

Contents

1	Introduction	1
2	Relativistic field theory	3
2.1	Scalar fields	3
2.2	Symmetries in field theory	5
2.3	Particle interpretation	8
2.4	Antiparticles	11
3	Scattering theory	13
3.1	Cross sections and decay rates	13
3.2	Semi-classical approximation and asymptotic conditions	20
3.3	Solution of the field equation	24
3.4	Calculation of the scattering amplitude	25
4	Feynman diagrams	31
4.1	The method of Feynman diagrams	31
4.2	The invariant amplitude	35
4.3	Feynman rules for the scalar theory	36
4.4	Unitarity, radiative corrections and renormalizability	39
5	Spinor fields	43
5.1	Spinor representations of the Lorentz group	43
5.2	Mass terms and coupling to scalars	50
6	Gauge symmetries	55
6.1	Electrodynamics	55
6.2	A sample calculation: Compton scattering	63
6.3	Non-commutative charges: the Yang-Mills theory	64

7	The standard model	69
7.1	A gauge theory of weak interactions	69
7.2	Electroweak unification	73
7.3	Hadrons	75
8	Spontaneous breaking of the gauge symmetry	81
8.1	Masses for vector bosons	81
8.2	Scalar electrodynamics and the abelian Higgs model	82
8.3	Physical content of the abelian Higgs model	87
8.4	The Higgs mechanism in the standard model	92
9	Breaking of accidental symmetries	95
9.1	Quark masses and flavour-mixing	95
9.2	Lepton masses	97
9.3	Accidental symmetries	99
10	Summary	101
11	Applications	105
11.1	Muon decay	105
11.2	Width of the W boson	108
11.3	Higgs decay into a vector boson pair	110
11.4	Weak neutral currents	111
11.5	Higgs production in e^+e^- collisions	115
12	Neutrino masses and mixing	119
A	Large-time evolution of the free field	125
B	Scattering from an external density	127
C	Dirac matrices	129
D	Violation of unitarity in the Fermi theory	131
	References	135