

netic field theory, often presented at a four-vector level. Considerable effort is spent in these chapters explaining and illustrating the mathematics used in physics. He discusses some examples of the basic theory and does a good job carefully selecting the essential material to make it interesting through unusual, thoughtful commentary.

Nearly all the remaining two-thirds of the book concerns itself with graduate-level atomic physics: the Dirac and Breit equations, the relativistic free hydrogen atom and, finally, the quantum theory of the electromagnetic field and its interaction with matter. Although often not rigorous, these chapters are again unusually readable and well worth looking at either before or after study of the more comprehensive classic texts such as the one by Hans Bethe and Edwin Salpeter (*One and Two Electron Atoms*) or that by W. Heitler (*Semiclassical Theory of Radiation*). I suspect that a real understanding of this subject matter by a good theoretical chemistry graduate student would involve considerable careful reading within the excellent bibliographies included in each chapter. The student would also need to elaborate upon the many unproven statements in Moss's book and to study various applications of the basic theory through problems discussed with a good instructor.

Courses intended to provide a quick familiarity with atomic and molecular physics can be found in a number of chemistry-department curricula; this book by Moss is an excellent guide for an advanced fundamental first term of such a course. The second term would need another text, to put molecules back into the subject matter. Moss includes only a brief qualitative discussion of the molecular multi-center Hamiltonian. All changes in the definition of molecular quantum mechanics aside, one still expects this subject to include such matters as the theory of diatomic molecules, the many-electron theories such as Hartree-Fock, and the problem of electron correlation.

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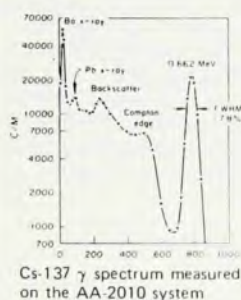
Functional Methods and Models in Quantum Field Theory

H. M. Fried
214 pp. MIT Press, Cambridge, Mass.,
1972. \$8.95

Functional techniques for solving problems in quantum mechanics and quantum field theories have been around for

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Optics

by Eugene Hecht and Alfred Zajac, Adelphi University

This intermediate-level undergraduate text, designed to follow one year of calculus-based physics, presents a detailed treatment of both classical optics and contemporary developments in such areas as lasers, the theory of coherence, and Fourier methods. A unique historical overview and the use of wave theory to give unity to what has often been treated as a mass of seemingly unrelated data reflect a welcomed and satisfying approach. The authors use photographs and diagrams extensively, often in pictorial sequence, to illustrate the development of abstract discussions. Complete solutions to roughly two-thirds of all problems are given within the body of the book.

Elementary Solid State Physics: Principles and Applications

by M. Ali Omar, Lowell Technological Institute

In this upper-division undergraduate text, the author demonstrates the unity of his discipline and adds coherence to his field by making valuable connections between seemingly disparate parts. Equal emphasis is given to practical applications and theoretical discussion with a stress on modern relevance to provide stronger student motivation. The book is elementary in nature; it introduces concepts gradually and supplies necessary mathematical details. The author provides unique chapters on solid state chemistry, metallurgy, materials science, and solid state biophysics. Each chapter provides questions, exercises, and summaries highlighting important concepts and enhancing subject retention. Dependent on specific course requirements, the material in this text is appropriate for a one- or two-semester course in physics, chemistry, or various engineering departments.

Circuit Electronics For Scientists

by B. K. Jones, University of Lancaster, England

Written for junior and senior students of physics, chemistry, biology and premedical students, this text covers the fundamentals of all electronic circuits. With one or two years' exposure to college physics and mathematics, including calculus, it may be readily understood. Discussion of physical electronics has been deliberately eliminated as unnecessary to the understanding or use of electronic systems and circuits. The author's functional, operational approach allows students to make the change from tubes to transistors to circuits. While theoretical principles are stressed, considerable practical advice is given on the actual use of devices. And a wide range of laboratory exercises, questions and an extensive bibliography are also included.

