Tags for FUSE & non-FUSE database structures (April 25, 2007)

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ABSTRACT

General thoughts on dealing with values which don't exist: My philosophy began with the idea that if some value wasn't available, the value of the tag should be set to zero, **unless** the value could actually *be* zero. In that case, tag should be set to '999'. For example, when only a limit to a column density exists, the Doppler parameter would be set to zero, because a line can't have $b = 0$ km s^{-1}; however, the *velocity* of the line would be set to 999.0 km s^{-1}, because a line could have $v = 0$ km s^{-1}. This is not quite the same when there's only a limit to the column density: errors in N when N is an upper limit are usually set to '0'. At least, that was the theory, and it's largely adhered to in the Datasets. More recently, however, I discovered IDL's NaN, which is a useful way to stop me from accidentally using zero or 999 when making a complicated plot. Although I haven't changed the datasets en masse, be on the lookout for the occasional tag where they've crept in.

In a few cases, there are some "universal variables" mentioned in the text. These are variables which all the programs use and which are stored in a single file. These can be recognized easily since they begin with "*O6var*" (e.g. *O6var_WDerr*). The actual values aren't quoted here (since it's hard to quote a .pro file verbatim in a LaTeXfile and the entries in the file aren't stable yet).

For all the structures described, the index to an array entry goes before the tag. Hence the name of the star for, e.g., the 7th entry to the FUSE DB would be found in *fuse[6].name*. Of course, some tags are arrays themselves. So, for the example star, its Galactic longitude would be found in *fuse[6].galpos[0]*.

Table 1. FUSE Program: Data Information **[DBfuse.sav]**

Tag	Type	Units	Description
.gendate	string	...	Date & time the database was generated. (IDL's *systime* format.)
.sat	string	...	String designating data being used. Value set to "fuse" for the FUSE database. (Other datasets will be identified with the string "coper", "zsargo", "savage"...).
.satcount	integer	...	Number of entries in the dataset. Just for convenience.
.root	string	...	Fuse program root. OVI-in-the-Disk program of the form P102?? and P122??.
.root_other	string	...	In a few cases, data from two different FUSE programs have been coadded to produce a final spectrum. This string records the root of the second program.
.unique_id	string	...	Unique ID number for paper.
.exptime	real	ksec	Total exposure time, based on the FUSE data which were actually used.
.dates	string(5)	...	Dates of observations. (No more than five strings are currently allowed.) Dates are simple strings of form "YYYY MM DD". A new date is added only if a day elapses between one exposure and the next[a] .
.aper	string	...	Aperture used. Usually "LWRS", but a few "MDRS" are included
.chan_numb	integer	...	FUSE channel. [1,2,3,4] corresponds to ['lif1a','lif2b','sic1a','sic2b'].
.shift_ang	real	Å	Shift applied to zero-point of FUSE wavelength scale.
.shift_vel	real	km s^{-1}	Ditto. Velocity calculated from *.shift_ang*, $\Delta v = c\,\Delta\lambda/\lambda_{\rm OVI}$.
.shifted	integer	...	Shift info: '1' = STIS data used ('S' in plots); '2' = FUSE 10 km s^{-1} adopted ('F'); '0' = No shift applied ('X'), because not LiF1A, because FPALXPOS > 200, or if MDRS used.

[a]For example, if a set observations begins on the 24th of the month, and continues to the 25th, the 25th is not listed.

Table 2. FUSE Program: Data Information (cont)

Tag	Type	Units	Description
.cont_flag	int	. . .	Indicator of difficult continuum. This is meant to be a simple, crude flag to highlight cases where humans have been critically involved in the continuum selection. ’0’ = no problem; ’1’ = cases for which we could have chosen a path for the continuum substantially different from the one adopted (and not covered by the continuum error envelopes), either side of the OVI line; ’2’ = same as 1, except the continuum would have been very different only on the red side of the OVI. These are the cases discussed in the text which would have to have additional, broad, +ve velocity OVI but which probably only arise in the wing of sharp O VI emission line profiles.

Table 2. continued: FUSE Program: Basic Stellar & Sightline Properties

Tag	Type	Units	Description
.name	string	...	Star name.
.altname	string	...	Alternative name (currently null).
.galpos	real(2)	degrees	Galactic co-ords, l [0] and b [1].
.RA & .DEC	real	degrees	Observed J2000 RA and DEC, in degrees, taken from RA_TARG, DEC_TARG keyword in header.
.properties	string	...	Stellar type & class summary, no spaces.
.types	strarr(3)	...	Sp/L class, with a space between each; up to three separate entries. (Used for automatically calculating distances.)
.numb_types	int	...	Number of sp/L class combinations; up to three entries in *.types* tag.
.vrad	real	km s^{-1}	Radial velocity of star. Frame not yet established[a] .
.vsini	real	km s^{-1}	$v\sin(i)$ of star[a] .
.rosat_class	int	...	EBJ's ROSAT classification.
.carina_class	int	...	Whether star lies in Carina's X-ray bubble.
.vela_class	int	...	Whether sightline through Vela.
.vcorr	real	km s^{-1}	Correction from Heliocentric to LSR velocity, Based on KRS's code, so $vcorr + v_{\odot} = v_{\rm LSR}$. Using what the function `helio2lsr` returns.
.hipp_id	string		Hipparcos record number, if in catalog.

[a]Gentle warning: these values haven't been checked for a long time!

