

Contents

Semiconductor Spintronics

<i>T. Dietl</i>	1
1 Why Spintronics?	1
2 Non-magnetic Semiconductors	4
2.1 Overview	4
2.2 Spin Relaxation and Dephasing	5
2.3 An Example of Spin Filter	6
3 Hybrid Structures	7
3.1 Overview	7
3.2 Spin Injection	8
3.3 Search for Solid-state Stern-Gerlach Effect	9
4 Diluted Magnetic Semiconductors	11
4.1 Overview	11
4.2 Magnetic Impurities in Semiconductors	12
4.3 Exchange Interaction Between Band and Localized Spins	14
4.4 Electronic Properties	15
4.5 Magnetic Polarons	17
4.6 Exchange Interactions between Localized Spins	17
4.7 Magnetic Collective Phenomena	18
5 Properties of Ferromagnetic Semiconductors	19
5.1 Overview	19
5.2 p-d Zener Model	20
5.3 Curie Temperature – Chemical Trends.....	22
5.4 Micromagnetic Properties.....	23
5.5 Optical Properties	26
5.6 Charge Transport Phenomena	28
5.7 Spin Transport Phenomena	36
5.8 Methods of Magnetization Manipulation	37
6 Summary and Outlook	37
References	40

Lectures on the Spin Pairing Mechanism in High-Temperature Superconductors

E. Arrighoni 47

1 Introduction 47

2 Superconductivity 48

3 Phonon-Mediated Effective Attraction between Electrons 50

4 BCS Theory 53

5 High-Temperature Superconductors 55

6 Pairing Mediated by Spin Fluctuations:
 Linear Response to Magnetic Excitations 59

References 65

Spin in Quantum Field Theory

S. Forte 67

1 From Quantum Mechanics to Field Theory 67

2 Spin and Statistics 68

 2.1 The Galilei Group and the Lorentz Group 68

 2.2 Statistics and Topology 70

 2.3 Bosons, Fermions and Anyons 74

3 A Path Integral for Spin 79

 3.1 The Spin Action 79

 3.2 Classical Dynamics 81

 3.3 Geometric Quantization 82

4 Relativistic Spinning Particles 86

 4.1 Path Integral for Spinless Particles 86

 4.2 The Classical Spinning Particle 88

 4.3 Quantum Spinning Particles and Fermions 90

5 Conclusion 93

References 94

Nucleon Spin

E. Leader 95

1 Introduction 95

2 Polarized Lepton-Nucleon Deep Inelastic Scattering 97

3 The Spin Crisis in the Parton Model 101

4 Resolution of the Spin Crisis: The Axial Anomaly 105

5 Matrix Elements of Angular Momentum Operators: The Problem . 108

6 Relativistic Spin States 111

7 Matrix Elements of Angular Momentum Operators: The Results .. 113

 7.1 Canonical Spin State Matrix Elements 114

 7.2 Helicity State Matrix Elements 116

8 Angular Momentum Sum Rules 118

 8.1 General Structure of Sum Rules:
 Parton Transverse Momentum 118

8.2	The Longitudinal Sum Rule	122
8.3	The Transverse Case: The New Sum Rules	123
8.4	Comparison with Results in the Literature	125
9	Interpretation of the Sum Rules	126
	References	127
	Index	129