New books on physics and related sciences

Berestetskii V B, Lifshitz E M, Pitaevskii L P *Teoreticheskaya Fizika* (Theoretical Physics) (Ed.-in-chief L P Pitaevskii) T. 4 *Kvantovaya Elektrodinamika* (Quantum Electrodynamics) 4th edition (Moscow: Fizmatlit, 2020) 720 p. ISBN 978-5-9221-0058-8.

The fourth edition of the fourth volume of the course *Theoretical physics* is well known in our country and abroad. The volume includes the relativistic theory of free particles in an external field, the theory of the emission and scattering of light, the relativistic theory of perturbations and its application to electrodynamic processes, the theory of radiative corrections, and the asymptotical theory of processes at high energies. The third edition appeared in 1989. The book is intended for senior physics majors and for postgraduates and research workers in corresponding specialties. (Fizmatlit publishers: tel. +7 (495) 005-32-79; URL: http://www.fml.ru/, https://www.fmllib.ru/)

Ginzburg V L, Rukhadze A A *Volny v Magnitoaktivnoi Plazme* (Waves in Magnetoactive Plasma). Stereotype Publishers (Moscow: URSS, 2023) 262 p. ISBN 978-5-9710-8825-7.

A consistent theory of magnetic wave propagation in plasma is presented. Plasma is considered a material medium not only with frequency but also with spatial dispersion. General questions of linear electrodynamics of media with spatial dispersion, as well as different models used to describe collisionless plasma and the range of their applicability, are discussed. Particle collisions in completely and weakly ionized plasma are taken into account. The model described by a kinetic equation is discussed in detail. This model underlies the calculation of isotropic and anisotropic plasma permittivity in the absence of external fields. Plasma behavior in an external electric field is considered. Wave propagation in plasma occupies the central place in the book. Waves in homogeneous and isotropic plasma in the absence of external fields and then waves in homogeneous magnetoactive plasma (cold and hot) are described. The stability of homogeneous anisotropic plasma is analyzed. The last lines of the book are devoted to fairly topical problems, namely, waves in inhomogeneous nonequilibrium plasma and the stability of magnetic confinement of plasma. The book is recommended to a wide range of physicists — students, teachers, and research workers. The first edition appeared in 1970, the second, in 1975 by the Nauka publishing house. The third edition of the book was published in 2012 by the Publishing group URSS. (Publishing group URSS: tel./fax: +7 (499) 724-25-45, e-mail: orders@URSS.ru, URL: http://urss.ru/)

Kotkin G L, Serbo V G, Chernykh A I *Lektsii po Analiticheskoi Mekhanike* (Lectures on Analytical Mechanics). 3rd edition revised and suppl. (Ser. ''Universitetskie Uchebniki i Uchebnye Posobiya'' (''University Textbooks and Teaching Aids'')) (Moscow–Izhevsk: the Institute of Computer Science, 2022) 272 p. ISBN 978-5-4344-0948-3.

Analytical mechanics is presented as part of the course in theoretical physics intended to acquaint students with a set of methods and concepts which will be extremely useful in field theory, quantum mechanics, and statistical physics. Particle motion in the central field and particle scattering are considered on the basis of Newtonian equations, while Lagrangian equations for different systems, linear and nonlinear oscillations, the Hamiltonian formalism, and the motion of a solid are introduced and thoroughly analyzed. Each topic contains problems already discussed at seminars. In the present edition, nearly ten new sections are added to illustrate the theoretical material. For teachers, these sections can underlie a special course, and inquisitive students who wish to get acquainted with various applications of the methods of analytical dynamics may use these sections for reading and independent studies. The book will be useful for students, postgraduates, and teachers of physics and mathematics. (Publishing house of technical literature, Institute of Computer Science URL: http://shop.rcd.ru, e-mail: subscribe@rcd.ru, tel. +7 (3412) 500-295.)

Borisov A B, Kiselev V V *Dvumernye i Trekhmernye Topologicheskie Defekty, Solitony i Tekstury v Magnetikakh* (Two-dimensional and Three-dimensional Topological Defects, Solitons, and Textures in Magnets) (Moscow: Fizmatlit, 2021) 464 p. ISBN 978-5-9221-1924-5).

The monograph is devoted to the theory of two- and three-dimensional solitons, and localized structures in magnetic media. Direct methods of integration, namely, special substitutions, the Hirota method, Backlund transformations, and the 'dressing' procedure are used to construct and analyze spatially multidimensional solutions of typical models of ferro- and antiferromagnets. They are used to analytically describe vortex solitons and soliton-vortex lattices not only against the background of a homogeneous ground state of a magnetic medium, but also against the background of a band domain structure or a nonlinear spin wave. Investigated also are annular waves in magnets, spiral mesostructures of exchange origin, and soliton states near magnetic disclinations showing macroscopic energy quantization. To solve nonlinear boundary problems associated with the calculation of fields of topological defects, special

