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New spectroscopic components in multiple systems. IV. ⋆

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Abstract. New close sub-systems are discovered and studied in eight visual multiple systems. Elements of one double-lined and eight single-lined spectroscopic orbits are given. Magnitudes, colors, spectral types, masses of individual components are estimated by combining all available data. The visual secondary component of the young binary HD 27639 is a double-lined pair of G-type dwarfs on a 17-day orbit with an unseen but massive ($> 1.2\ M_{\odot}$) spectroscopic tertiary on an 8-year orbit. The invisible secondary of HD 28271A is also massive, but it is not seen probably owing to a high luminosity of the primary – an F7 star with fast axial rotation and active chromosphere which evolves off the Main Sequence. Two additional companions are found in the visual triple system HD 179484.

Key words. binaries:spectroscopic – binaries:visual

1. Introduction

This work continues the publications of spectroscopic orbits for the components of late-type multiple stars observed with CORAVEL-type radial velocity spectrometer. In our first paper (Tokovinin 1997a, Paper I) the motivation for this observing program and the methods of data analysis are described. Subsequent orbits were published in (Tokovinin 1998, paper II) and in (Tokovinin 1999a, paper III). Here we present further nine orbits, following the same strategy which needs not to be repeated. The results of this study are incorporated into the current version of Multiple Star Catalogue (Tokovinin 1997b).

Now the observing program on multiple stars is almost finished. In this last paper we give the orbital elements that could not be determined earlier because of some problems (long periods, high eccentricity, close or additional companions etc.). Naturally, most of these orbits are of lower quality than those published previously in these series, and some may qualify only as preliminary ones.

A correlation Radial Velocity Meter (RVM) (Tokovinin 1987) was used for the measurements. Most observations which form the basis of this work were made in 1994-2000 with the 70-cm telescope located on the Moscow University campus and with the 1-m telescope of the Simeis Observatory in Crimea. Velocity zero point was determined by observations of several IAU velocity standards each night. The precision of radial velocities ranges from 0.3 km·s^{-1} for bright stars to 1-2 km·s^{-1} for faint objects or for low-contrast dips. Three observations were also made by AAT in 1994 with the CORAVEL spectrometer (Baranne et al. 1979) at the Haute Provence Observatory.

2. Basic data

Table 1. Object identification

IDS(1900)	ADS	HD	HIP	Other
00010 + 5752	61	123	518	HR 5
03317 + 0015	2644	22468B	16836	HR 1099
04165 + 2523	3161	27638B	20430	HR 1369
04226 + 3008	3243	28271	20904/07	HR 1406
04302 + 0957	3317	29140B	21402	HR 1458
15333 − 0827	9728	139461	76603/02	HR 5816
18214 + 5135	11328	169816	90141	BD+51 2372
19077 + 3837	12145	179484	94252	BD+38 3466

⋆ Table 4 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

Table 1 contains the identifications for the eight systems: IDS (1900) index, ADS number (Aitken 1932), HD number, Hipparcos number (ESA 1997), and other identifiers for primary components. The ADS and HD numbers exist for all these systems and they will be used throughout this paper.

Basic data on system components (spectral types, visual magnitudes and $B-V$ colors) are given in the left columns of Table 2 and were collected from the literature or from SIMBAD. Most of the photometry is taken from the Tycho catalogue (ESA 1997). Proper motions and trigonometric parallaxes are taken either from the Hipparcos catalogue or from other sources found through SIMBAD (in parentheses). The last four columns of Table 2 summarize the results of our study and contain the mean radial velocities, the number of measurements, the mean equivalent width EW of the cross-correlation (CC) dip, and the projected axial rotational velocities $V \sin i$, as found from the width of CC dip. The method of $V \sin i$ determination and the dependence of EW on $B-V$ color and metallicity are described in Paper I and in (Tokovinin 1990). Parameters of CC dip are given separately for both components of the double-lined system HD 27638Bab.

3. Spectroscopic orbits and system parameters

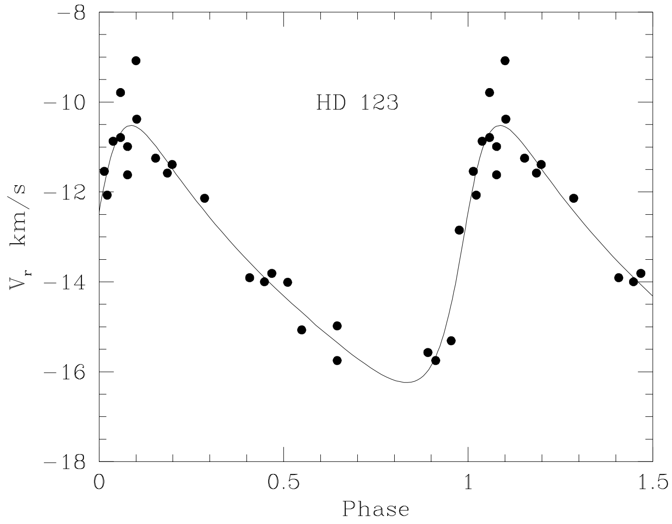

Fig. 1. Radial velocity curve of ADS 61B = HD 123. The amplitude is reduced owing to the blending of the A and B dips.

