

G. Ludwig, University of Marburg, Germany

An Axiomatic Basis for Quantum Mechanics

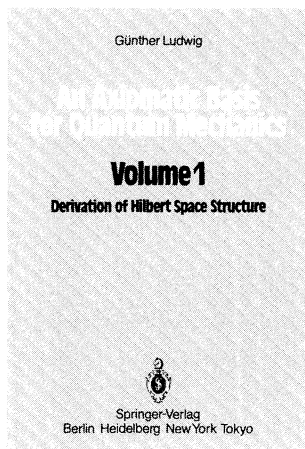
Volume 1

Derivation of Hilbert Space Structure

1985. 6 figures. X, 243 pages.
Hard cover DM 118,-. ISBN 3-540-13773-4

This is a work on the fundamental concepts of quantum mechanics. Professor Ludwig's aim is to deduce the description of microscopic objects solely from a macroscopic description of the devices used for their detection. The description of a two-part macrosystem where the microsystem is discovered as the system transmitting the interaction is the main topic of this volume. Empirically founded axioms then give rise to the Hilbert space structure of quantum mechanics.

This monograph will not only be an important source of inspiration for future research but should also appeal to all interested in the fundamental structure of nature and of what we may know about it.



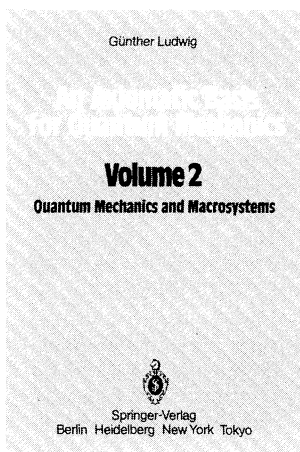
Volume 2

Quantum Mechanics and Macroscopic Systems

1987. 4 figures. IX, 242 pages.
Hard cover DM 155,-. ISBN 3-540-17540-7

In the first volume Professor Ludwig based quantum mechanics on the objective description of macroscopic devices. In the second volume the method is extended to many elementary systems, leading to the theory of "extrapolated quantum mechanics". The author establishes the statistical mechanics of macrosystems, and on this basis he solves the problem of the measuring process in a convincing new way as an interaction between microsystems and macroscopic devices.

Both volumes together present a consistent description of quantum mechanics, the measuring process and its interpretation.



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Texts and Monographs in Physics

Editors: W. Beiglböck, J. L. Birman, R. P. Geroch, E. H. Lieb, T. Regge, W. Thirring

S. A. Albeverio, F. Gesztesy, R. Høegh-Krohn,
H. Holden

Solvable Models in Quantum Mechanics

1988. 51 figures. XIV, 452 pages.
Hard cover DM 158,-. ISBN 3-540-17841-4

Next to the harmonic oscillator and the Coulomb potential the class of two-body models with point interactions is the only one where complete solutions are available. All mathematical and physical quantities can be calculated explicitly which makes this field of research important also for more complicated and realistic models in quantum mechanics. The detailed results allow their implementation in numerical codes to analyse properties of alloys, impurities, crystal and other features in solid state quantum physics.

This monograph presents in a systematic way the mathematical approach and unifies results obtained in recent years. The student with a sound background in mathematics will get a deeper understanding of Schrödinger operators and will see many examples which may eventually be used with profit in courses on quantum mechanics and solid state physics.

The book has textbook potential in mathematical physics and is suitable for additional reading in various fields of theoretical quantum physics.

Contents: The one-center point interaction. – Point interactions with a finite number of centers. – Point interactions with infinitely many centers. – Appendices. – References.

G. Börner, MPI für Physik und Astrophysik,
Garching, FRG

The Early Universe – Facts and Fiction

1988. 180 figures. Approx. 380 pages.
Hard cover, in preparation.
ISBN 3-540-16187-2

Contents:

I. THE STANDARD BIG-BANG COSMOLOGY

The Cosmological Models. – Facts: Observations of Cosmological Significance. – Thermodynamics of the Early Universe in the Classical Hot Big Bang Picture. – Can the Standard Model be Verified Experimentally?

