A book about extreme states of matter

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W. Ebeling, A. Förster, V. E. Fortov, V. K. Gryaznov, and A. Ya. Polishchuk, *Thermophysical Properties of Hot Dense Plasma*, B. G. Teubner Verlagsgesellschaft, Stuttgart, Leipzig, 1991, 316 pp.

The book under review, written by German and Russian authors, has been published in the Teubner Texts for Physics series, which deserves special mention. This series is intended for fast publication of timely problems of physics in German and English. In connection with fast publication the books of the series are produced by a photomechanical method and are published in a soft cover. In its orientation this series is analogous to the Soviet series *Sovremennye Problemy Fiziki* (*Current Problems of Physics*), which has been published by the Nauka publishing house since 1958. They differ only in quantitative aspects: the books of the Teubner Text series have on average twice as much material and are published ten times faster than the comparable books in *Sovremennye Problemy Fiziki*. Therefore, it is not surprising that Soviet authors are more eager to interact with Teubner Texts than with Nauka. By the way, the next book of this series, which is devoted to the interaction of laser radiation with solid bodies and their surfaces, has been written by the Soviet authors S. A. Akhmanov, V. I. Emel' yanov, and N. I. Koroteev.

Let us return to the book under review. The composite monograph *Thermophysical Properties of Hot Dense Plasma* summarizes the results of theoretical research on the thermodynamic and nonequilibrium properties of matter under the extreme conditions that are generated by the action of powerful pulses of energy.

The recent appearance of powerful laser radiation sources, generators of ion and electron beams, and of electromagnetic accelerators of macroscopic bodies enables one to generate under laboratory conditions states of matter over a broad range of parameters; densities which reach values of 100 g/cm^3 and temperatures which reach 10 keV. Under these conditions, matter is an object in which a whole set of physical factors which correspond to qualitatively new physical conditions develops at once. Ionization, strong interparticle interaction, topological disorder, correlation, and collective effects: here is an incomplete list of the phenomena with which a researcher has to deal in this complicated subject.

It is obvious that rigorous theoretical approaches "from first principles" turn out to be powerless for calculating thermophysical characteristics in such a broad subject. The main objective of the book is to describe and provide a basis for calculation methods that are practical over broad ranges. Here rigorous asymptotic results serve as the basis for obtaining broad-range equations, and comparison with experimental data is an indicator of the reliability of the results obtained.

Let us examine the structure and content of the book. The first part of the book is mainly devoted to the thermodynamic characteristics of a plasma. Here, in particular, the spectroscopic characteristics of ions in a dense plasma are considered, and the Padé approximation technique is used to obtain the thermodynamic functions for a single-component non-ideal plasma. Alternative approaches based both on a generalized "chemical" model of a plasma and also on a "squeezed" atom model are considered.

The second part is oriented towards the nonequilibrium characteristics of a dense, hot plasma: its thermal and electric conductivities, stopping power, and its optical characteristics. Here the problem is considered of describing ionization equilibrium with allowance for both ionization mechanisms: thermal ionization and pressure ionization. Next, descriptions are presented of collisions in a plasma in a variable electromagnetic field and, as a result, methods are given for calculating transport properties, absorption coefficients, and the "stopping" power of a plasma. One must note that many of the procedures suggested in this part by the authors are purely analytical, which makes them very convenient and attractive for applications.

The Appendix, in which tables of the compositions and the thermal and electric conductivities are shown for a number of metals that are important in applications, is a great merit of the book.

The book sums up the current state of the physics of condensed systems at high temperatures. It will be useful for specialists working in the field of the interaction of powerful energy fluxes with materials, the physics of powerful shock waves, and the physics of a non-ideal plasma. To a no lesser degree it is of interest to a broad cross section of specialists, who can get an idea about the current state of this rapidly developing subject and about the physics of the processes in a condensed system into which high energy fluxes are introduced. I recommend becoming acquainted with this book.

Translated by Frederick R. West

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