# <<电子液体量子理论>>

### 图书基本信息

书名:<<电子液体量子理论>>

13位ISBN编号: 9787510029646

10位ISBN编号:7510029643

出版时间:2011-1

出版时间:世界图书出版公司

作者:朱利安尼

页数:777

版权说明:本站所提供下载的PDF图书仅提供预览和简介,请支持正版图书。

更多资源请访问:http://www.tushu007.com

## <<电子液体量子理论>>

### 内容概要

The electron liquid paradigm is at the basis of most of our current understanding of the physical properties of electronic systems. Quite remarkably, the latter are nowadays at the intersection of the most exciting areas of science: materials science, quantum chem- istry, nano-electronics, biology, and quantum computation. Accordingly, its importance can hardly be overestimated. The field is particularly attractive not only for the simplicity of its classic formulation, but also because, by its very nature, it is still possible for individual researchers, armed with thoughtfulness and dedication, and surrounded by a small group of collaborators, to make deep contributions, in the best tradition of "small science".

# <<电子液体量子理论>>

### 书籍目录

#### preface

- 1 introduction to the electron liquid
- 1.1 a tale of many electrons
- 1.2 where the electrons roam: physical realizations of the electron

#### liquid

- 1.2.1 three dimensions
- 1.2.2 two dimensions
- 1.2.3 one dimension
- 1.3 the model hamiitonian
- 1.3.1 jeilium model
- 1.3.2 coulomb interaction regularization
- 1.3.3 the electronic density as the fundamental parameter
- 1.4 second quantization
- 1.4.1 fock space and the occupation number representation
- 1.4.2 representation of observables
- 1.4.3 construction of the second-quantized hamiltonian
- 1.5 the weak coupling regime
- 1.5.1 the noninteracting electron gas
- 1.5.2 noninteracting spin polarized states
- 1.5.3 the exchange energy
- 1.5.4 exchange energy in spin polarized states
- 1.5.5 exchange and the pair correlation function
- 1.5.6 all-orders perturbation theory: the rpa
- 1.6 the wigner crystal
- 1.6.1 classical electrostatic energy
- 1.6.2 zero-point motion
- 1.7 phase diagram of the electron liquid
- 1.7.1 the quantum monte carlo approach
- 1.7.2 the ground-state energy
- 1.7.3 experimental observation of the electron gas phases
- 1.7.4 exotic phases of the electron liquid
- 1.8 equilibrium properties of the electron liquid
- 1.8.1 pressure, compressibility, and spin susceptibility
- 1.8.2 the virial theorem
- 1.8.3 the ground-state energy theorem

- 2 the hartree--fock approximation
- 2.1 introduction
- 2.2 formulation of the hartree-fock theory
- 2.2.1 the hartree-fock effective hamiltonian
- 2.2.2 the hartree-fock equations
- 2.2.3 ground-state and excitation energies
- 2.2.4 two stability theorems and the coulomb gap
- 2.3 hartree-fock factorization and mean field theory
- 2.4 application to the uniform electron gas

# <<电子液体量子理论>>

2.4.1	the	exchange	energy
-------	-----	----------	--------

- 2.4.2 polarized versus unpolarized states
- 2.4.3 compressibility and spin susceptibility
- 2.5 stability of hartree--fock states
- 2.5.1 basic definitions: local versus global stability
- 2.5.2 local stability theory
- 2.5.3 local and global stability for a uniformly polarized electron gas
- 2.6 spin density wave and charge density wave hartree-fock states
- 2.6.1 hartree-fock theory of spiral spin density waves
- 2.6.2 spin density wave instability with contact interactions in one dimension
- 2.6.3 proof of overhauser's instability theorem
- 2.7 bcs non number-conserving mean field theory
- 2.8 local approximations to the exchange
- 2.8.1 slater's local exchange potential
- 2.8.2 the optimized effective potential
- 2.9 real-world hartree-fock systems

- 3 linear response theory
- 3.1 introduction
- 3.2 general theory of linear response
- 3.2.1 response functions
- 3.2.2 periodic perturbations
- 3.2.3 exact eigenstates and spectral representations
- 3.2.4 symmetry and reciprocity relations
- 3.2.5 origin of dissipation
- 3.2.6 time-dependent correlations and the fluctuation--dissipation theorem
- 3.2.7 analytic properties and collective modes
- 3.2.8 sum rules.
- 3.2.9 the stiffness theorem
- 3.2.10 bogoliubov inequality
- 3.2.11 adiabatic versus isothermal response
- 3.3 density response
- 3.3.1 the density--density response function
- 3.3.2 the density structure factor
- 3.3.3 high-frequency behavior and sum rules
- 3.3.4 the compressibility sum rule
- 3.3.5 total energy and density response
- 3.4 current response
- 3.4.1 the current--current response function
- 3.4.2 gauge invariance
- 3.4.3 the orbital magnetic susceptibility
- 3.4.4 electrical conductivity: conductors versus insulators
- 3.4.5 the third moment sum rule

