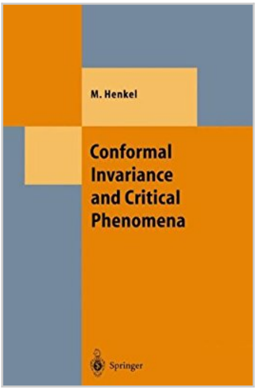

Conformal Invariance and Critical Phenomena (Theoretical and Mathematical Physics)

By Malte Henkel

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Critical phenomena arise in a wide variety of physical systems. Classi cal examples are the liquid-vapour critical point or the paramagnetic ferromagnetic transition. Further examples include multicomponent fluids and alloys, superfluids, superconductors, polymers and fully developed tur bulence and may even extend to the quark-gluon plasma and the early uni verse as a whole. Early theoretical investigators tried to reduce the problem to a very small number of degrees of freedom, such as the van der Waals equation and mean field approximations, culminating in Landau's general theory of critical phenomena. Nowadays, it is understood that the common ground for all these phenomena lies in the presence of strong fluctuations of infinitely many coupled variables. This was made explicit first through the exact solution of the two-dimensional Ising model by Onsager. Systematic subsequent developments have been leading to the scaling theories of critical phenomena and the renormalization group which allow a precise description of the close neighborhood of the critical point, often in good agreement with experiments. In contrast to the general understanding a century ago, the presence of fluctuations on all length scales at a critical point is emphasized today. This can be briefly summarized by saying that at a critical point a system is scale invariant. In addition, conformal invaTiance permits also a non-uniform, local rescal ing, provided only that angles remain unchanged.

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Editorial Review

From the Back Cover
This book provides an introduction to conformal field theory and a review of its applications to critical phenomena in condensed-matter systems. After reviewing simple phase transitions and explaining the foundations of conformal invariance and the algebraic methods required, it proceeds to the explicit calculation of four-point correlators. Numerical methods for matrix diagonalization are described as well as finite-size scaling techniques and their conformal extensions. Many exercises are included. Applications treat the Ising, Potts, chiral Potts, Yang-Lee, percolation and XY models, the XXZ chain, linear polymers, tricritical points, conformal turbulence, surface criticality and profiles, defect lines and aperiodically modulated systems, persistent currents and dynamical scaling. The vicinity of the critical point is studied culminating in the exact solution of the two-dimensional Ising model at the critical temperature in a magnetic field. Relevant experimental results are also reviewed.

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