

New books on physics and related sciences

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Gershberg R E, Kliorin N I, Pustil'nik L A, Shlyapnikov A A *Physics of Intermediate- and Low-Mass Stars with Solar Type Activity* (Moscow: Fizmatlit, 2020) 768 pp. ISBN 978-5-9221-1881-1.

In this monograph, the results of research into solar type activity by a considerable part of intermediate- and low-mass stars in the Galaxy are systemized and generalized, the characteristics of such stars in a quiet state and during sporadic flares are considered, and the evolutionary variation of such activity is analyzed. Observational data obtained in the entire range of the electromagnetic spectrum from decimeter radio waves to X-rays are described in detail. Modern flare models and star dynamo models are considered in two theoretical chapters. The catalog of stars with solar type activity is described in the appendix. The book is intended for research workers engaged in the study of stellar and solar physics and postgraduates and students of astrophysical specialties and those specializing in surface and space research. (Fizmatlit Publishers: tel. +7 (495) 005-32-79; URL: <http://www.fml.ru/>, <https://www.fmlib.ru/>)

Romanovskii O A (executive editor) *Light Scattering by Atmospheric Ice Crystals in the Physical Optics Approximation* (Novosibirsk: Publishing House of SB RAS, 2020) 219 pp. ISBN 978-5-6044349-1-8

This monograph considers questions of light scattering by large atmospheric ice particles. The physical optics method has been rigorously formulated for the first time in the Russian and world literature. The fidelity of this method and the range of its applicability are investigated in detail. Methods are presented to solve the problem of light scattering by ice crystal particles of porous clouds as applied to laser probing of the atmosphere. Questions of the construction of the optical model of both ideal- and complex-shaped atmospheric ice particles are the most comprehensively elucidated. Examples are given of the practical use of the optical model constructed to discover layers of quasi-horizontally oriented crystal particles and to determine their characteristics from the data of laser atmospheric probing. The monograph is addressed to specialists in the field solving the problem of light scattering by large nonspherical particles and also to postgraduates and students studying optics and the physics of the atmosphere and hydrosphere. (Publishing House 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/>)

Trusov P V, Shveikin A I *Multilevel Models of Single-Crystal and Polycrystalline Materials: Theory, Algorithms, Examples of Application* (Novosibirsk: Publishing House of SB RAS, 2019) 605 pp. ISBN 978-5-7692-1661-9. <https://doi.org/10.15372/MULTILEVEL2019TPV>.

This book is devoted to a consistent and detailed presentation of the methodology of construction, modification, and realization of multilevel models in order to describe the deformation of mono- and polycrystalline metals and alloys. The models are based on introducing internal variables and on physical theories of elastoplasticity and elastoviscoplasticity. The main concepts, axioms, laws, and relations of nonlinear mechanics of a deformable solid are formulated. The issues of solid-state physics necessary to construct the considered models are briefly analyzed. Reviews of publications on the physical theories of inelasticity and multilevel models are given. Two- and three-level models (for the most part static) allowing for the main mechanisms of deformation such as glide of dislocations, twinning, and grain-boundary glide are formulated. Considerable attention is paid to motion decomposition, which is exceedingly important for the construction of constitutive models to describe intense inelastic deformations. Submodels for the description of various crystallite strengthening and rotation mechanisms are considered. The algorithms of realization of different modifications of the considered models are described in detail. Applications of the examined models for the investigation of simple and complex bulk specimen loading are exemplified. Particular consideration is given to the use of a modified model to analyze deformation in superplasticity and transient regimes. The results of application of a direct elastoviscoplastic model to investigate single-crystal sample deformation are presented, and the causes of the occurrence of deformation nonuniformity are analyzed. The proposed monograph is meant for research workers specializing in constructing constitutive models (defining relations) of different materials. It may be useful for senior students of physico-mechanical specialties (Publishing House 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/>)

Burmistrov S N *Problems in Physical Kinetics* 2nd ed., suppl. (Moscow: URSS, 2021) 272 pp. ISBN 978-5-9710-8938-4.

