References (cont'd.)

86. Mori, K., Wiese, W.L., Shirai, T., Nakai, Y., Ozawa, K. and Kato, T.: 1986, At. Data Nucl. Data Tables 34, p.79.
87. Shirai, T., Nakai, Y., Ozawa, K., Ishii, K., Sugar, J. and Mori, K.: 1987, J. Phys. Chem. Ref. Data 16, p.327.
88. Fawcett, B.C.: 1986, At. Data Nucl. Data Tables 34, p.215.
89. Fawcett, B.C.: 1984, At. Data Nucl. Data Tables 31, p.495.
90. Fawcett, B.C.: 1987, At. Data Nucl. Data Tables 36, p.129.
91. Fawcett, B.C.: 1986, At. Data Nucl. Data Tables 35, p.203.
92. Fawcett, B.C.: 1986, At. Data Nucl. Data Tables 35, p.185.
93. Fawcett, B.C.: 1986, At. Data Nucl. Data Tables 36, p.151.
94. Biémont, E.: 1986, Phys. Scr. 33, p.324.
95. Kurucz, R.L.: 1987, unpublished material (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138, U.S.A.).
96. Palmer, B.A. and Engleman, Jr., R.: 1983, Los Alamos Natl. Lab Report LA-9615, UC-4 (Los Alamos Natl. Lab., Los Alamos, NM 87545, U.S.A.).
97. Palmer, B.A., Keller, R.A. and Engleman, Jr., R.: 1980, Los Alamos Natl. Lab. Report LA-8251-MS, UC-34a (Los Alamos Natl. Lab., Los Alamos, NM 87545, U.S.A.).
98. Sansonetti, C.J. and Weber, K.H.: 1984, J. Opt. Soc. Am. B 1, p.361.
99. Reader, J., Acquista, N., Sansonetti, C.J. and Engleman, Jr., R.: 1988, J. Opt. Soc. Am. B (to be submitted).
100. Reader, J., Acquista, N. and Sansonetti, C.J.: 1988, Wavelengths of Platinum Hollow-Cathode Discharge (to be submitted for publication).
101. Engleman, Jr., R.: 1985, J. Opt. Soc. Am. B 2, p.1934.
102. Eriksson, K.B.S.: 1987, J. Opt. Soc. Am. B 4, p.1369.
103. Persson, W. and Reader, J.: 1986, J. Opt. Soc. Am. B 3, p.959.
104. Reader, J., Kaufman, V., Sugar, J., Ekberg, J.O., Feldman, U., Brown, C.M., Seely, J.F. and Rowan, W.L.: 1987, J. Opt. Soc. Am. B 4 (in press).

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WORKING GROUP 2: ATOMIC TRANSITION PROBABILITIES

The Data Center on Atomic Transition Probabilities at the National Bureau of Standards, Gaithersburg, Maryland, 20899, U.S.A. has continued its critical compilation work and maintains an up-to-date bibliographical data base. Work to revise and expand the existing NBS critical data compilations for the allowed and forbidden transitions in Fe-group elements, (Refs. A-D) has been completed. A single volume containing all these data for the Fe-group elements Sc to Ni is in press (Volume III of the NBS series of atomic transition probability tables) and is scheduled to be published in the near future, as a supplement to the Journal of Physical and Chemical Reference Data.

In Table 1 the important recent literature references containing atomic transition probability data are presented, which have been published since the last Working Group report of August 1984; this material is ordered according to element and stage of ionization. For brevity the references are identified there only by the running number of the general reference list given at the end of this report. In order to keep the size of this list within the allowed space, both the spectra listed here as well as the references within each spectrum had to be on a selection basis. However, the NBS Data Center will supply all-inclusive lists of references on specific spectra on request. In the general reference list supplied with this report the literature is ordered alphabetically according to principal authors. Each reference contains one or more code letters indicating the method applied by the author. These code letters are defined as follows:

THEORETICAL METHODS:

Q - quantum mechanical (including self-consistent field) calculations.
I - interpolation within isoelectronic sequences, spectral series, or homologous atoms; also, data that are presented in graphical, rather than tabular form.

