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Book Review: *Statistical Mechanics Made Simple*

Statistical Mechanics Made Simple. Daniel C. Mattis, World Scientific Publishing Co., Singapore, 2003.

This book is a personal guide for students and researchers by an author who has contributed significantly to several topics in statistical mechanics. Much of his work focused on spin systems including the two-dimensional Ising model.

Chapter 1 on Elementary Concepts in Statistics and Probability has nice discussions of the central limit theorem and multinomial distributions. Chapter 2 on The Ising Model and the Lattice Gas presents a brief discussion of some thermodynamic concepts and mean-field theory. My first quibble concerning this book involves Chapter 3 on the Elements of Thermodynamics where the author starts by considering thermodynamics as a study of coupled partial differential equations instead of an extremely sophisticated description of macroscopic systems in equilibrium. There is a brief discussion of the three laws of thermodynamics again without presenting sufficient physical insight.

Chapter 4 on Statistical Mechanics again jumps into the fray without proper background although it does provide a nice discussion of the Gibbs paradox and Gibbs's brilliant solution to the problem. There is a discussion of non-ideal gases and 2-body correlation functions. The nice feature of this chapter is the examination of configurational partition functions in one, two and three dimensions.

Chapter 5 is entitled The World of Bosons and discusses conserved and non-conserved bosonic systems, specifically photons, phonons, and ferromagnons, and superfluid Helium. Again, the presentation comes alive when spin systems are described.

The content of Chapter 6 is adequately described by its title: All About Fermions: Theories of Metals, Superconductors, Semiconductors. There is a nice description of Cooper pairs and the BCS theory.

Chapter 7 is entitled: Kinetic Theory. There is special emphasis on the classical and quantum Boltzmann equations and their applications but no

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insight is given as to when these equations are valid and what the corrections to them are like. There is an application to the propagation of sound waves in fluids.

By far the best chapter in the book is Chapter 8 on The Transfer Matrix. There is emphasis placed on thermal zippers and applications to the Ising model and its phase transitions, frustration, and spin glasses. The author's expertise and enthusiasm for this area are apparent, and there are interesting physical insights.

The final chapter, Chapter 9, is entitled: Some Uses of Quantum Field Theory in Statistical Physics. There are applications to diffusion on lattices and long-range order. In particular, there is a nice discussion of the Mermin-Wagner theorem. There are sections on the Bogoliubov inequality, correlation functions, and thermodynamic Green's functions.

While Chapters 1–7 are more or less pedestrian in nature, Chapters 8 and 9 capture the author's excitement and deep knowledge and insight into the topics discussed. While I cannot recommend this book as a text for either an undergraduat or graduate course, I can recommend it to researchers in the field who will enjoy reading Chapters 8 and 9 for the author's insightful comments.

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