

Contents

Foreword	ix
Thibault DAMOUR	
<i>General Relativity Today</i>	1
1 Introduction	1
2 Special Relativity	2
3 The Principle of Equivalence	5
4 Gravitation and Space-Time Chrono-Geometry	6
5 Einstein's Equations: Elastic Space-Time	8
6 The Weak-Field Limit and the Newtonian Limit	11
7 The Post-Newtonian Approximation and Experimental Confirmations in the Regime of Weak and Quasi-Stationary Gravitational Fields	14
8 Strong Gravitational Fields and Black Holes	17
9 Binary Pulsars and Experimental Confirmations in the Regime of Strong and Radiating Gravitational Fields	21
10 Gravitational Waves: Propagation, Generation, and Detection . . .	27
11 General Relativity and Quantum Theory: From Supergravity to String Theory	31
12 Conclusion	46
References	47
Ignatios ANTONIADIS	
<i>Beyond Einstein's Gravity</i>	51
1 Introduction	51
2 Framework	53
3 Experimental implications in accelerators	55
4 Supersymmetry in the bulk and short range forces	57
5 Non-compact extra dimensions and localized gravity	59
5.1 Warped spaces	60
5.2 The induced gravity model	61
5.3 String theory realization	63
References	65

Michael KRAMER

	<i>The Double Pulsar</i>	69
1	Introduction	69
2	Pulsars	70
3	Pulsars as radio sources	71
4	Evolution of Pulsars	73
5	Formation of Millisecond Pulsars	74
6	Pulsar Timing	76
7	Binary Pulsars	78
8	The double pulsar – a magnificent laboratory	81
	8.1 A laboratory for plasma physics	81
	8.2 A laboratory for strong-field gravity	84
	8.3 Space-motion and evolution of the double pulsar	94
9	Orbital decay measurement & Alternative theories of gravity . . .	95
10	Future tests	97
11	Summary & Conclusions	98
	Acknowledgements	98
	References	99

John MESTER and the GP-B Collaboration

	<i>Testing Einstein in Space: The Gravity Probe B Relativity Mission</i>	101
1	Introduction	101
2	Gravity Probe B	102
3	Experimental System Overview	102
4	Gyroscopes and Gyroscope Readout	103
5	Telescope and Guide Star Selection	105
6	On-Orbit Operations and Performance	106
7	Data Analysis	108
8	Gyro Performance	108
	References	109

Jean-Yves VINET

	<i>Instruments for Gravitational Wave Astronomy on Ground and in Space</i>	111
1	Introduction	111
2	Gravitational Waves	112
	2.1 GW emission	112
	2.2 Physical signature of a GW	113
3	Ground based detectors	115
	3.1 General principles	115
	3.2 The insulation challenge	118
	3.3 Fighting the thermal noise	119
	3.4 Issues in Optical technology	123
	3.5 Planned spectral sensitivity	125
	3.6 Frequency Stabilization	125

3.7	Data Analysis	127
3.8	Present status	127
4	The LISA mission	128
4.1	Orbital configuration	128
4.2	Drag free operation	131
4.3	Data flow	132
4.4	Time Delay Interferometry	133
4.5	Data analysis	135
4.6	Simulators	135
5	Conclusion	136
	References	136