CHAPTER 4

Observations

4.1 Method of Observation

All observations were made using the symmetrical beam switching mode. The data is acquired in units of 'interrupts', which correspond to the pulses which trigger the beam-switching. Each interrupt corresponds to about 0.5 seconds of integration. It is useful to divide the total integration time of an observation in sets of a number of interrupts called runs. In case there occurs a transient event that may corrupt the data, this prevents loss of the whole stretch of observation and only one run is lost. The data is integrated for a specified number of interrupts within a run, by the data-acquisition system which then transfers this integrated data to the PDP 11/84 which attaches a sub-header and appends the data-file. The sub-header contains a record of the time-varying parameters like the direction of the telescope, weather parameters, inclinometer readings etc. Typically, a run consists of 100 interrupts. The data-file is closed on finishing all the runs and writing a header which contains information like the source, observer, back-end configuration, front-end status, etc. The observing procedure is stored as a sequence of numbers in a file called $.OBS$ which is read by the control program. An example of this sequence is as follows:

1, 100	1, 0	8, 0	0, 0
	chopper	mirror	

The first number is the number of runs to be acquired, each consisting of the number of interrupts as specified by the second number. The last two numbers give the pointing offset in units of the beam-throw in azimuth and elevation respectively. The third and fourth numbers refer to the chopper's status and the fifth and sixth refer to the mirror's status, which are coded in the following table.

Table 1: Mirror-Chopper Codes

Code	Operation
	Chopper
0	Sky
1	Hot-load
2	Cold load
3	Sky and Cold-load switching
4	Sky and Hot-load switching
5	Teflon and sky swithcing
6	Hot and Cold loads
7	Sky
	Mirror
8	Sky
9	-4 to +4 (motor-steps)
10	-2 to +2
11	0 to 18
12	18 to 22
13	0 to 22
14	22
15	Sky

The first of the two integers, which give the mirror/chopper status, is one of the numbers in Table 1. The second is either 1 or 0 which specifies whether the mirror/chopper is in switching or 'static' mode. The operation code has this latter information but when the mirror/chopper is not switching, the data is not acquired. For getting the pulses for data-acquisition even when the mirror/chopper is in the same position, the 'static' mode is utilised, e.g., while frequency switching. While taking test runs to check the back-ends, any differences between the 'on' and 'off' beam signals in the 'static' mode will not be zero and will indicate the gain variations in the back-ends, or a DC offset in the synchronous-detector, which can then be taken into account and corrected for.

After carrying out all such sequences in the *.OBS* file, the data-file is closed and is ready to be used by any program for spectral-line analysis. We have used POPS (Stobie 1981) to process the data. Using beam-switching, very flat (zero-slope) baselines were obtained in almost all the spectra. In the symmetrical switching mode, one expects effects like a baseline ripple to be the same in both the positions of the tertiary corresponding to the switched beams. However, there was a residual ripple with a peak-to-peak antenna temperature of about 0.5 to 1 K. This was cancelled exactly by acquiring two spectra which were given appropriate pointing offsets in azimuth. One was with the source on the positive peak of the beam-switched response pattern in azimuth, and the other with the source on the negative peak. A superposition of these two spectra is shown in Fig. 1. On subtracting these two acquisitions (and dividing by 2) we obtained very flat baselines (see the spectra in the Appendix, where we have not applied any baseline correction.) Incidentally, this technique is useful to observe sources having small angular extent (compared to the beam), but embedded in a larger source, e.g., bipolar outflows in molecular clouds. If one is interested only in the emission from the bipolar outflow one can observe with the above procedure and cancel out the ambient emission from the molecular cloud at relatively smaller velocities. This may help in obtaining profiles with less confused wings.

Using POPS, gaussians have been fitted to the spectral-lines as mentioned in the section on Calibration in Chapter 2.

4.2 Selection of Sources

The observed mira variables were selected from The General Catalogue of Variable Stars (Kholopov et al., 1985). Since one of our aims was to check the hypothesis that SiO masers exist only in very late-type mira variables (with mean

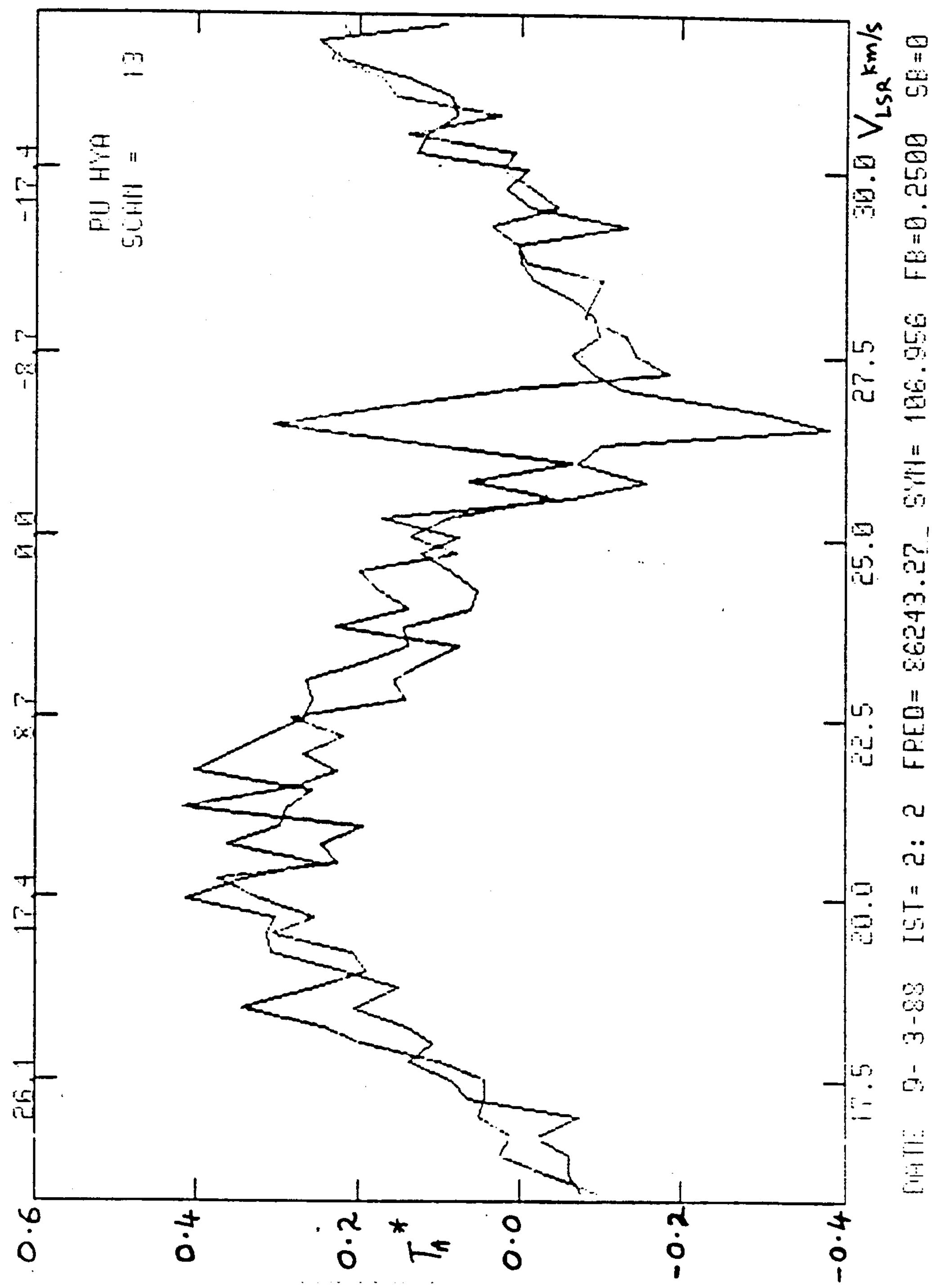

Figure 1: Two beam-switched spectra acquired with offsets in azimuth, to remove the baseline ripple

spectral-type greater than M5), unlike most other observations of SiO masers, we have tried to include a substantial number of objects at spectral types earlier than M6. We have also attempted to select those objects which have been well studied at near-infra-red wavelengths, so that we can obtain information about the variation of spectral-types during pulsation? and its relation to the maser emission. Thus, we have included many objects which are common to the catalog of Lockwood (1972). To avoid very long integrations, an attempt has been made to exclude objects that are at a distance greater than 1 Kpc from the Sun.

