

# Contents

<i>Preface</i>	<i>page xi</i>
<b>1 Introduction</b>	<b>1</b>
1.1 Probing the system with photons	2
1.2 A second probe of resonances: inelastic scattering	10
1.3 Energy transfer in inelastic scattering	15
1.4 Inelastic scattering with strongly interacting projectiles	19
1.5 Spin excitations	25
1.6 Excitation by heavy ions	28
<b>2 Basic concepts</b>	<b>33</b>
2.1 Vibrations of continuous systems	33
2.2 Resonance formulas	43
<b>3 Theoretical tools</b>	<b>46</b>
3.1 Operators	46
3.2 Sum rules	49
3.3 TRK sum rule and the oscillator strength	53
3.4 Photon cross section	53
3.5 Spin sum rules	58
3.6 Polarizability sum	58
<b>4 RPA</b>	<b>63</b>
4.1 Linear response	64
4.2 Matrix formulation of RPA	69
4.3 Sum rules	73
4.4 Separable interactions	74
<b>5 Dipole oscillations</b>	<b>81</b>
5.1 Dipole oscillations of electrons and the Mie theory	81
5.2 Nuclei	90

<b>6</b>	<b>Surface modes</b>	99
6.1	Liquid drop vibrations	102
6.2	Surface oscillations of Fermi liquids	106
6.3	Nuclear quadrupole modes	109
6.4	Low frequency vibrations	119
6.5	Higher multipolarities	124
<b>7</b>	<b>Compressional modes</b>	127
7.1	Nuclear breathing mode: classical	128
7.2	Nuclear breathing mode: RPA	130
7.3	Electronic breathing mode	135
<b>8</b>	<b>Spin modes</b>	137
8.1	Isobaric analog resonance	138
8.2	Magnetic modes in nuclei	140
8.3	Gamow–Teller resonances in nuclei	142
8.4	Spin in metal clusters	146
<b>9</b>	<b>Line broadening and the decay of oscillations</b>	148
9.1	Particle escape width	150
9.2	Landau damping	154
9.3	Deformation effects	161
9.4	Optical model of configurational damping	164
9.5	Other internal degrees of freedom	167
<b>10</b>	<b>Thermal effects</b>	171
10.1	Thermal line shifts	175
10.2	Thermal line broadening	176
10.3	A general theory	181
	<b>Appendix A: Mean field theory</b>	187
	<b>Appendix B: Specification of deformations</b>	193
	<b>Appendix C: Finite nucleus compressibility</b>	196
	<b>Appendix D: Nuclear surface reactions</b>	199
	<b>Appendix E: Numerical RPA</b>	203
	<i>References</i>	205
	<i>Index</i>	209