35,000 Radial Velocities for 348 Stars from the Tennessee State University Automatic Spectroscopic Telescope

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Abstract This paper presents radial velocities from a robotic telescope for stars that mainly have solar-type spectra (neutral iron-peak elements). These stars are mainly spectroscopic binaries, many of which are variables of various sorts. Data for such stars have measured random errors of roughly 0.1 km/s. We also publish velocities for a number of hotter stars for which the uncertainties are greater. The measured velocities are given in three electronic files at the AAVSO ftp site (ftp://ftp.aavso.org/public/datasets) as the .tar file AST-RVs-JAAVSO-481.tar). There are also .jpg plots of the data, electronic lists of the stars, and a FORTRAN program for extracting data for a particular star from the data files. The data cover roughly the Julian Dates 2452800–2455100 (09 June 2003–25 September 2009).

1. Introduction

While I was in the Center of Excellence for Information Systems at Tennessee State University I designed and built a two-meter robotic telescope (2-m AST) with a high-dispersion spectrograph for monitoring the velocities and line strengths of primarily cool stars. During this time (JD 2452800–2455100 (09 June 2003–25 September 2009)) I used that telescope to observe two groups of stars: 1) a group of bright cool giants in a synoptic (monitoring) program, and 2) a group of spectroscopic binaries being observed with the Georgia State University interferometer. These programs were intended to be a service to the astronomical community. This paper puts the velocities of those stars into the public record.

2. Extracting velocities from the observations

The observations consisted of echelle spectra (R ≈ 30,000) covering the wavelength range 5000–7100 Å taken with the TSU 2-m Automatic Spectroscopic Telescope at Fairborn Observatory in Washington Camp, Arizona (Eaton and Williamson 2004a, 2004b, 2007). These data were reduced at the observatory with a pipeline procedure using an echelle reduction program based on one we got from Jeff Hall of Lowell Observatory, which Williamson rewrote in C to run on our LINUX computers. We copied the resulting files back to Tennessee over the Internet every morning, knitted the separate orders of the echelle into a single array of intensity vs. (a continuous) wavelength, and archived the results.

To extract velocities from these spectra, we used lists of strong photospheric lines in the spectra, which we represented as delta functions, and cross correlated them with the observed spectrum as a function of velocity shift. We then fit the resulting cross-correlation function (CCF) with a Gaussian to get a velocity.

The initial zero point for the velocities came from observations of ~270 Th-Ar calibration lines measured at the beginning and end of the night. We corrected this velocity for drift during the night by measuring the shift of ~31 telluric O_2 lines available in each individual spectrum, in the range 6870–6924 Å, again calculating a CCF and fitting it with a Gaussian to get a velocity shift. So the wavelengths, hence velocities, are dependent on Th-Ar lines to establish the wavelengths of various echelle orders with respect to one another and telluric lines to correct for drifts during the night from such sources as thermal changes in the CCD and optical components of the spectrograph.

Most of the stars monitored by the AST have solar-type spectra dominated by neutral lines of iron-peak elements. For these we used a list of 128 strong metallic lines in the spectrum of the Sun, mostly Fe I, at the wavelengths given by Moore *et al.* (1966). For a few somewhat warmer stars, we used a list (ε Aur) containing 37 lines, mostly of singly-ionized species; for β Ori (Rigel), a list of 33 lines; for early B stars, a list (γ Peg) of 34 lines of He I and various singly and doubly-ionized metals; and for the few stars with spectra dominated by molecules, we picked a single spectrum of the star and used it as a cross-correlation mask to give velocities relative to that spectrum. For these other three classes, the wavelengths are from various publications of Charlotte Moore (1945, 1965, 1967, 1970). Table 1 gives the wavelengths used for these mask spectra and for the telluric O_2 lines.

The velocities given here are on the system I have just described, based on the wavelengths in Table 1. However, it may be useful for combining these velocities with others from different instruments to provide a transformation to a system defined by velocity standards, this following the philosophy used to define the UBV system (Johnson and Morgan 1953). We have done this for the stars with solar-type spectra (see Eaton and Williamson 2007 section 4.1) by using 23 IAU "standards," the closest thing we could find to a group of stars defining a velocity scale. From this analysis, the AST gives velocities 0.35 ± 0.09 km s^{-1} more negative than the canonical IAU values, so we would add 0.35 km s^{-1} to our measured values to bring them onto the IAU system.

From an analysis of the variation of sharp-lined stars with the most constant velocities, the random error of a single measured velocity is of the order of 0.1 km s^{-1}. This uncertainty, 0.10–0.11 km s^{-1}, should apply for those stars for which the solar mask spectrum is appropriate, namely those with moderately sharp lines of spectral type F to middle M. For the warmer stars (ε Aur, β Ori, and γ Peg mask spectra), the uncertainties are naturally greater and remain unknown because there were not enough data to analyze them.

For the double-lined spectroscopic binaries (SB2s), I used an interactive program to mark and isolate the two components in the CCF, first the weaker one and then the stronger minus the velocity range marked for the weaker line, then fit their separate profiles with Gaussians to get the velocities. Obviously this approach does not work for severely blended lines near conjunction. Also, many of these SB2s are RS CVn-type stars with decidedly blocky, non-Gaussian profiles, so the uncertainties are much larger than for single stars.