The catalogue of 166 selected objects along with their intrinsic properties, is given in Table 2. The distribution of the number of these mira variables as a function of period, mean spectral-type and spectral-type at maximum, are shown in Figs. 2-4.* In Figs. 3 and 4, 141 stars are included. From the remaining objects, 4 belong to S spectral-type, and 15 belong to C type. The spectral types of remaining 6 objects are not available (some of them are infra-red stars).

4.3 Results

The area under the observed line-profile is obtained from,

$$I = \sqrt{\frac{\pi}{\ln 2}} T_A^* \Delta V, \qquad (1)$$

where T_A^* and AV are the values of the antenna temperature (corrected for the atmospheric attenuation but not for the telescope losses), and the FWHM line-width in km/s, obtained by fitting a gaussian to the line-profiles. In case of multiple peaks within the profile, we have fitted gaussians to the individual peaks, where we could discern the peaks to be separate. In blended features, we have not fitted more than one gaussian. In Fig. 5, we see that the number of channels in the line-profile is large enough to allow the fitting of a gaussian.

*Comparing these with the corresponding histograms observed of the galactic Mira variables, one sees that the sample we have selected is unbiased (Kukarkin **1973).**

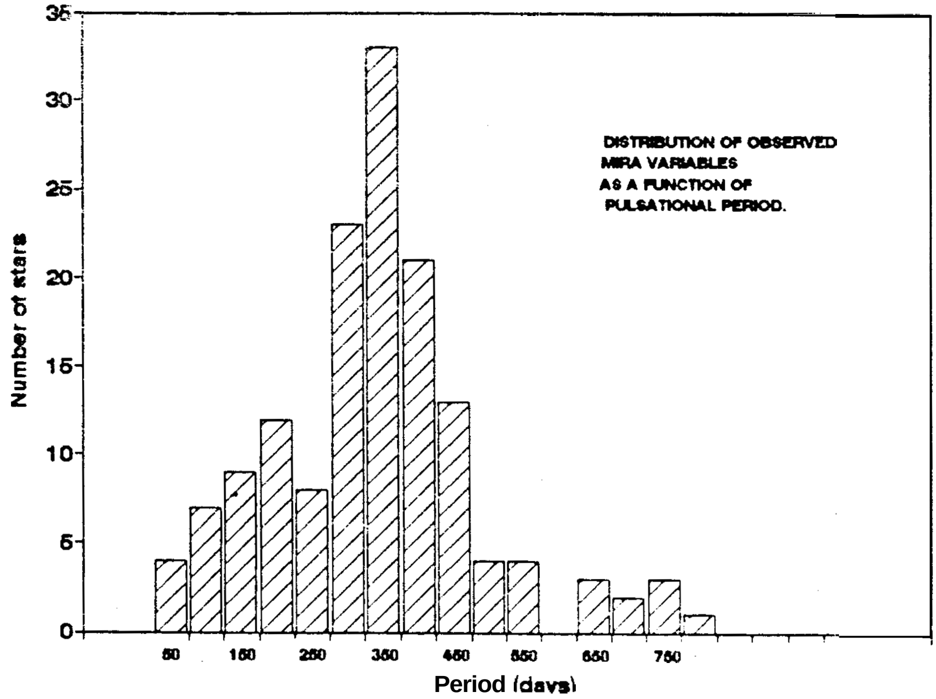

Figure 2: Histogram of pulsational periods for the selected sources

