BOOK REVIEWS

**Relativistic Heavy-Ion Collisions (CCAST (World Laboratory)
Symposium/Workshop Proceedings, June 1-5, 1989, Vol 7)**
edited by Rudolph C. Hwa, Chong-Shou Gao and Ming-Han Ye
Gorden and Breach Science Publishers : New York-Philadelphia--London -Paris - Montreux - Tokyo - Melbourne,
1989
xv + 316 pages, illustrated ; price : $ 90.00 (Soft cover); ISBN 2-88124-734-2

This volume contains the lectures prepared for the symposium held on June 1-5, 1989 at
Beijing, China on Relativistic Heavy-Ion Collisions as a part of the proceedings of the
China Centre of Advanced Science and Technology (CCAST). CCAST was established in
China in the year 1986 with an aim to introduce important frontier areas of science and to
promote exchange of scientific ideas between China and other nations. It is sponsored by
World Laboratory with support from Italian and China Government. The symposium was
originally planned for a duration of 2 weeks but unfortunately, due to some very serious and
tragic events at Beijing the symposium was abruptly terminated after only 2 days lectures.
Recently, the relativistic heavy ion collisions have become a major area of interest
throughout the world for both nuclear and high energy physics. Experiments done at CERN
and Brookhaven National Laboratory have produced exciting new results which play leading
role in the understanding of phase transition in quantum chromodynamics as well as in the
explanation of new developments involving quark-gluon plasmas. In this comprehensive
volume, world's three leading experimental physicists and two leading theoretical physicists
have reported current findings in their respective laboratories. Experimental studies in
nucleus-nucleus collisions carried out at the Brookhaven National Laboratory has been
reported by Nagamiya. Experimental findings with highly relativistic heavy ions carried out
at the GSI Darmstadt and at the CERN has been described by Gutbrod. Experimental studies
on vacuum states has been reported by Willis of CERN. On the theoretical side, some
important and exciting current investigations on relativistic heavy ion collisions carried out
at the theory division of CERN and Institute of Theoretical Science, University of Oregon
have been reported respectively by Jacob and Rudolph C Hwa. Due to unusual
circumstances prevailing at Beijing at that time, most of the lectures published in this book
could not be presented at the symposium. Most of the articles are written in a very lucid
manner and may be of help to the graduate students. It may also serve as an excellent
reference book on recent discoveries in this field.

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Inverse Schrödinger Scattering in Three Dimensions
(Texts and Monographs in Physics)
by R G Newton
Springer-Verlag : Berlin -Heidelberg - New York -London -Paris - Tokyo -Hong-Kong, 1989
x + 170 pages, 1 figure; price : DM 68.00 (Hard cover); ISBN 3-540-50563-6

This book is a very welcome edition on non-relativistic Inverse Scattering which gives a very rigorous account of the subject. The excessive use of abstract operator algebra has made the reading difficult at few plans, particularly for physicists who is interested in down to earth calculation of the inverse scattering problems, and that way discussion of a few specific examples for each methodology presented would have been welcome for such students of physics.

Sec. I : *On use of scattering solution :*

The discussion on Direct Scattering Problem in Chapter-1 is a short summary of his treatment of the subject in his earlier book on Scattering Theory for well-behaved locally integrable potentials.

The second chapter deals with the Inverse Problem, and its various aspects. The problem is recast into that of generalised Rieman-Hilbert problem and Wiener-Hopt factorisation problem, square-integrable solution of and generalised Marchenko equation where the system supports bound-states as well. Here the treatment has become too abstract at places to be useful for average readers of scattering theory. Some of the symbols used are not properly defined or listed at the end of book. Nevertheless. it contains all up-to-date informations on the topic.

Sec. II : *On use of regular and standing wave solutions :*

The regular solution, standing wave solution and generalised Gelfand-Lebitan are put in abstract footing, more or less translating earlier works in terms of abstract operators. More discussions on use of delta-bar technique of several complex variable would have been welcome.

