Introduction To Phase Transitions And Critical Phenomena International Series Of Monographs On Physics

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Nonequilibrium Phase Transitions in Lattice Models
Phase Transitions in Combinatorial Optimization Problems
Hysteresis and Phase Transitions
Statistical Mechanics of Phase Transitions
Phase Transitions in Materials
Quantum Phase Transitions
Phase Transitions For Beginners
Scale Invariance
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Equilibrium Statistical Physics
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Nonequilibrium Phase Transitions in Lattice Models

This is a textbook which gradually introduces the student to the statistical mechanical study of the different phases of matter and to the phase transitions between them. Throughout, only simple models of both ordinary and soft matter are used but these are studied in full detail. The subject is developed in a pedagogical manner, starting from the basics, going from the simple ideal systems to the interacting systems, and ending with the more modern topics. The textbook provides the student with a complete overview, intentionally at an introductory level, of the theory of phase transitions. All equations and deductions are included.

Phase Transitions in Combinatorial Optimization Problems

This book occupies an important place at the crossroads of several fields central to materials sciences. The expanded second edition incorporates new developments in the states of matter physics, and includes end-of-
Hysteresis and Phase Transitions

This book provides an introduction to nonequilibrium statistical physics via lattice models. Beginning with an introduction to the basic driven lattice gas, the early chapters discuss the relevance of this lattice model to certain natural phenomena and examine simulation results in detail. Several possible theoretical approaches to the driven lattice gas are presented. In the next two chapters, absorbing-state transitions are discussed in detail. The later chapters examine a variety of systems subject to dynamic disorder before returning to look at the more surprising effects of multiparticle rules, nonunique absorbing-states and conservation laws. Examples are given throughout the book, the emphasis being on using simple representations of nature to describe ordering in real systems. The use of methods such as mean-field theory, Monte Carlo simulation, and the concept of universality to study and interpret these models is described. Detailed references are included.

Statistical Mechanics of Phase Transitions

Continuum Models for Phase Transitions and Twinning in Crystals presents the fundamentals of a remarkably successful approach to crystal thermomechanics. Developed over the last two decades, it is based on the mathematical theory of nonlinear thermoelasticity, in which a new viewpoint on material symmetry, motivated by molecular theories, plays a central role. This is the first organized presentation of a nonlinear elastic approach to twinning and displacive phase transition in crystalline solids. The authors develop geometry, kinematics, and energy invariance in crystals in strong connection and with the purpose of investigating the actual mechanical aspects of the phenomena, particularly in an elastostatics framework based on the minimization of a thermodynamic potential. Interesting for both mechanics and mathematical analysis, the new theory offers the possibility of investigating the formation of microstructures in materials undergoing martensitic phase transitions, such as shape-memory alloys. Although phenomena such as twinning and phase transitions were once thought to fall outside the range of elastic models, research efforts in these areas have proved quite fruitful. Relevant to a variety of disciplines, including mathematical physics, continuum mechanics, and materials science, Continuum Models for Phase Transitions and Twinning in Crystals is your opportunity to explore these current research methods and topics.

Phase Transitions in Materials

Providing a comprehensive introduction with the necessary background material to make it accessible for a wide scientific audience, Kinetics of Phase Transitions discusses developments in domain-growth kinetics. This book combines pedagogical chapters from leading experts in this
area and focuses on incorporating various experimentally relevant effects—such as disorder, strain fields, and wetting surfaces—into studies of phase ordering dynamics. In addition, it highlights topics garnering recent interest, such as the growth of nanostructures on surfaces. This book also provides a comprehensive overview of numerical techniques, which have proven useful in studying these complex nonlinear problems.

**Quantum Phase Transitions**

This textbook describes the fundamental principles of structural phase transitions in materials in an easily understandable form, suitable for both undergraduate and graduate students.

**Phase Transitions For Beginners**

Describing the physical properties of quantum materials near critical points with long-range many-body quantum entanglement, this book introduces readers to the basic theory of quantum phases, their phase transitions and their observable properties. This second edition begins with a new section suitable for an introductory course on quantum phase transitions, assuming no prior knowledge of quantum field theory. It also contains several new chapters to cover important recent advances, such as the Fermi gas near unitarity, Dirac fermions, Fermi liquids and their phase transitions, quantum magnetism, and solvable models obtained from string theory. After introducing the basic theory, it moves on to a detailed description of the canonical quantum-critical phase diagram at non-zero temperatures. Finally, a variety of more complex models are explored. This book is ideal for graduate students and researchers in condensed matter physics and particle and string theory.

