who wish to explore the latest developments in the field.

An excellent review has been given in the book in a very concise form which includes one beam self-action of light, two beam interactions, four wave light mixing and optical bistability. In chapter 1, the contribution of different elementary excitations to non-linearity of semiconductors are discussed while the experimental methods of measuring the coefficients of refraction non-linearity alongwith the dynamics of self action is given in chapter 2. The experimental studies of dynamic holograms in wide gap semiconductors e.g. CdS, CdS(x)Se(1–x), ZnSe(x)–GaP(1–x), a–SiC and CdTe (chapter 3) is very informative. Theory of six photon mixing in semiconductors alongwith the experimental set-up (chapter 4) will surely be of interest to investigators in laser science. Chapter 5 contains the discussions on the optical bistability in wide-gap semiconductors. These chapters have been written by established scientists with outstanding works in their respective fields. It must be mentioned that the authors have taken a great care in preparing the texts for which they deserve heartful thanks from the readers.

The present volume of the series is sure to be very attractive to different classes of readers as a quick and current reference in the subject. I have no hesitation to say that this book will serve the purpose of scientists, students and also general readers, who are interested in the rapidly growing field of laser science and technology.

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An Experimental Study of Quasi-Particles in Antiferromagnetic Materials
(Soviet Scientific Reviews/Section A, Volume 13, part 3)
by B Ya Kotyuzhanskii and L A Prozorova
Harwood Academic: New York, 1990
131 pages; price . $ 54.00; ISBN 3-7186-4988-8

The present book is a review of the methods of microwave spectroscopy as applied to the experimental investigation of the elementary excitations magnons and phonons in antiferromagnetic (AFM) dielectric. The experiments described are on AFM crystals with anisotropy of the easy-plane type. The review is divided into four sections. The first section gives basic information on the linear dynamics of easy-plane AFM material. Magneto-elastic interaction is a characteristic feature of such materials. This interaction modifies the magnon and phonon spectra and leads to mutual scattering. In the region of momentum space where interaction between magnetic and elastic oscillations is very strong, the notion of individual excitations loses meaning and one should consider hybrid quasiparticles

corresponding to the spectrum of magneto-elastic oscillations. A brief outline of the classical calculation of magnon and phonon spectra taking magneto-elastic oscillation into account has been given.

Section 2 starts with a description of linear and nonlinear AFM resonances (AFMR). Linear AFMR implies weak microwave fields in which the high-frequency susceptibility does not depend on the magnitude of the microwave magnetic field h.In non-linear AFMR, the interaction of the AFM materials is with an intense electromagnetic field. One interesting non-linear effect is the parametric excitation of non-uniform oscillations or of the related quasiparticles. Parametric excitation of magnons has been describes followed by a brief outline of the experimental set-up. The third section gives a comprehensive discussion of the experimental study of the spectra and parametric excitation of quasiparticles. The different origins of the gap in the magnon spectrum like the contributions of the hyperfine and magnetoelastic interactions and the interaction of spin waves corresponding to different branches of the spectrum, also the impurity contribution are reported. Biresonant frequency doubling experiment which highlights the non-linear coupling between the branches of the spin-wave spectrum has been discussed. The experimental investigation of the parametric excitation of magnons, the kinetics of the process as well as change in magnetization have been described in fair details. The parametric excitation of phonons has also been treated and experimental verification of theoretically calculated dispersion laws of magnons and phonons described. Section 4 is devoted to the study of various processes of quasiparticle interaction with each other, crystal defects and sample boundaries. These interactions lead to different relaxation mechanisms. The major features of such mechanisms have been outlined with reference to actual experiments carried out on AFM samples. The review under discussion is a good introduction to the investigation of the properties of quasiparticles in AFM materials by microwave spectroscopy. The bulk of the work reported is that done by Russian groups. A large amount of technical information has been provided supplemented by descriptions of theories as and when required. The review should prove to be useful to experimentalists working in a similar or overlapping research area.

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