EXPERIMENTAL METHODS:

E - measurements in emission (arc, furnace, discharge tube, shock tube, etc.).
A - measurements in absorption (King furnace, absorption tube, etc.).
L - lifetime measurements (including Hanle-effect).
H - anomalous dispersion (hook) measurements.
M - miscellaneous experimental methods (for example, Stark effect, astrophysical measurements, etc.).

OTHER:

C - additions or suggested revisions to data in previous articles, comments on particular theoretical or experimental methods, etc.
Cp- data compilations.
R - relative (non-absolute) oscillator strengths have been tabulated.
F - data on forbidden (i.e. other than electric dipole) transitions have been tabulated.

References for Introductory Discussion

A. Smith, M.W., Wiese, W.L.: 1973, J. Phys. Chem. Ref. Data 2, p.85.
B. Wiese, W.L., Fuhr, J.R.: 1975, J. Phys. Chem. Ref. Data 4, p.263.
C. Younger, S.M., Fuhr, J.R., Martin, G.A., Wiese, W.L.: 1978, J. Phys. Chem. Ref. Data 7, p.495.
D. Fuhr, J.R., Martin, G.A., Wiese, W.L., Younger, S.M.: 1981, J. Phys. Chem. Ref. Data 10, p.305.

TABLE 1. Recent literature sources for atomic transition probability data of astrophysical interest

This table covers the 3 year period since the publication of our last IAU report (Reports on Astronomy, Vol. XIX A, 122 (1985); preparation date: August, 1984) to the present (September 1987). The table is arranged in alphabetical order of element symbols, with further subdivisions according to stage of ionization (I, II, etc.). The numbers are the running numbers of the reference list following this table.

Al I: 1
Al II: 26,55,122
Al III: 27,55
Al IV: 46

B II: 9,46,114,115,119
B III: 96,133
B IV: 84

Ba I: 8,11,48,74,99,104,135

Be I: 8,11,48,74,99,104,135
Be II: 38,108
Be III: 84

C I: 37,57,79,105
C II:70,92,113
CIII: 36,45,72,102,113,114,115,119
C IV: 95

Ca I: 8,10,51,54,71,80
Ca III: 7,93
Ca IV: 4

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Co II: 116

Cr I: 20,39,130

Fe I: 21,82,112
Fe II: 85
Fe V: 73
Fe VI: 73
Fe VII: 73
Fe IX: 57, 121
Fe X: 35
Fe XI: 17
Fe XII: 124
Fe XIII: 18
Fe XIV: 49,52,134
Fe XV: 3,5,47,125,134
Fe XVII: 15
Fe XIX: 94
Fe XXI: 6,13,37
Fe XXII: 14
Fe XXIII: 24,63,91
Fe XXIV: 24,63,91
Fe XXV: 24,63