The final orbital elements were found by least-squares fitting with weights inversely proportional to the square of formal velocity errors. The elements and their formal errors are given in Table 3. Number of measurements used (primary and secondary lines counted separately) and the rms error of unit weight are given in the 9th column of Table 3. Its last column contains mass function for single-lined systems or $M \sin^3 i$ for the components of the double-lined system. Individual observations, their errors and residuals can be found in Table 4 which is available in electronic form only. It contains also the measurements of non-variable components (a total of 403 velocities of fifteen components). The three CORAVEL measurements are marked as COR in the last column. The two measurements rejected in orbit computations are marked by colons.

As in the papers I-III, the best guess of the component's parameters ("models") is given in Table 5. The periods of outer sub-systems of the CPM type are estimated very roughly from their apparent separations. Each multiple system is discussed below individually.

4. Discussion of individual systems

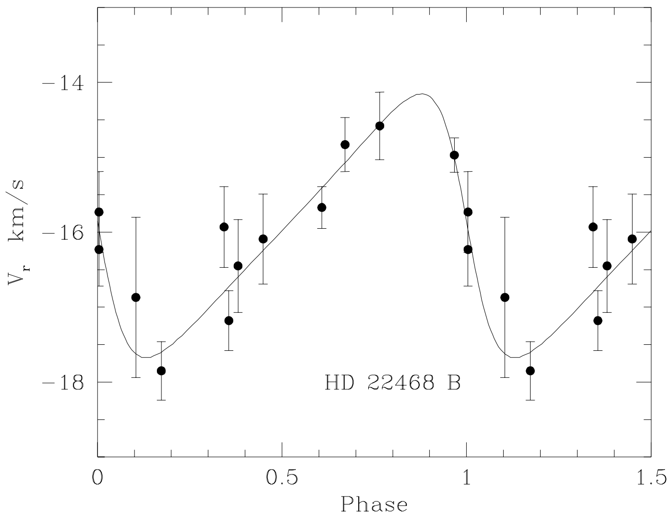

Fig. 2. Radial velocity curve of ADS 2644B = HD 22468B.

ADS 61 = HD 123. The components AB separated by 1$''$.5 were mostly unresolved and show small velocity variations with a period of 47.5 days (Fig. 1). Corresponding orbit is given in Table 3. On few occasions it was possible to measure the radial velocities of A and B separately, to establish that it is the component B that is actually a spectroscopic binary. At this stage R. F. Griffin kindly communicated us the results of his study of ADS 61 (Griffin 1999) which agreed with our conclusions. His orbit is of better quality, but its independent confirmation from the RVM data seems to be worth publication, in view of the controversial results of Weber & Strassmeier (1998). The value of K_1 is reduced by ~ 3 times because of dip blending, it is hence meaningless to compute the mass function from our orbit. For the same reason the orbital elements e and ω differ from those found by Griffin.

ADS 2644 = HD 22468. Slow variations of the radial velocity of B component are fitted to a 1152-day orbit of low quality (Fig. 2). Minimum secondary mass is 0.07 $M_\odot$. Visual primary A is a 2.8-day double-lined chromospheri-

