Transactions IAU, Volume XXVIIIA
Reports on Astronomy 2009–2012
Ian Corbett, ed.

doi:10.1017/S1743921312003080

ATOMIC DATA

DIVISION XII / COMMISSION 14 / WORKING GROUP ATOMIC DATA

CHAIR **Gillian Nave**
VICE-CHAIR **Glenn M. Wahlgren, Jeffrey R. Fuhr**

TRIENNIAL REPORT 2009–2012

This report summarizes laboratory measurements of atomic wavelengths, energy levels, hyperfine and isotope structure, energy level lifetimes, and oscillator strengths. Theoretical calculations of lifetimes and oscillator strengths are also included. The bibliography is limited to species of astrophysical interest. Compilations of atomic data and internet databases are also included. Papers are listed in the bibliography in alphabetical order, with a reference number in the text.

1. Energy levels, wavelengths, line classifications, and line structure

Major analyses of wavelengths, energy levels and line classifications have been published for **V I** 257, **Fe II** [52], [51], **Cr I** [262], **Te II** [246], and **Ho II** [102] in the past three years. Wavelengths and energy levels have also been measured in the symbiotic nova RR Telescopii for the following species: Al VI, Ar III-V, C II, Ca V-VII, Cl IV, K IV-VI, Mg V-VI, N II-III, Na IV-VI, Ne III-V, O IV, P IV, S IV-V, and Si II-IV. Line identifications based on solar flares and active regions were published for Ar XI,XIV, Ca XIV-XV, Fe XII, Fe XIII, Fe XVII, and Ni XV [240].

Additional publications of wavelengths, energy levels and line classifications include:
Al IV-XI [96], **Ar II** [200], **Ba I** [298], **Ca I** [15, 60] IS [229], **Ca XI** [119], **Ce II** [162], **Cl I** [44], **Co II** HFS [38], **Cr I** IS [262], **Cr III** [243], **D I** [213], **Dy I** HFS, IS [166], **Er I** [125], HFS, IS [123], **Er II** [272], **Eu I** [274], **Fe I** HFS, IS [148], **Fe II** [50, 51, 52, 126], **Fe VI-XIV** [170], **Fe VII-IX** [284], **Fe VII** [286], **Fe VIII** [287, 159], **Fe IX-XVI** [173], **Fe IX** [282, 158], **Fe X** [134], **Fe XI** [291, 288, 135], **Fe XII-XXII** [278], **Fe XIII** [260], **Fe XVII** [289, 94], **Gd I** IS [19, 125], **Ge I-II** [200], **H I** IS [213, 21], **Hg I** IS [231], **Ho II** HFS [102], **K I** IS, HFS [151, 37], **La I** HFS [32], **La II** HFS [86, 87, 88], **Li I** IS [230], **Mg I** IS [111, 244], **Mg II** IS [34], **Mg III** [46], **Mg VII** [173], **Na I-XI** [233], **Na I** [147], **Nb I** HFS [149], **Nb II** HFS [203], **O I** [121], **Os I** HFS [33], **Pb I-II** IS [266, 267], **Pr I-II** HFS [89], **S IX-XIII** [279], **S V** [186], **Si I** IS, HFS [165], **Si VII-IX** [173], **Sm I** [97], **Sn I** [299], **Ta I** HFS [95], **Ta II** HFS [261], **Tc I,II** [190], **Te II** [246], **Ti I** IS, HFS [124], **Ti II** IS, HFS [204], **Ti XIII** [119], **Tm I** HFS [13], **V I** [257], **V XXIII** [93], **Xe II** [285], **Zn II** [14].
The references for elements heavier than Ni ($Z>28$) are limited to the first three or four spectra only, these data being of most interest for astronomical spectroscopy.

Current analyses of neutral through doubly-ionized spectra are underway for iron-group spectra at the National Institute of Standards and Technology (NIST) and the University of Wisconsin, USA and Imperial College, London, UK. Work on rare-earth elements is being performed at the University of Wisconsin, USA; Laboratoire Aimé

Cotton, Orsay, France; Observatoire de Paris-Meudon, France; and the Institute of Spectroscopy, Troitsk, Russia. Studies of more highly-ionized elements are being done using electron beam ion traps at NIST, USA, Lawrence Livermore National Laboratory, USA, and Heidelberg, Germany, and with an accelerator in Beijing, China.

2. Wavelength standards

Much of the work on wavelength standards during the period of this report has focused on standards required for calibration of astronomical spectrographs and for detecting possible changes in the fine-structure constant during the history of the Universe. Wavelengths emitted by a uranium-neon hollow cathode lamp suitable for astronomical spectrograph calibration have been measured using Fourier transform spectroscopy (FTS) [219]. Updated wavelength standards suitable for detecting changes in the fine-structure constant have been measured using FTS for **Mg I, Mg II, Ti II, Cr II, Mn II, Fe II** and **Zn II** [14, 200]. The most accurate wavelength standards are now made using laser spectroscopy with a laser frequency comb for calibration. Frequency standards with uncertainties of below 1 MHz have been published using this method for **Li I** [230], **Mg II** [34, 112], **Ca I** [229], and **Ca II** [271]. Additional laser spectroscopy measurements include the 546 nm line of ^{198}**Hg** [231], which was a widely used wavelength standard for earlier studies. These laser spectroscopy measurements have been used to validate the scale of FTS measurements [200], putting all of these measurements on the same wavelength scale. Ritz wavelengths based on re-optimized energy levels of ^{198}Hg are found in [145].

3. Transition probabilities

The transition-probability data in the references in section 7 were obtained by both theoretical and experimental methods. The references for elements heavier than Ni ($Z>28$) are limited to the first three or four spectra only.

4. Compilations, Reviews, Conferences

Major compilations of wavelengths, energy levels or transition probabilities have been published for the following elements: **Al** [136], **Ar** [228], **B** [84, 143, 144], **Be** [84], **Cs** [234], **H I; D I; T I** [146, 269], **He** [269], **K** [232], **Li** [269], **Na** [233], **S** [214], **Si** [137], and **Sr I** [236]. Additional data can be found in *NIST Atomic Transition Probabilities,* section of the Handbook of Chemistry and Physics [85].

Papers on atomic spectroscopic data are included in the proceedings of the 10th International Conference on Atomic Spectra and Oscillator Strengths [2], the 7th International Conference on Atomic and Molecular data and their Applications [1], and the 2010 NASA Laboratory Astrophysics workshop [3]. Additional conferences including papers on atomic data include Atomic Processes in Plasmas, the Congress of the European Group on Atomic Systems; and the meeting of the Division of Atomic, Molecular and Optical Physics of the American Physical Society.

5. Databases

The following databases of atomic spectra at NIST have received significant updates since the last triennial report:

NIST Atomic Spectra Database:
http://www.nist.gov:/pml/data/asd.cfm contains critically compiled data on wavelengths, energy levels and oscillators strengths.

Ground Levels and Ionization Energies for the Neutral Atoms:
http://www.nist.gov/pml/data/ion_energy.cfm

NIST Atomic Spectra Bibliographic Databases:
http://www.nist.gov/pml/data/asbib/index.cfm
Consists of three databases of publications on atomic transition probabilities, atomic energy levels and spectra, and atomic spectral line broadening.

Additional on-line databases including significant quantities of atomic data include:

The MCHF/MCDHF Collection on the Web (C.Froese Fischer *et al.*) at http://nlte.nist.gov/MCHF/index.html contains results of multi-configuration Hartree-Fock (MCHF) or multi-configuration Dirac-Hartree-Fock (MCDHF) calculations for hydrogen and Li-like through Ar-like ions, mainly for $Z \leqslant 30$. Data for fine-structure transitions are included.