Quantum Mechanics: Principles and Applications

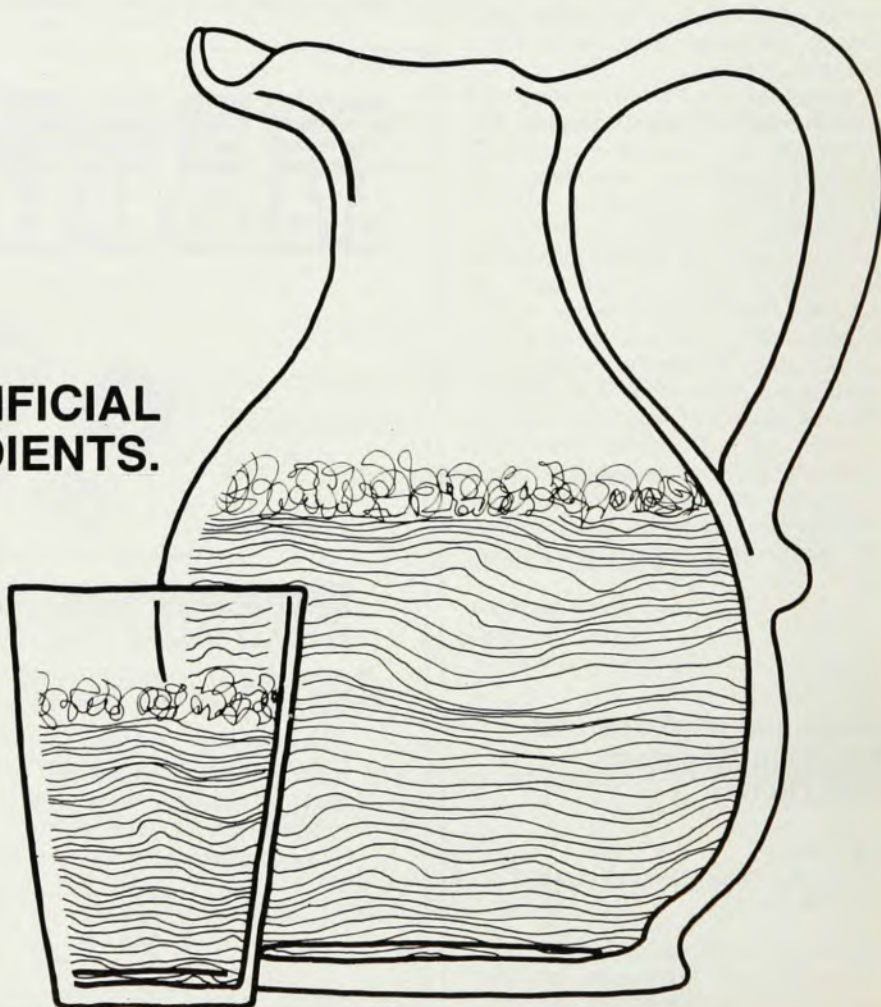
by Marcelo Alonso, Organization of American States and Henry Valk, Georgia Institute of Technology

This book is generally intended for a senior or first-year graduate level course in quantum mechanics. It has been thoroughly class-tested at three major universities over a period of seven years. Its strong orientation toward application of quantal techniques, an emphasis on problem solving, and a detailed explanation of points throughout the book will appeal to the student audience. The book is divided into three sections. The first two chapters, which comprise the initial section, provide a review of quantum concepts from intermediate quantum physics courses. The second section consists of eight chapters and constitutes a course in non-relativistic quantum mechanics. Section three provides insight into more advanced quantum theory and the elements of field theory.



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more than twenty years. As yet very few books on the subject exist. H. M. Fried has done much research on these techniques, and should be congratulated for producing such a fine volume to fill the gap.

What is the functional method? It is a method in which time-ordered products or covariant time-ordered products of operators are represented by functional differential operators. The advantage of this is that usually tedious algebraic and combinatorial operations on the operators are now reduced to familiar manipulations in (functional) differential calculus and applied mathematics.

In this way functional methods produce formal solutions of Green's functions and S-matrix elements in closed forms. For simple field theoretic models, such as the Thirring model and the two-dimensional quantum electrodynamics, such formal solutions may be converted into explicit solutions via usual applied mathematical techniques, as is shown in the book. For more complicated dynamical systems, no such explicit solutions can be obtained; but the formal solution can be used as a starting point for various approximations. The approximations discussed in the book include perturbation theory, and various "soft-photon type" approximations. The latter includes not only the usual Bloch-Nordsieck approximation and its application to the solution of the infrared divergence problem in quantum electrodynamics, but also certain eikonal type approximations for high-energy scatterings. The book also contains a discussion on the gauge problem of quantum electrodynamics, a chapter on chiral Lagrangians, a chapter on an eikonal high-energy model developed by the author, R. Blankenbecker and others, and an appendix explaining detailed mathematical manipulations.

All in all, the book treats lucidly a surprisingly large number of topics, many of them not to be found in standard textbooks. In a book full of mathematical formulas such as this one, it is a rather common fault to forget about the physics. Fried has admirably avoided this trap; the basic physical ideas and reasons are explained alongside the formalism.