II. PARTICLE PHYSICS AND COSMOLOGY

Gauge Theories and the Standard Model. – Grand Unification Schemes. – Relic Particles from the Early Universe. – Baryon Synthesis. – The Inflationary Universe.

III. DARK MATTER AND GALAXY FORMATION

Typical Scales: From Observations and Theory. – The Evolution of Small Perturbations. – Computer Simulations and the Large-Scale Structure.

A. Bohm

Quantum Mechanics: Foundations and Applications

2nd edition 1986. 94 figures. XVII, 596 pages.
Hard cover DM 135,-. ISBN 3-540-13985-0



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Texts and Monographs in Physics

Editors: W. Beiglböck, J. L. Birman, R. P. Geroch, E. H. Lieb, T. Regge, W. Thirring

O. Bratteli, D. W. Robinson

Operator Algebras and Quantum Statistical Mechanics I

C*- and W*-Algebras, Symmetry Groups, Decomposition of States

2nd edition 1987. XIV, 505 pages.

Hard cover DM 134,-. ISBN 3-540-17093-6

Operator Algebras and Quantum Statistical Mechanics II

Equilibrium States. Models in Quantum Statistical Mechanics

1981. XI, 505 pages.

Hard cover DM 102,-. ISBN 3-540-10381-3

"...I strongly recommend this book to anyone wishing to understand the foundations of quantum statistical mechanics. The authors succeed in convincing you about the naturalness and utility of algebraic methods."

Revue Roumaine de Physique

Here is the first really thorough and consistently developed presentation in two volumes of the applications of operator algebra theory to statistical physics.

The authors choose an approach which is particularly useful from the physicist's point of view, and all proofs are worked out in detail, making the book an excellent advanced text in mathematics and the first textbook in the field.

K. Chadan, P. C. Sabatier

Inverse Problems in Quantum Scattering Theory

2nd revised and enlarged edition 1988.

Hard cover, in preparation.

ISBN 3-540-18731-6

From the reviews of the first edition:

"There are many books on quantum mechanics which show how to calculate the scattering phase shifts from a given potential but there has been a lack of a book describing the extensive literature on the inverse problem of deriving the potential from the physical scattering amplitude. This has been very adequately filled by the present volume which should be read by any serious student of potential scattering."

Physics Bulletin

M. Chaichan, N. F. Nelipa

Introduction to Gauge Field Theories

1984. 75 figures. XII, 332 pages.

Hard cover DM 130,-. ISBN 3-540-13008-X

G. Gallavotti

The Elements of Mechanics

1983. 53 figures. XIV, 575 pages.

Hard cover DM 118,-. ISBN 3-540-11753-9

This is a detailed introduction to the techniques and problems of classical mechanics.

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Texts and Monographs in Physics

Editors: W. Beiglböck, J. L. Birman, R. P. Geroch, E. H. Lieb, T. Regge, W. Thirring

H. L. Cycon, R. G. Froese, W. Kirsch,
B. Simon

Schrödinger Operators

with Applications to Quantum Mechanics and
Global Geometry

1987. 2 figures. IX, 319 pages.
Soft cover DM 56,-. ISBN 3-540-16758-7

A complete understanding of Schrödinger operators is a necessary prerequisite for unveiling the physics of nonrelativistic quantum mechanics. Recent research shows that it also helps to deepen our insight into global differential geometry. This monograph, written for both graduate students and researchers, summarizes and synthesizes the theory of Schrödinger operators, emphasizing the progress made in the last decade by Lieb, Enns, Witten and others. Besides general properties, the book covers multiparticle quantum mechanics, including bound states of Coulomb systems and scattering theory, quantum mechanics in constant electric and magnetic fields, Schrödinger operators with random and almost periodic potentials, and Schrödinger operator methods in differential geometry to prove the Morse inequalities and the index theorem.

