Books on physics being published by Mir in 1988

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The publication plan for literature in physics for 1988 includes original monographs, collections of articles, textbooks and books for wide circles of readers on the most important fields of physics. Particular attention is devoted to books on the fundamental problems of physics which already at the present time exert direct influence on scientific-technological progress.

Research in the course of the 1970s of the phenomenon of optical bistability opened up the possibility of creating on its base of new in principle, entirely optical systems of processing information utilizing discrete logic. Designs are available for constructing in the nearest future operating systems for information processing. The book of the well-known American specialist H. M. Gibbs "Optical Bistability: Controlling Light with Light" (reviewed in the January 1987 issue of Uspekhi) is the first and so far the only monograph in world literature on the problem of the phenomenon of optical bistability and its applications. The monograph is characterized by the simple and at the same time well-structured presentation of the material, the completeness of the presentation of the problem and the extensive bibliography (approximately 1500 references). The book contains 7 chapters. The first chapter is of an introductory nature. It gives a definition of bistability, discusses the types of optical bistability, and the logic based on optical bistable devices. Optical bistability in lasers is discussed. Chapter 2 contains a detailed examination of steady state models of optical bistability. Their theory is presented, and an analysis is given of the conditions for realizing optical bistability, of the methods of its description and of the solution of a number of problems arising in this connection, etc. The third chapter is devoted to experimental research on optical bistability, a description is given both of the materials and of the devices with the aid of which optical bistability is realized. At the end of the chapter some proposals concerning further development of work on optical bistability are discussed. Chapter 4 discusses experiments on hybrid optical bistability, and Chapter 5 examines optical switches and methods of controlling light by light. Chapter 6 is devoted to the analysis of instabilities and transition processes. It concludes by examining fluctuations and noise. In the concluding chapter 7 problems are stated concerning the utilization of bistability for constructing various devices. This chapter and the book as a whole is concluded by a discussion of the possibility of constructing an optical computer. The book is of equal interest to specialists of different levels—both those beginning to study optical bistability and those reseaching this problem.

Statistical optics at the present time has transformed from a branch of modern optics into an independent object of research. J. Goodman's book "Statistical Optics" is an instructional monograph which examines both the general theory of random quantities and random processes and the fundamental problems of statistical objects—the theory of polarization and of coherence of the first and higher orders, the influence of partial coherence and inhomogeneity of media on forming images, the theory of photoelectric detecting of optical signals and other problems. The material is presented with considerable methodological mastery in a form convenient for utilization by wide circles of optics specialists, radio physicists and specialists working in the field of quantum electronics, holography and information processing, and also by students of upper years and graduate students of corresponding specializations.

In the book of H. A. Haus "Waves and Fields in Optoelectronics" a consistent presentation is given of the foundations of fiber, integrated and nonlinear optics utilizing the most modern mathematical methods of analyzing the propagation of light. A number of the problems presented in the book have been dealt with until now only in journal articles. The book is clear and concise, and contains quite a few numerical examples which enable the reader to visualize clearly the order of magnitude of the quantities in the phenomena being examined. The book consists of 14 chapters. It begins with an analysis of Maxwell's equations followed by an analysis of the problems of transmission and reflection of electromagnetic waves at an interface of two media. The formalism of the scattering matrix is described, which subsequently is applied to the examination of partially transmitting mirrors; Fresnel and Fraunhofer diffraction is described within the framework of an integral approach. The general properties of transformation of Gaussian beams in an arbitrary optical system and the propagation of waves in dielectric waveguides are analyzed in detail, and nonlinear optical systems are described and the formalism of coupled modes with its concrete applications is presented. An analysis of the propagation of waves in isotropic media needed for optoelectronics is given, and the operation of modulators based on the electrooptical effect is presented and the general theory of nonlinear phenomena is introduced. The presentation is directed primarily to specialists in the field of integrated, fiber and nonlinear optics, and also to students and graduate students of the corresponding specialties.

