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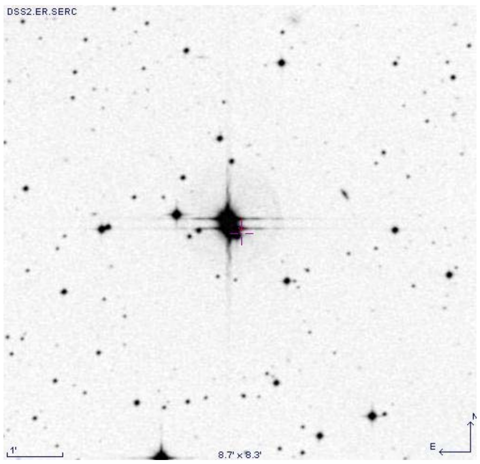

Digitized Sky Survey image of the binary star STF 710 AB. See "Study of Neglected Double Stars by LIADA ..." by Francisco Rica Romero.

Cancelled

Flagstaff Visual Double Star Workshop
Saturday and Sunday, May 30-31, 2009

has been cancelled.

We regret any inconvenience.

Inside this issue:

Astrometric Measurements of the Neglected Visual Double Star ARY 54 AC

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Abstract: As part of a research seminar, high school and college students measured the separation and position angle of the neglected double star ARY 54 AC. They compared their results to past observations reported in the Washington Double Star Catalog. Then, with the help of an experienced double star observer, they determined that ARY 54 AC is an optical double star rather than a gravitationally bound binary system.

Introduction

This project was part of a physics research seminar offered by Cuesta College. The seminar had a diversity of members, with six Coast Union High School students, three Cuesta College students, two college professors, and one middle school volunteer. As suggested by Johnson (2008), visual double stars are excellent targets for student observers because they offer students exposure to basic Newtonian orbital dynamics, calculating precision and accuracy statistics, conducting a straight-forward vector analysis, and forming cooperative working groups, all the while making a modest contribution to science. Our objectives were to contribute measurements of separation and position angle for an infrequently observed double star and to determine if this star is an optical double or a gravitationally bound binary.

We chose ARY 54 AC because it was bright, widely separated, and appropriately positioned in the sky, yet was still among those listed in the "neglected double star" section of the Washington Double Star Catalog (2006). The catalog magnitudes of the primary and secondary stars are 8.1 and 8.9, respectively. The 2006 equatorial coordinates for the primary star are 18h 46m 12.2s in Right Ascension, and +44° 8m 8.3s in Declination.

Observations and Results

On September 4, 2008, members of the research seminar met at Coast Union High School in Cambria, California, to learn a procedure for calibrating astrometric eyepieces using the drift method (Teague, 2004). Observations were made with Frey's 18" Dobsonian telescope and a 12.5 mm Celestron Micro Guide Eyepiece. Although this hands-on experience was educational, we used the scale constant of 12.2 arc seconds per division determined by Frey (2008) in a previous seminar because we deemed it to be more precise.

On September 20, 2008 (B2008.722), Frey, B. Hodges, L. Hodges, Genet, and Johnson met at a Central Coast Astronomical Society observing session near Santa Margarita Lake, California. Frey operated his 18" telescope and instructed seminar member B. Hodges in a proper method of measuring a double star's separation (Teague, 2004). B. Hodges measured the separation of ARY 54 AC while Frey measured its position angle using a novel method he had previously

Astrometric Measurements of the Neglected Visual Double Star ARY 54 AC

Figure 1: Members of the research seminar met at Coast Union High School at the end of the semester to receive certificates of completion. Top row, left to right: Russell Genet, Casey Marlow, Nicole Anderson, Nathan Heaston, Brittany Powell, Annelisa Green, Clifford Mathieson, Vera Wallen, and Jolyon Johnson. Bottom row, left to right: Matthew Dowdy, Erick Vega, Logan Hodges, Bohdi Hodges, and Jonna Horn.

developed to account for field rotation that is associated with alt-az mounted telescopes (Frey, 2008).

On September 25, 2008 (B2008.735), the research seminar members met at Coast Union High School to make additional measurements of the separation of the same neglected star, ARY 54 AC. Frey again measured its position angle. Table 1 shows, for both separation and position angle measurements, the number of observations as well as their average, standard deviations, and standard errors of the mean.

Analysis

Table 2 shows our recent measurements of the separation and position angle for ARY 54 AC as compared to the previously reported (2003) Washington Double Star Catalog values.

ARY 54 AC is reported in the Washington Double Star Catalog as having nine previous observations between 1893 and 2003. The first reported separation was 75.9” while the last was 75.2”. The separation measurements made by the authors differ from the 2003 value by +1.7”. However, the estimated standard deviation of the authors’ observations was 2.9” which was far greater than this difference. Thus our value for the separation is not significantly different from the 2003 value. The somewhat large standard deviation of 2.9” (3.8%) was not unexpected because most observers were making their first quantitative measurements.

The first reported position angle was 47° (1893)

	Separation	Position Angle
Number of Observations	25	14
Average	76.9″	46.7°
Standard Deviation	2.9″	0.8°
Standard Error Of the Mean	0.7″	0.5°

Table 1: Observational Results of ARY 54 AC Sept 4-25, 2008

	Observed (2008)	Literature (2003)
Separation	76.9 ± 2.9″	75.2″
Position Angle	46.7 ± 0.8°	48°

Table 2: Comparisons Between Observations and Catalog Values

while the last was 48° (2003). The 2003 observation was 1.3° larger than our 2008 position angle. A reviewer pointed out that the position angle appears to have been less in 1893 and 2008 then in 2003. Although the difference between 2003 and 2008 was about 1.6 times greater than the estimated standard deviation of 0.8° for our observations, this difference was not large enough to be significant at the 95% confidence level. Therefore, we do not claim that the position angle has decreased based on our observations.

To help determine if ARY 54 AC is a gravitationally bound binary system or, conversely, an unaffiliated optical double, Arnold analyzed the proper motion vectors, parallax, and spectral types of both stars. The proper motion values—the two dimensional motion through space—of the components can help make this determination because, while common proper motion is not a sufficient condition, it is a necessary condition for a visual double star to be in a binary system (Arnold, 2009). The specific proper motion values as reported in the Washington Double Star Catalog (2006) are (in milli-arc seconds per year) RA +2.15, Dec +12.68 for the primary star, and RA +6, Dec +7 for the secondary star.

One standard, which is commonly applied, is that a difference of more than about 10% between the respective proper motion values probably indicates that a given double star is an optical pair and is not bound by gravity. By simply comparing the above values, it can be calculated that the directions of the proper motion vectors, of the "A" and "C" components, have diverged by approximately 30°. The percentage difference of the length of the vector of the "C" component, relative to that of the "A" component, is 28%. The authors believe that, based on our vector analysis, ARY 54 AC is most likely an optical double because the values of the proper motion vector for the "A" component, in right ascension and declination, reveal too much divergence from the values of the "C" component.

Finally, the trigonometric parallax value of the "A" component is 3.7 milliarcseconds (which equates to a distance of 890 light years), while that of the "C" component is 28 milliarcseconds (which equates to a distance of 116 light years), about 7.7 times less (Hipparcos). Furthermore, the spectral type for the "A" component is A5, while that for "C" is K5 (Hipparcos). The large distance between the two stars probably explains why both components have similar apparent magnitudes (8.1 for the primary and 8.9 for the secondary), yet the primary is much more massive than the secondary.

Conclusions

The authors concluded that the difference between the 2003 separation and position angle measurements with respect to the results of this project were not significant at the 95% confidence level. The authors also concluded that ARY 54 AC is an optical double star rather than a binary star based on the 28% difference in proper motion vectors and the 24.3 milliarcsecond difference in trigonometric parallax.

Acknowledgments

The authors thank Coast Union High School instructor Jonna Horn for helping organize the seminar, for the use of her classroom, and for transporting students to special meetings at alternative locations. The authors also thank Coast Union High School instructor Lucinda Wilson for helping the students observe and reduce the data and for attending several meetings. The authors thank Vera Wallen, the retired Coast Union School District Superintendent, for helping organize this seminar. The authors thank the Central Coast Astronomical Society for inviting the students to present their scientific research at an astronomical symposium. The authors thank the United States Naval Observatory for the use of the Washington Double Star Catalog during this project. Lastly, the authors thank Bob Buchheim, Tom Smith, and Morgan Spangle for their helpful reviews and suggestions.

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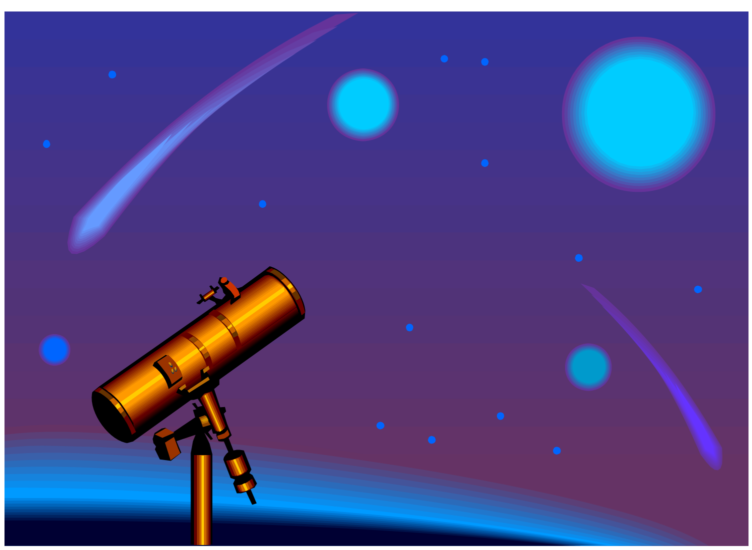
Matthew J. Dowdy, Annelisa F. Green, Nathan B. Heaston, Clifford T. Mathieson, Brittany Powell, and Erick E. Vega are students attending Coast Union High School, ranging from freshmen to juniors, and members of the Fall 2008 Physics 193A Research Seminar at Cuesta College. Bohdi R. Hodges and Megan A. Hoffman are Cuesta College students and also members of the research seminar. Thomas G. Frey provided and operated the telescope for the research seminar and is a Professor of Chemistry at California Polytechnic State University. Jolyon M. Johnson is a student at Cuesta College and the Science Advisor for the research seminar and the Orion Observatory, www.OrionObservatory.org. David Arnold is an experienced double star observer and the Director of Divinus Lux Observatory. Russell M. Genet is a Professor of Astronomy and led the research seminar at Cuesta College. He is also a Research Scholar in Residence at California Polytechnic State University and Director of the Orion Observatory. Logan Hodges, a course volunteer, is a sixth grade student at Santa Lucia Middle School.



Study of Neglected Double Stars by LIADA Double Star Section in 2004, II: Astrometry, Astrophysical Properties and Nature.

Francisco Rica Romero

Astronomical Society of Mérida – SPAIN
Coordinator of LIADA's Double Star Section – ARGENTINA

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Abstract: LIADA's (Liga Iberoamericana de Astronomía) Double Star Section presents angular separations, position angles as well as V magnitudes for 113 neglected visual double stars obtained in 2004. A total of 548 measures were averaged into 246 mean positions that range in separation from 2.6" to 421.9". Our observations were made by means of several techniques (CCD detectors, astrometric eyepieces and photographic and digital surveys). About 31% of the double stars were unconfirmed pairs discovered by John Herschel which remained neglected since before 1850. BVIJHK photometries, astrometric and kinematical data were used/obtained to determine astrophysical parameters (spectral types and luminosity classes, photometric distances, etc). Their nature was determined using several professional criteria classifying them as optical, physical or common origin pairs. Only 12 % were physical double stars. New systems were discovered.

Introduction

Very neglected and unconfirmed double stars were selected to design our observational programs. This sample of double stars have little astrophysical interest (only about 5-10 % are physical pairs), but the task to update their parameters and characterize them is important. Other objects studied were unconfirmed double stars discovered recently by the North American amateurs James Daley (DAL) and Dave Arnold (ARN) and the French amateur J.F. Courtot (CTT).

We present 548 individual relative measures for 113 double stars which were performed using different techniques. These observations are averaged into 246 mean positions and angular separation ranges from 2.6" (for the newly discovered FMR 4 AB) to 421.9" (for STF2417 AC). About 43% of the observed double stars were closer than 15". Thirty-five of them (31%) were discovered by John Herschel and they have remained unconfirmed since 1820-1850!

From January 2004 through December 2004, CCD cameras, micrometric eyepieces, on-line surveys such as the Digitized Sky Survey (hereafter DSS) and SuperCosmos Sky Survey (Hambly et al. 2001a,b,c, hereafter SCSS), astrometric catalogs like Two Micron All Sky Survey (Cutri et al. 2000, hereafter 2MASS), and AC2000 (Urban et al. 1998) were used to perform the astrometric measures.

Forty-five double stars have been confirmed and of the programmed unconfirmed double stars, 7 of them could not be identified (see Table 1). A brief study of all measured doubles showed the suspected physical nature for 13 double stars and others 13 pairs were classified as common origin pairs.

In 2004 we discovered 15 new double stars. Ten of them are suspected to be binaries of common origin (that is, pairs of stars that be born together but do not orbit each other), others are physical binaries, gravitationally bounded. Francisco Rica discovered nine systems and Rafael Benavides discovered three systems. Several of these systems were discovered during a work carried out by Francisco Rica consisting of characterization of about 300 proper motion stars recently discovered in 1999 by Wroblewski & Costa (1999).

We studied the nature of the programmed double stars. About 62% were optical pairs, that is, pairs with unrelated members. About 24% were physical pairs (whose members orbit each other) or common proper motion pairs.

One of the main goals for our group is the dessimination of our work and results to the professional and amateur double star community. In our last circular in 2004 we communicated our results to more than 10,000 amateurs and tens of professionals. Surprisingly to us, professional astronomers were more interested in our work than amateur astronomers. Well known professionals such as Dimistris Sinachopoulos, Brian Mason, Josefina Ling and others requested the last LIADA circular. Our last circular have traveled to different places in Europe, North America, Spanish America and even South Africa and Japan. Same well known amateurs have asked for our last circular, including Christian de Villiers (from South Africa), James Daley (from the U.S.A.), Andreas Alzner (from Germany) and the Spaniard Tofol Tobal.

Confirmation of Visual Double Stars

The WDS catalog includes several thousand double stars that have only been measured at their discovery epoch and some hundreds of them have not been even resolved since 1900. These double stars are unconfirmed and they need a second measure.

In the period between January 2004 to December 2004, LIADA confirmed the existence of 45 visual double stars.

There are several reasons for this neglect: poor coordinates or large proper motion, erroneous magnitude or delta-m estimates or truly neglected (it is nearly impossible to measure the large amount of neglected double stars due to the few constant observers).

WDS No.	Designation	Mg.A	Mg.B	Epoch	ρ["]	θ[°]
22446+1137	HJ 300	11	12	1820	2	220
19314+1841	HJ 890	10	12	1820	6	240
19331+3252	HJ 1415	11	13	1828	4	16
19331+3252	HJ 1415AC	11	14	1828	4	76
22051+4504	HJ 1723	9	10	1828	15	185
22267+6011	HJ 1769	10	11	1828	6	50
22077+0913	HJ 3090	12	12	1830	4	82

Table 1: Unidentified, Unconfirmed Double Stars

Of all programmed unconfirmed double stars, seven were not identified. These pairs are shown in Table 1. In the first and second columns, the WDS identifier and discoverer code with their sequential number are listed; in the followed columns, from left to right,the magnitude for primary and secondary are listed; in column five the epoch of the single measure; and in the last two columns, the relative astrometry, ρ and θ.

Measurements

Relative Astrometry

The results of 548 individual relative measures, averaged into 246 mean positions, made with different techniques, are listed in Table 2. These observations range in separation from 2.6" to 421.9".

From January 2004 through December 2004, CCD cameras, micrometric eyepieces, DSS and 2MASS images were used to measure the relative astrometry of 113 binaries. Forty-five double stars have been confirmed.

Several observational techniques were used to obtain astrometry and photometry. A Microguide eyepiece was used by Rafael Benavides (Astronomical Society of Córdoba (Spain)) in a 9 inch telescope. 0.2-0.3 meters (8-12 inches) telescopes with a CCD were used by John Ryan – North-American amateur living in Salamanca (Spain)—and Jim Jones (from U.S.A.). Francisco Rica – Astronomical Society of Mérida (Spain) – used astrometric catalogs and online surveys.

The Lahuerta' brothers are members of the Grupo de Estudio, Observación y Divulgación de la Astronomía (G.E.O.D.A.) and they work from Manises' Observatory (MPC-IAU Code J98) in Valencia (Spain). They used a S/C Meade LX200 telescope with a 0.25 meters (10 inches) diameter objective and a 2,500 mm (98.4 inches) focal length. A Starlight Xpress MX516 CCD has a chip with 500 x 290 pixels and was used to obtain digital images. The size of the pixels is 9.8 x 12.60 μm. The Lahuertas' brothers worked with an f/6.3 focal reduce (with a JMI motofocus) resulting in a focal length of 1,478 mm (58.2 inches). The pixel size is 1.37 x 1.76 arcseconds and the field of view is 11.39 x 8.50 arcminutes. For astrometry and photometry they used Charon software and the GSC-ACT catalogue. Jim Jones from U.S.A. used a 0.28 meter (11 inches) telescope with a CCD SBIG ST7 with a KAF401E chip. Jim take 20 images for each pair which were reduced using Astrometrica and

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

UCAC-2 catalog.

Internet resources were also used for astrometry. The astrometric catalogs 2MASS and AC2000, enabled us to obtain measures of great accuracy. In the case of AC2000, the astrometry is very important because it allowed us to obtain early data from more than 100 years ago. DSS was also used for astrometry. Guide 6.0/7.0, Astrometrica and FitsView software were used for documentation and astrometry.

Table 2 lists relative astrometry for 113 double stars. In the first and second columns, the WDS identifier and discoverer code with their sequential numbers are listed; in the following columns, from left to right, the Besselian epoch of the astrometry; the number of measurements; the position angle and the angular separation; the V magnitude of the primary and secondary. If the magnitude listed has two decimal numbers these came from Tycho-2 (Hog et al. 2000) or else they came from calibrated GSC-I/GSC-II/USNO-B1.0 photometry or inferred by spectral distribution using JHK photometry. The spectral type and luminosity class were estimated using photometric and kinematics data.

Column 11 lists the observer code as follow: ARU (Alejandro Russo, amateur from Argentina); BVD (Rafael Benavides, Astronomical Society of Córdoba, Spain); JRY (John Ryan, amateur from Spain/U.S.A.); DOS (Daniel Osanai, amateur from Argentina); FMR (Francisco Rica, Astronomical Society of Mérida, Spain); JJO (Jim Jones, amateur from USA); MRI (Edgardo Masa [member of SYRMA-MED group] amateur from Valladolid, Spain), OMG (Lahuerta's brothers from Spain); . In total 7 observers contributed to this circular.

The observation methods are listed in the next column (CCD: CCD camera; MCG: MicroGuide eyepiece; 2MASS: 2MASS project images; DSS: Digitized Sky Survey, SCSS: Super Cosmos Sky survey; AC2000: Astrographics Catalogue 2000; MICROM: Micrometers). Figure 1 shows a bifilar micrometer used in this study.

In column (12) the nature of the double star code is as follow: PHY = Physical; OPT = Optical; CO = Common Origin; CPM: Common Proper Motion; "¿?" = unknown; "--" = nature not studied. A "?"character at the end means that the nature listed is the most probable. In the last column the confirmed double stars show a "C"; a number indicates the years since the last measure. A "#" character followed by a number refers to a note number.

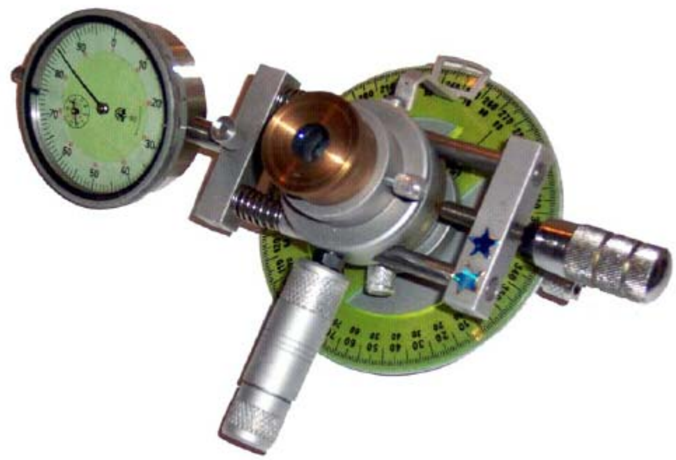

Figure 1: Filar micrometer made by Edgardo Masa. This is one of the techniques used by members of the LIADA Double Star Section to obtain measures in 2004.

