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MULTIPLICITY AMONG SOLAR-TYPE STARS

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ABSTRACT

A search has been made for spectroscopic binaries among 135 F3–G2 IV or V bright field stars. As a result of measuring 20 coudé radial velocities per star, we derived orbital elements for 25 newly discovered spectroscopic binaries. These data are combined with known orbital elements for 21 spectroscopic binaries, orbital elements for 23 visual binaries, and data for 25 common-proper-motion pairs. The observed frequencies of singles:doubles:triples:quadruples are 42:46:9:2 percent. The period distribution for the 88 periods has a single maximum, a large overlap between spectroscopic and visual pairs, and a median period of 14 years. Use of four-color and Hβ data shows no correlation between duplicity and age, or any strong decrease in duplicity rate toward lower masses.

It was found to be possible to estimate rather well the number of binaries not revealed by this study. The incompleteness study was based on seven reasonable assumptions and leads to the result that there are really 1.4 companions for each primary star, on the average. This result implies that single stars are rare.

It is also possible to determine statistically the secondary masses for both the observed and undetected binaries. These masses show that for binary periods less than about 100 years, the frequency of secondary masses varies as $\mathfrak{M}_2^{1/3}$, which is a marked departure from the van Rhijn distribution for single stars. However, for periods greater than 100 years, the frequency of various secondary masses fits the van Rhijn function within our accuracy, which is lower in this case than for the shorter periods. We conclude that there are two types of binaries: those with the shorter periods are fission systems in which a single protostar subdivided because of excessive angular momentum, whereas the longer periods represent pairs of protostars that contracted separately but are gravitationally held to each other. The dividing period of 100 years is such that if two solar masses were distributed over the corresponding volume, the mean density would agree with that assumed for the solar nebula at the time of planetary differentiation.

We find that two-thirds of the primary stars have stellar companions. If we assume that the cube-root mass function for periods less than 100 years holds for degenerate stars and planets ($< 0.07\,\mathfrak{M}_\odot$) too, we find that one-third of the primaries have nonstellar companions, i.e., all the primaries are fission systems. This tentative conclusion seems reasonable in that it solves the problem of excess angular momentum in the contraction of a protostar from an interstellar cloud. In addition, about 72 percent of the primaries have distant ($P > 100$ years) companions. Perhaps the distant companions are themselves fission doubles for the same reasons that the primaries are double. We conclude that perhaps all primaries in the range F3–G2 IV, V are either doubles (with nearby stellar or degenerate companions) or quadruples (in at least 72 percent of the cases) with a distant pair that resulted from a separate protostar.

The total mass in the companions is just half of the total mass in the primaries. On the average, the multiple systems are 0.22 mag brighter than the primaries alone.

Subject headings: stars: binaries — stars: formation

I. INTRODUCTION

Knowledge of the fraction of stars that are multiple has a bearing on various matters, such as (1) the frequency of formation of multiple systems with various numbers of components; (2) the frequency of planetary systems; (3) the frequency with which stellar evolution is affected by the presence of a companion; (4) the distribution of angular momentum in multiple systems; (5) a possible systematic luminosity difference between real stars, many of which have companions, and models computed for single stars; and (6) the affect that duplicity has upon the other observed characteristics of stars, such as surface composition, rotation rates, and mass loss. We have learned that certain special classes of stars have very high frequencies of duplicity (e.g., novae, Am stars, and perhaps Wolf-Rayet stars), while other classes have very low binary frequencies (high-velocity dwarfs, supergiants, Be stars, and late A-type dwarfs).

The present study is one of several that treat a specific section of the main sequence. It was deemed necessary because (1) previous studies (Luyten 1930;

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Table 1

Radial Velocities

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
HR 33 = 6 Cet		
40519.696	+15.7	±0.4
40526.673	+16.1	0.4
40549.627	+16.7	0.4
40550.611	+18.1	0.5
40817.900	+17.0	0.2
40872.746	+15.2	0.4
40873.751	+16.6	0.4
40874.726	+15.6	0.3
40900.771	+15.3	0.6
41175.945	+19.5	0.6
41193.928	+17.2	0.2
41201.875	+19.1	0.4
41202.790	+18.8	0.4
41203.873	+17.8	0.5
41204.874	+17.2	0.5
41525.902	+17.9	0.8
41551.949	+17.9	0.5
41552.908	+17.0	1.1
41553.947	+19.1	0.7
HR 82 = ρ And		
39068.686	+16.0	1.3
39097.707	+14.0	0.6
40052.900	+10.9	1.3
40519.701	+10.4	0.9
40526.679	+14.1	0.8
40549.662	+15.2	1.0
40550.622	+14.7	0.7
40758.954	+ 8.7	1.4
40817.901	+11.5	1.4
40872.754	+13.3	1.1
40873.758	+12.9	1.1
40874.731	+12.2	1.1
40900.785	+13.6	1.1
41175.952	+15.0	1.4
41193.934	+12.0	1.1
41194.935	+13.8	0.7
41201.882	+17.2	1.2
41202.801	+17.0	1.4
41203.884	+13.8	0.8
41204.899	+12.1	0.9
HR 219 = η Cas		
39067.718	+ 9.5	0.3
39068.693	+10.3	0.3
39097.718	+ 8.6	0.3
40052.906	+ 9.6	0.8
40519.707	+ 6.5	0.4
40526.684	+ 8.2	0.4
40549.670	+11.1	0.3
40550.628	+10.9	0.4
40552.717	+ 9.1	0.4
40758.948	+ 9.7	0.5
40817.903	+10.5	0.5
40872.760	+ 9.2	0.4
40873.763	+ 9.5	0.4
40874.734	+ 8.4	0.4
40900.788	+ 8.5	0.6
41175.958	+11.7	0.5
41193.940	+10.2	0.1
41194.945	+10.9	0.2
41201.888	+13.0	0.3
41202.811	+13.0	±0.3
41203.889	+10.5	±0.4
41204.902	+ 9.5	0.3
HR 225 = 64 Psc		
40052.914	-56.7	0.9
	+69.7	0.9
40519.714	+ 5.3	0.4
40526.690	+ 6.1	0.4
40549.676	-35.3	1.1
	+46.3	1.2
40550.635	-59.1	0.8
	+69.4	0.8
40817.912	+36.5	0.9
	-24.4	1.5
40872.766	+21.9	2.1
	-17.6	1.7
40873.771	-34.8	1.2
	+41.7	0.9
40874.741	-36.4	1.4
	+49.4	0.8
40900.794	+31.6	0.8
	-27.4	1.7
41175.966	+ 6.2	0.4
41193.974	-35.0	1.4
	+51.9	1.0
41194.956	-33.5	1.6
	+42.9	0.9
41201.896	-51.1	0.9
	+70.8	0.3
41202.822	-21.4	0.8
	+34.7	1.5
41203.899	+ 6.8	0.4
41204.891	+33.9	0.8
	-21.6	1.6
41525.893	-28.4	1.4
	+51.8	2.6
41551.957	-31.5	1.6
	+49.7	2.3
41552.910	-33.2	1.3
	+49.9	1.8
HR 235 = ϕ^2 Cet		
40052.924	+10.2	0.8
40519.719	+ 8.7	0.1
40526.695	+ 7.6	0.3
40549.684	+10.6	0.4
40550.641	+11.2	0.3
40817.917	+21.6	0.5
40872.773	+ 8.8	0.2
40873.780	+ 9.0	0.4
40874.748	+11.2	0.4
40900.779	+ 9.8	0.5
41175.974	+10.0	0.3
41201.906	+11.1	0.3
41202.836	+10.7	0.4
41203.908	+ 9.6	0.4
41204.884	+10.1	0.1
41525.905	+10.5	0.8
41551.951	+12.4	0.6
41552.915	+10.7	0.8
41553.954	+11.3	1.1
41580.917	+10.7	±0.5
HR 244		
39067.759	+23.5	±0.3
39068.719	+22.9	0.2
39097.744	+21.5	0.2
40519.724	+20.1	0.3
40526.701	+21.3	0.3
40549.694	+22.9	0.4
40550.655	+22.6	0.5
40758.944	+20.7	0.4
40817.906	+24.0	0.7
40872.778	+21.8	0.4
40873.785	+21.1	0.5
40874.753	+24.1	0.3
40900.798	+20.5	0.5
41175.977	+23.1	0.5
41193.946	+23.1	0.3
41194.966	+22.9	0.2
41201.945	+23.9	0.4
41202.903	+25.0	0.3
41203.929	+22.9	0.3
41204.921	+22.9	0.3
HR 366 = 37 Cet		
39068.732	+25.5	0.2
39097.691	+22.6	0.3
40519.732	+22.2	0.5
40526.708	+22.9	0.4
40549.703	+24.7	0.4
40550.665	+24.0	0.5
40817.924	+25.2	0.3
40872.786	+22.1	0.4
40873.793	+21.8	0.4
40874.762	+24.3	0.4
40900.867	+23.0	0.5
41175.988	+23.2	0.4
41201.914	+24.4	0.3
41202.854	+24.8	0.4
41203.917	+24.0	0.6
41204.911	+24.1	0.4
41525.997	+23.6	0.7
41551.954	+27.0	0.5
41552.920	+24.3	0.8
41553.958	+26.6	1.0
HR 413 = ρ Psc		
39068.746	- 9.2	1.7
39067.762	+ 1.2	2.0
40519.739	- 6.4	1.6
40526.717	- 6.9	2.7
40549.713	- 3.1	1.8
40550.677	+ 2.0	1.3
40817.919	- 9.8	1.3
40872.793	- 8.9	1.5
40873.799	-11.1	1.8
40874.769	- 9.3	3.0
40900.876	- 2.2	2.0
41175.993	- 8.2	1.0
41201.923	- 7.0	1.9
41202.877	- 6.9	2.1
41203.958	- 7.2	2.0
41204.951	- 8.9	1.6
41525.999	- 9.6	2.1
41551.959	-10.0	2.7
41552.923	- 8.8	±1.8
41553.963	-11.2	±2.0
HR 417 = ω And		
39068.757	+15.9	1.5
39097.777	+17.1	1.6
40519.745	+15.7	1.5
40526.722	+17.8	1.1
40549.720	+19.2	0.9
40550.686	+17.8	0.7
40758.959	+12.5	1.6
40817.927	+12.2	1.5
40872.798	+13.8	2.3
40873.804	+11.7	1.6
40874.773	+10.4	0.8
40900.803	+11.8	1.3
41175.998	+11.1	1.0
41193.953	+14.1	1.6
41194.983	+15.9	1.1
41201.928	+16.1	0.8
41202.864	+18.1	1.3
41203.922	+15.9	1.1
41204.916	+14.2	1.0
41313.609	+14.6	1.1
HR 458 = υ And		
39068.766	-28.3	0.4
39097.787	-28.9	0.3
40519.749	-29.8	0.3
40526.729	-29.9	0.3
40549.727	-27.8	0.5
40550.693	-26.9	0.5
40758.973	-28.0	0.4
40817.930	-27.3	0.4
40872.803	-30.0	0.3
40873.810	-28.8	0.2
40874.777	-28.3	0.5
40900.882	-28.3	0.4
41176.004	-25.3	0.5
41193.957	-26.2	0.3
41194.975	-26.8	0.3
41201.933	-25.5	0.2
41202.887	-24.2	0.3
41203.946	-26.6	0.4
41204.938	-26.5	0.3
41313.615	-28.3	0.3
HR 483		
39068.775	+ 5.8	0.4
39097.799	+ 4.8	0.3
40519.754	+ 3.7	0.4
40526.737	+ 4.2	0.4
40549.734	+ 6.1	0.4
40550.698	+ 5.9	0.3
40758.964	+ 3.2	0.4
40817.933	+ 4.7	0.3
40872.808	+ 1.9	0.3
40873.814	+ 3.3	0.4
40874.782	+ 3.3	0.2
40900.885	+ 4.3	0.4
41193.964	+ 7.7	0.1
41194.991	+ 6.0	0.3
41201.939	+ 7.5	0.3
41202.894	+ 7.0	0.5
41203.939	+ 6.1	±0.3

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
41204.930	+ 5.5	±0.4
41313.622	+ 5.2	0.4
41526.000	+ 4.9	0.4

HR 544 = α Tri

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39068.786	-33.1	2.6
39127.655	-35.5	4.4
40519.786	-15.9	2.8
40526.744	-21.4	3.1
40549.740	-30.1	2.3
40550.704	- 1.8	2.0
40817.937	-12.3	2.6
40872.814	-30.7	2.0
40873.820	-12.0	2.9
40874.787	-24.9	3.0
40900.890	-28.0	3.5
41176.008	- 8.9	1.9
41194.999	- 6.0	1.7
41201.952	- 8.2	3.6
41202.911	-24.8	2.0
41203.950	-17.5	2.7
41204.945	-15.1	2.2
41551.962	-22.0	3.0
41552.925	-13.8	3.6
41553.966	-21.6	2.4

HR 646 = η Ari

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39068.795	+ 6.2	0.5
39097.820	+ 9.6	0.3
39127.670	+ 9.5	0.4
40518.816	+ 6.3	0.6
40519.792	+ 5.4	0.4
40526.752	+ 5.5	0.6
40549.747	+ 7.0	0.4
40550.711	+ 7.4	0.4
40817.943	+ 6.6	0.4
40872.820	+ 5.3	0.4
40873.825	+ 4.4	0.2
40874.793	+ 4.7	0.2
40900.894	+ 6.6	0.6
41201.958	+ 8.7	0.4
41202.918	+ 9.5	0.4
41203.966	+ 8.3	0.5
41204.959	+ 7.5	0.6
41233.964	+ 8.0	0.6
41262.883	+ 6.4	0.5
41323.699	+ 5.0	0.4

HR 660 = δ Tri

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39068.831	+ 0.8	0.3
39127.686	- 2.3	0.2
40518.821	-14.7	0.4
40519.798	-10.5	0.3
40526.761	-14.0	0.4
40549.756	- 9.6	0.4
40550.722	- 3.3	0.3
40758.983	-15.7	0.4
40817.938	-14.9	0.5
40872.826	+ 1.2	0.3
40873.831	+ 2.5	0.3
40874.827	- 0.9	0.3
40900.899	- 9.2	0.4
41195.006	+ 4.8	0.3
41202.972	+ 2.7	0.4
41204.003	+ 6.4	0.3
41204.985	+ 5.2	±0.3
41233.967	+ 4.8	±0.4
41262.888	- 0.8	0.3
41313.630	+ 1.7	0.4
41315.691	+ 3.1	0.3

HR 781 = ϵ Cet

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40197.834	+17.1	0.5
40198.807	+15.6	0.5
40518.826	+18.8	0.5
40519.804	+17.9	0.4
40526.768	+17.9	0.6
40549.763	+18.5	0.5
40550.729	+18.2	0.4
40817.948	+16.0	0.6
40872.832	+13.9	0.5
40873.842	+13.5	0.5
40874.836	+14.8	0.4
40900.904	+14.3	0.5
41202.980	+17.0	0.3
41203.996	+19.0	0.4
41205.002	+17.9	0.3
41233.954	+16.8	0.4
41235.914	+17.5	0.4
41262.877	+16.1	0.5
41323.707	+17.5	0.3
41551.972	+19.4	0.5

HR 799 = θ Per

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39068.850	+25.9	0.3
39127.711	+24.5	0.3
40197.851	+24.8	0.3
40198.827	+24.1	0.5
40518.836	+25.2	0.5
40519.813	+24.0	0.3
40526.773	+25.3	0.3
40549.776	+27.2	0.5
40550.743	+26.4	0.4
40758.968	+24.5	0.5
40817.953	+26.8	0.4
40872.846	+25.1	0.3
40873.851	+25.6	0.2
40874.850	+25.7	0.3
40900.912	+24.9	0.6
41195.014	+27.8	0.3
41202.935	+28.9	0.5
41203.978	+27.3	0.3
41204.970	+27.4	0.3
41233.974	+27.7	0.5

HR 818 = τ^1 Eri

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40197.859	+31.4	0.5
40198.837	+27.6	0.4
40518.842	+28.7	0.3
40519.818	+29.7	0.2
40549.810	+30.9	0.6
40550.748	+31.0	0.5
40817.964	+33.8	0.3
40872.851	+31.0	0.4
40873.856	+30.8	0.3
40874.855	+30.8	0.5
40900.916	+31.6	0.5
40901.798	+31.4	0.6
40901.801	+31.0	0.6
41202.943	+29.4	0.6
41203.986	+28.3	0.5
41205.008	+27.6	±0.7
41233.958	+28.0	±0.5
41235.910	+27.6	0.6
41262.873	+25.7	0.3
41323.712	+25.8	0.4
41551.975	+30.3	0.7

HR 855 = 20 Per

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40197.871	+ 6.2	1.7
40198.848	+ 7.2	3.2
40518.868	- 0.2	2.3
40519.854	+ 3.9	1.6
40817.959	+ 0.2	1.8
40872.857	- 2.0	2.3
40873.862	+ 0.3	1.4
40874.862	- 0.5	1.6
40900.923	- 0.3	2.3
40901.845	- 0.3	2.3
41202.951	+ 4.9	2.0
41204.010	- 1.2	3.1
41204.977	+ 1.0	2.0
41233.978	+ 2.9	2.2
41234.974	- 0.2	2.1
41262.899	+ 5.9	2.2
41313.642	+ 8.7	1.9
41323.704	+ 7.2	0.8
41340.760	+ 8.2	1.6
41551.963	+ 5.4	2.0

HR 869 = ρ Ari

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39067.873	+19.3	0.1
39068.869	+15.4	0.2
39127.737	+17.9	0.4
40197.881	+10.0	0.6
40198.862	+ 9.2	0.5
40518.874	+ 5.4	0.7
40519.862	+ 4.5	0.6
40817.966	+ 5.2	0.4
40872.864	+ 4.3	0.4
40873.868	+ 5.0	0.6
40874.869	+ 3.4	0.6
40900.931	+ 5.3	0.6
40901.838	+ 4.4	0.6
41202.963	+10.0	0.5
41204.020	+ 9.8	0.8
41204.993	+ 9.6	0.4
41233.989	+ 9.4	0.5
41235.929	+ 9.4	0.5
41262.913	+ 8.0	0.6
41316.702	+10.7	0.5
41951.896	+15.2	0.8
41952.902	+13.8	0.8
41957.882	+14.2	0.9
41958.936	+13.3	1.2

HR 937 = ι Per

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39067.890	+50.5	0.3
39068.857	+50.1	0.4
39127.718	+49.5	0.4
40197.891	+49.2	0.2
40198.873	+48.5	0.4
40518.878	+49.7	0.4
40519.867	+49.2	0.2
40817.955	+52.8	0.3
40872.868	+50.6	0.5
40873.873	+50.4	0.4
40874.874	+51.1	±0.4
40900.937	+49.4	±0.5
40901.850	+50.6	0.5
41201.966	+53.9	0.3
41202.984	+52.4	0.3
41205.018	+52.6	0.3
41233.982	+52.2	0.2
41262.905	+51.5	0.2
41313.647	+49.5	0.5
41316.713	+52.1	0.4

HR 962 = 94 Cet

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39067.904	+27.6	0.4
39127.769	+25.9	0.3
40197.901	+20.4	0.5
40198.885	+19.4	0.3
40518.884	+18.3	0.4
40519.874	+18.9	0.4
40817.971	+22.5	0.4
40872.874	+19.5	0.4
40873.879	+20.2	0.2
40874.881	+20.1	0.4
40900.945	+18.6	0.6
40901.825	+20.3	0.5
41202.993	+21.1	0.4
41204.029	+21.5	0.2
41205.013	+21.8	0.4
41233.995	+20.7	0.3
41262.921	+20.8	0.4
41316.708	+21.4	0.4
41323.718	+18.9	0.3
41340.730	+18.5	0.4

HR 1101 = 10 Tau

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40197.913	+29.2	0.3
40198.898	+28.0	0.2
40518.888	+28.2	0.3
40519.878	+26.4	0.4
40817.975	+33.5	0.2
40872.879	+28.6	0.3
40873.884	+29.3	0.3
40874.886	+31.1	0.3
40900.953	+29.5	0.6
40901.832	+29.3	0.5
41203.004	+29.1	0.4
41205.022	+29.1	0.2
41234.000	+30.9	0.4
41234.938	+29.7	0.5
41262.927	+28.9	0.4
41316.717	+29.6	0.3
41323.721	+27.5	0.3
41340.736	+26.8	0.5
41341.725	+27.9	0.3
41551.967	+31.7	0.4

HR 1129

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
39551.643	- 7.6	0.3
40197.921	-19.8	1.3
40198.911	-19.6	1.5
40518.891	-14.0	1.0
40519.883	-13.5	1.0
40817.980	- 7.0	0.9
40872.882	- 9.9	0.8
40873.889	-10.5	0.8
40874.892	- 7.3	0.8
40900.957	- 8.4	1.1
40901.855	- 8.6	±1.1

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
41203.010	- 6.1	±0.7
41205.026	- 5.9	0.8
41234.028	- 6.7	0.9
41234.980	- 7.6	1.0
41262.953	- 7.0	0.7
41313.656	- 7.7	0.3
41323.735	- 7.3	0.8
41340.766	- 6.8	0.8
41341.768	- 6.7	0.9
HR 1210 = 43 Per		
39067.934	+26.4	0.3
39551.658	+23.1	0.3
40197.930	+25.6	0.6
40198.926	+26.4	1.0
40518.905	+10.7	0.2
	+43.6	1.2
40519.891	+ 8.9	1.2
	+42.2	1.5
40817.985	+48.2	1.2
	+ 7.6	1.3
40872.889	-55.5	0.9
	+108.7	1.0
40873.897	-15.6	1.1
	+67.3	1.9
40874.900	+27.5	0.7
40900.964	-14.3	1.5
	+62.2	1.5
40901.864	-28.3	1.3
	+85.8	0.3
41203.019	+24.6	0.5
41205.032	- 8.0	0.7
	+58.0	1.4
41234.034	+44.9	1.5
	+12.8	0.5
41234.990	- 2.4	1.8
	+55.5	0.7
41262.961	+27.2	0.8
41313.662	+27.5	0.1
41323.730	+25.3	0.3
41340.771	+42.0	1.6
	+12.7	1.7
HR 1249		
39551.624	+18.7	0.4
39552.622	+17.3	0.5
39553.591	+17.9	0.4
40518.912	+18.3	0.2
40519.898	+17.5	0.5
40818.002	+19.4	0.3
40872.897	+16.6	0.4
40873.905	+17.8	0.4
40874.908	+18.9	0.4
40900.972	+19.7	0.6
40901.894	+19.1	0.4
41234.005	+19.6	0.4
41234.945	+19.2	0.7
41262.932	+20.3	0.6
41316.722	+21.8	0.4
41323.725	+17.2	0.3
41340.745	+18.5	0.4
41341.729	+19.2	0.4
41342.725	+18.6	0.6
41553.006	+17.9	±1.0
HR 1254		
39067.919	+45.4	±1.1
40496.939	+38.0	0.6
40518.922	+38.4	0.9
40519.904	+40.4	0.8
40818.007	+40.9	0.8
40872.904	+37.4	0.4
40873.912	+38.0	0.4
40874.914	+39.8	0.8
40900.984	+40.0	1.1
40901.905	+39.1	0.7
41234.011	+41.1	1.0
41234.966	+40.9	0.8
41262.947	+40.0	0.9
41323.748	+37.8	1.0
41340.756	+37.8	0.8
41341.734	+37.3	0.8
41342.735	+37.1	1.0
41552.932	+40.5	1.8
41553.977	+39.7	2.3
41580.919	+42.0	1.4
HR 1257		
40518.927	-18.5	0.6
40519.910	-19.2	0.4
40818.011	-15.9	0.4
40872.912	-18.5	0.3
40873.918	-18.2	0.4
40874.921	-17.8	0.1
40900.994	-18.7	0.6
40901.914	-18.1	0.6
41234.018	-16.8	0.4
41234.956	-17.2	0.4
41262.940	-18.2	0.6
41316.727	-16.7	0.6
41323.756	-18.6	0.5
41340.750	-17.4	0.5
41341.740	-17.7	0.4
41551.987	-13.9	0.9
41552.937	-10.4	1.0
41553.983	-13.0	0.9
41580.925	-13.3	0.6
41581.827	-14.5	0.7
HR 1278 = 50 Per		
39067.953	+29.9	0.5
39551.674	+24.3	0.2
40518.935	+26.1	0.4
40519.917	+25.9	0.4
40526.911	+27.1	0.4
40817.990	+29.2	0.4
40872.920	+27.0	0.3
40873.925	+25.3	0.4
49874.931	+25.6	0.4
40901.003	+28.3	0.2
40901.883	+26.1	0.5
41235.011	+25.6	0.3
41262.968	+27.2	0.6
41313.678	+26.0	0.4
41323.745	+26.4	0.4
41340.799	+25.8	0.5
41341.754	+25.9	0.4
41551.982	+29.6	0.9
41552.926	+29.1	1.2
41553.970	+28.1	±1.1
HR 1306 = 52 Per		
39551.690	- 1.5	±0.3
40518.942	-19.3	0.7
40519.926	-19.1	0.6
40526.919	-18.6	0.6
40615.710	-14.8	0.9
40817.995	- 8.4	0.7
40872.928	- 8.8	0.6
40873.933	- 9.6	0.7
40874.940	- 9.3	0.7
40901.010	- 7.9	0.8
40901.872	- 8.8	0.9
41203.028	+ 5.2	0.8
41234.023	+ 5.6	0.6
41235.001	+ 5.2	0.9
41262.975	+ 6.4	0.7
41313.694	+ 8.2	0.8
41323.740	+ 9.9	0.7
41340.807	+ 9.9	0.6
41341.759	+11.1	0.6
41551.976	+18.3	1.4
HR 1309 = 46 Tau		
40518.949	+10.6	1.2
	-52.7	3.5
40519.933	+11.8	1.6
	-50.1	3.2
40526.929	+ 9.5	3.1
40872.939	+ 5.6	1.6
40873.940	+ 4.5	1.1
40874.948	+ 2.7	0.9
40901.019	+ 6.2	1.1
	-44.5	3.0
40901.923	+ 7.2	1.9
41234.040	+ 0.7	1.2
	-76.6	1.6
41235.024	+ 0.3	1.1
41262.983	+ 3.7	1.6
41323.752	+ 4.5	0.6
41340.784	+ 5.6	1.1
41341.744	+ 4.4	0.7
41551.989	+ 1.8	1.9
41553.011	- 2.9	1.6
41580.928	0.0	1.9
41581.831	+ 0.9	1.5
41588.877	+ 0.2	1.9
41589.842	+ 0.3	1.8
41951.910	- 2.5	1.6
41952.911	+ 0.1	1.8
41957.886	- 4.2	1.7
41958.941	+ 1.1	2.0
HR 1543 = π^3 Ori		
40280.581	+24.2	0.3
40281.577	+24.4	0.4
40496.947	+24.9	0.5
40518.960	+24.3	0.5
40519.936	+24.2	0.5
40526.933	+24.1	0.4
40872.948	+24.6	0.4
40873.943	+24.4	0.4
40874.953	+23.4	0.3
40901.024	+25.3	0.4
40901.928	+25.7	0.4
41234.042	+26.5	±0.5
41235.032	+24.1	±0.3
41262.992	+25.4	0.4
41323.755	+23.0	0.4
41340.789	+24.6	0.7
41341.748	+23.5	0.5
41553.014	+22.5	1.7
41580.966	+26.5	1.1
41581.833	+27.7	1.0
HR 1673 = 68 Eri		
40280.597	+11.0	0.3
40281.589	+ 9.7	0.2
40518.975	+ 8.8	0.4
40519.941	+ 9.4	0.4
40526.937	+ 9.7	0.5
40872.954	+10.3	0.5
40873.946	+ 9.4	0.5
40874.956	+ 9.9	0.3
40901.030	+10.2	0.6
40901.934	+10.5	0.5
41235.037	+10.2	0.5
41262.997	+11.0	0.5
41323.762	+ 9.7	0.6
41340.776	+11.5	0.6
41341.751	+11.0	0.2
41580.973	+14.8	1.0
41581.912	+13.8	1.0
41588.879	+14.4	0.5
41589.844	+14.7	1.3
41646.698	+15.0	0.9
HR 1686		
39908.710	- 8.7	1.0
40280.612	- 9.9	0.4
40281.601	- 9.7	0.4
40518.984	-10.5	0.4
40519.947	-12.3	0.5
40526.944	-11.6	0.4
40874.000	-11.3	0.4
40875.009	-10.5	0.4
40901.037	-11.4	0.6
40901.978	-10.6	0.5
41263.008	-10.1	0.4
41313.709	-12.3	0.5
41323.768	-13.2	0.4
41340.827	- 9.8	0.4
41341.773	-10.3	0.4
41347.805	-10.9	0.4
41404.664	-12.1	0.4
41580.968	- 7.1	0.7
41581.836	- 6.0	0.8
41588.882	-10.1	1.3
HR 1729 = λ Aur		
39067.975	+66.8	0.4
39127.908	+64.6	0.3
39551.783	+65.5	0.3
39908.728	+67.2	0.7
40280.630	+68.0	0.2
40281.613	+66.6	0.2
40518.993	+66.1	0.2
40519.956	+66.4	0.3
40526.952	+67.2	0.3
40874.013	+66.8	0.3
40875.020	+67.2	±0.4

