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Speckle Interferometry of Metal-Poor Stars in the Solar Neighborhood. II

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Abstract. The results of speckle interferometric observations of 115 metal-poor stars ([m/H] < -1) within 250 pc from the Sun and with proper motions $\mu \gtrsim 0.2''$/yr, made with the 6-m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences, are reported. Close companions with separations ranging from $0.034''$ to $1''$ were observed for 12 objects — G76-21, G59-1, G63-46, G135-16, G168-42, G141-47, G142-44, G190-10, G28-43, G217-8, G130-7, and G89-14 — eight of them are astrometrically resolved for the first time. The newly resolved systems include one triple star — G190-10. If combined with spectroscopic and visual data, our results imply a single:binary:triple:quadruple star ratio of 147:64:9:1 for a sample of 221 primary components of halo and thick-disk stars.

1. INTRODUCTION

Metal-poor stars of the Galactic halo and thick disk bear important information about the chemical and kinematical properties of matter at the epoch of the formation of the Milky Way. Of special importance is the study of the orbital parameters of binary and multiple systems, which provide a source of data on stellar masses and luminosities.

To estimate the fraction of multiple stars and determine the orbital parameters of old metal-poor stars, we started a speckle interferometric survey of such objects located within 250 pc from the Sun. Rastegaev et al. (2007) described a sample of 223 population-II dwarf stars in the solar neighborhood and reported the results of the survey of the first 109 stars of the sample performed with the 6 m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences (SAO RAS). The sample includes nearby F, G, and early K-type subdwarfs down to 12th magnitude in the V band (Fig. 1) with metalicities [m/H] < -1 and proper motions $\mu \gtrsim 0.2''$/yr (Fig. 2). In this paper we continue to report the results of speckle interferometric observations for the remaining 114 stars of the halo and thick disk performed with the 6 m telescope of the SAO RAS in 2007. We also report the results of repeated speckle-interferometric observations of our earlier resolved subsystem of the quadruple star G89-14 (Rastegaev et al., 2007).

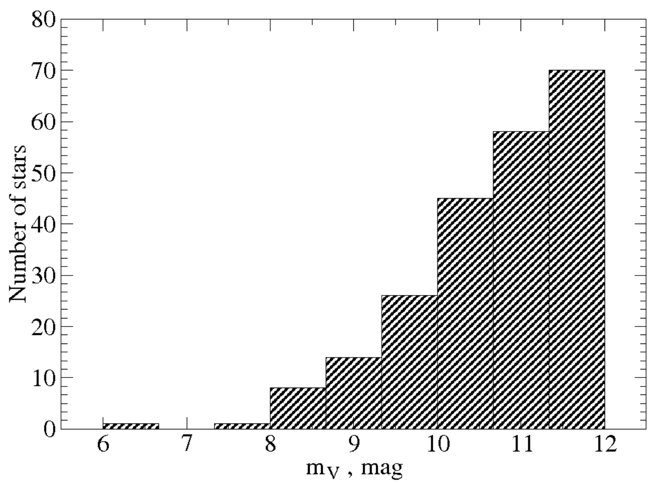

Fig. 1. Distribution of the V-band magnitudes of stars of the sample studied.

2. OBSERVATIONS

The speckle-interferometric observations were performed with the 6 m telescope of the of the SAO RAS in March (52 objects), June–July (52 objects), and September (10 objects), 2007. In addition, we also reobserved in two filters the interferometric subsystem of the quadruple star G89-14 that we discovered in December, 2006 (Rastegaev et al., 2007). In September we observed six objects resolved in June and July (G141-47, G142-44, G217-8, G130-7,G190-10, and G28-43). We also reobserved the unresolved objects G183-9, G24-17, G26-1, and G128-11 in order to obtain their power spectra with higher signal-to-noise ratio.

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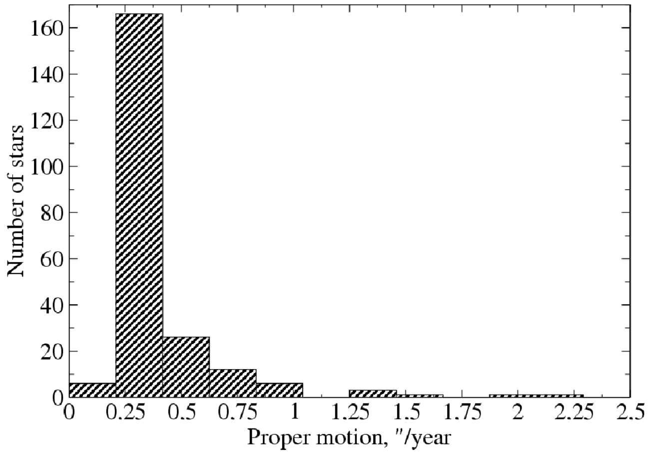

Fig. 2. Distribution of the proper motions of the stars of the sample. For better visualization, we do not show in the histogram the star G122-51 with anomalously high proper motion ($\mu = 7.042$ $''$/yr).

In our observations we use a facility based on EMCCD (a 512×512 CCD with internal electron gain), which has high quantum efficiency and linearity, allowing objects to be discovered with component magnitude differences $\triangle m \lesssim 5$ at the diffraction-limited resolution of the telescope. The size of the detector field ($4.4''$) allowed secondary components to be discovered at separations as large as $3''$ from the primary star.