The TOPbase and Opacity Projects include transition probability and oscillator strength data for astrophysically abundant ions ($Z \leqslant 26$). A database is available at http://cdsweb.u-strasbg.fr/topbase/topbase.html

CHIANTI, an atomic database for spectroscopic diagnostics of astrophysical plasmas at http://www.chianti.rl.ac.uk/ contains atomic data and programs for computing spectra from astrophysical plasmas, with the emphasis on highly-ionized atoms.

The Vienna Atomic Line Database (VALD) web site (http://ams.astro.univie.ac.at/ vald/) is a collection of atomic line parameters of astronomical interest, with tools for selecting subsets of astrophysical interest.

The bibl database is a comprehensive bibliographic database of experimental and theoretical papers on atomic spectroscopy, with an emphasis on papers published since 1983. It is available at http://das101.isan.troitsk.ru/bibl.htm).

6. Notes for References

The references are identified by a running number. This refers to the general reference list at the end of this report, where the literature is ordered alphabetically according to the first author. Each reference contains one or more code letters indicating the method applied by the authors, defined as follows:

THEORETICAL METHODS:

Q: quantum mechanical calculations. **QF:** Calculations of forbidden lines.

EXPERIMENTAL METHODS:

CL: New classifications
EL: Energy levels.
WL: Wavelengths.
HFS: Hyperfine structure.
IS: Isotope structure.
L: Lifetimes.
TE: Experimental transition probabilities.

OTHER:

CP: Data compilations. **R:** Relative values only. **F:** Forbidden lines.

Gillian Nave
chair of Working Group

https://doi.org/10.1017/S1743921312003080 Published online by Cambridge University Press

7. References on lifetimes and transition probabilities

Al II: 56
Al III: 172
Al IV: 168
Al IX: 104
Al V-XII: 212
Al XI: 117

Ar V: 255
Ar VIII: 172
Ar IX: 168
Ar XVI: 117

Au III: 281

B I: 292
B IV: 6

Ba I: 298
Ba II: 120, 224

Be III: 6

C I: 29
C II: 127, 247
C V: 6

Ca I: 15
Ca II: 92, 224, 226
Ca VIII: 132
Ca X: 172
Ca XI: 168
Ca XVII: 154
Ca XVIII: 117

Cd II: 224

Ce I: 59, 108
Ce II: 110, 162

Cl I: 44, 206
Cl VII: 172
Cl VIII: 168
Cl XV: 117

Co XII: : 259
Co XIII: 259
Co XIV: 259
Co XV: 98, 259
Co XVII: 172
Co XVIII: 168
Co XXIII: 104

Cr II: 35, 101
Cr VIII: 5
Cr XIV: 172
Cr XV: 168
Cr XXII: 264

Cu II: 48, 76

Er I: 109, 164
Er II: 163, 272

Eu I: 294
Eu III: 273

F VII: 12
F VIII: 10
F IX: 11

Fe II: 51, 52, 66, 100, 191, 218
Fe III: 63, 64, 65
Fe IV: 61, 67, 80, 113
Fe VI: 31
Fe VII: 270, 286
Fe VIII: 159, 287
Fe IX: 158
Fe X: 43
Fe XI: 259, 288, 291
Fe XII: 250, 252, 258, 259
Fe XIII: 245, 259
Fe XIV: 169, 248, 250, 252, 259
Fe XV: 152, 194
Fe XVI: 172, 198
Fe XVII: 168, 177
Fe XVII-XXV: 114
Fe XIX: 49, 142, 197
Fe XX: 142
Fe XXII: 104, 193, 195
Fe XXIII: 277
Fe XXIV: 178, 263
Fe XXVI: 4, 55

Ga I: 280

Gd I: L 107, 160

Ge IV: 74

He I: 16, 192

Hf I,III: 184

Hg II: 224

In I: 225

K I: 20, 54, 223
K II: 254
K IX: 172
K X: 168
K XVII: 117

Kr II: 131

La I: 77, 128, 129
La II: 150

Li I-II: 22
Li II: 6

Mg I: 56, 122, 256
Mg II: 69, 172
Mg III: 168
Mg IX: 118, 290
Mg X: 117

Mn I: 42
Mn XV: 172
Mn XVI: 168
Mn XXI: 104

Mo II: 180

N I-VII: 90
N I: 27, 29, 45
N II: 29, 239, 251
N III: 127
N V: 12
N VI: 10
N VII: 11

References

[1] 7 th International Conference on Atomic and Molecular Data and their Applications: 2010, AIP Conference Proceedings Volume 1344

[2] 10th International Colloquium on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory Plasmas: 2011 Canadian J. Physics, 89

[3] The 2010 NASA Laboratory Astrophysics Workshop: 2011, ed. D.R. Schultz, Oak Ridge National Laboratory http://www-cfadc.phy.ornl.gov/nasa_law/proceedings.html

[4] Aggarwal, K. M., Hamada, K., Igarashi, A., Jonauskas, V., Keenan, F. P., & Nakazaki, S.: 2008, Astron. Astrophys. 484, 879, **Q, QF**

[5] Aggarwal, K. M., Kato, T., Keenan, F. P., & Murakami, I.: 2009a, Astron. Astrophys. 506, 1501, **Q, QF**

[6] Aggarwal, K. M., Kato, T., Keenan, F. P., & Murakami, I.: 2011, Phys. Scr. 83, 015302, **Q, QF**

[7] Aggarwal, K. M. & Keenan, F. P.: 2008a, Astron. Astrophys. 489, 1377, **Q, QF**

[8] Aggarwal, K. M. & Keenan, F. P.: 2008b, Astron. Astrophys. 486 , 1053, **Q, QF**

[9] Aggarwal, K. M. & Keenan, F. P.: 2010, Phys. Scr. 82, 065302, **Q, QF**

[10] Aggarwal, K. M., Keenan, F. P., & Heeter, R. F.: 2009b, Phys. Scr. 80, 045301, **Q, QF**

[11] Aggarwal, K. M., Keenan, F. P., & Heeter, R. F.: 2010a, Phys. Scr. 82, 015006, **Q, QF**

[12] Aggarwal, K. M., Keenan, F. P., & Heeter, R. F.: 2010b, Phys. Scr. 81, 015303, **Q, QF**

[13] Akimov, A. V., Chebakov, K. Y., Tolstikhina, I. Y., Sokolov, A. V., Rodionov, P. B., Kanorsky, S. I., Sorokin, V. N., & Kolachevsky, N. N.: 2008, Quantum Electron. 38, 961, **HFS**

[14] Aldenius, M.: 2009, Phys. Scr. T134, 014008, **WL, CL**

[15] Aldenius, M., Lundberg, H., & Blackwell-Whitehead, R.: 2009a, Astron. Astrophys. 502, 989, **WL, CL, TE, EL**

[16] Alexander, S. A. & Coldwell, R. L.: 2008, Int. J. Quantum Chem. 108 , 2813, **Q, QF**

[17] Alonso-Medina, A.: 2010, Spectrochim. Acta, Part B 65, 158, **TE**

[18] Alonso-Medina, A., Colón, C., & Zanón, A.: 2009, Mon. Not. R. Astron. Soc. 395, 567, **Q**

[19] Ankush, B. K. & Deo, M. N.: 2010, Phys. Scr. 81, 055301, **IS, EL**

[20] J. M. P., Serrao, J. M. P. S.: 2008, J. Quant. Spectrosc. Radiat. Transfer 109, 453, **Q**

[21] Arnoult, O., Nez, F., Julien, L., & Biraben, F.: 2010, Eur. Phys. J. D 60, 243, **WL, EL**