Table 2. continued: FUSE Program: Catalog References

Tag	Type	Description
.binary_str	string	5 char string. Each char (one of 'Y', 'N', or '-') refers to an entry in a catalog: **char 1**—found in Batten's (SB8) original catalog[a] ; **char 2**—found in *SB9: The Ninth Catalogue of Spectroscopic Binary Orbits*, by Pourbaix et al (2004); **char 3**—found in the Hipparcos *Double and Multiples: Component solutions* catalog or tagged in the main catalog as binary from Acceleration solution (HD 185418 & HDE 232522); **char 4**—multiple system in the main Hipparcos catalog. Char indicates either component (C) or acceleration solution (G).[b] ; **char 5**—resolved double star in the Tycho main catalog; for Hipparcos/Tycho catalogs, '-' means the star is not in that catalog.
.binary_mags	real(4)	If individual components are listed in the Hipparcos *Double and Multiples: Component solutions* catalog, then this array contains a list of the (H_p) mags for each.
.sb9_pid	intarr(5)	If star found in SB9, this is the ID number that the catalog uses to reference a star. A star may have up to three ID numbers. *sb9_pid[0]* set to −1 if not in SB9.
.delta_L	real	This is the value of ΔL applied to the distance (*.dist*). Mainly for stars in SB9.

[a]This entry is redundant; there are no FUSE sightlines which have an entry in SB8 but not SB9.

[b]"The *component* solutions comprise resolved systems in which the individual components were modeled similarly to single stars." *Acceleration* solutions are applicable to "apparently (unresolved) stars, for which the motion appears to be significantly non-linear. They are probably astrometric binaries: either too close to be resolved (< 1 arcsec) or with a companion too faint to be seen by Hipparcos."

Table 2. continued: FUSE Program: Catalog References (cont)

Tag	Type	Description
.variable_str	string	4 character string. Each char refers to an entry in a catalog. **char 1**—if not ‘-’, then found in Hipparcos catalog; 1: <0.06 mag; 2: $0.06-0.6$ mag; 3: >0.6 mag peak-to-peak. **char 2**—found in the *Combined General Catalogue of Variable Stars* or the GCVS *Suspected Variable stars and Supplement* ({samus04}). Three possible entries[a] : *S:* (‘small’) difference between (corrected) Hipparcos *V* mag and faintest mag in GCVS (if available) is ≤ 0.06 mags; *B:* (‘big’) difference is >0.06 mags; *U:* (‘unknown’) faintest mag is not given in GCVS; *?:* strange entry, ignored; —*:* not in GCVS. **char 3**—“variable” in Tycho catalog[b] . [‘Y’ or ‘N’] **char 4**—This flag explains Hipparcos variabilty: C: no variability detected ("constant"); D: duplicity-induced variability; M: possibly micro-variable (amplitude < 0.03mag); P: periodic variable; U: unsolved variable which does not fall in the other categories.
.var_adjust	int	Magnitude has been adjusted: **-1:** mag from literature; **0:** no corrections; **1:** brightest component of multiple system in DMSA/C catalog adopted (i.e. smallest value in *.binary_magsHp* tag $\neq 0$); **2:** fainest mag found when star in *Variability Annex*, if not SB; **4:** distance adjusted because SB. (*.Vmag* not actually adjusted, but this tag is useful for checking if some ΔL was applied.)
.hipp_var_gcvs	string	GCVS designations given in the Hipparcos *Variability Annex*. Appended string ’A1’ if from Annex1 (“Periodic variables”) or A2 if from Annex2 (”Unsolved variables”).
.hipp_faintest	real	Star found in *Hipparcos Variability Annex*; “magnitudes at minimum luminosities... ... derived from (folded) light-curve fitting ... of the Hp photometry”.
.hipp_brightest	real	See above... for mag at max luminosity. Value is -1 if not available.
.gcvs_faint	real	The faint mag given by GCVS if available. NaN if not.

[a]**WARNING!** the difference may be measured from magnitudes obtained in different bands!!

[b]The variability flag from the Tycho catalog is included here, but thought to be too unreliable to use. The flag gives no indication on the level of variability anyway.

Table 2. continued: FUSE Program: Magnitudes

Tag	Type	Units	Description
.Bmag	real	mags	B mag from Hipparcos or Tycho catalogs[a] .
.Vmag	real	mags	V mag from Hipparcos or Tycho catalogs[a] .
.BT	real	mags	Original Tycho B_T.
.BT_err	real	mags	Errors on Tycho B_T.
.VT	real	mags	Original Tycho V_T.
.VT_err	real	mags	Errors on Tycho V_T.
.Kmag	real	mags	K mag from 2Mass, converted to Johnson K via transformation in {cutri03}[b] ; if the quality flag is not 'A', this value is set to zero.
.Hpmag	real	mags	Hipparcos H_p mag. Zero if not available.
.K_flag	string(1)	...	Quality flag from 2Mass catalog[c] . Set to 'Y' if $2\sigma(E_{V-K}) > E_{V-K}$ to avoid using noisy data. Set to 'Z' if more than one type or class given; a value other than 'A' means A_V will not be calculated from IR info (see *.our_Av*).
.excess	real	mags	$E(B-V)$; if one than one type or class is available, the average is taken of all the $E(B-V)$ values derived for each class or type. Equals 999 if literature distance used (see *.dist*).
.excess_err	real	mags	Error in $E(B-V)$. Assume error in $(B-V)_0$ is 0.01 mags[d] , which is added in quadrature to the error in $(B-V)$ given by $\sigma(B-V)$. Set to 999 if literature distance used.
.ekv	real	mags	$E(K-V)$; set to 999 if not calculated (see *.our_Av* below); if more than one type/class given, the average is stored in this variable.
.ekv_err	real	mags	Error in $E(K-V)$. Assume the error in $(K-V)_0$ is 0.03 mags[e] , so err in $E(K-V)$ is $\sqrt{\sigma(K_J)^2+\sigma(V_J)^2+\sigma[(V-K)_0]}$; set to 999 if *.ekv* not calculated.

[a]Converted from B_T and V_T. If star has multiple components in Hipparcos catalog, V is really H_p of the brightest component. For stars which are found in *Variability Annex*, V is changed to the (H_p) minimum of the light curve. In both cases, there's no B mag, so to get a Johnson B, use $B-V$ colors of total system, and use $B = 0.85*(B_T - V_T) + H_p$. Stars which are spectroscopic binaries never have their mags changed.

[b]If 2Mass J mag is unsuitable, we drop the color term.