The stars observed are listed in three tables: Table 2 for those in the synoptic program and the GSU binaries, Table 3 for various double-lined spectroscopic binaries, and Table 4 for the cool stars dominated by molecular lines. These tables list (1) HD number, (2) V, (3) (B–V), (4) the number of radial velocities, (5) a symbol indicating the line list used: blank for the Solar list, "eps" for the singly-ionized species chosen for ε Aur, "**" for β Ori, and "*" for γ Peg, (6) the spectral type from *The Bright Star Catalogue* (Hoffleit and Jaschek 1982), (7) the star's common name, and (8) notes, such as variable type or some other star type.

3. The archive

The actual data are available from the AAVSO ftp archive as a single tar file (AST-RVs-JAAVSO-481.tar at ftp://ftp.aavso.org/public/datasets/) containing the files listed in Table 5. Of these, there are four text files duplicating Tables 1–4 of the text and three electronic-only files giving the measured radial velocities. The FORTRAN program may be used to extract data from these latter three files. The .tar file of plots contains plots of the velocities, hd*.jpg, that may be displayed with MICROSOFT FILE EXPLORER, or an equivalent program, to preview the data. The two data files for stars with only one line component list the Heliocentric Julian Date – 2,400,000, radial velocity in km s^{-1}, and HD number in (F11.4,F8.2,I8) format; that for SB2, HJD – 2,400,000,RV1,RV2,HD no., in (F11.4,2F8.2,I8) format.

Some of these stars have been analyzed in published papers based on most of the data given here. Table 6 lists these.

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Table 1. Lines used to compute cross-correlations.

Lines used for stars with solar-type spectra

5446.591	Ti I (3)	5701.557	Fe I (209)	6056.013	Fe I (1259)	6261.106	Ti I (104)	6475.632	Fe I (206)
5446.924	Fe I (15)	5706.008	Fe I (1183)	6062.856	Zr I (3)	6265.141	Fe I (62)	6481.878	Fe I (109)
5455.624	Fe I (15)	5711.095	Mg I (8)	6065.494	Fe I (207)	6280.622	Fe I (13)	6482.809	Ni I (66)
5472.713	Ti I (107)	5763.002	Fe I (1107)	6085.257	Ti I (69)	6290.974	Fe I (1258)	6493.788	Ca I (18)
5497.526	Fe I (15)	5782.136	Cu I (2)	6086.288	Ni I (249)	6297.799	Fe I (62)	6494.994	Fe I (168)
5501.477	Fe I (15)	5790.990	Cr I (7)	6108.125	Ni I (45)	6327.604	Ni I (44)	6518.373	Fe I (342)
5505.889	Mn I (4)	5847.006	Ni I (44)	6111.078	Ni I (230)	6335.337	Fe I (62)	6546.252	Ti I (102)
5506.791	Fe I (15)	5852.228	Fe I (1178)	6122.226	Ca I (3)	6344.155	Fe I (169)	6569.224	Fe I (1253)
5525.552	Fe I (1062)	5853.688	Ba II (2)	6136.624	Fe I (169)	6355.035	Fe I (342)	6572.795	Ca I (1)
5528.418	Mg I (9)	5866.461	Ti I (72)	6137.702	Fe I (207)	6358.687	Fe I (13)	6574.252	Fe I (13)
5543.199	Fe I (926)	5867.572	Ca I (46)	6141.727	Ba II (2)	6366.491	Ni I (230)	6575.037	Fe I (206)
5543.944	Fe I (1062)	5883.814	Fe I (982)	6162.180	Ca I (3)	6393.612	Fe I (168)	6581.218	Fe I (34)
5562.716	Fe I (626)	5892.883	Ni I (68)	6166.440	Ca I (20)	6400.009	Fe I (916)	6586.319	Ni I (64)
5567.400	Fe I (209)	5899.304	Ti I (72)	6170.516	Fe I (1260)	6400.323	Fe I (13)	6592.926	Fe I (268)
5569.631	Fe I (686)	5930.191	Fe I (1180)	6173.341	Fe I (62)	6408.026	Fe I (816)	6593.884	Fe I (168)
5572.851	Fe I (686)	5934.665	Fe I (982)	6180.209	Fe I (269)	6411.658	Fe I (816)	6625.039	Fe I (13)
5576.099	Fe I (686)	5956.706	Fe I (14)	6191.186	Ni I (45)	6419.956	Fe I (1258)	6643.638	Ni I (43)
5581.979	Ca I (21)	5965.835	Ti I (154)	6191.571	Fe I (169)	6421.360	Fe I (111)	6663.448	Fe I (111)
5588.764	Ca I (21)	5975.353	Fe I (1017)	6200.321	Fe I (207)	6430.856	Fe I (62)	6677.997	Fe I (268)
5590.126	Ca I (21)	6013.497	Mn I (27)	6215.149	Fe I (1018)	6439.083	Ca I (18)	6710.323	Fe I (34)
5594.471	Ca I (21)	6020.186	Fe I (1178)	6216.358	V I (19)	6449.820	Ca I (19)	6717.687	Ca I (32)
5598.497	Ca I (21)	6021.803	Mn I (27)	6219.287	Fe I (62)	6450.179	Co I (37)	6743.127	Ti I (48)
5601.286	Ca I (21)	6024.068	Fe I (1178)	6230.736	V I (19)	6462.570	Ca I (18)	6750.164	Fe I (111)
5624.558	Fe I (686)	6027.059	Fe I (1018)	6232.648	Fe I (816)	6462.749	Fe I (13)	6945.210	Fe I (111)
5627.642	V I (37)	6039.736	V I (34)	6233.201	V I (20)	6469.192	Fe I (168)		
5641.448	Fe I (1087)	6042.104	Fe I	6237.328	Si I (28)	6471.668	Ca I (18)		

