

Books on Physics and astronomy to be published by Mir in 1991

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The 1991 publishing plan includes books that basically belong to four subject fields—fundamental problems of physics, computers and physics, optics, optoelectronics and solid-state electronics.

The book *Principles of String Theory* by L. Brink and M. Henneau deals essentially with all the basic ideas of string theory that have appeared up to the present. The presentation is characterized by an adequate degree of detail needed for the study of the subject by the readers who do not have even the preliminary ideas of string theory, but who have some preparation in the area of modern quantum field theory including supersymmetry. The book is provided with a detailed bibliography which makes it easier for the reader to penetrate into the subject further along the directions of interest to him. The first part of the book presents the history and the evolution of the concepts of strings in quantum theory of elementary particles, describes the theory of boson strings and spin strings, the basic ideas of superstrings, and discusses the variants of superstring theory, including the elements of the theory of representations, and introduces the concept of heterotic strings. The first part of the book concludes by examining the quantum theory of interacting strings, the problem of anomalies and a list of the basic problems awaiting solution. The second part presents in detail the classical Nambu–Goto string theory, the methods of quantizing the Nambu–Goto strings, and examines in great detail the classical and quantum theory of fermion strings, and presents the theory of superstrings.

The book *L'ordre dans le chaos. Vers une approche déterministe de la turbulence* by the French authors P. Berge, Y. Pomeau, and C. Vidal is an introduction to the field of investigations that is called synergetics. The authors have succeeded in providing in a lively, informal, and a very accessible form a clear presentation of modern concepts concerning the physics of turbulence and cooperative processes which are being intensively studied by specialists in the field of aero- and gas-dynamics, plasma physics, optics, chemical kinetics, and biology. The book can serve as a textbook.

The new book by H. Haken *Information and Self-organization. A Macroscopic Approach to Complex Systems* attempts to develop an original approach to the description of complex macroscopic systems which is based on bringing out the informational aspects in the phenomena of structural self-organization using systems and processes taken from physics, chemistry, biology, economics, and psychology. The material is presented in 14 chapters. The first, introductory, chapter acquaints the reader with the concept of a complex system, with the basic principles of modeling, with the processes of self-organization, with definitions of order, disorder, stability, informational efficiency, etc. Chapter 2 presents the usual scheme of constructing synergetics. Chapter 3 which in a conceptual sense is a direct continuation of the

preceding chapter formulates a kind of an inverse problem: to bring out and to provide an algorithm for the procedure of reconstructing the probability of the distribution of macroscopic or even microscopic variables for given macrodata concerning the system. In Ch. 4 the general principles discussed previously are illustrated using the example of thermodynamics. In Chs. 5 and 6 the principle of maximum information entropy is applied to systems with self-organization. The subject of Ch. 7 is information, its growth or dissipation, and some other characteristics of self-organizing systems close to stability. Chapter 8 discusses the technique of calculating the Lagrange multipliers, appearing in the expression for the distribution function and obtained in the neighborhood of a critical point. Chapter 9 examines the problem of modeling stochastic processes, and of reconstructing the correlation function. Chapter 10 contains a description of applications to more complicated physical systems, while in Ch. 11 the transition is made to biological systems. Chapter 12 is devoted to the new direction in synergetics developed by H. Haken in recent years—an original approach to the problem of pattern recognition. The contents of Ch. 13 are associated with quantum systems. It is shown how the principle of maximum information entropy must be modified in quantum mechanics. In the concluding Ch. 14 a résumé is given of the basic results and the degree of generality of the principle of maximum information entropy is interpreted practically.

The book *Schwache Wechselwirkung in der Kernphysik, Teilchen und Astrophysik* By K. Grotz and H. Klapdor is one of the first in the world monographs which presents in a unified manner the entire set of problems associated with weak interaction. The book successfully combines presentation of material both of a general and a specialized nature. In so doing the sections, in which the basic concepts of general theory of interactions, gauge fields, electroweak theory and the Grand Unification Theory are presented in a quite popular manner, alternate with specialized sections devoted to beta-decay theory, the effect of the structure of a specific nucleus on the beta-decay of a nucleon, the theory of double beta-decay and the problem of suppression of nuclear beta-transitions. A special section is devoted to neutrino physics. Considerable amount of attention is devoted to astronomical aspects of weak interactions. The material is presented in 9 chapters: a review of elementary particles and interactions; the classical theory of weak interactions, nuclear beta-decay, structure of the nucleus and beta-decay; the gauge principles; the theory of electroweak interactions due to Glashow–Weinberg–Salam; weak interaction within the framework of the Grand Unification Theory neutrinos, weak interaction and astrophysics; cosmological problems.

The subject of computers is represented by two books.