Spectral Types and luminosity classes estimates.

Columns (9) and (10) of Table 2 list, for both components, the spectral types and luminosity classes estimated by the LIADA group. When the luminosity class is unknown then the spectral type matches with the main sequence dwarf is listed. The process to estimate spectral types and luminosity classes using BVJHK photometry and kinematical data were explained in detail in Rica (2005).

Table 2 lists 150 spectral types estimated by LIADA group; of these, only 15 stars have spectral types published in the professional literature.

Table 3 lists components with spectral types and luminosity classes in the literature. LIADA spectral type estimates are also listed. In Table 2 there are many spectral types that were estimated using only JHK photometry due to the star component not being listed in Tycho-2, so their results are of lower accuracy than those obtained using BVJHK photometry.

Studying the Nature of Visual Double Stars

To study the nature of visual double stars and classify them as optical, physical, common proper motion or common origin pairs, BVJHK photometric and astrometric (proper motions and relative astrometry) data were used. The historical relative astrometry (θ corrected by precession and proper motions) in addition to our own measures are plotted in X (=ρ*cos(θ)) against Epoch and Y (=ρ*sin(θ)) against Epoch diagrams. A linear fit shows the relative proper motion of B with respect to A. These data are very

(Continued on page 91)

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
00003+5651	CTT 1	1983.776	1	92.3	47.03	8.56	11.35			FMR	DSS	OPT	#1
00515+5630	DAL 11	1954.752	1	231.2	40.76	8.11	12.7	G2V	M0V	BVD	DSS	CO/ PHY	C
		1993.623	1	231.5	40.69					BVD	DSS		
		1998.968	3	231.6	40.72					FMR	2MASS		
01572+2618	FMR 7BC	1997.842	1	354	85.80	10.77	20.2	G5V	M V	2MASS	2MASS	CO?	New
02053+2906	CTT 12 AC	1894.870	1	74.4	66.82	7.84	11.43	K1III	G7V	BVD	AC2000	OPT	C. #2
02361+5706	DAL 6	1997.772	3	128.5	8.57	12.35	13.12	F/G	K0III:	FMR	2MASS	OPT?	C. #3
03528-0557	HJ 2212	1955.884	1	296.9	27.39	9.58	13.3	A8V	G6V	BVD	DSS	OPT	C. 175. #4
		1982.709	1	294.5	28.65					BVD	DSS		
		1997.024	1	294.2	28.87					BVD	DSS		
04021-3429	BU1004AB-C	1912.739	1	137.5	55.87	6.73	11.8	G2V	K0V	BVD	AC2000	OPT	#5
		1996.852	1	163.9	42.26					DOS	DSS		
		1996.852	1	163.9	42.26					DOS	DSS		
04180-0700	HJ 23	1892.448	1	274.3	45.14	11.6	12.1	F6V	G6V:	FMR	AC2000	OPT	C. 173
		1953.932	1	274.8	45.72					BVD	DSS		
		1989.894	1	275.4	46.20					BVD	DSS		
04289+3926	HJ 3258	1953.025	1	252.8	14.76	11.75	12.6	F3V	G4V	BVD	DSS	OPT	C. 173. #6
		1993.730	1	253.1	14.89					BVD	DSS		
		1999.756	3	252.8	15.03					FMR	2MASS		
		2004.124	20	252.6	14.96					JJO	CCD		
04524+7052	HJ 1151AB	1953.785	1	10.2	10.38	10.53	12.4	K2III	G6V	FMR	DSS	OPT	101
		1994.834	1	12.4	10.76					BVD	DSS		
		2004.090	4	13.6	10.60					JRY	CCD		
04524+7052	HJ 1151AC	1953.785	1	331.2	20.22	10.53	13	K2III	K0V	FMR	DSS	OPT?	174
		1994.834	1	333.7	21.42					BVD	DSS		
		2004.090	4	334	21.18					JRY	CCD		
04550+3411	HJ 351AB	1955.861	1	86.6	15.29	9.72	12.1	K2V	F2V:	BVD	DSS	OPT	57. #7
		1995.897	1	79.1	17.26					BVD	DSS		
		2002.507	2	41.5	35.98					BVD	MCG		
		2004.090	4	78.5	18.13					JRY	CCD		
04550+3411	HJ 351AC	1955.861		27.4	22.23	9.72	18.4	K2V	K2:	BVD	DSS	OPT	C. 185. #7
		1995.897		28.1	24.60					BVD	DSS		
04550+3411	HJ 351AC	1955.861	1	27.4	22.23	9.72	18.4	K2V	K2:	BVD	DSS	OPT	C, 185, #7
		1995.897	1	28.1	24.60					BVD	DSS		

Table 2: Double star measurements made by LIADA in 2004.

Continued on next page.

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
04550+3411	HJ 351AD	1955.861	1	64	31.68	9.72	13.7	K2V	G6V	BVD	DSS	OPT	C, 185, #7
		1995.897	1	61.5	34.10					BVD	DSS		
04550+3411	HJ 351AE	1955.861	1	240.7	66.23	9.72	12.9	K2V	G7V	BVD	DSS	OPT	C, 185, #7
		1995.897	1	240.7	64.11					BVD	DSS		
		2004.090	4	241.4	63.24					JRY	CCD		
04586+2918	HJ 353	1954.995	1	242.5	14.22	11.84	12.6	G1III:	K5III	BVD	DSS	OPT?	C, 185
		1996.049	1	242.0	15.09					BVD	DSS		
		2004.090	4	241.3	14.92					JRY	CCD		
05012+0844	HJ 5462	1954.083	1	300.2	12.81	11.42	12.7	K2III	F5III:	BVD	DSS	CO?	C, 182
		2004.090	4	300.7	12.88					JRY	CCD		
05225+2916	HJ 362AB	1896.150	1	160.5	13.69	9.46	11.07	F4V	F4V	BVD	AC2000	OPT?	
		1901.960	1	157.1	13.13					BVD	AC2000		
		1955.807	1	154.9	13.99					BVD	DSS		
		1955.809	1	157.3	13.73					BVD	DSS		
		1996.774	1	157.4	13.66					BVD	DSS		
		2004.090	4	155.7	13.88					BVD	MCG		
05225+2916	HJ 362AC	1896.150	1	246.3	32.31	9.46	12.1	F4V	A4V	BVD	AC2000	OPT	
		1901.960	1	246.5	32.39					BVD	AC2000		
		1955.809	1	247.9	32.03					BVD	DSS		
		1996.774	1	248.7	32.05					BVD	DSS		
		2004.090	4	248.7	31.88					JRY	CCD		
05225+2916	HJ 362AD	1955.809	1	317.6	29.08	9.46	15.5	F4V	K4III:	BVD	DSS	¿?	C, 181
		1996.774	1	317.4	29.44					BVD	DSS		
05252-1119	HJ 5538AD	2004.090	4	85.5	54.67	8.6	12.55	A2V:	G4V	JRY	CCD	CO?	#8
05252-1119	STF 710AB	2004.090	4	195.6	10.78	8.6	8.9	A2V:	A1V:	JRY	CCD	PHY	#9
05289+3239	HJ 366	1913.365	1	17.8	15.20	8.7	12	M6.5III		BVD	AC2000	¿?	C, 185, #10
		1955.809	1	16.5	15.47					BVD	DSS		
		1993.809	1	17.0	15.78					BVD	DSS		
		2004.090	4	17.9	16.20					JRY	CCD		
05294+3230	BVD 7	1955.809	1	108.4	7.09	11.6	12	A2V:	A6V:	BVD	DSS	¿?	New, #11
		1993.809	1	108.0	6.91					BVD	DSS		
05316+3131	HJ 703	1903.100	1	276.4	18.02	8.45	11.3	K3III	K5III	BVD	DSS	OPT	C, 185, #12
		1955.809	1	277.3	16.96					BVD	DSS		
		1996.774	1	279.6	16.34					BVD	DSS		
		2004.090	4	279.4	16.46					JRY	CCD		

Table 2 continued on next page.

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
05386+2002	DAL 8AC	1951.908	1	84.5	13.11	9.72	13.3	G1:V:	G5	BVD	DSS	¿?	C, #13
05402+0157	HJ 2275	1951.911	1	314.4	24.19	11.22	12.4	G0V:	K5V:	BVD	DSS	CO?	C, 174
		1990.869	1	314.7	24.36					BVD	DSS		
		1999.774	3	314.7	24.24					FMR	2MASS		
		2004.090	4	314.7	24.08					JRY	CCD		
05439+5548	HJ 2274	1998.985	3	303.2	7.42	11.7	14.5	G4	K2	FMR	2MASS	¿?	C, 174, #14
		2004.090	4	303.8	7.33					JRY	CCD		
05512+2817	HJ 711	1955.812	1	350.8	13.81	10.33	12.1			BVD	DSS	OPT	105, #15
		1993.798	1	352.5	15.67					BVD	DSS		
		2004.090	4	353.7	16.12					JRY	CCD		
06581+1414	ARN 1AD	1903.633	1	285.8	85.35	7.3	10.26	B8V	F2V	AC2000	AC2000	CO/OPT	C
07154-0126	DAL 13	1897.100	1	338.3	36.49	10.43	10.48	F4V	F4V	BVD	AC2000	CO	C, #16
		1955.894	1	338.4	36.47					BVD	DSS		
		1990.205	1	338.6	36.75					BVD	DSS		
07275+7302	DAL 12	1898.583	1	94.8	27.03	10.55	11.38	G0V	G8V	BVD	AC2000	CO	C
		1953.113	1	94.8	26.76					BVD	DSS		
		1998.001	1	94.0	26.87					BVD	DSS		
11040+4321	YEU 1	1955.212	1	123.7	19.04	15.5	18	M0.5V	M2.5V	FMR	DSS	CO	New
		1990.070	1	123.2	19.32					FMR	SCSS		
		1997.183	1	123.8	19.07					FMR	SCSS		
		1998.939	1	123.7	19.31					2MASS	2MASS		
11053-0623	LDS4056	1954.158	1	42.9	14.16	13.1	15.5	M2V	M3V	FMR	SCSS	PHY	45
		1984.056	1	41.8	14.33					FMR	SCSS		
		1985.056	1	42.9	14.07					FMR	SCSS		
		1996.199	1	42.1	14.06					FMR	SCSS		
		2001.042	1	43.0	14.22					2MASS	2MASS		
11368+2923	FMR 3AC	2000.097	3	208.7	194.52	11.59	10.93	G5V	G3V	FMR	2MASS	CO	New, #17
12028+2841	HJ 514	1955.275	1	86.9	20.45	11.73	13.6	F5	G0	BVD	DSS	OPT?	C, 185, #18
		1996.212	1	87.6	20.88					BVD	DSS		
		2004.251	20	87.8	20.95					JJO	CCD		
		2004.456	4	87.8	21.04					JRY	CCD		
12079+0648	HJ 2597	1957.321	1	151.4	41.40	10.98	13.3	G1V	G5V	BVD	DSS	OPT	#19
		1998.327	1	149.8	44.71					BVD	DSS		
		2004.456	4	149.7	45.30					JRY	CCD		

Table 2 continued on next page.

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
13220+1028	HJ 225AB	1910.430	1	183.7	34.17	11.57	12.59	F8V:	G6V	BVD	AC2000	OPT	#20
		1921.400	1	183.5	34.26					BVD	AC2000		
		1955.370	1	181.4	35.41					BVD	DSS		
		1997.278	1	180.2	35.94					BVD	DSS		
		2004.459	3	180.3	35.90					JRY	CCD		
13220+1028	HJ 225AC	1955.370	1	55.4	80.62	11.57	13.83	F8V:	G9III:	BVD	DSS	OPT	#20
		1997.278	1	55.5	80.97					BVD	DSS		
		2004.459	3	55.4	81.03					JRY	CCD		
13220+1028	HJ 225AD	1955.369	1	16.1	42.66	11.57	15.4	F8V:	K3V	BVD	DSS	OPT	
13300-1430	HJ 2654	1954.392	1	336.9	17.61	12.1	13.2	K5V	K4V	DOS	DSS	OPT	C, 174, #49
		1982.300	1	328.1	17.79					BVD	DSS		
		1983.355	1	328.4	16.91					DOS	DSS		
		1983.360	1	328.3	17.78					DOS	DSS		
		1988.303	1	326.2	17.63					DOS	DSS		
		1988.303	1	327.0	18.07					BVD	DSS		
		1993.403	1	325.2	18.17					DOS	DSS		
13351-0933	FMR 4	1999.147	1	305.0	2.60	15.4	15.6	M1.5V	M3V	2MASS	2MASS	CPM	New
13368-0139	HJ 1235	1952.081	1	252.4	14.19	11.16	12.4	G4	K0	BVD	DSS	OPT?	C, 177, #21
		1996.230	1	252.7	16.42					BVD	DSS		
		2004.459	4	252.4	16.52					JRY	CCD		
13393-0436	BVD 6BC	1952.400	1	111.6	6.46	13.2	14.4	K6V	M0V	FMR	DSS	PHY?	New
		1999.290	3	112.8	6.46					FMR	2MASS		
13393-0436	HJ 1236	1952.393	1	98.0	28.72	11.3	13.2	G6V	K6V	BVD	DSS	OPT	C, 177
		1983.347	1	97.1	30.09					BVD	DSS		
		1999.291	3	98.1	30.74					FMR	2MASS		
		2004.459	3	97.5	31.52					JRY	CCD		
13403+0726	HJ 2668	1919.423	1	290.6	10.16	12.3	12.4	K5V	K7V	BVD	AC2000	CO	C, 175
		1950.300	1	290.0	9.92					BVD	DSS		
		1996.231	1	293.1	10.01					BVD	DSS		
		2000.229	3	294.4	9.93					FMR	2MASS		
		2004.459	4	294.1	10.15					JRY	CCD		
13419+1159	BVD 8BC	1954.247	1	75.6	2.76	13.8	14			BVD	DSS	¿?	New
		1993.316	1	69.9	2.99					BVD	DSS		
		1998.994	1	69.2	3.01					FMR	2MASS		

Table 2 continued on next page.

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
13419+1159	HJ 229AB	1954.247	1	34.8	16.48	11.9	13.2	K7III:		BVD	DSS	OPT	C, 185, #22
		1993.316	1	32.5	16.83					BVD	DSS		
13445+0732	HJ 1240	1919.420	1	288.8	10.53	11.33	13.2	G2III:	G4V:	BVD	AC2000	¿?	175
		1950.300	1	288.7	10.61					BVD	DSS		
		1996.231	1	289.0	10.34					BVD	DSS		
		2004.459	4	288.5	10.32					JRY	CCD		
13494+0524	HJ 1242	1918.360	1	118.1	10.83	11	12.3	G1V	G5V	BVD	AC2000	PHY	C, 177, #23
		1950.300	1	118.4	10.74					BVD	DSS		
		1996.231	1	118.6	10.66					BVD	DSS		
		2004.462	4	118.3	10.77					JRY	CCD		
13549-1442	HJ 2691	1956.349	1	108.7	13.29	11.8	14.4	F5V	G8V	BVD	DSS	OPT	C, 174
		1995.406	1	108.4	13.74					BVD	DSS		
		2004.462	4	108.4	13.84					JRY	CCD		
14214+1335	HJ 235	1950.272	1	265.5	10.90	11.87	13.4	F1V	G6V	BVD	DSS	OPT	
		1994.338	1	260.9	11.25					BVD	DSS		
		2004.462	1	259.6	11.05					JRY	CCD		
14310+1344	HJ 238AB	1994.338	1	73.5	26.52	11.64	12.91	G3V	G9V	ARU	DSS	OPT	#24
		2004.315	7	72.9	26.88					JJO	CCD		
		2004.320	7	72.9	26.88					JJO	CCD		
		2004.462	4	72.9	26.90					JRY	CCD		
14310+1344	HJ 238AC	1994.338	1	92.3	52.20	11.64	12.09	G3V	F9V	ARU	DSS	OPT	#24
		2004.315	7	92.3	52.36					JJO	CCD		
		2004.320	7	92.3	52.31					JJO	CCD		
14426+1929	LDS 968AB-C	2000.187	3	309.6	135.09	9.11	10.11	K0V	K8V	MRI	2MASS	PHY/CO	#25
14443-1826	FMR 6	1954.183	1	177.4	16.64	14.1	18.3	K7V	M2.5V	FMR	DSS	CO	New
		1976.414	1	178.0	16.47					FMR	DSS		
		1985.317	1	178.6	16.54					FMR	DSS		
		1994.194	1	178.5	16.32					FMR	DSS		
		1994.530	1	179.0	16.61					FMR	DSS		
15017-0707	GIC 123	1953.453	1	110.9	47.53	13.8	14.9	K7V	M2V	FMR	DSS	OPT	C
		1984.548	1	112.1	44.00					FMR	DSS		
		1991.264	1	111.8	43.43					FMR	DSS		
15092-0532	FMR 8	1999.190	3	236.3	5.25	13.3	13.9	M3V	M3V	FMR	2MASS	PHY?	New

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Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
15208-1749	FMR 11	1953.379	1	332.6	4.53	14.4	19.4	M2.5V	M5.5V	FMR	SCSS	PHY?	New
		1998.235	1	330.3	5.18					2MASS	2MASS		
15236-1504	FMR 12	1999.298	1	153.1	6.73	11.79	14.8	K9V	M3V	2MASS	2MASS	PHY?	New
15256-1513	WRO 1	1998.241	1	141.5	7.67	12.5		M0V		2MASS	2MASS	CPM	New
16044-1127	STF1999AB	1999.234	3	98.9	11.74					FMR	2MASS	PHY	#26
16044-1127	STF1999AC	1999.234	3	84.2	83.14					FMR	2MASS	OPT	
17010+3755	HJ 262	1982.554	1	303.4	20.23	12.7	13.1	G4III:	G2III:	FMR	DSS	OPT?	C, 186
		2004.563	20	303.8	20.35					JJO	CCD		
		2004.721	3	303.6	20.44					OMG	CCD		
17291+1727	DAL 14	1899.510	1	183.9	14.93	8.75	11.6	A3V	G1V	BVD	AC2000	OPT	#26b
17299+2246	DAL 3AC	1997.455	1	262.7	63.16	12	13.1	K1III	G4V	2MASS	2MASS	OPT	#27
17391+0202	SHJ 251BC	2004.741	3	69.6	100.40	7.74	10.67			OMG	CCD	OPT	#28
18099+4824	STF2293	1902.813	1	83.8	12.40	8.03	10.26	F6V	G8V	BVD	AC2000	PHY	#99
18546+2754	DAL 5AC	2000.264	1	273.5	26.30	12.2	12.3	G0V	K1III	2MASS	2MASS	OPT	#29
18548+3306	DAL 10	1983.513	1	51.9	30.49	10.31	12.1	K2III	K5III	FMR	DSS	OPT	#30
18562+0412	STF2417AB	2004.627	2	104.0	22.34	4.62	4.98			MRI	MICROM	PHY	#31
18562+0412	STF2417AC	2004.627	2	58.0	421.94	4.62	6.71	A5V	F9V	MRI	MICROM	OPT	C, 52, #32
18562+0412	STF2417BC	2004.627	1	57.0	407.05	4.98	6.71	A6V	F9V	MRI	2MASS	OPT	#33
19020+1907	ARN 18AE	1982.476	1	339.3	174.97	6.94	7.8	K0III	F9V:	FMR	DSS	OPT	#35
19020+1907	HJ 2851AB	1999.844	1	159.1	13.91	6.94	12.1	K0III	K1III	2MASS	2MASS	OPT	#34
19020+1907	HJ 2851AC	1982.476	1	294.1	47.92	6.94	11.5	K0III	G6V:	FMR	DSS	OPT	
19020+1907	WAL 102AD	1999.844	1	134.9	47.03	6.94	12.6	K0III	K4III	2MASS	2MASS	OPT	C, 62, #36
19125+2812	HJ 1375	2004.686	20	85.4	12.33	10.97	13	F7V	K3III:	JJO	CCD	OPT	C, 178, #37
		2004.721	3	86.8	12.64					OMG	CCD		
19290+0343	HJ 2872AC	2004.721	3	227.9	13.38	9.95	12.5	G9V	K6	OMG	CCD	¿?	C, 176, #38
19294+4052	HJ 1405	1894.832	1	47.7	15.16	10.8	12.03	K2III:	G5V:	AC2000	AC2000	OPT	C, 178
		2004.721	3	40.0	16.76					OMG	CCD		
19303+3320	HJ 1406AB	2004.743	3	300.9	12.80	11.9	11.8	K2III	F7V	OMG	CCD	OPT	
19303+3320	HJ 1406AC	2004.743	3	208.2	12.18	11.9	12.8	K2III	G2V	OMG	CCD	OPT	
19308+2929	HJ 1407	1898.779	1	287.9	11.64	10.26	12.3	F5V	A6V:	AC2000	AC2000	OPT	C, 178, #39
		2004.743	3	302.3	11.74					OMG	CCD		
19347+3152	HJ 1416	1912.901	1	244.9	9.13	11	11.9	A6V:	K1III:	AC2000	AC2000	OPT	#40
		2004.743	3	235.0	10.06					OMG	CCD		
19373+3254	HJ 1424	2004.743	3	30.7	15.12	11.8	11.92	F1V	G5V	OMG	CCD	OPT	C, 178, #41

