University of South Alabama

Journal of Double Star Observations

VOLUME 6 NUMBER 1 January 1, 2010

The appeal of observing double stars is the fun of measuring a difficult or long-neglected pair, and the fact that your data become part of a progression of measurements spanning over two centuries - data that may be combined with measures made long before you were born and used by someone long after you're gone.

William I. Hartkopf

Inside this issue:

Conversion Formula for the Celestron Micro Guide Eyepiece Used to Determine Position Angles

Thomas G. Frey[1] and Angie M. Frey[2]

1. California Polytechnic State University
San Luis Obispo, CA

2. Kent, Washington

Abstract: The Celestron Micro Guide eyepiece is used to measure the position angle of double stars. Mathematical formulas are used to convert values from one circular scale to another. This enables observers to measure values on an easy to read scale and convert the readings to values on another scale where the numerals are often more difficult to read. The latter are used to obtain position angles. Observations were made in all four quadrants to test the formula.

Introduction

Visual measurements of double stars use astrometric eyepieces to measure the separation and position angle. The Celestron Micro Guide astrometric eyepiece has two circular scales for measuring the position angle depending on the type of telescope being used. The inner scale numerals are larger and easier to read than the outer scale numerals that are smaller and difficult to read, despite focusing the eyepiece. A spreadsheet formula generated by the authors allows the observer to ascertain the outer scale values and position angles from inner scale values.

Position Angle Measurements

The outer two protractor-like or circular scales on the Celestron Micro Guide eyepiece measures the position angle. These scales are mirror images of one another. See Figure 1 for the pattern of the circular scales used in this eyepiece (Note: the actual reticle has a different appearance; only certain numbers are highlighted here). The inner circle scale (white numbers on black ovals) shows key values. Zero degrees on the inner scale is opposite 180 degrees on the outer scale; these scale values are reversed on the opposite side of the reticle. The values of 90 and 270 degrees are in the same position on both scales. Inner scale values increase in a counter-clockwise direction; outer scale values increase in a clockwise direction. Newtonian telescopes must use the outer scale to obtain the proper position angle values (Argyle, p.153). Smaller numerals on the outer scale make it difficult to read for some observers. This is especially true when the telescope being used has an alt az mount and uses the drift method for obtaining position angles (Frey, 2008). It may also be difficult to read the outer scale values when it is necessary to lower the illumination of the reticle so that the dimmer secondary star can still be detected.

Drift Method Technique

The drift method for determining position angles involves the following technique:

1. Rotate the eyepiece until the primary and secondary stars are aligned on the linear scale. Be sure the primary component is oriented toward the 60-division mark and the secondary toward the zero mark.

2.Turn off the drive motors.

3. Move the telescope to a position so the primary star can drift through the center (the 30th division mark) of the linear scale. This often takes several tri-

Conversion Formula for the Celestron Micro Guide Eyepiece Used to Determine Position Angles

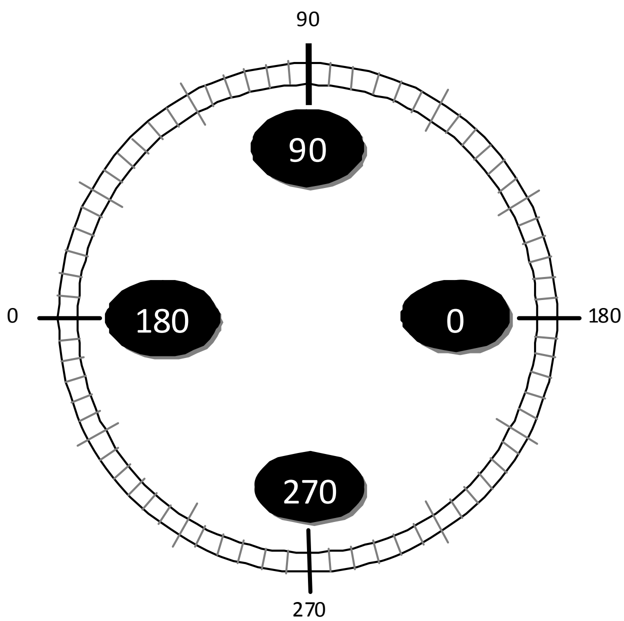


Figure 1: Celestron Micro Guide Astometric Reticle

als to accomplish.

4. Once this orientation is successful, allow the double star pair to drift to the circular scales.

5. As the primary star crosses the inner circular scale, record the angle and estimate to the nearest degree.

Conversion Formula

Two multiple "IF" formulas have been generated by the authors using a Microsoft Excel spreadsheet that allows an observer to record the value on the inner scale where the numerals are easier to read and convert it to the corresponding outer scale value. The outer scale value is then converted to the corresponding position angle.

Changing the inner scale value to the number on the outer scale does not give you the position angle directly. To get the position angle, 90 must be added to the outer scale value. And if this value exceeds 360 then 360 must be subtracted from this value to obtain the correct position angle.

Table 1 shows hypothetical examples of Inner Scale Values for all four quadrants of the circular scales, the corresponding calculated Outer Scale Values, and the calculated Position Angles.

Inner Scale Value: input from the observer based on recorded measurement and entered into cell A3.

Outer Scale Value: The value generated in cell B3 is produced from the following formula.

```
=IF(A3>360,"NA",IF(A3>180,540-A3,IF(A3>=0,180-A3)))
```

where cell A3 contains the input value from the inner scale. Formulas for values in column B are identical except for the corresponding row number.

Position Angle: The value generated in cell C3 is produced by simply adding 90 to the outer scale value in cell B3. If the value in C3 is less than or equal to 360, it corresponds to the position angle. If the value exceeds 360 then 360 must be subtracted from the value to obtain the correct position angle. The second "IF" formula makes this conversion.

```
=IF(B3+90<360,B3+90,IF(B3+90>=360,B3+90-360))
```

Note that this formula only applies to the Celestron Micro Guide astrometric eyepiece when used with a Newtonian telescope. If the reticle eyepiece made by a company other than Celestron is used, the formula does not apply.

Table 1: Excel Spreadsheet Examples for Converting Inner Scale Values to Position Angles

	A	B	C
2	Inner Scale Value	Outer Scale Value	Position Angle
3	45	135	225
4	115	65	155
5	192	348	78
6	288	252	342

Observations

Position angle measurements were carried out on four different double stars, each with a position angle in a different quadrant, and the data used to test the formula. The resulting values were compared with position angles from the Washington Double Star Catalog. All observations were made using the inner circular scale. The results are shown in Table 2; all values are in degrees. Eight trials were carried out for each double star and the mean value of the inner scale values determined (Mean ISV). The outer scale values and position angles were determined from the formulas. The calculated position angle is compared with the position angle from the Washington Double Star Catalog, PA(WDS). The DPA row corresponds to the difference between the position angles determined by observation/calculation and the values obtained from the WDS Catalog.

The values of the position angles determined from

Conversion Formula for the Celestron Micro Guide Eyepiece Used to Determine Position Angles

the formulas are very close to those obtained from the WDS. The 2.0° difference between the observed and WDS value for 61-Cygni is probably due to the shorter separation of 28 arcs-seconds compared to the separation of 34.7, 40.6, and 57 arcs-seconds in the others. The smaller the separation, the harder it is to align the double stars on the linear scale prior to determining the position angle. A false alignment can lead to an incorrect drift direction. 61 Cygni was also at the zenith when the measurement was made, making it difficult to move the telescope into the proper orientation for an accurate series of drifts.

Acknowledgments

The authors would like to thank Norma Frey, Jolyon Johnson, and Russell Genet, for their constructive suggestions regarding this paper.

References

Argyle, Robert, *Observing and Measuring Visual Double Stars*, Springer, London, 2004.

Frey, Thomas G., Spring 2008, *Journal of Double Star Observations*, **3(2),** p.59-65.

Mason, Brian, The Washington Double Star Catalog, July 2009, Astrometry Department, U.S. Naval Observatory, http://ad.usno.navy.mil/wds/wds.html.

Teague, Tom, "Simple Techniques of Measurement," *Observing and Measuring Visual Double Stars*, Ed. Bob Argyle, London: Springer (2004).

Table 2: Position Angle of Four Double Stars Obtained from Conversion Formula

Double Star	β-Cygni	61-Cygni	δ-Cephei	35-Cass
Mean ISV	214	117	80	289
Outer Scale	326	63	100	251
Position Angle	**56**	**153**	**190**	**341**
PA(WDS)	**56**	**151**	**191**	**342**
Epoch	2008	2008	2008	2001
DPA	0	+2	-1	-1

Thomas Frey is a Professor Emeritus of Chemistry at California Polytechnic State University. San Luis Obispo. He has been making double star measurements for three years.

Angie Frey is a strategic business developer and data analyst in Kent. Washington. She has been interested in astronomy since junior high school and built a ten-inch Dobsonian telescope in high school.

Divinus Lux Observatory Bulletin: Report #20

Dave Arnold

Program Manager for Double Star Research
2728 North Fox Run Drive
Flagstaff, AZ 86004

dvdarnl@aol.com

Abstract: This report contains theta/rho measurements from 98 different double star systems. The time period spans from 2009.449 to 2009.699. 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.

This article contains a listing of double star measurements that are part of a series, which have been continuously reported at Divinus Lux Observatory, since the spring of 2001. 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 Double Star Catalog (WDS) with published measurements that are no more recent than ten years ago. Several systems are included from the 2006.5 version of the WDS as well. There are also some noteworthy items that are discussed pertaining to the following table.

First of all, proper motion by the reference point star, for SLE 24, has caused a 2.5% rho value increase during the past 10 years. Next, proper motion by the "A" component, for the STF 3127 multiple star system, is responsible for numerous theta/ rho shifts. Changes for Aa-B amount to a 5 degrees theta value increase and a 3% rho value decrease during the past decade. For Aa-C, a theta value increase of approximately 4 degrees has been measured. Regarding Aa-D, a 2 degrees theta value increase has been detected. These rates of change for the STF 3127 system differ from what has been historically reported, so additional measurements by others could be useful to either confirm or adjust the parameters that are being reported in this article. All of the components of STF 3127, which have recorded measurements in the table, appear to be optical in nature.

A large proper motion by the reference point star, for STF 8, has caused a rho value increase of 3%, or 7.9", during the past 10 years. An even more significant rho value shift is being noted for STU 11 AC. Since 1986, a decrease of 8.5%, or about 14 arc seconds, has occurred because of proper motion by the "C" component. It is also worth mentioning that the theta values for 2 of the components, in this multiple star system, depart somewhat from what is listed in the WDS. For STT 188 AB, the reported theta value is at a 3 degrees variance, while the theta measurement for STU 11 BD varies by 2.5 degrees. Proper motion is not a factor in these cases and the micrometer calibration was verified. Because there is no apparent reason for these variances from catalog values, additional measurements by others could help to bring accuracy to the theta values for this system.

Next, proper motion primarily by the "A" component, for STT 588 AB & AC, is responsible for a 12 degrees theta value decrease and a 3% rho value increase for "AB" since 1999, and a 5 degrees theta value decrease and a 7% rho value increase for "AC" since 1989. Also, proper motion by the "A" component, for STF 2580 AC, has caused a 2.7% rho value decrease during the past decade. Likewise, proper motion by the "A" component, for STT 367 A-BC, has caused a rho value shift. In this case, a 2.9% increase has occurred during the past 10 years.

A rho value increase is also being noted for HO 145. Since 1999, a 3.8% shift appears to have taken place, because of proper motion, by the reference point star. In a like manner, a rho value increase is being reported for STF 2777 AB-C, with a shift of almost 4% during the past 10 years. Proper motion by the "AB" components is the cause for this increased rho value.

Three additional theta value shifts of some significance might also be mentioned. First of all, proper motion by the "C" component, in ES 831 AC, has caused this parameter to be measured at 312.7 degrees in spite of the fact that the WDS lists a value of 310 degrees. The proper motion vector for "C" suggests that this theta value should be increasing, not decreasing. Secondly, a 2 degrees theta value decrease is being reported for STF 2928 AB, since 2002. This common proper motion pair has displayed consistently significant decreases with the theta value over the decades, probably because of orbital motion. Thirdly, discordant theta values are being noted for ARY 3. This report lists a measured value of 211.9 degrees, the WDS lists a 1999 value of 214 degrees, and the Hipparcos/Tycho Catalogs suggest a value of 210.2 degrees. Because only a few measurements have been made for this optical pair, additional measurements are needed to bring increased accuracy for this parameter.

Lastly, proper motion shifts for BU 733 AC and HJ 310 deserve some mention. For BU 733 AC, the rho value has increased by 12" during this past decade because of a large proper motion by the "A" component. For HJ 310, a theta value increase of 2 degrees has occurred during the same time period as the result of proper motions by both component stars. Both of these double stars appear to be optical in nature.

In regards to visual binary STF 2140 Aa-B, the theta value appears to have decreased by one half of a degree, since 1999, because of orbital motion. However, a calculation using the orbital elements suggests a theta value of 103.6 degrees, instead of the measured value of 104.5 degrees. The measured rho value also differs by 6.5% from the value obtained from using an orbital elements calculation. Since the calculated orbit is rated as grade 5, as reported in Sky Catalog 2000.0 Vol. 2, this divergence in values shouldn't be totally surprising. Nevertheless, additional measurements by others would help to determine the accuracy of this apparent divergence between calculated and measured parameters.

Included in this report are four double stars, bearing the ARN prefix, which represent possible common proper motion pairs that don't appear to have been previously cataloged. The first such entry in the table is listed as ARN 107 (18317-1915), which is located near M25. Secondly, ARN 108 (19444+5107), which appears as another entry in the table, is located near ARY 22. Thirdly, ARN 109 (20023+1835) can be found near STT396. Finally, ARN 110 (20468-1655) can be located near SKI 11.

NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
STF2140Aa-B	17146+1423	3.3 5.3	104.5	4.94	2009.449	1
STF3127Aa-B	17150+2450	3.1 8.3	285.3	10.86	2009.449	2
STF3127Aa-C	17150+2450	3.1 10.3	356.9	173.80	2009.449	2
STF3127Aa-D	17150+2450	3.1 10.4	93.1	191.58	2009.449	2
SLE 24	17174+2501	8.9 10.7	16.1	39.50	2009.449	3
STF 8	18213-0254	3.2 10.7	55.1	250.83	2009.468	4
ARN 107*	18317-1915	9.6 10.8	288.2	20.74	2009.468	5
STF2404	18508+1059	6.7 7.6	180.0	3.46	2009.468	6
BU 359AB	19052+2326	8.8 9.7	81.0	4.44	2009.485	7
STF2487AB	19138+3909	4.4 8.6	80.0	28.64	2009.468	8
STT 367A-BC	19145+3434	7.3 10.2	226.1	34.56	2009.485	9

Table continued on next page.

Divinus Lux Observatory Bulletin: Report #20

NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
AG 376	19147+2853	9.3 9.7	77.0	4.44	2009.485	10
STT 588AB	19250+1157	5.2 8.6	287.8	101.71	2009.485	11
STT 588AC	19250+1157	5.2 10.1	281.2	145.16	2009.485	11
STT 188AB	19428+3741	7.5 7.9	122.9	60.24	2009.468	12
STU 11AC	19428+3741	7.5 8.1	228.6	146.15	2009.468	12
STU 11BD	19428+3741	7.9 9.6	174.4	59.25	2009.468	12
ARN 108*	19444+5107	9.1 9.6	282.8	41.97	2009.485	13
STF2580AB	19464+3344	5.0 9.3	69.0	26.17	2009.485	14
STF2580AC	19464+3344	5.0 9.3	126.8	109.61	2009.485	14
ENG 67AB	19476+0105	6.8 10.6	111.1	96.78	2009.485	15
HJ 1462	20001+2557	7.4 9.8	23.4	37.03	2009.526	16
HJ 1458	20001+1111	9.2 9.4	312.7	16.29	2009.504	17
STF2613	20014+1045	7.4 8.0	354.0	3.46	2009.526	18
BU 426AC	20021+5439	8.4 8.4	52.5	162.94	2009.504	19
ENG 68CE	20021+5439	8.4 8.8	157.6	159.98	2009.504	19
ARN 109*	20023+1835	9.6 10.2	191.4	30.61	2009.542	20
HJ 1481AB	20052+4923	10.7 10.6#	6.5	17.78	2009.490	21
HJ 1481AC	20052+4923	10.7 10.4#	272.0	27.65	2009.490	21
ARN9002BC	20052+4923	10.6 10.4#	240.3	34.07	2009.490	21
SHJ 316AB	20057+3536	7.8 8.8	323.0	69.62	2009.504	22
SHJ 315AD	20060+3546	7.9 8.7	235.6	20.24	2009.504	23
FOX 249	20104+5839	10.6 10.7	105.0	6.42	2009.490	24
AG 401	20124+2923	9.4 10.2	306.0	3.95	2009.504	25
SEI1008	20131+3209	10.6 10.7	73.4	20.24	2009.490	26
SEI1060	20169+3281	9.8 10.6	8.0	23.70	2009.490	27
HJ 912AB	20183+2002	10.5 10.5	77.3	5.43	2009.504	28
HJ 912AC	20183+2002	10.5 9.0#	169.7	89.37	2009.504	28
H 127AB	20226-1223	8.4 10.7	204.8	43.45	2009.490	29
AG 254	20246+3212	9.1 10.1	341.7	5.43	2009.490	30
BU 62AC	20280+3008	8.7 10.6	178.6	38.02	2009.490	31
STF2693	20284+5430	8.2 9.2	11.9	13.83	2009.504	32
HJ 1538	20338+3336	9.7 10.4	120.5	5.43	2009.490	33
STF2698	20338+2808	8.7 9.1	303.0	4.44	2009.504	34
ES 991AC	20358+5435	9.1 10.7	106.3	62.21	2009.490	35
AG 258	20366+1027	9.3 9.9	10.0	4.44	2009.542	36

Table continued on next page.

Divinus Lux Observatory Bulletin: Report #20

NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
AG 261	20382+3109	9.3 9.9	155.0	4.44	2009.526	37
HJ 1562AB	20400+5515	8.6 10.5	167.2	21.73	2009.490	38
BU 675AE	20422+5020	5.4 10.6	239.8	72.09	2009.490	39
ARN 110*	20468-1655	10.2 10.5	89.9	59.25	2009.542	40
HO 145	20522+3513	8.8 10.7	286.8	16.29	2009.526	41
BRT 52	20523+2839	9.3 10.6	86.6	8.39	2009.490	42
STT 417AB-C	20531+2909	8.2 10.5	107.8	30.61	2009.490	43
STT 212	20535+3057	7.9 10.1	154.3	65.58	2009.490	44
ES 511	20552+2705	10.1 10.7	46.3	8.39	2009.504	45
STF2736	20567+1300	8.3 9.3	217.1	5.43	2009.504	46
STF2738AB	20585+1626	7.5 8.6	254.3	14.81	2009.504	47
STF2738AC	20585+1626	7.5 8.1	103.6	209.35	2009.504	47
JCT 4	20592+1132	10.0 10.6	11.0	10.86	2009.504	48
STF2760AB	21068+3408	7.9 8.7	30.0	3.95	2009.542	49
BRT 512	21070-0435	10.5 10.5	64.1	5.43	2009.523	50
STT 215AC	21105+4742	6.6 7.4	189.0	136.28	2009.523	51
STF2777AB-C	21145+1000	4.5 10.1	6.2	74.06	2009.542	52
COU 132	21220+2350	8.8 10.3	201.4	13.33	2009.523	53
STT 220AC	21376+5546	9.0 9.4	190.0	41.48	2009.548	54
STF 2816AC	21390+5729	5.7 7.5	120.0	11.85	2009.523	55
STF 2816AD	21390+5729	5.7 7.5	339.2	20.24	2009.523	55
HJ 5291	21417-1412	9.5 10.4	106.7	24.69	2009.523	56
STF2820AB	21426+4226	7.5 10.5	232.9	16.29	2009.523	57
STF2826AC	21474-1307	8.7 9.0	80.0	3.95	2009.523	58
ES 831AB	22016+4921	9.5 10.6	312.7	20.24	2009.584	59
ARG 96	22032+0157	9.6 9.8	3.1	8.39	2009.542	60
HJ 1729	22057+5819	9.4 10.7	99.1	7.41	2009.584	61
HJ 1721	22057+2954	7.7 9.3	265.5	12.34	2009.548	62
ES 2716	22106+4755	7.5 10.6	313.2	20.24	2009.584	63
HJ 958	22132+2148	9.8 10.6	232.0	5.93	2009.548	64
ES 1114	22184+5201	10.3 10.5	256.0	6.42	2009.548	65
ES 687	22256+4807	9.4 9.8	267.0	4.44	2009.548	66
STT 234AC	22269+4943	8.2 8.5	133.9	36.04	2009.548	67
HJ 1779	22326+3414	7.9 10.5	219.4	21.73	2009.548	68
ES 839AB	22343+4849	10.3 10.7	101.1	30.12	2009.584	69

Table continued on next page.

Divinus Lux Observatory Bulletin: Report #20

NAME	RA DEC	MAGS		PA	SEP	DATE	NOTES
HJ 1795DE	22384+4720	9.0	10.7	210.6	120.41	2009.548	70
HJ 968	22395+3653	8.7	9.6	109.0	4.44	2009.548	71
STF2928AB	22396-1237	8.6	8.7	283.0	2.96	2009.584	72
STF2939	22453-0939	7.4	9.3	61.5	10.37	2009.548	73
ARG 45	23042+4636	9.3	10.0	16.5	3.95	2009.562	74
STF2991	23134+1104	5.9	10.0	358.8	33.08	2009.562	75
ARY 3	23207+4848	8.9	9.4	211.9	118.50	2009.584	76
HJ 310	23224-1259	9.8	10.6	339.2	10.37	2009.696	77
GRV 683	23412+1647	9.7	10.3	320.8	31.60	2009.696	78
STT 251AB	23536+5131	6.8	9.0	207.5	47.89	2009.562	79
STF3046AB	23564-0930	8.7	9.3	266.0	4.44	2009.562	80
CTT 5	23575+4817	9.3	10.7	324.7	34.07	2009.584	81
DU 4	00013+0742	9.4	10.6	263.9	15.31	2009.696	82
BU 733AC	00022+2705	5.8	9.8	326.4	173.80	2009.696	83
BGH 1AB-C	00024+1047	8.7	8.5#	300.7	63.20	2009.696	84
GRV 10AC	00098+3731	9.7	10.6	140.7	63.69	2009.696	85
LDS 9	00172-1921	10.2	10.7	100.9	115.04	2009.696	86
HDS 44	00203+5412	8.9	10.3	32.1	12.34	2009.696	87
GRV 28	00324+2353	9.9	10.7	172.4	14.81	2009.696	88
STF 37	00324+1539	10.5	10.7	247.2	5.93	2009.699	89
GRV 29	00331+0735	9.4	10.5	129.8	80.98	2009.699	90
HU 511	00337+5007	9.0	10.3	177.0	4.44	2009.699	91
GRV 40	00442+3132	8.8	9.4	357.5	55.30	2009.699	92
STF 58	00453+1019	9.1	10.6	169.5	45.92	2009.699	93
STF 71	00533+0500	9.2	10.5	338.8	8.89	2009.699	94
ES 405	00557+5748	10.2	10.3	116.8	4.44	2009.699	95
GRV 53	00568+4427	8.9	9.8	142.8	40.98	2009.699	96
WNC 1	00580+0917	10.0	10.4	130.5	5.43	2009.699	97
STF 78	00591+0523	10.2	10.4	243.0	4.94	2009.699	98

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

Notes

1. Alpha or 64 Herculis. Common proper motion; p.a. dec. Spect. M5I. M5II.
2. Delta Herculis. AB = p.a. inc. AC = sep. inc. AD = p.a. dec. Spect. A3IV.
3. In Hercules. Sep. increasing; p.a. decreasing. Spect. G8V.
4. Eta or 58 Serpentis. Sep. increasing; p.a. decreasing. Spect. K2III.
5. In Sagittarius. Common proper motion. Near M 25.

Divinus Lux Observatory Bulletin: Report #20

6. In Aquila. Position angle decreasing. Spect. K2. K5III.
7. In Vulpecula. Position angle decreasing. Spect. F2.
8. Eta or 20 Lyrae. Position angle slightly decreasing. Spect. B2.5IV.
9. In Lyra. Sep. increasing; p.a. decreasing. Spect. F5IV. K.
10. In Lyra. Position angle slightly decreasing.
11. 31 Aquilae. AB & AC = sep. increasing; p.a. decreasing. Spect. G8IV. G0.
12. In Cygnus. AB = sep. inc. AC = sep. dec. BD = p.a. inc. Spect. K2. F2. G0. G0.
13. In Cygnus. Common proper motion. Near ARY 22. Spect. F8. G5.
14. 17 Cygni. AB = sep. inc.; p.a. dec. AC = sep. & p.a. dec. Spect. F5V. K5. K0.
15. In Aquila. Sep. & p.a. decreasing. Spect. G0IV.
16. In Vulpecula. Separation increasing. Spect. K2.
17. In Aquila. Common proper motion; p.a. slightly decreasing. Spect. A9V. A.
18. In Aquila. Sep. decreasing; p.a. increasing. Spect. F5V. F5V.
19. In Cygnus. AB = sep. decreasing. CE = sep. & p.a. dec. Spect. K0. F0. K5.
20. In Sagittae. Common proper motion. Near STT 396. Spect. M0. F2.
21. In Cygnus. AB = sep. inc. AC = p.a. inc. BC = p.a. inc. Spect. K1III.
22. In Cygnus. Relatively fixed. Spect. O7III. B2.
23. In Cygnus. Relatively fixed. Common proper motion. Spect. B5. B5.
24. In Cygnus. Position angle slightly decreasing.
25. In Vulpecula. Relatively fixed. Spect. A0.
26. In Cygnus. Position angle decreasing. Spect. F5.
27. In Cygnus. Separation slightly increasing. Spect. A3.
28. In Sagittae. AB & AC = separation increasing. Spect. C = F8.
29. In Capricornus. Relatively fixed. Spect. K2III.
30. In Cygnus. Sep. & p.a. decreasing. Spect. K0.
31. In Cygnus. Sep. & p.a. slightly decreasing. Spect. A0.
32. In Cygnus. Relatively fixed. Common proper motion. Spect. A0.
33. In Cygnus. Common proper motion; sep. decreasing.
34. In Vulpecula. Relatively fixed. Spect. A0.
35. In Cygnus. Sep. decreasing; p.a. increasing. Spect. K7.
36. In Delphinus. Relatively fixed. Spect. G0.
37. In Cygnus. Relatively fixed. Spect. G5.
38. In Cygnus. Relatively fixed. Common proper motion. Spect. F8.
39. 51 Cygni. Separation slightly increasing. Spect. B2V.
40. In Capricornus. Common proper motion. Near SKI 11.
41. In Cygnus. Sep. increasing; p.a. decreasing. Spect. F8.
42. In Vulpecula. Relatively fixed. Spect. G0. G0.
43. In Vulpecula. Sep. & p.a. decreasing. Spect. A0. F0.
44. In Cygnus. Relatively fixed. Spect. B9V. A5.
45. In Vulpecula. Sep. increasing; p.a. decreasing. Spect. F8.
46. In Delphinus. Relatively fixed. Common proper motion. Spect. F2. F2.
47. In Delphinus. AB = relfix. AC = sep. slightly decreasing. Spect. F5V. A0. F5.
48. In Equuleus. Relatively fixed. Common proper motion. Spect. G6.
49. In Cygnus. Separation increasing. Spect. A4III. A2.
50. In Aquarius. Common proper motion; p.a. decreasing. Spect. G5.
51. In Cygnus. Separation increasing. Spect. B6IV. M5.

Divinus Lux Observatory Bulletin: Report #20

52. Delta Equulei. Sep. increasing; p.a. decreasing. Spect. F5.
53. In Pegasus. Position angle slightly decreasing. Spect. A3.
54. In Cepheus. Relatively fixed. Common proper motion. Spect. A. A.
55. In Cepheus. AC & AD = relfixed; c.p.m. Spect. O6. B0V. B0V.
56. In Capricornus. Separation increasing. Spect. F0V.
57. In Cygnus. Position angle increasing. Spect. A0.
58. In Capricornus. Relatively fixed. Common proper motion. Spect. A5II. A5II.
59. In Cygnus. Sep. decreasing; p.a. increasing. Spect. A3V.
60. In Aquarius. Relatively fixed. Spect. G0. G0.
61. In Cepheus. Common proper motion; p.a. slightly increasing. Spect. A0.
62. In Pegasus. Sep. increasing; p.a. decreasing. Spect. M0. G.
63. In Lacerta. Sep. decreasing; p.a. increasing. Spect. F5.
64. In Pegasus. Common proper motion; p.a. increasing. Spect. F8. G5.
65. In Lacerta. Common proper motion; p.a. slightly decreasing. Spect. F0V.
66. In Lacerta. Sep. increasing; p.a. decreasing.
67. In Lacerta. Relatively fixed. Common proper motion. Spect. B8. B8.
68. In Pegasus. Position angle increasing. Spect. A7IV.
69. In Lacerta. Relatively fixed.
70. In Lacerta. Separation slightly decreasing. Spect. G0.
71. In Lacerta. Relatively fixed. Common proper motion. Spect. A5.
72. In Aquarius. Common proper motion; sep. & p.a. decreasing. Spect. G8. G5.
73. In Aquarius. Relatively fixed. Common proper motion. Spect. A7III. A5.
74. In Andromeda. Common proper motion; p.a. increasing. Spect. O.
75. In Pegasus. Position angle slightly increasing. Spect. G8III.
76. In Andromeda. Separation increasing. Spect. G5. F8.
77. In Aquarius. Sep. decreasing; p.a. increasing. Spect. K0. K0.
78. In Pegasus. Relatively fixed. Common proper motion. Spect. G0. F8.
79. In Cassiopeia. Sep. & p.a. increasing. Spect. K0. K5.
80. In Aquarius. Sep. & p.a. increasing. Common proper motion. Spect. G5. G5.
81. In Andromeda. Position angle decreasing. Spect. M0.
82. In Pisces. Relatively fixed. Common proper motion. Spect. F8. F8.
83. 85 Pegasi. Separation increasing. Spect. G0. G0.
84. In Pegasus. Relatively fixed. Common proper motion. Spect. G0. F8.
85. In Andromeda. Relatively fixed. Common proper motion.
86. InCetus. Common proper motion; p.a. decreasing.
87. In Cassiopeia. Position angle increasing. Spect. B3. B3.
88. In Andromeda. Relatively fixed. Common proper motion. Spect. F5.
89. In Pisces. Relatively fixed. Common proper motion. Spect. K0. K0.
90. In Pisces. Relatively fixed. Common proper motion. Spect. G0. F8.
91. In Cassiopeia. Relatively fixed.
92. In Andromeda. Relatively fixed. Common proper motion. Spect. G5.
93. In Pisces. Sep. increasing; p.a. decreasing. Spect. G5.
94. In Pisces. Common proper motion; sep. & p.a. decreasing. Spect. F2. F2.
95. In Cassiopeia. Relatively fixed. Common proper motion.
96. In Andromeda. Relatively fixed. Common proper motion. Spect. F8.
97. In Pisces. Relatively fixed. Common proper motion. Spect. G5.
98. In Pisces. Common proper motion. Sep. inc.; p.a. dec. Spect. F8. F8.

STI2679 - Fr. Stein's Neglected Double-Double

Frank Smith

20 Coburn Way
Jaffrey, NH 03452

fhasmith@myfairpoint.net

Abstract: I report the measurement of neglected double STI2679 and two new companion stars “C” and “D”. The CCD data images were taken with a 20in f/16.8 Ritchey-Chretien reflector. The observing run was conducted at the National Optical Observatory at Kitt Peak Visitor's Center Advanced Observer Program. Information about instrumentation, methodology, results and notes is included.

Introduction and Instrumentation

On October 1, 2009 I conducted an observing run measuring neglected doubles [Mason,2006] at the Kitt Peak Advanced Observer Program (AOP) [noao.edu] run by the National Optical Observatory Visitors Center. The results of that run were reported earlier [Smith, 2009]. One neglected double I did not report was STI2679. This double was first measured by Fr. Stein in 1917 [Daley, 2006]

When I returned home and viewed the FITS images of STI2679, it was apparent that double was a neat---and close --- double-double. The A-B components were well separated in the original images, but the “C” and “D” components were too close to reliably measure. The first observations were done on a RC Optical Systems 20 inch f/8.4 Ritchey-Chretien carbon truss reflector on a Paramount ME German equatorial mount. The CCD camera was a SBIG STL-6303E non-ABG. No filter was used. This setup gave an effective focal length of 4,103 mm, a field of view of 22 X 15 arc minutes, and a plate scale of 0.45 arc seconds per pixel, which did not have enough image scale to measure the “C” and “D” components.

I contacted Kevin Bays, my observing guide from the AOP program, and asked if STI2679 could be re-imaged at a longer focal length. He kindly agreed and on July 11, 2009 took 15 images of the double. This run was done on the same telescope but with a 2X barlow, a clear filter and a ST-8 non-ABG CCD camera. This configuration gave an effective focal length of 8,229 mm and a field of view of 5.8 X 3.8 arc minutes. This was sufficient to make measurements of the two new components.

Methods

Fifteen unguided CCD exposures of 10 seconds with a clear filter were taken. A large number of exposures were taken as the 20in Optical Systems OTA pushes the limit of the Paramount ME mount for unguided exposures.

Despite the long focal length, only two images had elongated star images. Those were excluded as well as another image for which

STI2679 - Fr. Stein's Neglected Double-Double

the measuring software could not reach a plate solution. Figure 1 is an image showing the four components.

MOP Canopus [Warner, 2006] was the primary measurement and plate solution software. Canopus produces an astrometry plate solution and also provides raw instrumental magnitudes produced by a photometry routine from its internal catalogs (USNO-V2.0 and TYCHO2 datasets) [Monet, 1998 and Schwekendiek, 2000]. The CCD images have been copied to archival CD-ROM and are available from the author.

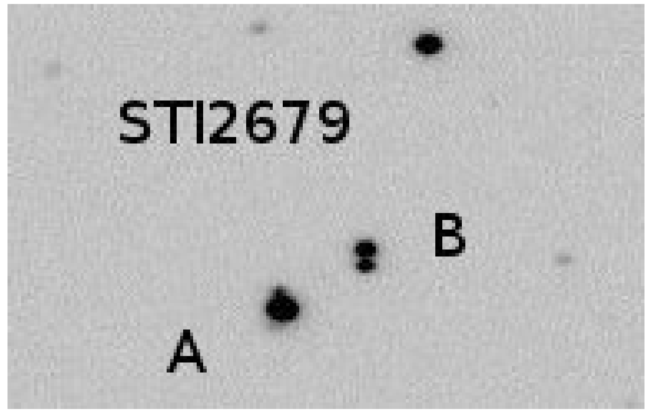


Figure 1: STI2679 shows four components in this CCD image.

Results

Table 1 reports the results of both imaging sessions of STI2679. It includes the WDS designation, arithmetic means of the separation and position angles of the A-B, A-C, and B-D

Table 1: Summary data for measures of neglected double star STI2679 at FL 4103 mm (top row) and 8229 mm (second row) are reported. WDS ID and Discoverer are the Washington Double Star Catalog identifier and discoverer codes. Magnitudes marked with an "*" are the arithmetic means of the raw instrumental magnitudes taken with a clear filter. They should NOT be considered precision photometry. PAsd and SEPsd are the standard deviations of the measures of position angle (PA) and separation (SEP) based on the number (No.) of CCD images measured. The date of discovery and number of previous measures are shown.

WDS ID	Discoverer	Mags*	PA	Sep	Epoch	No.	PAsd	SEPsd	Last	Prev	Notes
22171+5521	STI2679 A-B	A 12.13 B 13.60	305.9	13.70	2008.750	7	0.31	0.083	1917	1	#1
22171+5521	STI2679 A-B	A 12.13 B 13.60	307.5	13.86	2009.525	12	0.20	0.063			#2
	A-C	A 12.49* C 15.07*	20.3	2.24	2009.525	12	0.97	0.098		New	
	B-D	B 14.18* D 14.45*	180.9	2.05	2009.525	12	0.54	0.080		New	

Table Notes

1. I was originally puzzled by the difference in PA between the two measurement sessions. I eventually realized that at a focal length of 4.103 mm. both “B” and “D” components were merged so the software was reporting an average PA. This measure probably is similar to the conditions of the discovery measure, so I decided to publish both results.
2. At a focal length of 8.229 mm both “B” components are fully separated and the AB measure was taken between “A” and brighter “B” component at the “0” position angle of the BD pair.

STI2679 - Fr. Stein's Neglected Double-Double

components, the epoch, the standard deviations of the measurements as well as the arithmetic means of the raw instrumental magnitudes of the "C" and "D" components.

The Canopus' photometry routine attempts to provide a useful estimate of star image magnitudes by comparing the computed raw instrumental magnitudes with its internal catalogs. Of course, the raw instrumental values and the catalogs have numerous systematic errors. For comparison purposes, the "A" component of STI2679 is TYCHO2 3986/1355, catalog magnitude 12.13. The arithmetic mean of Canopus' twelve estimates of the "A" component magnitude was 12.49.

Acknowledgments

The measurement of STI2679, the two new companions, and this article, would not have been possible but for Kevin Bays of the Kitt Peak AOP; who --- on his own time---took the CCD images supplying the data. I am very grateful for his time and effort. Thanks also to Dr. Brian Mason of the USNO who provided the original observing list as well as encouragement. Thanks as well to Brian C. Warner of MOP Canopus, who helped with some deep software instruction. Special thanks to my sister, Gail Smith. for her proofreading of this article.

References

Daley, J., "Notes on the Double Stars of Father John W. Stein", 2006, *JDSO,* **2**, 134-137.

Kitt Peak National Observatory Visitors Center Advanced Observer Program (http://www.noao.edu/outreach/aop/)

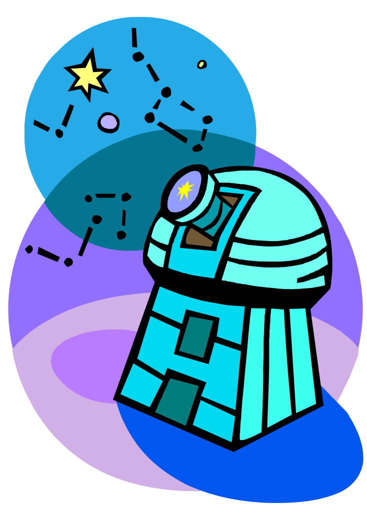
Mason, B.D., 2006, "Requested double star data from the US Naval Observatory", *JDSO*, **2**, 21-35.

Monet, D.G.,et al, 1998, USNO-A2.0 (Washington:US Nav. Obs.).

Schwekendiek, P and A. Wicenec, 2000, "The Tycho-2 Catalog of 2.5 Million brightest stars", *Astron. Astrophys.*, **355**, L27-L30.

Smith, Frank, 2009, "Neglected Double Star Observations Conducted at Kitt Peak Advanced Observer Program", *JDSO*, **5**, 135-140.

Warner, Brian, 2006, (http://www.minorplanetobserver.com/MPOSoftware/MPOCanopus.htm)



Astrometric Observations of WDS Neglected Binary Stars

Stephen J. Williams[1], John W. Wilson[1], Melissa Hursey[1, 2], and Saida M. Caballero-Nieves[1]

1. Dept. of Physics & Astronomy, Georgia State University, Atlanta, GA 30303
2. Dept. of Middle-Secondary Education and Instructional Technology, Georgia State University, Atlanta, GA 30303

Abstract: We present observations of 10 fields of stars from the Washington Double Star Catalog Neglected Doubles List, resulting in measures for 33 double or multiple stars. This research was a class project as part of the science teacher curriculum at Georgia State University. The data were gathered with the 31-inch telescope at Lowell Observatory's Anderson Mesa.

Introduction

The observation of visual binary stars may lead to orbits for such systems, and in some cases, ultimately to the measurement of one of the most fundamental properties of stars, their masses. The knowledge of the mass of a star, at virtually any point in its lifetime, can be used to constrain theories concerning the past, present, and future of the star.

Observations and Analysis

All observations were made on the night of 2009 Feb 7 (Universal Time) with the 31-inch telescope at Lowell Observatory's Anderson Mesa. These data were taken with the NASACam CCD, a 2048 by 2048 pixel array with a field of view of approximately 17 arcminutes on a side. All observations were taken with a Bessel V filter. Because we were only interested in the pixel locations and relative fluxes (counts) of each object, data were not processed and raw images were used in subsequent analyses. Digitized Sky Survey (DSS) images were used as finding charts for field identification with a field of 15 arcmintes on a side. Exposure times ranged from 15 seconds to 60 seconds depending on the brightness of the main target for each field.

Image orientation was determined for each image using the astrometric positions of field stars from the US Naval Observatory's Image and Catalog Archive (http://www.nofs.navy.mil/data/fchpix/). Utilizing field stars with known pixel positions and equatorial coordinates, the IRAF routine "ccmap" in the "imcoords" package was used to solve for the orientation of each image and the pixel scale in arcseconds per pixel. Next, the IRAF package "qphot" was used to determine the instrumental magnitude of the target stars, and their precise pixel locations. From these pixel coordinates and the pixel scale, the position angle (θ) and angular separation (ρ) were calculated for each star in the system relative to the particular companion star's location via trigonometry.

Due to inclement weather, no standard star fields were observed, so all brightness measurements from "qphot" were forced to be left as instrumental magnitudes. Thus, only delta magnitudes are listed in the "Results" section below.

Results

All the data presented in Table 1 were taken on a single night so N=1 for all observations. The epoch of observation for all data is 2009.104 in fractional Besselian years.

(Continued on page 17)

Astrometric Observations of WDS Neglected Binary Stars

Table 1: Measurements of neglected double stars. Our separation and position angle measurements are in the columns labeled "our θ" and "our ρ", respectively. All measurements are epoch 2009.104. Bold-faced and italicized objects were the main targets in each field. Others were serendipitous targets also in the fields.

WDS name	first	last	θ(1st)	last	ρ(1st)	last	our θ	our ρ	delta mag
04480+5307	1831	1983	130	131	20.0	28.4	139	29.0	0.2
04484+6411	1832	2007	165	164	12.0	14.0	164	13.5	1.2
04495+3914	1832	1998	311	332	8.0	9.1	332	9.2	1.9
04497+3920	1984	2007	223	223	30.2	30.2	223	30.1	0.9
05067+5121	1903	2006	139	135	4.2	5.1	135	5.1	0.4
05161+3632AB	1895	2007	109	113	24.8	25.1	294	25.0	<0.1
05161+3632AC	1895	2007	261	260	25.0	25.8	78	25.7	0.6
05161+3632CD	1998	2007	198	198	13.0	13.1	198	12.8	2.4
05165+3635AB	1895	2008	147	123	23.2	21.3	122	21.2	1.9
05165+3635AC	1998	2007	295	296	20.9	21.1	298	20.8	4.4
05231+3802	1895	2007	88	89	25.6	27.0	268	26.2	0.3
05234+3802	2007	2007	296	296	9.9	9.9	116	9.8	<0.1
05227+3755	1985	2007	83	123	9.2	11.1	303	11.2	0.2
05227+3758	2007	2007	78	78	16.6	16.6	78	16.6	2.2
05234+3758	2007	2007	82	82	15.7	15.7	82	15.9	0.7
05236+3803AB	2007	2007	324	324	11.0	11.0	143	10.7	0.2
05236+3803AC	2007	2007	178	178	14.5	14.5	177	14.5	0.7
05278+3446	1938	1940	113	121	6.8	6.5	114	6.2	0.4
05284+3546AB	1895	2007	186	187	25.1	25.4	187	24.9	0.3
05284+3546AC	1895	2007	207	209	17.8	18.0	209	17.9	1.0
05284+3546BD	2007	2007	199	199	10.4	10.4	199	10.2	0.3
05284+3545	1895	2007	17	20	9.8	10.3	19	10.2	0.3
05284+3549AB	1895	2007	288	288	12.2	11.5	288	11.4	0.2
05284+3549AC	1895	2007	358	359	15.2	15.4	359	15.3	1.3
05288+3547AB	1985	2007	106	108	23.6	23.4	108	23.2	0.7
05288+3547AC	1895	2007	50	50	24.7	24.9	50	24.8	2.6
05288+3547BC	1895	2007	352	353	22.7	23.3	352	23.2	1.9
05288+3547BD	1998	2007	133	133	16.0	16.1	134	15.9	2.7
05288+3546	1985	2007	295	292	17.5	19.0	292	18.9	2.2
05380+3643	1895	2007	195	196	19.0	17.0	197	17.4	0.6

Astrometric Observations of WDS Neglected Binary Stars

Discussion

WDS 04480+5307 STF 586

Also listed as BD+52 882 in the Simbad Astronomical database (http://simbad.u-strasbg.fr/simbad/). The measurements listed in Table 1 are not that different from historical measurements. The image for this object is shown in Figure 1.

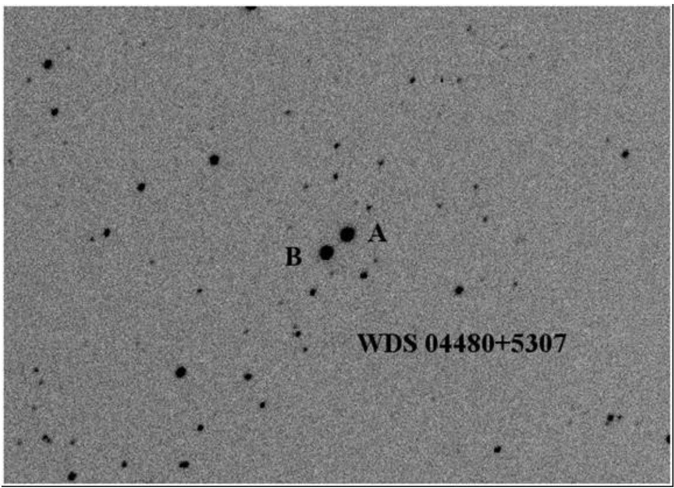


Figure 1: WDS 04480+5307 with North up and East to the left. This image is 8 arcminutes by 11.3 arcminutes.

WDS 04484+4611 HJ 2239

Measurements show no significant change in either position or angle from previous observations. The corresponding image is shown in Figure 2.

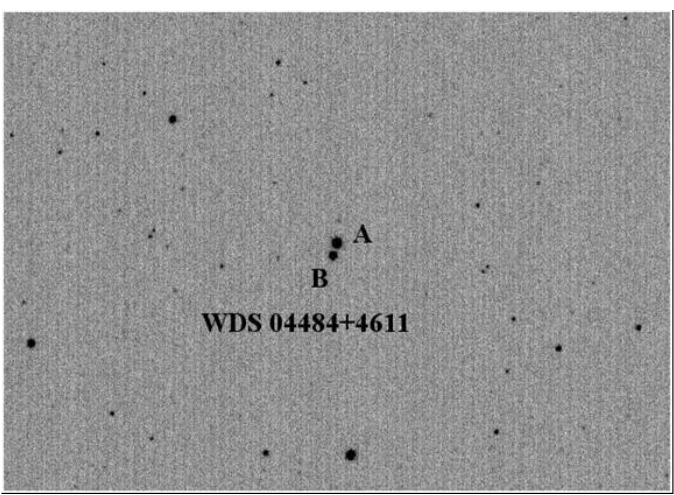


Figure 2: WDS 04484+4611 with North up and East to the left. The image is 8 x 11.3 arcminutes.

WDS 04495+3914 STF 594

Also listed as HD 276957 and HD 276957B in Simbad. Again, measurements from the image shown in Figure 3 show no difference between the most recent data (1998) and our data. The second object in the field of view that is also in the WDS is cross-listed as HD276951 and WDS 04497+3920. Analysis reveals numbers similar to the archival data.

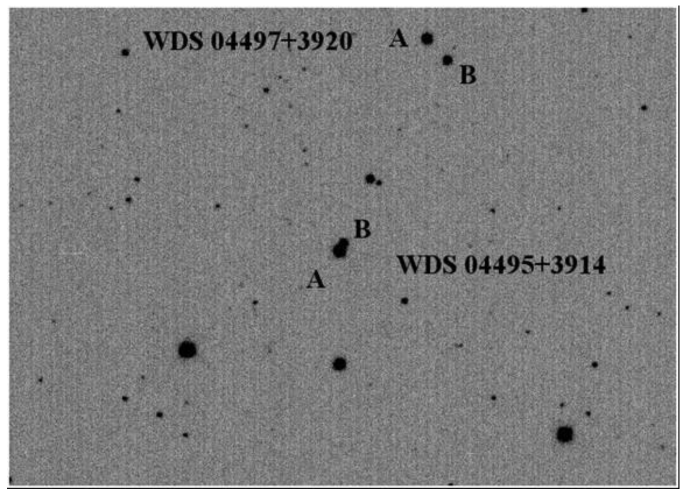


Figure 3: WDS 04495+3914 in the center with North up and East to the left. WDS 04497+3920 and components are marked near the top of the image. which is 8 x 11.3 arcminutes.

WDS 05067+5121 SMA 47

All historical data are essentially similar to the measurements made here on the image shown in Figure 4.

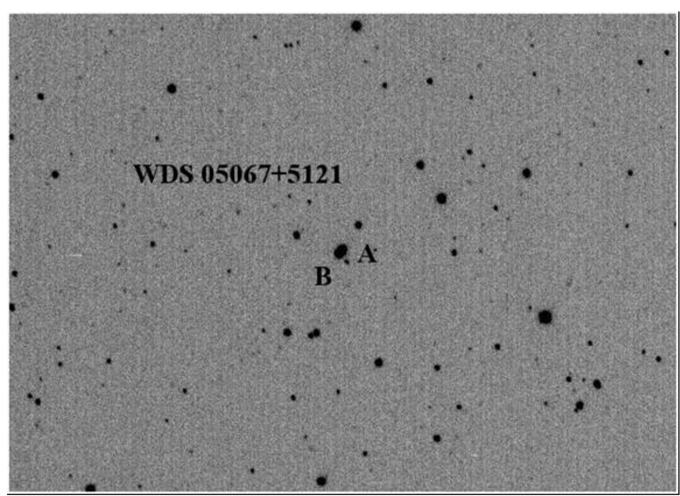


Figure 4: WDS 05067+5121 with North up and East to the left. The image is 8 x 11.3 arcminutes. The primary and secondary are very close together but not yet overlapping.

Astrometric Observations of WDS Neglected Binary Stars

WDS 05161+3632 SEI 132AB

The magnitudes of the primary and secondary are given in the WDS as 12.9 and 12.8 respectively. The data show the archival identification of the brighter star to be inconsistent, thus the measurements shown in Table 1 have a 180 degree difference. The two stars have less than a 0.1 magnitude difference in measurements from the data in Figure 5. Interestingly enough, star C in this four star entry is brighter than star B, and thus also brighter than star A. This is the cause for the 180 degree difference in each of these measurements in Table 1. The positions for each pair appear not to have changed, at least within the measurement uncertainty in our data.

As a bonus on this particular field, WDS 05165+3635 is nearby and is included in this analysis. The measurements for this pair were not significantly different than those listed in the WDS.

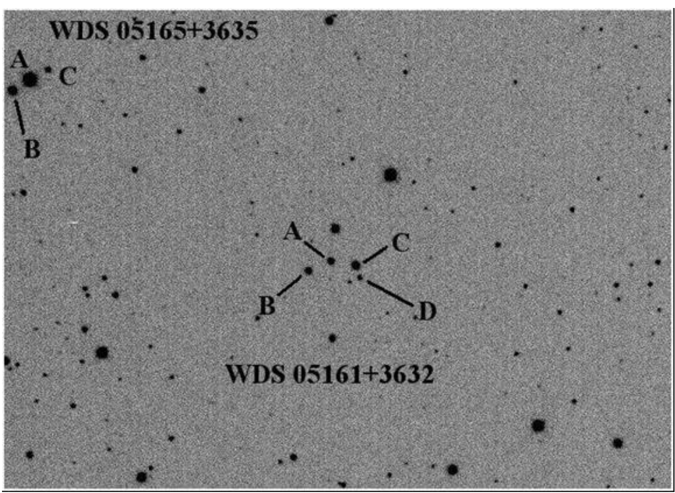


Figure 5: WDS05161+3632 at center with North up and East to the left. The top left shows WDS 05165+3635 with labels. The image is 8 x 11.3 arcminutes.

WDS 05231+3802 SEI 225

This object is also listed as CCDM J05232+3802A and B in SIMBAD. The magnitudes of the primary and secondary are given in the WDS as 12.5 and 13.0 respectively. In the SIMBAD Astronomical Database, the V magnitudes are 10.0 and 10.5 respectively. The measurements based on Figure 6 for these data give a delta magnitude in the Bessel V-band of 0.3. Aside from the 180 degree ambiguity, owing to the switch in identification of the brighter (thus, primary) star, there seems to be little change in the values of separation and position.

The second serendipitous target is WDS 05234+3802. This is listed in the WDS as having the secondary (B component) brighter than the primary (A component), but the position angle measurement does not reflect this. Aside from this 180 degree difference, all else appears similar to previous measurements for this target.

The next target also on the field is WDS 05227+3755. Again, the primary and secondary stars are reversed according to the data used in this analysis, so the position angle differs by 180 degrees. Given the change in separation between the first and last measurements, perhaps there is some evidence of a different proper motion between the two components?

Following these, the next target in the field is WDS 05227+3758. This shows no real difference between the measurements here and those conducted in 2007, except in the difference in magnitudes.

The next target is WDS 05236+3803, containing three stars, Star A is actually fainter than star B, and this is shown in the 180 difference in position angle in Table 1. Other values corresponding to this system show no significant differences compared to those listed in the WDS.

All these stars could not fit on one figure, so Figures 6a and 6b show all of the systems for which measurements were made.

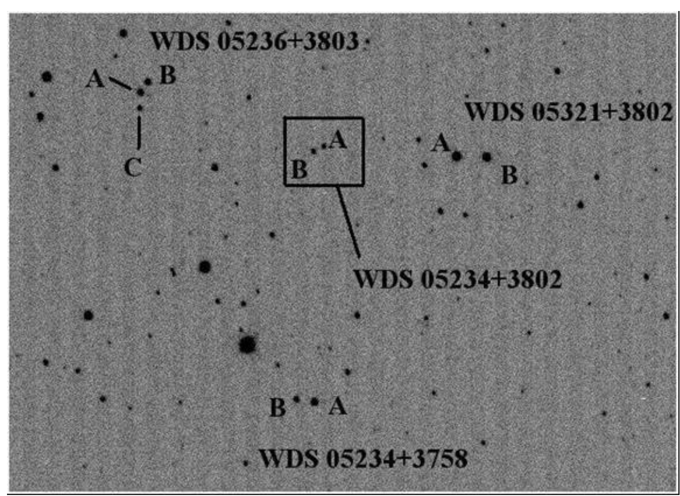


Figure 6a: The first part of the field where WDS 05231+3802 was the main target with North up and East to the left. Each system and its components are labeled. The image is 8 x 11.3 arcminutes.

Astrometric Observations of WDS Neglected Binary Stars

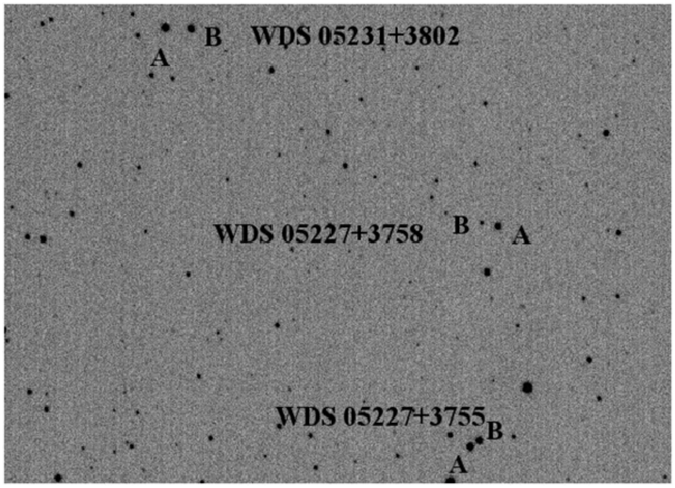


Figure 6b: A different field showing WDS 05231+3802 and two of the other systems measured and listed in Table 1. This image is 8 x 11.3 arcminutes.

WDS 05278+3446 MLB 1039

Again, no real change is seen in the measurements between these data and previous work. There are several other WDS objects in Figure 7, but all have separations lower than what can be measured from these data.

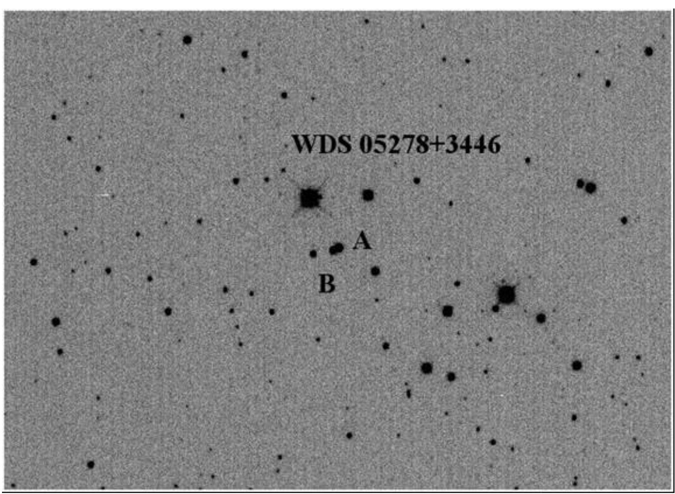


Figure 7 – WDS 05278+3446 with North up and East to the left. The image is 8 x 11.3 arcminutes.

WDS 05284+3546 SEI 277AB

There are two WDS systems in the field of view for this object. The identifications overlap somewhat. We have measured separations and position angles for WDS 05284+3546 AB, AC, and BD (also a separate listing under the name WDS 05284+3545). The second system is WDS 05284+3549, for which we have measured AB and AC. See Figure 8 for the precise locations of each component in the field of view. None of these measures are significantly different than those given in the WDS catalog.

