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Book Review

Many-Particle Physics, by Gerald D. Mahan, Plenum Press, 1981, 1003 pp.

This book is a treatise on applications of Green's function methods to problems in solid state physics. After an introductory chapter on second quantization, model Hamiltonians, and operators, there are chapters introducing Green's functions at zero temperature and at finite temperature. Thereafter the method of Green's functions is used throughout.

The strong points of the book are in the extended discussion of simple models and how they can be used to study a broad range of topics. The examples are worked out in considerable detail, frequently from different points of view, and with attention to pitfalls in carrying out the calculations. The author provides a unified approach that helps to bring out relationships between different problems and their solutions.

A text on many-particle systems is usually expected to include discussions of the electron gas, electron–phonon interactions, superconductivity, and possibly superfluidity. These are also included here. In addition, there are treatments of localized states, polarons, excitons, and polaritons. Some newer material is included on the electron gas, namely, a discussion of the Singwi *et al.* dielectric functions. A chapter on optimal properties of solids contains an extended discussion of soft x-ray spectra of metals.

Because of its length (over 1000 pages) this book is apt to give the impression of completeness. Though it contains a wealth of material it also suffers from some unfortunate omissions. For example, the chapter on superconductivity discusses the Cooper instability, BCS theory, tunneling, infrared absorption, and acoustic attenuation, all subjects which can be treated with Green's functions; but no mention is made of long-range order, correlation length, or flux quantization, concepts which are fundamental to understanding the subject. Ginzburg–Landau theory is only alluded to in passing and in connection with superfluid ^{3}He. A chapter of 100 pages is devoted to dc conductivity, but no mention is made of Anderson localization or the Mott transition, even though these latter concepts are emerging as fundamental problems for the theory. The empha-

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sis of the book is on the application of Green's function techniques even for treating problems where other methods give better results. Use of the book as a reference is hampered by an index with is quite sparse and omits many topics appearing in the text.

In spite of its deficiencies, this book should prove very useful to students and researchers who want to familiarize themselves with the use and applications of Green's function techniques. Sufficient general information is included that the book will provide rewards for almost everyone interested in many-particle systems or the theory of solids.

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