Activities 2009-2011 at the Atomic Spectroscopy Data Center at the National Institute of Standards and Technology (NIST)

Wolfgang L. Wiese

Atomic Spectroscopy Group, NIST

The NIST Atomic Spectroscopy Data Center

Data Center Area	Principal Scientists	Staff
a. Atomic Energy Levels and Wavelengths	J. Reader	E. Saloman, C. Sansonetti, W. Martin, J. Sansonetti, A. Kramida
b. Atomic Transition Probabilities	W. Wiese	D. Kelleher, L. Podobedova, J. Fuhr
c. Spectral Line Shapes and Shifts	W. Wiese	No activities other than updating the bibliography
d. Database Design and Expansion	Y. Ralchenko, A. Kramida	
e. Bibliographical Databases	A. Kramida, J. Fuhr	R. Ibacache

NIST Spectroscopic Databases on the World Wide Web (address: http://physics.nist.gov)

1. Annotated Bibliographic databases:

   Transition probabilities, 1914 – 2011

   Line Widths and Shifts, 1992 – 2011

   Energy levels and wavelengths, 1908 – 2011

NIST Spectroscopic Databases on the World Wide Web - Continued

2. Numerical databases:

(a) Atomic Spectra Database (ASD), Version 4

This is a new, greatly expanded database covering spectroscopic reference data for all chemical elements. Light elements up to Cu (Z = 29) are covered for most states of ionization, heavier elements are usually represented by neutral atoms and low stages of ionization.

Version 4.0.(Sept.2010) Major Update	Version 4.0.1 (Nov.2010)	Version 4.1.0 (May2011) Additions and Updates
Numerous additions for all data, full integration with NIST bibliographies	Mainly corrections	• 174 000 wavelengths • 92 000 energy levels • 68 000 transition probabilities

NIST Spectroscopic Databases on the World Wide Web – Continued

(b) Handbook of Basic Atomic Spectroscopic Data

(c) Ground Levels and Ionization Energies for Neutral Atoms (updated)

(d) X-ray Transition Energies

(e) Precise energy levels for Hydrogen and Deuterium

plus related Atomic and Molecular Physics Databases

The NIST Reference Data Program

- The NIST Atomic Spectroscopy Data Center puts considerable effort into critical assessment of numerical data.

- Only one numerical value is presented for each quantity, estimated to be the “best” value. This may be either from a single source, evaluated as being the most accurate one, or from an average of several sources of about equal reliability.

- For atomic transition probabilities (oscillator strengths), explicit accuracy ratings are given. For wavelengths and atomic energy levels, the number of tabulated digits indicate the accuracy.

- NIST data tables are limited to REFERENCE data, i.e., data of certain minimum quality.

Critical Spectroscopic Data Compilations Completed During 2009-2011

(usually published in the Journal of Physical and Chemical Reference Data)

a) Atomic Energy Levels and Wavelengths:

(Compilers: A. Kramida, J. Reader, E. Saloman, J. Sansonetti)

Hydrogen:	H, D, T
Cesium:	Cs I through Cs LV
Barium:	Ba III through Ba LVI
Argon:	Ar II through Ar XVIii
Tungsten:	W III through W LXXIV

b) Atomic Transition Probabilities:

(Compilers: J. Fuhr, D. Kelleher, L. Podobedova, J. Sansonetti, W. Wiese)

Hydrogen:	H I, D I, T I
Helium:	He I, He II
Lithium:	Li I through Li III
Beryllium:	Be I through Be IV
Boron:	B I through B V
Sulfur:	S I through S XVI
Cesium:	Cs I through Cs LV
Barium:	Ba III through Ba LVI

Major Spectroscopic Data Compilations in Progress or Nearing Completion

a) Atomic Energy Levels and Wavelengths:

(Compilers: A. Kramida, L. Podobedova, E. Saloman, J. Sansonetti)

Neon:	Ne IV
Chlorine:	Cl I – XVII
Nickel:	Ni I – Ni VIII

b) Atomic Transition Probabilities:

(Compilers: J. Fuhr, D. L. Podobedova, J. Sansonetti, W. Wiese)

Fluorine:	F V -- F IX
Neon:	Ne VI – Ne X
Chlorine:	Cl I – Cl XVII
Nickel:	Ni I – Ni VIII

Version History & Citation Information | Disclaimer
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NIST Atomic Spectra Database

Version 4

Welcome to the NIST Atomic Spectra Database, NIST Standard Reference Database #78. The spectroscopic data may be selected and displayed according to wavelengths or energy levels by choosing one of the following options:

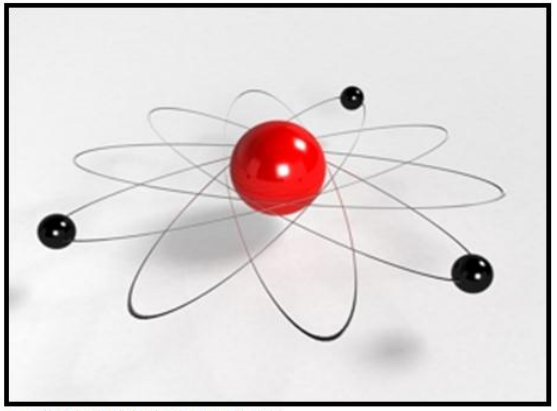
Lines — Spectral lines and associated energy levels displayed in wavelength order with all selected spectra intermixed or in multiplet order. Transition probabilities for the lines are also displayed where available.