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40901.044	+67.4	±0.4
40901.964	+67.5	0.6
41263.016	+67.1	0.4
41313.733	+66.8	0.4
41323.766	+65.2	0.3
41340.816	+65.5	0.2
41341.764	+67.3	0.4
41347.798	+67.0	0.6
41404.651	+66.0	0.3
HR 1780 = 111 Tau		
39551.707	+38.3	0.2
39552.673	+35.3	0.2
40280.648	+39.2	0.3
40281.623	+37.4	0.2
40518.998	+37.5	0.5
40519.962	+38.2	0.4
40526.958	+37.6	0.5
40549.877	+40.6	0.4
40550.951	+39.4	0.4
40872.971	+38.8	0.5
40873.952	+38.3	0.4
40874.964	+37.6	0.3
40901.943	+39.1	0.7
41044.602	+38.4	0.6
41045.621	+36.0	0.6
41046.625	+36.8	0.6
41047.641	+36.5	0.5
41048.594	+37.6	0.6
41263.022	+39.4	0.3
41313.742	+39.0	0.4
41340.793	+38.1	0.5
HR 2047 = χ^1 Ori		
39127.791	- 8.7	0.5
39551.719	-12.9	0.3
39908.680	- 9.8	0.8
40281.633	-11.3	0.2
40496.953	-11.2	0.4
40519.002	-12.8	0.3
40519.965	-12.6	0.5
40526.963	-12.8	0.3
40549.883	-10.4	0.5
40550.957	-11.4	0.4
40872.982	-12.7	0.5
40873.956	-12.3	0.4
40874.969	-12.7	0.3
40901.947	-12.2	0.6
41044.609	-13.6	0.6
41045.629	-14.4	0.5
41046.633	-14.6	0.5
41047.650	-15.4	0.5
41048.601	-14.3	0.4
41263.028	-13.7	0.3
HR 2220 = 71 Ori		
39127.807	+34.9	0.5
39551.734	+34.0	0.2
39908.691	+35.0	0.7
40281.642	+34.5	0.3
40519.006	+34.6	0.4
40519.970	+33.9	0.4
40526.969	+35.4	0.6
40549.890	+37.1	0.4
40550.963	+35.8	±0.5
40872.992	+35.4	±0.4
40873.961	+35.5	0.4
40874.974	+36.1	0.5
40901.952	+36.4	0.7
41044.615	+34.3	0.4
41045.635	+33.4	0.5
41046.639	+33.3	0.3
41047.659	+34.0	0.5
41048.608	+33.0	0.6
41263.033	+36.6	0.4
41313.750	+35.4	0.3
HR 2241 = 74 Ori		
39551.744	+ 9.0	0.4
40197.938	+ 9.0	0.6
40198.937	+ 8.4	0.7
40280.678	+ 9.5	0.3
40281.657	+ 9.9	0.4
40519.011	+ 7.6	0.6
40519.978	+ 8.1	0.5
40526.975	+ 8.2	0.7
40549.897	+11.0	0.6
40550.971	+10.2	0.5
40873.004	+ 9.3	0.6
40873.967	+ 9.8	0.5
40874.979	+10.0	0.6
40901.957	+10.1	0.6
41044.622	+10.6	0.6
41045.643	+ 8.1	0.4
41046.648	+ 7.2	0.4
41047.672	+ 9.3	0.8
41048.615	+ 8.4	0.3
41263.039	+ 9.5	0.4
HR 2401		
39551.841	+13.7	0.2
40197.948	+17.7	0.5
40198.946	+17.7	0.3
40281.668	+16.6	0.2
40519.021	+15.0	0.4
40519.989	+14.4	0.3
40526.980	+15.7	0.4
40549.904	+17.2	0.5
40550.981	+17.3	0.6
40874.021	+15.2	0.1
40875.028	+15.2	0.4
40901.986	+16.6	0.3
41045.661	+15.5	0.5
41046.677	+15.1	0.4
41047.695	+15.3	0.5
41048.637	+13.7	0.3
41263.047	+16.5	0.6
41313.779	+17.5	0.2
41315.902	+18.0	0.4
41316.904	+16.1	0.5
HR 2483 = ψ^5 Aur		
39551.798	-25.0	0.2
40197.963	-24.2	0.4
40198.963	-24.2	0.3
40281.693	-22.9	0.4
40519.031	-23.8	0.4
40519.998	-24.7	0.4
40526.989	-24.5	0.4
40549.917	-22.1	±0.5
40550.997	-23.4	±0.6
40874.032	-24.7	0.4
40875.039	-23.6	0.4
40901.970	-22.4	0.4
41044.630	-22.8	0.5
41045.651	-25.2	0.4
41046.659	-24.4	0.6
41047.684	-24.6	0.5
41048.625	-24.8	0.5
41313.814	-22.9	0.6
41315.909	-22.5	0.5
41340.822	-23.5	0.6
HR 2484 = ξ Gem		
39551.756	+28.6	1.5
40197.970	+37.2	3.9
40198.972	+30.4	1.8
40281.700	+28.4	1.2
40496.959	+28.5	3.1
4-519.036	+32.4	3.6
40519.038	+32.7	3.7
40520.004	+31.2	3.8
40526.994	+26.0	1.6
40549.923	+32.7	2.9
40551.004	+30.0	0.8
40873.012	+27.2	1.6
40873.969	+24.8	1.8
40874.982	+19.3	2.7
40902.008	+24.8	1.6
41044.636	+31.8	1.5
41045.671	+25.3	1.6
41046.689	+26.6	1.2
41047.703	+26.9	1.6
41048.647	+28.2	1.6
HR 2846 = 63 Gem		
39157.837	+106.8	1.6
39160.886	- 0.7	1.2
39185.796	-53.0	1.3
39551.765	+100.9	1.0
	-102.1	2.8
39908.747	-22.9	1.2
	+93.5	2.7
40197.986	- 3.4	1.3
	+47.1	1.7
40198.985	+59.9	1.8
	-21.8	2.0
40280.721	+90.3	0.8
	-69.4	2.4
40281.721	-53.7	0.8
	+82.8	2.8
40519.045	-61.8	1.0
	+139.4	3.6
40520.007	+114.7	1.0
	-77.9	3.1
40526.997	-68.1	1.0
	+140.9	3.8
40549.928	-54.1	0.8
	+143.6	2.7
40551.008	+125.9	0.6
	-81.7	3.3
40873.020	-60.2	1.0
	+137.2	2.8
40873.975	+118.2	1.1
	-79.0	±3.2
40874.986	-52.5	±1.2
	+134.0	2.4
40902.003	-60.0	1.2
	+132.4	1.4
41044.643	-56.4	0.9
	+77.9	4.2
41045.676	+96.8	0.9
	-84.2	1.8
HR 2849 = 22 Lyn		
39157.857	-28.7	0.6
39160.897	-28.7	0.5
39551.815	-29.9	0.3
39908.759	-25.1	0.5
40197.997	-27.3	0.4
40198.993	-26.9	0.4
40281.732	-26.9	0.3
40520.014	-27.0	0.5
40527.004	-26.9	0.3
40549.936	-26.3	0.5
40551.017	-27.1	0.5
40615.781	-25.8	0.6
40873.030	-27.9	0.3
40873.983	-25.8	0.4
40874.994	-25.5	0.4
40901.996	-26.3	0.4
41044.651	-27.7	0.5
41045.686	-28.2	0.5
41046.696	-27.8	0.5
41047.709	-27.5	0.5
41048.653	-28.5	0.4
HR 2943 = α CMi		
39127.951	- 3.7	0.8
39127.953	- 4.9	0.6
39157.771	- 2.2	0.6
39160.905	- 2.7	0.5
39160.907	- 3.2	0.4
39185.846	- 1.1	0.4
39185.848	- 0.6	0.4
39276.635	+ 0.3	0.8
39276.637	- 4.9	1.9
39277.624	- 4.9	0.2
39277.627	- 3.7	0.5
39551.777	- 3.2	0.4
39551.779	- 2.8	0.4
39553.670	- 0.9	0.3
39553.674	- 1.0	0.3
39553.678	+ 0.1	0.3
39553.684	- 4.2	0.3
39553.687	- 2.7	0.2
39553.691	+ 1.6	0.2
39553.696	- 4.8	0.4
39908.769	- 1.4	0.5
39929.707	- 0.1	1.2
40198.004	- 7.0	0.6
40199.000	- 6.2	0.5
40281.741	- 3.9	0.2
40520.020	- 5.2	0.4
40527.009	- 5.9	0.5
40549.943	- 4.1	0.6
40551.024	- 5.1	0.4
40615.787	- 3.5	0.5
40702.608	- 4.4	0.6
40702.612	- 3.8	±0.6

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40702.615	-4.4	±0.6
40702.622	-4.0	0.6
40702.625	-3.6	0.5
40702.628	-3.6	0.6
40873.037	-5.8	0.4
40873.990	-3.8	0.4
40875.000	-3.8	0.3
40902:011	6.4	0.5
40967.799	-3.5	0.2
40968.961	-4.9	0.6
41045.692	-0.7	0.8
41046.703	-5.7	0.7
41047.722	-6.5	0.5
41048.662	-5.9	0.5
41202.994	5.4	0.4
41313.827	-4.5	0.7
41315.914	-5.2	0.6
41341.786	-4.2	0.4
41347.814	-3.5	0.5
41373.816	-6.8	0.7
41374.820	-6.0	0.4
41404.674	-5.0	0.4
41441.610	-2.4	0.5

HR 3064 = 9 Pup

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39160.855	-21.4	1.1
39553.656	-18.1	0.3
39908.784	-16.6	0.5
39929.716	-19.7	0.9
40198.017	-21.1	0.4
40199.011	-20.1	0.4
40281.748	-20.7	0.3
40520.025	-20.0	0.2
40527.014	-20.6	0.4
40549.948	-19.7	0.3
40552.961	-18.4	0.3
40551.032	-20.2	0.3
40615.794	-19.5	0.5
40967.941	-19.3	0.4
41044.663	-20.4	0.6
41045.700	-22.4	0.8
41046.712	-19.9	0.4
41047.733	-20.7	0.4
41048.674	-21.5	0.5
41315.918	-20.3	0.5
41340.838	-20.0	0.5
41341.780	-19.9	0.4

HR 3176 = μ Cnc

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39908.803	-35.1	0.7
39929.728	-38.6	0.7
40198.033	-37.0	0.4
40199.025	-37.4	0.3
40281.767	-37.6	0.2
40520.032	-35.7	0.2
40527.023	-35.5	0.5
40549.960	-35.1	0.4
40551.045	-36.2	0.3
40615.803	-35.4	0.6
41044.678	-37.6	0.5
41045.709	-38.6	0.7
41046.724	-36.6	0.3
41047.748	-37.0	0.4
41048.691	-37.5	0.4
41313.834	-35.9	0.3
41315.923	-34.4	±0.6
41316.956	-36.6	±0.4
41341.790	-36.0	0.4
41347.821	-34.4	0.5

HR 3262 = χ Cnc

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39157.875	+33.1	0.6
39160.918	+36.3	0.4
39277.639	+30.9	0.6
39908.816	+33.2	0.7
39929.737	+33.1	0.5
40198.041	+32.2	0.3
40199.036	+32.1	0.5
40520.039	+33.2	0.5
40527.029	+32.5	0.3
40549.969	+34.6	0.4
40551.057	+33.6	0.3
40615.809	+34.2	0.6
41044.685	+32.4	0.4
41045.716	+31.8	0.5
41046.734	+32.8	0.4
41047.759	+32.1	0.4
41048.701	+31.3	0.5
41313.842	+36.2	0.4
41315.927	+35.5	0.5
41316.964	+33.4	0.5

HR 3579

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39157.886	+27.8	0.5
39160.928	+29.2	0.3
39277.648	+23.8	0.6
39551.861	+27.7	0.6
39908.823	+31.0	0.7
39929.744	+29.6	0.5
40198.046	+29.5	0.4
40199.043	+30.4	0.6
40520.043	+30.4	0.4
40527.039	+30.1	0.1
40549.973	+32.5	0.6
40551.063	+32.5	0.6
40577.966	+33.8	0.9
40615.813	+33.2	0.6
40638.902	+31.0	0.8
40967.958	+32.0	0.6
41044.691	+31.0	0.5
41045.721	+28.9	0.6
41046.742	+30.6	0.7
41047.770	+30.2	0.6
41048.721	+30.0	0.5
41313.847	+33.3	0.4

HR 3616 = σ^2 UMa

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39908.829	-0.3	0.6
39909.917	-1.8	0.9
39966.648	-4.1	1.2
40198.053	-2.5	0.3
40199.049	-1.7	0.5
40527.044	-4.2	0.4
40549.980	-2.1	0.3
40613.850	-0.2	0.4
40614.895	-2.4	0.4
40615.851	-0.3	0.5
40638.910	-2.7	0.5
40967.965	-2.0	0.6
41044.697	-1.1	0.5
41045.725	-4.5	0.6
41046.746	-1.2	±0.6
41047.776	-2.1	±0.4
41048.726	-3.2	0.6
41313.881	-1.7	0.4
41315.930	-0.9	0.4
41341.920	-2.3	0.4
41347.828	-0.7	0.5

HR 3648 = 16 UMa

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39160.937	-47.7	0.4
39277.669	-16.2	0.5
39551.932	-33.8	0.2
39908.841	-36.9	0.6
39909.926	-23.8	0.7
39966.656	+3.1	1.1
40198.062	-50.4	0.3
40199.059	-51.7	0.3
40527.050	-24.4	0.3
40549.989	+15.7	0.4
40613.854	+21.4	0.4
40614.888	+15.2	0.4
40615.846	+10.1	0.6
40638.922	-45.1	0.6
41044.712	-46.4	0.5
41045.733	-37.9	0.5
41046.756	-22.8	0.4
41047.786	-11.8	0.5
41048.736	-1.8	0.5
41313.889	+12.0	0.4
41315.937	-14.7	0.4

HR 3750

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39903.813	+52.1	0.4
39908.862	+56.2	0.6
39909.960	+54.4	0.7
40550.000	+57.8	0.3
40577.983	+59.3	0.6
40578.959	+57.9	0.6
40579.926	+60.0	0.6
40613.876	+58.3	0.6
40614.933	+55.9	0.5
40615.874	+57.0	0.6
41044.729	+56.5	0.5
41045.748	+54.1	0.4
41046.771	+55.2	0.6
41047.805	+54.7	0.6
41048.751	+56.0	0.6
41315.960	+60.4	0.2
41316.977	+56.1	0.3
41341.795	+58.7	0.4
41347.951	+57.2	0.4
41373.826	+59.0	0.5

HR 3754 = ω Leo

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39908.888	-8.0	0.8
39929.824	-9.1	0.5
40550.012	-7.1	0.4
40577.992	-7.7	0.6
40578.967	-7.8	0.7
40579.937	-6.2	0.6
40613.882	-7.7	0.6
40614.954	-9.5	0.6
40615.883	-9.4	0.5
41044.739	-8.1	0.5
41045.758	-10.0	0.5
41046.793	-8.9	0.4
41047.827	-8.3	±0.3
41048.773	-9.5	±0.4
41315.966	-6.4	0.4
41341.916	-8.9	0.5
41347.967	-8.4	0.5
41373.837	-7.1	0.5
41374.839	-8.9	0.4
41375.884	-9.1	0.5

HR 3759 = τ^1 Hya

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39127.927	+8.9	0.5
39160.952	+11.2	0.8
39277.656	+8.7	0.4
40550.020	+8.9	0.5
40577.998	+12.4	0.8
40578.973	+11.0	1.0
40579.943	+12.5	0.8
40613.885	+12.4	0.6
40615.889	+9.6	0.6
41044.747	+10.5	0.5
41045.766	+9.5	0.8
41046.781	+9.3	0.6
41047.816	+9.1	0.7
41048.763	+9.0	0.8
41315.970	+11.2	0.6
41341.801	+10.6	0.7
41347.959	+9.6	0.5
41371.826	+10.5	1.3
41371.828	+9.2	0.6
41371.830	+10.3	0.9
41373.882	+9.8	0.6
41374.827	+10.4	0.7
41375.869	+9.1	0.6

HR 3771 = 24 UMa

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39929.833	-26.9	0.7
40550.028	-25.5	0.4
40578.004	-24.6	0.6
40578.978	-23.9	0.6
40580.031	-24.2	0.8
40613.858	-24.8	0.4
40614.878	-26.8	0.4
40615.839	-25.2	0.5
40638.934	-27.4	0.5
41044.753	-26.2	0.6
41045.770	-28.6	0.5
41047.837	-27.1	0.3
41048.780	-27.2	0.5
41313.896	-25.9	0.2
41315.941	-24.1	0.4
41341.926	-26.5	0.5
41347.835	-25.7	0.6
41373.945	-25.5	0.5
41374.847	-26.2	0.3
41375.900	-26.2	0.5

HR 3775 = θ UMa

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39160.959	+15.0	0.3
39277.661	+10.8	0.5
39551.868	+15.0	0.2
39929.844	+15.1	0.6
40550.035	+15.0	0.5
40578.008	+16.1	0.7
40578.983	+18.2	0.8
40579.960	+17.2	0.7
40613.863	+17.6	0.5
40614.873	+15.2	±0.5

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40615.822	+17.5	±0.6
41044.762	+15.1	0.6
41045.775	+13.5	0.6
41047.844	+14.5	0.4
41048.788	+14.7	0.6
41313.900	+16.7	0.3
41315.945	+18.0	0.4
41341.950	+16.0	0.6
41347.841	+17.9	0.6
HR 3881		
39160.972	+ 4.2	0.5
39276.705	+ 5.0	0.2
39277.687	+ 1.1	0.4
39551.879	+ 4.7	0.3
40281.783	+ 4.8	0.3
40550.040	+ 6.6	0.3
40578.012	+ 5.7	0.6
40578.988	+ 7.6	0.6
40579.965	+ 6.4	0.6
40613.866	+ 7.3	0.6
40614.869	+ 5.0	0.4
40615.818	+ 6.4	0.6
41044.769	+ 5.7	0.5
41045.780	+ 4.4	0.5
41047.850	+ 4.2	0.4
41048.796	+ 4.9	0.4
41313.905	+ 6.2	0.5
41315.951	+ 7.4	0.4
41341.954	+ 6.4	0.4
41347.848	+ 7.5	0.5
HR 3928 = 19 LMi		
39160.986	+ 5.2	0.9
39551.914	- 4.1	0.3
39929.807	+ 4.9	0.8
40281.798	- 3.2	0.2
40550.048	-11.3	0.5
40578.017	-10.8	0.6
40578.994	- 1.5	0.7
40579.969	+ 7.5	0.6
40613.870	-22.4	0.6
40614.918	-13.5	0.8
40615.859	- 4.3	0.5
41044.778	+ 9.3	0.8
41045.788	+ 4.1	0.9
41047.859	-17.1	0.5
41048.805	-27.0	0.6
41313.912	+10.1	0.6
41315.955	- 2.8	0.4
41341.960	+10.3	0.4
41347.988	-16.7	0.7
41373.941	-27.5	0.7
HR 3991		
40281.811	+13.8	2.8
40550.056	+ 0.2	3.7
40578.021	- 5.0	4.2
40578.999	- 1.9	3.4
40579.975	- 1.0	4.2
40613.889	+ 5.2	3.3
40615.895	+ 6.3	5.3
41044.795	+14.0	2.4
41048.817	+11.1	2.7
41315.973	+12.2	±3.8

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
41341.908	- 6.4	±5.9
41347.975	+18.6	1.2
41372.959	+ 5.7	2.7
41373.899	+ 2.7	3.9
41374.833	+ 5.4	3.5
41375.873	+ 7.7	4.9
41404.767	+16.4	1.8
41440.742	+17.3	1.6
41441.618	+15.2	1.8
HR 4054 = 40 Leo		
39160.999	+ 3.4	0.4
39276.658	+ 5.3	0.3
39290.671	+ 6.6	0.2
39551.894	+ 5.8	0.5
40281.824	+ 5.3	0.5
40550.065	+ 7.1	0.4
40578.028	+ 6.4	0.5
40579.006	+ 7.0	0.7
40579.981	+ 7.7	0.6
40613.909	+ 7.5	0.7
40614.848	+ 7.1	0.5
40615.865	+ 7.4	0.5
41044.804	+ 6.8	0.6
41315.979	+ 8.8	0.6
41341.971	+ 7.4	0.6
41347.983	+ 6.8	0.6
41372.980	+ 4.5	0.4
41373.936	+ 5.8	0.5
41374.845	+ 8.8	0.5
41375.896	+ 7.4	0.6
41404.683	+ 6.3	0.5
HR 4084		
39127.938	+ 3.4	1.7
39161.012	+16.6	3.0
40281.833	+ 4.2	1.4
40578.036	+ 4.6	1.2
40579.012	+ 4.3	1.7
40579.986	+ 5.9	1.6
40613.925	+ 9.5	2.3
40615.940	+ 6.5	1.8
41048.841	+ 5.8	1.6
41313.977	+ 6.5	0.8
41315.996	+ 7.9	1.3
41341.933	+ 9.3	1.6
41347.992	+11.5	1.8
41372.989	+ 5.7	1.4
41373.963	+11.1	1.6
41374.852	+12.2	1.5
41375.906	+11.5	1.8
41404.727	+14.7	1.8
41440.750	+ 7.3	1.5
41441.698	+ 5.4	1.5
HR 4112 = 36 UMa		
39161.026	+ 9.1	0.3
39551.998	+ 8.1	0.1
40281.849	+ 9.3	0.3
40578.043	+ 9.7	0.5
40579.020	+10.7	0.6
40579.993	+10.9	0.6
40613.916	+10.7	0.5
40615.934	+ 9.9	0.6
41044.809	+ 9.5	±0.6

