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New books on physics and related sciences

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Penrose R ***Fashion, Faith, and Fantasy in the New Physics of the Universe*** (Series New Science, transl. from English by A Pasechnik, O Sivchenko) (St. Petersburg: Piter, 2020) 512 pp. ISBN 978-5-4461-1598-3.

Is it possible to speak about fashion, faith, or fantasy in fundamental science? The Universe is not interested in human fashion. Science cannot be interpreted as faith because scientific postulates permanently undergo strict experimental verification and are removed as soon as the dogma begins to conflict with objective reality. And fantasy generally neglects both facts and logic. Nevertheless, Roger Penrose prefers not to reject completely these phenomena, since the scientific fashion may turn out to be a progress driver, faith comes out whenever a theory is confirmed by actual experiments, and without the flight of fantasy one will not conceive the whole strangeness of our Universe. Roger Penrose is a well-known mathematician and physicist working actively in various fields of mathematics, general relativity, and quantum physics and is a 2020 Nobel Prize laureate in physics. (Piter Publishing House: tel. +7 (812) 703-73-74, e-mail: books@piter.com, URL: https://www.piter.com/)

Kanel G I ***Shock Waves in Solid-State Physics*** (Moscow: Fizmatlit, 2018) 203 pp. ISBN 978-5-9221-1810-1.

The book presents the method and the latest, most interesting results of experimental studies of strengthening properties, polymorphism, and metastable states of materials and substances subjected to shock waves of very short duration. An anomalous rise in the dynamic yield stress with increasing temperature at high deformation rates was discovered. The approximation to the maximum possible (ideal) bulk and shear strength of solids was realized. New data were obtained about the mechanism and the main laws of submicrosecond polymorphous transformations and phase transitions. The analysis of the behavior of high-strength brittle materials subjected to shock-wave loading and possible methods of fracture diagnostics through compression are given. Failure waves in shock-compressed glass were revealed and investigated. A number of specific features of the dynamics of elastic-plastic shock compression waves in relaxing media were discovered, but they are still to be understood and described. A detailed description of the theoretical basis of the method and a short discussion of the main ways to generate and analyze shock waves in solids appear before the presentation of the main results. The book is based on the results of many-year research largely supported by the Russian Foundation for Basic Research as well as the program of fundamental research of the Presidium of the Russian Academy of Sciences and the Russian Science Foundation and is intended for specialists in the field of physics of high dynamic pressures, the physics of metals, and the physics and mechanics of strength and plasticity. (Fizmatlit Publishers: tel. +7 (495) 005-32-79; URL: http://www.fml.ru/, https://www.fmllib.ru/)

Kirzhnits D A ***Field Theoretical Methods in Many-body Systems*** (Series Physico-Mathematical Heritage: Physics (Quantum Field Theory and Elementary Particle Physics)) (Moscow: URSS, 2020) 344 pp. ISBN 978-5-397-07290-8.

The book describes the basic concepts and methods of contemporary microscopic theory of many-body systems. It was written by the outstanding Soviet and Russian theoretical physicist and corresponding member of the Russian Academy of Sciences David Abramovich Kirzhnits (1926–1998) and was first published in 1963. This was one of the first and best books in the theoretical field and diagram methods of many-body theory. The theoretical apparatus presented in the book was used to solve many problems in nuclear physics, the theory of condensed media, quantum mechanics, and quantum statistics. The book retained its scientific significance and is being actively used both to solve new problems and train new generations of theoretical physicists. The methodical and pedagogical worthiness of the book is undoubted. Its new stereotype edition will be of use for research workers, teachers, postgraduates and students of physical faculties and can serve as a textbook in learning diagram technique, the Green function method in quantum mechanics and statistical physics, the theory of atomic and nuclear processes, and the physics of condensed media and extreme states of matter. The book is intended for theoretical physicists — research workers, postgraduates, and students in physical faculties, including beginners in quantum field theory. (URSS Publishing Group: tel./fax: +7 (499) 724-25-45, e-mail: orders@URSS.ru, URL: http://urss.ru/)

Kochelaev B I ***Basic Aspects of the Quantum Theory of Solids*** (Dolgoprudny: Publishing house Intellekt, 2019) 288 pp. ISBN 978-5-91559-272-7.