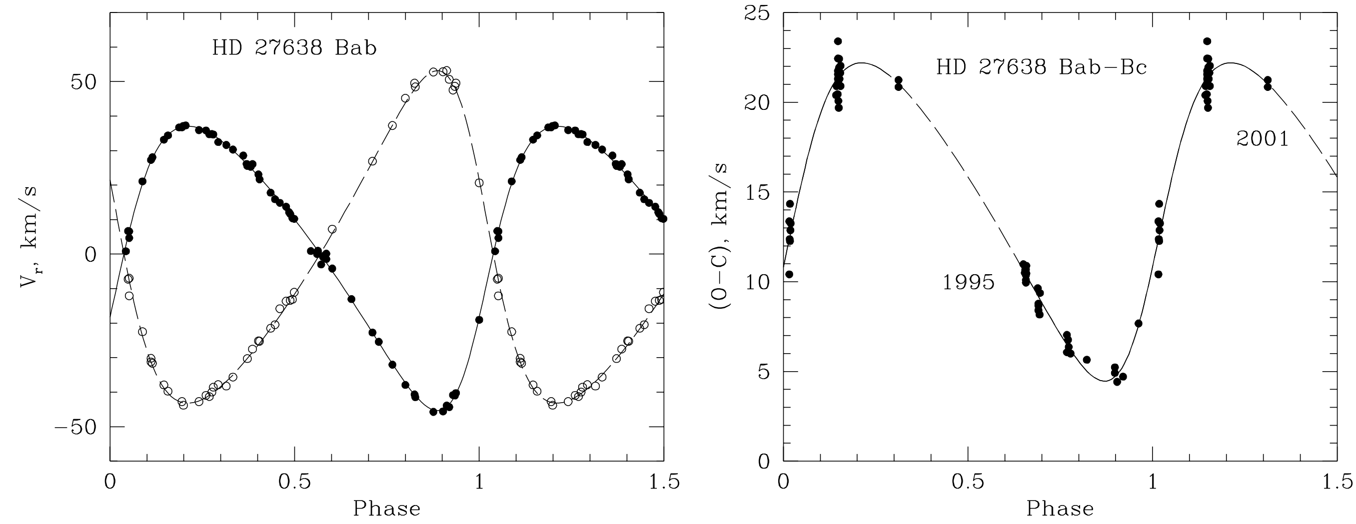

Fig. 3. The double-lined orbit of HD 27638Bab computed with removed long-period variations (left) and the residuals to this orbit fitted to a 8-yr orbit of Bab-Bc (right). Part of the orbit not yet covered by observations is plotted in dashed line.

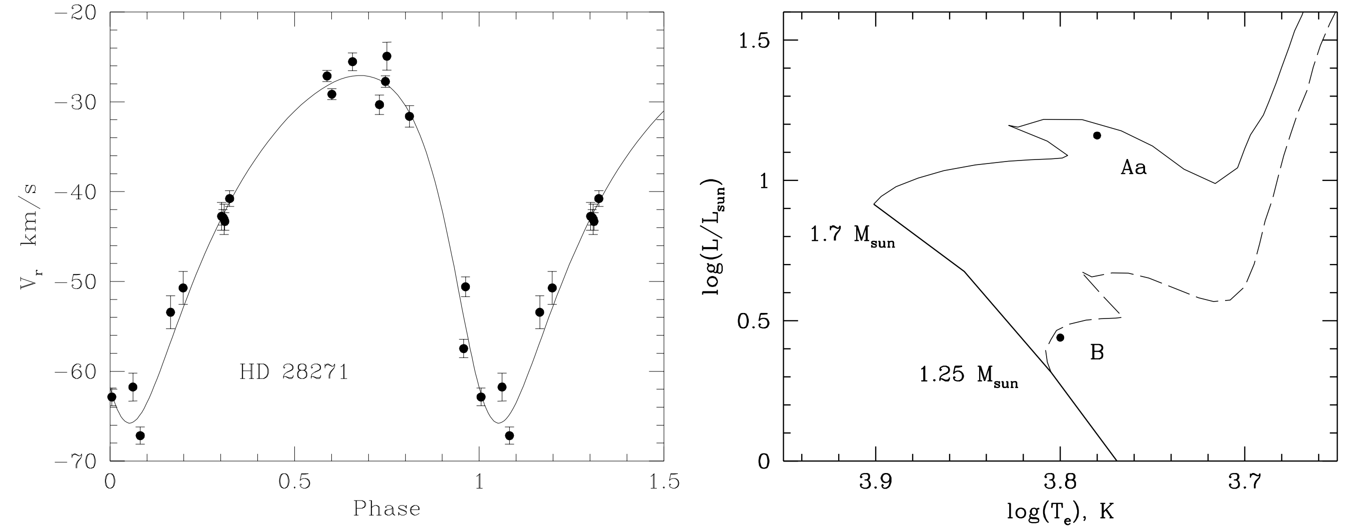

Fig. 4. Radial velocity curve of ADS 3243A = HD 28271 (left). The evolutionary tracks for stars with masses of 1.12 and 1.7 $M_\odot$ (Schaller et al. 1992), the Main Sequence and the positions of the components on the H-R diagram are shown on the right.

cally active binary V711 Tau with components of spectral types G5IV and K1IV. With the Hipparcos parallax the components Aa, Ab and Ba all lie some 1.2^m above the Main Sequence (MS); Ba has normal dip *EW* and slow axial rotation.

ADS 3161 = HD 27638. Double-lined nature of the G2V secondary accompanying a young B-type primary χ Tau (estimated age 123 Myr, Lindroos 1986) was discovered by Martín et al. (1992), who also found high lithium abundance. Independently, we discovered the double lines in 1995, after first observations. However, in the next season it became apparent that the systemic velocity changes, revealing the existence of a third component which is called here Bc. Only $\approx$ 70% of the long period is covered as yet, but a preliminary orbital solution is already reasonably well defined (Table 3 and Fig. 3 right). The discovery of this spectroscopic triple was announced in (Tokovinin 1999b).

