Preface

This textbook is a detailed survey of a course of lectures given in the Mathematics-Mechanics Department of Leningrad University for mathematics students. The program of the course in quantum mechanics was developed by the first author, who taught the course from 1968 to 1973. Subsequently the course was taught by the second author. It has certainly changed somewhat over these years, but its goal remains the same: to give an exposition of quantum mechanics from a point of view closer to that of a mathematics student than is common in the physics literature. We take into account that the students do not study general physics. In a course intended for mathematicians, we have naturally aimed for a more rigorous presentation than usual of the mathematical questions in quantum mechanics, but not for full mathematical rigor, since a precise exposition of a number of questions would require a course of substantially greater scope.

In the literature available in Russian, there is only one book pursuing the same goal, and that is the American mathematician G. W. Mackey's book, *Mathematical Foundations of Quantum Mechanics*. The present lectures differ essentially from Mackey's book both in the method of presentation of the bases of quantum mechanics and in the selection of material. Moreover, these lectures assume somewhat less in the way of mathematical preparation of the students. Nevertheless, we have borrowed much both from Mackey's

book and from von Neumann's classical book, *Mathematical Foundations of Quantum Mechanics.*

The approach to the construction of quantum mechanics adopted in these lectures is based on the assertion that quantum and classical mechanics are different realizations of one and the same abstract mathematical structure. The features of this structure are explained in the first few sections, which are devoted to classical mechanics. These sections are an integral part of the course and should not be skipped over, all the more so because there is hardly any overlap of the material in them with the material in a course of theoretical mechanics. As a logical conclusion of our approach to the construction of quantum mechanics, we have a section devoted to the interconnection of quantum and classical mechanics and to the passage to the limit from quantum mechanics to classical mechanics.

In the selection of the material in the sections devoted to applications of quantum mechanics we have tried to single out questions connected with the formulation of interesting mathematical problems. Much attention here is given to problems connected with the theory of group representations and to mathematical questions in the theory of scattering. In other respects the selection of material corresponds to traditional textbooks on general questions in quantum mechanics, for example, the books of V. A. Fok or P. A. M. Dirac.

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Preface to the English Edition

The history and the goals of this book are adequately described in the original Preface (to the Russian edition) and I shall not repeat it here. The idea to translate the book into English came from the numerous requests of my former students, who are now spread over the world. For a long time I kept postponing the translation because I hoped to be able to modify the book making it more informative. However, the recent book by Leon Takhtajan, *Quantum Mechanics for Mathematicians* (Graduate Studies in Mathematics, Volume 95, American Mathematical Society, 2008), which contains most of the material I was planning to add, made such modifications unnecessary and I decided that the English translation can now be published.

Just when the decision to translate the book was made, my coauthor Oleg Yakubovskiĭ died. He had taught this course for more than 30 years and was quite devoted to it. He felt compelled to add some physical words to my more formal exposition. The Russian text, published in 1980, was prepared by him and can be viewed as a combination of my original notes for the course and his experience of teaching it. It is a great regret that he will not see the English translation.

Leon Takhtajan prepared a short appendix about the formalism of classical mechanics. It should play the role of introduction for students who did not take an appropriate course, which was obligatory at St. Petersburg University.

I want to add that the idea of introducing quantum mechanics as a deformation of classical mechanics has become quite fashionable nowadays. Of course, whereas the term "deformation" is not used explicitly in the book, the idea of deformation was a guiding principle in the original plan for the lectures.

L. D. Faddeev
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