The book presents the basic elements of the modern quantum theory of the properties of normal and superconducting metals, dielectrics, and semiconductors and the phenomena inside them. The principles of the use of some these properties for the design of measuring and other electronic devices are described. The book may be of use to experimentalists

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engaged in solid-state physics, because the material is given at a level that omits sophisticated theoretical methods like the diagram technique and Green's functions. The reader is supposed to be acquainted with the fundamentals of quantum mechanics and statistics as given in ordinary university courses. The textbook is intended for students, postgraduates, and teachers studying or delivering a course on the theory of solids. (Intellekt Publishing House: tel. +7 (495) 579-96-45, e-mail: id-intellect@mail.ru, zakaz@id-intellect.ru, URL: http://www.id-intellect.ru/)

Okulov V I, Pamyatnykh E A, Silin V P ***Electron Quantum Waves in a Magnetic Field*** (Moscow: URSS, 2020) 224 pp. ISBN 978-5-9710-6978-2.

The book is devoted to the theory of a special type of wave propagating in low-temperature systems of conduction electrons of crystals in conditions of existing discrete quantization of the electron energy spectrum by a strong magnetic field. In the classical regime of electron motion, the existence of low-frequency electron waves is strongly limited, even with the weak influence of dissipation of energies and momenta because of the manifestation of a collisionless mechanism of energy absorption in wave processes. Discrete quantization of electron energies considerably alters the range of the effect of the collisionless wave absorption and leads to the occurrence of intervals of frequencies and wave vectors (transparency windows) in which the classical collisionless wave attenuation is suppressed, and, according to quantum laws, some characteristic waves of a purely quantum nature can appear, which are called quantum waves. Such waves can exist in a certain range of quantum systems, in which the electron motion in some direction appears to be quantized. The book presents a theoretical consideration of the frequency spectrum of different types of quantum waves in an isotropic electron system in a quantizing magnetic field: longitudinal, transverse spin waves associated with elastic oscillations. The character of the spectrum in different transparency windows and the important role of interelectron Fermi-liquid interaction are discussed in detail. In the framework of the available concepts, the possibility of the existence of quantum waves in actual systems is considered with allowance for the factors of thermal electron motion and scattering, as well as proposed methods of their experimental observation. (URSS Publishing Group: tel./fax: +7 (499) 724-25-45, e-mail: orders@URSS.ru, URL: http://urss.ru/)

Stupitskii E L, Kholodov A S ***Physical Research and Mathematical Simulation of Large-Scale Geophysical Experiments*** (Dolgoprudny: Intellekt, 2019) 799 pp. ISBN 978-5-91559-257-4.

The book presents the results of investigations and numerical simulation of ionization and chemical, optical, and magnetohydrodynamic characteristics of perturbed regions emerging from large-scale geophysical experiments in the near-Earth cosmic space. Considerable place is devoted to the physical analysis of considered phenomena and elaboration of numerical algorithms adapted to them. The material of the book is mostly based on the authors' published papers. The book is intended for research workers engaged in ionospheric plasma physics, laboratory studies of plasma streams, and charged particle propagation. The first part will be useful for senior students and postgraduates of corresponding specialities. (Intellekt Publishing House: tel. +7 (495) 579-96-45, e-mail: id-intellect@mail.ru, zakaz@id-intellect.ru, URL: http://www.id-intellect.ru/)

Sarychev V D, Nevskii S A, Granovskii A Yu, Gromov V E ***Mathematical Models of the Formation of Gradient Structures in Materials Under the Action of Concentrated Energy Fluxes*** (Novosibirsk: SB RAS publishers, 2019) 117 pp. ISBN 978-5-7692-1655-8.

The book presents the results of theoretical studies of the formation and evolution of structure gradients and the phase composition of titanium-, iron-, and aluminum-based alloys under the action of concentrated energy fluxes (heterogeneous plasma streams generated by an electric explosion of conductors, low-energy high-current electron beams, electro-arc overlaying). It has been established that the main mechanism of the formation of micro- and nanodimensional structural phase states under the action of these fluxes is hydrodynamic instabilities in molten layers. Dispersion equations for plasma-melt boundary perturbations were derived. The wavelength dependence of the perturbation growth rate was shown to be bimodal. The range of parameters was discovered for which micro- and nanostructural states are realized in metals and alloys under the action of heterogeneous plasma streams and electron beams on metals and alloys. The monograph is intended for specialists in the physics of the condensed state, metal science, and the thermal treatment of materials and alloys and can be useful to postgraduates and senior students of the corresponding backgrounds (Publishers of Siberian Branch of the Russian Academy of Sciences: tel. +7 (383) 330-17-58, e-mail: sprice@sibran.ru, URL: https://www.sibran.ru/)

Evtikhiev N N, Ochin O F, Begunov I A ***Laser Technology*** (Dolgoprudny: Intellekt, 2020) 240 pp. ISBN 978-5-91559-281-9.