Levels — Energy levels of a particular atom or ion displayed in order of energy above the ground state.

Additional information about the database may be obtained through the following links:

Introduction	Introduction to the Atomic Spectra Database.
List of Spectra	Overview of data contained in the database.
Ground States and Ionization Energies	Table of Ground States and Ionization Energies for Neutral Atoms.
Bibliography	Bibliography of data sources used for this database.
Help	On-line help in using the database.

This database provides access and search capability for NIST critically evaluated data on atomic energy levels, wavelengths, and transition probabilities that are reasonably up-to-date. The Atomic Energy Levels Data Center and Data Center on Atomic Transition Probabilities and Line Shapes have carried out these critical compilations. Both Data Centers are located in the Physical Measurement Laboratory at the National Institute of Standards and Technology (NIST).



NIST ASD Team

Principal Developers (Currently Active):
Yu. Ralchenko,[1] A.E. Kramida,[1] and J. Reader[1]

Data Compilers (Currently Active):
Atomic Energy Levels and Wavelengths:
A.E. Kramida,[1] E.B. Saloman,[1] J.E. Sansonetti,[1] and J.J. Curry[1]

Atomic Transition Probabilities:
D.E. Kelleher,[1] A.E. Kramida,[1] J.R. Fuhr,[1] L. Podobedova,[1] and W.L. Wiese[1]

Database Developers (Currently Active):
Database Management:
Yu. Ralchenko,[1] A.E. Kramida,[1] and K. Olsen[2]

World Wide Web Interface:
Yu. Ralchenko[1]

Past Contributors:
G.R. Dalton,[3] R. Dragoset,[2] F.-C. Jou,[1]

NIST Atomic Spectra Database Lines Data

O VI: 126 Lines of Data Found

Example of how to reference these results:
Ralchenko, Yu., Kramida, A.E., Reader, J., and NIST ASD Team (2011). *NIST Atomic Spectra Database* (ver. 4.1.0), [Online]. Available: http://physics.nist.gov/asd3 [2011, July 28]. National Institute of Standards and Technology, Gaithersburg, MD.

Wavelength in: **vacuum below 2000 Å, air between 2000 and 20000 Å, vacuum above 20000 Å**

Primary data sources		Query NIST Bibliographic Databases for **O VI** (new window)
Energy Levels:	Moore 1993	O VI Energy Levels
Lines:	Reader et al. 1980	O VI Line Wavelengths and Classification
Transition Probabilities:	Wiese et al. 1996	O VI Transition Probabilities

Observed Wavelength Vac (Å)	Ritz Wavelength Vac (Å)	Rel. Int. (?)	A_{ki} (s^{-1})	Acc.	E_i (cm^{-1})	E_k (cm^{-1})	Configurations	Terms	J_i - J_k	g_i - g_k	Type	TP Ref.
	103.206		1.73e+09	B	96 375.0	- 1 065 311.0	$1s^22p$ - $1s^29d$	$^2P^o$ - ^2D	$^1/_2$ - $^3/_2$	2 - 4		T3225LS
	103.260		2.07e+09	B	96 907.5	- 1 065 337.0	$1s^22p$ - $1s^29d$	$^2P^o$ - ^2D	$^3/_2$ - $^5/_2$	4 - 6		T3225LS
	103.263		3.46e+08	B	96 907.5	- 1 065 311.0	$1s^22p$ - $1s^29d$	$^2P^o$ - ^2D	$^3/_2$ - $^3/_2$	4 - 4		T3225LS
	104.612		2.48e+09	B+	96 375.0	- 1 052 288.0	$1s^22p$ - $1s^28d$	$^2P^o$ - ^2D	$^1/_2$ - $^3/_2$	2 - 4		T5118LS
	104.669		2.97e+09	B+	96 907.5	- 1 052 301.0	$1s^22p$ - $1s^28d$	$^2P^o$ - ^2D	$^3/_2$ - $^5/_2$	4 - 6		T5118LS
	104.670		4.95e+08	B+	96 907.5	- 1 052 288.0	$1s^22p$ - $1s^28d$	$^2P^o$ - ^2D	$^3/_2$ - $^3/_2$	4 - 4		T5118LS
	104.803		2.39e+08	B	96 375.0	- 1 050 543.0	$1s^22p$ - $1s^28s$	$^2P^o$ - ^2S	$^1/_2$ - $^1/_2$	2 - 2		T3127LS
	104.862		4.77e+08	B	96 907.5	- 1 050 543.0	$1s^22p$ - $1s^28s$	$^2P^o$ - ^2S	$^3/_2$ - $^1/_2$	4 - 2		T3127LS
	106.731		3.78e+09	B+	96 375.0	- 1 033 310.0	$1s^22p$ - $1s^27d$	$^2P^o$ - ^2D	$^1/_2$ - $^3/_2$	2 - 4		T5118LS
	106.789		4.53e+09	B+	96 907.5	- 1 033 334.0	$1s^22p$ - $1s^27d$	$^2P^o$ - ^2D	$^3/_2$ - $^5/_2$	4 - 6		T5118LS
	106.792		7.54e+08	B+	96 907.5	- 1 033 310.0	$1s^22p$ - $1s^27d$	$^2P^o$ - ^2D	$^3/_2$ - $^3/_2$	4 - 4		T5118LS
	107.020		3.62e+08	B	96 375.0	- 1 030 780.0	$1s^22p$ - $1s^27s$	$^2P^o$ - ^2S	$^1/_2$ - $^1/_2$	2 - 2		T3127LS
	107.081		7.22e+08	B	96 907.5	- 1 030 780.0	$1s^22p$ - $1s^27s$	$^2P^o$ - ^2S	$^3/_2$ - $^1/_2$	4 - 2		T3127LS
	110.157		6.18e+09	A	96 375.0	- 1 004 170.0	$1s^22p$ - $1s^26d$	$^2P^o$ - ^2D	$^1/_2$ - $^3/_2$	2 - 4		T5118LS