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
41045.795	+ 8.2	±0.6
41047.868	+ 8.3	0.4
41048.852	+ 7.6	0.5
41313.986	+ 8.6	0.3
41316.002	+ 9.8	0.6
41341.943	+ 9.6	0.4
41348.000	+ 9.9	0.5
41372.986	+ 9.7	0.4
41373.959	+10.8	0.6
41374.859	+10.1	0.4
41375.914	+11.2	0.4
HR 4251		
40281.872	- 4.7	0.3
40578.048	- 2.2	0.6
40579.028	- 2.9	0.5
40579.996	- 1.6	0.4
40613.894	- 3.5	0.5
40615.903	- 4.2	0.6
41048.833	- 4.7	0.3
41315.981	- 2.6	0.4
41341.984	- 3.8	0.7
41348.010	- 3.4	0.5
41372.966	- 5.2	0.4
41373.916	- 4.2	0.5
41374.881	- 3.8	0.5
41375.878	- 5.0	0.3
41404.785	- 5.7	0.4
41440.729	- 4.4	0.2
41441.624	- 3.9	0.5
41470.626	- 4.4	0.4
41471.627	- 4.9	0.4
HR 4277 = 47 UMa		
39276.678	+ 9.8	0.2
39551.985	+10.3	0.3
39608.701	+10.7	0.5
39960.810	+ 9.6	0.6
40281.885	+10.9	0.4
40578.058	+11.9	0.5
40579.040	+12.6	0.7
40580.004	+13.7	0.6
40613.913	+12.4	0.5
40615.924	+12.2	0.4
41316.007	+11.9	0.4
41341.964	+14.0	0.2
41348.021	+12.3	0.6
41372.983	+11.3	0.4
41373.955	+12.8	0.4
41374.874	+14.7	0.4
41375.921	+12.4	0.4
41404.700	+11.6	0.2
41440.648	+10.4	0.3
41440.651	+11.4	0.4
41440.654	+11.5	0.4
HR 4395 = λ Crt		
39960.749	+10.6	0.9
39966.727	+10.7	0.6
39987.681	+ 9.7	0.8
40578.062	+14.2	0.8
40579.046	+15.0	0.8
40580.008	+14.4	0.9
40613.898	+13.4	0.7
40615.914	+12.5	±0.7

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40697.741	+13.8	±0.7
41315.986	+20.6	0.8
41341.990	+19.1	0.7
41348.038	+20.6	0.9
41372.972	+18.5	0.9
41373.926	+20.2	0.6
41374.888	+19.5	0.6
41375.891	+19.9	0.7
41404.800	+18.9	0.5
41440.736	+19.9	0.6
41441.632	+20.8	0.6
HR 4399 = ι Leo		
39161.034	-11.6	0.6
39277.698	-16.2	0.3
39551.902	-14.4	0.6
39608.712	-13.3	0.9
39960.713	-13.0	0.9
39966.730	-13.7	0.7
39987.687	-13.9	0.9
40199.065	-12.9	0.6
40578.069	-11.0	0.8
40579.052	-10.5	0.9
40580.014	-10.9	0.9
40613.937	-11.8	0.6
40615.957	-12.0	0.8
40697.747	-12.6	0.8
40968.010	-12.2	0.6
41315.991	- 9.8	0.5
41341.978	-11.4	0.6
41348.045	-11.2	0.6
41372.977	-14.9	0.6
41373.933	- 9.9	0.6
HR 4439		
39960.762	-46.1	0.9
39966.734	-44.6	0.4
39987.691	-46.5	0.3
40578.075	-42.8	0.5
40579.058	-41.3	0.7
40580.019	-41.6	0.6
40613.932	-43.5	0.3
40615.950	-42.5	0.4
40666.875	-44.0	0.6
40667.855	-44.9	0.4
40697.751	-45.1	0.5
40967.055	-43.4	0.7
40968.017	-43.5	0.3
41316.013	-43.3	0.4
41324.051	-44.3	0.2
41341.996	-43.9	0.4
41348.028	-43.3	0.4
41373.971	-43.8	0.6
41374.865	-42.6	0.3
41375.925	-43.7	0.5
41404.714	-45.7	0.3
HR 4540 = β Vir		
39161.040	+ 3.5	0.6
39276.727	+ 3.5	0.3
39277.704	+ 1.2	0.3
39551.907	+ 4.5	0.3
39608.717	+ 3.9	0.4
39929.854	+ 4.9	0.6
39960.722	+ 3.7	±0.6

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error (km sec^{-1})
39966.744	+ 3.0	±0.5
39987.705	+ 2.9	0.4
40579.061	+ 6.4	0.6
40580.022	+ 7.0	0.6
40609.040	+ 5.6	0.4
40613.939	+ 4.8	0.5
40615.960	+ 5.0	0.4
40638.887	+ 6.6	0.6
40666.887	+ 5.0	0.6
40667.835	+ 4.1	0.4
40697.761	+ 4.3	0.4
41025.921	+ 3.1	0.4
41026.937	+ 4.3	0.6
41027.818	+ 3.9	0.5
HR 4753 = 18 Com		
39247.833	-47.7	5.3
39277.714	-58.0	4.3
39290.689	-51.5	3.9
39551.968	-27.0	2.2
39608.725	-32.5	2.9
39960.777	-44.6	3.1
39966.749	-27.6	1.6
39987.712	-43.2	4.9
40373.667	-38.5	2.9
40374.672	-41.8	4.0
40375.670	-23.8	6.8
40613.954	-32.8	3.3
40615.983	-36.0	2.3
40666.897	-41.1	3.3
40667.840	-45.1	3.1
40697.766	-44.1	3.4
41025.928	-43.3	2.7
41026.945	-42.2	3.0
41027.824	-40.1	3.8
41047.881	-40.5	2.7
HR 4785 = β CVn		
39127.914	+ 4.3	0.1
39247.846	+ 5.0	0.3
39277.722	+ 2.4	0.3
39903.953	+ 4.2	0.2
39908.940	+ 7.8	0.7
39909.990	+ 3.8	0.6
39960.730	+ 6.3	0.7
39966.754	+ 4.8	0.3
39987.720	+ 6.6	0.5
40373.671	+ 9.4	0.6
40374.676	+ 8.8	0.4
40375.674	+10.2	0.6
40613.967	+ 7.4	0.4
40615.999	+ 6.7	0.5
40638.891	+ 8.8	0.3
40666.883	+ 7.5	0.6
40667.863	+ 6.7	0.3
40697.771	+ 7.9	0.4
41025.943	+ 6.5	0.3
41026.958	+ 7.0	0.5
41027.832	+ 8.0	0.4
HR 4983 = β Com		
39247.891	+ 4.8	0.3
39277.739	+ 2.1	0.2
39903.983	+ 2.1	0.3
39908.950	+ 6.3	±0.5
39909.997	+ 7.9	±0.8
39960.740	+ 7.1	0.5
39966.764	+ 6.2	0.4
39984.787	+ 3.3	0.5
39987.726	+ 4.7	0.3
40281.917	+ 5.3	0.1
40373.682	+ 9.2	0.4
40374.681	+ 7.9	0.4
40375.681	+ 8.7	0.4
40613.957	+ 6.7	0.4
40615.988	+ 5.5	0.5
40666.902	+ 5.4	0.4
40667.845	+ 5.6	0.2
40697.779	+ 6.5	0.2
41025.937	+ 5.4	0.4
41026.953	+ 5.7	0.4
HR 5011 = 59 Vir		
39247.878	-26.9	0.2
39276.745	-27.9	0.4
39277.749	-30.7	0.4
39290.703	-27.9	0.2
39551.952	-27.3	0.3
39908.962	-25.7	0.7
39910.005	-25.0	0.6
39929.896	-25.6	0.5
39960.804	-29.4	0.7
39966.771	-29.0	0.5
39987.734	-28.6	0.4
40281.928	-27.9	0.2
40373.689	-24.4	0.4
40374.687	-25.8	0.5
40375.702	-24.3	0.7
40613.942	-26.0	0.5
40615.965	-25.9	0.5
40666.907	-27.0	0.6
40667.849	-27.7	0.4
40697.795	-27.3	0.6
41025.954	-27.9	0.5
HR 5185 = τ Boo		
39247.901	-16.4	0.3
39277.758	-18.8	0.3
39908.977	-16.1	0.4
39910.013	-15.8	0.8
39929.902	-15.6	0.6
39966.780	-18.3	0.4
39987.739	-18.8	0.3
40281.938	-16.2	0.2
40371.809	-15.5	0.6
40373.696	-12.5	0.4
40374.691	-14.6	0.5
40375.720	-14.5	0.7
40613.946	-15.1	0.4
40615.971	-14.6	0.4
40666.915	-15.3	0.7
40667.853	-16.5	0.4
40697.835	-17.1	0.5
41025.964	-17.9	0.4
41026.965	-17.1	0.4
41027.840	-16.5	0.5
HR 5235 = η Boo		
39247.907	- 6.0	0.3
39277.766	- 9.7	±0.4
39908.992	- 1.6	±0.7
39910.018	- 3.1	0.8
39929.906	- 1.8	0.6
39966.783	+ 2.2	0.5
39987.743	+ 6.3	0.5
40281.943	- 6.8	0.3
40371.814	- 4.8	0.6
40373.698	- 1.7	0.4
40374.756	- 4.5	0.6
40375.741	- 3.6	0.6
40613.949	+ 3.1	0.5
40615.975	+ 2.8	0.5
40666.918	- 0.7	0.5
40667.867	- 1.7	0.4
40697.838	- 4.6	0.5
41025.968	+ 8.3	0.4
41026.969	+ 9.2	0.7
41027.845	+10.0	0.4
HR 5304 = 12d Boo		
39247.915	-33.8	0.5
	+46.9	2.6
39277.772	-53.9	0.5
	+62.3	2.2
39317.707	-43.3	0.9
	+56.6	0.8
39909.003	+11.9	0.7
39910.025	-13.5	1.1
	+32.8	1.6
39929.914	-32.0	0.9
	+52.0	2.7
39966.786	+ 7.8	0.3
39984.755	+46.1	0.8
	-32.0	2.0
39987.746	-39.5	0.6
	+56.1	1.4
40281.953	+64.4	0.4
	-43.7	1.0
40373.702	-48.1	0.8
	+73.6	1.0
40374.759	-13.4	1.1
	+35.5	1.2
40375.747	+46.0	1.4
	-27.1	2.0
40613.960	-46.0	0.8
	+71.7	1.1
40615.993	+53.6	0.8
	-32.1	1.6
40666.921	+42.6	1.0
	-24.4	1.5
40667.870	+ 9.4	0.4
40695.845	+37.0	0.9
	-20.5	2.0
40697.842	-22.8	0.9
	+39.4	1.9
41025.973	-52.5	0.8
	+69.4	1.6
HR 5323 = 14 Boo		
39247.936	-40.5	0.3
39277.787	-43.3	0.3
39317.723	-43.3	0.6
39909.017	-37.4	0.7
39910.034	-39.9	0.7
39929.922	-40.2	±0.4
39960.821	-41.5	±0.6
39966.794	-42.3	0.4
39984.768	-42.9	0.5
39987.754	-43.2	0.3
40052.637	-41.4	0.8
40281.969	-39.2	0.3
40373.708	-37.0	0.4
40374.767	-38.8	0.5
40375.764	-37.3	0.4
40613.971	-39.0	0.6
40616.006	-38.3	0.4
40666.927	-37.3	0.5
40667.876	-40.0	0.3
40697.850	-40.4	0.6
HR 5338 = ι Vir		
39247.950	+14.0	0.4
39277.797	+11.1	0.2
39909.034	+13.2	0.6
39910.048	+16.9	0.7
39929.930	+14.3	0.7
39966.856	+12.5	0.5
39987.761	+11.6	0.6
40052.644	+13.0	0.8
40281.979	+12.7	0.3
40373.715	+17.2	0.5
40374.774	+15.4	0.6
40613.976	+13.4	0.5
40616.014	+13.3	0.6
40666.931	+15.9	0.6
40667.881	+14.0	0.4
40695.851	+13.5	0.5
40695.853	+15.1	0.6
40695.856	+14.2	0.7
40695.859	+15.2	0.7
40697.857	+13.9	0.7
HR 5365 = 18 Boo		
39247.961	+ 1.9	1.3
39277.814	- 2.4	0.5
39929.937	+ 0.3	1.0
39960.833	- 2.0	1.0
39966.860	- 2.0	0.9
39984.781	- 3.7	0.6
39987.765	- 0.2	0.9
40052.648	+ 2.9	1.0
40281.987	- 1.9	0.9
40373.730	+ 1.2	1.0
40613.981	- 0.5	0.9
40616.022	+ 1.3	1.0
40666.935	+ 2.6	1.0
40667.886	- 2.4	1.2
40697.871	+ 0.5	1.2
40753.671	+ 2.6	0.9
40758.628	+ 1.9	0.8
40759.633	+ 2.2	0.9
41025.983	- 5.2	1.3
41026.975	- 2.2	1.0
HR 5404 = θ Boo		
39277.823	-13.9	0.6
39929.947	-11.3	0.8
39966.866	-12.5	0.6
39984.789	-13.7	0.2
39987.767	-10.7	±0.4

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Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
40052.651	-11.6	±0.5
40281.999	-10.5	0.5
40373.719	-12.1	0.8
40666.941	- 8.4	0.7
40667.895	-12.7	0.7
40697.873	-10.1	0.7
40702.916	-10.4	0.6
40753.692	- 9.9	0.7
40758.660	- 9.9	0.7
40759.680	-10.4	0.8
41025.995	-12.4	0.5
41026.988	-11.7	0.6
41027.855	-11.6	0.6
41047.886	-11.4	0.6
41048.860	-13.9	0.6

HR 5447 = σ Boo

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39277.831	- 2.8	0.4
39929.952	- 0.3	0.6
39966.872	- 1.3	0.6
39984.773	- 1.8	0.4
39987.772	- 0.2	0.6
40052.657	- 0.1	0.8
40282.007	- 0.4	0.4
40373.724	+ 1.1	0.4
40666.938	+ 2.7	0.7
40667.892	- 1.7	0.4
40697.880	+ 1.2	0.5
40702.922	+ 1.5	0.6
40753.687	+ 1.4	0.5
40758.655	+ 2.2	0.5
40759.677	+ 1.5	0.7
41025.991	- 0.9	0.4
41026.983	- 0.5	0.6
41027.850	+ 0.8	0.4
41047.892	+ 0.3	0.6
41048.866	- 1.1	0.7
41078.755	+ 3.0	0.8
41085.723	+ 1.6	0.4

HR 5487 = μ Vir

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39277.842	+ 5.4	1.2
39909.040	+ 4.7	1.4
39910.053	+ 4.9	1.4
39929.957	+ 3.5	1.7
39966.877	+ 2.2	1.1
39987.777	+ 4.3	1.5
40052.662	+ 9.3	1.3
40282.013	+ 2.0	1.5
40373.736	+ 7.7	1.4
40613.985	+ 3.4	1.3
40616.028	+ 2.8	1.6
40666.961	+ 2.7	1.3
40667.910	+ 2.9	1.2
40697.884	+ 4.3	1.5
40753.677	+ 9.4	1.4
40758.634	+ 9.6	0.9
40759.638	+ 7.1	1.0
41026.003	- 5.2	2.4
41026.994	+ 0.7	1.5
41027.861	+ 0.5	1.6
41047.898	- 0.4	1.7

HR 5530 = α[1] Lib

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39929.967	-21.2	0.5
39960.865	-24.6	±0.6
39966.882	-25.2	±0.5
39984.801	-25.1	0.3
39987.797	-25.4	0.6
40052.668	-23.9	0.6
40282.046	-23.5	0.4
40373.744	-25.7	0.5
40613.990	-22.1	0.5
40616.043	-23.0	0.5
40666.968	-23.1	0.5
40667.915	-24.4	0.4
40697.892	-25.1	0.4
40753.684	-24.8	0.4
40758.638	-24.2	0.4
40759.659	-24.9	0.6
41026.011	-26.9	0.6
41027.000	-25.1	0.5
41027.913	-27.2	0.4
41047.906	-26.0	0.6

HR 5618 = 44i Boo

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39929.979	-29.9	0.5
39966.889	-29.1	0.5
39987.781	-28.5	0.4
40050.632	-30.6	0.6
40373.751	-30.5	0.5
40666.945	-26.8	0.3
40667.936	-30.1	0.4
40697.895	-30.3	0.5
40702.928	-29.1	0.7
40753.689	-29.9	0.4
40758.657	-30.8	0.5
40759.683	-29.6	0.4
41027.876	-30.8	0.3
41047.917	-30.8	0.5
41048.873	-30.6	0.3
41078.763	-29.6	0.4
41085.736	-29.2	0.5
41086.764	-31.0	0.4
41102.696	-30.2	0.4
41103.697	-30.0	0.2

HR 5634 = 45 Boo

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39277.854	-11.3	1.6
39966.898	-12.6	1.2
39987.789	-10.2	1.5
40050.642	- 7.7	1.6
40373.766	-10.8	1.1
40666.973	-11.4	1.1
40667.953	-11.8	0.9
40753.703	- 7.3	0.8
40758.653	- 9.1	0.5
40759.689	- 8.9	0.5
41026.022	-11.9	1.1
41027.007	-11.0	1.1
41027.868	-13.5	0.4
41047.927	-12.8	1.1
41048.882	-10.6	1.2
41078.772	- 9.8	1.5
41085.729	- 7.7	1.1
41086.794	-12.2	0.7
41102.708	-10.8	0.9
41103.707	- 5.9	1.1

HR 5691

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39277.864	-51.4	0.3
49609.824	-48.3	±0.4
39960.871	-49.0	±0.7
39966.901	-49.3	0.4
40050.651	-49.3	0.6
40373.757	-49.1	0.5
40666.951	-46.0	0.5
40667.944	-47.0	0.4
40753.695	-47.5	0.6
40758.665	-48.1	0.4
40759.690	-49.6	0.4
41027.884	-49.1	0.4
41047.932	-49.5	0.3
41048.943	-49.8	0.6
41078.777	-48.8	0.4
41085.742	-48.0	0.5
41086.779	-48.9	0.6
41102.699	-48.5	0.4
41103.700	-48.1	0.4

HR 5694 = 5 Ser

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39966.911	+52.6	0.4
39987.808	+52.7	0.5
40049.704	+53.7	0.9
40050.662	+52.9	0.7
40373.774	+52.4	0.5
40666.978	+56.4	0.3
40667.920	+55.1	0.4
40753.708	+56.1	0.4
40758.648	+54.6	0.1
40759.699	+53.6	0.4
41027.930	+54.8	0.4
41047.946	+53.7	0.5
41048.892	+54.0	0.4
41085.755	+54.4	0.3
41086.804	+54.0	0.4
41102.713	+53.3	0.5
41103.714	+54.8	0.6
41193.667	+54.4	0.4
41234.576	+53.5	0.4
41324.068	+54.8	0.2

HR 5723 = ε Lib

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39966.917	- 4.4	0.4
39987.814	+ 4.6	0.6
40049.710	-10.3	0.8
40050.669	-11.7	0.8
40373.832	-11.4	0.5
40666.982	+ 8.3	0.5
40667.926	+ 7.3	0.5
40753.715	-10.9	0.5
40758.644	-12.3	0.5
40759.707	-13.8	0.6
41027.938	-14.6	0.3
41047.953	-16.2	0.5
41048.901	-15.0	0.5
41085.764	-12.3	0.7
41086.813	-12.2	0.6
41102.718	- 0.3	0.4
41103.718	+ 1.8	0.5
41193.658	-10.0	0.4
41233.571	-14.6	0.5
41234.561	-14.7	0.2

HR 5868 = λ Ser

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39904.029	-69.8	0.3
39966.922	-69.3	0.4
39987.825	-68.0	±0.4
40049.717	-68.8	±0.8
40050.674	-68.4	0.4
40373.838	-64.1	0.5
40375.738	-63.8	0.2
40666.987	-65.8	0.4
40667.930	-66.5	0.4
40753.711	-64.5	0.3
40758.652	-66.0	0.4
40759.714	-67.1	0.2
41027.922	-67.0	0.5
41047.960	-67.3	0.5
41048.920	-66.6	0.4
41085.769	-67.5	0.4
41086.819	-67.5	0.6
41102.723	-67.3	0.3
41103.722	-66.6	0.4
41176.631	-67.5	0.5

HR 5914 = χ Her

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39609.840	-56.7	0.4
39987.816	-56.9	0.6
40049.722	-58.4	0.9
40050.677	-57.2	0.7
40373.861	-54.1	0.5
40758.671	-56.0	0.5
40759.728	-56.5	0.4
41027.895	-56.7	0.4
41047.964	-58.4	0.6
41048.961	-56.8	0.3
41078.877	-57.6	0.6
41085.777	-57.4	0.4
41086.852	-55.8	0.5
41102.724	-55.6	0.3
41103.731	-55.6	0.2
41176.636	-56.4	0.6
41193.684	-55.0	0.4
41233.624	-56.5	0.6

HR 5933 = γ Ser

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39609.851	+ 5.0	0.4
39987.830	+ 4.9	0.5
40049.728	+ 4.8	0.5
40050.690	+ 5.7	0.6
40282.055	+ 6.4	0.4
40666.990	+ 6.9	0.5
40667.956	+ 6.6	0.4
40753.726	+ 7.8	0.4
40758.675	+ 8.3	0.3
40759.718	+ 6.3	0.5
41027.906	+ 5.6	0.5
41047.971	+ 5.9	0.5
41048.926	+ 5.0	0.4
41085.774	+ 6.3	0.4
41086.839	+ 6.0	0.6
41102.729	+ 6.9	0.5
41103.724	+ 5.8	0.5

HR 5954 = 49 Lib

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error
39960.895	-21.9	0.6
39987.855	-23.8	0.5
40050.696	-23.0	0.8
40052.681	-21.4	0.8
40373.849	-21.0	0.7
40667.962	-17.4	0.4
40666.995	-17.1	0.5
40753.723	-16.2	±0.5

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40758.711	-15.7	±0.2
40759.725	-17.6	0.5
41027.947	-18.3	0.4
41047.979	-19.3	0.5
41048.910	-18.8	0.4
41085.846	-20.6	0.5
41086.830	-21.0	0.5
41102.735	-19.5	0.5
41103.729	-20.6	0.4
41193.615	-21.4	0.4
41233.589	-22.8	0.4
41234.568	-23.5	0.2
HR 5968 = ρ CrB		
39609.862	+16.3	0.4
39960.936	+17.6	0.7
39987.882	+17.6	0.4
40049.737	+15.9	0.6
40050.707	+18.3	0.5
40052.690	+19.3	0.8
40373.856	+20.4	0.6
40667.007	+19.2	0.4
40667.994	+17.5	0.3
40753.728	+18.5	0.3
40758.679	+19.0	0.3
40759.733	+18.3	0.4
41027.958	+18.0	0.3
41047.990	+17.8	0.5
41048.934	+17.6	0.6
41078.888	+17.3	0.6
41085.787	+18.4	0.4
41086.845	+18.9	0.5
41102.739	+19.4	0.3
41103.738	+19.4	0.5
HR 5986 = θ Dra		
39277.894	-14.6	0.4
39609.872	-26.8	0.7
40050.713	+15.7	1.3
40052.695	-31.0	0.8
40373.864	+ 7.3	0.9
40697.898	-17.5	0.8
40758.685	-33.3	0.7
40759.735	+ 2.9	0.6
41027.966	+ 3.0	0.4
41047.997	-18.7	0.6
41048.965	+15.2	0.6
41085.793	+17.4	0.6
41086.857	-22.7	0.6
41102.742	-32.5	0.5
41103.739	+ 7.0	0.6
41193.689	+ 9.7	0.2
41233.630	+ 7.4	0.7
41234.613	-32.1	0.4
41235.608	- 3.6	0.8
41324.052	-29.9	0.5
HR 6091		
39277.907	-42.6	2.3
39609.886	-34.9	2.3
40049.746	-32.9	3.3
40050.719	-43.6	2.6
40052.703	-34.8	3.1
40373.871	-37.7	2.6
40432.635	-31.3	3.6
40433.637	-40.8	±1.5

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40697.904	-30.7	±2.2
40758.683	-37.8	2.1
40759.743	-33.0	1.5
41027.973	-34.4	1.4
41048.006	-33.4	1.9
41048.973	-32.1	2.2
41078.866	-35.3	2.1
41085.804	-32.4	2.0
41086.866	-34.3	2.6
41102.751	-31.8	2.2
41103.745	-33.9	2.4
HR 6212 = ζ Her		
39988.980	-75.1	0.6
40050.727	-75.0	0.6
40052.709	-73.9	0.7
40373.876	-72.5	0.6
40432.642	-74.3	0.5
40433.647	-75.1	0.4
40697.908	-75.6	0.3
40758.677	-74.2	0.4
40759.807	-74.7	0.4
41027.981	-73.2	0.3
41048.013	-75.1	0.4
41048.978	-76.6	0.4
41085.915	-75.5	0.3
41086.874	-73.9	0.6
41102.756	-74.6	0.4
41103.750	-73.0	0.5
41168.742	-74.2	0.4
41193.694	-73.0	0.3
41233.619	-75.2	0.5
41234.599	-74.6	0.6
41324.040	-74.4	0.4
41470.802	-74.2	0.4
HR 6243 = 20 Oph		
39988.988	- 0.3	0.9
40050.735	+ 2.4	0.8
40051.725	+ 2.9	0.8
40373.888	+ 3.9	0.7
40432.650	+ 1.0	0.5
40433.656	+ 0.3	0.5
40697.913	- 0.5	0.7
40758.707	- 0.3	0.5
40759.814	- 1.5	0.6
41028.021	- 2.3	0.4
41048.017	- 2.8	0.5
41048.983	- 4.4	0.5
41085.836	- 2.9	0.7
41086.880	- 2.0	0.7
41102.762	- 2.3	0.5
41103.755	- 1.0	0.6
41193.676	- 1.2	0.6
41233.609	- 1.5	0.4
41234.583	- 2.4	0.5
41235.568	- 1.7	0.7
HR 6315 = 19 Dra		
39988.990	- 2.7	0.8
40051.631	-23.9	0.7
40052.713	-25.5	0.6
40373.902	-31.6	0.5
40432.655	-34.7	0.2
40433.664	-36.3	0.4
40697.916	-31.9	±0.5