An originally structured course on the kinetics of modern laser systems is described in the book of H. Haken "Light 2: Laser Light Dynamics." Although the book is intended primarily for students of higher educational institutions and for graduate students, specialists working in the field of quantum electronics and spectroscopy will also find much that is new and useful in the book. Along with the traditional problems an analysis is given of a number of the newest problems in laser optics (optical bistability, two-photon laser, stability of the regime of generation of ultra short pulses, etc.), that have an important technological significance, with which until the appearance of this book the reader es-

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sentially could familiarize himself only by consulting journal articles and texts of conference reports. The book consists of 13 chapters. In the first two introductory chapters the main principles of operation of masers and lasers are described. The subject of Chapter 3 is laser resonators. In Chapter 4 a description is given of a simple photon model of a single mode laser, of relaxation of oscillation, of Q-switching, the process of "burning holes" in a line contour is analyzed, the problems of mode competition are investigated in parallel. In Chapters 5 and 6 the semi-classical theory of lasers and its applications are presented. Chapter 7 is devoted to the theory of forming ultrashort pulses. The main portion of Chapter 8 is devoted to the problem of randomization of characteristics of laser radiation. Chapter 9 examines optical bistability, while Chapters 10 and 11 contain a presentation of the quantum theory of lasers. Chapter 12 describes an approach to the theory of a two-photon laser. The concluding Chapter 13 is devoted to the quantum interpretation, being developed by the author, of lasers as typical objects of synergetics.

Solid state physics continue to be a most important base for scientific-technological progress, and, as usual, much attention is devoted to it in the publications plan. In the collective monograph "Molecular-Beam Epitaxy and Heterostructures" edited by L. L. Chang, and K. Ploog and written by leading foreign scientists a systematic presentation is given of the physical and technological aspects of the problem of controlling electronic processes and crystal structure of various semiconductor materials by means of creating hetero- structures (among them quantum ones) by the method of molecular beam epitaxy (MBE)—a precision method of growing films whose thickness is controlled with an accuracy of up to a single atomic layer. The book consists of 18 chapters. The first chapter is introductory, in Chapters 2–5 the basic principles of the MBE process are presented, Chapters 6–9 are devoted to a presentation of specific methods of producing various heterostructures by the MBE method, while Chapters 12–15 examine electronic properties of heterostructures. Chapters 16 and 17 contain a presentation of the most important results on the realization of devices with heterojunctions which at present appear to be the most important ones for the solution of many practical problems—construction of heterolasers, photoreceivers and ultrafast-acting field transistors. The last chapter descibes a method of growing heterostructures by the method of decomposition of metalloorganic compounds which can compete with MBE.

The second issue (issue 1—Mir, M., 1987) of the collective monograph "The Physics of Hydrogenated Amorphous Silicon II. Electron and Vibrational Properties" edited by J. Jounopoulos and G. Lucovsky is devoted to the most recent investigations of the electronic properties of amorphous hydrogenated silicon. At the present time this monograph is the only one available in world literature as a comprehensive compilation of the entire material accumulated in this field of physics of disordered semiconductors. The book contains 6 chapters written by well-known scientists working in the field of physics of amorphous silicon. The first chapter is devoted to calculations of electronic structure of amorphous hydrogenated silicon and contains a discussion of the special features of applying standard methods of calculating band structure to amorphous materials, and a description of structure models. The second chapter examines the external photo effect and the optical properties of amorphous hydrogenated silicon. Transport processes are discussed in the third chapter on the basis of modern concepts concerning localization and the mobility threshold. The fourth chapter presents methods of spectroscopy of localized states. It also presents some results on the measurement of density of states by these methods. The methods of spectroscopy of localized states based on measuring the time dependence of transient currents in the regime of dispersion transport form the content of the fifth chapter. The last sixth chapter contains a detailed discussion of vibrational spectra of unalloyed amorphous silicon, hydrogenated amorphous silicon and other binary and ternary alloys based on silicon. Problems presented in the book are of great interest for scientists and other specialists involved in the physics of disordered semiconductors and its applications.

The book of J. S. Blakemore "Solid State Physics" is a textbook which is very popular abroad. It was published in 1985 in a third considerably extended edition (the first two editions were in 1969 and 1974). The book exhibits considerable pedagogical and methodological mastery, has a clear structure and is characterized by the completeness of its treatment of material which is presented at great length, but understandably and clearly. This is to a large extent aided by the widespread use of reference tables, of illustrations very modern in content, and by very clear graphs and diagrams. Many photographs and x-ray photographs are reproduced in the book. The material is presented in five chapters: Crystalline nature of and order in solids; lattice dynamics; electrons in metals; semiconductors; dielectric and magnetic properties of solids. Each chapter of the book is provided with problems. On the whole the book contains a large amount of illustrative and reference material on solid state physics.