[c]2Mass uses several flags to track quality—X,U,F,E,A,B,C,D—which we keep; see VizieR for full details.

[d]This is a good approximation, assuming the ±1 class or type error used for the range in distance. $B-V$ varies very slowly with class and type.

[e]$(V-K)_0$ varies slowly with luminosity class, but strongly with stellar type.

Table 2. continued: FUSE Program: Extinction

Tag	Type	Units	Description
.our_Av	string	...	'T' if we used the IR data to calculate A_V; otherwise 'F'. Extinction A_V is calculated as $-1.1 \times E(K-V)$. When do we calculate $E(K-V)$? *.k_flag* must be 'A'; when else is 'F'?: — Variable star in Hipparcos catalog (*.var_adjust*=2); — Resolved multiple system in Hipparcos catalog (*.var_adjust*=1); — Star has emission lines ('e' or 'f'); — Literature distance used (e.g. WNs); — One (or more!) Sp/Ls available. If 'F' then $A_V = 3.1\,E(B-V)$ is used instead.
.emm_ref	string		Reference to emission line information. For non-P102/P122 stars, and P102/P122 stars which are not in Hipparcos catalog, bibTeX entries are given. For P102/P122 stars which are in Hipparcos, the reference *kens_list* is given when stars in KSR's original list were marked with an 'f' or 'e'.

Table 2. continued: FUSE Program: Distances

Tag	Type	Units	Description
.dist	real	pc	Distance to star. If more than one type, or class is intermediate (e.g. "II–III") then the *average* is taken of the distance calculated for each class or type. If only class "I" is given, distance is the average of "Ia" and "Ib". If no class is given at all, average a distance assuming a class "Ia–V". A few values are from the literature: —the one O2 star (HD 093129A) (because no O2 M_V); —the four WNs (distances from various sources); —HD110432 (P11614) from Hipparcos (only 300 pc); —HD005005A (P10201) from IC 1590 distance ({guetter97}) (system is a quad). —LS277, taken directly from {reed93} due to lack of any other info. These should have *.dist_ref*$\neq$ {thispaper}
.dist_range	real(2)	pc	"Error" in distance. Several notes: —This is really a range in distances, using the rule that a value of M_V can be wrong by $\pm$ one class and one type. —An additional 0.25 mags is added in quadrature to these values to take into account the scatter in M_V found by different authors. —If one than one class or type is available, then the range is the min/max from whichever class or type gives the min or max. *.dist_range*[0] is the upper distance, *.dist_range*[1] lower. —Set to some % of *.dist* if lit distance used and no *dist_err* found in NOTES, with % given by system variable *O6var_d_err*. —NB: there's currently no error added to *.dist_range* if emission-line star.

Table 2. continued: FUSE Program: distances, then AoD Column Density Limits

Tag	Type	Units	Description
.lit_dist	integer	...	’1’ means the distance was taken from the literature and not calculated from type and class. ’0’ otherwise. If this is set, no changes in *.dist* are made even if spectroscopic binary.
.dist_basic	real	pc	Distance assuming $R_V = 3.1$ and $E(B-V)$. Same rules as above for multiple types/classes. Equals *.dist* if literature distance given.
.dist_ref	string	...	BibTex string containing reference to distance. Usually just “{thispaper}”.
.limitcol	real	cm^{-2}	AoD column density limit of data. We calculate $\sigma(N)_c = N_u - N_0$ and $\sigma(N)_r$ over a hard limit of $-120 < v_{\odot} < +120\ \mathrm{km\ s}^{-1}$, where N_0 is the column density measured from best-fit continuum, and N_u is the column density from the upper continuum fit. $\sigma(N)_r$ is the error from the FUSE noise arrays (see *.nv_err_noise* tag below). $\sigma(N)_c$ and $\sigma(N)_r$ are then combined in quadrature to produce N_{limit}. [This value is very similar (and often identical to) *.nv_err_total* (see below), except for the imposition of the 240 km s^{-1} velocity range.] If $N_0 < N_{\mathrm{limit}}$, we consider this to be a non-detection of O VI. If $N_0 > N_{\mathrm{limit}}$ and the line is detected, *.limitcol* is set to zero (to avoid confusion when selecting detections and non-detections during analysis of the data set). Measurements are made on data shifted by *.shift_ang*. (*.limitcol* could be referred to as the “conventional 1σ limit”.)
.limitcol_marsh	real	cm^{-2}	If a non-detection of O VI is indicated by *.limitcol*, then we also calculate a “2σ” $N_{\mathrm{limit,M}}$ via Marshall’s algorithm and EBJ’s upper_limit.pro routine, viz. $N_{\mathrm{limit,M}} = N_{\mathrm{limit}}$*upper_limit$(2, N_0/N_{\mathrm{limit}})$. Otherwise $N_{\mathrm{limit,M}} = 0$.
.limit_flag	integer	...	Flag to indicate whether O VI was detected. = 0 if detection, = 1 if non-detection. The same information can be derived from .limitcol, but this is included for convenience.

Table 2. continued: FUSE Program: AoD Column Density Limits

Tag	Type	Units	Description
.Nv_col	real(3)	cm^{-2}	AoD column density, measured over a velocity interval usually set to be $-120 < v_{\odot} < +120$ km s^{-1}, although in some cases this range is altered if the $N(v)$ profile extends beyond these boundaries. (*.vrange* is available if required.) Tag contains [N_0, N_u, N_l], where N_l is column from the lower continuum fit. Measurements are made on data shifted by *.shift_ang*.
.Nv_err_noise[1]	real	cm^{-2}	AoD column density error $\sigma(N)_r$ from FUSE error arrays, measured over same velocity interval as $N(v)$, using the best-fit continuum. These appear in the second set of parentheses in the bottom panel of the figures showing the data.
.Nv_err_cont	real(2)	cm^{-2}	AoD continuum error, $\pm\sigma(N)_c$ arranged as [$N_u - N_0$,$N_0 - N_l$]. These appear in the first set of parentheses in the bottom panel of the figures showing the data.
.Nv_err_Total	real(2)	cm^{-2}	Final AoD error, $\pm\sigma(N)_{\rm total}$, with continuum and noise error combined in quadrature.

