IPPJ-AM-24

# BIBLIOGRAPHY ON ELECTRON COLLISIONS WITH ATOMIC POSITIVE IONS 1978 THROUGH 1982 (SUPPLEMENT TO IPPJ-AM-7)

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# Errata

Recommended Values of Transport Cross Sections for Elastic Collision and Total Collision Cross Section for Electrons in Atomic and Molecular Gases

IPPJ-AM-19 (1981) by M.Hayashi

| | | |
|---|---|---|
| P. 5 | L.18 | corss ⟶ cross |
| p.39 | 0.14) | Experiment ⟶ Experiments |
| | | (1978) ⟶ (1979) |
| P.44 | 2.4) | (1979) ⟶ (1969) |
| P.46 | 2.24A) | R.W. Wagenar and F.J. de Heer |
| | | J. Phys. B 13 3855 (1980) |
| | | $Q_T$, 22.5 ~ 750 eV, 3.5 % |
| P.49 | 3.19A) | insert the same reference as 2.24A) |
| P.51 | 4.10) | erase (the same as 4.9)) |
| | 4.15A) | insert the same reference as 2.24A) |
| P.53 | 5.18) | insert the same reference as 2.24A) |
| P.55 | 6.17) | $q_t$ ⟶ $Q_T$ |
| P.56 | 7.2) | 7.2) ⟶ 7.3) |
| | | 7.3)* ⟶ 7.2)* |
| P.60 | 9.2) | 30 ⟶ 300 |

With a re-evaluation of the collected data, an improvement has been made over the values recomended in the report. The following tables should replace the corresponding parts of the tables in the report

(September, 1982)

P.17 Table 1. He

| E(eV) | $q_t(cm^2)$ | $q_m(cm^2)$ |
|---|---|---|
| 0 | 5.00(-16) | 5.00(-16) |
| 0.01 | 5.21(-16) | 5.28(-16) |
| 0.03 | 5.39(-16) | 5.51(-16) |
| 0.1 | 5.68(-16) | 5.91(-16) |
| 0.3 | 5.99(-16) | 6.40(-16) |
| 1.0 | 6.12(-16) | 6.88(-16) |
| 1.2 | 6.10(-16) | 6.93(-16) |
| 1.5 | 6.08(-16) | 6.98(-16) |
| 2.0 | 6.03(-16) | 7.01(-16) |
| 2.5 | 5.93(-16) | 6.95(-16) |
| 3 | 5.82(-16) | 6.86(-16) |
| 4 | 5.60(-16) | (6.62)(-16) |
| 5 | 5.38(-16) | 6.32(-16) |
| 6 | 5.15(-16) | 5.99(-16) |
| 8 | 4.75(-16) | (5.35)(-16) |
| 10 | 4.39(-16) | 4.76(-16) |
| 12 | 4.06(-16) | 4.21(-16) |

P.19 Table 2. Ne

| E(eV) | $q_m(cm^2)$ |
|---|---|
| 0 | (1.61)(-17) |
| 0.001 | 2.15(-17) |
| 0.003 | (2.41)(-17) |
| 0.01 | (3.14)(-17) |
| 0.03 | (4.42)(-17) |
| 0.1 | 7.07(-17) |
| 0.3 | 1.11(-16) |
| 1.0 | 1.62(-16) |
| 1.2 | 1.69(-16) |
| 1.5 | 1.75(-16) |
| 2.0 | 1.83(-16) |
| 2.5 | 1.88(-16) |
| 3 | 1.92(-16) |
| 4 | 1.99(-16) |
| 5 | 2.07(-16) |
| 6 | 2.14(-16) |
| 8 | 2.28(-16) |

P.27 Table 6. $H_2$

| E(eV) | $q_t$ ($cm^2$) | $q_m$ ($cm^2$) | $q_v$ ($cm^2$) | $Q_T$ ($cm^2$) |
|---|---|---|---|---|
| 1 | 1.29(-15) | 1.74(-15) | 8.5(-16) | 1.34(-15) |
| 1.2 | 1.35(-15) | 1.80(-15) | 8.7(-16) | 1.42(-15) |
| 1.5 | 1.42(-15) | 1.82(-15) | 8.9(-16) | 1.52(-15) |
| 2 | 1.51(-15) | 1.80(-15) | 9.1(-16) | 1.63(-15) |
| 2.5 | 1.54(-15) | 1.72(-15) | 9.2(-16) | 1.69(-15) |
| 3 | 1.55(-15) | 1.63(-15) | 9.1(-16) | 1.70(-15) |
| 4 | 1.50(-15) | 1.44(-15) | 8.6(-16) | 1.66(-15) |
| 5 | 1.42(-15) | 1.25(-15) | 7.9(-16) | 1.56(-15) |
| 6 | 1.33(-15) | 1.07(-15) | 7.2(-16) | 1.46(-15) |
| 8 | 1.14(-15) | 7.95(-16) | 6.1(-16) | 1.27(-15) |
| 10 | 9.8 (-16) | 5.9 (-16) | 5.0(-16) | 1.10(-15) |
| 12 | 8.4 (-16) | 4.45(-16) | 4.1(-16) | 9.8 (-16) |
| 15 | 6.7 (-16) | 3.05(-16) | 3.0(-16) | 8.4 (-16) |
| 20 | 4.9 (-16) | 1.88(-16) | 1.95(-16) | 6.7 (-16) |
| 25 | 3.75(-16) | 1.35(-16) | 1.40(-16) | 5.7 (-16) |
| 30 | 3.1 (-16) | 1.00(-16) | 1.07(-16) | 4.95(-16) |
| 40 | 2.23(-16) | 6.3 (-17) | 7.0(-17) | 4.3 (-16) |
| 50 | 1.73(-16) | 4.4 (-17) | 5.1(-17) | 3.7 (-16) |
| 60 | 1.40(-16) | 3.2 (-17) | 4.0(-17) | 3.3 (-16) |
| 80 | 1.00(-16) | 2.0 (-17) | 2.66(-17) | 2.8 (-16) |
| 100 | 7.9 (-17) | 1.38(-17) | 1.92(-17) | 2.55(-16) |

## INTRODUCTION

This is the first supplement to the Bibliography on Electron Collisions with Atomic Positive Ions: 1940 through 1977 (IPPJ-AM-7) and covers the literature on the subject which has been accessible to the present author after the publication (1978) of the previous bibliography through July 1982. Also contained here are the papers which were published prior to 1978 but not included in IPPJ-AM-7.

The list of the papers is divided into three sections: I. Review articles and data compilations, II. Experiment, and III. Theory. In each section, listing is arranged by year of publication and alphabetically by the name of the first author. The format of the record is almost the same as in the previous bibliography. A list of abbreviations used is given at the end of the Introduction. An index by ion species is attached after the bibliography sections. For readers' convenience, the index covers both the preceding bibliography (IPPJ-AM-7) and the present supplement.

In the course of the preparation of this report, the following two publications were very useful: International Bulletin on Atomic and Molecular Data for Fusion published quarterly by the International Atomic Energy Agency and Atomic Data for Fusion published bimonthly by the Oak Ridge National Laboratory and the U.S. National Bureau of Standards.

## List of Abbreviations Used

| | |
|---|---|
| AI | autoionization |
| BEA | binary encounter approximation |
| CB | Coulomb-Born approximation |
| CBO | Coulomb-Born-Ochkur approximation |
| CBX | Coulomb-Born approximation with electron-exchange taken into account |
| CC | close-coupling method |
| DW | distorted wave method |
| DWPO | distorted wave polarized orbital method |
| DWX | distorted wave method with electron-exchange taken into account |
| Exc | electron-impact excitation |
| Ion | electron-impact ionization |
| IPM | impact parameter method |
| SC | semiclassical approximation |
| Th | threshold |
| X | electron energy in threshold unit ($X=E/\Delta E$ for excitation and $X=E/I$ for ionization) |
| Y | electron temperature in threshold unit ($Y=kT/\Delta E$ for excitation and $Y=kT/I$ for ionization) |

## I. Review articles and data compilations

1977
N.H. Magee Jr., J.B. Mann, A.L. Merts and W.D. Robb
LA-6691-MS, Los Alamos Scientific Laboratory (1977)
Electron impact excitation of carbon and oxygen ions
[Exc, C II-VI, O IV-VIII]

1979
G.H. Dunn
in Atomic Processes in Fusion Plasmas, IPPJ-AM-13,
Institute of Plasma Physics, Nagoya University, ed. by Y. Itikawa and T. Kato, p. 57 (1979)
Electron-ion collisions: Experimental
[review]
S. Nakazaki and T. Hashino
IPPJ-AM-12, Institute of Plasma Physics, Nagoya University (1979)
Electron imapct excitation of positive ions calculated in the Coulomb-Born approximation—A data list and comparative survey—
[Exc]

1980
H. Jakubowicz and D.L. Moores
Comments At. Mol. Phys. 9 55 (1980)
Electron-impact ionization of positive ions
[Ion, review of CBX]
J.Wm. McGowan
in Electronic and Atomic Collisions, ed. by N. Oda and K. Takayanagi
(North-Holland 1980) p. 237
Electron-ion collisions—An update
[review]
A.L. Merts, J.B. Mann, W.D. Robb and N.H. Magee Jr.
LA-8267-MS, Los Alamos Scientific Laboratory (1980)
Electron excitation collision strengths for positive atomic ions: A collection of theoretical data
[Exc, Be II, C III,IV, N IV,V, O III-VI, Ne VII,VIII, Al V,VI, Si IV,XII, S IV, Ar XV,XVI, Ca X, Fe XV-XXIV, Mo XXXI-XL]
W.D. Robb
in Atomic and Molecular Processes in Controlled Thermonuclear Fusion, ed. by M.R.C. McDowell and A.M. Ferendeci (Plenum, 1980) p. 245
Theoretical studies of electron impact excitation of positive ions
[Exc, review of theory]

1981
V.A. Bazylev and M.I. Chibisov
Sov. Phys. Usp. 24 276 (1981)
Excitation and ionization of multicharged ions by electron collisions
[review, mainly on theory]
R.D. Cowan
Physica Scr. 24 615 (1981)
Progress in the spectroscopy of highly ionized atoms and its use in plasma diagnostics
[electron collisions are mentioned]
D.H. Crandall
Physica Scr. 23 153 (1981)
Electron impact ionization of multicharged ions
[Ion, review]
R.J.W. Henry
Phys. Rept. 68 1 (1981)
Excitation of atomic positive ions by electron impact
[Exc, review]

Y. Itikawa and T. Kato
IPPJ-AM-17, Institute of Plasma Physics, Nagoya University (1981)
Empirical formulas for ionization cross section of atomic ions for electron collisions–Critical review with compilation of experimental data–
[Ion]

D.L. Moores and H. Nussbaumer
Space Sci. Rev. 29 379 (1981)
The relevant atomic data
[for solar observations]

M.S. Pindzola and D.H. Crandall
ORNL/TM-7957, Oak Ridge National Laboratory (1981)
A compilation of theoretical electron-impact excitation cross sections for Fe atomic ions
[Exc, Fe IX-XXVI]

1982

D.H. Crandall
in Physics of Electronic and Atomic Collisions, ed. by S. Datz (North-Hollad 1982) p. 595
Experiments on collisions of electrons and multicharged ions
[review on experiment]

R.J.W. Henry
in Physics of Electronic and Atomic Collisions, ed. by S. Datz (North-Holland 1982) p. 609
Excitation processes in collisions of electrons with multicharged ions
[Exc, review on theory]

D.L. Moores
in Physics of Electronic and Atomic Collisions, ed. by S. Datz (North-Holland 1982) p. 623
Ionization processes in collisions of electrons with multicharged ions
[Ion, review on theory]

S.M. Younger
Comments At. Mol. Phys. 11 192 (1982)
Current theoretical problems in the electron impact ionization of positive ions
[Ion, review on theory]

## II. Experiment

1978

78E1 D.H. Crandall, R.A. Phaneuf and P.O. Taylor — C IV, N V Ion
Phys. Rev. A 18 1911 (1978)
Electron-impact ionization of $C^{3+}$ and $N^{4+}$
[beam, $C^{3+}$ 58-481 eV, $N^{4+}$: 103-529 eV, rate: $2x10^5$-$2x10^8$ K]

78E2 R.K. Feeney, W.E. Sayle II and T.F. Divine — Rb II Ion
Phys. Rev. A 18 82 (1978)
Absolute experimental cross sections for the electron-impact ionization of $Rb^+$ ions
[beam, 27-2000 eV]

78E3 M. Hamdan, K. Birkinshaw and J.B. Hasted — C II,III, O II,III, Ar II,III,IV, Ne II,III Ion
J. Phys. B 11 331 (1978)
[trapped-ion, 40-500 eV]

78E4 W.T. Rogers, J.O. Olsen and G.H. Dunn — Li II Exc
Phys. Rev. A 18 1353 (1978)
Absolute emission cross section for electron-impact excitation of $Li^+$ to the $(2^3P)$ level
[beam, $1^1S-2^3P$, 53-162 eV, rate: $10^4-10^7$ K]

78E5 P.R. Woodruff, M.-C. Hublet and M.F.A. Harrison — Ar II Ion
J. Phys. B 11 L305 (1978)
A measurement of the cross section for electron impact ionisation of $Ar^+$
[beam, Th-1000 eV]