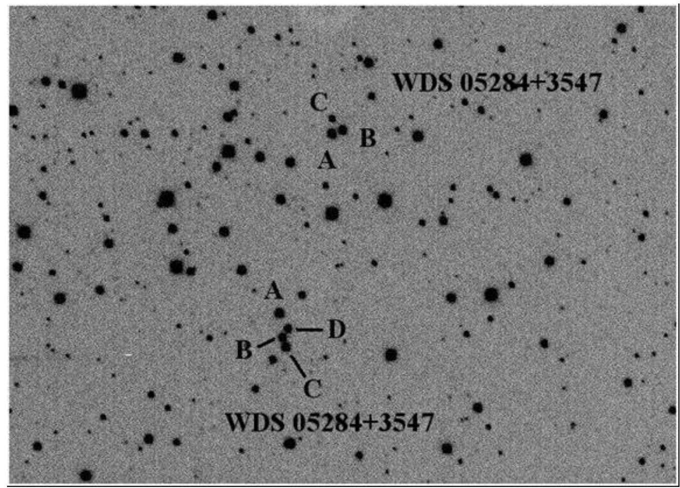


Figure 8: Components of WDS 05284+3546 with labels on the bottom. The components of WDS 05284+3547 with labels are shown at the top. North is up and East is to the left in this image spanning 8 x 11.3 arcminutes.

WDS 05288+3547

This frame also had two systems in the field of view. The first family of systems is WDS 05288+3547, containing a total of four stars. The second is just one pair of stars, listed in the catalog as WDS 05288+3546. See Figure 9 for proper identifications. Again, no major differences are seen between historical measurements and the values derived in this work.

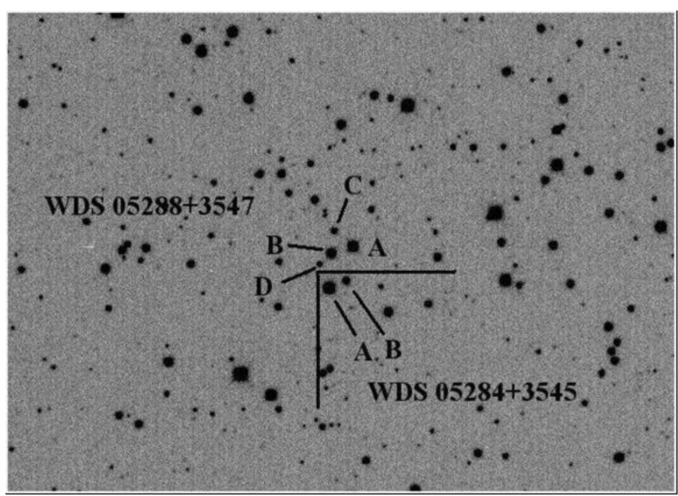


Figure 9: WDS 05288+3547 in the center of the frame with labels. North is up and East to the left. Also shown are the two components of WDS 05284+3545. This image is 8 x 11.3 arcminutes.

Astrometric Observations of WDS Neglected Binary Stars

WDS 05380+3643 SEI 358

In the WDS the primary and secondary are listed with the same magnitudes of 10.5 each. This analysis shows the difference in magnitude to be 0.6 in the V-band. This could cause a 180 degree ambiguity in the future, but here the same primary is used as past observers, and once again there is not a large difference between new measurements and those listed in the WDS.

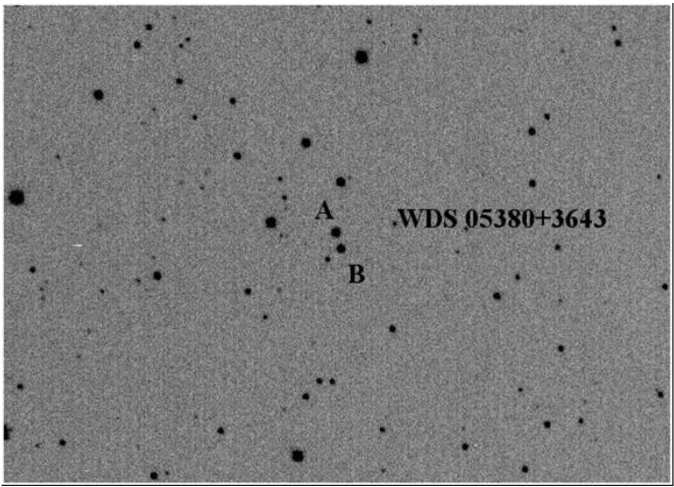


Figure 10: WDS 05380+3643 with North up and East to the left. The image is 8 x 11.3 arcminutes in size.

Acknowledgements

This research has made use of the USNOFS Image and Catalogue Archive operated by the United States Naval Observatory, Flagstaff Station (http://www.nofs.navy.mil/data/fchpix). This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. This research has also made use of IRAF. IRAF is distributed by the National Optical Astronomy Observatory, which is operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation. The Second Palomar Observatory Sky Survey (POSS-II) was made by the California Institute of Technology with funds from the National Science Foundation, the National Geographic Society, the Sloan Foundation, the Samuel Oschin Foundation, and the Eastman Kodak Corporation.

We would also like to thank the staff of Lowell Observatory, and in particular Brian Skiff, for making these observations possible.

Double Star Measures Using a DSLR Camera #5

Ernő Berkó

3188 - Ludányhalászi,
Bercsényi u. 3.
Hungary

berko@is.hu

Abstract: This article contains measures by the author made with a DSLR camera. The images used for the measures were taken in the period between 2008.847-2008.849. The result is 210 positive and 3 negative measures.

To continue the previous articles, the following results are that of the measuring period between 5 Nov – 6 Nov 2008. The equipment used for photographing, the methods of photo processing and measuring are the same as those detailed in my first article (Berkó, 2008). Therefore, the only thing I would like to note is that I am working with a Canon 350D digital camera, a 35.5cm Newton telescope, and focal length increased to 4200mm. The software used for measuring the images is Florent Losse's Reduc 3.85. For the present article, approximately 978 photos were used, and it contains the data of 1812 independent measures of 213 pairs.

The results are shown in the table, which is followed by the notes. In the first three columns of the table, the WDS coordinates and names of the doubles, and the components' brightness can be found. This latter feature was described on the basis of WDS, although it seems contradictory sometimes. When there is an Anon. component, I indicated the GSC or USNO "R" brightness; if not available, I provided the brightness that I estimated on the basis of the photo. This is followed by the position angle (PA) and the separation (S) measured and calculated by me. In both cases, the value of the standard deviation is also indicated (+/-). The column (Epoch) shows the time when the images were taken. Finally, in every row, the number of individual measures (N), the reference number to the description (Notes), and the reference number of the image belonging to the measures (Img) can be seen.

In the descriptions (notes), you can find the GSC number of the primary star of the doubles that I measured; in case it appears in the GSC. Besides this, my personal notes about the given double stars can be read here. The greatest problem I found was concerning the 10-character identification coordinates of WDS. In many cases it is different from the real position of the double. Although the coordinates that WDS contains are more accurate for most of the pairs, at times the double cannot be found at these locations. For the doubles measured by me, I "give suggestions" regarding these closest coordinates in the form of (xxxxx+xxxx!).

I would like to thank the work of Ágnes Kiricsi, who has helped a lot in this publication with the English translations and the correspondence.

References

1. Berkó, Ernő, 2008, "Double Star Measures Using a DSLR Camera", JDSO, **4**, 144-156.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
20219+2606	Anon. 1	11.5	12.5	268.41	0.37	5.08	0.03	2008.847	4	1	1
20222+2606	J 3078	10.2	10.2	23.93	0.24	6.89	0.05	2008.847	9	2	1
20223+2611	Anon. 2	11.5	13.3	83.70	0.32	8.18	0.06	2008.847	13	3	1
20225+2622	Anon. 3	13.0	13.2	80.39	0.53	5.36	0.05	2008.847	6	4	2
20225+2618	HJ 1504AB	7.1	10.6	251.20	0.11	22.46	0.04	2008.847	9	5	2
20225+2618	HJ 1504AC	7.1	9.9	227.66	0.05	51.74	0.04	2008.847	8	5	2
20274+2510	POU4503	12.18	12.2	103.62	0.14	18.43	0.04	2008.847	16	6	3
20276+2502	Anon. 4	14.0	14.0	350.10		3.17		2008.847	1	1	4
20279+2421	POU4509	11.00	12.3	279.66	0.14	8.98	0.02	2008.847	17	7	5
20280+2508	POU4513	13.2	14.5	37.56		7.04		2008.847	1	8	6
20280+2503	POU4510	14.0	14.3	355.69	0.26	14.07	0.05	2008.847	15	9	4
20280+2418	Anon. 5	13.0	13.2	32.27	0.20	7.40	0.03	2008.847	8	1	5
20280+2416	POU4511	12.11	12.33	195.64	0.07	17.78	0.02	2008.847	17	10	5
20281+2510	POU4514	13.8	13.9	92.61	0.24	17.20	0.05	2008.847	14	1	6
20282+2507	Anon. 6	13.4	13.9	207.93	0.20	8.61	0.03	2008.847	10	11	6
20289+2436	Anon. 7AB	14.0	14.2	0.26	0.33	4.08	0.06	2008.847	6	12	7
20289+2436	Anon. 7BC	14.2	14.5	259.63		1.32		2008.847	1	1	7
20290+2430	Anon. 8	13.8	13.9	163.97	0.25	8.15	0.05	2008.847	17	13	8
20290+2429	Anon. 9	13.2	14.0	55.57	0.19	9.78	0.04	2008.847	12	14	8
20291+2433	POU4521AB	13.05	13.30	327.50	0.13	6.60	0.02	2008.847	17	15	9
20291+2433	Anon.10Ax	13.05	14.0	179.38	0.11	3.55	0.02	2008.847	8	15	9
20291+2429	Anon.11	13.2	14.0	143.10	0.26	7.78	0.04	2008.847	17	16	8
20293+2437	Anon.12	12.6	13.2	137.36	0.21	6.88	0.02	2008.847	15	17	10
20294+2435	Anon.13	13.5	13.5	266.88	0.27	5.34	0.07	2008.847	11	18	10
20297+2442	POU4529	12.2	13.4	264.42	0.13	10.30	0.05	2008.847	11	19	11
20298+2613	Anon.14	13.5	13.5	29.61		2.74		2008.847	1	20	12
20298+2610	HJ 1520	11.00	12.18	325.50	0.13	19.21	0.04	2008.847	12	21	12
20298+2556	J 1882	9.5	11.0	113.96	0.25	10.05	0.03	2008.847	6	22	13
20298+2507	Anon.15	12.5	13.5	285.67	0.17	4.46	0.04	2008.847	4	23	14
20298+2504	POU4531	10.98	11.8	212.13	0.23	8.43	0.05	2008.847	16	24	14
20299+2445	Anon.16	12.5	13.5	219.87	0.25	4.34	0.05	2008.847	8	25	11
20299+2444	Anon.17	14.0	14.0	213.39	0.02	1.11	0.04	2008.847	2	1	11
20300+2438	POU4534	11.39	14.5	346.06	0.16	14.79	0.05	2008.847	14	26	15
20301+2509	Anon.18	10.9	13.3	85.35	0.34	4.98	0.06	2008.847	10	27	16
20301+2443	Anon.19	13.0	13.5	223.05	0.07	9.24	0.03	2008.847	3	28	15
20302+2506	POU4536	13.2	13.3	109.32	0.35	6.38	0.04	2008.847	15	29	16
20303+2441	POU4537	11.68	14.1	318.71	0.20	16.76	0.05	2008.847	13	30	15
20363+2321	POU4721	12.9	13.4	134.55	0.26	21.60	0.05	2008.847	13	31	17
20365+2430	POU4726AB	12.3	13.5	355.99	0.24	10.92	0.03	2008.849	17	32	18
20365+2430	POU4727AC	12.3	13.6	325.06	0.18	15.74	0.05	2008.849	17	32	18

Table continued on next page.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
20365+2428	Anon.20	13.8	14.0	21.95	0.32	2.74	0.05	2008.849	5	33	18
20365+2426	POU4728	11.06	14.5	80.46	0.36	11.80	0.03	2008.849	5	34	18
20365+2334	POU4722	10.88	13.0	57.36	0.26	18.21	0.04	2008.847	15	35	19
20365+2327	POU4724	12.1	12.8	226.45	0.18	17.37	0.06	2008.847	13	36	20
20367+2431	Anon.21	14.5	14.5	320.99	0.37	3.46	0.01	2008.849	3	1	21
20367+2328	POU4734	11.94	13.5	24.97	0.07	20.02	0.04	2008.847	16	37	22
20367+2320	Anon.22	13.5	13.8	344.85	0.33	4.83	0.06	2008.847	3	38	17
20367+2319	POU4733	12.3	13.4	241.31	0.26	4.54	0.05	2008.847	7	39	17
20367+2316	Anon.23	11.5	13.0	333.50	0.38	8.01	0.08	2008.847	8	40	17
20368+2434	Anon.24	13.0	14.5	151.06	0.04	4.20	0.01	2008.849	2	41	21
20368+2433	Anon.25	14.5	14.5	283.78	0.38	4.65	0.06	2008.849	9	42	21
20368+2324	POU4735	12.31	13.0	256.49	0.20	15.33	0.06	2008.847	11	43	20
20369+2432	POU4738	12.02	13.9	10.39	0.26	13.89	0.06	2008.849	15	44	23
20369+2330	POU4736	13.43	14.38	326.59	0.17	17.18	0.05	2008.847	11	1	22
20369+2325	POU4737	12.8	13.7	268.09	0.32	18.05	0.04	2008.847	8	45	20
20370+2429	POU4740	14.1	14.2	265.44	0.14	15.47	0.07	2008.849	18	1	23
20371+2331	Anon.26	14.0	14.5	36.11	0.34	3.18	0.03	2008.847	2	46	24
20372+2433	Anon.27	12.0	12.5	46.81	0.20	4.22	0.06	2008.849	4	47	23
20372+2319	POU4742	10.95	12.2	12.05	0.17	17.70	0.05	2008.847	16	48	25
20373+2429	POU4743	12.8	13.6	219.72	0.30	13.35	0.06	2008.849	13	1	23
20374+2338	POU4746	11.93	13.6	40.26	0.30	13.28	0.07	2008.847	4	49	26
20374+2321	POU4745AB	12.36	12.9	325.78	0.09	17.48	0.04	2008.847	16	50	25
20374+2321	Anon.28Ax	12.36	13.5	187.84	0.48	8.21	0.02	2008.847	2	51	25
20375+2339	POU4749	8.85	11.9	247.11	0.33	12.56	0.05	2008.847	11	52	26
20375+2319	POU4748	12.48	14.3	334.63	0.25	13.93	0.06	2008.847	12	53	25
20377+2334	POU4752	11.90	13.0	257.30	0.30	7.74	0.05	2008.847	7	54	27
20367+2327	Anon.29	13.5	13.6	301.93	0.37	8.11	0.07	2008.847	6	1	22
20377+2319	Anon.30	14.2	14.3	103.57	0.30	6.95	0.05	2008.847	4	55	28
20379+2442	POU4759	12.9	13.4	209.39	0.20	16.36	0.07	2008.849	11	56	29
20379+2317	POU4754	11.21	14.6	66.41	0.27	14.82	0.06	2008.847	8	57	28
20380+2334	POU4758	11.61	11.8	299.95	0.18	16.10	0.02	2008.847	15	58	27
20380+2332	POU4756	11.83	12.4	257.72	0.43	14.63	0.08	2008.847	9	59	27
20381+2403	POU4761	12.8	13.4	326.04	0.22	15.15	0.05	2008.849	8	1	30
20381+2357	POU4763	13.9	14.2	156.15	0.40	7.97	0.05	2008.849	12	60	31
20381+2353	Anon.31	14.0	14.0	335.04		1.72		2008.849	1	1	32
20381+2338	POU4762	13.7	14.0	215.44	0.16	17.63	0.04	2008.847	5	1	33
20382+2452	POU4765	13.4	13.9	139.28	0.23	16.66	0.04	2008.849	12	61	32
20382+2446	POU4770AB	11.34	13.1	111.34	0.33	13.23	0.04	2008.849	16	62	34
20382+2446	Anon.32Ax	11.34	13.5	304.26	0.29	10.32	0.04	2008.849	4	62	34
20382+2445	Anon.33	14.0	14.0	190.17	0.33	10.19	0.07	2008.849	5	1	34

Table continued on next page.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
20382+2435	POU4769	11.73	14.1	315.32	0.26	14.62	0.04	2008.849	12	63	35
20382+2400	Anon.34	13.5	14.0	36.97		5.08		2008.849	1	64	31
20383+2429	Anon.35	13.5	13.6	234.03	0.06	2.85	0.04	2008.849	2	1	36
20383+2411	POU4768	11.38	13.6	346.88	0.38	12.65	0.04	2008.849	8	65	30
20384+2433	Anon.36	12.5	13.5	208.27	0.19	6.48	0.06	2008.849	3	66	35
20384+2427	POU4772	13.0	13.4	104.27	0.28	8.06	0.04	2008.849	13	67	36
20385+2409	POU4777	13.6	13.8	267.57	0.31	16.40	0.07	2008.849	7	1	30
20385+2342	POU4774AB	12.9	13.8	6.66	0.28	8.89	0.05	2008.847	9	68	37
20385+2342	POU4775AC	12.9	13.8	269.11	0.38	14.64	0.04	2008.847	12	68	37
20385+2341	POU4773AB	13.6	13.9	35.72	0.07	7.09	0.08	2008.847	2	69	37
20385+2341	Anon.37Ax	13.6	14.2	28.36		3.84		2008.847	1	70	37
20386+2447	POU4783AB	14.3	14.9	62.21	0.49	12.38	0.06	2008.849	5	1	38
20386+2447	Anon.38Ax	14.3	14.0	166.99	0.11	9.88	0.09	2008.849	5	1	38
20386+2445	POU4782	14.1	14.3	48.04	0.06	5.16	0.03	2008.849	2	71	38
20386+2358	POU4779AB	12.25	13.97	64.85	0.31	17.16	0.08	2008.849	7	72	39
20386+2358	POU4780AC	12.25	13.83	39.56	0.10	21.06	0.05	2008.849	15	72	39
20386+2349	POU4781	14.0	14.3	30.15	0.16	17.46	0.05	2008.849	8	1	40
20386+2333	POU4778	13.4	13.8	198.59		2.01		2008.847	1	73	41
20388+2441	POU4788AB	12.4	14.3	200.79	0.25	11.13	0.04	2008.849	8	74	42
20388+2441	POU4787AC	12.4	13.7	134.59	0.30	15.47	0.04	2008.849	13	74	42
20389+2446	POU4791	12.04	12.6	62.23	0.16	7.17	0.07	2008.849	14	75	42
20389+2445	POU4792	12.2	13.0	332.62	0.08	4.47	0.02	2008.849	2	76	42
20389+2405	Anon.39	12.5	13.5	327.38		5.45		2008.849	1	77	43
20389+2350	POU4785	13.6	13.7	334.95	0.28	8.87	0.07	2008.849	11	78	44
20390+2409	POU4789	13.0	13.9	192.53		3.14		2008.849	1	79	43
20390+2352	POU4790	11.98	13.4	337.92	0.38	3.76	0.04	2008.849	3	80	44
20391+2352	POU4795AB	13.2	14.2	320.13	0.33	9.56	0.03	2008.849	11	81	44
20391+2352	Anon.40Ax	13.2	14.5	41.87	0.23	9.81	0.01	2008.849	3	81	44
20391+2347	Anon.41	12.5	13.0	111.98	0.52	2.38	0.07	2008.849	7	82	45
20391+2339	POU4797	12.23	14.5	222.85	0.12	16.27	0.07	2008.847	8	83	46
20391+2337	POU4796	12.2	14.3	277.91	0.51	16.65	0.05	2008.847	3	84	46
20391+2336	POU4794	12.2	13.7	115.69	0.33	9.84	0.06	2008.847	8	85	46
20392+2351	POU4801	14.0	14.1	292.65	0.34	11.15	0.05	2008.849	17	1	47
20393+2354	Anon.42	14.0	14.2	135.43	0.14	3.17	0.01	2008.849	3	1	47
20393+2328	POU4802	12.7	12.8	312.81	0.25	19.21	0.05	2008.847	15	1	48
20394+2321	POU4805	13.0	13.0	220.53	0.27	18.66	0.06	2008.847	10	1	49
20395+2444	POU4813	14.3	14.4	41.15	0.23	17.27	0.05	2008.849	12	1	50
20395+2326	POU4808AB	13.7	13.5	200.67	0.13	15.88	0.04	2008.847	15	86	48
20395+2326	Anon.43Ax	13.7	14.0	193.96	0.36	8.66	0.06	2008.847	8	86	48
20395+2319	POU4807	13.8	14.3	190.96	0.35	12.59	0.06	2008.847	10	1	49

Table continued on next page.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
20396+2515	POU4817	12.2	14.3	81.28	0.32	13.84	0.06	2008.849	8	1	51
20396+2508	POU4821	13.2	13.6	217.67	0.28	18.70	0.05	2008.849	15	1	52
20396+2503	POU4819	12.0	13.6	160.24	0.11	14.75	0.02	2008.849	15	87	53
20396+2503	POU4822	14.2	14.4	43.52	0.29	5.65	0.07	2008.849	8	88	53
20396+2417	POU4810	11.99	12.2	224.50	0.16	11.56	0.05	2008.849	14	89	54
20396+2403	POU4816	13.4	14.4	194.58	0.33	10.41	0.02	2008.849	3	90	55
20396+2352	POU4814AB	12.6	13.8	20.41	0.29	15.77	0.04	2008.847	11	91	56
20396+2352	POU4815AC	12.6	14.2	113.03	0.23	16.52	0.05	2008.847	13	91	56
20396+2345	POU4811AB	9.78	10.74	201.55	0.12	21.04	0.05	2008.847	14	92	57
20396+2345	POU4812AC	9.78	12.6	149.17	0.26	10.87	0.06	2008.847	5	92	57
20397+2516	Anon.44	11.1	14.0	196.86	0.24	10.78	0.06	2008.849	6	93	51
20397+2421	Anon.45	12.57	14.0	197.96	0.54	3.68	0.04	2008.849	3	94	54
20397+2419	POU4818	11.22	12.1	302.05	0.27	14.77	0.06	2008.849	14	95	54
20398+2512	Anon.46	14.0	14.2	285.87		4.78		2008.849	1	1	51
20398+2505	POU4825	13.5	14.0	107.61	0.26	16.61	0.04	2008.849	16	96	53
20398+2447	POU4828	13.5	13.6	342.87	0.17	18.07	0.05	2008.849	15	97	50
20398+2446	POU4826	14.3	14.5	18.61	0.33	5.49	0.03	2008.849	11	98	50
20398+2417	Anon.47	13.0	13.8	314.72	0.29	9.00	0.05	2008.849	9	1	54
20399+2352	POU4827	12.1	13.6	235.44	0.12	12.59	0.03	2008.847	17	99	58
20399+2326	POU4829	13.3	14.0	216.94	0.34	14.49	0.06	2008.847	14	1	59
20400+2503	POU4833	12.8	12.9	272.08	0.16	20.53	0.06	2008.849	14	100	60
20400+2417	POU4831	12.5	13.4	189.47	0.31	8.17	0.03	2008.849	16	101	61
20400+2350	POU4832	11.8	13.9	26.62	0.37	16.47	0.05	2008.847	5	102	56
20401+2516	POU4839	11.15	12.1	339.58	0.18	22.04	0.05	2008.849	15	103	62
20401+2513	POU4835	13.1	13.2	296.60	0.14	18.63	0.03	2008.849	17	104	62
20401+2509	POU4838	12.5	14.2	289.38	0.34	10.55	0.05	2008.849	13	105	63
20401+2458	POU4840	13.8	14.3	23.10	0.25	15.95	0.05	2008.849	7	106	60
20401+2450	POU4834	12.4	13.0	35.26	0.19	5.69	0.06	2008.849	10	107	64
20402+2418	POU4837	12.9	14.8	210.14	0.35	16.72	0.08	2008.849	8	108	61
20402+2356	POU4836AB	9.4	14.0	43.94	0.17	17.31	0.07	2008.849	2	109	65
20402+2356	Anon.48Ax	9.4	14.0	2.27	0.05	11.42	0.03	2008.849	2	109	65
20403+2510	POU4846	12.28	14.5	167.08	0.26	8.24	0.03	2008.849	10	110	63
20403+2501	POU4843	11.74	13.7	147.76	0.31	8.53	0.07	2008.849	12	111	60
20403+2451	POU4845	14.2	14.4	131.79	0.01	15.35	0.04	2008.849	2	112	64
20403+2357	POU4841AB	13.8	14.7	347.94	0.29	12.61	0.06	2008.849	17	113	65
20403+2357	Anon.49Ax	13.8	15.0	334.19	0.15	7.15	0.08	2008.849	3	113	65
20404+2422	POU4842	14.16	14.03	129.61	0.46	13.45	0.07	2008.849	5	1	66
20404+2401	POU4844	11.34	12.9	101.36	0.19	15.61	0.05	2008.849	18	114	67
20405+2448	POU4850	13.5	14.3	287.40	0.19	5.06	0.03	2008.849	2	115	64
20405+2346	POU4848AB	13.2	13.6	119.35	0.31	18.77	0.05	2008.847	13	116	68

Table continued on next page.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
20405+2346	POU4849BC	13.6	13.9	56.24	0.23	18.23	0.06	2008.847	6	117	68
20405+2346	Anon.50Bx	13.6	14.0	28.24	0.21	8.43	0.01	2008.847	3	117	68
20407+2346	Anon.51	11.5	13.8	161.84	0.26	9.06	0.06	2008.847	12	118	68
20408+2342	Anon.52	12.5	14.0	13.34	0.11	8.79	0.03	2008.847	2	119	68
20410+2419	POU4856	12.4	12.5	144.45	0.32	12.54	0.05	2008.849	11	120	69
20411+2426	POU4863	11.99	12.6	98.45	0.10	11.89	0.02	2008.849	16	121	70
20411+2419	POU4860	13.2	13.4	206.25	0.16	18.55	0.02	2008.849	11	122	69
20411+2414	POU4861	12.7	12.9	97.77	0.18	2.99	0.09	2008.849	2	123	69
20411+2341	POU4859	12.0	14.3	23.84	0.19	18.89	0.05	2008.847	12	124	71
20412+2433	Anon.53	13.2	13.5	197.10	0.43	3.26	0.04	2008.849	6	125	72
20412+2345	POU4867	12.8	14.1	219.76	0.30	17.82	0.05	2008.847	6	126	71
20413+2430	POU4870AB	13.6	14.1	146.31	0.08	17.70	0.02	2008.849	16	127	72
20413+2430	Anon.54Bx	14.1	14.3	169.77	0.22	10.55	0.05	2008.849	7	127	72
20416+2424	POU4872	12.3	14.5	269.93	0.22	6.44	0.02	2008.849	14	128	73
21385+2429	POU5447AB	12.00	13.6	255.94	0.17	18.66	0.05	2008.847	13	129	74
21385+2429	Anon.55Bx	13.6	14.0	211.99	0.23	11.79	0.05	2008.847	9	1	74
21386+2429	Anon.56	13.0	14.0	305.67	0.38	8.42	0.06	2008.847	4	130	74
21390+2433	POU5450	13.3	13.5	286.62	0.25	11.83	0.06	2008.847	14	131	75
21393+2429	Anon.57	13.5	14.0	55.28		2.95		2008.847	1	132	75
21395+2503	POU5453	12.8	13.5	320.97	0.17	13.87	0.05	2008.847	9	133	76
21397+2457	POU5454	8.49	11.6	84.84	0.26	6.95	0.07	2008.847	7	134	77
21401+2426	POU5456	12.2	12.3					2008.847		135	
21405+2426	Anon.58	14.0	14.0	165.13		3.62		2008.847	1	136	78
21429+2345	POU5462	12.3	12.3	321.52	0.33	10.75	0.04	2008.847	10	137	79
21430+2439	POU5463	11.11	14.0	237.90	0.33	7.81	0.04	2008.847	15	138	80
21431+2343	Anon.59	14.1	14.2	215.08		10.00		2008.847	1	139	79
21434+2424	POU5464	12.21	13.4	110.41	0.17	3.96	0.01	2008.847	3	140	81
21435+2725	Anon.60	13.0	13.5	24.16	0.13	5.63	0.03	2008.849	2	141	82
21435+2721	A 299AD	9.95	10.05	63.94	0.01	378.30	0.06	2008.849	9	142	83
21435+2721	A 299DF	10.05	11.6	26.01	0.03	146.73	0.04	2008.849	9	143	83
21437+2403	POU5466	12.4	13.3	319.13	0.33	22.30	0.03	2008.847	7	144	84
21438+2424	POU5467	13.0	13.8	0.55		3.84		2008.847	1	145	85
21439+2407	POU5468	9.3	12.7	288.16		7.29		2008.847	1	146	84
21441+2418	POU5471	12.8	13.8	129.10		8.35		2008.847	1	147	86
21441+2405	POU5470	11.80	13.30	213.48	0.17	13.77	0.08	2008.847	10	148	84
21442+2631	BUP 230AB	8.45	13.1	291.80		45.25		2008.849	1	149	87
21442+2631	BUP 230AC	8.45	9.84	260.41	0.01	571.71	0.06	2008.849	6	149	87
21442+2631	BUP 230AD	8.45	10.21	288.65	0.01	439.75	0.05	2008.849	10	149	87
21442+2631	Anon.61Ax	8.45	13.5	112.89		17.31		2008.849	1	149	87
21442+2631	BUP 230CD	9.84	10.21	31.92	0.01	277.92	0.06	2008.849	9	150	87

Table continued on next page.

Double Star Measures Using a DSLR Camera #5

RA +/- D	Discoverer	Mags		PA	+/-	Sep	+/-	Epoch	N	Notes	Img
21445+2409	POU5473	12.5	13.6	298.17	0.25	16.96	0.07	2008.847	9	151	88
21447+2402	POU5474AB	12.5	13.8	300.04		7.29		2008.847	1	152	89
21447+2402	POU5475AC	12.5	14.1	76.47		7.01		2008.847	1	152	89
21449+2414	POU5477	11.06	13.7	57.58	0.19	16.03	0.02	2008.847	3	153	90
21453+2722	HO 606	8.41	12.7	92.89	0.18	18.32	0.04	2008.849	12	154	91
21456+2709	MLB1050	10.82	13.0	65.92	0.20	7.10	0.08	2008.849	10	155	92
21456+2417	POU5491AB	13.0	13.6	5.52	0.29	10.09	0.05	2008.847	6	156	93
21456+2417	POU5492AC	13.0	13.8	49.62	0.25	20.13	0.07	2008.847	15	156	93
21457+2708	Anon.62	12.3	13.5	17.28		7.27		2008.849	1	157	92
21460+2707	J 2357	9.3	13.0					2008.849		158	92
21468+2405	POU5501	12.4	14.0	294.81	0.36	13.02	0.05	2008.849	7	159	94
21472+2648	HJ 943	10.0	10.0					2008.849		135	
21474+2404	POU5505	13.8	14.0	224.80	0.28	4.74	0.03	2008.849	4	160	95

Table Notes

1. Does not appear in GSC.
2. AB=GSC 2159 252 non star (20223+2607!).
3. A=GSC 2160 510 blended object.
4. AB=GSC 2164 1020 non star.
5. A=GSC 2164 938.
6. A=GSC 2160 587.
7. A=GSC 2156 727 non star.
8. AB=GSC 2160 1068 non star (20280+2507!).
9. A=GSC 2160 1286. The 1997 measures of the system are most probably not of this pair. The images available do not show significant proper motion of the nearby stars.
10. A=GSC 2156 535 (20281+2416!).
11. A=GSC 2160 1151.
12. Does not appear in GSC. "A" has a faint pair: PA=260.
13. A=GSC 2160 1464 non star.
14. A=GSC 2160 1525.
15. AB=GSC 2160 1321 non star.
16. AB=GSC 2160 1518 non star.
17. AB=GSC 2160 1199 non star.
18. AB=GSC 2160 1256 non star.
19. A=GSC 2160 1261 non star. The proper motion in PA 0 direction of component B accounts for the changes of the measured parameters.
20. AB=GSC 2160 435 non star.
21. A=GSC 2160 631 (20297+2610!).
22. A=GSC 2160 583 non star (20294+2554!).
23. AB=GSC 2160 327 non star.
24. AB=GSC 2160 1245 non star. The proper motion in PA 30 direction of component B accounts for the changes of the measured parameters.
25. AB=GSC 2160 1174 non star.
26. A=GSC 2160 1364.
27. A=GSC 2160 403.
28. A=GSC 2160 1011.
29. AB=GSC 2160 911 non star.
30. A=GSC 2160 1007 non star.
31. B=GSC 2157 622 non star.
32. A=GSC 2161 1475 non star.
33. AB=GSC 2161 1291 non star.
34. A=GSC 2161 1165.
35. A=GSC 2157 672.
36. A=GSC 2157 1131.
37. A=GSC 2157 1371.
38. AB=GSC 2157 834 non star.
39. AB=GSC 2157 913 non star.
40. AB=GSC 2157 728 non star.
41. AB=GSC 2161 968 non star.
42. AB=GSC 2161 892 non star.
43. A=GSC 2157 589.
44. A=GSC 2161 1580.
45. A=GSC 2157 802 non star.

46. AB=GSC 2157 386 non star.
47. AB=GSC 2161 1561 non star.
48. A=GSC 2157 369.
49. A=GSC 2157 286.
50. A=GSC 2157 424 non star. The images available do not show significant proper motion of the nearby stars.
51. A=GSC 2157 424 non star.
52. A=GSC 2157 712.
53. A=GSC 2157 1565.
54. A=GSC 2157 401 non star (20376+2334!).
55. A=GSC 2157 431.
56. A=GSC 2161 1099.
57. A=GSC 2157 1200.
58. A=GSC 2157 214.
59. A=GSC 2157 526.
60. AB=GSC 2157 579 non star.
61. I cannot find any other double.
62. SC 2161 597 non star (20383+2446!).
63. A=GSC 2161 447.
64. AB=GSC 2157 536 non star.
65. A=GSC 2157 912 non star (20382+2411!)
66. AB=GSC 2161 1543 non star.
67. A=GSC 2161 1086 non star. The proper motion in PA 240 direction of component B accounts for the changes of the measured parameters.
68. A=GSC 2157 1548.
69. ABx=GSC 2157 919 non star. The images available do not show significant proper motion of the nearby stars.
70. ABx=GSC 2157 919 non star.
71. AB=GSC 2161 915 non star (20385+2449!). Very different parameters. The images available do not show significant proper motion of the nearby stars.
72. A=GSC 2157 403
73. AB=GSC 2157 504 (20385+2333!). Very difficult to measure.
74. A=GSC 2161 925.
75. AB=GSC 2161 582 non star.
76. AB=GSC 2161 481 non star.
77. AB=GSC 2157 210 non star.
78. A=GSC 2157 1065.
79. AB=GSC 2157 519 (20389+2409!). Very difficult to measure.
80. A=GSC 2157 290.
81. A=GSC 2157 69.
82. AB=GSC 2170 306 non star.
83. A=GSC 2170 326.
84. A=GSC 2170 119.
85. AB=GSC 2157 702 non star (20390+2336!).
86. Bx=GSC 2170 45 non star.
87. A=GSC 2174 511.
88. AB=GSC 2174 445 non star (20397+2503!).
89. A=GSC 2170 50 non star (20395+2417!).
90. A=GSC 2170 80 (20396+2402!).
91. A=GSC 2170 276.
92. A=GSC 2170 127 (20395+2345!).
93. A=GSC 2174 314.
94. A=GSC 2170 192.
95. A=GSC 2170 12 (20396+2419!).
96. A=GSC 2174 110.
97. B=GSC 2174 144.
98. AB=GSC 2174 126 non star.
99. A=GSC 2170 200.
100. Does not appear in GSC. Very different parameters. The images available do not show significant proper motion of the nearby stars.
101. A=GSC 2170 136 non star (20399+2417!). The images available do not show significant proper motion of the nearby stars.
102. A=GSC 2170 104 (20397+2354!). Far from the indicated position.
103. A=GSC 2174 92 (20402+2516!).
104. A=GSC 2174 374.
105. A=GSC 2174 236 (20402+2509!).
106. A=GSC 2174 1580 (20402+2458!).
107. AB=GSC 2174 300 non star.
108. A=GSC 2170 60.
109. A=GSC 2170 162.
110. AB=GSC 2174 308 non star (20404+2511!).
111. A=GSC 2174 96 non star.
112. Does not appear in GSC. The 2000 measures of the system are most probably not of this pair.
113. A=GSC 2170 248 non star.
114. A=GSC 2170 52.
115. AB=GSC 2174 512 non star.
116. A=GSC 2170 263.
117. Bx=GSC 2170 1489 non star.
118. A=GSC 2170 317 non star.
119. AB=GSC 2170 446 non star.
120. A=GSC 2170 176 (20409+2419!).
121. A=GSC 2174 457.

Double Star Measures Using a DSLR Camera #5

122.A=GSC 2170 1201 (20410+2419!).
123.AB=GSC 2170 120 non star.
124.A=GSC 2170 199.
125.AB=GSC 2174 150 non star.
126.A=GSC 2170 113 (20412+2346!).
127.A=GSC 2174 540
128.AB=GSC 2174 466 non star.
129.A=GSC 2193 50
130.A=GSC 2193 90 non star.
131.A=GSC 2193 624.
132.AB=GSC 2193 422 non star.
133.A=GSC 2193 1606 (21396+2503!).
134.A=GSC 2193 1617.
135.I cannot find such double in the vicinity. It cannot be identified in the DSS images, either.
136.AB=GSC 2193 152 non star.
137.A=GSC 2189 1270 non star.
138.A=GSC 2193 398 (21431+2440!).
139.A=GSC 2189 873 non star.
140.AB=GSC 2193 230 non star (21434+2425!).
141.A=GSC 2197 1503 non star.
142.A=GSC 2197 1015. The proper motion of component D accounts for the changes of the measured parameters.
143.D=GSC 2197 1464. The proper motion of component D accounts for the changes of the measured parameters.
144.A=GSC 2189 935.
145.AB=GSC 2193 680 (21438+2425!). A little proper motion can be observed.
146.A=GSC 2189 1741. Very difficult to measure.
147.A=GSC 2189 733 non star.
148.A=GSC 2189 29 (21440+2404!).
149.A=GSC 2197 1717. The proper motion in PA 100 direction of component A accounts for the changes of the measured parameters.
150.C=GSC 2197 1794.
151.A=GSC 2189 1311.
152.ABC=GSC 2189 1049 non star (21447+2401!).
153.A=GSC 2189 1333.
154.A=GSC 2197 1271.
155.A=GSC 2197 1270 (21458+2707!).
156.A=GSC 2189 717.
157.A=GSC 2197 1486 non star.
158.In my opinion, it is the same as MLB 1050. I cannot find any other double.
159.A=GSC 2202 1053.
160.AB=GSC 2202 441 non star (21473+2403!).

New Wide Common Proper Motion Binaries

Rafael Benavides[1,2], Francisco Rica[2,3], Esteban Reina[4], Julio Castellanos[5], Ramón Naves[6], Luis Lahuerta[7], Salvador Lahuerta[7]

1. Astronomical Society of Córdoba, Observatory of Posadas, MPC-IAU Code J53, C/.Gaitán nº 20, 1º, 14730 Posadas (Spain)
2. Double Star Section of Liga Iberoamericana de Astronomía (LIADA), Avda. Almirante Guillermo Brown No. 4998, 3000 Santa Fe (Argentina)
3. Astronomical Society of Mérida, C/José Ruíz Azorín, 14, 4º D, 06800 Mérida (Spain)
4. Plza. Mare de Dèu de Montserrat, 1 Etlo 2ªB, 08901 L'Hospitalet de Llobregat (Spain)
5. Observatory with MPC-IAU Code 939, Av. Primado Reig 183, 46020 Valencia (Spain)
6. Observatory of Montcabrer, MPC-IAU Code 213, C/Jaume Balmes, 24, 08348 Cabrils (Spain)
7. G.E.O.D.A., Observatorio Manises, MPC-IAU Code J98, C/ Mayor, 111-4, 46940 Manises (Spain)

Abstract: In this work we report the discovery of 150 new double stars of which 142 are wide common proper motion stellar systems. In addition to this, we report the study of 23 recently catalogued wide common proper motion binaries discovered by other observers. Spectral types, photometric distances, kinematics and ages were determined from data obtained consulting the literature. Several criteria were used to determine the nature of each double star. Orbital periods and the semimajor axes were calculated.

1. Introduction

For several years double-star amateurs have contributed to the astronomical community with interesting works (see *Introduction* section in Rica (2008)). Recently Rafael Caballero (2009), a spanish amateur, has published in the JDSO an article reporting about 110 new uncataloged and wide common proper motion binaries.

One more example is the work that we present. In this work we report the study of 173 wide, common proper motion stellar systems of which 150 are new double stars. The remaining 23 were discovered by other observers and recently cataloged. The new double stars were discovered by Rafael Benavides inspecting visually the Guide 8.0 software and using the proper motion line showed by this software to detect common proper motion pairs. It was a great surprise to see that many binaries are discovered by this method.

Wide binaries of common proper motion are composed of stars with large separation that results in orbital periods ranging from a few thousand to millions of years. Because of their small binding energies, they are good sensors to detect unknown mass concentrations that they may encounter along their galactic trajectories. So, wide binary star systems have became objects of considerable theoretical and observational interest. They are relevant to the understanding of the processes of formation and dynamical evolution of the Galaxy. Thus, the present-day distribution of wide binaries can provide information about the disruption process as well as binary formation. Study of wide binaries have largely concentrated on the calculation of dissolution times since the main effect of encounters is to cause such weakly bound pairs to break up. Professionals have published many papers studying suc objects: (Retterer & King (1982), Dommanget (1984), Lathan, Tonry, Bahcall & Soniera (1984), Halbwachs (1988), Close & Richer (1990), Lathan, Abt et al. (1991), Poveda & Allen (2004), Sesar, Ivezić & Jurić (2008))

We finally would like cite to Dommanget (1984):

> *"Wide pairs and wide multiple systems have been too much neglected during many years by visual double star astronomers with the argument that only close visual pairs (short periods) may lead to mass-determination in a relatively short time interval. But mass-determination should*

not be considered as the only interest of double star astronomy, even if it is of a fundamental nature.

Today, it appears that researches on the origin and the evolution of the wide systems are urgently wanted, not only for the understanding of the evolution of the stellar medium, but also for a better knowledge of galactic dynamics".

In section 2, we explain how the binaries were found; sections 3-8 describe the astrophysical study (consulting astronomical literature, spectral type estimate, distance estimation, tangential velocity, stellar masses, age and stellar population). In section 9 we comment in detail on the criteria used to classify the double stars as optical or physical. In section 10 we explain how we obtained the semimajor axis and orbital periods; 11 the astrometric measures are analysed. The study for same binaries stars are in section 12.

2. Searching for New Binaries

The search for new wide common proper motion binaries was carried out by Rafael Benavides in 2005, inspecting visually the sky using the Guide 8.0 software of project Pluto. This software allows display the Tycho-2 (Hog et al. 2000) and Hipparcos (ESA 1997) proper motion vector and so the identification of common proper motion binaries is straightforward. Benavides found 141 uncataloged binaries. Literature was consulted carefully to confirm that the binaries are not cataloged. Since the time that these binaries were found to the publish date of this article, some binaries were reported by others double star observers and listed in the Washington Double Star Catalog (Mason, Wycoff & Hartkopf 2003), hereafter WDS.

So finally we report the discoveries of 148 new binaries.

Photometric data, spectral types, photometric distances, kinematical data and ages were determined from data obtained consulting the literature. Several criteria were used to determine the nature of each double star. Values for the orbital periods and the semi-axis major were calculated.

3. Consulting the Astronomical Literature

The astronomical literature was consulted in order to obtain photometric, astrometric and kinematical data. Aladin, VizieR, Simbad (Wenger et al. 2003) and the “services abstract” tools were used from the website of Centre de Dones Astronomiques de Strasburg (CDS), maintained by the Strasburg Observatory, and the Astrophysical Data Services (ADS) maintained by the NASA.

Photometry in B, V and I bands came from Hipparcos (ESA 1997) and Tycho-2 (Hog et al. 2000) catalogs. Infrared J, H and K photometry came from Two Micron All Sky Catalogue (Cutri 2000), hereafter 2MASS. Proper motion came from Tycho-2, UCAC-2 (Zacharias et al. 2004) and USNO-B1.0 (Monet et al. 2003) catalogs. Tycho-2 was chosen because the Hipparcos proper motions could be affected by Keplerian motion due to its smaller baseline. Historical relative astrometric data were kindly supplied by Brian Mason from The United States Naval Observatory (hereafter USNO). Spectral types, radial velocity and other astrophysical data were taken from several sources from CDS web page.

4. Spectral Types and Luminosity Class Estimates

Spectral types and luminosity classes were obtained from photometric and kinematical data. Several tables which relate photometric colours with spectral types were used (Allen 1973, Bessell & Brett 1988).

A computer program was designed to transform BVIJHK photometric data to Jy (1 Jy = 10^{-23} erg * sec^{-1} * cm^{2} * Hz^{-1}) which were plotted against wavelength (in Angstroms). This plot shows the spectral energy distribution which is compared automatically with the empirical spectral energy distribution deduced from Bessell & Brett (1988) and Zombeck (1990). The computer program gives the spectral type for the best fit.

The luminosity classes are determined by means of infrared two color diagram (Bessell & Brett 1988) and mainly by means of reduced proper motion diagrams (Jones 1972; Salim 2002; Nelson 2003). Reduced proper motion diagrams were very useful to distinguish dwarf stars from giants, subdwarfs or white dwarfs.

In a preliminary study (Rica 2005) we compared our spectral types and luminosity classes for 19 components (13 dwarf stars and 6 normal giants) with spectral types and luminosity classes obtained by professionals and published in the astronomical literature. These components are listed in Hipparcos, Tycho-2 and 2MASS catalogues so the BVIJHK photometric data and proper motions are known. The mean difference was 0.5 spectral subclasses and the luminosity classes were estimated correctly for the 19 components.

5. Distance Estimation

The absolute magnitudes were calculated using the tables published by Zombeck (1990) and Henry *et al.* (1997) who cite a RMS of 0.43 magnitudes for their absolute magnitudes.

When the object is located on or near the galactic

New Wide Common Proper Motion Binaries

plane, it is important to determine the interstellar absorption and correct the astrophysical data. Maps of Burtein & Heiles (1982) and Schlegel, Finkbeiner & Davis (1998) were used. The obtained values were scaled to the initial distance using the cosecant law of van Herk (1965).

If the star is located near the galactic plane (|b| < 10 - 15º) then the interstellar map of Paresce (1984) was used if the star is located nearer than 250 pc. If the star is located at a distance greater than 250 pc then the catalog of Neckel & Klare (1980) is used plotting the stars in a reddening-distance graphic and using a logarithmic fit.

A recursive method was used to obtain unreddening spectral types and distances. It begins by using the photometric data to estimate a preliminary photometric distance. With this preliminary distance, the interstellar reddening can be determined and the photometric data corrected. A new photometric distance is obtained, and the process is repeated until no significant change is produced. Generally in two or three iterations the data converge.

The estimation of photometric distance was calculated from apparent and absolute magnitudes. Against the stellar members studied in this work, 23 of them have trigonometric parallaxes obtained by Hipparcos satellite (mean errors of about 13 %). For those stars we have compared our photometric distances with Hiparcos trigonometric distances. Figure 1 shows both set of distances. The averaged difference was of +3.9 ± 26.0 pc. The mean error of our photometric distance

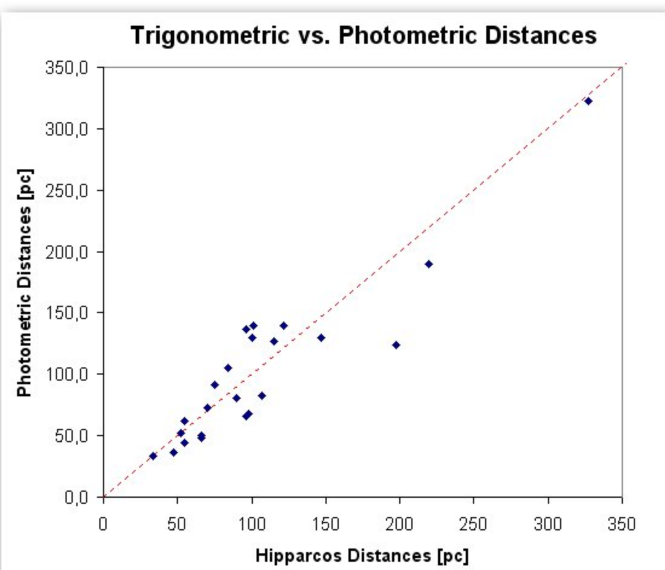


Figure 1: Comparison of spectral distances and trigonometric distances.

was of 20 % (in excellent agreement with the 18 % error estimate of Herny et al. (1997)). For BVD 148 we obtained the larger error. See discussion for BVD 148 in section 13.

6. Tangential Velocities

From the proper motion and the distance of a star, the calculation of the tangential velocity is straightforward. This is the projected motion of the star over the plane of the sky in km*s^{-1} and was calculated using the followed expression:

$$V_{\tan} = 4.74 * dist * \mu \qquad (1)$$

where *dist* is the distance in parsecs and μ is the total proper motion in arcsec*yr^{-1}. We estimated an error of 20% for our photometric distance so the error in tangential velocity must be greater than this value because we must to add the error in μ.

7. Stellar Masses

In our list, the latest spectral type was M0V. We used the luminosity-mass relation of Henry et al. (1993) if the star has a K absolute magnitude between 3.07 and 9.81. This relation use the K absolute magnitude which is obtained from Mv and V-K colors.

When the star is evolved then the mass is inaccurate. The theoretical studies indicate small masses for giant stars of about 1 $M_\odot$ (Scalo, Dominy & Pumphrey 1978) while empirical studies indicate larger masses for late-G giants between 2.7 $M_\odot$ and 3.1 $M_\odot$ (Russell & Moore (1940); Beer (1956), Stephenson & Sanwal (1969)). In this work we used a table of data from http://isthe.com/chongo/tech/astro/HR-temp-mass-table-byhrclass.html to obtain values of the masses for evolved stars. In this table, the masses were derived from many sources including *Astrophysical Formulae : Radiation, Gas Processes, and High Energy Physics* by Kenneth R. Lang. Many rows are heavily interpolated from known data on star mass. We can no access to this reference and we didn't determine the possible errors in the masses listed.

The mass errors when we use Henry et al. (1993) are 21 % for 0.08-0.50 $M_\odot$ and 15 % for 0.50-1.0 $M_\odot$. For evolved stars we fix an arbitrary error of 25% for stellar masses.

8. Age and Stellar Population

The galactic heliocentric velocity (U,V,W) for the members of stellar systems were calculated according to the work of van Herk (1965). Using the Eggen's diagrams (1969a, 1969b) and the Grenon (1987) kinematic age parameter, fG, the components were classified in the different stellar populations (old/young disk, thin/thick disk and halo population) .

9. Studying the Nature of the Visual Stellar Systems

Several criteria were used to determine if components of the pairs are optical, common origin binaries or physical binaries. A pair of stars could be located apparently nearby in the sky due to projection effects as they are seen from the Earth. These stars are not bound by the gravitational force and they are at different distances. We call this double stars, optical double stars. But same pairs of stars really form a real object and so they are located at the same distance of us travelling together in the space. They are called binary stars. Most of them are composed by coeval stars, that is, they born together, have the same metallicity, etc; the kinematic of both stars are (nearly) the same in direction and magnitude. If both stars orbit around the center of mass then we call them physical binary stars. But if both stars only have the same kinematical data and they are not orbiting around the center of mass, then we call these pairs, common origin binaries or comoving binaries. These criteria make use of photometric, astrometric, kinematical and spectroscopic data.

Relative proper motion is the projected angular velocity of the secondary with respect to the primary star. This data must be equal to the difference between individual proper motions of the components. It was calculated plotting rectangular coordinates $x = \rho * \sin\theta$ and $y = \rho * \cos\theta$ (prior to correction of θ by precession and proper motion) against time. The scope of the weighted linear fit gave the value of the relative proper motion in arcsec*yr^{-1}.

9.1 Criteria to Determine the Nature of a Visual Stellar System

The Double Star Section of LIADA used several criteria to determine if the components describe a Keplerian motion.

Criterion of Jean Dommanget (1955, 1956):

Starting with the expression for the energy integral (in the two body problem) and employing the mass-luminosity relationship, Dommanget establish a criterion for the non-periodicity of the relative motion of the components of a double star for which the apparent relative velocity is known. In a number of cases of visual binaries, this criterion permits the classification of the motion as non-periodic (i.e. parabolic, hyperbolic, or rectilinear) and therefore the classification as a true optical double star.

The expression used was

$$2.44 * \log \pi_i = -1.90 * 2 * \log V_a + \log \rho + 0.11 * m_a' - \log \mu$$

where π_i is the minimum parallax and indicate the maximum distance where the binary can be located to consider the motion as periodic; Va is the apparent velocity of B with respect to A (in as/yr), ρ is the angular separation (in arcseconds), m_a is the bolometric magnitude of A; and μ is 1+ΣM (ΣM is the sum of masses).

If the distance of a binary is greater than that determined in the expression, then the binary is consider an a optical pair, otherwise it is consider a physical binary star.

Criterion of Peter van de Kamp (1961):

This criterion starts with the equation of energy. The condition for a parabolic orbit is the critical value to determine if the relative velocity of the system is periodic or non-periodic. The condition for a parabolic orbit is the critical value

$$V^2 r = 8\pi^2 \left(M_a + M_b\right)$$

where M_a and M_b are the masses of the components (in solar mass units), π = 3.14159…; r is the distance between the components and V is the orbital velocity (in AU/yr). The orbit will be periodic (that is, the pair will be consider a physical binary star) if

$$V^2 r < 8\pi^2 \left(M_a + M_b\right)$$

The problem is in the calculation of V and r because we need to know the distance, the proper motion and the radial velocity. In most of the cases the radial velocity is unknown. At best, we can obtain a projected value of $V^2 r$, which will always be smaller than the true value. If the projected value is smaller than the critical value then the orbit may be elliptical. When the projected value of $V^2 r$ is calculated, then r is the projected separation calculated as ρπ (where π is the parallax). V is calculated as Δθr where Δθ is the annual variation of θ corrected by precession and proper motion. In this work we calculate Δθ by a linear fit.

Criterion of Halbwachs (1986)

The selection of physical systems is based in the ratio between the angular separation (in arcsec.) and the proper motion (in as/yr)

Criteria that relate stellar masses of the components with projected separations

We used several of these criteria: Abt (1988), and

New Wide Common Proper Motion Binaries

Close et al. (2003). In this work this criterion was calculated for all the pairs, but the influence in the final conclusion to determine the nature of the pair, was negligible.

Criterion of Sinachopoulos & Mouzourakis (1992)

This criterion studies the compatibility of the observed relative proper motion with that dynamically allowed. The tangential velocity, i.e. the observed relative proper motion, is compared with the maximum orbital velocity that follows from Kepler's third law.

The relative tangential velocity (in km/s) is calculated with the followed expression:

$$V_{\tan} = 4.74 d \Delta\mu$$

where d is the distance of the stellar system in parsecs (calculated averaging the distances for the stellar components), and $\Delta\mu$ is the relative proper motion of the stellar system in mas/yr.

If the pair that we are studing is indeed bound, then $V_{\tan}$ should be less than or equal to the maximum orbital velocity, $V_{\max}$. Using Kepler's third law:

$$V_{\max} = 29.78\sqrt{\frac{\Sigma M}{s}}$$

where s is the projected separation in Astronomical Units (AU) and ΣM is the sum of the stellar masses for the members of the stellar system (expressed in solar units). If a double star obeys Vtan > 3Vmax, then it will be consider an optical pair. For a double star to be considered a physical binary star, that is, a double star with bound components, it must obey Vtan < Vmax.

Criteria based on probability theory

There are several criteria which are based in probability theory. These were initially used by John Michell (1768) to determine the physical relation of some visual double stars and later used by others astronomers. The method of Grocheva & Kiselev (1998) which use the proper motion values for the components, was used by us.

When a double star has the same proper motion and their components are located at the same distance (within the error margins) but do not obey the celestial mechanics criteria (Dommanget, van de Kamp and Sinachopoulos criteria) then the double star is considered a common proper motion pair.

In spite of the large amount of tests, often it is not possible to clearly determine the nature due to (1) astrophysical data of poor quality or (2) not enough astrophysical data. The distribution of the nature of the double stars studied in this paper is shown in Figure 2. About 57% are binaries of common origin (the components of these binaries do not orbit each other), 36% are physical pairs, 3% are optical double stars and 1% are common proper motion pairs (pairs with no nature determined but with the same proper motion, within the errors, for both components).

10. Semimajor Axis and Orbital Periods

For these wide binaries it is not possible calculate orbital parameters, but the semimajor axis of such binaries can be determined from the angular separation. Fischer & Marcy (1992, hereafter FM) determined a statistical relation between the angular separation and semimajor axe. Unlike Abt & Levy (1976), who determined this relation assuming circular and face on orbits, FM calculated the expected semimajor axis, E(a), using a Monte Carlo simulation of a visual binary having all possible combination of orbital parameters. They obtained the relation

$$E(a) = 1.26\,\rho$$

where ρ is the angular separation in arcseconds. This relation gives $E(a)$ in arcseconds. To calculate E(a) in AU, the followed expression must be used:

$$E(a) = \frac{1.26\rho}{\pi}$$

or

$$E(a) = (distance)\,(1.26\rho)$$

where π is the trigonometric (or photometric) parallax for the stellar system and *distance* is the distance calculated averaging the distance of A and B components. This is statistically valid. FM didn't cite any error estimate and I assumed a random 10 % error.