This book contains 60 problems of different complexity, based on materials of seminars on the Physical Kinetics course for students in the Department of General and Applied Physics of MIPT. Detailed solutions to all the problems are given, and the comments show their relation to the questions and methods of contemporary physical kinetics. The brief introduction contains necessary information for the

solution and understanding of the problems. The book is meant for students and postgraduates studying theoretical physics. The author of the book, Sergei Nikolaevich Burmistrov, is doctor of physico-mathematical sciences, associate professor in the MIPT Department of Theoretical Physics, and senior researcher at the Scientific Research Center Kurchatov Institute (URSS Publishing Group: tel./fax: +7(499) 724-25-45, e-mail: orders@URSS.ru, URL: <http://urss.ru/>)

Riznichenko G Yu, Rubin A B *Dynamic Models of Electron Transport in Photosynthesis* (Moscow–Izhevsk: IKI, 2020) 332 pp. ISBN 978-5-4344-0866-0.

This book considers modern mathematical models of electron transport and related processes in photosynthesis: kinetic, many-body, and Brownian. The analysis of the models displays the role of diffusion, electrostatic protein interactions, the geometry of the reaction volume, and ionic force of the medium in regulating primary photosynthesis processes. The results of modeling in comparison with experimental data display the mechanisms of electron flow switching in plant and water-plant cells under different conditions, which is used in biotechnology and ecological monitoring. The book is addressed to research workers, postgraduates, and masters students carrying out fundamental research into photosynthesis and applied research in the field of photobiotechnology and ecological monitoring. The book includes the results of studies of the last two decades supported by the Russian Foundation for Basic Research. (Publishing House of Technical Literature, Institute for Computer Research: URL: <http://shop.rcd.ru>, e-mail: subscribe@rcd.ru, tel. +7 (3412) 500-295)

Grigoryev A D *Terahertz Electronics* (Moscow: Fizmatlit, 2020) 292 pp. ISBN 978-5-9221-1882-8.

This book considers the properties of terahertz electromagnetic radiation and specific features of its interaction with matter. The cause is shown of the occurrence of the so-called ‘terahertz dip,’ in which the output power of both quantum and classical radiation sources is minimum compared to the neighboring frequency ranges. Terahertz radiation sources are classified, while quantum sources of terahertz radiation, including quantum cascade lasers, molecular lasers, and Josephson generators, are considered in detail. The use of new broadband semiconductor materials is shown to improve considerably the operating frequency and the output power of semiconductor generators and amplifiers by increasing their maximum operating frequency up to several terahertz. The movement of vacuum microwave devices towards terahertz frequencies is analyzed thoroughly. ‘Classical’ microwave devices, such as klystrons, running- and backward-wave tubes, magnetrons, and orotrons, are described along with the gyroresonance facilities and free-electron lasers of already known sources. The state of the art of these devices and the prospects of their moving towards the terahertz range are presented. The construction and parameters of terahertz radiation detectors are described. Basic information on electrodynamic and electron-optical systems of vacuum electron devices and on some new technologies of fabrication of their parts is given in appendices. The book will be useful to

designers of terahertz- and microwave-range devices and setups, to postgraduates and students studying microwave electronics, and also to scientists and engineers using terahertz radiation in their work. (Fizmatlit Publishers: tel. +7 (495) 005-32-79; URL: <http://www.fml.ru/>, <https://www.fmlib.ru/>)

Popov S *The Universe. A Short Space and Time Guide. From the Solar System to the Most Remote Galaxies and from the Big Bang to the Future of the Universe* (Moscow: Alpina Non-Fiction, 2018) 400 pp. ISBN 978-5-91671-726-6.

Contemporary astrophysics is a fast developing science that makes use of up-to-date (and very expensive) facilities and supercomputers. This leads to a huge stream of results: exoplanets and dark energy, gravitational waves, and the first short-distance Pluton photos. As a result, the astrophysical picture of the world is constantly varying. However, many fundamental features of this picture have already been formed. It is a known fact that we are living in an expanding Universe a little less than 14 billion years of age. We know how the nuclei of elements have and are being formed. We can examine different stages of star and planetary system formation. We have even managed to see how planets are formed in discs around stars. Nevertheless, many questions and enigmas remain. What are dark matter and dark energy? How do supernovas of different types explode? What is the structure of black holes? And finally, is there other life in the Universe and what can it be? The book gives a unified and ordered description of our concepts of the Universe and the methods of its investigation. The book can supplement a school course in astronomy, and some parts will be useful for teaching natural sciences, including university-level teaching. The author of the book, Sergei Borisovich Popov, is a Russian astrophysicist and popularizer of science, doctor of physico-mathematical sciences, professor of RAS, and senior researcher at the Sternberg Astronomical Institute of Lomonosov Moscow State University. (The book can be downloaded freely, with a copyright reservation, at <https://vsenauka.ru/knigi/vsenauchnyie-knigi/book-details.html?id=185> in the framework of the Vsenauka project: free books.)