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40758.688	-16.6	±0.6
40759.746	-14.1	0.3
41028.042	- 1.6	0.4
41048.023	-31.2	0.2
41048.951	-33.5	0.3
41085.820	- 7.4	0.4
41086.908	- 8.7	0.4
41102.813	-32.7	0.4
41103.801	-33.2	0.3
41168.750	-30.4	0.4
41193.708	-15.0	0.2
41233.636	- 2.9	0.3
41234.617	- 1.1	0.5
HR 6458 = 72 Her		
40051.646	-79.1	0.8
40052.726	-79.6	0.7
40373.912	-77.2	0.4
40432.667	-78.6	0.4
40433.685	-78.9	0.4
40697.923	-78.3	0.5
40768.696	-76.5	0.3
40759.801	-78.4	0.4
41028.032	-79.3	0.6
41085.874	-78.1	0.4
41086.890	-76.2	0.3
41102.769	-79.1	0.3
41103.760	-76.1	0.6
41201.609	-77.1	0.2
41202.611	-78.7	0.4
41203.619	-78.5	0.7
41204.598	-78.4	0.3
41233.645	-79.6	0.4
41234.603	-79.6	0.9
HR 6493		
39277.920	- 0.1	0.8
39989.002	- 1.6	1.3
40051.659	+ 0.9	2.0
40373.894	+10.1	1.2
40432.675	+11.0	1.1
40433.699	+ 1.4	0.5
40697.929	- 0.8	1.4
40758.704	-20.6	1.5
	+24.5	1.6
40759.821	-22.5	1.8
	+17.8	0.7
41028.024	+ 2.0	0.7
41048.989	- 9.9	2.0
41085.856	+55.7	0.4
	-58.0	0.7
41086.885	+69.1	0.9
	-71.5	2.9
41102.766	- 5.4	1.8
41103.758	- 0.4	1.6
41201.676	-24.0	1.0
	+18.0	2.8
41202.724	-26.7	1.8
	+17.6	2.7
41204.655	-24.8	3.2
	+17.4	3.2
41233.615	- 2.1	0.6
41234.587	+ 1.9	1.0
HR 6573 = 26 Dra		
40051.663	-18.5	±0.8

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40370.950	-17.3	±0.6
4-406.840	-17.0	0.4
40432.680	-16.6	0.4
40433.710	-17.3	0.4
40697.939	-17.6	0.4
40758.723	-17.1	0.5
40759.828	-17.8	0.6
41085.889	-16.2	0.5
41086.916	-16.5	0.3
41102.819	-17.5	0.4
41103.806	-17.4	0.6
41201.625	-16.3	0.4
41202.632	-18.2	0.3
41203.642	-17.1	0.4
41204.608	-16.3	0.3
41233.742	-17.0	0.5
41234.623	-16.8	0.5
41235.600	-17.4	0.5
41324.057	-17.2	0.3
HR 6594		
39277.931	-43.2	0.5
39960.944	-40.8	1.2
40051.673	-42.5	1.1
40370.961	-39.0	0.6
40373.899	-37.3	1.0
40432.693	-40.6	0.8
40433.724	-41.1	0.9
40697.933	-39.7	1.0
40758.719	-40.2	0.7
40759.825	-40.6	0.9
41049.021	-40.1	1.0
41085.864	-39.2	0.6
41086.903	-39.1	0.7
41103.855	-37.1	1.2
41201.668	-39.8	1.3
41202.714	-42.5	0.8
41204.648	-41.6	0.8
41233.660	-42.0	1.2
41234.592	-40.3	0.9
HR 6596 = ω Dra		
40051.676	+18.4	1.3
	-57.3	2.3
40370.962	-43.3	0.8
40406.847	- 3.8	0.5
40429.708	-49.7	0.8
40432.699	+16.3	0.7
	-53.5	2.2
40433.733	-20.9	0.6
40697.945	-29.4	0.9
40758.731	+ 3.6	0.8
40759.833	+20.5	0.6
	-56.4	2.3
41085.905	- 3.4	0.7
41086.923	+22.9	0.7
	-55.9	2.4
41102.823	+22.6	1.0
	-56.1	2.6
41103.809	- 8.5	0.6
41201.633	-15.5	0.5
41202.645	+18.3	0.7
	-54.9	2.7
41203.655	+12.0	0.6
	-54.1	3.5
41204.616	-21.2	±0.7

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. (km sec^{-1})	Prob. Error (km sec^{-1})
41233.751	- 3.1	±0.8
41234.627	+23.0	0.8
	-59.2	1.9
41235.605	+ 0.3	0.6
HR 6636 = ψ Dra		
40051.683	-13.3	0.7
40370.968	-11.3	0.6
40406.853	-11.3	0.5
40429.717	-10.7	0.7
40430.702	-12.1	0.6
40432.705	-10.4	0.4
40758.737	-10.4	0.5
40759.838	-11.1	0.5
41085.917	-10.8	0.5
41086.928	-10.2	0.5
41102.826	- 9.8	0.6
41103.812	-10.5	0.5
41201.641	-10.6	0.6
41202.654	-10.3	0.6
41204.622	-11.1	0.5
41233.757	- 9.6	0.7
41234.631	-10.6	0.5
41235.614	-10.2	0.4
41324.063	-12.0	0.5
HR 6701 = 35 Dra		
40051.691	-24.4	0.8
40370.974	-25.2	0.5
40406.861	-24.3	0.4
40429.726	-25.3	0.6
40430.712	-24.3	0.5
40432.712	-25.1	0.5
40758.743	-25.1	0.6
40759.843	-26.3	0.5
41085.928	-25.7	0.6
41086.933	-25.5	0.5
41102.831	-24.1	0.6
41103.817	-24.9	0.4
41201.649	-25.6	0.5
41202.664	-25.2	0.4
41204.629	-24.4	0.3
41233.764	-24.6	0.6
41234.636	-25.4	0.5
41235.620	-24.5	0.6
41324.067	-25.8	0.4
41404.991	-25.3	0.3
HR 6710 = ζ Ser		
39277.943	-52.5	1.7
40051.705	-58.0	1.5
40370.987	-53.5	1.6
40429.703	-51.5	2.0
40430.729	-58.0	1.7
40432.726	-52.1	2.3
40758.716	-51.6	1.8
41087.001	-51.8	1.5
41103.860	-49.1	2.1
41233.676	-58.5	2.1
41234.597	-57.9	2.0
41235.566	-50.1	3.9
41405.029	-50.2	1.2
41440.978	-52.6	2.1
41469.867	-52.8	1.7
41470.853	-51.1	2.2
41471.872	-53.3	±1.7
41491.810	-54.0	±1.9
HR 6775 = 99 Her		
39277.951	- 2.1	0.5
40051.709	+ 1.7	0.8
40429.740	- 0.1	0.4
40430.736	+ 1.1	0.7
40432.732	+ 1.6	0.3
40758.722	+ 1.9	0.3
40759.861	+ 0.5	0.4
41102.847	+ 0.7	0.3
41103.837	+ 1.8	0.4
41201.660	+ 1.8	0.4
41202.701	+ 1.0	0.5
41204.639	+ 1.6	0.6
41233.716	+ 1.9	0.4
41234.609	+ 2.0	0.5
41235.594	+ 1.7	0.4
41405.014	- 0.1	0.3
41440.936	- 1.3	0.4
HR 6850 = 36 Dra		
39277.978	-38.3	0.6
40051.714	-36.6	0.8
40406.874	-35.5	0.4
40429.746	-35.0	0.4
40430.744	-37.1	0.6
40432.737	-35.5	0.5
40758.727	-36.1	0.5
40759.896	-35.9	0.4
40872.561	-37.1	0.3
40873.560	-37.0	0.5
40874.566	-36.2	0.6
41085.944	-37.8	1.1
41102.839	-35.4	0.6
41103.827	-36.5	0.5
41169.858	-35.0	0.4
41233.771	-34.6	0.4
41234.640	-36.1	0.5
41235.625	-35.2	0.5
41405.004	-35.4	0.4
41440.920	-37.3	0.4
HR 6927 = χ Dra		
40050.841	+44.7	0.4
40429.756	+15.0	0.3
40432.743	+16.2	0.4
40698.007	+13.3	0.5
40758.739	+28.8	0.4
40759.901	+27.5	0.7
40872.570	+43.4	0.4
40873.565	+44.2	0.4
40874.579	+41.8	0.4
41102.835	+37.5	0.4
41103.822	+38.9	0.2
41169.862	+46.3	0.3
41233.779	+24.0	0.5
41234.645	+23.3	0.6
41235.630	+23.1	0.6
41404.997	+42.2	0.2
41440.915	+44.5	0.4
41469.882	+46.3	0.4
41470.867	+47.0	0.3
HR 6985		
40050.855	-22.0	±1.8
40429.766	-23.3	±0.6
40432.753	-23.8	0.6
40484.588	-18.5	1.0
40752.953	-18.3	1.1
40758.761	-21.0	0.5
40759.878	-29.2	0.8
40872.609	-30.0	1.5
40873.588	-21.1	0.6
40874.604	-18.5	0.7
41103.863	-21.3	0.8
41233.688	-21.9	0.4
41234.651	-24.5	1.1
41235.583	-11.8	1.2
41440.969	-25.6	1.0
41469.871	-18.7	0.7
41470.857	-26.0	1.6
41471.876	-22.0	0.4
41491.814	-25.4	0.5
HR 6987		
40050.864	-39.0	2.5
40432.762	-39.1	2.4
40484.599	-47.1	4.4
40752.960	-34.5	2.1
40758.767	-31.5	1.8
40759.884	-35.8	1.6
40872.602	-34.8	2.1
40873.581	-41.3	3.5
40874.598	-37.5	4.3
41103.868	-31.9	2.6
41233.702	-29.5	4.2
41234.657	-32.2	3.4
41235.576	-35.0	2.4
41440.973	-32.4	2.0
41469.877	-32.6	2.1
41470.862	-33.3	2.2
41471.883	-34.6	2.2
41491.820	-34.2	2.8
41492.899	-36.5	2.8
HR 7001 = α Lyr		
39317.947	-10.0	2.3
39609.988	-15.6	0.9
39609.989	-14.1	0.7
39987.891	-14.0	0.6
40282.022	-12.7	0.5
41103.878	-13.4	1.1
41169.852	-13.8	0.6
41169.855	-12.6	0.6
41234.647	-12.0	0.5
41525.778	-15.6	0.9
41525.780	-14.2	0.7
41525.783	-13.9	1.0
41525.785	-14.6	0.7
41525.860	-13.2	1.4
41525.863	-11.8	0.3
41551.786	-13.8	0.6
41551.789	-11.8	0.2
41552.737	-14.9	0.6
41552.740	-14.5	1.4
41553.784	-13.7	1.1
41553.787	-14.1	1.0
HR 7061 = 110 Her		
39219.763	+19.1	0.7
40050.870	+22.5	±0.8
40432.768	+23.8	±0.8
40484.608	+23.7	0.6
40752.965	+24.2	0.6
40758.752	+24.0	0.6
40759.888	+22.0	0.4
40872.622	+23.1	0.6
40873.602	+23.7	0.5
40874.614	+22.3	0.6
41103.876	+25.7	0.6
41197.659	+24.6	0.5
41233.725	+22.3	0.4
41234.662	+24.4	0.4
41235.592	+23.7	0.5
41405.022	+22.2	0.4
41440.946	+23.7	0.6
41441.844	+22.3	0.6
HR 7172 = 11 Aql		
40050.878	+14.2	0.9
40432.776	+14.8	0.5
40484.617	+16.2	0.7
40752.971	+13.6	0.6
40758.756	+15.1	0.8
40759.893	+13.3	0.3
40872.617	+14.3	0.6
40873.596	+15.3	0.6
40874.610	+14.3	0.4
41103.872	+16.5	0.8
41197.671	+15.6	0.3
41201.686	+15.5	0.8
41202.734	+13.9	0.7
41204.664	+15.7	0.7
41233.732	+13.6	0.6
41234.667	+16.0	0.6
41235.588	+16.1	0.5
41440.951	+15.2	0.7
41469.882	+14.8	0.6
HR 7261 = 17 Lyr		
39317.941	-29.8	2.5
39609.980	-27.3	2.4
40050.884	-44.0	3.0
40484.631	-55.7	5.4
40752.975	-37.4	5.0
40758.804	-37.4	4.4
40759.909	-37.8	2.9
40872.593	-49.9	4.7
40873.576	-46.9	4.6
40874.592	-44.7	3.7
41103.889	-23.5	2.6
41169.875	-46.7	3.8
41197.685	-18.0	1.4
41201.697	-28.7	2.6
41204.672	-34.1	4.6
41234.673	-22.4	1.8
41235.637	-23.7	1.8
41405.036	-26.8	4.6
HR 7441 = 9 Cyg		
39317.955	-19.4	0.8
40050.890	-21.1	0.8
40197.538	-17.6	0.6
40198.540	-17.5	0.5
40484.646	-11.9	0.5
40752.979	-12.6	0.8
40758.770	- 9.5	±0.6

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Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})	
40759.918	-11.8	±0.8
40872.629	-9.0	0.6
40873.609	-6.2	0.7
40874.620	-8.3	0.4
41103.882	-13.4	0.9
41175.797	-48.5	0.9
41197.765	-46.3	0.7
41197.781	-45.9	0.7
41204.692	-43.3	1.2
41234.691	-38.6	0.8
41235.643	-37.2	0.8
41440.940	-25.1	0.8
HR 7469 = θ Cyg		
39068.604	-27.0	0.3
39317.962	-31.8	0.8
39319.775	-29.7	0.5
40051.730	-29.3	0.6
40197.545	-28.1	0.5
40198.548	-27.8	0.6
40484.655	-27.7	0.4
40758.812	-27.1	0.4
40759.912	-27.0	0.6
40872.588	-27.8	0.2
40873.572	-27.1	0.5
40874.586	-27.5	0.5
41102.898	-27.8	0.6
41103.890	-27.2	0.5
41175.805	-24.8	0.5
41197.695	-27.7	0.3
41204.699	-26.8	0.5
41234.696	-26.8	0.5
41235.633	-26.9	0.5
41440.924	-28.0	0.5
41469.887	-27.9	0.4
HR 7496		
40052.740	+14.3	0.8
40197.552	+14.9	0.5
40198.554	+14.6	0.6
40484.671	+17.9	0.4
40758.860	+17.0	0.5
40872.639	+19.2	0.4
40873.630	+20.5	0.5
40874.627	+19.5	0.5
41102.931	+16.1	0.7
41103.917	+14.6	0.4
41204.710	+16.2	0.5
41234.681	+15.8	0.4
41235.666	+16.8	0.5
41440.982	+13.7	0.5
41469.901	+14.2	0.6
41470.886	+14.2	0.4
41471.891	+14.2	0.4
41491.825	+15.2	0.4
41492.905	+15.6	0.4
HR 7534 = 17 Cyg		
39068.593	+6.9	0.2
39317.972	+0.9	0.6
40051.830	+5.4	0.7
40197.564	+4.2	0.5
40198.568	+2.6	0.3
40484.687	+5.3	0.5
40758.808	+5.3	0.4
40759.945	+3.9	±0.5
40872.657	+5.0	±0.6
40873.653	+5.5	0.4
40874.641	+5.2	0.5
41102.904	+4.0	0.4
41103.895	+4.1	0.4
41175.814	+6.4	0.6
41204.718	+5.7	0.5
41234.701	+4.9	0.5
41235.649	+6.9	0.5
41440.929	+2.9	0.4
41469.892	+4.6	0.6
41470.865	+5.3	0.5
41471.864	+3.2	0.5
HR 7560 = ο Aql		
39068.580	+4.9	0.4
40051.839	-0.8	1.0
40197.569	-0.4	0.4
40198.574	-1.0	0.2
40433.802	-0.1	0.4
40484.698	+1.2	0.4
40758.831	-0.4	0.4
40759.926	-0.6	0.4
40872.650	+1.3	0.5
40873.644	+1.1	0.5
40874.635	+0.4	0.4
41102.923	+0.4	0.4
41103.911	-1.3	0.3
41204.727	-0.2	0.7
41234.707	-0.5	0.6
41235.655	+1.6	0.4
41440.955	-1.0	0.6
41469.934	+1.0	0.4
41470.877	+1.7	0.5
41471.898	-0.4	0.4
HR 7882 = β Del		
40051.842	-27.8	1.0
40052.796	-25.3	1.3
40197.584	-26.0	1.4
40429.805	-24.4	1.4
40432.814	-24.6	1.1
40433.809	-25.0	1.1
40484.707	-24.1	2.2
40486.678	-22.6	1.3
40758.826	-22.9	1.2
40759.935	-22.9	1.0
40872.663	-20.6	1.6
40873.661	-20.3	1.4
40874.646	-20.5	1.5
41102.918	-20.5	1.0
41103.902	-21.5	1.5
41197.703	-23.2	1.0
41204.733	-21.9	2.2
41234.713	-21.8	1.0
41235.723	-22.8	0.9
41469.937	-20.9	1.0
41581.708	-22.5	1.6
HR 7947 = γ^1 Del		
40051.848	-8.5	1.3
40052.753	-7.7	0.9
40197.591	-4.5	0.4
40198.597	-7.2	0.6
40433.816	-8.4	0.4
40484.717	-5.4	±0.5
40486.683	-5.2	±0.6
40518.590	-6.9	0.4
40519.564	-7.8	0.6
40758.821	-5.9	0.3
40759.939	-8.4	0.4
41102.909	-7.7	0.4
41103.906	-7.5	0.4
41204.740	-6.5	0.6
41234.722	-6.5	0.4
41235.727	-7.0	0.4
41469.941	-6.4	0.4
41470.907	-6.8	0.3
41471.903	-7.3	0.3
41491.832	-7.8	0.4
HR 7955		
39068.612	-32.7	0.4
40197.600	-32.1	0.5
40198.606	-32.9	0.6
40429.812	-34.3	0.5
40484.728	-32.3	0.4
40486.690	-31.6	0.5
40518.613	-32.9	0.3
40519.572	-33.8	0.3
40758.900	-31.4	0.5
40759.947	-32.3	0.6
41102.941	-31.4	0.5
41103.928	-32.2	0.4
41175.826	-30.7	0.5
41197.709	-30.0	0.5
41204.745	-32.5	0.4
41234.771	-33.7	0.4
41235.699	-31.9	0.3
41469.967	-33.3	0.4
41470.921	-31.6	0.5
HR 8034 = 1 Equ		
40051.866	-6.6	1.9
40197.610	+17.0	1.2
40198.617	-1.9	1.4
40484.742	+1.9	1.3
40486.702	-4.3	2.1
40518.620	+14.6	1.1
40519.583	-1.9	1.5
40758.846	-9.5	1.5
40759.957	+14.4	2.0
40817.845	-3.6	1.6
40844.762	+4.0	0.8
41103.844	+7.0	1.1
41204.754	+19.9	1.1
41234.729	+7.0	0.9
41235.680	+18.9	0.9
41469.987	-8.6	1.4
41470.914	+32.1	1.7
41471.910	-14.9	1.7
41491.838	+0.6	1.4
41492.910	+9.7	1.6
41525.844	+28.0	3.9
41581.724	-6.0	3.4
41589.722	-2.0	2.7
HR 8034C		
41581.730	+13.5	0.6
41589.730	+14.8	±0.6
HR 8123 = δ Equ		
40051.873	-13.6	±1.9
40197.618	-15.6	0.4
40198.624	-16.2	0.5
40484.752	-15.0	0.8
40486.710	-14.2	1.0
40518.628	-15.0	1.1
40519.591	-15.6	1.0
40758.840	-16.2	0.4
40759.962	-17.4	0.4
40817.850	-14.8	0.3
41102.977	-15.7	0.4
41103.942	-13.9	0.5
41197.722	-15.7	0.3
41204.763	-17.0	0.6
41234.735	-14.7	0.1
41235.721	-15.7	0.4
41469.948	-15.8	0.3
41470.919	-13.5	0.5
41471.915	-16.7	0.5
41491.843	-16.6	0.5
41580.754	-12.2	0.9
41581.754	-11.9	1.0
HR 8283 = 42 Cap		
40052.769	-26.3	0.6
40197.627	-24.2	0.5
40198.637	-13.4	0.1
40484.764	-11.9	0.3
40486.725	-29.2	0.5
40518.640	+17.4	0.4
40519.609	+19.2	0.5
40758.867	+11.5	0.5
40759.973	+0.8	0.3
40817.855	-10.9	0.4
41102.973	-1.6	0.3
41103.938	-12.9	0.2
41204.771	+17.6	0.4
41234.743	-3.5	0.5
41235.715	-12.7	0.4
41469.956	+15.7	0.3
41470.966	+6.6	0.4
41471.923	-1.8	0.4
41471.986	-2.1	0.3
41491.922	+6.1	0.5
41492.915	+12.3	0.7
HR 8309 = μ^1 Cyg		
40052.778	+18.6	0.7
40197.640	+17.8	0.3
40198.651	+16.7	0.6
40484.778	+17.7	0.5
40518.649	+16.1	0.4
40519.616	+15.5	0.4
40758.891	+17.3	0.5
40759.977	+15.0	0.6
40817.859	+17.3	0.5
40844.838	+17.7	0.6
40872.668	+16.7	0.4
40873.669	+18.5	0.5
40874.651	+17.6	0.3
41102.979	+15.3	0.4
41103.944	+16.5	0.6
41175.852	+18.2	0.6
41197.751	+16.7	0.4
41204.779	+16.2	0.4
41234.766	+17.2	±0.4

Table 1 (continued)