Sec. III : *Use of Faddeev solution is relatively new in this field :*

This section recasts all earlier approach i.e. of Gelfand-Levitan, Marchenko etc. interms of Faddeev Green's function and then outlines the method of solutions of inverse problems. For delta-bar approach, for the first time case of a general potential of Schwartzian class is treated, and the treatment of equation is distribution theoretic. The discussion of earlier chapters for this larger class of potentials would have been welcome for a book of this type.

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Auger Spectroscopy and Electronic Structure
(Springer Series in Surface Sciences, Vol 18)
(Proceedings of the First International Workshop, Giardini Naxos-Taormina, Messina, Italy,
September 10-14, 1988)
edited by G Cubiotti, G Mondio and K Wandelt

The book contains a report on the Proceedings of the first International Workshop on Auger
Spectroscopy and Electronic Structure, held in Sicily, Italy during September 10-14, 1988.

The Auger process, since its discovery by French Scientist Auger, has been
recognised as a major probe to determine the surface elemental composition. But, recently,
the scope of Auger spectroscopy has been broadened much beyond that. It is now used to
investigate the electronic properties of the surface too. This is available from the analysis of
Auger line-shape containing valence electrons.

It is possible to investigate the electron or hole correlation effect which is very much
important in understanding many physical properties. The electron correlation energies at
both Cu and O sites have been derived in $YBa_2Cu_3O_7$, using Cu and O valence Auger
spectra in that compound both above and below the transition temperature T_c. Sometimes,
it becomes difficult to understand a complex spectra. This is evident from one of the work
where, only after considering a 2% local expansion of Cu lattice around Pd impurity sites,
it is possible to derive Pd (density of states) consistent with the results of AES
spectroscopy.

The contents of the book have been divided into five parts. After a brief introduction
on electron correlation effects, Part II deals with the theory of Auger process and electronic
structure determination. Part III has 14 papers on Auger spectra from solid and gaseous
samples. There has been much advancement on the understanding of the spectra of simple
metals and their alloys involving valence levels and now it is possible to extend this
knowledge to the more important systems having technological importance such as
structure of interfaces and of semiconducting materials. One of the most important aspects
of Auger spectroscopy is the spin polarisation analysis of the magnetically ordered solids.
A proper theoretical understanding of the above phenomena is still lacking.

In part IV, the analytical aspect of Auger electron emission has been discussed. The
role of electron backscattering in AES has been described. It is possible to determine the
inelastic mean free path from the experimental intensities of the elastic peak. A very
interesting experimental technique of EXFAS (Extended fine Auger transition) has been
described where the purpose is to obtain EXAFS like structure information without
resorting to the synchotron radiation. Further research in this area is defintely necessary. It
is not possible to review all the papers within this short space, but it is certain that this
book provides the reader with the most modern and recent applications of Auger

spectroscopy towards surface characterisation, structure determination and electronic correlations.

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Adhesion and Friction (Springer Series in Surface Science, Vol 17)
(Proceedings of the Third International Workshop on Interface Phenomena, Dalhousie
University, Halifax, N.S. Canada, August 23-27, 1988)
edited by M Grunze and H J Kreuzer
Springer-Verlag : Berlin -Heidelberg - New York -London -Paris - Tokyo -Hong-Kong, 1989
vii + 129 pages, 58 figures; price : DM 78.00 (Hard cover); ISBN 3-540-51526-7

The recent growth of surface science has caused extensive realignment of scientists of different disciplines. The title of the present volume suggests that it involves some practical issues such as adhesion, friction and lubrication. But actual articles involve a far deeper discussion on the fundamental interaction at atomic or molecular levels at interfaces between two materials. This volume contains proceedings of the third International Workshop on Interface Phenomena held at Dalhousie University, Halifax, Canada.

