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concepts, even in the somewhat limited setting provided by the mean-field theory, without becoming too fragmentary.

Overall, the authors succeeded in writing a well-balanced and widely accessible account of an active field of condensed-matter physics.

JOSEPH SAK
Rutgers University

Functional Integration and Quantum Physics

B. Simon
303 pp. Academic, New York, 1979.
$29.50

Writing in 1929, Norbert Wiener remarked, "Mathematical attacks on the quantum theory, except from the side of the professional physicist, have proved disappointing so far, and indeed Professor Weyl's treatment of the group theory is the only contribution from the side of the pure mathematician which has definitely become incorporated into the physics quantum theory."[1] Certainly, this is no longer true; in fact, Barry Simon's book *Functional Integration and Quantum Physics* describes recent developments in quantum dynamics that exploit one of Wiener's unique mathematical contributions—the functional integral. Wiener, who wrote frequently on the statistical basis for quantum mechanics, would have recognized as logical heir to his Maxwellian *versus* Gibbsian point of view[2] the present relation between real time and Euclidean (imaginary) time. This Euclidean framework has become the primary setting for constructive quantum field theory, which has spurred much of the development in quantum mechanics Simon discusses.

Functional integration serves to provide the main mathematical theorem by which the Euclidean framework enters quantum physics via the Feynman–Kac formula. This represents the semigroup generated by the Schrödinger Hamiltonian as an integral over a function space with respect to a Gaussian probability measure. Development of this formula as well as essential background from probability theory takes up Simon's first two chapters. By means of these ideas, Elliot Lieb has given a formula that allows estimates of the number of energy eigenvalues below a given value, as well as the stability-of-matter bound for a neutral system of electrons and fixed positive charges. Physical ideas from Thomas–Fermi theory play a key role here. When the Schrödinger equation requires velocity-dependent potentials, such as for magnetic fields, K. Ito's theory of stochastic integrals provides an extension of the Feynman–Kac formula, which may have further application to gauge theories. This discussion is particularly welcome, as Ito's ideas are not so accessible to physicists. Apart from a final chapter with overviews on special topics, among them constructive (Euclidean) field theory, the two remaining chapters treat properties of eigenvalues such as monotonicity in the coupling strength as well as perturbation theory and variational principles. This line of ideas inherited from statistical mechanics is possible in the imaginary time as opposed to the real-time formulation of quantum mechanics.

Throughout the book the discussion is expertly written and includes a wealth of detail amply rewarding the reader who wishes to become armed with the "tools of the trade." It is not, however, a book for the casual reader, for familiarity with integration theory and functional analysis is essential. It will therefore be of interest primarily to probabilists and mathematically oriented physicists. For students with this background, the book could serve as a text for an advanced graduate course. The less mathematically prepared reader will need to make a large step to enter this branch of mathematical physics. Amongst leading exponents of this art, Barry Simon has done more than his share producing books that are timely and provide entry to avenues of current research. This book is no exception.

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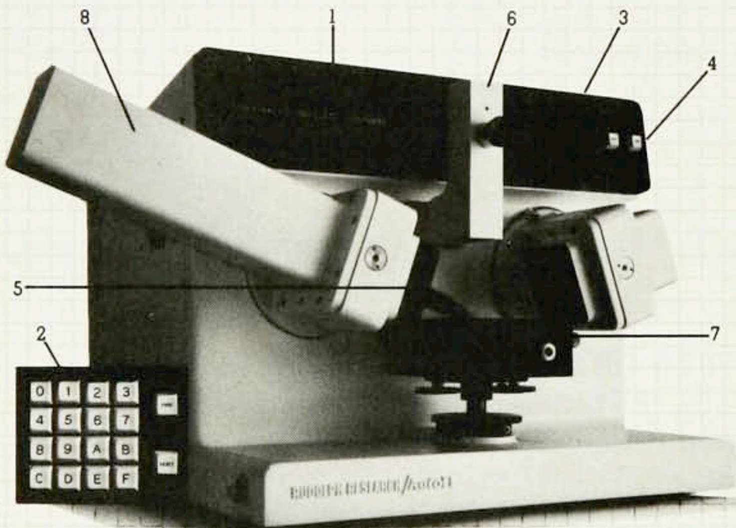

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