Helio. JD 2400000+	Rad. Vel. &	Prob. Error (km sec^{-1})
41235.736	+16.5	±0.4
41469.963	+15.7	0.5
HR 8315 = κ Peg		
40052.782	-23.2	0.8
40197.645	-31.5	0.7
40198.656	+ 0.2	1.1
40484.787	-18.6	0.6
40518.654	-28.8	0.6
40519.619	-40.5	1.0
40758.871	-32.5	1.2
40759.981	- 3.6	0.6
40817.862	-38.7	1.5
40844.843	+33.0	1.1
	-39.1	2.8
40872.673	-27.5	1.3
40873.674	+ 7.3	1.0
40874.654	+28.9	1.2
	-36.1	3.5
41102.990	- 2.6	0.9
41103.947	-28.8	1.8
41169.931	-35.1	1.7
41175.858	-34.8	1.6
41197.744	+24.0	0.5
	-34.7	3.1
41204.785	-11.5	0.6
41234.770	-15.5	1.0
41235.733	-42.5	1.7
	+ 5.0	3.6
41551.884	-31.2	1.9
41552.813	-32.7	2.0
41553.857	-14.6	1.5
41581.781	-26.1	2.4
HR 8400 = 16 Cep		
40052.786	-20.3	0.8
40197.657	-20.7	0.8
40198.665	-21.1	0.7
40518.664	-22.5	0.6
40519.628	-22.8	0.6
40758.904	-20.9	0.4
40817.861	-20.3	0.6
40872.678	-21.2	0.5
40873.679	-21.9	0.4
40874.657	-21.8	0.6
41197.803	-21.3	0.6
41204.790	-19.8	0.7
41233.785	-21.8	0.6
41234.777	-21.3	0.5
41235.759	-22.2	0.8
41469.970	-22.0	0.6
41470.985	-21.0	0.9
41471.960	-22.5	0.6
41492.930	-22.1	0.8
41525.851	-19.0	0.9
HR 8430 = ι Peg		
39067.655	+11.2	0.9
39068.623	+32.9	0.4
39319.788	-56.1	0.4
40050.897	+41.2	0.7
40197.661	-49.7	0.6
40198.670	-53.2	0.4
40518.673	+27.1	0.4
40519.633	+41.5	±0.4
40758.887	-40.9	±0.5
40759.983	-53.2	0.5
40817.872	+20.2	0.6
40872.686	-52.3	0.6
40873.686	-38.9	0.3
40874.664	-12.1	0.4
41175.864	+ 7.4	0.6
41193.866	+46.5	0.4
41204.803	+43.7	0.5
41233.817	+31.7	0.5
41234.792	+42.8	0.3
41235.739	+39.2	0.4
HR 8455		
40050.907	+20.1	0.7
40197.674	+20.1	0.4
40198.684	+20.8	0.3
40518.683	+19.8	0.4
40519.643	+19.8	0.4
40758.879	+21.7	0.4
40759.992	+20.1	0.4
40817.876	+21.4	0.4
40872.695	+21.0	0.4
40873.696	+18.8	0.4
40874.672	+21.5	0.5
41175.894	+23.5	0.3
41193.880	+23.8	0.3
41204.818	+21.4	0.4
41233.827	+20.7	0.4
41234.806	+21.0	0.4
41235.746	+20.8	0.5
41470.972	+21.8	0.5
41471.935	+20.6	0.5
41491.931	+20.5	0.3
HR 8472		
39068.631	-19.9	0.1
39097.604	-20.9	0.5
40050.920	-20.9	0.6
40197.696	-22.0	0.5
40198.703	-22.2	0.5
40518.696	-21.5	0.4
40519.657	-21.5	0.4
40758.894	-19.6	0.4
40817.867	-21.1	0.6
40872.709	-22.0	0.4
40873.706	-22.0	0.4
40874.682	-21.8	0.5
41175.901	-18.7	0.5
41193.855	-17.6	0.4
41204.830	-21.0	0.5
41233.794	-19.8	0.3
41234.786	-21.2	0.4
41235.769	-20.2	0.4
41469.976	-20.4	0.5
41470.980	-19.7	0.5
HR 8566 = 37 Peg		
40050.932	- 7.6	2.6
40197.705	+ 6.2	1.9
40198.713	+ 4.5	0.6
40519.667	+ 4.7	1.0
40526.639	+ 5.9	1.6
40758.942	- 3.8	2.2
40817.884	- 0.2	±3.0
40844.890	- 1.3	±2.5
40872.719	+ 4.5	1.8
40873.718	+ 4.9	2.1
40874.693	- 0.7	2.0
40900.761	+ 3.1	2.0
41175.914	- 1.7	2.3
41193.897	+ 2.9	1.5
41197.828	+ 4.2	2.6
41204.842	- 0.9	3.0
41233.806	+ 7.4	1.8
41235.778	+ 4.9	2.0
41471.971	- 2.3	1.8
41491.946	- 4.4	2.3
41492.921	- 8.3	2.7
41492.964	- 4.8	1.9
41492.976	-10.4	2.0
41492.979	-10.6	2.4
41492.982	-12.4	2.4
41525.847	-13.1	3.3
41551.916	- 6.1	2.6
41552.843	- 6.7	1.9
41553.896	- 4.9	3.8
HR 8665 = ξ Peg		
39067.672	- 2.7	0.3
39068.644	- 2.8	0.4
39097.621	- 1.8	0.4
40050.939	- 9.3	0.6
40518.709	- 5.0	0.5
40519.673	- 6.7	0.4
40526.645	- 6.0	0.6
40549.578	- 3.5	0.6
40550.565	- 4.1	0.5
40758.920	- 5.7	0.2
40817.887	- 4.6	0.3
40872.723	- 6.0	0.4
40873.726	- 6.1	0.6
40874.700	- 7.4	0.3
41175.918	- 4.1	0.3
41193.903	- 4.7	0.3
41204.853	- 5.4	0.5
41233.840	- 7.7	0.5
41235.785	- 5.7	0.5
41469.989	- 5.1	0.4
HR 8697 = σ Peg		
39068.652	+14.5	0.2
39097.635	+13.8	0.4
40519.678	+11.7	0.6
40526.650	+12.2	0.5
40549.586	+13.7	0.4
40550.570	+13.8	0.7
40758.925	+12.4	0.2
40817.890	+14.2	0.5
40872.728	+12.5	0.4
40873.731	+11.9	0.5
40874.707	+10.7	0.3
41175.924	+13.6	0.5
41193.908	+13.1	0.3
41204.859	+12.3	0.6
41233.843	+12.2	0.4
41235.792	+14.5	0.5
41471.977	+11.8	0.3
41492.928	+10.0	0.5
41525.899	+13.4	±0.7
HR 8905 = υ Peg		
39068.664	-15.5	±1.6
39097.650	- 6.7	2.9
40052.880	-15.3	1.7
40518.714	- 7.5	2.9
40519.684	-13.6	1.6
40526.657	-11.2	1.3
40549.610	- 4.8	3.1
40550.596	-10.3	2.7
40758.914	-14.4	1.4
40817.893	-14.6	1.7
40872.733	-13.5	2.0
40873.736	-13.1	3.3
40874.714	-18.2	2.1
41175.928	-12.1	1.7
41193.913	-14.2	1.4
41194.898	-12.2	1.6
41201.850	-14.3	2.1
41202.754	-14.9	1.8
41203.838	-18.3	2.3
41204.685	-13.1	2.1
HR 8969 = ι Psc		
39068.670	+ 7.3	0.1
39097.662	+ 7.8	0.4
40052.886	+ 5.7	0.4
40485.598	+ 5.5	0.4
40485.606	+ 6.5	0.3
40485.613	+ 6.4	0.4
40485.677	+ 5.9	0.3
40485.685	+ 5.6	0.4
40485.690	+ 5.4	0.4
40485.695	+ 6.7	0.5
40485.702	+ 6.7	0.3
40485.707	+ 6.4	0.4
40485.714	+ 6.2	0.6
40485.721	+ 6.6	0.5
40485.729	+ 6.3	0.5
40496.718	+ 8.2	0.5
40496.722	+ 7.8	0.4
40496.726	+ 7.4	0.4
40496.731	+ 7.1	0.4
40496.736	+ 6.8	0.6
40496.741	+ 6.7	0.3
40496.746	+ 6.1	0.5
40496.750	+ 6.1	0.4
40496.755	+ 5.7	0.5
40496.764	+ 7.1	0.5
40496.771	+ 6.4	0.5
40496.779	+ 6.1	0.5
40496.790	+ 6.2	0.4
40496.797	+ 7.0	0.3
40496.831	+ 6.7	0.5
40496.836	+ 7.3	0.5
40496.841	+ 7.8	0.7
40518.719	+ 6.3	0.4
40519.688	+ 5.5	0.4
40526.662	+ 6.6	0.6
40549.616	+ 7.4	0.3
40550.601	+ 8.4	0.5
40758.933	+ 5.4	0.2
40817.896	+ 7.2	0.4
40872.738	+ 6.1	0.4
40873.740	+ 5.4	0.3
40874.717	+ 5.5	±0.3

Table 1 (concluded)

Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})		Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})		Helio. JD 2400000+	Rad. Vel. & Prob. Error (km sec^{-1})		Helio. JD 2400000+	Red. Vel. & Prob. Error (km sec^{-1})	
41175.933	+ 7.3	±0.4	HR 9072 = ω Psc			40758.929	+ 1.5	±1.0	41194.917	+ 3.8	±1.1
41193.918	+ 7.0	0.4	39068.675	+ 7.0	±0.8	40817.897	+ 2.8	1.0	41201.867	+ 2.3	1.7
41194.909	+ 7.7	0.5	39097.670	+ 7.3	0.8	40872.742	+ 4.2	1.0	41202.778	+ 1.8	1.6
41201.861	+ 4.5	0.4	40519.693	+ 4.3	1.1	40873.745	+ 5.0	1.0	41203.863	+ 0.9	1.4
41202.768	+ 7.0	0.6	40526.666	+ 6.1	1.1	40874.721	+ 2.4	1.0	41204.866	+ 1.4	1.6
41203.854	+ 4.9	0.7	40549.621	+ 5.7	0.8	41175.937	+ 3.7	1.6	41233.815	+ 3.7	1.1
41204.849	+ 7.1	±0.4	40550.605	+ 6.9	±1.2	41193.921	+ 2.0	±1.5	41235.800	+ 4.6	±1.1

Table 2

Observing List and Results on Duplicity

HR	Name	<ρ> (km sec^{-1})	n	<p.e.> (km sec^{-1}) Internal	External	Comments and Conclusions
33	6 Cet	+17.3	19	± 0.5	± 0.9	Constant velocity
82	ρ And	+13.4	20	1.1	1.5	Constant velocity
219	η Cas	+ 9.2	22	0.4	1.0	SB1, P=9.209 days (first orbit); VB, 480 years
225	64 Psc	-15.4	20	1.0	20.9	SB2, P=13.8208 days (first orbit)
235	ϕ^2 Cet	+10.8	20	0.5	1.9	Probable constant velocity
244	....	+22.5	20	0.4	0.9	SB1, P=127.95 days (first orbit)
366	37 Cet	+24.0	20	0.5	1.0	Constant velocity; ADS 1003B has a CPM
413	ρ Psc	- 7.1	20	1.9	2.5	Constant velocity
417	ω And	+14.8	20	1.3	1.7	Constant velocity; ADS 1152B has a CPM
458	υ And	-27.6	20	0.4	1.1	SB1, P=197.9 days (first orbit)
483	....	+ 5.1	20	0.3	1.0	Constant velocity
544	α Tri	-19.2	20	2.7	6.4	SB1, P=1.73645 days (improved orbit)
646	η Ari	+ 6.9	20	0.4	1.1	Constant velocity
660	δ Tri	- 3.0	21	0.3	5.1	SB1, P=10.02009 days (improved orbit)
781	ε Cet	+16.9	20	0.4	1.2	VB, P=975.9 days (first spectroscopic orbit)
788	12 Per	....	0	...	...	SB2, P=331.0 days (Colacevich 1941)
799	θ Per	+26.0	20	0.4	1.0	Constant velocity; VB, P=2720 days
818	τ^1 Eri	+29.6	21	0.5	1.4	SB1, P=958 days (first orbit)
855	20 Per	+ 2.9	20	2.0	2.4	SB1, P=1269 days (first orbit); VB, P=31.6 or 63.1 years; ADS 2200C has a CPM
869	ρ Ari	+ 8.8	20	0.5	3.0	SB1, P=3507 days (first orbit)
937	ι Per	+50.8	20	0.4	1.0	Constant velocity
962	94 Cet	+20.8	20	0.4	1.6	Probable constant velocity; ADS 2406B has a CPM
1101	10 Tau	+29.2	20	0.4	1.1	Constant velocity
1210	43 Per	+13.2	20	0.9	17.8	SB2, P=30.43907 days (improved orbit); IDS 03492N5024B has a CPM
1249	....	+18.7	20	0.5	0.8	Constant velocity
1254	....	+39.6	20	1.0	1.3	Constant velocity
1257	....	-16.6	20	0.5	1.6	Probable constant velocity
1278	50 Per	+26.9	20	0.5	1.1	Constant velocity
1309	46 Tau	+ 3.9	20	1.5	2.6	SB2 ?; VB, 7.18 years
1543	π^3 Ori	+24.7	20	0.6	0.8	Constant velocity
1673	68 Eri	+11.2	20	0.6	1.4	Possible variable velocity
1686	....	-10.4	20	0.5	1.2	Constant velocity
1729	λ Aur	+66.6	20	0.4	0.6	Constant velocity
1780	111 Tau	+38.0	21	0.4	0.8	Constant velocity
2047	χ^1 Ori	-12.5	20	0.4	1.1	Possible variable velocity
2220	71 Ori	+34.9	20	0.4	0.8	Constant velocity
2241	74 Ori	+ 9.2	20	0.5	0.7	Constant velocity
2401	....	+16.0	20	0.4	0.9	SB1, P=60.0 days (first orbit)
2483	ψ^5 Aur	-23.8	20	0.4	0.6	Constant velocity
2484	ξ Gem	+28.6	20	± 2.2	± 2.6	Constant velocity

Table 2 (continued)

HR	Name	<ρ> (km sec^{-1})	n	<p.e.> (km sec^{-1}) Internal	External	Comments and Conclusions
2846	63 Gem	+13.3	20	± 1.1	±52.0	SB2, P=1.9326797 days (improved orbit); ADS 6089B has a CPM
2849	22 Lyn	-27.2	21	0.4	0.8	Constant velocity
2943	α CMi	- 3.7	55	0.5	1.3	SB1, P=40.23 years (known)
3064	9 Pup	-20.0	22	0.5	0.8	VB, P=23.18 years (known); questionable spectroscopic elements
3176	μ Cnc	-36.4	20	0.4	0.8	Constant velocity
3262	χ Cnc	+33.2	20	0.5	1.0	Possible variable velocity
3579	10 UMa	+30.4	22	0.6	1.5	VB, P=21.85 years
3616	σ^2 UMa	- 2.0	21	0.5	0.8	VB, P=1067.1 years
3648	16 UMa	-18.5	21	0.5	16.5	SB1, P=16.23969 days (improved orbit)
3750	....	+56.8	20	0.5	1.4	SB1, P=917 days (first orbit); IDS 09228S 0538B has a CPM
3754	ω Leo	- 8.3	20	0.5	0.7	VB, P=116.85 years; SB1, same period (first orbit)
3759	τ^1 Hya	+10.2	23	0.7	0.8	Constant velocity
3775	θ UMa	+15.7	19	0.5	1.2	SB1, P=371 days (first orbit); ADS 7420B has a CPM
3881	....	+ 5.6	20	0.4	1.0	Probable constant velocity
3928	19 LMi	- 5.5	20	0.6	8.2	SB1, P=9.2847 days (improved orbit)
3991	....	+ 7.2	19	3.3	5.2	SB1, P=28.098 days (first orbit)
4054	40 Leo	+ 6.6	21	0.5	0.9	Constant velocity
4084	....	+ 8.2	20	1.6	2.5	Probable constant velocity
4112	36 UMa	+ 9.6	20	0.4	0.7	Constant velocity
4251	....	- 4.0	19	0.4	0.7	Constant velocity
4277	47 UMa	+11.8	21	0.4	0.9	Probable constant velocity
4374/5	ξ UMa	....	..	...	...	A is an SB1, P=669.18 days (known orbit); B is an SB1, P=3.9805 days (known orbit); AB is a VB, P=59.840 years
4395	λ Crt	+16.4	19	0.7	2.6	SB1, P=1940 days (first orbit)
4399	ι Leo	-12.4	20	0.7	1.1	VB, P=192.00 years; SB1, same period (first orbit)
4439	....	-43.8	21	0.5	0.9	VB, P=72.87 years
4540	β Vir	+ 4.3	21	0.5	0.9	Constant velocity
4753	18 Com	-40.1	20	3.5	5.6	SB1, P=17.954 days (first orbit)
4785	β CVn	+ 6.7	21	0.4	1.4	SB1, P=2430 days (first orbit)
4968/9	α Com	....	..	...	...	VB, P=25.87 years
4983	β Com	+ 5.8	20	0.4	1.3	Possible variable velocity
5011	59 Vir	-27.1	21	0.5	1.1	Constant velocity
5185	τ Boo	-16.2	20	0.5	1.1	Constant velocity; ADS 9025B has a CPM
5235	η Boo	- 0.4	20	0.5	3.8	SB1, P=494.17 days (known orbit)
5304	12d Boo	- 4.1	20	0.8	27.6	SB2, P=9.604538 days (improved orbit)
5323	14 Boo	-39.7	20	0.5	1.5	SB1, P=726.6 days (first orbit)
5338	ι Vir	+14.0	20	0.6	1.1	Constant velocity
5365	18 Boo	- 0.3	20	1.0	1.6	Constant velocity
5404	θ Boo	-11.5	20	0.6	1.0	Constant velocity; IDS 14218N5219B has a CPM
5447	σ Boo	+ 0.3	22	0.5	1.0	Constant velocity
5487	μ Vir	+ 3.9	21	1.4	2.5	Probable SB1 with P∿358 days
5530	α^1 Lib	-24.6	20	0.5	1.0	Constant velocity; HR 5531 has a CPM
5618	44i Boo	-29.9	20	0.4	0.7	AB observed; constant velocity; VB, P= 246.2 years
5634	45 Boo	-10.4	20	1.1	1.4	Constant velocity
5691	....	-48.7	19	0.4	0.8	Constant velocity
5694	5 Ser	+54.1	20	± 0.4	± 0.7	Possible variable velocity; ADS 9584B has a CPM

Table 2 (concluded)

HR	Name	$\langle\rho\rangle$ (km sec^{-1})	n	<p.e.> (km sec^{-1}) Internal	External	Comments and Conclusions
5723	ε Lib	- 8.1	20	± 0.5	± 5.4	SB1, P=226.95 days (known orbit)
5868	λ Ser	-67.0	20	0.4	1.1	SB1, P=1837 days (first orbit)
5914	χ Her	-56.4	20	0.5	0.7	Constant velocity
5933	γ Ser	+ 6.1	17	0.5	0.7	Constant velocity
5954	49 Lib	-20.0	20	0.5	1.6	SB1, P=3100 days (first orbit)
5968	ρ CrB	+18.2	20	0.5	0.7	Constant velocity
5977/8	ξ Sco	....	..	...	...	VB, P=45.69 years; ADS 9909C has a CPM
5986	θ Dra	- 8.9	20	0.6	12.6	SB1, P=3.07078 days (improved orbit)
6091	....	-35.1	19	2.3	2.5	Constant velocity; IDS 16165N3957B has a CPM
6212	ζ Her	-74.4	22	0.5	0.6	VB, P=34.385 years; SB1, same period (known orbit)
6243	20 Oph	- 0.8	20	0.6	1.4	SB1, P=1290 days (first orbit)
6315	19 Dra	-20.8	20	0.4	8.7	SB1, P=52.10890 days (improved orbit)
6458	72 Her	-78.3	19	0.5	0.8	Constant velocity
6493	....	+ 0.7	20	1.3	16.3	SB2, P=26.2765 days (improved orbit)
6573	26 Dra	-17.2	20	0.4	0.4	Constant velocity during 1968-1972; VB, P=76.00 years
6594	....	-40.4	19	0.9	1.1	Constant velocity; ADS 10723B and C have a CPM
6596	ω Dra	- 2.0	20	0.7	15.0	SB2, P=5.27982 days (known SB1); IDS 17375 N6848B has a CPM
6636	ψ Dra	-10.9	19	0.6	0.6	Constant velocity; ADS 10759B has a CPM
6701	35 Dra	-25.0	20	0.5	0.4	Constant velocity
6710	ζ Ser	-53.3	18	1.9	2.0	Constant velocity
6775	99 Her	+ 0.9	17	0.4	0.8	Constant velocity; VB, P=54.7 years
6850	36 Dra	-36.2	20	0.5	0.7	Constant velocity
6927	Dra	+34.1	19	0.4	8.0	SB2, P=280.53 days (known orbit)
6985	....	-22.3	19	0.9	2.8	Probable variable velocity
6987	....	-35.4	19	2.7	2.8	Constant velocity
7061	110 Her	+23.2	18	0.6	1.0	Constant velocity
7172	11 Aql	+14.9	19	0.6	0.6	Constant velocity
7261	17 Lyr	-35.3	18	3.4	7.4	SB1, P=49.09 days (first orbit); ADS 12061 B has a CPM
7441	9 Cyg	-23.3	19	0.7	10.0	SB1, P=1717 days (first orbit); IDS 19309N 2915B has a CPM
7469	θ Cyg	-27.7	21	0.5	0.9	Constant velocity; ADS 12695B has a CPM
7496	....	+16.0	19	0.5	1.4	Variable velocity, P>1500 days
7534	17 Cyg	+ 4.7	21	0.5	1.0	Constant velocity; ADS 12913B has a CPM
7560	ο Cyg	+ 0.3	20	0.5	1.0	Constant velocity; ADS 13012C has a CPM
7882	β Del	-23.0	21	1.3	1.4	VB, P=26.65 years; SB1, same period (improved orbit)
7947	γ^1 Del	- 7.0	20	0.5	0.7	Constant velocity; ADS 14279A has a CPM
7955	....	-32.3	19	0.4	0.7	Constant velocity
8034	1 Equ	+ 5.0	23	1.7	8.4	SB1, P=2.03133 days (first orbit); VB, P=101.485 years; ADS 14499C has a CPM
8123	δ Equ	-15.1	22	0.7	1.1	VB, P=5.70 years; SB2 (no orbit)
8283	42 Cap	- 2.1	21	0.4	10.0	SB1, P=13.1740 days (improved orbit)
8309	μ^1 Cyg	+16.9	21	0.5	0.7	Constant velocity; VB, P=507.5 years
8315	κ Peg	-17.1	25	1.2	14.8	SB1, P=5.9716 days (improved orbit); VB, P=11.52 years
8400	16 Cep	-21.3	20	0.6	0.7	Constant velocity
8430	ι Peg	+ 1.4	20	0.5	27.4	SB1, P=10.21304 days (known orbit)
8472	....	-20.7	20	0.4	0.8	Constant velocity
8566	37 Peg	- 1.6	29	2.2	4.1	SB1, P=372 days (first orbit); VB, P=143 y.
8665	Peg	- 5.2	20	0.4	1.2	Probable constant velocity; ADS 16261B has a CPM
8697	Peg	+12.8	19	0.4	0.8	Constant velocity
8905	Peg	-12.9	20	2.0	2.3	Constant velocity
8969	Peg	+ 6.5	49	0.4	0.6	Constant velocity
9072	Psc	+ 3.9	20	± 1.2	± 1.3	Possible variable velocity

Table 3

Summary of Orbital Data

HR	Period	T_0 (JD)	K (km sec^{-1})	γ	e	ω	(O-C) (k/s)	a sin i (10^6 km)	f(M)
219	9^{d}209 ±.007	2439065.14 ±2.13	2.2 ±3.5	+9.2 ±1.1	0.45 ±.86	287° ±73	0.7	0.254	0.0000078
	480^y	2411221.	...	...	0.50	268.6	...	...	...
225	13^{d}8208 ±.0015	2440012.71 ±.13	58.5 ±.9	+4.9 ±.7	0.21 ±.01	196 ±28	1.0	10.87	0.2685
	assumed	2440013.08 ±.12	60.3 ±1.2	+8.6 ±.7	0.29 ±.02	28 ±4	1.9	10.97	0.2760
244	127^{d}951 ±.027	2414164.5 ±5.4	1.6 ±.2	+22.5 ±.1	0.55 ±.10	218 ±9	0.3	2.35	0.000032
458	197^{d}9 ±1.9	2439001.0 ±34.5	1.8 ±.2	-27.7 ±.2	0.21 ±.13	340 ±43	0.5	4.789	0.0000112
544	1^{d}73645 ±.00012	2439068.26 ±.30	12.4 ±.9	-20.0 ±.7	0.06 ±.09	110 ±65	2.2	0.296	0.000342
660	10^{d}02009 ±.00005	2418911.3 ±2.7	9.4 ±.2	-5.9 ±.2	0.01 ±.02	61 ±96	1.0	1.295	0.000864
781	975^{d}9	2437661.8	2.2	+16.4	0.28	76	0.4	20.26	0.00035
788	331^{d}0	2415019.0	21.4 24.8	-21.8 -21.8	0.67 0.67	267.7 87.7	... ...	72.31 83.80	0.1378 0.2145
799	2720^y	2310195.	...	...	0.13	100.6	...	...	...
818	958^d ±34	2439391.9 ±90.5	3.0 ±.4	+3.0 ±.2	0.45 ±.08	180 ±19	0.6	35.30	0.00191
855	1269^d ±70	2440023.3 ±66.4	4.8 ±.5	+2.4 ±.4	0.49 ±.06	306 ±17	1.0	73.02	0.00965
	31^{y}6 or 63^{y}1	2427292 2420316	...	...	0.76 0.00	260.2 0	...	...	...
869	3507^d ±13.5	2419459 ±138	6.7 ±.4	+12.1 ±.3	0.30 ±.05	149 ±11	0.6	308.2	0.0950
1210	30^{d}43907 ±.0001	2423796.914 ±.068	50.6 ±1.4	+23.6 ±1.1	0.68 ±.01	210 ±3	1.2	15.53	0.1615
	assumed	2423796.699 ±.138	53.9 ±1.8	+27.0 ±1.7	0.60 ±.02	16 ±5	5.1	16.54	0.1950
1309	2622^d	2435005	≥7	+4	0.29	327.9		245.2	0.0831
2401	60^{d}0 ±.21	2439545.2 ±5.4	1.7 ±.2	+16.2 ±.1	0.46 ±.11	112 ±16	0.5	1.245	0.0000214
2846	1.9326797 ±.0000006	2423429.68 ±.04	96.2 ±1.0	+22.5 ±.9	0.03 ±.01	42 ±8	4.9	2.555	0.1783
	assumed	2423428.69 ±1.18	115.9 ±1.7	+23.6 ±1.6	0.01 ±.02	34 ±220	8.3	3.080	0.3123
2943	40^{y}23	2410088	1.32	-3.77	0.31	65.7	...	253.6	0.00302
3064	8467^d	2420757	≥4	-21.2	0.69	67.7	0.4	337.1	0.02134
3579	21^{y}85	2433319	4.0	+27.2	0.15	30	...	434	0.0512

Table 3 (continued)

HR	Period	T_0 (JD)	K (km sec^{-1})	γ	e	ω	(O-C) (k/s)	a sin i (10^6 km)	f(M)
3616	$1067^{y}.1$	2421484	...	...	0.81	331°.5	...	...	...
3648	$16^{d}.23969$ ±.00004	2423048.47 ±.24	35.3 ±.3	-14.6 ±.2	0.09 ±.01	143 ±5	1.2	7.851	0.0733
3750	$917^{d}.1$ ±4.9	2439728 ±96	2.2 ±.4	+56.3 ±.2	0.21 ±.10	73 ±32	0.5	26.88	0.000922
3754	$116^{y}.85$	2436769	2.2	-6.0	0.56	124.6	...	1070	0.0269
3775	$371^{d}.0$ ±2.9	2439040 ±28	4.3 ±2.2	+13.0 ±1.4	0.25 ±.29	270 ±47	0.3	21.24	0.00278
3928	$9^{d}.2847$ ±.0004	2439162.3 ±.09	17.8 ±.3	-8.8 ±.2	0.07 ±.02	88 ±3	0.7	2.267	0.00540
3991	$28^{d}.098$ ±.035	2440271.3 ±4.9	10.1 ±1.2	+7.5 ±.8	0.07 ±.17	177 ±65	2.6	3.893	0.00298
4374	$3^{d}.9805$		5.04	-15.9	0.00	...	...	0.2759	0.000053
4375	$669^{d}.18$	2418582.0	7.97	-15.0	0.53	320	...	62.19	0.02145
4374/5	$59^{y}.840$	2427865	...	...	0.414	101.6	...	...	...
4395	1940^{y} ±84	2420136 ±848	6.9 ±7.4	+13.0 ±.3	0.62 ±.52	90 ±174	0.8	144.4	0.0319
4399	$192^{y}.00$	2432722	2.5	-11.3	0.54	140.7	1.0	2029	0.0678
4439	$72^{y}.87$	2418171	...	...	0.40	311	...	...	...
4753	$17^{d}.954$ ±.015	2439243.5 ±1.7	11.5 ±2.9	-42.5 ±1.9	0.42 ±.16	286 ±36	4.3	2.577	0.002120
4785	$2429^{d}.9$ ±6.5	2413397 ±106	2.6 ±1.0	+6.5 ±.3	0.49 ±.20	307 ±16	0.7	75.7	0.00294
4968/9	$25^{y}.87$	2419274	...	...	0.50	279	...	...	...
5235	$494^{d}.17$	2428136.2	8.42	+1.01	0.258	326.3	...	55.3	0.0276
5304	$9^{d}.604538$ ±.000022	2417680.052 ±.084	67.4 ±.8	+9.1 ±.4	0.189 ±.008	290 ±3	1.3	8.74	0.2890
	assumed	2417679.937 ±.113	66.5 ±.9	+9.2 ±.5	0.20 ±.01	103 ±5	1.5	8.61	0.2758
5323	$726^{d}.6$ ±6.9	2439271 ±13	2.9 ±.4	-39.2 ±.4	0.55 ±.08	155 ±14	0.7	24.20	0.00107
5618	$246^{y}.2$	2376962	...	...	0.36	48	...	...	...
5723	$226^{d}.95$ ±.23	2414785.12 ±.16	14.0 ±.1	-9.7 ±.3	0.68 ±.01	339.5 ±.9	0.9	32.03	0.0255
5868	1837^{d}	2440152 ±60	2.8 ±.7	-6.7 ±.3	0.55 ±.18	288 ±10	0.4	59.07	0.1441
5954	3100^{d} ±9.3	2419783 ±224	9.0 ±.9	-25.7 ±.5	0.13 ±.09	100 ±27	1.6	380.4	0.229
5977/8	$45^{y}.69$	2433698	3.7	-29.4	0.74	348	...	571	0.0267
5986	$3^{d}.07078$ ±.00001	2439277.02 ±.02	25.3 ±.3	-8.0 ±.2	0.01 ±.01	244 ±336	0.8	1.068	0.00516

