Preface

This small textbook attempts to present the vast field of quantum physics, including statistical thermodynamics, by focusing on a few basic concepts. Matter is made of particles which, like waves, interfere. There is a limiting case, namely classical mechanics and the various fields of continuum physics, where the interference of particles plays no role. Although the classical disciplines have been studied earlier, their laws and rules are to be derived from quantum physics.

Hence, quantum physics provides the foundation of classical physics and thermodynamics as well as of numerous applications in electronics, engineering, and so on. Moreover, with the advent of nanometer manipulations, useful devices directly based on quantum effects are already a reality or will soon become feasible.

Aside from touching on fundamental questions on the nature of things, the book concentrates on examples which demonstrate the principles as clearly as possible. All examples have been chosen carefully. They illustrate the principles and provide an overview over historically or intrinsically interesting topics and problem-solving strategies. Statistical thermodynamics, as quantum physics at nonvanishing temperature, fits quite naturally.

The mathematical level is intermediate, as low as possible and as high as necessary. The mathematical framework is coherently presented in a chapter on Mathematical Aspects, from topological spaces, measure theory, probability, generalized functions to linear operators.

Any theory should be based on carefully chosen principles which are either stated explicitly or implicitly by embedding the new in an already established theory. Science in general and physics in particular have to stand another test besides logical correctness, usefulness, and simplicity. Their rules and laws must also pass the test of experimental verification.

The presentation is neither purely axiomatic nor historic nor pedagogic, but a mixture of these approaches. Following history would require a deeper understanding of what contemporary scientists would think about nature. A purely pedagogic approach would depend too much on the educational background of the readers which certainly is far from homogeneous. And the problems of the axiomatic method in the sciences are well known. Axioms can only be formulated vaguely at first by using everyday language. They are subsequently employed to derive statements such that the terms in which the axioms were formulated gain precision and technical meaning. Then the wording of the axioms must be sharpened, and so on: an iterative approach.

Our main goal is a readable text with a few principles as guidelines. The many worked examples are discussed at various levels of abstraction and mathematical rigor.

Not only advanced students of general physics, chemistry, molecular biology, or materials science will profit from reading the book, but also philosophicalminded or curious people will like this treatise.

We recommend that the reader study at least the Introduction Sect. 1.1 and Sect. 1.3 on the Quantum Framework and Sect. 1.4 on Time and Space. She or he may then decide where to continue: reading Sect. 1.2 on the Classical Framework as well, Chap. 2 with Simple Examples or Chap. 7 on Mathematical Aspects. Although the book can be studied as a web, it is conceived to be read consecutively from the first to the last page. Enjoy!

Osnabrück, Germany Peter Hertel
June 2017

http://www.springer.com/978-3-319-58594-9

Quantum Theory and Statistical Thermodynamics
Principles and Worked Examples
Hertel, P.
2017, XIV, 368 p. 27 illus., 17 illus. in color., Hardcover
ISBN: 978-3-319-58594-9