ing on this practical but previously little-studied aspect of quantum measurement, the authors show a simple way to understand the limits that quantum mechanics places on classical measurements of force, energy, displacement and velocity. As in Braginsky's previous book, *Systems with Small Dissipation* (U. of Chicago P., Chicago, 1985), the ideas, all subtle, fundamental and useful, are the original work of the authors. The material is accessible to graduate students and can be interpreted for undergraduates. *Quantum Measurement* will provide easy-to-understand examples for the quantum mechanics texts of the future, and it will influence the direction of research in quantum measurements.

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Theory of Quanta

Iwo Bialynicki-Birula, Marek Cieplak and Jerzy Kaminski
Oxford U. P., New York, 1992. 494 pp. $49.95 hc ISBN 0-19-5-7157-3

Topics in Advanced Quantum Mechanics

Barry R. Holstein
Addison-Wesley, Redwood City, Calif., 1992. 436 pp. $48.50 hc ISBN 0-201-50820-6

Some time ago, quantum mechanics found its way into elementary physics at the college level. It is nonetheless common for advanced undergraduates or beginning graduate students to take a "serious" quantum mechanics course—two semesters, sometimes three, in length—that surveys the subject from the beginning. What should such a concentrated introductory course in quantum mechanics include, and what should be presented at the next level? To these problems the books under review—*Theory of Quanta*, by Iwo Bialynicki-Birula, Marek Cieplak and Jerzy Kaminski of the Polish Academy of Sciences and Warsaw University, and *Topics in Advanced Quantum Mechanics*, by Barry R. Holstein of the University of Massachusetts, Amherst—offer thoughtful resolutions.

It is to the beginning audience that *Theory of Quanta* is directed. In this volume the authors restrict themselves to Schrödinger's wave mechanics, promising extensions to matrix mechanics in a sequel. This self-

imposed limitation may affect the book's appeal as a primary text, because many teachers will want to stress commutators and the Dirac bracket notation. It does, however, afford the authors plenty of room for detailed discussions of many topics, making the book a very useful source for both students and professionals. The development is reasonably familiar, progressing through specific systems to approximation methods, relativistic equations and many-particle systems. Considerable attention is paid to the historical background and interpretation of the Schrödinger equation. This lengthy discussion—which precedes many of the elementary applications, such as the harmonic oscillator—contains some rather sophisticated developments, such as the Pauli equation and spinors.

Useful and generally clear graphics help illustrate the text, and the book includes many problems and a helpful set of appendices. A nice touch in *Theory of Quanta* is the itemized comments at the end of each section, which give the reader the sort of passing insight that a good teacher might offer during a lecture. Overall, this is a major effort that, as the preface explains, is the result of many years of classroom presentation. No single book can be all things to introductory quantum mechanics, because there are so many viewpoints from which to approach the subject. *Theory of Quanta*, however, achieves a rare depth by preserving its focus.

Even closer to the atmosphere of the classroom is *Topics in Advanced Quantum Mechanics*. Holstein has written a book in sections of lecture length, with the lecturer's personal style very much in evidence. The result is a vigorous guide to many advanced topics, unified in style of presentation and technique. The mathematics is often of a rough-and-ready sort, which will not be to everyone's taste, but it never fails to communicate the physics clearly.

Holstein has assumed familiarity with not only wave mechanics, but also the Dirac bracket formalism. He builds strongly on techniques that he introduces at the start: Green's functions, time-dependent perturbation theory and the path integral. He moves on to scattering theory, semiclassical approximation and other alternatives to perturbative approximations, right through to an introduction to relativistic perturbation theory, very much in the style of *Relativistic Quantum Mechanics* by James D. Bjorken and Sidney D. Drell (McGraw-Hill, New York, 1964). These issues are generally discussed by means of examples, with a heavy emphasis on charged-particle interactions and atomic physics.

Holstein's treatment of the Lamb shift illustrates his approach. Time-dependent perturbation theory gives one method for attacking this problem. Due credit is given to Hendrik Kramers, who made the crucial step of distinguishing the "bare" from the physical electron mass. The remaining divergent integrals are treated as they were by Hans Bethe, with simple cutoffs. Not content with only one approach, Holstein gives another, that of Theodore Welton, who pictured an electron riding the vacuum fluctuations of the electromagnetic field. Later on, the Lamb shift makes a third appearance, in the context of relativistic field theory and renormalization. In this fashion the emphasis stays consistently on results, enriched by multiple perspectives. Problems are numerous and help develop the subject. For example, after a discussion of Rayleigh scattering, the reader is invited to discover "why the sky is blue."

In his prologue, Holstein speaks of attempting to communicate the excitement of the subject and, in an epilogue, of attempting to convey a unity to its many applications. With *Topics in Advanced Quantum Mechanics* he has in large measure succeeded in these ambitions.

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A Modern Introduction to Particle Physics

Fayyazuddin and Riazuddin
World Scientific, River Edge, N. J., 1992.
656 pp. $68.00 hc ISBN 981-02-1072-8

This book is a good text or supplement for a graduate particle physics course that covers a wide range of phenomena without going deeply into field theory methods. (Those methods are often taught separately, and there are several excellent texts.) *A Modern Introduction to Particle Physics* uses Feynman diagram rules and proceeds from there.

The presentation is fairly complete and easy to follow, although at some points an instructor or educated reader will need to supply some background. The book is also an excellent reference for the practicing physicist— theorist or experimenter—and a source for learning about different areas of particle physics. In most chapters, calculations are given for important experiments relevant to the presented theory, and recent data are discussed.

Each chapter has a good bibliography, includes references to other texts, classic papers, reviews, summer-school lectures and recent papers. Especially useful for a course are the problems given at the end of many chapters; most introductory particle physics texts lack these. The instructor can supply additional shorter exercises.

The first six chapters give a good treatment of the basic quark model and in addition include Young's tableau for tensor representations in group theory, scattering cross sections (including the helicity formalism), discrete symmetries and SU(6).

The electroweak unification and Higgs mechanism are of course covered, and so also are W, Z and Higgs physics and searches. The authors discuss particle mixing and *CP* violation with thoroughness, explicitly defining the various asymmetries and deriving their results. The unitarity triangle and ρ–η plots are defined, and B mesons are discussed along with the standard K meson treatment. Several more of the many current topics covered, often as full chapters, are radiative corrections, the triangle anomaly, grand unified theories (but not supersymmetry), heavy flavors, quarkonium, Dirac and Majorana neutrinos, the Mikheyev–Smirnov–Wolfenstein mixing effect, cosmology, baryon asymmetry and inflation.

An appendix contains a translation between the Euclidean four-vector and the Pauli representation for the Dirac matrices used in the text, and the Minkowski four-vector and the Bjorken–Drell choice for the Dirac matrices, making the conventions largely irrelevant.

With the large amount of material covered in the book, the instructor will have a conveniently wide latitude when designing his or her course. Although the authors claim the book could be used for a one-semester course, there is enough material for a two-quarter or year-long course. In summary, this book deals with many of the most current topics, yet with a simplicity of presentation that will please both instructors and students.

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