**Scale Invariance**

The Physics of Phase Transitions occupies an important place at the crossroads of several fields central to materials sciences. This second edition incorporates new developments in the states of matter physics, in particular in the domain of nanomaterials and atomic Bose-Einstein condensates where progress is accelerating. New information and application examples are included. This work deals with all classes of phase transitions in fluids and solids, containing chapters on evaporation, melting, solidification, magnetic transitions, critical phenomena, superconductivity, and more. End-of-chapter problems and complete answers are included.

**Gibbs Measures and Phase Transitions**

Covering the elementary aspects of the physics of phases transitions and the renormalization group, this popular book is widely used both for core graduate statistical mechanics courses as well as for more specialized courses. Emphasizing understanding and clarity rather than technical
manipulation, these lectures de-mystify the subject and show precisely "how things work." Goldenfeld keeps in mind a reader who wants to understand why things are done, what the results are, and what in principle can go wrong. The book reaches both experimentalists and theorists, students and even active researchers, and assumes only a prior knowledge of statistical mechanics at the introductory graduate level. Advanced, never-before-printed topics on the applications of renormalization group far from equilibrium and to partial differential equations add to the uniqueness of this book.

**Equilibrium Statistical Physics**

Describing the physical properties of quantum materials near critical points with long-range many-body quantum entanglement, this book introduces readers to the basic theory of quantum phases, their phase transitions and their observable properties. This second edition begins with a new section suitable for an introductory course on quantum phase transitions, assuming no prior knowledge of quantum field theory. It also contains several new chapters to cover important recent advances, such as the Fermi gas near unitarity, Dirac fermions, Fermi liquids and their phase transitions, quantum magnetism, and solvable models obtained from string theory. After introducing the basic theory, it moves on to a detailed description of the canonical quantum-critical phase diagram at non-zero temperatures. Finally, a variety of more complex models are explored. This book is ideal for graduate students and researchers in condensed matter physics and particle and string theory.

**Reconstructive Phase Transitions**

Phase transitions typically occur in combinatorial computational problems and have important consequences, especially with the current spread of statistical relational learning as well as sequence learning methodologies. In Phase Transitions in Machine Learning the authors begin by describing in detail this phenomenon, and the extensive experimental investigation that supports its presence. They then turn their attention to the possible implications and explore appropriate methods for tackling them. Weaving together fundamental aspects of computer science, statistical physics and machine learning, the book provides sufficient mathematics and physics background to make the subject intelligible to researchers in AI and other computer science communities. Open research issues are also discussed, suggesting promising directions for future research.

**Synergetics**

This book deals with the phenomenological theory of first-order structural phase transitions, with a special emphasis on reconstructive transformations in which a group-subgroup relationship between the symmetries of the phases is absent. It starts with a unified presentation of
the current approach to first-order phase transitions, using the more recent results of the Landau theory of phase transitions and of the theory of singularities. A general theory of reconstructive phase transitions is then formulated, in which the structures surrounding a transition are expressed in terms of density-waves, providing a natural definition of the transition order-parameters, and a description of the corresponding phase diagrams and relevant physical properties. The applicability of the theory is illustrated by a large number of concrete examples pertaining to the various classes of reconstructive transitions: allotropic transformations of the elements, displacive and order-disorder transformations in metals, alloys and related structures, crystal-quasicrystal transformations.

Lectures On Phase Transitions And The Renormalization Group

Quantum phase transitions (QPTs) offer wonderful examples of the radical macroscopic effects inherent in quantum physics: phase changes between different forms of matter driven by quantum rather than thermal fluctuations, typically at very low temperatures. QPTs provide new insight into outstanding problems such as high-temperature superconditivit

Introduction to phase transitions and critical phenomena

From a review of the first edition: "This book [...] covers in depth a broad range of topics in the mathematical theory of phase transition in statistical mechanics. [...] It is in fact one of the author's stated aims that this comprehensive monograph should serve both as an introductory text and as a reference for the expert." (F. Papangelou, Zentralblatt MATH) The second edition has been extended by a new section on large deviations and some comments on the more recent developments in the area.