78E6 P.R. Woodruff, M.-C. Hublet, M.F.A. Harrison and E. Brook — C III Ion
J. Phys. B 11 L679 (1978)
A measurement of the cross section for electron impact ionisation of $C^{2+}$
[beam, Th-1000 eV]

1979

79E1 D.H. Crandall, R.A. Phaneuf, B.E. Hasselquist and D.C. Gregory — C IV, N V, O VI Ion
J. Phys. B 12 L249 (1979)
Measured cross sections for ionisation of $C^{3+}$, $N^{4+}$ and $O^{5+}$ ions with contribution due to excitation-autoionisation
[beam, Th-1500 eV]

79E2 D.H. Crandall, R.A. Phaneuf and D.C. Gregory — B IV, C IV,V, N IV,V,VI, O IV,V,VI, Ar V Ion
ORNL/TM-7020, Oak Ridge National Laboratory (1979)
Electron impact ionization of multicharged ions
[beam, Th-1500 eV]

79E3 D.C. Gregory, G.H. Dunn, R.A. Phaneuf and D.H. Crandall — N V Exc
Phys. Rev. A 20 410 (1979)
Absolute cross sections for 2s-2p excitation of $N^{4+}$ by electron impact
[beam, 2s–2p, 4-52 eV]

79E4 W.L. Rowan and J.R. Roberts — N V, O VI Ion
Phys. Rev. A 19 90 (1979)
Electron-impact ionization-rate coefficients for lithiumlike nitrogen and oxygen
[plasma, rate: 80 eV]

79E5 A.I. Zapesochnyii, I.S. Aleksakhin, I.P. Zapesochnyii and A.I. Imre — K II Exc
Sov. Phys. JETP Lett. 29 207 (1979)
Resonances in the cross section of excitation of a potassium ion by electron collision
[beam, $3p^6\ ^1S$–(4s, 4s', 3d), Th-250 eV, relative]

1980

80E1 A. Müller and R. Frodl — Ar II,III,IV Ion
Phys. Rev. Lett. 44 29 (1980)
L-shell contributions to multiple ionization of $Ar^{i+}$ ions (i=1,2,3) by electron impact
[beam, Ar II: 1→3,4,5+, Ar III: 2→4,5+, Ar IV: 3→5+, Th-800 eV]

80E2 A. Müller, E. Salzborn, R. Frodl, R. Becker, H. Klein and H. Winter — O II, Ne II, Xe II, Ar II-VI Ion
J. Phys. B 13 1877 (1980)
Absolute ionisation cross sections for electrons incidnet on $O^+$, $Ne^+$, $Xe^+$, and $Ar^{i+}$ (i=1, . . . , 5) ions
[beam, O II: 83-357 eV, Ne II: 47-830 eV, Xe II: 21-830 eV, Ar II: 25-664 eV, Ar III: 37-747 eV, Ar IV: 56-705 eV, Ar V: 75-830 eV, Ar VI: 124-830 eV]

80E3 P.O. Taylor, R.A. Phaneuf and G.H. Dunn — Be II Exc
Phys. Rev. A 22 435 (1980)
Absolute cross sections and polarization for electron-impact excitation of the resonance multiplet of the $Be^+$ ion
[beam, 2s–2p, 15-740 eV]

80E4 A.I. Zapesochnyi, A.I. Imre and I.S. Aleksakhin — Rb II, Cs II Ion
Sov. Phys. JETP Lett. 31 38 (1980)
Spectroscopic investigation of the production of doubly charged rubidium and cesium ions by electron-ion collisions
[beam, ionization of s-electrons, Th-300 eV]

1981

81E1 P. Defrance, F. Brouillard, W. Claeys and G. van Wassenhove — He II Ion
J. Phys. B 14 103 (1981)
Crossed beam measurement of absolute cross sections: an alternative method and its application to the electron impact ionisation of $He^+$
[beam, 55-74 eV]

81E2 E. Donets and V.P. Ovsyannikov — $C^{q+}$ q=1-5, $N^{q+}$ q=1-6, $O^{q+}$ q=1-7, $Ne^{q+}$ q=1-9, $Ar^{q+}$ q=4-17 Ion
Sov. Phys. JETP 53 466 (1981)
Investigation of ionization of positive ions by electron impact
[trapped-ion, 2-10 keV]

81E3 R.A. Falk, G.H. Dunn, D.C. Griffin, C. Bottcher, D.C. Gregory, D.H. Crandall and M.S. Pindzola — Ti III, Zr III, Hf III Ion
Phys. Rev. Lett. 47 494 (1981)
Excitation-autoionization contributions to electron impact ionization
[beam, Th-64 eV]

81E4 P. Greve, M. Kato, H.-J. Kunze and F.S. Hornady — B IV,V, C V,VI, N V,VI, O VI, F VII, Ne VIII Ion
Phys. Rev. A 24 429 (1981)
Experimental ionization-rate coefficients for hydrogenlike, heliumlike, and lithiumlike ions
[plasma, rates for B IV: 140,175 eV, B V: 230 eV, C V: 160,210 eV, C VI: 230 eV, N V: 110,120 eV, N VI: 235 eV, O VI: 135,160 eV, F VII: 160,180 eV, Ne VIII: 160,220 eV]

81E5 D.W. Hughes and R.K. Feeney — Rb II Ion
Phys. Rev. A 23 2241 (1981)
Absolute experimental cross sections for the electron-impact multiple ionization of singly charged rubidium ions
[beam, 1→3+: 50-3000 eV, 1→4+: 100-3000 eV, 1→5+: 160-3000 eV]

1982

82E1 D.H. Crandall, R.A. Phaneuf, R.A. Falk, D.S. Belic and G.H. Dunn — Mg II, Al III, Si IV Ion
Phys. Rev. A 25 143 (1982)
Absolute cross-section measurements for electron–impact ionization of Na-like ions–$Mg^+$, $Al^{2+}$, and $Si^{3+}$
[beam, Mg II: 15-406 eV, Al III: 29-994 eV, Si IV: 54-1492 eV, rate: $10^5$–$10^7$ K]

82E2 W.T. Rogers, G.H. Dunn, J.O. Olsen, M. Reading and G. Stefani — Zn II Exc
Phys. Rev. A 25 681 (1982)
Absolute emission cross sections for electron-impact excitation of $Zn^+$ ($4p\ ^2P$) and ($5s\ ^2S$) terms. I.
[beam, $4s\ ^2S$–$4p\ ^2P$, $5s\ ^2S$, 6.3-792 eV]

82E3 W.T. Rogers, G. Stefani, R. Camilloni, G.H. Dunn, A.Z. Msezane and R.J.W. Henry — Zn II, Ga II Ion
Phys. Rev. A 25 737 (1982)
Electron-impact ionization of $Zn^+$ and $Ga^+$
[beam, Th-2 keV]

82E4 G. Stefani, R. Camilloni, G.H. Dunn and W.T. Rogers — Ga II Exc
Phys. Rev. A 25 2996 (1982)
Absolute emission cross section for electron-impact excitation of $Ga^+$ to the $4\ ^1P$ level
[beam, $4^1S$–$4^1P$, Th-400 eV]

## III. Theory

1962

62T5 H. van Regemorter — Exc
Astorohys. J. 136 906 (1962)
Rate of collisional excitation in stellar atmospheres
[Gaunt factor approximations proposed]

1968

68T8 O. Bely — O VII Exc
Phys. Lett. 26A 408 (1968)
Theoretical excitation rates in O VII
[CBX, only line ratio $(2^1P-1^1S)/(2^3P-1^1S)$ given]

1969

69T17 W. Eissner, P. de A.P. Martins, H. Nussbaumer, H.E. Saraph and M.J. Seaton — O II,III Exc
Mon. Not. R. Astron. Soc. 146 63 (1969)
Resonances in collision strengths for excitation of [OII] and [OIII]
[rates calculated from 69T6 and 69T10]

69T18 K. Smith, M.J. Conneely and L.A. Morgan — N II, O III Exc
Phys. Rev. 177 196 (1969)
Trial wave functions in the close-coupling approxmation
[CC, transitions among $2s^22p^2\ ^3P, ^1D, ^1S$, 0.1-1.0 Ry]

1970

70T20 N.P. Poshyunaite, A.V. Lyash and A.B. Bolotin — N II, O III Exc
Opt. Spectosc. 29 424 (1970)
Excitation of carbon atoms and carbonlike ions by electron impact
[Vainshtein-Presnyakov-Sobelman approximation, Born and Born-Ochkur, $2s^22p^2-2s2p^3$]

1972

72T14 H. Nussabaumer — C III Exc
Astron. Astrophys. 16 77 (1972)
Spectral lines in the Be I isoelectronic sequence
[IPM, $2s^2\ ^1S-2s2p\ ^1P$ and transitions among $2s2p\ ^3P, ^1D, ^1S$, 0.7 – 2.0 Ry]

1973

73T15 A.R.G. Jackson — C II, N II,III, O III Exc
Mon. Not. R. Astron. Soc. 165 53 (1973)
Excitation of C II] λ2326, O III] λ1664 and other semi-forbidden lines in quasars
[C II, N III $2s^22p\ ^2P-2s2p^2\ ^4P$, N II, O III $2s^22p^2\ ^3P-2s2p^3\ ^5S$, rates calculated from 72T6 and 73T5]

1975

75T21 D.R. Flower and H. Nussbaumer — O IV Exc
Astron. Astrophys. 45 145 (1975)
On the extreme ultraviolet solar emission of B-like ions: O IV
[CC, $2s^22p\ ^2P_J-2s^22p\ ^2P_{J'}$, $2s2p^2\ ^4P, ^2D, ^2S, ^2P$; $2s2p^2\ ^4P_J-2s2p^2\ ^4P_{J'}, ^2D, ^2S, ^2P, 2p^3\ ^4S$; 2.8-5.6 Ry]

75T22 D.R. Flower and H. Nussbaumer — Na VII, Si X, S XII Exc
Astron. Astrophys. 45 349 (1975)
On the extreme ultraviolet solar emission of B-like ions:
Na VII, SI X, S XII
[DW, $2s^22p\ ^2P$, $2s2p^2\ ^4P-2s2p^2\ ^4P, ^2D, ^2S, ^2P$, 4-12 Ry]

75T23 L.A. Morgan and M.R.C. McDowell — He II Exc
J. Phys. B 8 1073 (1975)
Electron impact excitation of H and $He^+$ IV.
Orientation and alignment of the 2p state
[DWPO, 1s–2p]

75T24 L.A. Vainshtein — Li II, O V,VII,VIII Exc
Sov. Phys. JETP 40 32 (1975)
Role of exchange in the excitation of ions by electrons
[Ochkur with orthogonalized functions, O V 2s–2p X=1-10; O VII 1s–2p X=1-10; 1s–3d X=1-18; Li II 1s–2s, 2p, O V 2s–3s, 3p, O VII 1s–3s, 3p,4d,4f, O VIII 1s–2s, 2p X=1]

1976

76T18 A.K. Pradhan — O II, S II Exc
Mon. Not. R. Astron. Soc. 177 31 (1976)
Collision strengths for [OII] and [SII]
[CC and DW, O II transitions among $^4S,^2D,^2P$ rates calculated from 76T13; S II transitions among $^4S,^2D,^2P$]

1977

77T23 A. Burgess, H.P. Summers, D.M. Cochrane and R.W.P. McWhirter — He II, C II, N III, O II,III, Na II, Mg II,III, Ca II, Rb II, Sr II, Cs II, Ba II, Tl II Ion
Mon Not. R. Astr. Soc. 179 275 (1977)
Cross-sections for ionization of positive ions by electron impact
[exchange classical impact parameter (ECIP), X=1-10 for He II, N III, Na II, Mg II; X=1-2 for others]

77T24 J.J. Chang — Ne II Exc
J. Phys. B 10 3335 (1977)
Electron scattering by $Ne^+$: a relativistic R-matrix calculation
[R matirx, $2s^2 2p^5\ ^2P–2s2p^6\ ^2S$ 2.5 Ry]

77T25 J. Davis, P.C. Kepple and M. Blaha — Si VI-XIV Exc
J. Quant. Spectrosc. Rad. Transf. 18 535 (1977)
Line strengths, collision strengths and excitation rates for multiply-charged silicon ions
[DW, many transitions X=1-5]

77T26 Y. Hahn — C IV, N V, Ne IV, Ar IV, Fe IX,XVII Exc/Ion
Phys. Rev. A 16 1964 (1977)
Distorted-wave theory of electron-ion collisons.
I. Direct excitation and ionization
[modified Bethe, excitation C IV, 2s–2p 4-400 Ry; ionization C IV, N V, Ne IV, Ar IV, Fe IX,XVII 4-400 Ry]

77T27 J.M. Peek and J.B. Mann — Ne VIII Exc
Phys. Rev. A 16 2315 (1977)
Continuum orbital approximation in weak-coupling theories for inelastic electron scattering
[weak coupling theory with the Langer uniform approximation, 2s–2p X=1-300]

77T28 J.D. Perez — Al XIII Exc
J. Appl. Phys. 48 1969 (1977)
Electron imapct excitation cross sections and rates for hydrogen-like ions
[CB, n=1–2 X=1-10, rates for transitions among n=1–5]

77T29 P.R. Simony, J.H. McGuire, J.E. Golden and B.R. Junker — H-like Exc
Phys. Rev. A 16 1401 (1977)
Generalized Coulomb-projected Born-approximation cross sections for atomic excitation by charged-particle impact
[Coulomb-projected Born, 1s–2s]

