

# Contents

<b>1. Introduction</b>	1
1.1 History and Philosophy of the Quantum Theory	2
1.1.1 Blackbody Radiation	2
1.1.2 Photoelectric Effect	3
1.1.3 Compton Effect	4
1.1.4 Atomic Spectra and the Bohr Atom	4
1.1.5 The Seminal Experiment: Electron Diffraction	6
1.1.6 Interpretations of Quantum Mechanics	9
1.2 History and Philosophy of Theories of Gravity	
Leading to the Theory of General Relativity	11
1.2.1 Newton's Third Law of Motion	15
1.2.2 Predictions of Einstein's Theory of General Relativity	18
1.3 A Quantum Theory of Gravity	21
<b>2. The Theory of General Relativity:</b>	
<b>Einstein's Formulation</b>	25
2.1 The Spacetime Language	26
2.2 On Invariance of the Speed of Light	27
2.3 The Riemannian Metric	28
2.4 Expression of Einstein's Field Equations	30
2.5 Einstein's Equations from the Variational Principle	31
2.6 The Vacuum Equation	34
2.7 The Geodesic Equation	36
2.8 The Schwarzschild Solution and the Newtonian Limit	39
<b>3. A Unified Field Theory</b>	43
3.1 Einstein's Field Theory in Quaternion Form	44
3.2 Spin Affine Connection	47
3.3 The Quaternion Variables in a Riemannian Spacetime	48

3.4	Derivation of the Quaternion Metrical Field Equations from the Principle of Least Action . . . . .	50
3.5	A Symmetric Tensor–Antisymmetric Tensor Representation of General Relativity . . . . .	53
3.5.1	Einstein’s Field Equation from the Symmetric Tensor Part . . . . .	54
3.5.2	The Maxwell Field Equations from the Antisymmetric Part . . . . .	55
3.6	The Geodesic Equation in Quaternion Form . . . . .	58
3.7	Summary . . . . .	61
<b>4.</b>	<b>Quantum Mechanics</b>	
	<b>from a Theory of Inertial Mass in Relativity . . . . .</b>	<b>63</b>
4.1	Introduction . . . . .	64
4.2	Discovery of Quantum Mechanics . . . . .	67
4.3	Inertial Mass from General Relativity . . . . .	71
4.4	The Matter Field Equations in General Relativity . . . . .	73
4.5	Gauge Covariance . . . . .	73
4.6	The Elementary Interaction . . . . .	75
4.7	Proof of the Attractive Gravitational Force in the Newtonian Limit and the Oscillating Universe Cosmology . . . . .	76
4.8	From the Mach Principle to the Generalized Mach Principle . . . . .	77
<b>5.</b>	<b>Electromagnetism . . . . .</b>	<b>79</b>
5.1	Introduction . . . . .	80
5.2	Interpretation of Maxwell’s Equations in the Holistic Field Theory . . . . .	83
5.3	The Elementary Interaction Formulation . . . . .	84
5.4	A Spinor Formulation of Electromagnetic Theory in Special Relativity . . . . .	85
5.5	Invariants and Conservation Equations in the Spinor Formalism . . . . .	86
5.6	Lagrangian for the Spinor Formulation of Electromagnetism . . . . .	88
5.7	Faraday’s Approach and the Mach Principle . . . . .	90
5.8	Spinor Formulation of Electromagnetism in General Relativity . . . . .	90
5.9	Extension of the Spinor Conservation Laws of Electromagnetism in General Relativity . . . . .	91

5.10 The Electromagnetic Interaction Functional in the Matter Field Equations .....	94
5.11 Delayed Action at a Distance .....	95
<b>6. The Pauli Principle and Pair Creation/Annihilation</b> .....	97
6.1 Introduction .....	98
6.2 The Individual Particle Model .....	100
6.3 The Free Field Limit .....	100
6.4 Conservation of Interaction .....	101
6.5 The Pauli Exclusion Principle .....	103
6.6 Sufficiency of the Three Conditions for Proof of the Pauli Principle .....	108
6.7 Fermi–Dirac Statistics from the Nonrelativistic Approximation for $\Psi$ .....	110
6.8 Bound Particle–Antiparticle Pairs. Ground State .....	111
6.9 Energy and Momentum of the Bound Pair in its Ground State .....	113
6.10 Dynamical Properties of the Pair in its Ground State ..	114
6.11 Pair Creation, the Physical Vacuum, and Blackbody Radiation .....	117
<b>7. Atomic and Elementary Particle Physics</b> .....	121
7.1 Introduction .....	122
7.2 Hydrogen .....	124
7.2.1 Linearization of the Hydrogen Field Equation ...	124
7.2.2 The Lamb Splitting .....	127
7.3 The Neutron .....	130
7.3.1 Binding Energy of the Neutron: A Phenomenological Determination .....	131
7.3.2 The Neutron Lifetime .....	132
7.3.3 The Neutron Magnetic Moment .....	134
7.4 Mass Doublets: The Electron–Muon .....	135
7.5 Infinite Lepton Spectrum .....	136
7.6 The Pion .....	138
7.6.1 Ratio of Neutral and Charged Pion Masses .....	139
7.6.2 Ratio of Neutral and Charged Pion Lifetimes ....	140
7.7 CP Violation in Neutral Kaon Decay .....	141
7.8 Charge Quantization in General Relativity .....	143

<b>8. Astrophysics and Cosmology in General Relativity ..</b>	<b>147</b>
8.1 Introduction .....	148
8.2 Principle of Equivalence .....	150
8.3 The Quaternion Geodesic for a Stationary Orbit .....	152
8.4 Planetary Motion .....	153
8.5 The Schwarzschild Problem .....	155
8.6 The Radial Solution and Perihelion Precession .....	158
8.7 The Hubble Law and Cosmology .....	159
8.7.1 The Oscillating Universe Cosmology .....	160
8.7.2 Dynamics of the Expansion and Contraction of the Universe .....	161
8.7.3 Spiral Structure of the Universe .....	163
8.8 Black Holes and Pulsars .....	166
8.8.1 Possible Model of a Pulsar .....	168
8.8.2 Damped Oscillatory Motion and Pulsars .....	170
8.9 Separation of Matter and Antimatter in the Early Universe .....	171
<b>Bibliography .....</b>	<b>175</b>
<b>Index .....</b>	<b>189</b>



<http://www.springer.com/978-3-540-00800-2>

Quantum Mechanics and Gravity

Sachs, M.

2004, XIV, 192 p., Hardcover

ISBN: 978-3-540-00800-2