Preface

Statistical Mechanics is one of the strong pillars on which the house of physics stands. It is the branch of theoretical physics that deals with the bulk properties of systems composed of very many constituents. Statistical and probabilistic reasoning are the central tools that link the microscopic dynamics to the concepts of thermodynamics that provide the adequate description of the bulk properties.

These *Lectures on Statistical Mechanics* grew out of a set of lecture notes for a fourth-year undergraduate course that I taught at the National University of Singapore in recent years. The presentation is rather detailed and does not skip intermediate steps that — as experience shows — are not so obvious for the learning student.

Prior to this course, students would have gone through a second-year course on thermodynamics with a glimpse at statistical mechanics. Therefore, the review of basic thermodynamics at the beginning of these lecture notes omits some standard material, such as heat engines or the various equivalent versions of the Second Law, and emphasizes topics that relate more closely to the subsequent chapters on statistical mechanics proper.

While I was not following any particular textbook when preparing these lectures, I was certainly influenced by the splendid books on my shelf, in particular *Equilibrium and Non-Equilibrium Statistical Thermodynamics* by Michel Le Bellac, Fabrice Mortessagne, and G. George Batrouni, *Theorie der Wärme* by Richard Becker, *Thermodynamics and an Introduction to Thermostatistics* by Herbert B. Callen, *Introduction to Modern Statistical Mechanics* by David Chandler, *Thermodynamics and Statistical Physics* by Robert J. Finkelstein, *Statistical Mechanics* by Kerson Huang, *Statistical Mechanics* by Ryogo Kubo, *Statistical Physics* by Lev D. Landau and Evgeny M. Lifshitz, *Statistical Mechanics* by Raj K. Pathria and

Paul D. Beale, *Elements of Classical Thermodynamics for Advanced Students of Physics* by A. Brian Pippard, and *Thermodynamics and Statistical Mechanics* by Arnold Sommerfeld.

A set of lecture notes is not a monograph on the subject and is not meant to be one. Rather, its purpose is to give a solid introduction and prepare the student for further studies on her own. Accordingly, there is no ambition of, and no attempt at, treating each and every aspect of statistical mechanics in these notes — they just represent what I could and would deal with in one semester. The material of this book is my personal selection for that one-semester fourth-year course, presented in full during twenty-two two-hour lectures. Other lecturers will surely omit some of the material of my choice in favor of topics that I did not choose to include.

The feedback I received from students in class, from the Ph.D. students and postdoctoral fellows who conducted tutorial sessions, and from colleagues in Singapore and elsewhere was invaluable and led to many improvements of the text. While I am much obliged to all of them, I can only name a few: Georges BATROUNI, Ulrike BORNHEIMER, HAN Rui, Jun Hao HUE, LEN Yink Loong, Christian MINIATURA, Hui Khoon NG, Mikołaj PARANIAK, Jiaan QI, SEAH Yi-Lin, SHANG Jiangwei, SIM Jun Yan and Martin-Isbjörn TRAPPE, represent this large crowd.

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Ian ANG Xing Yang and Darren TEO Kar Seng typed the original set of notes and thus produced the electronic version that I could then work on; LIM Zheng Liang and CHAI Jing Hao helped me much in getting the text into shape. I thank them cordially.

This book would not exist without the outstanding teachers, colleagues, and students who taught me so much. I dedicate these lectures to them.

I wish to thank my dear wife Ola for her continuing understanding and patience by which she is giving me the peace of mind that is the source of all achievements.

Singapore, June 2020 *BG Englert*