Chapter 6 "Color Center Lasers", (L. Mollenauer, "Bell Telephone Labs", USA) summarizes the nearly fifteen-year history of the development of these sources. Modern lasers based on color centers in alkali halide crystals have turned out to be particularly effective in the range of 0.8–4 microns. The author of Ch. 6 has achieved pioneering results in the development and applications of such lasers; we recall, in particular, that specifically with the aid of a picosecond laser based on color centers L. Mollenauer and his collaborators had for the first time observed optical solitons.

The relatively short chapter 7 "Fiber Raman Lasers" (C. Lin, "Bell Telephone Labs", USA) is devoted to a very promising and rapidly developing field. The broad lines of Raman scattering in quartz optical fibers enable one to produce efficient combination lasers tunable in the range of 0.3–2 microns.

One can confidently assert that in the very near future such sources will occupy a prominent place in optical experimentation, as generators of tunable femtosecond pulses.

Chapter 8 "Tunable High-Pressure Infrared Lasers" (T. Jaeger, G. Wang, Norwegian Defence Research Establishment, Norway) contains a compilation of data on high-pressure on high-pressure molecular lasers based on $Co_2$,$Cs_2$ and $N_2O$. An increase in the pressure of the mixture to $\sim 10$ atm leads to overlapping of rotational lines; as a result of this the possibility arises of smooth frequency tuning in relatively narrow ranges of the infrared spectrum.

New experimental data and construction of lasers, utilized in experiments on selective action on polyatomic molecules are presented.

The concluding chapter 9 written by J. Walling (USA) is devoted to a review of the recent achievements in the development of tunable solid-state lasers. It can be stated quite definitely that here, just as in the field of development of parametric generators of light a true "reevaluation" of the possibilities is occurring.

Such outstanding achievements as the construction of a laser based on alexandrite tunable over the range of 710–820 nm, and in particular of a laser based on sapphire with titanium ions, the tuning range of which stretches from 660–1060 nm, radically alters the status of solid-state lasers based on paramagnetic ions within the wide-ranging family of tunable lasers.

The experimental material presented in this chapter shows that now with the aid of tunable solid-state lasers one can cover the range from 660 to 2280 nm. One should not particularly the promising nature of the use of wide-band solid-state materials for the amplification of femtosecond laser pulses; the saturation energies in them attain values of $\sim 1$ J/cm$^2$, i.e., the exceed by almost three orders of magnitude the values for excimer amplifiers and amplifiers based on dyes. The latter circumstance is of particular interest for the rapidly developing technique of generating ultraintense light fields, fields with intensities attaining the values of $E \approx 10^{10}$–$10^{11}$ V/cm.

On the whole the book under review gives an impressive picture of the progress in one of the most important fields of present-day laser physics.

Undoubtedly it will be welcomed with interest by specialists involved in the development of tunable lasers, by physicists and engineers involved in work in the field of laser spectroscopy, the physics of selective action of radiation on matter, and by specialists in pico- and femtosecond laser technology.

[1)]We note in connection with this that although the genertion of narrow-band tunable radiation with the aid of a dispersive resonator and the productionof ultrashort pulses as the result of synchronization of longitudinal modes are essentially alternative methods for utilizing laser action in media with wide amplification lines, in spectroscopy "the poles draw together". The "time-based spectroscopy" based on the use of ultrashort pulses produces information on the Fourier transforms of susceptibilities measured by the method of "frequency spectroscopy" using narrow band tunable lasers.

## Theoretical physics on the personal computer

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Usp. Fiz. Nauk **157**, 553-556 (March 1989)

**E. W. Schmid, G. Spitz, and W. Lösch.** *Theoretical Physics on Personal Computer.* Springer-Verlag, Berlin; Heidelberg; New York, 1988. 230 pp.

Until recently the uses of computers in theoretical physics was associated, as rule, with large projects which could be carried out only using large computers and even supercomputers. Computers with a prefix mini- and micro- were relegated to the role of controlling experiments in the laboratory or a low-power calculator for solving simple problems. Such a division is of course conventional and determined to a large extent by the level of development of computing technology.

The computer boom which is not abating already for two decades has given birth to new generations of computers with one of the most significant phenomena of this process being personal computers. Along with the high productivity which sometimes attains the level of productivity of mini- and supermini-computers personal computers now have de-

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veloped possibilities of interactive work and a rapid production of graphic information, which determine the expansion of the shpere of their application both in problems of education, and also in scientific investigations in theoretical physics.

Vivid testimony of this is the book under review. Being apparently one of the first practical manuals on solving problems in theoretical physics on a personal computer it occupies a special place in the literature. The point is that this book teaches the reader not only the alphabet of discrete mathematics, and translation into its language of a physical problem, compilation of program and analysis of them, but also working with graphical images of physical phenomena, and an interactive investigation of a model. In other words the personal computer in the hands of the reader is transformed into a universal "experimental laboratory" the objects of investigation of which are models of physical phenomena, and the instrument of investigation is the computer.