Lines Used for Warmer Stars (ε Aur)

4991.969	S II (7)	5041.024	Si II (5)	5320.723	S II (38)	5639.977	S II (14)	6402.247	Ne I (1)
5001.479	Ca II (15)	5047.738	He I (47)	5428.655	S II (38)	5640.346	S II (11)	6578.050	C II (2)
5009.567	S II (7)	5055.980	Si II (5)	5432.797	S II (6)	5647.020	S II (14)	6582.880	C II (2)
5014.045	S II (15)	5169.033	Fe II (42)	5453.855	S II (6)	5875.685	He I (11)	6678.152	He I (46)
5015.678	He I (4)	5234.625	Fe II (49)	5473.614	S II (6)	5978.930	Si II (4)		O II (85)?
5018.440	Fe II (42)	5276.002	Fe II (49)	5509.705	S II (6)	6347.110	N II (46)	7065.177	He I (10)
5032.434	S II (7)	5316.615	Fe II (49)	5606.151	S II (11)	6371.370	Si II (2)		

Lines for Early B Stars (γ Peg)

4921.929	He I (48)	5015.671	He I (4)	5243.313	Fe III (113)	5676.020	N II (3)	6347.091	Si II (2)
4994.358	N II (24,64)	5045.088	N II (4)	5432.770	S II (6)	5679.560	N II (3)	6371.359	Si II (2)
5005.145	N II (19,6)	5047.736	He I (47)	5453.836	S II (6)	5696.615	Al III (2)?	6402.245	Ne I (1)
5007.316	N II (24)	5143.477	C II (16)	5639.995	S II blend?	5722.723	Al III (2)	6578.030	C II (2)
5009.540	S II (7)	5145.160	C II (16)	5647.004	S II (14)	5739.762	Si III (4)	6582.850	C II (2)
5010.620	N II (4)	5151.080	C II (16)	5659.950	S II (11)	5833.920	Fe III (114)?	6678.149	He I (46)
5014.045	S II (15)	5156.100	Fe II	5666.620	S II (11)	5875.685	He I (11)		

Telluric O2 Lines for Velocity Calibration

6870.946	6876.715	6889.903	6904.117	6919.002
6871.285	6877.637	6892.369	6905.023	6923.369
6872.247	6879.928	6893.300	6908.534	6924.164
6872.843	6883.833	6896.037	6909.431	
6873.798	6885.754	6896.965	6913.200	
6874.653	6886.743	6899.954	6914.090	
6875.590	6888.948	6900.868	6918.122	

Table 2. Stars with solar–type spectra.

