Computational Many Particle Physics

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Complex Plasmas - Michael Bonitz 2014-04-09 This book provides the reader with an introduction to the physics of complex plasmas, a discussion of the specific scientific and technical challenges they present and an overview of their potential technological applications. Complex plasmas differ from conventional high-temperature plasmas in several ways: they may contain additional species, including nano meter- to micrometer-sized particles, negative ions, molecules and radicals and they may exhibit strong correlations or quantum effects. This book introduces the classical and quantum mechanical approaches used to describe and simulate complex plasmas. It also covers some key experimental techniques used in the analysis of these plasmas, including calorimetric probe methods, IR absorption techniques and X-ray absorption spectroscopy. The final part of the book reviews the emerging applications of microcavity and microchannel plasmas, the synthesis and assembly of nanomaterials through plasma electrochemistry, the large-scale generation of ozone using microplasmas and novel applications of atmospheric-pressure non-thermal plasmas in dentistry. Going beyond the scope of traditional plasma texts, the presentation is very well suited for senior undergraduate, graduate students and postdoctoral researchers specializing in plasma physics.

Computational Many-Particle Physics - Holger Fehske 2007-12-10

Looking for the real state of play in computational many-particle physics? Look no further. This book presents an overview of state-of-the-art numerical methods for studying interacting classical and quantum many-particle systems. A broad range of techniques and algorithms are covered, and emphasis is placed on their implementation on modern high-performance computers. This excellent book comes complete with online files and updates allowing readers to stay right up to date.

A Survey of Computational Physics - Rubin H. Landau 2011-10-30

Computational physics is a rapidly growing subfield of computational science, in large part because computers can solve previously intractable problems or simulate natural processes that do not have analytic solutions. The next step beyond Landau's First Course in Scientific Computing and a follow-up to Landau and Páez's Computational Physics, this text presents a broad survey of key topics in computational physics for advanced undergraduates and beginning graduate students, including new discussions of visualization tools, wavelet analysis, molecular dynamics, and computational fluid dynamics. By treating science, applied mathematics, and computer science together, the book reveals how this knowledge base can be applied to a wider range of real-world problems than computational physics texts normally address. Designed for a one- or two-semester course, A Survey of Computational Physics will also interest anyone who wants a reference on or practical experience in the basics of computational physics. Accessible to advanced undergraduates Real-world problem-solving approach Java codes and applets integrated with text Companion Web site includes videos of lectures

Modern Theories of Many-Particle Systems in Condensed Matter Physics - Daniel C. Cabra 2012-01-05

Condensed matter systems where interactions are strong are inherently difficult to analyze theoretically. The situation is particularly interesting in low-dimensional systems, where quantum fluctuations play a crucial role. Here, the development of non-perturbative methods and the study of integrable field theory have facilitated the understanding of the behavior of many quasi one- and two-dimensional strongly correlated systems. In view of the same rapid development that has taken place for both experimental and numerical techniques, as well as the emergence of novel testing-grounds such as cold atoms or graphene, the current understanding of strongly correlated condensed matter systems differs quite considerably from standard textbook presentations. The present volume of lecture notes aims to fill this gap in the literature by providing a collection of authoritative tutorial reviews, covering such topics as quantum phase transitions of antiferromagnets and cuprate-based high-temperature superconductors, electronic liquid crystal phases, graphene physics, dynamical mean field theory applied to strongly correlated systems, transport through quantum dots, quantum information perspectives on many-body physics, frustrated magnetism, statistical mechanics of classical and quantum computational complexity, and integrable methods in statistical field theory. As both graduate-level text and authoritative reference on this topic, this book will benefit newcomers and more experienced researchers in this field alike.

