A Classic Textbook Returns to the Classroom

Quantum Mechanics: Fundamentals

Kurt Gottfried and Tung-Mow Yan
Springer-Verlag, New York, 2003.
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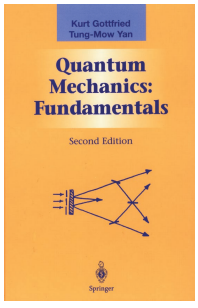
Reviewed by William Happer

Quantum mechanics has been a central conceptual tool of physics for almost 100 years. The theory reached its current form by the 1930s, so it is quite a challenge to bring out a new text that will add value to the many good books on quantum mechanics that have been written over the years. The second edition of *Quantum Mechanics: Fundamentals* by Kurt Gottfried and Tung-Mow Yan has met this challenge.



The book, whose first edition appeared in 1966, is intended for a graduate course in quantum mechanics. Examples of important topics not covered in the first edition but included in the second are Paul Dirac's relativistic theory of the electron, quantum optics, and hidden variables. Generations of Cornell University graduate students have benefited from Gottfried's graceful teaching of quantum mechanics. Indeed, *Quantum Mechanics: Fundamentals* could serve as a textbook for students who have already learned a lot of quantum mechanics from more elementary sources. The book would be especially useful for graduate students and professors who have the time to go beyond the bare essentials of a topic and explore it in depth.

The text is written very much from a theorist's viewpoint. The authors provide no figures of any of the extensive experimental observations that led to quantum mechanics, such as real spectra; real energy-level diagrams of atoms, molecules, or nuclei; or real scattering cross sections. The only experimental data illustrated are from recent tests of the canonical predictions of quantum mechanical measurements with photon interference. Dirac and the other founding fathers of quantum mechanics would not be surprised by such recent results.

The authors use a graceful, laconic mathematical formalism that is close to that most widely used in the literature. They omit unnecessary subscripts, superscripts, peculiar fonts, and other annoying typographical idiosyncrasies that sometimes creep into texts and that aim to make quantum mechanics more rigorous. The only slight notational sophistication is the use of bold Gothic German letters to denote Hilbert spaces, ordinary three-dimensional spaces, and so on. The discussions and explanations in the text strike the right balance between brevity and getting the key concepts across to the reader.

The topics covered are unusually complete, ranging from the basic framework used to describe quantum-mechanical situations in chapter 2 to relativistic quantum mechanics and the Dirac equation in the final chapter, 13. Along the way, one can learn about topics often not covered in more elementary textbooks: Wigner distributions, propagators, Green's functions, Feynman path integrals, Berry's phases, and others. The distorted-wave Born approximation, a very useful and important computational method, is touched on as a problem at the end of chapter 9.

I would recommend the book for its lucid discussions of less familiar topics alone, but the authors do not shortchange the standard subjects of quantum mechanics. Gottfried and Yan offer clear discussions of the harmonic oscillator, the hydrogen atom, scattering, angular momentum, spin, quantized electromagnetic fields, and other important and standard topics one expects to find in a textbook on quantum mechanics. Included in the book are nice sections on currently lively areas, such as condensation of weakly interacting bosons and Landau levels of charged particles in magnetic fields. At the back of the book is a table of fundamental physical constants, including some slightly eccentric units, such as a nuclear magneton of 3.152435×10^{-8} eV/T. Also included is a useful table of Clebsch–Gordan coefficients and simple rotation matrices.

The authors give an interesting, rather philosophical introduction that includes candid photographs of many pioneers of quantum mechanics: Werner Heisenberg, Erwin Schrödinger, Dirac, and so on. But, oddly, there is no photograph of Max Planck, to whom we owe the discovery of quantum mechanics and whose celebrated constant is unique to quantum mechanics. At the conclusion of many of the chapters are nice endnotes with suggestions for further reading of original literature on quantum mechanics or current, interesting issues. And appearing at the end of most chapters are engaging and challenging problems.

Having taught quantum mechanics for many years, I have a whole shelf of textbooks, some of which I refer to regularly and some I have hardly touched. I expect the second edition by Gottfried and Yan to join my library of well thumbed-through texts.

William Happer *has used quite a bit of quantum mechanics in his career as an experimental physicist and occasional teacher of quantum mechanics at Columbia University in New York City and Princeton University in Princeton, New Jersey.*

Jerry Wiesner: Scientist, Statesman, Humanist—Memories and Memoirs

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ISBN 0-262-18232-7

The important and useful book *Jerry Wiesner: Scientist, Statesman, Humanist—Memories and Memoirs* describes the life and work of a great man. Jerome Wiesner's academic career consisted of a variety of positions, all held at MIT. He became a professor of electrical engineering in 1950, was a wartime designer of radar devices, became an MIT academic officer who advanced to the presidency of that institution in 1971, and served as