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Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
19377+3255	FMR 10AC	1924.707	1	9.2	39.95	11.17	10.92	K0III:	K4III	AC2000	AC2000	CO	New
		1998.326	1	9.1	40.00					2MASS	2MASS		
19377+3255	HJ 1425AB	1924.707	1	236.5	12.03	11.17	11.9	G3III:	G1III:	AC2000	AC2000	OPT	C, 178
		2004.473	3	240.5	12.11					OMG	CCD		
19414+3313	BKO 78AC	1988.453	1	197.9	7.47	10.23	14.9	G2III:	K1	ARU	DSS	¿?	
19414+3313	HJ 1430AB	1921.926	1	152.3	17.43	10.23	11.51	G2III:	A4V:	AC2000	AC2000	OPT	
		1988.453	1	153.8	17.14					ARU	DSS		
		2004.538	20	153.7	17.31					JJO	CCD		
		2004.566	20	153.9	17.28					JJO	CCD		
		2004.743	3	153.8	16.87					OMG	CCD		
19415+0255	HJ 600	1999.591	1	165.2	22.06	10.92	11.37	K3III	F7	2MASS	2MASS	OPT	C, 186
		2004.743	3	164.5	21.31					OMG	CCD		
		2005.640	3	164.2	21.79					OMG	CCD		
19423+1937	HJ 2891	2004.743	3	108.4	12.06	10.93	11.77			OMG	CCD	OPT	#42
20599+4016	SEI1363CR	1900.549	1	38.2	8.64	9.65	10.59	G6V	G8V	AC2000	AC2000	PHY	
22017+0233	HJ 3080	1983.680	1	292.7	20.49	10.01	13.2	K2III	G8	FMR	DSS	OPT?	C, 176, #43
		2004.991	3	294.0	20.01					OMG	CCD		
22019+5506	HJ 1718AB	2004.991	3	219.8	9.25	11.13	11.97	A1V	F5V	OMG	CCD	OPT	#43
22019+5506	HJ 1718AC	1983.516	1	277.1	13.18	11.13	12.75	B7V	K III	FMR	DSS	OPT	#44
22019+5506	HJ 1718BC	2004.991	3	296.9	13.19	11.97	12.75	F5V	K5:III	OMG	CCD	OPT	
22035+0652	HJ 3084	2004.991	1	52.6	14.32	12.3	13.5	K0III:	G1V	OMG	CCD	OPT	
		2004.991	3	52.6	14.32					OMG	CCD		
22053+4629	HJ 1725	2004.991	3	78.2	29.09	10.68	11.13	A7	G0V	OMG	CCD	OPT	
22075+4152	HJ 1731	1895.692	1	207.3	14.00	10.11	12.4	F9V	G6V	AC2000	AC2000	PHY?	
		1999.986	1	207.6	13.99					2MASS	2MASS		
		2004.991	3	207.5	15.25					OMG	CCD		
22127+1134	HJ 3099	1909.747	1	57.0	11.69	11.7	13.35	K5III	G7	AC2000	AC2000	OPT	C. 176
		2004.991	3	57.9	11.46					OMG	CCD		
22157+3051	FMR 13	1999.751	1	216.1	3.71	14	14.1	K0V:	K2V:	2MASS	2MASS	¿?	New
22159+3051	HJ 960	2004.991	3	79.3	7.95	13.1	13.9	G5	G0	OMG	CCD	¿?	
22183+0442	HJ 3103	2005.026	3	111.3	14.67	12.9	13.3	K3	G5V	OMG	CCD	OPT?	C, 176
22217+5112	HJ 1757	1998.854	1	315.0	8.49	9.6	11.8	A3V	M1III	2MASS	2MASS	OPT	C, 178, #45
22276+0736	HJ 3117	2005.026	3	254.6	34.19	11.33	13.5	F7V	G8V	OMG	CCD	OPT	C, 176
22306+3706	HJ 1774AB	2005.026	3	52.7	16.39	10.39	13	K2III	G7V	OMG	CCD	OPT?	C, 178

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Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

WDS Id.	Discover	Epoch	N	θ (°)	ρ (")	V_A	V_B	SP_A	SP_B	Obs.	Method	Type	Notes
22306+3706	HJ 1774AC	2005.026	3	322.9	29.09	10.39	13.6	K2III	G6V	OMG	CCD	OPT?	C, 178
22306+3706	HJ 1774BC	1998.764	1	293.6	33.28	13	13.6	G7V	G6V	2MASS	2MASS	¿?	
22337+1230	HJ 298AB	2005.026	3	184.6	27.52	12.69	12.68	K5V	K4V	OMG	CCD	CPM?	#46
22337+1230	OMG 1AC	1997.720	1	91.6	10.54	12.68	12.3	K5V	G1V	2MASS	2MASS	OPT?	New
		2005.026	3	90.3	11.13					OMG	CCD		
22338+1206	HJ 3121	2005.026	3	32.2	17.97	9.28	11.9	M3III	G	OMG	CCD	OPT	#47
22401+0628	HJ 3131	1983.844	1	199.8	15.11	11.38	12.7	K3	G8V	FMR	DSS	OPT?	#48
		2005.026	3	202.5	15.75					OMG	CCD		

Notes:

1. Discovered in 1997 by the French amateur J. F. Courtot (92º and 46.5”). Proper motion incompatible. Optical pair.
2. Discovered in 2002 by the french amateur J. F. Courtot. Proper motion incompatible. Optical pair. Primary is a K1III giant star according to the literature (catalog “New Periodic Variable” (Koen & Eyer 2002) in total agreement with LIADA’s estimate. The radial velocity is –11.4±2.8 km/s.
3. Discovered in 2002 by the North-American amateur James Daley. Proper motion incompatible. Optical pair.
4. Primary is A1V+(G/K) [Michigan Catalog]
5. Proper motion incompatible. Optical pair. WDS lists measures of C with respect to A; this circular lists measures of AB with respect to C. The AB pair is a binary star with a high proper motion. They are G1/2V and G0 stars according to the literature. The AB pair was well studied by Nordstrom in the “Geneva-Copenhagen Survey of Solar Neighbourhood” catalog (Nordstrom et al. 2004).
6. A 13.3 magnitude star (spectral type estimated, F6V) located at 13.2” in direction 282º is not bounded to the primary star.
7. Primary is a K0 star according to Henry Draper catalog.
8. Abt & Corbally (2000) studied this system in a work titled “UBV Photometry and Ages of Trapezium Systems”. Abt concluded that they were unbounded components. In our study we obtained very similar photometric parallaxes and so maybe be a common origin system.
9. ADS 4017. Spectral types A0 and A0 (Michigan Catalogue). Lineal elements calculated: Δx = -0.4 mas/yr; Δy = +1.0 mas/yr; θ =194.4º; ρ=10.96” (1991.545)
10. Primary is the variable star V401 Aur with spectral type M6.5III.
11. Spectral types estimated by LIADA were corrected by interstellar absorption.
12. Primary is a K0 star according to Henry Draper catalog with a radial velocity of –26.4 km/s.
13. Discovered by the amateur James Daley in 2002 (82º and 13.4”).
14. In the NGC 2013 open cluster.
15. Hipparcos calculated a distance of 9 parsecs. It must be an error because the photometry and proper motion correspond to a main sequence star at a larger distance.
16. According to literature the components are F2 and G0 stars.
17. New common proper motion companion to HJ 2579 A. Spectral types G5 and G2 (“*Catalogue of Stellar Spectral Classifications*” [Skiff, 2003]).
18. A is an F6 star (*”Bergedorfe Spektral-Durchmusterung der 115 Nordlichen Kapteyn Eichfelder 44-67”* de 1947)
19. Due to the large proper motion of the primary we performed a search for new uncataloged compo-

nents. We used the ALADIN tool to search the Tycho-2, UCAC-2 and USNO-B1.0 catalogs for common proper motion stars. We also used photographic plates. No new companions were found.

20. Abt & Corbally (2000) listed the AB, AC and AD pairs in his catalog "*UBV photometry and Ages of Trapezium Systems*" . They concluded in the optical nature of these pairs.
21. The TASS2 catalog (Richmond et al., 2000) lists for primary magnitudes V = 11.10 and I = 10.36.
22. This double star is located 9 arcminutes southwest of the WDS position. The accurate coordinate is RA: 13h 41m 21s55 and DEC: +11º 55' 12.5".
23. This is a physical pair but Δ(V-Mv) = 0.7: is the primary an unresolved pair?
24. The professional Abt studied this triple star in 1988 obtaining UBV photometry (the V magnitude listed in Table II came from the Abt's work). Abt listed this system in his table "*UBV photometry and Ages of Trapezium Systems*". Abt concluded that the three components were optical in nature, in agreement with our result.
25. Spectral types M0 and M0 (Luyten, 1979, NLTT catalog).
26. The author edited a detailed work but it has not been published.
27. It was discovered by the North-American amateur James Daley in 2003 (184º and 17.8", mg. 8.75 and 11.7).
28. The amateur James Daley added a new member for the BRT 2434 system in 2003 measuring 262º and 64.4".
29. Primary is a K0 III + F4 IV star. Secondary is a F0 star (Henry Draper catalog); parallax from Hipparcos 0.009±0.001 arcsec. (110 parsecs).
30. The amateur James Daley added a new companion to the system BRT 3335 AB in 2001 (273º and 26.7").
31. Primary is a K2 star (catalog PPM); The amateur James Daley informed about this new pair in 2002. (51º and 30.9"). Galactic latitude of +13º so the spectral types must be corrected by interstellar reddening.
32. ADS 11853; literature lists spectral types A5 and A5.
33. It was only measured by Karl W. Kamper in 1954 (58º and 426"). Literature lists spectral types A5V and G5. The photometric distance of LIADA was of 33 parsecs. Hipparcos obtained distances of 40 and 27 pc. The main component is a suspected RR Lyrae catalogued as NSV 11558. The magnitud ranges between 4.59 and 4.72. The three components of this system are members of the Hyades association.
34. Literature lists spectral types A5Vn and G5. LIADA searched for unknown companions to component C. No companion was found.
35. ADS 11957; A is a giant K0 III ("MK Classification Extension").
36. A is a giant K0III ("MK Classification Extension"). The secondary is the binary STF2437 (15º and 0.5" in 1997) composed by two star of spectral types G2IV and F8IV (Stephenson. & Sanwal 1969). The Hipparcos parallax for the primary corresponds to a distance of 216±41 pc (LIADA obtained a photometric distance of 194 pc) and for the secondary a distance of 82±17 pc. The North-American Dave Arnold catalogued the component E in 2002 (340º and 173.8").
37. It was discovered by A. Wallenquist in 1944 (140º and 45").
38. There is a weak star (V=15.1; K=12.31) at 5.6 arcsec in direction 119 degrees. According to the study by LIADA this star is not bounded.
39. The primary is a K0 star (Henry Draper Catalog) although the Michigan Catalog lists G5/6 spectral type.
40. Spectral types F5 and A0 ("The LF Survey" (McCuskey 1947).
41. "The LF Survey" (McCuskey1947) lists spectral type of A2 for the primary.
42. The secondary star is brigther than the primary.
43. A is a K star (Henry Draper catalog).
44. A is a K0 star (PPM catalog).
45. This pair is on the Milky Way. Spectral types are corrected by reddening; Abt & Corbally (2000) ob-

tained for the primary: spectral type A1V, E(B-V) = 0.22 and V - Mv = +9.6. Abt concluded that B component is a background star.

46. Located at 7 minutes of arc North from the WDS position.
47. A star of 12.30 magnitude (M2000 catalog, Rapaport et al. 2001) is located at 11.13" and 90.3 degrees (measured performed by Lahuerta' Brothers in 2005.026) relative to A component. According to our study this star is not a bound G1V star. We classified it as OMG 1.
48. In 1996 (31 degrees and 12.8"). This measure is not in agree with our measure. The spectral type of the primary is M3 ("Dearborn Catalogue of Faint Red Stars (Lee, Baldwin, & Hamlin 1947); M0 in PPM. Is a infrared source in 12-25-60-100 μm bands.
49. It was measured in 1989 (201 degrees and 14.8"; mg. 10.7 and 11.3)
50. A new high proper motion star located at α=13h 29m 47s72 y δ= -14º 25' 31.99" was detected in the field of this double star. According to the study performed by LIADA it is a M3V star at a distance of 115 pc.

Name#1	Name#2	MgV	Sp_Lit	Sp_LIADA	Differ.
HD 12728	CTT 12A	7.84	K1III	K1III	0
HD 175638	STF 2417A	4.62	A5V	A5V	0
HD 175639	STF 2417B	4.98	A5V	A6V	+1
HD 176973	HJ 2851A	6.94	K0III	K0III	0
GSC 3973-1501	HJ 1718A	11.13	A1V	B7V	-4

Table 3: Comparison of Spectral Types between LIADA and the Literature

WDS Identifier	Desig.	θ – ρ (epoch)	mag. A - B spT. A - B	E(a) (A.U.)	Period (yrs)	$\Delta\mu_x$ (mas*yr^{-1})	$\Delta\mu_y$ (mas*yr^{-1})
05252-1119	STF 710AB	195.6 - 10.78 (2004.090)	8.60 – 8.90 A0V – A0V	4,941	147,000	-0.4	+1.0
11053-0623	LDS4056	43.0 - 14.22 (2001.042)	13.1 – 15.5 M2V – M3V	1,087	42,000	-0.1	-1.5
13494+0524	HJ 1242	118.3 – 10.77 (2004.462)	11.0 – 12.3 G1V – G5V	3,554	149,000	-0.7	0.0
18099+4824	STF2293	*85 – 13.3 (2005)*	8.03 – 10.26 F6V – G8V	1,484	38,000	+1.2	-1.6
185622+0412	STF2417AB	104.0 – 22.34 (2004.627)	4.62 – 4.98 A5V – A6V	1,084	17,500	-3.5	-0.6
20599+4016	SEI1363CR	43.6 – 9.93 (2004.634)	9.64 – 10.58 G6V – G8V	1,079	27,000	-3.2	+2.6
22075+4152	HJ 1731	207.5 – 14.25 (2004.991)	10.11 – 12.4 F9V – G6V	4,000	180,000	-0.9	-0.3
17360+2100	STF2190AB	*21 – 10.3 (2008)*	6.13 – 9.48 A5V – F3V	2,005	43,000	-2.5	+0.2
	FMR 4AB	305 – 2.6 (1999.147)	15.4 – 15.6 M1.5V – M3V	372	8,400		
	FMR 8	236.3 – 5.25 (1999.190)	13.3 – 13.9 M3V – M3V	202	3,700		
	FMR 11	330.0 – 5.18 (1998.235)	14.4 – 19.4 M2.5V – M5.5V	370	10,000	-11.0	+11.0
	FMR 12	153.1 – 6.73 (1999.298)	11.79 – 14.8 K9V – M3V	433	10,100		

Table 4: Orbital Data of Physical Pairs

Study of Neglected Double Stars by LIADA Double Star Section in 2004 ...

(Continued from page 80)

important because nearly all the methods that allow us to know their nature use them. If a double star is physical then these data will give us the projected relative orbital motion and velocity.

The Tycho-2 optical BV photometry and the 2MASS infrared JHK photometry in addition to the individual proper motions allow us to obtain the spectral type and luminosity class (see the last paragraph).

Finally the photometric and astrometric data are analyzed using up to 6 methods or criteria that allow us to classify visual double stars according to their nature.

Table 2 shows in column (12) the conclusion of this study. LIADA studied the nature of all 113 visual double stars measured. About 62% (71 visual double stars) were optical or suspected optical, while only 12% (13 doubles) were physical or suspected physical. Of the double stars studied, there were pairs with photometric and astrometric data consistent with pairs located at the same distance with the same kinematic but not gravitationally bounded: they are called 'common origin' and were 12% of all double stars studied. The common proper motion (CMP) pairs are composed by two stars with similar or very similar proper motion but with no nature suspected.

About 11% of visual double stars have an undetermined nature due to insufficient or no accurate data and more astrometric and photometric data are needed. These results are summarized in Figure 2 and are similar to those of the last year. As in previous surveys the very low percent of physical pairs did not surprise us because we previously know the low astrophysical interest of the very neglected and unconfirmed visual double stars where the most of them are bona-fide or candidate optical pairs.

Physical Pairs Orbital Data.

Table 4 shows same orbital data for the physical pairs studied in 2004 by LIADA. In the first and second columns, the WDS identifier and discoverer code with their sequential number are listed; in the following columns, from left to right, are listed ρ, θ and epoch for the last measure in LIADA database (if this column is in cursive came from WDS), magnitudes and spectral types for both components (determined by LIADA), expected semi major axe (in A.U.), crude period in years). The last two columns list the relative motion of the system (in mas/yr) in RA and DEC. A Digitized Sky Survey image of the first of these pairs (STF 710 AB) is shown in Figure 3.

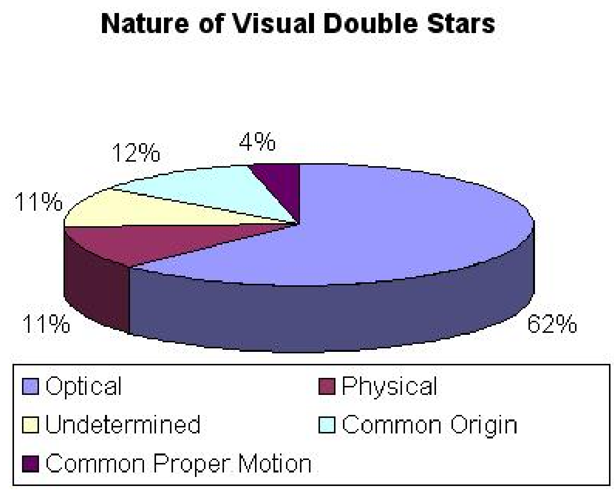

Figure 2: Results of the nature of visual double stars. Most of the neglected and unconfirmed visual double stars are optical pairs with no astrophysical interest.

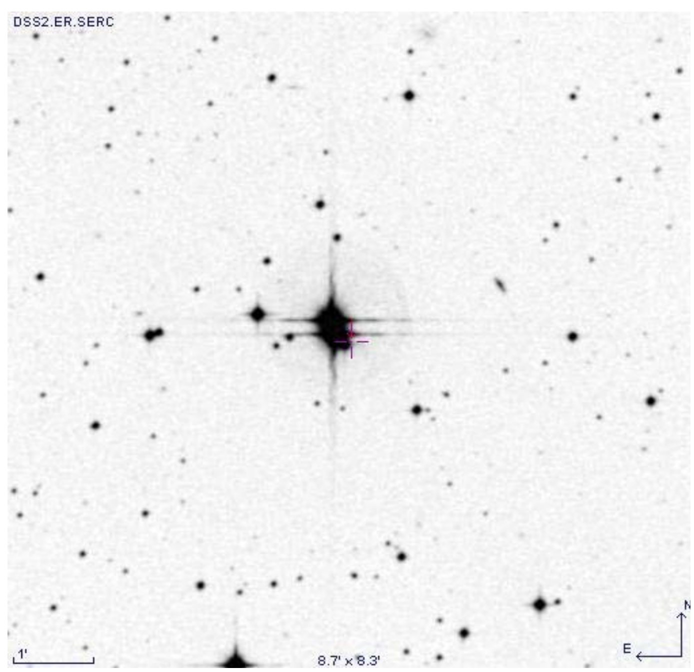

Figure 3: The binary STF 710 AB. Composed of white twin stars of 8.6 and 8.9 magnitudes, which seem to orbit about 147,000 years. Digitized Sky Survey photographic plate taken on January 21, 1985.

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The projected separation in A.U. is calculated using the followed simple formula:

$$Projected\_separation = \rho / \pi$$

where ρ is the angular separation and π is the mean parallax of the binary. LIADA considered the mean angular separation and the mean photometric parallaxes of the components. The photometric parallaxes were calculated using spectral types and luminosity class estimates and the absolute magnitude obtained from several professional references.

The expected semi-major axis, $E(a)$, in arcseconds, was calculated using the work of Paul Couteau (1960) by the followed formula:

$$Log\ E(a) - Log\ (\rho) = 0.146$$

Where a and ρ are the semi-major axis and the angular separation. The orbital period was calculated using the followed formula derived from the Kepler Laws:

$$P = \sqrt{\frac{E(a)^3}{\sum M_\Theta}}$$

The values of relative proper motion are showed in the two last columns. Since all double star in Table IV are physical then relative proper motion give us the projected relative orbital velocity.

