

Contents

Preface	ix
1. Scattering off the potential $V(r) = a\delta(r - r_0)$	1
2. Reflection and transmission of a one-dimensional barrier	4
3. The magnetic dipole moment interaction between two spin-1/2 particles	7
4. Scattering asymmetry due to $\ell \cdot s$ interaction	11
5. The "static" photoelectric effect	13
6. Scattering off a $1/r^2$ potential	17
7. Elastic scattering of electrons on atomic hydrogen	19
8. The Compton effect on bound electrons	21
9. Negative ions of noble gases in the semiclassical approximation	26
10. Physics of the spectral lines D_1D_2 of sodium	29
11. On dipole and quadrupole resonances	32
12. Quadrupole transitions	38
13. The width of the 2P level of hydrogen	40
14. Excitation of atomic levels by electron scattering	44
15. Ionization of hydrogen by X-rays	49
16. Atomic scattering of μ at low momentum transfer	51
17. The Frank and Hertz resonances	52
18. $p\bar{p}$ annihilation at low energies	56
19. Partial waves in $\pi - N$ scattering	58
20. Measuring proton polarization by the asymmetry in $p - C_{12}$ scattering	61
21. $\pi - C_{12}$ scattering at low energy	67
22. On the process $n + p \rightarrow d + \gamma$ and its inverse	68
23. A model of $\pi - N$ interaction	71
24. The $N - N$ interaction through π , ρ and ω exchange	74
25. Interaction in the heavy $q\bar{q}$ system	78
26. Strong interaction effects on the levels of π -mesic hydrogen	83
27. The secant law in the angular distribution of cosmic muons	89
28. Structure functions for a particle in a box	91
29. Inclusive pion distributions in $p - p$ scattering	95
30. The structure functions of a particle bound in a harmonic oscillator potential	97
31. The Fermi statistical model for π production	104
32. A model of $p - \bar{p}$ annihilation	107
33. The decay $\mu^- \rightarrow e^- \gamma$	112
34. $\pi^0 \rightarrow e^+ e^-$ in an external electric field	116
35. The decay $p \rightarrow e^+ + \pi^0$	118
36. Limits on Z_0 decay into electron plus heavy lepton	121
37. Possible production of massive neutrinos in triton (H_3) decay	124

38. On the possibility of a halo in the charge distribution of the proton	126
39. Limits on the existence of massless scalar particles coupled to leptons	129
40. Some consequences of the existence of axions	133
41. Virtual electron pairs, sign of the e^+ gravitational mass, and Eötvös experiment	136
42. The magnetic moment of neutrinos	139
43. Neutron-antineutron oscillations	143
44. Eigenstates of gravitons	147
45. The cosmic radiation spectrum	148
46. Correlations in sequential atomic decays	150
47. Preparation of polarized electron beams by scattering on laser radiation	153
48. Decays of the ϕ meson	157
49. The decays of Σ^0	159
50. l_2 decays of vector and pseudoscalar mesons	164
51. K_{l3}^0 decay	167
52. π^0 decay into $\gamma\gamma$ and Dalitz pairs	170
53. Narrow band ν beams	176
54. Positronium decay into $\gamma\gamma$ and $\nu_e\bar{\nu}_e$	180
55. Nuclear β -decay between 1^+ and 0^+ states	184
56. W decays	187
57. Muon capture by p	190
58. Rare decay modes of K_S^0	192
59. Leptonic decays of the ρ meson	200
60. The decay of positronium into two photons	202
61. Neutron β -decay	203
62. Some characteristics of $\Sigma \rightarrow N - \pi$ decays	205
63. The decays $W^\pm \rightarrow \pi^\pm + \pi^0$	209
64. $\Lambda \rightarrow N + \pi$ and the $\Delta T = 1/2$ rule	211
65. Electron helicity in $K_{\ell 3}$	213
66. The decay $\tau^- \rightarrow \pi^- + \nu_\tau$	216
67. Lepton-antilepton decays of Z_0	219
68. Verifications of the CVC hypothesis	221
69. Some consequences of Vector Meson Dominance	224
70. Possible β -decays of ρ^\pm and $D^{*\pm}$	227
71. The $\theta - \tau$ puzzle	232
72. Some aspects of muon decay	234
73. $\gamma - p$ scattering through a Δ resonance	238
74. The process $e^+e^- \rightarrow \mu^+\mu^-$	241
75. Measuring the π electromagnetic form factor by electron scattering	242
76. Threshold behaviour of the process $e^+e^- \rightarrow Q^+Q^-$ and the spin of Q	245
77. Low energy limits of the Compton effect	248
78. Production of heavy lepton pairs from e^+e^-	253

79. Scattering $\gamma - \gamma$	259
80. The electromagnetic form factor of K^0 through electron scattering	264
81. A general parameterization of the Compton amplitude	269
82. Resonances in $e^+e^- \rightarrow e^+e^-$ at low energy	272
83. Electroweak asymmetry in $e^+e^- \rightarrow \mu^+\mu^-$	274
84. π^0 production via the Primakov effect	277
85. The Compton effect on spin 0 particles	279
86. The Compton effect on neutrons	282
87. $p\bar{p} \rightarrow e^+e^-$ at rest	285
88. W and Z production in $p\bar{p}$ collisions	288
89. Electroweak effects in μe scattering	292
90. Quark model description and vector resonances in $e^+e^- \rightarrow$ hadrons at low energy	294
91. The coupling of a charged vector boson to the electromagnetic field	297
92. Electrons in a radial electric field: Transformation of longitudinal into transverse polarization	300
93. The Čerenkov effect	304
94. Cross section for the Drell-Yan process in πP	307
95. The Bethe model for the Lamb shift	309
96. On the possibility of detecting neutrino beams produced in accelerators onto distant laboratories	312
97. Relativistic scattering of electrons from a given distribution of charge and magnetic moment	315
98. On the electric dipole moment of the neutron and its measurement	317
99. Helicity states for spin 1/2 particles	320
100. Parity violating effects in the hydrogen atom	321
101. τ polarization in the decay of Z_0	326
102. Neutral currents and neutrino lepton scattering	327
103. Neutron polarization by scattering on a magnetized sheet	331
104. Reflection of neutrons from a sandwich of metal sheets	334
105. A proton-nucleus scattering process at low energy	337
106. Neutron interferometry	339
107. A model of the deuteron	345
108. Some properties of the deuteron	350
109. Neutron polarization by reflection	354
110. Muon catalyzed fusion	356
A Relativistic kinematics	359
A 1. Definitions and notations	359
A 2. Mandelstam variables	361
A 3. Phase space	365

B	The groups $SU(2)$ and $SU(3)$ and their representations	369
B 1.	$SU(2)$	369
B 2.	The representations of $SU(2)$	370
B 3.	$SU(3)$	374
C	Scattering and decays	379
C 1.	The decay operator	379
C 2.	The S matrix	380
C 3.	Scattering in a potential with spherical symmetry	382
C 4.	The Goldberger theorem	382
D	Relativistic equations	384
D 1.	Spin 0 particles	384
D 2.	Spin 1/2 particles	385
D 3.	Spin 1 particles	388
E	Discrete symmetries	390
E 1.	Helicity amplitudes	392
E 2.	Invariant amplitudes	394
F	Some useful formulae	397