Modern Physics with Modern Computational Methods - John Morrison 2020-10-13 Modern Physics with Modern Computational Methods, Third Edition presents the ideas that have shaped modern physics and provides an introduction to current research in the different fields of physics. Intended as the text for a first course in modern physics following an introductory course in physics with calculus, the book begins with a brief and focused account of experiments that led to the formulation of the new quantum theory, while ensuing chapters go more deeply into the underlying physics. In this new edition, the differential equations that arise are converted into sets of linear equation or matrix equations by making a finite difference approximation of the derivatives or by using the spline collocation method. MATLAB programs are described for solving the eigenvalue equations for a particle in a finite well and the simple harmonic oscillator and for solving the radial equation for hydrogen. The lowest-lying solutions of these problems are plotted using MATLAB and the physical significance of these solutions are discussed. Each of the later chapters conclude with a description of modern developments.

Makes critical topics accessible by illustrating them with simple examples and figures Presents modern quantum mechanical concepts systematically and applies them consistently throughout the book Utilizes modern computational methods with MATLAB programs to solve the equations that arise in physics, and describes the programs and solutions in detail Covers foundational topics, including transition probabilities, crystal structure, reciprocal lattices, and Bloch theorem to build understanding of applications, such as lasers and semiconductor devices Features expanded exercises and problems at the end of each chapter as well as multiple appendices for quick reference

Fundamentals of Many-body Physics - Wolfgang Nolting 2009-03-02

The goal of the present course on “Fundamentals of Theoretical Physics” is to be a direct accompaniment to the lower-division study of physics, and it aims at providing the ph- ical tools in the most straightforward and compact form as needed by the students in order to master theoretically more complex topics and problems in advanced studies and in research. The presentation is thus intentionally designed to be suf?ciently detailed and self-contained – sometimes, admittedly, at the cost of a certain elegance – to permit in- vidual study without reference to the secondary literature. This volume deals with the quantum theory of many-body systems. Building upon a basic knowledge of quantum mechanics and of statistical physics, modern techniques for the description of interacting many-particle systems are developed and applied to various real problems, mainly from the area of solid-state physics. A thorough revision should guarantee that the reader can access the relevant research literature without experiencing major problems in terms of the concepts and vocabulary, techniques and deductive methods found there. The world which surrounds us consists of very many particles interacting with one another, and their description requires in principle the solution of a corresponding number ofcoupledquantum-mechanicalequationsofmotion(Schrodinger equations),which,h- ever, is possible only in exceptional cases in a mathematically strict sense. The concepts of elementary quantum mechanics and quantum statistics are therefore not directly applicable in the form in which we have thus far encountered them. They require an extension and restructuring, which is termed “many-body theory”.

Computational Physics - Philipp Scherer

2013-07-17

This textbook presents basic and advanced computational physics in a very didactic style. It contains very-well-presented and simple mathematical descriptions of many of the most important algorithms used in computational physics. The first part of the book discusses the basic numerical methods. The second part concentrates on simulation of classical and quantum systems. Several classes of integration methods are discussed including not only the standard Euler and Runge Kutta method but also multi-step methods and the class of Verlet methods, which is introduced by studying the motion in Liouville space. A general chapter on the numerical treatment of differential equations provides methods of finite differences, finite volumes, finite elements and boundary elements together with spectral methods and weighted residual based methods. The book gives simple but non trivial examples from a broad range of physical topics trying to give the reader insight into not only the numerical treatment but also simulated problems. Different methods are compared with regard to their stability and efficiency. The exercises in the book are realised as computer experiments.

Modern Theories of Many-Particle Systems in Condensed Matter Physics - Daniel C. Cabra 2012-01-05