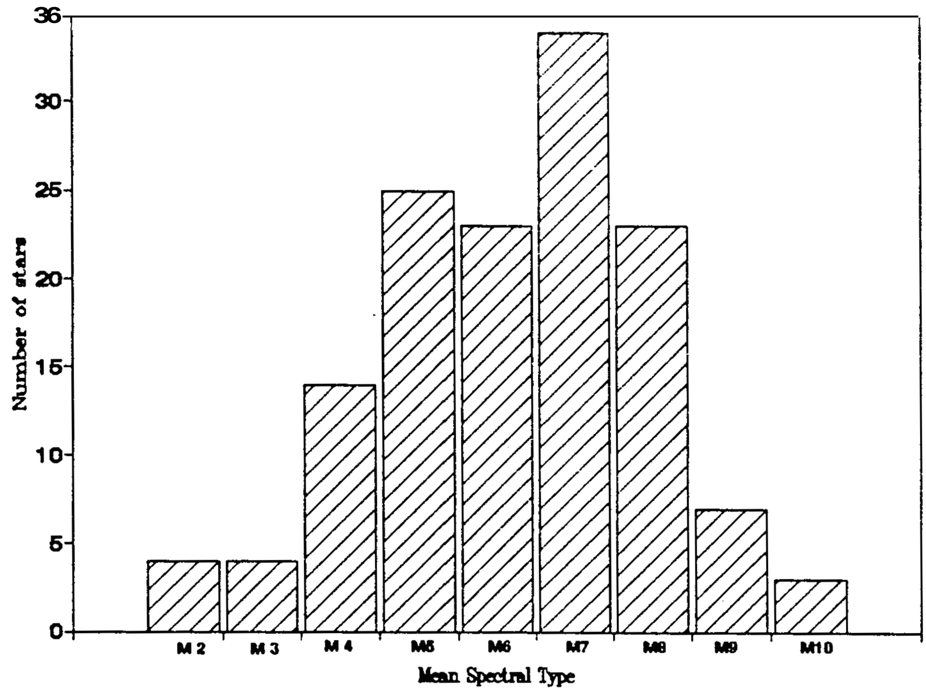

Figure 3: Histogram of mean spectral-type for the selected sources

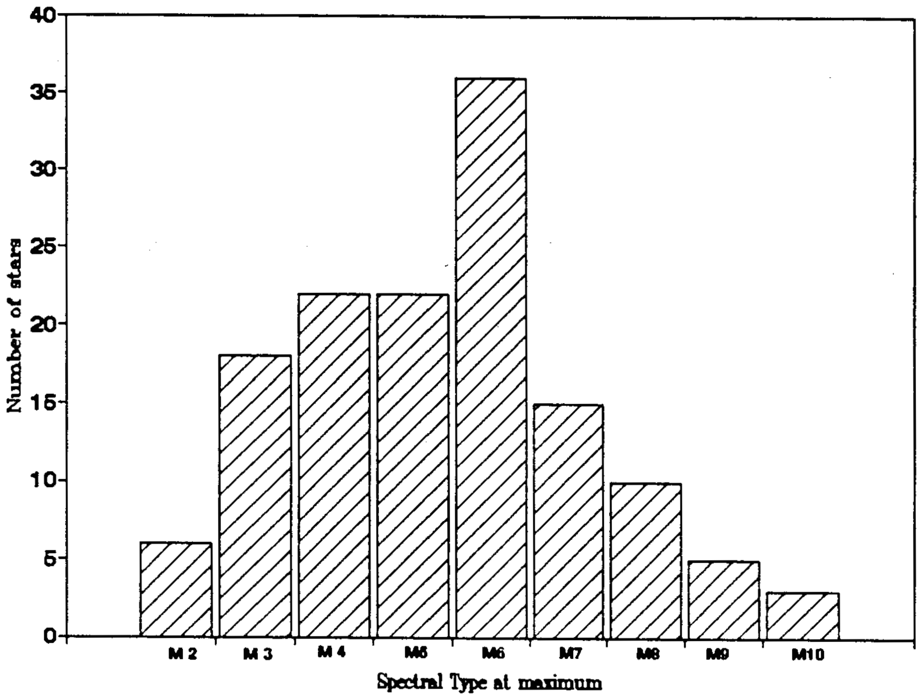

Figure 4: Histogram of maximum spectral-type for the selected sources

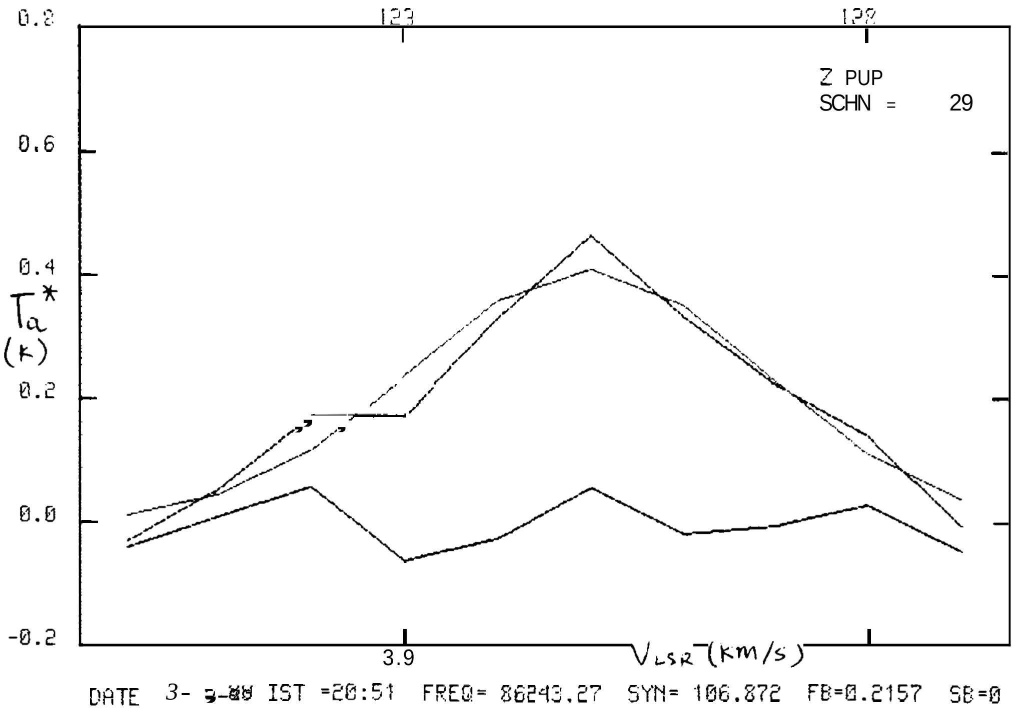

Figure 5: Fitting a gaussian to the observed line-profile

This Fig. also appears in the appendix with the full baseline

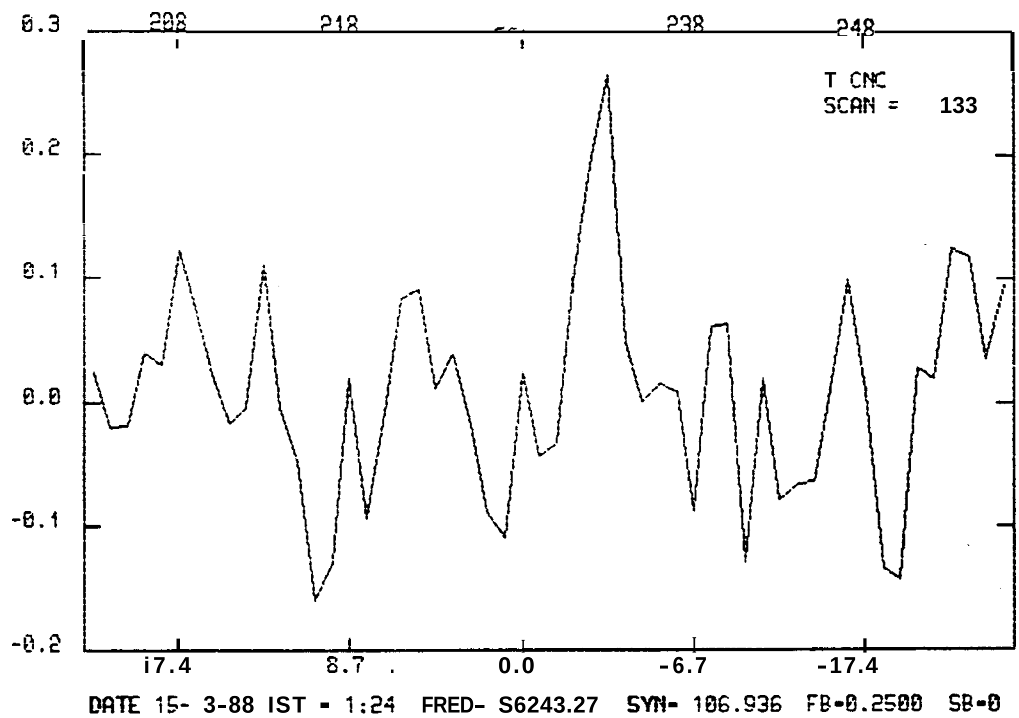

Figure 6: Detection from T Cnc

The conversion factor for antenna-temperature to Janskys, for a 10.4m antenna, is given by $32.5/\eta$ Jy/K where η is the aperture-efficiency. As discussed in Chapter 2, we have used a mean value of $\eta = 0.45$, for the observations made during 1988 and 1989. For the 1990 data, the aperture-efficiency was found to be elevation dependent (see Fig. 3.20), which we have corrected for. as listed in Table 3. Furthermore, all observations made between IST 12 hrs to 18 hrs have been corrected for a drop in the gain of the telescope, due to the heating of the dish by the Sun, as disscussed in Chapter 2 (see Fig. 3.9). After applying these corrections we obtain the flux F (Jy km/s), from which we obtain the photon flux (photons cm^{-2} $s^{-}1$), $S_\nu = 5.03 \times 10^{-3}$F. For non-detections. we have used a mean value of 5 km/s for the line-width, and 3σ, for an upper limit in antenna temperature, where a is the r.m.s. noise in the baseline. These results are given in Table 4.

