Transactions IAU, Volume XXVIIA
Reports on Astronomy 2006–2009
Karel A. van der Hucht, ed.

doi:10.1017/S1743921308025957

DIVISION XII / COMMISSION 14 / WORKING GROUP COLLISION PROCESSES

CO-CHAIRS **Gillian Peach, Milan S. Dimitrijevic, Phillip C. Stancil**

TRIENNIAL REPORT 2006 - 2009

1. Introduction

Research in atomic and molecular collision processes and spectral line broadening has been very active since our last report (Schultz & Stancil 2007, Allard & Peach 2007). Given the large volume of the published literature and the limited space available, we have attempted to identify work most relevant to astrophysics. Since our report is not comprehensive, additional publications can be found in the databases at the web addresses listed in the final section. Elastic and inelastic collisions among electrons, atoms, ions, and molecules are included and reactive processes are also considered, but except for charge exchange, they receive only sparse coverage.

Numerous meetings on collision processes and line broadening have been held throughout the report period. Important international meetings that provide additional sources of data through their proceedings are: the XXIV *International Conference on Photonic, Electronic, and Atomic Collisions* (ICPEAC) (Fainstein *et al.* 2006), XXV ICPEAC (Becker *et al.* 2007), the NASA *Laboratory Astrophysics Workshop* (Weck *et al.* 2006), the 18th *International Conference on Spectral Line Shapes* (ICSLS) (Oks & Pindzola 2006) and the VIth *Serbian Conference on Spectral Line Shapes in Astrophysics* (SCSLSA)(Popović & Dimitrijević 2007). The 19th ICSLS has just taken place in June 2008.

2. Electron collisions with atoms, ions, molecules, and molecular ions

Collisions of electrons with atoms, ions, molecules, and molecular ions are the major excitation mechanism for a wide range of astrophysical environments. In addition, electron collisions play an important role in ionization and recombination, contribute to cooling and heating of the gas, and may contribute to molecular fragmentation and formation. In the following sections we summarize recent work on electron collisions with astrophysically relevant species, including elastic scattering, excitation, dissociation, ionization, recombination, and electron detachment from negative ions.

2.1. *Electron-atom scattering*

New work on elastic scattering from neutral atoms is limited to Xe (Linert *et al.* 2007), Cs (Zatsarinny & Bartschat 2008), In (Rabasović *et al.* 2008) and Au (Maslov *et al.* 2008). The excitation of atomic oxygen has been investigated (Wang & Zhou 2006, Barklem 2007), while new work on ionization has been carried out for Mg (Bolognesi *et al.* 2008).

2.2. *Electron-ion scattering*

For atomic ions, new work has primarily focused on excitation and includes: C^+ (Wilson *et al.* 2005), N^+ (Hudson & Bell 2005), O^+ (Tayal 2007), Al^{12+} (Aggarwal *et al.* 2005, Aggarwal *et al.* 2008), S^{4+} (Hudson & Bell 2006), Ar^{16+} (Aggarwal & Keenan 2005b), Ca^{+} (Meléndez *et al.* 2007), Kr^{6+} (Ishikawa & Vilkas 2008), Fe^{+} (Ramsbottom *et al.* 2007), Fe^{3+} (McLaughlin *et al.* 2006), Fe^{4+} (Ballance *et al.* 2007), Fe^{6+} (Witthoeft & Badnell 2008), Fe^{9+} (Aggarwal & Keenan 2005a), Fe^{11+} (Storey *et al.* 2005), Fe^{15+} (Aggarwal & Keenan 2006), Fe^{17+} (Witthoeft *et al.* 2006), Fe^{19+} (Witthoeft *et al.* 2007), Fe^{22+} (Chidichimo *et al.* 2005), Fe^{25+} (Aggarwal *et al.* 2008), Ni^{3+} (Meléndez & Bautista 2005), and for Si, Cl, and Ar isonuclear sequences (Colgan *et al.* 2008).

New elastic data exists for He^{+} and Li^{2+} (Bhatia 2008). Ionization and detachment have been studied for H^{-} (Jung 2008); C^{2+}, N^{3+}, and O^{4+} (Fogle *et al.* 2008); Ne^{4+} and Au^{47+} (Pindzola *et al.* 2008); and Si, Cl, and Ar isonuclear sequences (Colgan *et al.* 2008).

Another important process is recombination for which a number of new works including radiative and dielectronic recombination have appeared: C^{2+}, N^{3+}, and O^{4+} (Fogle *et al.* 2005); Si^{3+} (Schmidt *et al.* 2007); Mg^{2+} (Fu *et al.* 2008); and Fe^{16+} (Chen 2008).

2.3. *Electron-molecule scattering*

For molecules, new elastic scattering references have appeared as follows: C_3 (Munjal & Baluga 2006); CH_4 (Cho *et al.* 2008); H_2CO (Kaur & Baluja 2005); C_6H_6, C_6F_6, C_6H_{12}, C_6H_{14}, C_6F_{14}, C_8H_{16}, C_8H_{18}, and C_8F_{18} (Shi *et al.* 2008); SF_4 (Szmytkowski *et al.* 2005); SO_2Cl_2 (Szmytkowski *et al.* 2006); SiN_2, SiCO, and CSiO (Fujimoto *et al.* 2007); pyrazine (Winstead 2007); propane (Bettega, da Costa, & Lima 2008); methanol and ethanol (Khakoo *et al.* 2008); propene and cyclopropane (Makochekanwa *et al.* 2008); and NeF (Kaur *et al.* 2008).

For excitation, new references include: H_2 (da Costa *et al.* 2005, Kato *et al.* 2008); C_3 (Munjal & Baluga 2006); CH_2 (Allan 2007); CH_4 (Čurik *et al.* 2008); CO and C_2H_4 (da Costa *et al.* 2007); CO_2 (Rescigno *et al.* 2007); CF_4 (Irrera & Gianturco 2005); N_2 (Tashiro & Morokuma 2007, Khakoo *et al.* 2007), ethene (Allan, Winstead, & McKoy 2008); and NeF (Kaur *et al.* 2008).

New work for dissociative processes are for dissociative electron attachment to H_2O (Haxton *et al.* 2007), C_2H_2 (Chourou & Orel 2008, May *et al.* 2008), and C_4H_2 (May *et al.* 2008). Research on molecular ionization has been limited to H_2 and D_2 (Martín 2007) and H_2O (Kaiser *et al.* 2007).

2.4. *Electron-molecular ion scattering*

References on dissociative processes have appeared for: H_2^+ (Motapon *et al.* 2008), He_2^+ (Buhr *et al.* 2008), NeH^+ and NeD^+ (Ngassam *et al.* 2008), H_3^+ (Kokoouline & Greene 2005), D_2H^+ (Zhaunerchyk *et al.* 2008b), HCO^+ and DCO^+ (Douguet *et al.* 2008), O_3^+ (Zhaunerchyk *et al.* 2008a), and $HCNH^+$ (Ngassam *et al.* 2005).

For excitation, a study has been conducted for H_3^+ (Faure *et al.* 2006). New results for ionization include H_2^+ (Pindzola *et al.* 2005), while detachment has been investigated for Si_2^- (Lindahl *et al.* 2008). Finally, vibrational excitation due to electron impact has been studied for NeH^+ and NeD^+ (Ngassam *et al.* 2008).

3. Heavy particle collisions

3.1. *Ion-atom and atom-atom collisions*

Charge exchange has seen a substantial amount of activity over the report period as it plays an important role in a variety of environments. Studies for collisions on H include: H^+ (Bradley *et al.* 2005, Dubois *et al.* 2005, Zeng *et al.* 2008), He^{2+} (Havener *et al.* 2005), Be^{4+} (Minami *et al.* 2006), C^{6+} (Liu *et al.* 2005), N^{2+} and O^{2+} (Barragán *et al.*

2006a, Barragán *et al.* 2006c), O^{8+} (Perez & Olson 2005), F^{2+} (Dutta *et al.* 2005), Ne^{10+} (Errea *et al.* 2005a, Barragán *et al.* 2006b), Si^{3+} (Wang *et al.* 2006, Bruhns *et al.* 2008), S^{16+} (Janowicz *et al.* 2005), Cl^{7+} (Zhao *et al.* 2007), and Ar^{18+} (Errea *et al.* 2005a). A database for cross sections for all carbon ions colliding with hydrogen has been constructed by Suno & Kato (2006).

Neutral helium is also an important target for which studies have been carried out for the incident ions: He^{+} (Bradley *et al.* 2005), C^{4+} (Hoshino *et al.* 2007), F^{7+} (Zouros *et al.* 2008), and $Ne^{(2-6)+}$ (Hasan 2005).

Charge exchange due to proton impact on Ca (Dutta *et al.* 2006, Pandey & Dubey 2007) and Mg (Pandey & Dubey 2007), alpha particles on Na (Lee 2006), and N^{7+} on atomic oxygen (Perez & Olson 2005) have been studied, while radiative charge transfer in Ne^{2+} collisions with He (Zhao *et al.* 2006) has been investigated.

Elastic scattering due to proton impact on He, Ne, and Ar (Ovchinnikov *et al.* 2006) have been studied. Inelastic processes involving hyperfine changing collisions have been investigated for: H + H (Zygelman 2005); $(n - n')$-mixing in $H^*(n)$ + H(1s) collisions (Mihajlov *et al.* 2005); fine structure transitions for O + H and C + H (Abrahamsson & Krems 2007), C^{+} + H and Si^{+} + H (Barinovs *et al.* 2005) and depolarization collisions of excited atoms and ions with hydrogen (Derouich *et al.* 2005b, Derouich *et al.* 2005a, Derouich 2007, Derouich & Barklem 2007, Sahal-Bréchot *et al.* 2007). Electronic transitions have been studied for O + H (Krems *et al.* 2006) and H impact on S^{3+}, Ar^{13+}, and Fe^{13+} (Burgess & Tully 2005).

