tist who has had an enormously stimulating and overall beneficial influence on the field despite the fact that his interpretations of his own results are now nearly universally regarded as erroneous. Weber's work did demonstrate a possible way of looking for gravity waves, and it triggered the development by other groups of more sensitive versions of bar gravity-wave detectors, including several operating at low temperatures to reduce thermal noise. Experiments that use bar gravity-wave detectors continue, but they are largely being superseded by a different technique using laser interferometers, an approach that is revolutionizing the field.

The basic idea behind the newer approach is to look for the relative motion of two or more separated masses by using a sensitive optical interferometer rather than by studying the two ends of one bar. The advantage is that the masses can be placed kilometers apart so that a gravitational wave induces larger relative motions. The problem, however, has been to obtain the unprecedented sensitivity required from optical techniques. A succession of new ideas, combined with technical developments in lasers and low-loss mirrors and practical laboratory experiments over baselines of tens of meters, demonstrated that the technique would have great promise if expanded in scale. The expansion would require correspondingly large high-vacuum systems, which would increase the overall cost significantly and could change the nature of the research from that of a small research group to that of a larger entity, such as a consortium that constructs and operates a large accelerator.

Such growth did occur in a particularly dramatic way at Caltech, where laser interferometers were being developed. The change had unfortunate effects for all concerned. I was personally involved, having been invited to lead the research at the institute and having originated several of the key optical and other techniques used. In my view, Collins, who devotes a small chapter to that particular situation, has done a careful job of summarizing some of the sociological problems that arose during that time and the overall effects on the management and execution of the research. He has refrained from giving full details but has summarized enough to give an impression of the extent and seriousness of the disturbances that took place. What is more important is the final outcome: The project, called the Laser Interferometer Gravitational-Wave Observatory (LIGO), led by Caltech and MIT, is now a major research endeavor involving several hundred collaborators around the world. It looks as though LIGO, in its current, initial form, has a reasonable chance of allowing researchers to observe gravitational waves.

For the next stage in the project, researchers have proposed plans to further significantly enhance the chances of detecting gravitational waves. Similar or slightly smaller projects in Europe and Japan are in operation, under construction, or proposed.

Gravity-wave detection is a good topic for Collins to use in examining the sociological aspects of certain types of scientific research. The author has done a very careful and responsible job. I do not completely agree with all of his conclusions or interpretations, but that is to be expected in a book of this scale. Although *Gravity's Shadow* is indeed dense, Collins has made it more readable by including anecdotal accounts of his experiences in visiting some of the scientists and experimental sites. He spent many years on his effort, attending numerous specialist conferences and interviewing a large number of the researchers involved. The book will be valuable to readers who desire a detailed account of this growing field and its sociological aspects, and to those interested in the history of science. It will also be helpful to students and others who wish to get firsthand accounts of what experimental physics can be like in practice.

I do not know of any other book quite like *Gravity's Shadow*. Collins has publicly announced his plan to produce a sequel when gravity waves have been unambiguously detected on Earth. I hope he does not have too long to wait.

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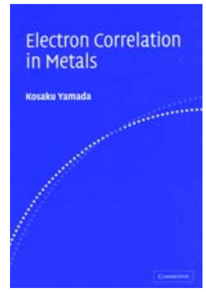
Electron Correlation in Metals

Kosaku Yamada
Cambridge U. Press, New York, 2004. $100.00 (245 pp.). ISBN 0-521-57232-0

Kosaku Yamada's book covers various topics in metal physics in which electron correlations play an important role. Starting with the free-electron gas and Fermi-liquid theory, the author discusses the Kondo effect and the Anderson and Hubbard models, with the goal of describing the physics of heavy fermions and superconductivity in the cuprates, ruthenates, and organics.

The positive features of *Electron Correlation in Metals* are its treatments of diagrammatic techniques for the different topics. The negatives are that the book's discussions are limited to perturbative techniques, without any critical analysis of when that approach may be valid for those same topics.



In the first part of the book, the author introduces the essential formalism of Green functions and response functions and, in chapters 4 and 5, gives much of the algebraic details for the single-impurity Kondo and Anderson Hamiltonians. For the Kondo problem, he also offers a brief discussion of scaling theory.

In the second part, chapters 6 through 9, Yamada turns to models relevant to heavy fermions and high-T_c superconductivity. Unfortunately, this part is where the book has its biggest lacunae: Many aspects of the phenomena are not well understood and are likely beyond the reach of perturbative diagrammatic methods. Yamada, however, seems convinced that a combination of superconductivity mediated by spin fluctuations (FLEX approximation) can describe the entire phenomenology of the high-T_c cuprates.

