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M. Hayashi

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E-mail: bunken@nifs.ac.jp

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Bibliography of Electron and Photon Cross Sections with Atoms and Molecules Published in the 20th Century

—— Xenon ——*

Makoto Hayashi

(Gaseous Electronics Institute)

A bibliographies of original and review reports of experiments or theories of electron and photon cross sections and also electron swarm data are presented for atomic or molecular species with specified targets. These works covered 17 atoms and 51 molecules. The present bibliography is only for xenon (Xe). About 1180 papers were compiled. A comprehensive author index is included. The bibliography covers the period 1921 through 2000 for Xe. Finally, author's recommended Xe electron collision cross section set is given by number tables

Keywords : Xe atom, collision cross section, electron, elastic scattering, electronic excitation, ionization, photon, photoabsorption, photodissociation, photoexcitation, photoionization, electron swarm, drift velocity, diffusion coefficient, ionization coefficient, excitation and ionization energies, transition probability, lifetimes of excited states

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Introduction

History

This bibliography is the result of a continuing literature survey which was begun in around 1970 and originally encompassed only electron collision cross section and electron swarm data. The organization responsible for continuing this survey is Nagoya Institute of Technology, Nagoya. From 1994, the work continued to Gaseous Electronics Insititute, Nagoya. In 1997, the collection of photon cross section references was begun. The search for references in both cases was retrospective and included all papers reporting measurements, calculations or reviews of such cross sections and electron swarm data.

Scope

This bibliograthy containes references to original research papers which report experiments or theoretical calculations of cross sections for electron and photon collisions with xenon (Xe) atom. The review papers on this subject are also included. Some xenon cluster papers are included. Some conference reports, company or agency reports and PhD thesis are added. Xenon ion papers and positron collision papers are not included in principle.

Papers of the following quantities are included.

For electron collision cross section :

1) elastic scattering
2) electronic excitation
3) ionization
4) grand total scattering (sum of elastic and inelastic cross sections)
5) metastable xenon
6) electron swarm parameters (drift velocity, diffusion coefficient)
7) excitation and ionization coefficients

For photon collision cross section :

1) photoabsorption
2) photoexcitation and fluorescence
3) photodissociation
4) photoionization

For some related data :

1) excitation and ionization energies
2) transition probabilitiy
3) lifetime of excited states
4) the others

The energy range for electron cross section data is 0 - 10 keV mostly, but some more higher electron energy papers are included. The wavelength range for photon cross section data is from microwave to X-ray. Almost papers are concerned with infrared, visible and ultraviolet ray region.

The bibliography include the papers published in the 20th century, from 1901 to 2000. But oldest paper in this list is given by C. Ramsauer (1921). So for this xenon bibliography, published papers from 1921 to 1999 are compiled by alphabetical order of the first author's surname of the paper. And the references published in 2000 and plus some old papers found very recently after compilation are added as "Addenda of References for Xenon". Totally, about 1180 papers are compiled in the xenon bibliography.

Organization

This report consists of four parts : introduction, the bibliography and its addenda, author index and electron collision cross section set recommended by the author.

Bibliography

In this section the complete citation for all references are given. At first following classifications are shown :

E : Elastic collision
EX : electronic EXcitation
I : Ionization
ME : MEtastable xenon
S : electron Swarm
O : the Others (photon cross sections and the others)

All authors' initial and surname, journal name, volume, inclusive pages and year of publication are given as well as the title, and some additional informations in the square bracket [ ]. E and T in the square bracket mean experiment and theory.

Bibliography for Xe are divided into three parts :

Part 1.	1980 - 1999	p. 1 - 42	
Part 2.	1921 - 1979	p. 43 - 76	
Part 3.	Addenda of References (1)	1997 - 1999	p. 77 - 79
	Addenda of References (2)	published in 2000, plus some old papers	p. 80 - 100
	Addenda of References (3)		p. 101 - 102

Author Index

In this section all authors are listed alphabetically by surname. After each author's name is a list of page numbers indicating which references he or she authored or coauthored. (Author Index of Addenda of References for Xe (2) is not complete and some selected authors are listed. I am sorry about it.)

Electron Collision Cross Section Set for Xenon (Xe)

Electron collision cross section set of elastic, electronic excitation and ionization collision for xenon recommended by the author are given by the tables. Final conclusions are given and detailed discussions are not shown here. Elastic total and elastic momentum transfer cross sections are obtained from author's recommended elastic differential cross sections. These values of the set are not final, in other words, tentative values. The author would like to improve this cross section set slightly.

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National Institute for Fusion Science, Toki
Institute for Molecular Science, Okazaki

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References for Xe (1980 - 1999)

(Xenon)

[Inert gas, Noble gas]

E	: Elastic collision,	EX	: Electronic excitation,
I	: Ionization,	QT	: Grand total cross section,
ME	: Metastable xenon,	S	: Swarm, O : The others,
α	: Ionization coefficient,	[ ]	: Additional informations, E : Exp., T : Theory.

Some important papers published till 1979 are included in this part.

E V. V. Afonin, Yu. M. Gapperin, V. L. Gurevich and A. Schmid : Phys. Rev. A36, 5729-5741 (1987)
Weak localization of electrons in a classical gas.
[T, general theory]

O S. Aksela : J. Elect. Spectrosc. Relat. Phenom. 79, 247-252 (1996)·
High resolution electron spectroscopy of atoms and molecules.
[E, hν, Xe, Kr, He, H_2S]

S N. L. Aleksandrov, I. V. Kochetov, D. Lo and A. P. Napartovich : J. Phys. D30, 2217-2222 (1997)
Negative differential conductivity of electrons in He - Xe mixtures.
[T, Xe + He; see N. L. Aleksandrov (1996), I. V. Kochetov (1998)]

O M. Allan : J. Phys. B26, L73-L77 (1993)
Low energy electron impact spectra of the van der Waals clusters Xe_2 and Xe_n (n = 3, 4). [E, Xe_2, Xe_3, Xe_4]

QT D. T. Alle, M. J. Brennan and S. J. Buckman : 18th ICPEAC, Aarhus 127-127 (1993)·Z
Total electron scattering cross sections for neon, nitrogen and xenon.
[E, Xe, Ne, N_2; 0.1 - 20 eV]