[1]Of course, there are really three values of $\sigma(N)_r$, one for the best fit and two for the upper and lower continuum fits. In practice, however, the difference in these three numbers is very small.

Table 2. continued: FUSE Program: Profile Fits

Tag	Type	Units	Description
.p_numb_comps	integer	...	Number of components used in fit. (Always ≤ 3.) **Below, we designate this as** n.
.p_best	real(3,n)[2]	...	Cloud model from fitting data normalized by best continuum fit. Arranged as [b_i, v_i, N_i] for each of i components. v_i is shifted by the velocity offset for the FUSE data (see .*shift_vel* tag). These are the numbers which appear in the middle panel of the figures showing the spectra.
.p_centroid	real	km s^{-1}	$\sum(v_i N_i)/\sum N_i$. 999 if upper limit. Heliocentric.
.p_upper	real(3,n)	...	Cloud model from fitting data normalized by upper continuum fit. Arranged as [$b_{i,u}$, $v_{i,u}$, $N_{i,u}$] for each of i components. $v_{i,u}$ is shifted by the velocity offset for the FUSE data (see .*shift_vel* tag).
.p_lower	real(3,n)	...	Cloud model from fitting data normalized by lower continuum fit. Arranged as [$b_{i,l}$, $v_{i,l}$, $N_{i,l}$] for each of i components. $v_{i,l}$ is shifted by the velocity offset for the FUSE data (see .*shift_vel* tag).
.p_err_bnoise	real(n)	km s^{-1}	Noise error $\sigma(b_i)_r$ on each b_i, from monte-carlo simulations.
.p_err_bcont	real(2,n)	km s^{-1}	Continuum error $\pm\sigma(b_i)_c$ on each b_i, arranged as [$b_{i,u}-b_i$, $b_i-b_{i,l}$]
.p_err_bTotal	real(2,n)	km s^{-1}	Final error $\pm b_{i,\mathrm{total}}$ on each b_i, formed from quadratic sum of .p_err_bcont and .p_err_bnoise. This is called $\sigma(b)_T$ in the paper.
.p_err_Nnoise	real(n)	cm^{-2}	Noise error $\sigma(N_i)_r$ on each N_i, from monte-carlo simulations.
.p_err_Ncont	real(2,n)	cm^{-2}	Continuum error $\pm\sigma(N_i)_c$ for each N_i, from monte-carlo simulations. Arranged as $[N_{i,u}-N_0, N_0-N_{i,l}]$.
.p_err_NTotal	real(2,n)	cm^{-2}	Final error $\pm N_{i,\mathrm{total}}$ formed from quadratic sum of .p_err_Nnoise and .p_err_Ncont.
.p_err_vnoise	real(n)	km s^{-1}	Noise error $\sigma(v_i)_r$ on each v_i, from monte-carlo simulations.

[2]In fact, these tags are really real(3,3). This array size has to be fixed, because we can't change the definition of an IDL structure tag from entry to entry. No sightline has more than three components, so the array never has to be longer than three rows. Obviously, if there is, e.g., only one component, then the remaining two columns and rows have values of zero.

Table 2. continued: FUSE Program: Profile Fits: Summation of Column Densities

Tag	Type	Units	Description
.p_total	real(3)	cm^{-2}	Sum of column densities for all component fits. Array arranged as [$\sum N_i$, $\sum N_{i,u}, \sum N_{i,l}$]. Values are 999 if limit.
.p_err_T_cont	real(2)	cm^{-2}	Continuum error in the total column densities. Array arranged as [$(\sum N_{i,u} - \sum N_i)$, $\sum N_i - \sum N_{i,l}$].
.p_err_T_noise	real	cm^{-2}	From the monte carlo simulations, add each component's column density to make a total, then measure the distribution of those 300 sums, i.e $\sigma \sum (N_i)_r$
.p_err_T_Total	real(2)	cm^{-2}	Final error, the quad sum of .p_err_T_noise and .p_err_T_cont. 999 if limit.

Table 2. continued: FUSE Program: H_2 information and 'ends' data.

Tag	Type	Units	Description
.h2r4	real(3,n)	...	Cloud model for the H_2 R(4) line. Arranged [b_i, v_i, N_i] for each of i components. The total number of components n depends on the fit to other R(4) lines, and need not be the same as the O VI or P(3) line. v_i is shifted by the velocity offset for the FUSE data (see *.shift_vel* tag).
.h2p3	real(3,n)	...	Cloud model for the H_2 P(3) line. Arranged [b_i, v_i, N_i] for each of i components. The total number of components n depends on the fit to other P(3) lines, and need not be the same as the O VI or R(4) line. v_i is shifted by the velocity offset for the FUSE data (see *.shift_vel* tag).
.ends_o6	real(6)	km s^{-1}	Velocity edges of O VI, currently measured at $N(v) = 2e11$. Format is [min,max, min_lo,max_lo, min_hi,max_hi], where 'lo' and 'hi' refer to upper and lower continuum fits. Vels shifted by the velocity offset for the FUSE data (see *.shift_vel* tag).
.ends_o1	real(6)	km s^{-1}	Same as *.ends_o6*, except for O I λ1039.2304 line, measured at a level of $N(v) = 5e12$. Vels shifted by the velocity offset for the FUSE data.
.ends_c2	real(6)	km s^{-1}	Same as *.ends_o6*, except for C II λ1334.532 line, measured at a level of $N(v) = 1e12$. (From STIS)
.ends_c3	real(6)	km s^{-1}	Same as *.ends_o6*, except for C III λ977.020 line, measured at a level of $N(v) = 4e11$. Vels are shifted to align SiC with LiF channel (if appropriate) and shifted by the velocity offset for the FUSE data.
.ends_si3	real(6)	km s^{-1}	Same as *.ends_o6*, except for Si III λ1334.532 line, measured at a level of $N(v) = 1e11$. (From STIS)

Table 2. continued: FUSE program: real data.