# <<电子液体量子理论>>

っん	spin	rann	0000
J .)	<1 111 I	1241	111111
$\circ$	90111	1000	

- 3.5.1 density and longitudinal spin response
- 3.5.2 high-frequency expansion
- 3.5.3 transverse spin response

#### exercises

- 4 linear response of independent electrons
- 4.1 introduction
- 4.2 linear response formalism for non-interacting electrons
- 4.3 density and spin response functions
- 4.4 the lindhard function
- 4.4.1 the static limit
- 4.4.2 the electron-hole continuum
- 4.4.3 the nature of the singularity at small q and to
- 4.4.4 the lindhard function at finite temperature
- 4.5 transverse current response and landau diamagnetism
- 4.6 elementary theory of impurity effects
- 4.6.1 derivation of the drude conductivity
- 4.6.2 the density-density response function in the presence of impurities
- 4.6.3 the diffusion pole
- 4.7 mean field theory of linear response

#### exercises

- 5 linear response of an interacting electron liquid
- 5.1 introduction and guide to the chapter
- 5.2 screened potential and dielectric function
- 5.2.1 the scalar dielectric function
- 5.2.2 proper versus full density response and the compressibility
- sum rule
- 5.2.3 compressibility from capacitance
- 5.3 the random phase approximation
- 5.3,1 the rpa as time-dependent hartree theory
- 5.3.2 static screening
- 5.3.3 plasmons
- 5.3.4 the electron-hole continuum in rpa
- 5.3.5 the static structure factor and the pair correlation

#### function

- 5.3.6 the rpa ground-state energy
- 5.3.7 critique of the rpa
- 5.4 the many-body local field factors
- 5.4.1 local field factors and response functions
- 5.4.2 many-body enhancement of the compressibility and the spin susceptibility
- 5.4.3 static response and friedel oscillations
- 5.4.4 the stls scheme
- 5.4.5 multicomponent and spin-polarized systems
- 5.4.6 current and transverse spin response
- 5.5 effective interactions in the electron liquid

# <<电子液体量子理论>>

- 5.5.1 test charge--test charge interaction
- 5.5.2 electron-test charge interaction
- 5.5.3 electron-electron interaction
- 5.6 exact properties of the many-body local field factors
- 5.6.1 wave vector dependence
- 5.6.2 frequency dependence
- 5.7 theories of the dynamical local field factor
- 5.7.1 the time-dependent hartree-fock approximation
- 5.7.2 first order perturbation theory and beyond
- 5.7.3 the mode-decoupling approximation
- 5.8 calculation of observable properties
- 5.8.1 plasmon dispersion and damping
- 5.8.2 dynamical structure factor
- 5.9 generalized elasticity theory
- 5.9.1 elasticity and hydrodynamics
- 5.9.2 visco-elastic constants of the electron liquid
- 5.9.3 spin diffusion

exercises

6 the perturbative calculation of linear response

functions

- 6.1 introduction
- 6.2 zero-temperature formalism
- 6.2.1 time-ordered correlation function
- 6.2.2 the adiabatic connection
- 6.2.3 the non-interacting green's function
- 6.2.4 diagrammatic perturbation theory
- 6.2.5 fourier transformation
- 6.2.6 translationaliy invariant systems
- 6.2.7 diagrammatic calculation of the lindhard function
- 6.2.8 first-order correction to the density-density response function
- 6.3 integral equations in diagrammatic perturbation theory
- 6.3.1 proper response function and screened interaction
- 6.3.2 green's function and self-energy
- 6.3.3 skeleton diagrams
- 6.3.4 irreducible interactions
- 6.3.5 self-consistent equations
- 6.3.6 two-body effective interaction: the local approximation
- 6.3..7 extension to broken symmetry states
- 6.4 perturbation theory at finite temperature

exercises

7 density functional theory

- 7.1 introduction
- 7.2 ground-state formalism
- 7.2.1 the variational principle for the density
- 7.2.2 the hohenberg-kohn theorem
- 7.2.3 the kohn--sham equation

