as a jeweler would take in selling a diamond."

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Long-Range Casimir Forces: Theory and Recent Experiments on Atomic Systems

Edited by Frank S. Levin and David A. Micha
Plenum, New York, 1993. 357 pp. $75.00 hc
ISBN 0-306-44385-6

As Hendrik Casimir showed theoretically in 1948, the attractive force between two plane, perfectly conducting, uncharged capacitor plates can be related to a decrease in the electromagnetic vacuum energy as the plates are brought together. This Casimir force is one example of a very general phenomenon in which objects that impose boundary conditions on a quantum field experience forces. The idea of forces exerted by a vacuum is so fascinating that an enormous body of literature has grown around it in the last 45 years. This book is a recent example.

The book begins with Larry Spruch's general theoretical introduction to the subject of forces between polarizable systems. Spruch has worked for many years on this problem and writes with a marvelous physical insight and an appropriately selective minimum of technical detail about the important concepts underlying Casimir forces. The closing chapter by Joseph Sucher and Gerald Feinberg is an excellent, broad discussion of the theoretical foundations of the quantum theory of long-range forces, and it includes some interesting remarks about the role of potentials. It is, however, quite technical and may not be easily accessible to the general reader.

The remaining three chapters of the book concentrate on the interaction between the outer electron of a highly excited (Rydberg) helium atom and its singly charged inner core. Although the energy is dominated by the Coulomb interaction, a small contribution due to Casimir forces is predicted. Chapters by Gordon Drake and Richard Drachman, two leading theorists on the Rydberg states of helium, devote 165 pages to a detailed account of the remarkable progress made over the last ten years in computations of this particular system. While they cover far more than the general reader could want to know, these two chapters provide a readable and useful reference work on this subject. The single chapter on experimental matters, in which Stephen Lundeen gives a well-written account of microwave spectroscopy in the Rydberg states of helium, concentrates mainly on the very precise measurements made by his own group. I enjoyed the level of experimental detail as well as the careful explanation of how one attempts to extract the minute Casimir–Polder interaction by comparing the measured and calculated microwave intervals.

The editors describe this book as a pedagogic review that should "allow a nonexpert to grasp the underlying ideas as well as understand the technical details." They are not entirely successful in this broad aim; many important aspects of Casimir forces are either omitted altogether or touched on only briefly in Spruch's introductory chapter. It is unfortunate, for example, that there is no account of pioneering work by Gabriel Barton on long-range atom–surface interactions, by Peter Milonni on many aspects of Casimir forces and the nature of the vacuum, and by many researchers on more recent topics, such as the fluctuations of the Casimir force and Casimir forces in accelerated systems.

On the experimental side, it would have been appropriate to include some account of the long and fascinating history, starting with the work of Jan Overbeek in 1946 on colloids that stimulated the original paper by Casimir and Dik Polder. After two decades of attempts by many experimenters to study Casimir forces on macroscopic conductors, dielectrics and liquid films, a new line of research was started by Donald Raskin and Polykarp Kusch, who looked for the van der Waals force between an atom and a macroscopic conductor. This led eventually to recent experiments in which the van der Waals and Casimir–Polder forces between an atom and a conductor have been measured with high precision.

I recommend two supplements to this book: *The Quantum Vacuum, An Introduction to Quantum Electrodynamics* (Academic, 1994) by Peter Milonni, provides a brilliant and scholarly introduction to all aspects of Casimir forces; some chapters in *Cavity Quantum Electrodynamics* (Academic, 1994), edited by Paul Berman, cover recent experiments and other current topics in the field.

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Particle Accelerator Physics

Helmut Wiedemann
Springer-Verlag, New York, 1993. 445 pp. $59.00 hc
ISBN 0-540-56550-7

The Principles of Circular Accelerators and Storage Rings

Philip J. Bryant and Kjell Johnsen
Cambridge U. P., New York, 1993. 357 pp. $100.00 hc
ISBN 0-521-35578-8

In the past 15 years, particle accelerators have been transformed from an exotic research instrument into a general-purpose tool. In addition to their traditional use in particle and nuclear research, particle accelerators have been applied to research in chemistry, biology and materials science and to a wide range of industrial and medical applications, such as micromachining, x-ray lithography and radiation therapy. The studies of dynamic properties of systems having a characteristic size of about 0.1 to 100 micrometers and a time scale of a few milliseconds or microseconds find a natural match in synchrotron radiation facilities, which can generate intense x rays with tunable frequency and well-defined time structure. The explosion of particle-accelerator applications, coupled with the maturity and sophistication of beam dynamics in accelerator design and operation, has led to the formalization of the education of accelerator scientists and engineers through classroom instruction and textbooks. The two books reviewed here are an outgrowth of this trend in accelerator education.

Helmut Wiedemann holds a joint appointment at Stanford University and at the Stanford Synchrotron Radiation Laboratory. His book, *Particle Accelerator Physics*, is the first of a two-volume series. It provides an introductory survey of the fundamental principles of particle accelerators, followed by the theory of linear beam dynamics in the transverse as well as longitudinal phase space, including a detailed discussion of basic magnetic focusing units. The author tries to derive most of the equations governing particle motion in an accelerator from first principles, while retaining the intuitive and pedagogical nature of the exposition. It is an ideal classroom textbook, especially because of its complete collection of well thought-