O D. P. Almeida and C. F. L. Godinho : Nucl. Instrum. Meth. B114, 337-340 (1997), Erratum 122, 167-167 (1997)
Integrated oscillator strengths for multiionization processes under the Bethe-Born formulation. [T, Ne - Xe]

O Z. Altun, M. Kutzner and H. P. Kelly : Phys. Rev. A37, 4671-4678 (1988)
Photoionization of the 4d subshell of xenon. [T, hν, Xe]

O M. Ya. Amus'ya, V. K. Ivanov, S. A. Sheinerman, S. I. Sheftel' and A. F. Ioffe : Sov. Phys. JETP 51, 458-465 (1980)
Manifestation of restructuring of the electron shells in atoms in the course of ionization. [T, hν, Xe, Ar, Cs, Ba]

O M.Ya.Amusia, N.B.Avdonina, L.V.Chernysheva and M.Yu.Kuchiev : J.Phys.B18, L791-L796 (1985a)
'Stripping' of the atom in bremsstrahlung. [T, Xe, La]

O M.Ya.Amusia, V.K.Ivanov and V.A.Kupchenko : J.Phys.B18, 3871-3879 (1985b)
The effect of atomic rearrangement on the photoionisation cross section for 3d subshells of the isoelectronic Xe series. [T, hν, Xe]

O M.Ya.Amusia : Comments At.Mol.Phys.16, 143-155 (1985c)・
Spectroscopic factor and the renormalization of interelectron interaction. [comments, hν, Ar - Xe]

O M.Ya.Amusia, I.M.Band, V.K.Ivanov, V.A.Kupchenko and M.B.Trzhaskovskaya : Bull.Acad.Sci.USSR Phys.Ser.50, No.7, 19-25 (1986)
Nonphysical characteristics of the photoionization cross sections of internal shells. [T, hν, Ar - Xe, Cu, Hg]

O M.Ya.Amusia and A.V.Korol : Nucl.Instrum.Meth.B79, 146-149 (1993)・
Recent developments of "polarizational" bremsstrahlung. [T, Xe, He, Ne]

EX N.Anderson, J.W.Gallager and I.V.Hertel : Phys.Rep.165, 1-188 (1988)
Collisional alignment and orientation of atomic outer shells. I. Direct excitation by electron and atomic impact.
[review, He - Xe, H, Li, Na, K, Hg, Ba]

ME E.A.Andreev and A.E.Bodrov : Chem.Phys.Lett.109, 450-455 (1984)・
Inelastic scattering of low-energy electrons by metastable atoms.
[T, He - Xe, C, N, O]

α T.Aoyama : Nucl.Instrum.Meth.A234, 125-131 (1985)
Generalized gas gain formula for proportional counters.
[T, Xe + CO_2, Ar + CH_4, etc.]

O I.Arcon, A.Kodre, M.Stuhec and D.Glavic-Cindro : Phys.Rev.A51, 147-154 (1995)
Multielectron excitations in the L-subshell photoabsorption of xenon.
[E, hν, Xe]

O G.B.Armen, J.Tulkki, T.Aberg and B.Crasemann : Phys.Rev.A36, 5606-5614 (1987b)
Quantum theory of post-collision interaction in inner-shell photo-ionization : Final-state interaction between two continuum electrons.
[T, hν, Xe, Ar]

O U.Arp, K.Iemura, G.Kutluk, T.Nagata, S.Yagi and A.Yagishita : J.Phys.B32, 1295-1304 (1999)
3d photoionization of Xe, Cs and Ba and the collapse of the 4f wave-function. [E, hν, Xe, Cs, Ba]

O T.U.Arslanbekov, F.A.Iskanderov and R.Ya.Pirogovskii : Bull.Acad.Sci.USSR Phys.Ser.52, No.6, 122-123 (1988)
Highly charged inert-gas ions produced by nanosecond laser pulses.
[E, hν, Ar - Xe]

O T. Auguste, P. Monot, L. A. Lompre, G. Mainfray and C. Manus : J. Phys. B25, 4181-4194 (1992)
Multiply charged ion produced in noble gases by a 1 ps laser pulse at λ = 1053 nm. [E, hν, Xe, He - Ar]

O L. Avaldi, R. I. Hall, G. Dawber, P. M. Rutter and G. C. King : J. Phys. B24, 427-438 (1991)
A study of post-collision interaction effects in Kr 3d and Xe 4d near-threshold photoionization. [E, hν, Xe, Kr]

I L. Avaldi, R. Camilloni, R. Multari, G. Stefani, X. Zhang, H. R. J. Walters and C. T. Whelan : Phys. Rev. A48, 1195-1203 (1993)
Coplanar asymmetric (e, 2e) experiments on xenon 4p and 5p orbitals. [E, Xe]

I L. Avaldi, P. Bolognesi, R. Camilloni and G. Stefani : Phys. Rev. Lett. 75, 1915-1918 (1995)
Observation of angle dependent postcollision interaction in the electron impact ionization of Xe $4d_{5/2}$. [E, Xe; 1000 eV]

EX L. Avaldi, P. Bolognesi, R. Camilloni, E. Fainelli, R. A. Multari and G. Stefani :
I Phys. Rev. A54, 2930-2943 (1996)
Formation and decay of Xe $4d^{-1}$ vacancies studied via electron-electron coincidence experiments. [E, Xe]

E B. Awe, F. Kemper, F. Rosicky and R. Feder : J. Phys. B16, 603-612 (1983)
Electron scattering of slow electrons from xenon atoms. [T, Xe; relativistic Hartree-Fock]

I M. Aydinol : J. Phys. B14, 741-750 (1981)
L-subshell ionization cross sections of xenon by electron impact near threshold region. [E, Xe; 6 - 14 keV]

S A. Bagheri, K. L. Baluja and S. M. Datta : Z. Phys. D32, 211-217 (1994)·
Density dependence of electron mobility in dense gases. [T, He - Xe, H_2, N_2, O_2, CO_2; multiple-scattering approach]