The book by S. Koonin *Computational Physics* is a text-

book on computer simulation of physical systems. The mathematical methods of simulation are presented with the aid of simple mathematical illustrations. Then it is proposed that the reader should, using the methods presented, examine 8 projects containing significant problems of classical, quantum and statistical mechanics. Almost one third of the book is occupied by completely documented programs written in basic. The material is presented in 8 chapters: principal mathematical operations; ordinary differential equations; boundary conditions and eigenvalue problems; special functions and Gaussian quadrature; matrix operations, elliptical equations in partial derivatives; parabolic equations in partial derivatives; Monte Carlo methods.

Programs of mathematical illustrations and solutions of physics problems are given in appendices.

The book *Computers in Physics* is a collection of articles from a new journal published by the American Physical Society *Computers in Physics*, which began publication starting in November 1987, with 6 issues per year. The journal publishes articles on all aspects of using computers in physics, and also on a number of aspects of information theory and computer technique. The present collection of articles contains primarily articles on computer technology of teaching physics to students in American universities and colleges, the methodology of instruction and its software. Also one article on the same subject is taken from *Physics Today*.

On the subject of optics and optoelectronics one should note first of all the book *Guided-Wave Optoelectronics* edited by T. Tamir which reflects the present state and the lines of future development of integrated devices which combine in one crystal electronic and optical components. The book successfully combines a presentation of experimental material and a clear physical treatment of the phenomena being observed. The material is presented in 6 chapters: introduction, theory of optical waveguides, waveguide transitions and junctions, waveguide devices, semiconductor lasers, integrated semiconductor devices. The book includes a detailed subject index and an extensive bibliography.

The collective monograph *Optical Fiber Sensors. Principles and Components* edited by J. Dakin and B. Culshaw summarizes the present-day world level of development of theoretical, technological and experimental work in the field of optoelectronics and fiber optics. Among the participants are authors from Great Britain, West Germany, France, USA, and South Korea each of whom is a well-known specialist in the field of optoelectronics and fiber optics. The material is presented in 9 chapters: introduction, sensor systems and fiber optics; fundamentals of optic-fiber sensors; fundamentals of optics; optical detectors and receivers; optical sources; materials and interactions in optic-fiber sensors; optic-fiber components; optic fibers for sensors; integrated optics for sensors.

In the collective monograph *Image Recovery. Theory and Application* edited by H. Stark prominent specialists from the USA and England present at a modern level the principal approaches and the newest results obtained in the field of recovery of signals of different kinds based on incomplete or distorted data. Particular attention is devoted to promising nonlinear methods. The material is presented in 13 chapters. The first two chapters of the book give a consistent presentation of the modern mathematical apparatus which serves as the foundation of the entire theory of image

recovery, if one considers the problem from a general point of view. The three following chapters are devoted to more concrete approaches in solving two-dimensional problems of restoring and reconstructing images. Chapters 6–8 analyze the methods of recovering amplitude and phase information concerning objects. The material presented in Chs. 9–11 essentially continues the presentation and tomographic subject matter which was already started in Ch. 3 within the framework of the probabilistic-statistical approach. Chapter 12—“Image synthesis: discovery instead of reconstruction” stands somewhat apart and contains a quite original mathematical apparatus for describing the resolving power for devices for which finds applications in photography, tomography and spectroscopy. The last Ch. 13 chapter of the book is devoted to an investigation of the role played by analyticity in the problem of image recovery.

Extensive material having many important applications is presented in the book *The Physics of Medical Imaging* edited by S. Webb. It is written by a group of leading investigators of the joint physics department of the Institute of Oncological Research and the Royal Marsden Hospital (Great Britain). Essentially the book is an encyclopedia of modern methods of obtaining images in medicine. The material is presented in 15 chapters. The introductory part of the book (Introduction and Ch. 1) provides a detailed formulation of the problem of obtaining medical images, presents a retrospective analysis of the more significant stages in the development of this field. The first six chapters are a description of the existing methods of obtaining images with the aid of ionizing radiation (x rays, radioisotopes), including x-ray tomography (Ch. 4), and also their analysis and quality control of the apparatus being used. Chapters 7–9 discuss ultrasound diagnostics; Ch. 8 discusses spatially localized NMR images, Ch. 9 deals with the physical aspects of infrared imaging. Chapter 10 is devoted to a presentation of two-dimensional echocardiography, while Ch. 11 presents the nontraditional diaphonographic method of imaging (obtaining images of organs by transmitted near IR radiation). Chapter 12 analyzes mathematical methods of obtaining, processing and improving images, Ch. 13 examines properties of the eye as a visual analyzer of images, the special features of perception by the brain of moving images and other similar problems. Since the majority of modern systems of obtaining medical images incorporate a computer, Ch. 14 is devoted to an analysis of requirements on computers included in these systems. In conclusion (Ch. 15) the book summarizes the results of examining all the methods of obtaining images in medicine, compares them and from a unified point of view discusses the problem of the safety of using such apparatus for imaging.