We estimate the orbital periods using the Kepler's third law and assuming circular (eccentricity = 0) and face-on orbits (inclination = 0), stellar masses and E(a).

The error in the estimation of P (in percentage) are calculate using the following formula

$$\varepsilon P = 100\sqrt{\left(\frac{3}{2}\varepsilon a\right)^2 + \left(\frac{1}{2}\varepsilon M\right)^2 + \left(\frac{3}{2}\varepsilon\pi\right)^2}$$

where εa, εM and εp are the errors in semimajor axis, the sum of masses, and parallax, respectively. Both

New Wide Common Proper Motion Binaries

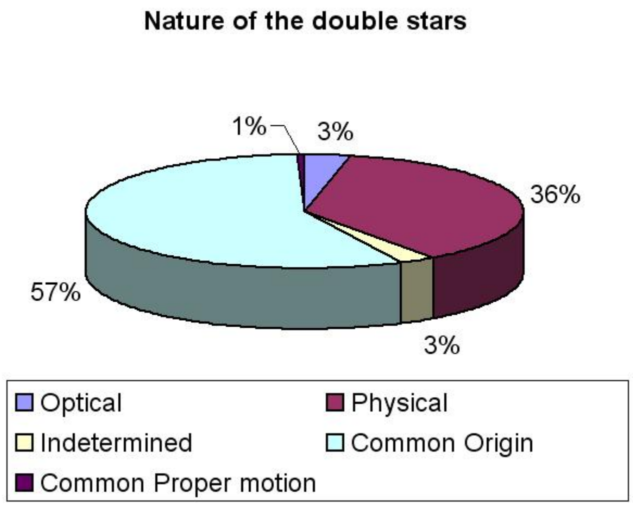


Figure 2: Distribution of the nature of the double stars.

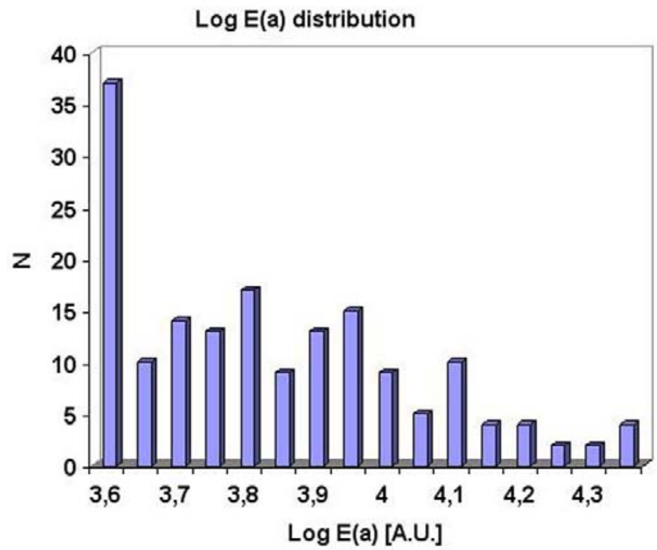


Figure 3: Distribution of the expected semimajor axes.

errors are expressed as percent/100. The error in sum of mass is 21% (0.21 when we used the formulae) for low mass stars and 15% for stars with stellar masses of 0.50-1.0. In photometric parallax are of 20 % (13 % if it is a Hipparcos trigonometric parallax). So the error in P (assuming circular and face-on) calculated ranges between 25-35 %.

Figure 3 shows the distribution of the expected semimajor axes. The plot shows the E(a) in Log E(a) and so log E(a) = 4.0 corresponds to a E(a) = 10,000 AU. Against the stellar systems studied in this work, 22 percent of them have E(a) of about 6,000 AU and is, with difference, the most numerous group of stellar systems. The widest stellar systems have E(a) > 30,000-35,000 AU.

11. CCD Measurements

In this work we made 1,538 measurements averaged into 636 measures. Against them 170 were CCD measures taken by 5 observers (in total 1,071 CCD images). 437 measures were obtained from AC2000, Tycho-2 and 2MASS catalogs, and we use Digitized Sky Survery plates for 29 measures.

Table 1 lists the observers that collaborated with CCD measurements. All of them are amateurs from Spain. The name of the observer and his affiliation are listed in column 1. The observatory in column 2 and the instruments used in column 3. This last column lists the telescopes used (model, diameters in meters and focal ratio), the CCD camera, the resolution used (in arcsecond per pixel) and the pretreat used. All the observers used Astrometrica to reduce the images. Rafael Benavides used REDUC for several double stars. The home-made software called DOBLES was designed by Julio Castellano to measure double stars in a great amount of CCD images. This software read the log file of Astrometrica and detect the coordinates for the components of the double stars, measuring theta and rho automatically. Finally, is shown the results and the sigmas for the measures.

Table 2 presents the main information for the double stars studied in this work. In column (1), the stellar system is identified by the designation name. Columns (2) and (3) list the equatorial coordinate for equinox 2000. Column (4) lists differential photometry. Magnitudes in V band and spectral types for primary and secondary components are listed in columns (5)-(8). The V magnitudes came from Tycho-2 catalog but for BVD 149 AB where came from Hipparcos catalog (Tycho-2 value for V is in error). So V magnitudes greater than 11th could have a low quality due to the larger errors in the weak end of the V magnitude. Column (9) lists the distance modulus from Tycho-2 V magnitude and Mv calculated in this work. Since the rms in Mv estimate is of 0.43, the error in V-Mv must be slightly greater because we must take into account the error in V magnitude. The expected semi-major axis (in AU) and the period (in years) are in columns (10) and (11). The last column shows the type of double star. The nature of the double star is coded as follows: 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, but could not be of this type. Often a combination the two types

Table 1: Observers that collaborated with the CCD measures.

Observer	Observatory	Instrument
Rafael Benavides (Astronomical Society of Córdoba)	Observatory of Posadas, MPC-IAU Code J53	Telescope: C11, 0.28-m, f/10 CCD: Atik 16HR Resolution: 0.50"/pixel and 0.99"/pixel. Using darks.
Julio Castellano	MPC-IAU Code 939	Telescope: S/C LX200 0.20-m, f/3.3 CCD: Sbig ST-7 ME Resolution: 2.7"/pixel Using darks y flats
Ramón Naves	Observatory of Montcabrer, MPC-IAU Code 213	Telescope: S/C LX200, 0.30-m, f/10 CCD: ST9 Resolution: 1.4"/pixel Using darks and flats
Esteban Reina	Observatory of Masquefa, MPC-IAU Code 232	Telecope: S/C LX200 0.25-m, f/3.3 CCD: ST7 Resolution: 2.17 "/pixel. Using darks and flats
Luis Lahuerta and Salvador Lahuerta	G.E.O.D.A., Observatory of Manises, MPC-IAU Code J98	Telescope: S/C Meade LX200 0.25-m, f/3.3 CCD: Starlight Xpress MX516 Resolution: 1.86x2.39 "/pixel. Using darks and flats

of double star are indicated separate by a "/" or "=" character. When a double star has approximately the same possibility to be, for example PHY and CO, then is indicated as "PHY=CO". Other example: when a double star is surely PHY but we can not reject the CO nature, then is indicated as "PHY/CO".

Table 3 presents the information for components of the double stars studied in this work. In columns (1) and (2) is the stellar system by the designation name. Column 3 lists the GSC identification; Columns 4 - 7 show V and B-V photometry and proper motion (in mas/yr) from Tycho-2. K magnitudes, J-K, and V-K colors from 2MASS are listed in columns (8) through (10). Columns (11) through (14) list the spectral type, V absolute magnitude, distance (in pc) and tangential velocities (in km/s) calculated in this work.

Table 4 lists the measures for the double stars studied in this work. In column 1 is the stellar system by the designation name. Columns 2 and 3 list the equatorial coordinate for equinox 2000. The besselian epoch, theta and rho are listed in columns 4 -6. Column 5 shows the number of measures. The observer and method code are given in columns 8 and 9. The observers are coded as follow: BVD (Rafael Benavides); FMR (Francisco Rica); JCA (Julio Castellano); OMG (Luis Lahuerta and Salvador Lahuerta); ERE (Esteban Reina); RNA (Ramón Naves). The method code: CCD: measure using CCD camera; DSS: measure using Digitalized Sky Survey plates; AC2000, TYCHO-2 and 2MASS: measures using AC-2000, Tycho-2 and 2MASS astrometric catalogs. The epoch of measures included in WDS catalog are flagged with an asterisk.

We analyzed statistically the internal errors of CCD measures for those double stars with at least 3 CCD measures. The sigma in θ and ρ were calculated for these double stars. Table 5 shows the mean and median for the sigma.

As we can see in Table 5, the accuracy of the CCD measures is very good with averaged σ of 0.045" (0.08º) in θ and 0.047" in ρ. As we can expect for CCD measures of wide pairs, the tangential internal errors (that is in θ) and the radial internal errors (in ρ) are very similar. So ρ measures are not affected by the proximity effect that use to made smaller the ρ measures.

Figures 4-6 show the sigma distribution in θ (in degrees and arcseconds) and ρ for the binaries with three of more CCD measures.

Table 5: Mean and Median for sigmas in θ and ρ.

	Mean	Median
σ(θ) [°]	0.08°	0.06°
σ(θ) ["]	0.045"	0.040"
σ(ρ) ["]	0.047"	0.040"

(Continued on page 38)

New Wide Common Proper Motion Binaries

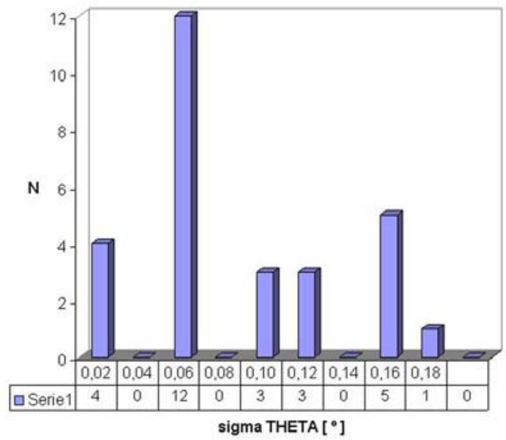


Figure 4: Sigma values for the theta (degrees) CCD measures.

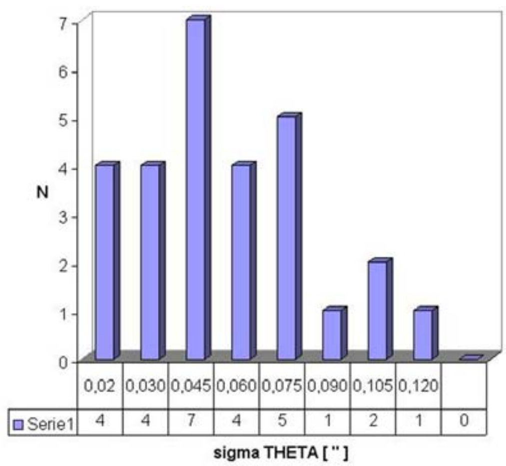


Figure 5: Sigma values for the theta (arcseconds) CCD measures.

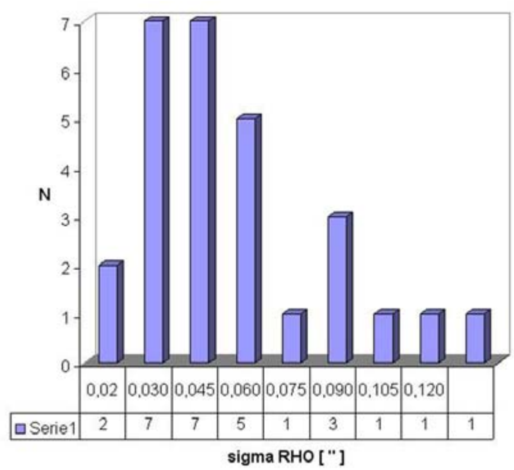


Figure 6: Sigma values for rho (arcseconds) CCD measures.

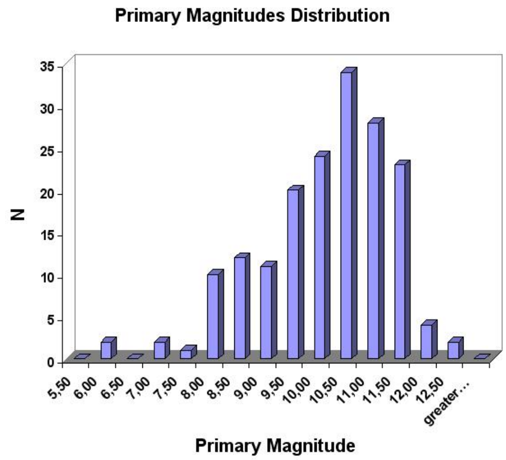


Figure 7: Distribution of the primary magnitudes.

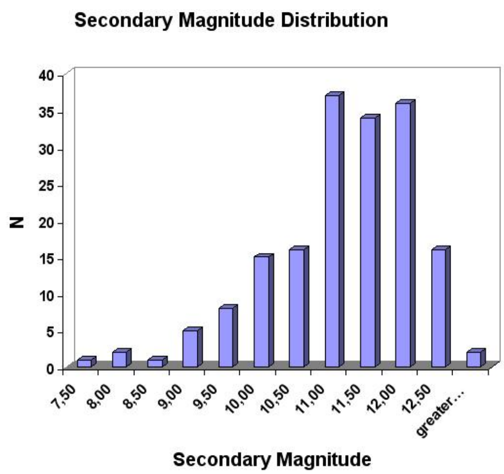


Figure 8: Distribution of the secondary magnitudes.

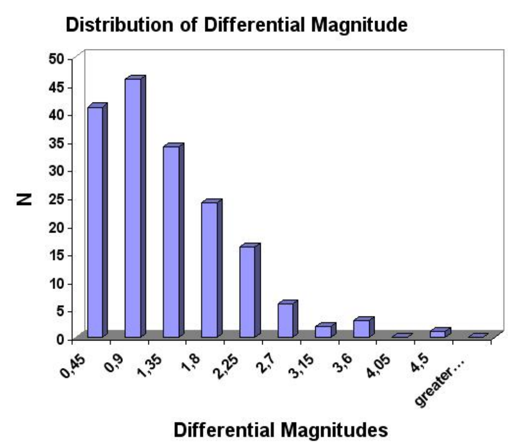


Figure 9: Distribution of the magnitude differences.

New Wide Common Proper Motion Binaries

12. The Binary Stars

Plotted in Figures 7 and 8 are the distribution of primary and secondary magnitudes in addition to the distribution of differential magnitude. In Figure 7 it can be seen that the most common primary magnitude is 10.5. The mean value is 9.85 and the median value is 10.09. Figure 8 shows the same for the secondary components. The most common values are from 11 to 12 magnitudes. The mean value is 10.90 and the median value is 11.05. The Figure 9 shows the differential magnitude with mean of 1.05 and median of 0.73.

Figure 10 shows the distribution of proper motion for components of the double stars that have proper motion from 4.4 to 306.2 mas/yr. We must to take into account that the optical pairs have been plotted too. The most common proper motion ranges from 25 to 75 mas/yr.

Figure 11 shows the relative motion of B with respect to A for those stellar systems with a significant possibility of being physical. This relative motion corresponds to the relative orbital motion for these systems.

In the next paragraphs we comment in detail same binaries.

BVD 30 AB-C

A common proper motion binary composed of stars with G9V and G9V spectral types separated by more than 37 arcsec. The differential distance moduli of +0.87 magnitudes is caused by the binary nature of primary component which is listed in WDS (Mason et al. 2003) as WDS 00029-7436 = TDS 3 discovered. It was discovered by Tycho-2 instrument in 1991 (48 degrees and 1.4 arcsec with magnitudes of 10.64 and 11.26). According to our study, the wide components are likely be a physical pair although a common origin must not be rejected.

If the components of the close binary are bounded then it will be a triple stellar system.

HJL 1 = WDS 00119+6621

Discovered by Halbwachs (1986) who measured 350º and 31". Roeser & Bastian (1988) obtained spectral type F8 for the primary. The astrophysical data were corrected for reddening. In this work we determined a E(B-V) of 0.16 and 0.19 for primary and secondary respectively.

LDS 5 = WDS 00137-2818

Common high proper motion binary composed of stars with 10.96 and 11.31 magnitudes and spectral types K2V and K5V separated by more than 44 arcsec. It was discovered by Luyten in 1954. Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 11.12 ± 2.34 mas (91 +23/-16 pc). The photometric distance determined by LIADA is in agreement with Hipparcos within the error margins. According to our study the wide components are likely a common origin binary, although a physical nature must

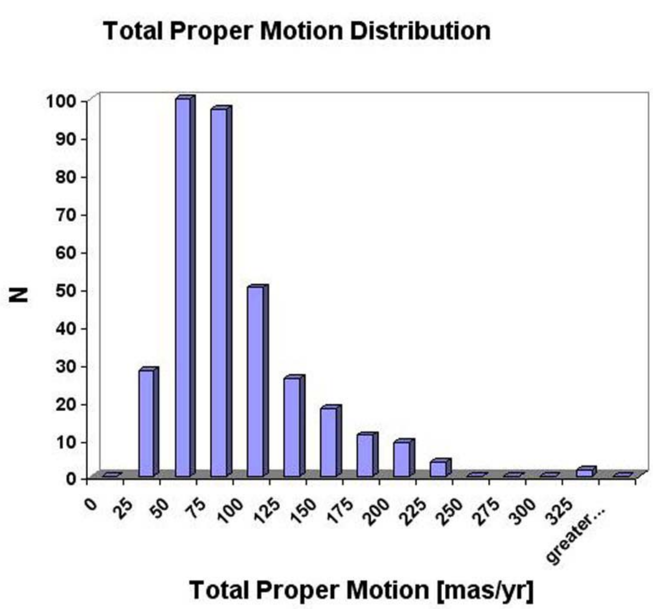


Figure 10: Distribution of the total proper motion of the observed double stars.

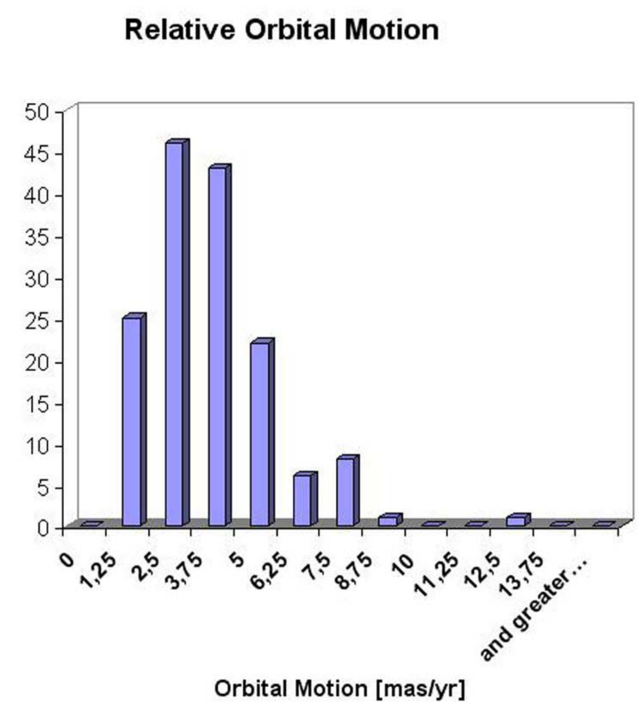


Figure 11: Distribution of the relative orbital motion.

not be rejected.

BVD 12

Common high proper motion binary composed of stars with 7.5 and 11.1 magnitudes with F6IV (evolutionary isochrona were used) and K0V spectral types separated by more than 143 arcsec. See Figure 12. We calculated a Mv = 1.8 for the primary which corresponds to about 140 pc of distance. Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 9.9 ± 1.0 mas (101 pc).

Houk & Smith-Moore (1988) classified it as a F5V star but this result is not in agreement with Hipparcos results.

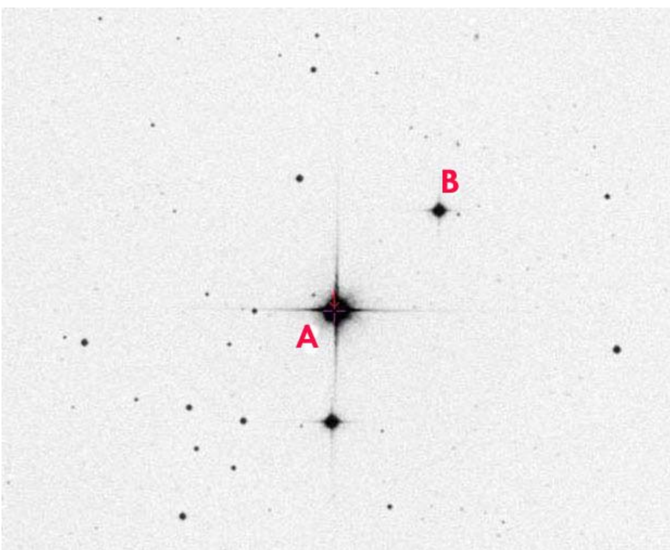


Figure 12: Binary BVD 12 (DSS image).

Barbier-Brossat, Petit & Figon (1994) determined a radial velocity of –4.3 km*s^{-1}.

Nordstrom et al. (2004) determined a metallicity [Fe/H] = -0.24 and a galactocentric velocity (U,V,W) = (-76, -49, -0) km/s^{-1}. According to Eggen diagrams (1969a, 1969b) it is an old disc star. A fG = 0.36 corresponds to a thick disk star of 10 Gyr old.

According to our study it is a common origin pair.

BVD 66

The differential distance moduli of –0.68 magnitudes could be caused by the binary nature of B.

BVD 13

Secondary is slightly brighter than the primary component and if it is a subgiant then the photometric parallaxes of the components will be nearly the same.

BVD 14

Roeser & Bastian (1988) classified the primary star as a G0 star (LIADA estimated a spectral type of F6V). It is composed by small proper motion stars with differential distance moduli of –2.67 magnitudes so this pair could be an optical pair.

BVD 15

Roeser & Bastian (1988) listed the primary star as a spectral type of F8.

BVD 16

Cannon & Pickering (1918-1924) listed the primary star as an F8 star. Houk (1978) determined a spectral type of G3V.

BVD 18

Cannon & Pickering (1918-1924) listed the primary star as a K0 star. Miskin (1973) listed the secondary component with spectral type of G5III. We estimated a spectral type of G7V for secondary. If it was a giant star its tangential velocity would be greater than 400 km*s^{-1}. This high velocity is very improbable and so surely Miskin made an error.

HJL 20 = WDS 01350+6047

Common high proper motion binary composed of stars with 8.5 and 9.1 magnitudes, both with F6V spectral types and separated by more than 44 arcsec. It was discovered by Halbwachs (1986).

Farnsworth & Alice (1955) and Jaschek, Conde & de Sierra (1964) classified the components as stars of F8V (LIADA determined spectral types of F6V).

Duflot, Figon & Meyssonnier (1995) determined radial velocity of –12 and –15 km*s^{-1} for components A and B.

The differential distance moduli of +0.54 magnitudes could be caused by the binary nature of the primary.

BVD 21

Common proper motion binary composed of stars with 7.9 and 10.8 magnitudes with G6V and K7V spectral types separated by more than 59 arcsec. Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 30.0±0.9 mas which corresponds to a distance of 33 pc (exactly the same value that LIADA obtained).

Cannon & Pickering (1918-1924) classified the primary as a G5 star (LIADA obtained G6V).

Nordstrom et al. (2004) determined a metallicity [Fe/H] = +0.02, a galactocentric velocity (U,V,W) = (+10, +7, -6) km*s^{-1} and a age of about 4 Gyr. According to Eggen diagrams (1969a, 1969b) it is a young disc star. In this work we calculated a fG = 0.06 that corresponds to a young-medium age thin disk star of about 3-4 Gyr old.

New Wide Common Proper Motion Binaries

According to our study, it is surely a physical double.

BVD 25

A common proper motion binary composed of stars with 9.1 and 9.4 magnitudes separated by more than 40 arcsec. Houk & Cowley (1975) classified the primary as an F6V star. LIADA determined a spectral type of F5V for both components.

BVD 26

According to the individual proper motions, this visual double star is likely an optical pair. The primary is the variable star V 405 Cep, a suspected eclipsing binary and the luminosity ranges from 8.75 to 8.95

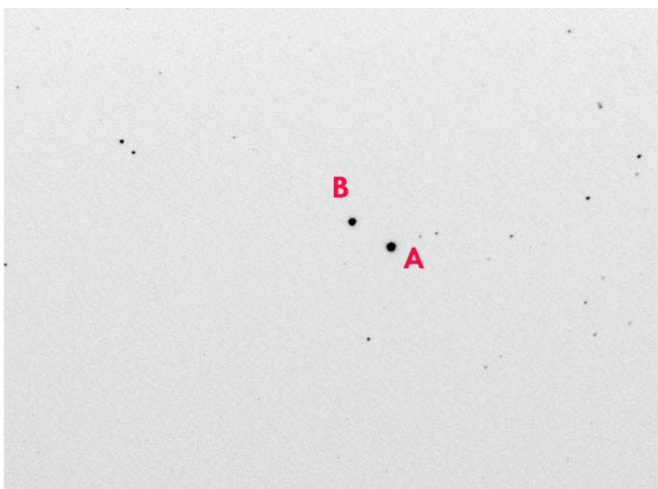


Figure 13: BVD 26 observed in 2009.255 by Benavides using a C11 telescope with CCD Atik in binning 2x2.

(Samus et al. 2004). See Figure 13.

Hipparcos (ESA 1997) observed the primary component and obtained a distance of 229 pc and an absolute magnitude of 1.92 (typical for a star A4/5V). Literature classified it as a A2 star. In this work a photometric distance of 211 pc and a spectral type of A6V were determined.

More astrometric measures are needed to confirm the nature of this pair.

BVD 27

A low common proper motion double star, whose nature is not clear. Surely it is a common origin binary. But the difference in distance moduli of -0.78 magnitudes could be caused by the binary nature of secondary component. More astrometrical data are needed to confirm the nature of this pair.

BVD 28

A high common proper motion binary composed of stars with 9.9 and 10.3 magnitudes separated by more than 105 arcsec. Cannon & Pickering (1918-1924) classified the primary as a K2 star (LIADA obtained K4V). The secondary is a K5V (this work). According to our photometric distance this pair could be a nearby physical system located at 39 pc, but we can not reject the common origin nature.

BVD 29

Common proper motion binary composed of stars with 10.7 and 11.1 magnitudes with K1 IV and F6 V spectral types separated by more than 51 arcsec. The spectral type for the primary was determined to obtain the same photometric distance for both components. It is a common origin system.

BVD 71

Common proper motion binary composed of stars with 9.0 and 10.5 magnitudes separated by more than 60 arcsec. Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 18.2±0.9 mas which corresponds to a distance of 55.5 pc (LIADA determined a photometric distance of 61 pc).

Cannon & Pickering (1918-1924) classified the primary as a K0 star. Houk & Cowley (1975) obtained a spectral type of G6V. In this work the primary was classified as a G5V star. Our estimate of photometric distance showed that this system is located at 50-60 pc.

According to our study surely it is a physical pair, although a common origin must not be rejected.

BVD 31

According to the individual proper motions this visual double star is an optical pair.

Hipparcos (ESA 1997) observed the primary component and obtained a distance of 138 pc and an absolute magnitude typical for a A7/8V star. In this work a photometric distance of 133 pc and a spectral type of A8V were determined in good agreement with Hipparcos results.

BVD 32

Roeser & Bastian (1988) classified the primary as a F5 star.

BVD 34

More astrometric data are needed to determine the nature for this pair. Roeser & Bastian (1988) classified the primary as a K0 star. LIADA determined a spectral type of G8III. The astrophysical data were corrected by reddening. In this work we determined a E(B-V) of 0.21 and 0.26 for primary and secondary respectively.

BVD 37

The astrophysical data were corrected for reddening. In this work we determined a E(B-V) of 0.17 and

New Wide Common Proper Motion Binaries

0.12 for primary and secondary respectively.

FEL 1

Common high proper motion binary composed of bright stars with 7.41 and 7.56 magnitudes separated by nearly 76 arcsec. Inicially catalogued by us as BVD 38. But in num. 4, vol. 5 of JDSO, Laurent Ferrero (2009), a French amateur, published the discovery of this binary which had not yet been listed in WDS catalog. In this paper we name it FEL 1.

Hipparcos (ESA 1997) observed the primary component and obtained parallaxes of 18.2 ± 0.6 and 19.2 ± 0.6 mas which correspond to distances of 55 and 52 pc. LIADA calculated photometric distances of 44 and 52 pc.

Cannon & Pickering (1918-1924) classified the components as G0 stars. Houk & Cowley (1975) obtained spectral types of G0V for both components. LIADA determined spectral types of F9V and F8V.

Nordstrom et al. (2004) determined galactocentric velocities (U,V,W) of (+29, -22, -8) and (+28, -22, -8) km*s^{-1} and radial velocities of +27.1 ± 0.1 and +27.3 ± 0.2 km*s^{-1} for the components. According to Eggen diagrams (1969a, 1969b) they are old disc stars. A value of 0.16 for fG was obtained in this work corresponding to a young-medium age thin disk star of 3-4 Gyr old. Nordstrom et al. (2004) calculated an age of about 6.9 Gyr.

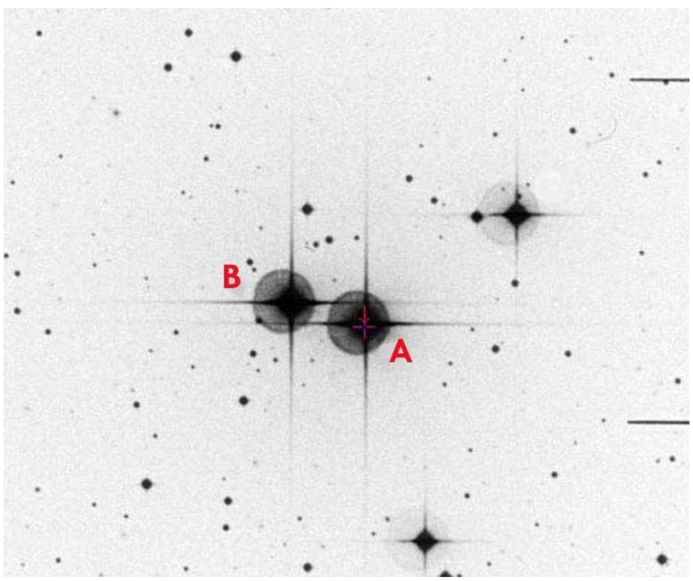


Figure 14: Binary FEL 1 (DSS image).

According to our study this double star is surely a physical pair.

HJL 54 = WDS 03597+8215

Common proper motion binary composed of stars with 9.7 and 10.2 magnitudes, separated by 24 arcsec, and discovered by Halbwachs (1986).

Roeser & Bastian (1988) classified it as a system of F5 and F8 stars. Our estimate determined spectral types of F6V and F8V.

According to our study this pair could be physical or a common origin binary.

BVD 40 AB-C

Common high proper motion binary composed of stars with 10.3 and 10.4 magnitudes, separated by 11.6 arcsec.

The primary component is listed in WDS catalog as WDS 04001-2902 = TDS 2713, discovered by Tycho-2 instrument in 1991 (276 degrees and 0.5 arcsec with magnitudes of 11.13 and 11.29).

LIADA determined photometric distances of 33 and 42 pc so this is a nearby stellar system.

Cannon & Pickering (1918-1924) classified the components as K0 stars. LIADA determined spectral types of K6V and K5V.

According to our study this is a clear physical pair.

BVD 41

Common proper motion binary composed of stars with 10.8 and 11.9 magnitudes, separated by 47 arcsec.

Roeser & Bastian (1988) classified the primary as a K0 star. Our work determined spectral types of G4V and K2V.

According to our study this pair could be physical or a common origin double star.

BVD 43

Common high proper motion binary composed of bright stars with 9.2 and 11.4 magnitudes separated by nearly 30 arcsec. Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 3.06 ± 0.98 mas which corresponds to a distance of 327 +154/-79 pc. The calculated absolute magnitude using trigonometric parallax and apparent magnitude of Hipparcos was of 1.7 +0.5/-0.9. Taking into account the photometric information this value corresponds to a K2 IV-III star. In this work we calculated a Mv = 1.6 which correspond to a distance of 322 pc.

Cannon & Pickering (1918-1924) classified the primary as K0 stars while Houk (1978) obtained a spectral type of K0III.

According to our study this double star is surely a common origin pair.

BVD 44

Common proper motion binary composed of bright stars with 8.8 and 9.5 magnitudes, separated by about

New Wide Common Proper Motion Binaries

26 arcsec.

Cannon & Pickering (1918-1924) classified the primary as a G0 star while Houk & Cowley (1975) obtained a spectral type of F7V. LIADA determined spectral types of F9V and G2V.

According to our study this double star is surely a physical pair.

HJL 2.- GSC 4069 1243 (AR: 04 25 40 DEC: +63 40 29)

Common proper motion binary composed of stars with 8.3 and 10.0 magnitudes and discovered by Halbwachs (1986), but it is not cataloged in WDS (Mason et al. 2003). We propose provisionally that this binary be named HJL 2

Hipparcos (ESA 1997) observed the primary component and obtained a parallax which corresponds to a distance of 66 pc. The calculated absolute magnitude, using trigonometric parallax and apparent magnitude from Hipparcos, corresponds to spectral types of F9V and K0V stars. LIADA determined a later spectral type of G7V for the primary.

According to our study this double star is surely a common origin pair.

BVD 47

delta(V-Mv)=-0.75; B is an unresolved double star?

SRT 2 = WDS 04116-2021

Common proper motion binary composed of bright stars with 5.2 and 7.7 magnitudes, separated by nearly 62 arcsec.

The main component is a spectroscopic binary known as GW Eri composed by star with spectral types of A1V and F/G (Houk & Smith-Moore 1988) which orbit in 3.659 days. The main component have a radial velocity of +32.8 km*s^{-1} (Abt & Levy 1977).

Secondary component is an F0 star (Houk & Smith -Moore 1988). LIADA estimated a spectral type of A9V. Nordstrom et al. (2004) obtained a metallicity of [Fe/H] = -0.26 and a distance of 91 pc in agreement with our result (109 pc) within error margins.

According to our study this double star is surely a common origin pair but we can not reject a physical nature.

BVD 48

This stellar system is composed of three stars with common proper motions and with spectral types of F6IV, G2V and G5V.

Hipparcos (ESA 1997) observed the components A (HD 31141) and C (HD 31130) and obtained parallaxes of 16.0 ± 0.6 mas and 16.1 ± 0.9 (about 62 pc).

From Hipparcos data the absolute magnitude for the primary is in agreement with the spectral type F6IV/V determined by Houk (1982).

Nordstrom et al. (2004) determined for the primary a metallicity [Fe/H] = -0.18, a stellar mass of 1.42 solar masses and an age of about 2.4 ± 0.2 Gyr old.

The B component is a G5 star (Bastian & Roeser 1993). We determined a spectral type of F7V, but using different photometric colors we obtained a G5V spectral type (colors J-H and H-K), G0V (B-V color) and F7V (color V-K).

The AB pair is composed of bright stars with 6.8 and 8.7 magnitude and with spectral types F6IV/V and G2V separated by 52.3 arcsec. According to our study it is surely a physical pair. The hypothetical parallax (Russell 1928) calculated in this work was π_{hyp} = 16.1 m.a.s. in excellent agreement with Hipparcos data for the primary (π_{trig} = 16.0 m.a.s.).

The component C is a G5V star (Houk 1982) of 8.9 magnitude. It is located at 99.6 arcsec of the primary. Hipparcos obtained a parallax of 16.2 ± 0.9 m.a.s. (62 pc). Nordstrom et al. (2004) determined a metallicity of [Fe/H] = -0.08 and a radial velocity of +45.9 ± 0.7 km/s. In this work we obtained a galactocentric velocity (U,V,W) of (-22, -44, -13) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) they are old disc stars. In this work we calculated a fG = 0.26 that corresponds to an old age thin disk star of 3-10 Gyr old. Nordstrom et al. (2004) calculated an age of about 6.9 Gyr.

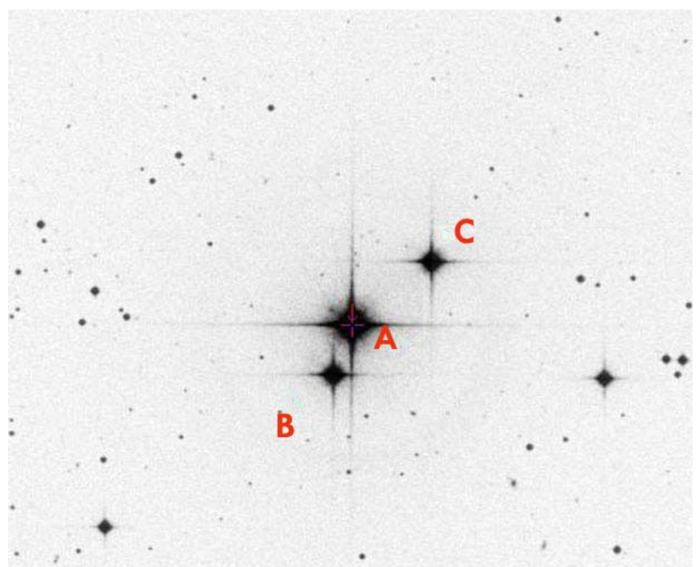


Figure 15: DSS image of BVD 48.

According to our study AC pair is likely a physical pair but we can not reject a common origin nature.

Is BVD 48 a Trapezium-like multiple system?

Trapezium systems named after the Trapezium in

New Wide Common Proper Motion Binaries

the Orion Nebula, are groups of three or more stars whose separations are roughly equal. As such, they are dynamically unstable and must evolve either into hierarchical systems or into hard binaries with outer components lost to the systems. The maximum age for trapezium systems seems to be 30-70 x 10^7 yr (Abt & Corbally 2000).

An arbitrary working rule (Ambartsumian 1954) is that the largest angular separation in a trapezium system is greater than 1/3 but less than 3 times the smallest angular separation.

In BVD 48 the smallest angular separation is 52.25 arcsec for AB components and the greatest angular separation (146.45 arcsec for BC components) is 2.8 time greater, so the apparent configuration of this system meets the Ambartsumian criterion.

The ages for the members obtained by Nordstrom et al. (2004) suggest that this system is much older that the maximum age of trapezia systems. Typically, a hierarchical system will consist of a close pair and a distant third star, or a close pair and distant close pair. We see the multiple-star systems only in projection against the plane of the sky. Therefore a hierarchical system could, if they lay nearly along our line of sight, simulate a Trapezium system. Ambartsumian (1954) called those "pseudo-Trapezium systems" and estimated in a statistical analysis that about 9% of a sample of hierarchical systems would appear to be such pseudo-Trapezium systems. So we can conclude that BVD 48 surely is a hierarchical system simulating a Trapezium system.

BVD 49

Common proper motion binary composed of stars with 9.7 and 11.0 magnitudes, separated by 48.5 arcsec.

Cannon & Pickering (1918-1924) classified the primary as a G0 star while Houk (1982) obtained a spectral type of F7/G0(V). LIADA determined spectral types of F8V and G8V.

According to our study this double star is surely a common origin pair but we can not reject a physical nature.

BVD 50

Common proper motion binary composed of stars with 8.3 and 8.5 magnitudes, separated for 31.0 arcsec.

Hipparcos (ESA 1997) observed both components and obtained parallaxes which correspond to 92 ± 10 and 130 ± 21 pc. The absolute magnitudes calculated were 3.5 ± 0.2 and 2.9 ± 0.4. According to this, the secondary could be a subgiant of F7IV spectral type (LIADA determined spectral types of F3V and F3V).

Nordstrom et al. (2004) obtained spectral types of F0 for both components, determined metallicities [Fe/H] of -0.40 and -0.30 and ages of 1.8 - 1.9 Gyr.

Olsen (1994b) suspected a variable nature. Nowadays it is classified as NSV 16253.

According to our study this pair could be a common origin or a physical pair.

BVD 51

Common proper motion binary composed of stars with 7.7 and 9.5 magnitudes, separated by 44.6 arcsec.

Houk & Swift (1999) classified the primary as a F7V star in agreement with our results (F7V and G1V).

The difference in distance modulus of the components is 1.0 magnitude. The primary could be a IV-V star or maybe an unresolved double star. Nordstrom *et al.* (2004) obtained an absolute magnitude of +2.9 which is typical for a F IV-V star.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = +0.03 for the primary. The galactocentric velocity (U,V,W) = (-17, +3, -24) km*s^{-1}. The radial velocity was of 22.5±0.4 km*s^{-1}. According to Eggen diagrams (1969a, 1969b) it is a young disc star. In this work we calculated a fG = 0.16 that corresponds to a young-medium age thin disk stars of 3-4 Gyr old.

According to our study it is surely a common origin pair.

BVD 52

Common high proper motion binary composed of stars with 7.6 and 9.0 magnitudes, separated by more than 90.1 arcsec. Hipparcos (ESA 1997) observed the primary component and obtained a parallax which corresponds to a distance of 57.4 ± 4.7 pc.

Houk and Smith-Moore (1988) classified them as K0IV and G5V stars.

Moore and Paddock (1950) calculated a radial velocity of +24 ± 5 km*s^{-1} and a spectral type of G9III for the primary star.

This binary is included in a catalog of red giant stars of the old disk population (Eggen 1976).

We obtained a galactocentric velocity (U,V,W) = (-20, +11, -34) km/s^{-1}. In this work we calculated a fG = 0.23 that corresponds to an old age thin disk star.

According to our study this pair could be a physical or a common origin pair.

BVD 89

Common proper motion binary composed of stars with 11.0 and 11.9 magnitudes, separated by 22.6 arcsec.

Cannon & Pickering (1918-1924) classified the pri-

New Wide Common Proper Motion Binaries

mary as a G5 star (LIADA determined spectral types of G2V and K1V).

According to our study this pair could be a physical or a common origin pair.

BVD 20 AC

Common proper motion binary composed of stars with 9.2 and 10.8 magnitudes, separated by 72.4 arcsec. The AB components compose the double star RSS 85 = WDS 05285-3922, separated at 8.12” in direction 136.1° (in 1999.18).

Hipparcos (ESA 1997) observed the primary component and obtained a parallax which corresponds to a distance of 39.4 ± 1.5 pc in agreement with our result (about 36 pc).

Upgren *et al.* (1972) classified the primary as a K3IV subgiant. Houk (1982) classified it as a K2V star. Olsen (1994a) classified it as a dwarf. We obtained spectral types of K2V and K7V.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.19 and a radial velocity of +27 ± 0.4 km/s. From data found in literature, we calculated the galactocentric velocity (U,V,W) = (-14, -28, -2) km/s^{-1}. According to Eggen diagrams (1969a, 1969b) it is a young disc star. In this work we calculated a fG = 0.16 that corresponds to a young-medium age thin disk star.

According to our study it is likely a physical pair.

BVD 55

Pair of stars with 9.4 and 10.7 magnitudes, separated by 21.0 arcsec. The relative motion of the system is about 8 mas*yr^{-1} and the common proper motion probability is about 30 percent.

Bastian & Roeser (1993) classified primary as an F8 star (LIADA determined spectral types of F5V for both components).

According to our study its nature is undetermined and we can not reject the optical nature.

BVD 56

Common proper motion binary composed of stars with 9.0 and 10.8 magnitudes, separated by 72.0 arcsec.

Houk & Smith-Moore (1988) classified the primary as an F7V star (LIADA determined spectral types of F9V and K0V).

According to our study this pair likely is a common origin pair but we can not reject the physical nature.

BVD 57 AB-C

Common proper motion binary composed of stars with 8.4 and 10.2 magnitudes, separated by 51.5 arcsec.

Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 15.13 ± 0.77 mas (66 pc). LIADA determined a distance of 48 and 57 pc. The absolute magnitude using Hipparcos data is +4.25.

Houk & Cowley (1975) classified the primary as a G5V star but this result is not in agree with Hipparcos. LIADA determined a G4V spectral type for primary. The brighter absolute magnitude of Hipparcos is caused by a unresolved duplicity of the primary star. The primary component is listed in WDS catalog as WDS 05536-5640 = FIN 93 discovered by Finsen (1932) in 1929 using a micrometers attached to a refractor of 26 inches (308.6 degrees and 0.30 arcsec).

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.20 and a radial velocity of -6.6 ± 0.1 km*s^{-1} and a galactocentric velocity (U,V,W) = (+16, +9, -6). According to Eggen diagrams (1969a, 1969b) it is a young disc star. In this work we calculated a fG = 0.08 that corresponds to a young age thin disk star of 3 -4 Gyr old.

According to our study this double star could be a physical or a common proper motion pair.

BVD 91

Common proper motion binary composed of stars with 9.2 and 10.5 magnitudes, separated by 46.2 arcsec.

Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 8.82 ± 0.90 mas (147 pc). LIADA determined photometric distances of 130 and 97 pc for primary and secondary component.

Houk (1982) classified the primary as an F5V (in this work we determined spectral types of F6V and G8V).

According to our study this pair likely is a common origin pair but we can not reject the physical nature.

BVD 93

Common high proper motion binary composed of stars with 10.5 and 12.3 magnitudes, separated by 20.1 arcsec.

Hipparcos (ESA 1997) observed the primary component and obtained a parallax of 11.85 ± 4.21 mas (84 pc). LIADA determined photometric distances of 105 pc.

According to our study this double star could be a physical pair or a common origin pair.

BVD 59

The difference in distance moduli of +1.5 magnitude surely is caused by an error in our luminosity classes and likely primary is an evolved star.

BVD 60

A pair composed of stars with 10.3 and 13.0 magnitudes, separated by 52.6 arcsec. Cannon & Pickering (1918-1924) classified the components as K0 and G0 stars. LIADA determined spectral types of K3V and

New Wide Common Proper Motion Binaries

G1V.

The Tycho-2 catalog lists a secondary proper motion very similar to that for the primary. But UCAC-2 lists a very different proper motion. 2MASS and GSC-I (Morrison et al. 2001) show an astrometry in more agreement with UCAC-2 catalog. GSC-II shows for B a similar motion than that of Tycho-2. Finally we performed a blink of several photographic plates from Digitized Sky Survey and a CCD images from 2MASS and no common proper motion could be seen for this system.

Due to very different proper motion for the components, this pair is optical.

BGH 22 = WDS 06386-0946

Common high proper motion binary composed of stars with 9.4 and 9.8 magnitudes, separated by 40.1 arcsec.

LIADA determined photometric distances of 50 and 47 pc.

Cannon & Pickering (1918-1924) classified the primary as a G5 star. Houk and Swift (1999) obtained an spectral type of K1/2. In this work we determined spectral types of K0V and K2V.

The WDS identification for BGH 22 is WDS 06386-0946. It was discovered by van den Bergh in 1946 (Bergh 1958) at a angular distance of 39.9 arcsec in direction 151.2 degrees. Since then, 10 measures have been performed, the last one in 1998 (151 degrees and 40.1 arcsec).

According to our study this is surely a physical pair.

BVD 61

Common proper motion binary composed of stars with 9.4 and 11.1 magnitudes, separated by 45.8 arcsec.

LIADA determined photometric distances of 100 and 85 pc.

Roeser & Bastian (1988) classified the primary as a G0 star. In this work we determined spectral types of G0V and K2V.

According to our study this pair could be a physical pair or a common origin pair.

BVD 120

Common proper motion binary composed of stars with 9.4 and 9.8 magnitudes, separated by 71.5 arcsec.

Cannon and Pickering (1918-1924) classified the primary as a F8 star while Houk and Smith-Moore (1988) classified it as a F5/6V star. In this work we determined spectral types of F6V and F6V.

According to our study this double star likely is a common origin pair but we can not reject the physical nature.

BVD 64

Common proper motion binary composed of stars with 10.6 and 11.5 magnitudes, separated by 149.5 arcsec.

Our spectral types were K0V and K7V. The difference in distance moduli of -0.85 magnitudes could be caused by an error in our luminosity classes or by the duplicity of the secondary star.

According to our study this double star likely is a common origin pair.

BVD 65

The relative motion infered from Tycho-2 and UCAC-2 catalog is very different. More astrometric data are needed to confirm the relative motion for this system.

BVD 67

Common proper motion binary composed of stars with 10.0 and 10.4 magnitudes, separated by 34.4 arcsec.

Stoy (1968) classified them as F8 and G0 stars. Our spectral types were G5V and G5V.

According to our study this double star likely is a physical pair but we can not reject the common origin nature.

BVD 69

Common proper motion binary composed of stars with 8.9 and 9.6 magnitudes separated by 20.5 arcsec.

In literature the primary is classified as a F3/5V star. In this work we determined spectral types of F4V and F5V.

The difference in distance moduli of +0.55 magnitudes could be caused by an error in our luminosity classes or by the binary nature of the primary.

According to our study this double star could be a common origin or a physical pair.

LEP 30 = WDS 08156+1126

Common high proper motion binary composed of stars with 7.7 and 9.6 magnitudes separated by more than 31.9 arcsec.

WDS catalog lists a double star separated by 31.9 arcsec in direction 239 degrees in 2000 (237 degrees and 31.7 arcsec in 1918).

Hipparcos (ESA 1997) observed the primary component (HD 69056) and obtained a distance of 38±2 pc. It was classified as NLTT 11-1796 with spectral type of G5. We obtained a spectral type of G6V for the primary and photometric distances of 31 and 38 pc for the components.

Nordstrom et al. (2004) determined a metallicity

New Wide Common Proper Motion Binaries

[Fe/H] = +0.10 and a galactocentric velocity (U,V,W) = (-21, -40, -37) km/s^{-1} for the primary. According to Eggen diagrams (1969a, 1969b) it is an old disc star. In this work we calculated a fG = 0.32 that corresponds to an old age thin disk star of 3-10 Gyr old.

According to our study it likely is a physical pair.

BVD 161 AC

Common high proper motion binary composed of stars with 8.5 and 11.7 magnitudes, separated by more than 72.8 arcsec. UCAC-2 proper motions for the secondary is in error. Using AC2000, Tycho-2 and 2MASS astrometric data the relative motion of the system is 17 mas*yr^{-1}. The AB pair is catalogued in WDS as LEP 31 = WDS 08213+3419. See Figure 17.

According to Lepine *et al.* (2005), the weak B component has V = 17.5 and (J, H, K) = (14.94, 14.60, 14.55) and a proper motion of 0.160 mas*yr^{-1}. In 2MASS images it is nearly invisible and in optical plates of DSS it is a very weak object. SDSS photometry in bands u, g, r, i and z for epoch 2001.8902 and 2002.0243 match with a M4V star of Mv = +12.75 at a distance of 215 pc. This weak star is slightly shown in optical photographic plates and the USNO-B1.0 proper motion is inaccurate. The large distance determined in this work suggests that this star is a background star. A blink using DSS plates in ALADIN software confirm that B component is not a high common proper motion star.

Hipparcos observed the primary component (HD 70088) and obtained a distance of 43 ± 2 pc. The infered absolute magnitude is 5.30 ± 0.11, which corresponds to a star of G6V spectral type. Our results are in agreement with Hipparcos data.

Montes et al. (2001) determined a radial velocity of +32.2 ± 0.5 km*s^{-1} and a spectral type of G5V for the primary.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.21 and a galactocentric velocity (U,V,W) = (-41, -23, -6) km*s^{-1} for the primary. This system is a supercluster Hyades member. According to Eggen diagrams (1969a, 1969b) it is a young disc star. Montes *et al.* (2000) diagrams showed that this stellar system is a member of this supercluster.

If the membership to the supercluster Hyades is confirmed then the age for this system could be about 600 Myr.

According to our study it is likely a common origin pair but more astrometric data are needed to confirm the system motion.

In this work we detected that the primary component is composed of two stars. Following the rules of component designation of the Washington Multiplicity Catalog (Hartkopf and Mason 2004) we named the components of this unreported close pair Aa and Ab. We use the astrometry of 2MASS to obtain an angular separation of 4.59" in direction 40.4º (Figure 17) for epoch 1998.217. The flux ratio in JHK bands for the components range from 0.8 to 1.1 magnitudes. Optical individual photometry was not found in the literature.

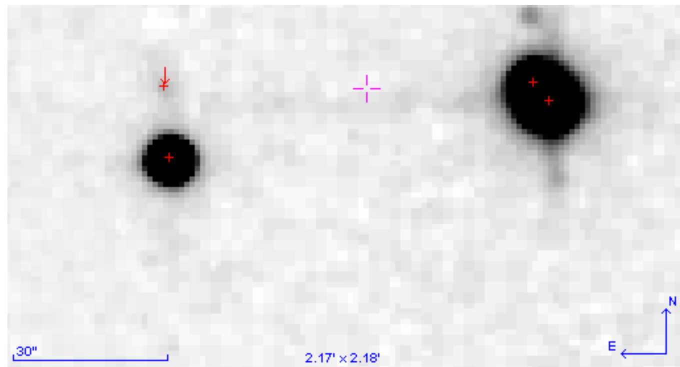


Figure 17: BVD 161 AC stellar system. CCD image from 2MASS. The primary component is a new, unreported double star. The red "plus" are positions from 2MASS catalog. The primary component is clearly elongated. The angular separation is 4.52".

Only the proper motion for Aa is known so more astrometric measures are needed to determine the common proper motion nature.

BVD 73

The difference in distance moduli of +1.84 magnitude surely is caused by an error in our luminosity classes and the primary component could be a subgiant star of spectral type G6-8.

BVD 75

The difference in distance moduli of +2.4 magnitude surely is caused by an error in our luminosity classes and the primary component could be an evolved star of K2V/IV spectral type.

BVD 76

Common proper motion binary composed of stars with 9.6 and 10.5 magnitudes, separated by 42.0 arcsec.

Houk (1982) classified the primary as a F5-6 IV/V star. We obtained a F6V spectral type.

According to our study this double star likely is a common proper motion pair, although a physical nature can not be rejected.

BVD 129

Common high proper motion binary composed of stars with 8.2 and 9.0 magnitudes, separated by 46.5

New Wide Common Proper Motion Binaries

arcsecs.

Houk and Smith-Moore (1988) classified the components as F3V and F5-6V stars. We obtained spectral types of F5V and F7V.

According to our study this double star could be a common proper motion or a physical pair.

BVD 81

Common high proper motion binary composed of stars with 5.9 and 10.1 magnitudes, separated by 79.4 arcsecs. See Figure 18.

Hipparcos observed the primary component and obtained a parallax of 10.4 ± 0.9 mas (97 pc). The calculated absolute magnitude is +1.0.

Cannon and Pickering (1918-1924) classified the primary as a K0 star. SIMBAD (Wenger *et al.* 2003) classified it as a K2III star in complete agreement with our result. The absolute magnitude for a K2III is about 0.2, but it is not in agreement with Hipparcos results.

Barbier-Brossat, Petit and Figon (1994) determined a radial velocity of +34.2 km*s^{-1}. Duflot, Figon and Meyssonnier (1995) obtained a value of +33.9 km*s^{-1}.

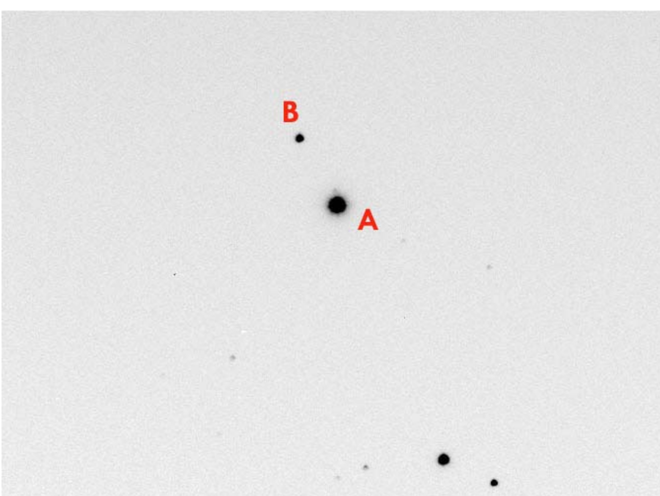


Figure 18: BVD 81 observed in 2009.197 by Benavides using a C11 telescope with CCD Atik in binning 2x2.

Our calculated galactocentric velocity was (U,V,W) = (-84, -21, -17) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) it is an old disc star. In this work, we calculated a fG = 0.32 that corresponds to an old age thin disk star of 3 - 10 Gyr old.

According to our study it is likely a physical pair, but a common origin nature can not be rejected.

BVD 146

Common proper motion binary composed of stars with 8.7 and 10.5 magnitudes, separated by 50.1 arcsecs.

Cannon and Pickering (1918-1924) and Houk and Cowley (1975) classified the primary star as a G5 star.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.38 and a galactocentric velocity (U,V,W) = (-22, -47, -3) km*s^{-1} with an age of about 8.2 +2.3/-1.9 Gyr and a radial velocity of 35.5 ± 1.1 km*s^{-1}. According to Eggen diagrams (1969a, 1969b), it is an old disc star. In this work we calculated a fG = 0.26 that cor-res-ponds to an old age thin disk star of 3 - 10 Gyr old.

According to our study this double star is likely a physical pair but a common origin nature can not be rejected.

BVD 147

Common proper motion binary composed of stars with 9.9 and 11.0 magnitudes, separated by 62.8 arcsecs.

Roeser & Bastian (1988) classified it as an F8 star. Our result was of G1 IV.

According to our study it likely is a common origin pair.

BVD 87

Common high proper motion binary composed of stars with 9.2 and 9.6 magnitudes, separated by 15.2 arcsecs.

Cannon and Pickering (1918-1924) classified the components as G0 stars. Houk (1978) classified them as stars with F7/G2 and F/G spectral types. In this work the components were classified as F7V and G1V stars.

According to our study this double could be a physical or a common origin pair.

BVD 88

Common high proper motion binary composed of stars with 9.9 and 10.9 magnitudes, separated by 48.3 arcsecs.

Cannon and Pickering (1918-1924) classified the primary as a G0 star. Houk and Smith-Moore (1988) classified it as G1V star. In this work the components were classified as G0V and G1V stars. The difference in distance moduli of +0.8 magnitudes is surely caused by an error in our luminosity classes for the primary star and the primary could be a G0V/IV evolved star. But other possibility could be the unresolved binarity for the primary.