E P. Baille, J.-S. Chang, A. Claude, R. M. Hobson, G. L. Ogram and A. W. Yau : J. Phys. B14, 1485-1495 (1981)·
Effective collision frequency of electrons in noble gases. [T, He - Xe; assuming Maxwellian distribution]

O S. J. Bajic, R. N. Compton, X. Tang and P. Lambropoulos : Phys. Rev. A44, 2102-2112 (1991)
Resonantly enhanced multiphoton-ionization photoelectron spectroscopy of krypton and xenon : Experiment and theory. [E and T, hν, Xe, Kr]

EX K. Bartschat and D. H. Madison : J. Phys. B20, 5839-5863 (1987)·,
Erratum 25, 1361-1361 (1992)
Electron impact excitation of rare gases : Differential cross sections and angular correlation parameters for neon, argon, krypton and xenon.
[T, Ne - Xe]

E K. Bartschat : Phys. Rep. 180, 1-81 (1989)·
EX Excitation and ionization of atoms by interaction with electrons,
I positrons, protons and photons.
O [review, Xe, Kr, Ar, Ca, Zn, etc.; general density matrix theory]

EX K. Bartschat and D. H. Madison : J. Phys. B25, 4619-4626 (1992)·
Non-statistical branching ratios for excitation of $[np^5(n+1)s]^{1,3}P^0_{0,1,2}$ states in noble gases. [T, Ne - Xe]

EX K. Becker, A. Crowe and J. W. McConkey : J. Phys. B25, 3885-3913 (1992)
A critical look at electron-photon coincidence experiments with heavy noble gases in the regime of large impact parameters.
[review, Ne - Xe]

O U. Becker, T. Prescher, E. Schmidt, B. Sonntag and H.-E. Wetzel : Phys. Rev. A33, 3891-3899 (1986)
Decay channels of the discrete and continuum Xe 4d resonances.
[E, hν, Xe]

O U. Becker, H. G. Kerkhoff, M. Kupsch, B. Langer, D. Szostak and R. Wehlitz : J. Physique 48, C9, 497-500 (1987)
Photoionization of xenon with soft X-rays. [E, hν, Xe; 250 - 1000 eV]

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Decay of the Xe 4d → np excitations : resonant shake-off versus shake-up and spectator transitions. [E, hν, Xe]

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Subshell photoionization of Xe between 40 and 1000 eV. [E, hν, Xe]

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Threshold behaviour and resonances in the photoionization of atoms and molecules. [review, hν, Ne - Xe, Li, CO, N_2]

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Double ionization of neutral atoms, positive and negative ions by electron impact. [E and T, Ne - Xe, Cu, etc.]

O P. Berejny, P. M. Millet, M. Saissac and Y. Salamero : J. Phys. B26, 3339-3353 (1993)
Spectroscopic and kinetic study of xenon after a multiphonic excitation of the $5d|5/2|_{J=3}$ and $5d|7/2|_{J=3}$ states. [E, hν, Xe]

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The elastic scattering of low energy electrons from xenon.
[T, Xe; 5.5 - 10 eV]

E O.Berger and J.Kessler : J.Phys.B19,3539-3557 (1986)・
Elastic scattering of polarised electrons from mercury and xenon.
[E, Xe, Hg; 40 - 350 eV]

E D.Bessis,A.Haffad and A.Z.Msezane : Phys.Rev.A49,3366-3375 (1994)・
EX Momentum-transfer dispersion ralations for electron-atom cross sections.
[T, Ar - Xe; 100 - 500 eV]]

ME A.B.Blagoev,T.M.Mishonov and Tc.K.Popov : J.Phys.B17,435-441 (1984a)・
Superelastic collisions between slow electrons and excited Kr and Xe atoms.
Possible reaction mechanism for rare-gas atoms. [E, Ar - Xe]

EX A.Blagoev,Iv.Ivanov,T.Mishonov and Tc.Popov : J.Phys.B17,L647-L652 (1984b)・Z
Absolute calibration of arbitrary cross sections for electron impact
excitation of Xe metastable states in the near-threshold region.
[E, Xe; th.- 12.5 eV]

EX D.P.Bochkova and A.P.Moritts : Opt.Spectrosc.56,104-106 (1984)
Rate of deexcitation of the xenon $^3P_2(6s[11/2]_2)$ state by slow electrons
as a function of electron impact in the 0.1 - 1-eV range.
[E, Xe]

EX I.P.Bogdanova and S.V.Yurgenson : Opt.Spectrosc.70,285-286 (1991)・
Cross sections for direct electronic excitation of atomic levels :
Measurements using a pulsed electron beam and time scanning of radiation.
V : Xenon, $5p^56p$ levels. [E, Xe]

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Experimental xenon 4d photoionization cross sections in the 75 - 140-eV
photon energy range. [E, hν, Xe]

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3726-3734 (1995)
Unexpected product fine-structure distributions in (3+1)-photon
ionization of xenon. [E, hν, Xe]

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Intensity dependence of the multiphoton-induced Xe(L) spectrum
produced by subpicosecond 248 nm excitation of Xe clusters. [E, hν, Xe]

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Vanishing post collision interaction in inner-shell photoionization.
[E, hν, Xe; 70 - 120 eV]

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Satellite structure of the xenon valence shell by electron-momentum
spectroscopy. [E, Xe]

I C. E. Brion, Y. Zheng, J. Rolke, J. Neville, E. R. Davidson and I. E. McCarthy : 20th ICPEAC, Vienna TU101 (1997)
Distorted wave effects at low momentum in (e, 2e) cross sections for a orbital ionization. [E, Xe, $Mo(CO)_6$]

E J. P. Bromberg : J. Chem. Phys. 61, 963-969 (1974) ○Z
Absolute differential cross sections of electrons elastically scattered by the rare gases. I. Small angle scattering between 200 and 700 eV.
[E, He - Xe; 300 - 700 eV, 3 - 25°]

I I. K. Bronic, M. Kimura, M. Inokuti and M. A. Dillon : Nucl. Instrum. Meth. B71, 366-370 (1992)・
The Fano factor for electrons in gas mixtures.
[T, He - Xe, H_2, N_2, O_2, CO_2, CH_4, C_2H_2]