Acknowledgments

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The Guide Star Catalog-I was produced at the Space Telescope Science Institute under a U.S. Government grant. These data are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The Guide Star Catalogue-II is a joint project of the Space Telescope Science Institute and the Osservatorio Astronomico di Torino. Space Telescope Science Institute and is operated by the Association of Universities for Research in Astronomy, for the National Aeronautics and Space Administration under contract NAS5-26555. The participation of the Osservatorio Astronomico di Torino is supported by the Italian Council for Research in Astronomy. Additional support is provided by European Southern Observatory, Space Telescope European Coordinating Facility,

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The Digitized Sky Survey was produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions. This research is based on data from the SuperCOSMOS Sky Surveys (SSS) at the Wide-Filed Astronomy Unit of the Institute for Astronomy, University of Edinburg.

This publication has made use of the Washington Double Star Catalog, UCAC2 and USNO-B1.0 maintained at the U.S. Naval Observatory.

The data mining required for this work has been made possible with the use of the SIMBAD astronomical database and VIZIER astronomical catalogs service, both maintained and operated by the Center de Données Astronomiques de Strasbourg (http://cdsweb.u-strasbg.fr/)

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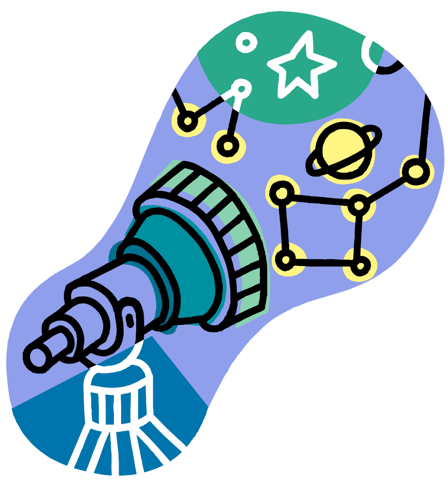

Divinus Lux Observatory: Report #17

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Abstract: This report contains theta/rho measurements from 86 different double star systems. The time period spans from 2008.724 to 2008.967. Measurements were obtained using a 20-cm Schmidt-Cassegrain telescope and an illuminated reticle micrometer. This report represents a portion of the work that is currently being conducted in double star astronomy at Divinus Lux Observatory in Flagstaff, Arizona.

Recently, an article came to my attention that was submitted by Helmut Abt to the 240th symposium of the International Astronomical Union in August 2006. This report entitled, "Observed Orbital Eccentricities," discussed the well-known phenomenon that the orbits of binary star systems with periods of less than a few days have been circularized, or have eccentricities near zero, because of tidal interaction between the components. Abt then goes on to state that for longer periods, the eccentricities of binaries with known orbital elements show a random distribution.

In order to put the second part of Abt's conclusions to the test, I decided to plot the period versus the eccentricity for all of the visual binary systems that appear in Sky Catalogue 2000.0, Volume 2. The periods of these systems range from a few months to over 5,000 years, and all possible eccentricity values were plotted against these periods. The following table shows the results for the 532 binary systems that have had the orbital elements at least roughly determined, with some systems having had the elements very well determined. Several observations can be made based upon the data in Table 1 below.

First of all, it becomes apparent that the most common eccentricity values, for the entire data base, range from .2 to .8. This pattern is especially noticeable for periods that fall into the range of 10 to 500 years. It is also apparent that the majority of the visual binaries that have had the orbital elements determined also fall into this period range of 10 to 500 years. This might imply that if the data base was larger for the other listed period ranges, a similar pattern for the eccentricity value could also possibly emerge.

Secondly, a result that might appear surprising to some is that highly eccentric orbits (.8 - .99) are just as likely to appear in this data base as those that are more circular (.0 - .2). Even in the categories that represent the shorter periods, high eccentricity is almost as likely to occur as low eccentricity. Although one might have been tempted to suppose that tidal interaction would be significant enough for a trend towards circularization for the shorter periods, this is clearly not the case.

Hence, these results seem to verify Abt's conclusion that if the lengths of the periods of binary stars are longer than a few days, the values of the orbital eccentricities will show a random distribution. Since the orbital periods of visual binaries are almost always measured in years, it follows that the eccentricity values should, therefore, be random. Presumably, circularized orbits would be encountered much more frequently among spectroscopic binaries because extremely short orbital periods would be more common in this group.

As has been done in previous articles, the selected double star systems, which appear in this report, have been taken from the 2001.0 version of the Washington

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Eccentricity → Period ↓	0-.09	.1-.19	.2-.29	.3-.39	.4-.49	.5-.59	.6-.69	.7-.79	.8-.89	.9-.99	Total
0-9	2	2	4	3	2	2	1	1	0	1	18
10-49	10	12	13	19	16	12	9	8	11	7	117
50-99	5	4	9	4	10	13	10	13	20	8	96
100-499	12	16	36	25	28	34	22	22	18	8	221
500-999	6	5	4	2	7	4	4	4	5	4	45
1000-2499	2	3	2	5	1	2	1	2	1	2	21
2500-5500	2	2	3	2	1	0	3	0	1	0	14
Total	39	44	71	60	65	67	50	50	56	30	532

Table 1: Period vs. Eccentricity for visual binary systems in Sky Catalog 2000.0, Volume 2.

Double Star (WDS) Catalog, with published measurements that are no more recent than ten years ago. Several systems are included from the 2006.5 version of the WDS Catalog as well. There are also some noteworthy items, which are discussed, pertaining to the table that follows below.

First of all, several double stars are being mentioned as having significant theta/rho shifts as a result of the effects of proper motion. Regarding STF 60 AE and AG, proper motion by the "A" component is responsible for 10% decrease in the rho value for AE, and a 2% increase in the rho value for AG, since 2002. A rho value shift is also being noted for HJ 3615. Since 1999, a 3.8% decrease appears to have occurred because of proper motion by the reference point star.

A significant theta value decrease is being reported for STF 497 because of proper motions by both components. Since 1999, a decrease of 4.2 degrees has been measured. Proper motions by both components have also possibly caused a noteworthy theta value shift for AG 317. Since 1991, an increase of 3 degrees appears to have occurred. However, this increase cannot be completely substantiated because the WDS 2006.5 Catalog, the WDS 2001.0 Catalog, and the Hipparcos/Tycho catalog don't reveal similarities in the listings for the theta values. The rho value listings also display some ambiguity. More measurements need to be made for AG 317 before any conclusions can be drawn.

Because Capella exhibits a large proper motion, the rho value, for HJ 2256 AF, has decreased by about 2.4" since 1999. The theta value has also decreased by approximately 1.4 degrees.

Some comments need to be made in regards to STF 60 AB. Because this is a visual binary star, significant theta/rho shifts have been observed resulting primarily from orbital motion during the past 10 years. Since 1999, the theta value appears to have increased by almost 3 degrees and the rho value has increased by almost 5%. When the theta/rho values are determined for 2008.738 by using the orbital elements, which are rated at grade 2 in Sky Catalogue 2000.0, the theta value is .4 degrees greater and the rho value is 1.3% less than the values that appear in the table below. Hence, the two sets of values are in very close agreement, which is what one would expect with a grade 2 rating for the orbital parameters.

In contrast, the visual binary STF 305AB, which has been given a grade 5 orbit rating, shows larger departures from the theta/rho values in the table as measured for 2008.855. The theta value is 1 degree less and the rho value is 7% greater, as determined from using the orbital elements, than what was measured for this report. The variances from catalogue values are 1.5 degrees less and 3% greater respectively.

Visual binary star STF 742, which appears in the table, also has a grade 5 orbit but the variances from measured theta/rho values are significantly less. In this case, the measured theta value is only .2 degrees less and the rho value is 3.5% less than the computed values obtained using the current orbital elements, for the date of 2008.861.

There are also some measured double stars, which appear in the table, that are not listed in the WDS catalog. These measurements, which are listed with the "ARN" prefix, represent possible common proper motion double stars that don't appear to have been previously cataloged. The first pair, listed as ARN 101 (02422+4247), is located in the M 34 open star cluster in Perseus. A second pair, ARN 102 (05308+0313), can be found near the STF 721 star system. A third double star, ARN 103 (06332+1719), is in the vicinity of the STF 924 star system.

Finally, it appears that a duplicate entry may exist in the WDS catalog for GUI 12 AD (06595+3706). BLO 1 AE is listed as the next component in this multiple star listing, but since the most recent theta/rho parameters for the BLO components closely match those of GUI 12 AD, and since a second system does not appear in this part of the sky with similar parameters, it seems likely that a duplication has occurred. An eleventh magnitude star is located near the listed theta/rho parameters in 1913 for GUI 12 AD, so perhaps updated measurements that include this star would provide correct current theta/rho parameters for the GUI listing.

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
HJ 1819AB	22513+2914	8.5 10.6	71.8	15.31	2008.724	1
WEI 1	00174+3550	9.3 9.3	285.1	5.43	2008.724	2
STF 60AB	00491+5749	3.4 7.4	320.7	13.33	2008.738	3
STF 60AE	00491+5749	3.4 10.1	127.0	82.46	2008.738	3
STF 60AG	00491+5749	3.4 9.5	257.7	418.70	2008.738	3
AG 12	01019+2347	9.8 10.6	244.2	6.42	2008.738	4
HJ 10AC	01052+1250	9.3 9.7	58.2	8.89	2008.738	5
STF 106	01163-0709	9.7 9.8	308.0	4.44	2008.738	6
STF 178	01520+1049	8.2 8.0**	204.0	3.46	2008.738	7
STF 244	02176+2214	9.2 9.3	290.0	4.44	2008.855	8
STT 30	02390+0855	7.7 9.5	214.3	68.63	2008.724	9
ARN 101*	02422+4247	8.7 10.1	334.3	32.58	2008.738	10
STF 305AB	02475+1922	7.5 8.2	307.5	3.46	2008.855	11
STT 31	03009+5940	7.3 8.0	230.3	73.57	2008.724	12
STF 331	03009+5221	5.2 6.2	84.8	11.85	2008.724	13
GLP 1	03108+1508	10.3 10.6	88.4	4.44	2008.724	14
STF 394Aa-B	03280+2028	7.0 8.1	163.7	6.91	2008.724	15
STF 390AC	03300+5527	5.1 10.5	170.6	110.60	2008.855	16
STF 435	03431+2541	7.2 8.8	2.9	12.84	2008.724	17
HJ 2215	04008+5323	10.0 10.4	67.9	22.71	2008.762	18

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
HJ 3615	04031-1509	9.1 10.1	147.1	18.76	2008.762	19
WAL 28AB-D	04069+3327	6.9 10.7	353.0	64.19	2008.762	20
WFC 20	04077+5258	10.4 10.5	186.2	8.39	2008.762	21
STF 497	04085+0827	9.3 10.6	215.8	11.36	2008.855	22
STF 512	04158+4524	8.7 8.7	218.2	5.43	2008.762	23
AG 79	04201+4030	9.9 10.7	113.0	26.17	2008.762	24
SHJ 40AB	04204+2721	5.0 7.4	256.9	48.39	2008.762	25
STF 519AB	04209+5023	7.7 9.4	348.1	18.27	2008.855	26
GUI 5AC	04209+5023	7.7 10.7	193.2	108.63	2008.855	26
STT 46AB	04211+5532	7.7 7.9	159.8	99.74	2008.762	27
STF 528	04226+2538	5.4 8.5	23.5	19.75	2008.762	28
HU 551AC	04347+5100	7.9 10.7	66.5	73.57	2008.762	29
S 455Aa-B	04422+2257	4.3 7.0	213.4	62.71	2008.762	30
HJ 348	04431+3356	7.3 9.4	286.1	30.61	2008.855	31
STF 608AB-C	04563+5206	8.2 9.4	112.1	4.44	2008.913	32
TOB 16	04592+4932	10.6 10.7	33.8	24.19	2008.762	33
S 461AB-C	05017+2640	6.8 8.2	159.4	78.51	2008.861	34
BUP 75AC	05093+0950	5.4 10.5	229.5	172.81	2008.861	35
GAL 378	05138-1641	7.6 9.0	318.3	39.00	2008.861	36
HJ 2256AF	05167+4600	0.2 10.2	135.6	109.61	2008.913	37
ES 574AB	05178+4720	10.1 10.7	67.1	34.56	2008.861	38
HLD 74	05233-1711	10.4 10.4	237.1	5.93	2008.861	39
HLD 75	05276-0843	9.5 10.3	88.1	6.42	2008.861	40
ARN 102*	05308+0313	10.3 10.9	96.8	23.21	2008.913	41
GAL 387	05316-1512	8.7 10.6	217.3	26.17	2008.861	42
STF 742	05364+2200	7.4 7.8	274.5	3.95	2008.861	43
STF 763	05393+1016	8.8 9.4	318.3	5.93	2008.861	44
AG 317	05467+1103	7.6 10.1	240.1	21.73	2008.913	45
HJ 2279	05502+5450	10.6 10.7	21.6	15.80	2008.861	46
ARG 61	05531+4127	9.6 10.7	115.3	23.21	2008.861	47
H 100AB	05584+0150	5.9 10.4	206.0	36.54	2008.861	48
ARN 37AC	05584+0150	5.9 6.9	293.0	177.75	2008.861	48
STF 825AB	06016+3631	7.9 9.2	146.9	7.90	2008.913	49
RST5220AB-C	06072+0028	10.1 10.4	33.2	30.12	2008.915	50
OPI 8	06119+0051	10.5 10.7	143.6	34.07	2008.915	51

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
A 2717AB-D	06152+0631	7.8 10.6	117.9	38.02	2008.915	52
STF 885	06169+0600	9.0 10.5	297.8	9.88	2008.915	53
GAL 225	06192-1151	10.3 10.4	165.4	8.39	2008.915	54
ES 2617	06219+5459	10.3 10.3	26.4	9.38	2008.915	55
BUP 88	06227-1757	1.9 10.5	339.7	186.64	2008.915	56
STT 72AB	06247+5940	7.5 10.3	304.8	45.92	2008.915	57
STT 72AC	06247+5940	7.5 7.6	322.9	134.30	2008.915	57
J 595AC	06264+1128	10.7 10.7	245.0	43.9	2008.915	58
ARN 103*	06332+1719	9.1 9.9	61.1	50.36	2008.913	59
POU1891	06415+2436	10.4 10.4	5.5	6.42	2008.915	60
ARG 64	06485+1010	10.0 9.9**	109.2	14.32	2008.923	61
STF 960	06496+5203	7.8 9.8	68.5	22.22	2008.923	62
BAL1047AB	06518+0029	10.4 10.1**	90.4	36.04	2008.923	63
BAL1350	06521+0146	10.4 10.5	29.6	18.27	2008.923	64
ARG 16	06521-1838	8.7 10.6	159.9	34.07	2008.923	65
STF 997AB	06561-1403	5.1 7.1	343.8	2.96	2008.923	66
STF 997AC	06561-1403	5.1 10.2	288.6	86.90	2008.923	66
STF 997AD	06561-1403	5.1 10.5	62.6	105.00	2008.923	66
STT 159AD	06573+5825	4.4 10.7	167.4	186.64	2008.923	67
STF 994AB	06595+3706	7.9 8.1	55.1	26.66	2008.923	68
BLO 1AE	06595+3706	7.9 9.0	353.0	207.38	2008.923	68
AG 131	07005+0239	10.0 10.0	90.9	4.44	2008.954	69
STF1007AD	07006+1243	7.4 7.7	28.3	68.14	2008.967	70
KR 29AB	07009+5651	9.9 10.2	356.1	6.42	2008.954	71
FOX 152AB	07090+0114	9.7 10.7	156.2	7.90	2008.954	72
HJ 2365AB	07130+0324	9.8 10.7	137.8	18.76	2008.954	73
STF1048	07142+0412	9.1 10.0	349.3	5.93	2008.954	74
A 2859AB-C	07185+0550	10.4 10.7	193.6	7.90	2008.954	75
BAL1399	07227+0110	10.6 10.7	317.1	18.76	2008.954	76
HJ 757	07229+3413	10.1 10.5	107.6	5.43	2008.954	77
D 13AC	07330-1250	10.3 10.6	288.1	11.85	2008.967	78
STF1098	07348+5933	10.2 10.5	289.4	27.16	2008.967	79
A 3049AC	07348+1138	9.8 10.6	124.7	41.97	2008.967	80
KU 93	07414+0149	9.9 10.7	15.0	48.88	2008.967	81
STF1123	07415+3325	9.2 9.7	166.0	3.46	2008.967	82

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
SCJ 7	07416+0912	8.4 10.3	347.1	28.64	2008.967	83
HU 709AC	07424-1816	10.3 10.2**	2.4	24.19	2008.967	84
B 1077AB-C	07480-1924	7.7 10.5	60.3	41.97	2008.967	85
HJ 2422	07558+0109	10.0 10.0	65.0	28.14	2008.967	86

* Not listed in the WDS CATALOG
** Companion star is the brighter component.

1. In Pegasus. Sep. & p.a. decreasing. Spect. A0.
2. In Andromeda. Relatively fixed. Common proper motion. Spect. G0, G0.
3. Eta or 24 Cassiopeiae. AB = sep. & p.a. inc.; c.p.m. Spect. AB = G0V, G0V.
4. In Pisces. Sep. & p.a. increasing. spect. F8.
5. In Pisces. Position angle increasing. Spect. F6V.
6. In Cetus. Relatively fixed. Spect. G0, G0.
7. In Aries. Common proper motion; sep. & p.a. increasing. Spect. F1V, F0.
8. In Aries. Relatively fixed. Common proper motion. Spect. F5, F5.
9. In Cetus. Relatively fixed. Common proper motion. Spect. A0, F0.
10. In M 34 open cluster in Perseus. Common proper motion. Spect. A0.
11. In Aries. Sep. inc; p.a. dec. Common proper motion. Spect. G0V, G0.
12. In Cassiopeia. Relatively fixed. Common proper motion. Spect. B9, A2.
13. In Perseus. Common proper motion; p.a. increasing. Spect. B7V, B9V.
14. In Aries. Relatively fixed. Common proper motion. Spect. F8.
15. In Aries. Relatively fixed. Common proper motion. Spect. A3, G5.
16. In Camelopardus. Sep. slightly inc; p.a. slightly dec. Spect. A1V.
17. In Taurus. Relatively fixed. Common proper motion. Spect. F3V, F5.
18. In Camelopardus. Sep. increasing; p.a. decreasing. Spect. A0.
19. In Eridanus. Sep. & p.a. decreasing. Spect. G8IV.
20. In Perseus. Separation slightly increasing. Spect. B3V.
21. In Camelopardus. Common proper motion; p.a. slightly decreasing.
22. In Taurus. Sep. & p.a. decreasing. Spect. F5, F5.
23. In Perseus. Common proper motion; p.a. decreasing. Spect. G5, G5.
24. In Perseus. Position angle increasing. Spect. A2, A0.
25. Phi or 52 Tauri. Sep. decreasing; p.a. increasing. Spect. K2III, F8.
26. In Perseus. AB = p.a. slightly increasing. AC = relatively fixed. Spect. K2.
27. In Camelopardus. Separation increasing. Spect. A3, A0.
28. Chi or 59 Tauri. Slight decrease in p.a. Spect. B9V, F8V.
29. In Perseus. Separation decreasing. Spect. F0.
30. Tau or 94 Tauri. Relatively fixed. Common proper motion. Spect. B3V, A0.
31. In Auriga. Separation increasing. Spect. K0.
32. In Auriga. Common proper motion; sep. slightly increasing. Spect. F8, F8.
33. In Auriga. Sep. increasing; p.a. decreasing.
34. In Taurus. Relatively fixed. Spect. G2V, G5.
35. 16 Orionis. Sep. & p.a. increasing. Spect. A2.

