BOOK REVIEWS

Light scattering in Solids V: Superlattices and Other Microstructures
(Topics in Applied Physics, Vol 66)
edited by M Cardona and G Güntherodt
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo-Hong Kong, 1989
xiii + 351 pages, 184 figures; price : DM 138.00 (Hard cover); ISBN 3-540-50400-1

Springer-Verlag has been bringing out from time to time volumes under' Topics in Applied Physics' series which deal with different aspects of scattering of light in solids. The present volume is devoted to light scattering by interfaces and artificial microstructures. The discovery of quantum Hall effect and the development of theoretical understanding of the phenomenon has led to the achievement of high degree of sophistication in the growth and characterization of these structures. As laser light can be focussed in micrometer diameter, light scattering is an ideal technique to study these structures.

The Book comprises, besides one introductory, eight chapters written by authors whose expertise in the specific field is very well-recognised. Mills in the first chapter discusses collective excitation in magnetic superlattice structures by Brillouin scattering and suggests study of superlattices which incorporate films of magnetically ordered materials. Jusserand and Cardona in their chapter on Raman spectroscopy of vibrations in superlattice present an exhaustive treatment of lattice dynamics of these structures, resonant light scattering mechanisms of the bulk constituents of semiconductor superlattices, photoelastic mechanism of scattering by acoustic phonons and Fröhlich mechanism and multiphonon scattering. In the fourth chapter, Pinczuk and Abstreiter review the mechanisms, selection rules and kinematics of free carrier excitation in semiconductor quantum wells. They also discuss use of Raman spectroscopic technique in the study of quantum wires and quantum dots, topics of current interest in condensed matter physics. Structural and electronic properties of non-periodic Fibonacci, Thua-Morse and Random superlattices and Raman scattering by phonons, plasmons and other elementary excitations in such structures are the topics treated by Merlin. Indeed, the reviewed experimental results on non-periodic superlattices are preliminary; the discussion, however, will surely be stimulating to many interested research scientists.

Problems associated with the physics and chemistry of surfaces and interfacial layers are now accessible for study by Raman scattering. Extremely weak scattering signal from these structures can now be detected by imaging photomultipliers and charged couple devices. Performance of these devices are improving and new devices are being available at a rapid pace so as to make to-day's best obsolete tomorrow. Use of multichannel detection and Raman spectroscopy for the study of surfaces, interfaces and ultra thin layers have been reviewed by Tsang in Chapter 6 in a lucid fashion. In Chapter 7, the use of Brillouin

scattering for the study of metallic superlattics has been discussed and the results of scattering from phonons and magnons has been reviewed by Grimsditch. In the final Chapter, Grünberg has reviewed light scattering from spin waves in thin films and magnetic structures. Modification of magnetic material properties by layering and the role of light scattering in their characterization has also been discussed.

In this volume, the editors have not only struck a most effective balance between the theoretical and experimental aspects of light scattering in solids but also have shown admirable judgement and a sense of dimension of the field in their selections. They have gone to some lengths to ensure adequate representation of the major approaches and aspect of the field. Their own contribution in form of an introductory chapter is far from perfunctory and is in fact most helpful. The general high level of readability of the contributions owes much to their editorial efforts. This is a volume to which many solid state physicists and chemists will turn frequently as much from necessity as for profit.

A photograph of Prof C V Raman on the first page is surely of most relevance to a book on light scattering; it has, however, been additionally satisfying to the Indian readers.

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Time-Harmonic Electromagnetic Fields in Chiral Media (Lecture Notes in Physics, Vol 335)
by A. Lakhtakia, V K Varadan and V V Varadan

With the spectacular progress of materials research, understanding of the electromagnetic response behaviour of chiral artificial composites assumes great importance. Since chirality is handedness in structure, it is possible in principle to have chiral materials which are mesoscopic or even of larger dimension-imparting activity even at microwave frequencies. As the authors of the book argue, we have to broaden the term "optical activity" to something like "electromagnetic activity" to encompass circular birefringence for the whole range of electromagnetic frequencies.

The book presents a lucid but thorough introduction to the physics of electromagnetic propagation through a chiral media, assuming throughout a harmonic wave for the treatment. It begins with a brief but informative introductory section, tracing the origin of circular birefringence and touching upon the more modern scenario where even atoms are deemed to be optically active due to chirality imparted by the parity-violating weak neutral current effects. The authors emphasize the possible technological importance

of the feasibility of synthesizing chiral polymers which will show activity at sub-optical frequencies. They argue that at super-optical frequencies classical electromagnetic theory is not a good tool, while at the really sub-optical threshold the molecular length scale is still too small compared to the wave-length of the electromagnetic radiation. In the intermediate range somewhere does the molecular chirality make itself manifest, and the choice of the proper length scales and of the proper materials makes the study of the phenomena very attractive.