Excitation, charge transfer, and ionization due to He^{2+} collisions with H including Debye screening in a dense plasma has been studied by Liu *et al.* (2008a), Liu *et al.* (2008b). Electron detachment in He collisions with H^{-} (Huang *et al.* 2005, Ogurtsov *et al.* 2006) and C^{-} (Huang *et al.* 2005) has also been investigated. Rate coefficients have been computed for the formation of HD (Dickinson 2005); CH^{+} (Barinovs & van Hemert 2005); and SO, SO^{+}, and S_2 (Andreazza & Marinho 2005) by radiative association.

3.2. *Ion-, atom-, and molecule-molecule collisions*

In photo-ionized environments, multiply charged ions may coexist with neutral molecules. Examples include x-ray ionized regions and solar wind interactions with cometary gas. In these environments charge transfer plays an important role. Recent studies of ion-molecule charge transfer include He^{2+} (Dubois *et al.* 2005, Kusakabe *et al.* 2006), C^{4+} (Zarour *et al.* 2005), O^{+} (Kimura *et al.* 2006), O^{5+} and Ar^{5+} (Dubois *et al.* 2005), and F^{7+} (Zouros *et al.* 2008) with H_2; H^{+} (Lindsay *et al.* 2005a, Wells *et al.* 2005, Kumar *et al.* 2006, Lin *et al.* 2007) and He^{2+} (Kusakabe *et al.* 2006) with CO; He^{2+} (Abu-Haija *et al.* 2005b, Kusakabe *et al.* 2006), $Ar^{5,4+}$ (Abu-Haija *et al.* 2005a), and Kr^{8+} (Kaneyasu *et al.* 2005) with N_2; H^{+} and O^{+} (Luna *et al.* 2005), He^{2+} (Abu-Haija *et al.* 2005b, Kusakabe *et al.* 2006), and $Ar^{5,4+}$ (Abu-Haija *et al.* 2005a) with O_2; H^{+} (Kimura *et al.* 2006), He^{2+} (Bodewits, *et al.* 2005, Seredyuk *et al.* 2005c), O^{6+} (Seredyuk *et al.* 2005b, Bodewits & Hoekstra 2007), and a range of ions (Otranto & Olson 2008) with water; H^{+} (Lindsay *et al.* 2005a), He^{2+} (Abu-Haija *et al.* 2005b, Kusakabe *et al.* 2006), and O^{6+} (Seredyuk *et al.* 2005b) with CO_2; H^{+} with NH_2 (Suno *et al.* 2006); He^{2+} (Abu-Haija *et al.* 2005b, Kusakabe *et al.* 2006) with NH_3; H^{+} (Lindsay *et al.* 2005b), He^{2+} (Seredyuk *et al.* 2005a), and C^{4+} and O^{6+} (Seredyuk *et al.* 2005b) with CH_4; H^{+} (Suzuki *et al.* 2005) and He^{2+} (Seredyuk *et al.* 2005a) with C_2H_4; and He^{2+} (Seredyuk *et al.* 2005a) with C_2H_6. Other charge exchange studies include H_2^{+} + H (Errea *et al.* 2005b); N_2^{+} + N_2 and O_2^{+} + O_2 (Tong & Nanbu 2007); and O^{+} + O_2 (Martinez *et al.*

https://doi.org/10.1017/S1743921308025957 Published online by Cambridge University Press

2006), while Cornelius (2006) has developed a scaling relation for total cross sections with H_2.

For applications to x-ray emission from comets and planetary atmospheres, charge exchange has been considered for molecular targets including $C^{(3-6)+}$, $N^{(4-7)+}$, and $O^{(5-7)+}$ with methane (Djurić *et al.* 2008); highly charged L-shell Fe ions with various neutrals (Wargelin *et al.* 2005, Beiersdorfer *et al.* 2008); and for a range of ions and molecules (Otranto *et al.* 2006).

The internal level populations of molecular rovibrational states are primarily controlled through collisional excitation by atom and molecule impact. Investigations have been carried out for excitation of H_2 by H (Wrathmall & Flower 2006, Wrathmall *et al.* 2007), He (Mack *et al.* 2006), H_2 (Lee *et al.* 2006), and H^- (Giri & Sathyamurthy 2006); HF by He (Reese *et al.* 2005); CO by H (Yang *et al.* 2006a, Shepler *et al.* 2007), He (Yang *et al.* 2006a), and H_2 (Wernli *et al.* 2006, Yang *et al.* 2006b); CO^+ by H (Andersson *et al.* 2008); CN by C_2H_2 (Olkhov & Smith 2007); CS by He (Lique *et al.* 2006b, Lique & Spielfiedel 2007); PN by He (Tobola *et al.* 2007); SiO by H (Palov *et al.* 2006) and He (Dayou & Balança 2006); SiS by He (Vincent *et al.* 2007); SO by He (Lique *et al.* 2006a, Lique *et al.* 2006c); H_2O by He (Yang & Stancil 2007) and H_2 (Dubernet *et al.* 2006), NH_3 (Machin & Roueff 2005, Yang & Stancil 2008), NH_2D (Machin & Roueff 2006), and ND_2H by He (Machin & Roueff 2007); and HC_2N by He and H_2 (Wernli *et al.* 2007).

Other investigations include: collisional dissociation of highly excited H_2 by He Ohlinger *et al.* (2007), fragmentation of CO by slow C^{6+} and Ar^{11+} (Wells *et al.* 2008), and dissociation and fragmentation of N_2 by slow Xe^{q+} ions, ($q = 15$-21), (Zhu *et al.* 2005). Mutual neutralization in H_2^+ collisions with H^- has been studied by Liu *et al.*(2006) and the formation of HeH_2^+ via radiative association by Mrugala & Kraemer (2005).

4. Reactive scattering and chemistry

Due to space limitations, we cannot review the many advances in reactive scattering and chemical processes relevant to astrophysics. One noteworthy and relevant study involves a quasi-classical trajectory investigation of $H + CH_4 \rightarrow H_2 + CH_3$ (Xie *et al.* 2006), and updates to the UMIST Astrochemistry database which gives rate coefficient fits for 4572 reactions, has been completed recently (Woodall *et al.* 2007).

5. Stark broadening

Knowledge of line widths and shifts for atomic transitions is very important for the interpretation of stellar spectra and also for circumstellar conditions and galactic H II regions.

The *Critical Review of Selected Data on Experimental Stark Widths and Shifts for Spectral Lines of Neutral and Ionized Atoms* for the period 2001 - 2007, see Lesage (2008), contains tables where measured values are listed and compared with semi-classical calculations. A book entitled *Stark Broadening of Hydrogen and Hydrogenlike Spectral Lines in Plasmas* has been published by Oks (2006) and contains many useful references.

5.1. *Developments in line broadening theory*

Poquérusse & Alexiou (2006) have extended standard semi-classical impact theory for hydrogen-like ions to include penetrating collisions. For transitions in highly excited hydrogen-like atoms and ions Stambulchik & Maron (2008) have produced a simple analytical method for calculating line shapes and Gigosos *et al.* (2007) have developed

https://doi.org/10.1017/S1743921308025957 Published online by Cambridge University Press

an exact expression for the impact broadening operator of hydrogen. The asymmetry of hydrogen lines has been studied by Demura *et al.* (2008a) and Demura *et al.* (2008b).

Stambulchik & Maron (2008) have studied broadening of lines subject to external electric and magnetic fields and Godbert-Mouret *et al.* (2006) have developed new code to calculate their lineshapes. Dubau *et al.* (2007) have carried out quantum mechanical calculations of electron impact broadening for XUV lines in plasmas.

5.2. *Isolated lines*

For isolated lines, Stark broadening is dominated by collisions with plasma electrons. Broadening parameters have been determined theoretically for:

Ar II 476.5 nm, 480.6 nm and Kr II 469.4 nm lines (Dimitrijević & Csillag 2006), Cd I 33 singlets and 37 triplets (Simić *et al.* 2005a), 26 Ne V multiplets (Hamdi *et al.* 2007) and 15 Si VI multiplets (Hamdi *et al.* 2008).

Also for: 4 N IV, 3 O V, 1 F VI and 4 Ne IV (Elabidi *et al.* 2008a), 2 N II, O III, F IV and Ne V (Ivković *et al.* 2005), O II (Mahmoudi *et al.* (2005)), F II (Srećković *et al.* 2005b), 1 F III (Simić *et al.* 2005b), 6 Ar I (Dimitrijević *et al.* 2007a), 9 Cr I (Dimitrijević *et al.* 2005), 3 Mn II (Popović *et al.* 2008), 3 Te I (Dimitrijević *et al.* 2007b, Dimitrijević *et al.* 2008), F III (Simić *et al.* 2005b), Ne VII, Ne VIII and Si XI (Elabidi *et al.* 2008b), S II, S III and S IV (Milovanović N. & Dimitrijević 2007), Cu III, Zn III and Se III (Simić *et al.* 2006), Ga II (N'Dollo & Donga-Passi 2006), Sn II (Colón & Alonso-Medina 2006) and Pb III (Alonso-Medina *et al.* 2008) lines.

Broadening parameters have been obtained experimentally for:

C I 247.8561 nm (Djeniže *et al.* 2006b), Mg II 448.1 nm (Djeniže *et al.* 2005b), Fe I 381.58 nm (Bengoechea *et al.* 2006) and Fe I 538.34 nm (Bengoechea *et al.* 2005) lines.