Of great interest is the collective monograph *Time-Resolved Spectroscopy* edited by R. Clark and R. Hester. The production of light sources tuneable over the spectrum with pulse duration in the pico- and femtosecond ranges combined with a number of new highly efficient methods of nonlinear laser spectroscopy have made it possible to obtain in optical spectroscopy the natural fast-action limit due to the period of a light wave. This book by authors from the USA, Canada and other countries presents for the first time in world literature a discussion in the form of a collective monograph of principles, a description of techniques and an examination of the principal results obtained to date in the

new branch of spectroscopy based on the most recent developments in laser physics and technology. The material is presented in 9 sections: picosecond spectroscopy of time dependent thermal phase lattices; a study of nonradiative energy relaxation; resonance Raman and hyper-Raman scattering by rotational levels; investigation of picosecond dynamics; investigation of subpicosecond vibrational dephasing by the method of coherent Raman scattering and librational relaxation by the method of degenerate four-wave mixing using noncoherent radiation; time-resolved spectroscopy of resonance Raman scattering; intermediate products of chemical reactions in solution; time-resolved Fourier spectroscopy; picosecond spectroscopy of coherent Raman scattering by excited electrons states of polyatomic molecules in solution; vibrational spectroscopy of nonstationary states in photosynthesizing bacterial reaction centers; picosecond and subpicosecond vibrational spectroscopy of hemoproteins; new achievements of femtosecond spectroscopy.

The book *Principles of Electron Optics. Vols. 1,2* by R. W. Hawkes and E. Kasper is a comprehensive presentation of the principles of optics of charged particles. It is in two volumes and includes the bases of classical mechanics, the methods of calculating electrostatic and magnetic fields, an examination of axisymmetric lenses and deflecting fields, and also the fundamentals in designing guns and systems with a curvilinear axis. It presents the modern methods of electron-optical calculations on a computer. It can serve as a textbook, and also as an encyclopedic handbook. The material in the book is divided into 10 parts and includes 53 chapters. The first volume consists of 6 parts (34 chapters): classical mechanics; calculation of static fields; paraxial approximations; aberrations; deflecting systems; computer methods in electron optics. The second volume includes 4 parts: instrumental optics; correction of aberrations and distribution of beam intensity; electron guns; systems with a curvilinear optical axis. The book has a detailed subject index and an extensive bibliography.

The collective monograph on solid-state electronics *Amorphous Silicon and Related Materials* edited by H. Fritzsche should also be noted. The book is a collection of reviews which present modern concepts concerning the majority of processes observed in amorphous hydrated silicon and in compounds based on it. The book examines structural inhomogeneities in hydrated amorphous high quality semiconductors intended for use in devices; micropores in a-Si:H; thermodynamic and kinetic properties of amorphous silicon obtained by ion implantation; effects associated with the establishment of thermodynamic equilibrium in doped hydrated amorphous silicon; the model of a hydrogen glass; kinetics of metastable defects formed by charge carriers in hydrated amorphous silicon, the energy and density of states in the mobility gap; determination of the characteristics of surface and bulk states with the aid of photothermal deflecting spectroscopy; microscopic structure of defects in a-Si:H and its analogs; metastable defects in hydrated amorphous silicon produced by irradiation with electrons; transport and the state of tails in amorphous silicon; recombination in a-Si:H; temperature and field quenching of luminescence; photoluminescence in films and multilayer structures of a-Si:H; drift mobilities in states far from thermodynamic equilibrium; picosecond optical investigations of electron trans-

port in amorphous multilayer structures; determination of the ambipolar diffusion length by the method of photocarrier lattice; photoluminescence in amorphous silicon-germanium alloys; the application of differential absorption spectroscopy to quantum wells based on amorphous silicon; the growth and structure of separation boundaries in multilayer structures and heterojunctions a-Si:H/a-SiO_x:H and a-Si:H/a-SiN_x:H; investigation of the structure of amorphous layers with the aid of Raman scattering; change of the acoustic phonon bands in amorphous superlattices.

The monograph *The Physics and Applications of Amorphous Semiconductors* by O. Madan and M. Shaw is devoted to a discussion of the physical phenomena and physical principles underlying practical applications of amorphous semiconductors. The first half of the book is devoted to amorphous silicon and compounds based on it that play an important role in semiconductor power engineering and electronics. The second half of the book is essentially devoted to questions associated with the properties of chalcogenide glass-like semiconductors and their applications. The presentation is not overburdened with mathematics and is quite accessible not only for specialists but also to those who would like to become acquainted with the main concepts and applied aspects of the physics of disordered semiconductors. The material is presented in 7 chapters: introduction; optoelectronic properties of amorphous materials based on silicon; optoelectronic applications of amorphous materials based on silicon; characteristics and properties of amorphous chalcogenide compounds; electrical switching and memory devices using films of amorphous chalcogenide compounds; electrophotography; optical memory.