Condensed matter systems where interactions are strong are inherently difficult to analyze theoretically. The situation is particularly interesting in low-dimensional systems, where quantum fluctuations play a crucial role. Here, the development of non-perturbative methods and the study of integrable field theory have facilitated the understanding of the behavior of many quasi one- and two-dimensional strongly correlated systems. In view of the same rapid development that has taken place for both experimental and numerical techniques, as well as the emergence of novel testing-grounds such as cold atoms or graphene, the current understanding of strongly correlated condensed matter systems differs quite considerably from standard textbook presentations. The present volume of lecture notes aims to fill this gap in the literature by providing a collection of authoritative tutorial reviews, covering such topics as quantum phase transitions of antiferromagnets and cuprate-based high-temperature superconductors, electronic liquid crystal phases, graphene physics, dynamical mean field theory applied to strongly correlated systems, transport through quantum dots, quantum information perspectives on many-body physics, frustrated magnetism, statistical mechanics of classical and quantum computational complexity, and integrable methods in statistical field theory. As both graduate-level text and authoritative reference on this topic, this book will benefit newcomers and more experienced researchers in this field alike.

Introduction to Computational Methods in Many Body Physics - Michael Bonitz 2006

This book is a multi-purpose and user-friendly textbook covering both fundamentals (in thermodynamics and statistical mechanics) and numerous applications. The emphasis is on simple derivations of simple results which can be compared with experimental data. The first half of the book covers basic thermodynamics, statistical ensembles, Boltzmann and quantum statistics; and the second half covers magnetism, electrostatic interactions (solutions and plasmas), non-equilibrium statistical mechanics, polymers, superfluidity, renormalization theory, and other specialized topics. This book, while serving well as a reference book for research scientists, is especially suitable as a textbook for a one-year statistical mechanics course for undergraduate students in physics, chemistry, engineering, biology, and material sciences. Alternatively, the first 5 chapters of the book can be used as the textbook for an undergraduate one-semester combined thermodynamics/statistical mechanics course (or statistical thermodynamics).

Introduction to Many-Body Physics - Piers Coleman 2015-11-26

A modern, graduate-level introduction to many-body physics in condensed matter, this textbook explains the tools and concepts needed for a research-level understanding of the correlated behavior of quantum fluids. Starting with an operator-based introduction to the quantum field theory of many-body physics, this textbook presents the Feynman diagram approach, Green's functions and finite-temperature many-body physics before developing the path integral approach to interacting systems. Special chapters are devoted to the concepts of Fermi liquid theory, broken symmetry, conduction in disordered systems, superconductivity and the physics of local-moment metals. A strong emphasis on concepts and numerous exercises make this an invaluable course book for graduate students in condensed matter physics. It will also interest students in nuclear, atomic and particle physics.

Introduction to Many-Body Physics - Piers Coleman 2015-11-26

This book explains the tools and concepts needed for a research-level understanding of the subject, for graduate students in condensed matter physics.

Second CPP Symposium - Y. Kurihara 2001

Computational Physics - Rubin H. Landau 2015-09-08

The use of computation and simulation has become an essential part of the scientific process. Being able to transform a theory into an algorithm requires significant theoretical insight, detailed physical and mathematical understanding, and a working level of competency in programming. This upper-division text provides an unusually broad survey of the topics of modern computational physics from a multidisciplinary, computational science point of view. Its philosophy is rooted in learning by doing (assisted by many model programs), with new scientific materials as well as with the Python programming language. Python has become very popular, particularly for physics education and large scientific projects. It is probably the easiest programming language to learn for beginners, yet is also used for mainstream scientific computing, and has packages for excellent graphics and even symbolic manipulations. The text is designed for an upper-level undergraduate or beginning graduate course and provides the reader with the essential knowledge to understand computational tools and mathematical methods well enough to be successful. As part of the teaching of using computers to solve scientific problems, the reader is encouraged to work through a sample problem stated at the beginning of each chapter or unit, which involves studying the text, writing, debugging and running programs, visualizing the results, and the expressing in words what has been done and what can be concluded. Then there are exercises and problems at the end of each chapter for the reader to work on their own (with model programs given for that purpose).

Computational Many-Particle Physics - Holger Fehske 2007-12-07

Looking for the real state of play in computational many-particle physics? Look no further. This book presents an overview of state-of-the-art numerical methods for studying interacting classical and quantum many-particle systems. A broad range of techniques and algorithms are covered, and emphasis is placed on their implementation on modern high-performance computers. This excellent book comes complete with online files and updates allowing readers to stay right up to date.