Phase Transitions in Liquid Crystals

The book provides an introduction to the physics which underlies phase transitions and to the theoretical techniques currently at our disposal for understanding them. It will be useful for advanced undergraduates, for post-graduate students undertaking research in related fields, and for established researchers in experimental physics, chemistry, and metallurgy as an exposition of current theoretical understanding. -

Recent developments have led to a good understanding of universality; why phase transitions in systems as diverse as magnets, fluids, liquid crystals, and superconductors can be brought under the same theoretical umbrella and well described by simple models. This book describes the physics underlying universality and then lays out the theoretical approaches now available for studying phase transitions. Traditional techniques, mean-field theory, series expansions, and the transfer matrix, are described; the Monte Carlo method is covered, and two chapters are devoted to the renormalization group, which led to a break-through in the field. The book will be useful as a textbook for a course in `Phase
Transitions', as an introduction for graduate students undertaking research in related fields, and as an overview for scientists in other disciplines who work with phase transitions but who are not aware of the current tools in the armoury of the theoretical physicist. -

Introduction; Statistical mechanics and thermodynamics; Models; Mean-field theories; The transfer matrix; Series expansions; Monte Carlo simulations; The renormalization group; Implementations of the renormalization group.

Theory of Phase Transitions

The Physics of Phase Transitions

First published in 1971, this highly popular text is devoted to the interdisciplinary area of critical phenomena, with an emphasis on liquid-gas and ferromagnetic transitions. Advanced undergraduate and graduate students in thermodynamics, statistical mechanics, and solid state physics, as well as researchers in physics, mathematics, chemistry, and materials science, will welcome this paperback edition of Stanley's acclaimed text.

Phase Transitions

This book provides a comprehensive introduction to the theory of phase transitions and critical phenomena. The content covers a period of more than 100 years of theoretical research of condensed matter phases and phase transitions providing a clear interrelationship with experimental problems. It starts from certain basic University knowledge of thermodynamics, statistical physics and quantum mechanics. The text is illustrated with classic examples of phase transitions. Various types of phase transition and (multi)critical points are introduced and explained. The classic aspects of the theory are naturally related with the modern developments. This interrelationship and the field-theoretical renormalization group method are presented in details. The main applications of the renormalization group methods are presented. Special attention is paid to the description of quantum phase transitions. This edition contains a more detailed presentation of the renormalization group method and its applications to particular systems.

Equilibrium Statistical Physics

Phase Transitions in Foods, Second Edition, assembles the most recent research and theories on the topic, describing the phase and state transitions that affect technological properties of biological materials occurring in food processing and storage. It covers the role of water as a plasticizer, the effect of transitions on mechanical and chemical changes, and the application of modeling in predicting stability rates of change. The volume presents methods for detecting changes in the physical state and various techniques used to analyze phase behavior of biopolymers and
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food components. It should become a valuable resource for anyone involved with food engineering, processing, storage, and quality, as well as those working on related properties of pharmaceuticals and other biopolymers. Contains descriptions of non-fat food solids as "biopolymers" which exhibit physical properties that are highly dependent on temperature, time, and water content. Details the effects of water on the state and stability of foods. Includes information on changes occurring in state and physicochemical properties during processing and storage. The only book on phase and state transitions written specifically for the applications in food industry, product development, and research.

**The Physics of Phase Transitions**

This book introduces new concepts in the phenomenon of 1st order phase transitions. It discusses the concept of kinetic arrest at a certain temperature, with this temperature being dependent on the second control variable (magnetic field, or pressure). It discusses interesting manifestations of this phenomenon when the 1st order transition is broadened, i.e. occurs over a finite range of temperatures. Many examples of this phenomenon, observed recently in many materials, will also be discussed.

**Microcanonical Thermodynamics: Phase Transitions In "Small" Systems**

The physics of phase transitions is an important area at the crossroads of several fields that play central roles in materials sciences. This work deals with broad classes of phase transitions in fluids and solids. It contains chapters on evaporation, melting, solidification, magnetic transitions, critical phenomena, superconductivity, etc., and is intended for graduate students in physics and engineering; for scientists it will serve both as an introduction and an overview. End-of-chapter problems and complete answers are included.

**Introduction to Phase Transitions and Critical Phenomena**

This is a textbook which gradually introduces the student to the statistical mechanical study of the different phases of matter and to the phase transitions between them. Throughout, only simple models of both ordinary and soft matter are used but these are studied in full detail. The subject is developed in a pedagogical manner, starting from the basics, going from the simple ideal systems to the interacting systems, and ending with the more modern topics. The textbook provides the student with a complete overview, intentionally at an introductory level, of the theory of phase transitions. All equations and deductions are included.