Table 3 (concluded)

HR	Period	T_0 (JD)	K (km sec^{-1})	γ (km sec^{-1})	e	ω	(O-C) (k/s)	a sin i (10^6 km)	f(M)
6212	$34^{y}.385$	2427201	3.8 ±.4	-69.9	0.44 ±.02	114° ±2.5	...	591.4	0.0524
6243	1290^{d} ±144	2440154 ±201	3.2 ±2.2	+0.2 ±.9	0.21 ±.56	320 ±65	0.9	55.4	0.00409
6315	$52^{d}.10890$ ±.00002	2439983.57 ±.60	17.6 ±.2	-20.9 ±.2	0.21 ±.01	339 ±4	0.6	12.33	0.0276
6493	$26^{d}.2765$ ±.0004	2418411.52 ±.30	47.5 ±1.0	+0.4 ±1.0	0.49 ±.01	14 ±8	...	14.96	0.1936
	assumed		50.7 ±1.2				...	15.91	0.2329
6573	$76^{y}.00$	2433428	...	...	0.16	322	...	...	...
6596	$5^{d}.27982$ ±.00003	2440052.6 ±.2	35.4 ±.8	-14.4 ±.6	0.04 ±.02	35 ±11	1.6	2.568	0.0243
	assumed	assumed	44.6 ±2.7				1.3	3.236	0.0485
6775	$54^{y}.7$	2430251	...	...	0.71	256	...	...	...
6927	$280^{d}.531$ ±.011	2422440.16 ±.60	18.0 ±.1	+32.5	0.452 ±.006	122.6 ±1.2	...	61.8	0.120
	assumed	assumed	23.6 ±1.6				...	81.2	0.272
7261	$49^{d}.09$ ±.09	2439360.5 ±2.8	11.9 ±1.8	-35.2 ±1.1	0.48 ±.16	223 ±6	4.5	7.047	0.00580
7441	$1717^{d}.3$ ±3.1	2420553 ±39	15.7 ±1.0	-17.1 ±.7	0.71 ±.04	135 ±8	3.7	261.1	0.241
7882	$26^{y}.65$ assumed	2429309 ±286	7.6 ±3.4	-24.1 ±.9	0.48 ±.19	190 ±9	1.6	563.8	0.0755
8034	$2^{d}.03133$ ±.00010	2440051.36 ±.11	15.8 ±1.3	+7.8 ±.7	0.17 ±.09	51 ±20	2.9	0.435	0.000796
	$101^{y}.485$	2422459	...	...	0.705	340.2	...	...	...
8123	$5^{y}.70$	2419683	20.7	-15.2	0.42	169	...	538	1.433
		assumed	21.3				...	553	1.561
8283	$13^{d}.17399$ ±.00014	2440051.75 ±.19	23.2 ±.5	-1.3 ±.3	0.18 ±.02	177 ±6	1.0	4.134	0.0163
8309	$507^{y}.5$	2437848	...	...	0.58	340	...	...	...
8315	$5^{d}.9716$ ±.0012	2440050.69 ±.03	34.2 ±.6	-5.7 ±.5	0.06 ±.02	15 ±5	1.7	2.803	0.0247
	$11^{y}.52$	2418621	...	...	0.30	131	...	...	...
8430	$10^{d}.21304$ ±.00002	2427364.96 ±.27	49.1 ±.3	-4.6 ±.3	0.008 ±.007	240 ±50	0.9	6.895	0.1255
8566	$372^{d}.4$ ±2.1	2440042 ±11	8.2 ±1.2	0.0 ±.9	0.48 ±.07	208 ±20	2.0	36.8	0.0144
	$143^{y}.0$	2419220	...	...	0.56	213	...	...	...

NOTES TO TABLES 2 AND 3

HR 82: The current velocities are 5 km s^{-1} larger than the 12 published ones from 1915–1926.

HR 219: The visual orbit is by Strand (1969). His conclusion that the primary is 0.7 mag overluminous may be due in part to its spectroscopic duplicity. The other visual components (C–H) are probably optical ones.

HR 225: The two components of this double-lined system give slightly discordant results (see Table 3). In Fig. 1 we assumed for the computed curves the values of γ, e, and ω of the primary. The values of $\mathfrak{M} \sin^3 i$ are 1.09 and 1.05 $\mathfrak{M}_\odot$ for the primary and secondary, respectively. The visual companions listed in the IDS are probably optical ones.

HR 235: Only one velocity is discordant.

HR 244: The solution includes six Lick measures by Campbell and Moore (1928).

HR 417: ADS 1152C is an optical companion.

HR 544: The present elements agree with Harper's (1915) within the probable errors; the period is from the combined data. The visual companions listed in the IDS are probably optical ones.

HR 660: The present elements agree with those by Pearce (1923) except for the period; he estimated incorrectly (by 4) the number of elapsed cycles between his early and later observations. The elements listed are from the combined data. The visual companion (ADS 1739B) is probably an optical one.

HR 781: Visual binary (IDS 02347S1218AB) with elements by Baize (1962). We assumed his P, T_0, e, and ω to obtain K and γ. However, since $\Delta V = 0.0$ mag, we suspect that the lines are blends and K_1 is actually larger.

HR 788: The orbital elements are by Colacevich (1941). Our spectra did not generally resolve the double lines.

HR 799: ADS 2081AB; companion C is probably an optical one. The elements quoted are by Hopmann (1958).

HR 855: The four 1917–1921 measures from the Lick Observatory (Campbell and Moore 1928) would fit the spectroscopic orbit if $P = 1256$ days and $\gamma = 9$ km s^{-1} at that time. It is not clear how much the 1269 day spectroscopic orbit is affected by motion in the visual orbit of 31.6 or 63.1 years (van den Bos 1938).

HR 869: The orbital solution includes five 1918–1920 observations (Abt 1970) from the Mount Wilson Observatory.

HR 937: There is one published measure of a visual companion at 46″; its physical association with the primary is indeterminate.

HR 962: Only the first two velocities deviate significantly from the mean. Anderson and Kraft (1972) found the velocity to be constant.

HR 1129: The spectral type of A1 V + G2 III (Slettebak 1955) of this composite system places it outside the present program. The velocity measures for the G star suggest a period of roughly 5 years. It is not a known visual double.

HR 1210: The present data alone give orbital elements that agree with those by Harper (1928) within the combined probable errors. The results listed in Table 3 are from the combined data. The values of $\mathfrak{M} \sin^3 i$ are 0.82 and 0.77 $\mathfrak{M}_\odot$ for the primary and secondary, respectively.

HR 1306: The spectral type of G5 Ib + A places this system outside the present program. The present velocities for the G star fit Osawa's (1957) orbit.

HR 1309: VB with an orbit by Finsen (1962). The spectral lines were measured as single lines and show a variation consistent with the visual period of 7.18 years. However, the observed amplitude of 7 km s^{-1} is only half that expected, and the lines show weak shortward components. The system is probably double-lined and unresolvable because $V \sin i = 60$ km s^{-1}. But then what are the shortward line components?

HR 1543: The visual companion is probably an optical one.

HR 1686: The visual companion (ADS 3864B) is evidently an optical one.

HR 1729: The visual companions (ADS 3886C, D) are evidently optical ones.

HR 1780: The visual companion (IDS 05186N1716B) is evidently an optical one.

HR 2047: If the velocity is variable, the period is very long.

HR 2220: The visual companions (ADS 4842B, C) are probably optical ones.

HR 2401: The least-squares solution gave no improvement.

HR 2483: The visual companion (ADS 5425B) is evidently an optical one.

HR 2846: The present data give orbital elements that agree within the probable errors with those by Harper (1925*b*). The elements listed in Table 3 are from the combined data. The values of $\mathfrak{M} \sin^3 i$ are 1.05 and 0.87 $\mathfrak{M}_\odot$ for the primary and secondary, respectively.

HR 2849: The distant companion (IDS 07223N4952B) is evidently an optical one.

HR 2943: The orbital elements by Jones (1928) were assumed and the system was used as a velocity standard.

HR 3064: The visual orbit is by Woolley and Symms (1937). Spectroscopic elements have been published by Struve (1923). The present measures agree with the visual orbit but are insufficient for an independent determination; we assumed P, T_0, e, and ω from Woolley and Symms. Also, the system may well be an unresolved SB2 in which K_1 is larger than 4 km s^{-1}.

HR 3579: The visual orbit for IDS 08542N4211AB is by Heintz (1967*a*). Components C–E are evidently optical ones. Preliminary spectroscopic elements have been published by Underhill (1963). Her velocities and the present ones fit the velocity variation predicted from Heintz's visual orbit. We suspect that her 1958–1962 velocities are 2 km s^{-1} high, although DAO standards had been monitored during the entire observing interval. We assumed Heintz's P, T_0, e, and ω to derive approximate values for K_1 and γ.

HR 3616: The visual orbital elements are by Baize (1948). There is slight evidence for a slow velocity increase, but spectroscopic orbital elements are indeterminate at present. The companion ADS 7203C is probably an optical one.

HR 3648: The present orbital elements do not differ significantly from those by Young (1923), except for a possible decrease in ω from $169° \pm 8°$ to the present $128° \pm 6°$. The elements listed are from the combined data.

HR 3750: Included in the solution are two measures by Anderson and Kraft (1972). This star is a visual pair (IDS 09228S0538) without known orbital elements.

HR 3754: Although the present measures, obtained during 4 years, show no significant variation, combination with the 1905–1917 measures listed by Frost (1918) and the 1921–1922 measures from the Mount Wilson Observatory (Abt 1970) and fitted to the orbital elements from the visual orbit (Muller 1957) yielded the listed K_1 and γ. However, the lines might be double, judging by the magnitude difference of the visual pair.

HR 3775: The least-squares solution gave no improvement to the orbital elements. The faint CPM companion is at 4″ and the period for that pair must be much longer than the spectroscopic period of 371 days.

HR 3881: Only one measure deviates significantly from the mean velocity.

HR 3928: The present measures give elements similar to those by Harper (1925*a*), but with smaller errors. The elements listed in Table 3 were derived from the present measures only.

HR 4251: The visual companion IDS 10486S1935B is evidently an optical one.

HR 4374/5: HR 4374 = ADS 8119B is a known SB1 (Berman 1931) with a period of $3\overset{d}{.}9805$. HR 4375 = ADS 8119A is a known SB1 (van den Bos 1928) with a period of $669\overset{d}{.}18$ and a VB (Heintz 1967*b*) with the same period. A and B form a VB (Heintz 1967*b*) with a period of 59.840 years. Berman derived values of the masses of A and B but did not publish the velocity amplitudes.

HR 4395: Also included in the orbital solution are the measures by Campbell and Moore (1928). The velocity had previously been considered (Campbell 1922) to be variable.

HR 4399: This is a VB (ADS 8148AB) with orbital elements by Baize (1952). Because the system is rather eccentric and periastron was in 1948, the published (Campbell and Moore 1928; Harper 1933; Petrie 1949) and present measures seem to show a significant variation. The elements K_1 and γ were derived after assumption of the other elements from Baize.

HR 4439: This is a VB (ADS 8197AB) with orbital elements by Heintz (1971). The present velocities plus previously published ones (Campbell and Moore 1928; Harper 1923) do not fit the visual orbital elements.

HR 4540: The visual companions (IDS 11454N0219B, C) are evidently optical ones.

HR 4968/9: This is a VB (ADS 8804AB) with orbital elements by Haffner (1948).

HR 4983: The present measures show no rapid variation but a possible period of 5 years or more. The visual companion (IDS 13072N2823B) is evidently an optical one.

HR 5185: ADS 9025AB is an apparent physical pair with an unknown period.

HR 5235: This SB1 has known orbital elements by Bertiau (1957). Our measures give similar elements, but Bertiau's are more accurate and are listed in Table 3. An astrometric study (Daniel and Burns 1939) confirmed the period.

HR 5304: This SB2 has known orbital elements by Harper (1916). Our elements agree with his within the probable errors. The errors are smaller if only the present measures are used, except for the period, which is derived from the combined data. The values of $\mathfrak{M} \sin^3 i$ are 1.13 and 1.14 $\mathfrak{M}_\odot$ for the primary and secondary, respectively.

HR 5365: The visual companion (IDS 14145N1328B) is probably an optical one.

HR 5404: IDS 14218N5219B has not changed position relative to A in 64 years.

HR 5447: IDS 14304N3011B is apparently an optical companion.

HR 5487: The measures are not well enough distributed in phase to derive orbital elements.

HR 5618: ADS 9494AB has orbital elements by Heintz (1963).

HR 5634: Both visual companions (IDS 15029N2516B, C) seem to be optical ones.

HR 5694: There might be a period of 1500 days in the velocities. ADS 9584B has a CPM.

HR 5723: The present orbital elements agree with those by Jones (1931); the elements derived by her are listed.

HR 5868: The 1898–1926 measures by Campbell and Moore (1928) were used to find the period, which was then held constant, and only the present measures were used to derive the other orbital elements listed.

HR 5933: The visual companion IDS 15518N1559B is an optical one.

HR 5954: The analysis includes the 1915–1921 velocities from the Mount Wilson Observatory (Abt 1973). The visual companion (IDS 15547S1614B) is evidently an optical one.

HR 5968: The visual companion (IDS 15573N3337B) is evidently an optical one.

HR 5977/8: Orbital elements for ADS 9909AB have been published by Baize (1942). Approximate spectroscopic orbital elements based on spectra of the unresolved pair have been published by Chang (1929) and are listed, but the magnitudes are sufficiently similar ($\Delta V = 0.3$ mag) that the system is probably really an SB2. The small masses suggest that K_1 has been underestimated; the computed values of $\mathfrak{M} \sin^3 i$ are 0.48 and 0.45 $\mathfrak{M}_\odot$ for the primary and secondary, respectively.

HR 5986: The present measures give orbital elements that are similar to those published by Luyten (1936), except for a larger K_1 (25.3 ± 0.3 km s^{-1}) than Luyten's value (23.4 ± 0.3 km s^{-1}). We list the present elements only, but a period derived from both sets of measures.

HR 6091: IDS 16165N3957B has a CPM.

HR 6212: ADS 10157AB is a VB with orbital elements by Baize (1949). Spectroscopic elements have been published by Berman (1941). The elements listed are mostly from the latter source. The present measures roughly fit the minimum of Berman's curve.

HR 6315: The present measures give orbital elements that agree within the probable errors with the earlier ones by Harper (1935). The listed period comes from a comparison of both sets of data, and the remaining elements come from the present measures only.

HR 6458: The visual companion (ADS 10488B) evidently does not have a CPM.

HR 6493: The present measures give orbital elements that agree well with those by Parker (1915). His elements are based on more data and are probably better; they are listed except for a period derived from the combined data. The values of $\mathfrak{M} \sin^3 i$ are 0.88 and 0.83 $\mathfrak{M}_\odot$ for the primary and secondary, respectively.

HR 6573: ADS 10660AB has visual orbital elements by Baize (1965). The present measures show no significant change during 3.5 years, but the mean is substantially lower than for the published measures.

HR 6594: ADS 10723B and C both seem to have a CPM with A.

HR 6596: Luyten (1936) has rediscussed Turner's (1907) observations. The present measures give similar but not necessarily more accurate orbital elements. However, the present spectra resolve the secondary components at elongations, so the present elements are listed, except for a period derived from both sets of measures. The values of $\mathfrak{M} \sin^3 i$ are 0.16 and 0.12 $\mathfrak{M}_\odot$ for the primary and secondary, respectively. The visual companion (IDS 17375N6848B) seems to have a CPM.

HR 6636: ADS 10759B evidently has a CPM with A, but not components C and D.

HR 6775: ADS 11077AB has orbital elements published by Makemson (1958). There is no significant evidence for variability in the present or published velocities.

HR 6927: Spectroscopic orbital elements have been published by Crawford (1928), Vinter-Hansen (1942), and Spite (1967). The present measures yield orbital elements that agree with the previous ones within the probable errors. Vinter-Hansen's elements seem to be the best determined and are listed, except for Spite's measures of the secondary. The values of $\mathfrak{M} \sin^3 i$ are 1.48 and 1.13 $\mathfrak{M}_\odot$ for the primary and secondary, respectively. An astrometric orbit by Breakiron and Gatewood (1974) leads to the individual masses. The visual companion (IDS 18229N7241B) seems to be an optical one.

HR 6985: We did not succeed in determining the period.

HR 6987: The two visual companions (ADS 11496B, C) are probably optical ones.

HR 7020: This pulsating star may have a CPM companion in ADS 11581C. Extensive measures by Paddock and Struve (1954) indicate no variation in the mean pulsational velocity.

HR 7061: The four visual companions in ADS 11658 all seem to be optical ones.

HR 7172: The two visual companions in ADS 11902 seem to be optical ones.

HR 7261: These are poor determinations of the orbital elements of this relatively broad-lined star. Only component B of the many components in ADS 12061 has a CPM with A.

HR 7441: The analysis includes measures published by Plaskett *et al.* (1920), Campbell and Moore (1928), Harper (1933), and Abt (1973); the large scatter may be due to the variety of the material used. There is a close visual companion (IDS 19309N2915B) of nearly the same brightness ($\Delta V = 0.5$ mag), and the spectrum of the unresolved pair has been called composite (Schlesinger 1930), but we think that the metallic lines measured come from only the F5 component. The spectroscopic motion probably refers to the visual pair.

HR 7469: ADS 12695B has a CPM with A, but not component C.

HR 7534: ADS 12913B has a CPM with A, but not component C.

HR 7560: ADS 13012C has a CPM with A, but not component B.

HR 7882: Orbital elements have been published for ADS 14073 by Couteau (1962). Spectroscopic orbital elements have been published by Underhill (1963). Her measures and the present tones have been combined to give the elements listed, although Couteau's period is assumed. The eccentricity is not well determined because the minimum of the velocity curve has not been well defined. The other visual companions (C–E) seem to be optical ones.

HR 7947: This star has a CPM with the brighter K1 V companion ADS 14279A = HR 7948 = γ^2 Del.

HR 7955: The visual companion (IDS 20429N5713B) seems to be an optical one.

HR 8034: ADS 14499AB has orbital elements by Zeller (1965). Component C has a CPM.

HR 8123: ADS 14773AB has orbital elements by Luyten and Ebbighausen (1934), van de Kamp and Lippincott (1945), and Wehlau (1955). The difference in brightness is only 0.1 mag. Our spectra show double lines at times, but they are too difficult to measure. The spectra of the two stars are very similar (Wehlau 1955). Campbell and Moore (1928) measured double lines on many spectra taken near periastron; Luyten and Ebbighausen used those measures to derive a mass ratio of 1.03, but the resultant values of $K_1 = 20.7$ and $K_2 = 21.3$ km s^{-1} give unrealistically large masses and mass functions. Rightfully, these elements have been questioned by Batten (1967). Only the visual data on this system are used in the analysis.

HR 8283: The present measures yield orbital elements that agree very well with those published by Sanford (1942). Our elements are listed, except for a period derived from the combined data.

HR 8309: The visual system ADS 15270AB has orbital elements by Heintz (1966); the other two components are probably optical ones.

HR 8315: ADS 15281AB is a known (Luyten 1934) triple system with a spectroscopic period of 5$^{\rm d}$97152 for star A and a period of 11.52 years for the visual pair. Our orbital elements for the 5 day binary differ significantly from Luyten's in K_1 and γ, and possibly in ω. Our derived change in γ during 4 years is marginal and does not agree with an amplitude even as high as 2.0 km s^{-1}. Our elements for A and Luyten's for AB are listed. Component C is probably an optical one.

HR 8400: The visual companion (IDS 21578N7242B) is probably an optical one.

HR 8430: Our orbital elements agree well with the published ones by Petrie and Phibbs (1949), and a comparison of the two sets of data gives exactly the Petrie-Phibbs period. Our elements are listed, mostly for a comparison. The visual companion (IDS 22023N2452B) is probably an optical one.

HR 8455: The brightness of this star as listed in Hoffleit (1964) is incorrect (Eggen 1968), and the star should not have been included in the program. The star is a dwarf (Kennedy and Buscombe 1974).

HR 8472: The visual companion (IDS 22081N5620B) is evidently an optical one.

HR 8566: ADS 15988AB has visual orbital elements by Jastrzebski (1960) and Knipe (1960); the former are listed.

HR 8665: ADS 16261B has a CPM with A; companion C is evidently an optical one.

HR 8969: The visual companion (IDS 23348N0505B) is evidently an optical one.

HR 9072: The published 2$^{\rm d}$158 period (Beardsley 1965) is not confirmed; our velocity range of 6.4 km s^{-1} is much less than the published ranges of 18 and 13 km s^{-1}. However, this star may have a variation with a period of several decades.

Kuiper 1935, 1942; Jaschek and Jaschek 1957; Petrie 1960; Jaschek and Gomez 1970) gave very different binary frequencies for stars at the middle of the main sequence, namely 18 to 54 percent spectroscopic duplicity; (2) those studies were based on published data that were subject to serious selection effects, and allowance was usually not made for those effects; and (3) the studies often did not include all kinds of binaries, namely spectroscopic binaries, visual doubles, and common-proper-motion pairs. In addition, the apparent variation in duplicity along the main sequence from 72 percent for B3 V stars (Kodaira 1971) to 10 percent for dwarf K and M stars (Wilson 1967) does not include a factor for the increased difficulty in detecting spectroscopic binaries while progressing to low-mass stars, and therefore does not necessarily represent a real difference.

This study concentrates on the bright field stars of types F3–G2 IV or V. The range was selected for the following reasons: (1) to avoid the region of the Am and Ap stars, which terminates at F1 or F2; (2) to concentrate on stars with narrow lines so that accurate radial velocities can be determined; (3) to include the stars of solar type for comparison with the solar system; (4) to stop at G2 because later-type dwarfs tend to be rare among the brighter stars. In addition, the selection of stars brighter than $V = 5.5$ mag includes stars that have been studied well by visual observers. The southern declination limit was $-20°$. The selection includes the stars with $0.25 \le (b - y) \le 0.40$ in the four-color system (Strömgren and Perry, unpublished) and those classified F3–G2 IV or V by Hoffleit (1964). No new observations were obtained for three closely spaced visual systems (HR 4374-5, 4968-9, 5977-8), but the known data for them were used. Several stars were observed and their velocities are listed, but they were later eliminated from consideration because they were too late in type (HR 3771, 8455) or too luminous (HR 1129, 1306). A total of 135 systems remain in the program.

II. SPECTROSCOPIC OBSERVATIONS

For each of the program stars we obtained approximately 20 coudé spectra with the 2.1 m coudé spectrograph at reciprocal dispersions of 13.3 Å mm^{-1} (before JD 2,441,525) or 16.9 Å mm^{-1} later. Generally nine stellar lines of Fe I ($\lambda\lambda$4045, 4063, 4071, 4383, 4404, and 4415), H I (Hδ, Hγ), and Ca I λ4226 were measured on a Grant profile comparator, using laboratory wavelengths (Moore 1945). In addition, we measured 22 spectra of Vega, 61 of Procyon (Jones [1928] orbital elements were assumed), and 14 of Arcturus, observed concurrently, to provide corrections to the Lick system (Moore 1932) of radial velocities. The corrections applied were $+3.4$ km s^{-1} (JD 2,439,068–2,439,100), -1.7 (2,439,128–2,440,052), $+0.7$ (2,440,053–2,441,524), and $+6.5$ km s^{-1} (2,441,525–2,441,591).