In recent years a tendency has been observed throughout the whole world towards expanding research on ice utilizing modern methods borrowed from solid state phyics, quantum chemistry, etc. The book by N. Maeno "The Science of Ice" in its level of presentation and the breadth of encompassing the problem has no analogs in modern scientific literature. In it in a very accessible form a broad range of modern knowledge of the physics, chemistry and mechancs of ice is presented. In the first and second chapters the role of ice and snow in the cycle of water in nature, in the transport of solar energy and the formation of the climate of the earth and of climatic epochs, the role of ice and snow in man's life activity are described. The third and fourth chapters are devoted to a description of the atomic structure of ordinary hexagonal ice and its physical properties—electrical, optical, elastic and plastic. The fifth chapter relates the unusual properties of the surface of ice—its "quasiliquid" structure, which determines the high electrical conductivity along the surface, sliding along ice and the miracle of ice—its "regelation," i.e., the disappearance of a trace after being cut. The unusual properties of the surface of ice also determine the process of "caking" of snow into an ice mass and, consequently, the formation of glaciers. The sixth chapter provides information on the structure and physical properties of numerous forms of ice that exist at high pressures, and also on cellular ice—clusters. The concluding seventh chapter is

devoted to the discovery of huge masses of ice in the universe made in recent years with the aid of automatic space instruments. The book is intended for a wide circle of readers who are interested in the present day status of knowledge on the physics, chemistry and mechanics of ice.

The collective monograph "Strong and Ultrastrong Magnetic Fields and their Applications" edited by F. Herlach is devoted to the problems of generation of strong and ultrastrong magnetic fields and the use of these fields in investigations in the fields of solid state physics, magnetism, biomolecules and polymers, and plasma physics. The introductory chapter provides information on magnet laboratories working in the field of strong magnetic fields and their experimental possibilities. The chapter "Quantum Transport Phenomena in Strong Magnetic Fields" is devoted to problems such as the Shubnikov–de Haas effect, cyclotron resonance and thermonuclear effects in three- and two-dimensional systems, and the quantum Hall effect. The chapter "Magnetism in a Strong Magnetic Field" presents research on magnetic properties of different objects in strong pulsed magnetic fields, and also the experimental technique for investigating magnetic resonance in the far IR domain, the Faraday effect and optical spectroscopy. The chapter "Biomolecules and Polymers in Strong Constant Magnetic Fields" reflects the latest achievements in the field of studying the behavior of synthetic and biological macromolecules and more complicated biological particles in dilute solutions and in the liquid-crystallline state in strong magnetic fields. In the chapter "Confinement of Thermonuclear Plasma in a Strong Magnetic Field" a detailed discussion is given of the technical problems of producing high-current magnets of large dimensions and of special geometry. The book concludes with a review of the methods of obtaining and of experimental research in fields above 20 T.

T. Moriya's monograph "Spin Fluctuations in Itinerant Electron Magnetism" presents the theory of spin fluctuations within the framework of which satisfactory descriptions have been obtained not only of the ground state of metallic ferromagnetic substances, but also of different thermodynamic characteristics of magnetic substances at high temperatures, including the temperature of a phase transition. A distinguishing feature of the monograph is the fact that the concept of spin fluctuations presented in it not only unifies limiting cases of completely localized and completely collectivized carriers of magnetic moment, but also enables one to describe the intermediate cases. The book consists of 11 chapters. The first chapter is of an introductory nature. In Chapter 2 the theory of effective field in the case of magnetic materials with collectivized effects is presented. Chapter 3 is devoted to the dynamic theory of spin fluctuations in the random phase approximation. Chapter 4 outlines the selfconsistent renormalized theory of static and dynamic susceptibility. In Chapter 5 the conclusions obtained in Chapter 4 are compared in detail with the available experimental data on weakly ferromagnetic metals and antiferromagnetic materials. In Chapter 6 a review is given within the framework of concepts of local magnetic moments of the existing theoretical approaches to the description of properties of magnetic dielectrics. Chapters 7 and 8 discuss concepts of constructing a unified theory of magnetism which enables one to describe magnetic substances both with localized and with collectivized carriers of magnetic moment. In the ninth chapter the conclusions of the developed theory are compared in detail with results of experiments on inelastic scattering of neutrons. Chapter 10 undertakes a successful attempt to describe from unified positions the dynamic spin fluctuations at finite temperatures. Chapter 11 contains a brief summary of the material presented in the book and a discussion of the prospects of further development of the theory. The presentation of the material has in mind both theoreticians and experimenters in the field of the physics of magnetic phenomena.