The book has twenty sections, discussing in a coincise manner the theoretical tools necessary for a quantitative treatment. It starts out with a section on scattering by helical ensembles, going onto the discussion of the constitutive equations for electromagnetic wave propagation in homophoric chiral media. The authors are quite elaborate here in their treatments, and discuss several interesting variants of the formulation and their relative efficacies. This is in the best tradition of Born and Wolf. They consider bi-anisotropic media as well. The analogous theorems of reaction, duality and reciprocity for chiral media are discussed. The T-matrix method is developed for describing scattering by 3-D chiral bodies. The Green's function for the propagation of light in chiral media is discussed next and its usefulness amply demonstrated. An unusual coverage is the discussion of radiation generated in chiral media. The last chapter discusses acoustically chiral solids and introduces chiral elasto dynamics, to describe acoustic wave scattering from chiral scatterer, which is of singular interest. I warmly recommend the book to the physical chemists and materials scientists, having a graduate knowledge of electromagnetism, who want to know about the expanding frontiers of chiral polymers and nanomaterials. I hope that the authors in their next endeavour would cover both anisotropy of the media and the nonlinear effects. The latter is bound to be of importance in the coming decade since nonlinear optical activity of isolated molecules has been gaining increasing importance in recent years.

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The rigged Hilbert space (RHS) formulation of quantum mechanics (QM) is one of the many approaches to it which was introduced around 1965 by Bohm and Roberts. Prior to

this application in QM, the tool itself was proposed around 1960 by Gelfand and collaborators and Maurin in connection with the spectral theory of self-adjoint operators. Its fundamental aim was to give a 'sensible' shape to Dirac's heuristic formalism of bras and kets which constitutes the core of the algebraic method. Von Neumann's Hilbert space formulation averred that it is sheer mathematical nonsense. The RHS approach provides a high degree of rigour to the Dirac's formulation. The matter—fortunately for the physicists—does not end there. The new language of RHS, it is seen in the recent times, describes quite well the exponentially decaying states termed in the text as Gamow vectors. These Gamow vectors represent physically either the quasi-stationary states or the resonances depending on the number of vectors. And the S-Matrix equivalents of these cases are the poles or pair of poles in the second sheet. The Dirac kets and the generalized eigen vectors of Hamiltonian correspond physically to the scattering states which in the S-Matrix description are cuts along the spectrum of the interaction Hamiltonian. At the very start, the authors have reproduced all the main features of Dirac formalism (for the particular case of harmonic oscillator) by using the RHS approach and, meanwhile, they managed to introduce to the readers the definitions and skeletal properties of the rigged Hilbert space. The journey, thereafter, was to apply the RHS approach in understanding somewhat rigorously the physics of scattering phenomena including the physics of resonances and the quasi-stationary states. Despite the sophisticated treatment of a very highbrow topic, the lucidity of presentation and the racy style was never sacrificed. To familiarise the high-level activists in the esoteric field of superhigh level of QM-research the authors have very deftly dealt with these new developments in an elaborate and step-by-step manner, albeit obviously with a textbook tilt.

In fact, this particular trait along has rendered the book extremely readable for even the most (interested) novices in this field and/or some related fields. The sufficiently good number of very useful appendices have provided additional support to the theorems proved and propositions made to prop them. The misprints, though unfortunately not very rare (from the first to the last page), did not, however, appear to create any communication barrier. In fact, the rich content, the very orderly presentation and the masterly treatment of the subject-matter score too highpoints to make it absolutely laudable.

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Cellular Automata and Modeling of Complex Physical Systems (Springer Proceedings in Physics, Vol 46)
(Proceedings of the Winter School, Les Houches, France, Feb 21-28, 1989)
edited by P Mannéville, N Boccara, G Y Vichniac and R Bidaux

This book is the proceedings of the Winter Scho Les Houches, held during February 21-28, 1989.

There are twenty eight papers in the book, which has about three hundred pages. Almost all the papers report just on their own studies and are not intended to review in details the background; one of the paper included gives an up-to-date (February' 89) bibliography on various lattice cellular automata.

The cellular automata models, with simple (local) update rules for the lattice-gas type variables on discrete lattices, have been very useful in the context of studies on the (nonlinear and cooperative) dynamics of many complex systems. Studies of cellular automata models of fluid flow (turbulence), viscous finguring, convection current (kinetic theory), molecular dynamics, biological networks (e.g., immunology) etc. have led to important insights and developments in recent years. Some of these important applications are discussed in various papers of the book. Discussions on the questions regarding long time behaviour (by e.g. Frenkel), information theoretical concepts (e.g. by Goles, Boccara), kinetic approach to Ising and other statistical models (e.g. by Parodi *et al*, Darñany *et al*), etc. are quite useful. The paper (by Bagnoli and Francescato) giving the architecture of the built-in parallel processing cellular automata machine (e.g. the connection machine), is a valuable one. However, the biological automata models, although discussed in the School (Evolution by Mutation-Selection discussed by Peliti and Immunology by Weisbuch), have not been included. Discussions on such models would have allowed the readers to get a glimpse of the recent advances in such biological-network models.