H-sequence: 106

He-sequence: 86

He I: 12,59,83,120,126,129

Li I: 44,53,97,127
Li II: 44,84,128,131

Mg I: 8,28,98
Mg II: 27,55
Mg IV: 16

Mn I: 27,75,109
Mn II: 103

N I: 25,34,56,65
N II: 37,132
N III: 72,111
N IV: 45,72,88,114,115,119

Na I: 43,55,97,101,127

Ni I: 41
Ni II: 90

O I: 2,29,40,50,76
O II: 2,37,117,140
O III: 2,30,36,37,77
O IV: 2,31,72

P I: 69
P II: 62,66,141
P III: 1
P IV: 55, 123

S I: 17,68,69
S II: 69
S III: 64,67,69
S IV: 1,78

Si I: 110,112
Si II: 1,89,136
Si III: 26,55,107
Si IV: 27,33,55

Ti I: 19
Ti II: 87

V I: 42,61,109,137
V II: 58,81,139
V III: 138

References

1. Aashamar, K., Luke, T.M. and Talman, J.D.: 1984, Phys. Scr. 30, 121. Q
2. Abramov, V.A., Zhukova, T.I., Zhidkov, A.G. and Kukushkin, A.S.: April 1984, IAEA Report INDC (CCP) - 205/GA. CP
3. Anderson, E.K. and Anderson, E.M.: 1983, Opt. Spectrosc. (USSR) 55, 500. Q, QF
4. Ansbacher, W., Inamdar, A.S. and Pinnington, E.H.: 1985, Phys. Lett. A 110, 383. L
5. Baluja, K.L. and Hibbert, A.: 1985, Nucl. Instrum. Methods Phys. Res., Sect. B 9, 477. Q
6. Baluja, K.L.: 1985, J. Phys. B 18, L413. QF
7. Beluja, K.L.: 1986, J. Phys. B 19, L551. Q
8. Barrientos, C. and Martin, I.: 1985, Can. J. Phys. 63, 1441. Q
9. Bashkin, S., McIntyre, L.C., Buttlar, H.V., Ekberg, J.O. and Martinson, I.: 1985, Nucl. Instrum. Methods Phys. Res., Sect. B 9, 593. L
10. Bauschlicher, C.W. Jr., Langhoff, S.R. and Partridge, H.: 1985, J. Phys. B 18, 1523.

https://doi.org/10.1017/S0251107X00007069 Published online by Cambridge University Press

11. Bauschlicher, C.W., Jr., Jaffe, R.L., Langhoff, S.R., Mascarello, F.G. and Partridge, H.: 1985, J. Phys. B 18, 2147. Q
12. Berrington, K.A., Burke, P.G., Freitas, L.C.G. and Kingston, A.E.: 1985, J. Phys. B. 18, 4135. Q
13. Bhatia, A.K., Seely, J.F. and Feldman, U.: 1987, At. Data Nucl. Data Tables 36,453. Q
14. Bhatia, A.K., Seely, J.F. and Feldman, U.: 1986, At. Data Nucl. Data Tables 35, 319. Q
15. Bhatia, A.K., Feldman, U. and Seely, J.F.: 1985, At. Data Nucl. Data Tables 32, 435. Q,QF
16. Biemont, E.: 1985, Phys. Scr. 31, 45. Q
17. Biemont, E. and Hansen, J.E.: 1986, Phys. Scr. 34, 116. QF
18. Biemont, E.: 1986, Phys. Scr. 33, 324. Q
19. Blackwell, D.E., Booth, A.J., Menon, S.L.R. and Petford, A.D.: 1986, Mon. Not. R. Astron.Soc.220, 289. A