J. Kessler's book "Polarized Electrons" is devoted to the discussion of a wide range of problems associated with polarization effects in photoatomic processes and in collision of particles, and also with obtaining and using beams of polarized electrons for research on the structure and properties of atoms, molecules, solids and their surfaces. The book reflects the very latest achievements in the field under discussion. The first two chapters are of an introductory nature and are devoted to a brief presentation of the basic ideas from nonrelativistic quantum mechanics associated with the description of electron spin. The third chapter is devoted to a discussion of polarization effects due to the spin-obit interaction in processes of electron scattering by atoms. Chapter 4 investigates polarization effects associated with exchange processes in the scattering of electrons by atoms. Chapter 5 describes different processes of ionization of atoms which lead to the appearance of polarized electrons, such as photoionization of polarized atoms, the Fano effect and other phenomena in processes of photoionization of unpolarized atoms, multiphoton ionization of atoms, collision ionization of polarized atoms. Chapter 6 gives a brief description of polarization effects arising in the case of relativistic electron velocities. Chapter 7 examines methods of obtaining polarized electrons in the course of emission from solids, and also diffraction of slow electrons on the surface of solids. The last eighth chapter discusses in detail methods of measuring the degree of polarization of electrons and possible ways of improving them, gives a comparative analysis of different sources of polarized electons, and describes some specific constructions of sources. At the end of the book a list is also given of different processes the investigation of which requires information on the polarization of electrons and provides an estimate of the degree to which they have been studied. The book is intended for specialists in the physics of atomic and electron collisions, on solid state physics and on surface physics.

In the book of T. S. Marshall "Free-Electron Lasers" the greater part of its material is presented in monographic form for the first time. It singles out two main directions of development—obtaining lasing action using high current relativistic electron fluxes in linear accelerators and in systems of storage rings. Construction features of existing and planned high current accelerators, linear accelerators, microtrons and storage rings, their operating parameters and electron dynamics are examined in detail. The material is presented clearly utilizing a minimum amount of mathematical apparatus. The book contains 8 chapters. Chapters 1 and 2 introduce the reader to the set of basic concepts concerning lasers and free-electon lasers. The third chapter is devoted to the theory of free-electron lasers, and their basic parameters are analyzed. In Chapter 4 the theory of free-electron lasers is presented for the case of high current electron fluxes on the

basis of models of parametric running wave accelerators. Chapter 5 examines the role of transverse motion of electrons, while Chapter 6 presents the theory of free-electron lasers operating using slow space charge waves. Chapter 7 is devoted to the description of experiments with free-electron lasers on obtaining UHF radiation from high current electron accelerators. Experiments on the generation of coherent radiaton from linear acceleraors and storage rings are examined in the final eighth chapter of the book. The material is intended for specialists on accelerator technology, on plasma physics and on UHF radio physics.

Of the books on the fundamental problems of theoretical physics one should first note the book "Fractals in Physics" edted by L. Pietronero and E. Tosatti which represents the proceedings of the international conference that took place in 1985 in Trieste. It is the first book in world literature on the theory of fractals as applied to physics. The material is presented in the following sections: General Properties of Fractals; Analysis of Fractal Properties of Materials; Statistics of Polymers and Nonselfintersecting Paths; Branch Polymers; Gel Formation and Percolation; Irreversible Models of Growth (Diffusion-limited aggregations, dendritic growth, etc.); Kinetics of Cluster Formation; Dynamic Properties of Fractal Structures, Hierarchical and Fractal Features of Disordered Systems; Chaos, Turbulence and Related Problems. Among the authors there are many prominent specialists in the theory of fractals. In its content the book encompasses practically all fields of physics in which fractal structures have been observed, from quantum field theory and statistical mechanics to turbulence and chaos in dynamic systems.

