

Table of Contents

Introduction

<i>Michael Beyer</i>	1
References	3

CP, T, and CPT Symmetries

<i>Ernest M. Henley</i>	4
1 Introduction, Parity, Charge Conjugation	4
1.1 Parity	4
1.2 Charge Conjugation	7
2 The CP Transformation	9
3 Time Reversal	12
3.1 Time Reversal	12
3.2 Consequences of Time Reversal Invariance	14
3.3 The Strong CP Problem	19
4 CPT, PCT, TPC,	22
5 Summary	24
References	24

CP Violation in the K^0 System

<i>Konrad Kleinknecht</i>	27
1 The Big Bang and the Expanding Universe	27
2 Symmetries	28
3 Phenomenology and Models of CP Violation	30
4 Theoretical Estimates for the Parameter ϵ' of Direct CP Violation .	32
5 Experiments on Direct CP Violation	33
5.1 Early Experiments: The Observation of Direct CP Violation .	33
5.2 The NA48 Detector	34
5.3 The KTeV Detector	36
5.4 Data Analysis NA48: Confirmation of Direct CP Violation ...	37
5.5 Analysis of KTeV Data: Confirmation of Direct CP Violation	39
6 Conclusion	41
References	43

Flavour Oscillation and CP Violation of B Mesons

<i>Roland Waldi</i>	43
1 Introduction	43
1.1 The Experiments	44
2 Quark Mixing and Particle Antiparticle Oscillations	45
2.1 The Unitary CKM Matrix	45
2.2 Oscillation Phenomenology	57
2.3 Experimental Determination of the Mixing Parameters of B Mesons	81
3 CP Violation	96
3.1 CP Eigenstates Versus Mass Eigenstates	98
3.2 CP Violating Interference Effects in B Decays	102
3.3 Direct CP Violation	103
3.4 CP Violation in the Oscillation	106
3.5 CP Violation in Common Final States of B^0 and $\bar{B}^0$	110
3.6 Measurement of Time-Dependent Asymmetries of Neutral B Mesons	146
3.7 Experimental Data on $B \rightarrow J/\psi K_S$	183
3.8 Experimental Data on $B \rightarrow \pi\pi$	188
4 Outlook	189
References	190

CP Asymmetries in Neutral Kaon and Beon Decays

<i>Klaus R. Schubert</i>	196
References	205

Time Reversal Invariance in Nuclear Physics:

From Neutrons to Stochastic Systems

<i>Christopher R. Gould, Edward David Davis</i>	206
1 Introduction	206
2 Overview of Electric Dipole Moment and Transmission Tests of Time Reversal Invariance	207
2.1 Electric Dipole Moments	207
2.2 Neutron Transmission Tests of Symmetry Violation	210
3 Total Cross Section and Forward Elastic Scattering Amplitude for Arbitrary States of Polarization	214
3.1 Generalization of the Optical Theorem to Include Spin Degrees of Freedom	214
3.2 Statistical Density Matrix for the Projectile Target Spin Space	217
3.3 Partial Wave Expansions on the Energy Momentum Shell	219
3.4 Decomposition of the Total Cross Section	223
3.5 Decomposition of the Forward Elastic Scattering Amplitude ..	227
References	235

CP Violation and Baryogenesis

<i>Werner Bernreuther</i>	237
1 Introduction	237
2 Some Basics of Cosmology	238
2.1 The Standard Model of Cosmology	238
2.2 Equilibrium Thermodynamics	241
2.3 Departures from Thermal Equilibrium	243
3 The Baryon Asymmetry of the Universe	244
3.1 Heuristic Considerations	244
3.2 The Sakharov Conditions	246
4 CP and B Violation in the Standard Model	249
5 Electroweak Baryogenesis	255
5.1 Why the SM Fails	259
5.2 EW Phase Transition in SM Extensions	262
5.3 CP Violation in SM Extensions	263
5.4 Electroweak Baryogenesis	269
5.5 Role of the KM Phase	275
6 Out-of-Equilibrium Decay of Super-Heavy Particle(s)	276
6.1 GUT Baryogenesis	277
6.2 Baryogenesis Through Leptogenesis	281
7 Summary	284
References	290

Physics Beyond the Standard Model

<i>Gian Francesco Giudice</i>	294
1 Introduction	294
2 Grand Unified Theories	295
2.1 SU(5)	295
2.2 Experimental Tests of GUTs	296
2.3 SO(10) and Neutrino Masses	298
3 The Hierarchy Problem	299
4 Supersymmetry	300
4.1 Supersymmetric Unification	302
4.2 Electroweak Symmetry Breaking	303
4.3 Higgs Sector	304
4.4 Supersymmetry and Experiments	306
4.5 The Flavour Problem	307
4.6 Recent Developments in Supersymmetry	308
4.7 More on Experimental Consequences	312
5 Technicolour	313
6 Extra Dimensions	316
6.1 Opening New Problems	319
6.2 Experimental Tests of Extra Dimensions	321
7 Conclusions	324
References	324

Subject Index	329
----------------------------	-----