20. Blackwell, D.E., Booth, A.J., Menon, S.L.R. and Petford, A.D.: 1986, Mon. Not. R. Astron. Soc. 220, 303. A
21. Blackwell, D.E., Booth, A.J., Haddock, D.J., Petford, A.D. and Leggett, S. K.: 1986, Mon. Not. R. Astron. Soc. 220, 549. A
22. Booth, A.J., Blackwell, D.E., Petford, A.D. and Shallis, M.J.: 1984, Observatory 104, 265. C
23. Bruneau, J.: 1984, J. Phys. B 17, 3009. Q
24. Buchet, J.P., Buchet-Poulizac, M.C., Denis, A., Desesquelles, J., Druetta, M., Grandin, J.P., Huet, M., Husson, X. and Lecler, D.: 1984, Phys. Rev. A 30, 309. L
25. Butler, K. and Zeippen, C.J.: 1984, Astron. Astrophys. 141, 274. QF
26. Butler, K., Mendoza, C. and Zeippen, C.J.: 1984, Mon. Not. R. Astron. Soc. 209, 343. Q
27. Butler, K., Mendoza, C., and Zeippen, C.J.: 1984, J. Phys. B 17, 2039. Q
28. Chantepie, M., Cojan, J.L., Landais, J., Laniepce, B. and Moudden, A.: 1984, Opt. Commun. 51, 396. L
29. Chung, S., Lin, C.C. and Lee, E.T.P.: 1986, J. Ouant. Spectrosc. Radiat. Transfer 36, 19. Q
30. Coetzer, F.J., Kotze, T.C., Mostert, F.J. and van der Westhuizen, P.: 1986, Spectrochim. Acta, Part B 41, 847. L
31. Coetzer, F.J., Kotze, T.C. and van der Westhuizen, P.: 1986, Spectrochim. Acta, Part B 41, 243. L
32. Coetzer, F.J., Kotze, T.C., Mostert, F.J. and van der Westhuizen, P.: 1986, Phys. Scr. 34, 328. L
33. Cohen, M. and McEachran, R.P.: 1984, J. Phys. B 17, 2979. Q
34. Copeland, R.A., Jeffries, J.B., Hickman, A.P. and Crosley, D.R.: 1987, J. Chem. Phys. 86, 4876. L
35. Cowan, R.D., Bromage, G.E. and Fawcett, B.C.: 1984, Mon. Not. R. Astron. Soc. 210, 439. Q,C
36. Czyzak, S.J., Keyes, C.D. and Aller, L.H.: 1986, Astrophys. J., Suppl. Ser. 61, 159. QF
37. Czyzak, S.J. and Poirier, C.P.: 1985, Astrophys. Space Sci. 116, 21. QF
38. Davis, B.F. and Chung, K.T.: 1984, Phys. Rev. A 29, 2586. Q
39. Delibas, M., Mindreci, I. and Dorohoi, D.: 1984, Rev. Roum. Phys. 29, 175. A
40. Doering, J.P., Gulcicek, E.E. and Vaughan, S.O.: 1985, J. Geophys. Res., Space Phys. 90, 5279. M
41. Doerr, A. and Kock, M.: 1985, J. Quant. Spectrosc. Radiat. Transfer 33, 307. E,H
42. Doerr, A., Kock, M., Kwiatkowski, M., Werner, K. and Zimmermann, P.: 1985, J. Quant. Spectrosc. Radiat. Transfer 33, 55. L,E
43. Engström, K., Young, L., Somerville, L.P. and Berry, H.G.: 1985, Phys. Rev. A 32, 1468. L.