We recorded the speckle interferograms in three filters: 550/20, 600/40, and 800/100 nm (the numbers indicate the central transmission wavelength of the filter and the transmission bandwidth, respectively) with exposures ranging from 5 to 20 milliseconds. We took 2000 images in each filter for almost all the objects observed in March and 1940 exposures for every object observed in June, July, and September.

Weather conditions during March set were not favorable for speckle-interferometric observations (seeing was at about $3''$). During the June and September observations, on the contrary, seeing was $(1.0 - 1.5)''$, and sometimes even better than $1''$.

We calibrated our measurements using the so-called "standard" pairs—binaries with well-known component separations and position angles. In addition, in September we used an opaque mask with a pair of circular holes, which was located in the beam converging from the primary mirror of the telescope, to calibrate the scale and position angle. The known geometry of the holes allows the image scale and angular orientation of the CCD to be determined in each filter from the fringe pattern. In this method we used Deneb as the bright source.

Descriptions of the technique that we used to determine the relative positions and component magnitude differences of the objects studied from speckle interferograms averaged over a series of power spectra can be found in Balega et al. (2002) and Pluzhnik (2005). The accuracy of this technique may be as good as 0.02^m, $0.001''$, and $0.1°$ for the component magnitude difference, separation, and position angle, respectively.

3. RESULTS OF OBSERVATIONS

Table 1 lists the resolved stars. We observed the speckle-interferometric components for 12 objects, one of them is the quadruple system G89-14, which was resolved for the first time in December, 2006 (Rastegaev et al., 2007). We were the first to astrometrically resolve eight (G76-21, G135-16, G141-47, G142-44, G190-10, G28-43, G217-8, and G130-7) of the 11 remaining systems. Among the new systems we point out G190-10, where we discovered the third component in the earlier known spectroscopic binary (Latham et al., 2002).

In addition to new observations, we also report the results of our re-reduction of stars from (Rastegaev et al., 2007) (Table 2). Our new results for these stars slightly differ from those reported in our previous paper (Rastegaev et al., 2007) by corrected estimates of angular separations due to the refined coefficients of the transition from pixel measurements to angular units. It goes without saying that these corrections have appreciable effect only for wide pairs. In addition, we also thoroughly analyzed the measurement errors for each object and, in contrast to our earlier paper (Rastegaev et al., 2007), give the epoch of observation for each individual pair. We list the so far unresolved stars in Table 3.

4. SUPPLEMENTARY DATA FOR RESOLVED STARS

In this section we gather the supplementary data on resolved stars (see also Table 4). For some of the objects we give two distances inferred from trigonometric (Perryman, 1997) and photometric (Carney et al., 1994) parallaxes. The latter distance is evidently underestimated, because it does not take the additional component into account. On the other hand, the additional component also contributes to the error of the measured trigonometric parallax, especially in short-period systems.

G76-21 ($02^h41^m13\overset{s}{.}6$ $+09°46'12''$; HIP 12529). It is an F2-type star (SIMBAD database) at a heliocentric distance of about 190 pc (Perryman, 1997) or 90 pc according to Carney et al. (1994). The star was observed using the method of lunar occultations, but it was not resolved into individual components (Richichi & Percheron, 2002). It is known as a suspected SB2 system based on the results of metallicity measurements (Carney et al., 1994). Spectroscopic observations of this star show signs of about 10-day periodicity, however, no conclusive evidence could be found for radial-velocity variations (Latham, 2008). We were the first to astrometrically resolve this star.

G89-14 ($07^h22^m31\overset{s}{.}5$ $+08°49'13''$; HIP 35756; WDS 07224+0854). We earlier discovered the fourth component (Rastegaev et al., 2007) in the triple system consisting of a spectroscopic binary with a period of 190 days (Latham et al., 2002) and a common proper-motion companion at an angular separation of 34″ from this binary (Allen et al., 2000). Repeated observations in the 550/20 filter failed to reveal the speckle interferometric component at a distance of 0.98″ from the spectroscopic pair, because in this part of the spectrum the component in question is 5^m fainter than the SB1 pair. Observations in the 800/100 filter (see Table 1) performed in March, 2007, confirmed the results of the December, 2006 observations to within the quoted errors. The heliocentric distance of the quadruple system is equal to 95 pc (Carney et al., 1994) or to about 170 pc according to (Perryman, 1997).

G59-1 ($12^h08^m54\overset{s}{.}7$ $+21°47'19''$; HIP 59233; WDS 12089+2147). It is a triple system. The inner pair, which has an integrated spectral type of G2V(SIMBAD database) was discovered by *HIPPARCOS* (Perryman, 1997). The outer component, which is located at an angular distance of about 16″, has common proper motion with the inner pair (Allen et al., 2000). We resolved the inner subsystem. The heliocentric distance is equal to about 110 pc (Perryman, 1997) or 50 pc according to (Carney et al., 1994).

