PREFACE

The beginning of the twentieth century, which brought us the basic theory of the structure of matter or quantum mechanics, has also moved atomic spectroscopy to the position of one of the leading fields of physics. Spectroscopic experiments have been one of the best tests of this theory. In the course of birth and development of various physical concepts, spectroscopy turned into the most powerful method of study of the structure of matter and has made its way into many scientific and practical applications.

During recent years the spectroscopy of atoms and ions in the visible, ultra-violet, and soft X-ray range has become very popular due to intense development of thermonuclear fusion, laser science, and accelerator technology. The reason is that besides providing essential information about atom and ion structure, atomic spectroscopy is capable of developing methods of measuring the parameters of a substance subjected to extreme conditions (super-high temperatures and pressures), solving problems of preservation of measurement uniformity, and improving the uniform system of standards and units of physical quantities in quantum metrology (a new field of metrology). The development of metrology in this particular direction is guided by the application of new physical principles for search and utilization of stable quantum effects in order to improve precision of measurements, to determine values of the fundamental constants, and to improve the system of standards and highly precise measurement methods.

The system of modern diagnostic methods which has been developed on the basis of the spectroscopy of atoms and ions requires first of all reliable and precise data concerning the most basic spectroscopic constants of atomic systems, i.e., the ionization potential, structure of energy levels, and radiative transition probabilities.

Presently this type of experimental information exists not only for neutral atoms but also for multiply-charged ions, whose spectral lines are located within a previously little-studied X-ray wavelength of $\lambda = 0.1$ to 1 nanometers. Simultaneously with the above-mentioned, an intense development of new methods in relativistic theory and employment of new fast computers have provided a significant amount of fairly precise theoretical data (at least for systems with a small number of electrons). However, the existing theoretical and experimental data on spectra of atoms and ions are spread through a large number of periodicals, which makes it difficult to utilize this information for practical spectroscopy.

In this book the authors systematically try to present the results of experimental and theoretical studies of spectra of the simplest atomic systems containing one or two electrons (atoms of hydrogen and helium, as well as ions of their isoelectronic sequences) and to provide a systemized set of reference data about their spectroscopic characteristics. On the one hand, the above-mentioned information has the highest precision and reliability, whereas on the other hand, it is necessary for the development of spectral diagnostic techniques to identify complex atomic spectra and develop methods for the calculation of structures of multielectron atoms and ions.

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