A Bibliography

This appendix (AppendixA) contains the bibliographic references list arranged on the atomic processes and on the elements. The gzipped .dvi file (appb-n.dvi.gz) of the APPENDIX can be found at A.F.Kholtygin's WWW home page:
http://www.aispbu.spb.su/staff/afk/afk.html)
via hypertext reference AtDatCent/Contents.html.

B Atomic catalogue and databases

This appendix (appendixB) contains the short atomic data sorces and databases guide. The gzipped .dvi file (appb-n.dvi.gz) of the APPENDIX can be found at A.F.Kholtygin's WWW home page:
http://www.aispbu.spb.su/staff/afk/afk.html)
via hypertext reference AtDatCent/Contents.html.

A lot of atomic data needed can be extracted from the databases and catalogues of atomic data. The most known of them are reviewed in this appendix. A special attention is drawn to the AMDIS atomic database and VALD atomic database. Moreover, there exists a lot of collections of atomic data, do not included in the regular journals. They are the laboratory and agency reports, workshop proceedings, newsletter, *etc.* which can be referred as miscellaneous atomic data sources. They are also named by Smith (1992) as a "grey literature". Such sources are also shortly reviewed.

B.1 Catalogues of atomic data and bibliographical sources

For half a century, the main source on atomic data was the USA National Institute of Standards and Technology (NIST) formerly named as the National Bureau of Standards (NBS). The most well known editions of NIST (NBS) are Charlotte Moore level and multiplet tables cited by Johansson & Cowley (1988), Wiese (1992a, b) and Martin (1992).

Current NIST atomic data are collected in two Data Centers. First one is the Atomic Energy Levels Center directed by W.C.Martin. They prepare atomic data bibliographical files including critically evaluated and compiled data on atomic energy levels and wavelengths, ionization potentials and related values. The NIST Data Centers on Atomic Transition Probabilities and Line Shapes leaded by W.L.Wiese compile and critically evaluate data on transition probabilities and radiative lifetimes and the shape parameters of their lines. Access to the NIST atomic database where these files can be found are described in the next section.

Some recent contributions from the NIST Data Centers are published in J.Phys.Chem.Ref.Data reviewed by Wiese (1992a,b) and Nartin(1992).

The commission 14 (atomic and Molecular Data) of the International Astronomical Union (IAU) compile the triénnial reports including references to spectroscopic data in the next fields: Atomic Spectra and Wavelength Standard, Transition Probabilities, Collision Processes, Line Broadening, Molecular structure and Spectra (see e.g., Sahal-Brechot 1991).

A lot of calculations of atomic data have been performed in Vilnius, most of this calculations are cited in Rudzikas et al. (1990)see, also, review Rudzikas and Bogdanovich (1994).

B.2 Atomic Databases

Until recently and even now most of the atomic data used by astronomers, physics and astrophysics have been taken from printed sources. Last years, some of the atomic data used by astronomers and physicists have become to be available electronically. There are a large number of atomic databases can be extracted using FTP (file transfer protocol) or can be reached with URL (uniform resource locator). Others, e.g. TOPBASE, atomic database of the Opacity project, require registration and/or use of a specialized database management system.

To facilitate for readers an orientation in the bulk of the existing atomic databases we list them in Table B1, compiled mainly from papers Ralchenko (1996), Smith et. al., 1996 and compilation by Nave (1994). A permanently updated hypertext list of atomic data and databases on the Internet can be found at the URL *http://plasma-gate.weizmann.ac.il/DBfAPP.html*. In the Table B2 one can find how the above mention databases can be accessed. Below we also present the detail description some of the atomic database mentioned.

B.2.1 VALD: The Vienna Atomic Line Data Base

The "The Vienna Atomic Line Data Base" (VALD) consists of a set of critically evaluated lists of astrophysically important atomic transition parameters and supporting extraction software. Lines of the neutral atoms and selected first ions of elements from H to U are included in the Data Base. VALD contains about 600 000 entries and is one of the largest collections of accurate and homogeneous data It also includes specific tools for extracting data for spectrum synthesis and model atmosphere calculations. The data base is presently restricted to spectral lines which are relevant for stars the LTE approximation is sufficient and molecular lines do not have to be taken into account. The structure of VALD, the available data sets and specific retrieval tools are described in paper by Piskunov et al. (1995). The created e-mail interface (VALD-EMS) allows remote access to VALD by external users.

