and theoretical—combines programming and modeling to achieve scientific insight that can be verified and validated. The field is mature enough that it can benefit from highly technical textbooks, meant to be archival in nature, that present penetrating analyses. But since computational science (and scientific programming) is interdisciplinary, practiced by scientists from various fields, it is also critical that thinking patterns and problem-solving methodologies are clear to each member of a research team. Therefore, an important role remains for tutorials that make obvious the author's expertise and thinking patterns.

Taking that approach, and executing it quite well, is *Scientific Computation* by Gaston Gonnet and Ralf Scholl. Both authors draw from their extensive teaching experiences: Gonnet is a computer science professor at ETH Zürich and is known for his contributions to the development of the commercial mathematical software Maple; Scholl teaches mathematics, physics, science, and technology at Geschwister-Scholl Gymnasium, a high school in Stuttgart, Germany.

In *Scientific Computation* (also available as an e-book), the authors lay out how they reason: They present a scientific model and then test it, providing along the way appropriate knowledge and strategies needed to solve problems. And yet, the book is organized in a way that will facilitate learning for most students. Each chapter contains basic and advanced instruction, a worked-out example, practical illustrations, and background information appropriate to the chapter's theme. Students using this textbook are assumed to have some mastery of Maple, which may make it unsuitable for Mathematica users or for courses that emphasize programming.

The introduction to the text lists the problems, academic goals, and algorithms covered. Each chapter focuses on one problem: Chapter 1 solves a minimization problem; chapter 2 deals with when to replace equipment like a car; chapters 3 through 6 deal with aspects of bioinformatics; chapter 7 with stock-market predictions; and chapter 8 with phylogenetic-tree generation.

Chapter 1, "Determination of the accurate location of an aircraft," is a good example of the book's organization and presentation of computational models. It poses a problem that is accessible to readers in any discipline: How do aircraft electronics compute position using data from standard avionics equipment? The authors build several models, error terms included, then use each model in Maple to solve the problem from three different approaches: first as a linear least squares, then as a mixed equation minimization, and finally as a nonlinear least squares. The chapter includes an error analysis of the solutions and verification of statistical confidence intervals.

Scientific Computation is far from a reference volume, and I would not recommend it as such. But the text makes an important contribution: It describes the thought process necessary to solve a problem computationally, considers the various possible models, and shows which ones lead to the most precise solutions. I recommend this text for instructors who are interested in problem-based or other interactive learning styles.

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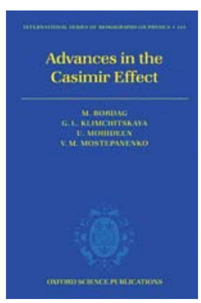
Advances in the Casimir Effect

M. Bordag, G. L. Klimchitskaya, U. Mohideen, and V. M. Mostepanenko
Oxford U. Press, New York, 2009. $150.00 (749 pp.). ISBN 978-0-19-923874-3

Interest in the Casimir force—the attraction between two uncharged plates resulting from the zero point energy in the vacuum between them—is greater now than ever before, in part due to the force's role in the physics of micro- and nano-electromechanical devices. However, despite major advances in experimental techniques and calculational methods, experts still dispute such issues as the accuracy with which the force can be measured and calculated.

In *Advances in the Casimir Effect*, theorists Michael Bordag, Galina Klimchitskaya, and Vladimir Mostepanenko and experimentalist Umar Mohideen seek to provide a critical analysis of those controversies. In general, the authors, who collectively have more than half a century of professional experience in the field, aim to give a comprehensive review of the force that Hendrik Casimir predicted more than 50 years ago.



As an experimentalist in the field, I was looking forward to reading *Advances in the Casimir Effect*; I was expecting a clear exposition of the authors' viewpoints, compared to others, on the points of contention. But I was left disappointed. This poorly edited book largely focuses on the authors' own papers; rare acknowledgments of others are often just to point out that they are wrong.