The book also serves as a good supplement to the traditional courses on theoretical physics and appeared as a result of a course of lectures given by the authors on the application of computers in theoretical physics to the students of the university in Tübingen (FRG), starting with 1979 (we recall that the first personal computers appeared five years earlier in 1974). It contains 19 chapters. Chapter 1 discusses specific details of numerical programming and input-output of information, chapters 2–3 provide the elements of discrete differentiation and integration, while the subsequent chapters investigate problems from different fields of theoretical physics.

The structure of these later chapters follows a typical model: at first the problem is formulated in the language of theoretical physics, then a discussion is given of the methods of writing it in the language of discrete mathematics, of the corresponding numerical methods of solution and finally of the programming of these methods on a personal computer. Each chapter is provided with well-selected exercises and their solutions. The value of the book is greatly increased by the large number of programs described in it and by examples of their application. The authors and the publishers have also taken care to facilitate immediate practical utilization of the described programs: a floppy disc recording their complete texts is appended to the book.

All the programs have been worked out using an IBM personal computer and have been tested on models of personal computers of other firms compatible with the IBM PC/XT/AT computers. (We note that in the COMECON (Council for Mutual Economic Aid) countries a number of such computers is manufactured: EC-1841, Robotron-1715/1834, Mazovia, Pravets-16 and others). The package of programs is intended for work with computers in different configurations (the minimum operating memory is 256 kilobytes, it is desirable to have an arithmetic coprocessor, a graphics adapter CGA, EGA and others, and a monochromatic or color monitor). The programs are written in FORTRAN-77 (IBM professional FORTRAN) and use a standard graphics package (IBM Professional FORTRAN Tool Kit Library) or a graphics package developed by the authors (available on a diskette).

In order to give a more detailed idea concerning the subject matter of the fields of theoretical physics discussed in the book we provide the titles of the corresponding chapters with brief *comments*.

Chapter 4. Harmonic oscillations taking into account static friction and rocking friction. Graphical presentation of results.

Chapter 5. Free and forced anharmonic oscillations.

Chapter 6. Coupled harmonic oscillations.

This group of chapters contains an analysis of problems of theoretical mechanics and the theory of oscilllations. It begins with the discussion of the model of a point oscillator performing oscillations under the action of an elastic force in the presence of static friction and gliding friction. This is followed by the model of an oscillator undergoing forced oscillations under the action of a nonlinear elastic force with a harmonic external excitation (in the absence of friction); finally the model is introduced of coupled harmonic oscillators. An interesting analysis is given with the aid of the above model of the construction of a skyscrapper stable with respect to earthquakes.

Chapter 7. Calculation of the trajectory of a spaceship.

Chapter 8. The three-body problem of celestial mechanics.

In these chapters with the aid of the Hamiltonian formalism the problem is examined of placing a spaceship on a lunar orbit with its subsequent return and the problem of motion of the spaceship in the field of the earth and the moon. In the latter case nontrivial trajectories are obtained: libration oscillations, horseshoe type trajectories and others.

Chapter 9. Calculation of electric fields.

The model of an electric lens is examined, and the problem of boundary conditions is analyzed.

Chapter 10. The Van-der-Waals equation.

In this chapter is it shown what a computer experiment provides in comparison with the usual experiment using the example of a gas of molecules with a Van-der-Waals interaction.

Chapter 11. Solution of the heat conductivity equation and the "geoelectrostation".

Problems of heat propagation in a continuous medium. With the aid of the constructed model the possibility is analyzed of utilizing the geothermal heat of the earth in the presence of natural anomalies, and also of producing artificial anomalies in order to construct geoelectrostations.

Chapter 12. Group and phase velocities of waves on the surface of water.

Problems of the propagation of wave packets and of interaction between them are discussed.

Chapter 13. Solution of the Schrödinger equation in the case of radial symmetry.

Chapter 14. The quantum-mechanical harmonic oscillator.

Chapter 15. Solution of the Schrödinger equation in the matrix representation.

Chapter 16. Calculation of the ground state of the helium atom.

Chapter 17. Spherical harmonics.

Chapter 18. Spherical Bessel functions.

Chapter 19. Scattering of a neutral particle by a spherically symmetric potential.

This last group of chapters is devoted to the solution of a number of problems in quantum mechanics among which are the motion of a particle in a given potential, the model of

a three-dimensional quantum oscillator, the solution of the Schrödinger equation in different representations, the calculation of energy states of the helium atom, the calculation of the differential scattering cross section of neutral particles by a sample, and others.

It is necessary to note that the book under review, of course, does not include (and cannot include due to its limited volume) all the problems of theoretical physics. In this respect its content is of an "etude" nature having as its aim to teach the reader the methods of experimentation on a personal computer with different models. The working out of individual "etudes" is nonuniform as regards to depth and, apparently, is determined by the interests of the authors. The list of references in the book has, in our opinion, an essential defect: it reflects primarily the pioneer work and references to the modern methods of numerical modeling are practically absent.

In summary one can say that the appearance of the book "Theoretical Physics on the Personal Computer" is very timely. It will be greeted with great interest by all those who are involved in physics and are studying it.

Translated by G. M. Volkoff