**Equilibrium Statistical Physics**

A clear, concise and rigorous textbook covering phase transitions in the
context of advances in electronic structure and statistical mechanics.

**Statistical Mechanics of Lattice Systems**

The publication of this second edition was motivated by several facts. First of all, the first edition had been sold out in less than one year. It had found excellent critics and enthusiastic responses from professors and students welcoming this new interdisciplinary approach. This appreciation is reflected by the fact that the book is presently translated into Russian and Japanese also. I have used this opportunity to include some of the most interesting recent developments. Therefore I have added a whole new chapter on the fascinating and rapidly growing field of chaos dealing with irregular motion caused by deterministic forces. This kind of phenomenon is presently found in quite diverse fields ranging from physics to biology. Furthermore I have included a section on the analytical treatment of a morphogenetic model using the order parameter concept developed in this book. Among the further additions, there is now a complete description of the onset of ultrashort laser pulses. It goes without saying that the few minor misprints or errors of the first edition have been corrected. I wish to thank all who have helped me to incorporate these additions.

**Kinetics of Phase Transitions**

About half a century ago Landau formulated the central principles of the phenomenological second-order phase transition theory which is based on the idea of spontaneous symmetry breaking at phase transition. By means of this approach it has been possible to treat phase transitions of different nature in altogether distinct systems from a unified viewpoint, to embrace the aforementioned transitions by a unified body of mathematics and to show that, in a certain sense, physical systems in the vicinity of second-order phase transitions exhibit universal behavior. For several decades the Landau method has been extensively used to analyze specific phase transitions in systems and has been providing a basis for interpreting experimental data on the behavior of physical characteristics near the phase transition, including the behavior of these characteristics in systems subject to various external effects such as pressure, electric and magnetic fields, deformation, etc. The symmetry aspects of Landau's theory are perhaps most effective in analyzing phase transitions in crystals because the relevant body of mathematics for this symmetry, namely, the crystal space group representation, has been worked out in great detail. Since particular phase transitions in crystals often call for a subtle symmetry analysis, the Landau method has been continually refined and developed over the past ten or fifteen years.

**Continuum Models for Phase Transitions and Twinning in Crystals**

A concise, comprehensive introduction to the topic of statistical physics of
combinatorial optimization, bringing together theoretical concepts and
algorithms from computer science with analytical methods from physics. The result bridges the gap between statistical physics and combinatorial
optimization, investigating problems taken from theoretical computing,
such as the vertex-cover problem, with the concepts and methods of
theoretical physics. The authors cover rapid developments and analytical
methods that are both extremely complex and spread by word-of-mouth,
providing all the necessary basics in required detail. Throughout, the
algorithms are shown with examples and calculations, while the proofs are
given in a way suitable for graduate students, post-docs, and researchers.
Ideal for newcomers to this young, multidisciplinary field.

**Kinetics of First Order Phase Transitions**

**The Physics of Phase Transitions**

The Nato Advanced Study Institute "Phase Transitions in Liquid Crystals"
was held May 2-12, 1991, in Erice, Sicily. This was the 16th conference
organized by the International School of Quantum Electronics, under the
auspices of the "Ettore Majorana" Centre for Scientific Culture. The
subject of "Liquid Crystals" has made amazing progress since the last
ISQE Course on this subject in 1985. The present Proceedings give a
tutorial introduction to today's most important areas, as well as a review
of current results by leading researchers. We have brought together some
of the world's acknowledged experts in the field to summarize both the
present state of their research and its background. Most of the lecturers
attended all the lectures and devoted their spare hours to stimulating
discussions. We would like to thank them all for their admirable
contributions. The Institute also took advantage of a very active audience;
mOST of the students were active researchers in the field and contributed
with discussions and seminars. Some of these student seminars are also
included in these Proceedings. We did not modify the original
manuscripts in editing this book, but we did group them according to the
following topics: 1) "Theoretical Foundations"; 2) "Thermotropic Liquid
Crystals"; 3) "Ferroelectric Liquid Crystals"; 4) "Polymeric Liquid
Crystals"; and 5) "Lyotropic Liquid Crystals".

**Phase Transition Dynamics**

No further information has been provided for this title.