Contents: Self-Adjointness. – L^p -Properties of Eigenfunctions, and All That. – Geometric Methods for Bound States. – Local Commutator Estimates. – Phase Space Analysis of Scattering. – Magnetic Fields. – Electric Fields. – Complex Scaling. – Random Jacobi Matrices. – Almost Periodic Jacobi Matrices. – Witten's Proof of the Morse Inequalities. – Patodi's Proof of the Gauss-Bonnet-Chern Theorem and Superproofs of Index Theorems. – Bibliography. – List of Symbols. – Subject Index.

W. Greiner, B. Müller, J. Rafelski

Quantum Electrodynamics of Strong Fields

With an Introduction into Modern
Relativistic Quantum Mechanics

1985. 258 figures. XI, 594 pages.
Hard cover DM 140,-. ISBN 3-540-13404-2

R. G. Newton

Scattering Theory of Waves and Particles

2nd edition 1982. 35 figures. XX, 743 pages.
Hard cover DM 130,-. ISBN 3-540-10950-1

"Clearly this treatise is an excellent textbook,
the best existing one on the subject."

Mathematical Reviews

J. M. Jauch, F. Rohrlich

The Theory of Photons and Electrons

The Relativistic Quantum Field Theory
of Charge Particles with Spin One-half

2nd corrected printing of the 2nd expanded
edition 1980. 64 figures, 10 tables.
XIX, 533 pages.
Hard cover DM 88,-. ISBN 3-540-07295-0

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Texts and Monographs in Physics

Editors: W. Beiglböck, J. L. Birman, R. P. Geroch, E. H. Lieb, T. Regge, W. Thirring

G. Ludwig

Foundations of Quantum Mechanics I

Translated by C. A. Hein

1983. XII, 426 pages.

Hard cover DM 140,-. ISBN 3-540-11683-4

Foundations of Quantum Mechanics II

Translated by C. A. Hein

1985. 54 figures. XVI, 416 pages.

Hard cover DM 228,-. ISBN 3-540-13009-8

For more than three decades Günther Ludwig has made brilliant contributions to the foundations of quantum physics. This is the first textbook, in two volumes, that presents his theory. Mathematically thorough and rigorous, these volumes document important progress towards the axiomatic formulation of quantum theory.

In Volume I the author presents the fundamental concepts of quantum mechanics from first principles. In particular his concept of "effect" becomes the important link between experiment and theory. In Volume II he shows how the basic concepts can be applied to problems of atomic spectra, structure and spectra of molecules, and scattering theory.

A. Perelomov

Generalized Coherent States and Their Applications

1986. XI, 320 pages.

Hard cover DM 134,-. ISBN 3-540-15912-6

R. D. Richtmyer

Principles of Advanced Mathematical Physics

Volume 1

1978. 45 figures. XV, 422 pages.

Hard cover DM 86,-. ISBN 3-540-08873-3

Volume 2

1981. 60 figures. XI, 322 pages.

Hard cover DM 88,-. ISBN 3-540-10772-X

N. Straumann

General Relativity and Relativistic Astrophysics

1984. 81 figures. XIII, 459 pages.

Hard cover DM 112,-. ISBN 3-540-13010-1

F. J. Yndurian

Quantum Chromodynamics

An Introduction to the Theory of Quarks and Gluons

1983. 31 figures. XI, 227 pages.