1978

78T1 K.L. Baluja, M.R.C. McDowell, L.A. Morgan and V.P. Myerscough — He II Exc
J. Phys. B 11 715 (1978)
Electron impact excitation of hydrogenic systems in a distorted-wave model
[DW, 1s–2s Th-1000 eV, 1s–2p Th-300 eV]

78T2 D. Banks and L.G.J. Boesten — He II Ion
J. Phys. B 11 2209 (1978)
Ionisation of $He^+$ ions by electron impact
[classical, scaled cross section for n=1–n', X=1-10]

78T3 W.D. Barfield — C IV,VI, N III, O IV,VI, Mg III, Fe XV,XXI Ion
IEEE Trans. Plasma Phys. PS-6 71 (1978)
On cross sections for electron impact ionization of multi-charged ions
[comparison of various calculations (CB, ECIP, semi-empirical) and measurements]

78T4 M. Blaha and J. Davis — Ca X, Fe XVI, Zn XX, Kr XXVI, Mo XXXII Exc
J. Quant. Spectrosc. Rad. Transf. 19 227 (1978)
Electron impact excitation of highly charged sodium-like ions
[DW, transitions among 3s,3p,4s,4p,4d,4f, X=1-16]

78T5 B.H. Bransden, M. Crocker, I.E. McCarthy, M.R.C. McDowell and L.A. Morgan — He II Exc
J. Phys. B 11 3411 (1978)
Effective exchange potentials for inelastic scattering
[CC, 1s–2s, 2p, 3.2-6.0 Ry]

78T6 A. Burgess and J.A. Tully
J. Phys. B 11 4271 (1978)
On the Bethe approximation
[Coulomb-Bethe approximatiion]

78T7 R.E.H. Clark and D.H. Sampson — O VII, Si XIII, Ca XIX, Fe XXV, Zn XXIX, Kr XXXV, Mo XLI, Sn XLIX Exc
Atomic Data Nucl. Data Tables 22 527 (1978)
Intermediate-coupling collision strengths for P-P and P-D transitions produced by electron impact on highly charged He-like ions
[CBX, transitions among 1s2p,1snp,1snd (n=3,4,5), X=1-4]

78T8 A.K. Das, N. Maiti and N.C. Sil — Li II Exc
Indian J. Phys. 52B 83 (1978)
Electorn exchange by the CBO approximation in the excitation of helium-like positive ions by electron impact
[CBO, $1^1S–2^1S$, $2^3S$, X=1-5]

78T9 J. Davis, K.G. Whitney and J.P. Apruzese — C V,VI Exc
J. Quant. Spectrosc. Rad. Transf. 20.353 (1978)
The importance of photoexcitation to the ionization dynamics of laser-produced carbon plasmas
[DW, C V $1^1S-2^1P,2^3S,2^3P,3^1P,3^3D,4^1P$, C VI 1s–2s,2p,3s,3p,3d,4s,4p, X=1-5]

78T10 P.L. Dufton, K.A. Berrington, P.G. Burke and A.E. Kingston — C III, O V Exc
Astron. Astrophys. 62 111 (1978)
The interpretation of C III and O V emission line ratios in the Sun
[R matrix, transitions among $2s^2\ ^1S$, $2s2p\ ^3P, ^1P$, $2p^2\ ^1D, ^1S$, rates for log T=4.3-5.3]

78T11 J. Franco and E. Daltabuit — $N^{q+}$q=1-6, $O^{q+}$q=1-7, Na II, Ca II Ion
Rev. Mexic. Astron. Astrof. 2 325 (1978)
On collisional ionization rate coefficients
[empirical formula for rate coefficient]

78T12 R.H. Garstang, W.D. Robb and S.P. Rountree — Fe III,VI Exc
Astrophys. J. 222 384 (1978)
Electron collisional excitation corss sections for Fe III and FE VI and iron abudances in gaseous nebulae
[CC, average collision strengths over transitions among 5 lowest multiplets of $3d^6$ and 6 lowest multiplets of $3d^3$]

78T13 L.B. Golden and D.H. Sampson — H-like Exc
Astrophys. J. Suppl. 38 19 (1978)
Scaled Coulomb-Born-Oppenheimer collision strengths for hydrogenic ions in the limits $z=\infty$
[CBO, 1s–2s,2p; 1s,2s,2p--ns,np,nd (n=3,4,5), X=1-4]

78T14 L.B. Golden, D.H. Sampson and K. Omidvar — Ion
J. Phys. B 11 3235 (1978)
Ionisation from the 3s sub-level of highly charged ions
[empirical formula, ionization from 3s]

78T15 Y. Hahn — Fe IX,XVI,XXIII, Mo XV,XXV,XXXIII Ion
Phys. Rev. A 18 1028 (1978)
Distorted-wave theory of electron-ion collisions.
II. Auger ionization and excitation fluorescence
[DW, 100-6400 Ry]

78T16 M.A. Hayes and M.J. Seaton — C VI, Ne X Exc
J. Phys. B 11 L79 (1979)
Resonances in 1s-2s and 1s-2p collision strengths for electron impact excitation of hydrogenic ions
[CC, 1s–2s,2p, X=1.02-1.10]

78T17 R.J.W. Henry, W.-L. van Wyngaarden and J.J. Matese — Be II Exc
Phys. Rev. A 17 798 (1978)
Excitation of $Be^+$ by electron impact
[CC, 2s–2p, 27-870 eV]

78T18 J.V. Kennedy, V.P. Myerscough and M.R.C. McDowell — Be II, Mg II, Ca II Exc
J. Phys. B 11 1303 (1978)
Electron impact excitation of the resonance lines of $Be^+$, $Mg^+$ and $Ca^+$
[DW (UDWPO), Be II 2s–2p 4-109 eV;
Mg II 3s–3p 5-54 eV; Ca II 4s–4p 3-109 eV]

78T19 Y.-K. Kim and K.T. Cheng — Na-like (Mg,Al,P,Ar,Fe,Kr, Mo,Xe,W,Au,Th) Exc/ Fe XVI Ion
Phys. Rev. A 18 36 (1978)
Bethe cross sections for the sodium isoelectronic sequence
[Bethe, excitation 3s–3p,4p Na-like (Mg-Th); ionization Fe XVI]

78T20 A. Kumar and B.N. Roy — C II, N II,III, O II,III Ion
Phys. Lett. 66A 362 (1978)
Electron impact ionization of positive ions
[BEA, 50-5000 eV]

78T21 C. Mitra and N.C. Sil — H-like Exc
Phys. Rev. A 18 1758 (1978)
Excitation of hydrogenlike ions by electron impact. II.
[CBO, Z=2,3,6,10,50 1s–2p X=1-10]

78T22 D.L. Moores — C III,IV, N IV,V Ion
J. Phys. B 11 L403 (1978)
Electron imapct ionisation of Li-like and Be-like carbon and nitrogen ions
[CB, X=1.25-6.0]

78T23 S. Nakazaki — H-like Exc
J. Phys. Soc. Jpn. 45 225 (1978)
Evaluation of the radial integrals in the Coulomb-Born approximation
[CB, Z=2,6,7,8,10,50 1s–2s,2p X=1-30]

78T24 S.D. Oh, J. Macek and E. Kelsey — H-like Exc
Phys. Rev. A 17 873 (1978)
Electron excitation of hydrogenlike ions in the Coulomb Born approximation
[CB, general formula given, example for He II 1s–2s,2p X=1-40]

78T25 I.C. Percival and D. Richards — H-like Exc
Mon. Not. R. Astron. Soc. 183 329 (1978)
Cross-sections and rates for electron excitation of excited positively-charged hydrogen and hydrogenic ions
[semiempirical formula, n–n', n,n'$\geqslant$5]

78T26 A.K. Pradhan — S II Exc
Mon. Not. R. Astron. Soc. 183 89P (1978)
Fine structure transitions by electron impact in singly-ionized sulphur
[CC, $^2D_{3/2}-^2D_{5/2}$, $^2D-^4S$, $^2P-^4S$, rates (5-20)x$10^3$ K]

78T27 D.H. Sampson and L.B. Golden — B IV, C IV,V, N V, O V,VI, Ne VII,VIII Ion
J. Phys. B 11 541 (1978)
Electron impact ionisation results by the Z=$\infty$ method
[empirical formula for He,Li,Be-like ions, rates B IV Y=0.77; C IV Y=0.27-2.33; C V Y=0.55; N V Y=0.26-2.0; O V Y=1.23; O VI Y=0.8-1.45; Ne VII Y=0.96; Ne VIII Y=0.95]

78T28 D.H. Sampson, A.D. Parks and R.E.H. Clark — He-like Exc
Phys. Rev. A 17 1619 (1978)
Intermediate-coupling collision strengths for fine-structure transitions between S and P levels and S and D levels in highly charged He-like ions
[scaled CBX, Z=14,26,42 $1s^2-1s2s,1s2p$ X=1-5.33; Z=26, 42 $1s^2$ 1s2s–1sns, 1snp, 1snd (n=3,4,5), 1s2p–1sns (n=3,4,5) X=1-4]

78T29 C. Sinha and N.C. Sil — H-like Exc
J. Phys. B 11 L333 (1978)
Electron impact excitation of hydrogenic ions to arbitrary s states including exchange effects
[CBX, 1s–ns (n-2,3,6, ∞), X=2]

78T30 C. Sinha, N. Roy and N.C. Sil — H-like Exc
J. Phys. B 11 1807 (1978)
Excitation of ground-state hydrogenic ions to an arbitrary s state
[CB, Z=2,3,4,10,∞, 1s–ns (n=2,3,4,5,6,7,8,9,10,∞), X=1.5-6.0]

78T31 B.K. Thomas — H-like Exc
Phys. Rev. A 18 452 (1978)
Applications of the Coulomb-modified Galuber approximation to n=2 and n=3 excitation of hydrogenlike ions by incident electrons II
[Coulomb-Glauber, Z=2-5,7,10,∞, 1s–2s,2p,3s,3p,3d, (0.9-10)$Z^2$ Ry]

78T32 J.A. Tully — Li II, Be III, B IV, C V, N VI, O VII Exc
J. Phys. B 11 2923 (1978)
Total cross sections for electron impact excitation of the $1^1S \rightarrow 2^3S$ transition in He-like ions
[Coulomb-projected Born, X=1-10]

78T33 W. van de Water, F.B. Kets, L.G.J. Boesten and H.G.M. Heideman — He II, Li III Ion
J. Phys. B 11 L465 (1978)
Angular momentum exchange between escaping electrons in the case of electron impact ionisation of hydrogenic targets
[classical, threshold law]

78T34 W. Williamson Jr., G. Foster and R. Kwong — He II Exc
Phys. Rev. A 17 1823 (1978)
Glauber exchange amplitudes for the scattering of electrons from hydrogenlike ions
[Coulomb-Glauber-Ochkur, 1s–2s, 59-1000 eV]

1979

79T1 K.A. Berrington, P.G. Burke, P.L. Dufton, A.E. Kingston and A.L. Sinfailam — O V Exc
J. Phys. B 12 L275 (1979)
Electron collisional excitation of O V: effect of resonances converging to the n=3 thresholds
[R matrix, $2s^2\ ^1S–2s2p\ ^3P,^1P$, 2-5.5 Ry]

79T2 A.K. Bhatia, G.A. Doschek and U. Feldman — O III Exc
Astron. Astrophys. 76 359 (1979)
New atomic data for $O^{2+}$
[DW, transitions among $2s^22p^2, 2s2p^3, 2p^4$ 0.5-6.0 Ry]

79T3 A.K. Bhatia, U. Feldman and G.A. Doschek — Si VII, S IX, Ar XI Exc
Astron. Astrophys. 80 22 (1979)
New atomic data for $Si^{+6}$, $S^{+8}$ and $Ar^{+10}$
[DW, transitions among $2s^22p^4\ ^3P,^1D,^1S, 2s2p^5\ ^3P,^1P, 2p^6\ ^1S$]

79T4 J. Callaway, R.J.W. Henry and A.P. Msezane — C IV, Fe XXIV, Mo XL, W LXXII Exc
Phys. Rev. A 19 1416 (1979)
Excitation of ions of the lithium isoelectronic sequence in the relativistic Coulomb-Born approximation
[CB, $1s-2p_{1/2}$, $2p_{3/2}$, C IV: 1-16 Ry, Fe XXIV: 4-50 Ry, Mo XL: 8-160 Ry, W LXXII: 16-1500 Ry]

79T5 R.D. Cowan and J.B. Mann — Fe XVI Ion
Astrophys. J. 232 940 (1979)
Contribution of autoionization to total ionization rates
[effect of AI estimated, 0.1-2 keV]

79T6 A.K. Das, N. Maiti and N.C. Sil — Li II, Be III, O VII Exc
Phys. Rev. A 20 639 (1979)
$2^1S$ states of the helium isoelectronic sequence
[CB, $1^1S-2^1S$ X=1-3]

79T7 K.P. Dere, H.E. Mason, K.G. Widing and A.K. Bhatia — Ar XIII,XIV, Ca XV,XVI Exc
Astrophys. J. Suppl. 40 341 (1979)
XUV electron density diagnostics for solar flares
[DW, Ar XIII, Ca XV taransitions among $2s^22p^2$,$2s2p^3$, 15-45 Ry; Ar XIV, Ca XVI transitions among $2s^22p$, $2s2p^2$, 10-80 Ry]

79T8 P.S. Ganas — N III Exc
J. Chem. Phys. 71 4169 (1979)
Electron-imact excitation cross sections for N III
[Born, 2p–3s,p,d, 4s,p,d 5s,d Th-1000 eV]