# <<电子液体量子理论>>

- 7.2.4 meaning of the kohn-sham eigenvalues
- 7.2.5 the exchange-correlation energy functional
- 7.2.6 exact properties of energy functionals
- 7.2.7 systems with variable particle number
- 7.2.8 derivative discontinuities and the band gap problem
- 7.2.9 generalized density functional theories
- 7.3 approximate functionais
- 7.3.1 the thomas-fermi approximation
- 7.3.2 the local density approximation for the exchange-correlation potential
- 7.3.3 the gradient expansion
- 7.3.4 generalized gradient approximation
- 7.3.5 van der waals functionals
- 7.4 current density functional theory
- 7.4.1 the vorticity variable
- 7.4.2 the kohn-sham equation
- 7.4.3 magnetic screening
- 7.4.4 the local density approximation
- 7.5 time-dependent density functional theory
- 7.5.1 the runge--gross theorem
- 7.5.2 the time-dependent kohn-sham equation
- 7.5.3 adiabatic approximation
- 7.5.4 frequency-dependent linear response
- 7.6 the calculation of excitation energies
- 7.6.1 finite systems
- 7.6.2 infinite systems
- 7.7 reason for the success of the adiabatic Ida
- 7.8 beyond the adiabatic approximation
- 7.8.1 the zero-force theorem
- 7.8.2 the "ultra-nonlocality" problem
- 7.9 current density functional theory and generalized

### hydrodynamics

7.9.1 the xc vector potential in a homogeneous electron

#### liquid

7.9.2 the exchange-correlation field in the inhomogeneous electron

#### liquid

- 7.9.3 the polarizability of insulators
- 7.9.4 spin current density functional theory
- 7.9.5 linewidth of collective excitations
- 7.9.6 nonlinear extensions

- 8 the normal fermi liquid
- 8.1 introduction and overview of the chapter
- 8.2 the landau fermi liquid
- 8.3 macroscopic theory of fermi liquids
- 8.3.1 the landau energy functional
- 8.3.2 the heat capacity

# <<电子液体量子理论>>

8.3.3 the landau fermi liquid paramet
---------------------------------------

- 8.3.4 the compressibility
- 8.3.5 the paramagnetic spin response
- 8.3.6 the effective mass
- 8.3.7 the effects of the electron-phonon coupling
- 8.3.8 measuring m\*, k, g\* and xs
- 8.3.9 the kinetic equation
- 8.3.10 the shear modulus
- 8.4 simple theory of the quasiparticle lifetime
- 8.4.1 general formulas
- 8.4.2 three-dimensional electron gas
- 8.4.3 two-dimensional electron gas
- 8.4.4 exchange processes
- 8.5 microscopic underpinning of the landau theory
- 8.5.1 the spectral function
- 8.5.2 the momentum occupation number
- 8.5.3 quasiparticle energy, renormalization constant, and effective mass
- 8.5.4 luttinger's theorem
- 8.5.5 the landau energy functional
- 8.6 the renormalized hamiitonian approach
- 8.6.1 separation of slow and fast degrees of freedom
- 8.6.2 elimination of the fast degrees of freedom
- 8.6.3 the quasiparticle hamiltonian
- 8.6.4 the quasiparticle energy
- 8.6.5 physical significance of the renormalized hamiltonian
- 8.7 approximate calculations of the self-energy
- 8.7.1 the gw approximation
- 8.7.2 diagrammatic derivation of the generalized gw

### seif-energy

- 8.8 calculation of quasiparticle properties
- 8.9 superconductivity without phonons?
- 8.10 the disordered electron liquid
- 8.10.1 the quasiparticle lifetime
- 8.10.2 the density of states
- 8.10,3 coulomb lifetimes and weak localization in two-dimensional metals

- 9 electrons in one dimension and the luttinger liquid
- 9.1 non-fermi liquid behavior
- 9.2 the luttinger model
- 9.3 the anomalous commutator
- 9.4 introducing the bosons
- 9.5 solution of the luttinger model
- 9.5.1 exact diagonalization
- 9.5.2 physical properties
- 9.6 bosonization of the fermions

## <<电子液体量子理论>>

~ ~	4	4 4.				·
uk	1	construction	nn at i	tha ta	rminn	TIDIME
J.U.		טטווטנו עטנונ	יוטווע	111515	5111111011	HEIUS

- 9.6.2 commutation relations
- 9.6.3 construction of observables
- 9.7 the green's function
- 9.7.1 analytical formulation
- 9.7.2 evaluation of the averages
- 9.7.3 non-interacting green's function
- 9.7.4 asymptotic behavior
- 9.8 the spectral function
- 9.9 the momentum occupation number
- 9.10 density response to a short-range impurity
- 9.1! the conductance of a luttinger liquid
- 9.12 spin-charge separation
- 9.13 long-range interactions

