

Contents

1	Two-Dimensional Interface Electron Systems	1
1.1	Introduction	1
1.2	Hovering Electrons Above Superfluid Helium ^4He	3
1.3	Electrons Bound to a Helium Film	13
1.4	Scattering by Vapor Atoms	17
1.5	Electron Scattering at an Uneven Interface	21
1.5.1	Capillary Wave Quanta (Ripplons)	21
1.5.2	Bloch Approach for Bound Electrons	23
1.5.3	Adiabatic Approximation	30
1.6	Mobility Along the Helium Surface	35
1.7	Other Cryogenic Interfaces	39
1.7.1	Electrons on the Surface of Fermi Liquid ^3He	39
1.7.2	Solid Interfaces (H_2 , Ne)	42
1.8	Retrapping Transition	47
1.9	Cyclotron Motion: Quantization and Collision Broadening ...	53
1.9.1	Self-Consistent Approximation	56
1.9.2	Cumulant Approach	59
2	Strongly Correlated Coulomb Liquid	65
2.1	Fundamental Correlation Functions	65
2.1.1	General Definitions	66
2.1.2	Density–Density Correlation Function	68
2.1.3	Dynamical Structure Factor	70
2.2	Fluctuational Electric Field Concept	78
2.3	Coulomb Narrowing of Landau Levels	80
2.3.1	Electric Field Effect on the Density of States	80
2.3.2	Ensemble of Electrons with Ultra-Fast Orbit Centers ..	83
2.4	Coulomb Broadening of the Dynamical Structure Factor	88
2.5	Plasmons and Magnetoplasmons in Reduced Dimensions ...	91
2.5.1	Interior Excitations	92
2.5.2	Edge Waves	95
2.6	Electron Correlations and Binding Energy	103

3	Quantum Transport Framework for Highly Correlated Electrons	115
3.1	An Approach to Universality	115
3.2	Phenomenological Analysis	119
3.3	Force-Balance Method (DC Case)	123
3.4	Memory Function Formulation (AC Case)	128
3.5	Comparison with the Kinetic Equation Method	136
3.6	Energy Relaxation Rate	143
4	Unconventional Hall Effect	149
4.1	Transport of Electrons with Discrete Energy Spectrum	149
4.2	Experimental Techniques	154
4.3	Quantization-Induced Decrease in the Hall Angle	157
4.4	Many-Electron Effects	159
4.5	Inelastic Magnetotransport	171
4.6	Cold Nonlinear Effect	176
5	Quantum Cyclotron Resonance	183
5.1	Early Achievements	183
5.2	Single-Electron Approaches	188
5.3	Cyclotron Resonance and Internal Forces	193
5.3.1	Many-Electron Effects in the Linear Regime	199
5.3.2	Power-Induced Coulomb Narrowing	205
5.4	Peak Shift	206
6	Interface Polarons	213
6.1	Relation to the General Polaron Problem	213
6.2	Ground-State Properties	217
6.2.1	Strong Coupling Theory	217
6.2.2	Detrapping Transition	221
6.3	Transport Along the Interface	227
6.3.1	Effective Mass	227
6.3.2	Viscosity Drag of Self-Trapped Electrons	230
6.3.3	Long Mean-Free-Path Regime	232
6.3.4	Ripplon-Limited Mobility	234
7	Wigner Solid. I. Dynamics on Rigid and Soft Interfaces ...	237
7.1	Contemporary Practice of an Old Hypothesis	237
7.2	Phase Diagram	241
7.2.1	Boundary Shape	242
7.2.2	Dislocation Melting in Two Dimensions	244
7.2.3	Quantum Melting Regime	246
7.3	Normal Modes and Quantization Under a Magnetic Field ...	249
7.3.1	Phonon Mode Mixing Induced by a Magnetic Field ...	252
7.3.2	Mean-Square Displacement	255

7.4	Coupling with Medium Vibrations	256
7.4.1	Dimple Lattice and Medium Response Force	257
7.4.2	Coupled Modes	261
7.4.3	Self-Consistent Debye–Waller Factor	267
7.4.4	Coupling Under a Magnetic Field	272
7.5	Dynamical Structure Factor	274
7.5.1	Conventional Approximations	276
7.5.2	Correlations in Two Dimensions	277
7.5.3	Strong Coupling and Consistency Requirements	280
7.5.4	High Magnetic Field Case	282
7.6	Shear Mode Excitation and Specific Heat Measurements	284
7.7	Bilayer Electron Crystals	286
8	Wigner Solid. II. Transport Properties	293
8.1	Solid Current	293
8.2	AC Conductivity and Phonon Damping	296
8.2.1	Basic Relations	296
8.2.2	Spectrum-Splitting Reduction of Phonon Damping	306
8.2.3	Resonance Structure of the Collision Rate	308
8.3	Mobility over Normal and Superfluid ^3He	313
8.3.1	Viscous Drag of the Dimple Lattice	314
8.3.2	Long Mean-Free-Path Regime	316
8.4	Nonlinear Transport	321
8.4.1	Bragg–Cherenkov Scattering	326
8.4.2	Sliding Wigner Solid	330
	References	335
	Index	345