NIST Transition Probabilities Bibliographic Reference # 3225

Extra data for NIST internal use: Abstract PDF

Transition probabilities for the alkali isoelectronic sequences, Li I, Na I, K I, Rb I, Cs I, Fr I,

A. Lindgård and S. E. Nielsen,

At. Data Nucl. Data Tables **19**, 533–633 (1977)
DOI:10.1016/0092-640X(77)90017-1

Comment: The transition probability for this line was calculated from the multiplet value assuming a pure LS-coupling.

Get all bibliography on O VI transition probabilities (new window)

Search for Publications on Atomic Energy Levels and Spectra

He

The database presently contains 17223 references dating from 1802 to 2011. Last updated on July 28, 2011.

Spectra: O V

e.g., Fe I, or Na, or Mg+, or Al3+, or mg iv,vi-VIII,
or Fe ne-like-S-like, or Ne-Fe I-III, or S-, or D I, or 7Li I

○ Exotic atoms only ○ Exclude exotic atoms

Word/Pattern in title:

Author(s):

Publication Year: From To

Publication Source:

- JOURNALS
- COLLECTIONS
- BOOKS
- REPORTS
- THESES
- PREPRINTS
  - Acta Phys. Acad. Sci. Hung.
  - Acta Phys. Austriaca
  - Acta Phys. Hung.
  - Acta Phys. Hung. New Ser.

Method type

- ☐ Experiment
- ☐ Theory
- ☐ Both

Specific Subject

- Energy Levels
- Ionization Potentials
- Series Formulae
- Wavelengths
- Classified Lines
- New Designations
- Hyperfine Structure
- Isotopic Shift

General Interest Category

1. Isoelectronic Sequences
2. Compilations
3. Reviews and Bibliographies
4. Additional Theoretical Papers
5. Other

Sort by: ◉ published year, ○ first author's last name.

Search for References | Clear Form

NIST National Institute of Standards and Technology Physical Meas. Laboratory

Publications on Atomic Energy Levels that include numerical data

Spectrum included: O V

Included are only references with the following research subjects:

Energy Levels or Classified Lines or Wavelengths

Publication Sources included:

All journals

101 references found

Back to search form

LaTeX source code *BibTex source code* Show search results as pdf

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State-Resolved Valence Shell Photoionization of Be-like Ions: Experiment and Theory,
A. Müller, S. Schippers, R. A. Phaneuf, A. L. D. Kilcoyne, H. Bräuning, A. S. Schlachter, M. Lu, and B. M. McLaughlin,
J. Phys. B **43**, 225201 (2010)
DOI:10.1088/0953-4075/43/22/225201

CHIANTI–An Atomic Database for Emission Lines. X. Spectral Atlas of a Cold Feature Observed with Hinode/EUV Imaging Spectrometer,
E. Landi and P. R. Young,
Astrophys. J. **706**, 1–20 (2009)
DOI:10.1088/0004-637X/706/1/1

Solar Transition Region Above Sunspots,
H. Tian, W. Curdt, L. Teriaca, E. Landi, and E. Marsch,
Astron. Astrophys. **505**, 307–318 (2009)
DOI:10.1051/0004-6361/200912114

Search for Publications on Atomic Transition Probabilities

Help on search

The database presently contains 8469 references dating from 1914 to 2011. Last updated on July 28, 2011.

Spectra: O V

e.g., Fe I, or Na, or Mg+, or Al3+, or mg iv,vi-VIII, or Fe ne-like-S-like, or Ne-Fe I-III, or S-, or D I, or 7Li I

Word/Pattern in title:

Author(s):

Publication Year: From To

Publication Source:

- JOURNALS
- COLLECTIONS
- BOOKS
- REPORTS
- THESES
- PREPRINTS
  - Acta Phys. Acad. Sci. Hung.
  - Acta Phys. Austriaca
  - Acta Phys. Pol.
  - Acta Phys. Pol. A

Method type

- ☐ Experiment
- ☐ Theory
- ☐ Both

Special *A*-value type

- ☐ Forbidden Lines
- ☐ Relative *A*-values
- ☐ Both

Specific Subject

- EXPERIMENTAL
- Absorption
- Emission
- Hook
- Lifetime
- Miscellaneous
- THEORETICAL
- Quantum

General Interest Category

1. Literature compilations
2. Review articles
3. Fundamental relationships and basic concepts
4. Detailed descriptions of experimental or theoretical methods
5. General Comments
6. Environmental influences on f-values

Sort by: ◉ published year, ○ first author's last name.