Hard cover DM 96,-. ISBN 3-540-11752-0

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Springer Series in Synergetics

Editor: H. Haken

Volume 13

C. W. Gardiner

Handbook of Stochastic Methods

for Physics, Chemistry and the Natural Sciences

2nd edition 1985. 29 figures. XIX, 442 pages.
Soft cover DM 99,-. ISBN 3-540-15607-0

Volume 37

W. Güttinger, G. Dangelmayr (Editors)

The Physics of Structure Formation

Theory and Simulation

Proceedings of the International Symposium,
Tübingen, FRG, October 27 – November 2,
1986

1987. 207 figures. XIII, 427 pages.
Hard cover DM 109,-. ISBN 3-540-18383-3

The Physics of Structure Formation presents reports by distinguished authors on recent advances in our understanding of the mechanisms by which patterns are generated in nature. Nonlinear dynamics, instabilities and bifurcations through which patterns evolve play a major role. The topics include structure formation and pattern recognition in disordered systems and in neural networks, interfacial patterns, diffusion limited aggregation, the growth of fractal structures, convection patterns in fluids, chaotic dynamics and turbulence.

Volume 18

H. Risken

The Fokker-Planck Equation

Methods of Solution and Applications

New edition in preparation

The Fokker-Planck equation deals with those fluctuations of systems which stem from many tiny disturbances, each of which changes the variables of the system in an unpredictable way. This book deals with the derivation of the equation and the methods for solving it. The methods are applied to the statistics of a simple laser model and to Brownian motion in potentials.

Volume 38

H. Haken (Editor)

Computational Systems – Natural and Artificial

Proceedings of the International Symposium on Synergetics

Schloss Elmau, Bavaria, FRG, May 4-9, 1987

1987. 115 figures. VIII, 215 pages.

Hard cover DM 90,-. ISBN 3-540-18477-5

The aim of this interdisciplinary book is to present the most recent results of leading scientists in neurobiology, computers and physics. Special emphasis is placed upon drawing a coherent picture of the various efforts and of our present understanding of pattern recognition and associative memory.

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Springer Series in Synergetics

Editor: H. Haken

Volume 20

H. Haken, University of Stuttgart, FRG

Advanced Synergetics

Instability Hierarchies of Self-Organizing Systems and Devices

1983. Corrected printing 1987.

105 figures. XV, 356 pages.

Hard cover DM 98,-. ISBN 3-540-12162-5

Systems in diverse disciplines can show similar behavior. When external conditions are changed, the individual parts of these systems can organize themselves into new macroscopic states at certain instability points. The instabilities can form hierarchies leading to more and more complicated patterns of structure and behavior.

This book is a thorough presentation of recently developed methods to cope with such instability hierarchies. The introductory chapter presents numerous examples from physics, electrical engineering, mechanical engineering, chemistry, biology, economics and other fields. The approach is based on the concepts of instability, the slaving principle, and order parameters. A thorough treatment of linear differential equations including those with quasiperiodic coefficients and an outline of the Ito and Stratonovich approach to nonlinear stochastic differential equations is given. For such equations, the slaving principle, which allows an enormous reduction of the degrees of freedom at instability points, is derived. The resulting order parameter equations, which in the absence of fluctuations describe various kinds of bifurcations of fixed points, limit cycles (Hopf bifurcation), tori and chaotic attractors, are presented in detail and the corresponding solutions are derived.

Volume 40

H. Haken, University of Stuttgart, FRG

Information and Self-Organization

A Macroscopic Approach to Complex Systems

1988. 58 figures. XII, 196 pages.

Hard cover DM 98,-. ISBN 3-540-18639-5

Complex systems are ubiquitous and practically all branches of science, ranging from physics through chemistry and biology to economy and sociology, have to deal with them. This book presents the concepts and methods needed to deal with complex systems from a unifying point of view whose basic idea stems from synergetics. Attention is focused on those situations where a complex system changes its macroscopic spatial, temporal or functional structure qualitatively without specific interference from outside, i. e. by self-organization. While synergetics starts from the microscopic level, this book presents an approach that uses macroscopic data. The vehicle used is information. Since this word can have quite different meanings, its various aspects are discussed. These range from Shannon information and the effects of information on receivers to the self-creation of meaning. The book utilizes the general formulation of Jaynes' maximum information entropy principle. With the aid of results from synergetics, adequate objective constraints for a large class of self-organizing systems which form a new structure via a "nonequilibrium phase transition" are presented. Thus the approach applies to situations which are among the most interesting ones.