Elements of the short 17-day orbit of Bab (Fig. 3 left) were computed by subtracting the long-period motion from the data. Hence, the systemic velocity is zero by definition. Residuals from the Bab orbit are then used to refine the long orbit Bab-Bc (in fact, we used only good measurements with errors less than 0.5 km·s^{-1} , and added two systemic velocities measured from blended dips in 2001). This iterative process was repeated twice. In Table 4 the final residuals to the short orbit (with long-period motion removed) are given.

The mass ratio Bb:Ba is 0.85, the magnitude difference (as found from the equivalent width of the two dips) is 1.1^m. The system Bab can be modeled by two dwarfs of spectral types G0V and G6V (cf. Table 5). This model matches the observed EW, combined luminosity, combined $B-V$ color, magnitude difference and mass ratio, leaving little room for the third light. Both components Ba and Bb have slow axial rotation.

The nature of the long-period companion Bc remains a mystery: it is too massive! Even with the minimum mass of Bab of 1.13 $M_\odot$ the minimum mass of Bc must be 0.9 $M_\odot$; our model corresponds to the Bc minimum mass of 1.28 $M_\odot$. Of course, the long orbit is still tentative, but period can not be much shorter, and the semi-amplitude is well defined, so the estimate of the Bc mass will not decrease when the definitive solution is available. We searched for the dip produced by Bc by taking long exposures at phases of maximum velocity difference in the Bab pair. Nothing was seen, which means that Bc must be at least 5 times fainter than Bb (dip contrast < 1 %).

The Bc component can be a close pair of M dwarfs with masses around 0.6 $M_\odot$ each. Alternatively, it may be a single star obscured by circumstellar dust. The apparent semi-major axis of the Bab-c orbit must be 0."07. In October 1997, when the B-component was observed by speckle interferometry in the K band at the 6 m telescope (Balega et al. 2001), the estimated separation of the Bab-Bc pair was 0."054 – just below the diffraction limit in the K band, 0."09.

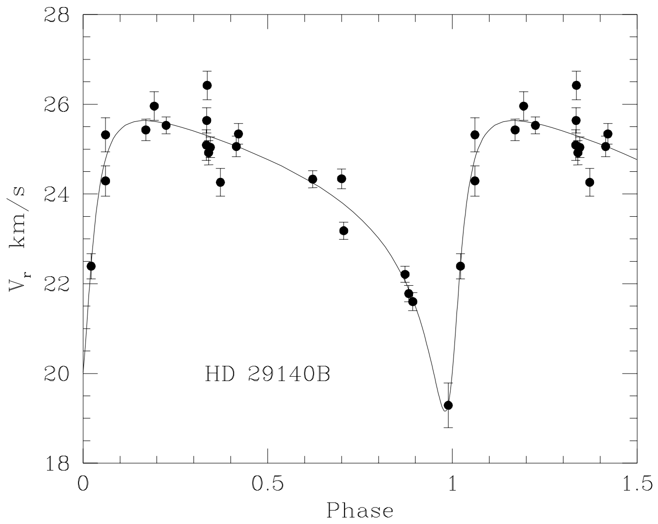

Fig. 5. Radial velocity curve of ADS 3317B = HD 29140B.

ADS 3243 = HD 28271. Both A and B components of this bright visual pair have correlation dips of very low contrast widened by a fast axial rotation. The scanning range of RVM is only 50 km·s^{-1} , and two overlapping scans were usually obtained to get the full dip profile. Radial velocities derived from such dips are of low accuracy, as seen in Fig. 4, and the dip parameters given in Table 2 are approximate.

The equivalent widths of the A and B dips correspond to their spectral type F7 and to their $B-V$ colors. Yet, the minimum mass of Ab is 1.4 $M_\odot$, i.e. comparable to the mass of Aa if it were an F7V dwarf. Looking at the photometric data for A and B, it becomes apparent that although A is brighter than B by 1.8^m, it has a sightly redder color (the latter is confirmed by Shatskii, 1998). Both components were measured by Hipparcos independently. Their concordant proper motions and radial velocities leave no doubt that it is a physical system. However, the Hipparcos parallax places A at 1^m above the MS, and B at 1^m below the MS.

We presume that the orbital motion of Aab with a period of 1.26 yr, unaccounted for in the reduction of Hipparcos data, caused a large error in the measured parallax. In fact, if B is indeed a normal F7V dwarf, the parallax must be around 12 mas. Then Aa must have an absolute magnitude of about $M_V = 1.8^m$. We place both components on the evolutionary tracks of Schaller et al. (1992) in Fig. 4 (right). It seems that the Aa component has a mass around 1.7 $M_\odot$ and an age of 1.8 Gyr; it is leaving the Main Sequence. Its fast axial rotation explains a high chromospheric activity as manifested by a large X-ray flux of 10^{30} erg·s^{-1} (Hünsch et al. 1998).