79T9 P.S. Ganas — O IV Exc
Phys. Lett. 74A 307 (1979)
Electron-impact excitation cross sections for O IV
[Born, 2p–3s,p,d,4s,d, 5s,d Th-1000 eV]

79T10 P.S. Ganas and A.E. S. Green — B II, C III, N IV, O V Exc
Phys. Rev. A 19 2197 (1979)
Electron-impact excitation of the beryllium isoelectronic sequence
[Born, B II 2s–2p,...,4d, C III 2s–2p,...,5d, N IV 2s–2p,...,5p, O V 2s–2p,...,5d, Th-1000 eV]

79T11 K Giles — Ne V Exc
Mon. Not. R. Astr. Soc. 187 49P (1979)
Collision strengths for [Ne V]
[CC, rates calculated from 79T12, transitions among $2p^2\ ^3P,^1D,^1S$, (5-20)x$10^3$ K]

79T12 K. Giles, A.R.G. Jackson and A.K. Pradhan — Ne V Exc
J. Phys. B 12 3415 (1979)
Electron impact excitation of $Ne^{4+}$ and energy levels of $Ne^{3+}$
[CC, transitions among $2s^22p^2\ ^3P,^1D,^1S$, Th-0.5 Ry]

79T13 M.A. Hayes — FE XXIV Exc
Mon. Not. R. Astron. Soc. 189 55P (1979)
Calculation of oscillator strengths and electron impact excitation collision strengths for Fe XXIV
[DW, 2s–2p 4-376 Ry; $2p_{1/2}-2p_{3/2}$, 2s,2p–3s,3p,3d 87-336 Ry]

79T14 R.J.W. Henry — C IV, N V, O VI Exc
J. Phys. B 12 L309 (1979)
Cross sections for inner-shell excitation of $C^{3+}$, $N^{4+}$ and $O^{5+}$ ions
[CC, $1s^2 2s-1s2s^2$, 1s2s2p, C IV: 25-90 Ry,
N V: 34-100 Ry, O VI: 45-125 Ry]

79T15 A. Kumar and B.N. Roy — Li II, Na II, K II, Rb II, Cs II Ion
J. Phys. B 12 3979 (1979)
Electron impact ionisation of alkali metal ions
[BEA, Li II: 100-5000 eV, Na II: 60-5000 eV,
K II: 100-5000 eV, Rb II: 100-2000 eV, Cs II: 100-2000 eV]

79T16 H.E. Mason, G.A. Doschek, U. Feldman and A.K. Bhatia — Fe XXI Exc
Astron. Astrophys. 73 74 (1979)
Fe XXI as an electron density diagnostics in solar flares
[DW, transitions among $2s^2 2p^2$, $2s2p^3$, $2s^2 2p3s$, $2s^2 2p3d$,
20-150 Ry]

79T17 E.J. McGuire — Cs II, Ba II, Tl II, $Ni^{q+}$ q=1-14, $Au^{q+}$ q=3-14 Ion
Phys. Rev. A 20 445 (1979)
Scaled electron ionization cross sections in the Born approximation for atoms with $55 \leqslant Z \leqslant 102$
[semiempirical based on Born, ionization from 4s-f, 5s-f, 6s-d, examples for Cs II, Ba II, Tl II Th-$10^3$ eV; $Ni^{q+}$, $Au^{q+}$ Th-$10^4$ eV]

79T18 D.L. Moores — C II, N III Ion
J. Phys. B 12 4171 (1979)
The autoionisation contribution to the electron impact ionisation cross sections of $C^+$ and $N^{2+}$ at low energies
[AI contribution estimated, C II: 24-38 eV, N III: 47-80 eV]

79T19 L.A. Morgan — He II Exc
J. Phys. B 12 L735 (1979)
Electron impact excitation of the n=2 states of $He^+$
[CC, 1s–2s,2p 3-3.25 Ry]

79T20 H. Nussbaumer and P.J. Storey — N III Exc
Astron. Astrophys. 71 L5 (1979)
N III lines for solar diagnostics
[DW, $2s^2 2p\ ^2P$, $2p^2\ ^4P-2s2p^2$, $2p^3$, 3 Ry]

79T21 M.S. Pindzola, A. Temkin and A.K. Bhatia — O VII Exc
Phys. Rev. A 19 72 (1979)
Calculation of resonant effects in electron-impact excitation of positive ions: Application to oxygen VII
[DW with resonance, $1^1S-2^1P$ 574-640 eV]

79T22 D.H. Sampson and L.B. Golden — Li-like Ion
J. Phys. B 12 L785 (1979)
Ionisation cross sections for Li-like ions including excitation-autoionisation cotributions
[empirical formula including AI, examples for C IV, O VI: X=1-25, N V: X=1-50]

79T23 D.H. Sampson, R.E.H. Clark and A.D. Parks — Li-like Exc
J. Phys. B 12 3257 (1979)
Intermediate coupling collision strengths for inner-shell excitation of highly charged Li-like ions
[scaled CBX, Z=18,26,42,∞ $1s^2 2s–1s2s^2$,$1s2p^2$, 1s2s2p, X=1-5]

79T24 S.N. Singh, S. Kumar and M.K. Srivastava — H-like Exc
J. Phys. B 12 2351 (1979)
Electron impact excitation of hydrogenic ions in a modified Coulomb-Glauber approximation
[Coulomb-Glauber, scaled cross section for any H-like ions, examples for He II 1s–2s,2p 100-1000 eV]

79T25 C. Sinha and N.C. Sil — H-like Exc
J. Phys B 12 1711 (1979)
First-order Coulomb exchange approximation and electron impact excitation of ground-state hydrogenic ions to an arbirtary s state
[CBX, 1s–ns (n=2,3,6,∞) X=1-4]

79T26 W.L. van Wyngaarden, K. Bhadra and R.J.W. Henry — Li II, C V, O VII, Si XIII Exc
Phys. Rev. A 20 1409 (1979)
Excitation of heliumlike ions by electron impact
[CC, $1^1S–2^1S,2^3S,2^1P,2^3P$, Li II: 5-23 Ry, C V: 23-110 Ry, O VII: 45-210 Ry, Si XIII: 138-684 Ry]

79T27 S.M. Younger — Ga III, Kr VIII, Mo XIV, Xe XXVI Exc
J. Quant. Spectrosc. Rad. Transf. 22 155 (1979)
Collision strengths and Gaunt factors for highly ionized atoms of the copper isoelectronic sequence
[DW and CB, 4s $^2S–4p\ ^2P$, X=2-20]

79T28 S.M. Younger and W.L. Wiese — Exc
J. Quant. Spectrosc. Rad. Transf. 22 161 (1979)
An assessment of the effective Gaunt factor approximation
[effective Gaunt factors derived for Δn=0 transitions of alkali-like ions]

1980

80T1 K.L. Baluja and J.G. Doyle — He-like Exc
Phys. Lett. 77A 153 (1980)
Electron impact excitation of helium-like ions
[DW, Z=3-6,8, $1^1S–2^1S,2^1P$, X=1.2-2.0]

80T2 K.L. Baluja, P.G. Burke and A.E. Kingston — O III Exc
J. Phys. B 13 829 (1980)
Electron impact excitation in semi-forbidden transitions in O III
[R matrix, $2s^2 2p^2\ ^3P–2s2p^3\ ^5S$, $2s2p^3\ ^5S–2s2p^3\ ^3D$, $^3P$ 0.8-6 Ry, rate: $(0.4\text{-}15)\times10^4$ K]

80T3 K.L. Baluja, P.G. Burke and A.E. Kingston — Si III Exc
J. Phys. B 13 L543 (1980)
Electron impact excitation of $3s^2\ ^1S–3s3p\ ^3P^0$ in Si III
[R matrix, Th-0.75 Ry, rate: $(0.5\text{-}25)\times10^4$ K]

80T4 K.L. Baluja, P.G. Burke and A.E. Kingston — Ne V Exc
J. Phys. B 13 4675 (1980)
Electron impact excitation of semi-forbidden transitions in Ne V
[R martirx, transitions among $2s^2 2p^2$,$2s2p^3$ 5-6 Ry, rate: $(0.5\text{-}15\times10^4$ K]

80T5 K. Bhadra and R.J.W. Henry — S IV Exc
Astrophys. J. 240 368 (1980)
Oscillator strengths and collision strenghts for S IV
[CC, $3s^2 3p\ ^2P$–$3s3p^2\ ^4P,^2D,^2P,^2S$, 1.3-6 Ry]

80T6 A.K. Bhatia and H.E. Mason — Fe XX Exc
Astron. Astrophys. 83 380 (1980)
New atomic data for $Fe^{+19}$
[DW, transitions among $2s^2 2p^3\ ^4S,^2D,^2P,2s2p^4\ ^4P,^2D,^2S,^2P$, 20-100 Ry]

80T7 A.K. Bhatia and H.E. Mason — Mg VI, Si VIII, S X, Ar XII, Ca XIV Exc
Mon. Not. R. Astron. Soc. 190 925 (1980)
Theoretical atomic structure and electron scattering data for ions in the nitrogen isoelectronic sequence
[DW, transitions among $2s^2 2p^3, 2s2p^4, 2p^5$]

80T8 A.K. Bhatia, U. Feldman and G.A. Doschek — $Ti^{q+}$ q=13-19 Exc
J. Appl. Phys. 51 1464 (1980)
Atomic data and level populations of highly ionized Ti for tokamak plasmas
[DW, various transitions among $2s^m 2p^n$, 8-45 Ry]

80T9 A.K. Bhatia, G.A. Doschek and U. Feldman — S IV Exc
Astron. Astrophys. 86 32 (1980)
Atomic data for S IV and solar observations of the $3s^2 3p\ ^2P$–$3s3p^2\ ^4P$ multiplet
[DW, 2-6 Ry]

80T10 M. Blaha and J. Davis — He II, Li II, C II,IV, N II, O II, Ne II, Na II, Mg II, K II Ion
NRL Memo. Rept. 4245, Naval Research Laboratory (1980)
Electron ionization cross sections in the distorted-wave approximation
[DWX, X=1.25-10 for He II, LiII, Mg II, X=2,4 for other ions]

80T11 L. Brundus — C II,III,IV Exc
Rev. Roum. Phys. 25 121 (1980)
Calculation of electronic excitation cross sections of lithium and carbon atmos
[Born, C II 2p–3s, C III 2s–3p, C IV 2s– 3p, 4-40 au]

80T12 R.E.H. Clark, D.H. Sampson and A.D. Parks — Be-like Exc
Astrophys. J. Suppl. 44 215 (1980)
Intermediate coupling collision strengths for $\Delta n=0$ transitions produced by electron impact on highly charged ions. III. Transitions within the $1s^2 2s2p$ and $1s^2 2p^2$ configurations and between the $1s^2\ 2s^2$ and $1s^2 2p^2$ configurations in beryllium-like ions
[scaled CBX, Z=14-74, Th-(Th+3.25$Z^2$) Ry]

80T13 R.D. Cowan — O V Exc
J. Phys. B 13 1471 (1980)
Resonant-scattering (autoionisation) contributions to excitation rates in $O^{4+}$ and similar ions
[resonance contributions estimated, $2s^2\ ^1S$–$2s2p\ ^3P$, rate: 10-50 eV]

80T14 P.L. Dufton and A.E. Kingston — S IV Exc
J. Phys. B 13 4277 (1980)
Electron impact excitation of the $^2P^o$–$^4P^e$ transition in S IV
[ R matrix, Th-1.4 Ry, rate: log T =4.3-5.3]

80T15 U. Feldman, G.A. Doschek, C.-C. Cheng and A.K. Bhatia — Cr XXI, Fe XXIII, Ni XXV Exc
J. Appl. Phys. 51 190 (1980)
Spectroscopy and atomic physics of highly ionized Cr, Fe, and Ni for tokamak plasmas
[DW, transitions among $2s^2$,2s2p,$2p^2$,15-45 Ry]

80T16 P.S. Ganas — O III Exc
Astron. Astrophys. Suppl. 40 259 (1980)
Electron impact excitation cross sections for O III
[Born, 2p–3s,p,d, 4s,p,d, 5s,d]

80T17 P.S. Ganas — N II Exc
J. Chem. Phys. 72 2197 (1980)
Electron-impact excitation cross sections for N II
[Born, 2p–3s,p,d, 4s,p,d, 5s,d, Th-1000 eV]

80T18 P.S. Ganas — N V Exc
J. Quant Spectrosc. Rad. Transf. 23 441 (1980)
Electron impact excitation cross section for N (V)
[Born, 2s–2p, 3s,p,d, 4s,p,d, 5s,p,d, Th-1000 eV]

80T19 P.S. Ganas and A.E.S. Green — Ne-like Exc
J. Chem. Phys. 73 3891 (1980)
Electron impact excitation of the neon isoelectronic sequence
[Born, Z=10-20, 2p–3s, Th-5000 eV]

80T20 S.J. Goett, R.E.H. Clark and D.H. Sampson — He-like, Be-like Exc
Atomic Data Nucl. Data Tables 25 185 (1980)
Intermediate coupling collision strengths for $\Delta n=0$ transitions produced by electron impact on highly charged He- and Be-like ions
[He-like 1s2ℓ–1s2ℓ', Be-like transitions among $2s^2$, 2s2p,$2p^2$, Z=6-74, analytical fit to the results mostly obtained in 80T12, 80T32 and 80T33]

