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Fluctuating Nonlinear Oscillators: From Nano-Mechanics to Quantum Superconducting Circuits, edited by Mark I. Dykman

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book. It will be appreciated not only by those seeking a comprehensive and stimulating introduction to the field, but also by seasoned researchers looking for an astute state of the art survey of the field.

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Time Reversibility, Computer Simulation, Algorithms, Chaos, 2nd edn., by William G. Hoover and Carol G. Hoover, Singapore, World Scientific Press, 2012, 428 pp., US\$88/£58/S\$116 (hardback), ISBN 978-981-4383-16-5. Scope: textbook. Level: postgraduate, advanced undergraduate, researcher.

It is well known that the laws of physics are time reversal invariant but that the world displays an obvious irreversibility: imposed by the additional 2nd law of thermodynamics on the macroscopic scale. As a cosmologist with an interest in the issue of the arrow of time, I was intrigued as to whether anything original could be further said on this long-standing issue. I was therefore pleasantly surprised by the overall ambition, breadth and scope of this book. The general contention is that we are led astray by theoretical studies of simple systems – searching for an elusive fundamental answer. Rather we would make more progress with computer simulations of more physically realistic cases in a somewhat similar fashion to how our understanding of Chaos was enhanced with computers than proceed to plot out, say, the strange attractors. In these realistic examples, we then generally observe that dissipation is an ubiquitous phenomenon giving entropy increase and so resulting in an overall irreversible behaviour.

The authors are able to run with this notion over a vast array of examples taken from mechanics, statistical mechanics, turbulence, shockwaves, etc. They particularly use the example of a Galton board to display many of the phenomena, including the phase-space collapse exemplifying dissipation. Along the way, many remarks and asides are very informative and will be of interest to a broad range of physicists.

I might just mention a few points of contention: along the way, they eschew the notion of initial conditions at the ‘big bang’ as being a possible solution to the problem. Although it is known that perpetually expanding models in classical general relativity can evade Poincaré recurrence – so the issue is somewhat more involved. I would also point out that in choosing a particular cosmological model to describe the universe, you are in some

sense taking an initial condition but it is, perhaps, of a more fundamental nature than what they have in mind.

They also briefly suggest that the extension to quantum mechanics should proceed in a similar fashion. Indeed, in say, the Caldeira–Leggett model of an open quantum system, dissipation occurs by interacting with an environment. But now the issue is also complicated by the requirement of quantum decoherence and further quantum interpretational issues. There could still be surprises in store before any final answers are obtained for this more general quantum case and similarly for any future quantum gravity description of nature.

Many of the Computer programs, written in fortran, are included within the text and competent readers should be able to transcribe them into other languages if necessary. An improvement might have been to make them available on a CD or on their website – <http://williamhoover.info/>, but this is a somewhat a minor oversight for an otherwise excellent book.

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Fluctuating Nonlinear Oscillators: From Nano-Mechanics to Quantum Superconducting Circuits, edited by Mark I. Dykman, Oxford, Oxford University Press, 2012, 432 pp., £65.00 (hardback), ISBN 978-0-19-969138-8. Scope: edited book. Level: postgraduate, researcher.

Rather unexpectedly, nonlinear oscillators have become quite a hot topic in condensed matter physics in the last decade and even more so in the last few years. To a large extent, this happened because of rapid experimental progress in nano-mechanical systems and solid-state quantum computing. Nonlinear resonators play a major role in these systems, so many researchers had to learn and understand the basic approaches to nonlinear oscillator dynamics. New experiments also posed new theoretical questions, many of them related to the role of classical and quantum fluctuations, especially near the bifurcation points. This has led to rapid progress in the field in recent years, which was also sped up by the importance of present-day and future applications.

This book presents a snapshot of the modern development in the field of fluctuating nonlinear resonators. There are 15 chapters written by the leading experts in the field; six of them are theoretical, eight of them discuss both theory and recent experiments and one chapter is mostly experimental. Each chapter is intended to be a concise

review of a sub-field, directly related to the research of its author(s), so that a reader can learn various subjects first-hand without needing to scan through many journal papers. Indeed, most chapters present well-written reviews, some of them in a quite pedagogical style, though some chapters look more like journal articles.