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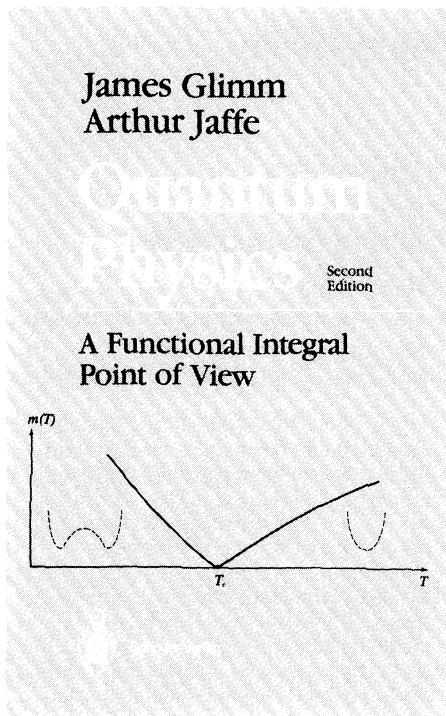
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J. Glimm, Courant Institute for Mathematical Sciences, New York University, NY;
A. Jaffe, Harvard University, Cambridge, MA, USA

Quantum Physics

A Functional Integral Point of View

2nd edition 1987. 51 figures. XXII, 535 pages.
 Hard cover DM 112,-. ISBN 3-540-96476-2
 Soft cover DM 56,-. ISBN 3-540-96477-0

Quantum Physics develops the mathematical structure of quantum theory and statistical mechanics. The central theme of the book is the quantization of nonlinear fields. The second edition includes new chapters on correlation inequalities and the cluster expansion, as well as one on the physical and mathematical requirements of nonabelian gauge theories.

From the reviews of the first edition:

"Quantum Physics provides a view of constructive quantum field theory, and related fields in statistical mechanics, by the two researchers with the greatest insights into the theory...

The presentation has many pleasant surprises."

– *Mathematical Reviews*

"... an important contribution toward establishing communication between the two communities [mathematics and physics]. The connection between quantum field theory and statistical mechanics is made early and used extensively throughout. The exposition is exceptionally crisp and clear. Theoretical physicists interested in learning the subjects treated need look no further."

– *Physics Today*

"This book is a milestone in the theory of quantized fields... The impact of this book on mathematics will be profound... It is an astounding achievement to have developed the theory given in this book."

– *Bulletin of the London Mathematical Society*

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Springer Series in Solid-State Sciences

Editors: M. Cardona, P. Fulde, K. von Klitzing, H.-J. Queisser

Volume 64

W. Ludwig, C. Falter

Symmetries in Physics

Group Theory Applied to Physical Problems

1988. 87 figures. XI, 461 pages.

Hard cover DM 98,-. ISBN 3-540-18021-4

We all know that symmetry is fundamentally important in physics. On one hand, the symmetry of a system is often the starting point for general physical considerations, and on the other hand, particular problems may be solved in simpler and more elegant ways if symmetry is taken into account.

This book presents the underlying theories of symmetry and gives examples of their application in branches of physics ranging from solid-state to high-energy physics via atomic and molecular physics. Finite discrete symmetries, continuous symmetries and also symmetry breaking are discussed, and exercises are provided which are intended to stimulate the reader to carry out original work.

Volume 19

G. Eilenberger

Solitons

Mathematical Methods for Physicists

2nd corrected printing 1983. 31 figures.

VIII, 192 pages.

Soft cover DM 64,-. ISBN 3-540-10223-X

"This impressive book – with its exhaustive bibliography of over 500 articles – will serve equally well as an advanced text and an authoritative reference guide to the mathematics of solitons. It is ideally suited for engineers, physicists and applied mathematicians..."