In the book of H. G. Schuster "Deterministic Chaos" the fundamentals of the theory of stochastic behavior of dynamic dissipative systems are presented at a modern level and at the same time quite accessibly. Practically all of the most important problems in this field are examined. The book also contains a brief presentation of chaotic dynamics of Hamiltonian systems. The book has been written with great pedagogic mastery, is well illustated and can serve as a textbook.

The monograph by W. D. Kraeft, D. Kemp, W. Ebeling, and G. Röpke "Quantum Statistics of Charged Particle Systems" is devoted to a systematic presentation of the methods of quantum statistical physics utilized in calculations of equilibrium, kinetic and optical properties of gas plasmas and solid state plasmas. It is based on the apparatus of quantum thermodynamic Green's functions. The first half of the book presents from a unified point of view the basic physical concepts regarding the properties of macroscopic systems of charged particles, while the second half of the book is devoted to concrete applications of the methods discussed in the earlier chapters to the calculation of properties of different systems of charged particles. Chapters 1–2 present the basic physical concepts concerning microscopic systems of charged particles, while Chapter 3 presents those from quantum statistics needed for subsequent reading of the book. Chapter 4 is devoted to methods of calculation of one- and two-particle Green's functions. Considerable attention is paid to cluster expansion taking into account bound states, the random phase approximation, dynamic screening and the problem of an acting field. Chapter 5 demonstrates the transition to classical systems. Chapters 6–8 decribe quantum statistical calculations of thermodynamic, kinetic and optical properties of plasmas respectively. Calculations of thermodynamic functions, derivation of equations of state and phase diagrams are discussed in detail. In examining transport phenomena the authors also dwell on the problem of the role played by higher Born approximations in the problem of the conductivity of nonideal plasma. In the final eighth chapter the method of Green's functions is applied to calculate the shape of absorption lines in a dense plasma.

The book by K. Gottfried and V. P. Weisskopf "Concepts of Particle Physics" V. 1 is devoted to elementary particle physics. The basic concepts of modern elementary particle physics are presented in the book. Particular attention is devoted to those sections which have undergone the most vigorus development in recent years. Results not only of theoretical but also of experimental research are quoted. Intuitive arguments are widely used. Approximately one-third of the book is devoted to the presentation of the basic ideas of quantum mechanics, atomic and nuclear physics needed for understanding the following material, and two-thirds of the book contain a detailed exposition of the principal ideas of quantum chromodynamics and the theory of the electroweak interaction. No special knowledge of quantum field theory is needed to read this book. The book can serve as a textbook. It is intended for readers interested in problems of elementary particle physics.

The publication plan includes the book "General Physics" by D. C. Giancoli in two volumes which is a textbook suitable either for those completing their secondary education, or for those beginning their higher education in the natural sciences or technology. The fundamentals of differential and integral calculus are used in the presentation. The examination of each problem begins with an analysis of the basic experimental facts presented in an absorbing manner with emphasis on physical content. The book encompasses a very wide range of material in all fields of physics beginning with mechanics and ending with atomic and subatomic physics. The book includes a total of 43 chapters. Each chapter is provided with well-selected problems (the total number approaches 2,000) with an indication of the degree of difficulty (three in number). The book includes indications concerning the method of solving problems, including advice of a general nature, and also approximately 12,000 questions for checking the degree of assimilation of the material by the reader. It is intended for students in the upper classes in secondary schools and for students in the early years of higher educational institutions in the natural sciences and technology.

The annual volume (in Russian) "Physics Abroad, 1988 Series A (Research)" contains popular-science articles of foreign scientists published in the journals "Physics Today" and "La Recherche." The articles reflect the newest achievements and the urgent problems of physical science. The presentation is characterized by its considerable informational content coupled with scientific rigor.

The collection of articles "Physics Abroad. 1988 Series B (Instruction)" makes use of the material published in the "American Journal of Physics." The articles examine many interesting problems of modern and classical physics, which

are presented either insufficiently clearly or incompletely in the pedagogic and scientific literature. Implicit assumptions are analyzed, which lead to paradoxes or seeming contradictions, and refutations are given of errors which are widespread even among professional physicists.

Translated by G. M. Volkoff