Also for: 2 N I (Bartecka *et al.* 2005), 3 O II (Bukvić *et al.* 2005), 23 O III (Srećković *et al.* 2005a), 10 N II and 8 O III (Ivković *et al.* 2005), F II (Srećković *et al.* 2005b), 4 Ne I (Dzierżega *et al.* 2006), 13 Ne I (Jovićević *et al.* 2005), 7 Ar I (Milosavljević *et al.* 2006), 6 Ar II (Iglesias *et al.* 2006), 6 Mn I (Srećković *et al.* 2007), 11 Mn II and 3 Mn III (Djeniže *et al.* 2006e), 17 Ni II (Mayo *et al.* 2008), 35 Kr II (del Val *et al.* 2008), 2 Ag I and 2 Au I (Djeniže *et al.* 2006c), 2 Ag I, 11 Ag II and 3 Ag III (Djeniže *et al.* 2005a), 26 Au II (Ortiz & Mayo 2005), 43 Sn I and 27 Sn II (Alonso-Medina & Colón 2008), 12 Sn I and 16 Sn II (Djeniže *et al.* 2006d), 16 In III (Djeniže *et al.* 2006a), 10 Pb III lines (Alonso-Medina & Colón 2007), 31 Pb II (Colón & Alonso-Medina 2006), 38 Xe III (Peláez *et al.* 2006a) and shifts of 110 Xe and 42 Xe III (Ćirišan *et al.* 2006) lines.

Djurović *et al.* (2006) have presented a review of experimental work on Stark broadening of 80 singly ionized xenon lines and Purić *et al.* (2008) have used published Stark widths for spectral lines originating from 3s-3p transition arrays of multiply charged ions, to establish trends from which Stark widths are predicted for Mg VII, Mg IX, Mg X, Na VII, Na VIII, Al VIII, Al IX, Si XI, Ti XI, Cr XIII, Cr XIV, Fe XV, Fe XVI, Fe XXIII and Ni XVIII.

Stehlé *et al.* (2005) have examined current Stark broadening theory as a basis for diagnostics of low-temperature plasmas and Mahmoudi *et al.* (2008) have provided new expressions for diagonal multiplet factors of complex configurations, required for studies of isolated lines. Zmerli *et al.* (2008) have proposed an improved interpolation method for widths as a function of temperature.

5.3. *Transitions in hydrogenic and helium-like systems*

New quantum mechanical calculations of the broadening of Lyβ, Lyγ and Lyδ have been carried out by de Kertanguy *et al.* (2005). Transitions in the Balmer series have been

https://doi.org/10.1017/S1743921308025957 Published online by Cambridge University Press

studied by Gigosos & González (2006), and by Stambulchik *et al.* (2007) for $n \leqslant 15$. Broadening of high-n transitions are considered by Lisgo *et al.* (2006) and benchmarked against electron density measurements. New experiments for Hβ for the wide range of plasma parameters have been carried out by Djurović *et al.* (2005) and Griem *et al.* (2005) compare Hα profiles measured at high electron densities with theoretical results.

Broadening of the radio recombination lines of hydrogen has been studied theoretically by Watson (2006) and Gavrilenko & Oks (2007) and lines of hydrogen-like and helium-like ions of C, Si and Ar have been examined by Stambulchik & Maron (2006) who find that ion dynamics is very important.

New theoretical calculations of broadening have been reported for He I 667.8 nm and 587.6 nm lines (Ben Chaouacha *et al.* (2007)) and He I 728.1, 706.5, 504.8, 492.2 and 471.3 nm lines in a dense plasma (Omar *et al.* (2006)). Peláez *et al.* (2006b) have carried out experiments for He I 318.8 nm and 402.6186 nm lines.

6. Broadening by neutral atoms and molecules

The analysis of experimental molecular spectra in order to extract line shape parameters is often very difficult. Line shapes can be affected by collisional narrowing and the dependence of collisional broadening and shifting on molecular speed. When these effects are sufficiently important, fitting Voigt profiles to experimental spectra produces systematic errors in the parameters retrieved.

A collection of papers concerning the status of the molecular spectroscopic database, HITRAN 2000, has been published by Rothman et al. (2003) and this has recently been updated for the current version HITRAN 2004 by Rothman *et al.* (2005).

6.1. *Broadening of atomic lines*

Some theoretical work has been published in the period 2005-2008 and the transitions with the perturbing atoms or molecules are listed below.

Li; 2s-3s transition broadened by Ar, Kr and Xe (Rosenberry *et al.* 2007).
Li; wings of the resonance line broadened by He and H_2 (Allard *et al.* 2005).
Na and K; wings of the resonance lines broadened by He (Zhu *et al.* 2006).
Li, Na and K; impact widths for the resonance lines broadened by He (Mullamphy *et al.* 2007).
Rb and Cs; resonance line profiles, including far line wings, broadened by He and H_2 (Allard & Spiegelman 2006).
Fe II; 24188 lines broadened by collisions with H (Barklem & Aspelund-Johansson 2005).
Sr: $5s^2\,{}^1S_0 \rightarrow 5s5p\,{}^3P_1$ and $5s5p\,{}^3P_{0,1,2} \rightarrow 5s6s\,{}^3S_1$ transitions broadened by the rare gases (Holtgrave & Wolf 2005).

6.2. *Broadening and shift of molecular lines*

Much new data have been published since the last report was prepared. The molecules are listed below with their perturbing atomic or molecular species and are labelled by 'E' and 'T' to indicate experimental work and theoretical analysis respectively.

H_2-H_2 collision-induced absorption (T) (Orton *et al.* 2007); in binary mixtures H_2-N_2 and H_2-CO (E) (Abu-Kharma *et al.* 2006).
H_2 lines broadened and shifted by He (T) (Ma *et al.* 2007).
HDO lines broadened and shifted by N_2 (E) (Bach *et al.* 2005).
HCN lines broadened and shifted by HCN and air (E) (Devi *et al.* 2005); N_2 (E) (Smith *et al.* 2008); H_2, N_2, O_2, CH_3CN and rare gases (E) (Rohart *et al.* 2007).
HC_3N lines broadened by H_2, He and N_2 (E) (Colmont *et al.* 2007b).

H_2CO lines broadened by H_2CO, N_2 and O_2 (E) (Staak *et al.* 2005).
HCO^+ lines broadened by He and Ar (T) (Buffa 2007).
HNO_3 lines broadened by air (E) (Cazzoli *et al.* 2005).
HO_2 lines broadened by air (E) (Ibrahim *et al.* 2007); H_2O and N_2 (E) (Kanno *et al.* 2005).
HI lines broadened by HI (E) (Bulanin *et al.* 2005, Hartmann *et al.* 2005); He (E) (Flaud *et al.* 2006).
HI, HBr lines broadened by rare gases (E) (Domanskaya *et al.* 2007).

H_2O lines broadened by H_2O (T) (Tolchenov & Tennyson 2005, Ptashnik *et al.* 2005, Antony & Gamache 2007, Antony *et al.* 2007); air (E) (Liu *et al.* 2007, Seta *et al.* 2008); H_2O and air (E+T) (Toth 2005, Jenouvrier *et al.* 2007, Ibrahim *et al.* 2008); N_2 (E+T) (Aldener *et al.* 2005, Bandyopadhyay *et al.* 2007, Tran *et al.* 2007, Bykov *et al.* 2008); N_2 and air (E+T) (Aldener *et al.* 2005, Bandyopadhyay *et al.* 2007, Tran *et al.* 2007, Bykov *et al.* 2008, Hodges *et al.* 2008); N_2 and O_2 (E) (Golubiatnikov *et al.* 2008, Hoshina *et al.* 2008); H_2O, N_2 and O_2 (E) (Cazzoli *et al.* 2007, Koshelev *et al.* 2007, Cazzoli *et al.* 2008); H_2O and Ar (E) (Li *et al.* 2008); H_2O, H_2, N_2, O_2, CO_2 and rare gases (E) (Golubiatnikov 2005); H_2O, H_2, N_2, O_2, CO_2, He and air (E) (Brown *et al.* 2005).

CH_4 lines broadened by air (E) (Predoi-Cross *et al.* 2006); CH_4 and air (E) (Predoi-Cross *et al.* 2007a); CH_4, air, He and H_2 (E) (Lucchesini & Gozzini 2007); CH4 (E) (Lepère 2006, Wishnow *et al.* 2007); H_2 and He (T) (Tran *et al.* 2006); N_2 (E) (Mondelain *et al.* 2007, Martin & Lepère 2008); CH_4 and N_2 (E) (Menard-Bourcin *et al.* 2007); N_2 and O_2 (E) (Mondelain *et al.* 2005, Lepère *et al.* 2005); N_2, O_2 and air (T) (Antony *et al.* 2008).
C_2H_2 self-broadened lines (E+T) (Lepère *et al.* 2007, Nguyen *et al.* 2008, Lyulin *et al.* 2008); broadened by He (T) (Thibault 2005, Nguyen *et al.* 2006); H_2, D_2, N_2, air and rare gases (E) (Arteaga *et al.* 2007); CO_2 (E+T) (Martin *et al.* 2006).
C_2H_4 lines broadened by N_2 (E) (Blanquet *et al.* 2005).
C_3H_2 lines self broadened (E) (Achkasova *et al.* 2006).
CH_3Br lines broadened by N_2 (E+T) (Jacquemart *et al.* 2007, Tran *et al.* 2008); CH_3Br and N_2 (E) (Jacquemart & Tran 2008).
CH_3F lines broadened by H_2 (E) (Lerot *et al.* 2006b); N_2, O_2 (E) (Lerot *et al.* 2006a); CH_3F (Lerot *et al.* 2005).
CH_3CN broadened by CH_3CN and N_2 (E) (Rinsland *et al.* 2008).