Tag	Type	Units	Description
.nvspec_npix	integer	...	Number of pixels in $N(v)$ profile
.nvspec_vel	real(331)[a]	km s^{-1}	Velocity array of $N(v)$ profile
.nvspec_nv	real(331)		$N(v)$ profile.

[1]The $N(v)$ profile doesn't neccessarily have 331 pixels. This is the number of the largest array in the dataset. To avoid using pixels where $v_i = 0$ use .nvspec_npix to use only the valid points.

Table 3. New Savage & Lehner WD paper[a] . **[DBwd2.sav]**

Tag	Type	Units	Tab,Col	Description
.gendate	string	…	…	Generation time & date.
.sat	string		…	String designating data being used; value set to "wd2".
.satcount	integer		…	Number of entries in the dataset. Just for convenience.
.name	string	…	1,1	Star name.
.galpos	real(2)	degrees	1,5&6	Galactic co-ords, l [0] and b [1].
.properties	string	…	…	Stellar type, set to "wd".
.vcorr	real	km s^{-1}	…	Correction needed to go from Heliocentric to LSR velocity; based on KRS's code, so $vcorr + v_{\odot} = v_{\rm LSR}$.
.dist	real	pc	1,5	Distance to star.
.dist_range	real	pc	…	Range in distance. Using a fixed % of *.dist*, taken from *O6var_WDerr* variable. *.dist_range[0]* is upper distance, *.dist_range[1]* is lower distance.
.Nv_vrange	real(2)	km s^{-1}	3,11	Velocity range over which EW (col 9) was calculated; presumably $N(v)$ uses the same range; values different for each sightline; lower and upper bounds given as $[v_l, v_u]$.
.Nv_col	real	cm^{-2}	3,7	AOD O VI column density (N_0) converted from $\log N$, with $N_0 = \int N(v)\,dv$. All stars have an $N(v)$.
.Nv_col_err	real(2)	cm^{-2}	3,7	Uncertainty in AOD column density, converted back from $\sigma(\log N)$[b] ; form is $[+\sigma(N),-\sigma(N)]$. Value is '999' if limit.
.Nv_vmean	real	km s^{-1}	3,5	Centroid of line, $v_0 = \int v N(v) dv / N_o$; zero point set by matching C II with LISM velocities in the literature if available, or else no correction made; value is '999' if limit; seems to be heliocentric.
.Nv_b	real	km s^{-1}	3,6	Doppler parameter derived from AOD method, defined as $b = [2\int (v-v_0)^2 N(v) dv/N_0]^{1/2}$; if limit, set to '999'. No contribution from LSF[c] .
.Nv_bsig	real	km s^{-1}	3,6	Error in AoD Doppler parameter (symmetrical); '999' if limit.

[a]Data removed: WD 1528+487—two components, no info on the summed quantities; WD0113+002—no distance given.

[b]Values are in log units so converted back via $\sigma(N) = N_0\,\sigma(\log N)/0.435$

[c]This is true — I checked with Blair.

Table 4. New Savage & Lehner WD paper, cont.

Tag	Type	Units	Tab,Col	Description
.limitcol	real	cm^{-2}	...	Column density limits are defined when measured EW is $< 2\sigma(W)$; set to '0' otherwise.
.limit_flag	integer	...	...	Set to '1' if 2σ limit; '0' otherwise.
.p_vel	real	km s^{-1}	3,2	Profile fit: velocity. 999 if limit
.p_vel_err	real	km s^{-1}	3,2	Profile fit: error in velocity. 999 if limit.
.p_b	real	km s^{-1}	3,3	Profile fit: Doppler parameter. 999 if limit.
.p_b_err	real	km s^{-1}	3,3	Profile fit: error in Doppler parameter. 999 if limit.
.p_col	real	cm^{-2}	3,4	Profile fit: column density. 999 if limit — use *.limitcol*.
.p_col_err	real	cm^{-2}	3,4	Profile fit: error in column density. 999 if limit.
.temperature	real	K	1,6	Effective temperature of star.
.contaminated	integer	...	3,9	'1' if O VI believed to be photospheric. '0' otherwise.
.rosat_class	integer	...	...	Assigned, according to EBJ's classifications

Table 5. Copernicus data, from Jenkins, ApJ, 219, 845 (1978)[a] . **[DBcoper.sav]**

Tag	Type	Units	Tab,Col	Description
.gendate	string	...	...	Generation time & date.
.sat	string		...	String designating data being used; value set to “coper”.
.satcount	integer		...	Number of entries in the dataset (for convenience).
.root	string	...	...	Number from EBJ’s list
.name	string	...	1,1	HD name.
.altname	string	...	1,2	Alternative star name.
.name_tex	string	...	1,2	The alternative name in a LaTeX-friendly format.
.galpos	real(2)	degrees	1,4&5	Galactic co-ords, l [0] and b [1].
.vcorr	real	...	...	Correction needed to go from Heliocentric to LSR velocity; based on KRS’s code, so $vcorr + v_{\odot} = v_{\rm LSR}$.
.properties	string	...	1,3	Stellar type & class, no spaces between the two. Taken from EBJ 1978. Flags ’e’, f’ & ’n’ in Table 1 kept. ’SB’, ’l’ and ’()’ discarded.
.types	string	...	1,3	Stellar type & class, space between each, used to calculate distance.
.Vmag	real	mags	...	Johnson V mag; from Hipparcos catalog.
.Bmag	real	mags	...	Johnson B mag.
.Hpmag	real	mags	...	Hipparcos magnitude.
.Kmag	real	mags	...	2Mass K-band mag. See FUSE DB entry.
.K_flag	string(1)	...	...	2Mass K-mag flag; see FUSE DB entry.
.vrad	real	km s^{-1}	1,10	Radial LRS velocity of star from EBJ78.
.excess	real	mags	...	$E(B-V)$.
.excess_err	real	mags	...	Error in $E(B-V)$; assume error in $(B-V)_0$ is 0.01 mag.
.ekv	real	mags	...	$E(K-V)$; set to ’999’ if not calculated (see *.our_Av* below).
.ekv_err	real	mags	...	Error in $E(K-V)$; set to ’999’ if not calculated.
.rosat_class	integer	...	...	EBJ’s Rosat classification.