If this model is correct, the minimum mass of the invisible spectroscopic secondary Ab is 1.4 $M_\odot$, and it could be either a slightly evolved F2V star or a close pair of low-mass dwarfs. The semi-major axis of Aab is 21 mas, which means that the photo-center must wobble with an amplitude of 10 mas. This triple system is an ideal target for future interferometric and astrometric work aimed at determining the physical parameters of the components which happen to transit a rare evolutionary stage.

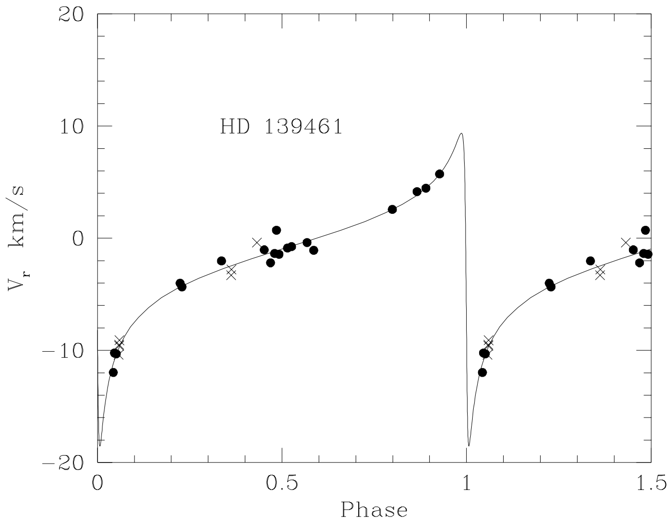

Fig. 6. Radial velocity curve for a highly eccentric orbit of ADS 9728A = HD 139461. The measurements by Struve & Zebergs (1959) are marked by crosses.

ADS 3317 = HD 29140. The visual primary A is a quadruple system, consisting of two close spectroscopic pairs forming a 18-yr interferometric binary (Balega et al.

Table 2. Basic observational data

ADS	Comp.	Sp. type	V	B–V	μ_α mas/y	μ_δ mas/y	π mas	V_r km·s^{-1}	$N_{\rm obs}$	EW km·s^{-1}	$V \sin i$ km·s^{-1}
61	A	G5V	6.34	0.67	247	18	49.3±1.0	-13.8 ± 0.2	24	2.71± 0.02	-
	B	G8V	7.27	-	280	56					
2644	A	G9V	5.91	0.86	-33	-163	34.5 ± 0.9	-15.0	-	-	-
	B	K6V	8.79	1/03				-15.9 ± 0.2	12	2.85 ± 0.09	< 4.7
3161	A	B9V	5.37	-0.05	20	-18	12.2±1.0	17.0	-	-	-
	B	G2V	8.41	0.58	(38)	(-12)	-	14.0 ± 0.3	90	1.51 ± 0.02	2.9 ± 0.6
										0.75 ±0.02	0
3243	A	F7V	6.38	0.54	23	-20	18.4 ±1.6	-41.6 ± 0.6	20	2.05 ± 0.07	33:
	B		8.17	0.48	14	-22	21.5 ±7.5	-43.3 ± 0.4	9	2.10 ± 0.15	22:
3317	A	A5m	4.25	0.18	45	-52	21.7±0.8	29.0			
	B	F8V	7.84	0.54	(38)	(-50)		24.0 ± 0.2	21	2.26 ± 0.03	4.9 ± 0.4
9728	A	F6V	6.49	0.49	17	-27	40.2 ±3.6	-1.3 ± 0.2	26	1.83 ± 0.03	5.3 ± 0.4
	B	F6IV	6.56	0.52	1	-24	44.2 ±4.7	1.2 ± 0.1	18	1.85 ± 0.03	6.8 ± 0.4
11328	A	G5	9.01	0.61	47	132	15.7±1.7	-35.9 ± 0.4	22	3.02:	-
	B		9.15	0.64				-31.7 ± 0.4	23	2.93:	-
	C		10.36	0.62				-21.5:	15	2.10 ± 0.11	-
12145	B	G6V	8.15	0.73	-228	-106	20.5 ±1.3	25.6 ± 0.1	35	2.53 ± 0.03	< 2.7
	A	G9V	8.60	0.79?	-238	-99		26.1 ± 0.1	32	1.68:	-
	C		9.10		-246	-84		22.8 ± 0.6	32	1.00:	-