CO lines broadened by He (E) (Thibault *et al.* 2007); CO_2 (E) (Sung & Varanasi 2005); Ar (E+T) (Wehr *et al.* 2006a, Wehr *et al.* 2006b); N_2, O_2, CO_2 and rare gases (Colmont *et al.* 2007a).
CO_2 lines broadened by air (E) (Predoi-Cross *et al.* 2007c, Toth *et al.* 2007); self-broadened lines (E) (Hikida *et al.* 2005, Le Barbu *et al.* 2006, Predoi-Cross *et al.* 2007b), (T) (Toth *et al.* 2006); air and CO_2 (E) (Devi *et al.* 2007a, Toth *et al.* 2008, Joly *et al.* 2008, Devi *et al.* 2007a); air and Ar (E) (Li *et al.* 2008); N_2 and O_2 (E) (Hikida & Yamada 2006).
Cs_2 lines broadened by N_2 (E+T) (Misago *et al.* 2006); O_2 (E+T) (Misago *et al.* 2007); Ar and air (E+T) (Misago *et al.* 2008).

N_2 self-broadened lines (E) (El-Kader & Moustafa 2005, Hashimoto & Kanamori 2006); N_2-H_2 collision-induced absorption (E) (Boissoles *et al.* 2005).
NH_3 lines broadened by NH_3 (E) (Leary *et al.* 2008); N_2, O_2 and air (Dhib *et al.* 2007).
N_2O lines broadened by air (E) (Grossel *et al.* 2008).

O_2 self-broadened lines (E) (Tretyakov *et al.* 2007, Predoi-Cross *et al.* 2008a); lines broadened by O_2 and N_2 (Tretyakov *et al.* 2005); N_2 (E+T) (Predoi-Cross *et al.* 2008b).

O_3 lines broadened by O_3 (E) (Yamada & Amano 2005); N_2 and O_2 (E+T) (Rohart *et al.* 2008).
OCS lines broadened by OCS (E) (Matton *et al.* 2006); N_2 and O_2 (E) (Koshelev *et al.* 2006).
PH_3 lines broadened by N_2 (E+T) (Bouanich *et al.* 2005, Bouanich & Blanquet 2007).
SO_2 self-broadened lines (E+T) (Zéninari *et al.*. 2007, Henningsen *et al.* 2008).

7. Databases

A database for atomic and molecular processes is maintained at the Oak Ridge National Laboratory Controlled Fusion Atomic Data Center (CFADC) at the address `<cfadc.phy.ornl.gov>` and a useful on-line database of rovibrational collisional excitation data, BASECOL, can be found at `<basecol.obspm.fr>`.

Some collisional data are also available on the Leiden Atomic and Molecular Database `<www.strw.leidenuniv.nl/∼moldata>` and the UMIST Astrochemistry database is at `<www.udfa.net>`.

A 'virtual observatory' for astronomers can be found at `<cdsarc.u-strasbg.fr>` and the latest version of the database High resolution Transmission, HITRAN 2004, is at `<www.hitran.com>`.

The current version of the database Gestion et Etude des Informations Spectroscopiques Atmosphériques (GEISA-03) is at `<ara.lmd.polytechnique.fr>` and the Spherical Top data System (STDS) has address `<icb.u-bourgogne.fr/OMR/SMA/SHTDS/STDS>`.

The National Institute for Standards and Technology (NIST) maintains a database at `<www.physics.nist.gov/PhysRefData>`. which contains the Bibliography on Atomic Line Shapes and Shifts up to 2008 and the database at the Observatoire de Paris, `<amrel.obspm.fr/balss>` contains a Bibliography up to 2007.

The Vienna Atomic Line Database (VALD) can be found at `<ams.astro.univie.ac.at/∼vald>` and the Belgrade database at `<www.aob.bg.ac.yu/BELDATA>`.

Acknowledgements

We thank Ms. Fay Ownby and Dr. David Schultz (Oak Ridge National Laboratory) for assistance with bibliographic data. Philip C. Stancil acknowledges support from NASA grant NAG NNG05GD98G.

References

Abrahamsson, E. & Krems, R. V. 2007, *ApJ*, 654, 1171
Abu-Haija, O., Faify S. A., Olmez, G., *et al.* 2005a, *Nucl. Inst. Meth. B*, 241, 109
Abu-Haija, O., Kamber, E. Y., Ferguson, S. M., *et al.* 2005b, *Phys. Rev. A*, 72, 042701
Abu-Karma, M., Stamp, C., Varghese, G., & Reddy, S. P. 2006, *JQSRT*, 97, 332
Achkasova, E., Araki, M., Denisov, A., & Maier, J. P. 2006, *JMoSp*, 237, 70
Aggarwal, K. M. & Keenan, F. P. 2005a, *A&A*, 439, 1215
Aggarwal, K. M. & Keenan, F. P. 2005b, *A&A*, 441, 831
Aggarwal, K. M. & Keenan, F. P. 2006, *A&A*, 450, 1249
Aggarwal, K. M., Hamada, K., Igarashi, A., *et al.* 2008, *A&A*, 484, 879
Aggarwal, K. M., Igarashi, A., Keenan, F. P., & Nakazaki, S. 2008, *A&A*, 479, 585
Aggarwal, K. M., Keenan, F. P., & Rose, S. J. 2005, *A&A*, 432, 1151
Aldener, M., Brown, S. S., Stark, H., *et al.* 2005, *JMoSp*, 232, 223
Allan, M. 2007, *J. Phys. B: At. Mol. Opt. Phys.*, 40, 3531
Allan, M., Winstead, C., & McKoy, V. 2008, *Phys. Rev. A*, 77, 042715

https://doi.org/10.1017/S1743921308025957 Published online by Cambridge University Press

Allard, N. F., Allard, F., & Kielkopf, J. F. 2005, *A&A*, 440, 1195
Allard, N. F. & Peach, G. 2007, in: O. Engvold (ed.), *Reports on Astronomy 2002 - 2005, IAU Transactions XXVIA* (Cambridge: CUP), 149
Allard, N. F. & Spiegelman, F. 2006, *A&A*, 452, 351
Alonso-Medina, A. & Colón, C. 2007, *A&A*, 466, 399
Alonso-Medina, A. & Colón, C. 2008, *ApJ*, 672, 1286
Alonso-Medina, A., Colón, C., & Zanón, A. 2008, *MNRAS*, 385, 261
Andersson, S., Barinovs, G., & Nyman, G. 2008, *ApJ*, 678, 1042
Andreazza, C. M. & Marinho, E. P. 2005, *ApJ*, 624, 1121
Antony, B. K. & Gamache, R. R. 2007, *JMoSp*, 243, 113
Antony, B. K., Neshyba, S., & Gamache, R. R. 2007, *JQSRT*, 105, 148
Antony, B. K., Niles, D. L., Wroblewski, S. B., *et al.* 2008, *JMoSp*, 251, 268
Arteaga, S. W., Bejger, C. M., Gerecke, J. L., *et al.* 2007, *JMoSp*, 243, 253
Bach, M., Fally, S., Coheur, P.-F, *et al.* 2005, *JMoSp*, 232, 341
Ballance, C. P., Griffin, D. C., *et al.* 2007, *JPhB: At. Mol. Opt. Phys.*, 40, F327
Bandyopadhyay, A., Ray, B., Ghosh, P. N., *et al.* 2007, *JMoSp*, 242, 10
Barinovs, G. & van Hemert, M. C. 2005, *ApJ*, 636, 923
Barinovs, G., Hemert, M. C., Krems, R., & Dalgarno, A. 2005, *ApJ*, 620, 537
Barklem, P. S. 2007, *A&A*, 462, 781
Barklem, P. S. & Aspelund-Johansson, J. 2005, *A&A*, 435, 373
Barragán, P., Errea, L. F., Méndez, L., Rabadán, I., & Riera, A. 2006a, *ApJ*, 636, 544
Barragán, P., Errea, L. F., Méndez, L., Rabadán, I., & Riera, A. 2006b, *PhRvA*, 74, 024701
Barrag'an, P., Le, A.-T.., & Lin, C. D. 2006c, *PhRvA*, 74, 012720
Bartecka, A., Baclawski, A., Wujec, T., & Musielok, J. 2005, *EPJD*, 37, 163
Becker, A., Mosshammer, R., Mokler, P., & Ullrich, J., eds. 2007, Proc. XXV *International Conference on Photonic, Electronic, & Atomic Collisions*, *JP-CS*, 88
Beiersdorfer, P., Schweikhard, L., Liebisch, P., & Brown, G. V. 2008, *ApJ*, 672, 726
Ben Chaouacha, H., Sahal-Bréchot, S., & Ben Nessib, N. 2007, *A&A*, 465, 651
Bengoechea, J., Aragón, C., & Aguilera, J. A. 2005, *Spectrochim. Acta B*, 60, 897
Bengoechea, J., Aguilera, J. A., & Aragón, C. 2006, *Spectrochim. Acta B*, 61, 69
Bettega, M. H. F., da Costa, R. F.,, & Lima, M. A. P. 2008, *PhRvA*, 77, 052706
Bhatia, A. K. 2008, *PhRvA*, 77, 052707
Blanquet, G., Bouanich, J.-P., Walrand, J., & Lepèere, M. 2005, *JMoSp*, 229, 198
Bodewits, D., Tielens, A. G. G. M., Morgenstern, R., & Hoekstra, R. 2005, *NIMPB*, 235, 358
Bodewits, D., Hoekstra, R., Seredyuk, B., *et al.* 2006, *ApJ*, 642, 593
Bodewits, D. & Hoekstra, R. 2007, *PhRvA*, 76, 032703
Boissoles, J., Domanskaya, A., Boulet, C., Tipping, R. H., & Ma, Q. 2005, *JQSRT*, 95, 489
Bolognesi, P., Pravica, L., Veronesi, S., *et al.* 2008, *PhRvA*, 77, 054704
Bouanich J.-P. & Blanquet, G. 2007, *JMoSp*, 241, 186
Bouanich, J.-P., Walrand, J., & Blanquet, G. 2005, *JMoSp*, 232, 40
Bradley, J., O'Rourke, S. F. C., & Crothers, D. S. F. 2005, *PhRvA*, 71, 032706
Brown, L. R., Benner, D. C., Devi, V. M., *et al.* 2005, *J. Mol. Struct.*, 742, 111
Bruhns, H., Kreckel, H., Savin, D. W., Seely, D. G., & Havener, C. C. 2008, *PhRvA*, 77, 064702
Buffa, G. 2007, *PhRvA*, 76, 042509
Bulanin, M. O., Domanskaya, A. V., Kerl, K., & Maul, C. 2005, *JMoSp*, 230, 87
Buhr, H., Pedersen, H. B., Altevogt, S., *et al.* 2008, *PhRvA*, 77, 032719
Bukvić, S., Srećković, A., & Djeniže, S. 2005, *Publ. Astron. Soc. 'Rudjer Bošković'*, 5, 135
Burgess, A. & Tully, J. A. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 2629
Bykov, A. D., Lavrentieva, N. N., Mishina, T. P., *et al.* 2008, *JQSRT*, 109, 1834
Cazzoli, G., Dore, L., Puzzarini, C., *et al.* 2005, *JMoSp*, 229, 158
Cazzoli, G., Puzzarini, C., Buffa, G., & Tarrini, O. 2007, *JQSRT*, 105, 438
Cazzoli, G., Puzzarini, C., Buffa, G., & Tarrini, O. 2008, *JQSRT*, 109, 1563
Chen, G.-X. 2008, *PhRvA*, 77, 022703
Chidichimo, M. C., Del Zanna, G., Mason, H. E., *et al.* 2005, *A&A*, 430, 331