Experimental and Computational Techniques in Soft Condensed Matter Physics - Jeffrey Olafsen 2010-09-02

Soft condensed matter physics relies on a fundamental understanding at the interface between physics, chemistry, biology, and engineering for a host of materials and circumstances that are related to, but outside, the traditional definition of condensed matter physics. Featuring contributions from leading researchers in the field, this book uniquely discusses both the contemporary experimental and computational manifestations of soft condensed matter systems. From particle tracking and image analysis, novel materials and computational methods, to confocal microscopy and bacterial assays, this book will equip the reader for collaborative and interdisciplinary research efforts relating to a range of modern problems in nonlinear and non-equilibrium systems. It will enable both graduate students and experienced researchers to supplement a more traditional understanding of thermodynamics and statistical systems with knowledge of the techniques used in contemporary investigations. Color versions of a selection of the figures are available at www.cambridge.org/9780521115902.

Computational Physics - Philipp O.J. Scherer 2010-11-26

This book encapsulates the coverage for a two-semester course in computational physics. The first part introduces the basic numerical methods while omitting mathematical proofs but demonstrating the algorithms by way of numerous computer experiments. The second part specializes in simulation of classical and quantum systems with instructive examples spanning many fields in physics, from a classical rotor to a quantum bit. All program examples are realized as Java applets ready to run in your browser and do not require any programming skills.

Computational Physics - J. M. Thijssen 1999-06-17

This book describes computational methods used in theoretical physics with emphasis on condensed matter applications.

Annual Reviews of Computational Physics III - Dietrich Stauffer 1995-10-01

This series of books covers all areas of computational physics, collecting together reviews where a newcomer can learn about the state of the art regarding methods and results. Articles are submitted by e-mail before deadlines which are kept by the editor.Biologically motivated simulations, glasses, world-record molecular dynamics, deposition on surfaces, and hydrodynamics are discussed in this volume which ends with an explanation of elementary particle physics (QCD) and their phase transitions.

Computational Plasma Physics - Toshi Tajima 2018-03-14

The physics of plasmas is an extremely rich and complex subject as the variety of topics addressed in this book demonstrates. This richness and complexity demands new and powerful techniques for investigating plasma physics. An outgrowth from his graduate course teaching, now with corrections, Tajima's text provides not only a lucid introduction to computational plasma physics, but also offers the reader many examples of the way numerical modeling, properly handled, can provide valuable physical understanding of the nonlinear aspects so often encountered in both laboratory and astrophysical plasmas. Included here are computational methods for modern nonlinear physics as applied to hydrodynamic turbulence, solitons, fast reconnection of magnetic fields, anomalous transports, dynamics of the sun, and more. The text contains examples of problems now solved using computational techniques including those concerning finite-size particles, spectral techniques, implicit differencing, gyrokinetic approaches, and particle simulation.

Interacting Electrons - Richard M. Martin 2016-06-30

Recent progress in the theory and computation of electronic structure is bringing an unprecedented level of capability for research. Many-body methods are becoming essential tools vital for quantitative calculations and understanding materials phenomena in physics, chemistry, materials science and other fields. This book provides a unified exposition of the most-used tools: many-body perturbation theory, dynamical mean field theory and quantum Monte Carlo simulations. Each topic is introduced with a less technical overview for a broad readership, followed by in-depth descriptions and mathematical formulation. Practical guidelines, illustrations and exercises are chosen to enable readers to appreciate the complementary approaches, their relationships, and the advantages and disadvantages of each method. This book is designed for graduate students and researchers who want to use and understand these advanced computational tools, get a broad overview, and acquire a basis for participating in new developments.