[22] Ateş, Ş. & Çelik, G.: 2009, Acta Phys. Pol. A 116(2), 169, **Q**

[23] Ateş, Ş., Tekeli, G., Çelik, G., Akin, E., & Taşer, M.: 2009, Eur. Phys. J. D 54, 21, **Q**

[24] Bacławski, A.: 2008a, J. Quant. Spectrosc. Radiat. Transfer 109, 1986, **TE, R**

[25] Bacławski, A.: 2008b, J. Phys. B 41, 225701, **TE**

[26] Bacławski, A.: 2011, Eur. Phys. J. D 61, 327, **TE, R**

[27] Bacławski, A. & Musielok, J.: 2008a, J. Quant. Spectrosc. Radiat. Transfer 109, 2537, **TE, R**

[28] Bacławski, A. & Musielok, J.: 2008b, Spectrochim. Acta, Part B 63, 1315, **TE**

[29] Bacławski, A. & Musielok, J.: 2009, Acta Phys. Pol. A 116(2), 176, **CP**

[30] Bacławski, A. & Musielok, J.: 2011, J. Phys. B 44, 135002, **TE, R**

[31] Ballance, C. P. & Griffin, D. C.: 2008, J. Phys. B 41, 195205, **Q**

[32] Başar, G., Başar, G., & Kröger, S.: 2009, Opt. Commun. 282, 562, **HFS, EL**

[33] Başar, G., Başar, G., Kröger, S., & Guthöhrlein, G. H.: 2010, J. Phys. B 43, 074008, **HFS**

[34] Batteiger, V., Knünz, S., Herrmann, M., Saathoff, G., Schüssler, H. A., Bernhardt, B., Wilken, T., Holzwarth, R., Hänsch, T. W., & Udem, T.: 2009, Phys. Rev. A 80, 022503, **IS, WL**

[35] Bautista, M. A., Ballance, C., Gull, T. R., Hartman, H., Lodders, K., Martínez, M., & Meléndez, M.: 2009a, Mon. Not. R. Astron. Soc. 393, 1503, **QF**

[36] Bautista, M. A., Quinet, P., Palmeri, P., Badnell, N. R., Dunn, J., & Arav, N.: 2009b, Astron. Astrophys. 508, 1527, **Q**

[37] Behrle, A., Koschorreck, M., & Köhl, M.: 2011, Phys. Rev. A 83, 052507, **IS, HFS**

[38] Bergemann, M., Pickering, J. C., & Gehren, T.: 2010, Mon. Not. R. Astron. Soc. 401, 1334, **HFS**

[39] Bhatia, A. K. & Landi, E.: 2011a, At. Data Nucl. Data Tables 97, 50, **Q, QF**
[40] Bhatia, A. K. & Landi, E.: 2011b, At. Data Nucl. Data Tables 97, 189, **Q, QF**
[41] Biémont, E., Blagoev, K., Engström, L., Hartman, H., Lundberg, H., Malcheva, G., Nilsson, H., Whitehead, R. B., Palmeri, P., & Quinet, P.: 2011, Mon. Not. R. Astron. Soc. 414, 3350, **L, Q**
[42] Blackwell-Whitehead, R., Pavlenko, Y. V., Nave, G., Pickering, J. C., Jones, H. R. A., Lyubchik, Y., & Nilsson, H.: 2011, Astron. Astrophys. 525, p. A44, **TE**
[43] Brenner, G., López-Urrutia, J. R. C., Bernitt, S., Fischer, D., Ginzel, R., Kubiček, K., Mäckel, V., Mokler, P. H., Simon, M. C., & Ullrich, J.: 2009, Astrophys. J. 703, 68, **LF**
[44] Bridges, J. M. & Wiese, W. L.: 2008a, Phys. Rev. A 78, 062508, **TE**
[45] Bridges, J. M. & Wiese, W. L.: 2010, Phys. Rev. A 82, 024502, **TE**
[46] Brown, C. M., Kramida, A. E., Feldman, U., & Reader, J.: 2009a, Phys. Scr. 80, 065302, **EL, CL, WL**
[47] Brown, J. B., Brown, M. S., Cheng, S., Curtis, L. J., Ellis, D. G., Federman, S. R., & Irving, R. E.: 2011, Can. J. Phys. 89, 413, **Q, R**
[48] Brown, M. S., Federman, S. R., Irving, R. E., Cheng, S., & Curtis, L. J.: 2009b, Astrophys. J. 702, 880, **L**
[49] Butler, K. & Badnell, N. R.: 2008, Astron. Astrophys. 489, 1369, **Q**
[50] Castelli, F., Johansson, S., & Hubrig, S.: 2008, J. Phys.: Conf. Ser. 130, 012003, **CL, WL**
[51] Castelli, F. & Kurucz, R. L.: 2010a, Astron. Astrophys. 520, p. A57, **EL, CL, Q**
[52] Castelli, F., Kurucz, R. L., & Hubrig, S.: 2009a, Astron. Astrophys. 508, 401, **CL, WL, EL, Q**
[53] Çelik, G. & Ateş, Ş.: 2008a, Acta Phys. Pol. A 113(6), 1619, **Q**
[54] Çelik, G. & Ateş, Ş.: 2008b, Can. J. Phys. 86, 487, **Q**
[55] Chen, C.-Y., Wang, K., Huang, M., Wang, Y.-S., & Zou, Y.-M.: 2010, J. Quant. Spectrosc. Radiat. Transfer 111, 843, **Q, QF**
[56] Cheng, C., Gao, X., Qing, B., Zhang, X.-L., & Li, J.-M.: 2011, Chin. Phys. B 20, 033103, **Q**
[57] Chwalla, M., Benhelm, J., Kim, K., Kirchmair, G., Monz, T., Riebe, M., Schindler, P., Villar, A. S., Hänsel, W., Roos, C. F., Blatt, R., Abgrall, M., Santarelli, G., Rovera, G. D., & Laurent, P.: 2009, Phys. Rev. Lett. 102, 023002, **WL**
[58] Colón, C. & Alonso-Medina, A.: 2010, J. Phys. B 43, 165001, **Q**
[59] Curry, J. J.: 2009, J. Phys. D 42, 135205, **TE**
[60] Dammalapati, U., Norris, I., Burrows, C., & Riis, E.: 2011, Phys. Rev. A 83, 062513, **CL, WL**
[61] Deb, N. C. & Hibbert, A.: 2008a, J. Phys. B 41, 081007, **Q**
[62] Deb, N. C. & Hibbert, A.: 2008b, At. Data Nucl. Data Tables 94, 561, **Q**
[63] Deb, N. C. & Hibbert, A.: 2008c, J. Phys.: Conf. Ser. 130, 012006, **Q, QF**
[64] Deb, N. C. & Hibbert, A.: 2009a, J. Phys. B 42, 065003, **QF**
[65] Deb, N. C. & Hibbert, A.: 2009b, At. Data Nucl. Data Tables 95, 184, **Q**
[66] Deb, N. C. & Hibbert, A.: 2010a, Astrophys. J. 711, L104, **QF**
[67] Deb, N. C. & Hibbert, A.: 2010b, At. Data Nucl. Data Tables 96, 358, **Q**
[68] Deb, N. C., Hibbert, A., Felfli, Z., & Msezane, A. Z.: 2009, J. Phys. B 42, 015701, **QF**
[69] Destree, J. D., Williamson, K. E., & Snow, T. P.: 2010a, Astrophys. J. 712, L48, **CL, WL, TE**
[70] Dixit, G., Nataraj, H. S., Sahoo, B. K., Chaudhuri, R. K., & Majumder, S.: 2008, J. Phys. B 41, 025001, **Q, QF**
[71] Dixit, G., Sahoo, B. K., Chaudhuri, R. K., & Majumder, S.: 2009, J. Phys. B 42, 165702, **Q, QF**
[72] Djeniže, S., Srećković, A., & Bukvić, S.: 2010, Spectrochim. Acta, Part B 65, 61, **TE, R**
[73] Duan, B., Bari, M. A., Zhong, J. Y., Yan, J., Li, Y. M., & Zhang, J.: 2008, Astron. Astrophys. 488, 1155, **Q, QF**
[74] Dutta, N. N. & Majumder, S.: 2011, Astrophys. J. 737, 25, **Q, QF**
[75] Fan, Q., Liao, Z. J., Yang, J. H., & Zhang, J. P.: 2009, Phys. Scr. 79, 015301, **Q**