The beginning sections of chapter 9 are rather flawed and unmotivated. The first section, on high-T_c superconductivity, starts out with "We explain the mechanism on the basis of Fermi liquid theory," which is a surprising statement because the system, in the normal state, shows considerable experimental evidence for a breakdown of Fermi-liquid theory. It is crucial for the reader to recognize that solving the problem of high-T_c superconductivity means understanding the physics of doped Mott insulators in the strong-correlation regime. The book's singular focus of describing electrons that interact via spin fluctuations is really only valid at high doping. In the case of heavy fermions, Yamada does not mention recent developments in non-Fermi liquid behavior near quantum critical points.

Given the fact that beautiful data from angle-resolved photoemission spectroscopy experiments are available, Yamada could have used the information to illustrate the tight binding model and its parameter values in chapter 9. Later in the chapter, the author goes back and forth between theory and experiments mainly involving transport and nuclear magnetic resonance respectively. The mysteries of the normal state are explained away in terms of electron–electron scattering due to antiferromagnetic spin fluctuations within the Fermi liquid. However, it is not clear whether the author believes that the theory, at the present level, can explain the experiments completely or whether some puzzles remain.

The author observes that "because of the strong on-site repulsion, the symmetry of the pairing state is not the *s*-wave symmetry but an anisotropic symmetry, such as the *p*- and *d*-wave symmetry." But he fails to mention the definitive experiments—of Chang Tsuei and John Kirtley and, independently, Dale van Harlingen and coworkers—that led to such a conclusion. Yamada also claims that, "from the theoretical point of view the superconductivity in strongly correlated electron systems can be discussed on the basis of the Dyson–Gorkov equation which corresponds to the Eliashberg equation based on the vertex function arising from the electron–electron interactions in place of the usual electron–phonon interactions." Does the Migdal theorem apply and thus justify such a conclusion? Yamada hardly discusses this point, which is the cornerstone for the applicability of the Eliashberg theory.

Admittedly, it is difficult, though not impossible, to write a book on topics such as heavy fermions and high-T_c superconductivity, topics that are still in a state of development. *Electron Correlation in Metals* contains detailed calculations but not enough discussion on the meaning of those calculations. In what regimes are the given approaches valid? What valuable explanation about the data can such methods give? What are the limitations? What are some of the other promising approaches? A thorough examination along those lines would have been desirable and valuable.

I was initially happy to see that some of the fascinating new developments of high-temperature superconductors, organic superconductors, heavy fermions, and unconventional superconductivity in the ruthenates were making their way into a textbook. The book does fill a gap by introducing readers to a variety of more recent topics in correlated-electron systems. Alexander Hewson's *The Kondo Problem to Heavy Fermions* (Cambridge U. Press, 1993) essentially covers the same material found in Yamada's first four chapters, but with greater emphasis on experiments and with in-depth discussion of scaling and renormalization-group techniques, exact solutions, and $1/N$ methods. Yamada sacrifices those topics to discuss some newer ones instead. Yet overall I was disappointed by the depth, or lack thereof, of the author's treatment.

Electron Correlation in Metals could serve as a supplementary reference in a graduate-level, special-topics course in condensed matter theory. When confronting a new problem, it is often instructive to take a first stab at it using perturbative techniques—and for that, Yamada is indeed an expert. But thereafter, one must take a dispassionate look at the experimental data to ascertain whether the theory actually works. On that score, the reader would have to complement Yamada's book with review articles and texts that examine more modern nonperturbative techniques, phenomenology, experiments—and, especially, open questions.

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New Books

Acoustics

Noise and Fluctuations. T. González, J. Mateos, D. Pardo, eds. *AIP Conference Proceedings 780*. Proc. conf., Salamanca, Spain, Sept. 2005. AIP, Melville, NY, 2005. $265.00 (836 pp.). ISBN 0-7354-0267-1, *CD-ROM*

The Physics of Birdsong. G. B. Mindlin, R. Laje. *Biological and Medical Physics, Biomedical Engineering*. Springer-Verlag, New York, 2005. $79.95 (157 pp.). ISBN 3-540-25399-8

Suspension Acoustics: An Introduction to the Physics of Suspensions. S. Temkin. Cambridge U. Press, New York, 2005. $110.00 (398 pp.). ISBN 0-521-84757-5

Voice and Speech Quality Perception: Assessment and Evaluation. U. Jekosch. *Signals and Communication Technology*. Springer-Verlag, New York, 2005. $99.00 (208 pp.). ISBN 3-540-24095-0

Astronomy and Astrophysics

Astroparticle Physics. C. Grupen. Springer-Verlag, New York, 2005. $59.95 (441 pp.). ISBN 3-540-25312-2

The Astrophysics of Cataclysmic Variables and Related Objects. J.-M. Hameury, J.-P. Lasota, eds. *Astronomical Society of the Pacific Conference Series 330*. Proc. mtg., Strasbourg, France, July 2004. Astronomical Society of the Pacific, San Francisco, 2005. $77.00 (517 pp.). ISBN 1-58381-193-1

Comets: Nature, Dynamics, Origin, and Their Cosmogonical Relevance.