G63-46 ($13^h39^m59\overset{s}{.}6$ $+12°35'22''$; HIP 66665; WDS 13400+1235). A double star of spectral type F9V (SIMBAD database) was first resolved by the *HIPPARCOS* satellite (Perryman, 1997) and measured speckle interferometrically by Zinnecker et al. (2004) and Hartkopf et al. (in preparation). The heliocentric distance of the system is equal to about 130 pc (Perryman, 1997) or 60 pc (Carney et al., 1994).

G135-16 ($14^h04^m01\overset{s}{.}6$ $+22°31'30''$; HIP 68714). A double star of spectral type G2 (SIMBAD database). This pair, which we astrometrically resolved for the first time, must be an SB1 type spectral binary with a period of 2606 days (Latham et al., 2002). Its estimated heliocentric distance is about 80 pc (Perryman, 1997) or 65 pc (Carney et al., 1994).

G168-42 ($16^h19^m51\overset{s}{.}7$ $+22°38'20''$; HIP 80003). An astrometric binary (Zinnecker et al., 2004, Law et al., 2006) of spectral type sd:G2 (SIMBAD database). We are the first to report the component magnitude difference for this system. Latham et al. (2002) list it as a spectroscopic binary with unknown period. The star exhibits a systematic decrease of radial velocity over more than 24 years of its spectroscopic observations(Latham, 2008). Its heliocentric distance is about 110 pc (Perryman, 1997) or 100 pc (Carney et al., 1994) if inferred from the trigonometric or photometric parallax, respectively.

G141-47 ($18^h53^m16\overset{s}{.}5$ $+10°37'26''$; BD+10°3711 TYC 1030-316-1). This first resolved pair with an angular separation of about 0.04″ is an SB1 spectroscopic binary with a period of 388.52 days (Latham et al., 2002) and a spectral type of F8 (SIMBAD database). We may have discovered the third component in the known spectroscopic pair. The heliocentric distance to this object is 110 pc (Carney et al., 1994). The system was observed twice in June in the 550/20 and 800/100 filters, and also in September in the 800/100 filter. In Table 1 we give only the preliminary photometry of the speckle interferometric pair based on the results of the June observations in the 800/100 filter due to the low signal-to-noise ratio of the integrated power spectra.

G142-44 ($19^h38^m53\overset{s}{.}2$ $+16°25'34''$; NLTT 48059; TYC 1602-2423-1). This first resolved G5-type binary is located at a heliocentric distance of 110 pc (Carney et al., 1994). We observed this pair four times (see Table 1), and three of them in the 800/100 filter. The weak fringe contrast in the power spectrum in the 600/40 filter allowed only the lower boundary of component magnitude difference to be estimated in this part of the spectrum.

G190-10 ($23^h07^m59\overset{s}{.}8$ $+41°51'20''$; NLTT 55914; TYC 3224-2564-1). A new triple system of spectral type G1 (SIMBAD database). We found the third, outer component at an angular distance of 0.98″ from this earlier known SB1 system with a period of 30 days (Latham et al., 2002). The object is located at a distance of 90 pc (Carney et al., 1994).

G28-43 ($23^h09^m32\overset{s}{.}9$ $+00°42'40''$; HIP 114349). A binary of the spectral type G2 (SIMBAD database), which we resolved for the first time. The object is located at a distance of 40 pc (Carney et al., 1994). The *HIPPARCOS* catalog lists no parallax for the system (SIMBAD database). The wide component CCDM J23096+0043B at an angular separation of 12.2″ does not form a physical pair (Zapatero Osorio & Martin, 2004).

G217-8 ($23^h26^m32\overset{s}{.}8$ $+60°37'43''$; HIP 115704). We were the first to astrometrically resolve this F2-type spectroscopic binary (SIMBAD database) with a preliminary orbit (9632 days period) (Latham et al., 2002). The distance to the system is equal to about 110 pc (Perryman, 1997) or 105 pc (Carney et al., 1994). We observed the object twice: in June, in the 600/40 filter and in September, in the 800/100 filter. Unfortunately, the insufficient quality of the power spectra in both filters did not make it possible to determine the component magnitude difference and showed up in the accuracy of the inferred positional parameters (see Table 1).

G130-7 ($23^h45^m00\overset{s}{.}1$ $+30°20'10''$; HIP 117150). An F-type system (SIMBAD database) at a distance of about 160 pc (Perryman, 1997) (or 120 pc from other data (Carney et al., 1994)), which was resolved for the first time.

5. MULTIPLICITY OF STARS

5.1. Distant Components

We use the additional available data on spectroscopic multiplicity (Goldberg et al., 2002, Latham et al., 2002) and distant components from the WDS (Mason et al., 2001) for the 114 objects studied. Whereas spectroscopic and interferometric measurements provide conclusive evidence indicating that the components in question are physically bound, wide visual components should be treated with more care. We found a total of 104 WDS companions for our stars and discarded most of them as optical projections. Table 5 lists the data for all the wide components found for the stars of our sample. Column 1 gives the names of the stars studied; column 2—all the WDS components found for the star. For the components found to be physically bound to the stars of the sample columns 3 and 4 list the angular separation (in arcsec) and magnitude difference, respectively. Column 5, which is entitled "Status", indicates the components that we consider to be physically bound with the primary star ("+") and optically projected (unbound) pairs ("−"). The additional question mark in this column indicates that we are not certain about the adopted decision, nd a single question mark indicates that only a single measurement is available, which does not allow any conclusions concerning the physical bound between the components. The last column gives the references to the papers containing the data on the corresponding pair and whether the physical association between the components is confirmed or disproved. These are in all cases the papers of Allen et al. (2000) and Zapatero Osorio & Martin (2004) dedicated to wide pairs of population-II stars and the HIPPARCOS catalog (Perryman, 1997). The additional $\star$ symbol in this column indicates that our observations confirm the presence of the component considered. In cases with no references given we made decision concerning the physical boundness on our own, based on the data listed in the WDS catalog. To this end, we analyzed the variations of component separations and magnitude differences with time.