#### exercises

10 the two-dimensional electron liquid at high magnetic

### field

- 10.1 introduction and overview
- 10.2 one-electron states in a magnetic field
- 10.2.1 energy spectrum
- 10.2.2 one-electron wave functions
- 10.2.3 fock-darwin levels
- 10.2.4 lowest landau level
- 10.2.5 coherent states
- 10.2.6 effect of an electric field
- 10.2.7 slowly varying potentials and edge states
- 10.3 the integral quantum hall effect
- 10.3.1 phenomenology
- 10.3.2 the "edge state" approach
- 10.3.3 streda formula
- 10.3.4 the laughlin argument
- 10.4 electrons in full landau levels: energetics
- 10.4.1 noninteracting kinetic energy
- 10.4.2 density matrix
- 10.4.3 pair correlation function
- 10.4.4 exchange energy
- 10.4.5 the "lindhard" function
- 10.4.6 static screening
- 10.4.7 correlation energy the random phase approximation
- 10.4.8 fractional filling factors
- 10.5 exchange-driven transitions in tilted field
- 10.6 electrons in full landau levels: dynamics
- 10.6.1 classification of neutral excitations
- 10.6.2 collective modes
- 10.6.3 time-dependent hartree-fock theory
- 10.6.4 kohn's theorem
- 10.7 electrons in the lowest landau level

# <<电子液体量子理论>>

1	Λ	7 1	one	full	lanc	lau	امريما	ĺ
- 1	w	. / . I	CH IE	11111	ומו ונ	ווהו	IEVEI	ı

10.7.2 two-particle states: haldane's pseudopotentials

10.8 the laughlin wave function

10.8.1 a most elegant educated guess

10.8.2 the classical plasma analogy

10.8.3 structure factor and sum rules

10.8.4 interpolation formula for the energy

10.9 fractionally charged quasiparticles

10.10 the fractional quantum hall effect

10.11 observation of the fractional charge

10.12 incompressibility of the quantum hall liquid

10.13 neutral excitations

10.13.1 the single mode approximation

10.13.2 effective elasticity theory

10.13.3 bosonization

10.14 the spectral function

10.14.1 an exact sum rule

10.14.2 independent boson theory

10.15 chern-simons theory

10.15.1 formulation and mean field theory

10.15.2 electromagnetic response of composite particles

10.16 composite fermions

10.17 the half-fi!led state

10.18 the reality of composite fermions

10.19 wigner crystal and the stripe phase

10.20 edge states and dynamics

10.20.1 sharp edges vs smooth edges

10.20.2 electrostatics of edge channels

10.20.3 collective modes at the edge

10.20.4 the chiral luttinger liquid

10.20.5 tunneling and transport

exercises

appendices

appendix 1 fourier transform of the coulomb interaction in low

dimensional systems

appendix 2 second-quantized representation of some useful

operators

appendix 3 normal ordering and wick's theorem

appendix 4 the pair correlation function and the structure

factor

appendix 5 calculation of the energy of a wigner crystal via the

ewaid method

appendix 6 exact lower bound on the ground-state energy of the

jellium model

appendix 7 the density--density response function in a

crystal

appendix 8 example in which the isothermal and adiabatic responses

# <<电子液体量子理论>>

appendix 9 lattice screening effects on the effective
electron-electron interaction
appendix 10 construction of the stls exchange-correlation
field
appendix 11 interpolation formulas for the local field
factors
appendix 12 real space-time form of the noninteracting green's
function
appendix 13 calculation of the ground-state energy and
thermodynamic potential
appendix 14 spectral representation and frequency summations
appendix 15 construction of a complete set of wavefunctions, with a
given density
appendix 16 meaning of the highest occupied kohn-sham eigenvalue in
metals

appendix 17 density functional perturbation theory

appendix 18 density functional theory at finite temperature

appendix 19 completeness of the bosonic basis set for the luttinger

model

differ

appendix 20 proof of the disentanglement iemma

appendix 21 the independent boson theorem

appendix 22 the three-dimensional electron gas at high magnetic

field

appendix 23 density matrices in the lowest landau level

appendix 24 projection in the lowest landau level

appendix 25 solution of the independent boson model

references

index

# <<电子液体量子理论>>

### 版权说明

本站所提供下载的PDF图书仅提供预览和简介,请支持正版图书。

更多资源请访问:http://www.tushu007.com