throughout the book. Although the emphasis is on coordinate-free presentations, the book does not discourage detailed calculations and is rich in examples and exercises.

Many newer topics are presented in an amusing way. Thus, Barry Simon's treatment of Michael Berry's phase in terms of a connection is called the "Simon connection (avoiding the temptation to call it the Berry–Barry connection)."

There are a few shortcomings, mainly in the oversimplification of physical examples and sketchy historical references, which a physicist will easily be able to complete and a mathematician will, one would hope, not propagate. I have been informed by the author that a number of typos and errors will be corrected in a second printing, which the publisher has scheduled. It is well worth watching for this second printing.

Two problems that will have to wait for a second edition are somewhat related: Owing to the proliferation of symbols used by the author (such as boldface and normal "partial dees," Greek letters and asterisks), a notation index would have been extremely helpful. And the typesetting used by the publisher is confusing. Equations in the main text are set in what looks like Times Roman (rather than Donald Knuth's Computer Modern Roman, which has become second nature to many of us) and in the exercises they are set in Helvetica. Even an experienced reader will have difficulty deciding whether two symbols in these different fonts mean the same thing! The spaces among elements of the equations and the mismatched sizes give one the impression of an old Microsoft Word screen rather than a typeset book and are rather tiring to the eyes.

In spite of these problems, the book will make an excellent course text or self-study manual for this interesting subject.

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Chaos in Atomic Physics

Reinhold Blümel
and William P. Reinhardt
Cambridge U. P., New York, 1997.
326 pp. $80.00 hc
ISBN 0-521-45502-2

Atomic physics is in flux. Bose–Einstein condensation, ultracold atomic collisions, quantum computing, artificial atoms and the subject of this book—chaos—make it an exciting discipline, one that straddles most of the important areas of physics.

It is remarkable how many of these recent developments can trace their origins to much earlier work that had experienced a hiatus, awaiting advances in other areas of physics before further progress could be made. Bose–Einstein condensates, for example, represent a test of N. N. Bogoliubov's theories of weakly interacting bosons, but their creation became possible only after advances occurred in optical physics and magnetic trapping. Similarly, chaos in atomic physics can be seen as the resumption, after a six-decade interlude, of the application of classical mechanics to atomic systems made possible by recent advances in computing, nonlinear dynamics and fundamental experiments on Rydberg atoms. In a sense, Reinhold Blümel and William P. Reinhardt's *Chaos in Atomic Physics* is an attempt to pick up where Max Born's 1925 book, *Mechanics of the Atom* (English translation: Bell, 1927; reprinted by Ungar, 1960), was forced to leave off, for lack of general interest after the "new" quantum mechanics was discovered.

The modern field of chaos in atomic physics started with the 1969 experiments of W. R. S. Garton and F. S. Tomkins on the energy-level structure of alkali earth atoms in strong magnetic fields (the so-called quadratic Zeeman effect, or QZE). A. R. Edmonds connected the unexpected regular modulations in these absorption spectra almost immediately to a particular classical electron orbit perpendicular to the magnetic field direction. This remarkable anticipation of Martin Gutzwiller's trace formalism was followed by numerous demonstrations of how well classical mechanics can describe atomic systems, a notion that is at once unfamiliar and alien to those trained in traditional areas of physics. A book that unifies the experimental and theoretical research on the chaotic aspects of atomic physics would certainly be welcome—a book with the broad view and authoritative sweep of, say, Gutzwiller's *Chaos in Classical and Quantum Mechanics* (Springer, 1990). *Chaos in Atomic Physics* is not quite that. It is, instead, a book about chaos that happens to select its examples from atomic physics.

To their credit, the authors provide a useful introduction to aspects of chaos that arise in some atomic problems. Maps, fractals, chaotic scattering and resonance overlap are illustrated with pedagogical examples. Ultimately, however, the book does not go far enough. For example, the authors retreat from providing a definite answer to the question that for many has been the *raison d'être* for the subject: Does quantum chaos exist? Instead, they organize a key chapter around fairly *ad hoc* definitions and classifications of quantum chaos that are all too likely to increase the confusion already surrounding this subject.

The reasons for the absence of chaos from quantum mechanics (oddities aside) have nothing to do with the linearity of quantum theory, which is mentioned in the preface but not pursued; after all, the Liouville equation, itself linear, manages to preserve all of the chaos contained in Hamilton's equations. Such shortcomings can be traced to a basic structural flaw: The book concentrates almost exclusively on the research interests of the first author, on whose lecture notes it is based.

Overall, the book's parochiality results in undue emphasis on model or spatially one-dimensional (1D) problems. With the exception of the ionization of 1D hydrogen atoms in microwave fields and the excellent application of complex coordinate methods to a model helium atom, the book's chief merit is the theoretical simplicity of the contents, rather than any pressing experimental interest. This bias is maintained at the expense of problems for which *bona fide* experiments exist.

Topping the list of casualties is the QZE itself: It strains credibility to attempt a discussion of chaos in atomic physics without discussing in some detail the problem that defined the field. In a curious reversal of history, the QZE is relegated to a brief section in the last chapter, which deals with *future* directions. Blümel and Reinhardt also exclude recent experiments on Rydberg atoms in circularly or elliptically polarized microwave fields, which exhibit chaos in more than a single space dimension. This all leads to a lopsided picture of the subject.

Our recommendation is to spend some time in the library, deciding whether or not this book is worth your $80, before taking the plunge.

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Adventures in Celestial Mechanics

Victor G. Szebehely and Hans Mark
Wiley, New York, 1998 [1989]. 2nd edition. 310 pp. $59.95 hc
ISBN 0-471-13317-5

Adventures in Celestial Mechanics by Victor Szebehely and Hans Mark, published after Szebehely's death in 1997, is the second edition of the 1989 Szebehely book from the University of Texas Press. Both editions are intended to introduce and attract students to celestial mechanics. This new edition has gained an author, doubled the number of pages and added pictures. The additions are chapters on rocket propulsion, elementary spacecraft dynamics and the history of exploration of the Solar System, which seem to be the contributions of the additional author. The preface promises more material on artificial satellites and chaos and, although the promise on chaos is not fulfilled, the book has gained some interesting material. What it loses in exchange, however, is some of its original focus on celestial mechanics.

Nonetheless, it retains the first edition's historical approach and readable introduction to the two- and three-body problems, Kepler's equation, Lambert's theorem and perturbation theory. The contributions of many well-known individuals are used to develop interest in the subject and illustrate the breadth of the mathematical applications in celestial mechanics.

The chapter on exploration of the Solar System is a good brief illustrated history, but it does not discuss some of the interesting celestial mechanical problems that arose with new discoveries, such as ring dynamics, resonances with satellites and librational and co-orbital satellites. There is a good introduction to the use of gravity assist for planetary missions, but details are avoided with the statement that they are too complicated.

The book unfortunately has not been updated in the areas of most interest in celestial mechanics today, which are also the topics that would be of most interest to new students. Thus, the Kuiper belt is never mentioned, and the explanation of the source of comets omits the interesting dynamics research on outer Solar System bodies. Near Earth objects are mentioned, but their dynamics are confused with an explanation of the Kirkwood gaps. There is no mention of relativity, although this may be understandable in an introductory text.

The largest disappointment for me was the inaccurate and inadequate coverage of the hottest current topic of celestial mechanics: chaos. Szebehely was always very interested in stability and the various definitions thereof. Today we have chaos, stable chaos, unstable chaos, multiplicative factors for Lyapunov stability and other terms. The preponderance of new terms leads to the conclusion that there is an urgent need for new definitions and measures for stability. I had hoped for