As a result, we left only seven WDS components (marked "+" or "+?") of 104, and took them into account when counting the number of systems of different multiplicity.

5.2. Ratio of systems of different multiplicity

We computed the ratio of systems of different multiplicity using all the published data on the observations of the corresponding systems using various methods. Of the 114 stars considered 27 are spectroscopic binaries (Goldberg et al., 2002; Latham et al., 2002; Carney et al., 1994) and 11 stars are speckle interferometric binaries. Seven stars have companions from the WDS catalog. When analyzing spectroscopic binaries we took into account both the pairs with known orbital periods and the systems for which no periods have been determined. It goes without saying that there exist components which can be found using several different methods. In addition, we also analyzed the ratio of systems of different multiplicity from Rastegaev et al. (2007). We excluded G120-15 from the list of binary stars, because only one measurement of the positional parameters is available for this star, which does not allow any conclusions be made for it. We added two unaccounted binaries BD+25° 1981 and HD97916 from (Carney et al., 2001), and assumed the three systems—G43-3 (see also (Carney et al., 2001)), G186-26, and G210-33 to be binaries based on the small variation of radial velocities (Latham, 2008).

As a result, the single:binary:triple:quadruple ratio for the 221 primary-component halo and thick-disk stars (Rastegaev et al., 2007) discovered using all methods is equal to 147:64:9:1. Thus out of 306 stars considered—223 observed stars and 83 their satellites—more than a half (159) belong to multiple systems. The multiplicity of the sample—i.e., the ratio of the number of multiple systems to the total number of systems—is about 33%.

Duquennoy & Mayor (1991) obtained a similar estimate for disk stars of spectral types ranging from F7 to G9 and found it to be 51:40:7:2. We point out the difference between the two samples compared. Whereas we constructed our sample by selecting stars with certain magnitudes and space velocities, the sample of Duquennoy and Mayor is only distance limited: all their stars are located within 22 pc from the Sun.

6. CONCLUSIONS

The speckle interferometric survey of 223 metal-poor stars from the solar neighborhood was performed with the 6 m telescope of the Special Astrophysical Observatory. Nineteen binary and multiple systems were resolved. From these, 15 objects were resolved astrometrically for the first time. Three of our resolved systems—G76-21 (HIP 12529), G114-25 (HIP 44111), and G217-8 (HIP 115704) have metallicities $[m/H] < -2$ (Carney et al., 1994). The additional data on the spectroscopic (Goldberg et al., 2002; Latham et al., 2002; Carney et al., 1994; Carney et al., 2001) and astrometric (Mason et al., 2001; Zapatero Osorio & Martin, 2004; Allen et al., 2000) multiplicity allowed us to estimate the single:binary:triple:quadruple star ratio to be 147:64:9:1.

Part of the speckle interferometric pairs with relatively short periods are suitable for monitoring in order to compute their orbits and determine the masses of metal-poor stars, which are necessary for the calibration of the mass–luminosity relation. Such studies are of great importance, because even now we badly lack the empirical data for the metallicity interval considered.

The sample presented in (Rastegaev et al., 2007) is the most thoroughly analyzed one in terms of the multiplicity of halo and thick-disk stars. This circumstance allows the sample to be used for statistical studies where physically bound components play important part. One must bear in mind the selection effects due to heliocentric distances to the objects, their multiplicity and proper motions. An addition, low-mass companions could be missed for the stars of survey because of limitations of the methods. All this must stimulate further observations and theoretical studies.