Search for References | Clear Form

NIST
National Institute of Standards and Technology
Physical Meas. Laboratory

Publications on Atomic Transition Probabilities that include numerical data

Spectrum included: O V

Publication Sources included:

All journals

197 references found

Back to search form

LaTeX source code *BibTex source code* *Show search results as pdf*

Hyperfine-dependent lifetimes in Be-like ions,
M. Andersson, Y. Zou, R. Hutton, and T. Brage,
Phys. Rev. A **79**, 032501 (2009)
DOI:10.1103/PhysRevA.79.032501

Hyperfine quenching of the 2s2p $^3P_0$ state of berylliumlike ions,
K. T. Cheng, M. H. Chen, and W. R. Johnson,
Phys. Rev. A **77**, 052504 (2008)
DOI:10.1103/PhysRevA.77.052504

Theoretical studies of hyperfine effects,
P. Jönsson,
J. Phys.: Conf. Ser. **72**, 012011 (2007)
DOI:10.1088/1742-6596/72/1/012011

Comparison of two theoretical methods for studying 2-2 transitions in beryllium isoelectronic sequence,
P. Bogdanovich and H.-S. Chou,
Lith. J. Phys. **47**(4), 387–395 (2007)

earch for Publications on Atomic Line Broadening and Shifts

Help on search

he database presently contains 6650 references dating from 1889 to 2011. Last updated on June 29, 2011.

Spectra: O V

e.g., Fe I, or Na, or Mg+, or Al3+, or mg iv,vi-VIII, or Fe ne-like-S-like, or Ne-Fe I-III, or S-, or D I, or 7Li I

Word/Pattern in title:

Author(s):

Publication Year: From To

Publication Source:

JOURNALS
COLLECTIONS
BOOKS
REPORTS
THESES
  Acta Astrophys. Sinica
  Acta Cient. Venezolana
  Acta Crystallogr.
  Acta Crystallogr., Sect. A
  Acta Fac. Rerum Nat. Univ. Comenianae, Phys.

Method type

- ☐ Experiment
- ☐ Theory
- ☐ Both
- ☐ Comment
- ☐ Compilation

Mechanism

Natural
Doppler
Zeeman
Pressure
  Resonance
  Stark
  van der Waals by:
    Al

Combine mechanisms by
- ◉ OR
- ○ AND

General Interest Category

General Articles on Line Shapes and Shifts
PRESSURE BROADENING...
  Stark broadening and shifts...
    Hydrogen and hydrogen-like (overlapping) lines
    Isolated lines of neutral spectra
    Isolated lines of ionic spectra
    Topics of particular interest...
      Line wings

Sort by: ◉ published year, ○ first author's last name.