44. Fairley, N.A. and Laughlin, C.: 1984, J. Phys. B 17, 2757. Q
45. Fawcett, B.C.: 1984, At. Data Nucl. Data Tables 30, 423. Q
46. Fawcett, B.C.: 1984, Phys. Scr. 30, 326. Q
47. Fawcett, B.C.: 1986, Phys. Scr. 34, 331. Q
48. Fisk, P.T.H., Bachor, H.-A. and Sandeman, R.J.: 1986, Phys. Rev. A 33, 2418. M
49. Froese Fischer, C. and Liu, B.: 1986, At. Data Nucl. Data Tables 34, 261. Q,QF
50. Froese Fischer, C.: 1987, J. Phys. B 20, 1193. Q
51. Froese Fischer, C. and Hansen, J.E.: 1985, J. Phys. B 18, 4031. Q
52. Frye, D. and Armstrong, L. Jr.: 1985, Phys. Rev. A 31, 2070. Q
53. Fulton, T. and Johnson, W.R.: 1986, Phys. Rev. A 34, 1686. Q
54. Glass, R.: 1985, J. Phys. B 18, 4047. Q
55. Godefroid, M., Magnusson, C.E., Zetterberg, P.O. and Joelsson, I.: 1985, Phys. Scr. 32, 125. QF
56. Goldbach, C., Martin, M., Nollez, G., Plomdeur, P., Zimmermann, J.-P. and Babic, D.: 1986, Astron. Astrophys. 161, 47. E
57. Goldbach, C. and Nollez, G.: 1987, Astron. Astrophys. 181, 203. E
58. Goly, A. and Weniger, S.: 1984, J. Quant. Spectrosc. Radiat. Transfer 32, 61. E
59. Gorny, M.B., Kazantsev, S.A., Matisov, B.G. and Polezhaevs, N.T.: 1985, Z. Phys. A 322, 25. L
60. Graham, R.L. and Yeager, D.L.: 1987, Int. J. Quantum Chem. 31, 99. Q
61. Gurtovendo, E.A., Kostyk, R.I. and Orlova, T.V.: 1985, Kinemat. Fiz. Nebesn. Tel 1, No.2, 62. M
62. Harris, A.W. and Mas Hesse, J.M.: 1986, Astrophys. J. 308, 240. MR
63. Hata, J. and Grant, I.P.: 1984, Mon. Not. R. Astron. Soc. 211, 549. Q,QF
64. Hayes, M.A.: 1986, J. Phys. B 19, 1853. Q
65. Hibbert, A., Dufton, P.L. and Keenan, F.P.: 1985, Mon. Not. R. Astron. Soc. 213, 721. Q
66. Hibbert, A.: 1986, J. Phys. B 19, L455. Q
67. Ho, Y.K. and Henry, R.J.W.: 1984, Astrophys. J. 282, 816. Q
68. Ho, Y.K. and Henry, R.J.W.: 1985, Astrophys. J. 290, 424. Q
69. Ho, Y.K. and Henry, R.J.W.: 1987, Phys. Scr. 35, 831. Q,C
70. Huber, M.C.E., Sandeman, R.J. and Tozzi, G.P.: 1984, Phys. Scr. T8, 95. E
71. Hunter, L.R. and Peck, S.K.: 1986. Phys. Rev. A 33, 4452. L
72. Ishii, K., Suzuki, M. and Takahashi, J.: 1985. J. Phys. Soc. Jpn. 54, 3742. L
73. Jacques, C., Moreau, J.-P. and Knystautas, E.J.: 1984, J. Phys. (Paris) 45, 1607. L
74. Jahreiss, L. and Huber, M.C.E.: 1985. Phys. Rev. A 31, 692. C
75. Jäger, H., Neger, T. and Sperger, R.: 1987. Opt.Commun. 61, 252. ER
76. Jenkins, D.B.: 1985, J. Quant. Spectrosc. Radiat. Transfer 34, 55. A
77. Johnson, B.C., Smith, P.L. and Knight, R.D.: 1984, Astrophys. J. 281, 477. L
78. Johnson, C.T., Kingston, A.E. and Dufton, P.L.: 1986, Mon. Not. R. Astron. Soc. 220, 155. QF
79. Jones, D.W. and Wiese, W.L.: 1984. Phys. Rev. A 29, 2597. E
80. Jonsson, G., Levinson, C. and Svanberg, S.: 1984, Phys. Scr. 30, 65. L
81. Karamatskos, N., Michalak, R., Zimmermann, P., Kroll, S. and Kock, M.: 1986, Z. Phys. D 3, 391. L,E
82. Kock, M., Kroll, S. and Schnehage, S.: 1984, Phys. Scr. T8, 84. E,H
83. Kono, A. and Hattori, S.: 1984, Phys. Rev. A 29, 2981. O
84. Kono, A. and Hattori, S.: 1984, Phys. Rev. A 30, 2093. Q
85. Kroll, S. and Kock, M.: 1987, Astron. Astrophys., Suppl. Ser. 67, 225. E,H
86. Kundu, B. and Mukherjee, P.K.: 1985. Astrophys. J. 298, 844. QF
87. Kwiatkowski, M., Werner, K. and Zimmermann, P.: 1985. Phys. Rev. A 31, 2695. L