**Phase Transitions and Renormalization Group**

During a century, from the Van der Waals mean field description (1874) of
gases to the introduction of renormalization group (RG techniques 1970),
thermodynamics and statistical physics were just unable to account for
the incredible universality which was observed in numerous critical
phenomena. The great success of RG techniques is not only to solve
perfectly this challenge of critical behaviour in thermal transitions but to introduce extremely useful tools in a wide field of daily situations where a system exhibits scale invariance. The introduction of scaling, scale invariance and universality concepts has been a significant turn in modern physics and more generally in natural sciences. Since then, a new "physics of scaling laws and critical exponents", rooted in scaling approaches, allows quantitative descriptions of numerous phenomena, ranging from phase transitions to earthquakes, polymer conformations, heartbeat rhythm, diffusion, interface growth and roughening, DNA sequence, dynamical systems, chaos and turbulence. The chapters are jointly written by an experimentalist and a theorist. This book aims at a pedagogical overview, offering to the students and researchers a thorough conceptual background and a simple account of a wide range of applications. It presents a complete tour of both the formal advances and experimental results associated with the notion of scaling, in physics, chemistry and biology.

**Phase Transitions in Foods**

Hysteresis is an exciting and mathematically challenging phenomenon that occurs in rather different situations: it can be a byproduct of fundamental physical mechanisms (such as phase transitions) or the consequence of a degradation or imperfection (like the play in a mechanical system), or it is built deliberately into a system in order to monitor its behaviour, as in the case of the heat control via thermostats. The delicate interplay between memory effects and the occurrence of hysteresis loops has the effect that hysteresis is a genuinely nonlinear phenomenon which is usually non-smooth and thus not easy to treat mathematically. Hence it was only in the early seventies that the group of Russian scientists around M. A. Krasnoselskii initiated a systematic mathematical investigation of the phenomenon of hysteresis which culminated in the fundamental monograph Krasnoselskii-Pokrovskii (1983). In the meantime, many mathematicians have contributed to the mathematical theory, and the important monographs of I. Mayergoyz (1991) and A. Visintin (1994a) have appeared. We came into contact with the notion of hysteresis around the year 1980.

**Introduction to the Theory of Critical Phenomena**

This book is an introduction to a comprehensive and unified dynamic transition theory for dissipative systems and to applications of the theory to a range of problems in the nonlinear sciences. The main objectives of this book are to introduce a general principle of dynamic transitions for dissipative systems, to establish a systematic dynamic transition theory, and to explore the physical implications of applications of the theory to a range of problems in the nonlinear sciences. The basic philosophy of the theory is to search for a complete set of transition states, and the general principle states that dynamic transitions of all dissipative systems can be classified into three categories: continuous, catastrophic and random. The audience for this book includes advanced graduate students and
researchers in mathematics and physics as well as in other related fields.

**Quantum Phase Transitions**

Written by an experimentalist famous for his discovery of stishovite, with vast experience in phase transition studies, this book is devoted to a description of the continuous and discontinuous phase transitions. It includes chapters outlining the Van der Waals model, hard sphere and soft sphere models of melting, scaling phenomena, renormgroup approach to phase transitions, and experimental examples to illustrate various phase transitions. Unlike conventional books covering the same topic, this is meant for undergraduate students and experimentalists to understand basic concepts in the physics of phase transitions.

**Phase Transitions in Ferroelastic and Co-elastic Crystals**

Filling a gap in the literature, this crucial publication on the renowned Lifshitz-Slezov-Wagner Theory of first-order phase transitions is authored by one of the scientists who gave it its name. Prof Slezov spent decades analyzing this topic and obtained a number of results that form the cornerstone of this rapidly developing branch of science. Following an analysis of unresolved problems together with proposed solutions, the book develops a theoretical description of the overall course of first-order phase transformations, starting from the nucleation state right up to the late stages of coarsening. In so doing, the author illustrates the results by way of numerical computations and experimental applications. The outline of the general results is performed for segregation processes in solutions and the results used in the analysis of a variety of different topics, such as phase formation in multi-component solutions, boiling in one- and multi-component liquids, vacancy cluster evolution in solids with and without influence of radiation, as well as phase separation in helium at low temperatures. The result is a detailed overview of the theoretical description of the whole course of nucleation-growth processes and applications for a wide audience of scientists and students.