Physics Today

Volume 20

M. Toda

Theory of Nonlinear Lattices

2nd edition 1988. 40 figures.

Approx. 240 pages.

Soft cover DM 60,-

ISBN 3-540-18327-2

Soliton theory, the theory of nonlinear waves in lattices composed of particles interacting by nonlinear forces, is treated rigorously in this book. The presentation is coherent and self-contained, starting with pioneering work and extending to the most recent advances in the field. Special attention is focused on exact methods of solution of nonlinear problems and on the exact mathematical treatment of nonlinear lattice vibrations. This new edition updates the material to take account of important new advances.

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Graduate Texts in Contemporary Physics

Editors: J. L. Birman, H. Faissner

This new series is intended to introduce graduate students to the latest developments in physics. The aim is to give them the means to take an active part in further research in these developing areas.

In preparation:

H. V. Klapdor (Editor)

Neutrinos

With contributions by F. T. Avignone, R. L. Brodzinski, P. Depommier, F. von Feilitzsch, G. Gelmini, W. Hillenbrandt, H. V. Klapdor, P. Langacker, S. P. Mikheyev, R. N. Mohapatra, K. Muto, A. Y. Smirnow, K. Winter

1988. 164 figures. Approx. 350 pages.
Hard cover. ISBN 3-540-50166-5

Rabindra N. Mohapatra,
University of Maryland, College Park

Unification and Supersymmetry

The Frontiers of Quark-Lepton Physics

1986. 49 figures. XIII, 309 pages.
Hard cover DM 92,-. ISBN 3-540-96285-9

Unification and Supersymmetry is a pedagogical introduction to the techniques of supersymmetric field theories and covers topics such as the implications of physical Goldstone bosons, strong CP-violation, baryon non-conservation, and left-right symmetry, among others. In addition, it provides a comprehensive list of references to relevant works for the benefit of advanced graduate students in elementary particle theory, as well as to postdoctoral particle theorists and experimentalists.

Contents: Important Basic Concepts in Particle Physics. – Spontaneous Symmetry Breaking, Nambu-Goldstone Bosons, and the Higgs Mechanism. – The $SU(2)_L \times U(1)$ Model. – CP-Violation: Weak and Strong. – Grand Unification and the $SU(5)$ Model. – Left-Right Symmetric Models of Weak Interactions. – $SO(10)$ Grand Unification. – Technicolor and Compositeness. – Global Supersymmetry. – Field Theories with Global Supersymmetry. – Broken Supersymmetry and Application to Particle Physics. – Phenomenology of Supersymmetric Models. – Supersymmetric Grand Unification. – Local Supersymmetry ($N = 1$). – Application of Supergravity ($N = 1$) to Particle Physics. – Beyond $N = 1$ Supergravity.

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Graduate Texts in Contemporary Physics

Editors: J. L. Birman, H. Faissner

Richard E. Prange, Steven M. Girvin (Editors)

The Quantum Hall Effect

1987. 116 figures. XVII, 419 pages.
Hard cover DM 68,-. ISBN 3-540-96286-7

This is the first full-scale overview of the quantum Hall effect, an intriguing fundamental discovery in solid-state physics with applications to semiconductor devices, elementary particle theory, and electrical metrology.

The Foreword was written by Klaus von Klitzing, who was awarded the 1985 Nobel Prize in Physics for his discovery of the quantum Hall effect.

Jeffrey W. Lynn, University of Maryland,
College Park (Editor)

High-Temperature Superconductivity

1988. Approx. 350 pages.
Hard cover, in preparation.
ISBN 3-540-96770-2

This book provides a unified, graduate-level tutorial on the latest breakthroughs in the theory and applications of high-temperature superconductivity, from courses given at the University of Maryland, College Park.