88. Lang, J., Hardcastle, R.A., McWhirter, R.W.P. and Spurrett, P.H.: 1987, J. Phys. B 20, 43. E
89. Lanz, T. and Artru, M.-C.: 1985, Phys. Scr. 32, 115. Q,Cp
90. Lawler, J.E. and Salih, S.: 1987, Phys. Rev. A 35, 5046. L
91. Lemen, J.R., Phillips, K.J.H., Cowan, R.D., Hata, J. and Grant, I.P.: 1984, Astron. Astrophys. 135, 313. Q
92. Lennon, D.J., Dufton, P.L., Hibbert, A. and Kingston, A.E.: 1985, Astrophys. J. 294, 200. Q
93. Loginov, A.V. and Gruzdev, P.F.: 1986, Opt. Spectrosc. (USSR) 61, 417. Q
94. Loulergue, M., Mason, H.E., Nussbaumer, H. and Storey, P.J.: 1985, Astron. Astrophys. 150, 246. Q,QF
95. Lunell, S., Cogordan, J.A. and Oster, P.: 1985, J. Phys. B 18, 3849. Q
96. Mannervik, S., Cederquist, H. and Martinson, I.: 1986, Phys. Rev. A 34, 231. L
97. Martin, I. and Barrientos, C.: 1986, Can. J. Phys. 64, 867. Q
98. Mendoza, C. and Zeippen, C.J.: 1987, Astron. Astrophys. 179, 339. Q
99. Migdalek, J. and Baylis, W.E.: 1987, Phys. Rev. A 35, 3227. Q
100. Moccia, R., and Spizzo, P.: 1985, J. Phys. B 18, 3537. Q
101. Müller, W., Flesch, J. and Meyer, W.: 1984, J. Chem. Phys. 80, 3297. Q
102. Nasser, R.M. and Varshni, Y.P.: 1985, Astron. Astrophys.Suppl. Ser. 60, 325. Q
103. Neger, T.: 1986, J. Phys. D. 19, L153. H
104. Niggli, S. and Huber, M.C.E.: 1987, Phys. Rev. A 35, 2908. E
105. Nussbaumer, H. and Storey, P.J.: 1984, Astron. Astrophys. 140, 383. Q
106. Nussbaumer, H. and Schmutz, W.: 1984, Astron. Astrophys. 138, 495. IF
107. Nussbaumer, H.: 1986, Astron. Astrophys. 155, 205. Q,QF
108. Parpia, F.A., Norcross, D.W. and da Paixao, F.J.: 1986, Phys. Rev. A 34, 4777. Q
109. Peterkop, R.K.: 1985, Opt. Spectrosc. (USSR) 58, 7. Q
110. Peterkop, R.K.: 1985, Opt. Spectrosc. (USSR) 58, 121. Q
111. Pinnington, E.H., Ansbacher, W., Gosselin, R.N. and Kernahan, J.A.: 1986, Phys. Lett. A 114, 373. L
112. Pitts, R.E.: 1986, J. Quant. Spectrosc. Radiat. Transfer 35, 365. E,A
113. Reistad, N., Hutton, R., Nilsson, A.E., Martinson, I. and Mannervik, S.: 1986, Phys. Scr. 34, 151. L
114. Reistad, N. and Martinson, I.: 1986, Phys. Rev. A 34, 2632. I
115. Rudzikas, Z.B., Szulkin, M. and Martinson, I.: 1984, Phys. Scr. T8, 141. Q
116. Salih, S., Lawler, J.E. and Whaling, W.: 1985, Phys. Rev. A 31, 744. L,E
117. Schartner, K.-H., Flaig, H.-J., Träbert, E. and Heckman, P.H.: 1985, Phys. Res., Sec. B 9, 642. E
118. Serrao, J.M.P.: 1985, J.Quant. Spectrosc. Radiat. Transfer 33, 219. Q
119. Serrao, J.M.P.: 1986, J.Quant. Spectrosc. Radiat. Transfer 35, 265. Q
120. Silim, H.A., El-Farrash, A.H. and Kleinpoppen, H.: 1987, Z. Phys. D 5, 61. L
121. Svensson, K.A., Eberg, J.O. and Edlen, B.: 1974, Sol. Phys. 34, 173. QF
122. Tayal, S.S. and Hibbert, A.: 1984, J. Phys. B 17, 3835. Q
123. Tayal, S.S.: 1985, Phys. Scr. 32, 523. Q
124. Tayal, S.S. and Henry, R.J.W.: 1986, Astrophys. J. 302, 200. Q
125. Tayal, S.S.: 1986, J. Phys. B 19, 3421. Q
126. Theodosiou, C.E.: 1984, Phys. Rev. A 30, 2910. Q
127. Theodosiou, C.E.: 1984, Phys. Rev. A 30, 2881. Q
128. Theodosiou, C.E.: 1985, Phys. Scr. 32, 129. Q
129. Theodosiou, C.E.: 1987, At. Data Nucl. Data Tables 36, 97. Q
130. Tozzi, G.P., Brunner, A.J. and Huber, M.C.E.: 1985, Mon. Not. R. Astron. Soc. 217, 423. E
131. Träbert, E., Blanke, J.H., Hucke, R. and Heckmann, P.H.: 1985, Phys. Scr. 31, 130. L
132. Träbert, E., Mannervik, S. and Cederquist, H.: 1986, Phys. Scr. 33, 222. L
133. Träbert, E., Mannervik, S. and Cederquist, H.: 1986, Phys. Scr. 34, 46. L