Search for References | Clear Form

NIST
National Institute of Standards and Technology
Physical Meas. Laboratory

Publications on Atomic Line Broadening and Shifts that include numerical data

Spectrum included: O V

21 references found

Back to search form

LaTeX source code *BibTex source code* Show search results as pdf

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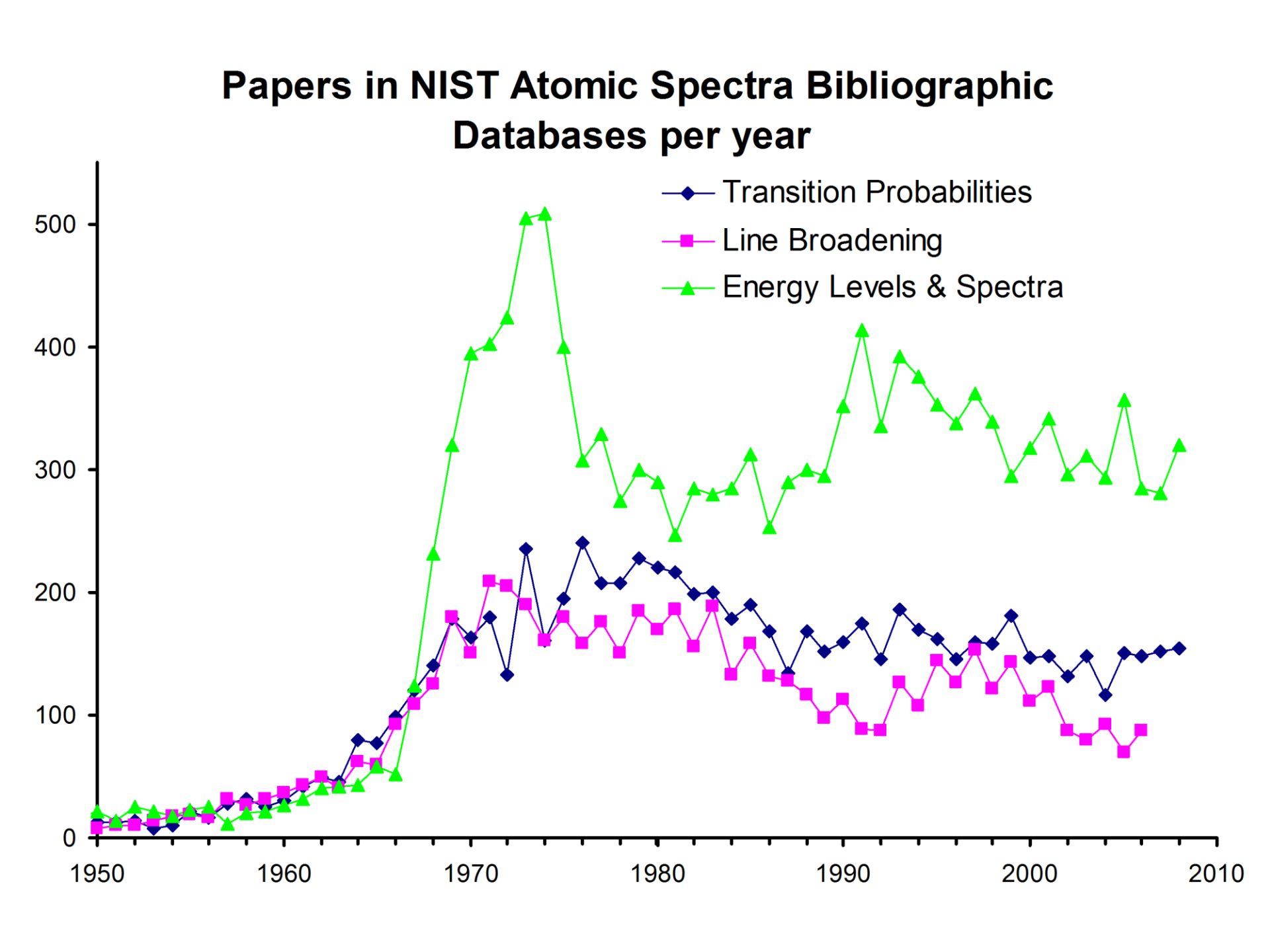
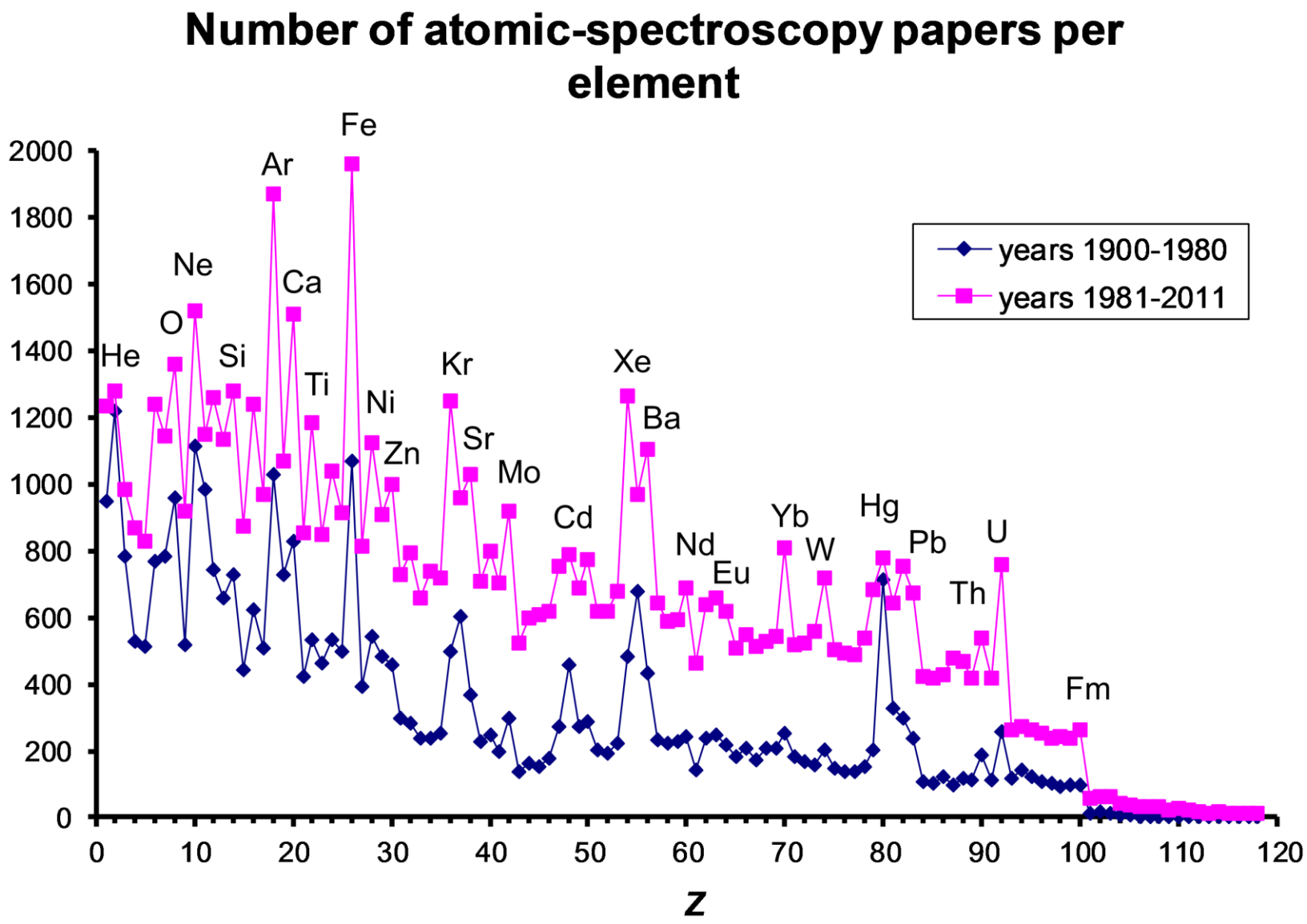
Stark broadening of O V 1371 Å line in stellar atmospheres,
M. S. Dimitrijević, A. Kovačević, Z. Simić, and M. Dačić,
AIP Conf. Proc. **1043**, 410–411 (2008)
DOI:10.1063/1.2993686