HD	V	(B–V)	N	CCF[a]	SP	Name	Notes
352	6.22	1.38	226		K2 III	5 Cet = AP Psc	SB1
571	5.04	0.40	110	eps	F2II	22 And	σ = 0.93
886	2.83	–0.23	1674	*	B2 IV	γ Peg	β Cep
1522	3.56	1.20	96		K1.5III	ι Cet	σ = 0.16
2261	2.37	1.09	41		K0III	α Phe	
3627	3.28	1.28	10		K3III	δ And	SB1
4502	4.06	1.12	229		K1IIe	ζ And	SB1; RS CVn
4656	4.43	1.50	124		K5III	δ Psc	σ = 0.24
5665	8.92	0.96	9		K		
6286	8.24	0.96	319		G2 V	BE Psc	SB1; RS CVn
6833	6.77	1.14	20		G9II		σ = 0.14
6860	2.06	1.58	221		M0IIIa	β And	σ = 0.24
7308	7.63	1.59	10		K5II		
7318	4.68	1.04	18		K0III	φ Psc	
7640	8.46	0.60	14		G		
7672	5.43	0.87	31		G5IIIe	39 AY Cet	
8556	5.92	0.37	93		F3V	HR 404	SB
8890	2.02	0.60	679		F7Ib–II	α UMi = Polaris	Cepheid
9053	3.41	1.57	32		M0IIIa	γ Phe	SB
9312	6.78	0.93	29		G5		
9352	5.70	1.52	61		K0Ib+B9V	HR 439	
9828	8.74	1.28	13		K0		SB1
9927	3.57	1.28	63		K3–III	υ Per	σ = 0.20
9939	6.99	0.91	45		K0I		SB1
10588	6.32	0.86	9		G8III–IV	HR 503	SB1
11353	3.74	1.13	28		K0III	ζ Cet	SB1
11636	2.64	0.13	21		A5V	β Ari	SB1
11909	5.11	0.90	12		K1Vp	ι Ari	SB1
12533	2.26	1.37	83		K3–IIb	γ^1 And	σ = 0.24
12641	5.96	0.83	31		G5II–III	61 Cen	SB1
12642	5.62	1.59	154		M1 //I		σ = 0.24
12923	6.29	0.89	19		K0	HR 616	SB1
12929	2.00	1.15	167		K2IIIab	α Ari	σ = 0.13
13974	4.90	0.58	105		G0.5V	δ Tri	SB1
14214	5.60	0.59	289		G0.5IV	HR 672	SB1
14985	8.83	1.23	20		K2		SB1
16620	4.82	0.43	34		F5V	ε Cet	SB1 σ = 0.27
16909	8.30	1.07	17		K		SB1?
17094	4.20	0.18	29		F0IV	μ Cet	δ Sct
17433	6.76	0.96	104		K0	VY Ari	SB1; RS CVn
17709	4.53	1.56	86		K7III	17 Per	
18778	5.91	0.17	104	eps	A7III–IV	HR 906	SB1; σ = 0.33
18884	2.53	1.64	150		M1.5IIIa	α Cet	LPV; σ = 0.26
19058	3.39	1.65	94		M4II	ρ Per	LPV; σ = 1.01
19476	3.80	0.98	69		K0III	κ Per	SB1?
20084	5.62	0.87	19		G3IIp+	HR 965	
20210	6.25	0.29	49		A1m	V423 Per	SB1
20394	8.74	1.07	16		G9III		SB1
20902	1.82	0.47	196		F5Ia	α Per	
21018	6.40	0.82	28		G5III	HR 1023	
21120	3.62	0.88	31		G6III	ο Tau	SB1
21552	4.36	1.35	54		K3III	σ Per	
21754	4.14	1.11	92		K0Iab	5 Tau	SB1
22649	5.12	1.67	169		S3	BD Cam	SB1; symbiotic
22905	6.35	0.86	37		G8/K0III	HR 1120	SB1
23249	3.52	0.92	15		K0III–IV	δ Eri	RS CVn
25408	7.62	1.16	18		C5,3	UV Cam	Carbon star
25604	4.36	1.07	119		K0III	37 Tau	σ = 0.15
26630	4.14	0.94	54		G0Ib	μ Per	SB1
26673	4.71	1.01	71		G5Ib+A2V	52 Per	SB
27697	3.76	0.99	26		K0III	δ^1 Tau	SB1
28394	7.01	0.47	25		F8V		SB1
29094	4.25	1.18	46		K4III+...	58 Per	SB1
29139	0.85	1.54	147		K5III	α Tau	LPV?; σ = 0.23
29317	5.09	1.08	11		K0III	3 Cam	Cepheid
30050	7.79	0.65	461		Am+K0 IV	RZ Ari	SB1; RS CVn
30197	5.99	1.22	18		K4III	HR 1517	SB1

Table continued on following pages

Table 2. Stars with solar–type spectra, cont.

HD	V	(B–V)	N	CCF[a]	SP	Name	Notes
30282	7.51	0.95	6		F0	AW Per	Cepheid
31398	2.69	1.52	172		K3II	ι Aur	σ = 0.23
32068	3.75	1.25	494		K4II+B8V	ζ Aur	SB1; ζ Aur
32357	6.25	0.95	446		K0 III	12 BM Cam	SB1; RS CVn
33254	5.43	0.24	25		A2m	16 Ori	SB1
33856	4.45	0.19	36		K0.5III	ρ Ori	SB1
34029	0.08	0.80	117		G5IIIe+?	α Aur = Capella	SB1; RS CVn
34085	0.12	–.03	1626	**	B8Ia	β Ori = Rigel	
34334	4.55	1.28	8		K2.5IIIb	16 Aur	SB1
36167	4.71	1.57	150		K5III	31 CI Ori	σ = 0.20
36389	4.38	1.92	149		M2Iab–Ib	119 CE Tau	SRV
36859	6.28	1.56	24		K0	HR 1878	SB1
38099	6.33	1.48	30		K4III	V1197 Ori	Ellipsoidal var
39801	0.50	1.85	331		M1–2Ia–Iab	α Ori	
41116	4.16	0.87	649		G7III	1 Gem	SB1
42995	3.28	1.61	129		M3III	η Gem	SRV
43039	4.35	1.02	105		G8.5IIIb	κ Aur	σ = 0.14
43282	7.76	1.31	31		G5II		SB1
43821	6.24	0.84	30		K0	HR 2259	SB1
43905	5.33	0.40	149		M6III	45 Aur	SB1
43930	7.64	1.07	33		K1V	260 Ori	SB1; RS CVn
44478	2.88	1.64	159		M3IIIab	μ Gem	LPV
44537	4.91	1.97	78		K5–M0I	ψ^1 Aur	
44762	3.85	0.85	38		G7II	δ Col	SB1
44990	5.98	1.22	607		G3 Iab+A0	T Mon	SB1; Algol bin
45168	6.33	1.02	39		G9III	HR 2317	SB1
45910	6.74	0.23	361		gK+B2 III	AX Mon	SB1
46407	6.27	1.12	41		G9.5III	HR CMa	SB1; Algol
48329	2.98	1.40	228		G8Ib	ε Gem	σ = 0.32
49293	4.48	1.12	38		K0IIIa	18 Mon	SB1
51956	7.52	0.76	39		F8I		var RV
52973	3.79	0.79	200		F7–G3Ib	ζ Gem	Cepheid
54716	4.90	1.45	97		K4III–II	63 Aur	
55496	8.40	0.90	35		GII(Ba*)		HV*; σ = 0.31
55751	5.35	1.19	174		K2II	HR 2729	σ = 0.20
58972	4.34	1.44	93		K3III	γ CMi	SB1
59148	5.02	1.12	24		K2III	65 Gem	SB1
59643	8.01	2.18	58		R9	NQ Gem	symbiotic
59693	6.8	1.1	37		K0Ibp	U Mon	RV Tau; H-α em; shallow lines
59878	6.52	0.96	35		K0II–III	HR 2879	SB1
60414	4.97	1.37	40		M2III	KQ Pup	H-α em
60522	4.06	1.54	139		M0III–II	υ Gem	
61421	0.40	0.43	60		F5IV–V	α CMi	SB1
61994	7.08	0.67	28		G6V		SB1
62044	4.28	1.12	665		K1 III	σ Gem	SB1; RS CVn
62345	3.57	0.93	205		G8IIIa	κ Gem	SB
62509	1.14	1.00	175		K0IIIb	β Gem	σ = 0.12
62522	7.03	0.54	12		F5		noisy
62721	4.88	1.49	33		K4III	81 Gem	SB1
65339	6.02	0.16	9	eps	A2p		α^2 CVn var
66216	4.94	1.14	31		K2III	χ Gem	SB1
68256	6.2	0.6	33		G5V	ζ^2 Cnc	SB1
69148	5.73	0.88	8		G8III	OS UMa	SB1; Algol
69267	3.52	1.48	223		K4III	β Cnc	σ = 0.21
73974	6.92	0.96	41		K0II		SB1
74442	3.94	1.08	148		K0III–IIIb	δ Cnc	σ = 0.14
74874	3.38	0.68	192		G5III	ε Hya	SB1; BY Dra
75289	6.36	0.58	33		F9V	HR 3497	HPM*; σ = 0.11
75958	5.57	0.86	11		G6III	6 UMa	SB1
76294	3.11	1.00	175		G9II–III	ζ Hya	σ = 0.14
76943	3.97	0.44	64		F5V	10 UMa	SB1; σ = 0.38
77247	6.86	0.99	25		G7III	PV UMa	SB1
77912	4.54	1.03	16		G7IIa	HR 3612	σ = 0.18
78362	4.65	0.34	47		Am	τ UMa	SB1
78515	5.15	0.97	38		G9III	ξ Cyg	SB1
78712	5.95	1.67	115		M6 IIIS	RS Cnc	SRV
79096	6.77	0.77	46		G9V	π^1 Cnc	SB1; peculiar velocities

