

U. Heiter¹, F. Kupka², T. Löffinger³, N. Nesvacil³, M. Obbrugger³, N. Piskunov¹, T.A. Ryabchikova^{3,4}, H.C. Stempels⁵, Ch. Stütz³ & W.W. Weiss³

¹ Department of Astronomy and Space Physics, Uppsala University, 751 20 Uppsala, Sweden

² Max-Planck-Institute for Astrophysics, Karl-Schwarzschild Str. 1, 85741 Garching, Germany

³ Department of Astronomy, University of Vienna, Türkenschanzstraße 17, 1180 Wien, Austria

⁴ Institute for Astronomy, Russian Academy of Sciences, Pyatnitskaya 48, 109017 Moscow, Russia

⁵ School of Physics & Astronomy, University of St Andrews, North Haugh, St Andrews KY16 9SS, Scotland

Abstract: VALD is a collection of atomic transition parameters and supporting extraction software. VALD services are available via EMail (VALD-EMS) and the Web interface. Different kinds of requests are useful for several needs like abundance analyses, radial velocity measurements, or line identifications. Since 1994, the early days of VALD, the database was constantly improved and the release of VALD-3 – incorporating, e.g. molecular data and new line lists – is in preparation. With meanwhile more than 5 000 000 requests VALD developed to a much appreciated tool.

1. Introduction:

The current version of VALD (VALD-2) contains atomic transition parameters for more than 40 000 000 spectral lines. The integrated software package enables the extraction of line parameters according to the chosen request type (see section 4.). The extracted information can be used for different scientific applications such as identification of spectral lines, radial velocity measurements, calculation of model atmospheres or abundance analysis.

2. Inside VALD:

Depending on the amount of required information the VALD output formats are Short format (Sf) or Long format (Lf). The two examples illustrate the parameters contained in the output file and the differences between the formats.

Short format

Elm	Ion	WL(A)	Excit(eV)	log(gf)	Rad.	Stark	Waals	Lande factor	References
Fe	2	4500.1340	9.6940	-3.851	8.461	-6.296	-7.920	0.520	5 5 5 5 5 5
Cr	1	4500.2780	3.0790	-0.350	7.834	-5.921	-7.612	0.830	7 7 11 7 7 12

5. GFIRON obs. energy level: Fe
7. GFIRON obs. energy level: Cr
11. NBS: Chromium
12. VALD 2: VanderWaals

Long format

Elm	Ion	WL(A)	log(gf)	Exc. lo	J lo	Exc. up	J up	lower	upper	mean	Rad.	Stark	Waals
Fe	2	4500.1340	-3.851	9.6940	3.5	12.4480	2.5	0.890	1.190	0.520	8.461	-6.296	-7.920
		d5 4s2 2G (4P)sp 2D			5	5	5	5	5	5	5	5	5
Cr	1	4500.2780	-0.350	3.0790	3.0	5.8330	3.0	0.910	0.750	0.830	7.834	-5.921	-7.612
		(4G)4s a3G(4G)4p y3G			7	11	7	7	7	7	12	7	

5. GFIRON obs. energy level: Fe
7. GFIRON obs. energy level: Cr
11. NBS: Chromium
12. VALD 2: VanderWaals

Number sequences (like: 7 7 11 7 7 7 12) correspond to references given at the end of the output. Because the data base contains entries from several sources with different accuracy, specific source lists can be chosen and all transition parameter values are ranked.

3. How to access VALD

EMS – Web Interface:

The main interface for accessing VALD by external users is the VALD EMail Service (VALD-EMS). A Web interface allows interactive submission of a request to VALD-EMS. The VALD websites at

<http://ams.astro.univie.ac.at/vald/>, or <http://www.astro.uu.se/~vald/>

contain further information, e.g. the NEWS section, which users should check regularly.

It is necessary to register first as a VALD-client via an email to the administrator - containing the email-address for receiving the VALD-EMS output. Submission of a request is possible via a specially formatted email (instructions, e.g., at the VALD websites) to vald@astro.univie.ac.at or vald@astro.uu.se, or via the Web Interface. Within less than 30 minutes a request is processed and the extracted data returned to the user. To avoid size limitations for email it is now also possible to obtain data via FTP.

Mirror sites:

In 1998 two mirror sites became operational: *Uppsala Astronomical Observatory* and the Astrophysics Data Facility at *NASA Goddard Space Flight Center*. The latter is not providing EMS, but is used for Virtual Observatory developments. Two years ago an additional mirror site at the Astronomical Institute of the *Russian Academy of Sciences*, Moscow, was put into service. Twice a day all mirror sites are automatically synchronised. Mirror site local users have additional advantages of not being limited by the maximum number of transitions per request and they also have special extraction modes not available via VALD – EMS.

4. Options in VALD

Request types:

1. Show Line:

All information contained in VALD about a specific spectral line of the same species in a wavelength range of up to 5 Å can be extracted. Different transition parameters originating from different sources can be displayed.

2. Extract Element:

This type of request extracts the atomic parameters with the highest ranking for all the spectral lines of a particular element or ion in a specified wavelength range.

