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Book Review: *Fundamental Problems in Statistical Mechanics VII*

Fundamental Problems in Statistical Mechanics VII. H. van Beijeren, North-Holland, Amsterdam, 1990.

This book contains the Proceedings of the Seventh International Summer School on Fundamental Problems in Statistical Mechanics, held at Altenberg, Germany, June 18–30, 1989. The organizers succeeded in putting together an excellent program, with many of the best people from the respective fields.

The largest chunk of material deals with recent advances in the theory of critical phenomena. The contribution by H. Knops introduces the applications of conformal invariance for two-dimensional systems at criticality. The important developments which took place in this field in the 1980s require the use of sophisticated mathematics. Furthermore, one works with continuum models, which to the novice in this field will be less familiar than lattice models. In this respect, Knops does an excellent job in introducing the fundamental ideas of the theory of conformal invariance for a reader with a knowledge of the renormalization group. In the contribution by Bernard Nienhuis we learn how simple lattice models can lead to a determination of universal properties of polymers. The link with critical phenomena is made very clear. The sections by Knops and Nienhuis serve as a basis for the one on renormalization and conformal invariance for polymers written by B. Duplantier. Again, this chapter is very well written and contains interesting material, such as how to renormalize the Edwards model or how to determine many exact critical properties of two-dimensional polymers using the Coulomb gas technique. Besides these developments in the theory of critical phenomena for two-dimensional systems, another topic of great interest is the behavior of interfaces and surfaces. The former play an essential role in, for example, wetting phenomena, while the latter occur in the study of membranes and vesicles. Richard Lipowski introduces the essential ideas in the description of the shape fluctuations of these structures and then discusses in more detail interfaces in quasicrystals, and unbinding transitions. R. B. Griffiths treats the

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Frenkel–Kontorova models for commensurate–incommensurate transitions. This paper also includes a rather detailed guide to the literature of this field.

Kinetic theory used to be the main topic in the first volumes of *Fundamental Problems in Statistical Mechanics*, edited by Uhlenbeck *et al.* back in the 1950s and 1960s. This Proceedings contains three papers related to kinetic theory. H. van Beijeren discusses the kinetic theory of dense gases and liquids. In fact, he presents calculations for an Enskog-type kinetic equation modeling a square-well fluid. The equations are hard work, as one would expect. The contribution by D. Frenkel and M. van der Hoef is particularly interesting because it demonstrates that the computer in capable hands has become the best "experimental" tool in kinetic theory. The paper recounts how the long-time tails of the velocity correlation for a lattice gas can be determined with stunning accuracy, and found to be in agreement with the predictions of mode-coupling theory. M. H. Ernst introduces us to the linear response theory for cellular automata fluids, whose study has been boosted by the promise of very precise computer simulations such as those of Frenkel *et al.*

The contributions by B. Derrida and by J. J. P. Veerman and M. J. Feigenbaum present innovative advances in statistical mechanics. These papers do not require a lot of prior knowledge. B. Derrida talks about dynamical phase transitions. The discussion of the properties of the Kaufmann model is particularly interesting. The paper by J. J. P. Veerman and M. J. Feigenbaum introduces a thermodynamic formalism for dynamical systems that possess scaling properties.

Finally, we mention the contributions by H. J. Hilhorst on the theory of aging in spin glasses, a discussion by E. G. D. Cohen and A. Monge of the apparent violation of the zeroth law of thermodynamics by a one-dimensional system of diatomic molecules, a review by H. Z. Cummins of the pattern-forming instabilities in crystal growth, and a discussion of the nice but difficult theory of hydrodynamics of suspensions by B. U. Felderhof.

To conclude, the papers presented in this Proceedings are of a uniformly high level both in quality of presentation and content. Unfortunately, this does not imply that the reading is easy. The topics are advanced, at research level, and a nonspecialist may need a more introductory textbook before he or she can consult some of the material in this book.

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