Table 3. Elements of spectroscopic orbits

ADS HD	P days	T JDH	e	ω °	K_1 km·s^{-1}	K_2 km·s^{-1}	γ km·s^{-1}	N σ_V	$f(m)$ or $M\sin^3 i$ $M_\odot$	
61 AB	47.51	50798.52	0.418	289	2.86	–	-13.79	24	–	
123	±0.04	±0.95	±0.056	±11	±0.21		±0.14	0.51		
2644 B	1152	50362	0.40	88	1.76	–	-15.94	12	0.0005	
22468 B	±44	±85	±0.22	±31	±0.55		±0.17	0.33	±0.0004	
3161 Bab	17.60249	50000.617	0.297	249.9	41.19	48.18	0	105	0.610	0.522
27638 Bab	± 0.00028	± 0.029	±0.003	±0.6	± 0.16	± 0.24	*	0.90/1.21	±0.006	±0.005
3161 Bab-c	2951	51010	0.262	254	8.87	–	14.06	57	0.192	
27638 Bab-c	±194	±32	±0.051	±6	±0.18		±0.28	0.69	±0.014	
3243 A	460.7	50456	0.314	143	19.35	–	-41.58	19	0.295	
28271 A	±3.5	±8	±0.048	±7	±0.88		±0.59	3.06	±0.037	
3317 B	1350	50498	0.663	223	3.24	–	23.97	21	0.0020	
29140 B	±35	±34	±0.075	±9	±0.44		±0.18	0.41	±0.0005	
9728 A	887.66	51016.8	0.900	105	13.96	–	-1.33	26	0.019:	
139461	±0.21	±3.9	*	*	±0.43			0.44		
11328 B	126.38	50498.6	0.331	319.0	18.27	–	-31.68	23	0.067	
169816B	±0.22	±2.1	±0.036	±6.0	±0.44		±0.37	1.01	±0.005	
12145 C	522.7	50761.0	0.606	58.3	16.66	–	22.83	33	0.126	
179484C	±2.2	±2.9	±0.041	±3.6	±1.09		±0.29	0.92	±0.012	

1999). The parameters of those 4 stars as listed in Table 5 are not yet well established. Here we show that B is also a binary with a low-mass companion on a 3.7-yr orbit (Fig. 5). Thus the whole system is sextuple. The semi-major axis of the Bab orbit must be 6 mas or more. The orbital motion may be detectable in the future by precise astrometry in order to find the inclination and the mass of Bb.

ADS 9728 = HD 139461/60. The bright pair ADS 9728 with negative declination could be observed only during a limited period of each year. The primary component HD 139461 was discovered as a spectroscopic binary by

Table 5. Models of multiple systems

ADS π, *mas* m-M	Comp.	V	B–V	Sp. type	Mass, $M_\odot$	Sys.	Type	Period	Sep. $''$
61	A	6.34		G3V	0.98	AB	V	106.8 y	1.43
49.3	Ba	7.99		G9V	0.86	Bab	SB1	47.7 d	0.013
1.5	Bb	10.4		M3V	0.31				
2644	Aa	6.24		G5IV	0.90	AB	V	2100 y	8.02
34.5	Ab	7.24		K1IV	0.76	Aab	SB2	2.84 d	0.0016
1.2	Ba	8.83	0.99	K6V	0.65	Bab	SB1	1152 d	0.066
	Bb			M	> 0.07				
3161	A	5.37	-0.05	B9V	3.80	AB	CPM	21000 y	19.4
12.2	Ba	8.75	0.54	G0V	1.10	Bac	SB1	8.1 y	0.073
4.6	Bb	9.83	0.69	G6V	0.94	Bab	SB2	17.6 d	0.002
	Bc	> 12		?	> 1.2				
3243	Aa	6.39	0.52	F7III	1.7	AB	CPM	20000 y	14.2
12	Ab			F2V?	> 1.4	Aab	SB1	461 d	0.020
4.6	B	8.31	0.48	F7V	1.2				
3317	Aa	4.52		A2Vm	1.9	AB	CPM	70000 y	69.7
21.7	Ab	6.92		F7V?	1.12	AP	V	18.05 y	0.241
3.3	Pa	7.16		F7V?	1.12	Aab	SB2	3.57 d	0.0014
	Pb	7.16		F7V?	1.12	Pab	SB?	-	-
	Ba	7.84	0.54	F8V	1.2	Bab	SB1	1350 d	0.057
	Bb			M?	> 0.15				
9728	Aa	6.48	0.50	F6V	1.25	AB	CPM	5000 y	11.8
27	Ab			M?	> 0.36	Aab	SB1	888 d	0.059
2.8	B	6.50	0.52	F6V	1.25				
11328	A	9.08	0.61	G5V	0.94	AB	v	1400 y	2.60
15.7	Ba	9.22	0.64	G5V	0.94	Bab	SB1	126 d	0.009
1.5	Bb			K-M	> 0.5				
12145	Ba	8.15	0.73	G6V	0.90	BA	CPM	2000 y	4.50
20.5	Bb	?		?	?	Bab	SB1	> 9 y	> 0.1
3.4	A	8.60	0.77	G7V	0.85	AC	V	63 y	0.37
	Ca	9.10	0.83	G9V	0.80	Cab	SB1	523 d	0.029
	Cb	12?		K8V?	> 0.64				