S H. L. Brooks, M. C. Cornell, J. Fletcher, I. M. Littlewood and K. J. Nygaard : J. Phys. D15, L51-L53 (1982)
Electron drift velocities in xenon. [E, Xe; 1 - 60 Td]

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An electron momentum spectroscopy investigation of the 4d core states of xenon. [E, Xe; 1000 eV]

EX J. N. H. Brunt, G. C. King and F. H. Read : J. Phys. B9, 2195-2207 (1976)・Z
A study of resonance structure in neon, argon, krypton and xenon using metastable excitation by electron impact with high energy resolution.
[E, Ne - Xe; th. - 13.8 eV]

EX J. N. H. Brunt, G. C. King and F. H. Read : J. Phys. B10, 3781-3796 (1977) Z
Near-threshold electron impact excitation of ultraviolet-emitting levels of neon, argon, krypton and xenon atoms.
[E, Ne - Xe; th. - 13.8 eV]

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Analytical partitioning of total cross sections for electron scattering on noble gases. [empirical formula, He - Xe, 20 - 5000 eV]

EX S. J. Buckman, G. C. King and F. H. Read : 12th ICPEAC, Gatlinburg 1, 200-201 (1981)・
High resolution electron impact excitation of negative ion resonances in Ne, Ar, Kr and Xe. [E, Ne - Xe]

EX S. J. Buckman, P. Hammond, G. C. King and F. H. Read : J. Phys. B16, 4219-4236 (1983) ○Z
High-resolution electron impact excitation functions of metastable states of neon, argon, krypton and xenon. [E, Ne - Xe]

EX S. J. Buckman and C. W. Clark : Rev. Mod. Phys. 66, 536-655 (1994) ○
Atomic negative-ion resonances. [review, for Xe, p. 599-603, 607-608]

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The extraction of Sherman functions from unpolarized, low-energy electron scattering from xenon. [E and T, Xe; DCS at 1 eV]

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Nonresonant above-threshold ionization by circularly polarized subpicosecond pulses. [E, hν, Xe; 140 fs]

O C. D. Caldwell : Nucl. Instrum. Meth. B56/57, 188-191 (1991)
Details of electron correlation explored with VUV and soft X-radiation. [E, hν, Xe only]

O C. D. Caldwell and S. Hallman : Phys. Rev. A53, 3344-3347 (1996)
Angular distribution of decay electrons from the 6p resonance excitations in xenon. [E, hν, Xe]

O R. J. Cedolin, R. K. Hanson and M. A. Cappelli : Phys. Rev. A54, 335-342 (1996)
Laser-induced fluorescence measurements of resonance broadening in xenon. [E, hν, Xe]

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Absolute optical oscillator strengths for the electronic excitation of atoms at high resolution. Ⅲ. The photoabsorption of argon, krypton, and xenon. [E, hν, Ar - Xe]

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Photoionization from the excited p states of the rare-gas atoms. [T, hν, Ne - Xe]

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Angular distributions of photoelectrons in resonantly enhanced multiphoton ionization via the $7s[1\ 1/2]^{o}_{1}$ and $8s[1\ 1/2]^{o}_{1}$ states of Xe. [E, hν, Xe]

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Cancellation effects in four-photon-resonant five-photon ionization through the nf J=2 states of Xe. [E, hν, Xe]

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Partial doubly differential cross sections for multiple ionization of argon, krypton and xenon atoms by electron impact. [E, Ar - Xe]

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Relativistic optical potential method for electron and positron scattering from heavy noble gases. [T, Xe; 20 - 150 eV]

EX Z. Chen and A. Z. Msezane : Phys. Rev. A55, 812-814 (1997)
Formula for the calculation of integral cross sections in a Fourier expansion method. [T, Xe, N_2; 100 and 500 eV for Xe]

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Orbital collapse and the photoionization of the inner 4d shells for Xe-like ions. [T, $h\nu$, Xe, Cs^+, etc.]

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Negative differential electron conductivity in He : Kr and He : Xe gas-discharge plasmas. [T, Xe + He, Kr + He]

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Tunnel ionisation of Xe in an ultra-intense CO_2 laser field (10^{14} Wcm^{-2}) with multiple charge creation. [E, $h\nu$, Xe]

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Xe-containing fast gas mixtures for gas-filled detectors.
[E, Xe, Xe + CF_4, Xe + C_2H_2, etc.]

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(Xenon)

E : Elastic collision, EX : Electronic excitation,
I : Ionization, QT : Grand total cross section,
ME : Metastable xenon, S : Swarm, O : The others,
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Electron Collision Cross Section Set for Xenon (Xe)