The book follows mainly the functional method developed by Kurt Symonik, as distinct from the technique of Julian Schwinger. I think that the contents of the book could be enriched if more discussions were devoted to Schwinger's technique. Symonik's method is very nice, and frequently differs from Schwinger's only in approach and detail. However, there is also an essential difference between the two. The Symonik method deals with a functional generating the vacu-



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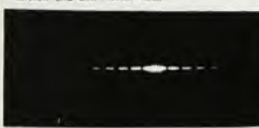
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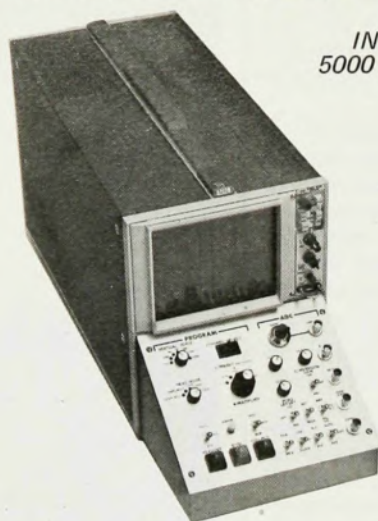
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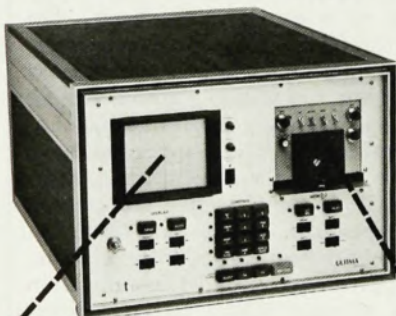
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um expectation values of time-ordered products (T-products) of operators, whereas the Schwinger technique deals with a functional generating the vacuum expectation values of covariant time-ordered products (T* -products) of operators. These two differ when high-spin fields, for example massive vector fields, are involved. The former is not covariant, whereas the latter is (being roughly speaking the covariant piece of the former). As physical objects are covariant, it is naturally simpler to deal with T* -products, rather than having to cancel the intermediary noncovariant objects arising through the use of T-products. Even in the case when high-spin fields are absent, for similar reasons the Schwinger approach may still simplify calculations in the presence of derivative couplings. Another omission in the book is the discussion of Richard P. Feynman's path-integral method. Only a small step is needed to convert functional expressions formally into path-integral formations, and with the recent resurgence of interest in the path-integral quantization of Yang-Mills fields and dual models, it might have been worthwhile, perhaps, to have the subject included. On the other hand, as the path integral is not a very well defined mathematical object, and as most problems soluble with the path-integral method are equally soluble with the functional methods, the omission is also very understandable.

A background in elementary quantum field theory is needed to read the book. It is suitable as a text or a reference for students with some knowledge of field theory, and it is also a very good book for non-expert researchers interested in the development of the field.

C. S. LAM
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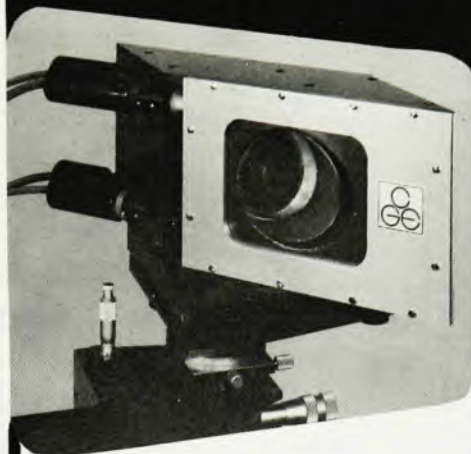
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High Energy Collisions—1973. (AIP Conf. Proc. No. 15, Particles and Fields Subseries No. 7). C. Quigg, ed. 314 pp. AIP, New York, 1973. \$13.75.

Particles and Fields—1973. (AIP Conf. Proc. No. 14, Particles and Fields Subseries No. 6). H. H. Bingham, M. Davier, G. R. Lynch, eds. 679 pp. AIP, New York, 1973. \$18.50

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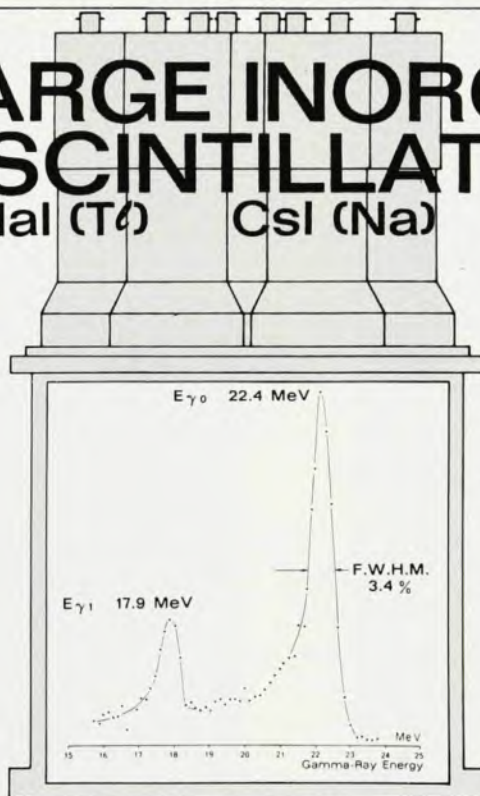
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