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36. In Lepus. Separation increasing. Spect. K0, K0.
37. Alpha Aurigae or Capella. Sep. & p.a. decreasing. Spect. G3III, K.
38. In Auriga. Sep. & p.a. increasing.
39. In Lepus. Position angle increasing..
40. In Orion. Position angle decreasing.
41. In Orion. Near STF 721 star system. Possible common proper motion.
42. In Lepus. Relatively fixed. Spect. A0.
43. In Taurus. Sep. & p.a. increasing. Common proper motion. Spect. F8, F8.
44. In Orion. Relatively fixed. Common proper motion. Spect. F8, F8.
45. In Orion. Sep. & p.a. increasing. Spect. G5.
46. In Auriga. Relatively fixed. Common proper motion.
47. In Auriga. Relatively fixed. Spect. B8.
48. 59 Orionis. AB = p.a. inc. AC = relfix.: c.p.m. Spect. AC = A5, A0.
49. In Auriga. Relatively fixed. Spect. A0.
50. In Orion. Relatively fixed. Spect. A0.
51. In Orion. Sep. & p.a. slightly increasing. Spect. G0.
52. In Orion. Position angle slightly decreasing. Spect. A0, A0.
53. In Orion. Position angle slightly increasing. Spect. A0.
54. In Canis Major. Position angle slightly decreasing. Spect. G0.
55. In Lynx. Relatively fixed. Common proper motion. Spect. A, A.
56. Beta or 2 Canis Majoris. Relatively fixed. Spect. B1II.
57. In Lynx. AB= sep. & p.a. inc. AC = relfix; cpm. Spect. AC = K0, A3.
58. In Monoceros. Relatively fixed.
59. In Gemini. Near STF 924 star system. Possible c.p.m. Spect. M0.
60. In Gemini. Relatively fixed. Common proper motion.
61. In Monoceros. Relatively fixed. Common proper motion. Spect. A0.
62. In Lynx. Relatively fixed. Common proper motion. Spect. F0, G.
63. In NGC 2301 open cluster in Monoceros. Relfixed. Common proper motion.
64. In Monoceros. Position angle slightly decreasing.
65. In Canis Major. Sep. increasing; p.a. decreasing. Spect. M.
66. Mu Canis Majoris. AB = sep. dec. AC = p.a. inc. AD = p.a. dec. Spect. G5III.
67. 15 Lyncis. Separation decreasing. Spect. G8III.
68. In Auriga. AB = sep.inc., p.a. dec. AE = sep. inc. Spect. B5, A0, B9.
69. In Monoceros. Separation increasing. Spect. F2, F2.
70. In Gemini. Relatively fixed. Common proper motion. Spect. A3, A2.
71. In Lynx. Separation slightly increasing. Spect. F5V.
72. In Monoceros. Relatively fixed. Common proper motion. Spect. A2.
73. In Canis Minor. Sep. increasing; p.a. decreasing.
74. In Canis Minor. Relatively fixed. Common proper motion. Spect. A5, A5.
75. In Canis Minor. Separation decreasing. Spect. A2.
76. In Canis Minor. Common proper motion; p.a. increasing.
77. In Gemini. Position angle decreasing. Spect. A2.
78. In Puppis. Separation increasing.
79. In Lynx. Position angle increasing. Spect. K0, F8.
80. In Canis Minor. Sep. & p.a. increasing. Spect. F2.
81. In Canis Minor. Relatively fixed. Spect. A2.

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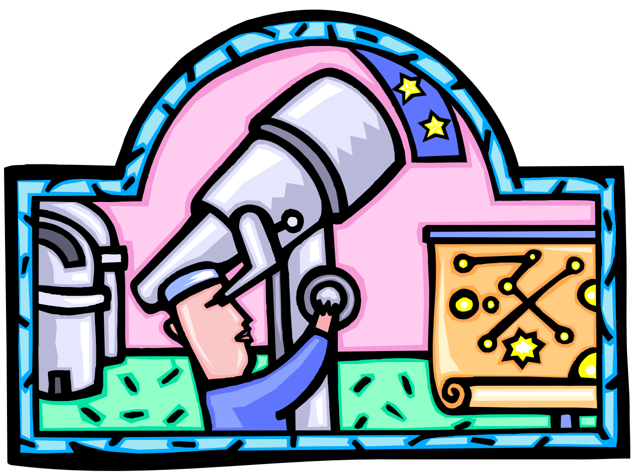
82. In Gemini. Common proper motion; p.a. increasing. Spect. F8.
83. In Canis Minor. Position angle slightly increasing. Spect. K0.
84. In Puppis. Sep. & p.a. decreasing. Spect. B9.5V.
85. In Puppis. Position angle increasing. Spect. A2.
86. In Canis Minor. Sep. & p.a. increasing.



About the Relative Proper Motion of 61 Cygni

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Abstract: While both physically connected components are often observed, the different background stars of 61 Cygni are infrequently described. In this paper, 12 new measurements between 61 Cygni and background stars from 2004, 2007 and 2008 are listed. Analyses of the different complete data sets are shown in detail and resulting proper motion were calculated.

Introduction

61 Cygni is a well known double star with high proper motion of both components. Its structure was found in 1753 by James Bradley, its proper motion was found in 1803/1804 by Giuseppe Piazzi (Fodera-Serio, 1990). Friedrich Wilhelm Bessel used 61 Cygni and some background stars to observe the first parallax of a fixed star in 1837/1838. Because of the slow orbital motion of both components, 61 Cygni is often observed.

If we have a look on the data listed in the Washington Double Star Catalog, over 1600 observations described distance and angle of the physically connected main components 61 Cygni AB. But just a few observations described the position between 61 Cygni and some background stars. If we take the 6 background stars AC to AH, a total of only 20 observations are listed in the Washington Double Star Catalog.

The 61 Cygni wide fields

Because of the high proper motion of 61 Cygni AB, the background field changes in time. The field of Piazzi's or Bessel's observations has completely changed. That's why it isn't easy to compare older observations with current values. To get a good overview of the 61 Cygni field, a photo with a common digital camera was shot (Figure 1). Figure 1 is rotated 180 degrees and gives the same orientation as an eyepiece view. On this wide field picture all components expect background stars C and D are marked. The components were identified by the J2000 coordinates given in the WDS catalog. Because of the large reproduction scale the wide field picture was not used in further analyses.

New Measurements

The double star measurements were made with an 8-inch Newtonian telescope with a focal length of 1500 mm. To record the observations a standard webcam was used (Schlimmer 2007a, Schlimmer 2008b). Reproduction scale of the optical system is about 0.794 ± 0.002 arc seconds / pixel. To get the greatest field surround 61 Cygni in 2008, the star was placed in the different corners of the image. Four videos were recorded. The faintest magnitude of stars which can be recorded directly is about 10.5. For components less than 10.5 magnitudes first the frames will be stacked. In this way, signal to noise ratio is improved and components with magnitudes of 11.5 could be detected. For analyses of the webcam records REDUC software package was used.

Table 1 shows my own measurements of 2004, 2007 and 2008. Some components, like AF, were measured for the first time since 1921. Other components near 61 Cygni A not yet listed in WDS catalog are marked with (1).

Calculation of the proper motion

To calculate the relative proper motion, the complete data set of the measurements from WDS (Mason et al., 2008) and the current measurement of the author are used. The different measurements will

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About the Relative Proper Motion of 61 Cygni

Name	RA+Dec	Mags		PA	SEP	Date	N
STF2758AB	21069+3845	5.35	6.10	151.3	31.00	2008.689	68
STF2758AE	21069+3845	5.35	9.63	271.4	305.89	2008.689	23
STF2758AF	21069+3845	5.35	11.32	241.5	329.14	2008.689	1
STF2758AG	21069+3845	5.35	10.84	237.6	198.03	2004.782	1
STF2758AG	21069+3845	5.35	10.84	236.7	212.85	2007.706	1
STF2758AG	21069+3845	5.35	10.84	236.7	217.69	2008.689	1
STF2758AH	21069+3845	5.35	10.89	302.0	73.12	2004.782	
STF2758AH	21069+3845	5.35	10.89	291.1	79.61	2007.706	
STF2758AH	21069+3845	5.35	10.89	288.2	82.33	2008.689	21
STF2758A1	21069+3845	5.35		47.7	40.89	2004.782	1
STF2758A1	21069+3845	5.35		45.0	25.99	2007.706	1
STF2758A1	21069+3845	5.35		43.9	20.64	2008.689	1

Table 1: Measurements by the author, N = 1 stacked frame was analyzed, N > 1 Number of analyzed single frames.

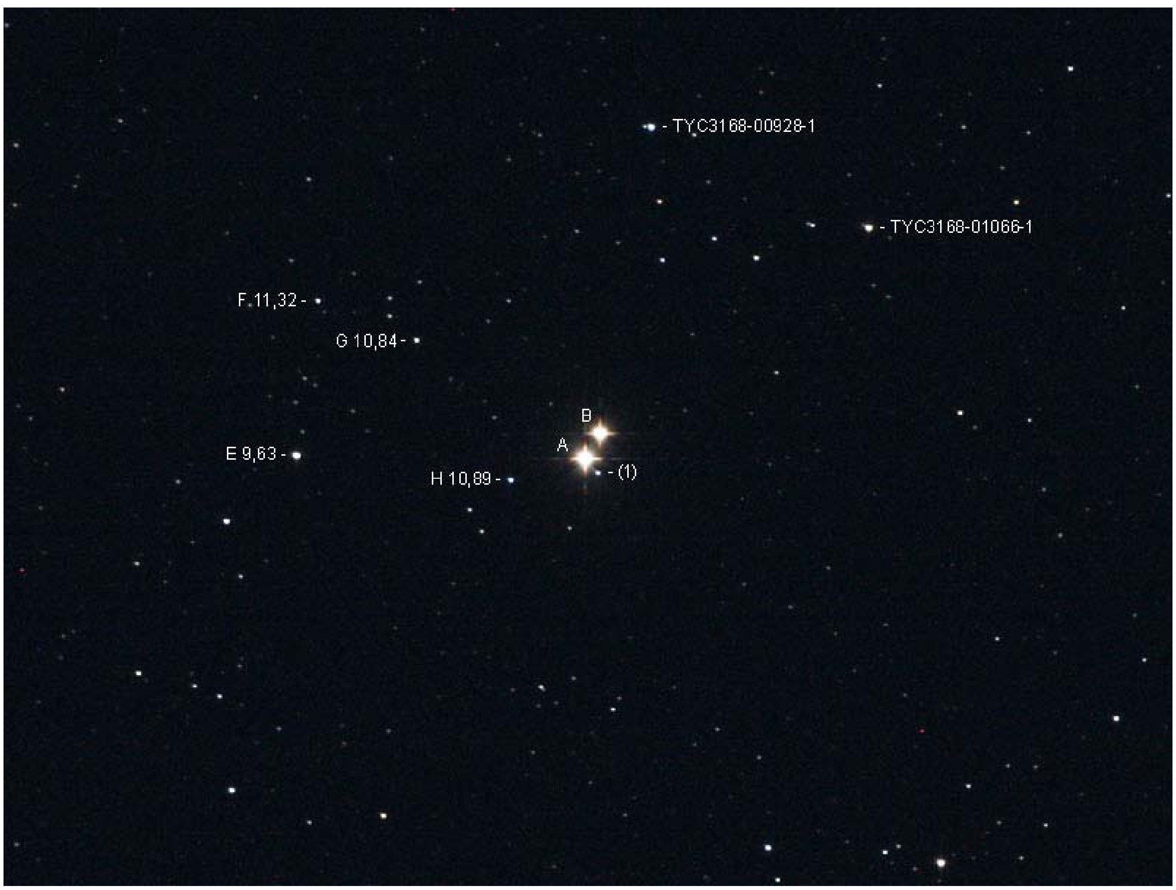

Figure 1: 61 Cygni wide field image, Canon EOS 400D, 30 s.

About the Relative Proper Motion of 61 Cygni

(Continued from page 102)

not be weighted. For plotting the relative proper motion the measurements will be transformed from polar to Cartesian coordinates by following formulae:

$$x = d \sin(\text{PA})$$
$$y = d \cos(\text{PA})$$

in which d is the distance or separation in arc seconds and PA is the position angle. A linear fit will be calculated with the Gaussian method of least squares. The x value of the proper motion, which represents the motion in right ascension, will be taken directly from Cartesian coordinates. To calculate the proper motion in declination, the y value from linear fit (y = mx + b) will be used.

Calculation of the residuals

61 Cygni AC

Component C is outside of the CCD and wide field image and was not measured. Three measurements between 1907 and 1924 are listed in the WDS catalog. Two of these measurements are faulty or one measurement is faulty and component C has also a significant proper motion. No linear fit and no residuals can be calculated.

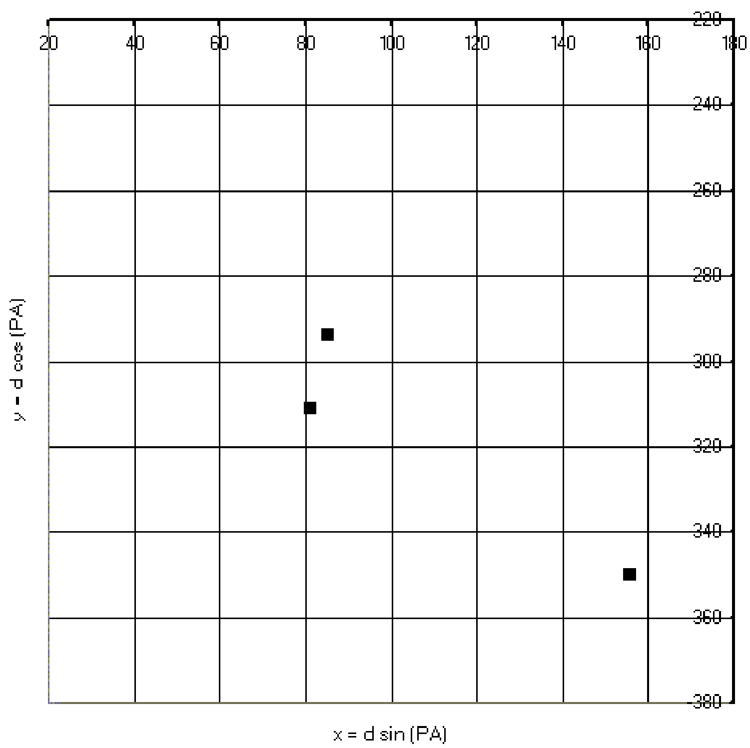

Figure 2: xy plot of 61 Cygni AC.

About the Relative Proper Motion of 61 Cygni

61 Cygni AD

Same situation as component C. Component D is outside of the CCD and wide field image. Three measurements between 1918 and 1991 are listed in the WDS catalog. Component D is outside of the CCD image. Three measurements between 1918 and 1991 are listed in the WDS catalog. Two of these measurements are faulty or one measurement is faulty and component D has also a significant proper motion. No linear fit and no residuals can be calculated.

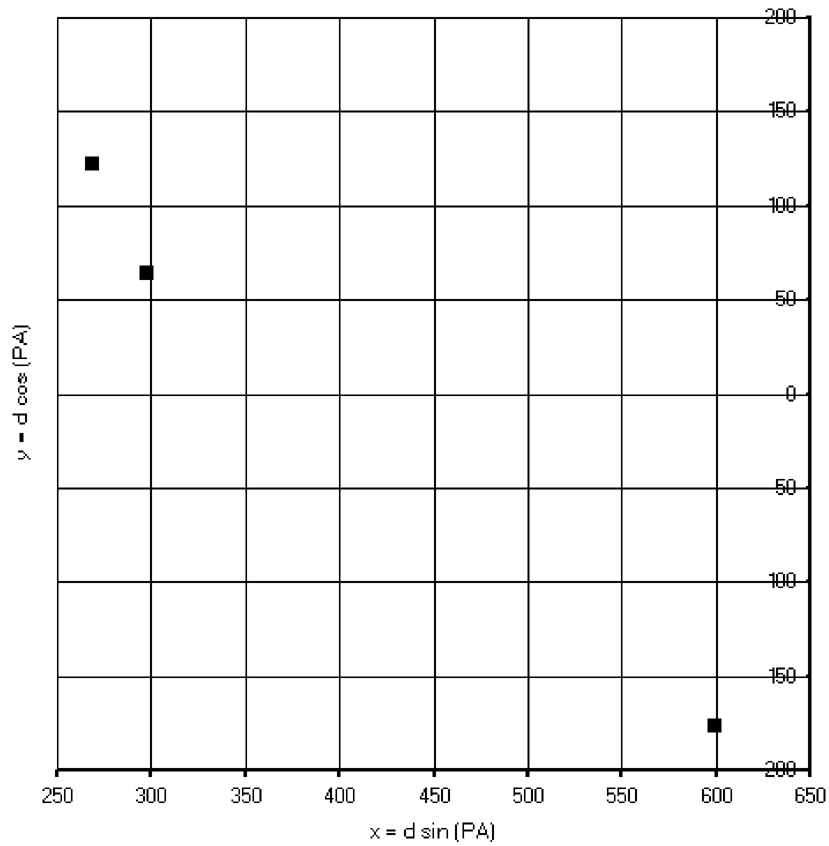

Figure 3: xy plot of 61 Cygni AD.

Ref. Code	Date	PA Observed	PA Calculated	PA residual	Sep. Observed	Sep. Calculated	Sep. Residual
VvS1919	1918.820	12.30	12.30	0.00	305.970	305.900	0.07
Tob2006c	1983.614	359.40	359.30	0.10	288.300	245.812	42.49
TYC2002	1991.680	284.50	284.96	-0.46	245.140	245.660	-0.52
Arn2002a	2001.688	277.00	276.45	0.55	280.450	280.135	0.32
Arn2003c	2002.625	276.00	275.65	0.35	284.400	284.225	0.18
Schlimmer2008	2008.741	271.44	271.90	-0.46	305.892	305.963	-0.07

Table 2: Measurements, linear fit and residuals of 61 Cygni AE

61 Cygni AE

Historic measurements of 61 Cygni AE are given in Table 2 along with measurements by me and results of a linear fit. Note that the observation of 1983 was not used in calculating the linear fit.

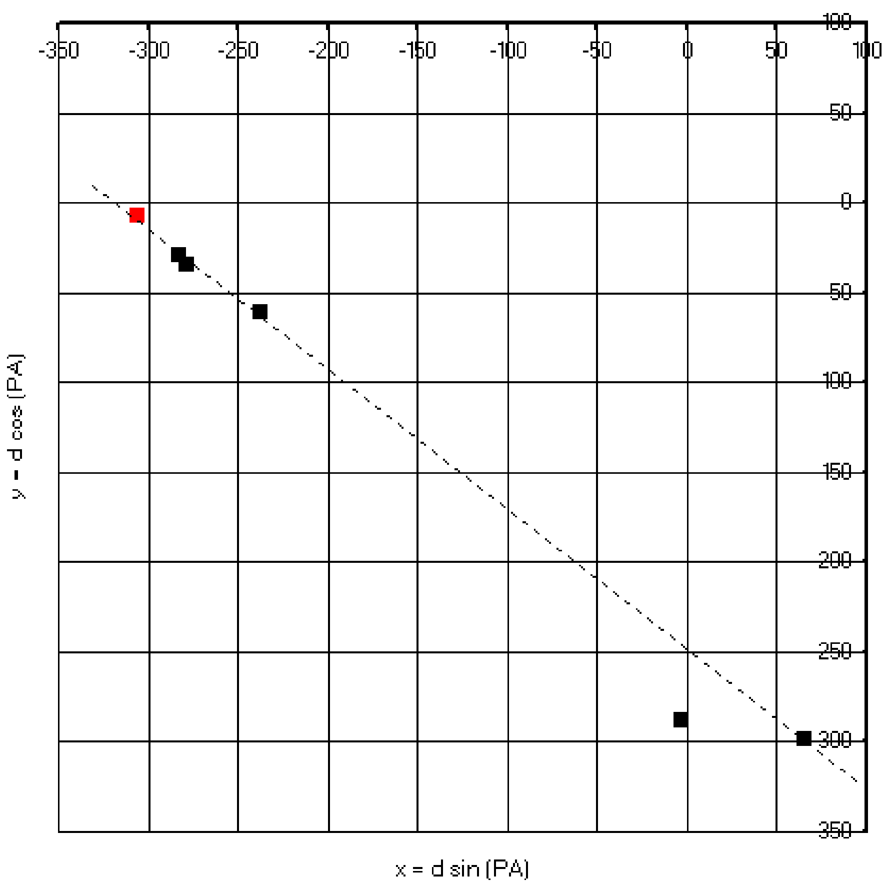

Figure 4: Measurements of 61 Cygni AE. The red square is the measurement by the author.

About the Relative Proper Motion of 61 Cygni

61 Cygni AF

Historic measurements of 61 Cygni AF are given in Table 3 along with measurements by me and the results of a linear fit. The measurements and fit are shown graphically in Figure 5.