Among the positive detections, the following sources are new detections at 86 GHz (Engels 1979, Engels and Heske 1989): R Cae, T Cnc, R Crt, R Hor, RU Hya, S Vir and SW Vir. It is interesting to note that T Cnc is a C type star. In these stars the oxygen to carbon ratio is < 1 and one expects SiO to be a less dominant silicon species compared to say SiS (Sahai, 1987), thus the presence of SiO maser in T Cnc is surprising. This detection is shown in Fig. 6. The integrated fluxes in spectral-lines from other sources are converted to luminosities in the following Chapter, and in Chapter 6, this luminosities are compared with several basic stellar-properties of the Mira variables. The observed spectral-lines, including some negative deteciion baselines are shown in the Appendix.

See also Lloyd Evans 1990.

Table 2: Catalogue of observed sources

No.	SOURCE	α(1950)	δ(1950)	Variable Type	Spectral Type	Period (days)
1	AFGL 3068	23 16 42.4	+16 55 10			
2	AFGL1977	17 29 42	+17 47 36			
3	And W	02 14 23.1	+44 04 30	M	S6.1E-S9.2E/M4-M10	396
4	And Z	23 31 15.4	+48 32 32	ZAND	M2III+B1EQ	
5	Ant V	10 18 54.9	-34 32 44	M	M7IIIE	303
6	Aql MU	19 39 52	+13 13 12	M	M4	142
7	Aql RT	19 35 36.0	+11 36 16	M	M6E-M8E(S)	327
8	Aql V450	19 31 18	+05 21 24	SRB	M5III-M8III	64
9	Aqr EP	21 43 56.8	-02 26 39	SRB	M8III	55
10	Aqr R	23 41 14.1	-15 33 40	M	M5E-M8.5E+PEC	387
11	Ari R	02 13 16.0	+24 49 28	M	M3E-M6E	187
12	Ari U	03 08 16	+14 36 48	M	M4E-M9.5E	371
13	Aur EY	04 49 39	+41 42 00	M	M6	270
14	Aur NV	05 07 20	+52 48 48	M	M10	635
15	Aur R	05 13 15	+53 31 57	M	M6.5E-M9.5E	457
16	Aur U	05 38 51.0	+32 00 46	M	M7E-M9E	408
17	Aur UV	05 18 33.3	+32 27 51	M	C6,2-C8.2	394
18	Aur YY	06 00 35	+42 01 30	M	M5E	337
19	Boo R	14 34 59	+26 57 12	M	M3E-M8E	223
20	Boo RX	14 21 56.6	+25 55 47	SRB	M6.5E-M8IIIE	340
21	Boo Z	14 04 04.2	+13 43 20	M	M5E-M6E	281
22	Cae R	04 38 43.9	-38 20 02	M	M6-M9*	391
23	Cam TX	04 56 42	+56 06 42	M	M8-M10	557
24	Cam W	06 19 05.0	+75 28 48	M	M7	284
25	Cas R	23 55 53	+51 06 36	M	M6E-M10E	430
26	Cas Y	00 00 45.0	+55 24 21	M	M6E-M8.5E	413
27	Cen RT	13 45 25	-36 36 48	M	M6-M7.5*	255
28	Cen RX	13 48 29.9	-36 41 57	M	M5E	328
29	Cen TU	14 31 02.0	-31 28 30	M	M4E-M7E	294
30	Cen UU	13 18 52.0	-61 02 54	M	M8E	368
31	Cen V423	12 02 28	-40 56 00	M		325
32	Cen V744	13 36 53.5	-49 41 48	SRB	M8III	90
33	Cen VX	13 47 48.3	-60 09 59	SR	S8.5E(M4-8)	308
34	Cen Y	14 28 01.6	-29 52 33	SRB?	M4E-M7	180
35	Cep μ	21 41 58.5	+58 33 01	SRC	M2EIA	730
36	Cep T	21 08 52.7	+68 17 13	M	M5.5E-M8.8E	388
37	Cet o	02 16 49.0	-03 12 12	M	M5E-M9E	332
38	CMa CY	07 20 59	-25 22 18	SRA	M6	117
39	CMa DN	06 53 03	-16 44 00	M	M8	
40	CMa SY	07 08 23	-19 45 00	M	M4-6	220

Table 2: Catalogue of observed sources (contd.)

No.	SOURCE	α(1950)	δ(1950)	Variable Type	Spectral Type	Period (days)
41	CMa VY	07 20 53.0	-25 40 24	?	M5EIBP(C6.3)	
42	CMi S	07 30 00	+08 25 34	M	M6E-M8E	333
43	CMi U	07 38 38	+08 29 54	M	M4E	414
44	Cnc R	08 13 48.4	+11 52 51	M	M6E-M9E	362
45	Cnc RR	08 08 05.0	+23 17 48	M	M3E	298
46	Cnc RS	09 07 37.8	+31 10 05	SRC?	M6	120
47	Cnc RT	08 55 33.0	+11 02 22	SRB	M5III	60
48	Cnc T	08 53 48.9	+20 02 28	SRB	C3.8-C5.5	482
49	Cnc W	09 06 58	+25 27 06	M	M6.5E-M9E	393
50	Cnc X	08 52 33.9	+17 25 21	M	C5.4(N3)	195
51	Col W	06 26 13.0	-40 04 00	M	M6E	327
52	Com R	12 01 41.6	+19 03 38	M	M5E-M8EP	363
53	CrB S	15 19 22	+31 32 36	M	M6E-M8E	360
54	Crt R	10 58 05.9	-18 03 20	SRB	M7	160
55	Crt S	11 50 11.6	-07 19 04	SRB	M6E-M7E	155
56	CrV R	12 17 02.3	-18 58 40	M	M4.5E-M9E	317
57	CvN T	12 27 44	+31 46 46	M	M6.5E	290
58	CvN TX	12 42 18	+37 02 12	ZAND	M4	
59	CvN V	13 17 17.1	+45 47 22	SRA	M4E-M6EIII	192
60	Cyg χ	19 48 38.0	+32 47 12	M	S6.2E-S10.4E	408
61	Cyg KY	20 24 06	+38 11 16	LC	M3.5IA	
62	Cyg R	19 35 28.7	+50 05 12	M	S2.5,9E-S6,9E	426
63	Cyg SX	20 13 36	+30 55 03	M	M7E	411
64	Cyg U	20 18 03.4	+47 44 09	M	C7,2E-C9,2	463
65	Cyg UX	20 53 00.0	+30 13 24	M	M4E-M6.5E	565
66	Cyg V407	21 00 26.0	+45 34 36	M+NB?	MEP	745
67	Cyg Z	20 00 00.0	+49 54 06	M	M5E-M9E	264
68	Dor R	04 36 10	-62 10 30	SRB	M8IIIE	338
69	Dra R	16 32 31	+66 51 30	M	M5E-M9EIII	246
70	Eri V	04 02 01.5	-15 51 37	SRC	M6II	97
71	Eri W	04 09 23.6	-25 16 04	M	M7E-M9	377
72	Eri Z	02 45 32.0	-12 40 03	SRB	M4III	80
73	Gem EE	06 36 30	+13 16 48	M	M6	289
74	Gem UZ	07 10 00	+17 44 24	M	M9	349
75	Her RU	16 08 05.7	+25 12 01	EA	M5.5-M9.2*	485
76	Her T	18 07 13	+31 00 42	M	M2.5E-M8E	165
77	Her U	16 23 35.0	+19 00 24	M	M6,5E-M9,5E	406
78	Her V443	18 20 05	+23 25 23	ZAND	M3EP+O	
79	Hor R	02 52 12	-50 05 42	M	M5E-M8E	408
80	Hya R	13 26 58.4	-23 01 23	M	M6E-M9E	389

Table 2: Catalogue of observed sources (contd.)

