out of a birthday cake, an exit behind a liquid-nitrogen flume, "interviews" with Albert Einstein and Isaac Newton, and an array of exciting demonstrations. Videotapes of his programs, which come with a manual describing each program and its associated demonstrations, have been available to the public for many years. Now Sprott's *Physics Demonstrations: A Sourcebook for Teachers of Physics*, which includes a set of two DVDs, presents details of about 85 of those demonstrations.

The book has chapters on motion, heat, sound, electricity, magnetism, and light; each contains sections labeled by demonstration or concept, with some sections containing several individual demonstrations. Many of the classic physics demonstration books contain a lot of descriptive material concerning demonstrations and their construction. What sets Sprott's book apart is additional material that is crucial to making quality presentations that are real teaching and learning experiences. Sprott uses lots of colorful pictures to discuss the apparatus for each demonstration, the physical basis for the demonstration, what the demonstration does and how it explains the concept of interest, and even a few of his favorite gags. He discusses safety considerations and highlights specific possible dangers.

Sprott's book should be placed in the libraries of all college physics departments and would be useful for many high-school physics programs. I would like to see a section specifically on demonstrations in modern physics—quantum mechanics, atomic and nuclear physics, for example. Yet scattered throughout the book's other topics are many nice modern-physics demonstrations. Several detailed presentations on chaos and related topics are included, which makes *Physics Demonstrations* a significant update compared with other classic demonstration books such as *Physics Demonstration Experiments* (Ronald Press, 1970), edited by Harry Meiners; *Physics Demonstration Experiments at William Jewell College* (William Jewell College, 1971) by Wallace Hilton; and *A Demonstration Handbook for Physics* (American Association of Physics Teachers, 1972) by George Freier and Frances Anderson.

Sprott offers some unusual and sophisticated demonstrations that often provoke discussion among physicists. He has something for everyone—from the novice physics lecturer to the experienced physicist who is looking for new ways to excite his or her students. Even after doing classroom demonstrations, including the "Physics is Phun" program, for more than 30 years at my university, I continue to get new ideas from Sprott.

A thorough bibliography is included at the end of the book. For those new to the physics-demonstration business, Sprott provides appendices of selected vendors of equipment and audiovisual and computer-based materials. I found the index helpful, too. In the accompanying DVDs, Sprott demonstrates with his unique style the experiments discussed in his book. The videos are of high quality; the camera work is excellent, allowing the viewer to see in detail exactly how the equipment works and how Sprott uses the demonstrations to teach physics. I found his interviews with his student subjects particularly interesting: His very personable approach and his effective use of humor make it easy to see why his programs have become so popular. Aspiring physics demonstrators should find these videos very helpful.

As with any book of this magnitude, a few typographical errors exist, but they do not detract from the book's pedagogical value. Sprott does an admirable job of simply explaining complex demonstrations. However, one error often found in many textbooks may merit further discussion: It is my understanding that the Coanda effect more accurately explains airfoil lift and the ball levitating on an air jet than does the Bernoulli effect.

Physics Demonstrations and its accompanying DVDs are excellent reference materials for beginning physics teachers, experienced lecture demonstrators, and interested students. I thoroughly enjoyed reading the book and watching the videos; they will assume an honored place in my library, among my collection of "The Wonders of Physics" tapes and kit. I hope many of my colleagues will also take the opportunity to learn from Sprott.

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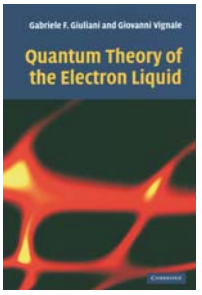
Quantum Theory of the Electron Liquid

Gabriele F. Giuliani and Giovanni Vignale
Cambridge U. Press, New York, 2005. $95.00 (777 pp.).
ISBN 0-521-82112-6



Quantum Theory of the Electron Liquid is a veritable encyclopedia of a field that continuously rejuvenates itself with fresh physics discoveries and novel materials. Nothing escapes the attention of authors Gabriele F. Giuliani and Giovanni Vignale, who seem to cover the gamut. Topics range from Eugene Wigner's 1934 theory of the three-dimensional electron crystal to the most recent developments of the time-dependent density functional theory, from weakly interacting electrons in two and three dimensions to the novel correlation phenomena occurring in a 1D conductor or in ultra-high magnetic fields.

The book, unquestionably attractive to the more experienced reader, is accessible and designed to be comprehensible to graduate students in condensed matter theory. It is an invaluable source of material for many-body theory as a part of condensed matter physics graduate courses. The reader is guided effectively through a large body of knowledge that the condensed matter community has produced over the course of 70 years.

Normally a book in this field would focus on a subclass of problems—strong correlations, density functional methods, lattices, 1D systems, and so forth. Instead, in 10 chapters, the authors cover with comparable care, clarity, and depth a broader area of the quantum theory of electronic systems. Topics are presented in a highly original manner, with the authors often deriving the same results through several different approaches.

Readers will likely find something remarkable just by opening the book at random. For instance, the authors provide the proof of Albert Overhauser's famous Hartree–Fock instability theorem. Except for the original articles, I know of no other literature that gives the proof. Giuliani and Vignale uniquely spell out the validity limits of the celebrated random-phase approximation of David Bohm and David Pines, and they clearly show how that random-phase approximation can be improved. The book contains sophisticated and important concepts, such as spin-dependent effective electronic interactions, a subject virtually impossible to find in other textbooks.

Giuliani and Vignale cover density functional theory and allow ample space for the most recent developments in the time-dependent theory. In particular, they discuss in great detail the formalism of current-density functional theory in magnetic fields and the problem of the ultra-nonlocality of the exchange-correlation potential. Their

formulation allows for the treatment of important effects—such as the intrinsic width of the collective excitations due to electron–electron interactions—that are inaccessible in a simple adiabatic approximation. The authors also discuss with authority the state-of-the-art microscopic theory for Landau parameters in a normal Fermi liquid. Recently, Fermi liquid and non-Fermi liquid theories have attracted considerable attention because of phenomena in the 2D, low-density electron liquid in semiconductor heterojunctions, where the role of interactions is particularly important. Readers can also find, for the first time in a textbook that I have seen, the renormalized Hamiltonian approach, a transparent method to obtain an approximate quasiparticle effective Hamiltonian.

The book's overall treatment of the above topics is in some sense to be expected; the authors are leaders in the field and have contributed substantially to it. However, the book contains much more. It also offers a full chapter on the Luttinger-liquid theory, with diligent coverage of Duncan Haldane's bosonization approach. All the main pillars of that approach and its physical consequences are explained in fewer than 50 pages. Similarly, for readers who want to learn or refresh their knowledge of the most exotic behaviors encountered in electron fluids, such as the quantum Hall effect, fractionally charged quasiparticles, or composite fermions, Giuliani and Vignale beautifully spell out those concepts in a self-contained form.

Quantum Theory of the Electron Liquid is enriched with 25 mathematical appendices elaborating on technical details. The appendices, coupled with the many exercises at the end of each chapter, make the book an unparalleled reference. Every graduate student and researcher studying condensed matter theory should obtain a copy of this exceptional text.

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new books

energy and environment

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