Quantum Mechanics

Franz Schwabl

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Fourth Edition
With 123 Figures, 16 Tables,
Numerous Worked Examples and 127 Problems

Springer

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Preface to the Fourth Edition

In this latest edition new material has been added, which includes many additional clarifying remarks to some of the more advanced chapters. The design of many figures has been reworked to enhance the didactic appeal of the book. However, in the course of these changes, I have attempted to keep intact the underlying compact nature of the book.

I am grateful to many colleagues for their help with this substantial revision. Special thanks go to Uwe Täuber and Roger Hilton for discussions, comments and many constructive suggestions on this new edition. Some of the figures which were of a purely qualitative nature have been improved by Robert Seyrkammer in now being computer-generated. I am very obliged to Andrej Vilfan for redoing and checking the computation of some of the scientifically more demanding figures. I am also very grateful to Ms Ulrike Ollinger who undertook the graphical design of the diagrams. It is my pleasure to thank Dr. Thorsten Schneider and Mrs Jacqueline Lenz of Springer for their excellent co-operation, as well as the LE-TEX setting team for their careful incorporation of the amendments for this new edition. Finally, I should like to thank all colleagues and students who, over the years, have made suggestions to improve the usefulness of this book.

Munich, August 2007 *F. Schwabl*

Preface to the First Edition

This is a textbook on quantum mechanics. In an introductory chapter, the basic postulates are established, beginning with the historical development, by the analysis of an interference experiment. From then on the organization is purely deductive. In addition to the basic ideas and numerous applications, new aspects of quantum mechanics and their experimental tests are presented. In the text, emphasis is placed on a concise, yet self-contained, presentation. The comprehensibility is guaranteed by giving all mathematical steps and by carrying out the intermediate calculations completely and thoroughly.

The book treats nonrelativistic quantum mechanics without second quantization, except for an elementary treatment of the quantization of the radiation field in the context of optical transitions. Aside from the essential core of quantum mechanics, within which scattering theory, time-dependent phenomena, and the density matrix are thoroughly discussed, the book presents the theory of measurement and the Bell inequality. The penultimate chapter is devoted to supersymmetric quantum mechanics, a topic which to date has only been accessible in the research literature.

For didactic reasons, we begin with wave mechanics; from Chap. 8 on we introduce the Dirac notation. Intermediate calculations and remarks not essential for comprehension are presented in small print. Only in the somewhat more advanced sections are references given, which even there, are not intended to be complete, but rather to stimulate further reading. Problems at the end of the chapters are intended to consolidate the student's knowledge.

The book is recommended to students of physics and related areas with some knowledge of mechanics and classical electrodynamics, and we hope it will augment teaching material already available.

This book came about as the result of lectures on quantum mechanics given by the author since 1973 at the University of Linz and the Technical University of Munich. Some parts of the original rough draft, figures, and tables were completed with the help of R. Alkofer, E. Frey and H.-T. Janka. Careful reading of the proofs by Chr. Baumgärtel, R. Eckl, N. Knoblauch, J. Krumrey and W. Rossmann-Bloeck ensured the factual accuracy of the translation. W. Gasser read the entire manuscript and made useful suggestions about many of the chapters of the book. Here, I would like to express my sincere gratitude to them, and to all my other colleagues who gave important assistance in producing this book, as well as to the publisher.

Munich, June 1991 *F. Schwabl*

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