As mentioned before, the book is just a collection of short papers. The book is thus not suitable for a beginer. For statistical physicists, involved in studies of similar models, there will be a number of papers relevant to his/her particular topic. Even then, the papers in the book are slightly out-dated.

The book will serve as a reference one in a specialised Group-Library for Statistical Physics.

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Collected Works of Meghnad Saha, Vol. 2
edited by Santimoy Chatterjee,
Orient Longman : Calcutta, 1987
xiii + 645 pages; price : Rs 75.00 (Soft cover); ISBN 0-86131-687-8

A true scientist hates to be groomed in seclusion within ivory towers. He will be coming to brass stacks of the reality. After all, science and technology are for the sake of the mankind and hence scientific and technological results are to respond to the concerned realities. A classic example of this realistic role of a scientist was the vast expanse of the area of activities of Prof Meghnad Saha. This was one of the reasons which brought him to politics. But a politics was not politicking, factionalism and power struggle for Prof Saha. Rather intense partriotism brought him to the political arena to serve his country.

Alongside his research activity in fundamentals of physics, Prof Saha was concerned about how best and how soon to achieve economic independence in India after the colonial rule. Which is why he took a pivotal role in the National Planning Committee when Subhas Chandra Bose was the President of the Indian National Congress. In 1937, he wrote an interesting piece, 'Indian national reconstruction and the Soviet Example' in Science and Culture. He delved deep into aspects of even micro-economic planning until he had breathed his last. Similarly, his thought-provoding discourses on "Fuel in India" (published in Nature, in 1956), river Valley Plananing and natural resources are very educative and relevant even today. For the scientists, these articles and papers are invaluabale resources for meaningful pastime.

Prof Santimoy Chatterjee deserves praise for piecing together the works of Prof Saha on social sciences including planning and industrialisation. How a scientist looks at these issues is important for the planner. For the students of economics and politics, the collection is an invaluable belonging.

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Computer Simulation Methods in Theoretical Physics (2nd edn.)
by D W Heerman
Springer-Verlag : Berlin-Heidelberg-New York-London-Pans-Tokyo-Hong Kong, 1990
xi + 145 pages, 30 figures; price : DM 39.00 (Soft cover); ISBN 3-540-52210-7

Computer Simulation Methods in Theoretical Physics' provides an excellent introduction to the subject for the beginners assuming that they have good working knowledge in classical

and statistical mechanics and elementary acquintance with a programming language.

The book has four chapters of which chapters 3 and 4 may be considered to be central to the theme. Chapter 3 introduces what is known as deterministic methods of computer simulation while chapter 4 deals with stochstic computer simulation methods. A general introduction to the deterministic and stochastic simulation methods forms the basic contents of chapter 1 while chapter 2 jumps ahead somewhat and introduces the essential features and problems of simulating a Physical system on a computer. In the appendix the author presents some program listings and a useful discussion on random number generators.

The science of simulation has been undergoing phenomenal changes and rapidly expanding as well. It is impossible for any introductory book to do justice to all the aspects of such a vast field. The author makes no attempt to do that. Instead he has concentrated on presenting a coherent and structured treatement of the basic methods and has succeeded in creating what may be called computer simulation physics-self taught. The prolems at the end of each chapter will sharpen the intution of an initiated reader and the program listings added to the appendix will encourage the learner to do numerical experiments which are essential for getting the proper feeling of the subject.

The present edition is a throghly overhauled version of the first edition and the author has stressed adequately on any new point of view or development in algorithm that might have emerged since the publication of the first edition.

In fine, this is a book which every serious student of the science of simulation would love to possess.

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Problems in Mathematical Analysis (Pure and Applied Mathematics : A Series of Monographs & Text Book, Vol 132)

by P Biler and A Witkowsk

This book is a huge collection of problems in mathematical analysis which covers many classical and modern topics. It contains nine chapters viz, real and complex numbers; Sequences; Series; function of one real variable; functional equations and functions of several variables; real analysis, measure and integration; analytic functions; fourier series and lastly functional analysis. In chapters 4 and 9 there are over 200 problems whereas in other chapters nearly 150 problems are given. There are other 9 chapters containing answers

corresponding to the problems of each chapter. In these chapters hints for solving the problems are given. In some cases direct answers of the problems are also given. The problems of this book are always not very easy to solve, for this, good grasp on the topic is required. On an advanced level there are some original problems which may lead to research works. There are also new proofs of some well-known theorems.

A list of reference books is given here which covers most of the well-known books from early days to till today, and no doubt this will help the readers a lot.

This book can be strongly recommended as a reference book for any science Library.

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Collective excitations in superlattice structures -- Raman spectroscopy of vibrations in superlattices -- Spectroscopy of Free Carrier Excitations in Semiconductor Quantum Wells -- Raman studies of Fibonacci, Thue-Morse, and random superlattices -- Multichannel detection and Raman spectroscopy of surface layers and interfaces -- Brillouin scattering from metallic superlattices -- Light scattering from spin waves in thin. films and layered magnetic structures. Subject Term