Computational Physics - Mark E. J. Newman 2013

This book explains the fundamentals of computational physics and describes the techniques that every physicist should know, such as finite difference methods, numerical quadrature, and the fast Fourier transform. The book offers a complete introduction to the topic at the undergraduate level, and is also suitable for the advanced student or researcher. The book begins with an introduction to Python, then moves on to a step-by-step description of the techniques of computational physics, with examples ranging from simple mechanics problems to complex calculations in quantum mechanics, electromagnetism, statistical mechanics, and more.

Modeling Approaches and Computational Methods for Particle-laden Turbulent Flows - Shankar Subramaniam 2022-10-28

Modelling Approaches and Computational Methods for Particle-laden Turbulent Flows introduces the principal phenomena observed in applications where turbulence in particle-laden flow is encountered while also analyzing the main methods for analyzing numerically. The book takes a practical approach, providing advice on how to select and apply the correct model or tool by drawing on the latest research. Sections provide scales of particle-laden turbulence and the principal analytical frameworks and computational approaches used to simulate particles in turbulent flow. Each chapter opens with a section on fundamental concepts and theory before describing the applications of the modelling approach or numerical method. Featuring explanations of key concepts, definitions, and fundamental physics and equations, as well as recent research advances and detailed simulation methods, this book is the ideal starting point for students new to this subject, as well as an essential reference for experienced researchers. Provides a comprehensive introduction to the phenomena of particle laden turbulent flow Explains a wide range of numerical methods, including Eulerian-Eulerian, Eulerian-Lagrange, and volume-filtered computation Describes a wide range of innovative applications of these models

Computational Approaches in Physics - Maria Fyta 2016-11-01

Computational Approaches in Physics reviews computational schemes which are used in the simulations of physical systems. These range from very accurate ab initio techniques up to coarse-grained and mesoscopic schemes. The choice of the method is based on the desired accuracy and computational efficiency. A bottom-up approach is used to present the various simulation methods used in Physics, starting from the lower level and the most accurate methods, up to particle-based ones. The book outlines the basic theory underlying each technique and its complexity, addresses the computational implications and issues in the implementation, as well as present representative examples. A link to the most common computational codes, commercial or open source is listed in each chapter. The strengths and deficiencies of the variety of techniques discussed in this book are presented in detail and visualization tools commonly used to make the simulation data more comprehensive are also discussed. In the end, specific techniques are used as bridges across different disciplines. To this end, examples of different systems tackled with the same methods are presented. The appendices include elements of physical theory which are prerequisites in understanding the simulation methods.

Quantum Theory and Statistical Thermodynamics - Peter Hertel 2017-08-16

This textbook presents a concise yet detailed introduction to quantum physics. Concise, because it condenses the essentials to a few principles. Detailed, because these few principles – necessarily rather abstract – are illustrated by several telling examples. A fairly complete overview of the conventional quantum mechanics curriculum is the primary focus, but the huge field of statistical thermodynamics is covered as well. The text explains why a few key discoveries shattered the prevailing broadly accepted classical view of physics. First, matter appears to consist of particles which, when propagating, resemble waves. Consequently, some observable properties cannot be measured simultaneously with arbitrary precision. Second, events with single particles are not determined, but are more or less probable. The essence of this is that the observable properties of a physical system are to be represented by non-commuting mathematical objects instead of real numbers. Chapters on exceptionally simple, but highly instructive examples illustrate this abstract formulation of quantum physics. The simplest atoms, ions, and molecules are explained, describing their interaction with electromagnetic radiation as well as the scattering of particles. A short introduction to many particle physics with an outlook on quantum fields follows. There is a chapter on maximally mixed states of very large systems, that is statistical thermodynamics. The following chapter on the linear response to perturbations provides a link to the material equations of continuum physics. Mathematical details which would hinder the flow of the main text have been deferred to an appendix. The book addresses university students of physics and related fields. It will attract graduate students and professionals in particular who wish to systematize or refresh their knowledge of quantum physics when studying specialized texts on solid state and materials physics, advanced optics, and other modern fields.

