Contents

Preface	vii
Acknowledgments	xiii
Introduction	1
Chapter 1	
Geometrical Structure of $\mathcal{M}$	7
1.1 Preliminaries	7
1.2 Minkowski Spacetime	9
1.3 The Lorentz Group	15
1.4 Timelike Vectors and Curves	46
1.5 Spacelike Vectors	61
1.6 Causality Relations	64
1.7 Spin Transformations and the Lorentz Group	74
1.8 Particles and Interactions	87
Chapter 2	
Skew-Symmetric Linear Transformations and Electromagnetic Fields	100
2.1 Motivation via the Lorentz Law	100
2.2 Elementary Properties	101
2.3 Invariant Subspaces	107
2.4 Canonical Forms	113
2.5 The Energy-Momentum Transformation	117
2.6 Motion in Constant Fields	121
2.7 Variable Electromagnetic Fields	126
Chapter 3	
The Theory of Spinors	143
3.1 Representations of the Lorentz Group	143

3.2 Spin Space 161
3.3 Spinor Algebra 170
3.4 Spinors and World Vectors 178
3.5 Bivectors and Null Flags 188
3.6 The Electromagnetic Field (Revisited) 196

Appendix A
Topologies For $\mathcal{M}$ 210
A.1 The Euclidean Topology 210
A.2 E-Continuous Timelike Curves 211
A.3 The Path Topology 215

Appendix B
Spinorial Objects 226
B.1 Introduction 226
B.2 The Spinning Electron and Dirac's Demonstration 227
B.3 Homotopy in the Rotation and Lorentz Groups 229

References 240
Symbols 243
Index 251