No.	SOURCE	$\alpha(1950)$	$\delta(1950)$	Variable Type	Spectral Type	Period (days)
81	Hya RR	09 42 42.0	-23 47 120	M	M3E-M8E	343
82	Hya RT	08 27 13.0	-06 09 00.	SRB	M6E-M8E	290
83	Hya RU	14 08 41.0	-28 39 00.	M	M6E-M8.8E	331
84	Hya S	08 50 57.4	+03 15 29	M	M4E-M8E	257
85	Hya SW	13 00 37.0	-28 50 00	M	M2E	219
86	Hya T	08 53 13.7	-08 56 56	M	M3E-M9:E	299
87	Hya TU	08 55 43.0	-00 38 12	M	M5E	277
88	Hya U	10 35 04.9	-13 07 24	SRB	C6.5,3(N2)	450
89	Hya V	10 49 11.3	-20 59 03	SRA	C6,3E-C7,5E	531
90	Hya W	13 46 12.2	-28 07 05	SRA	M7.5E-M9EP	361
91	Hya X	09 33 07	-14 28 02	M	M7E-M8.5E	301
92	Hya Y	09 48 45.0	-22 46 56	M	C5.4(N3P)	303
93	IR 11	23 32 01	$43 16 30			
94	IR 6	1711 56	+08 59 12			
95	IRC+60169	06 30 02.0	+60 58 54			
96	IRC+70066	05 41 16	+69 56 54			
97	IRC-10414	18 20 28	-13 44 06			
98	IRC-10529	20 07 46	-06 24 42			
99	Leo R	09 44 52.2	+11 39 40	M	M6E-M9.5IIIE	310
100	Leo S	11 07 58.7	+0G 27 01	M	M3E-M6E:	190
101	Leo VY	10 53 26	+06 27 12	LB:	M5.5III	
102	Lep R	04 57 19.7	-14 52 46	M	C7.6E	427
103	Lep RT	05 40 28	-23 43 00	M	M9E	399
104	Lep SY	060728	-130618	M	M5E	307
105	Lep T	05 02 43	-21 58 18	M	M6E-M9E	368
106	Lib FS	15 57 37	-12 12 35	M	M8.1-M9	415
107	Lib RR	15 53 27.9	-18 09 54	M	M4E-M8E	277
108	Lib RS	15 21 25	-22 43 44	M	M7E-M8.5E	218
109	Lib RU	153028	-150930	M	M5E-M6E	317
110	LMi R	09 42 34.6	+34 44 33	M	M6.5E-M9E	372
111	LMi RW	10 13 19	+30 49 07	SRA	C4.3EV	640
112	Lup R	15 50 13.1	-36 09 02	M	M5.5-M8*	236
113	Lyr RW	18 43 39.0	+43 34 54	M	M7E	504
114	Lyr V	19 07 08	+29 34 00	M	M7E	373
115	Mic T	20 24 51.9	-28 25 41	SRB	M6E	347
116	Mic V	21 20 35.5	-40 55 18	M	M3E-M6E	381
117	Mon ER	06 55 35	-07 59 12	M	M9:	326
118	Mon FX	06 42 21.4	+09 32 12	M	M1-M8	428
119	Mon GN	06 23 19	+08 05 24	M	M9:	
120	Mon GX	06 49 59	+08 29 06	M	M9	527

Table 2: Catalogue of observed sources (contd.)

No.	SOURCE	α(1950)	δ(1950)	Variable Type	Spectral Type	Period (days)
121	Mon U	07 28 24.2	-09 40 14	RVB	M2	91
122	Mon V	06 20 12	-02 10 12	M	M5E-M8E	340
123	Oph R	17 04 53	-16 01 42	M	M4E-M6E	306
124	Oph RS	17 47 32	-06 41 49	NR	OB+M2EP	
125	Oph RT	17 54 11	$11 10 30	M	M7E(C)	426
126	Oph RU	17 30 29.4	$09 27 23	M	M3E-M5E	202
127	Oph V1111	18 34 57.0	$10 22 27	M	M4III-M9	
128	Ori DT	06 00 38.0	$13 44 24		M10	429
129	Ori EP	04 48 19	$03 03 42	M	M10E	358
130	Ori EU	05 12 30	$03 26 00	M	M4	328
131	Ori S	05 26 33	-04 43 54	M	M6.5E-M9.5E	414
132	Ori U	05 52 50.9	$20 10 05	M	M6E-M9.5E	368
133	Ori V	05 03 25	$04 02 12	M	M3E-M8E	264
134	Ori W	03 02 48.5	+01 06 37	SRB	C5,4(N5)	212
135	Peg R	230408.0	$101622	M	M6E-M9E	378
136	Per AX	01 33 06	$54 00 18	ZAND	M3IIIEP+A0	682
137	Per S	02 19 15.1	$58 21 34		M3IAE-M7	822
138	Pic S	05 09 37	-48 34 00	M	M6.5E-M8III	428
139	PSc R	01 28 03	$02 37 30	M	M3E-M6E	344
140	PSc WX	01 03 48	$12 19 42	M	M8	660
141	Pup Z	07 30 29	-20 32 49	M	M4E-M9E	509
142	Pyx S	09 02 53.9	-24 52 49		M3-M7.5*	206
143	Pyx X	09 02 53.9	-24 52 49		ME	330
144	Sco AH	170801.9	-321551		M4E-M5	714
145	Sco RR	16 53 26	-30 30 06	M	M6-M9	281
146	Ser S	15 19 18.9	$14 29 33		M5E-M6E	372
147	Ser WX	15 25 31.7	+19 44 20		M8E	425
148	Sge HM	19 39 41	+16 37 33			
149	Sgr RR	195249	-291916	M	M4E-M9E	336
150	Sgr VX	18 05 05.0	-22 14 00		M4E-M10	732

Table 2: Catalogue of observed sources (contd.)