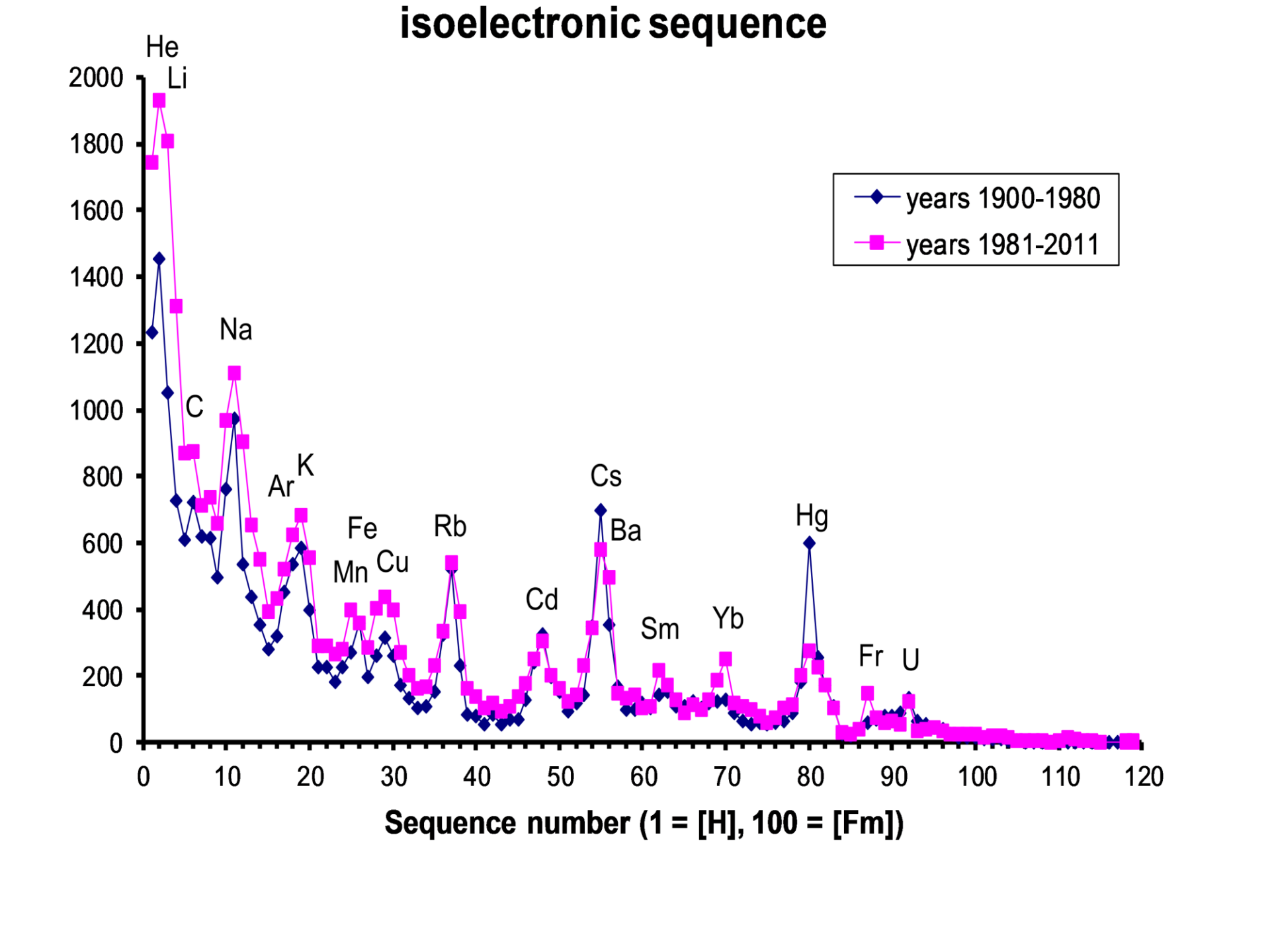
Electron impact broadening of spectral lines in Be-like ions: Quantum calculations,
H. Elabidi, N. Ben Nessib, M. Cornille, J. Dubau, and S. Sahal-Bréchot,
J. Phys. B **41**, 025702 (2008)
DOI:10.1088/0953-4075/41/2/025702