On the whole, the authors' analysis of the controversies is incomplete and often inaccurate. Concerning the measurement accuracy question, perhaps a dozen groups worldwide are actively measuring the Casimir force. Only two, one involving the authors, have claimed a 1% level of agreement between theory and experiment. No other group has been able to achieve anywhere near that level. My own 1997 demonstration experiment achieved 5% accuracy; at least that's what I believed at the time.

I was subsequently proven wrong, and recent studies of background electrostatic effects suggest further corrections that would make the accuracy of my demonstration no better than 10%. In fact, some studies have shown it is impossible to control the parameters of an experiment to obtain accuracy better than 20%. I and many other experimentalists agree that the issue of how to compare theory and experiment remains open for debate. But in attempting to defend their results, the authors of this book, none of whom have a serious background in precision measurement techniques, present a useless and logorrheic discussion.

Another controversy involves the thermal correction to the so-called transverse electric field modes that contribute to the Casimir force. In 2000 Bo Sernelius's group at the Linköping University in Sweden showed that using the Drude model of a metal's permittivity leads to a factor of 2 reduction of the Casimir force at large separations. Initially, I rejected that result as entirely incompatible with my experiment, but now I am not so sure. However, the authors remain adamant that Sernelius and company are incorrect, a stance that seems motivated solely by the incompatibility of the Sernelius work with the authors' 1% claim. The authors argue that Sernelius's correction violates the third law of thermodynamics because the force associated with the transverse electric modes increases with decreasing temperature. As a consequence, they say, energy (heat) would flow into the electromagnetic field, which suggests nonzero entropy at 0 K. However, such energy flow is not unprecedented, and apparent violations of the third law are resolved when the complete system is considered. Hopefully later editions of the book will streamline much of the repetitive discussion of the transverse electric mode issue and elaborate on the role of the third law.

The book's general incompleteness is startling, given that the body of the text runs to 701 pages. Much recent progress is missing, particularly with regard to the new numerical calculation techniques based on the fluctuation–dissipation theorem in the time domain. Lessening the book's usefulness is a weak subject index and the lack of an author index, which is normally expected when the author/date method of referencing is employed. *Advances in the Casimir Effect* cannot be considered up-to-date, nor can it be taken as a scholarly review of the field, since it merely rehashes the authors' own views. And although the book's intended audience includes advanced graduate and undergraduate students, I expect only experts will be able to draw anything from it.

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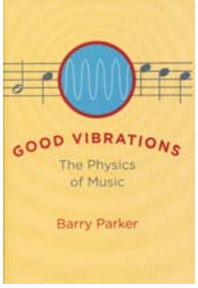
Good Vibrations

The Physics of Music

Barry Parker
Johns Hopkins U. Press, Baltimore, MD, 2009. $27.95 (274 pp.). ISBN 978-0-8018-9264-6

The quest to forge a connection between the physical sciences and music can be traced at least as far back as Johannes Kepler and the classical concept of the music of the spheres. Given my two decades of building guitars and teaching the physics of musical instruments, the mathematical development of musical scales, and guitar construction, I welcome books that aim to meld those fields.

Into this genre comes *Good Vibrations: The Physics of Music*, a book that seeks to "be of interest to musicians who are interested in learning more about the science behind music and to students and fans of physics, most of whom are also music lovers." Written by Barry Parker, professor emeritus of physics at Idaho State University, *Good Vibrations* covers an impressive variety of topics, including the physics of sound-wave generation and propagation, the overtone series, and the mathematical development of musical-scale theory, from the contributions of Pythagoras to equal temperament. In discussing the physics of various acoustic instruments, the book explains the harmonic differences between open and closed pipes and what makes a piano different from a harpsichord. Parker also delves into electronic instruments, room acoustics, sound recording, and even MIDI (musical instrument digital interface) software. I particularly liked the sections on acoustics, brass and woodwind instruments, and the physics of the human ear and the singing voice.



Overall, I applaud Parker's accessible writing style, but the real challenge in writing a book about the physics of music is to include an appropriate mix of the scientific and mathematic principles needed to understand the physics of acoustical phenomena and their application to music. In that light, *Good Vibrations* is too anecdotal in places and not focused enough on science. For example, we learn about guitar heroes