Cho, H., Park, Y. S., y Castro, E. A., *et al.* 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 045203
Chourou, S. T. & Orel, A. E. 2008, *PhRvA*, 77, 042709
Ćirišan, M., Peláez, R. J., Djurović, S., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 40, 3477
Colgan, J., Zhang, H. L., & Fontes, C. J. 2008, *PhRvA*, 77, 062704
Colmont, J.-M., Nguyen, L., Rohart, F., & Włodarczak, G. 2007a, *JMoSp*, 246, 86
Colmont, J.-M., Rohart, F., & Włodarczak, G. 2007b, *JMoSp*, 241, 119
Colmont, J.-M., Rohart, F., Włodarczak, G., & Bouanich, J.-P. 2006, *JMoSp*, 238, 98
Colón, C. & Alonso-Medina, A. 2006, *Spectrochim. Acta B*, 61, 856
Colón, C., Alonso-Medina, A., Rivero, C., & Fernández, F. 2006, *PhyS*, 73, 410
Cornelius, K. R. 2006, *PhRvA*, 73, 032710
da Costa, R. F., Bettega, M. H. F., Ferreira, L. G., *et al.* 2007, *JPh-CS*, 88, 012028
da Costa, R. F., da Paixão, F. J ., & Lima, M. A. P. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 4363
Čurik, R., Čársky P., & Allan, M. 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 115203
Dayou, F. & Balança, C. 2006, *A&A*, 459, 297
Demura, A. V., Demchenko, G. V., & Nikolić, D. 2008a, *EPJD*, 46, 203
Demura, A. V., Demchenko, G. V., & Nikolić, D. 2008b, *EPJD*, 46, 111
Derouich, M. 2007, *A&A*, 466, 683
Derouich, M. & Barklem, P. S. 2007, *A&A*, 462, 1171
Derouich, M., Barklem, P. S., & Sahal-Bréchot, S. 2005a, *A&A*, 441, 395
Derouich, M., Sahal-Bréchot, S., & Barklem, P. S. 2005b, *A&A*, 434, 779
Devi, V. M., Benner, D. C., Smith, M. A. H., *et al.* 2005, *JMoSp*, 231, 66
Devi, V. M., Benner, D. C., Brown, L. R., Miller, C. E., & Toth, R. A. 2007a, *JMoSp*, 242, 90
Devi, V. M., Benner, D. C., Brown, L. R., Miller, C. E., & Toth, R. A. 2007b, *JMoSp*, 245, 52
Dhib, M., Ibrahim, N., Chelin, P., *et al.* 2007, *JMoSp*, 242, 83
Dickinson, A. S. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 4329
Dimitrijević, M. S., Christova, M., & Sahal-Bréchot, S. 2007a, *PhyS*, 75, 809
Dimitrijević, M. S., Ryabchikova, T., Popović, L.Č., *et al.* 2005, *A&A*, 435, 1191
Dimitrijević, M. S., Simić, S., Kovačević, A., *et al.* 2007b, in: *Flows, Boundaries, and Interaction Workshop*, *AIP-CP*, 934, 202
Dimitrijević, M. S., Simić, S., *et al.* 2008, *Contr. Obs. Astron. Skalnate Pleso*, 38, 403
Dimitrijević, M. S. & Csillag, L. 2006, *JApSp*, 73, 458
Djeniže, S., Srećković, A., & Bukvić, S. 2005a, *Spectrochim. Acta B*, 60, 1552
Djeniže, S., Srećković, A., & Bukvić, S. 2005b, *Jap. J. Appl. Phys.*, 44, 1450
Djeniže, S., Srećković, A., & Bukvić, S. 2005c, *Z. Naturforsch. A*, 60, 282
Djeniže, S., Srećković, A., & Bukvić, S. 2006a, *Spectrochim. Acta B*, 61, 588
Djeniže, S., Srećković, A., & Bukvić, S. 2006b, *Z. Naturforsch. A*, 61, 91
Djeniže, S., Srećković, A., Bukvić, S., & Vitas, N. 2006c, *Z. Naturforsch. A*, 61, 491
Djeniže, S., Srećković, A., & Nikolić, Z. 2006d, *JPhB: At. Mol. Opt. Phys.*, 39, 3037
Djeniže, S., Bukvić, S., Srećković, A., & Nikolić, Z. 2006e, *New Astronomy*, 11, 256
Djurić, N., Smith, S.J., Simcić, J., & Chutjian, A. 2008, *ApJ*, 679, 1661
Djurović, S., Nikolić, D., Savić, I., Sörge, S., & Demura, A. V. 2005, *PhRvE*, 71, 036407
Djurović, S., Peláez, R. J., Ćirišan, M., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 2901
Domanskaya, A. V., Bulanin, M. O., Kerl, K., & Maul, C. 2007, *JMoSp*, 243, 155
Douguet, N., Kokoouline, V., & Greene, C. H. 2008, *PhRvA*, 77, 064703
Dubau, J., Blancard, C., & Cornille, M. 2007, *High Energy Density Physics*, 3, 76
Dubernet, M.-L., Daniel, F., Grosjean, A., *et al.* 2006, *A&A*, 460, 323
Dubois, A., Caillet, J., Hansen, J. O., *et al.* 2005, *NIMPB*, 241, 48
Dutta, C.M., Gu, J.P., Hirsch, G., *et al.* 2005, *PhRvA*, 72, 052715
Dutta, C.M., Oubre, C., Nordlander, P., Kimura, M., & Dalgarno, A. 2006, *PhRvA*, 73, 032714
Dzierżega, K., Musiol, K., Pokrzywka, B., & Zawadzki, W. 2006, *Spectrochim. Acta B*, 61, 850
Elabidi, H., Ben Nessib, N., Cornille, M., *et al.* 2008a, *JPhB: At. Mol. Opt. Phys.*, 41, 025702
Elabidi, H., Ben Nessib, N., & Dimitrijević, M. S. 2008b, *New Astronomy*, 12, 64
El-Kader, M. S. A. & Moustafa, S. I. 2005, *CP*, 318, 199
Errea, L.F., Illescas, C., Méndez, L., Pons, B., Riera, A. , & Suárez, J. 2005a, *NIMPB*, 235, 315

https://doi.org/10.1017/S1743921308025957 Published online by Cambridge University Press

Errea, L. F., Macias, A., Méndez, L., Rabadán, I., & Riera, A. 2005b, *NIMPB*, 235, 362

Fainstein, P. D., Lima, M. A., P., Miraglia, J. E., *et al.* (eds.) 2006, Proc. XXIV Intern. Conf. *Photonic, Electronic, & Atomic Collisions* (Singapore: World Scientific Publ. Co.)