Michio Kaku, CUNY, New York, USA

Introduction to Superstrings

1988. 48 figures. XVI, 568 pages.
Hard cover DM 98,-. ISBN 3-540-96700-1

This comprehensive tutorial introduces the development of, and current trends in, superstring theory, a significant and still controversial attempt to unify general relativity and quantum field theory. Intended for graduate students with a year of quantum mechanics and familiarity with relativistic methods, the book makes these exciting developments available to physicists, mathematicians, and others for the first time in one volume.

Stressing current areas of research activity, **Introduction to Superstrings** addresses all relevant topics including string field theory, multi-loops and Teichmüller spaces, conformal field theory, and four-dimensional superstrings. Professor Kaku is currently leading seminars in superspring theory at the Graduate Center of the City University of New York.

Contents:

- I. FIRST QUANTIZATION AND PATH INTEGRALS: Path Integrals and Point Particles. Nambu-Goto Strings. Superstrings. Conformal Field Theory and Kac-Moody Algebras. Multi-Loops and Teichmüller Space.
- II. SECOND QUANTIZATION AND THE SEARCH FOR GEOMETRY: Light Cone Field Theory. BRST Field Theory. Geometric String Field Theory.
- III. MODEL BUILDING AND PHENOMENOLOGY: Anomalies and the Atiyah-Singer Theorem. Heterotic Strings and Compactification. Calabi-Yau Spaces and Orbifolds.
- References. - Appendix.

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E. W. Schmid, G. Spitz, W. Lösch

Theoretical Physics on the Personal Computer

Translated from the German edition of 1987

1988. 152 figures. XI, 211 pages.

Hard cover DM 79,-. ISBN 3-540-18908-4

Theoretical Physics on the Personal Computer is a novel, easy-to-comprehend and well-structured text, ideal as an introduction to problem-solving with computers for advanced undergraduate students.

Sixteen instructive chapters are included in this book, covering the fields of classical mechanics, wave physics, electrodynamics, thermodynamics and quantum mechanics. In each chapter, a problem is first explained and placed into its physical context before an outline of the appropriate numerical steps, the corresponding program in FORTRAN 77 and various related problems are discussed. The final section of each chapter discusses the solutions and gives examples of graphics outputs.

The required software for this book is included on floppy disk. It has been designed for the IBM PC/AT and can be used on compatibles and mainframes with only minor changes.

For students and lecturers this book will prove to be an indispensable guide for classes in physics, applied mathematics, computer science and engineering.

Contents: Introduction. - Numerical Differentiation and Introduction into Screen Dialogue. - Numerical Integration. - Harmonic Oscillations with Sliding and Static Friction. -

Anharmonic Free and Forced Oscillations. - Coupled Harmonic Oscillations. - The Flight Path of a Space Craft as a Solution of the HAMILTON Equations. - The Celestial Mechanics Three-body Problem. - Computation of Electric Fields by the Method of Successive Overrelaxation. - The VAN DER WAALS Equation. - Solution of the FOURIER Heat Conduction Equation and the "Geo-power Station". - Group and Phase Velocity in the Example of Water Waves. - Solution of the Radial SCHRÖDINGER Equation by the FOX-GOODWIN Method. - The Quantum Mechanical Harmonic Oscillator. - Solution of the SCHRÖDINGER Equation in Harmonic Oscillator Representation. - The Ground State of the Helium Atom by the HYLLERAAS Method. - The Spherical Harmonics. - The Spherical BESSEL Functions. - Scattering of an Uncharged Particle from a Spherically Symmetric Potential. - Appendix.

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Optimal Control

F. Colonius

Optimal Periodic Control

1988. VI, 177 pages. (Lecture Notes in Mathematics, Volume 1313).
Soft cover DM 28,50. ISBN 3-540-19249-2

Contents: Introduction. – Optimization Theory. – Retarded Functional Differential Equations. – Strong Local Minima. – Weak Local Minima. – Local Relaxed Minima. – Tests for Local Properness. – A Scenario for Local Properness. – Optimal Periodic Control of Ordinary Differential Equations. – References.

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In preparation

C. K. Chui, G. Chen

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