[76] Federman, S. R., Curtis, L. J., Brown, M., Cheng, S., Irving, R. E., Torok, S., & Schectman, R. M.: 2008, J. Phys.: Conf. Ser. 130, 012007, **TE, R, L**
[77] Feng, Y.-Y., Zhang, W., Kuang, B., Ning, L.-L., Jiang, Z.-K., & Dai, Z.-W.: 2011, J. Opt. Soc. Am. B 28, 543, **L**
[78] Feng, Y.-Y., Zhang, W., Ning, L.-L., Kuang, B., Sun, G.-J., & Dai, Z.-W.: 2010, J. Phys. B 43, 225001, **L**
[79] Fischer, C. F. & Ralchenko, Y.: 2008, Int. J. Mass Spectrom. 271, 85, **Q**
[80] Fischer, C. F., Rubin, R. H., & Rodríguez, M.: 2008, Mon. Not. R. Astron. Soc. 391 , 1828, **QF**
[81] Fischer, C. F., Tachiev, G., Rubin, R. H., & Rodríguez, M.: 2009, Astrophys. J. 703, 500, **Q, QF**
[82] Fivet, V., Biémont, E., Engström, L., Lundberg, H., Nilsson, H., Palmeri, P., & Quinet, P.: 2008, J. Phys. B 41, 015702, **L, Q**
[83] Fivet, V., Quinet, P., Palmeri, P., Biémont, E., Asplund, M., Grevesse, N., Sauval, A. J., Engström, L., Lundberg, H., Hartman, H., & Nilsson, H.: 2009, Mon. Not. R. Astron. Soc. 396, 2124, **L, Q**
[84] Fuhr, J. R. & Wiese, W. L.: 2010, J. Phys. Chem. Ref. Data 39, 013101, **CP**
[85] Fuhr, J. R. & Wiese, W. L.: 2011, CRC Handbook of Chemistry and Physics, 92nd Edition, (Ed. D. R. Lide) CRC Press, Boca Raton, FL,
[86] Furmann, B., Elantkowska, M., Stefańska, D., Ruczkowski, J., & Dembczyński, J.: 2008a, J. Phys. B 41, 235002, **HFS**
[87] Furmann, B., Ruczkowski, J., Stefańska, D., Elantkowska, M., & Dembczyński, J.: 2008b, J. Phys. B 41, 215004, **HFS**
[88] Furmann, B., Stefańska, D., & Dembczyński, J.: 2010, J. Phys. B 43, 015001, **EL,CL, WL, HFS**
[89] Gamper, B., Uddin, Z., Jahangir, M., Allard, O., Knöckel, H., Tiemann, E., & Windholz, L.: 2011, J. Phys. B 44, 045003, **CL, WL, EL,HFS**
[90] García, J., Kallman, T. R., Witthoeft, M., Behar, E., Mendoza, C., Palmeri, P., Quinet, P., Bautista, M. A., & Klapisch, M.: 2009, Astrophys. J., Suppl. Ser. 185, 477, **Q**
[91] Gattinger, R. L., Lloyd, N. D., Bourassa, A. E., Degenstein, D. A., McDade, I. C., & Llewellyn, E. J.: 2009, Can. J. Phys. 87, 1133, **TE-R-F**
[92] Gerritsma, R., Kirchmair, G., Zähringer, F., Benhelm, J., Blatt, R., & Roos, C. F.: 2008, Eur. Phys. J. D 50, 13, **TE**
[93] Gillaspy, J. D., Chantler, C. T., Paterson, D., Hudson, L. T., Serpa, F. G., & Takács, E.: 2010, J. Phys. B 43, 074021, **CL, EL,WL**
[94] Gillaspy, J. D., Lin, T., Tedesco, L., Tan, J. N., Pomeroy, J. M., Laming, J. M., Brickhouse, N., Chen, G.-X., & Silver, E.: 2011, Astrophys. J. 728, 132, **WL**
[95] Głowacki, P., Uddin, Z., Guthöhrlein, G. H., Windholz, L., & Dembczyński, J.: 2009, Phys. Scr. 80, 025301, **CL, WL, EL, HFS**
[96] Gu, M. F., Beiersdorfer, P., & Lepson, J. K.: 2011, Astrophys. J. 732, 91, **CL, WL**
[97] Guan, F., Dai, C.-J., & Zhao, H.-Y.: 2008, Chin. Phys. B 17, 3655, **EL, CL, WL**
[98] Gupta, G. P. & Msezane, A. Z.: 2008, Eur. Phys. J. D 49, 157, **Q**
[99] Gupta, G. P. & Msezane, A. Z.: 2010, Phys. Scr. 81, 045302, **Q**
[100] Gurell, J., Hartman, H., Blackwell-Whitehead, R., Nilsson, H., Bäckström, E., Norlin, L. O., Royen, P., & Mannervik, S.: 2009a, Astron. Astrophys. 508, 525, **L, F**
[101] Gurell, J., Nilsson, H., Engström, L., Lundberg, H., Blackwell-Whitehead, R., Nielsen, K. E., & Mannervik, S.: 2010, Astron. Astrophys. 511, p. A68, **L, TE**
[102] Gurell, J., Wahlgren, G. M., Nave, G., & Wyart, J.-F.: 2009b, Phys. Scr. 79, 035306, **CL, WL, HFS, EL**
[103] Hamdi, R., Nessib, N. B., Milovanović, N., Popović, L. Č., Dimitrijević, M. S., & Sahal-Bréchot, S.: 2008, Mon. Not. R. Astron. Soc. 387, 871, **Q**
[104] Hao, L.-H. & Jiang, G.: 2011, Phys. Rev. A 83, 012511, **Q**
[105] Hartman, H., Gurell, J., Lundin, P., Schef, P., Hibbert, A., Lundberg, H., Mannervik, S., Norlin, L.-O., & Royen, P.: 2008, Astron. Astrophys. 480, 575, **LF, QF**
[106] Hartman, H., Nilsson, H., Engström, L., Lundberg, H., Palmeri, P., Quinet, P., & Biémont, E.: 2010, Phys. Rev. A 82, 052512, **L, Q**