Faure, A., Kokoouline, V., Greene, C. H., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 4261

Flaud, P.-M., Orphal, J., Boulet, C., & Hartmann, J.-M. 2006, *JMoSp*, 235, 149

Fogle, M., Badnell, N. R., Glans, P., *et al.* 2005, *A&A*, 442, 757

Fogle, M., Bahati, E. M., Bannister, M. E., *et al.* 2008, *ApJS*, 175, 543

Fu, J., Gorczyca, T. W., Nikolić, D., *et al.* 2008, *PhRvA*, 77, 032713

Fujimoto, M. M., Michelin, S. E., Mazon, K. T., *et al.* 2007, *PhRvA*, 76, 012709

Gavrilenko, V. P. & Oks, E. 2007, *PhyS*, 76, 43

Gigosos, M. A. & González, M. A. 2006, in: *Physics of Ionized Gases*, *AIP-CP*, 876, 294

Gigosos, M. A., González, M.Á., Talin, B., & Calisti, A. 2007, *A&A*, 466, 1189

Giri, K. & Sathyamurthy, N. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 4123

Godbert-Mouret, L., Capes, H., Koubiti, M., *et al.* 2006, in: *PLASMA 2005*, *AIP-CP*, 812, 423

Golubiatnikov, G. Yu. 2005, *JMoSp*, 230, 196

Golubiatnikov, G. Yu., Koshelev, M. A., & Krupnov, A. F. 2008, *JQSRT*, 109, 1828

Griem, H. R., *et al.* 2005, *JPhB: At Mol. Opt. Phys.*, 38, 975; erratum, 2006, 39, 3705

Griem, H. R. & Ralchenko, Y. 2006, in: *Spectral Line Shapes*, *AIP-CP*, 874, 14

Grossel, A., Zéninari, V., Parvitte, B., *et al.* 2008, *JQSRT*, 109, 1845

Hamdi, R., Ben Nessib, N., Dimitrijević, M. S., & Sahal-Bréchot, S. 2007, *ApJS*, 170, 243

Hamdi R., Ben Nessib, N., Milovanović, N., *et al.* 2008, *MNRAS*, 387, 871

Hartmann, J.-M., Bouanich, J.-P., Boulet, C., *et al.* 2005, *JQSRT*, 95, 151

Hashimoto, T. & Kanamori, H. 2006, *JMoSp*, 235, 104

Hasan, A. T. 2005, *EJPhD*, 35, 461

Havener, C. C., Rejoub, R., Kristić, P.S., & Smith, A. C. H. 2005, *PhRvA*, 71, 042707

Haxton, D. J., Rescigno, T. N., & McCurdy, C. W. 2007, *PhRvA*, 75, 012711

Henningsen, J., Barbe, A., & De Backer-Barilly, M.-R. 2008, *JQSRT*, 109, 2491

Hikida, T. & Yamada, K. M. T. 2006, *JMoSp*, 239, 154

Hikida, T., Yamada, K. M. T., Fukabori, M., Aoki, T., & Watanabe, T. 2005, *JMoSp*, 232, 202

Hodges, J. T., Lisak, D., Lavrentieva, N., *et al.* 2008, *JMoSp*, 249, 86

Holtgrave, J. C. & Wolf, P. J. 2005, *PhRvA*, 72, 012711

Hoshina, H., Seta, T., Iwamoto, T., *et al.* 2008, *JQSRT*, 109, 2303

Hoshino, M., Pichl, L., Kanai, Y., *et al.* 2007, *PhRvA*, 75, 012716

Huang, Y., Wu, S., Yang, E., Gao, M., Zhang, X., Li, G., & Lu, F. 2005, *NIMPB*, 229, 46

Hudson, C. E. & Bell, K. L. 2005, *A&A*, 430, 725

Hudson, C. E. & Bell, K. L. 2006, *A&A*, 452, 1113

Ibrahim, N., Chelin, P., Orphai, J., & Baranov, Y. I. 2008, *JQSRT*, 109, 2523

Ibrahim, N., Thiebaud, J., Orphal, J., & Fittschen, C. 2007, *JMoSp*, 242, 64

Irrera, S. & Gianturco, F. A. 2005, *New J. Phys.*, 7, 1

Ishikawa, Y. & Vilkas, M. J. 2008, *PhRvA*, 77, 052701

Iglesias, E. J., Ghosh, J., Elton, R. C., & Griem, H. R. 2006, *JQSRT*, 98, 101

Ivković, M., Ben Nessib, N., & Konjević, N. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 715

Jacquemart, D., Tchana, F. K., Lacome, N., & Kleiner, I. 2007, *JQSRT*, 105, 264

Jacquemart, D. & Tran, H. 2008, *JQSRT*, 109, 569

Janowicz, M., Słabkowska, K., Matuszak, P., & Polasik, M. 2005, *NIMPB*, 235, 337

Jenouvrier, A., Daumont, L., Régalia-Jarlot, L., *et al.* 2007, *JQSRT*, 105, 326

Joly, L., Gibert, F., Grouiez, B., *et al.* 2008, *JQSRT*, 109, 426

Jovićević, S., Ivković, M., Žikić, R., & Konjević, N. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 1249

Jung, Y.-D. 2008, *ApJ*, 674, 1207

Kaiser, C., Spieker, D., Gao, J., *et al.* 2007, *JPhB: At. Mol. Opt. Phys.*, 40, 2563

Kaneyasu, T., Azuma, T., & Okuno, K. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 1341

Kanno, N., Tonokura, K., Tezaki, A., & Koshi, M. 2005, *JMoSp*, 229, 193

Kato, H., Kawahara, H., Hoshino, M., *et al.* 2008, *PhRvA*, 77, 062708

Kaur, S. & Baluja, K. L. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 3917

Kaur, S., Baluja, K. L., & Tennyson, J. 2008, *PhRvA*, 77, 032718
de Kertanguy, A., Feautrier N., & Motapon O. 2005, *A&A*, 432, 1131
Khakoo, M.A., Wang, S., Laher, R., *et al.* 2007, *JPhB: At. Mol. Opt. Phys.*, 40, F167
Khakoo, M. A., Blumer, J., Keane, K., *et al.* 2008, *PhRvA*, 77, 042705
Kimura, M., Pichl, L., Li, Y., *et al.* 2006, *EPJD*, 38, 85
Kokoouline, V. & Greene, C. H. 2005, *JPh-CS*, 4, 74
Koshelev, M. A., Tretyakov, M. Yu., Golubiatnikov, G. Yu., *et al.* 2007, *JMoSp*, 241, 101
Koshelev, M. A., Tretyakov, M. Yu., Lees, R. M., & Xu, L.-H. 2006, *JMoSt*, 780, 7
Krems, R., Jamieson, M. J., & Dalgarno, A. 2006, *ApJ*, 647, 1531
Kumar, T. J. D., Saieswari, A., & Kumar, S. 2006, *JCP*, 124, 034314
Kusakabe, T., Miyamoto, Y., Kimura, M., & Tawara, H. 2006, *PhRvA*, 73, 022706
O'Leary, D. M., Orphal, J., Ruth, A. A., *et al.* 2008, *JQSRT*, 109, 1004
Le Barbu, T., Zéninari, V., Parvitte, B., *et al.* 2006, *JQSRT*, 98, 264
Lee, T.-G. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 3665
Lee, T.-G., Balakrishnan, N., & Forrey, R. C. 2006, *JCP*, 125, 114302
Lepère, M. 2006, *JMoSp*, 238, 193
Lepère, M., Blanquet, G., Walrand, J., *et al.* 2007, *JMoSp*, 242, 25
Lepère, M., Valentin, A., Henry, A., *et al.* 2005, *JMoSp*, 233, 86
Lerot, C., Blanquet, G., Bouanich, J.-P., Walrand, J., & Lepère, M. 2005, *JMoSp*, 230, 153
Lerot, C., Blanquet, G., Bouanich, J.-P., Walrand, J., & Lepère, M. 2006a, *JMoSp*, 235, 196
Lerot, C., Blanquet, G., Bouanich, J.-P., Walrand, J., & Lepère, M. 2006b, *JMoSp*, 238, 224
Lesage, A. 2008, *New Astron. Revs*, in press
Li, H., Farooq, A., Jeffries, J. B., & Hanson, R. K. 2008, *JQSRT*, 109, 132
Li, J. S., Liu, K., Zhang, W. J., Chen, W. D., & Gao, X. M. 2008, *JQSRT*, 109, 1575
Lin, C. Y., Stancil, P. C., Li, Y., *et al.* 2007, *PhRvA*, 76, 012702
Lindahl, A. O., Andersson, P., Collins, G. F., *et al.* 2008, *PhRvA*, 77, 022710
Lindsay, B. G., Yu, W. S., & Stebbings, R. F. 2005a, *PhRvA*, 71, 032705
Lindsay, B. G., Wu, W. S., & Stebbings, R. F. 2005b, *JPhB: At. Mol. Opt. Phys.*, 38, 1977
Linert, I., Mielewska, B., King, G. C., & Zubek, M. 2007, *PhRvA*, 76, 032715
Lique, F., Dubernet, M.-L., Spielfiedel, A., & Feautrier, N. 2006a, *A&A*, 450, 399
Lique, F., Spielfiedel, A., & Cernicharo, J. 2006b, *A&A*, 451, 1125
Lique, F., Spielfiedel, A., Dhont, G., & Feautrier, N. 2006c, *A&A*, 458, 331
Lique, F. & Spielfiedel, A. 2007, *A&A*, 462, 1179
Lisgo, S., Brooks, N., Oks, E., *et al.*D. 2006, in: *Spectral Line Shapes*, *AIP-CP*, 874, 253
Liu, C.-N., Cheng, S.-C., Le, A.-T., & Lin, C. D. 2005, *PhRvA*, 72, 012717
Liu, C. L., Wang, J. G., & Janev, R. K. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 1223
Liu, C. L., Wang, J. G., & Janev, R. K. 2008a, *PhRvA*, 77, 032709
Liu, C. L., Wang, J. G., & Janev, R. K. 2008b, *PhRvA*, 77, 042712
Liu, X., Zhou, X., Jeffries, J. B., & Hanson, R. K. 2007, *JQSRT*, 103, 565
Lucchesini, A. & Gozzini, S. 2007, *JQSRT*, 103, 209
Luna, H., McGrath, C., Shah, M. B., *et al.* 2005, *ApJ*, 628, 1086
Lyulin, O. M., Jacquemart, D., Lacome, N., *et al.* 2008, *JQSRT*, 109, 1856
Ma, Q., Tipping, R. H., Boulet, C., *et al.* 2007, *JMoSp*, 243, 105
Machin, L. & Roueff, E. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 1519
Machin, L. & Roueff, E. 2006, *A&A*, 460, 953
Machin, L. & Roueff, E. 2007, *A&A*, 465, 647
Mack, A., Clark, T. K., Forrey, R. C., *et al.* 2006, *PhRvA*, 74, 052718
McLaughlin, B. M., Hibbert, A., Scott, M. P., *et al.* 2006, *A&A*, 446, 1185
Mahmoudi, W. F., Ben Nessib, N., & Dimitrijević, M. S. 2005, *A&A*, 434, 773
Mahmoudi, W. F., Ben Nessib, N., & Sahal-Bréchot, S. 2008, *EPJD*, 47, 7
Makochekanwa, C., Hoshino, M., Kato, H., *et al.* 2008, *PhRvA*, 77, 042717
Martin, B. & Lepère, M. 2008, *JMoSp*, 250, 70
Martin, B., Walrand, J., Blanquet, G., Bouanich, J.-P., & Lepère, M. 2006, *JMoSp*, 236, 52
Martín, F. 2007, *JPh-CS*, 88, 012001