The monograph *Semiconductors and Semimetals* edited by J. K. Furdyna and J. Kossut is the first monograph in the world literature in which modern aspects of the physics of semimagnetic semiconductors (SMSC) are presented in detail and systematically. The greater part of the factual material quoted in the book has been previously published only in scientific periodicals. The book consists of 11 chapters. Chapter 1 examines the crystal structure of the most widely occurring triple SMSC. Chapter 2 is devoted to the band structure and optical properties of wide-band SMSC in zero magnetic field, while the third chapter is devoted to the magnetic properties of SMSC based on the magnetic Mn ion. Chapter 4 presents a study of the magnetic structure and dynamics of SMSC with the aid of slow neutron scattering. Chapter 5 discusses the band structure and the transport phenomena in SMSC with a narrow forbidden band. Chapter 6 is devoted to the magneto-optics of SMSC with a narrow forbidden band, while Ch. 7 deals with a wide forbidden band. The problem of shallow acceptors in SMSC is discussed in Ch. 8. Chapter 9 examines Raman scattering in SMSC. Chapter 10 presents the theory of bound magnetic polarons in SMSC. The last chapter of the monograph concludes by formulating the directions of future investigations and lists unsolved problems in SMSC. They include the study of the spin dynamics, free polarons, polarons in spin-glass regime, etc.

The Mir publishing house has in recent years devoted much attention to the physics of thin films. The plan for 1991 envisages the translation of the book *Analytical Techniques for Thin Films* edited by K. Tu and R. Rosenberg. The book contains extensive experimental and theoretical material in

the area of modern diagnostics of thin films and submicron structures based on them associated with achievements in the field of using synchrotron radiation, soft x rays, x-ray diffraction and analysis, high resolution transmission electron microscopy, including also scanning transmission microscopy. The material is presented in 4 parts: submicron structure and analysis; photon-probe and x-ray methodologies; electron-probe methodologies; ion-probe methodologies.

E. Schoell's monograph *Nonequilibrium Phase Transitions in Semiconductors. Self-Organization Induced by Generation and Recombination Processes*, is devoted to a new direction of research in semiconductor physics. The material is presented in 6 chapters: introduction (devoted to a general survey of instabilities in semiconductors, and to equilibrium and nonequilibrium phase transitions); bistability of homogeneous stable states; small fluctuations from the homogeneous stable state; steady-state transverse spatial structures; stability of transverse spatial structures; self-sustaining oscillations and chaos.

The book *Lectures on the Electrical Properties of Materials* by L. Solyman and D. Walsh is a carefully edited text of lectures on the physical bases of solid-state electronics, which are given in the engineering department of Oxford University (translated from the 4th edition). A special feature of the book is the clearly expressed applied tendency combined with a sufficiently rigorous presentation of the fundamental scientific propositions referring to practically all modern areas in electronics. Within the framework of a unified approach a methodically thought-out presentation is given both of the principles underlying construction of semiconductor devices, and of the fundamentals of acoustoelectronics, quantum electronics, and optoelectronics, and of questions of applying magnetic phenomena in superconductivity

(including high-temperature superconductivity). The book can be used as a textbook. The material is presented in 14 chapters: the electron as a particle; the electron as a wave; the electron as such; the hydrogen atom and the periodic table of the elements; types of couplings; the theory of a free electron in a metal; the band theory of the solid state; semiconductors; the fundamentals of the theory of semiconductor devices; dielectric materials; magnetic materials; lasers; optoelectronics; superconductivity.

The book *Bioelectricity. A Quantitative Approach* by the American scientists R. Plonsey and R. Barr gives for the first time a sufficiently complete and well-organized presentation of the foundations of electrophysiology on the basis of modern biophysical concepts concerning the origin of the bioelectric field at the level of a cell membrane, a live cell, a stimulated tissue, an organ and the organism as a whole. It represents a unique handbook on bioelectric phenomena, written on the basis of the most modern biophysical concepts concerning methods of mathematical modeling of biological objects. The material is presented in 12 chapters: vector analysis; electrical sources and fields; introduction to the biophysics of membranes; action potential; propagation of excitations; subthreshold stimulation; extracellular fields; biophysics of membranes; electrophysiology of the heart; neuro-muscular juncture; skeletal muscle; functional neuro-muscular stimulation.

The book by N. Nikolov and V. Kharalempiev *Zvezdoobroistsite na drevnostata (Astrologers of Antiquity)* is intended for the widest circle of readers. The book presents the history of the birth of astronomy among ancient peoples and its development to the middle of the XVI century. The book is written in simple language without using specialized astronomical terminology. The material is presented in a free informal manner.