Table 1 lists the corrected radial velocity and internal probable error for each heliocentric date. Table 2 lists the program stars. The third column gives the mean velocities, ρ, obtained from the present velocities only (these often differ from the γ-velocities in cases of binaries). The fourth column gives the number of measures, n. The fifth and sixth columns list the mean internal and external probable errors per observation, respectively; if the latter exceeds twice the former for a

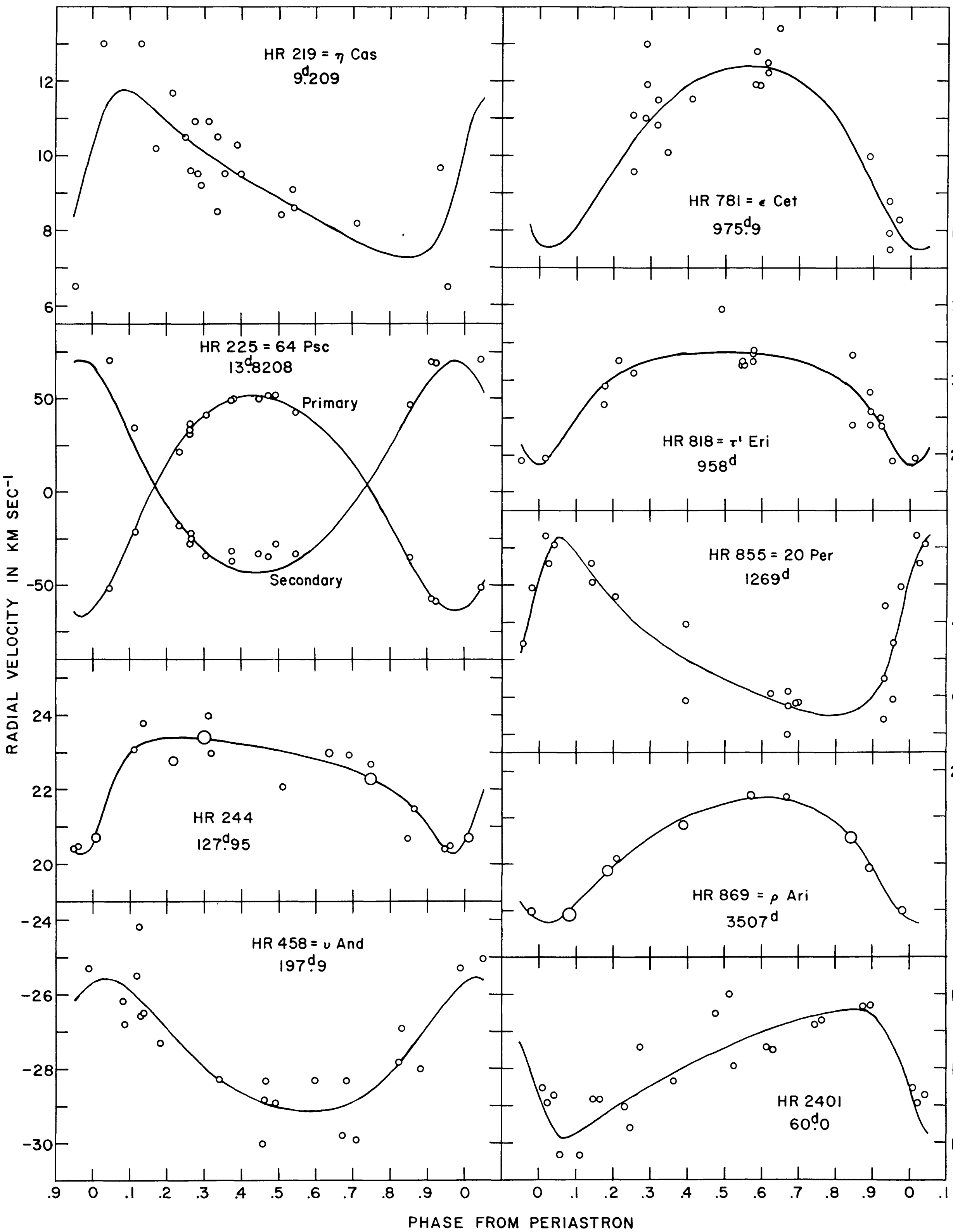

FIG. 1.—Measured velocities (*circles*) and computed velocity curves for nine newly discovered spectroscopic binaries. Note the different vertical scales. In cases where measures were averaged (*larger circles*), the sizes of the circles are roughly proportional to the number of measures.

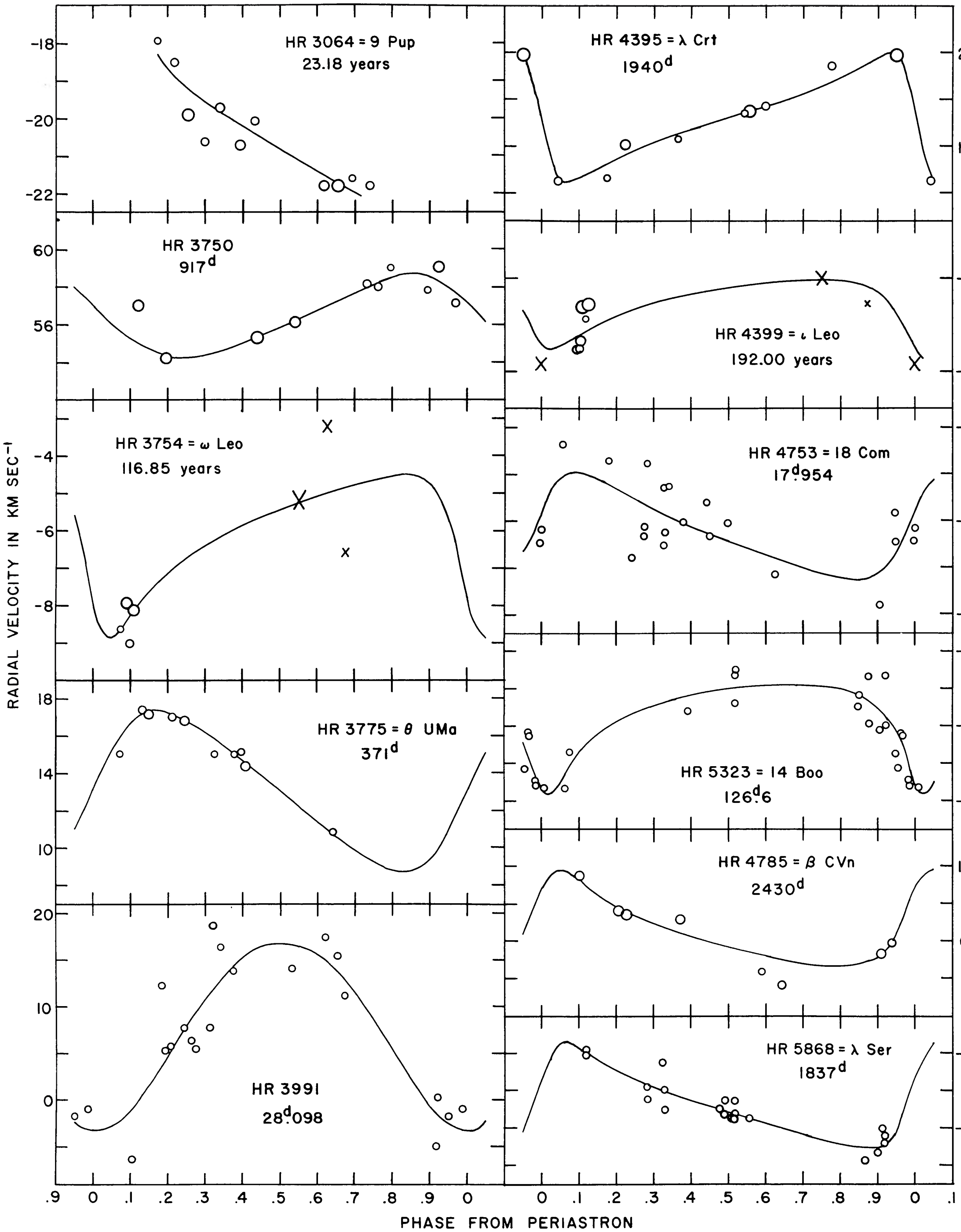

FIG. 2.—Measured velocities and computed velocity curves for 11 new spectroscopic binaries. The × 's refer to published measures from other observatories. Larger symbols refer to averages of several measures. Several curves (HR 3064, 3754, 4399) are based on visual orbital elements.

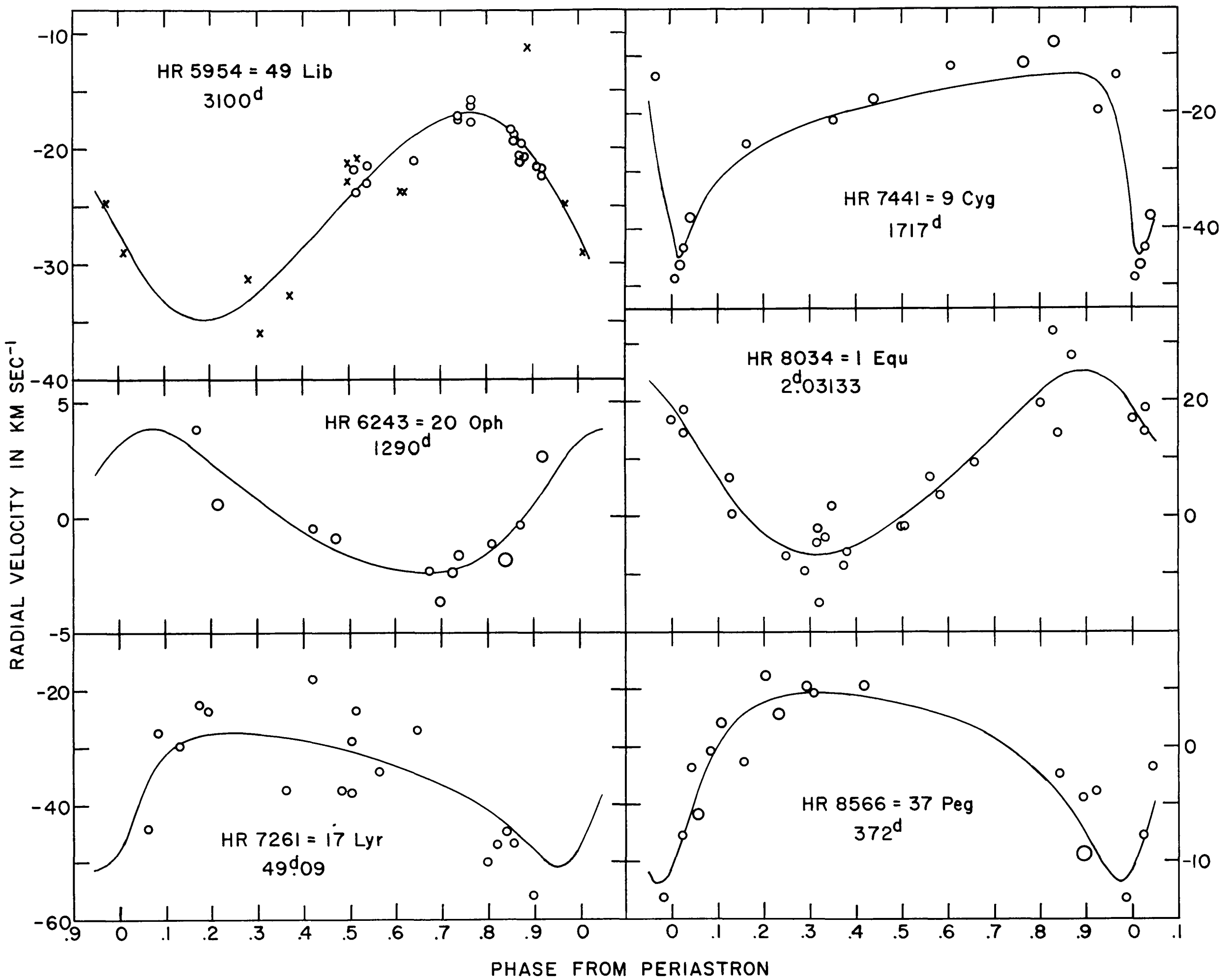

FIG. 3.—Computed velocity curves and measured velocities for six new spectroscopic binaries. The symbols are explained under Figs. 1 and 2.

star, the chances are large that its velocity is variable. The last column gives comments and conclusions about duplicity. No star is called a spectroscopic binary unless orbital elements have been derived. The notes to Tables 2 and 3 give many details and references about individual systems.

The orbital elements for the spectroscopic binaries are listed in Table 3. Orbital elements are generally not quoted unless the observations were good enough to permit a least-squares improvement of the preliminary elements. The least-squares solution was programmed for the observatory's CDC 6400 computer by John Varga. In a few cases the visual orbital elements were assumed, and some or all of the spectroscopic elements were then derived. In the case of double-lined systems, the period (and sometimes the epoch of periastron) from the primary was assumed in deriving elements for the secondary; in such cases the assumed elements are so marked in Table 3. The $(O - C)$ values in Table 3 are 0.6745 times the rms difference between the observed and computed velocities; if those values are twice the mean internal probable errors, no further improvement is likely to be made in the elements by using the present measures. There is an inconsistency in the longitudes of periastron, ω: visual observers list the values for the secondary orbit while spectroscopic observers give the value for the primary, which differs by 180°. This inconsistency remains in the values listed.

The measured velocities and computed curves are shown in Figures 1–3 for the newly found systems only. In some cases the agreement between the measures and curves is marginal or poor. In the case of small-amplitude binaries, the periods are especially in doubt, but generally not by a large factor because the extensive data were searched for short periods before long periods were tried. The bright systems that have large velocity amplitudes were analyzed decades ago, and so most of the new ones shown here are the difficult cases that had been neglected.

There are several stars (e.g., HR 4983, 5487, 5694, 6985, 7496, and 9072) that seem to be variable in velocity but for which we did not succeed in deriving orbital elements. Even including these stars, we have no program stars without orbital elements in which the external probable errors exceed the internal ones by more than a factor of 4.0, or for which the external probable errors are greater than 2.8 km s^{-1}. Thus the list of spectroscopic binaries in Table 2 probably represents essentially all the ones with $K_1 > 3$ km s^{-1} and many of the ones with $1.5 \leq K_1 \leq 3.0$ km s^{-1}.

III. THE HIGH-VELOCITY STARS

Previous studies (Abt and Levy 1969; Crampton and Hartwick 1972) have shown that spectroscopic binaries are relatively rare among field high-velocity dwarfs, that the difference between high- and low-velocity stars is probably the greatest for the shortest periods, and that the binary frequency decreases with increasingly higher space motions. Therefore it seems reasonable to separate the low- and high-velocity stars and to discuss them separately.

The high-velocity stars can be isolated either with four-color photometry (Strömgren 1964) or from space motions computed from proper motions, parallaxes, and radial velocities. In using data by Eggen (1964), we used the latter method because the data are more complete for our program stars.

Table 4 lists all of the program stars with space motions (Eggen 1964) in excess of 63 km s^{-1}. Available data (Hoffleit 1964) indicate that none of the stars not listed by Eggen would qualify. Therefore this list of high-velocity program stars seems to be complete. Using four-color data from Strömgren and Perry (unpublished) or other sources listed by Lindemann and Hauck (1973), and the technique of Strömgren (1964), we can derive the Strömgren-group assignments; these are also listed in Table 4. Both the lack of space motions greater than 100 km s^{-1} and the paucity of stars in Strömgren groups III–V show that these are intermediate high-velocity stars, not extreme ones. Finally, we list in Table 4 the conclusions (from Table 2) regarding duplicity.

By the definitions used below, four out of the 12 stars listed in Table 4 are double (spectroscopically, visually, or with common-proper-motion [CPM] companions). This fraction of 33 percent seems smaller than the 72 percent frequency of companions found below for the low-velocity stars. For binary periods less than 100 days, the relative binary frequencies for high- and low-velocity stars are 8 and 24 percent, respectively. If we consider only the stars with space motions greater than 70 km s^{-1}, there are 25 percent binaries and zero percent with periods less than 100 days. Thus these fragmentary data support the conclusions quoted above for high-velocity stars.

In the remaining analysis we will delete the high-velocity stars and discuss only the 123 low-velocity ones.

IV. THE COMMON-PROPER-MOTION STARS

The program stars include many members of visual pairs that seem to be gravitationally bound as shown by their CPMs, but evidently have periods so long that orbital elements have not been derived for them. It is appropriate to include them among the double stars in the sample, even if periods are lacking. One can obtain periods that are statistically valid, even though the numbers may be very inaccurate for individual systems.

If we observe at random times a visual pair in an edge-on circular orbit, the mean angular separation is $2/\pi$ times the maximum angular separation. Of course the discovery rate may be higher when the stars are well separated, but not too far apart. For face-on circular orbits the observed separation is always the maximum separation. For elliptical motion the ratio between the time-averaged angular separation and the semimajor axis of the relative orbit depends on the eccentricity, the longitude of periastron, the inclination of the orbit, and a complicated discovery factor that depends on the angular separation. Since we are interested only in statistical periods good to the nearest factor of 10, we will make the simplifying assumption that the semimajor axis of the relative orbit is $\pi/2$ times the current separation. The known parallaxes of these stars can be used to derive linear separations from the angular separations, and assumptions about the masses (derived from their spectral types or the assumption that the secondaries are also main-sequence stars) will yield periods from Kepler's laws.

TABLE 4

HIGH-VELOCITY STARS

HR Number	Space Motion (km s^{-1})	Strömgren Group	Conclusions Regarding Multiplicity
660.......	68	II	SB1, $P = 10^{d}.02009$
937.......	91	I	Constant velocity
1729.......	86	I	Constant velocity
5691.......	68	I	Constant velocity
5694.......	94	I	Possible variable velocity; CPM companion
5868.......	68	I	SB1, $P = 1837^{d}$
5914.......	79	IV	Constant velocity
5933.......	81	II	Constant velocity
5968.......	78	II	Constant velocity
6212.......	77	I	VB and SB1, $P = 34.385$ years
6458.......	97	III	Constant velocity
8697.......	67	II	Constant velocity

TABLE 5

THE COMMON-PROPER-MOTION STARS

HR Number	V_A (mag)	V_B (mag)	Separation
366............	5.0	8.5	49″.7
417............	4.9	11.6	2.0
855............	5.2	9.9	14.1
962............	5.1	11.5	3.3
1210............	5.3	10.1	75.3
2846............	5.2	9.4	42.9
3750............	5.4	6.2	0.4
3775............	3.2	13.9	4.1
5185............	4.5	11.1	5.4
5404............	4.1	11.1	69.2
5530............	5.2	2.8	231.0
5977–8..........	4.8	7.1	7.6
6091............	5.4	10.6	2.0
6594............	5.4	9.9	0.6
	5.4	12.2	155.5
6596............	4.8	13.1	72.3
6636............	4.9	6.1	30.3
7261............	5.0	9.1	3.4
7441............	5.3	5.8	0.1
7469............	4.5	12.8	4.2
7534............	5.0	9.2	26.0
7560............	5.1	13.6	22.5
7947............	5.1	4.2	10.0
8034............	5.3	6.6	10.5
8665............	4.2	12.2	11.8

Table 5 lists 25 CPM pairs among the low-velocity stars; the high-velocity star HR 5694 is thereby excluded. The data come mostly from Jeffers, van den Bos, and Greeby (1963). The differences in visual magnitude range up to 10.7 mag and average 4.9 mag. The separations range from 0″.1 to 231″ and average 34″. We will refrain from listing the computed periods because individual values will be very inaccurate, but the range is from 3.5 to 820,000 years with a mean of 67,000 years and a median of 3100 years. In the case (HR 7441) of the shortest period, the single-lined spectroscopic binary (SB1) with period of 4.7 years may coincide with the motion in the CPM pair. The statistical periods are discussed below with those from the other binaries.

V. OBSERVED FREQUENCY OF MULTIPLE SYSTEMS

Prior to this study, the 123 low-velocity stars in the program included 21 spectroscopic binaries (15 SB1, 6 SB2) with known orbital elements. We added 21 spectroscopic binaries (20 SB1, 1 SB2), changed one known SB1 to an SB2, and added four SB1 orbits to visual binary (VB) systems with known orbital elements. There are 23 VBs with known orbital elements, of which five have spectroscopic orbits. There are 25 CPM pairs, of which one is probably an SB1.

In total, we count 71 multiple systems (58 percent) having 88 companions (72 percent). These involve 57 double systems, 11 triples, and three quadruples. The ratios of observed singles:doubles:triples:quadruples are 42:46:9:2.

We shall see below that our inability to detect certain double systems will make the actual frequency of single stars drastically lower.

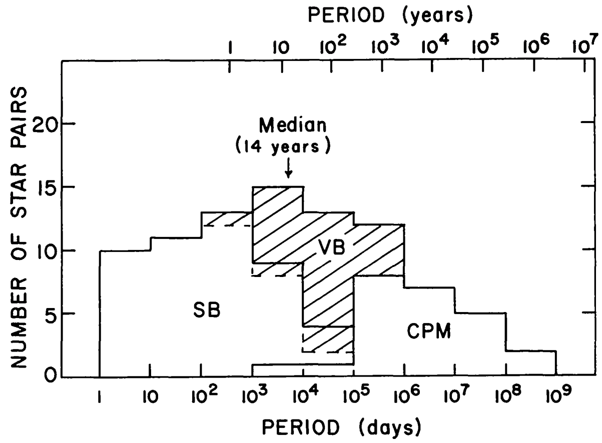

FIG. 4.—The frequencies of binary orbital periods expressed on a logarithmic scale in days (*below*) and years (*above*). The crosshatched section refers to systems with known visual orbital elements and overlaps the spectroscopic binary region (defined by solid lines). The periods for the CPM pairs are statistical and are very uncertain. One CPM pair may coincide with an SB orbit; that overlap has not been indicated.

VI. PERIOD DISTRIBUTION

The distribution of periods for the 88 known or estimated periods is shown in Figure 4. We see a relatively smooth distribution with one maximum. This distribution is reassuring because it means that there is enough of an overlap between the spectroscopic binaries and visual binaries that a bimodal distribution did not develop: if we studied the early-type stars where rotationally broadened lines prevent the discovery of many of the spectroscopic binaries with long periods, and the greater distances of most of the stars prevent the detection of most of the short-period visual pairs, we would expect a bimodal distribution.

The median period for the 88 pairs plotted in Figure 4 is 14 years. This is considerably shorter than the values of 320 years obtained by Luyten (1930) or 79 years by Kuiper (1935). Far fewer spectroscopic binaries were known to the latter two researchers, whereas their knowledge of visual systems was comparable to ours.

Finally, we see a range in periods of a factor of 10^8. Huang (private communication) feels that no single formation process will produce binaries with such a wide range of periods.

VII. DISTRIBUTION IN A COLOR-MAGNITUDE DIAGRAM

We wish to find out whether there is a tendency for the younger stars (near the zero-age main sequence [ZAMS]) to have a higher frequency of binaries, or possibly for the evolved stars to be richer in binaries on grounds that they might become trapped in an exchange process and be unable to evolve into giants. We might expect the later-type program stars to have fewer spectroscopic binaries than the earlier ones because the lower masses cause smaller velocity amplitudes. However, it is not clear whether, as Wilson (1966) pointed out, the observed decrease is not due

TABLE 6

Distribution of Stars in a Δc_1, $b - y$ Diagram

Period Range (years)	n	$\langle \Delta c_1 \rangle$ and p.e. in the Mean (mag)	Stars with $\Delta c_1 < 0.05$	Stars with $\Delta c_1 > 0.05$	$\langle b - y \rangle$ and p.e. in the Mean (mag)	Stars with $b - y < 0.32$	Stars with $b - y > 0.32$
10^{-3} to 1.........	19	0.069 ± 0.010	6	13	0.309 ± 0.007	13	6
1 to 10^2..........	17	0.062 ± 0.008	7	10	0.324 ± 0.008	8	9
10^2 to 10^4........	10	0.051 ± 0.008	5	5	0.303 ± 0.009	6	4
No companions...	48	0.064 ± 0.005	22	26	0.317 ± 0.004	25	32

primarily to observational selection effects or to a real decrease in binary frequency.

Some of these questions might be answered with four-color photometry and the present data on binaries. There is published (Lindemann and Hauck 1973) four-color photometry for 102 out of the 123 low-velocity program stars. This, plus Hβ photometry, can be used (e.g., Crawford 1973) to obtain evolutionary departures, Δc_1, above the ZAMS and colors, $b - y$, along the main sequence. We are grateful to D. C. Crawford and J. V. Barnes for some unpublished additional photometric data.

We divided the stars into three groups by periods, as listed in Table 6, plus one group having no companions. For triple or quadruple systems we used the shortest period. Figure 5 is a plot of pseudo color-magnitude diagram in which the ordinate is the evolutionary departure from the ZAMS. In a standard color-magnitude diagram a double-lined system should be about 0.7 mag high, but in this diagram it will fall at the average evolutionary place for the two components. The symbols in Figure 5 represent three of the four groups; the other one ($10^2 < P < 10^4$ years) was excluded to avoid too much confusion in the diagram.

Figure 5 looks like a pure scatter diagram for each symbol. There is no obvious trend for the short-period binaries to fall high or low, or toward the left or right relative to the other stars.

We list in Table 6 some statistics for the distributions in the diagram. The second column lists the number of stars. The mean values of Δc_1 show no significant differences between groups. The numbers of stars below or above $\Delta c_1 = 0.05$ mag show no statistically significant differences. Similarly there is no significant difference in mean color, $\langle b - y \rangle$, or in the numbers of stars left or right of $b - y = 0.32$ mag.

There is a qualification to this apparent lack of tendencies in the distributions in Figure 5. We will show below that we have probably failed to detect half of the actual binaries in this sample; therefore many of the fourth "no companions" group are probably actually binaries, and many doubles may have higher multiplicities. However, we see no obvious reason why the binaries that are undetected (because of low orbital inclinations, low secondary masses, or faint secondary magnitudes) should have a distribution that is different from that shown in Figure 5 for the discovered binaries.

We tentatively conclude that the binaries show no pronounced grouping tendency in age or evolutionary state, or to decrease in frequency at later types, at least within the F3–G2 range.