[107] Hartog, E. A. D., Bilty, K. A., & Lawler, J. E.: 2011, J. Phys. B 44, 055001, **L**
[108] Hartog, E. A. D., Buettner, K. P., & Lawler, J. E.: 2009, J. Phys. B 42, 085006, **L**
[109] Hartog, E. A. D., Chisholm, J. P., & Lawler, J. E.: 2010, J. Phys. B 43, 155004, **L**
[110] Hartog, E. A. D. & Lawler, J. E.: 2008, J. Phys. B 41, 045701, **L**
[111] He, M., Therkildsen, K. T., Jensen, B. B., Brusch, A., Thomsen, J. W., & Porsev, S. G.: 2009, Phys. Rev. A 80, 024501, **IS, HFS**
[112] Herrmann, Batteiger, M. V., Knünz S., Saathoff G., Udem Th., and Hänsch T. W., 2009, Phys. Rev. Lett. 102, 013006 **WL**
[113] Hibbert, A. & Deb, N. C.: 2008, J. Phys.: Conf. Ser. 130, 012012, **Q**
[114] Hou, H.-J., Jiang, G., Hu, F., & Hao, L.-H.: 2009, At. Data Nucl. Data Tables 95, 125, **Q**
[115] Hu, F., Jiang, G., Hong, W., & Hao, L. H.: 2008, Eur. Phys. J. D 49, 293, **Q**
[116] Hu, F., Jiang, G., Yang, J. M., Zhang, J. Y., & Zhao, X. F.: 2011, Acta Phys. Pol. A 120(3), 429, **Q**
[117] Hu, M.-H. & Wang, Z.-W.: 2009, Chin. Phys. B 18, 2244, **Q**
[118] Hudson, C. E.: 2009, Astron. Astrophys. 493, 697, **Q**
[119] Ishikawa, Y., Encarnación, J. M. L., & Träbert, E.: 2009, Phys. Scr. 79, 025301, **Q**
[120] Iskrenova-Tchoukova, E. & Safronova, M. S.: 2008, Phys. Rev. A 78, 012508, **Q, QF**
[121] Ivanov, T. I., Salumbides, E. J., Vieitez, M. O., Cacciani, P. C., de Lange, C. A., & Ubachs, W.: 2008, Mon. Not. R. Astron. Soc. 389, L4, **WL, CL**
[122] Jensen, B. B., Ming, H., Westergaard, P. G., Gunnarsson, K., Madsen, M. H., Brusch, A., Hald, J., & Thomsen, J. W.: 2011, Phys. Rev. Lett. 107, 113001, **LF**
[123] Jin, W.-G., Nakai, H., Kawamura, M., & Minowa, T.: 2009a, J. Phys. Soc. Jpn. 78, 015001, **HFS, IS**
[124] Jin, W.-G., Nemoto, Y., & Minowa, T.: 2009b, J. Phys. Soc. Jpn. 78, 094301, **IS, HFS**
[125] Jin, W.-G., Nemoto, Y., Nakai, H., Kawamura, M., & Minowa, T.: 2008, J. Phys. Soc. Jpn. 77, 124301, **IS**
[126] Johansson, S.: 2009, Phys. Scr. T134, 014013, **EL, CL**
[127] Jönsson, P., Li, J.-G., Gaigalas, G., & Dong, C.-Z.: 2010, At. Data Nucl. Data Tables 96, 271, **Q**
[128] Karaçoban, B. & Özdemir, L.: 2008a, J. Quant. Spectrosc. Radiat. Transfer 109, 1968, **Q**
[129] Karaçoban, B. & Özdemir, L.: 2008b, Acta Phys. Pol. A 113(6), 1609, **Q**
[130] Karaçoban, B. & Özdemir, L.: 2011, J. Kor. Phys. Soc. 58, 417, **Q**
[131] Karmakar, S. & Das, M. B.: 2010, Eur. Phys. J. D 59, 361, **L**
[132] Karpuškienė, R. & Bogdanovich, P.: 2009, At. Data Nucl. Data Tables 95, 533, **Q**
[133] Kedzierski, D., Kusz, J., & Muzolf, J.: 2010, Spectrochim. Acta, Part B 65, 248, **TE**
[134] Keenan, F. P., Jess, D. B., Aggarwal, K. M., Thomas, R. J., Brosius, J. W., & Davila, J. M.: 2008a, Mon. Not. R. Astron. Soc. 389, 939, **CL, Q, QF**
[135] Keenan, F. P., Milligan, R. O., Jess, D. B., Aggarwal, K. M., Mathioudakis, M., Thomas, R. J., Brosius, J. W., & Davila, J. M.: 2010, Mon. Not. R. Astron. Soc. 404, 1617, **CL, WL**
[136] Kelleher, D. E. & Podobedova, L. I.: 2008a, J. Phys. Chem. Ref. Data 37, 709, **CP**
[137] Kelleher, D. E. & Podobedova, L. I.: 2008b, J. Phys. Chem. Ref. Data 37, 1285, **CP**
[138] Kingston, A. E. & Hibbert, A.: 2008, J. Phys. B 41, 155001, **Q**
[139] Kingston, A. E. & Hibbert, A.: 2009, J. Phys. B 42, 185004, **Q**
[140] Kingston, A. E. & Hibbert, A.: 2010, J. Phys. B 43, 165003, **Q**
[141] Kisielius, R., Storey, P. J., Ferland, G. J., & Keenan, F. P.: 2009, Mon. Not. R. Astron. Soc. 397, 903, **Q**
[142] Kotochigova, S., Linnik, M., Kirby, K. P., & Brickhouse, N. S.: 2010, Astrophys. J., Suppl. Ser. 186, 85, **Q**
[143] Kramida, A., Ryabtsev, A. N., & Ekberg, J. O., Kink, I., Mannervik, S., Martinson, I.: 2008, Phys. Scr. 78, 025301 **CP**
[144] Kramida, A., Ryabtsev, A. N., Ekberg, J. O., Kink, I., Mannervik, S., Martinson, I.: 2008 Phys. Scr. 78, 025302 **CP**
[145] Kramida, A.: 2011a, J. Res. Natl. Inst. Stand. Technol. 116(2), 599, **EL, CL, WL**

https://doi.org/10.1017/S1743921312003080 Published online by Cambridge University Press