80T21 L.B. Golden and D.H. Sampson — Ion
J. Phys. B 13 2645 (1980)
Ionisation from the 3s, 4p, 4d and 4f sublevels of highly charged ions
[empirical formula]

80T22 Y. Hahn — O VI Ion
Phys. Lett. 78A 57 (1980)
Auger contributions to electron impact ionization of Li-like ions
[DW, 1.2-3.3 keV]

80T23 M.A. Hayes — N V, O IV Exc
J. Phys. B 13 819 (1980)
A perturbative treatment of exchange in close-coupling formalism for electron impact excitation of ions
[approximate treatment of exchange terms in CC formalism, applications to N V 2s–2p,3s,p,d at 6 Ry, O IV $2s^2 2p\ ^2P$–$2s2p^2\ ^4P$ at 3 Ry]

80T24 J.A. Kunc — He II, Li III, C IV, N V, O VI, Ne VIII, X Ion
J. Phys. B 13 587 (1980)
Electron ionisation cross sections of excited atoms and ions
[SC, He II Th-14 Ry, other ions 2-30 Ry]

80T25 M. Malinovsky, J. Dubau and S. Sahal-Brechot — Fe X Exc
Astrophys. J. 235 665 (1980)
Population processes of $3p^4 4s$ levels of Fe X
[DW (partly SC), $3s^2 3p^5 - (3s^2 3p^4)3d,4s,4p,4d,5s,5p, (3s3p^5)4s,4p,5s$]

80T26 H.E. Mason and P.J. Storey — Fe XXII Exc
Mon. Not . R. Astron. Soc. 191 631 (1980)
Atmic data for Fe XXII
[DW, transition among $2s^2 2p, 2s2p^2$]

80T27 R. Mewe, J. Schrijver and J. Sylwester — $Ca^{q+}$ q=1-19, $Fe^{q+}$ q=6-25 Exc/Ion
Astron. Astorphys. Suppl. 40 323 (1980)
Analysis of X-ray line sepctra from a transient plasma under solar flare conditions.
II. Rate coefficients
[empirical formula, various transitions of Ca XVIII-XX, Fe XXIV-XXVI and ionization of C-like through Ca-like ions]

80T28 R. Mewe, J. Schrijver and J. Sylwester — H-like, He-like Exc
Astron. Astrophys. 87 55 (1980)
Heliumlike ion line intenstities: IV.
Z-dependence of collision strengths for n=2→n=1 transitions in helium- and hydrogen-like ions
[empirical formula, He-like $1s^2\ ^1S - 2^1S, ^3S, ^1P, ^3P$, H-like 1s–2s,2p]

80T29 H. Nussbaumer and P.J. Storey — Fe II Exc
Astron. Astrophys. 89 308 (1980)
Atomic data for Fe II
[CC, transitions among $^6D, ^4F, ^4D, ^4P$, 0.15-0.25 Ry]

80T30 M.S. Pindzola and S.L. Carter — Fe XXV, Kr XXXV Exc
Phys. Rev. A 22 898 (1980)
Electron-impact excitation of Fe XXV and Kr XXXV in the relativistic distorted-wave approximation
[DW, $1^1S - 2^1P$, $^3P_2$, $^3P_1$, $^3P_0$ Fe XXV: 7-10 keV, Kr XXXV: 13-15 keV]

80T31 M.S. Pindozola, A.K. Bhatia and A. Temkin — Li II Exc
Phys. Rev. A 22 132 (1980)
Electron-impact excitation of Li II in the distroted-wave approximation
[DW, $1^1S - 2^3P$, 62-180 eV]

80T32 D.H. Sampson and R.E.H. Clark — He-like Exc
Astorophys. J. Suppl. 44 169 (1980)
Intermediate coupling collision strengths for $\Delta n=0$ transitions produced by electron impact on highly charged ions. I. Theoretical development and application to n=2 levels in helium-like ions
[scaled CBX, Z=6-74, transitions among 1s2s,1s2p, Th-$(Th+3.25Z^2)$Ry]

80T33 D.H. Sampson, R.E.H. Clark and L.B. Golden — Be-like Exc
Astrophys. J. Suppl. 44 193 (1980)
Intermediate coupling collision strengths for $\Delta n=0$ transitions produced by electron impact on highly charged ions. II. Transitions between states of the $1s^2 2s^2$ and $1s^2 2p^2$ configurations and those of the $1s^2 2s2p$ configuration in beryllium-like ions
[scaled CBX, Z=14-74, Th-(Th+3.25$Z^2$)Ry]

80T34 N.S. Scott and P.G. Burke — Fe XXIII Exc
J. Phys. B 13 4299 (1980)
Electron scattering by atoms and ions using the Breit-Pauli Hamiltonian: an R-martrix approach
[ R matrix, $2s^2\ ^1S-2s2p\ ^3P$, 7-25 Ry]

80T35 A. Tsuji, H. Kotegawa and H. Narumi — He II Ion
J. Phys. Soc. Jpn. 48 2062 (1980)
Eikonal approach to break-up processes of hydrogenic ions
[Coulomb-Glauber, X=1-8]

80T36 J.A. Tully — He-like Exc
J. Phys. B 13 3023 (1980)
The Coulomb Ochkur-Rudge approximation applied to excitation of triplet levels in helium-like ions
[Coulomb-Ochkur-Rudge, Z=2-8 $1^1S-2^3P$ X=1-$\infty$;
Li II $1^1S-n^3S,^3P,^3D$ (n=2-6) X=1-$\infty$]

80T37 S.A. Wakid and J. Callaway — He II Exc
J. Phys. B 13 L605 (1980)
Electron impact excitation of $He^+$
[CC, 1s–2s 40-102 eV]

80T38 S.A. Wakid and J. Callaway — He II Exc
Phys. Lett. 78A 137 (1980)
Scattering of electrons from $He^+$ targets for energies up to the n=3 threshold
[CC, 1s–2s,2p 3.08-3.24 Ry]

80T39 S.M. Younger — O V, Ar VII,XV, Fe XV, XXIII, As IV, Kr VII, XXV, Mo XIII,XXXI, Xe XXV Exc
J. Quant. Spectrosc. Rad. Transf. 23 489 (1980)
Electron impact excitation of the resonance transitions of highly ionized atoms of Be-, Mg-, and Zn-isoelectronic sequences
[DWX, $ns^2\ ^1S-nsnp\ ^1P$ n=2 for O V, Ar XV, Fe XXIII, n=3 for Ar VII, Fe XV, Kr XXV, Mo XXXI, n=4 for As IV, Kr VII, Mo XIII, Xe XXV, X=2-100]

80T40 S.M. Younger — He II, Be II, C VI, O VI, Ne X, Mg X Ion
Electron-impact ionization cross sections for highly ionized hydrogen- and lithium-like atoms
[DW, X=1.125-2.25]

80T41 S.M. Younger — Li II, B IV, N VI, Na X Ion
Phys. Rev. A 22 1425 (1980)
Electron-impact-ionization cross sections for highly ionized heliumlike atoms
[DW, X=1.1.25-5.0]

1981

81T1 N. Abu-Salbi and J. Callaway — C VI, O VIII Exc
Phys. Rev. A 24 2372 (1981)
Electron-impact excitation of hydrogenic ions
[CC, 1s–2s,2p X=1.3-4.9]

81T2 A. Allouche and F. Marinelli — B II, C III, N IV, O V Exc
J. Phys. B 14 2069 (1981)
Polarisation propagator study of the electron impact excitation of the beryllium isoelectronic sequence
[Born, $2s^2\ ^1S–2s2p\ ^1P$ 50-1000 eV, $2s^2\ ^1S–2s3p\ ^1P$, $2s4p\ ^1P$ 100-1000 eV]

81T3 K.L. Baluja, P.G. Burke and A.E. Kingston — O III Exc
J. Phys. B. 14 119 (1981)
Electron imapct excitation of transitions among states with configurations $2p^2$, $2s2p^3$ and $2p^4$ in O III
[R matrix, rate $(0.5\text{-}2.5)\times10^4$ K]

81T4 K.L. Baluja, P.G. Burke and A.E. Kingston — Si III Exc
J. Phys. B 14 1333 (1981)
Electron impact excitation of semi-forbidden and allowed transitions in Si III
[R matrix, transitions among $3s^2$,3s3p,$3p^2$,3s3d,3s4s,3s4p, rate $(0.5\text{-}25)\times10^4$ K]

81T5 V.A. Bazylev and M.I. Chibisov — C IV, N V, O V, Ne VII,VIII, Ar XVI, Fe XXIV, Mo XXXII,XL Exc
Opt. Sepctrosc. 50 457 (1981)
Electron-imapct excitation of dipole transitions with low excitation energies in multiply charged ions
[SC with dipole approximation, 2s–2p X=1-70 for C IV, 1-11 for N V, 1-10 for Ne VIII, 1-6 for Ar XVI, 0.5-2 keV for Fe XXIV and Mo XL; 3s–3p X=1,16 for MO XXXII; $2s^2\ ^1S–2s2p\ ^1P$ X=1-5 for O V and Ne VII]

81T6 F. Bely-Dubau, J. Dubau, P. Faucher and L. Steeman-Clark — O VI,VII Exc
J. Phys. B 14 3313 (1981)
Calculations for the satellite spectra of helium-like oxygen
[DW, O VI $1s^2 2s–1s2s2p$,$1s2s^2$, $1s^2 2p–1s2p^2$, 1s2s2p $10^{1.9\text{-}2.5}$ Ry, rate $(0.3\text{-}40)\times10^6$ K; O VII $1s^2–1s2p^1$ P rate $(0.3\text{-}40)\times10^6$ K]

81T7 K.A. Berrington, P.G. Burke, P.L. Dufton and A.E. Kingston — C III, O V, Ne VII, Si XI Exc
Atomic Data Nucl. Data Tables 26 1 (1981)
Electron-impact-excitation collision strengths for Be-like ions
I. Low-energy regions
[R matrix, transitions among $2s^2\ ^1S$, $2s2p\ ^3P,^1P$, $2p^2\ 3P,\ ^1D,\ ^1S$, Th-2.4 Ry for C III, Th-4.2 Ry for O V, Th-8 Ry for Ne VII, Th-15 Ry for Si XI]

81T8 P.G. Burke, K.A. Berrington and C.V. Sukumar — C III Exc
J. Phys. B 14 289 (1981)
Electron-atom scattering at intermediate energies
[$L^2$ integrable function method proposed, example for C III $2s^2\ ^1S–2s2p\ ^3P$ Th-12 Ry]

81T9 M.C. Chidichimo — Ca II Exc
J. Phys. B 14 4149 (1981)
Electron impact excitation cross sections of $Ca^+$ at low energies
[DW, 4s–4p,3d 0.24-6.93 Ry, 3d–4p 0.12-6.8 Ry]

81T10 U. Feldman, G.A. Doschek and A.K. Bhatia — S V Exc
Astrophys. J. 250 799 (1981)
Solar observations and atomic data for the $3s^2\ ^1S_0$–$3s3p\ ^3P_1$ transition in S V
[DW, transitions among $3s^2$,3s3p,$3p^2$,3s3d, 3-9 Ry]

81T11 P.S. Ganas — O-like Z=8-13 Exc
Phys. Lett. 84A 115 (1981)
Excitation of the oxygen isoelectronic sequence by electron impact
[Born, 2p–3s Th-5000 eV]

82T12 P.S. Ganas — He-like Exc
J. Appl. Phys. 52 6482 (1981)
Electron impact excitation of the helium isoelectronic sequence
[Born, Z=3-12, $1^1S$–$2^1P$, Th-5 keV]

81T13 P.S. Ganas and A.E.S. Green — O II,III,IV,V Ion
J. Quant. Spectrosc. Rad. Transf. 25 265 (1981)
Secondary electron distributions, ionization cross sections and loss functions for 0 (I)-0 (V)
[Born, 100-5000 eV]

81T14 L.B. Golden, R.E.H. Clark, S.J. Goett and D.H. Sampson — H-like Exc
Astrophys. J. Suppl. 45 603 (1981)
Scaled collision strengths for hydrogenic ions
[CBX, Z=∞, n→n' (n=1,2,3 and n'=n+1,n+2), X=1-10]

81T15 G.J. Hatton, N.F. Lane and J.C. Weisheit — H-like Exc
J. Phys. B 14 4879 (1981)
Inelastic electron-ion scattering in a dense plasma
[Born, 1s–2s,2p, 2s–2p, in a dense plasma]

81T16 H. Jakubowicz and D.L. Moores — C III,IV, N IV,V, O V,VI, Ne VII,VIII, Fe XXIII Ion
J. Phys. B 14 3733 (1981)
Electron impact ionisation of Li-like and Be-like ions
[CBX with distorted Coulomb waves (DCBX), X=1-5, including AI]

81T17 M. Klapisch, J. Oreg and A. Bar Shalom — Exc
J. Phys. B 14 L325 (1981)
Interpretation and relativistic extension of Bely's approximation for exchange in electron-ion collisions
[no data]

81T18 J.A. Kunc — C IV, N V, O VI, Ne VIII Ion
Int. J. Mass Spectrom. Ion Phys. 40 43 (1981)
Electron-impact ionization rates for excited atoms and ions
[applications of 80T24, rates of ionization from $1s^22s$ and $1s^23p$]