There are altogethers ten articles in this monograph. The articles careful blend review of existing knowledge and new results. In the first article McClelland discussed various theoretical models (e.g. Independent oscillator, Frenkel-Kontorova and numerical model of two dimensional lattice) to describe the friction between two weakly interacting, atomically flat surfaces. Woll and Vogel reviewed the structural and dynamic aspects of the crystalline properties of Langmuir-Blodgett films of fatty acids at air-water surface as studied by infrared spectroscopy, electron diffraction and near edge X-ray absorption fine spectroscopy (NEXAFS). In another article Friend discussed in considerable detail application of NEXAFS to study adsorption structure of organic molecules on $Mo(110)$. Pireaux *et al* summarised some recent application of HREELS (High resolution electron energy loss spectroscopy) to study the interface between vaporised aluminium deposited on certain polymers. The reverse process, namely vapour deposition of polymers on selected metal substrates is discussed by Lamb *et al* . In two separate articles Lyman and Seiberling and Tomberllo reviewed the effect of Mev-ion irradiation on the adhesion of thin film to a substrate. Mavroyannis discussed a microscopic theory on the calculation of line shapes of neutral rare gas atoms physisorbed on metal surfaces using a simple model hamiltonian. Vidal and Karimi presented two theoretical methods to model the interaction of large atomic molecules with rare gas atoms and with basal plane of graphite.

As the topics indicate, the small volume addresses a number of basic issues on interfacial interactions. The volume is well-balanced with respect to theory and experiment.

A wide range of audience will find this volume extremely useful and stimulating. For this reason, this book is very enthusiastically recommended to any physics, chemistry and engineering library.

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Dynamics and Stochastic Processes : Theory and Applications (Lecture Notes in Physics, Vol 355)
(Proceedings of a workshop, Lisbon, Protugal, October 24-29, 1988)
edited by R Lima, L Streit and R Vilela Mendes
Springer-Verlag : Berlin -Heidelberg - New York -London -Paris - Tokyo -Hong-Kong, 1990
v + 289 pages, price : DM 65.00 (Hard cover); ISBN 3-540-52347-2

The present Springer proceedings under review presents nineteen articles on the interface between the mathematical aspects of deterministic and stochastic dynamics of some complex nonlinear phenomena. The book starts with a lecture on the study of stochastic perturbation of classical finite-dimensional hamiltonian systems and some related quantization problems, followed by two articles on neural networks. These are addressed to the problems related to the dynamics of stochastic and deterministic networks with an emphasis on the viability of their computational capabilities and secondly related to learning processes mainly introducing two most widely used learning procedures, "Error back-propagation" and "Boltzman Machine Learning". Some general results based on a mathematical model using the concept of random graphs illustrate the propagation of human-immuno deficiency virus infection. Two articles have been devoted to the study of chaos in chemically reacting systems dealing with chemical bistability, periodic, quasiperiodoc and chaotic ocillations and Rayleigh-Benard instability in thermal convection in fluid mechanics. Chaotic dynamics has also been studied in mechanical problems such as vibro-transportation, in rattling vibrations in gearboxes, in Tokamaks and in accelerator physics. The discussions on some special aspects of chaos like controlling of chaos through parametric perturbation, disentangling between random noise and two dimensional deterministic chaos and the application of random perturbation to simulated annealing are also interesting. The white noise problem in some special problems of mathematical physics has been discussed in two articles.

Although subject-matter covered presents a broad spectrum, most of these articles are too short as lecture notes. A section-wise division could have been helpful for the reader. Nevertheless, the collection can be a good addition to a mathematical physics library.

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Whither Turbulence at the Cross-roads (Lecture Notes in Physics, Vol 357)
(Proceedings of a Workshop held at Carnelb University, Ithaca, New York, March 22-24,
1989)
edited by J L Lumley
Springer-Verlag : Berlin -Heidelberg - New York -London -Paris - Tokyo -Hong-Kong, 1990
iv + 535 pages, price : DM 102.00 (Hard cover); ISBN 3-540-52535-1

The avowed objective of the conference was "to provide the monitors of research (who
control the funding of research projects) with amunition to reach more informed decisions
about financial support". There seems to be a general feeling that there are instances of
wrong decision, biased judgement and even subtle pressures on the choice of topics ("We
will fund no more work in the direction A; hence forward we will fund only work in
direction B").

The academic activity was organised under six heads in six sessions : (1) The utility
and drawbacks of traditional approaches, R. Narasimha; (2) Future directions in turbulence
research and the role organised motion, B. Cantwell; (3) Can dynamical systems approach
turbulence ? P. Holmes; (4) The potential and limitations of direct and large eddy
simulations, W. C. Reynolds; (5) What can we hope from cellular automata ? G. Doolen;
(6) Phenomenological modelling : present and future ? B. E. Launder.

