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Book Note

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language. Fock, however, concludes without further justification that "a wave function describes the state of only one particle . . . and must be interpreted on the basis of the potential possibility of certain results being obtained in experiments (measurements) with the particle." (page 231) He does not explain how this conclusion would follow from his own preceding discussion, or even how one would measure for only one particle a potential possibility expressed by a probability distribution. Instead of concluding that ψ describes for each potentially possible an ensemble $E(\psi)$, he continues that "a quantum object cannot be an element of a statistical ensemble."

What is worse, Fock does not even warn the reader that most quantum-mechanical states (or preparations of states of physical systems) are not describable by any wave function or state vector at all;[6] as in von Neumann's sense most states are not "pure" but "mixed states" describable only by density matrices. The confusion is further increased by the use of the label "mixed state" for a pure state described by a superposition of wave functions on page 230. The author's tacit assumption that all states would be describable by wave functions also leads him to the assumption that necessarily normalization of wave function must be conserved, so that for ψ there should always exist a unitary evolution operator. This misunderstanding (in which he is not alone) means a tacit denial of the existence of physical systems that are not closed systems.[7]

As I already mentioned, Fock's book gives a lot of mathematics for some fundamental topics. One strong point of the book is its emphasis on similarities between the results of Schrödinger's theory and of classical theory, and between the results of Dirac's theory and Pauli's spin theory. However, many derivations are unnecessarily lengthy and can be much abbreviated by use of different methods. Compare, for instance, the 6 ½-page derivation of the radial Dirac equation starting on page 321, with the 1 ½-page derivation given on page 322 in L. I. Schiff, *Quantum Mechanics* (McGraw-Hill, New York, 1949).

Fock defines p_r as $i\hbar\partial/\partial r$ (which is not Hermitian when operating on conventionally normalized wave functions). His equation (6.42) on page 253, however, is valid only if p_r in it is understood to mean the Hermitian operator $-i\hbar[\partial/\partial r + 1/r]$ called $p_r{}'$ by Fock on his page 165. This error would not have occurred, if equation (6.42) would have been derived by the half-page-or-less derivation found in other books, instead of by Fock's five-page derivation on pages 248–253. He sometimes writes ψ for what others would called $r\psi$, and sometimes fails to indicate where a transformation is made from the one ψ to the other. Somewhere between pages 323 and 325 such a change of ψ must have taken place, or many later formulas would be incorrect. On the positive side, some readers may like Fock's use of "proper differentials" for avoiding explicit Dirac delta-functions in the discussion of the continuous spectrum.

The English of the translation by Yankovsky generally is good, except for the utilization of the verb *build* for *construct* when speaking of mathematical expressions and (on the last 50 pages) the use of *exclude* for *eliminate*.

To sum it up, this book belongs in libraries where it may serve as a reference book for properties of some functions often used in applications of wave mechanics. Those already familiar with wave mechanics might learn a few additional things from it. As a textbook for a starter course in wave mechanics for physics students, however, it would be a poor substitute of other books available, as beginning students may well become lost in some of the mathematical derivations.

References

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2. See for instance, A. S. Wightman and S. S. Schweber, Phys. Rev. **98**, 812 (1955).
3. H. A. Kramers, *Hand and Jahrbuch der chemischen Physik* 1/II, Akademische Verlagsgesellschaft, Leipzig (1938) or H. A. Kramers, *Quantum Mechanics*, North-Holland, Amsterdam (1956).
4. These wave functions are found also in A., S. Davydov, *Quantum Mechanics*, Pergamon, Oxford (1965).
5. J. von Neumann, Göttinger Nachrichten **1927**, 1, 245, 273 and D. ter Haar, Rep. Prog. Phys. **24**, 304 (1961).
6. See F. J. Belinfante, Int. J. Quantum Chem. **17**, 1 (1980).
7. See F. J. Belinfante, *Measurements and Time Reversal in Objective Quantum Theory*, Pergamon, Oxford (1975).

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book note

Table of Integrals, Series and Products: Corrected and Enlarged Edition. 1160 pp. I. S. Gradsteyn, I. M. Ryshik. Academic, New York, 1980. $19.50

The first Russian editions of this massive tome predate World War II; the first English edition (prepared from the fourth Russian) came out in 1965. Much has changed in that time. Where the earlier versions were intended to help scientists and engineers find analytical solutions to problems often involving complicated series of special functions, high-speed computers now find numerical solutions to these problems directly. Alan Jeffrey, professor of engineering mathematics at the University of Newcastle-upon-Tyne, has revised and enlarged the earlier edition to meet these changing needs. The emphasis on series is somewhat reduced and new material has been added: chapters on vectors, matrices and determinants, on inequalities and on integral transforms. The major part of the work is still the huge table of integrals (900 pages), but the new material should make the book useful for both traditional, analytic solutions as well as for complex problems for which one needs to be able to estimate the properties of solutions instead of finding them outright. —TVF

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Current Topics in Materials Science, Vol. 4. E. Kaldis, ed. 603 pp. North-Holland, New York, 1980. $102.50