Many-Particle Physics - Gerald D. Mahan 2012-12-06

This textbook is for a course in advanced solid-state theory. It is aimed at graduate students in their third or fourth year of study who wish to learn the advanced techniques of solid-state theoretical physics. The method of Green's functions is introduced at the beginning and used throughout. Indeed, it could be considered a book on practical applications of Green's functions, although I prefer to call it a book on physics. The method of Green's functions has been used by many theorists to derive equations which, when solved, provide an accurate numerical description of many processes in solids and quantum fluids. In this book I attempt to summarize many of these theories in order to show how Green's functions are used to solve real problems. My goal, in writing each section, is to describe calculations which can be compared with experiments and to provide these comparisons whenever available. The student is expected to have a background in quantum mechanics at the level acquired from a graduate course using the textbook by either L. I. Schiff, A. S. Davydov, or I. Landau and E. M. Lifshiftz. Similarly, a prior course in solid-state physics is expected, since the reader is assumed to know concepts such as Brillouin zones and energy band theory. Each chapter has problems which are an important part of the lesson; the problems often provide physical insights which are not in the text. Sometimes the answers to the problems are provided, but usually not.

Quantum Monte Carlo Methods - James Gubernatis 2016-06-02

Featuring detailed explanations of the major algorithms used in quantum Monte Carlo simulations, this is the first textbook of its kind to provide a pedagogical overview of the field and its applications. The book provides a comprehensive introduction to the Monte Carlo method, its use, and its foundations, and examines algorithms for the simulation of quantum many-body lattice problems at finite and zero temperature. These algorithms include continuous-time loop and cluster algorithms for quantum spins, determinant methods for simulating fermions, power methods for computing ground and excited states, and the variational Monte Carlo method. Also discussed are continuous-time algorithms for quantum impurity models and their use within dynamical mean-field theory, along with algorithms for analytically continuing imaginary-time quantum Monte Carlo data. The parallelization of Monte Carlo simulations is also addressed. This is an essential resource for graduate students, teachers, and researchers interested in quantum Monte Carlo techniques.

An Introduction to Computational Physics - Tao Pang 2006-01-19

Thoroughly revised for its second edition, this advanced textbook provides an introduction to the basic methods of computational physics, and an overview of progress in several areas of scientific computing by relying on free software available from CERN. The book begins by dealing with basic computational tools and routines, covering approximating functions, differential equations, spectral analysis, and matrix operations. Important concepts are illustrated by relevant examples at each stage. The author also discusses more advanced topics, such as molecular dynamics, modeling continuous systems, Monte Carlo methods, genetic algorithm and programming, and numerical renormalization. It includes many more exercises. This can be used as a textbook for either undergraduate or first-year graduate courses on computational physics or scientific computation. It will also be a useful reference for anyone involved in computational research.

Quantum Many-Body Physics - Yoshio Kuramoto 2020-02-05

This book offers a compact tutorial on basic concepts and tools in quantum many-body physics, and focuses on the correlation effects produced by mutual interactions. The content is divided into three parts, the first of which introduces readers to perturbation theory. It begins with the simplest examples—hydrogen and oxygen molecules—based on their effective Hamiltonians, and looks into basic properties of electrons in solids from the perspective of localized and itinerant limits. Readers will also learn about basic theoretical methods such as the linear response theory and Green functions. The second part focuses on mean-field theory for itinerant electrons, e.g. the Fermi liquid theory and superconductivity. Coulomb repulsion among electrons is addressed in the context of high-Tc superconductivity in cuprates and iron pnictides. A recent discovery concerning hydride superconductors is also briefly reviewed. In turn, the third part highlights quantum fluctuation effects beyond the mean-field picture. Discussing the dramatic renormalization effect in the Kondo physics, it provides a clear understanding of nonperturbative interaction effects. Further it introduces readers to fractionally charged quasi-particles in one and two dimensions. The last chapter addresses the dynamical mean field theory (DMFT). The book is based on the author's long years of experience as a lecturer and researcher. It also includes reviews of recent focus topics in condensed matter physics, enabling readers to not only grasp conventional condensed matter theories but also to catch up on the latest developments in the field.