[a]HD 41161 & HD 186994 not included because FUSE targets. NB: all stars are in the Hipparcos catalog.

Table 6. Copernicus data, continued; distances & catalog entries

Tag	Type	Units	Tab,Col	Description
.dist_orig	real	pc	1,6	EBJ's original (Table 1) distance to star.
.dist	real	pc	…	Distance to star, based on adopted class/type/luminosity.[b]
.dist_range	real(2)	pc	…	see FUSE DB entry.
.par	real	mas	…	parallax π from Hipparcos.
.par_err	real	mas	…	Error in parallax $\sigma(\pi)$.
.par_dist	real	pc	…	Distance, $d_\pi = 1.0/(\pi * 1E-3)$
.par_range	real(2)	pc	…	Range in parallax distance[c] .
.dist_use	real	pc	…	The distance we should actually use. Hipparcos distances are used if $\pi/\sigma(\pi) > 5$.
.dist_range_use	real(2)	pc	…	The range in distances we should use. Hipparcos (*.par_range*) range used if Hipparcos distance adopted.
.hipp_dist_use	int	…	…	=1 if Hipparcos distance used. For convenience.

[b]HD 68273 is of type WC; using Hipparcos distance. Need this tag to compare Sp/L method with parallax numbers.

[c]The error in the parallax is given by $\sigma(d_p) = \sigma(\theta)\, d_p/\theta$. In keeping with the other *range* tags in the other databases, we define *.par_range* to be [*.dist*+$\sigma(d_p)$,*.dist*-$\sigma(d_p)$].

Table 7. Copernicus data, continued; distances & catalog entries

Tag	Type	Units	Tab,Col	Description
.our_Av	string(1)	…	…	Different from FUSE tag; all Copernicus stars in Hipparcos, so if IR mag okay, use $E(K-V)$ only if no variabilty (intrinsic or multiple systems) (i.e. *.var_adjust* must equal 0) and not spectroscopic binaries (*.var_adjust = 4*)[a] .
.binary_str	string(4)	…	…	see FUSE DB entry.
.binary_magsHp	real(4)	…	…	see FUSE DB entry.
.sb9_pid	int	…	…	see FUSE DB entry.
.variable_str	string(4)	…	…	see FUSE DB entry; there's no Tycho char, since all stars are found in Hipparcos catalog, so char3 is a '-'.
.gcvs_faint	real	mag	…	Faint mag in GCVS if available. NaN if not.
.var_adjust	int	…	…	see FUSE DB entry.
.emm_ref	string	…	…	"ebj" if Sp/L gets an 'e' or 'f' in ebj87a; citation if good evidence found in literature; blank otherwise.
.garrison	string	…	…	Sp/L from *The Brightest Stars* in the 1996 Observers Handbook by Garrison & Beattie[b] .
.simbad_des	string	…	…	Simbad's description of star. Just for interest (not used anywhere.)

[a]Emission line stars are not excluded simply because they're emission line stars. Any short term variability will be picked up by Hipparcos or GCVS; of course, very long term variability might not be seen, but that's true for all stars!

[b]http://www.astro.utoronto.ca/ garrison/oh.html

Table 7. continued: Copernicus data; O VI quantities

Tag	Type	Units	Tab,Col	Description
.Nv_col	real	cm^{-2}	1,13	AOD O VI column density (hereafter N_0) converted from $\log N$, with $N_0 = \int N(v)\,dv$. Equals *.limitcol* if limit.
.Nv_col_err	real	cm^{-2}	...	uncertainty in AOD column density; from analysis of archive data.
.Nv_vmean	real	km s^{-1}	1,14	centroid of line, $v_0 = \int v\,N(v)dv/N_o$; value is '999' if limit. Heliocentric, converted from EBJ by subtracting *.vcorr*
.Nv_vwidth	real	km s^{-1}	1,15	2nd moment of line derived from AOD method, defined as $\Delta = \int (v - v_0)^2\,N(v)dv/N_0]$; value already has 38 km^2 s^{-2} LSF subtracted; '0' if limit.
.Nv_b	real	km s^{-1}	...	Dopper parameter, $b = \sqrt{2\,\Delta}$; '0' if limit.
.Nv_bsig	real	km s^{-1}	...	error in Doppler parameter (symmetrical); set to '999' since unavailable.
.limitcol	real	cm^{-2}	1,13	column density limits. Definition? Set to '0' if not limit. = *.Nv_col* if limit of course.
.limit_flag	integer	...	...	set to '1' if limit; '0' otherwise.