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References

C. Allen, A. Poveda and M. A. Herrera, A&A **356**, 529 (2000).

I. I. Balega, Y. Y. Balega, K.-H. Hofmann, et al., A&A **385**, 87 (2002).

B. W. Carney, D. W. Latham, J. B. Laird et al., AJ **107**, 2240 (1994) (CLLA).

B. W. Carney, D. W. Latham, J. B. Laird et al., AJ **122**, 3419 (2001).

A. Duquennoy and M. Mayor, A&A **248**, 485 (1991).

D. Goldberg, T. Mazeh, D. W. Latham et al., AJ **124**, 1132 (2002).

W. I. Hartkopf, B. D. Mason, and T. Rafferty, (in preparation).

D. W. Latham, R. P. Stefanik, G. Torres et al., AJ **124**, 1144 (2002).

D. W. Latham, personal communication (2008).

N. M. Law, S. T. Hodgkin, and C. D. Mackay, MNRAS **368**, 1917 (2006).

B. D. Mason, G. L. Wycoff, W. I. Hartkopf et al., AJ **122**, 3466 (2001).

M. A. C. Perryman, ESA, *The Hipparcos and Tycho Catalogues* (ESA Publ. Division, SP–1200, 1997).

E. A. Pluzhnik, A&A **431**, 587 (2005).

D. A. Rastegaev, Yu. Yu. Balega, E. V. Malogovets, AstBu **62**, 251 (2007).

A. Richichi, I. Percheron, A&A **386**, 492 (2002).

SIMBAD database: http://simbad.u-strasbg.fr/simbad/sim-fid

M. R. Zapatero Osorio and E .L. Martin, A&A **419**, 167 (2004).

H. Zinnecker, R. Kohler, and H. Jahreiss, Rev. Mex. A & A **21**, 33 (2004).

Table 1. Results of the speckle-interferometric measurements for resolved objects

Name of the object	Other designation	Epoch	$\Theta(^\circ)$	σ_Θ	$\rho\ ('')$	σ_ρ	$\triangle m$	$\sigma_{\triangle m}$	$\lambda/\triangle\lambda$
G76-21	HIP 12529	2007.73116	206.4	0.7	0.047	0.001	0.4	0.1	800/100
G89-14	HIP 35756	2007.24040	0.8	0.4	0.982	0.005	4.3	0.1	800/100
G59-1	HIP 59233	2007.24333	280.5	0.7	0.098	0.002	1.4	0.1	800/100
G63-46	HIP 66665	2007.24084	82.9	0.3	0.222	0.001	0.94	0.02	550/20
G135-16	HIP 68714	2007.24388	174.8	1.7	0.034	0.001	0.7	0.1	550/20
G168-42	HIP 80003	2007.24109	208.0	0.4	0.180	0.001	1.34	0.02	800/100
G141-47	BD+10 ° 3711	2007.48727	143	4	0.041	0.005	0.9	0.6	800/100
G141-47	BD+10 ° 3711	2007.48728	139	20	0.034	0.013			550/20
G141-47	BD+10 ° 3711	2007.73870	137	6	0.044	0.005			800/100
G142-44	NLTT 48059	2007.49008	193.2	0.7	0.661	0.007	3.7	0.2	800/100
G142-44	NLTT 48059	2007.49286	192.9	0.5	0.663	0.005	3.7	0.1	800/100
G142-44	NLTT 48059	2007.49287							600/40
G142-44	NLTT 48059	2007.73871	193.3	0.5	0.665	0.005	3.85	0.06	800/100
G190-10	NLTT 55914	2007.51184	287.0	0.2	0.977	0.001	1.39	0.02	800/100
G190-10	NLTT 55914	2007.73885	286.9	0.3	0.982	0.002	1.37	0.02	800/100
G190-10	NLTT 55914	2007.73886	286.9	0.3	0.982	0.002	1.73	0.03	550/20
G28-43	HIP 114349	2007.51209	37.6	0.4	0.425	0.003	3.35	0.04	800/100
G28-43	HIP 114349	2007.51210	37.4	0.6	0.425	0.004	3.5	0.1	600/40
G28-43	HIP 114349	2007.73877	37.7	0.4	0.424	0.003	3.32	0.03	800/100
G217-8	HIP 115704	2007.49527	263	5		0.09	0.02		600/40
G217-8	HIP 115704	2007.72510	260	5		0.07	0.02		800/100
G130-7	HIP 117150	2007.51188	230.0	1.5	0.191	0.005	2.98	0.06	800/100
G130-7	HIP 117150	2007.73888	230.7	1.0	0.191	0.004	2.95	0.04	800/100

Table 2. Speckle-intermerometric measurements of objects resolved by Rastegaev et al. (2007)

Name of the object	Other designation	Epoch	$\Theta(^\circ)$	σ_Θ	$\rho\ ('')$	σ_ρ	$\triangle m$	$\sigma_{\triangle m}$	$\lambda/\triangle\lambda$
G102-20	HIP 26676	2006.94164	308.0	2.8	0.119	0.006	3.2	0.4	550/20
G191-55	BD+58° 876	2006.94475	125.1	0.3	0.806	0.007	2.00	0.11	800/100
BD+19° 1185A	HIP 28671	2006.94711	183.6	0.7	0.114	0.002	1.77	0.04	550/20
G89-14	HIP 35756	2006.94455	0.8	0.4	0.979	0.009	4.1	0.4	800/100
G87-45	NLTT 18038	2006.94723	271.3	0.5	0.282	0.004	2.01	0.04	550/20
G87-45	NLTT 18038	2006.94724	270.7	0.4	0.282	0.003	1.76	0.04	800/100
G87-47	HIP 36936	2006.94725	54.0*	2.1	0.077	0.003	1.7	0.3	800/100
G111-38AB	HIP 38195	2006.94751	7.9	0.7	0.084	0.002	0.78	0.03	550/20
G111-38AB	HIP 38195	2006.94749	7.8	1.3	0.084	0.002	0.75	0.03	800/100
G111-38AC	HIP 38195	2006.94751	200.0	0.3	2.111	0.018	1.34	0.04	550/20
G111-38AC	HIP 38195	2006.94749	200.0	0.3	2.112	0.018	1.10	0.04	800/100
G111-38BC	HIP 38195	2006.94751	199.5	0.3	2.193	0.019	0.57	0.05	550/20
G111-38BC	HIP 38195	2006.94749	199.5	0.3	2.194	0.019	0.36	0.05	800/100
G114-25	HIP 44111	2006.94742	323.7	0.5	0.773	0.008	3.9	0.2	800/100

*—the position of the secondary component is known with ±180° ambiguity.