versions of the method of inverse scattering problems are proposed, and new techniques of integration of nonlinear equations based on differential geometry methods are developed. In the framework of the considered models, this made it possible to find solutions describing annular-domain 'targets,' spiral dipoles consisting of segments of domain boundaries with torsion near the ends, string configurations of domain wall segments, including those against the background of the band domain structure, three-dimensional defects like filamentary helical vortex structures, etc. Presented are the results of numerical simulation of three-dimensional solitons in an easy-axis ferromagnet with a nonzero Hopf invariant and a final energy, whose internal structure is the linking of vortex rings. The main theoretical and experimental studies of skyrmions in chiral magnets are considered. Skyrmion formation mechanisms, scenarios of their evolution in crystals of bounded geometry (in nanowires and nanostrips), and interactions of skyrmions among themselves and skyrmions with sample edges are discussed. New types of skyrmions, chiral vortices, and their lattices in chiral magnet films are predicted and theoretically described. The monograph is addressed to research workers, postgraduates, and university students in the corresponding specialties. (Fizmatlit publishers: tel. $+7$ (495) 005-32-79; URL: http://www.fml.ru/, https://www.fmllib.ru/)

Ermolin N E, Fomin V M *Gorenie Gazofaznykh i Kondensirovannykh System. Metody Rascheta. Struktura Plameni* (Combustion of Gas-phase and Condensed Systems. Methods of Calculation. Flame Structure) (Moscow: Fizmatlit, 2021) 520 p. ISBN 978-5-9221-1923-8.

The book demonstrates a complex approach to solving heat-mass exchange problems related to the investigation of chemical flame structure. Methods are presented for calculating chemically nonequilibrium flows described by both a complete system of Navier–Stokes equations supplemented with the mass conservation law and approximate sets of equations based on this system. Methods for singling out the leading stages of chemical processes are considered. Calculated are gas-dynamic fields in samplers as applied to justification of the validity of mass-spectrometric methods for examining chemical structures. The main factors affecting the process of freezing the mixture inside samplers are found. As to other applications of the developed methods, a complex wave structure, which sets in upon supersonic combustion of the hydrogen-air mixture in the channel, is calculated. Data on the physico-chemical processes in flames of energetic materials AP, AND, RDX and mixtures on the basis of AP and polybutadiene caoutchouc are systemized. Much attention is given to a review of studies on thermal decomposition and combustion of the indicated condensed systems. Detailed kinetic mechanisms are described, the flame structure is examined, and the leading stages of the processes are distinguished. The flame structure of layer systems based on ammonium perchlorate and polybutadiene caoutchouc is investigated. The structure of microflames in the neighborhood of a large Ap particle protruding above an active binder surface is analyzed. Questions connected with specific features of modeling fast chemical processes in a flow-type reactor with small Reynolds numbers are considered. The book is intended for research workers, postgraduates, and students specializing in the field of numerical methods, chemical kinetics, and combustion chemistry. The book was

prepared at the S A Khristianovich Institute of Theoretical and Applied Mechanics of the Siberian Branch of RAS as a state task. (Fizmatlit publishers: tel. $+7$ (495) 005-32-79; URL: http://www.fml.ru/, https://www.fmllib.ru/)

Matvienko Yu G *Osnovy Fiziki i Mekhaniki Razrusheniya* (Basic Principles of Fracture Physics and Mechanics) (Moscow: Fizmatlit, 2022) 144 p. ISBN978-5-9221-1949-8.

The book presents the content of the lecture courses Mechanics of a Deformable Solid, Physics of Strength and Fracture Mechanics, and Structural Strength delivered by the author at technical universities. The book is addressed to senior students at technical universities, holders of a master's degree, postgraduates, and technical engineers occupied with problems of the strength of materials, safety, survivability, and the durability of machines and structures. Reviewers: a corresponding member of RAS, professor N A Makhutov (IMASH RAS); doctor of technical sciences, professor E M Morozov (MEPhI). (Fizmatlit publishers: tel. $+7$ (495) 005-32-79; URL: http://www.fml.ru/, https://www.fmllib.ru/)

Annin B D *Mekhanika Deformiruemogo Tverdogo Tela*: *Izbrannye Trudy* (Mechanics of a Deformable Solid: Selected Proceedings) (Novosibirsk: SB RAS publishers, 2022) 288 p. ISBN 978-5-6046429-8-6.

The book, by academician of RAS Boris Dmitrievich Annin, consists of papers written by him personally or with co-authors and devoted to the mechanics of a deformable solid with application to some areas of technology. The papers contain the development and examination of general relations of the theory of plasticity with an experimental verification in experiments on complex loading, analyses of non-one-dimensional elastoplastic problems, numerical solutions based on the method of variational inequalities of dynamic elastoplastic problems on a sandwich plate deformation, and the glancing collision of slabs. Methods are developed to solve spatial problems of elasticity theory using the theory of quaternion functions. A new representation of the general solution to equations of the dynamics of transversally isotropic elastic media is given. The book is meant for research workers, postgraduates, and students specializing in the mechanics of deformable solids and structures. (Publishing house of the Siberian Branch of RAS: 630090 Novosibirsk, Morskoi prospect 2, subscr. box 187; URL: https://sibran.ru/)

Dudareva L V *Biologicheskoe Deistvie Nizkointensivnogo Lazernogo Izlucheniya*: *Puti Regulyatsii Rastitel'nogo Metabolizma* (Biological Effect of Low-intensity Laser Radiation: Methods of Regulation of Vegetative Metabolism) (Novosibirsk: SB RAS publishers, 2021) 135 p. ISBN 978-5-6046078-0-0.