**Understanding Quantum Phase Transitions**

Boltzmann's formula $S = \ln[W(E)]$ defines the microcanonical ensemble. The usual textbooks on statistical mechanics start with the microensemble but rather quickly switch to the canonical ensemble introduced by Gibbs. This has the main advantage of easier analytical calculations, but there is a price to pay — for example, phase transitions can only be defined in the thermodynamic limit of infinite system size. The question how phase transitions show up from systems with, say, 100 particles with an increasing number towards the bulk can only be answered when one finds a way to define and classify phase transitions in small systems. This is all possible within Boltzmann's original definition of the microcanonical ensemble. Starting from Boltzmann's formula, the book formulates the microcanonical thermodynamics entirely within the
frame of mechanics. This way the thermodynamic limit is avoided and the formalism applies to small as well to other nonextensive systems like gravitational ones. Phase transitions of first order, continuous transitions, critical lines and multicritical points can be unambiguously defined by the curvature of the entropy $S(E,N)$. Special attention is given to the fragmentation of nuclei and atomic clusters as a peculiar phase transition of small systems controlled, among others, by angular momentum. The dependence of the liquid-gas transition of small atomic clusters under prescribed pressure is treated. Thus the analogue to the bulk transition can be studied. The book also describes the microcanonical statistics of the collapse of a self-gravitating system under large angular momentum.

**Phase Transitions and Crystal Symmetry**

A self-contained, mathematical introduction to the driving ideas in equilibrium statistical mechanics, studying important models in detail.

**Introduction to the Theory of Critical Phenomena**

**Phase Transitions in Machine Learning**

The sophistication of modern tools used in the study of statistical mechanics and field theory is often an obstacle to the easy understanding of new important current results reported in journals. The main purpose of this book is to introduce the reader to the methods of the fluctuation (field) theory of phase transitions and critical phenomena so as to provide a good source for research. The introductory contents are concerned with ideas of description, thermodynamic stability theory related to phase transitions, major experimental facts, basic models and their relationships. Special attention is paid to the mean field approximation and to the Landau expansion for simple and complex models of critical and multicritical phenomena. An instructive representation of the modern perturbation theory and the method of the renormalization group is developed for field models of phase transitions. The essential influence of the fluctuations on the critical behaviour is established together with the theory of correlation functions, Gaussian approximation, the Ginzburg criterion, $\alpha$- and $1/n$- expansions as practical realizations of the renormalization group ideas. Applications of the theory to concrete aspects of condensed matter physics are considered: quantum effects, Bose condensation, crystal anisotropy, superconductors and liquid crystals, effects of disorder of type randomly distributed quenched impurities and random fields. This volume can be used as an advanced University course book for students with a basic knowledge of statistical physics and quantum mechanics. It could be considered as a complementary text to a standard University course on statistical physics.

**First Order Phase Transitions of Magnetic Materials**
Theory of Phase Transitions: Rigorous Results is inspired by lectures on mathematical problems of statistical physics presented in the Mathematical Institute of the Hungarian Academy of Sciences, Budapest. The aim of the book is to expound a series of rigorous results about the theory of phase transitions. The book consists of four chapters, wherein the first chapter discusses the Hamiltonian, its symmetry group, and the limit Gibbs distributions corresponding to a given Hamiltonian. The second chapter studies the phase diagrams of lattice models that are considered at low temperatures. The notions of a ground state of a Hamiltonian and the stability of the set of the ground states of a Hamiltonian are also introduced. Chapter 3 presents the basic theorems about lattice models with continuous symmetry, and Chapter 4 focuses on the second-order phase transitions and on the theory of scaling probability distributions, connected to these phase transitions. Specialists in statistical physics and other related fields will greatly benefit from this publication.

Synergetics

Phase transitions--changes between different states of organization in a complex system--have long helped to explain physics concepts, such as why water freezes into a solid or boils to become a gas. How might phase transitions shed light on important problems in biological and ecological complex systems? Exploring the origins and implications of sudden changes in nature and society, Phase Transitions examines different dynamical behaviors in a broad range of complex systems. Using a compelling set of examples, from gene networks and ant colonies to human language and the degradation of diverse ecosystems, the book illustrates the power of simple models to reveal how phase transitions occur. Introductory chapters provide the critical concepts and the simplest mathematical techniques required to study phase transitions. In a series of example-driven chapters, Ricard Solé shows how such concepts and techniques can be applied to the analysis and prediction of complex system behavior, including the origins of life, viral replication, epidemics, language evolution, and the emergence and breakdown of societies. Written at an undergraduate mathematical level, this book provides the essential theoretical tools and foundations required to develop basic models to explain collective phase transitions for a wide variety of ecosystems.

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