

Book Review: *Methods of Statistical Physics*

Methods of Statistical Physics. Tomoyasu Tanaka, Cambridge University Press, Cambridge, 2002

This book is intended to be a textbook for beginning graduate students. but it is more suitable as a monograph on the cluster variation method. There are introductory chapters on thermodynamics (Chapters 1 and 2) and statistical mechanics (Chapters 3–5). Neither of these introductions is completely satisfactory since the author confuses quasistatic and reversible processes and ensembles and assemblies.

The centerpiece of the book is Chapter 6 on the cluster variation method. This method was invented by R. Kikuchi in 1951 and extended by Tohru Tomita and the present author. One of the advantages of this method is that it is amenable to calculation by computer and is expressible in straightforward diagrams. The aim of this chapter and the subsequent chapters is to calculate correlation functions in a variety of systems.

Chapter 7 is devoted to infinite-series representations of correlation functions, and it is claimed that the most accurate critical point exponents can be obtained from the cluster variation method. Chapter 8 is devoted to the extended mean field approximation. The BCS theory is discussed as is the spin wave Hamiltonian for the Heisenberg ferromagnet. The claim is made that since the Hamiltonians for these systems satisfy the Wentzel criteria, the mean field theory gives exact results for these systems. Chapter 9 on Exact Ising lattice identities again uses the cluster variation method as does Chapter 10 on the propagation of short-range order and Chapter 11 on the phase transition of the two-dimensional Ising model.

There are many modern developments in statistical mechanics that are not discussed in this book. It is difficult to say who will find this book useful although some may find it of historical interest.

As a personal note, I knew Kikuchi well when he was developing his method, and it was considered to be quite exciting at the time.

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