Ref. Code	Date	PA Observed	PA Calculated	PA residual	Sep. Observed	Sep. Calculated	Sep. Residual
VvS1919	1918.660	31.100	31.42	-0.32	157.130	155.685	1.45
Abt1922	1921.680	29.700	29.35	0.35	140.560	142.079	-1.52
Schlimmer2008	2008.689	241.520	241.51	0.01	329.141	329.167	-0.03

Table 3: Measurements, linear fit and residuals of 61 Cygni AF

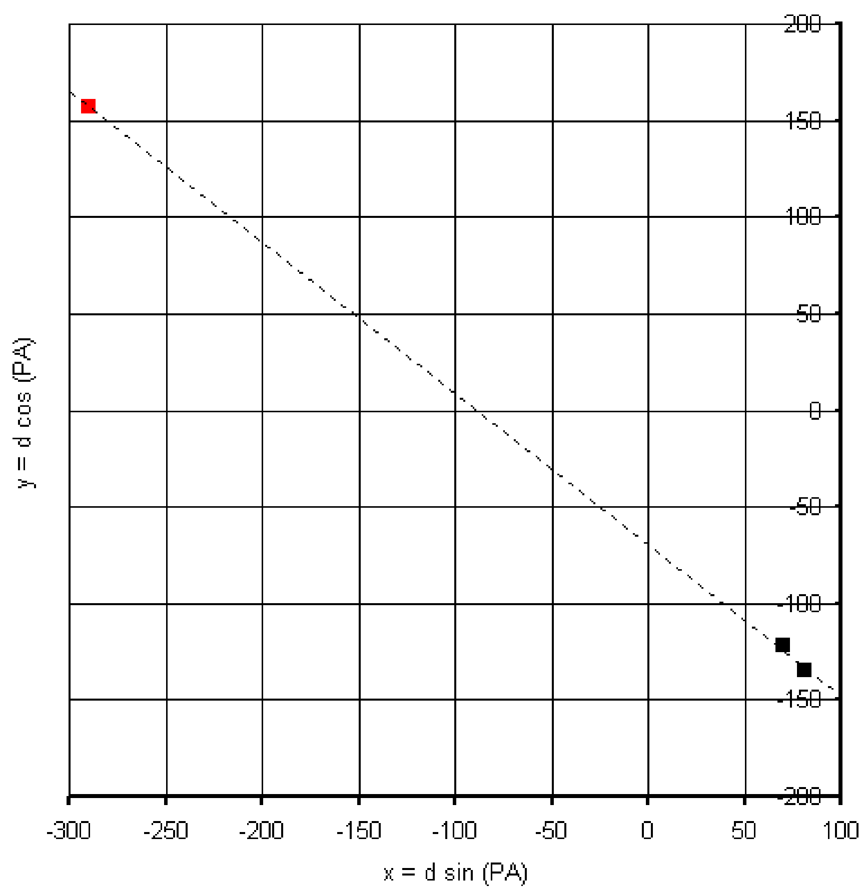

Figure 5: Measurements of 61 Cygni AF. The red square is the measurement by the author

About the Relative Proper Motion of 61 Cygni

61 Cygni AG

Historic measurement of 61 Cygni AG are given in Table 4 along with measurements by me and the results of a linear fit. The measurements and fit are shown graphically in Figure 6.

Ref. Code	Date	PA Observed	PA Calculated	PA residual	Sep. Observed	Sep. Calculated	Sep. Residual
Ole1977a	1975.560	255.800	255.94	-0.14	48	47.970	0.03
Schlimmer2004	2004.782	237.620	237.28	0.34	198.033	198.788	-0.76
Schlimmer2007	2007.706	236.690	236.91	-0.22	212.851	212.309	0.54
Schlimmer2008	2008.689	236.720	236.78	-0.06	217.693	217.533	0.16

Table 4: Measurements, linear fit and residuals of 61 Cygni AG

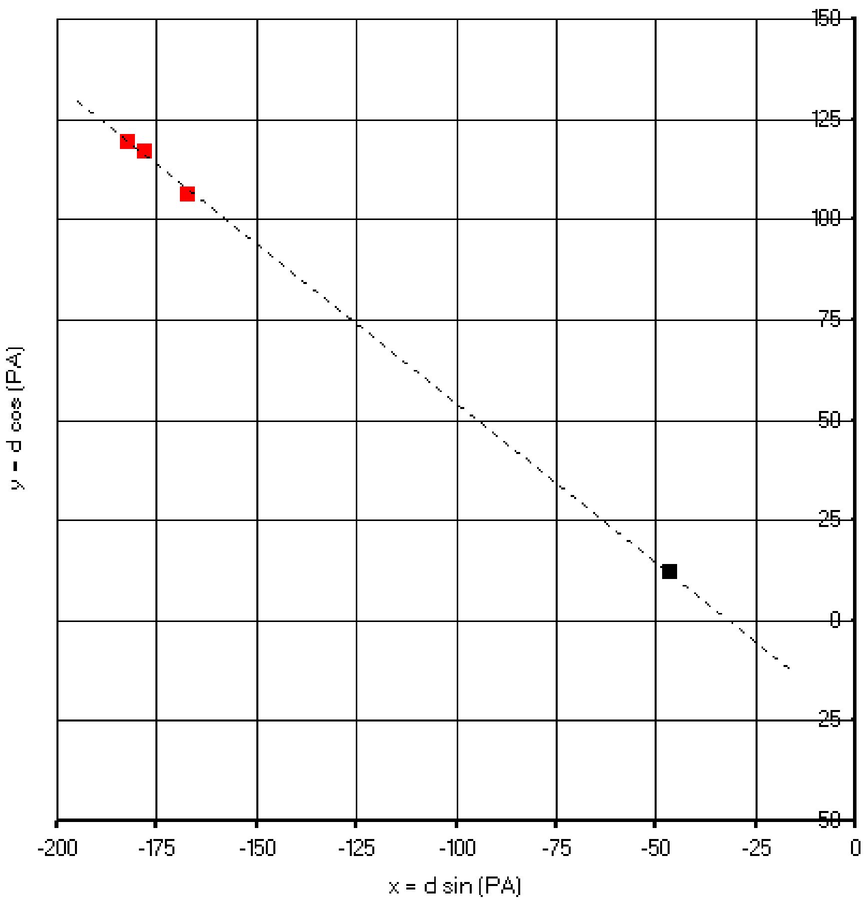

Figure 6: Measurements of 61 Cygni AG. The red squares are the measurements by the author

About the Relative Proper Motion of 61 Cygni

61 Cygni AH

Historic measurement of 61 Cygni AG are given in Table 5 along with measurements by me and the results of a linear fit. The measurements and fit are shown graphically in Figure 7.

Ref. Code	Date	PA Observed	PA Calculated	PA residual	Sep. Observed	Sep. Calculated	Sep. Residual
Ary2004	2003.028	307.900	307.52	0.38	70.680	70.320	0.36
Ary2004	2003.882	304.300	304.85	-0.55	70.830	71.297	-0.47
Arn2006c	2004.732	300.800	301.63	-0.83	72.090	72.723	-0.63
Schlimmer2004	2004.782	302.020	301.56	0.46	73.119	72.756	0.36
Ary2005	2004.983	300.600	300.01	0.59	73.990	73.548	0.44
Ary2006	2005.878	296.900	297.00	-0.10	75.240	75.304	-0.06
Ary2007	2006.836	294.300	294.22	0.08	77.240	77.191	0.05
Schlimmer2007	2007.706	291.07	291.12	-0.05	79.606	79.635	-0.03
Schlimmer2008	2008.689	288.18	288.18	0.00	82.331	82.333	0.00

Table 5: Measurements, linear fit and residuals of 61 Cygni AH

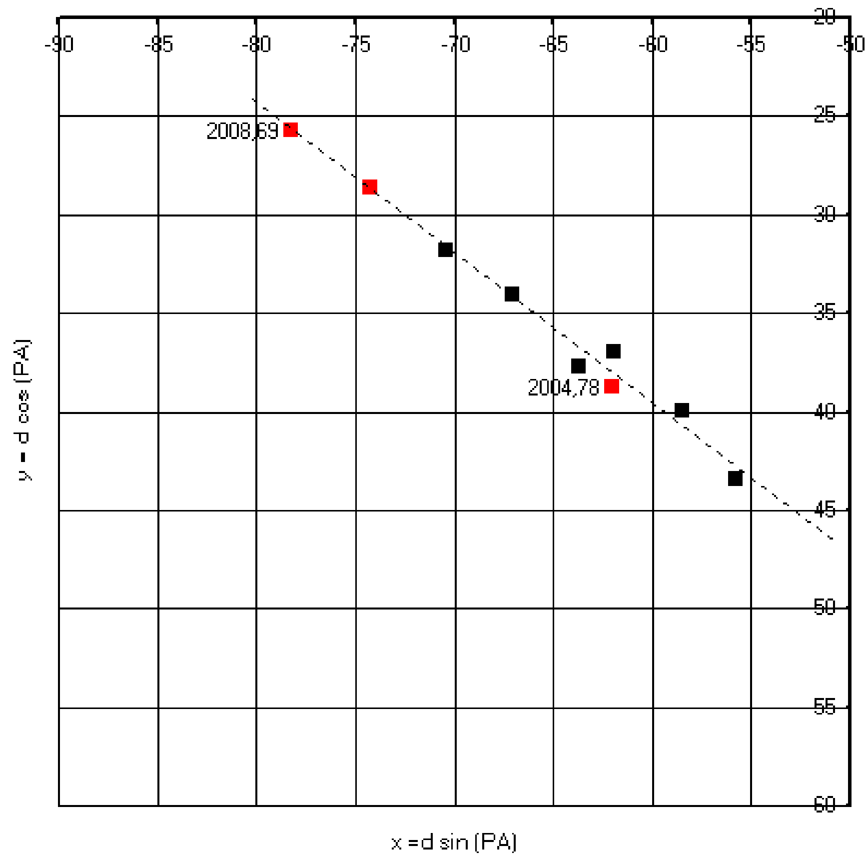

Figure 7: Measurements of 61 Cygni AH. The red squares are the measurements by the author

About the Relative Proper Motion of 61 Cygni

61 Cygni AI

Measurements of 61 Cygni AI made by the author are given in Table along with the results of a linear fit. The measurements and fit are shown graphically in Figure 8.

Ref. Code	Date	PA Observed	PA Calculated	PA residual	Sep. Observed	Sep. Calculated	Sep. Residual
Schlimmer2004	2004.782	47.740	42.31	5.43	40.889	40.921	-0.03
Schlimmer2007	2007.706	44.960	44.75	0.21	25.987	25.855	0.13
Schlimmer2008	2008.689	43.880	46.39	-2.51	20.643	20.744	-0.10

Table 6: Measurements, linear fit and residuals of 61 Cygni AH

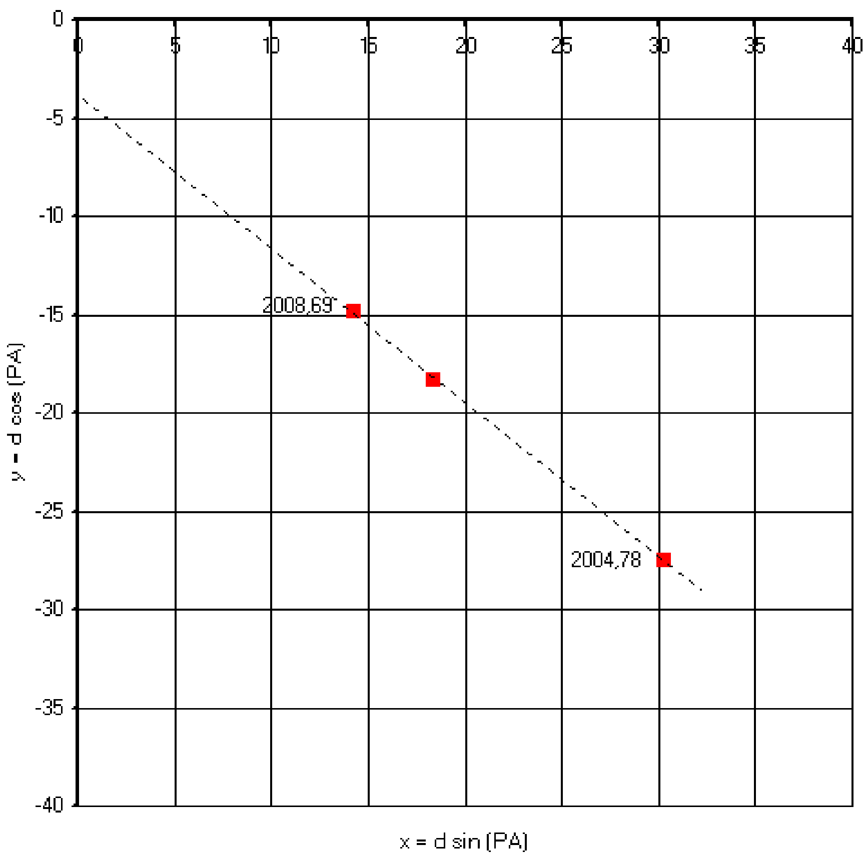

Figure 8: Measurements of 61 Cygnii AI made by the author. The dashed line is a linear fit to the points.

About the Relative Proper Motion of 61 Cygni

Summary of Results

Table 7 below shows the relative proper motion between background stars and 61 Cygni AB.

At least we compare these proper motion calculated from observation data with results of Hipparcos mission: pm (x)= 4133 mas, Pm (y) = 3202 mas, pm = 5228 mas. As we can see, the results from observation values of AF, AG and AH are close to Hipparcos results.

References

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Brian D. Mason, Gary L. Wycoff, and William I. Hartkopf, The Washington Double Star Catalog, http://ad.usno.navy.mil/wds/

Schlimmer 2007a, Double Star Measurements Using a Webcam, Journal of Double Star Observations, Vol. 3 No. 3, Pages 131-134

Schlimmer 2008b, Double Star Measurements Using a Webcam: Annual Report of 2007, Journal of Double Star Observations, Vol. 4 No. 2, Pages 81-83

	pm(x)/ mas	pm (y) / mas	pm / mas
AB	-	-	-
AC	not calculated	not calculated	not calculated
AD	not calculated	not calculated	not calculated
AE	4013	3123	5085
AF	4115	3220	5225
AG	4089	3245	5220
AH	4153	3170	5225
AI	4083	3206	5192
average	**4091**	**3193**	**5189**

Table 7: Results of the Proper Motion

Double Star Measurements Using a Webcam, Annual Report of 2008

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Abstract: I report on the measurements of 109 double stars of 2008 using a standard webcam. For STF 60, STF 697, STFB 10 and BU 1516 I recommend companions not yet listed in the WDS catalog.

For my observations I use a small 8 inch Newtonian telescope with a standard webcam described in my previous reports (Schlimmer 2007a, Schlimmer 2008b). This webcam is running on a Windows 2000 notebook. For analyzing the records the program REDUC (Version 3.82) is used.

In 2008 I applied my attention more to the double stars from the neglected list and also to optical double stars with high proper motion (Schlimmer, 2009a). Often, background stars are dim and the signal to noise ratio is too low to detect the background star directly in every frame.

To improve the signal to noise ratio an advanced technique called "shift and add" method or also known as "stacking" was used. This technique was first used in speckle interferometry analyses of Betelgeuse (Lynds et. al, 1976). In some cases it's useful to make a "dark frame", which will be subtracted from every single frame. After this procedure, a flat stacked image is the result. Hot pixels are eliminated and background stars are better evaluated. The stacking technique is implemented in REDUC and REGISTAX. Flat images can also be made with REGISTAX.

Figure 1 illustrates this technique using images of 61 Cygni AB with optical companion H. The first row shows a part of a single frame from the webcam record, the histogram of this clipping and a splice through component H and background noise. The second row shows a stacked frame as result of 50 single frames. The histogram shows less variance in the background noise. As a result, we get a much better signal to noise ratio. Component H is easy to detect. The third row shows the stacked frame after subtraction of the dark frame. The brightness in this example is normalized to the background of rows one and two.

In this case, the signal to noise ratio of component H is good enough so that REDUC can analyze every single frame of the 61 Cygni record. However, in this field are background stars fainter than component H.

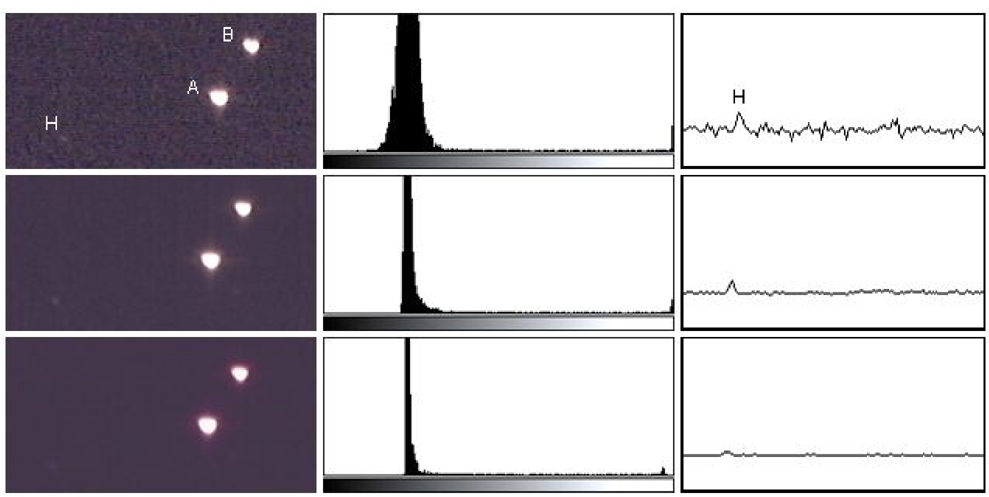

Figure 1: Left Column: images of 61 Cygni; Middle Column: Histogram of images to left; Right Column: slice through component H and background noise

Double Star Measurements Using a Webcam, Annual Report of 2008

WDS 00491+5749, STF 60AB is also known as η Cassiopeiae. See Figure 2. Its component B is physical, with a period of about 480 years. Eta Cassiopeiae is also a high proper motion star, with proper motion of nearly 1300 mas per year. In WDS catalog a couple of optical background stars are listed, but in my observations only component E could be identified. Component A moves towards background star E. Time of closest approach is the year 2059, distance will be about 15 as and position angle will be about 205°. In my analyses, I found two small background components which can't be attached to components C through H.

WDS 05235+1602, STF 697AB was discovered in 1828. Figure 3 is an image of this system. A second component (WAL 38AC) was discovered in 1901. In the WDS (Mason et. al., 2008) 45 measurements for AB and 7 measurements for AC are listed. In nearly

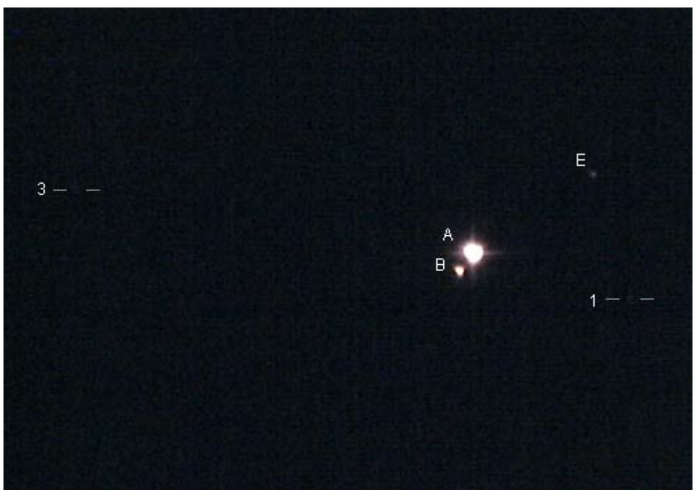

Figure 2: Eta Cassiopeiae with background stars marked 1 and 3, not listed in WDS catalog

200 years of observation, no movement can be found for component B. For component C there is a very small movement in 100 years of observation.

At a distance of about 248 arc seconds a further background star can be found. Figure 3 shows a result of 50 stacked frames. The unknown background star is marked with lines. Because the position angles of all four components are the same, all components are in line.

WDS 19508+0852, STFB 10, Altair, is in constellation Aquila. See Figure 4. Altair is not known as binary star, but three optical companions are listed in the WDS catalog. Because of these companions, the high proper motion of Altair is easy to observe. In my own observations I found two further optical companions, marked with lines.

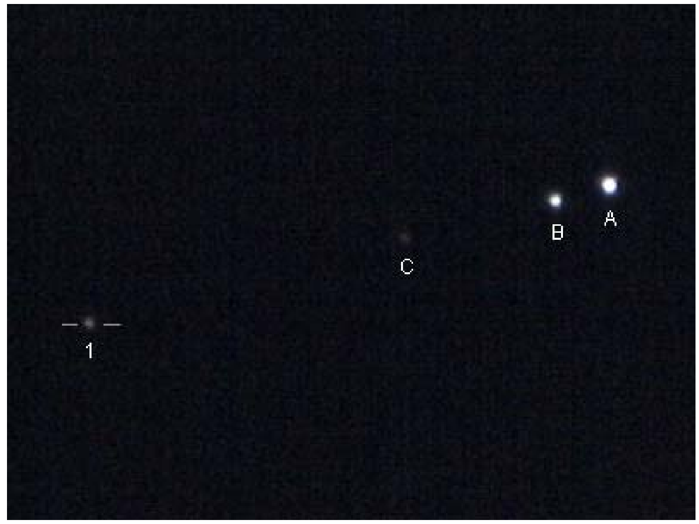

Figure 3: WDS 05235+1602 with an unlisted background star marked with lines

WDS 22415+1050, BU 1516 was discovered in 1879. The primary star is known as 42 Pegasi. Two background stars B and C are listed in the WDS catalog. Component B has a brightness of 11.6 magnitudes and has been observed only 7 times. Because of its low brightness, component B is not visible in figure 5. Component C is a little bit brighter (magnitude 11.0) and has been observed only 2 times (1879 and 2000). A third measurement was done by the author. Two further components which are not listed in WDS catalog were also found.