Table 8. Savage's halo paper, ApJS, 146, 125 (2003). **[DBsavage.sav]**

Tag	Type	Units	Tab,Col	Description
.gendate	string	...	...	Generation time & date.
.sat	string		...	String designating data being used; value set to "savage".
.satcount	integer		...	Number of entries in the dataset (for convenience).
.name	string	...	2A,1	QSO/AGN name.
.galpos	real(2)	degrees	2A,2&3	Galactic co-ords, l [0] and b [1].
.properties	string	...	...	Set to 'agn'.
.dist	real	pc	...	Set to `O6var_exgdist`, except for PG0832+675
.vrad	real	km s^{-1}	...	Redshift, cz.
.vcorr	real	...	...	Correction needed to go from Heliocentric to LSR velocity; based on KRS's code, so $vcorr + v_{\odot} = v_{\rm LSR}$.
.quality	integer	...	...	Data S/N quality flag; '1'—S/N poor, 3 – 5; '2'—fair, 5 – 9; '3'—good, 9 – 14; '4'—excellent, > 14. We're only going to use the data if *.quality* is '3' or '4'.
.Nv_col	real	cm^{-2}	2A,13	AOD O VI column density (N_0) converted from $\log N$, with $N_0 = \int N(v)\,dv$; velocity range is variable, and set to exclude, e.g. HVCs.
.Nv_col_err	real	cm^{-2}	2A,14&15	Uncertainty in AOD column density; quad sum of continuum error and systematic error[a] ; symmetrical; set to '0' if limit.
.limitcol	real	cm^{-2}	2A,13	Column density limits. Set to '0' if not limit.
.limit_flag	integer	...	...	Set to '1' if limit; '0' otherwise.
.Nv_vmean	real	km s^{-1}	2A,9	Centroid of line, $v_0 = \int v\,N(v)dv/N_o$; value is '999' if limit. Heliocentric, converted from LSR in Table 2 by subtracting *.vcorr*
.Nv_b	real	km s^{-1}	2A,11	Dopper parameter, $b = [2\int(v-v_0)^2\,N(v)dv/N_0]^{1/2}$; '0' if limit. Doesn't include for LSF.
.Nv_bsig	real	km s^{-1}	2A,12	Error in Doppler parameter (symmetrical); set to '999' if limit.

[a] $\sigma(N)$ converted back in the usual way: $\sigma(N) = N_0\,\sigma(\log N)/0.435$

Table 9. Zsargo's halo paper, ApJ, 586, 1019[a,b]. **[DBzsargo.sav]**

Tag	Type	Units	Tab,Col	Description
.gendate	string	...	...	Generation time & date.
.sat	string	...	...	String designating data being used; value set to "zsargo".
.satcount	integer	...	...	Number of entries in the dataset. Just for convenience.
.root	string	...	3,1	FUSE root.
.name	string	...	1,1	Star name.
.galpos	real(2)	degrees	...	Galactic co-ords, l [0] and b [1]. For the PAGBs, l,b generated from the FUSE RA & DEC info. Positions checked with Simbad.
.vcorr	real	...	...	Correction needed to go from Heliocentric to LSR velocity; based on KRS's code, so $vcorr + v_{\odot} = v_{\rm LSR}$.
.properties	string	...	1,2	Stellar type and class.
.types	string	...	...	Stellar type and class, (space between each for use in calculating distances).
.Bmag	real	mags	...	B mag, derived from Hipparcos catalog[c] . Set to zero for PAGBs.
.Vmag	real	mags	...	V mag, derived from Hipparcos catalog[c] . Set to zero for PAGBs.
.Kmag	real	mags	...	K mag from 2 Mass; set to zero if Hipparcos data not available.
.K_flag	string(1)	...	...	See FUSE DB; in addition, is set to 'I' if distance is derived from literature, (which includes the PAGBs).
.rosat_class	integer	...	...	Rosat classification.
.dist_orig	real	pc	1,8	Original distance in Zsargo paper.
.dist_ref	string	...	...	Reference to distance estimate from literature. "{thispaper}" means that distance (and range) was calculated from sp/L in the same way that FUSE and Copernicus stellar distances were derived.

[a]HD 88115, HD148422, HDE225757—in FUSE database (we re-reduced it), so not in this DB.

[b]HD177566 was rejected, since no clear distance estimate for this PAGB star.

[c]All stars are in the Hipparcos catalog, except for the PAGBs. NB: none of the stars in the Hipparcos catalog are flagged as multiples, so no *.binary_str* tag in this DB.

Table 9. Zsargo, cont.

Tag	Type	Units	Tab,Col	Description
.wmd	string(1)	…	…	Much the same as *.dist_ref*, but for simplicity, set to 'R' if distance from the literature (from "**R**evised" distance) and 'S' if calculated from sp/L class (from "**S**tandard" distance).
.excess	real	mags	…	$E(B-V)$; only calculated for 'S' sightlines'; otherwise '999'
.excess_err	real	mags	…	Error in $E(B-V)$.
.dist	real	pc	…	Adopted distance.
.dist_range	real(2)	pc	…	Range in distances.
.ekv	real	mags	…	$E(K-V)$; see FUSE DB; only calculated for 'S' sightlines'; otherwise '999'
.ekv_err	real	mags	…	Error $E(K-V)$.
.our_Av	string(1)	…	…	See FUSE DB—most of those rules apply; only calculated for 'S' sightlines'; otherwise '999'.
.variable_str	string(2)	…	…	See FUSE DB; 2 chars, first is Hipparcos variability flag, then GCVS entry.
.limitcol	real	cm^{-2}	4,6	Column density limits. Set to '0' if not limit.
.limit_flag	integer	…	…	Set to '1' if limit; '0' otherwise.
.Nv_col	real	cm^{-2}	4,6	AOD O VI column density (N_0) converted from $\log N$, with $N_0 = \int N(v)\,dv$; velocity range is variable, and set to exclude, e.g. HVCs.
.Nv_col_err	real	cm^{-2}	4,6	Uncertainty in AOD column density; set to '0' if limit.
.Nv_vmean	real	km s^{-1}	5,5	Centroid of line, $v_0 = \int v\,N(v)dv/N_o$; value is '999' if limit. Heliocentric, converted from LSR in Table 5 by subtracting *.vcorr*
.Nv_b	real	km s^{-1}	5,6	Dopper parameter, $b = [2\int(v-v_0)^2\,N(v)dv/N_0]^{1/2}$; '0' if limit; doesn't include contribution from LSF.