According to our study this double star is likely a physical pair but a common origin nature must not be rejected.

HJL 141 = WDS 11153+0204

Common high proper motion binary composed of stars with 8.4 and 10.2 magnitudes, separated by 64.2 arcsecs and discovered by Halbwachs (1986).

Hipparcos observed the primary component and obtained a parallax of 4.56 ± 1.02 mas (~219 pc). In this work a photometric distance of 190 pc was calculated.

Houk & Swift (1999) classified the primary as a K0 -1 III star. The Hipparcos absolute magnitude corresponds to a subgiant/giant star of K1 IV/III. Our spectral type was determined using Hipparcos data. Roeser and Bastian (1988) classified the secondary component as a F8 star. Our result was a F7V spectral type.

According to our study this double star could be a physical or a common origin pair.

BVD 148

Common proper motion binary composed of stars with 8.7 and 10.9 magnitudes, separated by 54.0 arcsecs.

Hipparcos observed the primary component and obtained a parallax of 5.06 ± 1.23 mas (189 +63/-39 pc). In this work we obtained a photometric distance of 123.6 pc (assuming the dwarf nature). The absolute magnitude calculated from Hipparcos data (+2.23) is 1.0 magnitude brighter than that calculated in this work. So, the primary component could be an evolved star or an unresolved pair.

Houk (1982) classified the primary as an F5V star in agreement with our result (F4V). The Hipparcos absolute magnitude could correspond to an F4-5 giant star.

According to our study, this double star is likely a common origin pair but a physical nature must not be rejected.

GRV 840 = WDS 11374+2853

Common proper motion binary composed of stars with 11.4 and 12.4 magnitudes, separated by 27 arcsecs. The binary was discovered by the British amateur John Greaves.

WDS catalog lists 6 measures from 1901 (296 degrees and 27.3 arcseconds) to 2006 (296 degrees and 27.0 arcseconds).

Schwassmann and Van Rhijn (1947) classified the components as G3 and G2 stars. In this work the components were classified as G7V and K1V stars.

According to our study this double likely is a physical pair.

GRV 841 = WDS 11424+3934

Common high proper motion binary composed of stars with 10.0 and 10.6 magnitudes, separated by 64.6 arcsecs. The binary was discovered by the British amateur John Greaves.

WDS catalog list 6 measures from 1895 (203 degrees and 64.5 arcseconds) to 2000 (203 degrees and 64.5 arcseconds).

Upgren (1962) classified the primary as a G6III stars. In this work the components were classified as G7V and K3V stars.

According to our study this double star likely is a physical pair. The giant nature of the primary star must be in error, because then the tangential velocity would be of 490 km*s^{-1}, something very improbable.

According to our study this double star is surely a physical or a common origin pair.

The difference in distance moduli is -0.6 magnitud and the secondary could be an unresolved pair.

BVD 96

Tycho-2 lists spectral types G0V and G6V. We obtain spectral types F7V and G6V. The proper motion for the secondary was discovered by Wroblewski and Torres (1997) who include the note "probably companion of Perth 10627". The secondary was cataloged as WT1905.

According to our study this double star is likely a common origin pair, but a physical nature can not be rejected.

BVD 98

The difference in distance moduli of +4.0 magnitude is surely caused by an error in our luminosity classes and the primary likely is a K1 III/IV.

BVD 99

Common proper motion binary composed of stars with 9.5 and 11.7 magnitudes, separated by 25.7 arcsecs.

Houk (1978) classified the primary as an A2V star. We obtained a spectral type A7V.

More astrometric measures are needed to confirm the relative motion for this system and determine its nature.

BVD 149 AB-C

Common high proper motion binary composed of stars with 8.5 and 11.0 magnitudes, separated by 88.5 arcsecs.

Hipparcos observed the primary component and obtained a parallax of 10.35 ± 3.00 mas (97 +39/-22 pc).

The difference of +2.22 in distance moduli must be corrected by the duplicity of the bright component. We estimated that AB is composed of F9V and G1V stars with absolute magnitude of +4.2 and +4.54 and distance moduli of +4.94 and +4.90. The distance modulo of C is +5.43 so the corrected difference in distance moduli is only of about +0.5.

Houk (1978) classified the primary as a F8V star.

New Wide Common Proper Motion Binaries

The Hipparcos absolute magnitude corresponds to a F6-7V dwarf star.

According to our study this double star could be a physical or a common origin pair.

BVD 101

Common proper motion binary composed of stars with 8.2 and 11.1 magnitudes, separated by 66.5 arcsecs. See Figure 19.

Hipparcos observed the primary component and obtained a parallax which corresponds to a distance of 172 pc. In this work a photometric distance of 135 and 162 pc was obtained.

Cannon and Pickering (1918-1924) classified the primary as an F0 star. LIADA determined a spectral type of A9V. Hill, Barnes *et al.* (1982) calculated a distance of 189 pc and the reddening observed was negligible (E(b-y) = -0.001).

Oja (1985) obtained photometric results of V = 8.16, B-V = +0.27 and U-B = +0.06. Barbier-Brossat, Petit & Figon (1994) calculated a radial velocity of -13.7 ± 3.5 km*s^{-1}.

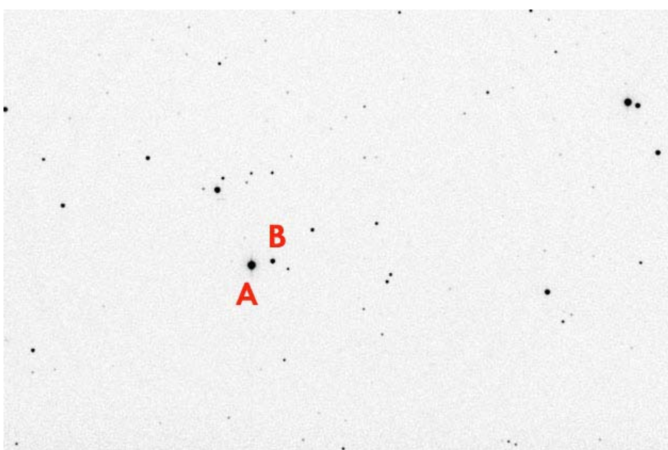


Figure 19: BVD 101. CCD image taken by Julio Castellanos using a S/C LX200 telescope of 0.2 meters. The CCD used was a SBIG ST-7 ME.

Our galactocentric velocity was (U,V,W) = (-15, -21, -11) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) it is a young disc system. A value of 0.14 for fG was obtained in this work corresponding to a young-medium age thin disk system of 3-4 Gyr old.

According to our study this pair could be a physical or a common origin double star.

BVD 102

The difference in distance moduli of +1.8 magnitude surely is caused by an error in our luminosity classes and the primary could be a K2 IV/V star.

BVD 150

Common proper motion binary composed of stars with 10.1 and 11.6 magnitudes separated by 38.1 arcsecs.

Bastian and Roeser (1993) classified the primary as a G5 star. We obtained a spectral type of G5V.

According to our study this double star likely is a physical pair but a common proper motion nature must not be rejected.

BVD 103

More astrometric measures are needed to determine the relative velocity of this system and determine the nature of this pair.

HJL 193 = WDS 13401+6844

Common proper motion binary composed of stars with 9.2 and 9.3 magnitudes, separated by 34.3 arcsecs and discovered by Halbwachs (1986).

WDS catalog list 9 measures from 1896 (111 degrees and 34.7 arcseconds) to 2006 (110 degrees and 34.4 arcseconds).

Roeser & Bastian (1988) classified the components as stars G0 and G5. We obtained spectral types of G3V and G3V.

According to our study this double star could be a common origin pair or a physical pair.

HJL 195 = WDS 13535+0338.

Common proper motion binary composed of stars with 8.6 and 10.1 magnitudes, separated by 36.1 arcsecs and discovered by Halbwachs (1986).

WDS catalog lists 7 measures from 1907 (225 degrees and 36.0 arcseconds) to 2000 (225 degrees and 36.1 arcseconds).

Hipparcos observed the primary component and obtained a parallax of 8.24±1.17 mas (121 +20/-15 pc) in agreement with our photometric distance.

Houk (1999) classified the primary as an F0V star and Roeser & Bastian (1988) classified the secondary as a G0 star. LIADA determined spectral types of F2V and F7V. According to Hipparcos data, the absolute magnitude is consistent with a F4V star.

According to our study, this pair could be a physical or a common origin double star.

BVD 104

Common proper motion binary composed of stars with 10.0 and 12.1 magnitudes, separated by 48.3 arcsecs.

Roeser and Bastian (1988) classified the primary as a F8 star. We obtained a spectral type of G2V.

The difference in distance moduli of +1.3 magnitude surely is caused by an error in our luminosity classes and likely the primary is a G2 IV/V star.

New Wide Common Proper Motion Binaries

According to our study this double star is likely a common origin pair, but a physical nature must not be rejected.

BVD 105

Common proper motion binary composed of stars with 10.0 and 10.2 magnitudes, separated by 45.8 arcsecs.

The common proper motion shows that at least this pair is a common origin double star. The difference in distance moduli of +1.8 magnitude is surely caused by an error in our luminosity classes.

Roeser and Bastian (1988) classified them as K0 and F8 stars. LIADA determined spectral types of K2 and G4 if both components are on the dwarf main sequence.

Different environments, which could show similar distance moduli for the components, were studied. Both components would be at similar distances if the primary were a V/IV star. Another possibility could be that both components are subgiants.

BVD 108

Common low proper motion binary composed of stars with 7.7 and 10.1 magnitudes, separated by 46.2 arcsecs.

Hipparcos observed the primary component and obtained a parallax which corresponds to a distance of 750 ± 500 pc and an absolute magnitude of –1.7 ± 1.5. We determined a spectral type of M1III and an absolute magnitude of –0.5.

Houk & Swift (1999) classified the primary as a M0III star.

According to our study this pair could be optical.

BVD 109

Common proper motion binary composed of stars with 8.3 and 9.0 magnitudes, separated by 59.1 arcsecs.

Houk and Smith-Moore (1988) classified the components as F5V and G1V stars. We determined spectral types of F5V and F8V.

According to our study this double star is likely a common origin pair, but a physical nature must not be rejected.

BVD 151

Common high proper motion binary composed of stars with 9.6 and 9.8 magnitudes, separated by 23.3 arcsecs.

Houk and Cowley (1975) classified the primary as a G0 star. We determined spectral types of G3V and G3V.

According to our study this double star surely is a common origin pair, but a physical nature must not be rejected.

GRV 903 = WDS 15211+2534

Common high proper motion binary composed of stars with 9.0 and 11.0 magnitudes, separated by 66.6 arcsecs. The binary was discovered by the British amateur John Greaves.

WDS catalog lists 6 measures from 1900 (244 degrees and 69.3 arcseconds) to 2000 (243 degrees and 69.0 arcseconds).

Hipparcos observed both components and obtained parallaxes which correspond to distances of 40 ± 2 and 45 ± 5 pc. The calculated absolute magnitudes using Hipparcos trigonometric parallaxes and apparent magnitudes correspond to spectral types of K0.5V and K6V.

Jenkins (1963) classified the primary as a K0V star while the secondary was classified as a K7 star (Stephenson 1986). LIADA determined spectral types of K2V and K8V.

Hypothetical parallax (Russell 1928) corresponds to a distance of 39 pc in good agreement with Hipparcos data.

Upgren and Caruso (1988) determined radial velocities of –32.5 and –36.1 km*s^{-1} and a galactocentric velocity (U,V,W) = (-5, -41, -22) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) they are old disc stars.

This pair is surely a physical double star.

BVD 118

Common proper motion binary composed of stars with 10.4 and 10.6 magnitudes, separated by 21.9 arcsecs.

Roeser & Bastian (1988) classified the primary as a K0 star. We determined spectral types of K2V and K2V.

According to our study this double surely is a physical pair but a common origin nature must not be rejected.

BVD 119 AB-C

Common proper motion binary composed of stars with 9.2 and 11.6 magnitudes, separated by 27.0 arcsecs.

AB components are listed in WDS catalog as WDS 16556-5434 = RST3056. It has 2 measures performed in 1934 (66 degrees and 2.1 arcseconds) to 1966 (69 degrees and 2.1 arcseconds).

Houk & Cowley (1975) classified the primary as a F3V star. We determined spectral types of F7 and G9V.

According to our study this double star surely is a common origin pair, but a physical nature can not be rejected. More astrometric data are needed to confirm

New Wide Common Proper Motion Binaries

the relative motion of this system.

GRV 959 = WDS 17302+2901

Common high proper motion binary composed of stars with 10.2 and 10.8 magnitudes, separated by 24.3 arcsecs. The binary was discovered by the British amateur John Greaves.

WDS catalog list 7 measures from 1901 (356 degrees and 24.0 arcseconds) to 2000 (356 degrees and 24.3 arcseconds).

The differential distance moduli is significant and could be caused by the evolved nature of same component.

According to our study this pair is surely a common proper motion pair.

BVD 121

Common high proper motion binary composed of stars with 9.1 and 10.0 magnitudes, separated by 39.6 arcsecs.

Hipparcos observed the primary component and obtained a parallax of 8.68 ± 1.35 mas., which corresponds to a distance of 115 +21/-15 pc and an absolute magnitude which corresponds to a F7V star.

Houk & Cowley (1975) classified the primary as a F6-7V star. We determined spectral types of F6V and F7V.

According to our study this pair could be an optical pair.

BVD 122

The difference in distance moduli is +1.1 magnitude. Primary could be an evolved star or an unresolved pair.

According to our study this double could be a common origin or a physical pair.

BVD 124

The difference in distance moduli is +0.9 magnitude. Primary could be an evolved star or an unresolved pair.

According to our study this double star surely is a common origin pair but a physical nature must not be rejected.

BVD 125

Common high proper motion binary composed of stars with 8.2 and 9.9 magnitudes, separated by 48.3 arcsecs.

Hipparcos observed the primary component and obtained a parallax of 9.35 ± 0.89 mas (107 +11/-9 pc).

Cannon and Pickering (1918-1924) classified the primary as a F8 star. We determined spectral types of F6V and G7V. From Hipparcos data, the absolute magnitude for the primary (+3.1) suggest that maybe it is an evolved star or an unresolved double star.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.08, a radial velocity of 22.2 ± 0.3 km*s^{-1} and a galactocentric velocity (U,V,W) = (+62, -22, +9) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) it is an old disc star. In this work we calculated a fG = 0.24 that corresponds to an old age thin disk star of 3-10 Gyr old.

According to our study it is a common origin pair.

BVD 152

Common proper motion binary composed of stars with 9.2 and 11.3 magnitudes, separated by 50.5 arcsecs. See Figure 20.

Hipparcos observed the primary component and obtained a parallax of 10.00 ± 1.48 mas (100 +17/-13 pc). We obtained a photometric distance of 130 pc.

Houk (1982) classified the primary as a F6/7V star. We determined spectral types of F6V and G9V. From Hipparcos data the absolute magnitude for the primary (+4.15) suggest that maybe it is a cooler star.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] = -0.26, a radial velocity of -8.4 ± 0.2 km*s^{-1}., a distance of 142 pc and a galactocentric velocity (U,V,W) = (-13, -44, +9) km*s^{-1}. According to Eggen diagrams (1969a, 1969b) it is an old disc star. In this work we calculated a fG = 0.24 corresponding to an old age thin disk star of 3-10 Gyr old. Nordstrom et al. (2004) determined an age of 3.5 +2.2/-0.8 Gyr.

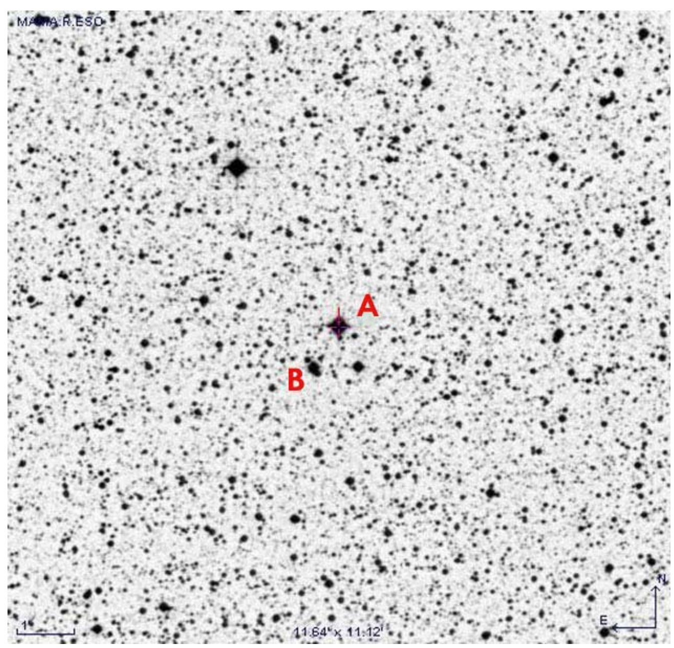


Figure 20: DSS image of binary BVD 152.

According to our study this double star could be a common origin pair but a physical nature can not be rejected.

BVD 127

Common high proper motion binary composed of stars with 9.6 and 11.4 magnitudes, separated by 20.0 arcsecs.

Roeser and Bastian (1988) classified the primary as an F8 star. We determined a spectral type of F6 and G8V.

According to our study this double star is surely a common origin pair but a physical nature can not be rejected.

SRT 1 = WDS 18501-1317

A is HD 174226 with G5V spectral type (Houk and Swift 1999) in excellent agreement with our result. According to our study it is a physical pair.

WDS catalog lists 10 measures from 1906 (251 degrees and 29.0 arcseconds) to 1998 (251 degrees and 28.9 arcseconds).

BVD 130

Common proper motion binary composed of stars with 10.3 and 10.9 magnitudes, separated by 30.1 arcsecs.

Roeser and Bastian (1988) classified the primary as a G0 star. We determined spectral types of G0V and G6V.

According to our study this double star is surely a common origin pair but a physical nature can not be rejected.

ARY 48 = WDS20378+3224

Common high proper motion binary composed of stars with 8.2 and 8.7 magnitudes, separated by 53.1 arcsecs. and discovered by Argyle.

WDS catalog list 11 measures from 1893 (42 degrees and 53.3 arcseconds) to 2004 (41 degrees and 53.1 arcseconds).

Roeser & Bastian (1988) classified the primary as a G0/2V star. We determined a spectral types of F9V and G6V.

According to our study this double star is surely a physical pair.

BVD 132 AB-C

Common high proper motion binary composed of stars with 9.1 and 10.0 magnitudes, separated by 70.7 arcsecs.

AB components are listed in WDS catalog as WDS 03408+7946 = TDT2624. It has been measured only in its discovery in 1991 (51 degrees and 0.5 arcseconds) and it is composed by stars of 11.52 and 11.61 magnitudes.

Houk and Cowley (1975) classified the components as F8 and G0 stars. We determined spectral types of F6V and F9V.

According to our study this double star could be a common origin pair but a physical nature can not be rejected. More astrometric measures are needed to confirm the relative motion of the secondary.

BVD 133

Common proper motion binary composed of stars with 10.4 and 10.5 magnitudes, separated by 21.2 arcsecs.

The differential distance moduli of –0.72 magnitudes could be caused by the duplicity of B.

According to our study this double could be a common origin pair but a physical nature can not be rejected. More astrometric measures is needed to confirm the relative motion of the secondary.

BVD 153

Common proper motion binary composed of stars with 10.3 and 11.2 magnitudes, separated by 44.0 arcsecs.

Cannon and Pickering (1918-1924) classified the primary as an F5 star and Houk (1978) as an F3/5 (IV). We determined spectral types of F5V and F6V.

The difference in distance modulus of the components is 0.7 magnitude. The primary star could be a V-IV star or maybe an unresolved double star.

According to our study this double star could be a physical or a common origin pair.

BVD 134

Common proper motion binary composed of stars with 10.4 and 11.2 magnitudes, separated by 22.8 arcsecs.

We determined spectral types of K3 IV/V and F6V. The spectral type for the primary was determined in order to obtain the same photometric distance that the secondary component.

According to our study this double could be a common origin pair but a physical nature must not be rejected.

BVD 135

Common proper motion binary composed of stars with 7.9 and 9.4 magnitudes, separated by 24.8 arcsecs. See Figure 21.

Hipparcos observed the primary component and obtained a parallax of 13.31 ± 0.67 mas (75 ± 4 pc). In this work we determined a photometric distance of 92 pc.

Roeser and Bastian (1988) classified the components as F0V and G5 stars. In this work we determined spectral types of F3V and F9V. The Hipparcos absolute magnitude for the primary corresponds to a F5/6V star.

Nordstrom et al. (2004) determined a metallicities [Fe/H] of -0.24 and –0.32 and ages of 2.3 +1.5/-0.9 and 9 Gyr for both components. For the primary he determined a galactocentric velocity (U,V,W) = (10, 1, -15) km*s^{-1} and a radial velocity of –5.2 ± 9.5 km*s^{-1}.

According to Eggen diagrams (1969a, 1969b), it is surely a young disc star. In this work we calculated a fG = 0.10 that corresponds to a young-medium age thin disk star of 3-4 Gyr old.

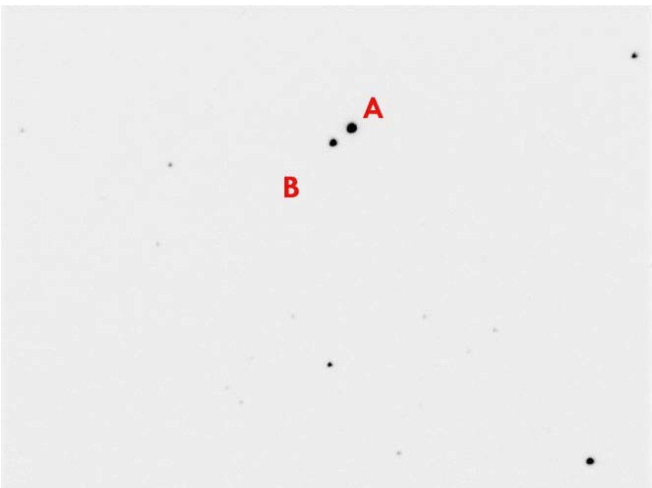


Figure 21: BVD 135 observed in 2009.255 by Benavides using a C11 telescope with CCD Atik in binning 2x2.

According to our study this double star could be a common origin pair but a physical nature must not be rejected.

BVD 137

Common proper motion binary composed of stars with 7.6 and 9.8 magnitudes, separated by 40.2 arcsecs. This system has a very high proper motion: μ (α) = +201 arcsec*yr^{-1} and μ(δ) = -64 arcsec*yr^{-1} for the primary component.

Hipparcos observed the primary component and obtained a parallax of 21.19 ± 0.95 mas (45.6 +3.8/-0.4 pc). In this work we determined a photometric distance of 36 pc.

Jaschek, Conde and de Sierra (1964) classified the primary as a G2V star and Houk (1982) as a G2/3V star. In this work we determined spectral types of G3V and K1V. The Hipparcos absolute magnitude for the primary is 4.3 (about 0.5 magnitudes brighter than a G2/3V star). Our differential distance moduli of +0.76 magnitudes could be caused by the double star nature or by a slightly evolved nature of the primary.

Barbier-Brossat & Figon (2000) determined a radial velocity of –26.6 ± 1.2 km*s^{-1}.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] of +0.02 and a age of 9.2 +3.0/-3.4 Gyr for the primary. The galactocentric velocity (U,V,W) has a value of (-49, -24, -11) km*s^{-1} and a radial velocity of –29.6 ± 0.1 km*s^{-1}.

According to Eggen diagrams (1969a, 1969b) it is surely an old/young disc star. In this work we calculated a fG = 0.22 that corresponds to an old age thin disk star of 3-10 Gyr old.

According to our study this double star could be a common origin pair but a physical nature can not be rejected.

BVD 139 AB-C

Common high proper motion binary composed of stars with 8.4 and 10.9 magnitudes, separated by 128.0 arcsecs. This system has a very high proper motion: μ (α) = +135 arcsec*yr^{-1} and μ(δ) = +36 arcsec*yr^{-1} for the primary component. See Figure 22.

AB components are listed in WDS catalog as WDS 21397-1237 = RST4090. It has 3 measures from 1938 (326 degrees and 1.2 arcseconds) to 1950 (325 degrees and 1.3 arcseconds).

Hipparcos observed the primary component and obtained a parallax of 15.21 ± 1.28 mas (66 +6/-5 pc). In this work we determined a photometric distance of 50 pc.

Houk and Smith-Moore (1988) classified the primary as a G2V star. In this work we determined spectral types of G4V and G8V. The Hipparcos absolute magnitude for the primary is 4.39 (corresponding to a G0V star). Our differential distance moduli is of +1.8 magni-tudes.

Nordstrom *et al.* (2004) determined a metallicity [Fe/H] of -0.25 and an age of 11.7 +2.9/-3.1 Gyr for the primary. The galactocentric velocity (U,V,W) has a value of (-69, -24, +17) km/s^{-1} and a radial velocity of –60.9 ± 0.3 km*s^{-1}.

According to Eggen diagrams (1969a, 1969b), it is surely an old disc star. In this work we calculated a fG = 0.28 that corresponds to an old age thin disk stars of 3-10 Gyr old.

According to our study this double star could be a common origin pair but a physical nature must not be rejected.

BVD 155

Common high proper motion binary composed of stars with 9.6 and 10.2 magnitudes, separated by 47.5 arcsecs. This system has a very high proper motion: μ

New Wide Common Proper Motion Binaries

(α) = +70 arcsec*yr^{-1} and μ(δ) = -140 arcsec*yr^{-1} for the primary component.

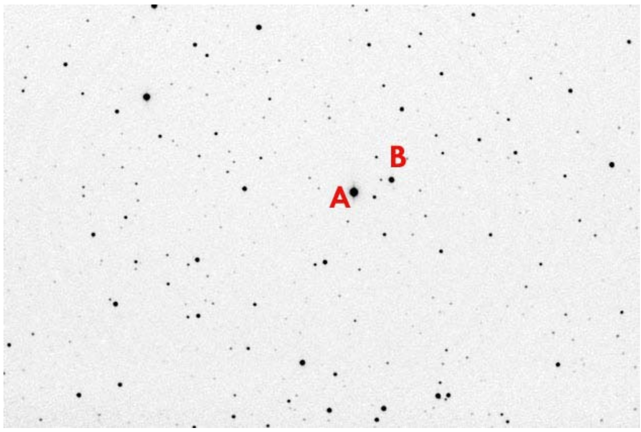


Figure 22: Binary BVD 139. CCD image taken by J. Castellanos using a S/C LX200 telescope of 0.2 meters. The CCD used was a SBIG ST-7 ME.

Houk and Smith-Moore (1988) classified the components as G3V and G6V stars. In this work we determined spectral types of G0V and G4V.

According to our study this double star could be a common origin or a physical nature pair.

BVD 141

Common high proper motion binary composed of stars with 9.3 and 10.6 magnitudes separated by 11.6 arcsecs. This system has a very high proper motion: μ(α)= +117 arcsec*yr^{-1} and μ(δ)=- +44 arcsec*yr^{-1} for the primary component.

Houk (1978) classified the primary as a G0-2 IV star. In this work we determined spectral types of G0V and G9V.

According to our study, this double star could be a common origin pair but a physical nature must not be rejected. More astrometric measures are needed to confirm the relative motion of this system.

BVD 156

Common proper motion binary composed of stars with 9.9 and 11.4 magnitudes, separated by 18.3 arcsecs.

Cannon and Pickering (1918-1924) classified the primary as an F8 star while Houk (1978) classified it as a G0/1V star. In this work we determined spectral types of F8V and G6V.

According to our study, this double star could be a common origin or a physical nature pair.

BVD 142 AB-C

Common high proper motion binary composed of stars with 7.7 and 10.2 magnitudes separated by 79.6 arcsecs. This is a system with a very high proper motion: μ(α)= -98 arcsec*yr^{-1} and μ(δ)= -84 arcsec*yr^{-1} for the primary component.

AB components are listed in WDS catalog as WDS 23105+4118 = TDT3916. It has been measured in its discovery in 1991 (89 degrees and 0.6 arcseconds) with magnitudes 10.69 and 11.41.

Hipparcos observed the primary component and obtained a parallax of 14.26 ± 0.93 mas (70 +5/-4 pc). In this work we determined a photometric distance of 73 pc in excellent agreement with Hipparcos data.

Cannon and Pickering (1918-1924) classified the primary as a F5 star in excellent agreement with our result.

Nordstrom et al. (2004) determined a metallicity [Fe/H] of -0.33 and an age of 3.4 +0.7/-0.6 Gyr for the primary. The galactocentric velocity (U,V,W) has a value of (41, 4, -11) km*s^{-1} and a radial velocity of –1.9 ± 0.3 km*s^{-1}.

According to Eggen diagrams (1969a, 1969b) it is surely an old disc star. In this work we calculated a fG = 0.15 that corresponds to a young-medium age thin disk star of 3-4 Gyr old in good agreement with results of Nordstron.

According to our study this double star is surely a physical pair.

BVD 158

Common proper motion binary composed of stars with 9.1 and 10.1 magnitudes, separated by 37.9 arcsecs.

Hipparcos observed the primary component and obtained a parallax of 10.25 ± 1.42 mas (98 +15/-12 pc). In this work we determined a photometric distance of 68 and 75 pc.

Cannon and Pickering (1918-1924) classified the primary as a G5 star while Houk (1978) determined a G2V spectral type. In this work we obtained spectral types of G4V and G9V.

Nordstrom et al. (2004) determined a metallicity [Fe/H] of +0.02 and an age of 10.7 +3.4/-3.1 Gyr for the primary. The galactocentric velocity (U,V,W) has a value of (10, -31, 8) km*s^{-1} and a radial velocity of +4.3 ± 0.2 km*s^{-1}.

According to Eggen diagrams (1969a, 1969b), it is an old disc star. In this work we calculated a fG = 0.17 corresponding to a young-medium age thin disk star of 3-4 Gyr old in good agreement with result of Nordstron.

According to our study, this double star surely is a

New Wide Common Proper Motion Binaries

physical pair.

BVD 143

Common proper motion binary composed of stars with 9.9 and 10.6 magnitudes, separated by 47.9 arcsecs.

The differential distance moduli of –0.62 magnitudes could be caused by a duplicity of B.

According to our study this double star could be a common origin pair but a physical nature can not be rejected. More astrometric measures are needed to confirm the relative motion of the secondary.

12. Conclusions

In this work we reported on the study of 173 double stars (most of then binaries). About 149 are new wide common proper motion stellar systems first published in this work and discovered by Rafael Benavides.

Photometric, kinematical and spectroscopic data were obtained from astronomical literature. These data were analysed to determine other astrophysical properties (absolute magnitudes, spectral types and luminosity classes, galactocentric velocities, etc). Several tests and criteria were used to determine the nature of each double star classifying them as physical, common origin or optical pairs. Orbital periods and the semimajor axes were estimated.

1,538 astrometric measurements were made using CCDs and astrometric catalogs. The internal errors for the CCDs measures have a median of 0.06 degrees (0.040 arcseconds) in θ and 0.040 arcsecond in ρ.

In the study of the nature of the pairs we calculated that 57 % are common origin pairs and 36 % are physical pairs. Only 3 % are optical pairs.

We studied some distributions of data. The mean magnitudes for the components are 10.09 and 10.90 magnitudes. The median differential magnitude are 0.73. Many stellar components have proper motion that ranges from 25 to 75 mas/yr although the most rapid star has a proper motion of 306.2 mas/yr. Many binaries have relative orbital motion witch range from 1.25 to 3.75 mas/yr.

Some of the binaries are triple systems and there is one suspected trapezium system.

Acknowledgements

This report makes use of data from the Two Micron All Sky Survey (MASS), which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

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,

the International GEMINI project and the European Space Agency Astrophysics Division.

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 publication has made use of the Washington

(Continued on page 86)

Table 2: Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
BVD 30 AB-C	00 02 51	-74 35 52	0.74	10.58	11.32	G9V	G9V	0.64	4,897	268,593	PHY/CO
BVD 46	00 08 01	-31 38 42	0.72	10.84	11.56	F6V	F6V	0.90	9,036	519,818	CO/PHY
BVD 11	00 09 35	+53 24 56	1.07	11.55	12.62	G0V	G5V	-0.59	4,998	246,226	CO?
BVD 63	00 11 25	-40 48 39	0.12	10.54	10.66	G5V	G7V	-0.20	10,569	805,862	CO/PHY
HJL 1	00 11 55	+66 21 10	0.91	10.05	10.96	F1V	F4V	-0.03	7,401	407,184	CO/PHY

Table 2 continues on next page.

New Wide Common Proper Motion Binaries

Table 2 (continued): Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
LDS 5	00 13 39	-28 18 03	0.23	10.97	11.20	K2V	K5V	-0.61	3,946	218,867	CO/PHY
BVD 12	00 30 38	-18 37 15	3.50	7.55	11.05	F6IV-III	K0V	1.20	18,922	1,374,629	CO
BVD 13	00 36 49	-38 48 26	0.18	10.78	10.96	F5V	G0V	-0.82	7,313	391,298	PHY=CO
BVD 66	00 50 16	-02 27 00	0.88	10.06	10.94	F6V	G6V	-0.69	8,104	483,305	PHY/CO
BVD 14	00 52 46	+27 13 32	0.49	10.50	10.99	F6V	K3V	-2.65			¿?
BVD 15	01 20 21	+09 36 44	1.83	9.62	11.45	F6V	K1V	0.47	9,035	592,462	CO/PHY
BVD 16	01 23 40	-41 48 14	1.31	10.06	11.37	F7V	K0V	-0.15	4,361	199,470	CO/PHY
BVD 17	01 30 06	-40 24 08	0.06	11.95	12.01	G6V	G6V	-0.08	5,990	343,749	CO/PHY
BVD 18	01 32 19	+45 59 27	0.36	10.25	10.61	G8V	G7V	0.52	10,540	825,279	PHY=CO
BVD 19	01 34 04	+82 25 38	0.35	11.23	11.58	G6V	G1V	1.03	4,338	202,613	CO=PHY
HJL 20	01 35 02	+60 46 45	0.52	8.56	9.08	F6V	F6V	0.52	6,268	300,320	PHY=CO
BVD 21	01 56 47	+23 03 04	3.01	7.86	10.87	G6V	K7V	0.29	2,632	107,726	PHY?
BVD 22	02 05 16	+23 52 16	0.37	11.56	11.93	G6V	G7V	0.16	11,413	912,803	CO
BVD 23	02 05 38	+00 31 10	0.95	10.77	11.72	F8V	G7V	-0.31	8,382	528,264	CO?
BVD 24	02 19 52	-31 54 05	0.09	11.13	11.22	G4V	G3V	0.23	26,002	2,977,986	CO
BVD 25	02 33 03	-77 37 44	0.20	9.13	9.33	F5V	F5V	0.20	7,568	388,364	CO/PHY
BVD 65	02 43 23	-42 32 02	1.34	10.52	11.86	G6V	K3V	0.06	4,590	248,605	PHY=CO
BVD 26	02 44 34	+79 11 56	0.88	8.71	9.59	A6V	F4V	-0.24	12,159	711,481	¿?
BVD 27	02 50 27	+29 58 21	0.49	11.48	11.97	G4V	K1V	-0.78	5,734	331,909	CO?
BVD 28	02 53 28	-03 29 39	0.48	9.83	10.31	K4V	K5V	0.20	5,140	334,349	PHY=CO
BVD 29	02 59 15	-05 15 42	0.46	10.64	11.10	K1IV	F6V	3.04	20,967	1,763,138	CO
BVD 71	03 07 31	-74 30 27	1.49	9.02	10.51	G5V	K4V		4,259	222,364	PHY/CO
POP 223	03 11 24	+44 29 57	1.20	9.79	10.99	F0V	F5V	0.40	5,716	240,776	CO/PHY
BVD 31	03 17 06	+67 05 27	1.59	7.99	9.58	A8V	K2V	-2.51			OPT
BVD 32	03 17 43	+58 46 58	3.19	8.14	11.33	F6V	K6V	-0.23	7,741	491,733	CO/PHY
BVD 33	03 18 24	-27 34 12	0.88	10.27	11.15	F5V	F6V	0.68	8,675	482,634	CO/PHY
BVD 34	03 20 07	+36 10 51	1.55	9.53	11.08	G8III	F2III:	0.27	10,497	403,609	¿?
BVD 35	03 22 03	-33 49 07	0.15	11.42	11.57	G4V	G2V	0.36	5,091	255,810	CO/PHY
BVD 36	03 35 28	+42 18 03	0.33	9.93	10.26	G3V	G2V	0.47	5,778	306,765	PHY/CO
BVD 37	03 44 43	+49 39 38	0.16	11.30	11.46	G0V	G4V	-0.55	3,100	119,325	CO/PHY
FEL 1	03 44 47	-70 01 35	0.16	7.41	7.57	F9V	F8V	0.36	4,561	198,486	PHY?
BVD 39	03 48 56	-28 06 34	0.60	11.33	11.93	G8V	K1V	-0.10	9,601	748,415	CO/PHY
HJL 54	03 59 43	+82 15 28	0.50	9.72	10.22	F6V	F8V	0.10	5,194	232,137	PHY=CO
BVD 40AB-C	04 00 04	-29 02 17	0.02	10.38	10.40	K6V	K5V	0.36	550	12,056	PHY
BVD 41	04 07 02	-11 46 10	1.55	10.51	12.06	G1V	G7V	0.46	4,067	185,479	CO/PHY
BVD 42	04 07 51	+02 16 00	1.03	10.64	11.67	G4V	K2V	-0.23	7,971	551,477	PHY=CO
BVD 43	04 08 21	-48 12 39	2.41	9.19	11.60	K2 IV-III	G0V	-0.54	10,821	632,510	CO?
BVD 44	04 10 04	-67 19 34	0.65	8.83	9.48	F9V	G2V	0.17	2,928	106,445	PHY?

Table 2 continues on next page.

New Wide Common Proper Motion Binaries

Table 2 (continued): Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
SRT 2	04 11 36	-20 21 24	1.84	5.81	7.65	A4III:	A9V	1.11	7,960	325,985	CO/PHY
BVD 45	04 18 01	-00 30 36	0.28	11.23	11.51	K2V:	F9V:	2.94	9,553	684,039	CO?
HJL 2	04 25 40	+63 40 29	1.56	8.31	9.87	G7V	K2V	0.52	11,610	999,691	CO?
BVD 144	04 26 27	+78 47 26	0.94	10.92	11.86	F9V	G8V	-0.41	3,342	136,059	CO/PHY
BVD 72	04 39 48	-10 09 34	1.40	9.92	11.32	K0V	K3V	0.46	2,231	87,771	PHY/CO
BVD 47	04 45 25	+29 55 28	0.33	11.34	11.67	G7V	K2V	-0.75	13,363	1,236,602	CO?
BVD 38	04 46 36	-29 31 16	0.61	11.24	11.85	K4V	K8V	-0.26	1,381	45,297	PHY=CO
BVD 48AB	04 51 54	-34 14 19	1.91	6.70	8.61	F6III:	F7V	1.91	7,061	252,984	PHY?
BVD 48AC	04 51 54	-34 14 19	2.16	6.70	8.86	F6III:	G4V	1.00	11,343	531,101	CO?
BVD 49	04 56 26	-38 39 05	1.36	9.69	11.05	F8V	G8V	-0.22	7,969	493,375	CO/PHY
BVD 50	05 09 13	+11 29 43	0.15	8.31	8.46	F3V	F3V	0.15	4,394	164,425	PHY=CO
BVD 51	05 15 24	-03 21 58	1.79	7.70	9.49	F7V	G1V	1.05	4,537	198,054	CO/PHY
BVD 52	05 18 09	-16 11 14	1.35	7.62	8.97	G/K IV	G3V	-0.05	7,856	431,161	PHY=CO
BVD 53	05 20 45	-23 08 33	0.73	10.55	11.28	F6V	F9V	0.53	6,093	298,534	PHY/CO
BVD 89	05 27 04	-65 33 26	1.13	11.00	12.13	G2V	K1V	-0.63	4,580	232,402	PHY=CO
BVD 20AC	05 28 28	-39 22 16	1.56	9.22	10.78	K2V	K7V	0.04	3,296	162,705	PHY?
BVD 54	05 28 35	-50 53 48	0.43	12.21	12.64	F8V	G1V	-0.14	14,838	1,187,901	CO
BVD 55	05 45 00	-30 30 24	1.31	9.40	10.71	F5V	F5V	1.31			OPT?
BVD 56	05 45 56	-15 47 38	2.58	9.05	11.63	F9V	K4V	-0.09	8,294	563,638	CO?
BVD 57AB-C	05 53 36	-56 40 13	1.91	8.40	10.31	G4V	K2V	0.41	3,406	154,074	PHY=CO
BVD 58	06 00 20	+78 33 46	0.64	11.41	12.05	G4V	K1V	-0.16	3,765	176,631	PHY=CO
BVD 91	06 03 13	-37 57 46	1.47	9.15	10.62	F6V	G8V	-0.51	6,596	360,438	CO/PHY
BVD 93	06 14 35	-33 37 14	1.47	10.48	11.95	G7V	K5V	-0.04	2,608	109,981	PHY=CO
BVD 59	06 24 26	-64 29 57	0.01	11.36	11.37	G6V	F6V	1.49	6,872	377,825	MPC
BVD 60	06 35 31	+32 41 50	1.91	10.32	12.23	K3V	G1V	5.0			OPT
BGH 22	06 38 34	-09 45 41	0.35	9.44	9.79	K0V	K2V	-0.21	2,455	100,105	PHY?
BVD 112	06 39 36	-43 21 48	1.10	9.00	10.10	F4V	F9V	0.14	3,773	141,732	CO/PHY
BVD 61	06 52 27	+59 39 08	1.67	9.43	11.10	G0V	K2V	-0.39	5,346	290,782	PHY=CO
BVD 120	06 58 28	-20 05 52	0.66	9.16	9.82	F6V	F6V	0.66	13,761	976,986	CO/PHY
BVD 62	06 59 40	+55 08 25	0.15	11.23	11.38	G4V	G7V	-0.13	6,406	376,964	CO?
ARN 94	07 06 04	+52 59 16	0.41	10.51	10.92	F6V	G1V	-0.53	4,523	194,509	PHY/CO
BVD 129	07 07 17	-11 26 13	0.35	10.24	10.59	G7V	G9V	0.03	8,237	575,110	PHY=CO
BVD 64	07 09 46	-13 59 37	0.93	10.58	11.51	K0V	K7V	-0.81	13,030	1,236,229	CO?
XMI 63	07 31 41	-13 00 09	0.21	10.30	10.51	F9V	G0V	0.01	3,988	166,445	PHY/CO
GRV 737	07 32 49	+17 57 55	1.09	9.57	10.66	G3 IV	F9 V	-0.10	6,030	284,986	CO?
BVD 67	07 43 41	-81 42 09	0.32	10.09	10.41	G5V	G5V	0.32	4,584	226,027	PHY/CO
BVD 68	07 48 07	+50 13 02	0.05	11.20	11.25	G9V	G9V	0.05	4,894	268,286	PHY/CO
BVD 69	07 57 09	-13 23 40	0.72	8.87	9.59	F4V	F5V	0.56	3,927	143,551	PHY=CO

Table 2 continues on next page.

New Wide Common Proper Motion Binaries

Table 2 (continued): Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
BVD 70	08 08 20	-38 55 42	1.01	10.34	11.35	F5V	G0V	0.08	9,088	542,102	CO/PHY
LEP 30	08 15 33	+11 25 51	2.04	7.71	9.75	G6V	K3V	0.56	1,388	41,364	PHY?
BVD 161AC	08 21 21	+34 18 36	3.18	8.52	11.70	G6V	M0V	0.12	3,977	205,379	CO?
BVD 73	08 53 18	+28 11 06	1.08	10.63	11.71	G7V	G0V	1.84	6,841	400,849	CO/PHY
BVD 74	09 12 33	-56 31 50	0.83	10.83	11.66	F7V	F8V	0.61			¿?
BVD 75	09 15 50	-31 22 38	0.43	11.81	12.24	K3V	G0V	2.40	8,604	599,424	CO?
BVD 76	09 21 23	-36 45 38	0.87	9.63	10.5	F6V	F9V	0.27	9,012	536,981	CO/PHY
BVD 145	09 21 32	-17 45 27	0.81	8.16	8.97	F5V	F7V	0.41	5,852	270,566	PHY=CO
BVD 77	09 31 25	-00 12 11	1.03	10.52	11.55	F7V	G0V	0.33	12,488	897,627	CO/PHY
BVD 78	09 35 16	+34 57 43	0.66	10.88	11.54	G1V	G6V	-0.54	9,128	618,404	CO?
BVD 79	10 06 05	-35 00 47	1.65	10.45	12.10	K0 IV	G2V	0.00	11,365	745,359	CO/PHY
BVD 80	10 07 07	+56 13 00	0.75	11.47	12.22	F6V	G1V	-0.14	11,516	790,284	CO
BVD 81	10 16 42	+25 22 14	4.17	5.84	10.01	K2III	G6V	-0.87	11,402	659,486	PHY/CO
BVD 82	10 34 01	-13 54 14	0.70	10.69	11.39	G6V	K4V	-0.53	2,502	101,151	CO/PHY
BVD 83	10 34 10	-51 03 11	0.95	11.01	11.96	F3V	F9V	-0.12	7,419	385,968	CO?
BVD 84	10 39 51	-66 02 44	1.65	10.22	11.87	K1III	F4V	-1.22	19,011	1,327,056	CO/OPT
BVD 146	10 42 54	-71 44 52	1.78	8.73	10.51	G1V	G9V	0.58	5,182	271,053	PHY/CO
BVD 147	10 49 07	-00 57 40	1.01	9.94	10.95	G1 IV:	F7V	---	20,560	1,794,148	CO/PHY
BVD 85	10 52 14	-45 10 55	0.28	10.33	10.61	G0V	G4V	-0.28	8,034	497,900	CO/PHY
BVD 86	10 52 50	+78 38 43	1.19	11.13	12.32	G6V	K1V	0.12	4,227	214,303	CO
BVD 87	10 53 20	-43 16 01	0.51	9.20	9.71	F7V	G1V	-0.23	2,151	64,685	PHY=CO
BVD 88	11 06 34	-25 13 51	0.75	9.98	10.73	G0V	G1V	0.61	9,453	620,081	PHY/CO
GRV 829	11 09 15	+00 44 22	0.14	12.04	12.18	G9V	G8V	0.30	7,114	466,043	CO/PHY
HJL 141	11 15 18	+02 03 48	1.89	8.33	10.22	K1 IV-III	F7V	-0.28	16,510	1,167,844	CO=PHY
BVD 148	11 26 26	-27 35 06	2.21	8.71	10.92	F4V	G8V	-0.13	8,216	486,331	CO/PHY
BVD 90	11 30 44	-21 26 09	0.75	9.87	10.62	F6V	F2V	1.43			OPT
GRV 840	11 37 25	+28 53 14	0.98	11.43	12.41	G7V	K1V	0.10	5,328	306,295	PHY/CO
BVD 92	11 38 43	+32 37 33	0.12	9.89	10.01	F6V	F6V	0.12	26,566	2,620,602	CO/PHY
GRV 841	11 42 26	+39 34 52	0.63	10.00	10.63	G7V	K3V	-0.69	5,917	367,812	PHY?
BVD 94	11 44 17	-59 54 43	0.55	10.35	10.9	G1V	G4V	0.13	4,882	237,944	PHY/CO
BVD 95	11 47 23	+54 58 00	1.92	9.82	11.74	F7V	G9V	0.46	6,227	337,953	CO/PHY
BVD 96	11 53 06	-27 18 29	1.01	8.83	9.84	F7V	G6V	-0.45	15,727	1,327,118	CO/PHY
BVD 97	11 54 25	-20 45 46	1.15	10.37	11.52	G5V	G8V	0.99	5,370	294,427	OPT
BVD 98	12 11 42	-49 57 26	1.74	10.15	11.89	K1V	F9V	3.93	5,922	329,848	CO?
BVD 99	12 21 59	-47 01 01	2.14	9.48	11.62	A7V	G0V	0.01			¿?
BVD 149AB-C	13 07 52	-52 42 29	2.51	8.50	11.01	G0V	G8V	2.22	10,489	737,100	PHY=CO
BVD 100	13 10 44	+70 46 06	0.19	11.05	11.24	G9V	G7V	0.51	14,360	1,323,933	CO?
BVD 101	13 18 45	+32 10 12	2.89	8.16	11.05	A9V	G8V	0.37	12,452	847,855	CO=PHY

Table 2 continues on next page.

New Wide Common Proper Motion Binaries

Table 2 (continued): Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
BVD 102	13 28 57	+40 40 33	1.03	11.15	12.18	K2V	G8V	1.85	8,350	616,127	CO/PHY
BVD 150	13 29 41	-16 33 55	1.55	10.14	11.69	G5V	K5V	-0.70	4,206	220,204	PHY/CO
BVD 103	13 30 08	-04 12 58	0.50	10.35	10.85	G1V	G3V	0.22	7,383	439,028	PHY=CO
HJL 193	13 40 09	+68 44 28	0.05	9.22	9.27	G3V	G3V	0.05	3,327	135,169	CO=PHY
HJL 195	13 53 30	+03 37 37	1.33	8.66	9.99	F2V	F7V	0.45	7,316	365,337	PHY=CO
BVD 104	13 56 40	+78 02 00	1.79	10.08	11.87	G2V	G8V	1.18	9,843	711,147	CO/PHY
BVD 105	13 59 46	+64 41 30	0.21	9.95	10.16	K2V:	G4V:	1.72	4,729	231,441	CO/PHY
BVD 106	14 16 43	+79 35 49	0.14	10.45	10.59	F9V	F8V	0.34	6,167	312,143	CO/PHY
BVD 107	14 22 21	+66 16 26	1.13	10.51	11.64	K0IV	F6V	3.26	16,427	1,222,676	CO
BVD 108	14 38 04	-09 44 16	2.38	7.68	10.06	M1III					OPT?
BVD 109	14 51 32	-18 30 59	0.71	8.31	9.02	F5V	F8V	0.11	7,343	384,940	CO/PHY
BVD 151	15 14 35	-58 01 06	0.13	9.61	9.74	G3V	G3V	0.13	2,778	103,142	CO/PHY
BVD 110	15 14 36	+59 17 05	0.26	10.73	10.99	K3V	K3V	0.26	1,911	72,919	PHY/CO
BVD 111	15 16 41	-70 13 26	0.24	10.4	10.64	G6V	G6V	0.24	4,319	210,548	PHY?
GRV 903	15 21 09	+25 34 02	1.97	9.02	10.99	K2V	K8V	0.11	2,938	138,305	PHY?
BVD 113	15 21 27	-34 57 45	1.26	10.66	11.92	G7V	K2V	0.04	3,854	191,203	PHY=CO
BVD 114	15 21 40	-20 40 05	0.93	10.62	11.55	G8V	G9V	0.56	3,168	138,457	PHY=CO
BVD 115	15 30 48	-69 23 45	0.89	10.28	11.17	F7V	F8V	0.69	7,550	412,031	CO/PHY
BVD 116	15 39 37	-30 10 48	0.23	11.42	11.65	G1V	F8V	0.47	5,310	254,280	CO/PHY
BVD 117	16 15 27	-40 22 16	1.07	10.41	11.48	G1V	G9V	-0.23	4,369	209,853	CO/PHY
BVD 118	16 26 29	-00 42 21	0.18	10.47	10.65	K2V	K2V	0.18	1,783	64,073	PHY?
BVD 119AB-C	16 55 38	-54 34 11	2.16	9.24	11.40	F7V	G9V	0.40	4,575	212,838	CO/PHY
GRV 959	17 30 13	+29 01 13	0.59	10.17	10.76	K2IV:	G2V	-0.58	5,682	263,492	CO?
BVD 121	17 38 40	-54 28 10	0.86	9.14	10.00	F6V	F7V	0.66	7,463	394,952	CO/PHY
BVD 122	17 41 19	-34 40 37	0.81	10.61	11.42	G7V	G6V	1.05	6,674	408,170	PHY=CO
BVD 123	17 42 27	-13 53 15	0.52	10.79	11.31	G7V	G9V	0.35	2,979	125,073	CO/PHY
BVD 124	17 47 15	+08 50 51	0.88	11.30	12.18	G4V	G5V	0.89	5,807	319,616	CO/PHY
BVD 125	17 54 05	+27 20 34	1.77	8.15	9.92	F6V	G7V	-0.05	4,930	231,276	CO?
BVD 152	17 55 13	-39 34 03	2.24	9.13	11.37	F6V	G9V	-0.02	8,158	499,144	CO/PHY
BVD 126	18 23 21	-11 37 01	0.63	11.21	11.84	G9V	K2V	-0.27	2,818	121,938	CO?
BVD 127	18 24 04	+72 20 07	1.73	9.63	11.36	F6V	G8V	-0.18	3,861	161,420	CO/PHY
BVD 128	18 25 15	+80 27 44	0.90	9.99	10.89	F7V	G3V	-0.12	5,213	247,730	CO/PHY
SRT 1	18 50 04	-13 16 30	0.49	8.96	9.45	G5V	G7V	0.17	2,205	76,814	PHY
BVD 130	19 22 05	-00 36 37	0.57	10.26	10.83	G0V	G6V	-0.29	5,357	275,505	CO/PHY
ARY 48	20 37 45	+32 23 43	0.52	8.18	8.7	F6V	F9V	-0.08	5,402	249,215	PHY?
BVD 131	20 39 02	-00 34 42	0.81	10.34	11.15	G0V	G3V	0.39	6,308	343,724	CO/PHY
BVD 132AB-C	20 54 30	-60 59 34	0.90	9.08	9.98	F9V	G6V	-0.16	8,074	502,864	CO/PHY
BVD 133	21 08 05	-45 04 35	0.22	10.29	10.51	F7V	G2V	-0.66	4,763	214,780	CO/PHY

Table 2 continues on next page.

Table 2 (continued): Visual Double Stars Studied in This Work.

Double	AR_2000	DEC_2000	ΔV	V_A	V_B	SP_A	SP_B	Δ(V-Mv)	E(a) [A.U.]	P [yr]	Type
BVD 153	21 12 09	-41 27 50	0.82	10.31	11.13	F5V	F6V	0.62	15,799	1,186,321	PHY=CO
BVD 134	21 15 13	+53 50 34	1.16	10.51	11.67	K3 IV-V	G5V		2,420	122,652	CO/PHY
BVD 135	21 15 43	+68 21 08	1.37	7.92	9.29	F3V	F9V	0.25	3,104	104,472	CO/PHY
BVD 136	21 16 47	-51 23 23	2.07	9.96	12.03	F7V	K0V	-0.09	6,953	401,508	CO/PHY
BVD 137	21 33 31	-27 53 24	2.13	7.65	9.78	G3V	K1V	0.77	2,239	80,217	PHY/CO
BVD 138	21 34 16	-23 53 31	0.57	11.45	12.02	K0V	K3V	-0.37	3,616	181,128	CO=PHY
BVD 139AB-C	21 39 39	-12 37 20	2.38	8.47	10.85	G4V	G8V	1.76	13,242	1,129,988	PHY/CO
BVD 154	21 41 54	-37 09 47	0.95	10.25	11.2	G0V	G9V	-0.39	5,496	293,181	CO=PHY
BVD 140	21 54 19	-20 20 10	0.43	10.63	11.06	G8V	G8V	0.43	5,073	278,135	CO/PHY
BVD 155	22 09 53	-25 13 38	0.73	9.60	10.33	G0V	G4V	0.17	6,551	366,624	PHY=CO
BVD 141	22 24 50	-66 51 33	1.30	9.30	10.60	G0V	G9V	-0.04	1,364	36,251	CO/PHY
BVD 156	23 04 48	-40 22 39	1.50	9.97	11.47	F8V	G6V	0.16	3,716	154,729	PHY=CO
BVD 157	23 10 18	-50 16 07	1.75	10.46	12.21	F9V	K2V	-0.87	10,178	752,255	CO?
BVD 142AB-C	23 10 29	+41 19 19	2.43	7.75	10.18	F5V	K0V	-0.07	7,295	417,962	PHY?
BVD 158	23 12 51	-51 41 09	0.99	9.11	10.10	G4V	G9V	0.21	3,402	148,398	PHY?
BVD 143	23 33 41	-64 13 52	0.72	9.86	10.58	F7V	G5V	-0.58	8,794	550,698	CO?