Table 3. Unresolved stars

Name	Filter ($\lambda/\Delta\lambda$,nm)	Epoch	Name	Filter ($\lambda/\Delta\lambda$,nm)	Epoch
G265-1	550/20; 800/100	2007.4952	G20-15	550/20; 800/100	2007.4871
G130-65	800/100	2007.5147	G182-31	550/20	2007.2493
G31-55	600/40; 800/100	2007.7253	G183-9	550/20	2007.2494
HD 3567	600/40; 800/100	2007.7254	G183-9	600/40	2007.5090
G242-65	600/40	2007.4953	G183-11	550/20	2007.2493
G242-71	600/40	2007.4952	G182-32	800/100	2007.2437
G271-162	800/100	2007.7391	G183-16	550/20	2007.2493
BD-1° 306	550/20; 800/100	2007.7391	G20-24	550/20; 800/100	2007.4872
G75-31	800/100	2007.7312	G140-44	550/20; 800/100	2007.4873
G4-36	800/100	2007.7312	G140-46	550/20; 800/100	2007.4872
G4-37	800/100	2007.7312	G206-34	800/100	2007.2493
G75-56	800/100	2007.7366	G21-19	550/20; 800/100	2007.4872
G95-11	800/100	2007.7367	G125-5	550/20	2007.2493
G89-14	550/20	2007.2404	G92-6	600/40; 800/100	2007.4901
G13-9	550/20	2007.2406	BD+26° 3578	550/20; 800/100	2007.4901
G11-44	550/20	2007.2406	HD 188510	550/20; 800/100	2007.4901
G123-9	800/100	2007.2464	G186-26	600/40; 800/100	2007.4929
G12-21	550/20	2007.2406	HD 194598	600/40	2007.4954
G13-35	550/20	2007.2406	G262-14	600/40; 800/100	2007.4953
G13-38	550/20	2007.2406	G24-17	600/40	2007.4955
G199-20	800/100	2007.2465	G24-17	800/100	2007.5065
G59-27	800/100	2007.2464	G24-25	800/100	2007.5064
G60-46	550/20	2007.2407	G210-33	800/100	2007.5117
G60-48	550/20	2007.2407	G212-7	550/20; 800/100	2007.5117
G14-33	800/100	2007.2408	HD 201891	550/20; 800/100	2007.4955
G177-23	550/20	2007.2465	G25-24	800/100	2007.5065
G255-32	800/100	2007.2466	G187-40	800/100	2007.5118
G62-52	550/20	2007.2435	G26-1	600/40; 800/100	2007.4901
G64-12	800/100	2007.2436	G26-1	800/100	2007.5065
G150-40	800/100	2007.2464	G126-10	800/100	2007.5093
G165-39	550/20	2007.2464	G93-27	800/100	2007.5065
G65-22	800/100	2007.2463	G231-52	600/40; 800/100	2007.4953
G64-37	800/100	2007.2409	G188-22	800/100	2007.5118
G239-12	800/100	2007.2466	G126-36	800/100	2007.5066
G178-27	550/20	2007.2464	G188-30	800/100	2007.5118
G201-5	800/100	2007.2435	G232-40	600/40	2007.4953
G66-30	550/20	2007.2410	G214-5	800/100	2007.5118
G166-54	800/100	2007.2409	G27-8	800/100	2007.5066
G66-51	550/20	2007.2410	G126-52	600/40	2007.5092
G179-22	550/20	2007.2465	G126-62	600/40	2007.5092
G201-44	550/20	2007.2435	LFT 1697	800/100	2007.5066
G15-24	800/100	2007.2466	G18-39	800/100	2007.5093
G168-26	800/100	2007.2410	G156-7	800/100	2007.5093
G180-24	550/20	2007.2434	G18-54	600/40	2007.5093
G202-35	800/100	2007.2435	G27-33	800/100	2007.5093
G180-58	800/100	2007.2434	G233-26	600/40	2007.4953
G153-64	800/100	2007.2438	G128-11	600/40	2007.5094
G17-25	550/20; 800/100	2007.2438	G128-11	800/100	2007.5119
G202-65	800/100	2007.2435	G242-14	600/40	2007.4952
G180-66	800/100	2007.2435	G68-3	550/20; 800/100	2007.5119
G169-28	800/100	2007.2412	G190-15	550/20; 800/100	2007.5119
G139-8	800/100	2007.2411	G29-25	800/100	2007.5121
G19-25	550/20	2007.2494	G29-71	800/100	2007.5121
G139-49	550/20	2007.2494	G20-8	550/20	2007.2494