81T19 K.J. LaGattuta and Y. Hahn — Fe XVI Ion
Phys. Rev. A 24 2273 (1981)
Electron impact ionization of $Fe^{15}$ by resonant excitation double Auger ionization
[estimate of the effect of resonant excitation double Auger ionization ($e + 2p^6 3s \rightarrow 2p^5 3s3pns \rightarrow 2p^5 3s^2 + e \rightarrow 2p^6 + 2e$), 726-1000 eV]

81T20 C. Mendoza — Mg II Exc
J. Phys. B 14 2465 (1981)
Electron impact excitation cross sections of Mg II calculated in a four-state close-coupling approximation
[CC, 3s–3d,4s, 3p–3d,4s, 4s–3d Th-(Th+0.25) Ry; rate for 3s–3p (5-12)x$10^3$ K]

81T21 P.H. Norrington — Ne II Exc
J. Phys. B 14 L261 (1981)
Electron scattering from Ne II using the relativistic R-matrix method
[R matrix, $2p^5\ ^2S$–$2s2p^6\ ^2S$ 2.5-3.0 Ry]

81T22 A.K. Pradhan — O VII, Fe XXV Exc
Phys. Rev. Lett. 47 79 (1981)
Effect of dielectronic recombination on electron-ion scattering cross sections
[DW, estimate of the radiative decay of the resonance states, $1^1S$–$2^1S$,$^3S$ for O VII, $1^1S$–$2^3S$ for Fe XXV, near threshold]

81T23 A.K. Pradhan, D.W. Norcross and D.G. Hummer — Be III, C V, O VII, Fe XXV Exc
Phys. Rev. A 23 619 (1981)
Cross sections and excitation rates for electron collisions with heliumlike ions
[DW with resonance, Be III $1^1S$–$2^3S$,$2^3P$ 8.7-10.5 Ry, C V $1^1S$–$2^3S$ 22-26 Ry, O VII $1^1S$–$2^1P$ 42-49 Ry, rates: Be III $1^1S$–$2^3S$, Fe XXV $1^1S$–$2^1P$, $2^1P$–$2^3S$]

81T24 A.K. Pradhan, D.W. Norcross and D.G. Hummer — Be III, C V, O VII, Ne IX, Si XIII, Ca XIX, Fe XXV Exc
Astrophys. J. 246 1031 (1981)
Rate coefficients for electron impact excitation of helium-like ions
[DW with resonance, transitions among $1^1S$,$2^1S$,$2^1P$,$2^3S$,$2^3P$, rates $10^4$-$10^9$ K]

81T25 D.H. Sampson and L.B. Golden — Li-like, Be-like, B-like Ion
J. Phys. B 14 903 (1981)
Ionisation cross sections with the inclusion of excitation-autoionisation contributions for ions with five or fewer bound electrons
[empirical formula, example for O V X=1-20]

81T26 D.H. Sampson, R.E.H. Clark and S.J. Goett — Be-like Exc
Phys. Rev. A 24 2979 (1981)
Intermediate-coupling collision strengths and line strengths for certain transitions to n=3 levels in highly charged B-like ions
[scaled CBX, Z=14-54, $2s^2$–2s3p, $2p^2$–2p3d, X=1-10]

81T27 S.S. Tayal and A.N. Tripathi — Be II, N V, Ne VIII Exc
Phys. Rev. A 24 2221 (1981)
Electron-impact excitation of the lithium isoelectronic sequence
[Born, 2s–2p,3s,3p, 2p–3d, $E/Z^2$=1-40 Ry]

81T28 J.A. Tully and K.L. Baluja — O III Exc
J. Phys. B 14 L831 (1981)
Collisional excitation of the O III auroral line
[CB, $2p^2\ ^1D–2p^2\ ^1S$, Th-(Th+28) Ry]

81T29 W.L. van Wyngaarden and R.J. W. Henry — S V Exc
Astrophys. J. 246 1040 (1981)
Oscillator strengths and collision strengths for S V
[CC, $3s^2\ ^1S–3s3p\ ^3P,^1P$, $3s3d\ ^1D$, $3p^2\ ^3P$, $3s3d\ ^3D$, $3s4s\ ^3S$;
$3s3p\ ^3P–3p^2\ ^3P$, $3s3d\ ^1D,^3D$, $3s4s\ ^3S$, 2-6.3 Ry]

81T30 S.A. Wakid and J. Callaway — Fe XXVI Exc
Phys. Lett. 81A 333 (1981)
Electron impact excitation of $Fe^{25+}$
[CC, 1s–2s,2p, 530–10140 Ry]

81T31 S.M. Younger — Na II, Mg III, Al IV, Ar IX Ion
Phys. Rev. A 23 1138 (1981)
Distorted-wave electron-impact-ionization cross sections for highly ionized neonlike atoms
[DW, X=1.125-3]

81T32 S.M. Younger — Mg II, Al III, P V, Ar VIII Ion
Phys. Rev. A 24 1272 (1981)
Cross sections and rates for direct electron-impact ionization of sodiumlike ions
[DW, X=1.125-5, also for $Z=\infty$ and extraporation to Fe XVI]

81T33 S.M. Younger — C III, N IV, O V, F VI, Ar XV Ion
Phys. Rev. A 24 1278 (1981)
Electron-impact-ionization cross sections and rates for highly ionized berylliumlike ions
[DW, X=1.125-5.0, also for $Z=\infty$]

81T34 S.M. Younger — H-like, He-like, Li-like Ion
J. Quant. Spectrosc. Rad. Transf. 26 329 (1981)
Electron impact ionization cross sections and rates for highly ionized atoms
[empirical formula based on DW calculation]

1982

82T1 F. Bely-Dubau, J. Dubau, P. Faucher and A.H. Gabriel — Fe XXIV,XXV Exc
Mon. Not. R. Astron. Soc. 198 239 (1982)
Dielectronic satellite spectra for highly charged helium-like ions
VI. Iron spectra with improved inner-shell and helium-like excitation rates
[DW, Fe XXIV $1s^22s\ ^2S–1s2s2p\ ^2P.\ ^4P$, $1s2s^2\ ^2S$, Fe XXV
$1s^2\ ^1S–1s2s\ ^1S,^3S$, $1s2p\ ^1P,^3P$, 500-5000 Ry]

82T2 R.E.H. Clark, N.H. Magee, Jr., J.B. Mann and A.L. Merts — H-like, He-like, Li-like, Be-like, B-like, Na-like, Mg-like Exc
Astrophys, J. 254 412 (1982)
Collisional excitation rates of complex atomic ions by electron impact
[empirical formula based on DW calculation, 1s–2s,2p for H-like Z=2-42; $1s^2$–1s2s $^1$S, 1s2p $^1$P for He-like Z=4-26; 2s–2p,3s,3p,3d for Li-like Z=4-42; $2s^2$–2s2p $^1$P, 2s3s $^1$S, 2s3p $^1$P, 2s3d $^1$D for Be-like Z=6-42; $2s^2$2p–2s$2p^2$ $^2$D,$^2$S,$^2$P, $2s^2$3s $^2$S, $2s^2$3d $^2$D for B-like Z=6-42; 3s–3p for Na-like Z=12-42; $3s^2$–3s3p $^1$P for Mg-like Z=13-42]

82T3 D.C. Griffin, C. Bottcher and M.S. Pindzola — Mg II, Al III, Si IV Ion
Phys. Rev. A 25 154 (1982)
Contributions of excitation autoionization to the electron-impact ionization of $Mg^+$, $Al^{2+}$, and $Si^{3+}$ in the distorted-wave approximation with exchange
[DW, Mg II: 25-70 eV, Al III: 50-110 eV, Si IV: 70-150 eV]

82T4 D.C. Griffin, C.Bottcher and M.S. Pindzola — Ti IV, Fe IV,V, Zr IV, Hf IV Ion
Phys. Rev. A 25 1374 (1982)
Theoretical calculations of the contributions of excitation autoionization to electron-impact ionization in ions of the transition series of elements
[excitation AI estimated by DW, Th-80 eV]

82T5 E.J. McGuire — $C^{q+}$q=1-3, $N^{q+}$q=1-3, $O^{q+}$q=1-4, $F^{q+}$q=1-5 Ion
Phys. Rev. A 25 192 (1982)
Electron ionization of some low-Z ions in the plane-wave Born approximation
[Born including AI, Th-3000 eV]

82T6 C. Mendoza — S III Exc
J. Phys. B 15 867 (1982)
Electron impact excitation of the forbidden transitions of S III and calculated term structure of S II
[CC, $^3$P–$^1$D,$^1$S, $^1$D–$^1$S, rate (5-20)x$10^3$ K]

82T7 A.Z. Msezane and R.J.W. Henry — Zn II Exc
Phys. Rev. A 25 692 (1982)
Electron-impact excitation of Zn II. II
[CC, 4s–4p,3$d^9$$4s^2$,5s,4d,3$p^5$3$d^{10}$$4s^2$, 1-59 Ry]

82T8 D.H. Oza, J. Callaway and N. Abu-Salbi — Ar XVIII Exc
Phys. Rev. A 25 2812 (1982)
Elctron-impact excitation of hydrogenlike argon ions
[CC, 1s–2s,2p, X=1.05-20]

82T9 J.M. Peek and J.B. Mann — He II, C III,IV,V, Ne VIII, Fe XXIV Exc
Phys. Rev. A 25 749 (1982)
Cross sections for inelastic electron-ion scattering in weak-coupling approximation
[DW (partly CBX), He II 1s–2s X=1-40; C III $2^1$S–$2^1$P X=1-50; C IV 2s–2p,3p,3d X=1-180; C V $1^1$S–$2^1$P X=1-20, $1^1$S–$2^1$S X=1-40; Ne VIII 2s–2p X=1-11; Fe XXIV 2s–2p,3s,3p,3d X=1-320]

82T10 M.S. Pindzola, D.C. Griffin and C. Bottcher — Ga II Ion
Phys. Rev. A 25 211 (1982)
Electron-impact excitation autoionization of Ga II
[DW, Th-40 eV]

82T11 H.P. Saha and E. Trefftz — Si X Exc
J. Phys. B 15 1089 (1982)
Electron impact excitations of Si X
[CC and DW, transitions among $2s^2 2p, 2s2p^2, 2p^3$, 6-70 Ry]

82T12 D.H. Sampson — Ar VIII, Ca X, Ti XII, Cr XIV, Fe XVI, Ni XVIII, Zn XX, Ge XXII, Kr XXVI, Mo XXXII Ion
J. Phsy. B 15 2087 (1982)
Ionisation of Na-like ions including excitation-autoionisation
[scaled CBX including AI, rate kT/I (3s)=0.2-3.0]

82T13 S.M. Younger — Ar II, K III, Sc V, Fe X Ion
Phys. Rev. A 25 3396 (1982)
Electron-impact-ionization cross sections for higly ionized chlorinelike ions
[DWX, X=1.25-5.0]

82T14 S.M. Younger — $Fe^{q+}$ q=16-25 Ion
J. Quant. Spectrosc. Rad. Transf. 27 541 (1982)
Electron impact ionization rate coefficients and cross sections for highly ionized iron
[DW, X=1.125-5.0]

82T15 V.P. Zhdanov — Fe XVI Exc
J. Phys. B 15 L297 (1982)
Electron impact excitation of multiply charged ions via autoionisation states with inner-shell vacancy
[DW, 3s–4s,4d,4f through resonance via innershell excited state of Fe XV ($2p^5$ 3s3dnl), rate: T=100-500 eV]

# INDEX (EXPERIMENT)

The papers with an asterisk give data only on rate coefficients.