Table continued on following pages

Table 2. Stars with solar–type spectra, cont.

HD	V	(B–V)	N	CCF[a]	SP	Name	Notes
79910	5.24	1.19	56		K2III	23 Hya	SB1
80493	3.13	1.52	164		K7IIIab	α Lyn	σ = 0.22
81025	6.37	0.87	26		G2III	HR 3725	SB1; double
81797	1.98	1.44	247		K3II–III	α Hya	σ = 0.20
81809	5.40	0.62	45		G2V	HR 3750	SB1
82674	6.26	1.17	48		K2III	HR 3805	SB1
83240	5.01	1.04	44		K1III	10 Leo	SB1
84441	2.98	0.80	242		G1II	ε Leo	σ = 0.13
85622	4.59	1.19	34		G5Ib	m Vel = HR 3912	SB1
88284	3.61	1.01	48		K0III	λ Hya	SB1
89758	3.05	1.59	138		M0III	μ UMa	SB1
90537	4.22	0.89	39		G9IIIb	β LMi	SB?; noisy σ = 0.14
92214	4.91	0.90	53		G8III	$φ^3$ Hya	SB1
93813	3.11	1.25	190		K2III	ν Hya	σ = 0.18
94363	6.12	0.90	52		K0III+...	HR 4249	SB1
95689	1.79	1.07	28		G9III+A7	α UMa	SB1
96833	3.01	1.15	115		K1III	ψ UMa	σ = 0.15
97528	7.31	0.12	103		A1+K0	TT Hya	SB1; Algol bin
97907	5.32	1.20	45		K3III	73 Leo	SB1
98231	4.41	0.59	40		G0V	ξ UMa A	SB1
99028	4.00	0.35	53	eps	F4IV	ι Leo	SB1; σ = 0.20
99967	6.32	1.27	29		K0V	EE UMa = HR 4430	SB1
101013	6.12	1.07	33		G9III	HR 4474	SB1
101606	5.70	0.46	33		F4V	62 UMa	SB1
102212	4.03	1.51	175		M1IIIab	ν Vir	LPV
102509	4.54	0.51	49		F8III+A7V	DQ Leo	SB1; RS CVn
102928	5.64	1.03	48		K0III	HR 4544	SB1
105981	5.67	1.43	44		K4III	4 Com	SB1
105982	6.74	1.00	38		K0III		SB1
106760	5.00	1.15	33		K0.5IIIb	HR 4668	SB1
110024	5.49	0.96	48		G9III	26 Com	SB1
112048	6.45	1.09	70		K0	HR 4896	SB1
112300	3.38	1.58	169		M3III	δ Vir	σ = 0.40
112769	4.78	1.56	154		M1IIIb	36 Com	
113226	2.83	0.94	176		G8IIIab	ε Vir	σ = 0.11
115521	4.80	1.67	168		M2IIIa	σ Vir	var
116594	6.44	1.07	39		K0III	HR 5053	SB1
119458	5.99	0.85	28		G5III	HR 5161	SB1
120064	5.97	0.52	37		F6IV–V	3 Boo	SB1
120539	4.93	1.40	44		K4III	6 Boo	SB1
121370	2.68	0.58	49		G0IV	ε Boo	SB1
121844	7.89	1.13	40		K1III		SB1
122223	4.34	0.57	51		F6II	$υ^2$ Cen	SB1
122563	6.20	0.90	55		F8IV	HR 5270	σ = 0.39
124547	4.81	1.39	13		K3III	4 UMi	SB1
124897	0.04	1.23	201		K1III	α Boo	σ = 0.21
125351	4.81	1.05	29		K0III	A Boo	SB1
127665	3.58	1.30	129		K3III	ρ Boo	σ = 0.20
129132	6.14	0.37	53		G0V	HR 5472	SB; spectra noisy
129333	7.61	0.79	22		G0V	EK Dra	BY Dra
129989	2.70	1.00	153		K0II–III	ε Boo	
131511	6.00	0.84	23		K2V	DE Boo	SB1; RS CVn
133208	3.50	0.97	76		G8IIIa	β Boo	flare star; σ = 0.16
133640	4.76	0.65	125		G2	44 i Boo C	Brightest comp.; σ = 0.16
134320	5.67	1.25	31		K2III	46 Boo	SB1
137052	4.93	0.41	57		F5IV	ε Lib	SB1
137107	5.58	0.58	34		G2V	η CrB	SB1
139195	5.26	0.94	37		K0IIICNs	16 Ser	SB1
140538	5.86	0.68	94		G2.5V	ψ Ser	HPM*; σ = 0.11
142267	6.10	0.60	43		G0V	39 Ser	SB1
144889	6.19	1.36	31		K4III	HR 6005	SB1
145206	5.40	1.45	38		K4III	HR 6016	SB1
145849	5.64	1.37	15		K3III	HR 6046	SB1
145931	5.87	1.45	70		K4II+F6–8V	HR 6050	σ = 0.21
146051	2.74	1.58	171		M0.5III	δ Oph	
147395	6.61	1.56	24		M2III		SB1
147508	7.38	1.35	42		K2		SB1

