

# Contents

<b>1 Introduction</b>	1
1.1 Quantum Mechanics	1
1.2 Magnetic Resonance (MR)	7
1.3 Dissertation Outline	10
<b>2 Longitudinal Relaxation in Solid <math>^{129}\text{Xe}</math></b>	13
2.1 Introduction	13
2.2 History of the Problem	14
2.2.1 Foundations of Theory and Experiment	14
2.2.2 Reincarnation via Hyperpolarization	19
2.2.3 Review of Hyperpolarized $^{129}\text{Xe}$ Experimental Results	20
2.2.4 Theoretical Formulation	24
2.2.5 Epilogue	36
2.3 Methods	36
2.3.1 Flow-Through Polarizer	36
2.3.2 Convection Cell	39
2.3.3 Temperature Control	40
2.3.4 Measurement of Longitudinal Relaxation	41
2.4 Results	43
2.4.1 Temperature Dependence of Ice	46
2.4.2 Temperature Dependence of Snow	48
2.4.3 Additional Measurements	52
2.5 Discussion	55
2.5.1 Ice Theory	55
2.5.2 Snow Theory	62
2.6 Summary	63
<b>3 Dipolar and Exchange Coupling Between Carrier Pairs in Disordered Semiconductors Undergoing Resonance</b>	65
3.1 Introduction	65
3.2 Intermediate-Spin-Pair Model with Dipolar and Exchange Coupling	67

3.2.1	Finer Points of the Hamiltonian .....	67
3.2.2	Energy Basis and Observable .....	72
3.3	Analytical and Numerical Methods .....	74
3.3.1	Rotating-Frame Stochastic Liouville Equation .....	75
3.3.2	Limiting Cases of the Rabi Frequencies .....	75
3.3.3	Liouville-Space Formalism .....	78
3.4	Results and Discussion .....	80
3.4.1	Dipolar Coupling Only .....	81
3.4.2	Dipolar and Exchange Coupling .....	84
3.5	Summary and Conclusion .....	88
<b>4</b>	<b>Low-Frequency Modulation of Longitudinal Field: Modified Rabi Envelopes .....</b>	<b>89</b>
4.1	Introduction .....	89
4.2	Theoretical .....	90
4.2.1	Description of Three Limiting Regimes .....	90
4.2.2	Rabi Frame .....	92
4.3	Experimental .....	94
4.3.1	Methods .....	94
4.3.2	Results and Discussion .....	96
4.4	Summary .....	100
	<b>Appendix A Rb <math>P_{1/2}</math>-orbital Absorption-Emission Cycles .....</b>	<b>105</b>
	<b>Appendix B Dilute-Spin Solid <math>^{129}\text{Xe}</math> Transverse Relaxation .....</b>	<b>113</b>
	<b>Appendix C Longitudinal Relaxation in Gaseous <math>^{129}\text{Xe}</math> .....</b>	<b>119</b>
	<b>References .....</b>	<b>127</b>

<http://www.springer.com/978-3-319-13631-8>

129 Xe Relaxation and Rabi Oscillations

Limes, M.

2015, XXI, 136 p. 42 illus., 33 illus. in color., Hardcover

ISBN: 978-3-319-13631-8