VIII. INCOMPLETENESS NUMBERS AND SECONDARY MASSES

How many binaries have we missed? By noting the characteristics of the binaries discovered, we can

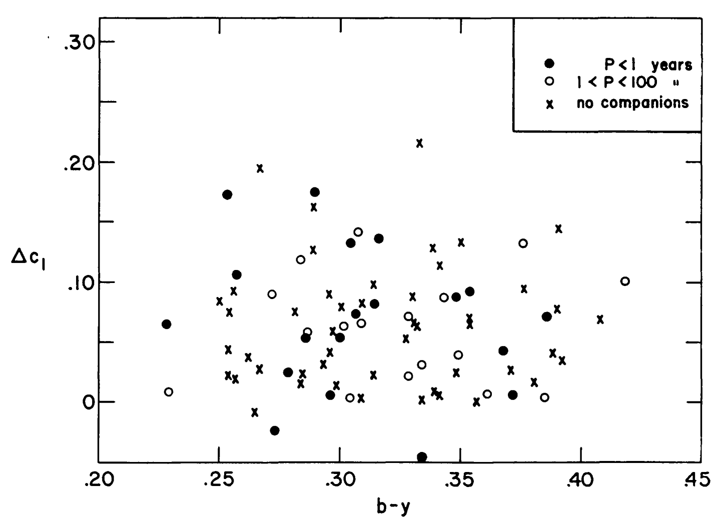

Fig. 5.—Evolutionary deviations from zero age main-sequence are expressed as Δc_1 measures and plotted against colors, both in mag. The types of binaries and stars not known to be double are plotted with different symbols.

predict which ones would be overlooked. These predictions are based on seven assumptions that seem reasonable, *viz.*:

A. random orientation of orbital axes, even within multiple systems;
B. failure to detect any SB1s with $K_1 < 2.0$ km s^{-1};
C. failure to detect any SB2s with $K_1 < 20.0$ km s^{-1};
D. failure to detect any VBs with $a < 0''.3$ and $\Delta V > 0.4$ mag;
E. failure to measure half of the VBs with $0''.3 < a < 1''.0$ and $2.0 < \Delta V \leq 3.5$ mag, and essentially all of those with $\Delta V > 3.5$ mag;
F. failure to measure one-third of the VBs or CPM stars with $a > 1''$ and $10.0 < V_2 \leq 12.0$ mag, or two-thirds of those with $12.0 < V_2 \leq 13.0$ mag, or all of those with $V_2 > 13.0$ mag;
G. failure to discover almost all CPM stars with $a > 75''$.

Let us comment on these assumptions. Assumption A seems reasonable because there is (1) a lack of evidence (Huang and Wade 1966) for preferred galactic distribution of orbital planes of eclipsing binaries, or (2) a lack of a dependence of inclinations in visual systems on galactic latitude (Finsen 1933), or (3) the evidence for random orientation of rotational axes of field Ap stars (Abt, Chaffee, and Suffolk 1972). With regard to assumption B, we noted in § II the absence of any nonbinaries with sufficient scatter in their radial velocities to allow $K_1 > 3.0$ km s^{-1}; only four binaries (HR 244, 458, 2401, 2943) with $K_1 < 2.0$ km s^{-1} have been found, partly by others. Actually, the incompleteness grows steeply from zero at $K_1 = 3.0$ km s^{-1} to 100 percent at $K_1 = 1.3$ km s^{-1}, but for convenience of calculation we shall assume total completeness above $K_1 = 2.0$ km s^{-1} and total incompleteness below that value. With regard to C, since our spectral resolution is about 20 μ or 20 km s^{-1}, we will generally not detect SB2s with $K_1 < 20$ km s^{-1}.

The remaining assumptions do not imply that violations are impossible, but simply that violating cases are generally neglected. For instance, despite van Biesbroeck's concentration on closely spaced visual systems that were likely to show appreciable orbital motion in a lifetime, and his use of large telescopes, we note that his last set of measures (van Biesbroeck 1974) included about 500 systems with $d < 1''.0$, but only 2.2 percent of those had $\Delta V \geq 3.5$ mag (after correction to the Finsen-Worley [1970] system of magnitude differences). With regard to assumption G, we note that the probability is 66 percent that, averaged over the sky, there will be a 13 (± 0.5) or 14 (± 0.5) mag field star within 75″ of any star; therefore observers have not bothered to measure faint companions of bright stars to find out whether or not they have common proper motions.

The weakest part of these assumptions is probably the first part of E.

In the following analysis we will consider a grid of parameters with secondary masses (five different

TABLE 7

PRINCIPAL FACTORS ENTERING INTO THE CALCULATIONS OF INCOMPLETENESS AND SECONDARY MASSES

Period (years)	$\mathfrak{M}_2$ ($\mathfrak{M}_\odot$) 1.2	0.6	0.3	0.15	0.075
10^{-3} to 10^{-1}					
Kind	SB2	SB1	SB1	SB1	SB1
Assumption	C	B	B	B	B
Inclinations	90°–21°	90°–3°	90°–5°	90°–9°	90°–18°
10^{-1} to 1					
Kind	SB2	SB1	SB1	SB1	SB1
Assumption	C	B	B	B	B
Inclinations	90°–47°	90°–5°	90°–9°	90°–17°	90°–33°
1 to 10					
Kind	VB	SB1	SB1	SB1	SB1
Assumption	D	B	B	B	B
Inclinations	...	90°–14°	90°–25°	90°–51°	90°–90°
Mean separation	0″.17	...	...	...	...
10 to 10^2					
Kind	VB	VB	...	...	...
Assumption	E	E	...	...	...
Mean separation	0″.77	0″.89	...	...	...
10^2 to 10^3					
Kind	VB	VB	CPM	...	...
Assumption	F	F	F	...	...
Mean separation	1″.64	4″.1	3″.73	...	...
10^3 to 10^5					
Kind	CPM	CPM	CPM	...	...
Assumption	F	F	...	...	...
Mean separation	16″	22″	51″	...	...
$>10^5$					
Kind	CPM	CPM	...	...	...
Assumption	G	G	...	...	...
Mean separation	75″	193″	...	...	...

TABLE 8

SUMMARY OF FREQUENCIES OF VARIOUS SECONDARY MASSES

PERIOD (years)	$\mathfrak{M}_2$ ($\mathfrak{M}_\odot$)					TOTAL
	1.2	0.6	0.3	0.15	0.075	
10^{-3} to 10^{-1}						
Measured....	6	4	4	2	2	18
I*..........	0.42	0.00	0.02	0.03	0.11	0.58
Total........	6.42	4.00	4.02	2.03	2.11	18.58
10^{-1} to 1						
Measured....	2	2	1	1	2	8
I...........	0.94	0.01	0.01	0.04	0.40	1.40
Total........	2.94	2.01	1.01	1.04	2.40	9.40
1 to 10						
Measured....	3	6	5	3	0	17
I...........	...	0.17	0.50	1.78	...	...
Total........	...	6.17	5.50	4.78	...	...
10 to 10^2						
Measured....	8	4	1	...	...	13
I...........	0.00	2.48	...	...	...	...
Total........	8.00	6.48	...	...	...	...
10^2 to 10^3						
Measured....	4	5	4	1	0	14
I...........	0.00	0.4	6.8	...	...	...
Total........	4.00	5.4	10.8	...	...	...
10^3 to 10^5						
Measured....	3	8	3	1	0	15
I...........	0.00	0.6	6.8	...	...	...
Total........	3.00	8.6	9.8	...	...	...
$>10^5$						
Measured....	1	2	...	...	...	
I...........	...	...	...	...	...	...
Total........	...	...	...	...	...	...

* $I \equiv$ Number of undetected binaries, or incompleteness value.

values) as one coordinate and period (seven period ranges) as the other. Many of the resulting 35 sets of parameters involve special observational situations, and they will have to be discussed individually to demonstrate how we can determine (in most of the cases) the numbers of observed and undetected systems having those characteristics. Table 7 gives the principal kinds of systems observed in each bin, the principal assumption made in deriving the incompleteness (in addition to random orientation of orbital planes), the observed inclination ranges, and the mean angular separation. The discussion will lead to the near-completion of Table 8.

Double-lined spectroscopic binaries yield the ratio of masses; if the value of the primary mass is assumed from its spectral type, the secondary mass becomes known. In the case of visual binaries, knowledge of the primary type and magnitude difference will lead to secondary masses if the assumption is made that the secondaries are also main-sequence stars. The occurrence of one exception—the white-dwarf companion to HR 2943 = α CMi—does not appear to be statistically significant.

The primary stars of types F3–G2 have masses of 1.5–1.0 $\mathfrak{M}_\odot$; the average is about 1.3 $\mathfrak{M}_\odot$. The double-lined spectroscopic binaries have nearly equal (and known) secondary masses, but all systems with $\mathfrak{M}_2 \sim 1.2\,\mathfrak{M}_\odot$ will not be detected because some of them will have inclinations i (between the plane of the orbit and the plane of the sky) that are too small for the velocity amplitude $K_1 = 2\pi P^{-1} a_1 (1 - e^2)^{-1/2} \sin i$ to be greater than 20 km s^{-1}. For random orientation of orbital planes, the probability of detecting an inclination such that $i_1 \leq i \leq i_2$ is ($\cos i_1 - \cos i_2$). For a given small range in period P, mean values of $\mathfrak{M}_1$ and $\mathfrak{M}_2$ ($=1.2\,\mathfrak{M}_\odot$), and a mean value of the eccentricity e, we can compute the fraction of systems with K_1 greater than 20 km s^{-1} relative to those with smaller values. We will identify the former group with the observed systems and compute the number of undiscovered systems in the latter group. For $P \approx 10^{-2}$ years and $\mathfrak{M}_2 = 1.2\,\mathfrak{M}_\odot$, we observe six double-lined systems (HR 2846, 6596, 5304, 225, 6493, and 1210) with $\langle e \rangle = 0.13$; we compute that $K_1 < 20$ km s^{-1} for $i < 21°$, and since $\cos 0° - \cos 21° = 0.065$, there will be $0.065 \times 6 \times (0.935)^{-1} = 0.42$ undetected binaries. Let us define I as the number of undetected systems in a sample; $I = 0.42$ in this case and the total number of binaries is 6.42. These are the numbers given in the upper left box of Table 8.

In a similar way, we can compute that for $10^{-1} < P \leq 1$ years, we will miss the SB2s with $\mathfrak{M}_2 = 1.2\,\mathfrak{M}_\odot$ if $i < 47°$, and the observed two binaries correspond to an actual total of 2.94 binaries.

For longer periods and $\mathfrak{M}_2 \sim 1.2\,\mathfrak{M}_\odot$, the systems will not be SB2s, but rather VBs, and different assumptions will provide incompleteness values. For instance, for $1 < P \leq 10$ years, we admit temporary defeat because the angular separation has an average value of 0".17 and assumption D is applicable. For the three observed binaries all have $\Delta V < 0.3$ mag. But to predict the total with $1.3 \leq \mathfrak{M}_2 < 0.9\ \mathfrak{M}_\odot$ requires knowledge of the luminosity function of the secondaries, which we do not know at this point. Let us bypass this set of parameters until later.

For the period range 10–100 years, the mean separation is 0$''$.77 and for $1.3 \leq \mathfrak{M}_2 < 0.9\ \mathfrak{M}_\odot$, the brightness difference will be $V \leq 2.0$ mag or $V_2 \leq 7.8$ mag. According to assumption E, all such systems will be detected and our incompleteness value will be zero. Similarly, for longer periods $I = 0$ also, and the observed systems nearly complete the first column of Table 8.

Let us consider next the smaller secondary masses, proceeding by factors of 2.0 in mean mass, i.e., $\mathfrak{M}_2 =$ 0.6, 0.3, 0.15, and 0.075 $\mathfrak{M}_\odot$ (hereafter solar mass units will be used throughout). The data on SB2s make it clear that all these systems will be SB1s or VBs and CPM pairs with large magnitude differences. The treatment of the latter two groups is straightforward: for long periods where the components are separated visually, the secondary masses for the observed systems can be estimated from their absolute magnitudes and the mass-luminosity relation (Harris, Strand, and Worley 1963). Then the incompleteness values can be derived from application of the assumptions. This procedure works until the incompleteness values dominate the observed numbers, at which point the method is statistically unsound. At that stage in the analysis the entries will be indeterminate. This indeterminacy occurs for $\mathfrak{M}_2 = 0.3$ and $P > 10^5$ years, for $\mathfrak{M}_2 = 0.15$ and $P > 10$ years, and for $\mathfrak{M}_2 = 0.075$ and $P > 1$ year.

For the SB1s ($P \leq 10$ years, generally) and $\mathfrak{M}_2 <$ 0.6, the following procedure applies. Single-lined spectroscopic binaries yield values of the mass function, $\mathfrak{M}_2{}^3 \sin^3 i(\mathfrak{M}_1 + \mathfrak{M}_2)^{-2}$, which depend on the primary mass (assumed known), secondary mass (unknown), and orbital inclination (unknown). But it is possible to derive statistical values of $\mathfrak{M}_2$ and i plus the incompleteness numbers. From the mass function we can estimate values of $\mathfrak{M}_2 \sin i$ because the remaining factor of $\mathfrak{M}_1 + \mathfrak{M}_2$ is relatively insensitive to $\mathfrak{M}_2$ if $\mathfrak{M}_1 > \mathfrak{M}_2$. In a given period range (or for a mean value of the period) and for a given $\mathfrak{M}_2$, we can compute the probabilities of observing various values of $\mathfrak{M}_2 \sin i$ and match them against the observed values. We start with the largest values of $\mathfrak{M}_2 \sin i$ (>0.45) and attribute them to $\mathfrak{M}_2 = 0.6$ to find how many stars have $\mathfrak{M}_2 =$ 0.6 and i above a certain cutoff value. The cutoff value is determined by computing for that mean period and secondary mass the range in i such that $K_1 < 2.0$ km s^{-1} (assumption B). For instance, for $\langle P \rangle = 10^{-2}$ years and $\mathfrak{M}_2 = 0.6$, $K_1 < 2.0$ km s^{-1} if $i < 3°$, for which the probability of $0° \leq i < 3°$ is 0.001, and for four observed systems the incompleteness value is 0.004, which is insignificant.

After all the larger measured values of $\mathfrak{M}_2 \sin i$ are used up with stars of $\mathfrak{M}_2 = 0.6$, we will consider the $\mathfrak{M}_2 = 0.3$ group and match the larger remaining values of $\mathfrak{M}_2 \sin i$ against the probability distribution for that mass. We again compute the cutoff value in i ($=5°$) to

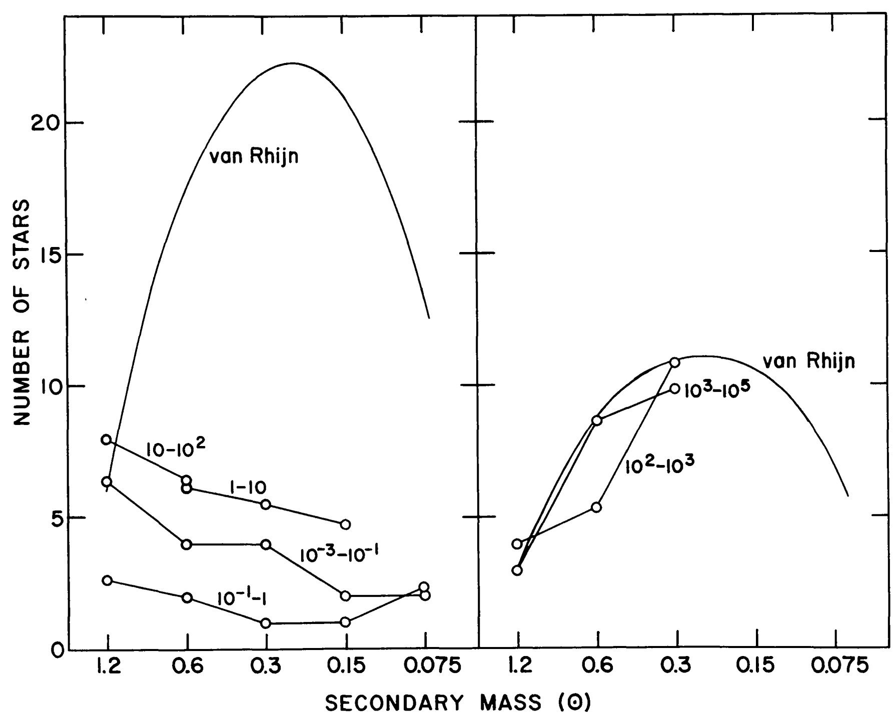

FIG. 6.—The frequencies of binaries having various secondary masses (grouped in bins) are plotted as circles. The segments connect data points for various period ranges expressed in years. Data for binaries with periods less than 100 years are shown in the left panel and for binaries with larger periods in the right panel. The van Rhijn luminosity function, transformed to a mass scale, has been normalized at 6.0 stars of mass 1.2 $\mathfrak{M}_\odot$ in the left panel and at 3.0 stars of mass 1.2 $\mathfrak{M}_\odot$ in the right panel. The data points include both the observed and undetected binaries.

determine the incompleteness ($I = 0.02$) for the four observed systems. This proceeds until all 12 of the known SB1s with $10^{-3} < P \leq 10^{-1}$ years are assigned to specific secondary masses; the results are listed in the first rows of Table 8.

The same procedure can be used to analyze the eight systems with $10^{-1} < P \leq 1$ years and the 17 systems with $1 < P \leq 10$ years because all these are SB2s or SB1s. Admittedly the total numbers are small for a statistical analysis, but we did not want to use too large steps in period for fear of missing the period at which a drastic change in secondary luminosity functions occurs (see below).

The results of this lengthy analysis are given in Table 8. The measured or observed stars in the table can be identified with specific systems (by HR number), but the undetected systems listed as "I" cannot be assigned to specific HR systems, i.e., we do not know which HR systems will have the undetected companions.

The totals for each (P, $\mathfrak{M}_2$) bin in Table 8 are plotted in Figure 6, where the data for $P < 100$ years are plotted on the left and for $P > 100$ years on the right. In each panel we plotted a van Rhijn distribution function in which the standard (Allen 1963) luminosity function is converted to frequencies for the mass groups used; the van Rhijn functions have been normalized to six stars with $\mathfrak{M}_2 = 1.2$ in the left panel and three stars with $\mathfrak{M}_2 = 1.2$ in the right panel. The revisions proposed recently to the van Rhijn function for $\mathfrak{M} < 0.15$ do not significantly effect the analysis below.

We see that the mass-function segments for the secondaries in systems with $P < 100$ years deviate drastically from a van Rhijn function, but that the secondary mass-function segments for systems with $P > 100$ years seem to fit the van Rhijn function within the expected accuracy, which is the square root of the total number in each case. Since the numbers of systems with $P > 100$ years are small, the conclusion for these systems is less secure. The combined data for all the segments in the left panel suggest that the frequency is proportional to $\mathfrak{M}_2^{1/3}$. Formally, the exponent is computed to be 0.35 with an estimated probable error of at least ± 0.10. We would like to have a better determination of this exponent, but unfortunately many more systems would be needed in the analysis.

The large difference in secondary mass functions for $P < 100$ and $P > 100$ years suggests that there are two types of binaries involved. We can guess that the shorter-period binaries are the fission or bifurcation systems in which the contracting protostar has too much angular momentum to form a stable single star, so it subdivides into a binary system. The mass function for such systems suggests that there is a tendency for the angular momentum and hence mass to divide roughly equally, i.e., very dissimilar masses become increasingly infrequent. Then the longer-period binaries are ones in which the two stars contract independently, but they happen to be bound gravitationally to one another. In that case there is no relation between the values of the two component masses, so the van Rhijn distribution should hold true separately for each component.

The break period of 100 years corresponds to a sum of the semimajor axes of 28 AU or 4×10^9 km. This, then, is probably a characteristic size for a protostar at that time that it starts to subdivide. If a mass of $2.4\, \mathfrak{M}_\odot$ is distributed uniformly over this diameter, the density is 1.5×10^{-10} g cm^{-3}. We note that this value is close to the gas density of 7.5×10^{-10} g cm^{-3} often assumed (e.g., Goldreich and Ward 1973) in the primordial solar nebula at the time of planetary formation. Could it be that the formation of planetary systems is one result of the subdivision of a protostar having excessive angular momentum?

It might be strange, if there are two mechanisms for binary formation involved, that the distribution of periods shown in Figure 4 shows no change in slope at the break period of 100 years. However, without a detailed understanding of the mechanisms, we are unable to comment constructively on this matter.

At this point we can understand the failure of Anderson and Kraft (1972) to find many small-amplitude SB1 systems. They used a very high dispersion (5 Å mm^{-1}) and measured only sharp-lined stars. Since their observations were all made within 2 years, they did not detect the numerous systems with small secondary masses and $P > 100$ years; instead, they were looking at systems with $P < 100$ years and hence found few with low secondary masses, as is expected from the left panel of Figure 6. We should add that for stars that occurred in both studies we found no discrepancies, and we were aided by the use of some of their individual measures that Anderson and Kraft kindly furnished to us.

IX. TOTAL MULTIPLICITY FREQUENCIES

There are gaps in Table 8 that are caused by our inability to detect some or all of the binaries with certain combinations of P and $\mathfrak{M}_2$. If we now assume that the secondary mass function is proportional to $\mathfrak{M}_2^{1/3}$ for $P < 100$ years and the van Rhijn relation for longer periods, we can fill in the gaps.

After Table 8 is completed, we calculated 172 stellar companions for 123 primaries, or a duplicity frequency of 140 percent. Again we emphasize that it is no longer possible to assign the companions to individual primaries. Obviously single stars are going to be infrequent. It will be possible to present below a plausible, but not certain, estimate of the frequencies of singles, doubles, triples, and quadruples.

So far we have only considered secondary masses down to $0.07\, \mathfrak{M}_\odot$, but it is perhaps likely that the left set of mass functions in Figure 6 does not vanish at that mass. According to Kumar (1963), smaller masses do not produce main-sequence stars, but rather contracting "black dwarfs" with degenerate cores that cool off in less than 10^9 years. Lower-mass components would directly become planets; let us refer to both as "degenerate companions."

We could predict the number of degenerate companions if we were certain of the exponent in the mass function for the bifurcation-binary secondaries and that the power law was valid to very small masses. However, acceptance of the cube-root mass function gives results that yield an interesting model.

For periods less than 100 years, the 123 primaries have 83 companions (67 percent) with $1.3 > \mathfrak{M}_2 > 0.06$. Extrapolating the cube-root relation to zero mass implies the existence of 45 degenerate companions (37 percent); some of these could be multiple planets. The sum is very close to 100 percent. This would mean that each primary has either a stellar secondary (in 2/3 of the cases) or a degenerate companion (in 1/3 of the cases), each with a period less than about 100 years. We find this tentative result plausible for the following reason.

Interstellar clouds have mean random internal motions (Cunningham 1968) of about 1.0 km s^{-1}. It may be that a protostar condensation consists of a single turbulent eddy with a smaller mean motion, but one that is unlikely to be orders of magnitude smaller. After the condensation has contracted by a factor of between 10^3 and 10^4 to form a single rotating protostar, the angular speed is likely to be too high for stability because the critical rotational speed of a solar-type star is about 400 km s^{-1}. There may be ways involving magnetic braking or rapidly spinning cores to solve the discrepancy between the high expected rotational velocity (e.g., $\sim 10^3$ km s^{-1}) and the small observed values (1–10 km s^{-1}) for such stars, but a more frequent solution may be the universal one. Data for typical binary systems indicate that those systems have 10^2 to 10^3 times as much angular momentum in orbital motion as in rotational motion. Both the rotational and orbital angular momentum must have come from the angular momentum of the protostar prior to subdivision. Therefore it seems rather logical to suppose that *all* protostar condensations subdivided to form binaries with either stellar or degenerate companions.

For periods greater than about 100 years, the van Rhijn function predicts about 89 stellar secondaries for the 123 primaries, or about 72 percent. There is probably no problem in a binary, as described in the previous paragraph and with a period less than 100 years, having a second companion with a longer period. For instance, for observed triple and quadruple systems with fairly well determined periods (no CPM stars), the smallest ratios of periods are as follows: 9.1 or 18.2 for HR 855 (31.6 or 63.1 years to 3.48 years); 32.7 for HR 4374-5 (59.840 years to 1.832 years); 140 for HR 8566 (143 years to 1.02 years). These extremely small ratios imply that we can combine the two parts of Figure 6 with the result that, if a pair has a period less than roughly 100 years, it may also have an additional companion with a longer period.

The van Rhijn function has not been determined for degenerate components, so we cannot extrapolate that function below 0.07 $\mathfrak{M}_\odot$. But just as we argued that the primary is unlikely to be a single star, so we can argue that the distant secondary, which contracted independently of the primary condensation, also is unlikely to be a single star if the subdivision process occurs universally for protostars of less than solar mass. If so, we will encounter either doubles or quadruples but few singles or triples. The numbers above imply that 72 percent of the primaries have distant stellar companions (that may themselves be doubles in each case), but we cannot say whether the remaining 28 percent of the primaries have distant degenerate companions or no distant companions at all. In summary, our plausible model is given in Table 9, i.e., all of the primaries are double and at least 72 percent may be quadruple.

We should emphasize that the results above are derived for F3–G2 IV, V stars, and they may not apply to much earlier or later-type dwarfs, even though there seems to be no major change within the narrow spectral range studied.

We should also emphasize that statements above regarding certain aspects of star and binary formation are simply apparent deductions from the observational data; a real understanding of the formation processes must depend on a consistent physical analysis.

Finally, we can ask two additional questions. First, how much mass occurs in the companions to the 123 primaries? Most of it occurs in the more massive of the stellar companions. The sum of the secondary masses gives 81 $\mathfrak{M}_\odot$ for 162 $\mathfrak{M}_\odot$ in the primaries, i.e., the companions have just half of the total primary mass. Thus the problem with the missing mass in galaxies is unlikely to be solved by the mass in companions to stars. Second, how much visual light is contributed by the companions? Again, the more massive of the stellar companions contribute almost all of the light. On the average the secondaries contribute 0.23 of the primary light, so the multiple systems are 0.22 mag brighter than the primaries. Therefore, when comparing real stars with stellar models, the former should be about 0.22 mag brighter on the average.

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TABLE 9

CONCLUSIONS REGARDING TOTAL MULTIPLICITY

	Primaries ($P <$ 100 years)	Distant Companions ($P >$ 100 years)
Stellar companions............	~67%	~72%
Degenerate companions........	~33	0–28

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