Almost half of the book (seven chapters out of 15) is devoted to superconducting systems based on Josephson junctions. Two chapters review the recent progress in nano- and micro-mechanical resonators, two chapters discuss resonators made of carbon nanotubes and graphene, one chapter is devoted to nano-magnetic oscillators and one chapter focuses on cold atom systems. Two of the theoretical chapters discuss the general properties of nonlinear oscillators, including quantum heating, quantum activation, power spectra and collective dynamics in arrays of nonlinear resonators. Even though each chapter is fully independent (in particular, notations in different chapters are different), the book to a significant extent feels unified, possibly due to significant communication between the authors and the Editor. The Editor's own research in the last four decades strongly affected the modern development of the field and this serves as one of the unifying themes of the book (the Editor also contributed a chapter to the book).

For me, personally, one of the most interesting subjects covered in five chapters of the book is the modern development of nearly quantum-limited microwave amplifiers based on Josephson junctions that include linear and bifurcation amplifiers. These amplifiers revolutionised the measurement of superconducting qubits in the last few years and will certainly have many applications in the future. The book is a convenient source to learn about the operational principles and various designs of such superconducting microwave amplifiers.

Overall, I think the book is very good and will be useful to many people, including experts and people who wish to learn about the modern developments in the field of nonlinear resonators, especially related to superconducting quantum computing, nano-mechanical resonators and carbon nanotube resonators. The book is well produced and it is certainly more pleasant to read than a multitude of original papers downloaded over the Internet. An added convenience is provided by the Index. Since the chapters review modern progress in the field, the book is mainly intended to be read within the next few years. However, I hope that at least a few chapters will remain interesting to readers for several decades.

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Fundamentals of Geophysical Fluid Dynamics, by James C. McWilliams, Cambridge, Cambridge University Press, 2011, 272 pp., £29.99 (paperback), ISBN 978-1-107-40408-3. Scope: textbook. Level: undergraduate students.

Geophysical fluid dynamics (GFD) is a topic taught in faculties for very different purposes and from different points of view. Do you need to teach a general course on GFD to undergraduates? Do you want the material packaged and ready to do it being sure that it is what you need? The book by James C. McWilliams, resulting from years of experience teaching and as a leading researcher in this field, is a great choice and tool. Not being a brand new text (the first edition was published in 2006), this paperback edition of 250 pages divided in six chapters (in fact can be considered five, as Chapter 1 is simply an eight-page introduction) and with a very competitive price, is ideal to show the fundamentals to beginners or to refresh your knowledge of the field. With the book, the student can perfectly follow the lessons. Moreover, it is a nice feature that this book is in some way 'alive' as McWilliams maintains in his web page a list of corrections to the text (not mentioned in the book), although this last edition is very improved with respect to the initial one and only a few are of application.

The book is shorter than the others, but this is the goal that McWilliams pursues. You are not going to find here encyclopaedic material, it is simply the material that you need for a short introductory course. Yet, some explanations with nice links to the basics of calculus are included. In this way, the student can make the connection with other courses. For those with need of additional enlightenment on punctual topics, the classical books with more profound or specific discussion are referenced. Of course, it is always hard to find the balance between what should be known and what needs to be explained, what to include or what to avoid. For example, you should not expect to find an application to the atmosphere of potential vorticity, but a simple explanation of what it is and its use along the text. Because of it, in some cases, the theory or concepts introduced could read slightly 'artificial', as for example the first time that a gravity wave is mentioned, but it is not a big problem.

A good part of GFD deals with atmospheres and oceans. Chapter 2 includes approximations to both and further along the text the examples deal with them, without missing the mathematical basis. It is a pity that at least in the version reviewed here, the figures are in grey scale instead of colour, as in full colour they are really nice.

There is no need for a full description of the index here. Anything that you could expect in this kind of book is included, from barotropic equations to baroclinic