134. Träbert, E., Hutton, R. and Martinson, I.: 1987, Z. Phys. D 5, 125. L
135. Ueda, K., Hamaguchi, Y., Fujimoto, T. and Fukuda, K.: 1984, J. Phys. Soc. Jpn. 53, 2501. HR
136. Van Buren, D.: 1986, Astrophys. J. 311, 400. M
137. Whaling, W., Hannaford, P., Lowe, R.M., Biemont, E. and Grevesse, N.: 1985, Astron. Astrophys. 153, 109. L,E
138. Wujec, T. and Musielok, J.: 1986, J. Quant. Spectrosc. Radiat. Transfer, 35, 239. E
139. Wujec, T. and Musielok, J.: 1986, J. Quant. Spectrosc. Radiat. Transfer, 36, 7. E
140. Zeippen, C.J.: 1987, Astron. Astrophys. 137, 410. QF
141. Zhechev, D.Z. and Koleva, I.T.: 1986, Phys. Scr. 34, 221. L

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WORKING GROUP 3: COLLISION PROCESSES

Of the vast array of data on electron and heavy-particle collisions that are produced each year, I select only those that have an obvious immediate bearing on astronomical research. A brief review of recent developments in atomic data for astrophysics has been published (1).

1. Electron Collisions

1.1 ELECTRON IMPACT IONIZATION

Experimental impact ionization (2) and theoretical (3,4) values of the cross sections for electron impact ionization were obtained for the magnesium-like ions S^{4+}, Cl^{5+} and Ar^{6+} and theoretical values were obtained for Al^{+} (3). Experimental cross sections were published for electron-impact ionization of B^{2+} and O^{5+} (5), of N^{4+} and N^{5+} (6), of Fe^{5+}, Fe^{6+} and Fe^{9+}(7), of Fe^{11+}, Fe^{13+} and Fe^{15+} (8), of Ni^{3+}, Cu^{2+}, Cu^{3+} and Sb^{3+} L(9) and of Ti^{2+}, Fe^{2+}, Ar^{2+}, Cl^{2+} and F^{2+} (10). Double ionization cross sections were measured for Ar^{+} and Ar^{4+} (11). Theoretical cross sections for the single ionization of Fe^{13+} were calculated (12). Total ionization and partial ionization cross sections of many systems have been complied by Tawara and Kato (13). A list of ionization rate coefficients for astrophysical applications was compiled by Arnaud and Rothenflug (14).

1.2 ELECTRON IMPACT EXCITATION

An evaluated compilation of data for electron-impact excitation of atomic ions was published as a JILA report (15). Many calculations of varying degrees of sophistication have appeared in the literature: excitation cross sections of transitions of He-like and Be-like ions (16) Li-like ions, outer-shell (17) and inner-shell (18), B-like ions (19), C-like ions (20) and Ne-like ions (21) and singly and multiply-charged ions of carbon and oxygen (22) have all been carried out for He^{+} (23). Li^{+} (24), Be^{+} (25), C^{+} (26), C^{2+} (27), C^{4+} (28), Ne^{+} (20), Ne^{4+} and Mg^{6+} (30), Mg^{10+} (31), Mg^{3+} and Mg^{4+} (32), Al^{+} (33), Si^{3+} (34), Si^{9+} (35), Si^{10+} (36), S^{+} (37), S^{2+} (38), S^{7+} (30), Cl^{5+} (40), Fe^{+} (41), Fe^{6+} and Fe^{22+} (42), Fe^{11+} (43), Fe^{12+} (44), Fe^{14+} (45), Fe^{16+} (46), Fe^{17+} (47), Fe^{19+} (48), Fe^{24+} (49), Ca^{14+} (50), Ca^{18} (51), and Cu^{12+} and Cu^{16+} (52). Excitation to autoionizing states and their contribution to ionization has been investigated for magnesium-like ions (2,3) and for nickel ions (53). Experiments on the excitation of Si^{2+} transitions have been carried out (54).

Electron impact excitation of neutral systems has received less attention. New cross section data are available on He (55) with a list of rate coefficients (56). Collisions with neutral C atoms (57) and with neutral S atoms (58) have

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