Fiber lasers are now the most widespread class of technological lasers in the world, serving as equipment of laser technological facilities used in mechanical engineering (automobile, shipbuilding, aircraft, and machine-tool industries), instrument engineering, medicine, oil and gas, the chemical industry, and other spheres of economics. Laser radiation is a source of high-concentration well-controlled energy capable of effectively affecting materials, thus providing the development of both additive and subtractive technologies of sawing, welding, facing, and surface treatment of metals and alloys. The book is aimed at providing basic competence for specialists engaged in the application of laser technologies in various sectors of economics. First and foremost, it may be directed at students of specialized secondary schools, namely, engineering lycées, technical schools, and colleges, as well as to students in general engineering disciplines in universities interested in a review of contemporary technologies of material laser processing. (Intellekt Publishing House: tel. +7 (495) 579-96-45, e-mail: id-intellect@mail.ru, zakaz@id-intellect.ru, URL: http://www.id-intellect.ru/)

Arutyunyan R V, Bol'shov L A, Borovoi A A, Velikhov E P ***System Analysis of Causes and Consequences of the Fukushima-1 NPP Accident*** (Moscow: Institute of Problems of Safe Development of Nuclear Power of RAS, 2018) 407 pp. ISBN 978-5-9907220-5-7

Many years have passed since the Fukushima-1 Nuclear Power Plant (NPP) accident. Hundreds of papers devoted to this event have already been published. They all give a rather detailed and comprehensive picture of what happened then, but many points have not yet been sufficiently clarified. Questions arose concerning not only the technical aspects, but also the expedience, timeliness, and effectiveness of some organizational solutions. In this connection, it is of particular importance to come to an understanding of what strategical errors caused the unfavorable scenario in the course of the accident. The authors' prime goal was to collect and analyze information important for an adequate estimation of the events. On the basis of the available information, a large array of data and the results of calculated simulations of Fukushima-1 NPP accident processes were critically analyzed; the data on the dynamics of the occurrence of a radiation situation and on the estimates and prognoses of the social and economic consequences due to radiation from the accident were reviewed. The performance and shortcomings of the Fukushima-1 NPP security systems and the measures for accident control were studied. The topical problems of improving the operational readiness to radiative emergency response were formulated. Appendix 1 and Appendix 2 of the monograph present the results of operative projections and assessments of radiative and radiological consequences of the Fukushima-1 NPP accident and summarize the experience of the operative response of the Center of Scientific and Technical Support of IBRAE RAS to this event. The book is written in a simple language conducive to understanding and will be interesting not only to specialists in nuclear safety but also to a wide range of readers, too. (Institute of Problems of Safe Development of Nuclear Power of RAS: URL: http://www.ibrae.ac.ru/; reference to the book file: http://www.ibrae.ac.ru/docs/Monografii/velikhov_web.pdf)

Emel'yanov N V ***The Dynamics of Natural Satellites of the Planets Based on Observations*** (Fryazino: Vek 2, 2019) 575 pp. ISBN 978-5-85099-199-9.

The book presents an extensive set of methods and results of studying the motion of natural satellites of the planets. The main focus is on refining the parameters of satellite motion on the basis of observations. Many actual facts are given concerning the orbits and the physical properties of the natural satellites of the large planets in the Solar System. The chapters are supplied with an extensive bibliography of the studies underlying the data presented. The material is intended for researchers in a wide area of Solar System dynamics and for specialists implementing projects on preparing missions to other planets. The book is also aimed at use in educational processes in classical universities. It will be useful to science popularizers, too. (Vek 2 Publishers: tel./fax: +7 (496) 567-82-35, e-mail: vek2@vek2.ru, URL: http://www.vek2.ru)

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