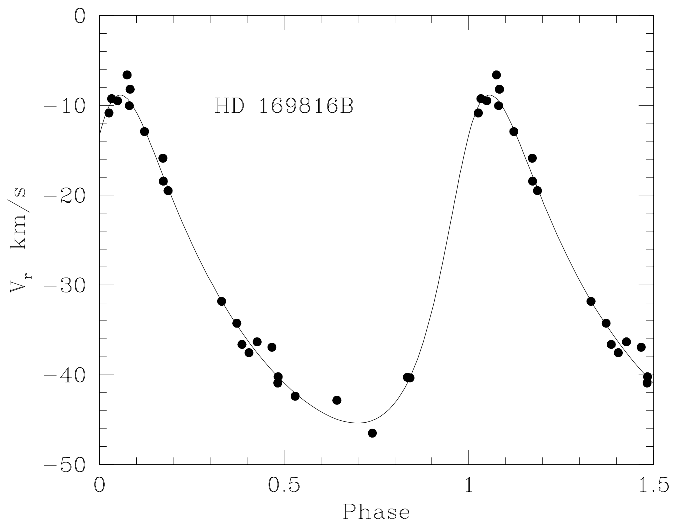

Fig. 7. Radial velocity curve of ADS 11328B = HD 169816B.

Christie & Wilson (1938) and confirmed by Struve & Zebergs (1959), although neither of them attempted to determine an orbit. The orbital period is now known to be 2.4 yr, but it is evident that the eccentricity is high and not yet constrained by the data (Fig. 6). The data from Struve & Zebergs were used to refine the period, after a correction of -1.8 km·s^{-1} that brings the mean velocity of the B component into the agreement with our measurements. Elements e and ω are kept fixed in our preliminary orbital solution.

A special observing campaign must be planned to "catch" the periastron passage which may be very short (e.g. 2 days in case of ADS 11061A, Tokovinin 1995). Unfortunately, the last periastron passage occurred in January 2001 when the object was difficult to reach even from the southern hemisphere. This means that there are at least 3 years to wait for a definitive orbit, which justifies the publication of the preliminary solution.

The model of the system presented in Table 5 assumes that both components have normal luminosities, and that the Hipparcos parallax is erroneous because of the orbital motion of A (its large error of 4 mas can be viewed as an

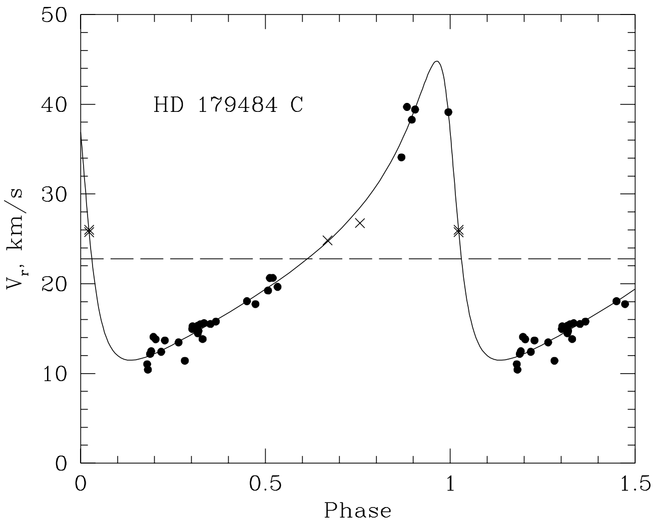

Fig. 8. Radial velocity curve of ADS 12145C (left) and the radial velocities of B as a function of Julian date with a linear trend fitted (right).

indirect evidence of the astrometric perturbation in the parallax solution).

ADS 11328 = HD 169816. The observations of AB with a separation of only 2.″6 were always difficult. Components could be measured separately only under good seeing, without guaranteeing that the resolution was indeed complete. Nevertheless, the orbit presented in Fig. 7 almost qualifies for a definitive one. When the velocities of A and B differed by more than 15 km·s^{-1} they could also be measured as an unresolved double-lined system. The profile parameters in Table 2 are unreliable because of components blending on the slit.