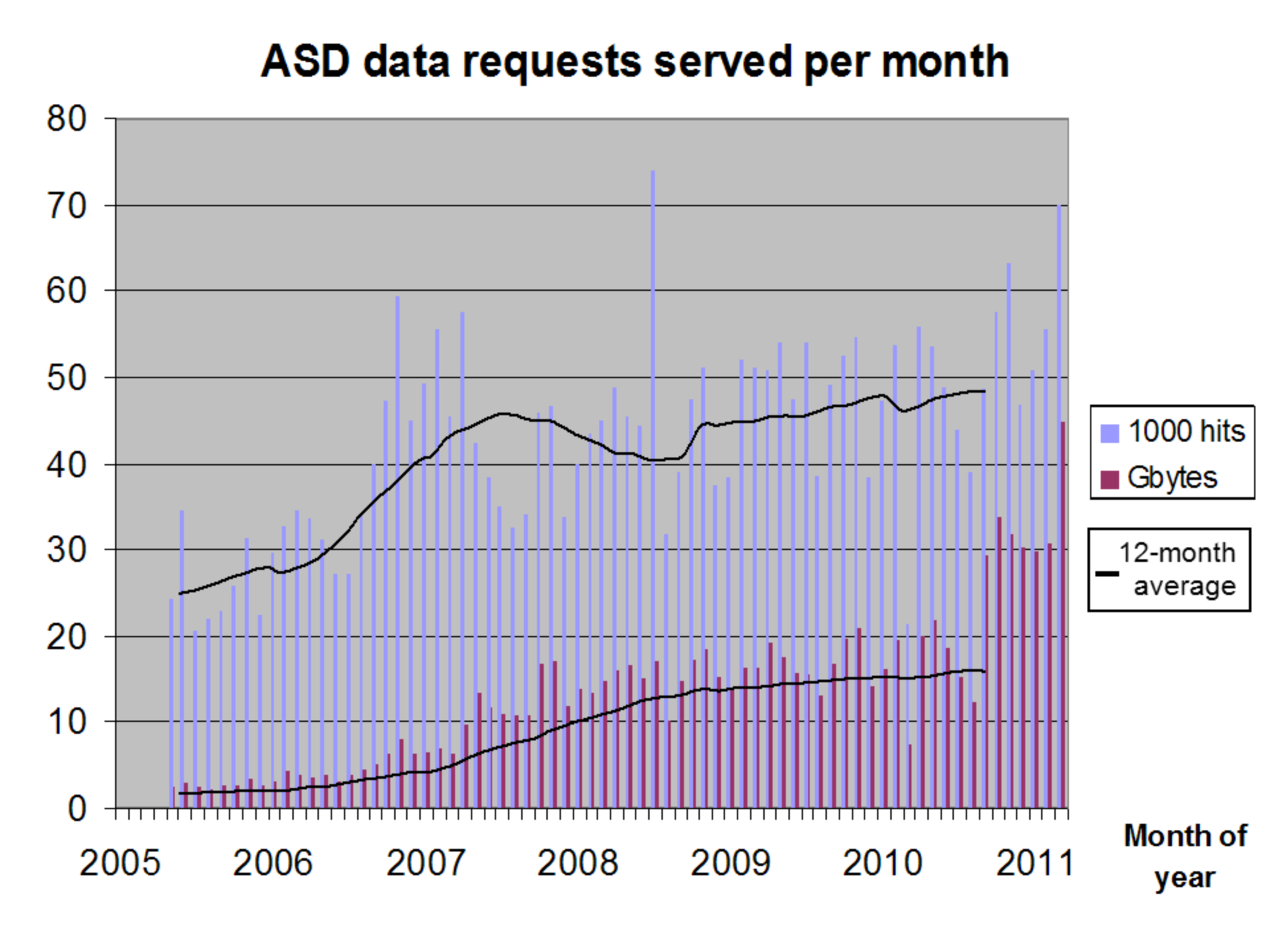
Influence of dense plasma on the low-lying transitions in Be-like ions: Relativistic multiconfiguration Dirac-Fock calculation,
B. Saha and S. Fritzsche,
J. Phys. B **40**, 259–270 (2007)
DOI:10.1088/0953-4075/40/2/002

Semiclassical calculations of line broadening in plasmas: Comparison with quantal results,
S. Alexiou and R. W. Lee,
J. Quant. Spectrosc. Radiat. Transfer **99**, 10–20 (2006)
DOI:10.1016/j.jqsrt.2005.05.001


Papers in NIST Atomic Spectra Bibliographic Databases per year
Transition Probabilities
Line Broadening
Energy Levels & Spectra
500
400
300
200
100
0
1950
1960
1970
1980
1990
2000
2010


Number of atomic-spectroscopy papers per element
years 1900-1980
years 1981-2011
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Z
He
O
Ne
Si
Ar
Ca
Ti
Fe
Ni
Zn
Kr
Sr
Mo
Cd
Xe
Ba
Nd
Eu
Yb
W
Hg
Pb
Th
U
Fm


isoelectronic sequence
years 1900-1980
years 1981-2011
He
Li
C
Na
Ar
K
Mn
Fe
Cu
Rb
Cd
Cs
Ba
Sm
Yb
Hg
Fr
U
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Sequence number (1 = [H], 100 = [Fm])


ASD data requests served per month
80
70
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Month of year
1000 hits
Gbytes
12-month average