Table 3: Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
BVD 30	**AB**	9140 1577	10.58	0.51	26.9	-50.3	8.43	0.32	1.92	G9V	5.74	83.7	22.6	0.81
	C	9140 1881	11.32	0.50	25.9	-50.7	9.30	0.48	1.92	G9V	5.74	125.0	33.7	0.81
BVD 46	**A**	6989 184	10.84	0.54	20.7	-8.8	9.62	0.32	1.25	F6V	3.60	285.0	30.4	1.37
	B	6989 130	11.56	0.30	21.2	-6.0	10.49	0.29	1.25	F6V	3.60	425.4	44.4	1.37
BVD 11	**A**	3652 1330	11.55	0.38	2.1	-5.2	10.34	0.33	1.45	G0V	4.40	301.2	8.0	1.12
	B	3652 1378	12.62	0.45	0.2	-4.4	10.92	0.39	1.62	G5V	5.10	308.2	6.4	0.94
BVD 63	**A**	7526 405	10.54	0.73	74.5	32.0	8.99	0.41	1.62	G5V	5.10	126.7	48.7	0.94
	B	7526 447	10.66	0.86	76.7	30.6	9.01	0.45	1.76	G7V	5.42	117.7	46.1	0.88
HJL 1	**A**	4026 488	10.05	0.45	71.1	-11.7	8.83	0.29	1.25	F1V	2.76	223.9	71.0	1.687
	B	4026 536	10.96	0.49	68.3	-13.0	9.36	0.35	1.48	F4V	3.24	274.2	59.9	1.08
LDS 5	**A**	6419 998	10.97	0.99	213.4	1.8	8.72	0.58	2.26	K2V	6.46	80.3	81.2	0.69
00137-2818	**B**	6419 991	11.20	1.00	220.7	2.6	8.38	0.74	2.89	K5V	7.30	62.3	65.2	0.59
BVD 12	**A**	5843 674	7.55	0.46	187.6	-5.8	6.28	0.30	1.25	F6IV	2.50	101.5	90.0	2.80
	B	5843 167	11.05	0.71	193.5	-8.5	9.05	0.56	2.00	K0V	5.90	107.3	98.6	0.79

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
BVD 13	**A**	7525 403	10.78	0.58	-31.6	-16.6	9.79	0.31	1.14	F5V	3.40	321.2	54.3	1.44
	B	7525 244	10.96	0.43	-30.9	-16.7	9.39	0.37	1.45	G0V	4.40	194.4	32.4	1.12
BVD 66	**A**	4674 269	10.06	0.39	-63.4	-65.2	8.72	0.31	1.25	F6V	3.60	188.0	81.0	1.37
	B	4674 49	10.94	0.61	-62.3	-64.7	9.27	0.39	1.68	G6V	5.26	137.7	58.6	0.91
BVD 14	**A**	1742 549	10.50	0.48	10.4	-11.8	9.27	0.28	1.25	F6V	3.60	242.5	18.1	1.37
	B	1742 555	10.99	0.78	10.9	-14.6	8.58	0.67	2.47	K3V	6.74	72.7	6.3	0.66
BVD 15	**A**	613 251	9.62	0.46	0.1	-71.4	8.39	0.23	1.25	F6V	3.60	161.7	54.7	1.37
	B	613 223	11.45	1.26	1.2	-73	9.88	0.54	2.13	K1V	6.18	146.8	50.8	0.74
BVD 16	**A**	7544 441	10.06	0.46	52.6	25.2	8.74	0.30	1.36	F7V	3.80	182.3	50.4	1.30
	B	7544 366	11.37	0.89	49	25.5	9.68	0.50	2.00	K0V	5.90	143.5	37.6	0.79
BVD 17	**A**	7544 932	11.95	0.80	88.5	-26.6	10.47	0.38	1.62	G6V	5.26	233.0	102.0	0.91
	B	7544 992	12.01	0.57	90.6	-18.5	10.36	0.41	1.68	G6V	5.26	227.4	99.7	0.91
BVD 18	**A**	3278 1981	10.25	0.84	79.5	-57	8.41	0.43	1.84	G8V	5.58	86.1	39.9	0.84
	B	3278 2009	10.61	0.66	81.5	-56.8	8.87	0.41	1.76	G7V	5.42	110.4	52.0	0.88
BVD 19	**A**	4506 558	11.23	0.48	0.9	-36.9	9.51	0.31	1.68	G6V	5.26	153.7	26.9	0.91
	B	4506 572	11.58	0.40	1.5	-34.7	10.06	0.34	1.48	G1V	4.54	251.1	41.3	1.08
HJL 20	**A**	4031 574	8.56	0.48	111.4	-22.9	7.31	0.26	1.25	F6V	3.60	98.4	53.0	1.37
	B	4031 552	9.08	0.48	113.2	-21.3	7.85	0.27	1.25	F6V	3.60	126.1	68.9	1.37
BVD 21	**A**	1757 372	7.86	0.66	-83.8	-18.1	6.19	0.38	1.68	G6V	5.26	33.3	13.5	0.91
	B	1757 1489	10.87	0.97	-82.3	-14.8	7.62	0.84	3.20	K7V	7.98	37.1	14.7	0.66
BVD 22	**A**	1758 388	11.56	0.74	76.4	-1.8	10.03	0.41	1.68	G6V	5.26	195.3	70.8	0.91
	B	1758 236	11.93	0.82	80.5	0.3	10.27	0.43	1.76	G7V	5.42	210.3	80.2	0.88
BVD 23	**A**	37 1046	10.77	0.69	33.7	-0.3	9.54	0.38	1.39	F8V	4.00	243.7	38.9	1.23
	B	37 1139	11.72	0.65	36.6	1	10.04	0.44	1.76	G7V	5.42	189.1	32.8	0.88
BVD 24	**A**	7007 526	11.13	0.67	107.4	40.5	9.54	0.37	1.57	G4V	4.96	170.1	92.6	0.97
	B	7007 1165	11.22	0.56	109.2	39.4	9.69	0.40	1.54	G3V	4.82	191.3	105.3	1.01
BVD 25	**A**	9353 563	9.13	0.41	38.9	28.3	7.99	0.29	1.14	F5V	3.40	140.2	32.0	1.44
	B	9353 104	9.33	0.46	40.7	31.3	8.21	0.29	1.14	F5V	3.40	155.2	37.8	1.44
BVD 65	**A**	7565 72	10.52	0.64	67.5	30.0	8.79	0.43	1.68	G6V	5.26	110.4	38.6	0.91
	B	7565 60	11.86	1.79	69.2	29.9	9.59	0.63	2.47	K3V	6.74	115.8	41.4	0.66
BVD 26	**A**	4516 1246	8.71	0.26	36.1	-24.4	8.26	0.08	0.48	A6V	2.12	211.3	43.6	2.05
	B	4516 540	9.59	0.41	39.2	-34	8.54	0.16	1.05	F4V	3.24	186.3	45.8	1.50
BVD 27	**A**	1793 120	11.48	1.13	-11.2	-21.8	10.04	0.37	1.57	G4V	4.96	214.2	24.9	0.97
	B	1793 118	11.97	0.63	-9.9	-25.2	9.92	0.52	2.13	K1V	6.18	149.6	19.2	0.74
BVD 28	**A**	4703 693	9.83	1.01	144.2	-21.5	7.22	0.67	2.67	K4V	7.02	37.6	26.0	0.62
	B	4703 247	10.31	1.73	146.0	-19.5	7.41	0.76	2.89	K5V	7.30	39.9	27.8	0.59

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass (M☉)**
BVD 29	**A**	4706 719	10.64	0.76	43.2	-28.7	8.55	0.52	2.13	K1IV	3.10	329.0	81.0	1.60
	B	4706 509	11.10	1.00	45.4	-32.6	9.84	0.36	1.25	F6V	3.60	315.4	83.5	1.37
BVD 71	**A**	9151 1732	9.02	0.70	-54.1	-33.9	7.42	0.42	1.62	G5V	5.10	61.5	18.6	0.94
	B	9151 1733	10.51	1.25	-55.7	-33.0	7.87	0.72	2.67	K4V	7.02	50.7	16.0	0.62
POP 223	**A**	2860 2207	9.79	0.26	20.8	-5.2	9.00	0.14	0.74	F0V	2.60	268.4	27.3	1.78
03113+4431	**B**	2860 1629	10.99	0.39	17.5	-5.5	9.88	0.17	1.14	F5V	3.40	334.8	29.1	1.44
BVD 31	**A**	4061 98	7.99	0.26	40.7	-32.7	7.37	0.10	0.61	A8V	2.36	133.1	32.9	1.91
	B	4061 387	9.58	0.84	30.6	-31.6	7.29	0.59	2.26	K2V	6.46	41.6	8.7	0.69
BVD 32	**A**	3714 1092	8.14	0.46	72.8	-6.7	6.85	0.31	1.25	F6V	3.60	79.6	27.6	1.37
	B	3714 1080	11.33	0.98	71.8	-3.8	8.61	0.72	3.05	K6V	7.64	63.7	21.7	0.55
BVD 33	**A**	6445 850	10.27	0.57	12.1	24.1	9.18	0.30	1.14	F5V	3.40	242.5	31.0	1.44
	B	6445 883	11.15	0.34	10.5	26.7	9.84	0.28	1.25	F6V	3.60	315.4	42.9	1.37
BVD 34	**A**	2353 1073	9.53	1.09	20.3	-12.5	6.64	0.64	2.89	G8III	0.58	455.0		2.20
	B	2353 1699					***9.50***	0.30	1.36	F2III:	1.12	634.0		4.90
BVD 35	**A**	7023 675	11.42	0.47	-9.5	-30.6	9.94	0.36	1.57	G4V	4.96	204.6	31.1	0.97
	B	7023 583	11.57	0.67	-9.2	-35.1	10.09	0.35	1.50	G2V	4.68	241.4	41.5	1.04
BVD 36	**A**	2870 895	9.93	0.72	-0.9	-39.3	8.45	0.36	1.54	G3V	4.82	108.1	20.1	1.01
	B	2870 917	10.26	0.54	-0.6	-39.7	8.69	0.37	1.50	G2V	4.68	126.7	23.8	1.04
BVD 37	**A**	3321 2332	11.30	0.45	11.0	-26.3	9.87	0.33	1.45	**G0V**	**3.08**	242.5	32.8	1.12
	B	3321 1003	11.46	0.70	12.8	-27.6	9.76	0.37	1.57	G4V	4.96	188.3	27.2	0.97
FEL 1	**A**	9156 2166	7.41	0.60	-10.7	-96.5	5.99	0.36	1.42	F9V	4.20	43.9	20.2	1.17
	B	9156 742	7.57	0.56	-10.4	-98.3	6.17	0.31	1.39	F8V	4.00	51.6	24.2	1.23
BVD 39	**A**	6454 219	11.33	0.70	2.8	-52.2	9.64	0.44	1.84	G8V	5.58	151.6	37.6	0.84
	B	6454 319	11.93	1.08	2.0	-50.8	9.85	0.53	2.13	K1V	6.18	144.8	34.9	0.74
HJL 54	**A**	4521 1378	9.72	0.49	-43.5	50.7	8.45	0.26	1.25	F6V	3.60	166.3	52.6	1.37
	B	4521 1350	10.22	0.54	-43.2	52.9	8.84	0.35	1.39	F8V	4.00	176.5	57.1	1.23
BVD 40AB-C	**A**	6461 1120 1	10.38	1.05	77.2	-18.4	7.20	0.76	3.05	K6V	7.64	33.3	12.5	0.55
	B	6461 1120 2	10.40	1.11	73.7	-18.8	7.52	0.76	2.89	K5V	7.30	42.0	15.1	0.59
BVD 41	**A**	5315 308	10.51	0.67	-1.0	36.2	9.10	0.36	1.48	G1V	4.54	161.4	27.7	1.08
	B	5315 310	12.06	0.45	-0.7	32.8	10.09	0.44	1.76	G7V	5.42	193.6	30.1	0.88
BVD 42	**A**	73 204	10.64	0.78	50.2	-8.0	9.20	0.40	1.57	G4V	4.96	145.5	35.1	0.97
	B	73 769	11.67	1.29	49.5	-6.9	9.65	0.55	2.26	K2V	6.46	123.3	29.2	0.69
BVD 43	**A**	8071 1288	9.19	1.15	-7.7	-34.4	6.52	0.71	2.67	K2 IV-III	1.70	327.0	53.0	2.05
	B	8071 854	11.60	0.47	-7.1	-36.4	9.91	0.33	1.45	G0V	4.40	247.1	43.4	1.12
BVD 44	**A**	8874 383	8.83	0.55	-37.6	-25.6	7.41	0.35	1.42	F9V	4.20	84.5	18.2	1.17
	B	8874 1276	9.48	0.69	-37.5	-26.0	8.03	0.35	1.50	G2V	4.68	93.5	20.2	1.04
SRT 2	**A**	5889 1441	5.81	0.16	44.9	51.1	5.46	0.08	0.34	A1V+ F/G:	0.90	96.0	31.0	2.90
	B	5889 1440	7.65	0.30	45.3	48.3	6.98	0.18	0.68	A9V	2.48	108.5	34.1	1.85

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		GSC	V	B-V	μ(α)	μ(δ)	K	J-K	V-K	Sp	Mv	Dist. (pc)	Vt (km/s)	Mass ($M_{\odot}$)
BVD 45	A	4726 649	11.23	0.45	32.8	-33.3	8.85	0.54	2.26	K2V:	6.46	85.3	18.9	0.69
	B	4726 749	11.51	0.37	34.9	-35.9	10.2	0.32	1.42	F9V:	4.20	305.4	72.5	1.17
HJL 2	A	4069 1243	8.31	0.76	-127.1	-57.2	6.55	0.40	1.76	G7V	5.42	37.9	25.0	0.88
	B	4069 1103	9.87	1.03	-126.8	-52.5	7.69	0.54	2.26	K2V	6.46	50.0	32.5	0.69
BVD 46	A	4518 173	10.92	0.81	-4.4	-24.2	9.50	0.36	1.42	F9V	4.20	221.2	25.8	1.17
	B	4518 337	11.86	0.50	-6.9	-24.1	10.05	0.46	1.84	G8V	5.58	183.1	21.8	0.84
BVD 72	A	5324 24	9.92	0.78	-87.0	-61.9	7.88	0.48	2.00	K0V	5.90	62.6	31.7	0.79
	B	5324 172	11.32	1.03	-86.1	-59.5	8.75	0.59	2.47	K3V	6.74	78.7	39.0	0.66
BVD 47	A	1843 331	11.34	0.51	1.3	-156.4	9.51	0.43	1.76	G7V	5.42	148.0	110.0	0.87
	B	1843 1	11.67	1.01	2.2	-159.6	9.30	0.56	2.26	K2V	6.46	104.9	79.4	0.69
BVD 38	A	6471 619	11.24	0.73	-20.2	65.0	8.48	0.72	2.67	K4V	7.02	67.1	21.7	0.62
	B	6471 785	11.85	1.50	-22.1	71.4	8.74	0.79	3.37	K8V	8.15	61.9	21.9	0.66
BVD 48AB	A	7049 1852	6.70	0.47	75.1	10.2	5.39	0.33	1.36	F6III:	1.34	121.0	43.0	4.20
	B	7049 1853	8.61	0.59	75.8	11.6	7.29	0.37	1.36	F7V	3.80	93.5	34.0	1.30
	C	7049 1507	8.86	0.62	71.8	7.5	7.27	0.36	1.57	G4V	4.96	59.8	20.5	0.97
BVD 49	A	7587 338	9.69	0.53	4.9	-54.8	8.29	0.32	1.39	F8V	4.00	137.0	35.7	1.23
	B	7587 414	11.05	0.86	7.7	-56.6	9.20	0.49	1.84	G8V	5.58	123.8	33.5	0.84
BVD 50	A	706 1025	8.31	0.36	-6.8	-22.6	7.31	0.20	0.96	F3V	3.08	109.0	12.2	1.57
	B	706 1835	8.46	0.33	-4.3	-21.9	7.44	0.22	0.96	F3V	3.08	115.7	12.2	1.57
BVD 51	A	4756 1243	7.70	0.52	-45.5	3.4	6.41	0.30	1.36	F7V	3.80	62.3	13.5	1.30
	B	4756 1194	9.49	0.63	-49.9	4.1	8.04	0.40	1.48	G1V	4.54	99.0	23.5	1.08
BVD 52	A	5902 1130	7.62	0.93	-99.8	28.9	5.44	0.57	2.26	G/K IV	3.50	69.0	34.0	1.60
	B	5902 856	8.97	0.72	-103.7	28.6	7.49	0.38	1.54	G3V	4.82	69.5	35.4	1.01
BVD 53	A	6475 1563	10.55	0.49	3	24.8	9.3	0.31	1.25	F6V	3.60	245.9	29.1	1.37
	B	6475 132	11.28	0.33	3.3	24.4	9.85	0.32	1.42	F9V	4.20	259.9	30.3	1.17
BVD 89	A	8887 836	11.00	0.88	-8.3	93.2	9.50	0.43	1.50	G2V	4.68	184.0	81.6	1.04
	B	8887 497	12.13	0.64	-9.4	92.6	9.74	0.55	2.13	K1V	6.18	137.7	60.7	0.74
BVD 20AC	A	7595 710	9.22	0.94	86.5	19.4	6.98	0.55	2.26	K2V	6.46	36.0	15.1	0.69
	B	7595 649	10.78	1.17	89.9	18.7	7.57	0.78	3.20	K7V	7.98	36.2	15.8	0.66
BVD 54	A	8098 261	12.21	0.58	7.9	41.9	10.83	0.31	1.39	F8V	4.00	441.4	89.2	1.23
	B	8098 233	12.64	0.48	6.8	42.0	11.15	0.34	1.48	G1V	4.54	414.8	83.6	1.08
BVD 55	A	7057 1444	9.40	0.43	-35.0	8.4	8.22	0.24	1.14	F5V	3.40	155.9	26.6	1.44
	B	7057 1445	10.71	0.45	-42.1	6.1	9.52	0.25	1.14	F5V	3.40	283.7	57.2	1.44
BVD 56	A	5918 1241	9.05	0.52	52.1	-1.2	7.62	0.32	1.42	F9V	4.20	93.1	23.0	1.17
	B	5918 1151	11.63	1.22	53.7	-1.5	9.11	0.64	2.67	K4V	7.02	89.7	22.8	0.62
BVD 57AB-C	A	8528 1345	8.40	0.63	-30.2	-51.3	6.80	0.40	1.57	G4V	4.96	48.2	13.6	0.97
	B	8528 1324	10.31	0.75	-29.4	-51.9	7.97	0.66	2.26	K2V	6.46	56.9	16.1	0.69

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
BVD 58	**A**	4529 13	11.41	0.53	-14.5	-41.3	9.79	0.36	1.57	G4V	4.96	190.9	39.6	0.97
	B	4529 245	12.05	0.94	-17	-44.5	10.07	0.53	2.13	K1V	6.18	160.3	36.2	0.74
BVD 91	**A**	7611 1572	9.15	0.45	-36.4	53.2	7.92	0.28	1.25	F6V	3.60	130.3	39.8	1.37
	B	7611 98	10.62	0.53	-33.5	55.2	8.66	0.45	1.84	G8V	5.58	96.6	29.6	0.84
BVD 93	**A**	7076 2300	10.48	0.80	-68.1	152.4	8.77	0.52	1.76	G7V	5.42	105.4	83.4	0.88
	B	7076 2317	11.95	0.93	-72.9	151.1	9.43	0.71	2.89	K5V	7.30	101.1	80.4	0.59
BVD 59	**A**	8902 1379	11.36	0.63	1.7	34.6	9.80	0.41	1.68	G6V	5.26	175.7	28.9	0.91
	B	8902 1812	11.37	0.36	0.5	36.6	10.06	0.29	1.25	F6V	3.60	349.0	60.5	1.37
BVD 60	**A**	2426 368	10.32	1.09	41.2	-42.3	7.86	0.59	2.47	K3V	6.74	52.0	15.0	0.66
	B	2426 1311	12.23	0.75	43.5	-46.2	11.54	0.34	1.48	G1V	4.54	492.0	33.0	1.08
BGH 22	**A**	5382 166	9.44	0.86	-164.1	95.9	7.41	0.55	2.00	K0V	5.90	50.4	45.4	0.79
06386-0946	**B**	5382 402	9.79	0.91	-162.9	97.5	7.54	0.59	2.26	K2V	6.46	46.6	42.0	0.69
BVD 112	**A**	7626 224	9.00	0.39	25.2	-57.5	7.96	0.23	1.05	F4V	3.24	142.6	42.4	1.50
	B	7626 2206	10.10	0.47	22.8	-58.8	8.59	0.35	1.42	F9V	4.20	145.5	43.5	1.17
BVD 61	**A**	3778 947	9.43	0.55	62.3	4.9	7.95	0.33	1.45	G0V	4.40	100.2	29.7	1.12
	B	3778 1205	11.10	0.71	60.9	3.0	8.85	0.49	2.26	K2V	6.46	85.3	24.6	0.69
BVD 120	**A**	5971 1405	9.16	0.40	26.6	-68.8	7.91	0.24	1.25	F6V	3.60	129.7	45.3	1.37
	B	5971 2457	9.82	0.45	27.9	-70.3	8.57	0.30	1.25	F6V	3.60	175.7	63.0	1.37
BVD 62	**A**	3771 839	11.23	0.86	-61.7	-37.6	9.63	0.34	1.57	G4V	4.96	177.3	60.7	0.97
	B	3771 837	11.38	0.77	-58.7	-39.5	9.80	0.44	1.76	G7V	5.42	169.4	56.8	0.88
ARN 94	**A**	3767 1058	10.51	0.60	-2.5	-20.1	9.24	0.29	1.25	F6V	3.60	239.2	23.0	1.37
07061+5259	**B**	3767 1380	10.92	0.31	-1.8	-20.4	9.43	0.28	1.48	G1V	4.54	187.8	18.2	1.08
BVD 129	**A**	5389 255	10.24	0.68	-72.6	29.4	8.50	0.45	1.76	G7V	5.42	93.1	34.6	0.88
	B	5389 869	10.59	0.63	-74.5	29.0	8.66	0.51	1.92	G9V	5.74	93.1	35.3	0.81
BVD 64	**A**	5406 482	10.58	0.67	72.8	-180.9	8.48	0.52	2.00	K0V	5.90	82.6	76.3	0.79
	B	5406 658	11.51	0.56	78.6	-182	8.51	0.75	3.20	K7V	7.98	55.8	52.5	0.66
XMI 63	**A**	5404 59	10.30	0.63	-44.4	30.0	8.93	0.37	1.42	F9V	4.20	170.1	43.2	1.17
07317-1300	**B**	5404 285	10.51	0.71	-45.3	30.5	9.15	0.41	1.45	G0V	4.40	174.1	45.1	1.12
GRV 737	**A**	1364 1203	9.57	0.71	-36	-77.6	8.08	0.36	1.54	G3IV	3.00	205.0	83.0	1.50
07328+1757	**B**	1364 1217	10.66	0.85	-32.8	-77.2	9.23	0.38	1.43	F9 V	4.20	196.0	78.0	1.20
BVD 67	**A**	9393 594	10.09	0.62	-46.0	-10.2	8.41	0.37	1.62	G5V	5.10	97.0	21.7	0.94
	B	9393 670	10.41	0.58	-45.4	-10.8	8.77	0.38	1.62	G5V	5.10	114.5	25.3	0.94
BVD 68	**A**	3413 210	11.20	0.83	-33.1	-154.1	9.27	0.47	1.92	G9V	5.74	123.3	92.1	0.81
	B	3413 5	11.25	0.66	-34.7	-153.6	9.31	0.43	1.92	G9V	5.74	125.5	93.7	0.81
BVD 69	**A**	5424 2530	8.87	0.35	-7.4	-7.2	7.81	0.24	1.05	F4V	3.24	133.1	6.5	1.50
	B	5424 2531	9.59	0.47	-8.6	-9	8.43	0.32	1.14	F5V	3.40	171.7	10.1	1.44
BVD 70	**A**	7659 2220	10.34	0.48	-26.3	33.9	9.24	0.26	1.14	F5V	3.40	249.3	50.7	1.44
	B	7659 3173	11.35	0.43	-27.0	32.9	9.97	0.33	1.45	G0V	4.40	254.0	51.2	1.12
LEP 30	**A**	802 408	7.71	0.71	-198.3	-233.3	6.06	0.38	1.68	G6V	5.26	31.4	45.6	0.91
	B	802 150	9.75	0.91	-198.3	-229.5	7.15	0.60	2.47	K3V	6.74	37.7	54.1	0.66

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
BVD 161AC	**A**	2478 858	8.52	0.66	-118.8	-111.3	6.82	0.37	1.68	G6V	5.26	44.5	34.4	0.91
	B	2478 671	11.70	0.82	-132.6	-149	8.43	0.82	3.69	M0V	9.00	42.1	39.8	0.58
BVD 73	**A**	1949 1327	10.63	0.67	-34.1	0.6	8.83	0.46	1.76	G7V	5.42	108.3	17.5	0.88
	B	1949 1809	11.71	0.15	-33.1	-1.6	10.00	0.33	1.45	G0V	4.40	257.5	40.4	1.12
BVD 74	**A**	8591 1674	10.83	0.47	-7.4	21.0	9.47	0.32	1.36	F7V	3.80	255.2	26.9	1.30
	B	8591 1575	11.66	0.18	-7.6	18.3	10.25	0.31	1.39	F8V	4.00	337.9	31.7	1.23
BVD 75	**A**	7152 476	11.81	0.94	-27.7	13.3	9.43	0.60	2.47	K3V	6.74	107.6	15.7	0.66
	B	7152 1558	12.24	0.71	-29.1	15.0	10.50	0.33	1.45	G0V	4.40	324.2	50.3	1.12
BVD 76	**A**	7165 2125	9.63	0.46	42.5	-49.0	8.35	0.32	1.25	F6V	3.60	158.8	48.8	1.37
	B	7165 3003	10.50	0.53	41.0	-47.7	9.07	0.40	1.42	F9V	4.20	181.5	54.1	1.17
BVD 145	**A**	6033 79	8.16	0.42	9.9	-77.1	7.05	0.25	1.14	F5V	3.40	90.9	33.5	1.44
	B	6033 1949	8.97	0.45	12.4	-80.2	7.62	0.37	1.36	F7V	3.80	108.8	41.9	1.30
BVD 77	**A**	4894 325	10.52	0.46	-58.3	20.9	9.13	0.36	1.36	F7V	3.80	218.2	64.0	1.30
	B	4894 595	11.55	0.40	-58.3	22.6	10.00	0.33	1.45	G0V	4.40	257.5	76.3	1.12
BVD 78	**A**	2497 222	10.88	0.39	-80	5.4	9.2	0.38	1.48	G1V	4.54	169.0	64.2	1.08
	B	2497 518	11.54	0.19	-89.2	13.8	9.6	0.41	1.68	G6V	5.26	160.3	68.6	0.91
BVD 79	**A**	7178 1299	10.45	0.78	-65.7	15.2	8.44	0.57	2.00	K0 IV	3.10	294.0	94.0	1.60
	B	7178 1718	12.10	0.69	-64.6	15.4	10.74	0.35	1.50	G2V	4.68	325.7	102.5	1.04
BVD 80	**A**	3818 626	11.47	0.49	-49.0	-6.3	10.23	0.27	1.25	F6V	3.60	377.4	88.4	1.37
	B	3818 677	12.22	0.63	-51.0	-5.2	10.81	0.34	1.48	G1V	4.54	354.6	86.2	1.08
BVD 81	**A**	1972 1402	5.84	1.22	-128.8	3.8	3.01	0.85	2.89	K2III	0.22	137.0	83.7	2.50
	B	1972 1272	10.01	0.74	-127.7	4.1	8.37	0.37	1.68	G6V	5.26	90.9	55.1	0.91
BVD 82	**A**	5498 919	10.69	0.77	-45.1	2.2	9.02	0.42	1.68	G6V	5.26	122.7	26.3	0.91
	B	5498 633	11.39	1.29	-43.5	5.1	9.25	0.66	2.67	K4V	7.02	95.7	19.9	0.62
BVD 83	**A**	8209 1398	11.01	0.28	-24.5	17.9	10.04	0.18	0.96	F3V	3.08	383.2	55.1	1.57
	B	8209 1274	11.96	0.40	-29.3	19.8	10.59	0.32	1.42	F9V	4.20	365.4	61.3	1.17
BVD 84	**A**	8969 805	10.22	0.85	-22.3	7.0	7.41	0.74	2.67	K1III	0.36	880.6	97.6	2.40
	B	8969 857	11.87	0.51	-19.7	5.0	10.83	0.23	1.05	F4V	3.24	534.7	51.5	1.50
BVD 146	**A**	9219 3416	8.73	0.56	-65.3	43.1	7.22	0.35	1.48	G1V	4.54	67.9	25.2	1.08
	B	9219 2375	10.51	0.83	-66.2	44.7	8.59	0.45	1.92	G9V	5.74	90.1	34.1	0.81
BVD 147	**A**	4913 1016	9.94	0.51	-69.3	-48.8	8.39	0.35	1.48	G1IV:	2.90	248.0	99.0	1.40
	B	4913 764	10.95	0.54	-68.1	-48.2	9.61	0.37	1.36	F7V	3.80	272.0	108.0	1.30
BVD 85	**A**	8198 1896	10.33	0.52	-61.0	-21.8	8.83	0.39	1.45	G0V	4.40	150.2	46.1	1.12
	B	8198 1628	10.61	0.67	-62.9	-21.4	9.03	0.38	1.57	G4V	4.96	134.5	42.4	0.97
BVD 86	**A**	4552 884	11.13	0.61	6.2	-56.5	9.42	0.41	1.68	G6V	5.26	147.5	39.7	0.91
	B	4552 933	12.32	0.65	9.3	-62.7	10.04	0.52	2.13	K1V	6.18	158.1	47.5	0.74
BVD 87	**A**	7736 1514	9.20	0.52	76.7	-71.1	7.85	0.29	1.36	F7V	3.80	121.0	60.0	1.30
	B	7736 1515	9.71	0.48	78.9	-69.6	8.13	0.40	1.48	G1V	4.54	103.2	51.5	1.08
BVD 88	**A**	6640 948	9.98	0.55	-85.6	-0.9	8.48	0.35	1.45	G0V	4.40	127.9	51.9	1.12
	B	6640 821	10.73	0.75	-85.2	-0.9	9.37	0.34	1.48	G1V	4.54	182.7	73.8	1.08

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
GRV 829	**A**	262 917	12.04	0.65	18.6	-39.2	10.17	0.47	1.92	G9V	5.74	186.6	38.4	0.81
11092+0044	**B**	262 542	12.18	0.58	21.7	-40.5	10.19	0.45	1.84	G8V	5.58	195.3	42.5	0.84
HJL 141	**A**	263 534	8.33	1.00	22.0	-117.7	5.73	0.67	2.67	K1 IV -III	1.70	219.0	124.0	2.00
11153+0204	**B**	263 505	10.22	0.45	21.4	-119.3	8.82	0.35	1.36	F7V	3.80	189.1	108.7	1.30
BVD 148	**A**	6658 179	8.71	0.43	-62.8	10.0	7.65	0.20	1.05	F4V	3.24	123.6	37.3	1.50
	B	6658 143	10.92	0.80	-66.6	9.0	9.09	0.51	1.84	G8V	5.58	117.7	37.5	0.84
BVD 90	**A**	6091 2201	9.87	0.39	-7.5	-20.8	8.6	0.30	1.25	F6V	3.60	178.2	18.7	1.37
	B	6091 2202	10.62	0.24	-8.5	3.3	9.64	0.16	0.86	F2V	2.92	328.7	14.2	1.63
GRV 840	**A**	1984 683	11.43	0.60	-101.8	-44.6	9.56	0.42	1.76	G7V	5.42	151.6	79.9	0.88
11374+2853	**B**	1984 680	12.41	0.60	-101.1	-43.9	10.08	0.53	2.13	K1V	6.18	161.0	84.1	0.74
BVD 92	**A**	2523 1622	9.89	0.50	-92.2	43.3	8.64	0.26	1.25	F6V	3.60	181.5	87.6	1.37
	B	2523 1878	10.01	0.52	-94.1	45.9	8.73	0.27	1.25	F6V	3.60	189.1	93.9	1.37
GRV 841	**A**	3014 2133	10.00	0.77	-139.4	-11.5	8.25	0.38	1.76	G7V	5.42	82.9	55.0	0.88
11424+3934	**B**	3014 2397	10.63	0.94	-139.5	-12.2	8.25	0.61	2.47	K3V	6.74	62.5	41.5	0.66
BVD 94	**A**	8642 1106	10.35	0.51	-12.0	33.6	8.81	0.37	1.48	G1V	4.54	141.2	23.9	1.08
	B	8642 764	10.90	0.57	-12.0	35.4	9.33	0.33	1.57	G4V	4.96	154.5	27.4	0.97
BVD 95	**A**	3832 140	9.82	0.57	-43	30	8.48	0.29	1.36	F7V	3.80	161.7	40.2	1.30
	B	3832 138	11.74	1.19	-47.4	35.3	10.07	0.48	1.92	G9V	5.74	178.2	49.9	0.81
BVD 96	**A**	6674 350	8.83	0.50	-183.9	3.6	7.49	0.32	1.36	F7V	3.80	102.5	89.4	1.30
	B	6674 246	9.84	0.80	-186.4	-0.2	8.18	0.42	1.68	G6V	5.26	83.3	73.6	0.91
BVD 97	**A**	6099 1575	10.37	0.66	72.4	-55.7	8.76	0.40	1.62	G5V	5.10	114.0	49.3	0.94
	B	6099 1313	11.52	0.75	55.5	-42.2	9.83	0.46	1.84	G8V	5.58	165.5	54.7	0.84
BVD 98	**A**	8238 2116	10.15	0.90	-36.6	-2.7	7.99	0.58	2.13	K1V	6.18	61.5	10.7	0.74
	B	8238 2252	11.89	0.73	-35.8	-4.3	10.68	0.32	1.42	F9V	4.20	380.9	65.1	1.17
BVD 99	**A**	8234 897	9.48	0.19	-26.5	-5.4	8.93	0.10	0.54	A7V	2.24	279.8	35.9	1.98
	B	8234 663	11.62	0.73	-24.2	-4.4	10.20	0.33	1.45	G0V	4.40	282.4	32.9	1.12
BVD 149AB-C	**A**	8649 894	8.50	0.54	-143.0	-38.8	7.04	0.34	1.41	G0V	4.40	66.0	46.0	1.28
	B	8649 1075	11.01	0.93	-144.1	-37.6	9.17	0.53	1.84	G8V	5.58	122.1	86.2	0.84
BVD 100	**A**	4404 396	11.05	0.65	58.6	-92.7	9.13	0.43	1.92	G9V	5.74	115.6	60.1	0.81
	B	4404 778	11.24	1.59	58.5	-96.5	9.50	0.54	1.76	G7V	5.42	147.5	78.9	0.88
BVD 101	**A**	2535 1190	8.16	0.26	-35.8	-10.5	7.46	0.14	0.68	A9V	2.48	135.4	23.9	1.85
	B	2535 60	11.05	0.86	-35.3	-10.6	9.79	0.46	1.84	G8V	5.58	162.0	28.0	0.84
BVD 102	**A**	3028 862	11.15	0.81	-7.4	-48.2	8.96	0.59	2.26	K2V	6.46	89.7	20.7	0.69
	B	3028 888	12.18	0.57	-4.1	-48.4	10.28	0.44	1.84	G8V	5.58	203.6	46.9	0.84
BVD 150	**A**	6121 325	10.14	0.66	-65.4	8.5	8.50	0.37	1.62	G5V	5.10	101.1	31.6	0.94
	B	6121 320	11.69	1.03	-66.1	9.3	8.75	0.68	2.89	K5V	7.30	73.9	23.4	0.59
BVD 103	**A**	4969 722	10.35	0.63	15.6	-38.7	8.87	0.40	1.48	G1V	4.54	145.1	28.7	1.08
	B	4969 783	10.85	0.65	17.5	-40.6	9.30	0.40	1.54	G3V	4.82	159.9	33.5	1.01
HJL 193	**A**	4402 1313	9.22	0.62	64.1	-77.5	7.67	0.34	1.54	G3V	4.82	75.5	36.0	1.01
13401+6844	**B**	4402 1621	9.27	0.65	60.8	-80.8	7.75	0.34	1.54	G3V	4.82	78.3	37.5	1.01

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
HJL 195	**A**	312 1291	8.66	0.31	-44.5	0.1	7.78	0.20	0.86	F2V	2.92	139.6	29.4	1.63
13535+0338	**B**	312 1001	9.99	0.62	-46.0	-1.4	8.74	0.32	1.36	F7V	3.80	182.3	39.8	1.30
BVD 104	**A**	4561 812	10.08	0.54	41.1	-51.3	8.50	0.37	1.50	G2V	4.68	116.1	36.2	1.04
	B	4561 1444	11.87	0.88	40.4	-51.0	10.32	0.45	1.84	G8V	5.58	207.4	64.0	0.84
BVD 105	**A**	4174 293	9.95	0.99	-7.2	-43.9	7.68	0.55	2.26	K2V:	6.46	50.0	10.0	1.00
	B	4174 305	10.16	0.73	-10.3	-43.4	8.67	0.36	1.57	G4V:	4.96	114.0	24.1	0.97
BVD 106	**A**	4562 1801	10.45	0.61	-30.2	32.3	9.05	0.34	1.42	F9V	4.20	179.8	37.7	1.17
	B	4562 1649	10.59	0.68	-28.1	32.7	9.34	0.29	1.39	F8V	4.00	222.2	45.4	1.23
BVD 107	**A**	4178 720	10.51	0.93	-14.5	40.9	8.50	0.51	2.00	K0IV	3.10	303.0	62.0	1.60
	B	4178 737	11.64	0.40	-14.2	40.2	10.22	0.27	1.25	F6V	3.60	375.7	75.9	1.37
BVD 108	**A**	5568 839	7.68	1.67	-13.9	5.5	3.52	1.03	4.15	M1III	-.50	431.3	30.6	5.30
	B	5568 743	10.06	2.19	-20.1	8.4	10.67	0.33	-.31					
BVD 109	**A**	6159 1112	8.31	0.43	-47.8	-46.4	7.15	0.22	1.14	F5V	3.40	95.2	30.1	1.44
	B	6159 1111	9.02	0.59	-47.1	-48.5	7.65	0.32	1.39	F8V	4.00	102.0	32.7	1.23
BVD 151	**A**	8702 170	9.61	0.68	-90.6	-31.2	8.09	0.34	1.54	G3V	4.82	91.6	41.6	1.01
	B	8702 53	9.74	0.66	-93.7	-28.8	8.23	0.38	1.54	G3V	4.82	97.7	45.4	1.01
BVD 110	**A**	3874 17	10.73	0.89	-75.3	74.0	8.31	0.62	2.47	K3V	6.74	64.2	32.1	0.66
	B	3874 553	10.99	1.07	-75.1	69.1	8.46	0.63	2.47	K3V	6.74	68.8	33.3	0.66
BVD 111	**A**	9263 434	10.40	0.84	-12.2	-48.1	8.83	0.38	1.68	G6V	5.26	112.4	26.4	0.91
	B	9263 412	10.64	0.72	-11.8	-47.7	8.93	0.40	1.68	G6V	5.26	117.7	27.4	0.91
GRV 903	**A**	2028 273	9.02	0.93	-90.8	-114.6	6.77	0.54	2.26	K2V	6.46	32.7	22.7	0.69
15211+2534	**B**	2028 252	10.99	0.97	-86.2	-118.5	7.66	0.80	3.37	K8V	8.32	34.8	24.2	0.63
BVD 113	**A**	7321 464	10.66	0.85	-44.7	-43.0	8.93	0.42	1.76	G7V	5.42	113.4	33.4	0.88
	B	7321 467	11.92	0.43	-43.6	-46.7	9.48	0.56	2.26	K2V	6.46	114.0	34.5	0.69
BVD 114	**A**	6183 882	10.62	0.87	-3.6	-32.0	8.80	0.47	1.84	G8V	5.58	103.0	15.7	0.84
	B	6183 1018	11.55	0.42	-4.5	-29.0	9.42	0.47	1.92	G9V	5.74	132.1	18.4	0.81
BVD 115	**A**	9263 591	10.28	0.45	-20.1	-37.6	8.86	0.34	1.36	F7V	3.80	192.7	38.9	1.30
	B	9263 541	11.17	0.48	-17.9	-35.0	9.71	0.31	1.39	F8V	4.00	263.5	49.1	1.23
BVD 116	**A**	7327 2239	11.42	0.81	-20.1	-17.7	9.90	0.34	1.48	G1V	4.54	233.2	29.6	1.08
	B	7327 2240	11.65	0.45	-22.7	-19.6	9.91	0.31	1.39	F8V	4.00	288.9	41.1	1.23
BVD 117	**A**	7856 701	10.41	0.53	-22.6	-30.8	8.88	0.28	1.48	G1V	4.54	145.8	26.4	1.08
	B	7856 822	11.48	0.78	-23.5	-32.8	9.46	0.47	1.92	G9V	5.74	134.5	25.7	0.81
BVD 118	**A**	5035 472	10.47	0.80	-46.2	-0.5	8.14	0.56	2.26	K2V	6.46	61.5	13.5	0.69
	B	5035 226	10.65	1.50	-47.5	-0.5	8.36	0.60	2.26	K2V	6.46	68.0	15.3	0.69
BVD 119AB-C	**A**	8730 170	9.24	0.46	-51.9	-45.6	7.86	0.32	1.36	F7V	3.80	121.6	39.8	1.30
	B	8730 401	11.40	0.70	-46.4	-47.1	9.66	0.47	1.92	G9V	5.74	147.5	46.2	0.81
GRV 959	**A**	2087 425	10.17	0.82	-15.3	-45.5	7.9	0.59	2.26	K2IV:	3.50	215.0	49.0	1.60
17302+2901	**B**	2087 1177	10.76	0.51	-18.6	-49.6	9.15	0.40	1.50	G2V	4.68	156.6	39.3	1.04
BVD 121	**A**	8733 308	9.14	0.44	83.9	-2.6	7.87	0.29	1.25	F6V	3.60	127.3	50.6	1.37
	B	8733 814	10.00	0.47	81.2	-4.8	8.61	0.31	1.36	F7V	3.80	171.7	66.2	1.30

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_\odot$)**
BVD 122	**A**	7384 122	10.61	0.67	-17.8	-34.9	8.83	0.45	1.76	G7V	5.42	108.3	20.1	0.88
	B	7384 35	11.42	0.56	-18.1	-36.0	9.82	0.41	1.68	G6V	5.26	177.3	33.9	0.91
BVD 123	**A**	5672 536	10.79	0.90	4.4	-43.6	9.03	0.53	1.76	G7V	5.42	118.8	24.7	0.88
	B	5672 877	11.31	0.47	5.5	-40.6	9.54	0.48	1.92	G9V	5.74	139.6	27.1	0.81
BVD 124	**A**	994 240	11.30	0.54	-4.0	-37.3	9.58	0.36	1.57	G4V	4.96	173.3	30.8	0.97
	B	994 1499	12.18	0.85	-5.2	-39.8	10.56	0.39	1.62	G5V	5.10	261.1	49.7	0.94
BVD 125	**A**	2098 629	8.15	0.43	-42.1	-116.9	6.94	0.26	1.25	F6V	3.60	82.9	48.9	1.37
	B	2098 496	9.92	0.65	-39.2	-123.3	8.15	0.50	1.76	G7V	5.42	79.2	48.6	0.88
BVD 152	**A**	7890 1416	9.13	0.49	-44.2	-52.1	7.91	0.25	1.25	F6V	3.60	129.7	42.0	1.37
	B	7890 2073	11.37	0.40	-43.1	-52.1	9.33	0.47	1.92	G9V	5.74	126.7	40.6	0.81
BVD 126	**A**	5698 3041	11.21	1.29	19.2	60.0	9.28	0.57	1.92	G9V	5.74	123.8	37.0	0.81
	B	5698 5013	11.84	1.00	22.6	66.5	9.40	0.57	2.26	K2V	6.46	109.8	36.6	0.69
BVD 127	**A**	4438 1755	9.63	0.50	28.4	95.7	8.37	0.26	1.25	F6V	3.60	160.3	75.8	1.37
	B	4438 1785	11.36	0.55	31.9	96.4	9.59	0.46	1.84	G8V	5.58	148.2	71.3	0.84
BVD 128	**A**	4578 808	9.99	0.52	-12.9	25.6	8.64	0.29	1.36	F7V	3.80	174.1	23.7	1.30
	B	4578 843	10.89	0.67	-13.3	23.1	9.35	0.35	1.54	G3V	4.82	163.6	20.7	1.01
SRT 1	**A**	5705 507	8.96	0.54	41.2	-155.1	7.31	0.38	1.62	G5V	5.10	58.5	44.5	0.94
18501-1317	**B**	5705 286	9.45	0.64	40.6	-152.6	7.63	0.42	1.76	G7V	5.42	62.3	46.7	0.88
BVD 130	**A**	5130 357	10.26	0.62	35.4	27.7	8.83	0.28	1.45	G0V	4.40	150.2	32.0	1.12
	B	5130 817	10.83	0.54	37.6	26.8	9.18	0.42	1.68	G6V	5.26	132.1	28.9	0.91
ARY 48	**A**	2690 1597	8.18	0.49	46.4	79.2	6.93	0.26	1.25	F6V	3.60	82.6	35.9	1.37
20378+3224	**B**	2690 1464	8.70	0.58	45.7	78.7	7.26	0.31	1.42	F9V	4.20	78.8	34.0	1.17
BVD 131	**A**	5177 10	10.34	0.48	-29.2	-27.9	8.81	0.39	1.45	G0V	4.40	148.9	28.5	1.12
	B	5177 1136	11.15	0.44	-32.5	-28.5	9.60	0.36	1.54	G3V	4.82	183.6	37.6	1.01
BVD 132AB-C	**A**	9101 1039	9.08	0.53	2.3	-101.4	7.65	0.31	1.42	F9V	4.20	94.4	45.4	1.17
	B	9101 408	9.98	0.64	5.2	-97.8	8.27	0.40	1.68	G6V	5.26	86.9	40.3	0.91
BVD 133	**A**	8421 1258	10.29	0.59	4.6	-32.4	9.02	0.31	1.36	F7V	3.80	207.4	32.2	1.30
	B	8421 1224	10.51	0.68	6.8	-32.9	9.04	0.41	1.50	G2V	4.68	148.9	23.7	1.04
BVD 153	**A**	7974 946	10.31	0.45	64.7	12.2	9.15	0.28	1.14	F5V	3.40	239.2	74.7	1.44
	B	7974 244	11.13	0.46	60.9	10.0	9.94	0.29	1.25	F6V	3.60	330.2	96.6	1.37
BVD 134	**A**	3953 330	10.51	1.13	-13.9	-60.3	7.95	0.63	2.47	K3IV-V				
	B	3953 964	11.67	0.34	-16.8	-62.7	9.61	0.39	1.62	G5V	5.10	168.6	51.9	0.94
BVD 135	**A**	4461 627	7.92	0.37	10.6	-46.8	6.93	0.20	0.96	F3V	3.08	91.5	20.8	1.57
	B	4461 677	9.29	0.65	13.9	-48.2	7.93	0.36	1.42	F9V	4.20	107.3	25.5	1.17
BVD 136	**A**	8434 1082	9.96	0.61	-17.2	-44.0	8.66	0.37	1.36	F7V	3.80	175.7	39.3	1.30
	B	8434 737	12.03	1.42	-18.2	-43.3	9.97	0.51	2.00	K0V	5.90	164.0	36.5	0.79
BVD 137	**A**	6947 961	7.65	0.61	200.7	-63.5	6.09	0.38	1.54	G3V	4.82	36.5	36.4	1.01
	B	6947 759	9.78	0.87	206.7	-66.0	7.62	0.68	2.13	K1V	6.18	51.9	53.3	0.74
BVD 138	**A**	6939 947	11.45	0.96	3.4	-60.5	9.36	0.51	2.00	K0V	5.90	123.8	35.6	0.79
	B	6939 913	12.02	1.22	1.6	-59.3	9.37	0.63	2.47	K3V	6.74	104.7	29.4	0.66

Table 3 continues on next page.

New Wide Common Proper Motion Binaries

Table 3 (continued): Astrophysical data for the components of the double stars.

			Tycho-2				2MASS							
Double		**GSC**	**V**	**B-V**	**μ(α)**	**μ(δ)**	**K**	**J-K**	**V-K**	**Sp**	**Mv**	**Dist. (pc)**	**Vt (km/s)**	**Mass ($M_{\odot}$)**
BVD 139AB-C	**A**	5795 175	8.47	0.60	136.0	36.3	6.87	0.40	1.57	G4V	4.96	49.8	33.2	0.97
	B	5795 250	10.85	0.67	136.7	35.0	9.03	0.53	1.84	G8V	5.58	114.5	76.6	0.84
BVD 154	**A**	7493 121	10.25	0.62	56.1	-23.5	8.84	0.35	1.45	G0V	4.40	150.9	43.5	1.12
	B	7493 627	11.20	0.65	56.7	-20.7	9.26	0.47	1.92	G9V	5.74	122.7	35.1	0.81
BVD 140	**A**	6382 814	10.63	0.64	27.0	-46.4	8.82	0.45	1.84	G8V	5.58	103.9	26.4	0.84
	B	6382 964	11.06	0.22	31.2	-45.7	9.17	0.35	1.84	G8V	5.58	122.1	32.0	0.84
BVD 155	**A**	6958 1533	9.60	0.55	66.9	-140.3	8.10	0.34	1.45	G0V	4.40	107.3	79.1	1.12
	B	6958 1454	10.33	0.51	65.1	-139.9	8.62	0.37	1.57	G4V	4.96	111.4	81.5	0.97
BVD 141	**A**	9123 153	9.30	0.55	116.7	43.7	7.84	0.34	1.45	G0V	4.40	95.2	56.3	1.12
	B	9123 1881	10.60	0.75	122.8	43.3	8.64	0.54	1.92	G9V	5.74	92.2	56.9	0.81
BVD 156	**A**	8008 899	9.97	0.47	56.9	-48.7	8.53	0.36	1.39	F8V	4.00	153.0	54.3	1.23
	B	8008 734	11.47	0.50	58.6	-46.6	9.71	0.40	1.68	G6V	5.26	168.6	59.8	0.91
BVD 157	**A**	8454 750	10.46	0.60	26.3	-52.5	9.07	0.37	1.42	F9V	4.20	181.5	50.5	1.17
	B	8454 716	12.21	0.57	24.4	-51.5	9.59	0.58	2.26	K2V	6.46	119.9	32.4	0.69
BVD 142AB-C	**A**	3225 2806	7.75	0.42	-97.7	-83.6	6.56	0.24	1.14	F5V	3.40	72.6	44.2	1.44
	B	3225 2312	10.18	0.94	-96.0	-83.5	8.21	0.51	2.00	K0V	5.90	72.9	44.0	0.79
BVD 158	**A**	8454 107	9.11	0.62	-3.5	-79.3	7.54	0.36	1.57	G4V	4.96	67.7	25.5	0.97
	B	8454 6	10.10	0.82	-3.5	-77.2	8.19	0.46	1.92	G9V	5.74	75.0	27.5	0.81
BVD 143	**A**	9129 969	9.86	0.47	47.5	-28.9	8.54	0.29	1.36	F7V	3.80	166.3	43.8	1.30
	B	9129 1760	10.58	0.62	51.0	-25.8	8.96	0.39	1.62	G5V	5.10	125.0	33.9	0.94

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 30 AB-C	00 02 51.02	-74 35 52.0	1907.981	11.0	37.53	1	FMR	AC2000
			1991.700	11.5	37.81	1	FMR	TYCHO2
BVD 46	00 08 01.35	-31 38 41.8	1912.922	328.0	20.01	1	FMR	AC2000
			1991.693	328.4	20.18	1	FMR	TYCHO2
			1998.874	328.5	20.19	1	FMR	2MASS
BVD 11	00 09 34.95	+53 24 56.2	1901.817	111.9	13.11	1	FMR	AC2000
			1991.657	111.8	12.95	1	FMR	TYCHO2
			1998.847	113.1	13.02	1	FMR	2MASS
			2006.516	113.2	12.93	10	RNA	CCD
			2006.578	113.4	12.92	5	OMG	CCD
			2006.626	113.1	12.99	5	ERE	CCD

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 63	00 11 24.73	-40 48 39.6	1899.337	126.2	68.41	1	FMR	AC2000
			1991.675	126.2	68.67	1	FMR	TYCHO2
HJL 1	00 11 54.81	+66 21 09.8	1895.341	351.1	30.94	1	FMR	AC2000
			1991.620*	350.7	30.90	1	FMR	TYCHO2
			1999.795*	350.7	30.92	1	FMR	2MASS
			2006.609	350.6	30.89	10	RNA	CCD
			2006.625	350.6	30.96	5	ERE	CCD
			2006.635	350.5	30.88	5	OMG	CCD
LDS 5	00 13 39.15	-28 18 02.6	1991.705*	3.0	44.01	1	FMR	TYCHO2
			1998.850*	2.8	43.90	1	FMR	2MASS
			2006.631	2.8	43.85	5	ERE	CCD
BVD 12	00 30 38.04	-18 37 15.4	1991.635	314.2	143.74	1	FMR	TYCHO2
			1999.549	314.3	143.81	1	FMR	2MASS
BVD 13	00 36 49.02	-38 48 26.1	1905.339	223.6	22.62	1	FMR	AC2000
			1977.687	223.6	22.74	1	BVD	DSS
			1991.800	222.9	22.51	1	FMR	TYCHO2
			1999.582	222.9	22.51	1	FMR	2MASS
BVD 66	00 50 16.50	-02 26 59.8	1895.807	108.6	39.50	1	FMR	AC2000
			1991.568	108.7	39.59	1	FMR	TYCHO2
			1995.893	108.8	39.67	1	BVD	DSS
			1998.746	108.5	39.50	1	FMR	2MASS
BVD 14	00 52 45.94	+27 13 31.7	1897.181	225.9	12.31	1	FMR	AC2000
			1991.662	225.0	12.56	1	FMR	TYCHO2
			1997.825	224.7	12.73	1	FMR	2MASS
			2006.629	224.6	12.73	5	ERE	CCD
BVD 15	01 20 21.31	+09 36 45.0	1910.887	213.4	46.29	1	FMR	AC2000
			1954.681	213.1	46.45	1	BVD	DSS
			1991.657	213.4	46.47	1	FMR	TYCHO2
			1995.801	213.3	46.67	1	BVD	DSS
			2000.732	213.4	46.48	1	FMR	2MASS
			2006.626	213.5	46.62	4	ERE	CCD
BVD 16	01 23 39.94	-41 48 14.1	1900.988	98.7	21.44	1	FMR	AC2000
			1977.632	98.7	21.31	1	BVD	DSS
			1991.615	98.3	21.28	1	FMR	TYCHO2
			1998.833	98.4	21.25	1	FMR	2MASS
BVD 17	01 30 06.46	-40 24 07.8	1900.870	175.9	21.21	1	FMR	AC2000
			1977.632	176.7	20.38	1	BVD	DSS
			1991.657	175.6	20.46	1	FMR	TYCHO2
			1998.833	176.2	20.65	1	FMR	2MASS

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 18	01 32 19.10	+45 59 27.4	1898.575	231.1	85.49	1	FMR	AC2000
			1953.784	230.9	85.68	1	BVD	DSS
			1991.537	231.1	85.32	1	FMR	TYCHO2
			1992.801	230.8	85.57	1	BVD	DSS
			1999.702	231.1	85.18	1	FMR	2MASS
			2006.557	231.0	85.28	9	RNA	CCD
			2006.626	231.1	85.33	4	ERE	CCD
BVD 19	01 34 03.62	+82 25 39.0	1898.728	37.7	17.06	1	FMR	AC2000
			1991.718	37.2	17.30	1	FMR	TYCHO2
			2000.722	37.5	17.01	1	FMR	2MASS
			2009.197	37.2	17.05	6	BVD	CCD
HJL 20	01 35 01.39	+60 46 45.5	1991.857*	79.0	44.31	1	FMR	TYCHO2
			1999.741*	79.0	44.32	1	FMR	2MASS
			2006.617	79.0	44.33	9	RNA	CCD
			2006.626	79.0	44.32	5	ERE	CCD
			2009.205	79.0	44.38	6	BVD	CCD
BVD 21	01 56 47.31	+23 03 04.2	1892.368	137.9	59.61	1	FMR	AC2000
			1991.677	137.7	59.41	1	FMR	TYCHO2
			1998.880	137.9	59.36	1	FMR	2MASS
BVD 22	02 05 15.48	+23 52 15.6	1892.539	0.5	44.49	1	FMR	AC2000
			1991.745	1.1	44.70	1	FMR	TYCHO2
			1997.798	0.7	44.66	1	FMR	2MASS
			2006.640	0.7	44.74	5	ERE	CCD
			2006.905	0.6	44.70	8	RNA	CCD
BVD 23	02 05 38.24	+00 31 09.8	1903.514	341.9	30.70	1	FMR	AC2000
			1953.774	341.7	30.47	1	BVD	DSS
			1991.875	342.6	30.80	1	FMR	TYCHO2
			1996.784	343.1	30.81	1	BVD	DSS
			2000.658	342.4	30.74	1	FMR	2MASS
BVD 24	02 19 51.74	-31 54 05.6	1913.330	128.9	114.15	1	FMR	AC2000
			1991.492	128.9	114.33	1	FMR	TYCHO2
BVD 25	02 33 03.13	-77 37 44.7	1895.944	271.9	40.71	1	FMR	AC2000
			1991.690	272.1	40.66	1	FMR	TYCHO2
BVD 65	02 43 23.21	-42 32 02.8	1900.260	330.2	31.98	1	FMR	AC2000
			1991.695	330.4	31.92	1	FMR	TYCHO2
BVD 26	02 44 34.24	+79 11 56.0	1897.872	60.8	48.73	1	FMR	AC2000
			1991.590	61.8	48.62	1	FMR	TYCHO2
			2000.744	62.0	48.55	1	FMR	2MASS
			2009.255	62.0	48.42	6	BVD	CCD

