

<<非平衡态量子场论>>

图书基本信息

前言

The purpose of this book is to provide an introduction to the applications of quantum field theoretic methods to systems out of equilibrium. The reason for adding a book on the subject of quantum field theory is two-fold: the presentation is, to my knowledge, the first to extensively present and apply to non-equilibrium phenomena the real-time approach originally developed by Schwinger, and subsequently applied by Keldysh and others to derive transport equations. Secondly, the aim is to show the universality of the method by applying it to a broad range of phenomena. The book should thus not just be of interest to condensed matter physicists, but to physicists in general as the method is of general interest with applications ranging the whole scale from high-energy to soft condensed matter physics. The universality of the method, as testified by the range of topics covered, reveals that the language of quantum fields is the universal description of fluctuations, be they of quantum nature, thermal or classical stochastic. The book is thus intended as a contribution to unifying the languages used in separate fields of physics, providing a universal tool for describing non-equilibrium states. Chapter 1 introduces the basic notions of quantum field theory, the Bose and Fermi quantum fields operating on the multi-particle state spaces. In Chapter 2, operators on the multi-particle space representing physical quantities of a many-body system are constructed. The detailed exposition in these two chapters is intended to ensure the book is self-contained. In Chapter 3, the quantum dynamics of a many-body system is described in terms of its quantum fields and their correlation functions, the Green's functions. In Chapter 4, the key formal tool to describe non-equilibrium states is introduced: Schwinger's closed time path formulation of non-equilibrium quantum field theory, quantum statistical mechanics. Perturbation theory for non-equilibrium states is constructed starting from the canonical operator formalism presented in the previous chapters. In Chapter 5 we develop the real-time formalism necessary to deal with non-equilibrium states; first in terms of matrices and eventually in terms of two different types of Green's functions. The diagram representation of non-equilibrium perturbation theory is constructed in a way that the different aspects of spectral and quantum kinetic properties appear in a physically transparent and important fashion for non-equilibrium states. The equivalence of the real-time and imaginary-time formalisms are discussed in detail. In Chapter 6 we consider the coexistence regime between equilibrium and non-equilibrium states, the linear response regime. In Chapter 7 we develop and apply the quantum kinetic equation approach to the normal state.

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内容概要

The purpose of this book is to provide an introduction to the applications of quantum field theoretic methods to systems out of equilibrium. The reason for adding a book on the subject of quantum field theory is two-fold : the presentation is , to my knowledge , the first to extensively present and apply to non-equilibrium phenomena the real-time approach originally developed by Schwinger , and subsequently applied by Keldysh and others to derive transport equations. Secondly , the aim is to show the universality of the method by applying it to a broad range of phenomena. The book should thus not just be of interest to condensed matter physicists , but to physicists in general as the method is of general interest with applications ranging the whole scale from high-energy to soft condensed matter physics. The universality of the method , as testified by the range of topics covered , reveals that the language of quantum fields is the universal description of fluctuations , be they of quantum nature , thermal or classical stochastic. The book is thus intended as a contribution to unifying the languages used in separate fields of physics , providing a universal tool for describing non-equilibrium states.