Each opening lecture is a competent review of the current state-of-art in the area
followed by comments by well-informed participants and illuminating discussion. The
problem of turbulence has been examined from a variety of angles and the book provides a
rich and stimulating intellectual feast to the reader. Much has been achieved since 1883 (the
year of birth of our subject), but very much more remains to be done.

The book abounds with serious discussion of mathematical theories, empirical
approach and experimental work, but there are lighter moments also : Achilles and Tortoise
(and the Hare) discuss CFD (Chaotic Fluid Dynamics) and turbulent flow", and even
quotations from poetry :

(a)   'This may be a Theory of Everything :

    I hope it is at least a theory of something'

(b)   Between the idea

·   And the reality ......
    Falls the shadow

    T. S. Eliot

The book is highly recommended to connoiseurs of fluid dynamics and research
workers in Turbulence.

I shall end by giving a persian quotation :

'Hanoz dilli door ust' (Delhi is still far away);

complete understanding of turbulence is still a far cry.

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Geometry and Robotics (Lecture Notes in Computer Science, Vol 391)
(Workshop Proceedings, Toulouse, France, May 1988)
edited by J D Boissonnat and J P Laumond
Springer-Verlag : Berlin -Heidelberg - New York -London -Paris - Tokyo -Hong-Kong, 1989
413 pages, ISBN 3-540-51683-2

During the last few years, robotics, whose earlier history in the fields of mechanical engineering and artificial intelligence, has come to attract the attention of mathematicians and theoretical computer scientists in rapidly increasing degree. Initial investigations have shown that robotics is a rich source of deep theoretical problems, which range over computational geometry, control theory, and many aspects of physics, and whose solutions draw upon methods developed in subjects as diverse as automata theory, algebraic topology, Fourier analysis.

Thus robotics is a highly interdisciplinary field including kinematics, dynamics, planning systems, control, sensing, programming languages and machine intelligence. It is, however, not an over-simplification to state that the problems in robotics is largely geometric rather than anything else. This become apparent when we view robot as a machine in the Euclidean space. The primary tasks of a robot are :

1.   To sense the objects around it and understand them, primarily in terms of their shapes and positions in space.
2.   To navigate through the obstacles to the desired location in space.
3.   To manipulate objects as directed.

In each of these takes, geometry occupy a principal role. At a more fundamental level, some of the problems in geometry that need to be solved in order to solve the robotics problems may be briefly mentioned :

1.   Intersection problems among geometric objects in the 2D and 3D spaces.
2.   Transformation of geometric objects from ordinary 2D and 3D spaces to a configuration space, and vice versa.
3.   Modeling geometric description of the shapes of objects. More precisely, it is the representation of the object.   .
4.   Extraction of 3D geometric information from various 2D descriptions.
5.   Understanding motion of 2D and 3D objects in space.

The papers in this volume addressed some of the above problems. The results of the papers are indeed interesting from the viewpoint of the computational complexity of algorithms as well mathematics. The papers in this volume can be classified broadly into two categories: algorithms for motion planning and applications of mathematics in computer vision.

The papers on algorithms for motion planning deal with the movement of robot under various constrains in the 2D and 3D spaces. Some of these algorithms are approximate and heuristic in nature, which could be used in solving large scale problems. In general, these algorithms are both theoretical and practical interests for robotics community.

Some papers here demonstrated that known results from Algebraic topology, Projective Geometry, Algebraic geometry and Grassmann geometry can be used in understanding computer vision. Moreover, it has been shown that the known results of these areas of mathematics have also natural applications in computer vision. These papers can be considered as a novel attempt to formalize the problems of robotics in the mathematical framework. There is a general feeling that mathematical tools in these areas will eventually lead to designing algorithms for large number of problems in robotics and these papers have contributed in a positive way in that direction.

The book covers several important areas of robotics and contains many interesting results. This book is extremely useful for the researchers in robotics and suggests several new issues for further research.

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