Table continued on following pages

Table 2. Stars with solar–type spectra, cont.

HD	V	(B–V)	N	CCF[a]	SP	Name	Notes
148783	5.04	1.52	77		M6III	g Her	SRV
148856	2.77	0.94	146		G7IIIa	β Her	SB1
150050	6.72	1.30	61		K0 III		σ = 0.18
150680	2.8	0.0	40		G0 IV–V	ζ Her	SB1
155410	5.08	1.29	12		K3III	HR 6388	SB1
156014	3.48	1.44	237		M5Ib–II	α Her	
156283	3.16	1.44	96		K3IIab	π Her	σ = 0.24
157999	4.34	1.50	158		K2II	σ Oph	σ = 0.23
158614	5.31	0.72	47		G9IV–V	HR 6516	SB1; σ = 0.25
158837	5.59	0.81	41		G8III	HR 6524	SB1
159181	2.79	0.98	80		G2Ib–IIa	β Dra	σ = 0.20
160346	6.52	0.96	41		K3V		SB1
161471	3.02	0.47	54	eps	F2Iae	ι^1 Sco	emission-line star
161832	6.68	1.39	13		K3III+...	V826 Her	SB1
162338	7.19	0.46	21		G0		SB1; σ = 0.58
162596	6.32	1.13	40		K0	HR 6659	SB1
162714	6.18	1.33	43		F8Iab	Y Oph	Cepheid
163506	5.47	0.33	28	eps	F2Ibe	89 Her	post–AGB
163770	3.86	1.39	81		K1IIa	θ Her	σ = 0.24
164058	2.23	1.52	69		K5III	γ Dra	σ = 0.19
164975	4.66	0.33	51		F7.2Ib	W Sgr	Cepheid
165195	7.34	1.29	47		F6/7p	V256 Oph	LPV?
165341	4.03	0.86	41		K0V	70 Oph	BY Dra; σ = 0.14
168532	5.29	1.56	30		K4Iab	105 Her	SB1
168723	3.26	0.94	168		K2IIIab	η Ser	
169156	4.67	0.95	33		G9IIIb	ζ Sct	SB1
169690	5.67	0.85	92		G8III–IV+?	V2291 Oph = HR6902	SB1
169985	5.21	0.50	42		G0III+...	59 Ser	SB1
170153	3.55	0.49	17		F7Vvar	χ Dra	SB1
170547	6.28	0.93	38		G8II–III	HR 6940	SB1
170829	6.50	0.79	75		G8IV	HR 6950	SB1
172831	6.14	1.00	37		K0.5III	HR 7024	SB1
172865	6.94	0.79	19		G5III–IV		SB1; σ = 0.13
173093	6.3	0.42	54		F7 V		SB1
173297	7.47	0.86	103		F8 Ib–II	V350 Sgr	Cepheid
173764	4.22	1.12	197		G4II+B9.5	β Sct	SB1
174208	6.00	1.60	37		K2Ib	HR 7083	SB1
175515	5.58	1.04	25		G9III	HR 7135	SB1
175865	4.13	1.59	23		M5III	13 R Lyr	SRV
176155	5.31	0.54	61		F5Iab	FF Aql	Cepheid
176411	4.03	1.06	43		K1III	ε Aql	SB1
178428	6.07	0.70	70		G5V	HR 7260	SB1
180809	4.36	1.26	47		K0II	θ Lyr	σ = 0.15
181330	6.81	1.82	14		K5		SB1
181391	5.00	0.92	104		G8III	f Aql	SB1
182593	7.00	1.15	6		K0		SB1
182989	7.4	0.3	124		F5	RR Lyr	RR Lyr
183344	6.37	0.95	28		F8Ib–II	U Aql	Cepheid
183439	4.44	1.50	119		M0III	α Vul	
183864	7.38	1.18	24		G2I		SB1
183912	3.08	1.13	192		K3II+B0.5V	β Cyg	
185662	7.37	1.48	16		K2		SB1
186791	2.72	1.52	229		K3II	γ Aql	
187076	3.82	1.41	190		M2II+A0V	γ Sge	SB1; ζ Aur
187299	7.17	1.53	30		G5Ia0–Ia		SB1
187929	3.88	0.74	218		F6Iab	η Aql	Cepheid
188507	6.74	1.55	23		K4II–II		SB1
188727	5.72	0.88	29		G5Ib	S Sge	RV Tar var
188981	6.28	1.06	45		K1III	HR 7612	SB1
189319	3.47	1.57	123		M0III	γ Sge	σ = 0.27
189340	5.88	0.58	31		F8V		SB? σ = 0.16
190658	6.41	1.68	28		M2.5III	V1472 Aql	SB1; SRV?
192577	3.79	1.28	376		K3 Ib+B2	31 Cyg	SB1; ζ Aur
192713	5.15	1.06	161		G3Ib–II	22 Vul	SB1; ζ Aur
192876	4.24	1.07	155		G3Ib	α^1 Cap	σ = 0.22
192909	3.98	1.55	548		K3Ib+B3V	32 Cyg	SB1; ζ Aur
193370	5.18	0.61	7		F5Ib	35 Cyg	SB1