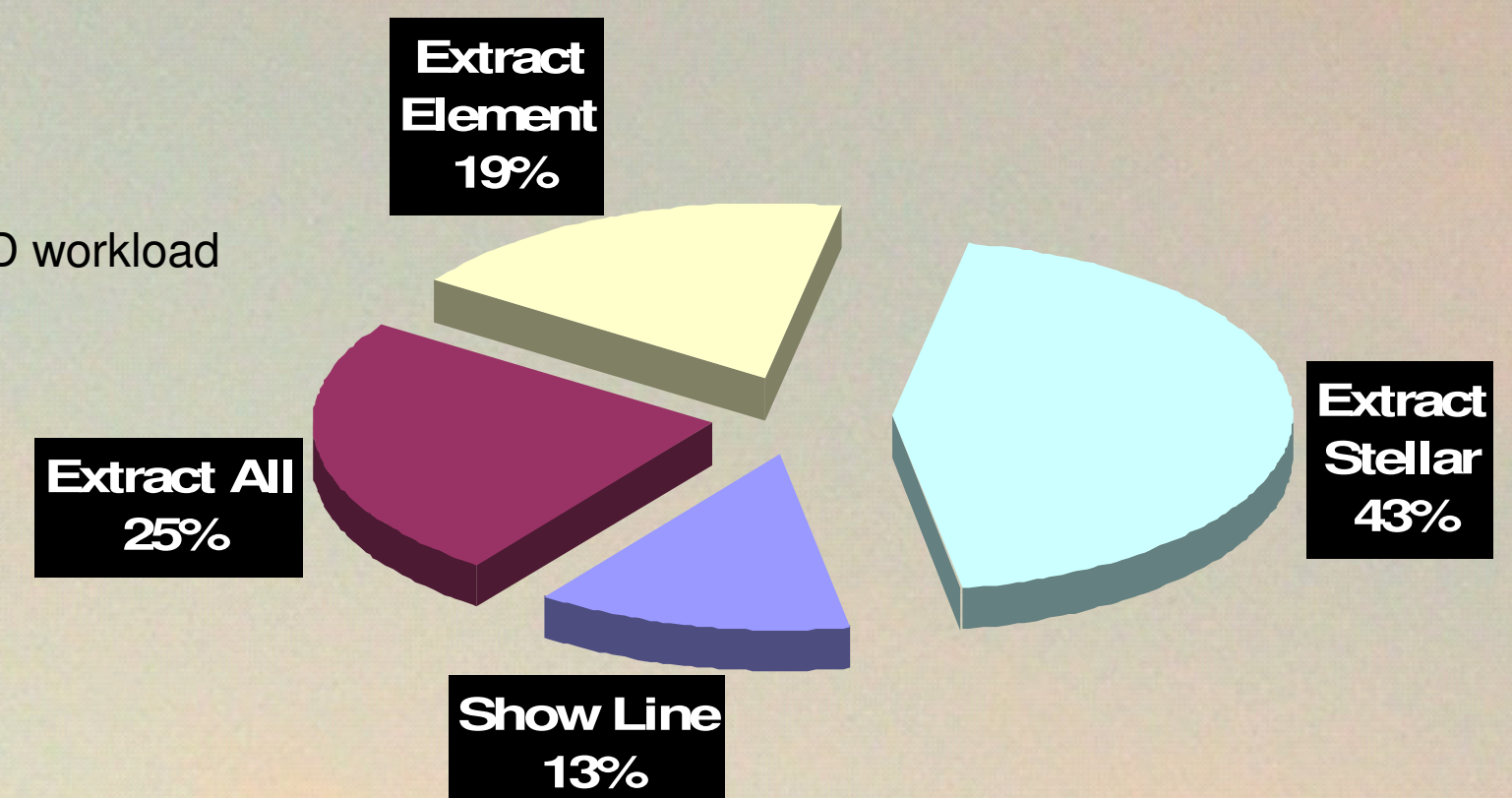
3. Extract All:

Extract All does the same as *Extract Element*, but for all elements and ions in a specified wavelength range.

4. Extract Stellar:

Different astrophysical parameters, like effective temperature, microturbulence and surface gravity have to be provided by the user, if a spectrum synthesis shall be prepared. All spectral lines with the highest ranked transition parameters and producing significant absorption are extracted.

Figure 1: VALD workload



Customisation Options:

Next to Lf and Sf (default) exist several other options for customising VALD output. The default configuration file – containing a selection of the atomic line lists – can be altered according to specific needs. This personal configuration file will be stored by VALD-EMS and can be edited through the VALD Web interface. If specifically radiative damping constants, the Stark damping constants, Van der Waals damping constants, Landè factors and/or term designations are requested, corresponding Web interface options have to be chosen.

Extraction software:

The VALD extraction tools are SHOW LINE, PRESELECT and SELECT.

PRESELECT extracts the data a specified wavelength range, combines the best quality values and filter according to the specifications of the requests. This program is used for *Extract Element*, *Extract All* and *Extract Stellar*.

SELECT solves the Radiative-Transfer-Equation for the central wavelength of each line, based on a model atmosphere with effective temperature, surface gravity, chemical composition, and microturbulent velocity set by the user. It is only used for the *Extract Stellar* request.

5. The future of VALD

VALD is continuously updated with new atomic line data. The next release, VALD 3, is scheduled for end of 2007 and will also contain molecular data. Other changes are related to the file format and units (eV → cm⁻¹). The web interface will be further tuned to extract the relevant data more efficiently. The output of each VALD request will contain the references to the original sources in BibTeX format.

References:

- Piskunov, N.E., Kupka, F., Ryabchikova, T.A., Weiss, W.W., Jeffery, C.S., 1995, A&AS 112, 525
Kupka, F., Piskunov, N.E., Ryabchikova, T.A., Stempels, H.C., Weiss, W.W., 1999, A&AS 138, 119
Ryabchikova, T.A., Piskunov, N.E., Stempels, H.C., Kupka, F., Weiss, W.W., 1999, PhST 83, 162

