

Contents.

	Page
Introduction. Units.	2
I. THE HYDROGEN ATOM WITHOUT EXTERNAL FIELDS	4
a) Nonrelativistic theory	4
1. Separation of SCHRÖDINGER's equation in spherical polar coordinates. Angularly dependent eigenfunctions and the angular momentum matrix	4
2. Derivation of BALMER's formula	8
3. The radial eigenfunctions of the discrete spectrum	12
4. The eigenfunctions of the continuous spectrum	21
5. Motion of the nucleus	25
6. Separation of SCHRÖDINGER's equation in parabolic coordinates	27
7. Methods for the continuous spectrum for a general central potential	32
8. Wave functions in momentum space. Discrete spectrum	36
9. Wave functions in momentum space. Continuous spectrum	40
b) DIRAC theory	47
10. General properties of the DIRAC theory	47
11. Angular momentum	51
12. PAULI theory of the spin-electron	54
13. PAULI theory for a central potential	54
14. The exact solution of the DIRAC equation	63
15. DIRAC equation. Continuous spectrum	71
16. The DIRAC equation in momentum space	78
17. The fine structure formula	83
c) Radiative and other corrections	89
18. Radiative corrections. S-matrix theory	89
19. Radiative corrections. Bound states	94
20. Corrections for nuclear motion and structure	100
21. Fine structure and the LAMB shift	103
22. Hyperfine structure splitting	107
23. The fine structure of positronium	114
II. THE HELIUM ATOM WITHOUT EXTERNAL FIELDS	118
a) Nonrelativistic theory	118
24. The SCHRÖDINGER equation for helium (symmetry)	118
25. Discussion of variation and perturbation methods	121
26. Level scheme of helium	124
27. Survey of approximations to be used	127
28. First order HEISENBERG's method (excited states)	131
29. Polarization for excited states	137
30. FOCK's method (excited S-states)	140
31. HARTREE's method	143
32. RITZ variation method (helium ground state)	146
33. Ground state of helium-like ions with arbitrary Z	151
34. The negative hydrogen ion	154
35. Variation method for excited states	157
36. Miscellaneous calculations	160
37. Motion of the nucleus	166
b) Relativistic theory	170
38. Discussion of the BREIT equation	170
39. The PAULI approximation (low Z)	178

	Page
40. Fine structure splitting of helium	183
41. Relativistic corrections for the ground state	189
42. BREIT equation without external field	192
43. Treatment for large Z	196
44. Hyperfine structure	201
III. ATOMS IN EXTERNAL FIELDS	205
a) ZEEMAN effect	205
45. ZEEMAN effect for a single-electron atom	205
46. Dependence on magnetic field strength	208
47. Some corrections to the ZEEMAN effect	213
48. Extension to many-electron atoms	218
49. Comparison with precision experiments	222
50. The diamagnetism of helium	227
b) STARK effect in hydrogen	228
51. Linear STARK effect	228
52. The quadratic STARK effect	232
53. STARK effect for strong fields	234
54. Ionization by the electric field. Quenching of the lines in the STARK effect	235
55. STARK effect of the fine structure of hydrogen	238
c) STARK effect in helium	241
56. The STARK effect for weak fields	241
57. Dependence on field strength	244
58. The dielectric constant of helium	246
IV. INTERACTION WITH RADIATION	248
a) Discrete spectrum	248
59. General formulas	248
60. Selection rules for orbital and magnetic quantum numbers	252
61. Sum rules	255
62. Proof of the sum rules	259
63. The transition probabilities for hydrogen in polar coordinates	262
64. Intensity of fine structure lines	269
65. Intensities in parabolic coordinates (STARK effect)	276
66. Higher multipole radiation	278
67. Lifetimes of excited states in hydrogen	284
68. Alkali and X-ray spectra	292
b) The photoeffect	295
69. General survey	295
70. The BORN approximation	299
71. The absorption coefficient without retardation	303
72. Angular distribution and retardation	308
73. Relativistic effects.	311
74. The optical region	315
75. Recombination	320
c) Bremsstrahlung	323
76. General survey	323
77. Nonrelativistic BORN approximation	326
78. Calculations for low energies	331
79. Relativistic effects.	336
Appendix on spherical harmonics	344
Bibliography	350
Addenda and errata	351
Author index	360
Subject index	365
Index of Tables	369