Martinez, H., Hernandez, C. L., & Yousif, F. B. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 2535
Maslov, M., Brunger, M. J., Teubner, P. J. O., *et al.* 2008, *PhRvA*, 77, 062711
Matton, S., Rohart, F., Bocquet, R., *et al.* 2006, *JMoSp*, 239, 182
May, O., Fedor, J., Ibänescu, B. C., & Allan, M. 2008, *PhRvA*, 77, 040701
Mayo, R., Ortiz, M., & Plaza, M. 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 095702
Meléndez M. & Bautista, M. A. 2005, *A&A*, 436, 1123
Meléndez, M., Bautista, M. A., & Badnell, N. R. 2007, *A&A*, 469, 1203
Menard-Bourcin, F., Menard, J., & Boursier, C. 2007, *JMoSp*, 242, 55
Mihajlov, A. A., Ignjatović, M. Lj., & Dimitrijević, M. S. 2005, *A&A*, 437, 1023
Milosavljević, V., Ellingboe, A. R., & Djeniže, S. 2006, *Spectrochim. Acta B*, 61, 81
Milovanović, N. & Dimitrijević, M. S. 2007, in: *Spectral Line Shapes in Astrophysics*, Proc. VI Serbian Conf., *AIP-CP*, 938, 258
Minami, T., Pindzola, M. S., Lee, T.-G., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 2877
Misago, F., Lepère, M., Bouanich, J.-P., & Blanquet, G. 2008, *JMoSp*, 248, 14
Misago, F., Lepère, M., Walrand, J., Bouanich, J.-P., & Blanquet, G. 2006, *JMoSp*, 237, 46
Misago, F., Lepère, M., Walrand, J., Bouanich, J.-P., & Blanquet, G. 2007, *JMoSp*, 241, 61
Mondelain, D., Chelin, P., Valentin, A., *et al.* 2005, *JMoSp*, 233, 23
Mondelain, D., Payan, S., Deng, W., *et al.* 2007, *JMoSp*, 244, 130
Motapon, O., Tamo, F. O. W., Urbain, X., & Schneider, I. F. 2008, *PhRvA*, 77, 052711
Mrugala, F. & Kraemer, W. P. 2005, *JCP*, 122, 224321
Mullamphy, D. F. T., Peach, G., Venturi, V., *et al.* 2007, *JPhB: At. Mol. Opt. Phys.*, 40, 1141
Munjal, H. & Baluja, K. L. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 3185
N'Dollo, M. & Donga-Passi, J. 2006, *PhyS*, 74, 208
Ngassam, V., Orel, A. E., & Suzor-Weiner, A. 2005, *JPh-CS*, 4, 224
Ngassam, V., Florescu-Mitchell, A. I., & Orel, A. E. 2008, *PhRvA*, 77, 042706
Nguyen, L., Blanquet, G., Anwera, J. V., & Lepère, M. 2008, *JMoSp*, 249, 1
Nguyen, L., Ivanov, S. V., Buzykin, O. G., & Buldyreva, J. 2006, *JMoSp*, 239, 101
Ogurtsov, G. N., Mikoushkin, V. M., Ovchinnikov, S. Yu., *et al.* 2006, *PhRvA*, 74, 042720
Ohlinger, L., Forrey, R. C., Lee, T.-G., & Stancil, P. C. 2007, *PhRvA*, 76, 042712
Olkhov, R. V. & Smith, I. W. M. 2007, *JCP*, 126, 134314
Oks, E., *et al.* (eds.) 2006, Proc. 18th Intern. Conf. *Spectral Line Shapes*, *AIP-CP*, 874
Oks, E. 2006, *Stark Broadening of Hydrogen, & Hydrogenlike Spectral Lines in Plasmas* (Oxford: Alpha Science International)
Omar, B., Günter, S., Wierling, A., & Röpke, G. 2006, *PhRvE*, 73, 056405
Ortiz, M. & Mayo, R. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 3953
Orton, G. S., Gustafsson, M., Burgdorf, M., & Meadows, V. 2007, *Icarus*, 189, 544
Otranto, S. & Olson, R. E. 2008, *PhRvA*, 77, 022709
Otranto, S., Olson, R. E., & Beiersdorfer, P. 2006, *PhRvA*, 73, 022723
Ovchinnikov, S. Yu, Krstić, P. S., & Macek, J. H. 2006, *PhRvA*, 74, 042706
Palov, A. P., Gray, M. D., Field, D., & Balint-Kurti, G. G. 2006, *ApJ*, 639, 204
Pandey, M. K. & Dubey, R. K. 2007, *EPJD*, 41, 275
Peláez, R. J., Ćirišan, M., Djurović, S., *et al.* 2006a, *JPhB: At. Mol. Opt. Phys.*, 39, 5013
Peláez, R. J., González, V. R., Rodríguez, F., Aparicio, J. A., & Mar, S. 2006b, *A&A*, 453, 751
Perez, J. A. & Olson, R. E. 2005, *NIMPB*, 241, 134
Pindzola, M. S., Loch, S. D., Colgan, J., & Fontes, C. J. 2008, *PhRvA*, 77, 062707
Pindzola, M. S., Robicheaux, F., & Colgan, J. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, L285
Popović, L.Č., & Dimitrijević, M.S. (eds, 2007, *Spectral Line Shapes in Astrophysics*, Proc. VIth Serbian Conf., *AIP-CP*, 938
Popović, L.Č., Dimitrijević, M. S., Simić, S., *et al.* 2008, *New Astron.*, 13, 85
Poquérusse, A. & Alexiou, S. 2006, *JQSRT*, 99, 493
Predoi-Cross, A., Brawley-Tremblay, M., Brown, L. R., *et al.* 2006, *JMoSp*, 236, 201
Predoi-Cross, A., Hambrook, K., Keller, R., *et al.* 2008a, *JMoSp*, 248, 85
Predoi-Cross, A., Holladay, C., Heung, H., *et al.* 2008b, *JMoSp*, 251, 159
Predoi-Cross, A., Unni, A. V., Heung, H., *et al.* 2007a, *JMoSp*, 246, 65