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 27	02 50 26.95	+29 58 21.5	1902.418	141.5	24.88	1	FMR	AC2000
			1991.733	141.6	25.19	1	FMR	TYCHO2
			1997.962	141.1	25.02	1	FMR	2MASS
			2006.626	141.1	25.05	4	ERE	CCD
			2006.635	141.1	25.02	5	OMG	CCD
			2006.904	141.1	25.05	12	RNA	CCD
			2009.197	141.4	24.98	6	BVD	CCD
BVD 28	02 53 27.89	-03 29 38.5	1991.690	338.8	105.15	1	FMR	TYCHO2
			1998.740	338.8	105.34	1	FMR	2MASS
BVD 29	02 59 15.22	-05 15 41.8	1895.076	0.3	52.02	1	FMR	AC2000
			1991.670	0.6	51.66	1	FMR	TYCHO2
			1998.741	0.7	51.65	1	FMR	2MASS
BVD 71	03 07 31.05	-74 30 27.0	1894.877	276.2	60.26	1	FMR	AC2000
			1991.705	276.3	60.31	1	FMR	TYCHO2
POP 223	03 11 23.71	+44 29 56.6	1895.932	180.2	15.01	1	FMR	AC2000
			1991.650*	181.4	15.04	1	FMR	TYCHO2
			1998.850*	181.2	15.04	1	FMR	2MASS
			2006.651	181.2	15.06	5	ERE	CCD
			2006.904	181.2	15.05	10	RNA	CCD
BVD 31	03 17 06.28	+67 05 27.1	1894.428	162.0	53.58	1	FMR	AC2000
			1991.790	163.2	53.23	1	FMR	TYCHO2
			1999.807	163.3	53.25	1	FMR	2MASS
			2009.255	163.6	53.11	6	BVD	CCD
BVD 32	03 17 42.76	+58 46 58.1	1914.073	58.4	86.14	1	FMR	AC2000
			1991.730	58.3	85.77	1	FMR	TYCHO2
			1999.875	58.2	85.79	1	FMR	2MASS
			2009.255	58.2	85.61	6	BVD	CCD
BVD 33	03 18 24.38	-27 34 12.8	1913.035	301.2	24.52	1	FMR	AC2000
			1991.787	301.4	24.57	1	FMR	TYCHO2
BVD 34	03 20 07.47	+36 10 51.1	1938.216	64.7	15.39	1	FMR	AC2000
			1998.827	62.6	15.30	1	FMR	2MASS
			2006.626	62.4	15.22	5	ERE	CCD
			2006.904	62.1	15.21	10	RNA	CCD
			2009.205	62.3	15.24	6	BVD	CCD
BVD 35	03 22 02.67	-33 49 06.6	1914.298	239.6	17.93	1	FMR	AC2000
			1991.703	238.7	18.08	1	FMR	TYCHO2
BVD 36	03 35 28.14	+42 18 03.2	1896.023	291.5	39.07	1	FMR	AC2000
			1991.568	291.5	39.02	1	FMR	TYCHO2
			1999.765	291.4	39.06	1	FMR	2MASS

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2006.651	291.4	39.08	5	ERE	CCD
			2006.904	291.4	39.05	6	RNA	CCD
			2009.112	291.3	39.05	6	BVD	CCD
BVD 37	03 44 43.36	+49 39 38.5	1903.952	142.2	11.03	1	FMR	AC2000
			1991.613	141.9	11.20	1	FMR	TYCHO2
			1999.779	142.4	11.42	1	FMR	2MASS
			2006.777	142.3	11.35	15	ERE	CCD
			2009.112	142.5	11.37	6	BVD	CCD
FEL 1	03 44 46.86	-70 01 35.1	1893.541	82.8	75.87	1	FMR	AC2000
			1991.640	83.1	75.88	1	FMR	TYCHO2
BVD 39	03 48 55.73	-28 06 33.0	1913.777	36.0	51.39	1	FMR	AC2000
			1991.625	35.8	51.38	1	FMR	TYCHO2
HJL 54	03 59 43.23	+82 15 27.0	1898.908*	42.0	23.99	1	FMR	AC2000
			1991.672*	41.7	24.06	1	FMR	TYCHO2
			2009.120	41.7	24.12	6	BVD	CCD
BVD 40AB-C	04 00 03.78	-29 02 16.4	1912.148	170.6	11.24	1	FMR	AC2000
			1991.650	171.7	11.45	1	FMR	TYCHO2
BVD 41	04 07 01.74	-11 46 10.0	1902.383	326.5	18.44	1	FMR	AC2000
			1991.642	326.3	18.15	1	FMR	TYCHO2
			2009.112	326.5	18.19	6	BVD	CCD
BVD 42	04 07 51.04	+02 16 00.6	1909.705	142.6	47.23	1	FMR	AC2000
			1991.557	142.6	47.15	1	FMR	TYCHO2
			2000.061	142.5	47.08	1	FMR	2MASS
			2009.112	142.6	47.20	6	BVD	CCD
BVD 43	04 08 21.26	-48 12 38.9	1903.099	238.2	29.79	1	FMR	AC2000
			1991.613	237.8	29.86	1	FMR	TYCHO2
BVD 44	04 10 03.66	-67 19 33.7	1893.273	256.1	26.22	1	FMR	AC2000
			1991.772	256.1	26.09	1	FMR	TYCHO2
SRT 2	04 11 36.18	-20 21 22.6	1918.837*	334.2	62.20	1	FMR	AC2000
			1991.488*	334.4	61.77	1	FMR	TYCHO2
BVD 45	04 18 01.38	+00 30 35.9	1901.112	182.0	38.73	1	FMR	AC2000
			1951.009	182.4	38.73	1	BVD	DSS
			1991.042	181.9	38.84	1	BVD	DSS
			1991.705	178.3	38.96	1	FMR	TYCHO2
			1998.722	181.8	38.82	1	FMR	2MASS
HJL 2	04 25 40.25	+63 40 29.5	1908.046	213.5	209.93	1	FMR	AC2000
			1991.500	213.5	209.63	1	FMR	TYCHO2
			1999.187	213.6	209.67	1	FMR	2MASS
			2009.255	213.6	209.73	6	BVD	CCD

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 144	04 26 27.25	+78 47 26.0	1898.913	344.8	12.97	1	FMR	AC2000
			1991.675	343.8	13.01	1	FMR	TYCHO2
			1999.888	344.0	13.12	1	FMR	2MASS
			2009.197	343.9	13.12	6	BVD	CCD
BVD 72	04 39 48.39	-10 09 33.1	1903.992	123.4	25.08	1	FMR	AC2000
			1991.613	122.7	25.09	1	FMR	TYCHO2
			1998.866	122.8	25.06	1	FMR	2MASS
BVD 47	04 45 25.41	+29 55 29.8	1991.645	145.4	84.16	1	FMR	TYCHO2
			1999.009	145.2	83.87	1	FMR	2MASS
			2006.694	145.3	84.23	5	ERE	CCD
			2009.112	145.3	84.14	6	BVD	CCD
BVD 38	04 46 36.21	-29 31 16.6	1912.101	226.8	17.21	1	FMR	AC2000
			1991.563	228.7	17.08	1	FMR	TYCHO2
BVD 48AB	04 51 54.19	-34 14 19.2	1913.483	160.1	52.02	1	FMR	AC2000
			1991.773	159.8	51.91	1	FMR	TYCHO2
			1997.008	160.0	51.86	1	BVD	DSS
			1998.975	160.0	52.25	1	FMR	2MASS
BVD 48AC	04 51 54.19	-34 14 19.2	1913.483	308.7	99.61	1	FMR	AC2000
			1991.758	308.5	99.59	1	FMR	TYCHO2
			1997.008	307.8	99.56	1	BVD	DSS
			1998.975	308.4	99.58	1	FMR	2MASS
BVD 49	04 56 25.97	-38 39 04.0	1912.564	101.4	48.23	1	FMR	AC2000
			1991.657	101.3	48.61	1	FMR	TYCHO2
BVD 50	05 09 12.56	+11 29 43.2	1910.414	104.1	30.86	1	FMR	AC2000
			1991.665	103.8	31.06	1	FMR	TYCHO2
			1999.984	103.8	31.03	1	FMR	2MASS
BVD 51	05 15 23.72	-03 21 57.5	1901.795	317.9	43.81	1	FMR	AC2000
			1991.820	317.5	44.57	1	FMR	TYCHO2
			1998.719	317.3	44.62	1	FMR	2MASS
BVD 52	05 18 08.92	-16 11 13.6	1905.759	225.9	90.13	1	FMR	AC2000
			1991.742	226.0	90.11	1	FMR	TYCHO2
			1999.751	226.0	90.05	1	FMR	2MASS
BVD 53	05 20 45.29	-23 08 33.2	1916.450	84.2	19.10	1	FMR	AC2000
			1980.105	84.8	19.21	1	BVD	DSS
			1991.740	84.4	19.13	1	FMR	TYCHO2
			1999.708	84.6	19.12	1	FMR	2MASS
BVD 89	05 27 04.46	-65 33 26.9	1892.084	31.0	22.78	1	FMR	AC2000
			1991.585	30.8	22.67	1	FMR	TYCHO2
BVD 20AC	05 28 28.01	-39 22 15.7	1904.639	96.1	71.93	1	FMR	AC2000

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			1976.963	95.9	72.24	1	BVD	DSS
			1991.645	96.1	72.37	1	FMR	TYCHO2
			1999.178	96.1	72.42	1	FMR	2MASS
BVD 54	05 28 34.83	-50 53 48.9	1905.048	35.7	27.32	1	FMR	AC2000
			1991.630	35.5	27.35	1	FMR	TYCHO2
BVD 55	05 44 59.58	-30 30 24.3	1913.921	315.1	20.65	1	FMR	AC2000
			1991.645	313.7	21.12	1	FMR	TYCHO2
BVD 56	05 45 55.97	-15 47 38.1	1903.065	108.8	72.75	1	FMR	AC2000
			1991.605	108.9	72.30	1	FMR	TYCHO2
			2009.197	109.0	72.02	6	BVD	CCD
BVD 57AB-C	05 53 35.84	-56 40 13.5	1893.937	115.1	51.34	1	FMR	AC2000
			1991.605	116.0	51.42	1	FMR	TYCHO2
BVD 58	06 00 20.31	+78 33 46.2	1898.542	114.3	17.05	1	FMR	AC2000
			1954.766	115.8	17.01	1	BVD	DSS
			1991.598	115.5	16.95	1	FMR	TYCHO2
			1997.178	116.0	16.96	1	BVD	DSS
			1999.162	115.4	17.02	1	FMR	2MASS
			2009.255	115.2	16.92	6	BVD	CCD
BVD 91	06 03 12.81	-37 57 46.1	1911.715	56.4	45.53	1	FMR	AC2000
			1991.645	55.9	46.10	1	FMR	TYCHO2
BVD 93	06 03 12.81	-37 57 46.1	1999.189	55.9	46.16	1	FMR	2MASS
			1991.660	251.1	20.15	1	FMR	TYCHO2
BVD 59	06 24 25.81	-64 29 57.4	1912.267	124.4	20.86	1	FMR	AC2000
			1991.667	124.0	20.72	1	FMR	TYCHO2
BVD 60	06 35 30.57	+32 41 50.7	1925.417	78.4	54.37	1	FMR	AC2000
			1991.853	77.9	53.99	1	FMR	TYCHO2
			1998.146	74.8	52.64	1	FMR	2MASS
			2006.883	74.6	52.57	5	ERE	CCD
			2009.197	74.5	52.45	6	BVD	CCD
BGH 22	06 38 33.72	-09 45 41.6	1991.835*	150.6	40.01	1	FMR	TYCHO2
BVD 112	06 39 36.12	-43 21 47.9	1899.598	227.4	20.42	1	FMR	AC2000
			1979.955	227.6	20.60	1	BVD	DSS
			1991.655	227.3	20.79	1	FMR	TYCHO2
			1999.255	227.7	20.79	1	FMR	2MASS
BVD 61	06 52 27.26	+59 39 07.8	1907.167	65.9	46.05	1	FMR	AC2000
			1991.728	66.1	45.77	1	FMR	TYCHO2
			2000.012	66.1	45.76	1	FMR	2MASS
			2009.112	66.0	45.74	6	BVD	CCD
BVD 120	06 58 28.46	-20 05 50.8	1918.350	232.1	71.86	1	FMR	AC2000

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			1991.823	232.0	71.61	1	FMR	TYCHO2
BVD 62	06 59 40.58	+55 08 25.9	1913.346	337.7	29.54	1	FMR	AC2000
			1991.540	338.1	29.33	1	FMR	TYCHO2
			1999.012	338.5	29.33	1	FMR	2MASS
			2009.197	338.5	29.35	6	BVD	CCD
ARN 94	07 06 04.09	+52 59 16.0	1903.472	90.8	16.77	1	FMR	AC2000
			1991.807*	91.2	16.79	1	FMR	TYCHO2
			1998.947*	91.2	16.81	1	FMR	2MASS
			2009.112	91.3	16.87	6	BVD	CCD
BVD 129	07 07 17.29	-11 26 13.6	1902.652	89.7	70.26	1	FMR	AC2000
			1991.833	89.6	70.11	1	FMR	TYCHO2
			2009.197	89.6	70.19	6	BVD	CCD
BVD 64	07 09 46.27	-13 59 35.5	1902.175	20.0	149.69	1	FMR	AC2000
			1986.397	20.1	149.81	1	BVD	DSS
			1991.825	20.2	149.72	1	FMR	TYCHO2
			2000.011	20.2	149.46	1	FMR	2MASS
XMI 63	07 31 40.66	-13 00 09.8	1902.103	340.9	18.15	1	FMR	AC2000
			1991.705*	340.8	18.22	1	FMR	TYCHO2
			2009.112	340.8	18.43	6	BVD	CCD
GRV 737	07 32 49.09	+17 57 55.9	1895.743	55.8	23.60	1	FMR	AC2000
			1991.800*	56.1	23.91	1	FMR	TYCHO2
			2009.255	56.1	23.76	6	BVD	CCD
BVD 67	07 43 41.63	-81 42 08.8	1898.436	32.9	34.49	1	FMR	AC2000
			1991.680	32.9	34.44	1	FMR	TYCHO2
			1999.908	32.9	34.40	1	FMR	2MASS
BVD 68	07 48 07.51	+50 13 04.5	1991.730	341.9	31.20	1	FMR	TYCHO2
			2000.225	341.9	31.22	1	FMR	2MASS
			2009.112	341.9	31.21	6	BVD	CCD
BVD 69	07 57 08.93	-13 23 40.3	1902.198	101.9	20.55	1	FMR	AC2000
			1991.657	102.3	20.53	1	FMR	TYCHO2
BVD 70	08 08 19.65	-38 55 42.9	1910.281	318.1	28.68	1	FMR	AC2000
			1991.718	318.2	28.63	1	FMR	TYCHO2
LEP 30	08 15 33.32	+11 25 53.4	1913.261	238.1	32.07	1	FMR	AC2000
			1951.236	238.6	32.09	1	BVD	DSS
			1991.542*	238.3	31.91	1	FMR	TYCHO2
			2000.116*	238.5	31.92	1	FMR	2MASS
			2009.112	238.4	31.88	6	BVD	CCD
BVD 161AC	08 21 20.81	+34 18 36.8	1940.830	98.7	72.79	1	FMR	AC2000
			1991.515	100.5	72.35	1	FMR	TYCHO2

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			1998.217	98.7	72.82	1	FMR	2MASS
			1999.873	99.9	72.43	1	BVD	DSS
			2009.255	98.7	72.79	6	BVD	CCD
BVD 73	08 53 18.33	+28 11 05.9	1898.224	233.3	29.55	1	FMR	AC2000
			1991.590	233.1	29.58	1	FMR	TYCHO2
			2009.197	233.4	29.74	6	BVD	CCD
BVD 74	09 12 32.80	-56 31 50.2	1925.146	104.1	17.63	1	FMR	AC2000
			1991.720	104.8	17.68	1	FMR	TYCHO2
BVD 75	09 15 50.38	-31 22 38.4	1913.063	250.6	31.41	1	FMR	AC2000
			1991.557	251.0	31.49	1	FMR	TYCHO2
BVD 76	09 21 22.46	-36 45 37.1	1913.328	9.9	41.95	1	FMR	AC2000
			1991.682	9.7	42.16	1	FMR	TYCHO2
BVD 145	09 21 32.34	-17 45 25.6	1915.117	317.6	46.60	1	FMR	AC2000
			1991.655	317.4	46.44	1	FMR	TYCHO2
			2009.197	317.4	46.36	6	BVD	CCD
BVD 77	09 31 24.60	+00 12 11.0	1902.870	276.7	41.65	1	FMR	AC2000
			1991.938	276.8	41.75	1	FMR	TYCHO2
			2009.197	276.4	41.72	6	BVD	CCD
BVD 78	09 35 16.06	+34 57 42.5	1937.118	289.0	43.58	1	FMR	AC2000
			1991.547	289.3	44.09	1	FMR	TYCHO2
			1998.225	289.2	44.01	1	FMR	2MASS
			1998.291	288.8	44.14	1	BVD	DSS
			2009.255	289.3	44.04	6	BVD	CCD
BVD 79	10 06 04.83	-35 00 47.0	1913.596	30.3	29.28	1	FMR	AC2000
			1991.672	30.4	29.30	1	FMR	TYCHO2
			1999.219	30.4	29.11	1	FMR	2MASS
BVD 80	10 07 06.64	+56 13 00.2	1912.273	139.9	24.99	1	FMR	AC2000
			1991.740	140.3	24.90	1	FMR	TYCHO2
			1999.053	140.6	24.97	1	FMR	2MASS
			2009.197	140.5	24.93	6	BVD	CCD
BVD 81	10 16 41.83	+25 22 14.5	1991.785	28.1	79.67	1	FMR	TYCHO2
			2009.197	28.1	79.32	38	BVD	CCD
BVD 82	10 34 00.56	-13 54 14.1	1901.237	208.5	18.37	1	FMR	AC2000
			1991.690	208.5	18.00	1	FMR	TYCHO2
			2009.205	209.0	18.24	6	BVD	CCD
BVD 83	10 34 09.64	-51 03 11.6	1905.400	216.9	15.64	1	FMR	AC2000
			1991.677	218.7	15.81	1	FMR	TYCHO2
BVD 84	10 39 50.93	-66 02 43.9	1903.497	24.1	21.13	1	FMR	AC2000
			1991.705	24.9	21.14	1	FMR	TYCHO2

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
BVD 146	10 42 53.84	-71 44 52.9	1892.700	32.6	52.00	1	FMR	AC2000
			1991.660	32.4	52.05	1	FMR	TYCHO2
BVD 147	10 49 07.16	+00 57 39.6	1896.192	128.6	62.81	1	FMR	AC2000
			1991.853	128.6	62.83	1	FMR	TYCHO2
			2009.205	128.7	62.77	6	BVD	CCD
BVD 85	10 52 14.15	-45 10 54.4	1902.776	224.7	44.55	1	FMR	AC2000
			1991.762	224.9	44.72	1	FMR	TYCHO2
BVD 86	10 52 49.54	+78 38 43.7	1896.812	214.0	21.79	1	FMR	AC2000
			1991.795	212.5	22.12	1	FMR	TYCHO2
			2009.205	212.9	21.90	6	BVD	CCD
BVD 87	10 53 20.22	-43 15 59.9	1902.851	354.2	15.11	1	FMR	AC2000
			1991.585	354.7	15.10	1	FMR	TYCHO2
BVD 88	11 06 34.30	-25 13 51.2	1910.202	75.6	48.33	1	FMR	AC2000
			1991.703	75.5	48.36	1	FMR	TYCHO2
GRV 829	11 09 15.26	+00 44 22.0	1909.236*	62.0	29.70	1	FMR	AC2000
			1991.815*	62.4	29.86	1	FMR	TYCHO2
			2009.255	62.1	29.67	6	BVD	CCD
HJL 141	11 15 17.89	+02 03 49.3	1909.810	59.7	64.12	1	FMR	AC2000
			1991.813*	59.9	64.16	1	FMR	TYCHO2
			2000.124*	59.7	64.23	1	FMR	2MASS
			2009.205	59.7	64.19	6	BVD	CCD
			2009.255	59.8	64.19	6	BVD	CCD
BVD 148	11 26 26.08	-27 35 06.1	1913.234	37.2	54.46	1	FMR	AC2000
			1991.627	36.9	54.03	1	FMR	TYCHO2
BVD 90	11 30 43.79	-21 26 09.0	1919.382	153.1	23.96	1	FMR	AC2000
			1991.720	151.5	22.21	1	FMR	TYCHO2
			2009.255	150.9	21.74	4	BVD	CCD
GRV 840	11 37 24.63	+28 53 14.1	1902.083	296.0	27.05	1	FMR	AC2000
			1991.830*	296.4	27.03	1	FMR	TYCHO2
			2000.097*	296.1	27.05	1	FMR	2MASS
			2006.496	296.1	27.06	4	ERE	CCD
			2006.497	296.1	27.06	5	JCA	CCD
			2006.554	296.0	27.02	10	RNA	CCD
			2009.255	296.1	27.05	6	BVD	CCD
BVD 92	11 38 43.15	+32 37 33.1	1925.874	60.0	113.92	1	FMR	AC2000
			1991.758	59.9	113.79	1	FMR	TYCHO2
			2000.277	59.9	113.78	1	FMR	2MASS
			2006.497	59.9	113.95	4	JCA	CCD
			2006.524	59.9	113.82	8	RNA	CCD

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2009.255	59.8	113.82	6	BVD	CCD
GRV 841	11 42 26.53	+39 34 52.0	1895.316*	202.6	64.56	1	FMR	AC2000
			1991.625*	202.6	64.57	1	FMR	TYCHO2
			2000.031*	202.6	64.58	1	FMR	2MASS
			2006.497	202.7	64.55	5	JCA	CCD
			2009.255	202.7	64.48	6	BVD	CCD
BVD 94	11 44 16.90	-59 54 43.5	1894.020	305.4	26.16	1	FMR	AC2000
			1991.640	305.7	26.17	1	FMR	TYCHO2
BVD 95	11 47 23.33	+54 58 00.2	1914.207	215.9	28.98	1	FMR	AC2000
			1950.217	217.1	28.91	1	BVD	DSS
			1991.645	216.7	29.00	1	FMR	TYCHO2
			1994.286	217.3	29.00	1	BVD	DSS
			2000.127	216.7	29.08	1	FMR	2MASS
			2006.497	216.7	29.08	5	JCA	CCD
			2006.642	216.7	29.07	5	ERE	CCD
			2009.255	216.7	29.05	5	BVD	CCD
BVD 96	11 53 05.83	-27 18 29.1	1912.359	238.1	134.02	1	FMR	AC2000
			1978.401	238.0	134.18	1	BVD	DSS
			1991.617	238.0	134.35	1	FMR	TYCHO2
			2000.086	238.0	134.32	1	FMR	2MASS
BVD 97	11 54 25.37	-20 45 45.6	1919.272	183.7	31.58	1	FMR	AC2000
			1991.593	186.0	30.71	1	FMR	TYCHO2
			2009.255	186.7	30.38	6	BVD	CCD
BVD 98	12 11 41.83	-49 57 26.2	1904.871	206.6	21.24	1	FMR	AC2000
			1991.535	206.7	21.36	1	FMR	TYCHO2
BVD 99	12 21 58.87	-47 01 00.7	1902.212	319.0	25.74	1	FMR	AC2000
			1991.880	319.6	25.84	1	FMR	TYCHO2
			1999.343	319.9	25.68	1	FMR	2MASS
BVD 149AB-C	13 07 52.27	-52 42 29.8	1991.880	276.8	88.55	1	FMR	TYCHO2
			1999.392	276.5	88.50	1	FMR	2MASS
BVD 100	13 10 43.66	+70 46 07.0	1991.728	246.3	86.62	1	FMR	TYCHO2
			1999.373	246.5	86.65	1	FMR	2MASS
			2009.205	246.4	86.68	6	BVD	CCD
BVD 101	13 18 45.29	+32 10 11.7	1922.433	283.0	66.69	1	FMR	AC2000
			1991.510	283.0	66.49	1	FMR	TYCHO2
			1999.141	283.0	66.47	1	FMR	2MASS
			2006.439	283.0	66.55	7	ERE	CCD
			2006.477	283.1	66.55	4	JCA	CCD
			2006.502	283.0	66.57	10	RNA	CCD

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2009.255	283.1	66.43	6	BVD	CCD
BVD 102	13 28 56.56	+40 40 33.3	1896.245	264.8	45.34	1	FMR	AC2000
			1991.557	264.8	45.06	1	FMR	TYCHO2
			1998.294	264.7	45.19	1	FMR	2MASS
			2006.496	264.7	45.30	4	ERE	CCD
			2006.497	264.5	45.22	3	JCA	CCD
			2009.205	264.7	45.19	6	BVD	CCD
BVD 150	13 29 40.67	-16 33 55.5	1906.545	344.8	38.20	1	FMR	AC2000
			1991.810	344.9	38.33	1	FMR	TYCHO2
BVD 103	13 30 08.24	-04 12 57.4	1893.931	82.6	38.47	1	FMR	AC2000
			1991.617	82.8	38.47	1	FMR	TYCHO2
			1999.091	82.7	38.42	1	FMR	2MASS
			2009.205	82.8	38.47	6	BVD	CCD
HJL 193	13 40 08.39	+68 44 29.0	1897.488	110.1	34.50	1	FMR	AC2000
			1991.703*	110.9	34.36	1	FMR	TYCHO2
			1999.261*	110.9	34.34	1	FMR	2MASS
			2006.497	110.9	34.38	5	JCA	CCD
			2006.576	111.1	34.40	4	ERE	CCD
			2009.205	111.0	34.33	6	BVD	CCD
HJL 195	13 53 29.85	+03 37 36.8	1909.354	225.1	36.04	1	FMR	AC2000
			1991.583*	225.2	36.05	1	FMR	TYCHO2
			2000.160*	225.2	36.08	1	FMR	2MASS
			2006.515	225.2	36.08	3	ERE	CCD
BVD 104	13 56 40.32	+78 02 00.3	1898.315	66.6	48.24	1	FMR	AC2000
			1991.760	66.3	48.28	1	FMR	TYCHO2
			1999.439	66.2	48.30	1	FMR	2MASS
			2009.205	66.2	48.25	6	BVD	CCD
BVD 105	13 59 46.36	+64 41 30.4	1895.321	276.7	45.55	1	FMR	AC2000
			1991.728	276.7	45.81	1	FMR	TYCHO2
			1999.343	276.8	45.78	1	FMR	2MASS
			2006.441	276.7	45.80	8	ERE	CCD
			2006.477	276.6	45.79	4	JCA	CCD
			2006.502	276.6	45.68	10	RNA	CCD
			2009.255	276.8	45.77	6	BVD	CCD
BVD 106	14 16 43.57	+79 35 49.4	1898.849	344.0	24.50	1	FMR	AC2000
			1953.524	344.9	24.61	1	BVD	DSS
			1991.877	344.2	24.49	1	FMR	TYCHO2
			1998.226	343.7	24.51	1	BVD	DSS
			1999.308	343.9	24.35	1	FMR	2MASS

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2009.255	344.1	24.42	6	BVD	CCD
BVD 107	14 22 21.30	+66 16 25.1	1895.313	231.9	38.38	1	FMR	AC2000
			1991.670	231.8	38.39	1	FMR	TYCHO2
			1999.381	231.7	38.42	1	FMR	2MASS
			2006.497	231.7	38.48	5	JCA	CCD
			2006.576	231.5	38.46	4	ERE	CCD
			2009.205	231.8	38.45	6	BVD	CCD
BVD 108	14 38 04.28	-09 44 16.4	1905.415	280.2	45.68	1	FMR	AC2000
			1991.760	280.5	46.20	1	FMR	TYCHO2
			1999.198	279.8	46.21	1	FMR	2MASS
			2006.515	279.3	46.10	4	ERE	CCD
			2006.562	279.4	46.00	5	JCA	CCD
			2006.628	279.5	45.96	5	ERE	CCD
			2009.255	279.4	46.27	6	BVD	CCD
BVD 109	14 51 32.50	-18 30 58.1	1916.584	91.9	59.09	1	FMR	AC2000
			1991.748	92.3	59.13	1	FMR	TYCHO2
			1998.349	92.2	59.08	1	FMR	2MASS
			2006.560	92.3	59.08	5	ERE	CCD
BVD 151	15 14 35.65	-58 01 05.5	1922.999	168.1	23.44	1	FMR	AC2000
			1991.712	168.5	23.24	1	FMR	TYCHO2
BVD 110	15 14 36.06	+59 17 03.6	1905.671	171.1	22.33	1	FMR	AC2000
			1991.673	171.0	22.82	1	FMR	TYCHO2
			1999.278	171.2	22.79	1	FMR	2MASS
			2006.500	171.1	22.92	5	JCA	CCD
			2006.574	171.1	22.83	5	ERE	CCD
			2006.642	171.1	22.82	8	RNA	CCD
			2009.205	171.1	22.85	6	BVD	CCD
BVD 111	15 16 40.81	-70 13 25.1	1894.998	124.8	29.76	1	FMR	AC2000
			1991.660	124.7	29.77	1	FMR	TYCHO2
GRV 903	15 21 09.41	+25 34 02.7	1905.868	243.4	68.96	1	FMR	AC2000
			1991.515*	242.8	69.23	1	FMR	TYCHO2
			2000.075*	243.1	69.07	1	FMR	2MASS
			2006.441	242.9	69.34	12	ERE	CCD
			2006.477	242.9	69.22	4	JCA	CCD
			2006.505	242.9	69.20	13	RNA	CCD
			2009.255	242.8	69.16	6	BVD	CCD
BVD 113	15 21 26.56	-34 57 44.1	1913.227	266.9	26.73	1	FMR	AC2000
			1991.525	266.3	26.64	1	FMR	TYCHO2
BVD 114	15 21 39.75	-20 40 05.0	1919.931	119.6	21.47	1	FMR	AC2000

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			1991.550	119.0	21.43	1	FMR	TYCHO2
			1998.368	119.3	21.39	1	FMR	2MASS
			2006.560	119.4	21.33	5	ERE	CCD
BVD 115	15 30 47.58	-69 23 45.0	1894.991	338.3	26.00	1	FMR	AC2000
			1991.685	338.9	26.20	1	FMR	TYCHO2
BVD 116	15 39 36.91	-30 10 48.1	1913.549	170.2	16.12	1	FMR	AC2000
			1991.583	170.7	16.21	1	FMR	TYCHO2
BVD 117	16 15 26.58	-40 22 15.6	1901.870	303.1	24.77	1	FMR	AC2000
			1991.520	302.4	24.73	1	FMR	TYCHO2
BVD 118	16 26 28.68	+00 42 21.3	1893.821	239.1	21.85	1	FMR	AC2000
			1991.565	239.2	21.95	1	FMR	TYCHO2
			1999.218	238.9	21.85	1	FMR	2MASS
			2006.516	239.0	21.87	5	ERE	CCD
			2006.530	239.1	21.87	5	JCA	CCD
			2006.601	239.0	21.87	10	RNA	CCD
			2006.631	239.1	21.89	5	RNA	CCD
			2009.255	238.9	21.87	6	BVD	CCD
BVD 119AB-C	16 55 37.76	-54 34 10.7	1903.216	354.6	28.54	1	FMR	AC2000
			1991.542	353.3	27.12	1	FMR	TYCHO2
GRV 959	17 30 13.31	+29 01 12.9	1903.517	356.3	24.50	1	FMR	AC2000
			1991.565*	355.7	24.16	1	FMR	TYCHO2
			2000.256*	355.7	24.27	1	FMR	2MASS
			2006.499	355.6	24.26	1	JCA	CCD
			2006.499	355.6	24.26	24	RNA	CCD
			2006.500	355.7	24.23	5	ERE	CCD
			2009.255	355.3	24.24	6	BVD	CCD
BVD 121	17 38 40.32	-54 28 09.7	1903.614	184.7	39.45	1	FMR	AC2000
			1992.005	185.0	39.68	1	FMR	TYCHO2
BVD 122	17 41 18.87	-34 40 36.1	1912.859	98.2	37.31	1	FMR	AC2000
			1991.450	98.4	37.24	1	FMR	TYCHO2
			1999.507	98.4	37.08	1	FMR	2MASS
BVD 123	17 42 26.77	-13 53 14.3	1907.387	269.1	18.66	1	FMR	AC2000
			1991.792	269.9	18.50	1	FMR	TYCHO2
			1998.321	270.3	18.30	1	FMR	2MASS
			2006.493	270.3	18.49	4	ERE	CCD
			2006.530	270.2	18.52	5	JCA	CCD
			2006.606	270.3	18.48	10	RNA	CCD
BVD 124	17 47 15.46	+08 50 51.6	1912.200	243.0	21.04	1	FMR	AC2000
			1991.588	242.6	21.32	1	FMR	TYCHO2

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2000.319	242.5	21.22	1	FMR	2MASS
			2006.518	242.4	21.20	5	ERE	CCD
			2006.530	242.5	21.19	5	JCA	CCD
			2006.565	242.5	21.18	10	RNA	CCD
			2006.597	242.5	21.20	5	OMG	CCD
			2006.625	242.5	21.22	4	RNA	CCD
BVD 125	17 54 05.10	+27 20 34.0	1991.615	32.5	48.36	1	FMR	TYCHO2
			2000.204	32.4	48.26	1	FMR	2MASS
			2006.496	32.5	48.32	5	ERE	CCD
			2006.500	32.6	48.24	4	JCA	CCD
			2006.565	32.5	48.29	15	RNA	CCD
			2009.255	32.6	48.27	6	BVD	CCD
BVD 152	17 55 13.02	-39 34 03.0	1907.438	147.9	50.68	1	FMR	AC2000
			1991.358	148.1	50.64	1	FMR	TYCHO2
BVD 126	18 23 21.01	-11 37 01.3	1906.640	288.7	19.10	1	FMR	AC2000
			1991.738	290.7	18.98	1	FMR	TYCHO2
			1999.319	290.3	19.14	1	FMR	2MASS
			2006.518	290.2	19.10	4	ERE	CCD
			2006.530	290.1	19.14	4	JCA	CCD
			2006.606	290.2	19.13	10	RNA	CCD
			2006.625	289.9	19.23	5	RNA	CCD
BVD 127	18 24 04.02	+72 20 05.2	1895.480	326.4	20.00	1	FMR	AC2000
			1991.680	327.2	19.90	1	FMR	TYCHO2
			2000.245	327.5	19.87	1	FMR	2MASS
			2008.544	327.4	19.83	1	BVD	CCD
BVD 128	18 25 14.68	+80 27 44.1	1897.175	317.1	24.90	1	FMR	AC2000
			1991.740	316.8	24.74	1	FMR	TYCHO2
			1999.439	316.5	24.50	1	FMR	2MASS
			2009.205	316.6	24.63	6	BVD	CCD
SRT 1	18 50 04.34	-13 16 28.9	1907.153*	250.9	29.05	1	FMR	AC2000
			1988.309	251.0	29.22	1	BVD	DSS
			1991.637*	251.2	28.92	1	FMR	TYCHO2
			1998.338*	251.3	28.98	1	FMR	2MASS
			2006.493	251.1	29.01	4	ERE	CCD
			2006.513	251.1	28.96	25	RNA	CCD
			2006.530	251.1	28.99	5	JCA	CCD
BVD 130	19 22 04.77	+00 36 37.8	1896.784	295.9	30.44	1	FMR	AC2000
			1991.685	296.2	29.96	1	FMR	TYCHO2
			1999.322	296.0	30.12	1	FMR	2MASS

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			2006.557	296.0	30.21	5	ERE	CCD
			2006.563	296.1	30.16	5	JCA	CCD
			2006.601	296.1	30.12	10	RNA	CCD
ARY 48	20 37 44.96	+32 23 42.3	1914.914	41.2	53.01	1	FMR	AC2000
			1991.670*	41.1	53.16	1	FMR	TYCHO2
			1998.456*	41.2	53.12	1	FMR	2MASS
			2006.557	41.2	53.19	5	ERE	CCD
			2006.563	41.3	53.09	4	JCA	CCD
BVD 131	20 39 01.80	+00 34 42.0	1903.043	133.6	30.23	1	FMR	AC2000
			1991.500	134.0	30.08	1	FMR	TYCHO2
			1998.713	133.9	30.12	1	FMR	2MASS
			2006.557	134.0	30.17	4	ERE	CCD
			2006.563	134.1	30.14	5	JCA	CCD
BVD 132AB-C	20 54 29.92	-60 59 33.2	1923.574	175.4	70.87	1	FMR	AC2000
			1991.735	175.0	70.69	1	FMR	TYCHO2
BVD 133	21 08 04.57	-45 04 35.0	1904.569	246.4	21.61	1	FMR	AC2000
			1991.867	246.0	21.18	1	FMR	TYCHO2
BVD 153	21 12 08.84	-41 27 50.4	1904.090	131.3	44.22	1	FMR	AC2000
			1991.790	131.7	44.17	1	FMR	TYCHO2
BVD 134	21 15 12.76	+53 50 34.6	1900.805	57.2	23.00	1	FMR	AC2000
			1991.655	57.4	22.71	1	FMR	TYCHO2
			1998.860	57.2	22.79	1	FMR	2MASS
			2006.557	57.4	22.91	4	ERE	CCD
			2006.563	57.2	22.93	4	JCA	CCD
			2006.582	57.4	22.79	10	RNA	CCD
BVD 135	21 15 42.59	+68 21 08.1	1894.409	310.2	25.22	1	FMR	AC2000
			1991.780	310.1	24.83	1	FMR	TYCHO2
			2000.768	310.1	24.78	1	FMR	2MASS
			2006.557	310.2	24.99	5	ERE	CCD
			2006.563	310.2	24.88	5	JCA	CCD
			2009.255	310.3	24.76	6	BVD	CCD
BVD 136	21 16 45.98	-51 23 22.7	1902.761	212.1	32.42	1	FMR	AC2000
			1991.800	212.4	32.51	1	FMR	TYCHO2
			1999.647	212.0	32.49	1	FMR	2MASS
BVD 137	21 33 30.86	-27 53 24.4	1991.618	58.3	40.34	1	FMR	TYCHO2
			1998.571	58.0	40.24	1	FMR	2MASS
			2006.553	58.2	40.26	4	ERE	CCD
BVD 138	21 34 16.49	-23 53 29.9	1910.186	121.0	25.44	1	FMR	AC2000
			1991.525	121.1	25.19	1	FMR	TYCHO2

Table 4 continues on next page.

New Wide Common Proper Motion Binaries

Table 4: Astrometric Measurements

Designation	RA_ 2000	DEC_2000	Epoch	θ	ρ	N	Observer	Method
			1998.540	121.3	25.12	1	FMR	2MASS
			2006.552	121.2	25.21	5	JCA	CCD
			2006.553	121.1	25.18	4	ERE	CCD
BVD 139AB-C	21 39 39.19	-12 37 20.2	1991.607	287.4	127.96	1	FMR	TYCHO2
			1999.412	287.4	127.97	1	FMR	2MASS
			2006.496	287.3	128.24	4	ERE	CCD
			2006.552	287.3	128.03	5	JCA	CCD
BVD 154	21 41 54.30	-37 09 46.6	1912.843	100.1	31.93	1	FMR	AC2000
			1991.560	99.5	31.87	1	FMR	TYCHO2
BVD 140	21 54 19.41	-20 20 09.6	1920.859	256.3	36.17	1	FMR	AC2000
			1991.593	256.1	35.91	1	FMR	TYCHO2
			1998.521	256.1	35.62	1	FMR	2MASS
			2006.552	256.2	35.75	5	JCA	CCD
			2006.574	256.1	35.81	5	ERE	CCD
			2006.635	256.2	35.83	5	OMG	CCD
BVD 155	22 09 53.23	-25 13 36.0	1991.693	281.4	47.62	1	FMR	TYCHO2
			1998.839	281.5	47.54	1	FMR	2MASS
			2006.552	281.4	47.62	5	JCA	CCD
			2006.553	281.4	47.62	4	ERE	CCD
BVD 141	22 24 49.56	-66 51 33.9	1991.705	183.2	11.61	1	FMR	TYCHO2
BVD 156	23 04 48.01	-40 22 38.3	1903.193	276.3	18.17	1	FMR	AC2000
			1991.593	277.1	18.11	1	FMR	TYCHO2
BVD 157	23 10 18.13	-50 16 06.5	1904.762	17.8	53.63	1	FMR	AC2000
			1991.710	17.9	53.65	1	FMR	TYCHO2
			1999.841	17.9	53.61	1	FMR	2MASS
BVD 142AB-C	23 10 29.37	+41 19 19.5	1991.540	164.7	79.57	1	FMR	TYCHO2
			1999.699	164.6	79.59	1	FMR	2MASS
			1999.699	164.6	79.59	1	FMR	2MASS
			2006.557	164.7	79.68	4	ERE	CCD
BVD 158	23 12 51.36	-51 41 08.9	1905.720	166.3	38.08	1	FMR	AC2000
			1905.720	166.3	38.08	1	FMR	AC2000
			1991.605	166.3	37.78	1	FMR	TYCHO2
			1991.605	166.3	37.78	1	FMR	TYCHO2
BVD 143	23 33 41.24	-64 13 51.7	1906.303	275.7	47.80	1	FMR	AC2000
			1906.303	275.7	47.80	1	FMR	AC2000
			1991.748	275.7	47.92	1	FMR	TYCHO2
			1991.748	275.7	47.92	1	FMR	TYCHO2
			1999.880	275.8	47.93	1	FMR	2MASS
			1999.880	275.8	47.93	1	FMR	2MASS

New Wide Common Proper Motion Binaries

(Continued from page 55)

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/)

References

Abt, H. A., & Levy, S. G. 1976, ApJS, 30, 273

Abt H.A., Levy S.G., 1977, PASP, 89, 185

Abt H.A., 1988, AJ, 331, 922

Abt H.A. & Corbally C.J. 2000, ApJ, 541, 841

Allen C.W., 1973, Astrophisical Quantities, Athlone Press.

Ambartsumian V.A., 1954, Contr. Obs. Byurakan 15, 3.

Barbier-Brossat M., Petit M., & Figon P., 1994, A&AS, 108, 603

Barbier-Brossat M. & Figon P., 2000, A&AS, 142, 217

Bastian U., Roeser S., 1993, Catalogue of Position and Proper Motion-South, Astronomisches Rechen-Institut, Heidelberg

Beer A., 1956, Vistas in Astronomy, A.Beer , Ed. (Pergamon Press, London), Vol. 2, p. 1387

Bergh, S. van den, 1958, Cont. Perkins Obs. Ser.2, #10,186

Bessell M.S. & Brett J.M., 1988, PASP 100, 1134

Burstein D. & Heiles C., 1984, ApJS, 54, 33

Caballero, R. 2009, JDSO, 5, 156

Cannon A.J. & Pickering E.C., 1918-1924, Henry Draper Catalogue and Extension 1, Harv. Ann. 91-100

Close, L. M. & Richer, H. B. 1990, AJ, 100, 1968

Close S.M. et al., 2003, ApJ, 587, 407

Cutri R.N., et al. Explanatory to the 2MASS Second Incremental Data Release, 2000, http://www.ipac.caltech.edu/2mass/releases/second/index.html

Dommanget J., 1955, BAORB, 20, 1

Dommanget J., 1956, BAORB, 20, 183

Dommanget, J. 1984, Ap&SS, 99, 23

Duflot M., Figon P., & Meyssonnier N., 1995, A&AS, 114, 269

Eggen O.J., 1969a, PASP, 81, 741

Eggen O.J., 1969b, PASP, 81, 553

Eggen O.J,. 1976, PASP, 88, 426

ESA SP-1200, ESA Noordwijk, 1997, catalogs HIPPARCOS and TYCHO

Farnsworth, A.H., 1955, ApJS, 2, 123

Finsen, W. S. 1932, Union Obs. Circ. 3, 237

Fischer D.A., & Marcy G.W., 1992, AJ, 396, 178

Ginestet N. & Carquillat J.M., 2002, ApJS, 143, 513

Grenon M., 1987, JApA, 8, 123

Grocheva E. & Kiselev A., 1998, ASP Conference Series, Vol. 145

Halbwachs J. L., 1986, A&AS, 66,131

Halbwachs, J. L. 1988, Ap&SS, 142, 237

Hartkopf, William I.; Mason, Brian D., 2004, RMxAC, 21, 83H

Henry T.J., & D. W. McCarthy Jr. 1993, AJ, 106, 773

Henry T.J., Ianna P.A., Kirkpatrick J.D., & Jahreiss, H., 1997, AJ, 114, 388

Hill G., Barnes J. V. et al., 1982, PDAO, 16, 111

Hog E. et al., 2000, AJ, 335, 27

Houk N. & Cowley A.P., 1975, Michigan Catalogue of Two-Dimensions. Vol. 1: Declinations from -90deg < δ < -53deg (Ann Arbor, Univ. of Michigan)

Houk N., 1978, Michigan Catalogue of Two-Dimensions. Vol. 2: Declinations from –52 to –40 degrees (Ann. Arbol: Univ. Michigan))

Houk N., 1982, Michigan Catalogue of Two-Dimensions. Vol. 3: Declinations from –40 to –26 degrees (Ann. Arbol: Univ. Michigan))

Houk N., Smith-Moore M., 1988, Michigan Catalogue of HD stars, Vol.4, (Ann. Arbol: Univ. Michigan)).

Houk N. & Swift C., 1999, "Michingan Catalogue of Two-Dimensional Spectral Types for the HD Stars", vol. 5

Jaschek C., Conde H., & de Sierra A.C., 1964, Publ. La Plata Obs., Ser. Astron. 28, No. 2

New Wide Common Proper Motion Binaries

Jenkins L.F., 1963, Yale Univ. Obs.

Jones E.M., 1972, AJ, 173, 671

Kirkpatrick J.D. & McCarthy D.W. Jr, 1994, AJ, 107, 333

Lathan, D. W., Tonry, J., Bahcall, J. N., Soniera, R. M. 1984, ApJ, 281, 41

Ferrero, L. 2009, JDSO, 5, 211

Lepine S. & Shara M. M. 2005, AJ, 129, 1483

Mason B.D., Wycoff G., & Hartkopf W.I., 2003, The Washington Double Star Catalog, http://ad.usno.navy.mil/proj/WDS/wds.html

Michell J., 1768, Philosophical Transaction, London LVII, part. I, 234

Miskin N.A., 1973, AbaOB, 44, 231

Monet D.G., Levine S.E., Casian B., et al., 2003, AJ, 125, 984

Montes D., Lopez-Santiago J., Galvez M.C., Fernandez-Figueroa M.J., De Castro E., & Cornide M., 2001,MNRAS, 328, 45

Neckel Th. & Klare G., 1980, A&AS, 42, 251

Nelson C.A. et al., 2002, ApJ, 573 644

Nordstrom B. et al., 2004, A&A, 418, 989N

Oja T., 1985, A&AS, 61, 331

Olsen E.H., 1994a, A&AS, 104, 429

Olsen E.H., 1994,b A&AS, 106, 257

Paresce F., 1984, AJ, 89, 1022

Poveda, A., Allen, C. 2004,RMxAC, 21, 49

Retterer, J. M. & King, I. R. 1982, ApJ, 254, 214

Rica F., 2005, JDSO, 1, 8

Rica F., 2006, JDSO, 2, 36

Rica F., 2008, RMxAA, 44, 137

Roeser S. & Bastian U., 1988, A&AS, 74, 449

Russell H.N., 1928, AJ, 38, 89

Russell H.N. & Moore C.E., 1940, The Masses of the Stars (University of Chicago Press, Chicago)

Samus N.N., Durlevich O.V., et al., 2004, Combined General Catalog of Variable Stars (GCVS4.2, 2004 Ed.), Institute of Astronomy of Russian Academy of Sciences and Sternberg, State Astronomical Institute of the Moscow State University

Salim S. & Gould A., 2002, ApJ, 575, 83

Scalo J.M., Dominy J.F., & Pumphrey W.A., 1978, ApJ, 221, 616

Schwassmann A. & Van Rhijn P.J., 1947, BSD, C03, 0S

Schlegel D.J., Finkbeiner D.P., & Davis M. 1998, ApJ, 500, 525

Sesar, B., Ivezić, Ž., Jurić, M. 2008, ApJ, 689, 1244

Sinachopoulos D. & Mouzourakis P., 1992, Complementary Approaches to Double and Multiple Star Research in the IAU Colloquium 135, ASP Conferences Series, Vol. 32

Stephenson C.B., 1986, AJ, 92, 139

Stephenson C.B. & Sanwal N.B., 1969, AJ, 74, 689

Stoy, R. H., 1968, Annals of the Cape Observatory ; v. 22, [Cape Town : Cape Observatory], 1968., xxxii, 141 p. ; 31 cm

Upgren A.R., 1962, AJ, 67, 37

Upgren A.R., Grossenbacher R., Penhallow W.S., MacConnell D.J., & Frue R.L., 1972, AJ, 77, 486

Upgren A. R., & Caruso J.R., 1988, AJ, 96, 719

van de Kamp P., 1961, PASP, 73, 389

van Herk G., 1965, BAN, 18, 71

Wenger M., Ochsenbein, F., Egret, D., et al. 2003, SIMBAD astronomical databa base, http://simbad.u-strasbg.fr/

Wroblewski W. & Torres C., 1997, A&AS, 122, 447

Zacharias N., et al., 2004, AJ, 127, 3043

New Double Stars from Asteroidal Occultations, 1971 - 2008

Dave Herald, Canberra, Australia
International Occultation Timing Association (IOTA)

Robert Boyle, Carlisle, Pennsylvania, USA
Dickinson College

David Dunham, Greenbelt, Maryland, USA;
Toshio Hirose, Tokyo, Japan;
Paul Maley, Houston, Texas, USA;
Bradley Timerson, Newark, New York, USA
International Occultation Timing Association (IOTA)

Tim Farris, Gallatin, Tennessee, USA
Volunteer State Community College

Eric Frappa and Jean Lecacheux, Paris, France
Observatoire de Paris

Tsutomu Hayamizu, Kagoshima, Japan
Sendai Space Hall

Marek Kozubal, Brookline, Massachusetts, USA
Clay Center

Richard Nolthenius, Aptos, California, USA
Cabrillo College and IOTA

Lewis C. Roberts, Jr., Pasadena, California, USA
California Institute of Technology/Jet Propulsion Laboratory

David Tholen, Honolulu, Hawaii, USA
University of Hawaii

E-mail: DRHerald@bigpond.net.au

Abstract: Observations of occultations by asteroids and planetary moons can detect double stars with separations in the range of about 0.3” to 0.001”. This paper lists all double stars detected in asteroidal occultations up to the end of 2008. It also provides a general explanation of the observational method and analysis. The incidence of double stars with a separation in the range 0.001” to 0.1” with a magnitude difference less than 2 is estimated to be about 1%.

New Double Stars from Asteroidal Occultations, 1971 - 2008

Introduction

Asteroids and planetary moons will naturally occult many stars as they move through the sky. The biggest challenge in observing such occultations is to accurately predict the time of the occultation event and the location of the shadow path as it crosses the Earth. Since the Hipparcos mission, and the availability of catalogues like Tycho2 and UCAC2, predictions of occultations by asteroids and planetary moons with uncertainties of 100km in the path location have become routine. For the last few years almost 200 occultation events per year have been observed around the world.

In the early days of asteroidal occultations, most observations were made visually. For the last several years the great majority of observations are made using video cameras with a time signal obtained from the GPS satellite system inserted into the video stream. Compared to visual observing, video provides enhanced time resolution, and a record that can be measured to deduce accurate event times. Asteroid profiles can be measured at the 1-km scale using small telescopes and inexpensive video detectors, as has been illustrated by Timerson [1].

In a typical occultation the asteroid is not visible. The occultation is recorded as the sudden disappearance of the star, followed some seconds (or tens of seconds) later with a sudden reappearance of the star. For a small number of events, the occultation may involve:

A partial drop in light, followed by a complete drop in light. The order of the light change may be either the same, or reversed, when the star reappears; or

There is simply a partial drop in light.

These are characteristics of the star being a double star – with the changes of light occurring as the two stars are sequentially hidden by the asteroid. When this occurs, a double star is typically 'discovered'. If there are several observers at spaced locations, it is possible to combine the observations in a way that allows the PA and separation to be solved. The typical measurement accuracy obtained is a milli-arcsec in separation, and a few degrees in PA.

The practical minimum separation detectable by this method is about 1 milli-arcsec – a limit arising from the time resolution of the video cameras being used, and Fresnel diffraction. The maximum separation detectable is limited by the apparent diameter of the asteroid involved. If the diameter is less than the separation, an occultation of only one star might occur – with there being no data to measure the separation from the second star, but these cases usually involve doubles already known from visual or other observations. More detail about the method of analysis is set out in the Appendix.

Results – 1971 to 2008

Double stars have been detected in occultations by asteroids and planetary satellites since 1971. While some of these detections have been published in the literature, almost none are listed in the Interferometric Catalogue or the Washington Double Star catalogue. Table 1 presents the measures of all double stars observed or discovered in these occultations up to the end of 2008 – whether or not they have been reported elsewhere. They include the bright stars γ Gem (HIP 31681), λ Vir (HIP 69974), β^2 Sco (HIP 78821), 1 Vul (HIP 78821) and 16 Psc (HIP 116495). References are given for those events known to have been published in the literature.

At the time these observations were made, little attention was given to determining the star magnitudes. Component magnitudes determined from photoelectric recordings were published for the three events listed below observed before 1983. Most of the other occultations listed were video recorded, but until recently there was no easy way to quantify the magnitudes of the component stars from video recordings. The authors plan to digitize the older video recordings and publish a list of component magnitudes for most of the listed events in a future publication.

There are three types of entries in Table 1:

Single-line entry. The double star solution for these stars is unique and well determined.

Single-line entry with a 3-point range (TYC 5614-00026-1 and HIP 38465). For these stars the data is insufficient to provide a unique solution, but are constrained by the geometry of the event. The values given are the extreme values in PA (where the separation is also greatest) - and the intermediate value of PA where the separation is least. If the asteroid profile is significantly elliptical, the range in PA can be significantly greater than 180 degrees. The values are given in order of increasing PA.

Double-line entry (TYC 1808-00641-1 and HIP 69974). For these stars there are two well-determined solutions. The observations are insufficient to resolve the ambiguity, or associate a formal uncertainty with the solution.

On the night following the occultation of TYC 1879

(Continued on page 91)

New Double Stars from Asteroidal Occultations, 1971 - 2008

Table 1: Double stars discovered or measured in asteroidal occultations: 1971 - 2008

Star number, J2000 RA/Dec WDS/4th Interfer. ID	Position Angle (PA) (degrees)	Angular Separation (masec)	Date	Asteroid	Publ Ref
TYC 0622-00932-1 01 46 51.55 +08 16 08.3 -	248.7 ± 2.5	18.8 ± 1.1	2005 Nov 11 2005.865	116 Sirona	-
TYC 1808-00641-1 03 53 33.26 +27 18 06.1 -	278.1 or 272.1	5.1 or 25.1	2008 Jan 14 2008.034	1258 Sicilia	-
TYC 1879-02151-1 06 31 17.55 +22 47 50.9 COU 581	240.0 ± 0.5	261.9 ± 1.5	2006 Sep 19 2006.715	144 Vibilia	-
TYC 1908-00844-1 07 14 41.22 +29 52 38.7 -	302.9 ± 0.1	170.4 ± 0.3	2006 Nov 29 2006.909	578 Happelia	-
TYC 1947-00293-1 08 25 01.65 +28 33 55.3 -	105.6	106.3	2006 Dec 18 2006.961	87 Sylvia	2
TYC 2411-01645-1 05 31 33.75 +35 01 45.8 -	248.7 ± 0.5	6.3 ± 0.1	1996 Nov 25 1996.899	93 Minerva	-
TYC 2916-02502-1 05 52 44.43 +40 10 45.0 -	70.4 ± 3.9	57.5 ± 2.3	1999 Sep 21 1999.719	375 Ursula	-
TYC 5614-00026-1 15 54 10.20 -09 44 49.8 -	165 - 270 - 36	41.0 - 7.0 - 16.0	2002 May 10 2002.353	638 Moira	-
TYC 6154-00401-1 14 41 45.96 -16 36 09.2 -	81.9 ± 1.4	5.4 ± 0.2	2003 Apr 21 2003.301	210 Isabella	-
HIP 26902 05 42 41.48 +36 08 59.4 -	30.3 ±19.7	1.1 ± 0.3	2005 Dec 1 2005.915	99 Dike	3
HIP 30570 06 25 32.94 +23 19 37.8 MCA 26	344.9 ± 1.3	36.5 ± 3.7	2001 Sep 7 2001.682	9 Metis	4
HIP 31681 06 37 42.70 +16 23 57.3 BUP 90A	126.3 ± 4.7	63.4 ± 1.0	1991 Jan 13 1991.032	381 Myrrha	5
HIP 31694 06 37 51.49 +06 40 59.7 HD 47239	26.1 ± 1.4	45.9 ± 2.1	1978 Dec 11 1978.942	18 Melpomene	6
HIP 32525 06 47 13.67 +16 55 34.9 -	70.9 ± 1.9	9.7 ± 0.3	2007 Mar 28 2007.235	72 Feronia	-
HIP 34452 07 08 30.95 +21 59 09.4 OCC 337;	89.0	39.0	1974 Aug 29 1974.657	Saturn 5 (Rhea)	7
HIP 36189 07 27 09.12 +11 57 18.0 HD 58686	230.7 ± 2.5	12.8 ± 0.5	2003 Mar 23 2003.221	704 Interam- nia	-

Table continued on next page.

New Double Stars from Asteroidal Occultations, 1971 - 2008

Table 1 (continued): Double stars discovered or measured in asteroidal occultations: 1971 - 2008

Star number, J2000 RA/Dec WDS/4th Interfer. ID	Position Angle (PA) (degrees)	Angular Separation (masec)	Date	Asteroid	Publ Ref
HIP 38465 07 52 45.59 +18 49 37.4 HD 64072	342 - 103 - 226	43 - 8 - 52	2002 Dec 24 2002.977	334 Chicago	-
HIP 66446 13 37 15.76 +04 25 03.4 HD 118510	309.3 ± 5.4	19.7 ± 1.5	2001 Mar 15 2001.201	423 Diotima	8
HIP 69974 14 19 06.59 -13 22 15.9 HD 125337	13.0 or 210.0	8.0 or 18.1	2006 Apr 12 2006.277	305 Gordonia	-
HIP 76293 15 35 06.23 -25 06 20.2 HD 138790	81.0 ± 3.3	39.5 ± 2.0	2007 May 18 2007.374	1177 Gonnessia	-
HIP 78821 16 05 26.57 -19 48 06.9 MCA 42 CE	311.6 ± 2.3	98.6 ± 3.0	1971 May 14 1971.363	Jupiter I (Io)	9
HIP 94703 19 16 13.04 +21 23 25.5 HJ 2862 AB	272.0 ±13.6	3.0 ± 0.6	1983 May 29 1983.405	2 Pallas	10
HIP116495 23 36 23.29 +02 06 08.0 THP 1	117.6 ± 5.1	9.8 ± 0.8	2006 May 5 2006.340	7 Iris	11

(Continued from page 89)

-02151-1 Jean Lecacheux measured the pair from Pic-du-Midi observatory, using the 1.05-m reflector at 43-meters focal length and fast CCD imaging. The position angle and separation were measured as 241 deg and 260 masec, which can be compared with the occultation values of 240.0 ± 0.5 deg and 261.9 ± 1.5masec.