Table 10. Vela data **[DBvela.sav]**

Tag	Type	Units	Description
.gendate	string	...	Generation time & date.
.sat	string		String designating data being used; value set to “vela”.
.satcount	integer	...	Number of entries in the dataset (for convenience).
.name	string	...	HD name.
.galpos	real(2)	degrees	Galactic co-ords, l [0] and b [1].
.ref	string	...	Either {JSW} or {slavin04}.
.properties	string	...	Stellar type & class, no spaces between the two. Taken from ref.
.vcorr	real	...	Correction needed to go from Heliocentric to LSR velocity; based on KRS’s code, so $vcorr + v_{\odot} = v_{\rm LSR}$.
.types	string	...	Stellar type & class, space between each, used to calculate distance.
.Vmag	real	mags	Johnson V mag; from Hipparcos catalog.
.Bmag	real	mags	Johnson B mag; from Hipparcos catalog.
.Hpmag	real	mags	Hipparcos magnitude. 0.0 if from Tycho[a]
.Kmag	real	mags	2Mass K-band mag. See FUSE DB entry.
.K_flag	string(1)	...	2Mass K-mag flag[b] ; see FUSE DB entry.
.excess	real	mags	$E(B-V)$.
.excess_err	real	mags	Error in $E(B-V)$; assume error in $(B-V)_0$ is 0.01 mag.
.ekv	real	mags	$E(K-V)$; set to ’999’ if not calculated (see *.our_Av* below).
.ekv_err	real	mags	Error in $E(K-V)$; set to ’999’ if not calculated.
.our_Av	string(1)	...	see FUSE DB entry—most of those rules apply here.
.rosat_class	integer	...	EBJ’s Rosat classification. Automatically assignmed to ’3’].

[a]HD 072088 & HD 072089 not in Hipparcos catalog.

[b]The intrinsic 2Mass quality flag is ’A’ for all stars, although flag value may get changed to an ’L’ — see FUSE DB entry.

Table 11. Vela continued; distances & catalog entries

Tag	Type	Units	Description
.dist_orig	real	pc	Original distance to star.
.dist	real	pc	Distance to star, based on adopted class/type/luminosity.[a]
.dist_range	real(2)	pc	see FUSE DB entry.
.par	real	mas	parallax θ from Hipparcos. 0 if Tycho catalog.[b]
.par_err	real	mas	Error in parallax $\sigma(\theta)$.
.par_dist	real	pc	Distance, $d_p = 1.0/(\theta * 1E-3)$
.par_range	real	pc	Range in parallax distance.
.binary_str	string(4)	...	see FUSE DB entry.
.binary_mags	real(2)	...	see FUSE DB entry.
.sb9_info	string	...	see FUSE DB entry.
.variable_str	string(2)	...	see FUSE DB entry.

[a]Using *.dist_orig* for HD 072088 & HD 072089 since ambiguous class.

[c]In fact, none of the sightlines satisfy $d_p/\sigma(d_p) > 5$, so Hipparcos distances never used and no need for *.dist_use* tag

Table 11. Vela continued: O VI quantities

Tag	Type	Units	Description
.numb_comps	real	...	Number of components (for convenience). There are either one or two components only.
.Nv_col	real(2)	cm^{-2}	AOD O VI column density N_0.
.Nv_col_err	real(2)	cm^{-2}	Uncertainty in AOD column density.
.Nv_vmean	real(2)	$km\ s^{-1}$	Velocity of lines. Heliocentric, converted from LSR by subtracting *.vcorr*
.Nv_total	real	cm^{-2}	Sum of column densities.
.Nv_err_total	real	cm^{-2}	Quad sum of *.Nv_col_err*.
.Nv_centroid	real	$km\ s^{-1}$	Centroid of absorption, $\sum(v_i N_i)/\sum N_i$.
.limit_flag	integer	...	set to ’0’ (retained for convenience).

Note. — O VI quantities come from either Table 10 of JSW or Tables 2 & 3 of {slavin04}.

Table 12. Simple sum of several data sets **[DBtotal.sav, DBtotal2.sav]**

Tag	Type	Units	Description
.gendate	string	...	Generation time & date.
.sat	string		String designating data being used.
.satcount	integer	...	Number of entries in the dataset (for convenience).
.name	string	...	HD name.
.dist	real	pc	distance
.dist_range	real(2)	pc	distance range.
.rosat_class	int	...	ROSAT class. Savage exg halo sightlines set to −1.
.gl	real	degrees	Galactic longitude.
.gb	real	degrees	Galactic latitude.
.unique_id	string		
.col1	real	cm^{-2}	*N*(O VI):
			FUSE: all measured $N(v)$s (+ve & −ve values);
			WD2: detected $N(v)$s or S&L's 2σ ULs;
			COPER: $N(v)$ or 2σ ULs.
.col2	real	cm^{-2}	FUSE: profile fit columns or Marshall 2σ ULs;
			WD2: profile fit columns or S&L's 2σ ULs.
.col3	real	cm^{-2}	Same as *.col1* except all 2σ limits set to zero.
.col4	real	cm^{-2}	Same as *.col2* except all 2σ limits set to zero.
.col1_err	real(2)	cm^{-2}	Errors for *.col1*. Similar tags for *.col2, .col3, .col4*. NaN if limit
.limit_flag	int	...	Upper limit flag.
.spec_v	int	...	Vela flag; includes three FUSE sightlines and DBvela.sav star.
.spec_c		...	Carina flag; only FUSE sightlines.

Note. — The structure root for DBtotal.sav is simply called "t": databases used: FUSE, Copernicus, WD2 & Vela. For WD2, stars which S&L designate as 'contaminated' are not included. DBtotal2.sav has the structure root called "t2" and includes everything *t* includes as well as Savage and Zsargo.

Table 13. Special versions: **DBtotal-LB.sav and DBtotal2-LB.sav**

Description	Value	
LB radius removed:	100 pc	(*dist_lism*)
LB density used:	3.6×10^{-8} cm^{-3}	
LB rejection radius:	100 pc	(*dist_cutoff*)

Note. — These versions are identical to DBtotal.sav and DBtotal2.sav except the Local Bubble has been removed. The parameters used are those listed above. The save files also include two variables: *dist_lism*, the size assumed for the LB in pc; and *dist_cutoff* which is the distance below which stars are rejected *after* the dist_lism has been subtracted.