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Nota di contenuto	Molecular Dynamics -- to Molecular Dynamics -- Wigner Function Quantum Molecular Dynamics -- Classical Monte Carlo -- The Monte Carlo Method, an Introduction -- Monte Carlo Methods in Classical Statistical Physics -- The Monte Carlo Method for Particle Transport Problems -- Kinetic Modelling -- The Particle-in-Cell Method -- Gyrokinetic and Gyrofluid Theory and Simulation of Magnetized Plasmas -- Semiclassical Approaches -- Boltzmann Transport in Condensed Matter -- Semiclassical Description of Quantum Many-Particle Dynamics in Strong Laser Fields -- Quantum Monte Carlo -- World-line and Determinantal Quantum Monte Carlo Methods for Spins, Phonons and Electrons -- Autocorrelations in Quantum Monte Carlo Simulations of Electron-Phonon Models -- Diagrammatic Monte Carlo and Stochastic Optimization Methods for Complex Composite Objects in Macroscopic Baths -- Path Integral Monte Carlo Simulation of Charged Particles in Traps -- Ab-Initio Methods in Physics and Chemistry -- Ab-Initio Approach to the Many-Electron Problem -- Ab-Initio Methods Applied to Structure Optimization and Microscopic Modelling -- Effective Field Approaches -- Dynamical Mean-Field Approximation and Cluster Methods for Correlated Electron Systems -- Local Distribution Approach -- Iterative Methods for Sparse Eigenvalue

Problems -- Exact Diagonalization Techniques -- Chebyshev Expansion Techniques -- The Density Matrix Renormalisation Group: Concepts and Applications -- The Conceptual Background of Density-Matrix Renormalization -- Density-Matrix Renormalization Group Algorithms -- Dynamical Density-Matrix Renormalization Group -- Studying Time-Dependent Quantum Phenomena with the Density-Matrix Renormalization Group -- Applications of Quantum Information in the Density-Matrix Renormalization Group -- Density-Matrix Renormalization Group for Transfer Matrices: Static and Dynamical Properties of 1D Quantum Systems at Finite Temperature -- Concepts of High Performance Computing -- Architecture and Performance Characteristics of Modern High Performance Computers -- Optimization Techniques for Modern High Performance Computers.

Sommario/riassunto

Complicated many-particle problems abound in nature and in research alike. Plasma physics, statistical physics and condensed matter physics, as primary examples, are all heavily dependent on efficient methods for solving such problems. Addressing graduate students and young researchers, this book presents an overview and introduction to 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.