Figure 4: WDS 19508+0852, STFB 10, Altair with two companions which are not listed in WDS catalog

Double Star Measurements Using a Webcam, Annual Report of 2008

References

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Brian D. Mason, Gary L. Wycoff, and William I. Hartkopf, The Washington Double Star Catalog, http://ad.usno.navy.mil/wds/

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Schlimmer 2008b, Double Star Measurements Using a Webcam: Annual Report of 2007, Journal of Double Star Observations, Vol. 4 No. 2, Pages 81-83

Schlimmer 2009a, An Investigation on the Relative Proper Motion of Some Optical Double Stars, Journal of Double Star Observations, Vol. 5 No. 1, Pages 10-17

Figure 5: WDS 22415+1050 with component C and two further companions not listed in WDS catalog.

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
H 5 32Aa-B	00084+2905	2.22, 11.11	284.4	89.55	2008.916	1	α And
STFA 1	00464+3057	7.25, 7.43	47.4	47.03	2008.916	43	1
STF 60AB	00491+5749	3.52, 7.36	323.0	12.97	2008.908	85	η Cas
STF 60AE	00491+5749	3.52, 10.15	124.3	82.61	2008.908	19	η Cas
STF 60A1	00491+5749	3.52	75.2	94.32	2008.908	1	2
STF 60A3	00491+5749	3.52	272.0	234.70	2008.908	1	3
STF 180AB	01535+1918	4.52, 4.58	0.9	7.70	2008.016	15	γ Ari
STF 180AB	01535+1918	4.52, 4.58	0.3	7.47	2008.906	51	γ Ari
STF 180AB-C	01535+1918	4.52, 8.63	82.1	214.65	2008.906	54	γ Ari
STT 47Aa-B	02500+2716	3.63, 11.04	290.2	32.77	2008.995	1	41 Ari
STT 47Aa-C	02500+2716	3.7, 10.66	230.3	27.17	2008.995	1	41 Ari
STT 47Aa-D	02500+2716	3.58, 8.80	233.3	121.39	2008.995	30	41 Ari
MLB 115	03162+5810	10.99, 11.38	3.0	4.80	2008.992	23	
STFA 7	03311+2744	7.41, 7.81	233.3	43.96	2008.992	41	
STF 401	03313+2734	6.58, 6.93	269.4	11.31	2008.995	35	Mayer 11

Table 1: Double star measurements by the author in 2008.

Table continued on next page.

Double Star Measurements Using a Webcam, Annual Report of 2008

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
STFA 11AB	04393+1555	4.69, 5.09	194.2	436.34	2008.016	73	σ Tau
STF 620	04583+1357	8.77, 9.81	237.8	3.92	2008.107	61	
SHJ 49AB	04590+1433	6.06, 7.43	305.4	39.15	2008.090	81	
SHJ 49AC	04590+1433	6.06, 9.60	88.7	54.37	2008.090	61	
STF 697AB	05235+1602	7.27, 8.10	285.7	25.88	2008.102	78	
WAL 38AC	05235+1602	7.27, 10.83	284.4	97.19	2008.102	32	
STF 697A1	05235+1602	7.27, ...	284.7	248.32	2008.102	1	4
HJ 3273	05267+1513	9.4, 9.9	47.6	11.48	2008.102	32	
STF 738AB	05351+0956	3.51, 5.45	43.5	4.12	2008.107	22	λ Ori AB
STF 738AC	05351+0956	3.7, 10.72	184.6	28.71	2008.107	53	λ Ori AC
STF 738AD	05351+0956	3.51, 9.63	271.5	77.96	2008.107	75	λ Ori AD
GUI 9AE	05351+0956	3.51, 9.22	279.2	150.44	2008.107	86	λ Ori AE
STF 748Aa-B	05353-0523	6.55, 7.49	31.0	8.85	2008.016	17	θ1 Ori
STF 748Aa-C	05353-0523	6.55, 5.06	131.8	12.79	2008.016	36	
STF 748Aa-D	05353-0523	6.55, 6.38	96.2	21.53	2008.016	24	
STFA 16AB	05354-0525	5.03, 6.19	93.1	52.04	2008.016	36	θ2 Ori
STFA 16AC	05354-0525	5.2, 9.1	98.4	128.04	2008.016	37	
STF 761AB	05386-0233	7.86, 8.39	202.6	68.06	2008.016	39	
STF 761AB	05386-0233	7.86, 8.55	208.9	71.89	2008.016	39	
STF 762AB-C	05387-0236	3.73, 8.79	238.9	10.94	2008.016	7	σ Ori
STF 762AB-D	05387-0236	3.76, 6.56	83.8	12.94	2008.016	40	
STF 762AB-E	05387-0236	3.76, 6.34	61.6	41.41	2008.016	32	
J 1905	05456+2141	9.4, 9.7	266.0	5.76	2008.109	68	
HJ 712	05498+0605	9.4, 9.8	83.9	9.01	2008.109	41	
STF 816	05549+0552	6.90, 9.27	286.3	4.63	2008.107	1	
STF 919AB	06288-0702	4.62, 5.00	132.5	7.21	2008.090	213	β Mon
STF 919AC	06288-0702	4.63, 5.39	125.8	9.92	2008.090	167	
STTA 77Aa-BC	06290+2013	4.10, 8.01	329.9	112.16	2008.109	42	ν Gem
J 394	06320+1311	10.7, 11.5	291.1	4.50	2008.178	20	
AG 326	06324+1312	8.7, 9.5	4.1	23.54	2008.178	1	
STF1110AB	07346+3153	1.93, 2.97	59.2	4.59	2008.016	51	Castor
STF1110AC	07346+3153	1.93, 9.83	166.0	70.29	2008.016	42	

Table continued on next page.

Double Star Measurements Using a Webcam, Annual Report of 2008

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
LAM 6AC	07393+0514	0.38, 11.7	20.8	175.22	2008.178	1	Procyon
D 29AE	07393+0514	0.38, ...	67.5	467.84	2008.178	1	Procyon
STF1196AB	08122+1739	5.30, 6.25	42.6	0.98	2008.330	55	ζ Cnc
STF1196AC	08122+1739	5.31, 5.85	70.3	6.21	2008.319	116	
HJ 2452	08316+1806	5.35, 10.0	62.7	72.11	2008.319	1	θ Cnc
STFB 6AB	10084+1158	1.40, 8.24	308.3	174.93	2008.341	81	Regulus
STF1424AB	10200+1950	2.37, 3.64	126.1	4.64	2008.319	140	Algieba
STF1424AD	10200+1950	2.60, 10.0	302.1	367.77	2008.319	22	
STF1523	11182+3132	4.33, 4.80	224.8	1.59	2008.330	413	ξ UMa
STF1744AB	13239+5456	2.23, 3.88	152.4	14.39	2008.653	77	Mizar
STF1744AC	13239+5456	2.23, 4.01	70	706.08	2008.653	77	5
STF1744A1	13239+5456	2.23,	101.8	492.25	2008.653	21	6
SHJ 169	13547+1824	2.72, 9.99	85.8	111.99	2008.352	42	η Boo
STF1864AB	14407+1625	4.88, 5.79	112.7	5.47	2008.352	68	π Boo
STF1864AB-C	14407+1625	4.88, 10.6	166.2	126.2	2008.352	24	π Boo
STF1888AB	14514+1906	4.76, 6.95	308.8	6.17	2008.352	83	ξ Boo
STF1909	15038+4739	5.20, 6.10	59.2	1.72	2008.341	160	44 Boo
STFA 31Aa-B	16406+0413	5.76, 6.92	230.0	69.32	2008.560	56	36 Her
STF3127Aa-B	17150+2450	3.14, 8.3	286.3	11.85	2008.497	43	δ Her
STF3127Aa-C	17150+2450	3.12, 10.5	353.3	173.34	2008.497	45	δ Her
STF3127Aa-D	17150+2450	3.12, 10.6	90.4	191.85	2008.497	36	δ Her
STF1670AE	12417-0127	3.48, 8.94	168.2	258.75	2008.319	34	γ Vir
STF1670AF	12417-0127	3.48, 9.53	267.8	422.81	2008.319	22	γ Vir
STFA 34AB	17346+0935	5.80, 7.50	190.3	40.98	2008.560	53	53 Oph
STFA 34AC	17346+0935	5.80, 11.9	344.0	97.15	2008.560	1	53 Oph
STFA 34AD	17346+0935	5.80, 10.8	213.4	127.04	2008.560	1	53 Oph
STFA 34BD	17346+0935	7.50, 10.8	223.7	91.10	2008.560	1	53 Oph
STF2272AB	18055+0230	4.20, 6.20	133.2	5.69	2008.538		70 Oph
TOB 271AC	18073+1557	6.82, 8.70	340.6	111.87	2008.653	44	
H 5 39AB	18369+3846	0.02, 9.5	183.2	80.67	2008.497	34	Vega
STFA 37AB-CD	18443+3940	5.15, 5.25	172.3	208.58	2008.689	53	ε Lyr
STFA 37AI	18443+3940	6.10, 10.43	137.4	150.13	2008.689	40	ε Lyr
STFA 37Cc-I	18443+3940	5.25, 10.43	37.4	121.00	2008.689	33	ε Lyr
STF2383CD-E	18443+3940	4.56, 11.71	333.0	64.48	2008.560	1	ε Lyr

Table continued on next page.

Double Star Measurements Using a Webcam, Annual Report of 2008

Name	RA + DEC	Mags	PA	Sep	Date	N	Notes
STFA 39AB	18501+3322	3.63, 6.69	148.1	45.59	2008.664	85	β Lyrae
BU 293AE	18501+3322	3.63, 10.14	318.6	66.84	2008.664	17	β Lyrae
BU 293AF	18501+3322	3.63, 10.62	18.9	86.74	2008.664	17	β Lyrae
STFB 10AB	19508+0852	0.95, 9.82	285.9	192.49	2008.653	35	Altair
STFB 10AC	19508+0852	0.77, 10.1	107.1	188.78	2008.653	1	Altair
STFB 10A1	19508+0852	0.77, 11.0	354.9	153.36	2008.653	1	7
STFB 10A2	19508+0852	0.77	44.7	298.38	2008.664	1	8
STT 532AC	19553+0624	3.81, 11.24	348.7	214.83	2008.664	1	β Aql
LAU 4	20309+1126	10.0, 11.26	270.8	28.21	2008.664	1	
STF2690Aa-BC	20312+1116	7.12, 7.39	254.8	17.66	2008.664	57	9
STF2727	20467+1607	4.36, 5.03	266.1	9.16	2008.664	73	γ Del
STF2742	21022+0711	7.41, 7.64	214.2	2.82	2008.741	18	HIP103813
STFA 54AD	21103+1008	4.70, 6.06	152.2	334.62	2008.741	48	γ Equ
S 781AB-D	21135+0713	7.42, 7.17	172.0	183.13	2008.741	24	
STF2777AB-C	21145+1000	4.54, 10.17	7.2	73.90	2008.741	1	δ Equ
STT 433AB	21179+3454	4.43, 10.0	219.5	14.15	2008.689	1	66 Cyg
STT 433AC	21179+3454	4.43, 9.95	181.0	21.23	2008.689	1	66 Cyg
BU 1516AC	22415+1050	3.40, 11.0	8.9	175.49	2008.771	1	42 Peg
BU 1516A1	22415+1050	3.40, ...	164.8	147.03	2008.771	1	10
BU 1516A2	22415+1050	3.40, ...	129.2	62.32	2008.771	1	11
BU 1144Aa-BC	22430+3013	3.02, 9.87	338.1	93.12	2008.771	33	η Peg
HJ 301AB	22467+1210	4.19, 12.36	91.0	10.46	2008.771	1	46 Peg
STTA241	22586+1203	8.28, 8.37	160.7	84.13	2008.771	38	12
GIC 192AB	23266+4520	7.36, 9.83	330.1	55.10	2008.908	34	
GIC 192AC	23266+4520	7.37, 12.39	353.9	57.13	2008.908	1	
GIC 192BC	23266+4520	7.37, 12.39	67.2	23.18	2008.908	1	
STF3048AB	23581+2420	7.94, 10.17	313.6	8.49	2008.916	35	
STF3048AC	23581+2420	7.94, 11.33	265.0	37.46	2008.916	1	

Notes:

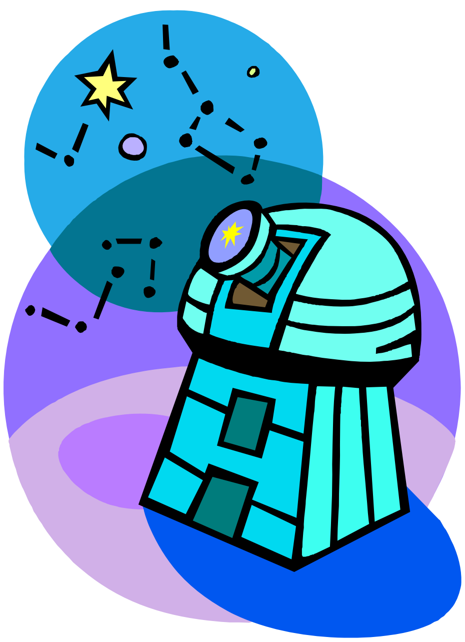
1. STFA 1 = Mayer 1 (Schlimmer 2007b)
2. Components are not one of C,D,F,G or H in WDS. See report above and Figure 2.
3. Components are not one of C,D,F,G or H in WDS. See report above and Figure 2.

(Continued on page 118)

Double Star Measurements Using a Webcam, Annual Report of 2008

(Continued from page 117)

4. Companion or background star not listed in Washington Double Star Catalog. See report above and Figure 3.
5. Measured with Leitz ocularmicrometer and not electronically.
6. Star between Mizar and Alcor, not yet listed in Washington Double Star Catalog.
7. Companion or background star near Altair not listed in Washington Double Star Catalog, magnitude estimated to be 11.0
8. Companion or background star near Altair not listed in Washington Double Star Catalog, magnitude estimated to be 11.0
9. STF2690Aa-BC = Mayer 65 (Schlimmer, 2007a)
10. Companion not listed in Washington Double Star Catalog.
11. Companion not listed in Washington Double Star Catalog.
12. Near 52 Pegasi



Observations of 4th and 5th Hour Doubles

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Abstract: I report measures for 100 visual doubles, many of which are neglected. Three new pairs are reported. Observations were made with the GRAS002 robotic telescope located at the Remote Astronomical Society Observatory, Mayhill, NM, USA (http://www.remote-astronomical-society.org/). In addition to theta and rho values (and standard deviations), I report catalog numbers and magnitude differences of pairs, some of which lack precise positional information, and delta-M values.

In this paper, I report a total of 100 mean and standard deviation measures of theta (PA) and rho (Sep) values of visual double stars imaged using a Takahashi Mewlon 300 Dall-Kirkham cassegrainian reflector located at the Remote Astronomical Society Observatory in Mayhill, New Mexico. The instrument, with a focal reducer, works at F9.1, with an approximate focal length of 2730 mm. It is equipped with a non-antiblooming ST8E CCD camera (9 micron pixels) and the combination has an approximate resolution of 0.68 arcseconds/pixel with a field of view of 11.5 x 17.3 arcminutes. The OTA is mounted on a Bisque Paramount 1100 GEM.

Methods

Methods largely follow previous methods (Wiley 2008). Observing lists were requested from the USNO (Mason, 2006). The list is processed as detailed in Wiley (2007) using the Aladin interactive sky atlas (Bonnarel et al., 2000), the Washington Double Star Catalog (Mason et al., 2006) and a number of catalogs; minimally UCAC2.0 (Zacharias et al., 2004), USNO-B.1 (GSC2.3.2 (STScI, 2006), 2MASS (Skrutskie et al., 2006), and AC2000.2 (Urban, 1998). Note was taken of the published proper motions of each pair. In most cases the proper motion estimates were too low or errors too high to evaluate the system. In some cases, noted in the discussion, the proper motion of one component was much different than the other and these are noted as probable optical pairs.

Exposures are carried out with a clear filter and the initial image was checked by downloading a JPEG of the FITS image to insure that the correct field was imaged. Exposures ranged from 20-40 seconds. MPO Canopus (Warner, 2006) is used to reduce the images. Magnitudes reported are V-magnitudes from the GSC2.3.2 catalog or J-magnitudes from 2MASS catalog, except as noted. Delta-M was computed from catalog values. New doubles are named using recommendations in Hartkopf and Mason (2004).

Results

Measures for all pairs, neglected and recently measured are presented in Table 1. This is followed by a discussion of selected pairs.

Table 1. Measures of 100 double stars bounded by from 4hr to 5hr RA and +0º to +40ºDEC. Primary and secondary catalog numbers are GSC2.3.2 catalog numbers or 2MASS unique identifiers (no prefix). Magnitudes are catalog magnitudes (V for GSC, J for 2MASS). DM is difference in magnitude computed from catalog values. PA and sdPA refer to angle (theta) and standard deviation of N measures in

(Continued on page 124)

Observations of 4th and 5th Hour Doubles

WDS/ Disc.Code	Primary	Secondary	Primary	Secon-dary	dMag	PA	sdPA	Sep	sdSep	Date	N	Notes
04015+2443 POU 345	NCG2000717	NCG2000721	12.74	13.26	0.52	214.2	0.37	14.3	0.09	2007.117	4	1
04038+2402 POU 364	NC3N000220	NC3N000221	13.31	13.91	0.6	217.3	0.16	17.72	0.04	2007.117	5	1,2
04041+2358 POU 368	NC3N000241	NC3N000238	12.87	15.12	2.25	21.6	0.18	10.69	0.13	2007.117	5	1
04041+2401 POU 367	879714556	879714552	12.682	13.519	0.837	222.6	0.62	6.07	0.22	2007.117	5	1
04042+2510 POU 370	NCG3000806	NCG3004862	12.84	15.14	2.3	254.6	0.1	13.94	0.06	2007.117	4	1
04045+2510 POU 375?	NCG3000796	NCG3005012	13.89	14.9	1.01	337.7	0.09	36.4	0.05	2007.117	4	1
04049+2323 POU 380	NC3N000443	NC3N012963	13.56	16.05	2.49	141.4	0.11	20.17	0.09	2007.117	4	1,2
04051+2324 POU 382	NC3N000439	NC3N013172	14.35	15.74	1.39	345.8	0.61	7.56	0.16	2007.117	5	1
04051+2510 POU 383	837141520	837141518	11.382	12.637	1.255	117.3	1.1	6.6	0.15	2007.117	7	1
04053+2328 POU 384	NC3N013996	NC3N000412	15.88	15.81	0.07	123.6	0.85	7.95	0.14	2007.117	4	1
04056+2330 POU 387	NC3N000398	NC3N014433	12.55	12.87	0.32	214.3	0.2	8.22	0.09	2007.117	4	1
04063+2424 POU 393	NCG0000550	NCG0000548	13.07	14.8	1.73	75.8	0.22	11.98	0.12	2007.117	6	1
04068+2336 POU 396	NC3K007353	NC3K000383	15.16	15.15	0.01	135	0.17	18.89	0.11	2007.117	5	1
04068+2342 POU 398AC	NC3K000319	NC3K000318	12.63	12.83	0.2	278.6	0.07	14.78	0.04	2007.117	5	1
04068+2342 POU 399AB	NC3K000319	NC3K000321	12.63	15.34	2.71	109.5	0.31	11.92	0.09	2007.117	5	1,2
04101+2423 POU 416	NCG0000001	NCG0003767	14.98	15.27	0.29	79.6	0.19	15.71	0.06	2007.117	4	1
04125+3538 HJ 341	NCDM001299	NCDM001298	11.3	11.45	0.15	333.5	0.17	13.73	0.05	2007.117	8	1,2
04147+2356 POU 427	NA2O000086	NA2O000088	13.08	14.36	1.28	231.3	0.38	8.18	0.07	2007.126	5	1
04237+2450 POU 445	138271241	138271243	10.412	11.264	0.852	225.7	1.65	4.06	0.24	2007.126	4	1
04243+2414 POU 448	138274215	138274211	11.041	11.794	0.753	206.1	2.03	4.8	0.19	2007.126	6	1
04244+3419 STF 533AB	NCDU038705	NCDU001010	7.3	8.49	1.19	61.6	0.11	19.58	0.05	2007.126	5	1,2
04246+3421 MLB1036	1197763692	1197763697	11.012	13.177	2.165	216.6	NA	5.14	99.9	2007.126	1	1
04251+2341 POU 451	NA2Q000271	NA2Q000269	14.47	14.12	0.35	78.7	0.87	10.9	0.04	2007.126	4	1
04268+0843 HJ 678AB	NA5I000091	NA5I000089	10.84	12.18	1.34	294.2	0.27	19.92	0.02	2007.126	4	1,2
04268+0843 OPI 2AC	NA5I000091	NA5I000088	10.84	15.18	4.34	266.5	0.06	167.34	0.06	2007.126	4	1
04285+2401 POU 457	NA2X000079	NA2X000080	13.24	14.36	1.12	128.5	0.76	8.73	0.14	2007.126	4	1

Table 1. Measures of 100 double stars bounded by from 4hr to 5hr RA and +0º to +40ºDEC. Primary and secondary catalog numbers are GSC2.3.2 catalog numbers or 2MASS unique identifiers (no prefix). Magnitudes are catalog magnitudes (V for GSC, J for 2MASS). DM is difference in magnitude computed from catalog values. PA and sdPA refer to angle (theta) and standard deviation of N measures in degrees; Sep and sdSep refer to separation (rho) in seconds and standard deviation of N measures. Date is date of observation.