[146] Kramida, A. E.: 2010a, At. Data Nucl. Data Tables 96, 586, **E, WL, CL, HFS, QF**
[147] Kramida, A. E.: 2010b, J. Phys. B 43, 205001, **EL,WL, CL**
[148] Krins, S., Oppel, S., Huet, N., von Zanthier, J., & Bastin, T.: 2009, Phys. Rev. A 80, 062508, **IS, HFS**
[149] Kröger, S., Er, A., Öztürk, I. K., Başar, G., Jarmola, A., Ferber, R., Tamanis, M., & Začs, L.: 2010, Astron. Astrophys. 516, p. A70, **HFS**
[150] Kułaga-Egger, D. & Migdałek, J.: 2009, J. Phys. B 42, 185002, **Q**
[151] Kumar, P. V. K. & Suryanarayana, M. V.: 2011, J. Phys. B 44, 055003, **IS, HFS, WL**
[152] Landi, E.: 2011, At. Data Nucl. Data Tables 97, 587, **Q**
[153] Landi, E. & Bhatia, A. K.: 2008, At. Data Nucl. Data Tables 94, 1, **Q, QF**
[154] Landi, E. & Bhatia, A. K.: 2009a, At. Data Nucl. Data Tables 95, 155, **Q, QF**
[155] Landi, E. & Bhatia, A. K.: 2009b, At. Data Nucl. Data Tables 95, 547, **Q, QF**
[156] Landi, E. & Bhatia, A. K.: 2010, At. Data Nucl. Data Tables 96, 52, **Q, QF**
[157] Landi, E. & Young, P. R.: 2009a, Astrophys. J. 706, 1, **DB**
[158] Landi, E. & Young, P. R.: 2009b, Astrophys. J. 707, 1191, **CL, WL, EL,Q**
[159] Landi, E. & Young, P. R.: 2010a, Astrophys. J. 713, 205, **CL, WL, EL,Q**
[160] Lawler, J. E., Bilty, K. A., & Hartog, E. A. D.: 2011, J. Phys. B 44, 095001, **TE**
[161] Lawler, J. E., Chisholm, J., Nitz, D. E., Wood, M. P., Sobeck, J., & Hartog, E. A. D.: 2010a, J. Phys. B 43, 085701, **TE**
[162] Lawler, J. E., Sneden, C., Cowan, J. J., Ivans, I. I., & Hartog, E. A. D.: 2009a, Astrophys. J., Suppl. Ser. 182, 51, **L, TE**
[163] Lawler, J. E., Sneden, C., Cowan, J. J., Wyart, J.-F., Ivans, I. I., Sobeck, J. S., Stockett, M. H., & Hartog, E. A. D.: 2008b, Astrophys. J., Suppl. Ser. 178, 71, **TE**
[164] Lawler, J. E., Wyart, J.-F., & Hartog, E. A. D.: 2010b, J. Phys. B 43, 235001, **TE**
[165] Lee, S. A. and Jr., W. M. F.: 2010, Phys. Rev. A 82, 042515, **IS, HFS**
[166] Leefer, N., Cingöz, A., & Budker, D.: 2009, Opt. Lett. 34, 2548, **IS, HFS, EL**
[167] Li, H.-L., Li, P., Cheng, Z., & Ma, H.-R.: 2008, Commun. Theor. Phys. 49, 217, **Q**
[168] Liang, G. Y. & Badnell, N. R.: 2010, Astron. Astrophys. 518, p. A64, **Q**
[169] Liang, G. Y., Badnell, N. R., López-Urrutia, J. R. C., Baumann, T. M., Zanna, G. D., Storey, P. J., Tawara, H., & Ullrich, J.: 2010, Astrophys. J., Suppl. Ser. 190, 322, **Q**
[170] Liang, G. Y., Baumann, T. M., López-Urrutia, J. R. C., Epp, S. W., Tawara, H., Gonchar, A., Mokler, P. H., Zhao, G., & Ullrich, J.: 2009a, Astrophys. J. 696, 2275, **CL**
[171] Liang, G. Y., Whiteford, A. D., & Badnell, N. R.: 2009b, Astron. Astrophys. 499, 943, **Q**
[172] Liang, G. Y., Whiteford, A. D., & Badnell, N. R.: 2009c, Astron. Astrophys. 500, 1263, **Q**
[173] Liang, G. Y. & Zhao, G.: 2010, Mon. Not. R. Astron. Soc. 405 , 1987, **WL, CL**
[174] Liang, L., Jiang, W. X., Zhou, C., & Zhang, L.: 2008a, Opt. Commun. 281, 2107, **Q**
[175] Liang, L. & Zhou, C.: 2008, J. Quant. Spectrosc. Radiat. Transfer 109 , 1995, **Q**
[176] Liang, L., Zhou, C., & Zhang, L.: 2008c, Chin. Opt. Lett. 6, 804, **Q**
[177] López-Urrutia, J. R. C. & Beiersdorfer, P.: 2010, Astrophys. J. 721, 576, **EF, LF**
[178] Louzon, E., Feigel, A., Frank, Y., Raicher, E., Klapisch, M., Mandelbaum, P., Levy, I., Hurvitz, G., Ehrlich, Y., Frankel, M., Maman, S., & Henis, Z.: 2011, High En. Dens. Phys. 7, 124, **Q**
[179] Luna, F. R. T., Mania, A. J., & Hernandes, J. A.: 2009, J. Appl. Spectrosc. 76, 447, **Q**
[180] Lundberg, H., Engström, L., Hartman, H., Nilsson, H., Palmeri, P., Quinet, P., & Biémont, E.: 2010, J. Phys. B 43, 085004, **L, TE, Q**
[181] Lundin, P., Gurell, J., Mannervik, S., Royen, P., Norlin, L.-O., Hartman, H., & Hibbert, A.: 2008, Phys. Scr. 78, 015301, **LF, QF**
[182] Malcheva, G., Mayo, R., Ortiz, M., Ruiz, P., Engström, L., Lundberg, H., Nilsson, H., Quinet, P., Biémont, E., & Blagoev, K.: 2009a, Mon. Not. R. Astron. Soc. 395, 1523, **L, Q**
[183] Malcheva, G., Nilsson, H., Engström, L., Lundberg, H., Biémont, E., Palmeri, P., Quinet, P., & Blagoev, K.: 2011, Mon. Not. R. Astron. Soc. 412 , 1823, **L, Q**
[184] Malcheva, G., Yoca, S. E., Mayo, R., Ortiz, M., Engström, L., Lundberg, H., Nilsson, H., Biémont, E., & Blagoev, K.: 2009b, Mon. Not. R. Astron. Soc. 396, 2289, **L, Q**

[185] Mandal, S., Dixit, G., Sahoo, B. K., Chaudhuri, R. K., & Majumder, S.: 2008, J. Phys. B 41, 055701, **Q, QF**
[186] Mania, A. J., Luna, F. R. T., Borges, F. O., & Cavalcanti, G. H.: 2009a, J. Quant. Spectrosc. Radiat. Transfer 110, 2162, **EL, CL, WL, Q**
[187] Mania, A. J., Luna, F. R. T., & Hernandes, J. A.: 2009c, J. Quant. Spectrosc. Radiat. Transfer 110, 82, **Q**
[188] Mania, A. J., Luna, F. R. T., & Mania, E.: 2011, J. Appl. Spectrosc. 77, 758, **Q**
[189] Mashonkina, L., Ryabchikova, T., Ryabtsev, A., & Kildiyarova, R.: 2009, Astron. Astrophys. 495, 297, **Q**
[190] Mattolat, C., Gottwald, T., Raeder, S., Rothe, S., Schwellnus, F., Wendt, K., Thörle-Pospiech, P., & Trautmann, N.: 2010, Phys. Rev. A 81, 052513, **EL**
[191] Meléndez, J. & Barbuy, B.: 2009, Astron. Astrophys. 497, 611, **TE, Q**
[192] Morton, D. C. & Drake, G. W. F.: 2011, Phys. Rev. A 83, 042503, **Q, QF**
[193] Nahar, S. N.: 2008, J. Quant. Spectrosc. Radiat. Transfer 109 , 2731, **Q**
[194] Nahar, S. N.: 2009, At. Data Nucl. Data Tables 95, 577, **Q, QF**
[195] Nahar, S. N.: 2010a, At. Data Nucl. Data Tables 96, 26, **Q, QF**
[196] Nahar, S. N.: 2010b, At. Data Nucl. Data Tables 96, 863, **Q**
[197] Nahar, S. N.: 2011, At. Data Nucl. Data Tables 97, 403, **Q, QF**
[198] Nahar, S. N., Eissner, W., Sur, C., & Pradhan, A. K.: 2009, Phys. Scr. 79, 035401, **Q, QF**
[199] Nakhate, S. G., Mukund, S., & Bhattacharyya, S.: 2010, J. Quant. Spectrosc. Radiat. Transfer 111, 394, **L**
[200] Nave, G. & Sansonetti, C. J.: 2011, J. Opt. Soc. Am. B 28, 737, **WL, EL**
[201] Nilsson, H., Engström, L., Lundberg, H., Palmeri, P., Fivet, V., Quinet, P., & Biémont, E.: 2008, Eur. Phys. J. D 49, 13, **L, Q**
[202] Nilsson, H., Hartman, H., Engström, L., Lundberg, H., Sneden, C., Fivet, V., Palmeri, P., Quinet, P., & Biémont, E.: 2010, Astron. Astrophys. 511, p. A16, **L, TE, Q, T**
[203] Nilsson, H. & Ivarsson, S.: 2008a, Astron. Astrophys. 492, 609, **HFS, TE**
[204] Nouri, Z., Rosner, S. D., Li, R., Scholl, T. J., & Holt, R. A.: 2010, Phys. Scr. 81, 065301, **IS, HFS**
[205] Oliver, P. & Hibbert, A.: 2008a, J. Phys. B 41, 165003, **Q**
[206] Oliver, P. & Hibbert, A.: 2008b, J. Phys.: Conf. Ser. 130, 012016, **Q**
[207] Oliver, P. & Hibbert, A.: 2010, J. Phys. B 43, 074013, **Q**
[208] Özdemir, L., Ürer, G., & Karaçoban, B.: 2008, J. Quant. Spectrosc. Radiat. Transfer 109 , 1886, **Q**
[209] Palmeri, P., Quinet, P., Biémont, E., Gurell, J., Lundin, P., Norlin, L.-O., Royen, P., Blagoev, K., & Mannervik, S.: 2008, J. Phys. B 41, 125703, **LF, QF**
[210] Palmeri, P., Quinet, P., Fivet, V., Biémont, E., Cowley, C. R., Engström, L., Lundberg, H., Hartman, H., & Nilsson, H.: 2009, J. Phys. B 42, 165005, **L, Q**
[211] Palmeri, P., Quinet, P., Fivet, V., Biémont, E., Nilsson, H., Engström, L., & Lundberg, H.: 2008, Phys. Scr. 78, 015304, **L, Q**
[212] Palmeri, P., Quinet, P., Mendoza, C., Bautista, M. A., García, J., Witthoeft, M. C., & Kallman, T. R.: 2011, Astron. Astrophys. 525, p. A59, **Q**
[213] Parthey, C. G., Matveev, A., Alnis, J., Pohl, R., Udem, T., Jentschura, U. D., Kolachevsky, N., & Hänsch, T. W.: 2010, Phys. Rev. Lett. 104, p. 233001, **IS, EL, WL**
[214] Podobedova, L. I., Kelleher, D. E., & Wiese, W. L.: 2009, J. Phys. Chem. Ref. Data 38, 171, **CP**
[215] Quinet, P., Biémont, E., Palmeri, P., Engström, L., Hartman, H., Lundberg, H., & Nilsson, H.: 2011, J. Electron Spectrosc. Relat. Phenom. 184, 174, **Q**
[216] Quinet, P., Fivet, V., Palmeri, P., Biémont, E., Engström, L., Lundberg, H., & Nilsson, H.: 2009, Astron. Astrophys. 493, 711, **Q, L**
[217] Quinet, P., Palmeri, P., Fivet, V., Biémont, E., Nilsson, H., Engström, L., & Lundberg, H.: 2008, Phys. Rev. A 77, 022501, **L, Q**
[218] Ramsbottom, C. A.: 2009, At. Data Nucl. Data Tables 95, 910, **Q**
[219] Redman, S. L., Lawler, J. E., Nave, G., Ramsey, L. W., & Mahadevan, S.: 2011, Astrophys. J., Suppl. Ser. 195, 24, **CL, WL**