The third visual component ADS 11328C was observed and found to be a double-lined binary. Most of the velocities given in Table 4 are obtained from the unresolved dip of varying contrast, they concentrate around −20 km·s^{-1} indicating that it is an optical companion. Dip contrast is smaller than that of A and B, also suggesting that C is in fact a background star in this rich galactic-plane field. For this reason we stopped the observations of C and did not attempt to derive its orbit. The spectral type of C can be estimated as G3V from the $B-V$ color or as F7V from the dip EW.

ADS 12145 = HD 179484. This star was recognized as double for the first time by W. Struve in 1830 and was named Σ 2481. Both components are nearly equal, but the northern one is slightly brighter, and hence it was called A. Since its discovery, the pair AB has opened up from 3.″8 to 4.″6 and moved clockwise in position angle from 234 to 204 degrees.

Later, in 1856, A. Secchi (1860) has found that one of the visual components is a closer binary SE 2. In the ADS (Aitken 1932) this close pair is attributed to the component B and is called BC. The WDS (Worley & Douglass 1997) continues this notation, but, nevertheless, in the Notes it is said that "SE 2 is the NP component of STF 2481 (van den Bos)". Heintz (1991) confirms that the close pair is indeed the northern component of Σ 2481, the same follows from the Double and Multiple Star Annex to the Hipparcos catalogue (ESA 1997). We keep this notation of the components: the close pair is hence called AC. Although the northern system AC is brighter than B in combined light, the component B is brighter than either A or C taken separately.

We measured the radial velocities of ADS 12145 from 1994 to 2000. The relatively small separation between AC and B made it necessary to rotate the RVM instrument in order to turn the slit in the unusual east-west direction for better discrimination between the components. Even with this precaution, the separation of the light from AC and B was not complete under bad seeing conditions.

It was found that the radial velocity of B is apparently constant, while that of AC changes by few km·s^{-1} . Those variations were accompanied by the changing width and contrast of the correlation dip. Here we deal with a triple system: the strongest dip of A is stationary, and the dip of C changes its position, although these two dips always remain blended.

After several trials, we found a period of 520 days and selected the dip parameters (contrasts of 6% for C and 10% for A, a FWHM of 15 km·s^{-1} for both) that lead to an acceptable orbital solution for the Cab motion (Fig. 8 left) when the individual velocities were extracted from the blended dips. The elements of the final spectroscopic orbit of C computed with the adopted dip parameters are given in Table 3. Four unresolved measurements of AC corresponding to the superposition of their dips were also used in orbit computation with reduced weight, these points are shown by crosses.

The radial velocities of the constant dip (component A), when fitted to this 522-day orbit, show only a slight trace of the orbital motion (formally, $K_1 = -0.96$ km$\cdot$s^{-1} , $V_0 = 26.14 \pm 0.20$ km$\cdot$s^{-1}). This proves that the dip parameters adopted in de-blending are almost correct. No additional periods were found in the velocities of A. Note that the average velocity of A is different from that of C because of the AC motion in its 63-yr visual orbit. The components AC are actually close to apastron, hence the variation of the velocity caused by the visual orbit during the time of our observations can be neglected.

Taking the mass of Ca to be 0.8 $M_\odot$ according to its spectral type, we obtain from the orbit the minimum mass of the invisible component Cb, 0.64 $M_\odot$. This corresponds to a dwarf star of the late K spectral type which must have an apparent magnitude around 12^m. The contrast of its dip would be 0.4%, i.e. not noticeable. Alternatively, Cb can be a white dwarf. We note that the mass ratio of the AC system that follows from the adopted masses (Table 5), $\beta = M_C/M_A = 0.64$, does not agree with the astrometric determination of Heintz (1991) who finds $\beta = 0.454$. The amplitude of the wobble in the AC orbital motion that is caused by the Cab sub-system is estimated to be $0\farcs01$, it can be detectable by speckle interferometry.

Turning to the radial velocities of B (Fig. 8 right), we detect an apparent trend of 0.3 km$\cdot$s^{-1} per year. The measurement obtained in 1992 by Smekhov & Tokovinin (1993) is added to this plot (originally it was attributed to the wrongly identified southern component BC). Thus, B itself is a spectroscopic binary with a period longer than 9 yr and, apparently, a low-mass secondary which does not manifest itself by changing the dip shape. The total number of components known to date in ADS 12145 is thus five.

5. Conclusions

Among the nine spectroscopic sub-systems presented in this paper, only three were known previously and re-discovered by us independently. Compared to the previous papers of this series, the objects studied here are more difficult, but also more interesting. They include a young spectroscopic triple HD 27638B with unseen and massive tertiary, an interesting evolutionary stage of HD 28271A, an additional sub-system in the sextuple stellar system χ Tau, a candidate high-eccentricity binary HD 139461, and two additional components in the visual triple ADS 12145. In these cases further studies with complementary techniques (interferometry, precise astrometry) will be needed.

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