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作者简介

作者: (瑞典) 拉梅

<<非平衡态量子场论>>

书籍目录

Preface
 1 Quantum fields
 1.1 Quantum mechanics
 1.2 N-particle system
 1.2.1 Identical particles
 1.2.2 Kinematics of fermions
 1.2.3 Kinematics of bosons
 1.2.4 Dynamics and probability current and density
 1.3 Fermi field
 1.4 Bose field
 1.4.1 Phonons
 1.4.2 Quantizing a classical field theory
 1.5 Occupation number representation
 1.6 Summary
 2 Operators on the multi-particle state space
 2.1 Physical observables
 2.2 Probability density and number operators
 2.3 Probability current density operator
 2.4 Interactions
 2.4.1 Two-particle interaction
 2.4.2 Fermio boson interaction
 2.4.3 Electron-phonon interaction
 2.5 The statistical operator
 2.6 Summary
 3 Quantum dynamics and Green's functions
 3.1 Quantum dynamics
 3.1.1 The Schrödinger picture
 3.1.2 The Heisenberg picture
 3.2 Second quantization
 3.3 Green's functions
 3.3.1 Physical properties and Green's functions
 3.3.2 Stable of one-particle Green's functions
 3.4 Equilibrium Green's functions
 3.5 Summary
 4 Non-equilibrium theory
 4.1 The non-equilibrium problem
 4.2 Ground state formalism
 4.3 Closed time path formalism
 4.3.1 Closed time path Green's function
 4.3.2 Non-equilibrium perturbation theory
 4.3.3 Wick's theorem
 4.4 Non-equilibrium diagrammatics
 4.4.1 Particles coupled to a classical field
 4.4.2 Particles coupled to a stochastic field
 4.4.3 Interacting fermions and bosons
 4.5 The self-energy
 4.5.1 Non-equilibrium Dyson equations
 4.5.2 Skeleton diagrams
 4.6 Summary
 5 Real-time formalism
 5.1 Real-time matrix representation
 5.2 Real-time diagrammatics
 5.2.1 Feynman rules for a scalar potential
 5.2.2 Feynman rules for interacting bosons and fermions
 5.3 Triagonal and symmetric representations
 5.3.1 Fermion-boson coupling
 5.3.2 Two-particle interaction
 5.4 The real rules: the RAK-rules
 5.5 Non-equilibrium Dyson equations
 5.6 Equilibrium Dyson equation
 5.7 Real-time versus imaginary-time formalism
 5.7.1 Imaginary-time formalism
 5.7.2 Imaginary-time Green's functions
 5.7.3 Analytical continuation procedure
 5.7.4 Kadanoff-Baym equations
 5.8 Summary
 6 Linear response theory
 6.1 Linear response
 6.1.1 Density response
 6.1.2 Current response
 6.1.3 Conductivity tensor
 6.1.4 Conductance
 6.2 Linear response of Green's functions
 6.3 Properties of response functions
 6.4 Stability of the thermal equilibrium state
 6.5 Fluctuation-dissipation theorem
 6.6 Time-reversal symmetry
 6.7 Scattering and correlation functions
 6.8 Summary
 7 Quantum kinetic equations
 7.1 Left-right subtracted Dyson equation
 7.2 Wigner or mixed coordinates
 7.3 Gradient approximation
 7.3.1 Spectral weight function
 7.3.2 Quasi-particle approximation
 7.4 Impurity scattering
 7.4.1 Boltzmannian motion in a random potential
 7.4.2 Brownian motion
 7.5 Quasi-classical Green's function technique
 7.5.1 Electron-phonon interaction
 7.5.2 Renormalization of the a.c. conductivity
 7.5.3 Excitation representation
 7.5.4 Particle conservation
 7.5.5 Impurity scattering
 7.6 Beyond the quasi-classical approximation
 7.6.1 Thermo-electrics and magneto-transport
 7.7 Summary
 8 Non-equilibrium superconductivity
 8.1 BCS-theory
 8.1.1 Nambu or particle-hole space
 8.1.2 Equations of motion in Nambu Keldysh space
 8.1.3 Green's functions and gauge transformations
 8.2 Quasi-classical Green's function theory
 8.2.1 Normalization condition
 8.2.2 Kinetic equation
 8.2.3 Spectral densities
 8.3 Trajectory Green's functions
 8.4 Kinetics in a dirty superconductor
 8.4.1 Kinetic equation
 8.4.2 Ginzburg-Landau regime
 8.5 Charge imbalance
 8.6 Summary
 9 Diagrammatics and generating functionals
 9.1 Diagrammatics
 9.1.1 Propagators and vertices
 9.1.2 Amplitudes and superposition
 9.1.3 Fundamental dynamic relation
 9.1.4 Low order diagrams
 9.2 Generating functional
 9.2.1 Functional differentiation
 9.2.2 From diagrammatics to differential equations
 9.3 Connection to operator formalism
 9.4 Fermions and Grassmann variables
 9.5 Generator of connected amplitudes
 9.5.1 Source derivative proof
 9.5.2 Combinatorial proof
 9.5.3 Functional equation for the generator
 9.6 One-particle irreducible vertices
 9.6.1 Symmetry broken states
 9.6.2 Green's functions and one-particle irreducible vertices
 9.7 Diagrammatics and action
 9.8 Effective action and skeleton diagrams
 9.9 Summary
 10 Effective action
 10.1 Functional integration
 10.1.1 Functional Fourier transformation
 10.1.2 Gaussian integrals
 10.1.3 Fermionic path integrals
 10.2 Generators as functional integrals
 10.2.1 Euclid versus Minkowski
 10.2.2 Wick's theorem and functionals
 10.3 Generators and 1PI vacuum diagrams
 10.4 1PI loop expansion of the effective action
 10.5 Two-particle irreducible effective action
 10.5.1 The 2PI loop expansion of the effective action
 10.6 Effective action approach to Bose gases
 10.6.1 Dilute Bose gases
 10.6.2 Effective action formalism for bosons
 10.6.3 Homogeneous Bose gas
 10.6.4 Renormalization of the interaction
 10.6.5 Inhomogeneous Bose gas
 10.6.6 Loop expansion for a

<<非平衡态量子场论>>

trapped Bose gas10.7 Summary11 Disordered conductors11.1 Localization11.1.1 Scaling theory of
localization11.1.2 Coherent backscattering11.2 Weak localization11.2.1 Quantum correction to conductivity11.2.2
Cooperon equation11.2.3 Quantum interference and the Cooperon11.2.4 Quantum interference in a magnetic
field.....12 Classical Statistical DynamicsAppendices

<<非平衡态量子场论>>

章节摘录

插图：

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