Preface

Quantum physics, which governs the motions and interactions of micro-objects, is a firmly established part of our lives. It has provided working formulae for the design of nuclear reactors, electronic devices, and superconductive magnets, and has helped us understand processes occurring in solids, liquids, gases — even the stars. Many technologies are based directly on quantum laws, which differ in principle from the vastly more familiar laws of classical physics.

Quantum mechanics was originally formulated to explain the structure and properties of atoms. Its further development showed that it can describe a huge variety of physical phenomena. It has served as a basis for the creation of atomic and nuclear physics, elementary particle physics, and solid-state physics. It underpins the operation of semiconductors and lasers, of nuclear reactors and weapons, etc. These directions within science and technology are fascinating, and the many engineering and military applications are of great importance in today's world.

Various aspects of quantum mechanics, describing the motion and structure of molecules, atoms, atomic nuclei, and elementary particles, as well as the structure of substances, do receive attention in high school physics textbooks. The coverage given is, however, cursory at best; necessary concepts are typically treated in a way that is both incomplete and inconsistent, and the unfortunate reader is left without a solid understanding of this essential branch of physics.

The creation and development of quantum mechanics have also led to deep alterations in certain philosophical views regarding the world in which we live. This alone warrants an integrated and sufficiently simple presentation of those quantum concepts that every educated person should know, regardless of his or her profession.

Quantum physics has shown that the main laws of Nature have a statistical rather than a dynamical character. This means that various physical processes follow probabilistic laws, and the strict determinism of classical mechanics is only revealed as a limiting case of this probabilistic description. Moreover, the probabilistic behavior is characteristic of not only large ensembles but of individual objects (molecules, atoms, atomic nuclei, and elementary particles) as well.

Quantum mechanics may seem inaccessible to many people. The main barrier, however, is a simple hesitancy to abandon the habitual notions of classical physics that are subject to constant reinforcement during our everyday experience. Indeed modern physics, by its very character, lends itself to understanding by anyone willing to devote sufficient time to its study. The present book was written to facilitate this. No attempt has been made to expound quantum mechanics to its fullest extent; rather, the presentation is restricted to main ideas, concepts, and applications to the theory of atoms and subatomic structures.

Despite the rather complicated mathematics that governs its behavior, the quantum world is a truly fascinating place to visit. The author invites anyone with an interest in modern science to "take the plunge" into this microscopic universe of atoms and nuclei. The book will have fulfilled its mission if it manages to spark some interest in atomic and nuclear physics.

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