Ne-like (N=10)

Ion

| | |
|---|---|
| Na II | 68E5, 68E5, 77E8 |
| Ar IX | 75E3*, 76E3*, 81E2* |

Na-like (N=11)

Exc

| | |
|---|---|
| Mg II | 75E8, 75E12, 75E13 |
| Ar VIII | 72E1* |

Ion

| | |
|---|---|
| Mg II | 68E3, 69E6, 69E8, 75E5, 82E1 |
| Al III | 82E1 |
| Si IV | 82E1 |
| Ar VIII | 67E5*, 72E1*, 76E3*, 81E2* |

Mg-like (N=12)

Ion

| | |
|---|---|
| Ar VII | 67E5*, 71E10*, 76E3*, 81E2* |

Al-like (N=13)

Ion

| | |
|---|---|
| Ar VI | 67E5*, 70E3*, 71E10*, 75E3*, 76E3*, 80E2, 81E2* |

Si-like (N=14)

Ion

| | |
|---|---|
| Ar V | 67E5*, 70E3*, 71E10*, 76E3*, 79E2, 80E2, 81E2* |

P-like (N=15)

Ion

| | |
|---|---|
| Ar IV | 67E5*, 70E3*, 71E10*, 72E4*, 78E3*, 80E1, 80E2 |

S-like (N=16)

Ion

| | |
|---|---|
| Ar III | 64E1, 67E5*, 70E3*, 71E10*, 72E4*, 78E3*, 80E1, 80E2 |

Cl-like (N=17)

Exc

| | |
|---|---|
| Ar II | 72E5, 72E7 |
| Fe X | 75E2* |

Ion

| | |
|---|---|
| Ar II | 64E1, 66E1*, 67E5*, 70E3*, 71E10*, 72E4*, 78E3*, 78E5, 80E1, 80E2 |
| Fe X | 75E2* |

Ar-like (N=18)

Exc

| | |
|---|---|
| K II | 79E5 |
| Fe IX | 75E2* |

Ion

| | |
|---|---|
| K II | 66E5, 68E5 |
| Fe IX | 75E2* |

K-like (N=19)

Exc

| | |
|---|---|
| Ca II | 71E7, 73E8, 74E5*, 75E7, 75E13 |
| Fe VIII | 75E2* |

Ion

| | |
|---|---|
| Ca II | 75E5, 75E9 |
| Fe VIII | 75E2* |

Ca-like (N=20)

Ion

| | |
|---|---|
| Ti III | 81E3 |

Cu-like (N=29)

Exc

| | |
|---|---|
| Zn II | 82E2 |

Ion

| | |
|---|---|
| Zn II | 82E3 |
| Kr VIII | 67E5* |

Zn-like (N=30)

Exc

| | |
|---|---|
| Ga II | 82E4 |

Ion

| | |
|---|---|
| Ga II | 82E3 |
| Kr VII | 67E5* |
| Xe XXV | 75E3* |

Ga-like (N=31)

Ion

| | |
|---|---|
| Kr VI | 67E5* |

Ge-like (N=32)

Ion

| | |
|---|---|
| Kr V | 67E5* |

As-like (N=33)

Ion

| | |
|---|---|
| Kr IV | 67E5* |

Se-like (N=34)

Exc

| | |
|---|---|
| Kr III | 74E4 |

Ion

| | |
|---|---|
| Kr III | 64E1, 67E5* |
| Xe XXI | 75E3* |

Br-like (N=35)

Exc

| | |
|---|---|
| Kr II | 72E7 |

Ion

| | |
|---|---|
| Kr II | 63E3, 64E1, 65E1*, 66E1*, 67E5* |

Kr-like (N=36)

Ion

| | |
|---|---|
| Rb II | 75E9, 78E2, 80E4, 81E5 |

Rb-like (N=37)

Exc

| | |
|---|---|
| Sr II | 70E1*, 75E6, 75E12, 75E13 |

Ion

| | |
|---|---|
| Sr II | 75E5, 75E9 |

Sr-like (N=38)

| Ion | |
|---|---|
| Zr III | 81E3 |

Y-like (N=39)

| Ion | |
|---|---|
| Xe XVI | 75E3* |

Ru-like (N=44)

| Ion | |
|---|---|
| Xe XI | 67E5*, 75E3* |

Rh-like (N=45)

| Ion | |
|---|---|
| Xe X | 67E5* |

Pd-like (N=46)

| Ion | |
|---|---|
| Xe IX | 67E5* |
| Cs X | 71E9* |

Ag-like (N=47)

| Ion | |
|---|---|
| Xe VIII | 67E5* |
| Cs IX | 71E9* |
| Ba X | 71E9* |

Cd-like (N=48)

| Ion | |
|---|---|
| Xe VII | 67E5* |
| Cs VIII | 71E9* |
| Ba IX | 71E9* |

In-like (N=49)

| Ion | |
|---|---|
| Xe VI | 67E5* |
| Cs VII | 71E9* |
| Ba VIII | 71E9* |

Sn-like (N=50)

| Ion | |
|---|---|
| Xe V | 67E5* |
| Cs VI | 71E9* |
| Ba VII | 71E9* |

Sb-like (N=51)

| Ion | |
|---|---|
| Xe IV | 67E5* |
| Cs V | 71E9* |
| Ba VI | 71E9* |

Te-like (N=52)

| Ion | |
|---|---|
| Xe III | 64E1, 67E5* |
| Cs IV | 71E9* |
| Ba V | 71E9* |

I-like (N=53)

| Ion | |
|---|---|
| Xe II | 63E3, 66E1*, 67E5*, 80E2 |
| Cs III | 71E9* |
| Ba IV | 71E9* |

Xe-like (N=54)

| Ion | |
|---|---|
| Cs II | 67E3*, 71E9*, 75E9, 75E10, 80E4 |
| Ba III | 71E9* |

Cs-like (N=55)

| Exc | |
|---|---|
| Ba II | 69E2, 69E4, 70E1*, 73E3, 73E6, 74E1, 74E5*, 75E13 |

| Ion | |
|---|---|
| Ba II | 68E6, 69E3, 71E9*, 72E3, 73E7, 75E5 |

Yb-like (N=70)

| Ion | |
|---|---|
| Hf III | 81E3 |

Lu-like (N=71)

| Ion | |
|---|---|
| Hg X | 68E8* |

Hf-like (N=72)

| Ion | |
|---|---|
| Hg IX | 68E8* |

Ta-like (N=73)

| Ion | |
|---|---|
| Hg VIII | 68E8* |

W-like (N=74)

| Ion | |
|---|---|
| Hg VII | 68E8* |

Re-like (N=75)

| Ion | |
|---|---|
| Hg VI | 68E8* |

Os-like (N=76)

| Ion | |
|---|---|
| Hg V | 68E8* |

Ir-like (N=77)

| Ion | |
|---|---|
| Hg IV | 68E8* |

Pt-like (N=78)

| Ion | |
|---|---|
| Hg III | 64E1, 68E8* |

Au-like (N=79)

| Exc | |
|---|---|
| Hg II | 75E1, 75E11, 76E4 |
| **Ion** | |
| Hg II | 63E3, 64E1, 68E8* |

Hg-like (N=80)

| Ion | |
|---|---|
| Tl II | 76E2 |

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| | |
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| | |
|---|---|
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| | |
|---|---|
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| Ne VI | 68T3, 69T2, 69T15, 76T5, 76T9 |
| Na VII | 68T3, 75T23 |
| Mg VIII | 68T3, 75T9, 76T5, 76T9 |
| Al IX | 68T3 |
| Si X | 68T3, 69T2, 75T22, 76T4, 76T9, 77T25, 82T11 |
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| | |
|---|---|
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| Ne V | 53T2, 55T1, 58T1, 66T13, 68T3, 68T5, 69T2, 69T15, 76T9, 79T11, 79T12, 80T4 |
| Na VI | 66T4, 68T3, 69T2 |
| Mg VII | 66T13, 68T3, 69T15, 76T9 |
| Al VIII | 68T3 |
| Si IX | 68T3, 69T2, 75T9, 76T5, 76T9, 77T25 |
| P X | 66T4, 68T3 |
| S XI | 66T13, 68T3, 75T9, 76T9 |
| Cl XII | 68T3 |
| Ar XIII | 66T4, 68T3, 69T2, 79T7 |
| K XIV | 66T4, 68T3 |
| Ca XV | 66T4, 68T3, 69T2, 75T9, 75T11, 76T9, 79T7 |
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| Ti XVII | 80T8 |
| Fe XXI | 75T9, 76T5, 76T9, 79T16 |
| Ni XXIII | 76T9 |
| Zn XXV | 66T13 |
| Ion | 77T9 |
| N II | 67T9, 67T10, 69T9, 69T16, 70T12, 71T17, 72T9, 76T14, 78T11, 78T20, 80T10, 82T5 |
| O III | 67T10, 70T12, 72T9, 76T3, 76T14, 77T23, 78T11, 78T20, 81T13, 82T5 |
| F IV | 82T5 |
| Ne V | 74T12, 76T14 |
| Si IX | 67T14 |
| Ar XIII | 74T12, 75T14 |
| Ca XV | 80T27 |
| Fe XXI | 78T3, 80T27, 82T14 |
| Kr XXXI | 73T11 |
| Xe XXXXIX | 74T12 |

N-like (N=7)

| | |
|---|---|
| Exc | |
| O II | 48T1, 50T1, 53T2, 66T1, 57T1, 58T1, 67T7, 69T2, 69T7, 69T10, 69T11, 69T15, 69T17, 73T9, 74T4, 75T20, 76T13, 76T18 |
| F III | 53T2, 55T1, 58T1, 67T7, 69T2, 69T11, 69T15 |
| Ne IV | 53T2, 55T1, 58T1, 67T7, 68T5, 69T2, 69T11, 69T15, 76T9 |
| Na V | 53T2, 55T1, 58T1, 67T7, 69T2, 69T11, 69T15 |
| Mg VI | 67T7, 69T2, 69T15, 76T9, 80T7 |
| Si VIII | 75T9, 76T9, 77T25, 80T7 |
| S X | 69T2, 75T9, 76T9, 80T7 |
| Ar XII | 67T2, 69T2, 80T7 |
| Ca XIV | 69T2, 75T9, 76T9, 80T7 |
| Ti XVI | 80T8 |
| Fe XX | 75T9, 76T5, 80T6 |
| Ni XXII | 75T9, 76T9 |
| Ion | 77T9 |

| | |
|---|---|
| O II | 67T10, 70T12, 72T9, 76T3, 76T14, 77T23, 78T11, 78T20, 80T10, 81T13, 82T5 |
| F III | 67T10, 82T5 |
| Ne IV | 74T12, 76T14, 77T26 |
| Ar XII | 74T12, 76T14 |
| Ca XIV | 80T27 |
| Fe XX | 80T27, 82T14 |
| Kr XXX | 73T11 |
| Xe XXXXVIII | 74T12 |

O-like (N=8)

| | |
|---|---|
| Exc | 81T11 |
| F II | 53T2, 55T1, 58T1, 67T7, 68T3, 69T2, 69T15 |
| Ne III | 53T2, 55T1, 58T1, 67T7, 68T3, 68T5, 69T2, 69T15, 74T11, 76T9 |
| Na IV | 53T2, 55T1, 58T1, 67T7, 68T3, 69T2, 69T15 |
| Mg V | 53T2, 55T1, 58T1, 67T7, 68T3, 69T2, 69T15, 76T9 |
| Al VI | 67T7, 68T3, 69T2, 69T15 |
| Si VII | 68T3, 75T9, 76T9, 77T25, 79T3 |
| P VIII | 68T3 |
| S IX | 68T3, 75T9, 76T9, 79T3 |
| Cl X | 68T3 |
| Ar XI | 67T7, 68T3, 69T2, 79T3 |
| K XII | 68T3 |
| Ca XIII | 68T3, 69T2, 75T9, 75T11, 76T9 |
| Sc XIV | 68T3 |
| Ti XV | 68T3, 69T2, 80T8 |
| V XVI | 68T3 |
| Fe XIX | 70T15, 75T9, 76T5, 76T9 |
| Ni XXI | 75T9, 76T9 |
| Ion | 77T9 |
| F II | 67T10, 82T5 |
| Ne III | 67T10, 74T12, 76T14 |
| Ar XI | 74T12, 76T14 |
| Ca XIII | 80T27 |
| Fe XIX | 80T27, 82T14 |
| Kr XXIX | 73T11 |
| Xe XXXVII | 74T12 |

F-like (N=9)

| | |
|---|---|
| Exc | |
| Ne II | 68T3, 69T2, 69T15, 77T24, 81T21 |
| Na III | 68T3, 69T2, 69T15 |
| Mg IV | 68T3, 69T2, 69T15, 76T9 |
| Al V | 68T3, 69T2, 69T15 |
| Si VI | 68T3, 69T2, 69T15, 75T9, 76T9, 77T25 |
| P VII | 68T3 |
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| Sc XIII | 68T3 |
| Ti XIV | 68T3, 69T2, 80T8 |
| V XV | 68T3 |
| Cr XVI | 68T3 |
| Fe XVIII | 75T9, 76T9 |
| Ni XX | 76T9 |
| Ion | |
| Ne II | 67T9, 67T10, 69T9, 69T16, 71T17, 72T9, 74T12, 76T14, 80T10 |
| Na III | 67T10, 82T9 |
| Ar X | 74T12, 76T14 |
| Ca XII | 80T27 |
| Fe XVIII | 80T27, 82T14 |
| Kr XXVIII | 73T11 |
| Xe XXXXVI | 74T12 |

Ne-like (N=10)

| | |
|---|---|
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| Si V | 76T9 |
| S VII | 79T9 |
| Ar IX | 76T7, 76T9 |
| Ca XI | 76T9 |
| Fe XVII | 67T5, 71T5, 75T9, 76T5, 76T9 |
| Ni XIX | 75T9, 76T9 |
| Z=10 – 20 | 80T19 |
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| Al IV | 81T31 |
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| | |
|---|---|
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| Al III | 71T4, 78T19 |
| Si IV | 63T1, 69T3, 75T5 |
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| S VI | 75T5, 76T9 |
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| Ca X | 75T5, 76T9, 78T4 |
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| Cu XIX | 70T9 |
| Zn XX | 78T4 |
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| Mo XXXII | 78T4, 78T19, 81T5 |

| | |
|---|---|
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| Au LXIX | 78T19 |
| Th LXXX | 78T19 |
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| Si IV | 82T3 |
| P V | 68T1, 71T10, 81T32 |
| Ar VIII | 74T12, 76T14, 81T32, 82T12 |
| Ca X | 68T1, 71T10, 80T27, 82T12 |
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| Mo XXXII | 82T12 |
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| | |
|---|---|
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| Mo XXXI | 80T39 |
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| Fe XV | 66T12, 67T13, 68T7, 78T3, 80T27 |
| Kr XXV | 73T11 |
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| | |
|---|---|
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| P III | 68T3, 69T2, 70T11, 80T5, 80T9, 80T14 |
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| Ti X | 68T3, 69T2 |
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| Cr XII | 68T3, 70T11 |
| Mn XIII | 68T3, 70T11 |
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| Co XV | 68T3 |
| Ni XVI | 68T3, 76T9 |
| Ion | |
| Ar VI | 74T12, 76T14 |
| Ca VIII | 80T27 |
| Fe XIV | 51T1, 59T1, 63T6, 67T13, 68T7, 69T1, 80T27 |
| Kr XXIV | 73T11 |
| Xe XXXXII | 74T12 |