The NIST Reference Data Program

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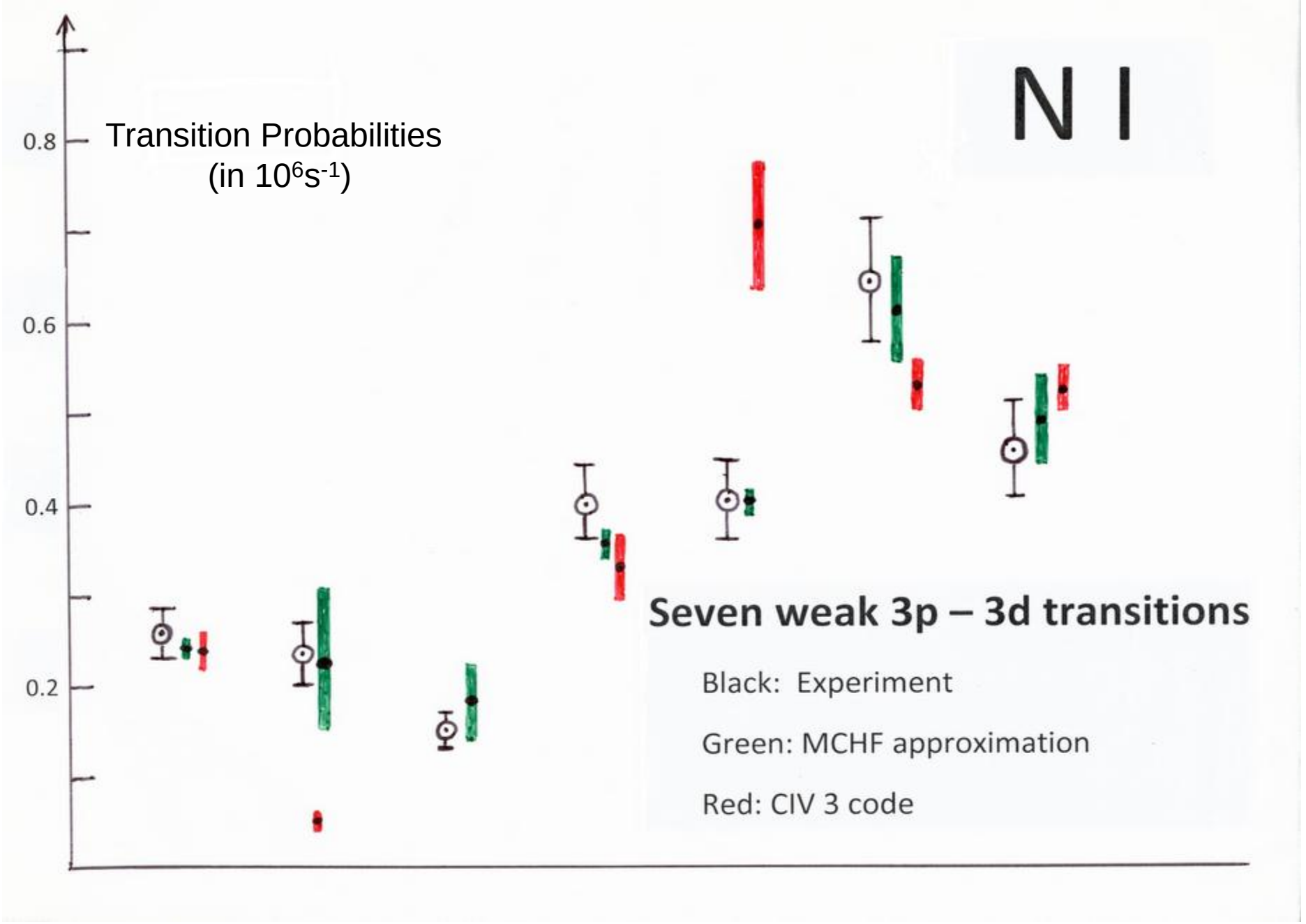
Radiative Lifetimes (in ns) for two N I Levels

Energy Level	Bengtsson et al. (1992)	Copeland et al. (1987)	Catherinot et al. (1979)
$3p\ {}^4D^o_{7/2}$	44 ± 2	43 ± 3	----------
$3p\ {}^4S^o_{3/2}$	26.0 ± 1.5	----------	23.3 ± 2.3

(Selected from 21 available publications)


N I
Transition Probabilities
(in $10^6 s^{-1}$)
0.8
0.6
0.4
0.2
Seven weak 3p – 3d transitions
Black: Experiment
Green: MCHF approximation
Red: CIV 3 code

ICAMDATA 2012

Washington, DC skyline at night. © Shutterstock/fstockfoto

September 30-October 4, 2012

National Institute of Standards and Technology (NIST)
Gaithersburg, MD 20899-0001 USA

International Program Committee

Local Conference Committee

ICAMDATA Charter

ICAMDATA History

Visitor Information - NIST is located about 25 miles (40 kilometers) from the center of Washington, D.C.

Click here to be added to the conference mailing list.

Eighth International Conference on Atomic and Molecular Data and Their Applications (ICAMDATA 2012)

ICAMDATA 2012 continues the series of international conferences since 1997 that promotes the use of atomic and molecular data in various fields of science and technology, and provides a forum for interaction of producers and users of such data. The conference will focus on the following topics:

I. Applications of and needs for atomic and molecular data:

- Astrophysics and atmospheric physics
- Magnetic and inertial fusion
- Laboratory and industrial plasmas
- Lighting science and technology
- Biomedicine and biophysics
- Combustion and environmental sciences and technology
- Surface physics, gaseous electronics, solid state optics and spectroscopy, optoelectronics, etc.

II. Atomic and molecular data collections, assessment and dissemination:

- Data collection and selection, critical evaluation, estimate of uncertainties
- Databases, data exchange and dissemination
- Data center activities, standardization of data formats

III. Experimental and theoretical atomic and molecular data generation:

- Atomic and molecular structure and spectroscopy
- Electron collisions with atoms and molecules
- Heavy particle collisions
- Particle - surface interactions

The scientific program will include invited review lectures, oral reports and poster sessions. Both experimental and theoretical contributions will be welcome. A first announcement will be posted in the fall of 2011.