Table continued on next page

Table 2. Stars with solar–type spectra, cont.

HD	*V*	*(B–V)*	*N*	*CCF*[a]	*SP*	*Name*	*Notes*
193495	3.08	0.79	194		K0II+...	β[1] Cap	SB1
193664	5.93	0.60	22		G3V		HPM*; σ = 0.08
194184	6.10	1.39	30		K3III	HR 7799	SB1
194215	5.86	1.10	44		G8II–III	HR 7801	SB1
194317	4.43	1.33	71		K3III	39 Cyg	SB
196093	4.61	1.60	129		K2Ib+B3V	47 Cyg	SB1
196321	4.89	1.60	138		K5II	70 Aql	SB?
196574	4.33	0.96	45		G7.5III	l Aql	SB1
196795	7.88	1.23	32		K5Va	OQ Del	SB1; BY Dra
197345	1.25	0.09	134	eps	F2Iae	α Cyg	σ = 1.92
197752	4.93	1.18	16		K2III	30 Vul	SB1
197989	2.46	0.99	146		K0III	ε Cyg	SB?
200428	7.69	0.91	28		G5		SB1
200905	3.72	1.65	66		K4–5Ib–II	ξ Cyg	σ = 0.38
201251	4.55	1.57	40		K4Ib–IIa	63 Cyg	σ = 0.21
201626	8.13	1.07	22		R5–CH		SB?; CH star
202109	3.20	0.99	94		G8III–IIIa	ζ Cyg	SB1
202448	3.95	0.50	41		G6II+B9.5V	α Equ	SB1
203504	4.09	1.11	23		K1III	1 Peg	HPM*; σ = 0.14
203631	7.60	1.59	19		K5		SB1
204075	3.75	1.00	31		G4Ib	ζ Cap	SB1
204724	4.57	1.62	107		M1III	2 Peg	σ = 0.33
204867	2.91	0.83	155		G0Ib	β Aqr	σ = 0.22
206778	2.39	1.53	235		K2Ib	ε Peg	LPV
206859	4.34	1.17	115		G5Ib	9 Peg	σ = 0.21
207098	2.83	0.28	34	eps	F0mF2III	δ Cap	SB; Algol bin
208816	5.18	1.55	34		M2Iape+B8	VV Cep	SB1; ζ Aur
209750	2.96	1.04	162		G2Ib	α Aqr	σ = 0.25
209813	6.96	1.05	41		K0III...	HK Lac	SB1; RS CVn, noisy
210745	3.35	1.57	53		K1.5Ib	ζ Cep	
211388	4.13	1.46	72		K3II–III	1 Lac	σ = 0.23
212943	4.78	1.04	125		K0III	35 Peg	σ = 0.16
213306	3.75	0.40	79		F5Ib–G2I	δ Cep	Cepheid
213310	4.36	1.68	104		M0II+B8V	5 Lac	
213389	6.43	1.17	35		K2III	V350 Lac	SB1; RS CVn
213428	6.16	1.07	20		K0III	HR 8580	SB1
213429	6.17	0.52	33		F7V	HR 8581	SB1
215182	2.94	0.80	81		G2II–III	η Peg	SB1
215648	4.20	0.49	199		F6III–IV	ξ Peg	σ = 0.13
216131	3.48	0.93	97		G8III	μ Peg	σ = 0.12
216489	5.64	1.12	960		K1III	IM Peg	RS CVn
216946	4.95	1.78	111		K5Ib	V424 Lac	LPV
217014	5.49	0.67	144		G2.5IVa	51 Peg	double?; σ = 0.11
217188	7.43	1.01	25		K0III	AZ Psc	SB1; RS CVn
217476	5.00	1.42	37	eps	G4 0++B1	V509 Cac	SB1; ζ Aur?
217580	7.46	0.95	27		K3V		SB1
217906	2.42	1.67	168		M2.5II–III	β peg	LPV
219615	3.69	0.92	126		K0III	γ Psc	σ = 0.11
219834	5.19	0.79	26		G6/G8IV	94 Aqr	SB1
221170	7.71	1.09	20		G2 IV		σ = 0.13
222107	3.82	1.08	217		G8III	λ And	SB1; RS CVn
222516	6.99	0.43	13		F5		σ = 0.38
224014	4.54	1.22	72		G2 0e	ρ Cas	
224935	4.41	1.63	165		M3III	YY Psc	30 Psc Var
225212	4.94	1.63	195		K3Ibv	3 Cet	σ = 0.37
500001	8.26	0.72	67		G5IV	LX Per	SB1; RS CVn

