

CONTENTS

Preface v Preface to the second edition vii

1	Forces and fields	1
1.1	Action and motion	1
1.2	Gravitation	7
1.3	Electricity and magnetism	8
1.4	Electromagnetism	12
1.5	Relativity	17
2	The structure of matter	22
2.1	Atoms and molecules	22
2.2	The internal structure of atoms	24
2.3	Probing the atom with light	28
2.4	The inherent uncertainty in matter	34
2.5	Waves and particles	38
2.6	Electron waves and atomic energy levels	42
2.7	Quantum theory and relativity	47
3	Inside the nucleus	53
3.1	The nuclear binding force	53
3.2	Nuclear fission and alpha radioactivity	58
3.3	Beta radioactivity	62
3.4	The neutrino	67
3.5	Antimatter	70
4	Nuclear forces	78
4.1	The quantum theory of fields	79
4.2	Virtual particles	84
4.3	The strong interaction: a first look	89
4.4	The weak interaction: a first look	95
4.5	The muon	97
5	Symmetry in the microworld	104
5.1	Law and order among particles	105

5.2	Symmetry and conservation laws	110
5.3	Reflection symmetry and its violation	115
5.4	Strange particles	120
5.5	More symmetry violation	123
5.6	Isotopic spin	125
5.7	Unitary symmetry	130
6	The road to unification	133
6.1	Quarks	134
6.2	Gluons	141
6.3	Weak force revisited	145
6.4	Grand unified theories	151
6.5	Superunification	155
6.6	Cosmology	159
6.7	Conclusions	163
	<i>Further reading</i>	168
	<i>Index</i>	169