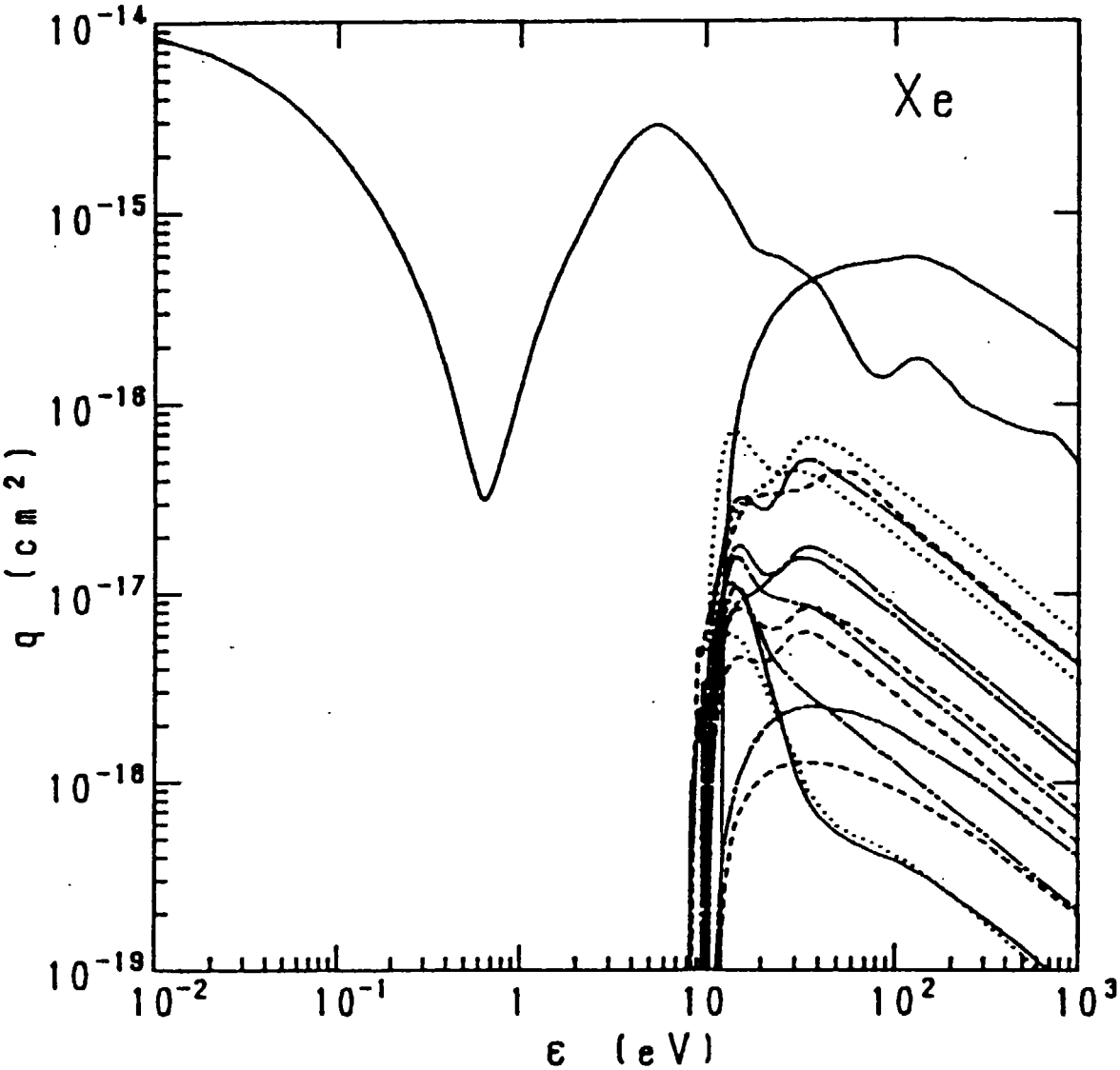

Figure 1. Electron collision cross section set for Xe.

Elastic momentum transfer cross section q_m. Electronic excitation cross sections q_{e1} - q_{e14} divided into fourteen energy levels as shown in the next table. Total ionization cross section q_i. Detailed cross section values are shown in the following tables.

Important Energy Levels for Xenon

	Pachen notation	designation	energy (eV)	resolved feature	
0	P_0	$5p^6$	0		
1	$1s_5$	$6s\ [3/2]_2$	8.315	q_{e1}	metastable state
	$1s_4$	$6s\ [3/2]_1$	8.437	q_{e2}	
	$1s_3$	$6s'\ [1/2]_0$	9.447	q_{e3}	metastable state
	$1s_2$	$6s'\ [1/2]_1$	9.570	q_{e4}	
5	$2p_{10}$	$6p\ [1/2]_1$	9.580		
	$2p_9$	$6p\ [5/2]_2$	9.686	q_{e5}	
	$2p_8$	$6p\ [5/2]_3$	9.721		
	$2p_7$	$6p\ [3/2]_1$	9.789	q_{e6}	
	$2p_6$	$6p\ [3/2]_2$	9.821		
10	$3d_6$	$5d\ [1/2]_0$	9.891		
	$3d_5$	$5d\ [1/2]_1$	9.917		
	$2p_5$	$6p\ [1/2]_0$	9.934	q_{e7}	
	$3d_4'$	$5d\ [7/2]_4$	9.943		
	$3d_3$	$5d\ [3/2]_2$	9.959		
15	$3d_4$	$5d\ [7/2]_3$	10.039	q_{e8}	
	$3d''$	$5d\ [5/2]_2$	10.158	q_{e9}	
	$3d_1'$	$5d\ [5/2]_3$	10.220	q_{e10}	
	$3d_2$	$5d\ [3/2]_1$	10.401	q_{e11}	
	$2s_5$	$7s\ [3/2]_2$	10.562		
20	$2s_4$	$7s\ [3/2]_1$	10.593		
	$3p_{10}$	$7p\ [1/2]_1$	10.902		
	$3p_9$	$7p\ [5/2]_2$	10.954		
	$2p_4$	$6p'\ [3/2]_1$	10.958		
	$3p_8$	$7p\ [5/2]_3$	10.969		
25	$4d_6$	$6d\ [1/2]_0$	10.972		
	$4d_5$	$6d\ [1/2]_1$	10.979		
	$3p_6$	$7p\ [3/2]_2$	10.996		
	$4d_3$	$6d\ [3/2]_2$	10.999	q_{e12}	
	$3p_7$	$7p\ [3/2]_1$	11.008		
30	$3p_5$	$7p\ [1/2]_0$	11.015		
	$4d_4'$	$6d\ [7/2]_4$	11.024		
	$4d_4$	$6d\ [7/2]_3$	11.038		
	$2p_3$	$6p'\ [3/2]_2$	11.055		
	$4d_1'$	$6d\ [5/2]_2$	11.065		
35	$2p_2$	$6p\ [1/2]_1$	11.069		
	$4d_1'$	$6d\ [5/2]_3$	11.101		
	$2p_1$	$6p'\ [1/2]_0$	11.141		
	$4d_2$	$6d\ [3/2]_1$	11.163		
39	$3s_5$	$8s\ [3/2]_2$	11.259	q_{e13}	
74	$4s_5$	$9s\ [3/2]_2$	11.580	q_{e14}	
	$^2P^0_{3/2}(Xe^+)$		12.130		ionization potential

Cross Section Set for Xe determined at 1990. 2. 24.