The first step is to register in the list of VALD clients, which contains INTERNET e-mail addresses from where VALD-EMS request will be accepted. To do so, send an e-mail message to the VALD manager at the address: VALDADM@GALILEO.AST.UNIVE.AC.AT with your full name and your e-mail address. The detail descriptions of the typical VALD-EMS requests can also be found in paper Piskunov et al (1995)

B.2.2 Atomic and Molecular Data Information System

AMDIS, the Atomic and Molecular Data Information System, currently contains atomic and molecular collision and particle-surface interaction data is located at the International Atomic Energy Agency (IAEA), Vienna, Austria. The AMDIS consists of next databases:

The ALADDIN, **A L**abelled **A**tomic **D**ata **In**terface, is the system adopted by the IAEA for exchange of data since 1988 (Hulse 1990). The system is available on-line on INTERNET. The IP address is: ripcrs01.iaea.or.at (161.5.74.1) To access it, telnet to this address and login using: user id: aladdin , password: aladdin. The non-registered users may work with userid guest but may not save the search results into a file. In order to become a registered user one can send an e-mail to psm@ripcrs01.iaea.or.at The ALLADIN is also available as a set of FORTRAN77 codes and data files which can be downloaded from *anonymous* FTP-site at ftp://ripcrs01.iaea.or.at. Any comments and/or suggestions are very welcome.

ATOMIC DATABASES

NAME	Location	Country	Types of Data
ADA : Atomic Data for Astrophysics	University of Kentucky	USA	MSCD
ADRAL : Atomic Data for Resonance Absorption lines	Herzberg Institute of Astrophysics	Canada	WL, TP, OS, damping constants
ATOM PHTI : Atomic Photoionization Database	St.Petersburg Phys. Techn. Institute	Russia	PHI
ATOM VNIFTRI : Atomic Data Database	any kind of PC Radio Measurements, Mendeleevo	Many	DR, ElEx. ElIon
BIBL : Spectral Bibliography Database	Institute of Spectroscopy, Troitsk	Russia	Bibl: MSCD
CCP7 : CCP7 Data Library	University of St.Andrews	U.K.	EL, WL
CDS :	Centre de Données Astronomiques de Strasbourg	France	MSCD
CfAD: Harvard-Smitsonian Center for Astrophysics Databases	Harvard	U.S.A.	EL, OS, TP, WL
DASGAL: Bibliography Database on Atomic Line Shapes and Shifts	Observatory of Paris-Meudon	France	Bibl: LS, SH
GAPHYOR: GAPHYOR Data Centre	Centre de Données, Orsay	France	Bibl: MSCD
IAEA AMDIS: IAEA Atomic and Molecular Data Information System	Intern. Atomic Energy Agency, Vienna	Austria	ElEx, ElIon, CT, HP, Bibl
LLNL EPAS: Elastic-Photon-ATOM Scattering Database	Lawrence Livermore National Laboratory	U.S.A.	SF
NIFS: Database	National Institute for Fusion Science	Japan	ElEx, ElIon, CT, HP
NIST ASD: Atomic Spectroscopy Database	NASA Astroph. Data System	U.S.A.	EL, OS, TP, WL
NIST ATPBD: Atomic Transition Probability Bibliographic Database	NASA Astroph. Data System	U.S.A.	Bibl: OS, TP
TOPbase: Opacity Project Database	Centre de Données Astronomiques de Strasbourg	France	EL, OS, TP, PHI, WL
TRINITI:	No information	Russia	ElEx
CFADC: ORNL Controlled Fusion Atomic Data Center DataBases	Oak Ridge National Laboratory	U.S.A.	Bibl:MSCD
SAM: Systematic, Accurate, Multiconf. Calculations Project Data	NASA	U.S.A.	EL,OS,TP,HfS
UUD: Uppsala University Databases	Uppsala University	Sweden	OS, SF, WL
VALD: Vienna Atomic Line Database	Institute für Astronomie,Vienna	Austria	EL, OS, TP

Notes to atomic parameters and processes:

Bibl: AAA - bibliography for data marked AAA; CT - Charge transfer; EL - energy levels; ElEx - electron impact excitation; ElIon - electron impact ionization; DR - dielectronic recombination; HP - heavy-particles interaction; Hfs - hyperfine structure parameters; LSSH - line shapes and line shifts; MSCD - miscellaneous spectroscopic and collision data; OS - Oscillator strengths; PHI - photoionization cross sections; SF - scattering factors; TP - transition probabilities; WL - wavelengths

-ALADDIN (format and interface program) - recommended and evaluated data,

- AMBDS - Atomic and Molecular Bibliographical Data Retrieval System containing over 35000 references on atomic, molecular and plasma-material interaction data of interest to fusion,

- AMBB - Electronic Bulletin Board with Atomic and Molecular related news.

B.3 Miscellaneous atomic data sources

This part of the work is based mainly on the review of Smith (1992). Many useful information can be also extracted from review of C.Mendoza (1986).