Table 4. Supplementary data on resolved stars

Name of the system/subsystem	**Coordinates (2000.0)**	$\mathbf{m_V}$	**[m/H]***	**Total number of components**
G76-21	$02^h41^m13^s.6$ $+09°46'12''$	10.17	−2.28	2
G89-14	$07^h22^m31^s.5$ $+08°49'13''$	10.40	−1.90	4
G59-1	$12^h08^m54^s.7$ $+21°47'19''$	9.49	−1.14	3
G63-46	$13^h39^m59^s.6$ $+12°35'22''$	9.37	−1.03	2
G135-16	$14^h04^m01^s.6$ $+22°31'30''$	10.16	−1.04	2
G168-42	$16^h19^m51^s.7$ $+22°38'20''$	11.51	−1.42	2
G141-47	$18^h53^m16^s.5$ $+10°37'26''$	10.5	−1.34	2
G142-44	$19^h38^m53^s.2$ $+16°25'34''$	11.16	−1.17	2
G190-10	$23^h07^m59^s.8$ $+41°51'20''$	11.22	−1.92	3
G28-43	$23^h09^m32^s.9$ $+00°42'40''$	9.96	−1.80	2
G217-8	$23^h26^m32^s.8$ $+60°37'43''$	10.47	−2.24	2
G130-7	$23^h45^m00^s.1$ $+30°20'10''$	11.72	−1.62	2

*—metallicities are adopted from the CLLA catalog (Carney et al., 1994).

Table 5: WDS components for the stars of the sample

Name	WDS companion	ρ ($''$)	$\triangle m$	Status	References
G242-65	00437+7211OSO 10AB			–	(Zapatero Osorio & Martin, 2004)
	00437+7211OSO 10AC			–	(Zapatero Osorio & Martin, 2004)
G59-1	12089+2147HDS1714Aa	0.3	2.25	+	(Perryman, 1997), $\star$
	12089+2147LDS 930AB	15.7	5.51	+	(Allen et al., 2000)
G62-52	13360+0112OSO 54			–	(Zapatero Osorio & Martin, 2004)
G63-46	13400+1235HDS1917	0.2	0.68	+	(Perryman, 1997), $\star$
G239-12	14189+7314OSO 55AB			–	(Zapatero Osorio & Martin, 2004)
	14189+7314OSO 55AC			–	(Zapatero Osorio & Martin, 2004)
G179-22	15144+3301OSO 62			–	(Zapatero Osorio & Martin, 2004)
G15-24	15307+0824OSO 64			–	(Zapatero Osorio & Martin, 2004)
G180-24	16032+4215OSO 67			–	(Zapatero Osorio & Martin, 2004)
G168-42	16199+2238OSO 68AB			–	(Zapatero Osorio & Martin, 2004)
	16199+2238OSO 68AC			–	(Zapatero Osorio & Martin, 2004)
G180-58	16283+4441OSO 71			–	(Zapatero Osorio & Martin, 2004)
G153-64	16325-0834OSO 72			–	(Zapatero Osorio & Martin, 2004)
G17-25	16348-0412GIC 144AB	1170.7	4.25	+	(Zapatero Osorio & Martin, 2004)
	16348-0412LMP 14AC			–	(Zapatero Osorio & Martin, 2004)
	16348-0412LMP 14BD			–	(Zapatero Osorio & Martin, 2004)
	16348-0412LMP 14BE			–	(Zapatero Osorio & Martin, 2004)
G169-28	16502+2219OSO 74AB			–	(Zapatero Osorio & Martin, 2004)
	16502+2219OSO 74AC			–	(Zapatero Osorio & Martin, 2004)
G19-25	17260-0245OSO 78AB			–	(Zapatero Osorio & Martin, 2004)
	17260-0245OSO 78AC			?	
G20-8	17398+0225OSO 83AB			–	(Zapatero Osorio & Martin, 2004)
	17398+0225OSO 83AC			–	(Zapatero Osorio & Martin, 2004)
G20-15	17475-0847OSO 84AB			–	
	17475-0847OSO 84AC			–	
	17475-0847OSO 84AD			–	
G182-31	17523+3624OSO 85			–	(Zapatero Osorio & Martin, 2004)
G183-9	17530+1521OSO 86AB			–	(Zapatero Osorio & Martin, 2004)
	17530+1521OSO 86AC			–	(Zapatero Osorio & Martin, 2004)
G183-11	17547+2016OSO 88			–	(Zapatero Osorio & Martin, 2004)
G182-32	17551+3745OSO 89AB			–	(Zapatero Osorio & Martin, 2004)
	17551+3745OSO 89AC			–	(Zapatero Osorio & Martin, 2004)
	17551+3745OSO 89AD			–	(Zapatero Osorio & Martin, 2004)
G20-24	18079+0153OSO 93AB			?	
	18079+0153OSO 93AC			–	(Zapatero Osorio & Martin, 2004)
	18079+0153OSO 93AD			–	(Zapatero Osorio & Martin, 2004)
	18079+0153OSO 93AE			–	(Zapatero Osorio & Martin, 2004)
	18079+0153OSO 93AF			–	
G140-44	18115+1455OSO 94			–	(Zapatero Osorio & Martin, 2004)
G140-46	18124+0524OSO 95			–	(Zapatero Osorio & Martin, 2004)
G206-34	18353+2842OSO 101AB			–	(Zapatero Osorio & Martin, 2004)
	18353+2842OSO 101AC			–	(Zapatero Osorio & Martin, 2004)
	18353+2842OSO 101AD			–	(Zapatero Osorio & Martin, 2004)
	18353+2842OSO 101AE			–	(Zapatero Osorio & Martin, 2004)
	18353+2842OSO 101AF			–	(Zapatero Osorio & Martin, 2004)
G92-6	19297+0102OSO 109AB			–	(Zapatero Osorio & Martin, 2004)
	19297+0102OSO 109AC			–	(Zapatero Osorio & Martin, 2004)
	19297+0102OSO 109AD			?	
	19297+0102OSO 109AE			?	
	19297+0102OSO 109AF			–	(Zapatero Osorio & Martin, 2004)
	19297+0102OSO 109AG			?	
	19297+0102OSO 109AH			–?	