No.	SOURCE	α(1950)	δ(1950)	Variable Type	Spectral Type	Period (days)
151	Tau NML	03 50 40.0	+11 15 00	M	M6E-M10E	470
152	Tau R	04 25 36.0	+10 03 30	M	M5E-M9E	321
153	UMa R	10 41 08	+69 02 18	M	M3E-M9E	302
154	UMa ST	11 25 06.8	+45 27 38		M4-M5III	110
155	UMa T	12 34 07	+59 45 42+59	M	M4IIIE-M7E	257
156	UMi RR	14 56 47	+66 07 54	SRB	M5III	43
157	UMi S	15 31 27	+78 48 08	M	M6E-M9E	331
158	Vel RW	09 18 37	-49 18 37	M	M7III(II)E	443
159	Vir BK	12 27 48.0	+04 41 33		M7III	150
160	Vir R	12 35 58	+07 15 45	M	M3.5IIIE-M8.5E	146
161	Vir RT	13 00 06	+05 27 18	SRB	M8III	155
162	Vir RU	12 44 28.9	+04 25 49		C8.1E(R3EP)	433
163	Vir S	13 30 24	-06 56 18	M	M6IIIE-M9.5E	375
164	Vir SS	12 22 46	+01 04 28	SRA	C6.3E(NE)	364
165	Vir SW	13 11 29.7	-02 32 31		M7III	150
166	Vul R	21 02 09	+23 37 18	M	M3E-M7E	137

Table 3: Corrections due to Telescope Losses 1988–1989

No.	SOURCE	IST(hrs)	EL.(deg)	Daytime	η	Jansky/K
1	And W	14.92	47.93	0.8	0.32	101.56
2	And Z	12.03	50.65	1	0.4	81.25
3	Ant V	0.18	41.00	1	0.4	81.25
4	Aql MU	9.72	71.43	1	0.4	81.25
5	Aql RT	12.38	71.60	1	0.4	81.25
6	Aqr R	12.00	58.30	1	0.4	81.25
7	Ari R	15.93	74.50	0.8	0.32	101.56
8	Ari U	20.60	61.57	1	0.4	81.25
9	Aur EY	22.57	56.65	1	0.4	81.25
10	Aur R	13.00	44.13	0.8	0.32	101.56
11	Aur U	19.28	69.17	1	0.4	81.25
12	Aur UV	19.87	56.22	1	0.4	81.25
13	Aur YY	0.48	50.73	1	0.4	81.25
14	Boo RX	2.32	67.00	1	0.4	81.25
15	Boo Z	3.63	83.00	1	0.4	81.25
16	Cae R	18.08	38.00	1	0.4	81.25
17	Cam TX	16.17	43.10	0.8	0.32	101.56
18	Cam W	15.03	27.40	0.8	0.32	101.56
19	Cas R	20.00	39.00	1	0.4	81.25
20	Cas Y	12.57	41.67	0.8	0.32	101.56
21	Cen RT	4.48	38.10	1	0.4	81.25
22	Cen RX	2.72	30.37	1	0.4	81.25
23	Cen TU	3.93	40.58	1	0.4	81.25
24	Cen UU	3.68	15.87	1	0.4	81.25
25	Cen V423	3.62	34.38	1	0.4	81.25
26	Cen V744	2.28	26.00	1	0.4	81.25
27	Cen VX	0.10	16.00	1	0.4	81.25
28	Cen Y	5.37	45.53	1	0.4	81.25
29	Cep T	10.50	28.82	1	0.4	81.25
30	CMa CY	1.20	45.28	1	0.4	81.25
31	CMa DN	1.87	42.42	1	0.4	81.25
32	CMa SY	23.10	57.28	1	0.4	81.25
33	CMi U	1.97	55.00	1	0.4	81.25
34	Cnc R	22.40	77.45	1	0.4	81.25
35	Cnc RR	17.67	54.23	0.8	0.32	101.56
36	Cnc RS	23.47	55.53	1	0.4	81.25

Table 3: Continued

No.	SOURCE	IST(hrs)	EL.(deg)	Daytime		Jansky/K
37	Cnc RT	22.52	79.30	1	0.4	81.25
38	Cnc T	1.75	32.32	1	0.4	81.25
39	Cnc W	23.13	68.87	1	0.4	81.25
40	Cnc X	17.83	76.43	0.8	0.32	101.56
41	Col W	20.97	36.78	1	0.4	81.25
42	Com R	2.28	71.55	1	0.4	81.25
43	CrB S	2.58	64.05	1	0.4	81.25
44	Crt R	0.47	58.35	1	0.4	81.25
45	Crt S	0.00	67.72	1	0.4	81.25
46	CrV R	22.43	38.12	1	0.4	81.25
47	CvN TX	3.60	62.45	1	0.4	81.25
48	CvN V	0.03	56.03	1	0.4	81.25
49	Cyg R	10.50	44.53	1	0.4	81.25
50	Cyg U	7.83	55.25	1	0.4	81.25
51	Cyg UX	11.70	70.22	1	0.4	81.25
52	Cyg V407	8.13	57.07	1	0.4	81.25
53	Cyg Z	2.13	36.93	1	0.4	81.25
54	Eri V	17.62	53.03	0.8	0.32	101.56
55	Eri W	14.18	32.23	0.8	0.32	101.56
56	Eri Z	16.50	50.00	0.8	0.32	101.56
57	Gem EE	2.85	34.13	1	0.4	81.25
58	Gem UZ	23.32	84.67	1	0.4	81.25
59	Her RU	8.32	74.37	1	0.4	81.25
60	Her U	3.58	82.55	1	0.4	81.25
61	Her V443	10.23	31.25	1	0.4	81.25
62	Hor R	15.47	27.18	0.8	0.32	101.56
63	Hya R	14.15	52.50	0.8	0.32	101.56
64	Hya RR	22.67	53.03	1	0.4	81.25
65	Hya RT	22.28	59.73	1	0.4	81.25
66	Hya RU	2.58	46.68	1	0.4	81.25
67	Hya S	23.00	74.27	1	0.4	81.25
68	Hya SW	1.97	47.05	1	0.4	81.25
69	Hya T	18.12	67.62	1	0.4	81.25
70	Hya TU	0.38	41.55	1	0.4	81.25
71	Hya U	10.03	67.37	1	0.4	81.25
72	Hya V	20.77	43.90	1	0.4	81.25
73	Hya Y	23.87	58.00	1	0.4	81.25

Table 3: (Continued)

No.	SOURCE	IST(hrs)	EL.(deg)	Daytime	η	Jansky/K
74	IRC+60169	16.68	42.00	0.8	0.32	101.56
75	Leo S	1.50	73.03	1	0.4	81.25
76	Lep R	15.75	79.57	0.8	0.32	101.56
77	Lep RT	22.75	50.98	1	0.4	81.25
78	Lep SY	22.35	63.90	1	0.4	81.25
79	Lep T	19.47	49.75	1	0.4	81.25
80	Lib FS	4.03	59.43	1	0.4	81.25
81	Lib RR	4.28	51.17	1	0.4	81.25
82	LMi R	2.30	54.38	1	0.4	81.25
83	Lup R	4.10	34.82	1	0.4	81.25
84	Lyr RW	2.23	53.77	1	0.4	81.25
85	Lyr V	3.68	71.98	1	0.4	81.25
86	Mic V	12.07	24.67	1	0.4	81.25
87	Mon ER	1.58	49.58	1	0.4	81.25
88	Mon FX	17.85	62.43	1	0.4	81.25
89	Mon GN	0.28	66.67	1	0.4	81.25
90	Mon GX	0.78	67.83	1	0.4	81.25
91	Mon U	19.73	66.30	1	0.4	81.25
92	Oph RS	10.00	63.68	1	0.4	81.25
93	Oph RU	6.27	76.98	1	0.4	81.25
94	Oph V1111	8.00	84.10	1	0.4	81.25
95	Ori DT	19.12	75.98	1	0.4	81.25
96	Ori EP	19.85	45.82	1	0.4	81.25
97	Ori EU	20.92	79.43	1	0.4	81.25
98	Ori S	22.12	70.80	1	0.4	81.25
99	Ori V	20.48	40.68	1	0.4	81.25
100	Ori W	19.17	59.13	1	0.4	81.25
101	Peg R	12.90	40.48	0.8	0.32	101.56
102	Per AX	18.78	46.92	1	0.4	81.25
103	Per S	16.98	43.87	1	0.4	81.25
104	Pic S	17.72	28.42	0.8	0.32	101.56
105	Pup Z	0.63	48.18	1	0.4	81.25
106	Pyx S	0.07	49.38	1	0.4	81.25
107	Pyx X	2.92	39.23	1	0.4	81.25
108	Sco AH	1.08	37.85	1	0.4	81.25