B.3.1 Laboratory, agency and society reports

The international Atomic Energy Agency (IAEA) in Vienna published the *International Bulletin on Atomic and Molecular Data for Fusion*. The bulletin presents a comprehensive compilation of references to papers on atomic (*and molecular*) structure, spectra and collisions (many of these references are included in Appendix B). There were quarterly issues of Bulletin until 1988, semiannual ones until no 41 in 1990, and a hiatus will end with publication Nos. 42-45. Last issue that authors have seen is No. 49 (June 1995). The editor of Bulletin is J.Botero, who can be reached by e-mail RNDS@IAEA1.BITNET.

Japan institute for Plasma physics (it is now National Institute for Fusion Science) produced more then a hundred compilations of atomic data for fusion research in the IPPJ-AM series (1977-1988) and the issue has been continued by the NIFS-DATA series. The current editor of these series is Hiro Tawara, who can be contacted via e-mail TAWARA@NIFS.AC.JP. Some of the IPPJ and NIFS reports have also been published in J.Phys.Chem.Ref.Data. Atomic data compilations produced by Japan Atomic Energy Institute (JAERI) mostly are published in J.Phys.Chem.Ref.Data too. The current editor is T.Shirai having e-mail J3323@JPNJAERI.

GAYPHOR GAYPHOR (Gas-PHYsics-ORsay) database at Centre de Données, Orsay, France maintains the bibliographicl data includes references to properties of neutral and ionized atoms (and molecules) and to parameters for electron and proton collision processes. The quests for expert's reports can also be sent by e-mail to gaphyor@lpgp.u-psud.fr but this service is not free of charge.

B.3.2 Newsletters and Proceedings from Symposia and Workshops

Collaborative Computational Project No. 7 (CCP7) supported by the Science and Engineering Research Council (SERC) of the U.K. produces the *Newsletter on Analysis of Astronomical Spectra*, which includes data or other information useful in modelling stellar spectra. The issue No. 17 contains a review of plasma diagnostic methods using line intensity ratios, useful summary of the most reliable atomic data, a bibliography of Opacity Project and a review od Stark broadening data. The current editor is C.S.Jeffery, who can be contacted by e-mail CJS@ST-AND.AC.UK.

Collaborative Computational Project No. 2 (CCP2) on the Continuum States of Atoms and Molecules and on Applications to Solar Physics and Astrophysics publishes the *Information Quarterly for Atomic Processses and Applications*. Current editors are W.Eissner from Queen's University in Belfast (e-mail AMG0400@VAX1.APP-MATHS.QUEENS-BELFAST.AC.UK ({capital letters are mandatory}) and C.J.Noble from Daresbury Laboratory , e-mail CJN@CXA.DL.AC.UK.

CCP2 and other agencies sponsored international workshops on atomic data for fusion and astrophysics. They are partly resulted in a report on recommended data (Aggarwal et al. 1985) and were stored in the Queen's University / Daresbury Laboratory Atomic Data Bank directed by K.A.Berrington (e-mail AMG0016@VAX1.APP-MATHS.QUEENS-BELFAST.AC.UK

A lot of useful information can be extracted from the proceedings of a meetings on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory plasmas, the last and 5th in a series was held in Meudon, France, August 28-31, 1995 (Tchang-Brillet et al. 1996).

References

[1] Aggarwal K., Berrington K., Eisner W., Kingston A., 1985, *Recomended Data from the Daresbury Atomic Data Workshop (Daresbury: SERC Daresbury laboratory)*

[2] Canto W., Mendoza C., Oshenbein F., Zieppen C.J. 1993, *Astron. Astrophys.*, **275**, L5.

[3] Johanson S., Cowley C.R., 1988, *J. Opt. Soc. Am., B* **5**, 2264

[4] Hulse R.A., 1990, in *Atomic Processes in Plasmas*, AIP Conf. Proc., **206**, 63

[5] Martin W.C. 1992, in *Atomic and Molecular Data for Space Astronomy: Needs, Analysis and Availability*, eds. P.L.Smith, W.L.Wiese, Berlin, Springer-Verlag, p. 121

[6] Mendoza C. 1986, *Publ. Astron. Soc. Pacif.* , **96**, 999

[7] Nave G. *Databases and Compilations of Atomic Data of Relevance to Astrophysics:* at the URL *http: //cfa-www.harvard.edu/amp/data/g_nave.html*

[8] Piskunov N.E., Kupka F., Ryabchikova T.A., Weiss W.W., Jeffery C.S. 1995, *Astron.Astroph.Suppl.Ser.*, **275**, 525

[9] Ralchenko Y.V. 1996, *Preprint WIS-96/4/Jan-PH.*

[10] Rudzikas Z.B., Nikitin A.A., Kholtygin A.F. 1990. Theoretical Atomic Spectroscopy (in Russian). Leningrad, Izd. Lgu.