Predoi-Cross, A., Unni, A. V., Liu, W., *et al.* 2007b, *JMoSp*, 245, 34
Predoi-Cross, A., Liu, W., Holladay, C., *et al.* 2007c, *JMoSp*, 246, 98
Ptashnik, I. V., Smith, K. M., & Shine, K. P. 2005, *JMoSp*, 232, 186
Purić, J., Dojčinović, I. P., Nikolić, M., *et al.* 2008, *ApJ*, 680, 803
Rabasović, M. S., Kelemen, V. I., Tošić, S. D., *et al.* 2008, *PhRvA*, 77, 062713
Rabli, D. & McCarroll, R. 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 3311
Ramsbottom, C. A., Hudson, C. E., Norrington, P. H., & Scott, M. P. 2007, *A&A*, 475, 765
Reese, C., Stoecklin, T., Voronin, A., & Rayez, J.C. 2005, *A&A*, 430, 1139
Rescigno, T. N., McCurdy, C. W., Haxton, D. J., *et al.* 2007, *JPh-CS*, 88, 012027
Rinsland, C. P., Devi, V. M., Benner, D. C., *et al.* 2008, *JQSRT*, 109, 974
Rohart, F., Nguyen, L., Buldyreva, J., *et al.* 2007, *JMoSp*, 246, 213
Rohart, F., Włodarczak, G., Colmont, J.-M., *et al.* 2008, *JMoSp*, 251, 282
Rosenberry, M. A., Burgess, K. M., & Stewart, B. 2007, *JPhB: At. Mol. Opt. Phys.*, 40, 177
Rothman, L. S., Jacquemart, D., Barbe, A., *et al.* 2005, *JQSRT*, 96, 139
Sahal-Bréchot, S., Derouich, M., Bommier, V., & Barklem, P.S. 2007, *A&A*, 465, 667
Schmidt, E. W., Bernhardt, D., Müller, A., *et al.* 2007, *PhRvA*, 76, 032717
Schultz, D. R. & Stancil, P. C. 2007, in: O. Engvold (ed.), *Reports on Astronomy 2002 - 2005, IAU Transactions XXVIA* (Cambridge: CUP), 134
Seredyuk, B., McCullough, R. W., & Gilbody, H. B. 2005a, *PhRvA*, 71, 022713
Seredyuk, B., McCullough, R. W., & Gilbody, H. B. 2005b, *PhRvA*, 72, 022710
Seredyuk, B., McCullough, R. W., Tawara, H., *et al.* 2005c, *PhRvA*, 71, 022705
Seta, T., Hoshina, H., Kasai, Y., *et al.* 2008, *JQSRT*, 109, 144
Shepler, B. C., Yang, B. H., Kumar, T. J. D., *et al.* 2007, *A&A* (Letters), 475, L15
Shi, D., Sun, J., Liu, Y., & Zhu, Z. 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 025205
Simić, Z., Dimitrijević, M. S., Milovanović, N., & Sahal-Bréchot, S. 2005a, *A&A*, 441, 391
Simić, Z., Dimitrijević, M. S., Popović, L.Č., & Dačić, M. D. 2005b, *JApSp*, 72, 443
Simić, Z., Dimitrijević, M. S., Popović, L.Č., & Dačić, M. D. 2006, *New Astron.*, 12, 187
Smith, M. A. H., Rinsland, C. P., Blake, T. A., *et al.* 2008, *JQSRT*, 109, 922
Sobocinski, P., Pešić R., Hellhammer, R., *et al.* 2005, *NIMPB*, 233, 207
Srećković, A., Bukvić, S., & Djeniže, S. 2005a, *PhSc*, 71, 218
Srećković, A., Bukvić, S., Djeniže, S., *et al.* 2005b, *Publ. Astron. Soc. "Rudjer Bošković"*, 5, 275
Srećković, A., Nikolić, Z., Bukvić, S., & Djeniže, S. 2007, *JQSRT*, 105, 536
Staak, M., Gash, E. W., Venables, D. S., & Ruth, A. A. 2005, *JMoSp*, 229, 115
Stambulchik, E., Alexiou, S., Griem, H. R., & Kepple, P. C. 2007, *PhRvE*, 75, 016401
Stambulchik, E. & Maron, Y. 2006, *JQSRT*, 99, 730
Stambulchik, E. & Maron, Y. 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 095703
Stehlé, C., Busquet, M., Gilles, D., & Demura, A.V. 2005, *Laser & Particle Beams*, 23, 357
Storey, P. J., Del Zanna, G., Mason, H. E., & Zeippen, C. J. 2005, *A&A*, 433, 717
Sung, K. & Varanasi, P. 2005, *JQSRT*, 91, 319
Suno, H. & Kato, T. 2006, *At. Data Nucl. Data Tables*, 92, 407
Suno, H., Rai, S. N., Liebemann, H.-P., *et al.* 2006, *PhRvA*, 74, 012701
Suzuki, R., Rai, S. N., Liebemann, H.-P., *et al.* 2005, *PhRvA*, 71, 032710
Szmytkowski, C., Domaracka, A., Możejko, P., *et al.* 2005, *JPhB: At. Mol. Opt. Phys.*, 38, 745
Szmytkowski, C., Możejko, P., Kwitnewski, S., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 2571
Tashiro, M. & Morokuma, K. 2007, *PhRvA*, 75, 012720
Tayal, S. S. 2007, *ApJS*, 171, 331
Thibault, F. 2005, *JMoSp*, 234, 286
Thibault, F., Mantz, A. W., Claveau, C., *et al.* 2007, *JMoSp*, 246, 118
Tobola, R., Klos, J., Lique, F., Chalasinski, G., & Alexander, M. H. 2007, *A&A*, 468, 1123
Tolchenov, R. N. & Tennyson, J. 2005, *JMoSp*, 231, 23
Tong, L. & Nanbu, K. 2007, *Vacuum*, 81, 1119
Toth, R. A. 2005, *JQSRT*, 94, 1
Toth, R. A., Brown, L. R., Miller, C. E., Devi, V. M., & Benner, D. C. 2006, *JMoSp*, 239, 243
Toth, R. A., Brown, L. R., Miller, C. E., Devi, V. M., & Benner, D. C. 2008, *JQSRT*, 109, 906

Toth, R. A., Miller, C. E., Devi, V. M., Benner, D.C., & Brown, L.R. 2007, *JMoSp*, 246, 133
Tran, H., Bermejo, D., Domenech,J.-L., *et al.* 2007, *JQSRT*, 108, 126
Tran, H., Flaud, P.-M., Flouchet, T., Gabard, T., & Hartmann, J.-M. 2006, *JQSRT*, 101, 306
Tran, H., Jacquemart, D., Mandin, J.-Y., & Lacome, N. 2008, *JQSRT*, 109, 119
Tretyakov, M. Yu., Koshelev, M. A., Dorovskikh, V. V., *et al.* 2005, *JMoSp*, 231, 1
Tretyakov, M. Yu., Koshelev, M. A., Koval, I. A., *et al.* 2007, *JMoSp*, 241, 109
del Val, J. A., Peláez, R. J., Mar, S., *et al.* 2008, *PhRvA*, 77, 012501
Valognes, J. C., Bardet, J. P., Vitel, Y., & Flih, S.A. 2005, *JQSRT*, 95, 113
Vincent, L. F. M., Spielfiedel, A., & Lique, F. 2007, *A&A*, 472, 1037
Wang, J. G., He, B., Ning, Y., Liu, C. L., Yan, J., *et al.* 2006, *PhRvA*, 74, 052709
Wang, Y. & Zhou, Y. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 3009
Wargelin, B. J., Beiersdorfer, P., Neill, P. A., Olson, R. E., & Scofield, J. H. 2005, *ApJ*, 634, 687
Watson ,J. K. G. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 1889
Weck, P. F., Kwong, V. H. S., & Salama, F. 2006, Proc. *NASA Laboratory Astrophysics Workshop*, *NASA-CP* 2006-214549
Wehr, R., Ciuryło, R., Vitcu, A., *et al.* 2006a, *JMoSp*, 235, 54
Wehr, R., Vitcu, A., Thibault, F., *et al.* 2006b, *JMoSp*, 235, 69; erratum, 237, 126
Wells, E., Krishnamurthi, V., Carnes, K. D., *et al.* 2005, *PhRvA*, 72, 022726
Wells, E., Nishide, T., Tawara, H., *et al.* 2008, *PhRvA*, 77, 064701
Wernli, M., Valiron, P., Faure, A., *et al.* 2006, *A&A*, 446, 367
Wernli, M., Wiesenfeld, L., Faure, A., & Valiron, P. 2007, *A&A*, 464, 1147
Wilson, N. J., Bell, K. L., & Hudson, C. E. 2005, *A&A*, 432, 731; erratum 461, 765
Winstead, C. & McKoy, V. 2007, *PhRvA*, 76, 012712
Wishnow, E. H., Orton, G. S., Ozier, I., & Gush, H. P. 2007, *JQSRT*, 103, 102
Witthoeft, M. C. & Badnell, N. R. 2008, *A&A*, 481, 543
Witthoeft, M. C., Badnell, N. R., Del Zanna, G., *et al.* 2006, *A&A*, 446, 361
Witthoeft, M. C., Del Zanna, G., & Badnell, N. R. 2007, *A&A*, 466, 763
Woodall, J., Agúndez, M., Markwick-Kemper, A. J., & Millar, T. J. 2007, *A&A*, 466, 1197
Wrathmall, S. A. & Flower, D. R. 2006, *JPhB: At. Mol. Opt. Phys.*, 39, L249
Wrathmall, S. A., Gusdorf, A., & Flower, D. R. 2007, *MNRAS*, 382, 133
Xie, Z., Bowman, J. M., & Zhang, X. 2006, *JChPh*, 125, 133120
Yamada, M. M. & Amano, T. 2005, *JQSRT*, 95, 221
Yang, B. & Stancil, P. C. 2007, *JCP*, 126, 154306
Yang, B. & Stancil, P. C. 2008, *EuPhJD*, 47, 351
Yang, B., Perera, H., Balakrishnan, N., *et al.* 2006a, *JPhB: At. Mol. Opt. Phys.*, 39, S1229
Yang, B., Stancil, P. C., Balakrishnan, N., & Forrey, R. C. 2006b, *JCP*, 124, 104304
Zarour, B., Champion, C., Hanssen, J., & Lasri, B. 2005, *NIMPB*, 235, 374
Zatsarinny, O. & Bartschat, K. 2008, *PhRvA*, 77, 062701
Zeng, S. L., Liu, L., Wang, J. G., & Janev, R. K. 2008, *JPhB: At. Mol. Opt. Phys.*, 41, 135202
Zéninari, V., Joly, L., Grouiez, B., Parvitte, B., & Barbe, A. 2007, *JQSRT*, 105, 312
Zhao, L. B., Wang, J. G., Stancil, P. C., *et al.* 2006, *JPhB: At. Mol. Opt. Phys.*, 39, 5151
Zhao, L.B., Watanabe, A., Stancil, P. C., & Kimura, M. 2007, *PhRvA*, 76, 022701
Zhaunerchyk, V., Geppert, W. D., Österdahl, F., *et al.* 2008a, *PhRvA*, 77, 022704
Zhaunerchyk, V., Thomas, R. D., Geppert, W. D., *et al.* 2008b, *PhRvA*, 77, 034701
Zhu, C., Babb, J. F., & Dalgarno, A. 2006, *PhRvA*, 73, 012506
Zhu, X. L., Ma, X., Wei, B., Liu, H. P., Wang, Z. L., *et al.* 2005, *NIMPB*, 235, 387
Zmerli, B., Ben Nessib, N., & Dimitrijević, M. S. 2008, *EPJD*, 48, 389
Zouros, T. J. M., Sulik, B., Gulyás, L., & Tökési, K. 2008, *PhRvA*, 77, 050701
Zygelman, B. 2005, *ApJ*, 622, 1356