Petrov I B *Computational Mathematics for Physicists* (Moscow: Fizmatlit, 2020) 376 pp. ISBN 978-5-9221-1887-3.

Computational methods for solving physical problems (in particular, problems of mechanics, including continuum mechanics) and of different applied problems are considered. The book includes elements of functional analysis, methods for exact solutions of difference equations, questions from the theoretical minimum in computational mathematics for physicists, and problems for computational practicums. The book is intended for university students (departments of physics and mathematics) and technical institutes. The author of the textbook, Igor Borisovich Petrov, is doctor of physico-mathematical sciences, professor, corresponding member of RAS, head of the informatics division at MIPT, and one of the leading Russian specialists in the field of computer simulation of complex physical processes. (Fizmatlit Publishers: tel. +7 (495) 005-32-79; URL: <http://www.fml.ru/>, <https://www.fmlib.ru/>)

Marov M Ya *A Word about the Teacher: Academician Mstislav Vsevolodovich Keldysh* (Moscow: Fizmatlit, 2020) 136 pp. ISBN 978-5-9221-1904-7.

This book is devoted to the outstanding scientist and organizer of science, former president of the USSR Academy of Sciences, a key participant in the Atomic Project, one of the founders and leaders ('chief theoretician') of the Russian Space Program, Mstislav Vsevolodovich Keldysh. The book is based on the reminiscences of his disciple and one of his closest associates, Academician of RAS Mikhail Yakovlevich Marov. The course of Mstislav Vsevolodovich's life, his invaluable contribution to science and technology, to strengthening the country's defense capacity, and to the formation and development of the most important areas of modern science, such as mathematics, aircraft building, the atomic industry, space research, and computation engineering, are briefly described. The book contains unique material and photos from unpublished sources and the author's personal archive. The book is addressed to a wide readership, to all those interested in the history of science and its most brilliant representatives. It reminds people of the older generation of glorious chapters in the country's history, and to younger people it will serve as an educational goal, using the example of the life of the prominent scientist and citizen, Academician M V Keldysh. (Fizmatlit Publishers: tel. +7 (495) 005-32-79; URL: <http://www.fml.ru/>, <https://www.fmlib.ru/>)

Boris Borisovich Kadomtsev (Compiler/editor, candidate of phys.-math. sci., L K Kuznetsova, scientific editor, doctor of phys.-math. sci., A V Timofeev) (Prominent Scientists of the Kurchatov Institute series, editor-in-chief of the series, doctor of phys.-math. sci., A Yu Gagarinskii, executive editor of the series, candidate of chem. sci., S E Voinova) (Moscow: SRC Kurchatov Institute, 2020) 364 pp. ISBN 978-5-00004-059-1.

This book is devoted to the distinguished theoretical physicist, the father of plasma physics, one of the outstanding specialists in the field of collective phenomena in plasma, co-discoverer of the 'current-convective instability of plasma', director of the Plasma Physics Division of the I V Kurchatov NEI (later, Institute of Nuclear Fusion of Kurchatov Institute), Academician of the USSR Academy of Sciences and RAS Boris Borisovich Kadomtsev. The book demonstrates B B Kadomtsev's work covering the main fields of his scientific activity at the Kurchatov Institute, reminiscences of his friends from his youth, colleagues, pupils, his younger son Mikhail, as well as local Penza historian A V Volkov, who examined the origin of the Kadomtsevs' family and the photograph album demonstrating the academician's life path. Academician B B Kadomtsev successfully combined active scientific work with intense scientific-organizational, pedagogical, and scientific-publishing activity. In particular, a number of reminiscences pointed out the great role of B B Kadomtsev, who headed the journal *Uspekhi Fizicheskikh Nauk (UFN)*¹ from 1976 to 1998, in safeguarding the journal through the difficult 1990s and in creating the

basis for *UFN*'s successful work already in the 21st century. The book will be interesting not only for specialists in the field of controlled thermonuclear fusion, postgraduates, and students, but also for both students of special secondary schools and a wide range of readers interested in the history of Russian science, in particular, atomic science and controlled thermonuclear fusion. (SRC Kurchatov Institute, tel. +7 (499) 196-70-45, e-mail: kuznetsova_lk@nrcki.ru)

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¹ English translation of *Uspekhi Fizicheskikh Nauk* journal was published by American Institute of Physics in 1958–1992 under the title *Soviet Physics–Uspekhi* and since 1993 is published under the title *Physics–Uspekhi*