Si-like (N=14)

| | |
|---|---|
| Exc | |
| P II | 66T4, 67T7, 68T3, 69T2, 70T3, 70T11 |
| S III | 64T4, 66T2, 66T4, 67T7, 68T3, 69T2, 70T11, 82T6 |
| Cl IV | 64T4, 66T2, 66T4, 67T7, 68T3, 69T2, 70T11 |
| Ar V | 64T4, 66T2, 66T4, 67T7, 68T3, 69T2, 70T11 |
| K VI | 67T7, 68T3, 69T2, 70T11 |
| Ca VII | 66T4, 67T7, 68T3, 70T11, 76T9 |
| Sc VIII | 68T3 |
| Ti IX | 68T3 |
| V X | 66T4, 67T7, 68T3, 70T11 |
| Cr XI | 66T4, 67T7, 68T3, 70T11 |
| Mn XII | 66T4, 67T7, 68T3, 70T11 |
| Fe XIII | 66T4, 66T7, 67T4, 67T7, 68T3, 69T2, 70T11, 71T5, 73T3, 74T6 75T9, 76T9 |
| Co XIV | 68T3 |
| Ni XV | 66T4, 67T7, 68T3, 69T2, 76T9 |
| Cu XVI | 68T3 |
| Ion | |
| Ar V | 74T12, 76T14 |
| Ca VII | 80T27 |
| Fe XIII | 67T13, 68T7, 80T27 |
| Ni XV | 79T17 |
| Kr XXIII | 73T11 |
| Xe XXXXI | 74T12 |

P-like (N=15)

| | |
|---|---|
| Exc | |
| S II | 53T2, 55T1, 58T1, 64T4, 67T6, 69T2, 70T3, 70T4, 70T11, 76T18, 78T26 |

| | |
|---|---|
| Cl III | 67T6, 69T2, 70T3, 70T4, 70T11 |
| Ar IV | 67T6, 69T2, 70T3, 70T4, 70T11 |
| K V | 67T6, 69T2, 70T4, 70T11 |
| Ca VI | 67T6, 69T2, 70T4, 70T11, 76T9 |
| Sc VII | 69T2 |
| V IX | 67T6, 70T4, 70T11 |
| Cr X | 70T4, 70T11 |
| Mn XI | 70T4, 70T11 |
| Fe XII | 67T6, 69T2, 70T4, 70T11, 76T9, 77T6 |
| Ni XIV | 69T2, 70T11, 76T9 |
| Ion | |
| Ar IV | 74T12, 77T10, 77T20 |
| Ca VI | 80T27 |
| Fe XII | 67T13, 68T7, 80T27 |
| Ni XIV | 79T17 |
| Kr XXII | 73T11 |
| Xe XXXX | 74T12 |

S-like (N=16)

| | |
|---|---|
| Exc | |
| Cl II | 67T7, 68T3, 69T2, 70T3, 70T11 |
| Ar III | 67T7, 68T3, 69T2, 70T11 |
| K IV | 67T7, 68T3, 69T2, 70T11 |
| Ca V | 67T7, 68T3, 69T2, 70T11 |
| Sc VI | 68T3, 69T2 |
| Ti VII | 68T3 |
| V VIII | 67T7, 68T3, 70T11 |
| Cr IX | 67T7, 68T3, 70T11 |
| Mn X | 67T7, 68T3, 70T11 |
| Fe XI | 67T7, 68T3, 69T2, 70T11, 75T11, 76T5, 76T9 |
| Co XII | 68T3 |
| Ni XIII | 67T7, 68T3, 69T2, 70T11, 76T9 |
| Cu XIV | 68T3 |
| Zn XV | 68T3, 69T2 |
| Ga XVI | 68T3 |
| Ion | |
| Ar III | 70T13, 74T12 |
| Ca V | 80T27 |
| Fe XI | 67T13, 68T7, 80T27 |
| Ni XIII | 79T17 |
| Kr XXI | 73T11 |
| Xe XXXIX | 74T12 |

Cl-like (N=17)

| | |
|---|---|
| Exc | |
| Ar II | 68T3, 69T2, 70T11, 73T1, 75T1 |
| K III | 68T3, 69T2, 70T11 |
| Ca IV | 68T3, 69T2, 70T11 |
| Sc V | 68T3, 69T2 |
| Ti VI | 68T3, 69T2 |
| V VII | 68T3 |
| Cr VIII | 68T3, 70T11 |
| Mn IX | 68T3, 70T11 |
| Fe X | 68T3, 69T2, 70T11, 70T15, 75T11, 76T9, 80T25 |
| Co XI | 68T3, 70T11 |
| Ni XII | 68T3, 69T2, 70T11, 76T9 |
| Cu XIII | 68T3 |
| Zn XIV | 68T3, 69T2 |
| Ga XV | 68T3 |
| Ge XVI | 68T3 |
| Ion | |
| Ar II | 70T13, 74T12, 82T13 |
| K III | 82T13 |
| Ca IV | 80T27 |
| Sc V | 82T13 |
| Fe X | 67T13, 68T7, 80T27 |
| Ni XII | 79T17 |
| Kr XX | 73T11 |
| Xe XXXVIII | 74T12 |

Ar-like (N=18)

| | |
|---|---|
| Exc | |
| Fe IX | 76T5, 76T9, 77T7 |
| Ni XI | 76T9 |
| Ion | |
| K II | 67T9, 67T10, 69T9, 69T16, 71T12, 71T16, 71T17, 76T3, 79T15, 80T10 |
| Ca III | 80T27 |
| Fe IX | 67T13, 68T7, 77T10, 77T26, 78T15, 80T27 |
| Ni XI | 79T17 |
| Kr XIX | 73T11 |
| Mo XXV | 77T11, 78T15 |
| Xe XXXVII | 74T12 |

K-like (N=19)

| | |
|---|---|
| Exc | |
| Ca II | 54T1, 60T2, 60T3, 61T5, 65T4, 66T6, 68T4, 69T3, 70T19, 73T12, 74T2, 74T3, 78T18, 81T9 |
| Sc III | 70T11 |
| V V | 70T11 |
| Fe VIII | 66T9, 69T3, 76T9 |
| Ni X | 76T9 |
| Ion | |
| Ca II | 69T8, 77T23, 78T11, 80T27 |
| Sc III | 69T8 |
| Ti IV | 69T8, 82T4 |
| Fe VIII | 80T27 |
| Ni X | 79T17 |
| Kr XVIII | 73T11 |
| Xe XXXVI | 74T12 |

Ca-like (N=20)

| | |
|---|---|
| Exc | |
| Fe VII | 70T15 |
| Ion | |
| Sc II | 69T8 |
| Ti III | 69T8 |
| V IV | 69T8 |
| Fe VII | 80T27 |
| Ni IX | 79T17 |
| Kr XVII | 73T11 |
| Xe XXXV | 74T12 |

Sc-like (N=21)

| | |
|---|---|
| Exc | |
| Fe VI | 78T12 |
| Ion | |
| Ti II | 69T8 |
| V III | 69T8 |
| Cr IV | 69T8 |
| Ni VIII | 79T17 |
| Kr XVI | 73T11 |
| Xe XXXIV | 74T12 |

Ti-like (N=22)

| | |
|---|---|
| Ion | |
| V II | 69T8 |
| Cr III | 69T8 |
| Fe V | 82T4 |
| Ni VII | 79T17 |
| Mn IV | 69T8 |
| Kr XV | 73T11 |
| Xe XXXIII | 74T12 |

V-like (N=23)

| | |
|---|---|
| Ion | |
| Cr II | 69T8 |
| Mn III | 69T8 |
| Fe IV | 69T8, 82T4 |
| Ni VI | 79T17 |
| Kr XIV | 73T11 |
| Xe XXXII | 74T12 |

Cr-like (N=24)

| | |
|---|---|
| Exc | |
| Fe III | 78T12 |
| Ion | |
| Mn II | 69T8 |
| Fe III | 69T8 |
| Co IV | 69T8 |
| Ni V | 79T17 |
| Kr XIII | 73T11 |
| Xe XXXI | 74T12 |

Mn-like (N=25)

| | |
|---|---|
| Exc | |
| Fe II | 55T3, 80T29 |
| Ion | |
| Fe II | 69T8 |
| Co III | 69T8 |
| Ni IV | 69T8, 79T17 |
| Kr XII | 73T11 |
| Xe XXX | 74T12 |

Fe-like (N=26)

| | |
|---|---|
| Ion | |
| Co II | 69T8 |
| Ni III | 69T8, 79T17 |
| Cu IV | 69T8 |
| Kr XI | 73T11 |
| Xe XXIX | 74T12 |

Co-like (N=27)

| | |
|---|---|
| Ion | |
| Ni II | 69T8, 79T17 |
| Cu III | 69T8 |
| Zn IV | 69T8 |
| Kr X | 73T11 |
| Xe XXVIII | 74T12 |

Ni-like (N=28)

| | |
|---|---|
| Ion | |
| Cu II | 69T8 |
| Zn III | 69T8 |
| Ga IV | 69T8 |
| Kr IX | 73T11 |
| Mo XV | 78T15 |
| Xe XXVII | 74T12 |

Cu-like (N=29)

| | |
|---|---|
| Exc | |
| Zn II | 82T7 |
| Ga III | 79T27 |
| Kr VIII | 79T27 |
| Mo XIV | 79T27 |
| Xe XXVI | 79T27 |
| Ion | |
| Zn II | 69T8, 70T13 |
| Ga III | 69T8 |
| Kr VIII | 73T11 |
| Xe XXVI | 74T12 |

Zn-like (N=30)

| | |
|---|---|
| Exc | |
| As IV | 80T39 |
| Kr VII | 80T39 |
| Mo XIII | 80T39 |
| Xe XXV | 80T39 |
| Ion | |
| Ga II | 69T8, 82T10 |
| Kr VII | 73T11 |
| Xe XXV | 74T12 |

Ga-like (N=31)

| | |
|---|---|
| Ion | |
| Kr VI | 73T11 |
| Xe XXIV | 74T12 |

Ge-like (N=32)

| | |
|---|---|
| Ion | |
| Kr V | 73T11 |
| Xe XXIII | 74T12 |

As-like (N=33)

| | |
|---|---|
| Ion | |
| Kr IV | 73T11 |
| Xe XXII | 74T12 |

Se-like (N=34)

| Ion | |
|---|---|
| Kr III | 70T3, 73T11 |
| Xe XXI | 74T12 |

Br-like (N=35)

| Ion | |
|---|---|
| Kr II | 70T13, 73T11 |
| Xe XX | 74T12 |

Kr-like (N=36)

| Ion | |
|---|---|
| Rb II | 69T9, 77T23, 79T15 |
| Xe XIX | 74T12 |

Rb-like (N=37)

| Exc | |
|---|---|
| Sr II | 74T2 |
| **Ion** | |
| Sr II | 70T13, 77T23 |
| Zr IV | 82T4 |
| Xe XVIII | 74T12 |

Sr-like (N=38)

| Ion | |
|---|---|
| Xe XVII | 74T12 |

Y-like (N=39)

| Ion | |
|---|---|
| Xe XVI | 74T12 |

Zr-like (N=40)

| Ion | |
|---|---|
| Xe XV | 74T12 |

Nb-like (N=41)

| Ion | |
|---|---|
| Xe XIV | 74T12 |

Mo-like (N=42)

| Ion | |
|---|---|
| Xe XIII | 74T12 |

Tc-like (N=43)

| Ion | |
|---|---|
| Xe XII | 74T12 |

Ru-like (N=44)

| Ion | |
|---|---|
| Xe XI | 74T12 |

Rh-like (N=45)

| Ion | |
|---|---|
| Xe X | 74T12 |

Pd-like (N=46)

| Ion | |
|---|---|
| Ag II | 70T13 |
| Xe IX | 74T12 |

Ag-like (N=47)

| Ion | |
|---|---|
| Cd II | 70T13 |
| Xe VIII | 74T12 |

Cd-like (N=48)

| Ion | |
|---|---|
| Xe VII | 74T12 |

In-like (N=49)

| Ion | |
|---|---|
| Sn II | 70T13 |
| Xe VI | 74T12 |

Sn-like (N=50)

| Ion | |
|---|---|
| Xe V | 74T12 |

Sb-like (N=51)

| Ion | |
|---|---|
| Xe IV | 74T12 |

Te-like (N=52)

| Ion | |
|---|---|
| Xe III | 70T13, 74T12 |

I-like (N=53)

| Ion | |
|---|---|
| Xe II | 70T13, 74T12 |

Xe-like (N=54)

| Ion | |
|---|---|
| Cs II | 69T9, 77T23, 79T15, 79T17 |

Cs-like (N=55)

| Exc | |
|---|---|
| Ba II | 65T4, 70T5, 70T8, 74T2, 74T3, 79T17 |
| **Ion** | |
| Ba II | 70T13, 71T1, 77T23 |
| Hf IV | 82T4 |

Pt-like (N=78)

| Ion | |
|---|---|
| Hg III | 70T13 |

Au-like (N=79)

| Ion | |
|---|---|
| Hg II | 70T13 |

Hg-like (N=80)

| Ion | |
|---|---|
| Tl II | 77T23, 79T17 |

Others

| Ion | |
|---|---|
| $Au^{q+}$ | |
| q = 3 – 14 | 79T17 |

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