On the basis of a critical analysis of literature sources and the results of personal studies, the author presents material illustrating the possibility of applying low-intensity laser radiation to stimulate biological processes in living organisms, namely, in fungi, microorganisms, animals, and humans. Special attention is paid to plants, including seeds and plant tissue culture. Considered are possible mechanisms of the action of a helium-neon (He-Ne) laser, one of which can be related to the induction of phytochrome reversion to an active form, inducing fast changes in the phytohormone balance. The results of investigations of the influence of low-

intensity radiation of a helium-neon laser on initiation of callusogenesisand morphogenetic processes in cereal tissue culture, and qualitative and quantitative analyses of irradiation-induced biochemical changes in cultivated tissues are presented. The book is recommended to specialists in the field of biophysics, photobiology, biochemistry and physiology of plants, and agrobiology, and can also be used as a manual for students and postgraduates in biological departments at institutes. (Publishing house of Siberian Branch of RAS: 630090 Novosibirsk, Morskoi prospect 2, subsc./box 187; URL: https://sibran.ru/)

Semikhatov A *Vse chto Dvizhetsya***: *Progulki po Bespokoinoi Vselennoi ot Kosmicheskikh Orbit do Kvantovykh Polei* (Everything That Moves: Wanderings About the Restless Universe from Cosmic Orbits to Quantum Fields) (Scientific editors: candidate of phys.-mat. sci. V Surdin, doctor of phys.-mat. sci. S Nechaev, ed. P Favorov) (Moscow: Alpina nonfiction, 2022) 628 p. ISBN 978-5-00139-749-6.

The book, by the chief researcher at the P N Lebedev Physical Institute, popularizer of science, presenter of popular scientific TV programs, and doctor of phys.-mat. sciences, Alexei Semikhatov, presents the fundamental scientific picture of the world in its development from more visual to more abstract: from a thrown stone to the explanation of Einstein's and Schrödinger's equations. Humankind gains insights into the functioning of the Universe by observing motion, guessing the rules that govern it, and extracting hints about the hidden parts of the world or about new rules from inconsistencies between the theoretically expected and actual motion: celebrated examples include the predicted existence of Neptune, Planet 9, and the invisible matter in galaxies, the cause of accelerated expansion of the Universe, and the quantum origin of thermal radiation. Discussed in the book are the functioning of the Solar System and the possibilities of traveling about it; interrelations of space, time, and motion in the special relativity theory and the related problems of galactic flights; the general relativity theory and its effects, including non-Keplerian orbits, time dilation, gravitational waves, and exotic options for faster-than-light travel; entropy as ignorance about microscopic motion and its application from heat engines to Maxwell's demon and black holes; and quantum mechanics, including passing through walls, the uniqueness of the atomic structure, entanglements and interpretations aimed at clarifying the state of the Schrödinger cat. According to the rules of our Universe, staying at rest is forbidden, and it is for the reader to appreciate its restless variety. (Publishing house Alpina nonfiction: Publishing group Alpina: https://www.nonfiction.ru, book projects e-mail: k.lepekha@alpina.ru)

Sokolov D *Nebesnye Magnity. Priroda i Printsipy Kosmicheskogo Magnetizma* (Celestial Magnets. The Nature and Principles of Cosmic Magnetism) (Sci. editor doctor of phys.-mat. sciences D Wibe) (Moscow: Alpina nonfiction, 2021) 160 p.

The book, by doctor of physico-mathematical sciences and professor at M V Lomonosov Moscow State University, Dmitry Sokolov, was not thought of as a study of the world of physical phenomena, but largely as a saga about science itself. In speaking of magnetic fields, the author tries to show how physicists work and what they work for. What is the structure of the magnetic fields of distant stars? Where do they appear from. What is the difference among them. What do they affect and how? How can Earth's magnetic field be changed and what are the ways of watching it? What is the phenomenon of the Kursk magnetic anomaly? What is the structure of magnetic fields of spiral galaxies and the Sun and how are they related to magnetic cycles, which scientists have been tracing for a long time? The answers to these and many other questions are accompanied by entertaining stories from the life of scientists and the history of Russian and world science. The book is meant for schoolchildren and students interested in the physics of celestial bodies and for all those who would like to learn interesting facts about our Universe. (Publishing house Alpina nonfiction, Publishing group Alpina: URL: https//nonfiction.ru/)

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