Table 5: WDS components of the stars of the sample (Contd.)

Name	WDS companion	ρ ($''$)	$\triangle m$	Status	Reference
	19297+0102OSO 109AI			?	
	19297+0102OSO 109AJ			–	(Zapatero Osorio & Martin, 2004)
	19297+0102OSO 109AK			?	
G142-44	19389+1626OSO 110AB			–	
	19389+1626OSO 110AC			–	(Zapatero Osorio & Martin, 2004)
	19389+1626OSO 110AD			–	(Zapatero Osorio & Martin, 2004)
	19389+1626OSO 110AE			–	(Zapatero Osorio & Martin, 2004)
	19389+1626OSO 110AF			–	(Zapatero Osorio & Martin, 2004)
	19389+1626OSO 110AG			–?	
	19389+1626OSO 110AH			–	(Zapatero Osorio & Martin, 2004)
G186-26	20248+2503OSO 125AB			?	
	20248+2503OSO 125AC			–?	
G210-33	20454+4023OSO 133AB			–	(Zapatero Osorio & Martin, 2004)
	20454+4023OSO 133AC			–	(Zapatero Osorio & Martin, 2004)
	20454+4023OSO 133AD			–	(Zapatero Osorio & Martin, 2004)
	20454+4023OSO 133AE			–	(Zapatero Osorio & Martin, 2004)
G212-7	20553+4218OSO 137AB			–	(Zapatero Osorio & Martin, 2004)
	20553+4218OSO 137AC			–	(Zapatero Osorio & Martin, 2004)
	20553+4218OSO 137AD			–	(Zapatero Osorio & Martin, 2004)
	20553+4218OSO 137AE			?	
	20553+4218OSO 137AF			–	(Zapatero Osorio & Martin, 2004)
	20553+4218OSO 137AG			–	(Zapatero Osorio & Martin, 2004)
G187-40	21220+2727OSO 145			–	(Zapatero Osorio & Martin, 2004)
G93-27	21399+0623OSO 151AB	3.3	2.66	+	(Zapatero Osorio & Martin, 2004)
	21399+0623OSO 151AC			–	(Zapatero Osorio & Martin, 2004)
G231-52	21393+6017OSO 150			–	(Zapatero Osorio & Martin, 2004)
G188-22	21440+2723OSO 155	5.0	6.93	+	(Zapatero Osorio & Martin, 2004)
G188-30	21553+3239OSO 162AB			–	(Zapatero Osorio & Martin, 2004)
	21553+3239OSO 162AC			–	(Zapatero Osorio & Martin, 2004)
G232-40	21554+5608OSO 163AB			–	(Zapatero Osorio & Martin, 2004)
	21554+5608OSO 163AC			–	(Zapatero Osorio & Martin, 2004)
G214-5	21592+4102OSO 164AB			–	(Zapatero Osorio & Martin, 2004)
	21592+4102OSO 164AC			–	(Zapatero Osorio & Martin, 2004)
	21592+4102OSO 164AD			–	(Zapatero Osorio & Martin, 2004)
G27-8	22032-0113LDS4938AB			–?	
	22032-0113OSO 166AC			?	
G126-62	22115+1806CHR 119Aa,Ab	0.2		+?	
	22115+1806OSO 171Aa,B			–	(Zapatero Osorio & Martin, 2004)
LFT 1697	22144-0845OSO 174			–	(Zapatero Osorio & Martin, 2004)
G18-39	22186+0827OSO 175			–	(Zapatero Osorio & Martin, 2004)
G27-33	22328-0557OSO 181			–	(Zapatero Osorio & Martin, 2004)
G233-26	22399+6143OSO 184AB			–	(Zapatero Osorio & Martin, 2004)
	22399+6143OSO 184AC			–	(Zapatero Osorio & Martin, 2004)
G190-10	23080+4151OSO 189			–	(Zapatero Osorio & Martin, 2004)
G217-8	23265+6038OSO 196AB			–	(Zapatero Osorio & Martin, 2004)
	23265+6038OSO 196AC			–	(Zapatero Osorio & Martin, 2004)
	23265+6038OSO 196AD			–	(Zapatero Osorio & Martin, 2004)
	23265+6038OSO 196AE			–	(Zapatero Osorio & Martin, 2004)
G130-7	23450+3020OSO 204			–	(Zapatero Osorio & Martin, 2004)
G29-71	23500+0843OSO 207			–	(Zapatero Osorio & Martin, 2004)