

Fields, Symmetries, and Quarks

Bearbeitet von
Ulrich Mosel

Neuauflage 1999. Buch. xiii, 310 S. Hardcover

ISBN 978 3 540 65235 9

Format (B x L): 15,5 x 23,5 cm

Gewicht: 1400 g

[Weitere Fachgebiete > Physik, Astronomie > Quantenphysik > Hochenergiephysik](#)

schnell und portofrei erhältlich bei

The logo for beck-shop.de features the text 'beck-shop.de' in a bold, red, sans-serif font. Above the 'i' in 'shop' are three red dots of increasing size. Below the main text, 'DIE FACHBUCHHANDLUNG' is written in a smaller, red, all-caps, sans-serif font.

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung [beck-shop.de](#) ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Contents

Part I. Preliminaries

1. Units and Metric	3
1.1 Units	3
1.2 Metric and Notation	4

Part II. Fundamentals of Field Theory

2. Classical Fields	9
2.1 Equations of Motion	9
2.1.1 Examples	11
2.2 Symmetries and Conservation Laws	14
2.2.1 Geometrical Space-Time Symmetries	15
2.2.2 Internal Symmetries	17
3. Free Fields and Their Quantization	21
3.1 Classification of Fields	21
3.2 Scalar Fields	23
3.2.1 Quantization of the Hermitian Scalar Field	24
3.2.2 Quantization of the Charged Scalar Field	27
3.3 Vector Fields	29
3.3.1 Massive Vector Fields	29
3.3.2 Massless Vector Fields	30
3.4 Fermion Fields	32
3.4.1 Dirac Equation	32
3.4.2 Lagrangian for Fermion Fields	34
3.4.3 Quantization of the Dirac Field	35
3.4.4 Massless Fermions	38
3.4.5 Neutrinos	40
3.5 Transition Rates in Quantum Field Theory	44
3.6 Quantum Mechanical Consistency	52

Part III. Global Symmetries

4. Symmetries of Meson and Baryon Systems	57
4.1 $U(1)$ Symmetry	57
4.1.1 Properties of the Group $U(1)$	58
4.1.2 Structure of the Nucleon Lagrangian	59
4.2 $SU(2)$ Symmetry	60
4.2.1 Properties of the Group $SU(2)$	60
4.2.2 General Definitions	64
4.2.3 Application to the Pion–Nucleon System	64
4.2.4 Structure of $SU(2)$ Multiplets	72
4.3 $SU(3)$ Symmetry	74
4.3.1 Properties of the Group $SU(3)$	75
4.3.2 Structure of $SU(3)$ Multiplets	78
4.3.3 Assignments of Hadrons to $SU(3)$ Multiplets	83
4.3.4 $SU(3)$ Symmetry Breaking	85
5. Quarks	87
5.1 Construction of $SU(3)$ Multiplets	87
5.1.1 Construction of the Representation $3 \otimes \bar{3}$	89
5.1.2 Construction of the Representation $3 \otimes 3 \otimes 3$	90
5.2 State Vectors for the Multiplets	92
5.2.1 Tensor Algebra	93
5.2.2 Hadron Multiplets	96
5.3 Color Degree of Freedom	100
6. Chiral Symmetry	103
6.1 Phenomenology of β -Decay	103
6.1.1 Leptonic β -Decay	103
6.1.2 Semileptonic β -Decay	104
6.2 Current Conservation in Strong Interactions	106
6.2.1 Vector Current Conservation	106
6.2.2 Axial Vector Current Conservation	108
6.3 Chiral Symmetry Group	110
6.3.1 Chiral Symmetry Transformations for the Fermions	110
6.3.2 Chiral Symmetry Transformations for the Mesons	112
7. Spontaneous Global Symmetry Breaking	115
7.1 Goldstone Theorem	115
7.1.1 Goldstone Bosons	116
7.2 Examples of the Goldstone Mechanism	119
7.2.1 Spontaneous Breaking of a Global Non-Abelian Symmetry	119
7.2.2 σ -Model	121
7.2.3 Nambu–Jona–Lasinio Model	129

Part IV. Local Gauge Symmetries

8. Gauge Field Theories	135
8.1 Conserved Currents in QED	135
8.2 Local Abelian Gauge Invariance	137
8.3 Non-Abelian Gauge Fields	139
8.3.1 Lagrangian for Non-Abelian Gauge Field Theories	139
8.3.2 Properties of Non-Abelian Gauge Field Theories	144
9. Spontaneous Symmetry Breaking in Gauge Field Theories	147
9.1 Higgs Mechanism	147
9.2 Spontaneous Breaking of a Local Non-Abelian Symmetry	150
9.3 Summary of the Higgs Mechanism	155

Part V. Electroweak Interaction

10. Weak Interactions of Quarks and Leptons	159
10.1 Phenomenological Introduction	159
10.1.1 Strangeness Changing Weak Decays	159
10.1.2 Neutral Currents	160
10.2 Intermediate Vector Bosons	161
10.3 Fundamentals of a Theory of Weak Interactions	164
11. Electroweak Interactions of Leptons	167
11.1 Leptonic Multiplets and Interactions	167
11.1.1 Electroweak Currents	174
11.2 Lepton Masses	175
11.3 Electroweak Interactions	176
11.3.1 Generalization to Other Leptons	180
11.4 Parameters of the Lagrangian	180
11.4.1 Charged Current Experiments	180
11.4.2 Neutral Current Experiments	182
12. Electroweak Interactions of Quarks	187
12.1 Hadronic Multiplets	187
12.1.1 Hadron Masses	190
13. Electroweak Interactions of Quarks and Leptons	193
13.1 Lagrangian of Electroweak Interactions	193
13.2 Standard Model	194

14. CP Invariance of Electroweak Interactions	197
14.1 Kobayashi–Maskawa Matrix	197
14.2 Unitarity of the KM Matrix	198
14.3 K^0 Decay and CP Violation	201
14.4 CP Invariance and the KM Matrix	203

Part VI. Strong Interaction

15. Quantum Chromodynamics	209
15.1 Gauge Group for Strong Interactions	209
15.2 QCD Lagrangian	211
15.3 Properties of QCD	213
15.3.1 Scale Invariance	213
15.3.2 Chiral Invariance	214
15.3.3 Antishielding and Confinement	215
15.3.4 Deconfinement Phase Transition	217

Part VII. Hadron Structure

16. Bag Models of Hadrons	223
16.1 Potential Well in the Dirac Theory	223
16.2 The MIT Bag	228
16.2.1 Fermions in the MIT Bag	229
16.2.2 Hadron Masses	232
16.2.3 Gluons in the MIT Bag	234
16.2.4 Hyperfine Structure of Bag States	235
16.2.5 Magnetic Moments of the Nucleon	243
16.2.6 Axial Vector Current	246
16.2.7 Chiral Symmetry in the MIT Bag	251
17. Soliton Models of Hadrons	257
17.1 Skyrmion Model	258
17.2 Hybrid Chiral Bag Model	262
17.3 Linear σ -Model	269
17.4 Friedberg–Lee Soliton Bag Model	272
17.5 NJL Soliton Model	274

Part VIII. Appendices

A. Solutions of the Free Dirac Equation	279
A.1 Properties of Free Dirac States	279
A.2 Massless Fermions	284
A.3 Dirac and Majorana Fields	286
B. Explicit Quark States for Hadrons	289
C. Table of Hadron Properties	293
Bibliography by Subject	297
References	303
Index	307