Applied Computational Physics - Joseph F. Boudreau 2018

A textbook that addresses a wide variety of problems in classical and quantum physics. Modern programming techniques are stressed throughout, along with the important topics of encapsulation, polymorphism, and object-oriented design. Scientific problems are physically motivated, solution strategies are developed, and explicit code is presented.

Computational Fluid and Particle Dynamics in the Human Respiratory System - Jiyuan Tu 2012-09-18

Traditional research methodologies in the human respiratory system have always been challenging due to their invasive nature. Recent advances in medical imaging and computational fluid dynamics (CFD) have accelerated this research. This book compiles and details recent advances in the modelling of the respiratory system for researchers, engineers, scientists, and health practitioners. It breaks down the complexities of this field and provides both students and scientists with an introduction and starting point to the physiology of the respiratory system, fluid dynamics and advanced CFD modeling tools. In addition to a brief introduction to the physics of the respiratory system and an overview of computational methods, the book contains best-practice guidelines for establishing high-quality computational models and simulations. Inspiration for new simulations can be gained through innovative case studies as well as hands-on practice using pre-made computational code. Last but not least, students and researchers are presented the latest biomedical research activities, and the computational visualizations will enhance their understanding of physiological functions of the respiratory system.

Computational Plasma Physics - Toshi Tajima 2018-03-14

The physics of plasmas is an extremely rich and complex subject as the variety of topics addressed in this book demonstrates. This richness and complexity demands new and powerful techniques for investigating plasma physics. An outgrowth from his graduate course teaching, now with corrections, Tajima's text provides not only a lucid introduction to computational plasma physics, but also offers the reader many examples of the way numerical modeling, properly handled, can provide valuable physical understanding of the nonlinear aspects so often encountered in both laboratory and astrophysical plasmas. Included here are computational methods for modern nonlinear physics as applied to hydrodynamic turbulence, solitons, fast reconnection of magnetic fields, anomalous transports, dynamics of the sun, and more. The text contains examples of problems now solved using computational techniques including those concerning finite-size particles, spectral techniques, implicit differencing, gyrokinetic approaches, and particle simulation.

High Performance Computing in Science and Engineering ' 08 - Wolfgang E. Nagel 2009-01-10

The discussions and plans on all scienti?c, advisory, and political levels to realize an even larger "European Supercomputer" in Germany, where the hardware costs alone will be hundreds of millions Euro – much more than in the past – are getting closer to realization. As part of the strategy, the three national supercomputing centres HLRS (Stuttgart), NIC/JSC (Julic h) and LRZ (Munich) have formed the Gauss Centre for Supercomputing (GCS) as a new virtual organization enabled by an agreement between the Federal Ministry of Education and Research (BMBF) and the state ministries for research of Baden-Wurttem berg, Bayern, and Nordrhein-Westfalen. Already today, the GCS provides the most powerful high-performance computing -frastructure in Europe. Through GCS, HLRS participates in the European project PRACE (Partnership for Advances Computing in Europe) and - tends its reach to all European member countries. These activities aligns well with the activities of HLRS in the European HPC infrastructure project DEISA (Distributed European Infrastructure for Supercomputing Appli- tions) and in the European HPC support project HPC-Europa. Beyond that, HLRS and its partners in the GCS have agreed on a common strategy for the installation of the next generation of leading edge HPC hardware over the next ?ve years. The University of Stuttgart and the University of Karlsruhe have furth- more agreed to bundle their competences and resources.

