

Contents

1	Introduction	1
	References	4
2	The Two-Dimensional Electron System	7
2.1	Realizing a 2DES in a GaAs/AlGaAs Heterostructure	7
2.2	Classical Electron Transport	12
2.3	The Integer Quantum Hall Effect	14
2.3.1	Quantum Mechanical Treatment in the Single-Particle Picture	15
2.3.2	Microscopic Picture	20
2.4	The Fractional Quantum Hall Effect	24
2.4.1	Laughlin's Wavefunction	25
2.4.2	The Composite Fermion Theory	27
2.5	Density-Modulated Phases in the Quantum Hall Regime	29
2.5.1	The Bubble Phase	30
2.5.2	The Stripe Phase	32
2.6	The Second Landau Level	34
2.6.1	Reentrant States in the Second Landau Level	35
2.6.2	The $\nu = 5/2$ and $7/2$ States	35
	References	39
3	Electron-Nuclear Spin Interaction in the Quantum Hall Regime	47
3.1	Introduction to the Spin Physics in the Quantum Hall Regime	47
3.1.1	The Role of the Electron Spin System	47
3.1.2	The Nuclear Spin System in a GaAs/AlGaAs Heterostructure	51
3.1.3	The Hyperfine Coupling of Electronic and Nuclear Spins	52

3.2	Nuclear Spin Relaxation Rate in the Quantum Hall Regime	54
3.2.1	Nuclear Magnetometry Based on the $\nu = 2/3$ Spin Transition.	54
3.2.2	Results and Discussion	58
3.3	Filling Factor Dependence of the Nuclear Spin Polarization	61
	References	66
4	The Spin Polarization of the $5/2$ State	69
4.1	Resistively Detected NMR	69
4.2	Results and Discussion.	72
4.2.1	Discussion of the NMR Lineshape	74
4.2.2	The Spin Polarization at $\nu = 5/2$	76
	References	78
5	Probing the Microscopic Structure of the Stripe Phase at $\nu = 5/2$	81
5.1	Tilt-Induced Phase Transition at $\nu = 5/2$	81
5.2	NMR Spectroscopy of the Stripe Phase	85
5.3	Modeling of the NMR Response	86
	References	90
6	Surface Acoustic Wave Study of Density-Modulated Phases.	93
6.1	Surface Acoustic Waves on a GaAs/AlGaAs Heterostructure.	93
6.2	Experimental Setup and Measurement Technique	97
6.3	SAW Propagation in the Quantum Hall Regime	98
6.3.1	Discussion of the Negative Phase Shift	102
6.3.2	Reentrant States in the Second Landau Level	104
6.3.3	Impact of current flow	106
	References	108
7	Summary	111
	References	114
	Appendix A: Sample Parameters	117
	Appendix B: The Low-Temperature Sample Holder	119
	Curriculum Vitae	127

Spin and Charge Ordering in the Quantum Hall Regime

Frieß, B.

2016, XV, 129 p. 62 illus., 61 illus. in color., Hardcover

ISBN: 978-3-319-33535-3