[11] Rudzikas Z., Bogdanovich. P., *Baltic Astron.*, **3**, 131

[12] Sahal-Brechot S. 1991, in *Reports on Astromomy,* **XXA**, 105

[13] Smith P.L. *Proceedings of the First Symposium on Nuclear Physics in the Universe, Oak Ridge, TN, September 1992*, 387

[14] Smith P.L., Esmond J.R., Heise C., Kurucz R.L., 1996, in: *Proceedings of the 5th International Colloquim on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory Plasmas*, Meudon, France, August 28-31.

[15] Tchang-Brillet W.-U.L., Wyart J.-F., Zeippen C.J., eds, 1996, *Proceedings of colloquium on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory plasmas, Meudon, France, August 28-31, Observatory (Publications de l'Observatoire de Paris).* In Press.

[16] Wiese W.L. 1992a, Spectroscopic data for fusion edge plasmas, *Atomic and plasma-material interaction data for fusion- Vol. 2 (Supplement to Nuclear Fusion)* ed. R.K.Janev., Vienna, IAEA, p. 7

[17] Wiese W.L. 1992b, Spectroscopic reference data, in *Inductively Coupled Plasmas in Analytical Atomic Spectroscopy 2nd ed.*, eds. A.Montaser, D.W.Colighty, N.Y., p. 451.

ACCESS TO ATOMIC DATABASES

NAME	Contact	Access
ADA	D.Verner	**www:** *http://www.pa.uky.edu/verner/atom.html*
ADRAL	D.C.Morton	**www:** *http://www.dao.nrc.ca/dcm/atomic_data.html*
ATOM VNIFTRI	I.Skobelev,A.Faenov	**e-mail:** faenov@glas.apc.org
BIBL	A.N.Ryabtsev	**www:** *http://plasma-gate.weizmann.ac.il/bibl.html*
CCP7	C.S.Jeffery	**ftp:** *ftp://ccp7.st-and.ac.uk/ccp7/*
CDS	-	**www:** *http://cdsweb.u-strasbg.fr/cats/VI.html* **www:** *http://cdsweb.u-strasbg.fr/cats/J.html*
DASGAL	A.Lesage	**www:** *http://www.obspm.fr/department/dasgal/lesage/*
CfAD	P.L.Smith	**www:** *http://cfa-www.harvard.edu/amp/data/amdata.html* **e-mail:** plsmith@cfa.harvard.edu
GAPHYOR	J.L.Delcroix	**www:** *http://gaphyor.lpgp.u-psud.fr/* **e-mail:** gaphyor@lpgp.u-psud.fr
IAEA AMDIS	R.K.Janev	**telnet:** *aladdin@.ripcrs01.iaea.or.at* **e-mail:** psm@.ripcrs01.iaea.or.at
LLNL EPAS **NIFS**	L.Kyssel H.Tawara	**www:** *http://www-phys.llnl.gov/V_Div/scattering/elastic.html* **telnet:** *msp.nifs.ac.jp** **e-mail** tawara@dptawara.nifs.ac.jp
NIST ASD	D.Kelleher A.Musgrove	**www:** *http://aeldata.phy.nist.gov/nist_atomic_spectra.html* **e-mail** ael@enh.nist.gov
NIST ATPBD	P.J.Mohr J.Fuhr	**www:** *http://physics.nist.gov/PhysRefData/fvalbib/reffrm0.html* **e-mail** fuhr@tiber.nist.gov
TOPbase:	C.Mendoza	**www:** *http://cdsarc.u-strasbg.fr/OP.html* **telnet:** *cdsarc.u-strasb.fr* (userid: *topbase*, password *Seaton+*)
CFADC	D.R.Schultz	**www:** *http://www-cfadc.phy.ornl.gov/*
SAM	T.Brage	**www:** *http://aniara.gsfc.nasa.gov/sam/sam.html*
TRINITI	A.Godunov	**e-mail:** not known
UUD	-	**www:** *http://xray.uu.se/* **ftp:** *grace.lbl.gov/pub/sf/* *xray1.physics.sunysb.edu/pub/henke/*
VALD	F.Kupka	**e-mail:** vald@galileo.ast.univie.ac.ut

Note: $*$ - There is no *anonymous* access to the NIFS database so to be an userid with a password one ought to send a request to Research Information Center, NIFS, Nagoya 464-01, Japan