An Introduction to Computational Physics - Tao Pang 2006-01-19

Thoroughly revised for its second edition, this advanced textbook provides an introduction to the basic methods of computational physics, and an overview of progress in several areas of scientific computing by relying on free software available from CERN. The book begins by dealing with basic computational tools and routines, covering approximating functions, differential equations, spectral analysis, and matrix operations. Important concepts are illustrated by relevant examples at each stage. The author also discusses more advanced topics, such as molecular dynamics, modeling continuous systems, Monte Carlo methods, genetic algorithm and programming, and numerical renormalization. It includes many more exercises. This can be used as a textbook for either undergraduate or first-year graduate courses on computational physics or scientific computation. It will also be a useful reference for anyone involved in computational research.

Condensed Matter Field Theory - Alexander Altland 2010-03-11

Modern experimental developments in condensed matter and ultracold atom physics present formidable challenges to theorists. This book provides a pedagogical introduction to quantum field theory in many-particle physics, emphasizing the applicability of the formalism to concrete problems. This second edition contains two new chapters developing path integral approaches to classical and quantum nonequilibrium phenomena. Other chapters cover a range of topics, from the introduction of many-body techniques and functional integration, to renormalization group methods, the theory of response functions, and topology. Conceptual aspects and formal methodology are emphasized, but the discussion focuses on practical experimental applications drawn largely from condensed matter physics and neighboring fields. Extended and challenging problems with fully worked solutions provide a bridge between formal manipulations and research-oriented thinking. Aimed at elevating graduate students to a level where they can engage in independent research, this book complements graduate level courses on many-particle theory.

Computational Physics - Jos Thijssen 2007-03-22

First published in 2007, this second edition describes the computational methods used in theoretical physics. New sections were added to cover finite element methods and lattice Boltzmann simulation, density functional theory, quantum molecular dynamics, Monte Carlo simulation, and diagonalisation of one-dimensional quantum systems. It covers many different areas of physics research and different computational methodologies, including computational methods such as Monte Carlo and molecular dynamics, various electronic structure methodologies, methods for solving partial differential equations, and lattice gauge theory. Throughout the book the relations between the methods used in different fields of physics are emphasised. Several new programs are described and can be downloaded from www.cambridge.org/9781107677135. The book requires a background in elementary programming, numerical analysis, and field theory, as well as undergraduate knowledge of condensed matter theory and statistical physics. It will be of interest to graduate students and researchers in theoretical, computational and experimental physics.

The Flow Equation Approach to Many-Particle

Systems - Stefan Kehrein 2007-01-09

This self-contained introduction addresses the novel flow equation approach for many particle systems and provides an up-to-date review of the subject. The text first discusses the general ideas and concepts of the flow equation method, and then in a second part illustrates them with various applications in condensed matter theory. The third and last part of the book contains an outlook with current perspectives for future research.

Computational Physics: Proceedings Of The 2nd Imacs Conference - Potvin Jean 1994-06-09

The proceedings contain the invited papers delivered at the 2nd IMACS International Conference on Computational Physics, held in St. Louis MO, USA, on October 6 - 9, 1993. The meeting was aimed at bringing together computational scientists and engineers of different disciplines for a fruitful exchange of information on methods, software and hardware. The topics covered include fluid mechanics, aerodynamics, material physics, condensed matter physics, neural networks, nonlinear dynamics, particle physics and others.

An introduction to computational physics - Sauro Succi 2003-10-01

These volumes collect the lecture notes of the course "An introduction to computational physics" held in the academic year 2000/01 for students of the University of Pisa and Scuola Normale Superiore at the level of the last two-year undergraduates in physics and chemistry. The second part deals with various types of particle methods, both deterministic and stochastic, used in modern applications of computer simulations in physics and related disciplines.

Computational Many-Particle Physics - Holger Fehske 2009-09-02

Looking for the real state of play in computational many-particle physics? Look no further. This book presents an overview of state-of-the-art numerical methods for studying interacting classical and quantum many-particle systems. A broad range of techniques and algorithms are covered, and emphasis is placed on their implementation on modern high-performance computers. This excellent book comes complete with online files and updates allowing readers to stay right up to date.

First CPP Symposium - Y. Kurihara 2002