Table 3: (Continued)

No.	SOURCE	IST(hrs)	EL.(deg)	'Daytime.	η	Jansky/K
109	Sco RR	6.82	41.52	1	0.4	81.25
110	Ser S	22.55	67.72	1	0.4	81.25
111	Ser WX	0.35	36.52	1	0.4	81.25
112	Sge HM	5.33	63.15	1	0.4	81.25
113	Sgr RR	4.00	44.60	1	0.4	81.25
114	Sgr VX	9.67	54.80	1	0.4	81.25
115	Tau NML	20.83	53.63	1	0.4	81.25
116	Tau R	13.35	63.62	0.8	0.32	101.56
117	UMa ST	1.00	13.55	1	0.4	81.25
118	Vir BK	3.22	48.30	1	0.4	81.25
119	Vir R	4.60	68.33	1	0.4	81.25
120	Vir RT	22.90	72.55	1	0.4	81.25
121	Vir RU	5.83	63.88	1	0.4	81.25
122	Vir S	3.02	58.35	1	0.4	81.25
123	Vir SS	12.92	75.75	0.8	0.32	101.56
124	Vir SW	3.82	51.23	1	0.4	81.25
125	VY Leo	23.05	78.00	1	0.4	81.25

Table 3: (continued) 1990

No.	SOURCE	IST (hrs)	EL.(deg)	η	Daytime	eta Jansky/K
1	AFGL 3068	12.57	58.87	0.32	0.8	0.25 127.58
2	AFGL1977	2.18	46.53	0.35	1	0.35 92.05
3	Aql RT	7.12	88.58	0.32	1	0.32 102.29
4	Aql V450	9.35	53.70	0.33	1	0.33 97.83
5	Aut NV	17.78	42.85	0.36	0.8	0.29 111.69
6	Aur R	20.67	29.00	0.40	1	0.39 82.19
7	Boo R	1.40	74.27	0.30	1	0.29 110.05
8	Cep μ	9.17	44.37	0.36	1	0.36 90.43
9	CMi S	22.15	43.63	0.36	1	0.36 89.90
10	CvN T	23.50	65.00	0.31	1	0.30 106.50
11	Cyg KY	11.03	41.23	0.37	1	0.37 88.26
12	Cyg SX	8.35	69.97	0.30	1	0.30 109.05
14	Dor R	22.82	14.62	0.40	1	0.40 81.86
15	Dra R	5.03	36.07	0.38	1	0.38 85.17
16	Her T	4.72	68.42	0.30	1	0.30 108.39
17	fiya X	0.38	36.73	0.38	1	0.38 85.53
18	Aqr EP	10.18	65.42	0.30	1	0.30 106.76
19	IR 6	3.42	71.67	0.30	1	0.30 109.60
20	Mic T	9.10	43.23	0.36	1	0.36 89.62
21	IRC+70066	15.25	32.83	0.39	0.8	0.31 104.52
22	IRC-10414	8.08	50.82	0.34	1	0.34 95.45
23	IRC-10529	8.03	69.47	0.30	1	0.30 108.85
24	Lep T	18.62	43.75	0.36	1	0.36 89.99
25	Lib RU	1.78	56.53	0.32	1	0.32 100.17
26	LMi RW	20.28	58.27	0.32	1	0.32 101.58
27	Lyr V	6.82	73.18	0.30	1	0.29 109.92
28	Oph RT	2.90	53.48	0.33	1	0.33 97.65
29	Pic S	17.92	25.67	0.40	1	0.40 81.36
30	PSc R	14.25	66.62	0.30	0.8	0.24 134.33
31	PSc WX	16.68	36.93	0.38	0.8	0.30 107.05
32	Sco RR	5.45	44.72	0.36	1	0.36 90.69
33	Sgr RR	7.88	47.73	0.35	1	0.35 92.98
34	UMa R	0.53	30.65	0.39	1	0.39 82.72
35	UMa T	1.08	43.18	0.36	1	0.36 89.59
36	UMi RR	3.25	37.05	0.38	1	0.38 85.71
37	UMi S	3.68	24.42	0.40	1	0.40 81.15
38	Vir R	2.20	62.15	0.31	1	0.31 104.5
39	Vir S	23.77	61.75	0.31	1	0.31 104.28
40	Vir SS	21.58	43.72	0.36	1	0.36 89.96
41	Vul R	8.88	70.00	0.30	1	0.30 109.06

Table 4: Results 1990

No.	SOURCE	Ta^{*}(K)	V km/s	AV km/s	a	σ_{fit}
1	AFGL 3068				0.11	
2	AFGL1977				0.1	
3	Aql RT				0.1	
4	Aql V450				0.087	
5	Aur NV	0.34	3.5	2.3	0.08	0.09
6	Aur R				0.14	
7	Boo R				0.1	
8	Cep μ	0.6,1.1	-1.9,-9.7	6.7,3.2	0.18	0.19
9	CMi S				0.097	
10	CvN T				0.074	
11	Cyg KY				0.14	
12	Cyg SX				0.1	
13	Dor R	1.6,0.8	9.7,2.7	5.1,5.1	0.18	0.22
14	Dra R				0.09	
15	Her T				0.095	
16	Hya X				0.085	
17	Aqr EP				0.096	
18	IR 6				0.056	
19	Mic T				0.13	
20	IRC+70066	0.38	-2.6	4.4	0.09	0.09
21	IRC-10414	0.24,0.45	51.6,42.2	1.6,7	0.07	0.07
22	IRC-10529				0.08	
23	Lep T				0.14	
24	Lib RU				0.12	
25	LMi RW				0.063	
26	Lyr V				0.073	
27	Oph RT				0.1	
28	Pic S				0.16	
29	PSc R				0.1	
30	PSc WX	0.5	8.1	3.1	0.07	0.07
31	Sco RR				0.08	
32	Sgr RR				0.12	
33	UMa R				0.093	
34	UMa T				0.09	
35	UMi RR				0.085	
36	UMi S				0.14	
37	Vir R				0.092	
38	Vir S	0.28	9.3	3.3	0.08	0.08
39	Vir SS				0.1	
40	Vul R				0.073	