elastic momentum transfer cross section q_m for xenon

ε (eV)	q_m ($10^{-16}cm^2$)	ε (eV)	q_m ($10^{-16}cm^2$)	ε (eV)	q_m ($10^{-16}cm^2$)
0	131	1.3	2.77	35	4.60
0.001	123	1.4	3.38	40	4.05
0.0025	113	1.6	4.68	45	3.40
0.005	99.0	1.8	5.98	50	2.78
0.01	84.3	2	7.39	55	2.30
0.02	67.1	2.2	8.95	60	1.95
0.03	55.7	2.4	10.6	65	1.70
0.04	47.2	2.6	12.4	70	1.52
0.05	40.8	2.8	14.3	75	1.43
0.06	35.3	3	16.1	80	1.39
0.08	27.3	3.3	18.8	85	1.38
0.1	21.5	3.6	21.1	90	1.39
0.12	17.2	4	24.1	95	1.43
0.16	11.4	4.4	26.2	100	1.50
0.2	7.79	4.8	27.7	110	1.62
0.24	5.45	5	28.3	120	1.70
0.28	3.91	5.2	28.7	125	1.73
0.32	2.87	5.4	28.8	130	1.73
0.35	2.16	5.6	28.7	140	1.71
0.4	1.47	6	28.0	150	1.65
0.45	0.970	6.5	26.8	200	1.24
0.5	0.640	7	25.5	220	1.10
0.55	0.450	8	22.5	250	0.980
0.6	0.340	9	19.5	300	0.910
0.62	0.320	10	17.0	400	0.800
0.64	0.315	11	14.9	500	0.740
0.66	0.320	12	13.1	600	0.710
0.7	0.360	13	11.6	700	0.700
0.75	0.440	15	9.04	750	0.680
0.8	0.540	17	7.10	800	0.650
0.9	0.810	18	6.55	1000	0.490
1	1.21	20	6.12	2000	0.
1.1	1.66	25	5.73	4000	0.
1.2	2.21	30	5.11	8000	0.

error 3 - 5 %

electronic excitation of $1s_5$

ε (eV)	q_e1 ($10^{-16}cm^2$)	ε (eV)	q_e1 ($10^{-16}cm^2$)
8.315	0.00	50	0.00540
8.35	0.00552	60	0.00480
8.4	0.0101	80	0.00420
8.5	0.00420	100	0.00384
8.6	0.00540	120	0.00348
8.7	0.00840	150	0.00312
8.8	0.0122	200	0.00252
8.9	0.0181	300	0.00192
9.0	0.0228	500	0.00132
9.07	0.0244	1000	0.000720
9.2	0.0176	10000	0.00
9.25	0.0166		
9.3	0.0170		
9.35	0.0180		
9.4	0.0176		
9.52	0.0179		
9.55	0.0332		
9.59	0.0228		
9.63	0.0341		
9.68	0.0252		
9.73	0.0221		
9.78	0.0224		
9.83	0.0276		
9.9	0.0325		
9.94	0.0311		
10.0	0.0331		
10.25	0.0408		
10.5	0.0451		
10.75	0.0486		
11.0	0.0542		
11.5	0.0732		
12	0.0912		
12.5	0.104		
13	0.112		
14	0.114		
15	0.106		
16	0.0948		
17.5	0.0768		
20	0.0468		
22	0.0336		
25	0.0216		
30	0.0112		
35	0.00804		
40	0.00660		

electronic excitation of $1s_4$

ε (eV)	q_e2 ($10^{-16}cm^2$)	ε (eV)	q_e2 ($10^{-16}cm^2$)
8.437	0.00	16	0.286
8.5	0.00115	17.5	0.316
8.6	0.00720	20	0.334
8.7	0.0130	22	0.338
8.8	0.0202	25	0.342
8.9	0.0288	30	0.352
9.0	0.0418	32	0.355
9.1	0.0533	35	0.370
9.2	0.0461	40	0.410
9.3	0.0446	45	0.430
9.4	0.0461	50	0.442
9.5	0.0490	55	0.440
9.6	0.0518	60	0.434
9.7	0.0562	70	0.390
9.8	0.0590	80	0.341
9.9	0.0619	100	0.270
10.0	0.0677	120	0.230
10.5	0.0840	150	0.190
11.0	0.101	200	0.151
12	0.137	300	0.110
13	0.175	500	0.0730
14	0.215	1000	0.0430
15	0.253	10000	0.00

error 30 - 50 %

Xenon 2

electronic excitation of $1s_3$		electronic excitation of $1s_2$ and $2p_{10}$		electronic excitation of $2p_9$ and $2p_8$	
ε (eV)	q_e3 ($10^{-16}cm^2$)	ε (eV)	q_e4 ($10^{-16}cm^2$)	ε (eV)	q_e5 ($10^{-16}cm^2$)
9.447	0.00	9.570	0.00	9.686	0.00
9.52	0.00408	9.6	0.0202	10	0.0100
9.55	0.00756	9.62	0.0259	10.2	0.0180
9.59	0.00516	9.7	0.0144	10.5	0.0280
9.63	0.00780	9.8	0.0175	10.7	0.0350
9.68	0.00576	9.9	0.0230	11	0.0460
9.73	0.00504	10	0.0288	11.5	0.0660
9.78	0.00516	10.5	0.0550	12	0.0900
9.83	0.00780	11	0.0850	12.5	0.112
9.9	0.00924	11.5	0.117	13	0.135
9.94	0.00888	12	0.152	13.5	0.156
10.0	0.0102	12.5	0.191	14	0.171
10.25	0.0166	13	0.232	14.5	0.178
10.5	0.0220	13.5	0.267	15	0.180
10.75	0.0259	14	0.294	16	0.174
11	0.0312	14.5	0.312	17	0.160
11.5	0.0432	15	0.320	18	0.146
12	0.0516	16	0.322	20	0.126
12.5	0.0570	18	0.296	22	0.125
13	0.0600	20	0.276	25	0.135
14	0.0612	21	0.278	30	0.167
15	0.0576	22	0.287	32	0.173
16	0.0540	25	0.350	35	0.177
18	0.0432	27	0.420	40	0.170
20	0.0354	30	0.480	50	0.150
22	0.0270	32	0.500	60	0.132
25	0.0204	35	0.510	80	0.103
30	0.0134	40	0.490	100	0.0840
35	0.00912	50	0.420	120	0.0730
40	0.00756	60	0.370	150	0.0620
50	0.00588	80	0.300	200	0.0490
60	0.00528	100	0.250	300	0.0630
80	0.00468	120	0.220	500	0.0240
100	0.00408	150	0.180	1000	0.0140
120	0.00372	200	0.146	10000	0.00
150	0.00312	300	0.105		
200	0.00252	500	0.070		
300	0.00180	1000	0.0420		
500	0.00120	10000	0.00		
1000	0.000720				
10000	0.00				