[220] Rehse, S. J. & Ryder, C. A.: 2009, Spectrochim. Acta, Part B 64, 974, **TE**
[221] Safronova, M. S. & Safronova, U. I.: 2011a, Phys. Rev. A 83, 052508, **Q, QF**
[222] Safronova, U. I. & Mancini, R.: 2009, At. Data Nucl. Data Tables 95, 54, **Q**
[223] Safronova, U. I. & Safronova, M. S.: 2008, Phys. Rev. A 78, 052504, **Q**
[224] Safronova, U. I. & Safronova, M. S.: 2011b, Can. J. Phys. 89, 465, **Q, QF**
[225] Sahoo, B. K. & Das, B. P.: 2011, Phys. Rev. A 84, 012501, **Q, QF**
[226] Sahoo, B. K., Das, B. P., & Mukherjee, D.: 2009, Phys. Rev. A 79, 052511, **Q**
[227] Sahoo, B. K., Nataraj, H. S., Das, B. P., Chaudhuri, R. K., & Mukherjee, D.: 2008, J. Phys. B 41, 055702, **QF**
[228] Saloman, E. B.: 2010, J. Phys. Chem. Ref. Data 39, 033101, **CP**
[229] Salumbides, E. J. , Maslinskas, V., Dildar, U. M., Wolf, A. L., van Duijn, E.-J., Eikema, K. S. E., Ubachs, W.: 2011 Phys. Rev. A 83, 012502 **WL**
[230] Sansonetti, C. J., Simien, C. E., Gillaspy, J. D., Tan, J. N., Brewer, S. M., Brown, R. C., Wu, S.-J., & Porto, J. V.: 2011, Phys. Rev. Lett. 107, 023001, **WL, HFS, IS, EL**
[231 Sansonetti, C. J. & Veza, D.: 2010, J. Phys. B 43, 205003, **WL, IS, HFS**
[232] Sansonetti, J. E.: 2008a, J. Phys. Chem. Ref. Data 37, 7, **CP**
[233] Sansonetti, J. E.: 2008b, J. Phys. Chem. Ref. Data 37, 1659, **CP**
[234] Sansonetti, J. E.: 2009a, J. Phys. Chem. Ref. Data 38, 761, **CP**
[235] Sansonetti, J. E.: 2009b, J. Phys. Chem. Ref. Data 38, 761, **CP**
[236 Sansonetti, J. E. & Nave, G.: 2010a, J. Phys. Chem. Ref. Data 39, 033103, **CP**
[237] Santos, J. P., Costa, A. M., Madruga, C., Parente, F., & Indelicato, P.: 2011, Eur. Phys. J. D 63, 89, **Q**
[238] Shah, M. L., Pulhani, A. K., Gupta, G. P., & Suri, B. M.: 2010, J. Opt. Soc. Am. B 27, 423, **L, TE**
[239] Shen, X.-Z., Yuan, P., & Liu, J.: 2010, Chin. Phys. B 19, 053101, **Q, QF**
[240] Shestov, S. V., Bozhenkov, S. A., Zhitnik, I. A., Kuzin, S. V., Urnov, A. M., Beigman, I. L., Goryaev, F. F., & Tolstikhina, I. Y.: 2008, Astron. Lett. 34, 33, **CL, WL**
[241] Singh, J., Jha, A. K. S., & Mohan, M.: 2010a, J. Phys. B 43, 115005, **Q**
[242] Singh, J., Jha, A. K. S., Verma, N., & Mohan, M.: 2010b, At. Data Nucl. Data Tables 96, 759, **Q**
[243] Smillie, D. G., Pickering, J. C., & Smith, P. L.: 2008, Mon. Not. R. Astron. Soc. 390, 733, **WL, CL**
[244] Steenstrup, M. P., Brusch, A., Jensen, B. B., Hald, J., & Thomsen, J. W.: 2010, Phys. Rev. A 82, 054501, **IS**
[245] Storey, P. J. & Zeippen, C. J.: 2010, Astron. Astrophys. 511, p. A78, **Q**
[246] Tauheed, A., Joshi, Y. N., & Steinitz, M.: 2009, Can. J. Phys. 87, 1255, **WL, CL, EL**
[247] Tayal, S. S.: 2008a, Astron. Astrophys. 486, 629, **Q**
[248] Tayal, S. S.: 2008b, Astrophys. J., Suppl. Ser. 178, 359, **Q**
[249] Tayal, S. S.: 2009a, Phys. Scr. 79, 015303, **Q**
[250] Tayal, S. S.: 2009b, Phys. Rev. A 80, 032512, **QF**
[251] Tayal, S. S.: 2011a, Phys. Rev. A 83, 012515, **Q, QF**
[252] Tayal, S. S.: 2011b, At. Data Nucl. Data Tables 97, 481, **Q**
[253] Tayal, S. S. & Zatsarinny, O.: 2010a, Astrophys. J., Suppl. Ser. 188, 32, **Q, QF**
[254] Tayal, S. S. & Zatsarinny, O.: 2010b, Astron. Astrophys. 510, p. A79, **Q**
[255] Tayal, V., Gupta, G. P., & Tripathi, A. N.: 2009, Indian J. Phys. 83, 1271, **Q**
[256] Therkildsen, K. T., Jensen, B. B., Ryder, C. P., Malossi, N., & Thomsen, J. W.: 2009, Phys. Rev. A 79, 034501, **TE**
[257] Thorne, A. P., Pickering, J. C., & Semeniuk, J.: 2011, Astrophys. J., Suppl. Ser. 192, 11, **CL, WL, EL**
[258] Träbert, E., Hoffman, J., Reinhardt, S., Wolf, A., & Zanna, G. D.: 2008, J. Phys.: Conf. Ser. 130, 012018, **LF**
[259] Träbert, E., Hoffmann, J., Krantz, C., Wolf, A., Ishikawa, Y., & Santana, J. A.: 2009, J. Phys. B 42, 025002, **LF**
[260] Träbert, E., Ishikawa, Y., Santana, J. A., & Zanna, G. D.: 2011, Can. J. Phys. 89, 403, **EL, CL, TE**