Observers

The determination of the double star details from an asteroidal occultation is usually the result of combining the results from all observers who successfully observed the event. The names of the observers for each double star determination are given in Table 2.

A Statistical Observation

Asteroidal occultations will expose a double star if the separation is in the range of 0.001” to 0.l”. There is also a magnitude limitation arising from the brightness of the stars being observed and the equipment being used to record the event; generally, if the magnitude difference is less than 2 magnitudes any component would be expected to be identified in the video recording.

Video observations became the dominant recording technique from about 2002. For the years 2003 to 2008, there have been a total of 1009 observed occultations. Over that period 11 double stars were detected in the occultation. From this it may be inferred that the incidence of double stars with a separation in the range 0.001” to 0.1” with a magnitude difference less than 2 is about 1%.

References

1. Timerson et al, 2009, “A Trio of well-observed Asteroid occultations in 2008”, Minor Planet Bulletin vol. 36, #3, pp. 98-100
2. Chi-Long Lin et al. “A Close Binary Star Resolved from Occultation by 87 Sylvia”, Publications of the Astronomical Society of the Pacific, vol. 121, pp. 359–364, 2009 April
3. Dunham, D. W. 2006, “Occultations and the Bright Star Catalog”, in The Hoffleit Centennial: A Year of Celebration, ed. A. G. Davis Philip, William van Altena, and Rebecca A. Koopmann (Schenectady, L. Davis Press), pp. 159-166.

(Continued on page 93)

New Double Stars from Asteroidal Occultations, 1971 - 2008

Table 2: Observers for double star determinations.

Star number	Observers
0622-00932-1	T. Farris, M. Good, J. Goss, R. James, D. Snyder, B. Stevens
1808-00641-1	R. Venable
1879-02151-1	L. Blommers, I. Bryukhanov, O. Canales, J. Caquel, R. Casas, E. Frappa, R. Goncalves, A. Klotz, C. Labordena, M. Lavayssiere, J. Lecacheux, C. Perello, J. Ripero, L. Smelcer, S. Sposetti, G. Vaudescal, I. Vinyaminov.
1908-00844-1	M. Castets, F. Colas, O. Dechambre, A. Eberle, O. Farago, J. Lecacheux, M. Meunier
1947-00293-1	King, C. Lin, Lin, Zhang
2411-01645-1	H. Akazawa, N. Ohkura
2916-02502-1	F. Anet, R. Buchheim, J. McCormick, B. Owen, J. Sanford
5614-00026-1	R. Baldrige, D. Dunham, R. Nolthenius, R. Venable
6154-00401-1	A. Gilmore, D. Herald, R. Price, P. Purcell
HIP 26902	D. Dunham, G. Fishkorn, J. Sedlak, W. Warren, J. Wetmore
HIP 30570	D. Dunham, R. Innes, W. Morgan, R. Nolthenius, K. Okasaki, S. Preston
HIP 31681	Y. Ban, S. Fukushima, A. Hagiwara, T. Hasegawa, A. Hashimoto, Y. Hirose, T. Homma, J. Horiuchi, W. Kakei, S. Kaneko, H. Karasaki, T. Kiyokawa, H. Koyama, Y. Moriya, H. Oya, I. Sato, M. Sato, H. Shibuya, K. Shima, M. Soma, Y. Suenaga, M. Sugai, A. Suzuki, K. Tanaka, S. Waku, M. Yamada
HIP 31694	M. A'Hearn, R. Bolster, D. Dunham, J. Dunham, F. Espenak, T. Van Flandern, Schmidt, D. Skillman
HIP 32525	K. Coughlin, R. Fleishman
HIP 34452	M. De Coca, V. De Gaia, A. Quintanilla
HIP 36189	A. Nakanishi, A. Tsuchikawa, A. Yaeza, A. Miyamoto, J. Bedient, B. Brevoort, S. Bus, C. Sakaki, E. Cleintuar, D. Dunham, O. El, W. El, V. Fukunaga, W. Fukunaga, H. Nihei, H. Hamanowa, H. Nagai, H. Sugai, H. Sato, H. Watanabe, I. Ootsuki, K. Kitazaki, K. Usuki, M. Sato, P. Maley, M. Momose, M. Koishikawa, M. Ishida, M. Okamoto, M. Fujita, M. Ida, N. Kita, S. O'Meara, L. Roberts, R. Ikeshita, S. Uehara, S. Kaneko, S. Suzuki, R. Savalle, S. Yoneyama, J. Swatek, R. Sydney, H. Takashima, D. Tholen, Ts. Sato, A. Watanabe, Y. Tonomura, Y. Hirose, Y. Itou, Y. Sugiyama, M. Kouda, H. Yoshida, M. Yokokawa, E. Konno, K. Sasaki, To. Sato, T. Oribe, H. Sugawara, H. Tomioka, A. Kuboniwa
HIP 38465	C. Bader, G. Billings, M. Damashek, R. D'Egidio, D. Dunham, R. Emmons, J. Holtz, A. Lowe, C. Roelle
HIP 66446	G. Akrivas, M. Appakutty, P.M. Berge, M. Bonnet, J. Caquel, F. Colas, P. Gilabert, K. Jayakumar, H. Kulkarni, J. Lecacheux, C. Leyrat, M. Maillard, P. Martinez, A. Paranjpye, J. Piraux, R. Poncy, M. Prabhunne, O. Ruau, M. Senegas, K. Shah, B. Tregon, R. Vasundhara, C. Velu.
HIP 69974	R. Venable
HIP 76293	L. Barak, S. Gebhard, T. Janik, F. Lomoz, J. Manek, Z. Moravec, M. Parl, V. Priban, H. Raab, L. Smid
HIP 78821	Bartholdi, Fallon, Devinney, Oliver, Owen, Smith
HIP 94703	J. Abdias, M. Adams, M. A'Hearn, S. Austin, D. Baker, J. Barton, Bartz, R. Binz, B. Birdsong, B. Blagg, Brady, J. Bragg, J. Breazeale, M. Brewster, D. Brunett, J. Camp, T. Campbell, J. Cannizzo, J. Chauvin, D. Clark, J. Craft, Crawford, J. Culberson, B. Cuthbertson, S. Dale, B. Darnell, C. Davis, L. Dedear, L. Delaney, J. Dellinger, R. Dietz, R. Diiulio, J. Doryk, W. Douglass, D. Dunham, J. Dunham, G. Ellis, S. Elsner, J. Erickson, G. Felos, D. Foster, T. Fox, T. Freeman, M. Frueh, D. Garland, D. Garnet, G. Gonzales, C. Graham, J. Graves, D. Green, Greer, J. Hagan, R. Harper, F. Harvey, N. Henderson, D. Hensch, C. Herold, W. Hoffler, Hok, A. Hradesky, Hubbard, B. Hudgens, S. Ireland, B. Jansen, A. Jon, A. Jones, K. Jurgens, C. Kennedy, R. Kennedy, T. Kenyon, G. Kiser, E. Kolarich, D. Kornbluh, M. Lawson, D. Leblanc, J. Lucke, P. Maley, T. Malone, E. Manual, M. McCants, R. McCormack, C. McDougal, J. McGaha, J. Meadows, G. Metcalf, B. Mitchell, M. Mooney, Moreno, S. Morgan, J. Mote, W. Nissen, R. Nolthenius, D. Oliver, T. Oswalt, G. Page, R. Peters, J. Petersen, H. Povenmire, P. Powell, B. Prislovsky, J. Ratley, L. Reed, A. Reeves, B. Riefer, G. Roark, J. Robicheaux, S. Roby, P. Romig, J. Rose, Rouw, P. Roy, S. Sawyer, D. Schinkevic, G. Schneider, R. Schnurr, J. Schroeder, T. Schult, M. Seslar, W. Settle, C. Sexton, J. Shinner, D. Siner, J. Smith, B. Snow, J. Stafford, H. Stanley, D. Strum, D. Sventek, P. Sventek, Tafliger, R. Taibi, R. Teed, M. Treadway, R. Weber, A. Whipple, T. Williams, R. Wood, L. Woods, Wren, J. Young, G. Zentz, J. Zitwer
HIP116495	R. Boyle, L. Garrett, J. Holtz, M. Kozubal, F. Melillo, B. Thompson

(Continued from page 91)

4. Dunham, D. W., "Planetary Occultations for 2002", Sky and Telescope, vol. 103, no. 3, March 2002, pp. 92 – 97.

5. Sato, I, Soma, M and Hirose, T. "The occultation of gamma Geminorum by the asteroid 381 Myrrha", Astronomical Journal, vol. 105, no. 4, April 1993, pp. 1553-1561.

6. Dunham, D. W., 1979, "Duplicity of both (18) Melpomene and SAO 114159 discovered during occultation", Occultation Newsletter, vol. 2, pp. 12 – 16.

7. Taylor, G. E.; Walker, E. N.; Quintanilla, A. R.; López de Coca, P., "Results of the occultation of the star SAO 79100 by RHEA on 1974 August 29", Astronomy and Astrophysics, vol. 50, no. 1, July 1976, pp. 121-123.

8. Vasundhara, R., "Observations of occultation of HIP 66446 by (423) Diotima on 2001 March 15 from India - Detection of a companion to the star", Bull. Astr. Soc. India, vol. 29, 2001, pp. 577-584.

9. Taylor, G.E. et al, "Occultation of Beta Scorpii C by Io on May 14, 1971", Nature vol. 234, pp. 405 - 406 17 December 1971.

10. Dunham, D. W., et al, "The size and shape of (2) Pallas from the 1983 occultation of 1 Vulpeculae", Astronomical Journal, vol. 99, May 1990, pp. 1636-1662.

11. B. Thompson and T. Yeelin, "Duplicity in 16 Piscium Confirmed from Its Occultation by 7 Iris on 2006 May 5", Publications of the Astronomical Society of the Pacific (PASP), 118, 1648-1655, December 2006

Appendix:

Deriving Double Star Measurements from an Asteroidal Occultation

An asteroidal occultation results in the sudden extinction of light from a star as an asteroid passes in front of it. The typical duration of an occultation is a few seconds. A 'good' occultation will last for over 10 seconds; on rare occasions an occultation will last for over a minute. You can visualise an asteroidal occultation by thinking of the shadow of the asteroid cast on the Earth by the star. That shadow will cross the Earth as a result of the asteroid's motion. Typically the shadow will cross the Earth in about 20 minutes, and the path of the shadow will have a width equal to the diameter of the asteroid. An observer within the path can record the shadow passing over them by recording the time at which the star light disappears and reappears. Place several observers across the shadow path, and the occultation times recorded by the observers effectively map out the size and shape of the shadow – and hence of the asteroid. This has been the main motivation for observing asteroidal occultations.

The greatest difficulty with observing asteroidal occultations is accurately predicting the location of the shadow path. For a well-known main belt asteroid, the uncertainty in the path location is rarely less than 50km, and is often well over 100km. For a trans-Neptunian asteroid, the uncertainty is typically thousands of km or larger!

For a small number of events, the occulted star is observed to be a double star. This is typically detected as a two-step change in light level as the occultation starts or ends. For a double star to be detected and measured, the separation cannot be much larger than the apparent diameter of the asteroid. In practice, this means that most double stars discovered in an asteroidal occultation have a separation less than 0.1", and none have been recorded with a separation greater than 0.3". The minimum separation is limited by Fresnel diffraction, and the time resolution of the video cameras used. So far no double star with a separation of less than 1 masec has been identified.

The majority of observations are presently made using low-light video cameras, running at either 30 fps (NTSC) or 25fps (PAL). The vertical synchronisation pulse for each video frame is used to trigger the reading of a GPS-controlled clock, with a corresponding time-stamp being video-inserted near the bottom of that frame. The video recording is analysed using a tool such as Limovie (http://www005.upp.so-net.ne.jp/k_miyash/occ02/limovie_en.html) to extract a timed light curve.

The process for reducing an asteroidal occultation involves the following:

- The process uses the "Fundamental plane". This is a plane through the centre of the Earth that is normal to the *apparent* direction of the star;
- A moving reference frame is defined on that plane – with its motion corresponding to the ephemeris motion of the asteroid's shadow on

New Double Stars from Asteroidal Occultations, 1971 - 2008

the plane. A nominal zero position is arbitrarily defined using one of the observations.

- For each observed event by each observer, the observer's location on the surface of the oblate Earth is projected onto the moving reference frame.

The projection of the observers' locations results in a series of data points in the moving reference frame that represents the outline of the asteroid. Figure 1 is such a plot from an occultation of HIP 36189 by Interamnia on 2003 March 23 – an occultation involving a double star. In this plot, only the events for the primary star are included. (The points in a line at the top and bottom of the plot represent the time of closest approach for observers who recorded no occultation. The direction of motion of the asteroid is normal to these lines.)

Figure 1: Projection of observers' locations from occultation of HIP 36189.

Normal processing of the occultation observations entails a least-squares fitting of an ellipse to the data points. The least-squares solution involves 5 unknowns – the X and Y coordinates of the centre of the ellipse, the major and minor axes of the ellipse, and the orientation of the ellipse.

When a double star is involved, the effect is to create a second set of data points that is displaced from the first set. Importantly, the shadow of the asteroid cast by the companion star will have the same size, shape and orientation as the shadow cast by the primary star – it will merely be displaced from the main shadow by an amount dependent upon the separation, and in a direction dependent upon the PA of the companion. As a result, the double star solution *merely* requires solving for two additional unknowns - the separation and position angle that will bring the two shadow profiles into mutual alignment.

In Figures 2 - 4, Figure 2 shows the data points corresponding to the secondary star. Figure 3 has the data points of both the primary and secondary stars plotted together, with no offset. Figure 4 has the data points offset so that the two profiles are in full alignment. The offset is indicated by the double star representation in the centre of the plot, which is drawn at the scale of the asteroid. In this case, the apparent diameter of Interamnia was 0.177", and the measured separation of the stars was 12.8masec. The duration of the occultation was up to 71 seconds, with the time

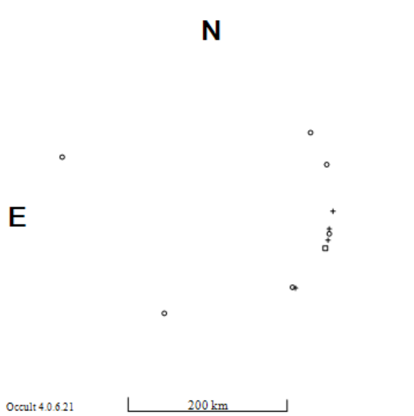


Figure 2: Data points corresponding to the secondary star.

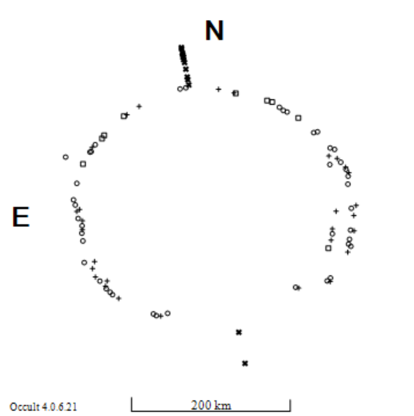


Figure 3: Data points for both stars with no offset.

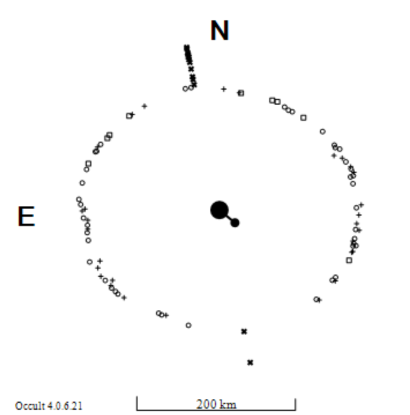


Figure 4: Data points for both stars with offset so that profiles are aligned.

New Double Stars from Asteroidal Occultations, 1971 - 2008

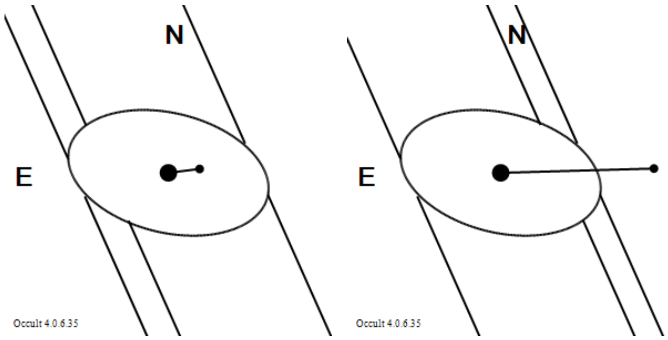


Figure 5: Illustration of possible amibiguity if only one observer records double star events.

difference between the two components being up to 9 seconds.

Where the occultation is well observed with several chords, and the double star is recorded at both the disappearance and reappearance events, the solution for the separation and position angle can have very high precision.

If only one of several observers records double star events, the solution may have an ambiguity. In such circumstances the observed chord might fit on both sides of the asteroid – leading to two solutions for the separation and position angle. This is illustrated by the following two diagrams (Figure 5), which relate to the occultation of TYC 1808-00641-1. Two observers (actually for this event, one observer running two widely-separated stations, with video techniques making it possible to run separate stations remotely) recorded the occultation of the main star – with chords being near the extremities of the asteroid. One of those stations (the left-most in the diagram) also recorded an occultation by a secondary star. As shown in the diagrams, there are two possible locations where the observed chord of the secondary matches the profile of the asteroid – leading to two possible solutions for separation and PA, as indicated by the double star representation in each diagram. In this case both solutions have a similar PA. However in general the two PAs can differ by up to 180 deg. Note that one of the solutions can be excluded if it is clear that stations that 'should have' recorded the second star occulted under that solution definitely did not see that star occulted.

When there is a large magnitude difference between the stars, it may be that the companion star is detected at only one of the disappearance and reappearance events. If there are several spaced observers who record the companion star, a reliable unique solution can still be obtained. However if only one observer (or two closely spaced observers) record the companion, a unique solution is not possible. Rather there will be a range of possible solutions extending over a range of position angles of about 180 degrees. The following diagrams (Figure 6) are for the occultation of HIP 38465. The first diagram shows the outline of the asteroid as determined by nine observers. One observer detected a step event on the reappearance (in the diagram, the star is moving from right to left). The location of the star path is constrained by the diameter of the asteroid. The 2nd diagram shows the solution for the secondary star assuming its chord is at its maximum position north. The fourth diagram is for the chord being at the maximum position south, and the third diagram is the solution for minimum separation of the components.

The situation differs from a single lunar occultation with a vector separation in three ways:

1. For a lunar observation the range of possible PA values is 180°. For an asteroidal observation the possi-

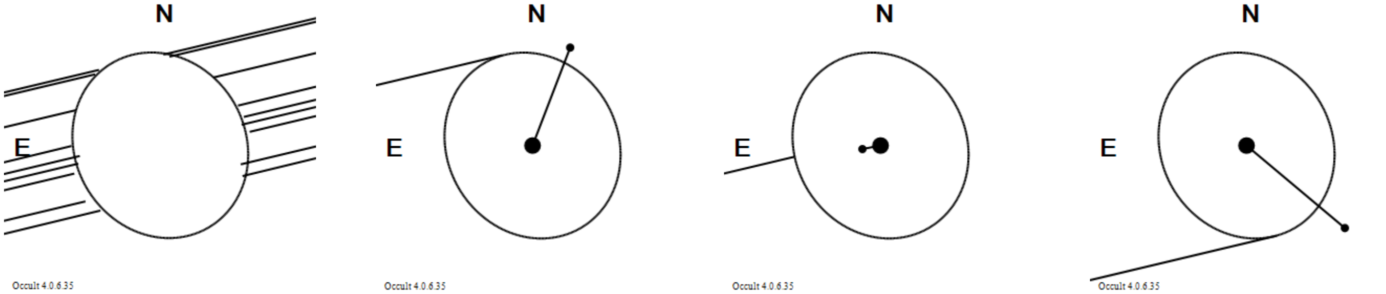


Figure 6: Possible amibiguities in separation and position angle if only one observer sees the secondary as a step event in the light curve. See text.

New Double Stars from Asteroidal Occultations, 1971 - 2008

ble range of PA is usually greater than 180°. (In this case, it is 244°)

2. In a lunar observation, no limit on the separation can be derived from a single observation. In an asteroidal occultation the diameter of the asteroid imposes an upper limit on the separation. In this case it is 0.052" – assuming the solution of the fourth diagram.

3. In a lunar occultation the separation is related to the difference between the PA of the star components and of the occultation vector by a simple secant relationship. For an asteroidal occultation the relationship is more complex, and depends upon the shape of the asteroid.

These are illustrated in the following plot of the separation against position angle for this star, together with a plot of the separation curve for an equivalent lunar occultation, Figure 7. As can be seen, the lunar solution is symmetric, and is asymptotic at 90° from the central location (of 105°). In contrast the asteroid solution is asymmetric, has no asymptotes, but has limiting values of PA with corresponding maximum values of separation.

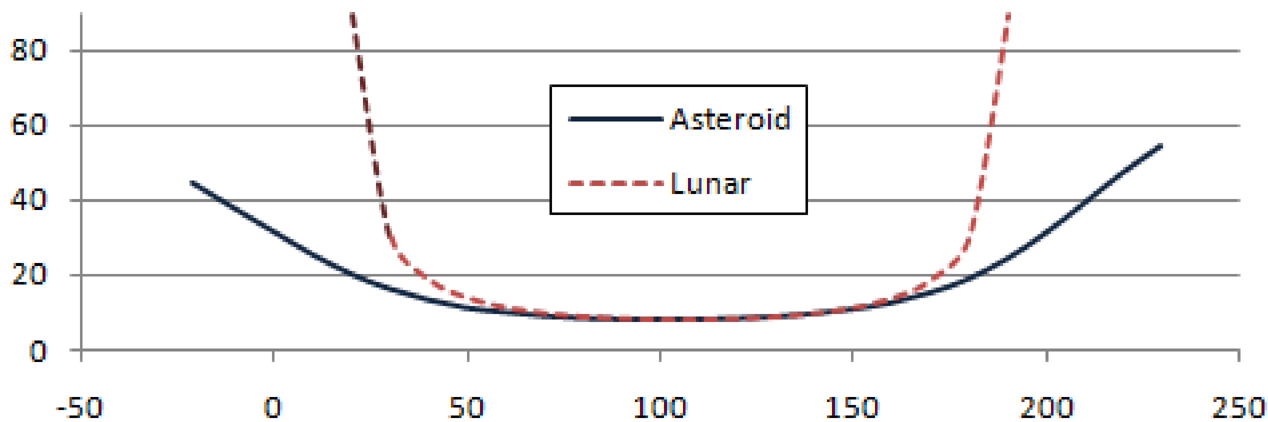


Figure 7: Separation versus position angle for a double star for both lunar and asteroidal occultations.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Rafael Caballero

Agrupación Astronómica Hubble,
Martos, Jaén, Spain

Email: rafa@sip.ucm.es

Abstract: This paper presents 310 new common proper-motion pairs obtained by data mining the recently released UCAC-3 in positive declinations. The pairs were selected by using statistical criteria and have been confirmed by checking the photographic plates.

Introduction

The purpose of this research was to find new common proper-motion pairs (CPMPs from now on) in the UCAC3 catalog (Zacharias N. et al., 2009). CPMPs are pairs of stars where the two components share noticeable and very similar proper motion. Although not all the CPMPs need to correspond to orbiting binaries, their similar motion is a first clue that points out these pairs as possible candidates to true binaries.

The UCAC3 catalog extends the previous version UCAC2 (Zacharias N. et al., 2004) by covering the complete sky and improving some aspects, such as photometry and proper motion data. In 2004, J. Greaves data-mined UCAC2 finding 705 uncataloged pairs. The goal of this work was to check if the improvements in the new release would allow the detection of new pairs.

First list of candidates

The process was started by selecting an initial subset of UCAC3. The conditions were:

- Positive declination, thus restricting the search to the northern hemisphere.
- Proper motion > 50 mas/yr. This is one of the Halbwachs' criteria (Halbwachs, 1986).
- UCAC fit model (579-642nm) magnitude, also called f.mag in VizieR, < 22. Our goal was finding new pairs with optical magnitude V < 15, but UCAC3 does not include V. The condition f.mag <22 was obtained after browsing a subset of more than 100 000 arbitrary stars from UCAC3 and finding their corresponding V magnitudes in the Guide Star Catalog, version 2.3.2 (GSC 2.3) (Lasker B. et al. 2008). It was found that the condition f.mag<22 in UCAC3 was sufficient for ensuring V<15 in GSC 2.3.

The resulting set consisted of more than one million stars. From this subset of UCAC3 we formed our initial set of candidate pairs considering every star A such that it was possible to find another star B verifying:

- Separation between 5 and 122 seconds.
- Proper motions differences did not exceed 30 mas/yr neither in RA nor in Dec.
- Both stars with optical magnitude V<15 (V obtained from GSC 2.3).

The first point ensured that the two stars were neither too far nor too close. Although close pairs are especially interesting, they are very difficult to recognize in the photographic plates. Therefore an arbitrary limit of 5 seconds was established. The second condition discarded pairs with very different proper motions, while the last point checked that our initial constraint of V<15 was satisfied. Moreover, all the stars lying in a radius of 60 seconds of any primary star in the WDS (Washington Double Star Catalog, Mason B. et al, 2003) were removed to avoid duplications. A list of 2100 pairs was obtained after this initial selection.

Halbwachs' criteria

The set of candidates was reduced by considering the three criteria proposed by Halbwachs for distinguishing physical and optical pairs from their proper motion:

$$(\mu_1 - \mu_2)^2 < -2(\sigma_1^2 + \sigma_2^2)\ln(0.05)$$
$$|\mu_1|, |\mu_2| \geq 50 \text{ mas/yr}$$
$$\rho/|\mu_1|, \rho/|\mu_2| < 1000 \text{ yr}$$

where μ_1, μ_2 are the two proper motion vectors, σ_i is the mean error of the projections on the coordinate axes of μ_i, and ρ is the angular separation of the two stars. The first condition indicates whether the hypothesis $\mu_1 = \mu_2$ is admissible with a 95% confidence considering the given errors σ_1 and σ_2. This criterion selected 1600 out of the initial 2100 pairs. The second condition establishes that the proper motion must be ≥ 50 mas/yr for both components of the pair. This condition was satisfied by all the pairs in our list because this was an initial constraint. The third condition is an empirical way of relating the separation and the modulus of the proper motion vector. After applying the third condition, 1060 pairs remained as CPMP candidates, including many pairs with large proper motion differences. Therefore an additional condition was considered, keeping only those pairs whose proper motion difference in each coordinate was either smaller than 10 mas/yr, or smaller than the 10% of the minimum of the two values. This filter reduced the number of pairs to 900 candidates.

Reduced Proper Motion Discriminator

The Reduced Proper Motion (RPM) diagram and its associated RPM discriminator h were introduced by Salim & Gould (2003) and have been proposed for discriminating binaries in Chanamé and Gould (2004). The discriminator h is defined as $h = V_{RPM} - 3.1\,(V\text{-}J) - 1.47\,|\sin b\,| - 2.73$, with and b the Galactic latitude of the star and $V_{RPM} = V + 5 \log m$, m the star proper motion. According to this discriminator, stars are classified as disk (or main sequence, MS) if $h < 0$, as halo (or subdwarf, SD) if $0 < h < 5.15$ and as white dwarf (WD) if $h > 5.15$. The idea is that both components of a binary must have similar metallicities and proper motions, although possibly different luminosities. The criterion used in Chanamé and Gould (2003) is that the members of a pair are considered unrelated when:

1. the pair is composed of one MS and one SD.
2. the pair is composed of two MS or two SD stars, but the line connecting the two points in the RPM diagram is not approximately parallel to their corresponding MS or SD track for disk and halo binaries (Figure 12 of Salim and Gould, 2003).

Applying the first item reduced the set of candidates from 900 to 841. It is worth noticing that all the pairs kept after this filter verified that both components were MS. The second point didn't exclude any other pair: the few cases where the lines were clearly not parallel to their corresponding track (red lines in the Figure 1) corresponded to pairs already discarded by the first item. In some cases the length of the lines connecting the points was too short to discriminate clearly whether the line was correctly oriented.

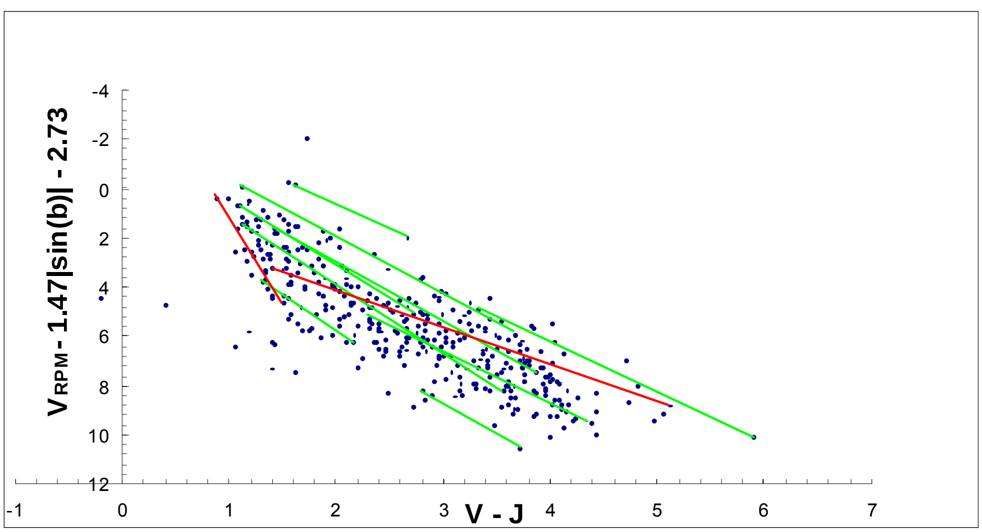


Figure 1: RPM diagram including some of the lines connecting the new CPMPs

Checking the photographic plates

Finally each of the 841 candidates was introduced in VizieR (Allende & Dambert 1999) looking for WDS stars in a radius of 10 minutes. The idea was that some of these new pairs could be actually WDS neglected doubles

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

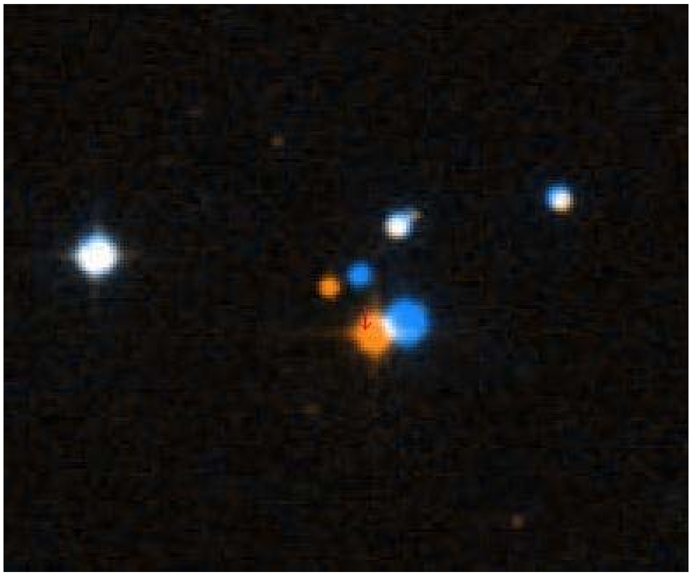


Figure 2: ALADIN composite image showing the movement of the pair 01 50 28.06 +18 17 46.5 between 1954 (blue) and 1991 (red)

with erroneous coordinates. Each WDS pair found by this query was examined individually. In most of the cases, the data of the WDS pairs found had no relation with the CPMPs extracted from UCAC3, but 9 WDS pairs matched quite well the astrometry of pairs in this set. These pairs corresponded to old Luyten pairs with only one observation in WDS: LDS1922, LDS3573, LDS3664, LDS4604, LDS4763, LDS5946, LDS1049, LDS4868, and LDS1014. The corresponding pairs in our set were removed.

The rest of the pairs were examined individually using the photographic plates of the first and second Palomar Observatory Sky Surveys (Reid I.N. et al., 1991) available at ALADIN (Bonnarel, F. et al., 2000). For every pair, POSSI and POSSII images were selected and combined, either by the RGB or by the blink utilities available at ALADIN, observing whether two stars with noticeable movement and the same astrometry data really existed in the expected position. See Figure 2 for an example. All the uncertain cases were discarded, leaving a final set of 310 systems. Most of the fake CPMPs corresponded to positions in crowded areas, where the PM data stored in the catalogs is often erroneous.

Results

The main result of this research was a set of 310 new CPMPs which can be found in Table 1. The first two columns of the table are the UCAC3 identifiers of the two components of each pair. The list includes pairs with the following characteristics:

- Optical magnitudes ranging from 6.54 to 15.
- Proper motion between 50 and 259 mas/yr.
- Separations between 6.8 and 122 seconds.

Among the most remarkable systems of the list are:

- The bright pairs 03 29 50.60+50 10 11.7, with mags. 8.89/10.96, and 03 45 22.39+23 12 17.4, with mags. 8.48/10.81, located less than 1 degree from Alpha Persei and in the limit of the Pleiades star cluster, respectively.
- The pairs 14 59 32.92+45 27 51.0 with mags 8.7/10.76, and 21 41 01.38+11 15 46.9, with mags. 9.32/12.62. According to Hipparcos (Perryman 1997) the two pairs are at a distance of 105 and 107 light-years, respectively. These are the closest pairs to our solar system that can be found in the list.
- The pair 09 50 37.83+39 50 19.1. The secondary looks clearly elongated in the plates, showing that it is likely a triple system. However the third star is not in the catalogs and the system is listed here as double.
- The triple 12 28 03.64 +59 48 39.8. The B component was found in the photographic plates while checking the pair A-C. Although its PM is not in the catalogs this component seems to move together with the A-C system and it has been included in the list.

As explained above, the photometry was obtained from the GSC 2.3 catalog. For the astrometry the UCAC3 data seemed the natural choice, but there was a problem: the UCAC3 registered epochs were often very different for the two pair components, or even different in RA and Dec for the same star. While this poses no problem for stars will small PM, in our case it could result in erroneous astrometry. Therefore, in those cases the astrometry from the 2MASS catalog was preferred. It is worth noticing that for every pair in the list, the dates for both components in the 2MASS catalog were usually the same and that when this was not the case, the values were so close that choosing one or another didn't affect the date displayed in the table. The data of Table 1 is complemented by the list of proper motions and errors in Table 2. Observe that in a few cases UCAC3 does not provide error bounds for the PM data.

Conclusions and Future Work

The release of UCAC3 provides an interesting new source for finding CPMPs not included in the WDS.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

However one must be careful because indiscriminate data mining would produce a large and almost useless set of mostly unrelated stars. The different criteria fulfilled by the pairs included in this paper indicate that they could be physical pairs. It also must be noticed that the data mining process cannot replace the final and time-consuming phase of checking the photographic plates.

Future work can be seen in two different directions. First, we plan to image and study in detail the new pairs, in order to discriminate whether they constitute physical systems. Second, similar techniques can be applied to other catalogs, looking for other uncataloged CPMPs.

Acknowledgements

Dr. William I. Hartkopf first introduced me to the 'detective work' using VizieR, while Francisco Rica first introduced me to ALADIN. Thanks to both of them for their help and patience with my never ending questions. This research makes use of the ALADIN Interactive Sky Atlas and of the VizieR database of astronomical catalogs, all maintained at the *Centre de Données Astronomiques*, Strasbourg, France, and of the data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/ California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation. The research has been partially supported by projects MERIT-FORMS (TIN2005-09027-C03-03), PROMESAS-CAM(S-0505/ TIC/0407) and STAMP (TIN2008-06622-C03-01).

References

Allende Prieto, C; Dambert D.L.; 1999, "Fundamental parameters of nearby stars from the comparison with evolutionary calculations: masses, radii and effective temperatures". Astronomy and Astrophysics, **352**, p.555-562 (1999).

Bonnarel, F.; Fernique, P.; Bienaymé, O.; Egret, D.; Genova, F.; Louys, M.; Ochsenbein, F.; Wenger, M.; Bartlett, J. G.; 2000, "The ALADIN interactive sky atlas. A reference tool for identification of astronomical sources", Astronomy and Astrophysics Supplement, **143**, p.33-40.

Chanamé, J.; Gould A.; 2004 "Disk and halo wide binaries from the Revised Luyten Catalog; probes of star formation and MACHO dark matter". The Astronomical Journal, **601**, 289-310.

Greaves, J., 2004, "New Northern hemisphere common proper-motion pairs". Monthly Notices of the Royal Astronomical Society **355**, 585-590.

Halbwachs, J.L., 1986, "Common proper motion stars in the AGK3". Bull. Inf. Centre Donnees Stellaires, **30**, p.129.

Lasker B., Lattanzi M.G., McLean B.J., et al., 2008, "The Guide Star Catalogue, Version 2.3.2". The Astronomical Journal **136**(2), 735-766.

Mason B. D.; Wycoff, G.; Hartkopf, W. I., 2003, "The Washington Double Star Catalog", http:// ad.usno.navy.mil/proj/WDS/wds.html

Perryman, M. A. C.; Lindegren, L.; Kovalevsky, J.; Hoeg, E.; Bastian, U.; Bernacca, P. L.; Crézé, M.; Donati, F.; Grenon, M.; van Leeuwen, F.; and 9 coauthors; "The Hipparcos Catalogue" Astronomy and Astrophysics, **323**, *L49-L52.*

Salim, S.; Gould, A., 2003, "Improved Astrometry and Photometry for the Luyten Catalog. II. Faint Stars and the Revised Catalog", The Astrophysical Journal, **582**, 1011-1031.

Reid, I. N.; Brewer, C.; Brucato, R. J.; McKinley, W. R.; Maury, A.; Mendenhall, D.; Mould, J. R.; Mueller, J.; Neugebauer, G.; Phinney, J.; and 3 coauthors, 1991, "The second Palomar Sky Survey", Astronomical Society of the Pacific **103**, 661-674.

Zacharias, N.; Urban, S. E.; Zacharias, M. I.; Wycoff, G. L.; Hall, D. M.; Monet, D. G.; Rafferty, T. J., 2004, "The Second US Naval Observatory CCD Astrograph Catalog (UCAC2)". The Astronomical Journal **127(5)**, 3043-3059.

