

CONTENTS

1.	SUPERFLUIDITY: THE PARADOX OF ATOMIC SIMPLICITY AND REMARKABLE BEHAVIOR	F. REIF
	Challenge of the many-particle problem	1
	Liquid helium	2
	General nature of the challenge	4
	Intermediate concepts for liquid helium	5
	Intermediate concepts and the observed behavior of helium II	8
	Large-scale quantum effects	11
	Concluding remarks	13
PART I		
2.	FIELD THEORETIC METHODS IN THE MANY-BODY PROBLEM	DAVID LURIE
	Review of second quantization	17
	Green's function	19
	Information contained in G	21
	Free particle Green's function	21
	Physical interpretation of the boundary condition	25
	Perturbation theory	26
	Diagrams in momentum space	34
	Dyson equation	35
	Extension to $T \neq 0$	39
	Boundary conditions	41
3.	PHENOMENOLOGICAL THEORY OF SUPERCONDUCTIVITY	C. G. KUPER
	Macroscopic description	51
	Skin penetration	53
	The Ginzburg-Landau theory	57
4.	INTRODUCTION TO THE THEORY OF SUPERCONDUCTIVITY THE PAIR WAVE-FUNCTION ORDER PARAMETER	LEON GUNTHER
	Introduction	63
	London theory	65
	Ginzburg-Landau theory	68
	Cooper pairing	71
	Gorkov theory	72
5.	TYPE-II SUPERCONDUCTORS	M. WEGER
	The Landau-Ginsburg equations	81
	Predictions of the Landau-Ginsburg equation	84
	Type-II superconductors	86
	The structure of an individual fluxoid	88
	The forces acting on fluxoids	89
	Experiments to determine the structure of fluxoid cores	94
	Vibrations of fluxoid	95
	Fluxoid lattice	97
	Experiments to determine the structure of the fluxoid lattice	98

6. THEORY OF FERMI LIQUIDS	<i>S. G. LIPSON</i>
Introduction	101
The Fermi gas	102
The interacting system	106
Calculation of equilibrium properties of the Fermi liquid	110
Transport properties	112
Experimental values in He^3	115
7. LIQUID He^4	<i>MARSHALL LUBAN</i>
Introduction	117
Bogoliubov theory	122
8. FORMALISM OF LINEAR RESPONSE IN MANY-BODY SYSTEMS	<i>DANIEL J. AMIT</i>
Introduction	141
Linear response	142
Analytic properties	143
Symmetry properties	144
Dissipation and stability	144
Sum rules	146
Fluctuation dissipation theorem	146
The density-density response function in the RPA	147
9. THE T-MATRIX APPROXIMATION	<i>C. G. KUPER</i>
Introduction: Selective summation of diagrams to infinite order	151
Scattering of hard-core particles	153
The T-matrix approximation for many-body system	156
PART II	
10. EXPERIMENTAL STUDIES OF SUPERFLUID HELIUM FROM A MICROSCOPIC POINT OF VIEW: IONS, VORTICES, AND "EXCITONS"	<i>F. REIF</i>
Introduction and background	165
Studies of ion motion	175
Vortex rings and lines	189
"Excitons"	234
Concluding remarks	246
11. SELECTED PROBLEMS IN SOUND PROPAGATION IN LIQUID HELIUM	<i>I. J. RUDNICK</i>
First sound in the immediate neighborhood of the lambda point of helium	251
The sound waves of helium: first through fourth	263
Some experiments with third and fourth sound	271
12. THEORY OF LIQUID HELIUM	<i>E. P. GROSS</i>
Introduction	285
Configuration space description of low lying states	289
Time dependent density correlation function at absolute zero	302
Thermodynamics	309
13. LOW TEMPERATURE EXPANSION OF RELAXATION TIMES IN FERMI LIQUIDS	<i>V. J. EMERY</i>
Introduction	317
Relaxation times	321
Non-analyticity in T	324
14. SUPERFLUIDITY OF LIQUID He^3	<i>V. J. EMERY</i>
	333

15.	DILUTE MIXTURES OF He^3 IN LIQUID He^4 AT LOW TEMPERATURES	<i>V. J. EMERY</i>
	Introduction	343
	Effective Hamiltonian for the He^3	346
	Analysis of experiments	352
16.	THE SUPERCONDUCTING PHASE TRANSITION: FLUCTUATIONS AND PARACONDUCTIVITY	<i>RICHARD A. FERRELL</i>
	Introduction	367
	Mean field approximation	370
	Specific heat	379
	Fluctuation frequency spectrum	384
	Paraconductivity	388
	Electron dynamics	392
	Summary	397
17.	THE INFLUENCE OF IMPURITIES AND BOUNDARY EFFECTS ON TRANSITIONS IN SUPERCONDUCTIVITY	<i>GERHART LÜDERS</i>
	Impurity scattering	401
	Boltzmann equation	411
	Approximations	420
	Boundary conditions	428
	Going beyond the approximations	437
18.	SPIN FLUCTUATIONS IN ALMOST MAGNETIC MATERIALS AND THE KONDO EFFECT	<i>W. BRENIG</i>
	Introduction	449
	The selfenergy	460
	The specific heat	466
	Transport processes	470
	Localized spin fluctuations	474
	Introduction to the Kondo effect	479
	Dispersion equation for the scattering	488
	Solution of the dispersion equation	493
19.	STATISTICAL MECHANICAL APPROACH TO THE THEORY OF QUANTUM FLUIDS	<i>G. L. SEWELL</i>
	Introduction	501
	The model	502
	Equilibrium properties	503
	Ergodic properties	508
	Hydrodynamical variables	510
	Generalised master equation	514
	Phenomenological law	517
	Hydrodynamical equations	521
20.	THE kq -REPRESENTATION	<i>J. ZAK</i>
		525
21.	THE HARTREE-FOCK PROBLEM WITH SUBSIDIARY CONDITIONS AND THE RANDOM PHASE APPROXIMATION	<i>A. MANN</i>
	Introduction	533
	The Hartree-Fock approximation	533
	Subsidiary conditions and the R. P. A.	535
	Discussion	541
22.	SYMMETRY BREAKING IN THE SUPERFLUID CONDENSATION	<i>DAVID LURIE</i>
		543

23.	ENERGY AND STABILITY OF VORTEX RINGS IN LIQUID HELIUM II; CRITICAL VELOCITIES	<i>A. G. VAN VIJFEIKEN, A. WALRAVEN and F. A. STAAS</i>	
	Introduction		555
	A vortex ring in an unbounded fluid		561
	A vortex ring in an enclosure		568
	Stability conditions for vortex rings		574
24.	THE EFFECT OF ORBITAL QUANTIZATION ON THE CRITICAL FIELD OF TYPE-II SUPERCONDUCTORS	<i>LEON GUNTHER</i>	
	Introduction		579
	Why and when?		580
	Some mathematics		581
	Results		584
25.	ON THE TRANSPORT PROPERTIES OF PURE TYPE-II SUPERCONDUCTORS NEAR H_{c1}	<i>E. CANEL</i>	
			587
26.	MAGNETIZATION IN SUPERCONDUCTING FILMS	<i>C. DI CASTRO, P. TOMBESI and W. YOUNG</i>	
			593
27.	DAMPING OF HELICONS IN A METAL WITH ANISOTROPIC FERMI SURFACE	<i>P. HALEVI</i>	
			597
28.	SELF-CONSISTENT PAIRING THEORY OF THE BOSE SUPERFLUID	<i>Y. IMRY</i>	
	Introduction		603
	Quasi particle approximation for the Bose system		604
	General considerations		607
	Discussion		612