error 30 - 50 %

Xenon 3

electronic excitation of $2p_7$ and $2p_6$		electronic excitation of $3d_6$, $3d_5$, $2p_5$, $3d_4'$ and $3d_3$		electronic excitation of $3d_4$	
ε (eV)	q_e6 ($10^{-16}cm^2$)	ε (eV)	q_e7 ($10^{-16}cm^2$)	ε (eV)	q_e8 ($10^{-16}cm^2$)
9.789	0.00	9.891	0.00	10.039	0.00
10	0.00400	10	0.0170	10.2	0.00600
10.2	0.00800	10.2	0.0560	10.5	0.0170
10.5	0.0150	10.5	0.120	10.7	0.0250
10.7	0.0200	10.7	0.160	11	0.0380
11	0.0270	11	0.225	11.2	0.0460
11.5	0.0390	11.2	0.275	11.5	0.0580
12	0.0490	11.5	0.347	12	0.0800
12.5	0.0590	12	0.472	12.5	0.101
13	0.0680	12.5	0.597	13	0.123
13.5	0.0750	13	0.672	13.5	0.141
14	0.0790	13.5	0.710	14	0.153
14.5	0.0820	14	0.720	14.5	0.157
15	0.0830	14.5	0.712	15	0.155
16	0.0810	15	0.697	15.5	0.151
17	0.0780	15.5	0.677	16	0.144
18	0.0750	16	0.652	18	0.118
20	0.0670	18	0.560	20	0.102
22	0.0640	20	0.494	22	0.0970
25	0.0660	22	0.450	25	0.0930
30	0.0790	25	0.430	30	0.0890
32	0.0820	30	0.450	35	0.0860
35	0.0840	35	0.430	40	0.0800
40	0.0820	40	0.400	50	0.0690
50	0.0740	50	0.340	60	0.0580
60	0.0660	60	0.296	80	0.0460
80	0.0530	80	0.240	100	0.0380
100	0.0440	100	0.200	120	0.0330
120	0.0380	120	0.173	150	0.0280
150	0.0320	150	0.148	200	0.0225
200	0.0260	200	0.118	300	0.0164
300	0.0190	300	0.0860	500	0.0110
500	0.0125	500	0.0580	1000	0.00640
1000	0.00730	1000	0.0340	10000	0.000
10000	0.00	10000	0.00		

error 30 - 50 %

electronic excitation of 3d''		electronic excitation of $3d_1'$		electronic excitation of $3d_2$	
ε (eV)	q_e9 ($10^{-16}cm^2$)	ε (eV)	q_e10 ($10^{-16}cm^2$)	ε (eV)	q_e11 ($10^{-16}cm^2$)
10.158	0.00	10.220	0.00	10.401	0.00
10.2	0.00100	10.5	0.00300	10.6	0.0180
10.5	0.00900	10.7	0.00700	11	0.0550
10.7	0.0160	11	0.0120	11.2	0.0760
11	0.0250	11.2	0.0150	11.5	0.102
11.2	0.0310	11.5	0.0210	12	0.148
11.5	0.0410	12	0.0275	12.5	0.185
12	0.0570	12.5	0.0346	13	0.216
12.5	0.0730	13	0.0390	13.5	0.240
13	0.0870	13.5	0.0420	14	0.259
13.5	0.0990	14	0.0440	14.5	0.277
14	0.106	14.5	0.0453	15	0.290
14.5	0.108	15	0.0460	15.5	0.304
15	0.107	15.5	0.0460	16	0.315
15.5	0.104	16	0.0460	18	0.345
16	0.100	18	0.0430	20	0.370
18	0.0750	20	0.0430	22	0.390
20	0.0590	22	0.0440	25	0.440
22	0.0480	25	0.0510	30	0.600
25	0.0400	28	0.0590	32	0.640
30	0.0330	30	0.0610	35	0.670
35	0.0290	35	0.0630	40	0.660
40	0.0260	40	0.0590	50	0.600
50	0.0220	50	0.0500	60	0.530
60	0.0190	60	0.0440	80	0.430
80	0.0150	80	0.0350	100	0.360
100	0.0127	100	0.0290	120	0.320
120	0.0109	120	0.0250	150	0.270
150	0.00920	150	0.0210	200	0.218
200	0.00730	200	0.0170	300	0.158
300	0.00540	300	0.0123	500	0.105
500	0.00360	500	0.00820	1000	0.0600
1000	0.00210	1000	0.00480	10000	0.00
10000	0.00	10000	0.000		