[a]*Note (column 5): "eps", line list for ε Aur; "**", line list for β Ori; "*", line list for γ Peg.*

Table 3. Double-lined spectroscopic binaries.

HD	V	(B–V)	N	SP	Name	Notes
483	7.17	0.63	53	G2III		SB2
5516	4.40	0.94	13	G8III	η And	SB2
17841	8.4	0.8	33	K		SB2
22468	5.91	0.85	149	G9V	V711 Tau	RS CVn
64096	5.16	0.60	41	G2V	9 Pup	SB2
66751	6.5	0.6	15	F8V		SB2; hpm*
93765	6.06	0.34	69	F3V	44 LMi	SB2
157948	8.10	0.76	22	G5		SB2
166285	5.69	0.47	25	F5V	HR 6797	SB2
202275	4.49	0.50	31	F5V	δ Equ	SB2
205539	6.25	0.36	133	F0IV		SB2 Fekel *et al.* (2009)
206301	5.18	0.65	159	G2V	BY Cap	SB2; wk 2. line; RS CVn
210334	6.13	1.0	535	G2 IV+F	AR Lac	RS CVn
214608	6.83	0.55	32	F9V		SB2
214686	6.89	0.51	85	F7V		SB2 Tomkin and Fekel (2008)
218738	7.91	0.90	60	K0Ve	KZ And	SB2 BY Dra
219113	7.44	1.0	385	K4 IV-V+F	SZ Psc	SB2 RS CVn

Table 4. Stars with molecular lines.

HD	V	(B–V)	N	CCF	SP	Name	Notes
14386	3.04	1.42	141	self	M7IIIe	o Cet = Mira	Mira
16115	8.15	1.21	57	self	C2,3		C star; sig = 0.59
39816	6.70	2.00	82	self	M6.5IIIe	U Ori	Mira
132813	4.71	1.47	7	self	M4.5III	RR UMi	LPV; treat as M star
141850	7.1	1.39	82	self	M7IIIe	R Ser	Mira
182040	7.00	1.02	90	self	C1,2		CH star
223075	5.04	2.70	61	self	CII...	TX Psc	var C star

Table 5. Files Included in AST-RVs-JAAVSO-481.tar.

File Name	Contents
AST-RVs T1 LineLists.txt	Lines used to measure the radial velocities.
AST-RVs T2 SOLAR.txt	ASCII table of stars with single-lined photospheric spectra.
AST-RVs T3 SB2.txt	ASCII table of double-lined spectroscopic binaries.
AST-RVs T4 MOLEC.txt	ASCII table of stars with dominant molecular spectra.
AST-RVs ET1 SOLAR-RVs.txt	Data table of radial velocities for single-lined stars with solar-type photospheric spectra.
AST-RVs ET2 SB2-RVs.txt	Data table of radial velocities for double-lined binaries.
AST-RVs ET3 MOLEC-RVs.txt	Data table of radial velocities for stars with molecular spectra.
AST-RVs plots.tar	Plots (hd*.jpg) of the RVs vs. JD or phase for all the stars.
extract-RVs-for-HD.f	A FORTRAN program for extracting the velocities for a star, specified by its HD number, from the archive files.

Table 6. Published papers related to the data presented in this paper.

HD	Name	Reference
352	5 Cet	Eaton (2008)
886	γ Peg	Handler *et al.* (2009)
8890	α UMi = Polaris	Bruntt *et al.* (2008)
32068	ζ Aur	Eaton *et al.* (2008)
34085	β Ori = Rigel	Moravveji (2012)
45910	AX Mon	Eaton (2008)
97528	TT Hya	Eaton (2008)
173297	V350 Sgr	Evans *et al.* (2011)
205539		Fekel *et al.* (2009)
216489	IM Peg	Marsden *et al.* (2007)
192577	31 Cyg	Eaton *et al.* (2008)
192909	32 Cyg	Eaton *et al.* (2008)
192713	22 Vul	Eaton and Shaw (2007)
214686		Tomkin and Fekel (2008)