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Book review

Franz Schwabl (translated from German by Ronald Kates): Quantum mechanics, 3rd edn

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This book, first published in German in 1988, is a result of the author's lectures on the subject. The current edition is the third English one, the second having appeared in 1995. The book covers most of the standard topics in nonrelativistic quantum mechanics and is intended for an audience with some knowledge of classical mechanics and electrodynamics.

A comparison of the third and second editions shows that there has been very little substantive updating. The first 19 chapters (there are 20 in all) have the same chapter subdivisions with the same number of pages assigned to each subdivision. The 20th chapter has two additional pages, but mostly to accommodate some new references. But even with these, the third edition has, overall, less than five citations to work done after 1990.

Many of the references in this book are to the very early literature and are rarely supplemented with accompanying citations to more recent articles or reviews. For example, Schrodinger's 1928 article in *Die Naturwissenschaften* is the only citation in a two-page discussion of coherent states (reference to which, incidentally, is missing in the index). Again in discussing the variational principle, the author writes of how, for the ground state of helium, "Such computations have been carried out using a large number of variational parameters ($\sim$200) with fantastic precision". For this he cites Bethe and Jackiw's 1958 edition of *Intermediate quantum mechanics* (which incidentally is now in its third, 1983, English edition) and thus has missed even the 1959 calculation of Pekeris (1,059 parameters) to say nothing of more recent work. These are just a few examples.

It is stated in the preface that the comprehensibility of the book is "guaranteed by giving all mathematical steps and by carrying out the intermediate calculations completely and thoroughly". But I have found this to be somewhat exaggerated and, indeed, colleagues who are also familiar with the book have expressed to me similar difficulties with this claim. The problem is that the author has by virtue of achieving a commendable compactness in his treatment of a variety of subjects assumed of his readers (first-year graduate students) a cleverness in unraveling unstated intermediate steps that, unfortunately, most do not possess. Added to this there are numerous unnumbered equations which are presented without any proof at all.

There are other problems with the book. It is often the case that something will be stated without any reference to its further development later in the book. For example, the Dirac delta function is used early in chapter two without any reference to the appendix in which it is ultimately discussed. Again, a bit later a phase shift to express a one-dimensional density of scattering states is introduced before the meaning of the phase shift is defined. Selection rules are mentioned in chapter seven, as are electric dipole transitions in chapter 13, but in neither place with reference to their subsequent discussion in chapter 16. Similarly the time-ordering operator, introduced in chapter 13 without explanation, awaits chapter 16 for its discussion. Again these are but a few of such examples.

It is clear that the author has certainly a mastery of the subject and describes many things quite well; but in the interests of compactness he often neglects to tell the reader some important aspects of what is being discussed. For example, he fails to mention the gauge dependence of the separation into diamagnetic and paramagnetic terms in the Hamiltonian of a particle in a magnetic field. In his discussion of the Landau levels he fails to mention the origin of their degeneracy and connections to the quantum Hall effect. There is no discussion of the symmetry properties of the Clebsch–Gordon coefficients nor any reference to tables of these beyond the case of $j_1 = 1/2$. A three-page discussion of the Thomas–Fermi atom is provided but nothing is mentioned of density functional techniques. In a discussion of potential scattering resonances, the Jost functions are brought in without mention of their ana-

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lytical properties as origins of their utility. He mentions the $2s^2$ resonance in helium but without explanation of why it is a resonance. The chapter on supersymmetric quantum mechanics seems mostly an exercise in solving some problems with various superpotentials without any insights offered into the utility of the technique. Thus the eigenvalues of the Coulomb potential are rederived in this section, but the basic question of why do it over is left unanswered. Again, these are just a few examples.

The book is certainly quite broad in scope and very reasonably priced and for these reasons alone may find its market. But for use as a first year graduate text, one might want to consider other options.