Table 4: (contd.) 1988

No.	SOURCE	ϕ	JD244—	Ta^*(K)	V km/s	ΔV km/s	σ	σ_{fit}
1	And W	0.54	7272				0.07	
2	And Z		7260				0.05	
3	Ant V	0.46	7229				0.06	
4	Aqr R	0.46	7229	0.54	-27.8	4.5	0.04	0.08
5	Ari R	0.59	7233				0.05	
6	Aur R	0.11	7280				0.05	
7	Aur U	0.84	7233				0.05	
8	Aur UV	0.68	7240				0.05	
9	Boo RX	0.73	7229	0.2	-38.0	6.0	0.05	0.1
10	Boo Z	0.8	7235				0.05	
11	Cae R	0.65	7232	0.2	6.6	8.9	0.07	0.07
12	Cam TX	0.4	7223	0.96	8.9	4.5	0.06	0.07
13	Cam W	0.43	7288				0.09	
14	Cas Y	0.68	7270				0.05	
15	Cen TU	0.74	7249				0.06	
16	Cen UU	0.63	7216				0.2	
17	Cen V744	0.91	7258				0.07	
18	Cen VX		7258				0.09	
19	Cen Y		7217				0.04	
20	Cep T	0.85	7269				0.1	
21	Cet o	0.21	7241	8	45.6	7.8	0.1	0.3
22	CMa VY			4.1,9.2	7.5,4.5	14.0,21		
23	Cnc R	0.27	7228	1.2	13.8	3.3	0.08	0.2
24	Cnc RR	0.58	7249				0.04	
25	Cnc RS		7245				0.06	
26	Cnc RT		7249				0.04	
27	Cnc T		7235	0.26	-3.5	1.8	0.09	0.09
28	Cnc X	0.56	7250				0.05	
29	Col W	0.26	7214				0.07	
30	Com R	0.23	7233				0.05	
31	CrB S	0.28	7237	0.66	-1.8	3.3	0.04	0.04
32	Crt R		7231	0.39	6.5	5.8	0.04	0.04
33	Crt S		7232				0.05	
34	CrV R	0.95	7234				0.05	
35	CvN V	0.32	7255				0.04	
36	Cyg χ	0.51	7276	2	9.7	4.9	0.1	0.2
37	Cyg R	0.12	7237				0.08	
38	Cyg U	0.84	7254				0.07	
39	Cyg V407	0.82	7256				0.09	
40	Cyg UX	0.89	7216				0.23	

Table 4: (contd.)

No.	SOURCE	ϕ	JD244—	Ta^*(K)	V km/s	ΔV km/s	σ	σ_{fit}
41	Cyg Z	0.15	7290				0.07	
42	Eri V		7248				0.06	
43	Eri W	0.39	7233				0.05	
44	Eri Z		7215				0.06	
45	Her U	0.56	7256	1.4	-15.7	3.2	0.05	0.08
46	Her V443		7251				0.09	
47	Hor R	0.37	7239	0.33	33.7	3.8	0.07	0.07
48	Hya R	0.38	7210	0.4	-9.8	6.5	0.06	0.1
49	Hya RR	0.62	7231				0.03	
50	Hya RT		7244				0.06	
51	Hya RU	0.23	7230	0.32	-4.95	2.07	0.083	0.053
52	Hya S	0.28	7228				0.07	
53	Hya SW	0.93	7244				0.05	
54	Hya T	0.2	7285				0.05	
55	Hya TU	0.21	7243				0.06	
56	Hya U		7248				0.04	
57	Hya V	0.75	7247				0.04	
58	Hya W			11.3	39.9	3.7		
59	Hya Y		7229				0.06	
60	IRC+60169		7282	0.46	-23.8	6.3	0.1	0.1
61	Leo R	0.72	7224	0.72	2.6	3.2	0.1	0.1
62	Leo S	0.14	7229				0.06	
63	Lep R	0.89	7237				0.05	
64	Lep T	0.64	7232				0.05	
65	Lib FS	0.41	7230				0.04	
66	Lib RR	0.36	7219				0.05	
67	LMi R	0.65	7210	0.2	1.5	9.4	0.06	0.08
68	Lup R	0.26	7218				0.1	
69	Lyr RW	0.67	7294				0.05	
70	Lyr V	0.55	7293				0.1	
71	Mic V	0.15	7248				0.09	
72	Mon FX	0.33	7264				0.06	
73	Mon U	0.26	7238				0.04	
74	Oph RU	0.61	7250				0.05	
75	Oph V1111		7246				0.05	
76	Ori DT	0.71	7246				0.1	
77	Ori EP	0.28	7246				0.07	
78	Ori U	0.24	7213	0.51, 0.82	-32.9, -38.0	3.3, 2.3	0.16	0.08
79	Ori V	0.38	7246				0.06	

Table 4: (contd.)

No.	SOURCE	ϕ	JD244—	Ta^*(K)	V km/s	ΔV km/s	σ	σ_{fit}
80	Ori W		7245				0.06	
81	Peg R	0.92	7272	0.37	25.7	6.5	0.06	0.1
s2	Per S	0.27	7219	0.96	9.3	3.3	0.06	0.06
83	Pic S	0.19	7245				0.09	
84	Pyx S	0.73	7217				0.08	
85	Sco AH	0.53	7283	0.5	-13.7	5.5	0.08	0.1
86	Ser S	0.9	7283				0.1	
87	Ser WX	0.64	7238				0.1	
88	Sge HM		7256				0.1	
99	Sgr RR	0.6	7290				0.06	
100	Tau NML	0.63	7210	2.3	33.3	3.6	0.07	0.4
101	Tau R	0.21	7268				0.05	
102	UMa ST		7256				0.04	
103	Vir BK	0.48	7249				0.05	
104	Vir R	0.17	7209				0.05	
105	Vir RT			0.46	10.9	2.4	0.06	0.06
106	Vir SS	0.19	7249				0.05	
107	Vir SW	0.57	7244	0.31	-13.9	6.5	0.05	0.06
108	VY Leo		7229				0.05	

Table 4: (contd.) 1989

No.	SOURCE	ϕ	JD244—	Ta^*(K)	V km/s	ΔV km/s	σ	σ_{fit}
1	Aql MU	0.1	7562				0.05	
2	Aql RT	0.95	7559				0.04	
3	Ari U	0.74	7560				0.06	
4	Aur EY	0.96	7546				0.05	
5	Aur YY	0.12	7548				0.05	
6	Cas R	0.1	7545	0.8	26.1	3.5	0.06	0.06
7	Cen RT	0.4	7556				0.08	
8	Cen RX	0.6	7567				0.04	
9	Cen V423	0.82	7562				0.06	
10	CMa CY	0.74	7548				0.06	
11	CMa DN		7547				0.05	
12	CMa SY	0.69	7552				0.1	
13	CMa VY		7560	1.3	10.0	33.0	0.05	0.1
14	CMi U	0.64	7553				0.06	
15	Cnc W	0.33	7563				0.05	
16	CrB S	0.15	7548					
17	CvN TX		7553				0.06	
18	Gem EE	0.08	7547				0.05	
19	Gem UZ	0.89	7547				0.05	
20	Her RU	0.52	7560				0.06	
21	Hya W	0.75	7560	5.3	34.9	3.4	0.1	0.4
22	Leo R	0.75	7544	5.3	-1.3	2.9		
	Leo R	0.77	7551	0.95	-6.7	2.8		
23	Lep RT	0.55	7549				0.05	
24	Lep SY	0.44	7551				0.07	
25	Mon ER	0.13	7547				0.08	
26	Mon GN		7547				0.05	
27	Mon GX	0.89	7546	0.28	3.4	4.3	0.06	0.07
28	Oph RS		7566				0.1	
29	Ori EU	0.9	7552				0.07	
30	Ori S	0.92	7549				0.05	
31	Per AX	0.94	7551				0.09	
32	Pup Z	0.76	7561	0.26	1.9	4.5	0.06	0.07
33	Pyx X	0.39	7559				0.07	
34	Sco RR	0.59	7561				0.05	
35	Sgr VX	0.12	7561	2	6.7	12.5	0.05	0.3
36	Vir RU	0.55	7561				0.03	
37	Vir S	0.63	7565				0.08	

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