error 30 - 50 %

electronic excitation of $2s_5$ - $4d_2$		electronic excitation of $3s_5$ -		electronic excitation of $4s_5$ -	
ε (eV)	q_e12 ($10^{-16}cm^2$)	ε (eV)	q_e13 ($10^{-16}cm^2$)	ε (eV)	q_e14 ($10^{-16}cm^2$)
10.562	0.00	11.259	0.00	11.580	0.00
10.6	0.00300	11.5	0.00105	12	0.000900
11	0.0135	12	0.00255	12.5	0.00195
11.2	0.0188	12.5	0.00405	13	0.00300
11.5	0.0270	13	0.00525	13.5	0.00390
12	0.0420	13.5	0.00645	14	0.00495
12.5	0.0555	14	0.00750	14.5	0.00585
13	0.0675	14.5	0.00885	15	0.00660
13.5	0.0758	15	0.0102	15.5	0.00705
14	0.0825	15.5	0.0113	16	0.00765
14.5	0.0878	16	0.0122	18	0.00930
15	0.0900	18	0.0158	20	0.0105
15.5	0.0930	20	0.0186	22	0.0113
16	0.0945	22	0.0206	25	0.0122
18	0.101	25	0.0228	30	0.0128
20	0.110	30	0.0245	35	0.0128
22	0.119	35	0.0252	40	0.0126
25	0.134	40	0.0251	50	0.0123
27	0.144	50	0.0240	60	0.0114
30	0.153	60	0.0234	80	0.0102
32	0.155	80	0.0210	100	0.00915
35	0.153	100	0.0191	120	0.00840
40	0.147	120	0.0170	150	0.00735
50	0.128	150	0.0149	200	0.00615
60	0.111	200	0.0125	300	0.00480
80	0.0885	300	0.00975	500	0.00330
100	0.0750	500	0.00675	1000	0.00195
120	0.0645	1000	0.00405	10000	0.00
150	0.0540	10000	0.00		
200	0.0435				
300	0.0315				
500	0.0213				
1000	0.0123				
10000	0.00				

error 50 %

ionization cross sections q_i for xenon

ε (eV)	q_i (10^{-16} cm^2)	ε (eV)	q_i (10^{-16} cm^2)
12.130	0.00	45	4.87
12.5	0.105	50	5.09
13	0.247	55	5.23
13.5	0.409	60	5.34
14	0.570	65	5.40
14.5	0.751	70	5.46
15	0.931	75	5.50
15.5	1.09	80	5.51
16	1.25	85	5.60
17	1.56	90	5.63
18	1.82	95	5.69
19	2.06	100	5.76
20	2.30	105	5.80
21	2.54	110	5.88
22	2.76	115	5.87
23	2.96	120	5.87
24	3.14	125	5.88
25	3.29	130	5.85
26	3.41	135	5.80
27	3.55	140	5.76
28	3.70	145	5.71
29	3.82	150	5.63
30	3.92	160	5.48
31	4.02	170	5.36
32	4.11	180	5.23
33	4.21	190	5.10
34	4.28	200	5.02
35	4.36	250	4.37
36	4.43	300	3.96
37	4.48	500	2.97
38	4.55	700	2.43
39	4.61	1000	1.90
40	4.66	10000	0.00

error 10 %

elastic total cross sections q_t for xenon

ε (eV)	q_t (10^{-16} cm^2)	ε (eV)	q_t (10^{-16} cm^2)
0.05	60.0	6	39.7
0.1	36.5	8	42.0
0.15	23.0	10	40.5
0.2	15.3	12	37.7
0.25	10.8	15	33.6
0.3	7.96	20	27.5
0.4	4.51	25	20.9
0.5	2.66	30	15.8
0.6	1.74	40	10.1
0.7	1.35	50	7.21
0.8	1.30	60	5.79
0.9	1.44	80	4.77
1	1.77	100	4.71
1.2	2.80	125	4.76
1.5	4.81	150	4.65
1.75	6.75	200	4.30
2	8.91	250	3.96
2.5	13.7	300	3.73
2.75	16.3	400	3.40
3	18.7	500	3.17
4	28.5	700	2.83
5	35.9	1000	2.30

error 5 %

comparison of Σq and Q_T for xenon

$\Sigma q = q_t + \Sigma q_e + q_i$
Q_T : grand total cross sections measured by experiments

ε (eV)	q_t	Σq_e	q_i (10^{-16} cm^2)	Σq	Q_T
10	40.5	0.15	0	40.7	38.8
12	37.7	1.40	0	39.1	37.4
15	33.6	2.41	0.93	36.9	35.6
20	27.5	2.09	2.30	31.9	33.3
25	20.9	2.15	3.29	26.3	27.0
30	15.8	2.53	3.92	22.3	19.8
40	10.1	2.58	4.66	17.34	14.9
50	7.21	2.34	5.09	14.64	13.0
60	5.79	2.10	5.34	13.23	12.0
80	4.77	1.69	5.51	11.97	11.1
100	4.71	1.40	5.76	11.87	10.7
150	4.65	1.02	5.63	11.30	10.0
200	4.30	0.82	5.02	10.14	9.5
300	3.73	0.60	3.96	8.29	8.1
500	3.17	0.40	2.97	6.54	6.4
1000	2.30	0.23	1.90	4.43	4.35

2003. 6. 18.

Numbers of References

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Atoms (17)			Molecules (51)				
A + e,	A + hν			M + e,		M + hν,	
He 2	2170 *		2	H_2, D_2	1870	5	CH_4 780
Ne 10	1140 *			N_2	2240 ○		
Ar 18	1960 ○			O_2	1700		CF_4 390
Kr 36	1000			CO	1190		CCl_4 210
Xe 54	1180 ○			NO	880		CCl_2F_2 250
							CH_3Cl 90
Li 3	450			F_2	190		
Na 11	800			Cl_2	360		SiH_4 230
				Br_2	140		SiF_4 140
K 19	370			I_2	240		GeH_4 50
Rb 37	220						
Cs 55	370			HF	260	6	C_2H_4 370
				HCl	320		CH_3OH 240
O 8	390			HBr	200		
				HI	130	7	SF_6 920 ○
F 9	90						
Cl 17	130		3	CO_2	1240 ○		
						8	C_2H_6 260
Cu 29	180			H_2O	900		C_2F_6 150
Cd 48	210			H_2S	270		Si_2H_6 70
Ba 56	340			O_3	480		
				N_2O	450	9	C_3H_6 120
Hg 80	600			NO_2	300		C_2H_5OH 60
				SO_2	260		
				CS_2	260		
				OCS	280	11	C_3H_8 190
not final, but							C_3F_8 100
finished mostly			4	C_2H_2	390		
						12	C_4F_8 100
include electron				NH_3	500		C_6H_6 240
swarm papers				NF_3	110		C_6F_6 100
				BF_3	110		
include				BCl_3	90	60	C_{60} 300
review papers				PH_3	80		
				H_2CO	180		M_r + M_v 850

* He(Ne) + e only. Not include He(Ne) + hν papers.

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