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Book Review: *An Introduction to Stochastic Processes and Non-Equilibrium Statistical Physics*

An Introduction to Stochastic Processes and Non-Equilibrium Statistical Physics. Horacio S. Wio, World Scientific, Singapore, 1994.

There are many books on nonequilibrium statistical physics, although not specifically identified as such. The vastness of topics covered by this field makes it difficult to choose only one for use as an introductory text. The present book is a good choice for single book covering the field. As in any introduction to a general topic, some things are left out that might be desirable in an introductory text, but the material can be read on its own and, equally important, is written in a clear style.

The book is divided into six chapters. Chapter I introduces the theory of stochastic processes, which is the major tool for studying fluctuations in physical systems. This introduction is brief, but includes the main features required in the next chapters. The examples include a brief summary of the physics that motivates the mathematical tools discussed. The section on van Kampen's Ω-expansion is written in a particularly clear and lucid style. The second chapter contains a derivation of kinetic equations from the BBKGY hierarchy. A short discussion of the reduced density operator is devoted to quantum systems. Appendices to the first two chapters develop topics related to those discussed in the body of the text. For example, one of the appendices presents examples of the calculation of transport coefficients. The third chapter considers the departure of a system from equilibrium making use of Onsager's ideas on the subject. The Onsager relations are studied in numerous examples. The chapter ends with an explanation of the minimum production entropy theorem. The framework of linear response theory is introduced in the fourth chapter after a discussion of some general properties of the self-correlation function. The famous fluctuation-dissipation theorem is dealt with in some generality in the framework of this theory. Some references to quantum systems are also included. Chapter V deals with systems far from equilibrium which cannot

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be described by Onsager's theory. Nonequilibrium phenomena emerge in fields as disparate as chemistry and sociology. The analysis of these systems demands new tools that are explained through examples. The control of the evolution of a system by an external parameter is analyzed, as well as the influence of external fluctuations of this parameter on the macroscopic behavior. Finally, in the last chapter, the formation and propagation of patterns in far-from-equilibrium systems is discussed by using a reaction–diffusion model. Despite the relative simplicity of the model, it illustrates the main features of pattern formation and even gives insights into the propagation of such patterns.

The text is suitable for undergraduate students in the last year and graduate students. They will find in it a suggestive introduction that motivates them to dig deeper into the field and to look for those topics omitted from the text. A selected bibliography for each chapter is a suggested guide for further readings. As is the case with most introductory textbooks, this one presents only a few out of a huge number of subjects which qualify for inclusion under the general heading of nonequilibrium processes, but the elements included are explained in a concise and suggestive style. There are occasional misprints that may confuse the reader, but they will become obvious when one pursues the specifics of the material. Although many examples accompany the questions discussed, I feel that a set of problems would have reinforced the introductory character of the book. In summary, the book is highly recommended to anyone interested in becoming acquainted with nonequilibrium statistical physics.

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