[261 Uddin, Z. and Windholz, L.: 2009, Chin. J. Phys. 47(4), 454, **HFS, CL, WL**
[262] Wallace, L. & Hinkle, K.: 2009, Astrophys. J. 700, 720, **CL, WL, EL**
[263] Wang, Z.-W., Li, X.-R., Hu, M.-H., Liu, Y., & Wang, Y.-N.: 2008a, Chin. Phys. Lett. 25, 2004, **Q**
[264] Wang, Z.-W., Liu, Y., Hu, M.-H., Li, X.-R., & Wang, Y.-N.: 2008b, Chin. Phys. B 17, 2909, **Q**
[265] Wang, Z.-W., Wang, Y.-N., Hu, M.-H., Li, X.-R., & Liu, Y.: 2008c, Sci. China, Ser. G 51, 1633, **Q**
[266] Wasowicz, T. J.: 2009, Eur. Phys. J. D 53, 263, **IS**
[267] Wasowicz, T. J., Werbowy, S., Kwela, J., & Drozdowski, R.: 2010, J. Opt. Soc. Am. B 27, 2628, **IS**
[268] Wei, H. G., Shi, J. R., Zhao, G., & Liang, Z. T.: 2010, Astron. Astrophys. 522, p. A103, **Q**
[269] Wiese, W. L. & Fuhr, J. R.: 2009, J. Phys. Chem. Ref. Data 38, 565, **CP**
[270] Witthoeft, M. C. & Badnell, N. R.: 2008, Astron. Astrophys. 481, 543, **QF**
[271] Wolf, A. L., van den Berg, S. A., Gohle, C., Salumbides, E. J., Ubachs, W., & Eikema, K. S. E.: 2008, Phys. Rev. A 78, 032511, **WL, EL**
[272] Wyart, J.-F. & Lawler, J. E.: 2009a, Phys. Scr. 79, 045301, **EL, CL, W, Q**
[273] Wyart, J.-F., Tchang-Brillet, W.-U. L., Churilov, S. S., & Ryabtsev, A. N.: 2008, Astron. Astrophys. 483, 339, **Q**
[274] Xie, J., Dai, C.-J., & Li, M.: 2011, J. Phys. B 44, 015002, **EL**
[275] Xu, J.-X., Feng, Y.-Y., Sun, G.-J., & Dai, Z.-W.: 2009, Chin. Phys. B 18, 3828, **L**
[276] y. Zhang, T. & w. Zheng, N.: 2009, Chin. J. Chem. Phys. 22, 246, **Q**
[277] Yang, J.-H., Li, P., Zhang, J.-P., & Li, H.-L.: 2008, Commun. Theor. Phys. 50, 468, **Q**
[278] Yang, Z. H., Du, S. B., Chang, H. W., Zhang, Y. P., Zhang, B. L., Xu, Q. M., Yu, D. Y., & Cai, X. H.: 2010, J. Quant. Spectrosc. Radiat. Transfer 111 , 2007, **WL, CL**
[279] Yang, Z. H., Du, S. B., Zeng, X. T., Chang, H. W., Zhang, B. L., Wang, W., Yu, D. Y., & Cai, X. H.: 2009, Astron. J. 137, 4020, **CL, WL**
[280] Yildiz, M., Çelik, G., & Kiliç, H. Ş.: 2009, Acta Phys. Pol. A 115, 641, **Q**
[281] Yoca, S. E., Biémont, E., Delahaye, F., Quinet, P., & Zeippen, C. J.: 2008, Phys. Scr. 78, 025303, **Q**
[282] Young, P. R.: 2009, Astrophys. J. 691, L77, **CL, WL, EL**
[283] Young, P. R., Feldman, U., & Lobel, A.: 2011, Astrophys. J., Suppl. Ser. 196, 23, **CL, WL, EL**
[284] Young, P. R. & Landi, E.: 2009, Astrophys. J. 707, 173, **CL, WL, EL**
[285] Yüce, K., Castelli, F., & Hubrig, S.: 2011a, Astron. Astrophys. 528, p. A37, **CL, WL, EL, TE**
[286] Zanna, G. D.: 2009a, Astron. Astrophys. 508, 501, **CL, WL, EL, Q**
[287] Zanna, G. D.: 2009c, Astron. Astrophys. 508, 513, **CL, WL, EL, Q**
[288] Zanna, G. D.: 2010a, Astron. Astrophys. 514, p. A41, **EL, CL, WL, Q, QF**
[289] Zanna, G. D. & Ishikawa, Y.: 2009, Astron. Astrophys. 508, 1517, **EL, CL, WL**
[290] Zanna, G. D., Rozum, I., & Badnell, N. R.: 2008, Astron. Astrophys. 487, 1203, **Q, QF**
[291] Zanna, G. D., Storey, P. J., & Mason, H. E.: 2010a, Astron. Astrophys. 514, p. A40, **EL, CL, WL, Q**
[292] Zhang, T.-Y. & Zheng, N.-W.: 2009, Acta Phys. Pol. A 116(2), 141, **Q**
[293] Zhang, T.-Y., Zheng, N.-W., & Ma, D.-X.: 2009, Int. J. Quantum Chem. 109, 145, **Q**
[294] Zhang, W., Du, S., Feng, Y.-Y., Jiang, L.-Y., Jiang, Z.-K., & Dai, Z.-W.: 2011a, Mon. Not. R. Astron. Soc. 413 , 1803, **L**
[295] Zhang, W., Feng, Y.-Y., & Dai, Z.-W.: 2010a, J. Opt. Soc. Am. B 27, 2255, **L**
[296] Zhang, W., Feng, Y.-Y., Sun, G.-J., & Dai, Z.-W.: 2010b, J. Phys. B 43, 235005, **L**
[297] Zhang, W., Feng, Y.-Y., Xu, J.-X., Palmeri, P., Quinet, P., Biémont, E., & Dai, Z.-W.: 2010c, J. Phys. B 43, 205005, **L**

[298] Zhang, W., Palmeri, P., Quinet, P., Biémont, E., Du, S., & Dai, Z.-W.: 2010d, Phys. Rev. A 82, 042507, **EL, CL, L**

[299] Zhang, Y., Xu, J.-X., Zhang, W., You, S., Ma, Z.-G., Han, L.-L., Li, P.-F., Sun, G.-J., Jiang, Z.-K., Yoca, S. E., Quinet, P., Biémont, E., & Dai, Z.-W.: 2008a, Phys. Rev. A 78, 022505, **L**