Table continued on next page.

Observations of 4th and 5th Hour Doubles

WDS/ Disc.Code	Primary	Secondary	Primary	Secon- dary	dMag	PA	sdPA	Sep	sdSep	Date	N	Notes
04286+0128 BAL1271	N9XF000023	N9XF000024	11.99	12.36	0.37	254.2	0.18	12.21	0.07	2007.126	4	1
04400+3428 ES 2464	880247314	880247321	9.445	11.512	2.067	186	1.73	7.07	0.13	2007.126	4	1
04423+2345 POU 474	NA3O000229	NA3O000232	12.09	14.39	2.3	193.8	0.86	11.36	0.24	2007.126	5	1
04454+0359 BAL2124	N9L5000510	N9L5000508	11.37	12.29	0.92	326.9	0.17	38.69	0.25	2007.139	4	1
04455+0424 BAL2617	NA4N000636	NA4N000635	12.77	12.91	0.14	6.3	0.48	12.39	0.03	2007.139	4	1,2
04456+0420 BAL2618	786448304	786448308	10.224	12.481	2.257	13.2	0.38	7.74	0.07	2007.139	4	1,2
04476+2350 POU 490	NA3Q000131	NA3Q000132	12.1	14.4	2.3	98.1	0.25	13.12	0.09	2007.139	5	1
04493-0020 BAL 664	197552759	197552767	10.344	10.445	0.101	130.5	0.09	19.13	0.05	2007.139	4	1,2
04495+3914 STF 594	386803172	386803163	9.355	10.617	1.262	333	0.51	9.07	0.07	2007.139	4	1
04497+3920 WLY 19	NCF2000019	NCF2000021	10.86	11.4	0.54	222.7	0.05	30.15	0.05	2007.139	4	1
04508+3607 ALI 66	NCEQ000756	NCEQ000757	12.01	11.42	0.59	13.5	0.29	11.72	0.13	2007.139	4	1
04508+3926 MLB1003	386845966	386845965	12.418	12.179	0.239	274.6	99.9	5.73	99.9	2007.139	1	1
04522+4244 ES 1525	407173884	407173883	9.676	11.454	1.778	85.3	1.43	5.69	0.38	2007.142	4	1
04543+0722 STF 612AB	NA57000074	NA57000079	8.33	8.41	0.08	200	0.1	16.14	0.04	2007.142	4	1,2
04543+0722 STF 612BC	NA57000079	NA57000076	8.41	13.19	4.78	276.8	0.13	53.3	0.19	2007.142	4	1
04555+0503 BAL2620	N9MF000234	N9MF000236	11.48	12.4	0.92	112.6	0.22	23.13	0.05	2007.142	4	1
04562+0304 BAL1654	802609130	802609131	8.565	10.318	1.753	249.4	1.6	5.44	0.22	2007.142	5	1,2
04596+3908 ALI 781	351762913	351762925	9.402	5.319	4.083	335.1	0.7	7.22	0.08	2007.142	4	1
05007+2343 POU 510	NA3K000055	NA3K000056	11.93	13.2	1.27	117	0.11	18.77	0.05	2007.156	4	1
05013+3851 ALI 782?	NC9U001182	NC9U001180	12.96	13.06	0.1	70.8	0.33	12.73	0.04	2007.156	4	1
05033+2409 POU 515	N9QO000284	N9QO000286	12.31	13.42	1.11	150.9	0.19	17.2	0.11	2007.156	4	1
05038+3921 ALI1046	NCA5000091	NCA5000095	12.66	12.82	0.16	160.8	0.15	13.61	0.03	2007.156	4	1
05046+2401 POU 525	932291410	932291408	10.152	12.128	1.976	117.8	0.37	6.72	0.11	2007.156	4	1
05049+2329 POU 532	NA3K000849	NA3K000854	13.21	13.67	0.46	167.2	0.2	14.65	0.09	2007.156	5	1
05052+0914 HJ 691	N9LT000072	N9LT000080	10.28	12.09	1.81	157.6	0.07	27.57	0.1	2007.156	4	1,2
05063+3722 SEI 60	NC9T000060	NC9T000058	11.22	12	0.78	74.6	0.04	19.94	0.03	2007.156	4	1
05066+2321 POU 543	NA8G000343	NA8G000346	13.29	12.64	0.65	248.3	0.25	14.84	0.08	2007.156	4	1,2
05079+1103 J 322	1310946410	1310946407	10.595	11.547	0.952	329.9	3.72	3.5	0.13	2007.156	3	1
05079+2425 POU 554	N9TS000993	N9TS000994	14.28	14.38	0.1	106	0.49	10.72	0.09	2007.156	4	1

Table 1 continued on next page.

Observations of 4th and 5th Hour Doubles

WDS/ Disc.Code	Primary	Secondary	Primary	Secon-dary	dMag	PA	sdPA	Sep	sdSep	Date	N	Notes
05084+2357 POU 557	N9SW000168	N9SW000170	12.01	12.88	0.87	122.8	0.08	16.73	0.02	2007.156	4	1
05095+0325 BAL2136	N9LJ000200	N9LJ000199	12.5	13.11	0.61	289.6	0.12	17.25	0.03	2007.164	4	1,2
05104+3910 ALI1049	UC45473848	UC45473850	9.05	12.78	3.73	61.4	0.32	9.34	0.11	2007.164	4	1
05107+2452 POU 570	N9TS001304	N9TS001307	12.53	13.36	0.83	185.7	0.08	15.58	0.07	2007.164	4	1
05124+1632 BU 1391	NA7C000273	NA7C000271	12.04	12.1	0.06	73.2	0.16	23.48	0.01	2007.164	4	1
05126+3657 SEI 99	N9OY000167	N9OY017236	11.8	12.95	1.15	102.5	0.21	19.52	0.03	2007.164	4	1
05130+3753 SEI 103	NC9T000704	NC9T032034	13.02	13.81	0.79	13.5	0.22	21.56	0.09	2007.164	5	1
05133+2502 POU 585	N9SZ000188	N9SW000745	11.31	12.62	1.31	295.5	0.12	18	0.02	2007.164	3	1
05135+2451 POU 587AB	139924515	139924522	11.495	9.269	2.226	4.3	NA	9.4	NA	1997.93	1	1,3
05135+2451 WLY 17AC	139924515	139924516	11.495	11.536	0.041	79	NA	3.2	NA	1997.93	1	1,3
05153+2342 POU 606	NA6Q000045	NA6Q000047	14.06	13.35	0.71	337.7	0.19	12.94	0.07	2007.167	4	1,2
05156+2340 POU 611	NA6Q000062	NA6Q000063	12.46	14.74	2.28	133.7	0.34	12.09	0.06	2007.167	4	1
05157+3738 SEI 125AB	459453452	459453471	12.242	13.103	0.861	311.8	0.37	19.61	0.23	2007.167	5	1,2
05157+3738 WLY 18AC	459453452	459453478	12.242	12.316	0.074	318.1	0.27	23.46	0.08	2007.167	5	1
05161+3632 SEI 132	N9PB000393	N9PB000395	13.04	13.1	0.06	259.5	0.15	25.73	0.04	2007.167	4	1
05164+3651 SEI 134	N9PB017600	N9P9000267	12.83	11.95	0.88	6.8	0.03	25.23	0.02	2007.167	4	1
05165+3650 SEI 135	N9PB000224	N9PB017182	11.09	12.65	1.56	144.1	0.06	18.26	0.02	2007.167	4	1,2
05166+3646 SEI 140	N9PB000261	N9PB014555	12.71	13.08	0.37	152.9	0.04	25.71	0.03	2007.167	4	1
05170+3811 SEI 146AB	1207035003	1207035013	11.395	11.385	0.01	157	0.49	4.01	0.02	2007.167	5	1,2
05170+3811 SEI 146AC	1207035003	1207035014	11.395	12.03	0.635	250	0.52	11.56	0.07	2007.167	5	1,2
05170+3811 SEI 146AD	1207035003	1207034994	11.395	12.861	1.466	5	0.78	5.24	0.03	2007.167	5	1
05174+3753 SEI 151	N9P5000439	N9P5003701	12.4	13.67	1.27	291.6	0.14	12.79	0.06	2007.18	4	1,2
05175+2446 POU 637	140092729	140092733	9.773	11.276	1.503	200.6	0.26	4.51	0.04	2007.167	4	1,2
05176+2446 POU 640	N9SZ009721	N9SZ009761	15.39	15.35	0.04	57.2	0.33	16.5	0.14	2007.168	4	
05175+3630 SEI 153	N9PB000421	N9PB000419	12.99	11.88	1.11	54.9	0.08	27.86	0.04	2007.167	4	1
05175+3710 SEI 152	N9P9000204	N9P9008811	13.54	14.07	0.53	173.6	0.05	15.77	0.04	2007.167	4	1
05176+3629 SEI 157	880428002	880427996	10.251	11.515	1.264	322.6	0.25	7.34	0.03	2007.167	4	1,2
05176+3731 SEI 154	N9P9020399	N9P9000460	13.64	13.66	0.02	81.7	0.12	21.09	0.06	2007.18	8	1

Table 1 continued on next page.

Observations of 4th and 5th Hour Doubles

WDS/ Disc.Code	Primary	Secondary	Primary	Secon-dary	dMag	PA	sdPA	Sep	sdSep	Date	N	Notes
05177+3757 SEI 156	N9P5006979	N9P5000383	13.08	12.24	0.84	244.1	0.05	24.81	0.06	2007.18	7	1,2
05177+3801 SEI 158	N9P5009995	N9P5000331	12.67	13.27	0.6	148.3	0.09	23.9	0.03	2007.18	7	1,2
05179+3736 SEI 163	N9P9000419	N9P9034906	13.17	12.53	0.64	258.8	0.41	7.15	0.12	2007.18	6	1,2
05179+3758 SEI 161	N9P5000359	N9P5000356	12.14	13.43	1.29	310.3	0.14	13.16	0.02	2007.18	7	1,2
05180+3646 SEI 165	N9PB000256	N9PB015536	12.86	13.57	0.71	121	0.05	25.94	0.07	2007.18	4	1
05180+3733 SEI 164	N9P9000440	N9P9000436	12.02	12.23	0.21	164	0.1	27.83	0.02	2007.18	8	1,2
05183+3650 SEI 167AB	880435060	880435072	12.292	13.219	0.927	143.2	0.89	6.05	0.19	2007.18	4	1
05183+3650 SEI 167AC	880435060	880435103	12.292	12.472	0.18	9.9	0.2	19.77	0.14	2007.18	4	1
05184+3644 SEI 170	N9PB000279	N9PB000280	12.1	12.69	0.59	123.8	0.21	10.75	0.04	2007.18	7	1,2
05184+3645 SEI 169	N9PB000267	N9PB014792	12.77	13.19	0.42	104.9	0.24	10.77	0.05	2007.18	7	1,2
05186+3745 SEI 172	880478156	880478149	9.449	12.443	2.994	2.4	0.77	5.51	0.22	2007.18	4	1,2
05186+3745 SEI 173	N9P9000319	N9P9037820	11.89	14.33	2.44	101.4	0.6	8.94	0.07	2007.18	4	1,2
05187+3722 SEI 174	N9P9000136	N9P9015605	12.43	13.93	1.5	12.9	0.15	28.69	0.05	2007.18	5	1
05197+3722 SEI 183	N9PB000030	N9PB031195	11.5	13.49	1.99	27.6	0.27	16.75	0.07	2007.18	4	1
05197+3755 SEI 184	N9P5000386	N9P5006653	12.89	13.68	0.79	113.2	0.19	17.1	0.09	2007.18	4	1
05198+3755 SEI 188	N9P5000396	N9P5000399	12.27	12.75	0.48	157.3	0.21	15.06	0.05	2007.18	4	1,2

Notes

1. Measures from CCD images taken with a F9.1 300mm cassegrainian telescope (0.68 arcseconds/pixel resolution) and measured using the program MPO Canopus.
2. Recently measured
3. Measures from 2MASS catalog data retrieved via Aladin

Observations of 4th and 5th Hour Doubles

(Continued from page 119)
degrees; Sep and sdSep refer to separation (rho) in seconds and standard deviation of N measures. Date is date of observation

Discussion

Several pairs are shown to have fainter stars in the immediate neighborhood. However, in all cases the proper motions of the original pair are too small to determine their possible nature and the same is true of additional possible components. These stars are noted but not designated. Brief note of proper motion is made in the following format: catalog number, proper motions in RA and Dec in mas/yr; as in: USNO -B1.01151-0049804, +132-216 where +130 mas/yr and +034 mas/yr are the proper motions in RA(*cos(Dec)); and Dec respectively, rounded to the nearest 1 mas/yr.

04045+2510POU 375.

High proper motion of primary (USNO-B1.01151-0049804, +132-216) and low proper motion of the secondary (2UCAC 40640459, -002-002) probably explains discrepancy of this measure to original. An optical pair.

04051+2324POU 382.

Relatively high proper motion of the secondary (USNO-B1.01134-0054389, -086+380) compared to the primary (USNO-B1.001134-0054390, +014-026) probably explains the difference between original and reported measure. An optical pair.

04056+2330POU 387.

The primary (UCAC2.0 40136864, +29-26) has a measurable proper motion.

04454+0359BAL2124.

Proper motions are very different (A, UCAC2.0 32992677, +85, -215; B, UCAC2.0 32992674, -016, -010) and this pair is optical.

04559+0347BAL2130 and 04565_0427BAL2622.

Both of these entries have B components entered into the AC2002.2 catalog that agree with the original measures, However, there are not stars at either B positions.

04268+0842.

All components of this system have very different proper motions (A, UCAC2.0, +113+015; B USN-BOB1.0, -034 +022; C UCAC2.0, -002-004) and the two pairs (HJ 678AB and OPI 2AC) are optical.

04497+3920WLY 19.

Although the proper motions in RA are small, so are the errors, and this pair may be a common proper motion pair. A = UCAC 45469359: pmRA 7.9±0.7 mas/yr (*cos(Dec)); pmDE -13.4±0.9 mas/yr. B = UCAC 45469354: pmRA 6.7±1.9 mas/yr (*cos(Dec)); pmDE -13.9±3.4 mas/yr.

04543+0722STF 612.

STF 612 AB is a physical pair of KO stars with a relatively high proper motions, similar radial velocities (Kharchenko et al., 2007), and parallax (0.0340 arcsec; 29.4 parsecs distance; Lepine, 2005) and is designated a physical association in the WDS (tagged "V"). In contrast, component C has a small proper motion (UCAC2.034226405, +002-009) and thus STF 612BC is optical. Precessing to 1906 gives a measure of BC comparable to the last measure in the WDS.

04555+0503BAL2620.

Proper motion are very different, an optical pair (A, UCAC2.033516872, +002+006; B, UCAC2.033516879, +061-041).

04596+3908ALI 781.

POSSII plates and 2MASS show three point sources, two corresponding to ALI 781 and another (MASS 351762903) approximately 242 and 7.5" from the primary. Proper motions are too small to evaluate.

05007+2343POU 510.

Proper motion are very different, an optical pair (A, UCAC2.0 40142499, -003-003; B, UCAC2.040142504, +037-051).

05013+3851ALI 782?

It is very doubtful that this is the same pair measured by Ali, or, alternately, there was a mistake in transcribing measures. Nothing in the field matches the original theta and rho.

05038+3921ALI1046

Proper motions are not similar, probably optical (A, UCAC2.0 54572216, -015-010; B UCAC2.0 50082905, -031-014).

05063+3722SEI 60.

The A component has a significant proper motion (UCAC 2.0 44800268, -121, -080. Although no proper motion estimates were found for B, it is virtually the same position on POSSII plates as cataloged in the AC20002 catalog (Urban et al. 2001: mean epoch of position, 1912.978), implying a very different (and small) proper motion. Probably an optical pair.

05124+1632BU 1391.

The 2007 measure reported in the WDS of PA = 56°, Sep = 30.8" may refer to another pair. The measure reported here agrees closely with the initial measure of 1910 (PA = 73° Sep = 23.5")

Observations of 4th and 5th Hour Doubles

05049+2329POU 532.

The 2MASS catalog shows a faint "companion" of B: Unique Identifier = 144751528; 185º, 4.6" from B. Proper motion of A is too small to evaluate; B lacks proper motion measure.

05052+0914HJ 691.

Proper motions are not similar, probably optical (A, UCAC2.0 34965343, +041-048; B UCAC2.0 34965346, +015-014).

05063+3722SEI 60.

Primary has a relatively large proper motion (UCAC 4480268 -121-080) and secondary lacks a measure. AC2002 position is close to 1895 measure and indicates that the B component has not moved significantly since 1912. Probably optical.

05135+2451POU 587AB and WLY17AC.

The primary is resolved into two stars on 2MASS plates and my CCD images. The brighter star of these two stars was taken as the A component and the pair is reported as 05135+2451WLY 17AC. Unfortunately A and C were not well separated and PA and Sep are determined from positions reported in the 2MASS catalog. The B component is actually the brightest of the three. Note that the original measure of POU587AB is approximately between the two resolved stars.

05157+3738SEI 125AB, 05157+3738WLY 18AC.

WLY 18AC is probably optical. However, the two different measures reported to SEI 125 are explained by the fact that "B" is actually two stars, each correlated separately with the two different 1895 measures; prompting the naming of the third component.

05170+3811SEI 146.

In addition to the B, C, and D components, there is another star at 59.4º, 8.8" in the 2MASS catalog (1207034995; Jmag 14.667). No proper motions are not large enough to evaluate this collection of stars.

05175+2446POU 637.

Although the B component lack a proper motion measure, the discovery measure can be duplicated by precessing A to 1898 (first report) and assuming B has no measurable proper motion. Since A has a relatively large proper motion (UCAC2.0 40476260,-069-064) and B apparently does not, this is probably an optical pair.

05176+2446POU 640.

This pair's position corresponds to the WDS precise coordinates. Theta and rho are a good match, but the pair is much fainter that reported in the WDS.

05177+3757SEI 156.

The apparent brightness of B may be due to the proximity of a star (GSC2.3 N9P5038947) at 45º 4.97" from B on the POSSII image.

05179+3724SEI 162.

AC2000 has a catalog position for B that corresponds fairly closely to the original position, but no plate examined shows a star in this position and no star in the field has a large enough proper motion to explain the discrepancy. The star GSC2.3 N9P9016265 is approximately the same angle, but is much fainter that the magnitude difference of 0.7 reported. The star GSC2.3 N9P9015942 is about the right difference in magnitude but both separation and angle are completely different; a dubious double.

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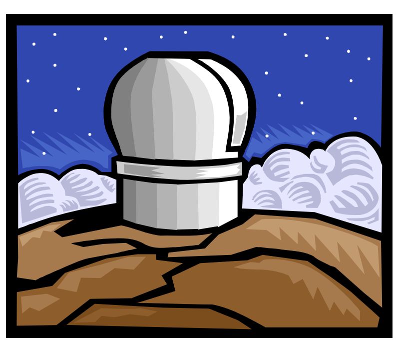

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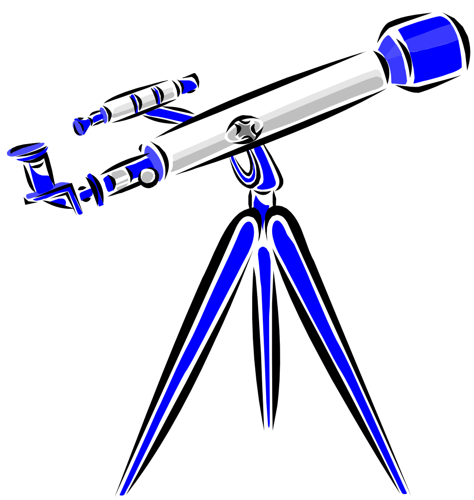

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