Zacharias N. et al., 2009, "UCAC 3 Catalogue". VizieR Online Data Catalog, August 2009.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1: Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
280-003272	280-003273	00 10 45.61 +49 44 41.0	AB	13.51 14.80	1.34	53.97	1998.848	(2)
298-007963	298-007968	00 26 46.93 +58 48 57.0	AB	13.06 14.65	172.82	40.17	1998.985	(2)
303-010568	303-010612	00 27 06.72 +61 09 33.7	AB	12.71 13.81	130.33	52.72	2000.765	(2)
309-009942	309-009948	00 36 41.69 +64 22 30.8	AB	12.07 12.38	31.66	19.72	1999.869	(2)
229-004263	229-004266	00 50 30.30 +24 06 27.3	AB	14.06 14.81	91.29	40.12	1997.827	(2)
248-005615	248-005622	00 52 21.03 +33 54 41.4	AB	10.55 13.63	112.05	50.07	1997.917	(2)
301-024034	301-024030	00 57 23.93 +60 26 50.7	AB	13.89 14.15	261.67	6.81	2000.888	(2)
201-003358	201-003356	01 01 27.70 +10 23 55.6	AB	11.85 12.45	201.60	21.67	2000.748	(2)
287-018883	287-018881	01 01 40.35 +53 29 35.0	AB	13.91 14.35	350.26	19.13	1998.916	(2)
252-008010	252-008007	01 06 16.87 +35 54 16.1	AB	12.55 13.87	285.16	19.65	2000.795	(2)
232-005667	232-005670	01 07 38.59 +25 57 28.2	AB	10.67 12.71	24.98	62.60	1997.829	(2)
252-008880	252-008881	01 13 45.71 +35 41 31.7	AB	13.70 14.91	93.28	16.05	1999.968	(2)
284-021513	284-021528	01 15 53.09 +51 52 50.2	AB	13.46 13.52	142.61	43.54	1998.916	(2)
218-005470	218-005474	01 19 31.32 +18 49 58.0	AB	11.75 11.86	94.41	78.80	1997.780	(2)
309-021190	309-021197	01 23 28.66 +64 11 44.3	AB	13.64 14.10	91.28	14.57	1999.020	(2)
295-035708	295-035716	01 31 51.10 +57 08 48.2	AB	14.33 14.34	100.13	22.07	1999.790	(2)
255-012371	255-012363	01 39 45.48 +37 10 01.6	AB	11.63 13.32	279.14	43.92	1998.837	(2)
233-008358	233-008355	01 39 59.19 +26 11 08.1	AB	11.22 13.65	231.97	8.14	2001.600	(1)
206-005846	206-005847	01 41 19.51 +12 45 42.9	AB	12.00 14.35	147.67	31.42	1998.717	(2)
255-013451	255-013447	01 47 45.90 +37 24 14.1	AB	11.07 12.76	295.26	15.02	1997.884	(2)
217-007337	217-007339	01 50 28.06 +18 17 46.5	AB	11.02 14.36	44.36	18.79	2000.880	(1)
249-011974	248-011597	01 51 24.54 +34 00 18.3	AB	11.02 14.52	232.70	85.29	1997.859	(2)
245-012584	245-012583	01 57 34.70 +32 02 08.2	AB	9.00 13.37	316.60	19.26	1999.845	(2)
242-011968	242-011961	02 02 06.27 +30 31 17.1	AB	12.30 12.30	215.49	53.05	1997.955	(2)
251-014545	251-014550	02 02 52.89 +35 25 21.4	AB	12.46 13.97	86.44	15.01	1997.955	(2)
194-006325	194-006331	02 03 25.89 +06 48 01.0	AB	13.74 14.37	58.42	110.76	2000.742	(2)
277-028062	277-028053	02 03 45.49 +48 22 57.0	AB	13.37 14.56	299.61	20.02	1998.927	(2)
274-027335	274-027323	02 04 18.62 +46 47 51.0	AB	10.61 14.10	252.96	28.44	1998.823	(2)
186-006247	186-006244	02 06 17.34 +02 37 41.2	AB	9.90 12.24	308.88	67.19	2000.907	(2)
286-036701	286-036693	02 07 18.36 +52 45 22.8	AB	11.40 11.88	237.79	14.55	1998.927	(2)
284-040160	284-040134	02 16 49.60 +51 45 44.4	AB	11.90 13.35	287.65	34.84	1998.927	(2)
220-009171	220-009172	02 18 01.44 +19 57 39.3	AB	11.34 11.65	6.96	76.02	1997.802	(2)
293-049864	293-049847	02 18 02.11 +56 16 00.9	AB	11.76 14.01	321.45	29.87	1999.782	(2),(5)
208-008351	208-008353	02 20 08.44 +13 33 29.8	AB	12.09 12.88	85.92	28.38	1997.710	(2)
184-006787	184-006788	02 20 26.07 +01 35 21.5	AB	9.04 14.58	156.25	52.46	2000.658	(2)
237-012990	237-012989	02 21 51.38 +28 27 34.1	AB	12.41 14.57	194.14	25.32	1997.854	(2)
263-021491	263-021488	02 24 05.49 +41 16 31.4	AB	12.86 14.20	186.16	18.82	1998.774	(2)
308-042385	308-042390	02 24 18.72 +63 42 57.9	AB	13.91 14.91	155.99	11.22	1999.012	(2)
255-018971	255-018973	02 24 53.12 +37 02 49.0	AB	11.43 14.66	17.35	34.52	1998.774	(2)
233-012322	233-012320	02 25 04.44 +26 12 05.5	AB	9.15 12.53	339.02	41.4	1997.854	(2)
302-052915	302-052898	02 25 55.49 +60 48 59.7	AB	10.85 14.98	285.67	62.15	1999.012	(2)
260-022902	260-022889	02 36 02.73 +39 56 41.0	AB	12.82 14.16	292.99	35.63	1998.782	(2)
290-055108	290-055088	02 39 17.74 +54 34 58.0	AB	12.70 12.97	330.72	41.17	1997.772	(2)
234-014522	234-014523	02 47 47.16 +26 35 05.0	AB	11.76 11.80	58.41	10.36	1999.897	(2)
262-026037	262-026040	02 47 53.43 +40 55 56.7	AB	9.48 14.20	5.91	19.08	1999.755	(2)
250-022229	250-022225	03 06 13.04 +34 57 01.3	AB	10.44 14.80	246.99	21.43	1998.032	(2)
250-022739	250-022741	03 09 28.75 +34 37 09.7	AB	12.18 13.55	24.97	28.06	1998.032	(2)
258-028892	258-028868	03 13 36.18 +38 53 59.3	AB	13.80 13.86	273.54	65.77	1998.826	(2)
246-022344	246-022351	03 22 18.85 +32 36 40.7	AB	10.24 11.20	108.28	52.61	1998.054	(2)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
201-011079	201-011074	03 24 32.01 +10 02 41.3	AB	12.14 12.86	261.17	51.69	1999.935	(2)
302-064333	302-064334	03 29 43.21 +60 30 14.4	AB	11.46 12.35	15.82	19.51	1999.812	(2)
188-010836	188-010828	03 29 44.38 +03 55 39.4	AB	10.82 12.70	266.71	94.15	2000.110	(2)
281-056701	281-056707	03 29 50.60 +50 10 11.7	AB	8.89 10.96	162.71	28.82	1999.998	(2)
244-021306	244-021305	03 30 27.77 +31 52 57.0	AB	12.70 13.30	203.90	14.77	1998.059	(2)
213-013620	213-013618	03 32 15.17 +16 13 02.6	AB	10.97 12.33	228.89	19.66	1997.745	(2)
246-023955	246-023953	03 37 12.45 +32 51 26.3	AB	13.14 14.58	244.69	26.22	1998.761	(2)
262-039079	262-039073	03 44 44.75 +40 41 50.7	AB	13.47 14.27	335.88	37.57	1998.777	(2)
227-017613	227-017618	03 45 22.39 +23 12 17.4	AB	8.48 10.81	140.42	57.44	1998.859	(2)
251-030086	251-030085	03 49 26.17 +35 26 59.2	AB	12.99 13.88	187.74	10.6	1998.067	(2)
190-012141	190-012140	03 49 43.99 +04 38 09.8	AB	13.54 13.77	321.42	19.24	2000.050	(2)
181-012106	181-012102	03 53 04.15 +00 02 49.9	AB	12.57 14.06	268.96	58.72	2000.126	(2)
258-037122	258-037117	03 54 40.27 +38 40 31.1	AB	10.41 14.64	300.62	28.74	2000.022	(2)
181-012215	181-012214	03 55 04.67 +00 03 07.8	AB	12.08 14.07	323.00	23.53	2000.058	(2)
236-023146	236-023150	03 56 05.91 +27 57 58.9	AB	12.87 13.71	130.41	42.85	1998.785	(2)
331-015669	331-015664	03 57 55.66 +75 16 54.9	AB	10.41 14.72	232.90	25.59	2000.751	(2)
300-069680	300-069678	03 59 57.69 +59 41 38.5	AB	12.57 12.77	186.14	13.38	1999.034	(2)
278-058643	278-058647	04 01 27.42 +48 45 44.8	AB	9.77 11.46	173.93	25.24	1999.782	(2)
189-013340	189-013334	04 03 27.83 +04 17 31.0	AB	12.34 12.35	293.09	46.87	2000.060	(2)
296-073651	296-073661	04 07 06.83 +57 56 17.2	AB	12.76 13.60	68.61	17.77	1999.034	(2)
199-013874	199-013873	04 07 39.45 +09 29 38.5	AB	11.28 13.66	222.47	26.11	1999.946	(2)
187-014934	186-015157	04 30 40.93 +03 00 04.8	AB	11.48 13.32	101.50	49.00	2000.069	(2)
222-022240	222-022236	04 37 06.92 +20 43 08.6	AB	13.86 14.80	262.19	24.57	1998.755	(2)
310-047623	310-047589	04 42 58.08 +64 38 21.2	AB	12.84 13.11	245.23	95.34	1999.001	(2)
270-067345	270-067339	04 44 33.54 +44 53 14.4	AB	13.08 13.91	208.78	23.03	1999.774	(2)
270-067666	270-067672	04 45 37.72 +44 43 42.8	AB	12.03 12.69	116.79	18.53	1999.774	(2)
217-024477	216-024264	04 56 29.45 +18 00 08.6	AB	9.09 14.26	105.05	34.59	1997.838	(2)
263-061067	263-061063	05 00 22.97 +41 04 56.6	AB	12.55 12.68	318.81	15.58	1998.766	(2)
272-070757	272-070741	05 04 16.19 +45 46 45.7	AB	6.54 12.73	321.85	44.46	1999.853	(2)
295-089559	295-089556	05 05 33.30 +57 09 32.8	AB	9.83 14.51	351.11	35.97	1998.990	(2)
245-041142	245-041147	05 10 43.84 +32 29 13.4	AB	11.55 11.79	130.12	29.45	1999.905	(2)
210-025818	210-025817	05 17 43.17 +14 43 01.9	AB	10.41 12.39	190.02	23.01	1997.781	(2)
219-029978	219-029979	05 24 58.51 +19 11 34.2	AB	10.10 11.17	175.40	18.39	1997.846	(2)
199-026133	199-026131	05 26 13.92 +09 06 25.6	AB	12.67 13.29	334.46	17.41	1999.933	(2)
336-016186	336-016187	05 31 08.04 +77 52 48.0	AB	10.09 11.40	170.61	19.49	2000.751	(2)
216-037683	216-037704	05 39 41.70 +17 41 51.8	AB	11.41 13.28	77.34	34.95	1998.744	(2)
240-048792	240-048796	05 41 11.08 +29 39 01.1	AB	11.45 14.87	4.88	41.31	1997.961	(2)
247-058491	247-058509	05 46 01.56 +33 16 21.2	AB	12.07 13.83	120.40	25.75	1998.892	(2)
245-054095	245-054102	05 47 28.21 +32 19 52.0	AB	12.43 13.51	75.30	11.05	1998.892	(2)
204-036789	204-036783	05 58 35.86 +11 43 55.6	AB	10.74 11.65	336.19	18.57	1999.714	(2)
265-092983	265-092978	06 00 23.34 +42 06 29.9	AB	11.96 12.75	227.54	11.48	1998.843	(2)
343-011292	343-011297	06 00 32.43 +81 24 20.1	AB	13.00 13.23	48.27	14.36	1999.163	(2)
187-030817	187-030850	06 01 07.98 +03 21 54.4	AB	11.74 13.20	75.47	88.76	1999.801	(2)
259-078347	259-078346	06 06 36.35 +39 05 43.9	AB	8.79 13.04	197.96	22.82	1998.799	(2)
220-056444	220-056453	06 27 09.33 +19 32 53.2	AB	11.67 12.42	163.56	19.58	2000.855	(2)
193-049763	193-049768	06 37 00.94 +06 21 56.2	AB	12.99 13.80	119.36	9.42	1999.815	(2)
340-016131	340-016137	06 38 07.35 +79 34 46.5	AB	12.95 13.19	118.67	20.26	1999.889	(2)
244-072452	245-076984	06 40 48.76 +31 59 22.4	AB	10.11 10.32	37.40	55.56	1998.892	(2)
267-107336	267-107337	06 42 19.75 +43 14 53.4	AB	13.22 14.63	170.10	12.25	1999.788	(2)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
259-089076	259-089075	06 43 08.90 +39 20 44.9	AB	10.70 12.76	349.77	56.33	2000.746	(2)
290-096662	290-096656	06 55 45.43 +54 33 08.0	AB	10.26 11.77	316.38	35.63	1999.012	(2)
255-084186	255-084196	06 55 52.82 +37 15 53.1	AB	9.17 12.24	90.12	32.15	1998.84	(2)
254-084271	254-084280	06 57 05.49 +36 59 34.7	AB	12.85 13.36	148.92	26.84	1998.84	(2)
277-099321	277-099327	06 57 50.03 +48 25 41.0	AB	10.43 12.93	57.69	33.17	1998.947	(2)
252-083088	252-083084	06 58 06.94 +35 34 42.7	AB	12.42 13.06	224.66	14.56	1998.163	(2)
276-102182	276-102187	06 58 43.68 +47 38 58.3	AB	11.43 11.50	147.38	20.59	1998.846	(2)
216-080787	216-080774	07 03 38.09 +17 51 30.1	AB	10.59 13.34	240.02	23.51	1997.876	(2)
277-100331	277-100334	07 05 42.93 +48 27 02.2	AB	9.47 10.74	59.48	19.82	1998.947	(2)
273-103418	273-103431	07 09 42.68 +46 01 32.8	AB	12.92 12.93	71.77	35.07	1999.971	(2)
188-062178	188-062169	07 13 19.74 +03 58 47.3	AB	10.11 14.97	224.44	22.04	1999.946	(2)
193-073132	193-073125	07 15 04.43 +06 04 50.0	AB	8.97 12.26	252.5	12.92	1999.924	(2)
203-082532	203-082540	07 16 13.12 +11 21 45.4	AB	13.31 14.57	30.64	31.94	1999.924	(2)
249-087859	249-087851	07 17 19.45 +34 06 45.0	AB	10.20 12.69	214.61	27.75	1999.91	(2)
188-066234	188-066237	07 22 06.48 +03 35 10.4	AB	11.49 13.62	1.77	64.97	1999.938	(2)
255-089557	255-089559	07 27 26.88 +37 27 33.0	AB	12.38 12.81	76.22	9.34	1998.286	(2)
219-082189	219-082195	07 28 50.24 +19 03 02.4	AB	10.61 14.44	141.44	28.93	1997.923	(2)
200-096552	200-096560	07 34 59.58 +09 54 44.0	AB	13.16 14.37	22.34	55.76	1999.889	(2)
226-087969	226-087971	07 35 58.68 +22 36 21.7	AB	12.50 12.73	144.18	24.25	1997.926	(2)
344-012930	344-012929	07 38 12.91 +81 35 05.5	AB	11.52 13.92	190.29	28.95	1999.157	(2)
244-087452	244-087460	07 47 10.14 +31 56 15.4	AB	8.61 13.34	125.13	60.73	1998.172	(2)
205-097079	205-097077	08 14 32.09 +12 16 58.8	AB	13.19 14.66	345.51	32.1	1997.841	(2)
278-108421	278-108420	08 25 33.13 +48 41 24.3	AB	12.90 13.57	199.12	8.52	1999.818	(2)
200-109275	200-109281	08 28 55.61 +09 40 23.7	AB	14.62 14.80	95.32	27.54	2000.181	(2)
295-109915	295-109911	08 34 16.97 +57 28 34.0	AB	11.91 13.57	251.5	23.23	2000.012	(2)
190-091842	190-091831	08 34 54.35 +04 50 48.6	AB	9.94 12.62	265.27	27.29	2000.888	(2)
229-098927	229-098931	08 35 26.86 +24 15 39.4	AB	11.37 13.02	92.11	32.93	1998.092	(2)
263-111338	262-112210	08 38 29.14 +41 00 01.6	AB	10.45 12.64	160.45	50.95	1998.253	(2)
198-111124	198-111123	08 41 09.36 +08 36 57.2	AB	12.56 12.72	281.27	21	2000.181	(2)
273-111192	273-111191	08 45 23.93 +46 10 15.8	AB	7.97 11.67	358.92	32.32	1998.925	(2)
202-105592	202-105595	08 45 26.81 +10 54 46.7	AB	11.69 14.88	60.35	13.62	2000.116	(2)
222-097774	222-097773	08 46 30.68 +20 51 22.0	AB	13.41 13.94	229.78	16.9	1998.81	(2)
251-097276	251-097275	08 46 52.62 +35 21 02.2	AB	13.03 13.07	325.64	13.89	1998.194	(2)
226-099172	226-099166	09 00 19.56 +22 35 08.7	AB	10.90 14.08	228.36	47.72	1998.849	(2)
202-107142	202-107141	09 00 54.51 +10 34 41.0	AB	11.41 14.49	352.14	11.54	2000.14	(2)
210-105987	210-105982	09 04 06.68 +14 35 06.5	AB	12.58 12.91	250.99	47.85	2000.252	(2)
191-097202	191-097204	09 04 35.96 +05 12 21.2	AB	12.87 14.13	155.00	34.3	2000.083	(2)
325-041277	325-041278	09 19 27.20 +72 22 06.1	AB	12.83 14.33	178.21	50.2	1999.31	(2)
278-111047	278-111046	09 19 59.40 +48 39 08.1	AB	12.37 13.87	325.17	19.09	2000.004	(2)
278-111388	278-111390	09 28 22.77 +48 47 09.7	AB	11.15 14.56	32.33	57.93	1998.982	(2)
261-108447	261-108445	09 36 54.52 +40 24 34.6	AB	13.89 14.05	340.03	29.24	1998.256	(2)
324-042285	324-042282	09 42 32.31 +71 53 25.0	AB	13.65 14.43	279.49	13.83	1999.168	(2)
212-108227	212-108230	09 45 26.05 +15 40 39.8	AB	10.13 12.31	69.32	35	1997.912	(2)
280-113728	280-113721	09 46 02.03 +49 51 32.5	AB	11.83 12.33	250.47	26.86	1999.859	(2)
251-100549	251-100555	09 47 02.35 +35 13 09.7	AB	10.14 13.14	55.89	65.42	1998.183	(2)
331-029543	331-029544	09 47 43.55 +75 03 42.3	AB	11.12 12.12	2.22	30.64	1999.239	(2)
318-045950	318-045951	09 48 37.51 +68 50 28.8	AB	13.68 14.16	63.39	20.61	1999.168	(2)
235-100239	235-100241	09 49 02.94 +27 00 08.9	AB	13.98 14.32	16.58	13.47	1999.078	(2)
260-109225	260-109227	09 50 37.83 +39 50 19.1	AB	12.03 14.71	144.37	24.39	2002.14	(1),(4)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
251-100932	251-100934	09 55 27.79 +35 00 08.9	AB	10.74 13.40	59.42	31.29	1998.183	(2)
237-103705	237-103704	10 00 39.89 +28 10 25.1	AB	7.99 13.99	341.09	56.64	1998.914	(2)
246-103109	246-103116	10 01 25.73 +32 39 06.9	AB	11.77 14.43	72.19	48.56	1998.218	(2)
202-111786	202-111788	10 03 23.68 +10 45 15.3	AB	10.00 13.14	162.08	18.48	2000.154	(2)
202-111812	202-111815	10 03 40.98 +10 48 52.2	AB	10.91 12.84	85.05	37.51	2000.154	(2)
211-109503	211-109498	10 03 56.57 +15 26 32.9	AB	13.11 14.50	191.37	15.81	2000.913	(2)
250-099913	250-099911	10 05 20.93 +34 43 11.1	AB	12.97 14.62	221.33	47.25	1998.947	(2)
293-109929	293-109928	10 10 20.70 +56 29 12.8	AB	12.47 14.54	199.52	14.5	1999.054	(2)
260-110005	260-110003	10 10 41.16 +39 54 39.9	AB	9.51 11.31	190.34	82.78	1998.246	(2)
280-114620	280-114621	10 10 44.00 +49 51 36.2	AB	12.12 14.37	124.17	14.75	2000.17	(2)
275-116426	275-116427	10 15 17.83 +47 25 47.9	AB	12.31 13.88	52.62	47.88	1998.325	(2)
274-115424	274-115423	10 21 45.41 +46 50 55.4	AB	10.38 11.87	187.72	13.07	1999.176	(2)
289-111122	289-111120	10 29 56.31 +54 23 08.4	AB	14.48 14.60	243.00	21.68	2000.026	(2)
231-103328	231-103329	10 30 24.63 +25 14 14.5	AB	11.50 12.25	83.46	11.77	1998.164	(2)
283-109688	283-109687	10 39 01.53 +51 04 24.8	AB	10.32 14.01	294.92	17.63	1998.936	(2)
245-103671	245-103669	10 39 40.30 +32 27 07.0	AB	12.98 14.41	316.65	48.73	2001.32	(1)
282-110658	282-110661	10 42 17.65 +50 55 25.8	AB	13.32 14.50	106.14	29.63	1998.936	(2)
210-112049	210-112048	10 43 59.65 +14 44 22.0	AB	12.26 13.63	256.02	9.08	2000.296	(2)
213-107039	213-107038	10 48 17.14 +16 24 12.0	AB	11.52 11.71	353.28	11.01	1997.956	(2)
196-117811	196-117807	10 52 39.12 +07 56 01.9	AB	10.88 12.19	223.37	33.45	2000.165	(2)
197-123028	197-123030	11 18 05.63 +08 10 10.6	AB	11.35 12.21	146.94	38.05	2000.173	(2)
256-102475	256-102477	11 24 35.50 +37 52 25.1	AB	10.8 11.00	29.62	16.27	1998.281	(2)
246-106851	246-106850	11 38 57.73 +32 53 09.6	AB	12.45 13.42	270.92	34.19	2000.277	(2)
256-103103	256-103100	11 44 50.74 +37 51 19.9	AB	13.17 14.48	233.32	8.41	1998.284	(2)
198-123402	198-123405	11 45 00.99 +08 38 25.6	AB	12.12 13.39	57.62	62.42	2000.184	(2)
185-110565	185-110570	11 49 49.04 +02 21 33.5	AB	9.78 11.92	106.01	69.76	2000.116	(2)
267-128272	267-128269	12 09 44.83 +43 26 43.1	AB	12.70 13.96	346.49	59.12	2000.214	(2)
256-104117	256-104119	12 15 37.29 +37 48 55.2	AB	12.67 13.74	155.77	45.96	2000.034	(2)
252-104938	252-104939	12 16 24.44 +35 41 45.1	AB	11.73 14.92	29.32	24.91	1998.191	(2)
186-107854	186-107857	12 22 46.95 +02 46 18.2	AB	12.79 13.00	53.36	40.85	2000.151	(2)
300-106346	300-106347	12 28 03.64 +59 48 39.8	AB	10.95 ?	121.32	5.81	1999.382	(2),(3)
300-106346	300-106342	12 28 03.64 +59 48 39.8	AC	10.95 12.34	221.07	45.58	1999.382	(2),(3)
266-128982	266-128979	12 28 59.91 +42 47 03.2	AB	12.94 13.12	258.25	30.16	1999.395	(2)
187-104686	187-104685	12 29 42.14 +03 06 28.0	AB	10.93 11.18	303.98	34.48	2000.151	(2)
258-107248	258-107249	12 31 07.59 +38 36 29.3	AB	9.98 12.07	137.07	21.89	2000.283	(2)
296-112770	296-112773	12 31 12.95 +57 47 10.9	AB	13.34 14.64	37.02	78.21	1999.294	(2)
263-120077	263-120082	12 32 13.88 +41 02 44.4	AB	13.19 14.13	146.77	112.06	2000.255	(2)
343-018495	343-018496	12 42 18.18 +81 04 56.8	AB	13.12 13.54	20.54	7.16	2000.192	(2)
205-115661	205-115655	12 55 35.02 +12 18 41.9	AB	11.95 12.84	214.25	92.53	1998.063	(2)
267-129844	267-129843	13 03 03.97 +43 27 02.6	AB	11.80 12.85	185.89	65.4	1999.1	(2)
209-116522	209-116518	13 05 02.91 +14 29 58.2	AB	11.39 12.84	205.83	47.82	1998.063	(2)
290-112249	290-112248	13 05 22.89 +54 52 24.1	AB	13.20 14.41	183.91	43.33	1999.193	(2)
305-095847	305-095846	13 16 48.29 +62 22 03.0	AB	11.45 12.17	332.07	71.51	1999.161	(2)
257-108988	257-108990	13 19 56.59 +38 22 08.6	AB	8.34 11.33	52.61	61.93	1998.292	(2)
206-121674	206-121675	13 53 44.49 +12 40 48.4	AB	8.64 13.35	144.64	20.8	1998.333	(2)
204-119835	204-119837	13 56 20.38 +11 48 04.2	AB	11.01 12.55	127.45	45.49	2000.233	(2)
312-058195	312-058197	13 57 43.05 +65 44 22.5	AB	13.04 13.72	98.89	16.18	1999.343	(2)
188-108413	188-108415	14 00 08.33 +03 56 13.2	AB	10.92 11.87	138.43	21.54	2000.187	(2)
259-114654	259-114653	14 00 22.48 +39 24 27.2	AB	13.15 13.43	212.96	32.55	1998.298	(2)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
219-108294	219-108297	14 05 06.65 +19 17 18.8	AB	11.94 13.53	46.44	20.98	1998.369	(2)
202-124288	202-124290	14 14 32.50 +10 44 15.4	AB	11.68 12.13	84.94	13.3	2000.247	(2)
265-129304	265-129305	14 16 32.73 +42 09 06.8	AB	11.36 12.63	158.41	41.29	1998.394	(2)
280-122154	280-122153	14 21 05.50 +49 42 19.9	AB	12.22 12.80	316.84	9.66	1999.39	(2)
292-113146	292-113145	14 32 41.31 +55 53 28.0	AB	12.18 12.21	192.53	15.08	2000.263	(2)
209-121233	209-121234	14 38 08.34 +14 02 58.0	AB	11.79 13.57	21.22	18.82	1998.334	(2)
221-114647	221-114652	14 41 49.15 +20 25 43.6	AB	9.90 11.96	101.47	30.46	1997.441	(2)
210-123093	210-123092	14 46 50.55 +14 53 25.7	AB	12.30 13.10	290.25	18.1	2000.012	(2)
188-112265	188-112268	14 58 38.15 +03 55 18.5	AB	10.03 14.90	65.68	38.78	2000.28	(2)
217-122110	216-122449	14 59 26.46 +18 00 06.3	AB	12.09 13.30	200.43	37.33	1997.451	(2)
271-125121	271-125119	14 59 32.92 +45 27 51.0	AB	8.70 10.76	202.94	63.11	2000.133	(2)
295-121225	295-121226	15 02 42.31 +57 06 03.1	AB	14.31 14.93	170.08	13.48	1999.155	(2)
187-114183	187-114178	15 09 18.11 +03 11 35.8	AB	11.15 14.07	313.83	47.82	2000.28	(2)
214-122862	214-122863	15 15 56.80 +16 43 10.8	AB	11.93 12.67	106.78	27.35	2000.34	(2)
267-134593	267-134594	15 18 46.24 +43 13 51.9	AB	13.51 13.90	27.76	16.2	1999.396	(2)
221-116860	221-116854	15 20 27.64 +20 12 41.0	AB	12.47 12.64	259.41	27.26	1997.452	(2)
215-126270	215-126272	15 20 37.98 +17 06 36.1	AB	13.92 14.41	167.42	48.85	2000.034	(2)
224-121847	224-121848	15 23 41.28 +21 57 36.7	AB	10.72 13.20	26.34	28.03	2000.201	(2)
293-118854	293-118849	15 23 53.87 +56 09 32.1	AB	11.49 12.02	248.07	67.96	1999.278	(2)
314-055121	314-055119	15 24 28.68 +66 55 15.1	AB	14.27 14.30	291.23	18.58	1999.437	(2)
220-116054	220-116053	15 24 35.98 +19 46 24.6	AB	9.28 12.68	220.29	39.72	2000.174	(2)
311-069564	311-069566	15 32 27.20 +65 22 19.8	AB	12.36 14.40	20.43	29.34	2000.157	(2)
257-114265	257-114261	15 33 45.19 +38 17 52.0	AB	13.37 13.52	211.16	68.48	1998.312	(2)
272-123657	272-123659	15 42 32.07 +45 32 47.5	AB	13.57 13.79	95.12	14.65	1999.193	(2)
265-133022	265-133015	15 45 35.05 +42 05 06.6	AB	13.97 14.41	253.67	60.79	1999.194	(2)
238-116855	238-116858	15 49 45.51 +28 39 13.6	AB	12.24 12.65	60.07	9.81	2000.133	(2)
192-127706	192-127707	15 51 08.44 +05 37 49.6	AB	13.73 14.35	178.03	16.56	2000.326	(2)
290-117644	290-117646	15 56 47.77 +54 59 11.2	AB	9.23 12.77	68.40	22.23	1999.303	(2)
240-119395	240-119394	16 03 51.30 +29 35 18.9	AB	11.84 14.24	318.04	28.72	1999.428	(2)
196-139380	196-139381	16 23 42.61 +07 41 49.7	AB	12.05 13.76	5.67	17.19	2000.267	(2)
233-119052	233-119051	16 26 48.10 +26 21 38.4	AB	11.95 14.94	312.16	13.17	2001.58	(1)
198-142704	198-142698	16 27 32.63 +08 31 47.4	AB	12.48 14.49	315.97	53.88	2000.392	(2)
242-119916	242-119918	16 34 29.50 +30 34 20.8	AB	12.57 14.84	51.42	31.34	1998.26	(2)
259-122290	259-122286	16 38 45.74 +39 23 20.5	AB	11.86 14.43	226.76	17.44	1998.328	(2)
209-131973	209-131972	16 39 19.65 +14 23 59.6	AB	14.35 14.63	207.03	31.55	2000.187	(2)
300-114895	300-114902	16 46 57.72 +59 54 21.4	AB	12.23 13.32	122.88	50.28	2000.171	(2)
276-129175	276-129171	16 52 06.06 +47 50 35.6	AB	12.05 14.04	272.34	11.73	1998.429	(2)
319-054492	319-054490	17 14 10.95 +69 04 01.5	AB	11.61 12.43	340.07	50.96	1999.379	(2)
190-137937	190-137938	17 18 15.11 +04 58 48.6	AB	10.20 12.11	176.88	18.56	2000.422	(2)
204-140531	204-140536	17 19 52.08 +11 55 08.3	AB	13.32 13.32	107.44	18.82	1998.164	(2)
210-140085	210-140071	17 22 28.31 +14 40 43.2	AB	8.77 11.99	225.44	77.29	1998.342	(2)
263-133587	263-133588	17 22 56.90 +41 12 35.5	AB	9.35 13.54	165.27	44.67	1998.358	(2)
260-129029	260-129034	17 29 09.19 +39 33 18.7	AB	13.26 13.58	115.02	34.97	1998.361	(2)
258-122121	258-122123	17 29 45.13 +38 41 45.2	AB	13.89 14.67	167.56	15.74	2000.193	(2)
331-039490	331-039491	17 33 46.66 +75 02 43.5	AB	13.24 14.74	1.57	13.65	1999.391	(2)
272-132906	272-132917	17 52 36.11 +45 30 55.3	AB	12.07 12.71	94.41	24.27	1998.437	(2)
214-147166	214-147157	17 54 44.23 +16 33 19.0	AB	9.12 12.09	204.68	32.61	2000.168	(2)
324-055413	324-055412	18 02 09.22 +71 50 31.8	AB	10.56 12.97	352.99	32.54	1999.377	(2)
281-134256	281-134255	18 09 26.10 +50 18 54.0	AB	11.04 11.10	322.75	13.47	2000.324	(2)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
316-059616	316-059619	18 12 47.28 +67 37 05.1	AB	11.59 14.48	172.42	57.05	1999.434	(2)
240-137406	240-137414	18 17 02.81 +29 36 45.4	AB	9.35 11.83	66.37	48.8	1998.522	(2)
319-057207	319-057202	18 22 29.36 +69 23 40.1	AB	11.19 13.99	264.12	23.84	2000.226	(2)
272-137234	272-137222	18 24 11.43 +45 39 47.7	AB	8.91 11.75	314.27	63.57	1999.407	(2)
262-152018	262-152022	18 56 46.54 +40 38 40.5	AB	12.67 13.61	145.36	14.78	1998.391	(2)
187-186482	187-186483	18 57 21.01 +03 01 51.6	AB	13.50 14.11	179.78	19.86	1999.606	(2)
187-186544	187-186546	18 57 50.91 +03 15 14.3	AB	12.96 13.98	90.53	10.95	1999.606	(2)
297-132795	297-132778	19 11 14.90 +58 23 39.5	AB	13.42 13.60	260.17	38.42	2000.327	(2)
322-061922	322-061927	19 22 09.85 +70 50 45.4	AB	12.08 14.34	172.62	53.81	1999.432	(2)
269-173852	269-173821	19 47 27.30 +44 06 43.1	AB	11.38 13.03	252.59	47.22	1998.449	(2)
261-172811	261-172835	19 49 17.28 +40 05 24.1	AB	10.69 13.98	30.82	40.51	1998.394	(2)
216-241128	216-241058	19 49 21.88 +17 44 36.2	AB	13.20 14.33	243.92	32.03	1999.811	(2)
220-257358	220-257382	20 15 16.29 +19 37 29.5	AB	8.54 13.29	164.92	83.44	2000.704	(2)
184-251018	184-251007	20 16 44.29 +01 58 27.9	AB	13.08 15.00	250.79	25.21	2000.65	(1)
220-270707	220-270738	20 30 36.61 +19 31 44.1	AB	11.30 12.44	37.66	39.88	2000.322	(2)
185-266509	185-266514	20 41 55.13 +02 17 37.7	AB	14.06 14.59	164.14	62.85	2000.477	(2)
248-236255	248-236234	20 42 01.65 +33 49 16.5	AB	12.21 14.38	202.66	42.43	1998.76	(2)
277-185181	277-185180	20 45 24.35 +48 16 25.9	AB	8.37 11.97	181.19	17.84	1999.467	(2)
220-283672	220-283665	20 50 53.66 +19 52 44.5	AB	13.83 14.89	262.66	11.95	1999.369	(2)
241-273822	241-273849	21 07 40.74 +30 22 11.7	AB	8.79 11.10	67.20	48.11	1999.754	(2)
246-259374	246-259381	21 09 08.25 +32 32 15.0	AB	12.64 12.82	37.66	9.65	1999.754	(2)
236-269319	236-269314	21 19 48.98 +27 30 16.6	AB	8.35 12.82	331.18	13.87	1997.821	(2)
261-222252	261-222295	21 20 52.28 +40 09 49.8	AB	13.04 13.52	109.23	54.77	1999.699	(2)
241-281470	241-281459	21 23 32.60 +30 11 45.3	AB	11.96 13.78	242.55	33.33	1998.462	(2)
213-299708	213-299715	21 27 28.18 +16 17 49.6	AB	12.72 14.43	151.52	48.32	2000.898	(2)
263-215171	263-215161	21 28 38.77 +41 01 51.0	AB	13.15 13.61	199.42	48.4	2000.762	(2)
271-233893	271-233962	21 33 38.21 +45 22 06.0	AB	10.27 14.27	63.95	66.16	1998.905	(2)
283-191045	283-191044	21 37 55.05 +51 22 43.9	AB	13.83 14.22	180.50	10.26	2000.764	(2)
203-312575	203-312568	21 41 01.38 +11 15 46.9	AB	9.32 12.62	282.82	17.31	2000.516	(2)
200-310214	200-310199	21 53 27.04 +09 42 27.2	AB	11.00 14.04	221.90	122.08	2000.51	(2)
273-259694	273-259676	21 58 47.91 +46 18 53.0	AB	9.68 10.66	247.21	17.02	2000.442	(2)
261-238034	261-238042	22 01 22.53 +40 08 27.9	AB	10.63 13.57	157.33	13.51	1999.948	(2)
307-145076	307-145099	22 07 40.63 +63 02 22.5	AB	11.90 12.26	46.99	51.83	1999.746	(2)
201-314637	201-314642	22 10 59.25 +10 20 23.0	AB	12.75 12.87	155.33	42.05	2000.532	(2)
280-238794	280-238803	22 15 56.53 +49 31 22.0	AB	11.92 13.23	123.96	12.02	1999.765	(2)
201-315608	201-315600	22 19 12.13 +10 11 21.7	AB	11.21 13.14	309.96	57.52	2000.595	(2)
233-285037	233-285041	22 23 27.00 +26 21 04.1	AB	10.38 13.88	109.96	10.48	1997.854	(2)
267-248931	267-248924	22 24 03.15 +43 23 58.9	AB	10.72 13.52	317.57	11.71	1998.777	(2)
220-309173	220-309175	22 35 39.45 +19 38 54.7	AB	12.20 12.77	117.78	14.23	1997.758	(2)
225-302304	225-302305	22 37 19.58 +22 24 59.2	AB	12.23 13.86	168.35	15.33	1997.758	(2)
215-329017	215-329015	22 47 32.56 +17 13 25.9	AB	13.36 14.74	342.39	14.92	1998.881	(2)
188-297404	188-297407	22 47 55.50 +03 36 07.3	AB	11.40 11.40	154.24	23.2	2000.608	(2)
248-294467	248-294473	22 50 22.85 +33 43 42.7	AB	11.80 12.96	48.54	19.65	1999.754	(2)
183-267791	183-267787	22 58 15.06 +01 24 14.1	AB	11.17 12.71	241.75	37.06	2000.709	(2)
215-330607	215-330604	23 04 09.83 +17 15 04.0	AB	9.32 14.40	306.64	16.35	1997.728	(2)
258-265109	258-265105	23 05 05.62 +38 40 57.8	AB	12.50 13.94	236.73	19.52	1999.699	(2)
280-269697	280-269707	23 09 32.80 +49 58 24.9	AB	12.44 14.13	32.25	14.63	1998.938	(2)
232-284928	232-284932	23 13 49.67 +25 35 44.7	AB	10.77 12.39	139.08	49.49	1998.749	(2)
216-336720	216-336729	23 16 19.99 +17 50 32.0	AB	8.43 13.49	94.26	59.65	1998.73	(2)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 1 (continued): Measures of the new pairs

3UC Id.		RA DEC		MAGS	PA	SEP	DATE	NOTES
224-316429	224-316422	23 21 08.84 +21 48 09.4	AB	13.63 14.96	293.18	69.74	1997.777	(2)
236-296319	236-296330	23 22 50.25 +27 34 28.0	AB	8.82 13.34	146.27	82.92	1997.884	(2)
205-310503	205-310502	23 25 21.95 +12 20 59.9	AB	13.08 13.71	180.22	29.3	1997.745	(2)
225-307459	225-307462	23 25 53.66 +22 10 39.6	AB	12.32 13.34	67.68	39.35	2000.423	(2)
265-257751	265-257738	23 26 20.55 +42 08 14.2	AB	11.33 14.93	274.85	27.76	1998.799	(2)
274-293666	274-293667	23 29 30.84 +46 44 18.7	AB	13.40 14.01	4.61	11.08	2002.79	(1)
316-091811	316-091805	23 36 29.20 +67 41 43.9	AB	12.94 13.66	296.26	13.6	1999.779	(2)
182-267614	182-267615	23 41 10.44 +00 47 24.2	AB	9.99 10.96	124.71	28.27	2000.658	(2)
210-325486	210-325491	23 41 17.43 +14 54 51.9	AB	12.54 13.78	82.80	15.1	2000.87	(1)
199-322540	199-322537	23 41 47.71 +09 14 25.1	AB	12.58 13.19	254.45	29.86	2000.792	(2)
259-266251	259-266255	23 43 36.60 +39 08 14.8	AB	10.50 14.01	9.61	50.7	1999.757	(2)
323-080933	323-080944	23 44 22.25 +71 26 52.5	AB	11.27 14.11	46.40	36.13	2000.469	(2)
254-290935	254-290934	23 49 24.30 +36 54 02.8	AB	10.26 14.18	210.68	20.17	1999.76	(2)
227-287226	227-287228	23 49 30.53 +23 25 45.0	AB	10.36 12.96	130.56	29.44	1999.97	(2)
243-307522	243-307516	23 58 05.47 +31 09 44.5	AB	9.12 13.40	244.89	46.44	1998.78	(2)
184-281828	184-281830	23 58 53.39 +01 48 44.8	AB	14.05 14.64	143.25	37.91	2000.661	(2)

Table Notes:

1. Astrometry from UCAC3
2. Astrometry from 2MASS
3. Triple system, PM of component B not in UCAC3
4. The secondary seems a close pair in the plates
5. The primary seems a close pair in the plates

Table 2: Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
00 10 45.61 +49 44 41.0	AB	(57.0, 3.0)	(2.2, 1.9)	(57.0, 5.4)	(5.2, 4.0)
00 26 46.93 +58 48 57.0	AB	(-69.9, -3.3)	(3.5, 2.3)	(-70.7, -5.0)	(3.2, 3.6)
00 27 06.72 +61 09 33.7	AB	(135.6, 23.8)	(4.8, 3.4)	(132.2, 26.0)	(6.5, 2.6)
00 36 41.69 +64 22 30.8	AB	(60.3, 20.3)	(1.5, 1.5)	(62.4, 19.9)	(1.9, 0.5)
00 50 30.30 +24 06 27.3	AB	(51.1, -25.5)	(10.0, 10.1)	(48.6, -23.3)	(10.4, 10.5)
00 52 21.03 +33 54 41.4	AB	(46.4, -35.6)	(0.8, 0.7)	(42.5, -41.5)	(10.1, 9.6)
00 57 23.93 +60 26 50.7	AB	(-26.7, -45.8)	(1.3, 2.2)	(-26.6, -51.4)	(4.1, 2.2)
01 01 27.70 +10 23 55.6	AB	(-45.0, -52.1)	(2.7, 1.9)	(-49.7, -51.4)	(7.7, 2.4)
01 01 40.35 +53 29 35.0	AB	(-47.0, -77.9)	(7.3, 7.2)	(-50.2, -76.4)	(7.2, 7.2)
01 06 16.87 +35 54 16.1	AB	(-30.5, -55.3)	(3.0, 4.4)	(-31.0, -46.7)	(9.4, 9.4)
01 07 38.59 +25 57 28.2	AB	(93.9, 8.7)	(1.4, 1.0)	(87.8, 16.8)	(11.3, 11.3)
01 13 45.71 +35 41 31.7	AB	(62.5, -15.5)	(9.4, 9.4)	(64.8, -11.9)	(9.5, 9.4)
01 15 53.09 +51 52 50.2	AB	(-25.2, -59.0)	(7.6, 1.4)	(-34.7, -56.6)	(2.7, 4.5)
01 19 31.32 +18 49 58.0	AB	(93.6, -34.2)	(3.5, 2.1)	(89.7, -33.9)	(9.8, 9.7)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
01 23 28.66 +64 11 44.3	AB	(-71.6, 24.2)	(3.8, 3.4)	(-69.8, 18.1)	(4.4, 10.8)
01 31 51.10 +57 08 48.2	AB	(54.6, -33.4)	(3.6, 2.4)	(53.3, -33.9)	(7.6, 3.8)
01 39 45.48 +37 10 01.6	AB	(94.4, 4.7)	(0.9, 0.8)	(99.7, 4.3)	(8.9, 8.6)
01 39 59.19 +26 11 08.1	AB	(150.0, -151.0)		(150.0, -151.0)	
01 41 19.51 +12 45 42.9	AB	(129.6, 21.6)	(3.5, 2.9)	(123.7, 25.6)	(11.2, 11.8)
01 47 45.90 +37 24 14.1	AB	(-56.1, -18.6)	(0.9, 0.5)	(-55.3, -17.4)	(3.2, 2.9)
01 50 28.06 +18 17 46.5	AB	(246.0, -83.0)		(239.0, -77.0)	
01 51 24.54 +34 00 18.3	AB	(138.1, 13.0)	(0.8, 1.4)	(134.3, 15.3)	(9.0, 8.8)
01 57 34.70 +32 02 08.2	AB	(116.7, -88.9)	(1.1, 0.7)	(115.5, -92.5)	(6.4, 6.5)
02 02 06.27 +30 31 17.1	AB	(55.3, -24.1)	(1.6, 2.6)	(63.8, -30.8)	(2.9, 2.4)
02 02 52.89 +35 25 21.4	AB	(60.2, -8.4)	(3.1, 3.3)	(67.9, -4.3)	(8.1, 7.9)
02 03 25.89 +06 48 01.0	AB	(96.0, -103.5)	(10.4, 10.0)	(98.5, -99.4)	(10.3, 10.0)
02 03 45.49 +48 22 57.0	AB	(84.4, -57.8)	(6.9, 6.8)	(74.5, -58.2)	(7.0, 6.8)
02 04 18.62 +46 47 51.0	AB	(57.3, -25.1)	(0.7, 0.7)	(56.1, -21.6)	(8.1, 7.8)
02 06 17.34 +02 37 41.2	AB	(52.6, -66.8)	(0.8, 0.6)	(52.6, -62.1)	(9.3, 8.9)
02 07 18.36 +52 45 22.8	AB	(40.7, -46.9)	(1.5, 0.9)	(38.5, -49.5)	(2.8, 0.7)
02 16 49.60 +51 45 44.4	AB	(141.7, -25.7)	(3.9, 3.5)	(129.7, -33.6)	(14.7, 7.7)
02 18 01.44 +19 57 39.3	AB	(-75.6, -33.3)	(0.7, 1.2)	(-74.9, -32.8)	(9.7, 9.2)
02 18 02.11 +56 16 00.9	AB	(-92.7, -66.8)	(2.4, 2.1)	(-88.2, -75.9)	(3.6, 1.9)
02 20 08.44 +13 33 29.8	AB	(1.3, -53.3)	(10.0, 9.9)	(-2.4, -56.2)	(9.8, 9.7)
02 20 26.07 +01 35 21.5	AB	(150.0, -24.0)		(142.9, -27.3)	(7.5, 10.4)
02 21 51.38 +28 27 34.1	AB	(2.0, -66.8)	(8.2, 7.9)	(0.7, -70.0)	(7.8, 7.8)
02 24 05.49 +41 16 31.4	AB	(49.7, -43.6)	(7.7, 7.7)	(52.6, -43.3)	(7.4, 7.4)
02 24 18.72 +63 42 57.9	AB	(57.4, -33.5)	(4.6, 8.5)	(62.9, -42.1)	(5.6, 9.4)
02 24 53.12 +37 02 49.0	AB	(90.4, -3.1)	(0.9, 0.7)	(86.0, -8.6)	(7.2, 7.5)
02 25 04.44 +26 12 05.5	AB	(55.8, -37.5)	(0.9, 0.7)	(56.7, -30.1)	(6.9, 11.4)
02 25 55.49 +60 48 59.7	AB	(54.7, -87.5)	(1.3, 0.6)	(46.0, -87.5)	(5.9, 6.0)
02 36 02.73 +39 56 41.0	AB	(69.4, -5.2)	(2.2, 1.9)	(67.1, -6.6)	(2.6, 4.2)
02 39 17.74 +54 34 58.0	AB	(138.2, -52.7)	(2.6, 4.1)	(138.0, -58.4)	(1.7, 3.6)
02 47 47.16 +26 35 05.0	AB	(-71.5, -64.6)	(2.4, 6.4)	(-70.3, -61.2)	(2.1, 1.3)
02 47 53.43 +40 55 56.7	AB	(58.8, -16.0)	(0.7, 0.9)	(60.3, -12.7)	(2.8, 6.2)
03 06 13.04 +34 57 01.3	AB	(-48.0, -146.0)		(-50.6, -148.1)	(8.8, 8.8)
03 09 28.75 +34 37 09.7	AB	(71.7, -21.2)	(3.4, 2.8)	(69.5, -29.3)	(8.7, 8.5)
03 13 36.18 +38 53 59.3	AB	(58.0, -42.1)	(3.1, 3.9)	(59.5, -42.8)	(5.0, 1.9)
03 22 18.85 +32 36 40.7	AB	(51.2, -25.7)	(0.6, 0.8)	(51.1, -27.5)	(0.8, 1.2)
03 24 32.01 +10 02 41.3	AB	(-17.4, -56.8)	(2.8, 2.7)	(-17.7, -59.3)	(2.4, 2.9)
03 29 43.21 +60 30 14.4	AB	(30.5, -62.1)	(0.6, 0.7)	(32.2, -63.0)	(0.5, 1.5)
03 29 44.38 +03 55 39.4	AB	(116.9, -4.7)	(1.0, 0.6)	(118.8, -10.1)	(11.1, 11.3)
03 29 50.60 +50 10 11.7	AB	(46.4, -139.9)	(2.9, 1.5)	(53.8, -137.4)	(5.7, 1.4)
03 30 27.77 +31 52 57.0	AB	(58.1, -1.6)	(2.2, 1.2)	(55.4, -7.1)	(3.1, 4.4)
03 32 15.17 +16 13 02.6	AB	(-3.9, -50.1)	(0.6, 0.7)	(-12.5, -51.5)	(11.5, 11.8)
03 37 12.45 +32 51 26.3	AB	(52.1, -74.3)	(5.2, 5.6)	(53.7, -70.6)	(3.5, 9.8)
03 44 44.75 +40 41 50.7	AB	(51.5, -39.5)	(8.5, 8.2)	(47.2, -33.6)	(8.2, 7.8)
03 45 22.39 +23 12 17.4	AB	(-51.4, -58.4)	(10.8, 11.5)	(-55.0, -50.1)	(1.0, 1.2)
03 49 26.17 +35 26 59.2	AB	(57.6, -41.2)	(1.9, 2.2)	(57.1, -43.6)	(3.5, 3.0)
03 49 43.99 +04 38 09.8	AB	(33.6, -44.5)	(11.2, 11.7)	(34.8, -50.6)	(11.2, 11.5)
03 53 04.15 +00 02 49.9	AB	(-15.7, -68.7)	(9.0, 8.7)	(-24.9, -73.3)	(8.5, 9.3)
03 54 40.27 +38 40 31.1	AB	(65.3, -65.3)	(0.9, 1.0)	(74.4, -67.3)	(11.3, 9.9)
03 55 04.67 +00 03 07.8	AB	(-47.0, -90.2)	(9.0, 8.6)	(-41.5, -87.8)	(8.2, 8.3)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
03 56 05.91 +27 57 58.9	AB	(30.0, -56.8)	(4.0, 6.1)	(36.1, -49.1)	(5.7, 7.4)
03 57 55.66 +75 16 54.9	AB	(35.2, -42.3)	(1.5, 2.0)	(34.9, -43.0)	(8.8, 8.7)
03 59 57.69 +59 41 38.5	AB	(5.9, -77.0)	(1.4, 1.2)	(5.7, -77.0)	(1.3, 1.4)
04 01 27.42 +48 45 44.8	AB	(77.0, -63.4)	(1.1, 1.5)	(77.7, -64.1)	(0.5, 0.8)
04 03 27.83 +04 17 31.0	AB	(-19.5, -63.4)	(3.3, 3.5)	(-21.3, -61.6)	(1.7, 1.8)
04 07 06.83 +57 56 17.2	AB	(27.1, -56.8)	(8.3, 8.3)	(33.0, -51.4)	(7.7, 7.9)
04 07 39.45 +09 29 38.5	AB	(-43.2, -33.9)	(4.2, 2.5)	(-41.7, -36.9)	(10.7, 10.3)
04 30 40.93 +03 00 04.8	AB	(52.2, -57.2)	(1.3, 1.3)	(43.1, -58.6)	(5.4, 5.6)
04 37 06.92 +20 43 08.6	AB	(66.4, -26.7)	(2.4, 3.6)	(66.7, -32.9)	(8.6, 8.8)
04 42 58.08 +64 38 21.2	AB	(-64.2, -112.2)	(8.4, 8.6)	(-60.2, -116.3)	(8.5, 8.6)
04 44 33.54 +44 53 14.4	AB	(0.7, -52.6)	(2.9, 1.5)	(-2.7, -51.6)	(5.8, 2.0)
04 45 37.72 +44 43 42.8	AB	(60.7, -63.2)	(1.0, 1.1)	(56.9, -63.3)	(1.3, 3.4)
04 56 29.45 +18 00 08.6	AB	(-78.5, -82.1)	(1.2, 0.9)	(-83.1, -73.8)	(3.1, 5.5)
05 00 22.97 +41 04 56.6	AB	(-1.2, -75.5)	(5.5, 3.1)	(-8.2, -67.0)	(2.5, 2.0)
05 04 16.19 +45 46 45.7	AB	(17.2, -61.5)	(0.7, 0.7)	(21.1, -62.7)	(3.1, 2.9)
05 05 33.30 +57 09 32.8	AB	(60.2, -103.5)	(0.8, 0.8)	(51.0, -107.2)	(7.7, 7.8)
05 10 43.84 +32 29 13.4	AB	(19.2, -79.6)	(2.2, 1.8)	(15.7, -79.9)	(2.6, 3.4)
05 17 43.17 +14 43 01.9	AB	(-7.2, 54.8)	(0.8, 0.9)	(-7.8, 50.4)	(6.1, 12.8)
05 24 58.51 +19 11 34.2	AB	(67.9, 9.1)	(0.9, 2.6)	(68.9, 6.9)	(0.5, 1.4)
05 26 13.92 +09 06 25.6	AB	(-40.9, -37.2)	(3.3, 4.7)	(-40.9, -39.9)	(4.8, 5.1)
05 31 08.04 +77 52 48.0	AB	(5.7, -51.9)	(2.2, 3.2)	(5.2, -58.4)	(1.5, 1.9)
05 39 41.70 +17 41 51.8	AB	(-1.1, -90.1)	(1.3, 1.4)	(-8.7, -91.8)	(10.7, 10.7)
05 41 11.08 +29 39 01.1	AB	(30.3, -62.6)	(0.8, 2.0)	(27.7, -65.4)	(8.1, 7.9)
05 46 01.56 +33 16 21.2	AB	(-35.7, -81.9)	(1.8, 2.5)	(-33.7, -82.1)	(2.5, 5.2)
05 47 28.21 +32 19 52.0	AB	(19.8, -54.8)	(1.7, 6.1)	(27.3, -55.7)	(1.7, 3.2)
05 58 35.86 +11 43 55.6	AB	(-2.3, -52.6)	(0.8, 1.1)	(-5.5, -52.8)	(14.8, 19.7)
06 00 23.34 +42 06 29.9	AB	(8.0, -67.9)	(3.3, 1.4)	(9.9, -71.4)	(1.9, 1.4)
06 00 32.43 +81 24 20.1	AB	(40.6, 33.0)	(3.8, 6.4)	(38.8, 42.3)	(3.8, 4.2)
06 01 07.98 +03 21 54.4	AB	(17.7, -99.1)	(8.2, 8.1)	(19.3, -92.9)	(7.3, 7.4)
06 06 36.35 +39 05 43.9	AB	(-31.0, -156.0)		(-32.8, -159.1)	(2.3, 2.4)
06 27 09.33 +19 32 53.2	AB	(31.7, -46.3)	(0.8, 1.7)	(32.7, -41.0)	(2.1, 2.7)
06 37 00.94 +06 21 56.2	AB	(-18.9, -63.3)	(4.5, 3.9)	(-22.5, -54.2)	(2.0, 1.5)
06 38 07.35 +79 34 46.5	AB	(-9.5, -63.4)	(4.9, 6.3)	(-14.2, -68.7)	(8.3, 5.4)
06 40 48.76 +31 59 22.4	AB	(57.6, -71.6)	(0.7, 0.7)	(55.5, -71.2)	(1.1, 1.1)
06 42 19.75 +43 14 53.4	AB	(74.3, -16.4)	(8.4, 8.7)	(81.9, -14.3)	(5.6, 8.5)
06 43 08.90 +39 20 44.9	AB	(8.5, -103.1)	(0.7, 1.0)	(4.4, -103.5)	(2.8, 1.6)
06 55 45.43 +54 33 08.0	AB	(-2.4, -64.1)	(0.8, 0.7)	(-4.5, -62.5)	(0.9, 0.6)
06 55 52.82 +37 15 53.1	AB	(4.5, -55.4)	(0.6, 1.0)	(3.7, -56.3)	(1.4, 1.4)
06 57 05.49 +36 59 34.7	AB	(55.1, -30.6)	(8.9, 8.9)	(53.7, -27.5)	(8.8, 8.9)
06 57 50.03 +48 25 41.0	AB	(43.3, -35.4)	(0.7, 0.5)	(44.9, -32.5)	(3.7, 5.0)
06 58 06.94 +35 34 42.7	AB	(52.0, -37.3)	(10.2, 5.8)	(53.0, -35.7)	(8.9, 9.0)
06 58 43.68 +47 38 58.3	AB	(35.9, -66.1)	(1.0, 0.9)	(37.0, -65.2)	(0.9, 0.8)
07 03 38.09 +17 51 30.1	AB	(-40.7, -55.0)	(0.6, 0.6)	(-48.7, -58.7)	(8.8, 8.8)
07 05 42.93 +48 27 02.2	AB	(22.4, -83.4)	(1.3, 0.7)	(22.7, -86.7)	(1.1, 1.4)
07 09 42.68 +46 01 32.8	AB	(-129.6, -65.6)	(2.6, 3.5)	(-123.9, -63.4)	(5.6, 4.0)
07 13 19.74+03 58 47.3	AB	(44.8, -112.9)	(1.4, 0.7)	(40.5, -111.9)	(10.8, 10.0)
07 15 04.43 +06 04 50.0	AB	(26.7, -79.4)	(0.9, 1.8)	(23.0, -71.1)	(7.8, 9.9)
07 16 13.12 +11 21 45.4	AB	(-18.2, -80.5)	(6.6, 6.4)	(-20.7, -71.8)	(6.8, 7.2)
07 17 19.45 +34 06 45.0	AB	(-36.6, -38.4)	(0.8, 0.8)	(-35.0, -40.3)	(3.2, 4.9)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
07 22 06.48 +03 35 10.4	AB	(13.9, -81.7)	(2.2, 2.6)	(5.8, -76.1)	(9.7, 9.8)
07 27 26.88 +37 27 33.0	AB	(-36.5, -46.1)	(2.2, 2.8)	(-30.6, -40.9)	(3.9, 7.5)
07 28 50.24 +19 03 02.4	AB	(25.9, -73.6)	(0.6, 0.7)	(27.3, -76.1)	(8.3, 8.9)
07 34 59.58 +09 54 44.0	AB	(-38.2, 72.5)	(7.5, 3.5)	(-44.8, 65.4)	(10.7, 10.3)
07 35 58.68 +22 36 21.7	AB	(21.7, -54.4)	(8.9, 3.7)	(13.8, -56.2)	(4.1, 4.2)
07 38 12.91 +81 35 05.5	AB	(48.1, 31.3)	(2.7, 2.1)	(43.1, 28.7)	(2.8, 1.2)
07 47 10.14 +31 56 15.4	AB	(33.0, -156.0)		(35.0, -150.7)	(3.8, 2.8)
08 14 32.09 +12 16 58.8	AB	(0.3, -55.8)	(8.2, 8.2)	(-5.1, -53.0)	(7.9, 8.2)
08 25 33.13 +48 41 24.3	AB	(-19.1, -64.7)	(6.5, 4.3)	(-12.0, -56.4)	(1.9, 3.1)
08 28 55.61 +09 40 23.7	AB	(-43.7, -91.4)	(8.5, 9.0)	(-40.0, -101.0)	(8.0, 8.4)
08 34 16.97 +57 28 34.0	AB	(1.0, -108.8)	(1.9, 1.3)	(4.1, -118.0)	(4.6, 8.3)
08 34 54.35 +04 50 48.6	AB	(41.1, -88.0)	(1.9, 1.2)	(42.6, -93.2)	(10.5, 3.0)
08 35 26.86 +24 15 39.4	AB	(-8.8, -101.8)	(1.1, 1.5)	(-2.8, -97.8)	(4.1, 6.0)
08 38 29.14 +41 00 01.6	AB	(-20.3, -54.0)	(0.8, 0.8)	(-24.1, -54.2)	(9.4, 9.0)
08 41 09.36 +08 36 57.2	AB	(43.0, -41.3)	(2.8, 4.4)	(42.6, -44.0)	(1.7, 3.0)
08 45 23.93 +46 10 15.8	AB	(7.5, -77.4)	(0.7, 0.6)	(15.5, -80.2)	(6.2, 6.2)
08 45 26.81 +10 54 46.7	AB	(-226.0, -42.0)		(-220.0, -47.0)	
08 46 30.68 +20 51 22.0	AB	(10.7, -56.3)	(9.1, 8.7)	(9.2, -58.3)	(3.8, 4.3)
08 46 52.62 +35 21 02.2	AB	(-46.7, -36.3)	(6.5, 6.4)	(-55.2, -44.7)	(9.3, 9.2)
09 00 19.56 +22 35 08.7	AB	(16.3, -55.8)	(1.0, 1.2)	(19.1, -52.0)	(3.3, 3.5)
09 00 54.51 +10 34 41.0	AB	(-124.6, -46.6)	(1.0, 1.1)	(-125.8, -41.0)	(2.1, 2.5)
09 04 06.68 +14 35 06.5	AB	(-58.8, -10.5)	(9.1, 8.9)	(-56.3, -7.2)	(9.2, 9.0)
09 04 35.96 +05 12 21.2	AB	(-64.0, 3.8)	(10.0, 10.1)	(-62.5, 3.6)	(9.5, 9.7)
09 19 27.20 +72 22 06.1	AB	(-15.8, -60.5)	(8.6, 5.7)	(-13.5, -55.5)	(14.6, 7.6)
09 19 59.40 +48 39 08.1	AB	(-44.8, -42.1)	(1.9, 2.2)	(-46.2, -35.3)	(4.8, 3.5)
09 28 22.77 +48 47 09.7	AB	(-34.8, -71.7)	(0.8, 0.7)	(-33.0, -81.1)	(10.3, 10.5)
09 36 54.52 +40 24 34.6	AB	(-42.2, -33.0)	(3.3, 3.9)	(-47.3, -33.9)	(3.4, 2.0)
09 42 32.31 +71 53 25.0	AB	(-20.1, -61.3)	(8.9, 9.2)	(-23.5, -59.1)	(9.0, 9.3)
09 45 26.05 +15 40 39.8	AB	(-96.6, 65.8)	(0.8, 1.7)	(-93.9, 67.8)	(10.2, 11.3)
09 46 02.03 +49 51 32.5	AB	(-23.5, -61.0)	(0.8, 2.4)	(-23.3, -68.6)	(7.6, 5.0)
09 47 02.35 +35 13 09.7	AB	(-156.0, 23.0)		(-162.8, 21.0)	(3.6, 1.3)
09 47 43.55 +75 03 42.3	AB	(-39.1, -34.3)	(1.4, 2.1)	(-41.2, -34.5)	(3.2, 1.5)
09 48 37.51+68 50 28.8	AB	(-28.2, -44.4)	(8.9, 9.2)	(-23.1, -47.3)	(9.0, 9.3)
09 49 02.94 +27 00 08.9	AB	(14.0, -52.5)	(11.1, 10.7)	(18.8, -57.5)	(10.4, 10.2)
09 50 37.83 +39 50 19.1	AB	(-142.0, -58.0)		(-142.0, -58.0)	
09 55 27.79 +35 00 08.9	AB	(-35.8, -61.9)	(0.6, 0.7)	(-33.1, -63.3)	(1.8, 2.5)
10 00 39.89 +28 10 25.1	AB	(-42.7, -138.0)	(0.9, 1.3)	(-43.8, -139.1)	(11.6, 11.0)
10 01 25.73 +32 39 06.9	AB	(-70.2, -47.8)	(1.0, 1.0)	(-74.7, -39.2)	(5.0, 5.0)
10 03 23.68 +10 45 15.3	AB	(-74.7, -1.7)	(0.5, 0.5)	(-68.8, 7.0)	(3.6, 13.0)
10 03 40.98 +10 48 52.2	AB	(-87.3, -34.6)	(0.6, 0.6)	(-90.4, -34.7)	(3.3, 4.4)
10 03 56.57 +15 26 32.9	AB	(-84.2, -6.9)	(15.5, 7.5)	(-92.9, -12.2)	(4.8, 3.1)
10 05 20.93 +34 43 11.1	AB	(-67.1, 14.2)	(1.4, 2.3)	(-69.0, 10.5)	(5.1, 4.5)
10 10 20.70 +56 29 12.8	AB	(-91.7, -56.1)	(3.8, 2.5)	(-91.8, -49.2)	(3.8, 3.2)
10 10 41.16 +39 54 39.9	AB	(-44.1, -77.1)	(1.1, 0.5)	(-41.9, -75.9)	(1.4, 1.0)
10 10 44.00 +49 51 36.2	AB	(-97.5, -70.4)	(1.4, 1.0)	(-91.6, -76.1)	(6.3, 6.3)
10 15 17.83 +47 25 47.9	AB	(-77.7, -117.9)	(10.6, 9.8)	(-82.1, -110.4)	(10.9, 10.6)
10 21 45.41 +46 50 55.4	AB	(-91.3, -64.6)	(0.8, 0.6)	(-90.3, -66.7)	(1.9, 1.5)
10 29 56.31 +54 23 08.4	AB	(-51.2, -61.1)	(3.6, 5.2)	(-54.0, -59.8)	(3.6, 4.6)
10 30 24.63 +25 14 14.5	AB	(50.9, -23.5)	(1.7, 1.2)	(50.7, -18.0)	(4.3, 2.3)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
10 39 01.53 +51 04 24.8	AB	(-110.6, -28.4)	(0.8, 0.8)	(-115.3, -27.9)	(2.7, 3.5)
10 39 40.30 +32 27 07.0	AB	(114.0, -140.0)		(114.0, -140.0)	
10 42 17.65 +50 55 25.8	AB	(-61.3, -31.8)	(3.0, 2.2)	(-58.9, -28.9)	(3.2, 5.8)
10 43 59.65 +14 44 22.0	AB	(-59.9, -16.8)	(5.8, 3.5)	(-69.5, -20.5)	(3.9, 8.9)
10 48 17.14 +16 24 12.0	AB	(46.2, -39.9)	(1.2, 0.6)	(48.8, -45.1)	(8.6, 1.5)
10 52 39.12 +07 56 01.9	AB	(-62.0, -5.0)	(6.3, 2.5)	(-59.1, -8.9)	(5.6, 3.6)
11 18 05.63 +08 10 10.6	AB	(51.1, -102.7)	(4.0, 6.5)	(42.9, -105.1)	(15.5, 13.5)
11 24 35.50 +37 52 25.1	AB	(-137.8, -1.9)	(0.5, 0.8)	(-138.9, 1.0)	(1.7, 1.3)
11 38 57.73 +32 53 09.6	AB	(42.8, -63.9)	(2.5, 2.9)	(36.8, -59.5)	(13.1, 11.9)
11 44 50.74 +37 51 19.9	AB	(51.0, -34.5)	(2.8, 3.7)	(41.6, -29.3)	(4.6, 4.0)
11 45 00.99 +08 38 25.6	AB	(-77.1, -31.0)	(2.2, 2.2)	(-72.3, -31.6)	(12.6, 11.1)
11 49 49.04 +02 21 33.5	AB	(-80.6, 12.2)	(0.9, 0.8)	(-83.3, 10.1)	(3.1, 3.8)
12 09 44.83 +43 26 43.1	AB	(-61.5, -20.2)	(10.8, 9.7)	(-65.5, -19.8)	(10.1, 9.5)
12 15 37.29 +37 48 55.2	AB	(-83.7, 37.4)	(3.4, 6.0)	(-79.0, 40.1)	(7.0, 6.5)
12 16 24.44 +35 41 45.1	AB	(-137.0, -1.6)	(3.8, 3.7)	(-147.5, -0.8)	(8.8, 8.3)
12 22 46.95 +02 46 18.2	AB	(-68.2, -24.8)	(2.8, 4.8)	(-64.8, -24.4)	(5.4, 4.4)
12 28 03.64 +59 48 39.8	AB	(44.8, -45.3)	(1.8, 1.6)		
12 28 03.64 +59 48 39.8	AC	(44.8, -45.3)	(1.8, 1.6)	(37.8, -45.9)	(3.9, 4.4)
12 28 59.91 +42 47 03.2	AB	(-70.8, 9.3)	(10.0, 9.1)	(-73.0, 3.4)	(9.8, 9.1)
12 29 42.14 +03 06 28.0	AB	(-60.7, -0.5)	(1.4, 1.4)	(-58.4, -1.6)	(1.5, 1.5)
12 31 07.59 +38 36 29.3	AB	(-69.5, -44.6)	(0.7, 0.7)	(-66.6, -48.3)	(1.8, 1.0)
12 31 12.95 +57 47 10.9	AB	(-88.5, -1.7)	(1.7, 2.3)	(-92.6, 2.0)	(1.6, 2.7)
12 32 13.88 +41 02 44.4	AB	(-136.6, 35.2)	(2.0, 4.3)	(-144.0, 44.4)	(11.1, 10.8)
12 42 18.18 +81 04 56.8	AB	(58.5, -57.9)	(2.3, 2.5)	(63.4, -48.4)	(3.4, 2.7)
12 55 35.02 +12 18 41.9	AB	(-120.0, 78.8)	(2.2, 2.7)	(-117.1, 82.9)	(3.2, 3.7)
13 03 03.97 +43 27 02.6	AB	(-115.3, -22.3)	(0.5, 0.5)	(-118.9, -21.5)	(11.9, 11.2)
13 05 02.91 +14 29 58.2	AB	(-53.0, -19.5)	(0.7, 2.4)	(-58.9, -17.6)	(8.4, 10.5)
13 05 22.89 +54 52 24.1	AB	(-70.3, 23.4)	(6.0, 6.8)	(-79.2, 16.1)	(2.7, 3.8)
13 16 48.29 +62 22 03.0	AB	(-98.1, 26.5)	(0.6, 0.6)	(-99.7, 27.0)	(2.9, 1.2)
13 19 56.59 +38 22 08.6	AB	(-74.9, 21.4)	(0.5, 0.5)	(-72.9, 24.2)	(2.5, 2.3)
13 53 44.49 +12 40 48.4	AB	(34.7, -59.7)	(0.6, 0.9)	(34.4, -56.6)	(2.7, 6.1)
13 56 20.38 +11 48 04.2	AB	(-60.5, -5.7)	(1.1, 1.1)	(-52.2, 2.4)	(3.5, 6.9)
13 57 43.05 +65 44 22.5	AB	(-82.9, 21.8)	(4.3, 5.0)	(-78.1, 15.3)	(3.8, 5.8)
14 00 08.33 +03 56 13.2	AB	(62.6, -67.1)	(1.8, 1.6)	(63.7, -67.7)	(6.7, 3.8)
14 00 22.48 +39 24 27.2	AB	(-80.3, 17.5)	(9.5, 8.9)	(-75.8, 14.8)	(9.4, 8.7)
14 05 06.65 +19 17 18.8	AB	(-41.4, 46.6)	(1.0, 0.8)	(-49.5, 49.6)	(10.9, 6.2)
14 14 32.50 +10 44 15.4	AB	(2.0, -58.4)	(2.8, 4.4)	(-0.2, -59.8)	(2.9, 1.7)
14 16 32.73 +42 09 06.8	AB	(31.3, -50.0)	(1.1, 0.9)	(34.1, -52.0)	(1.5, 1.8)
14 21 05.50 +49 42 19.9	AB	(-32.1, -77.8)	(1.7, 0.9)	(-39.6, -74.0)	(3.4, 3.3)
14 32 41.31 +55 53 28.0	AB	(84.3, -88.1)	(3.0, 1.9)	(79.0, -88.9)	(4.0, 2.2)
14 38 08.34 +14 02 58.0	AB	(-34.1, -45.3)	(2.1, 1.9)	(-33.5, -45.4)	(9.8, 11.0)
14 41 49.15 +20 25 43.6	AB	(-58.4, 6.7)	(0.5, 0.6)	(-56.9, 1.3)	(1.6, 1.5)
14 46 50.55 +14 53 25.7	AB	(44.1, -47.3)	(10.3, 10.3)	(42.9, -43.1)	(4.6, 4.8)
14 58 38.15 +03 55 18.5	AB	(-96.1, -13.3)	(1.0, 0.6)	(-102.9, -17.4)	(9.1, 9.1)
14 59 26.46 +18 00 06.3	AB	(-56.4, 15.6)	(1.5, 1.5)	(-57.5, 18.6)	(9.9, 10.9)
14 59 32.92 +45 27 51.0	AB	(-32.9, 100.0)	(0.7, 0.5)	(-33.8, 102.3)	(0.8, 1.1)
15 02 42.31 +57 06 03.1	AB	(54.3, 15.8)	(10.2, 10.1)	(54.6, 15.9)	(10.8, 10.4)
15 09 18.11 +03 11 35.8	AB	(-63.3, -10.8)	(1.2, 1.2)	(-67.3, -5.4)	(4.7, 7.6)
15 15 56.80 +16 43 10.8	AB	(-82.3, 25.7)	(1.2, 1.3)	(-80.6, 20.5)	(2.7, 4.7)

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		μ_1	σ_1	μ_2	σ_2
15 18 46.24 +43 13 51.9	AB	(-62.9, -65.0)	(12.0, 11.9)	(-65.4, -68.5)	(11.9, 12.2)
15 20 27.64 +20 12 41.0	AB	(-0.1, -73.7)	(4.1, 3.4)	(-3.0, -73.8)	(1.5, 1.6)
15 20 37.98 +17 06 36.1	AB	(-87.9, -31.9)	(2.7, 2.2)	(-86.1, -29.7)	(3.2, 5.0)
15 23 41.28 +21 57 36.7	AB	(-66.9, -38.2)	(0.9, 0.8)	(-66.1, -38.1)	(1.5, 1.9)
15 23 53.87 +56 09 32.1	AB	(70.9, -38.1)	(3.5, 5.9)	(74.1, -39.6)	(3.7, 4.0)
15 24 28.68 +66 55 15.1	AB	(-43.5, 34.9)	(9.7, 9.7)	(-44.2, 36.0)	(9.5, 9.9)
15 24 35.98 +19 46 24.6	AB	(-85.9, 64.5)	(0.8, 0.8)	(-90.3, 61.1)	(16.7, 9.1)
15 32 27.20 +65 22 19.8	AB	(-37.8, 74.6)	(3.6, 2.3)	(-45.2, 65.4)	(9.4, 9.7)
15 33 45.19 +38 17 52.0	AB	(-77.4, 7.4)	(10.8, 10.7)	(-71.5, 6.0)	(10.6, 10.6)
15 42 32.07 +45 32 47.5	AB	(-54.1, 27.9)	(10.0, 10.0)	(-48.5, 23.1)	(10.0, 10.0)
15 45 35.05 +42 05 06.6	AB	(97.1, 3.8)	(10.3, 10.3)	(101.1, 4.2)	(10.0, 10.2)
15 49 45.51 +28 39 13.6	AB	(-95.4, 77.6)	(10.9, 6.8)	(-87.4, 68.6)	(1.8, 2.1)
15 51 08.44 +05 37 49.6	AB	(17.7, -90.2)	(6.3, 4.1)	(10.7, -98.7)	(6.7, 4.9)
15 56 47.77 +54 59 11.2	AB	(-56.9, 32.9)	(2.2, 0.7)	(-49.7, 37.5)	(2.0, 4.2)
16 03 51.30 +29 35 18.9	AB	(-36.4, 80.2)	(1.0, 0.6)	(-41.2, 84.3)	(9.1, 8.9)
16 23 42.61 +07 41 49.7	AB	(-0.7, -81.8)	(1.9, 4.3)	(7.9, -73.1)	(10.7, 9.4)
16 26 48.10 +26 21 38.4	AB	(47.0, -150.0)		(46.0, -143.0)	
16 27 32.63 +08 31 47.4	AB	(112.2, 58.8)	(6.1, 7.4)	(109.9, 61.1)	(8.6, 8.2)
16 34 29.50 +30 34 20.8	AB	(-57.2, 38.4)	(0.8, 1.4)	(-56.6, 40.8)	(8.5, 8.7)
16 38 45.74 +39 23 20.5	AB	(2.7, -63.3)	(0.5, 1.4)	(2.9, -65.1)	(4.5, 3.7)
16 39 19.65 +14 23 59.6	AB	(-45.8, -48.4)	(9.0, 9.0)	(-48.8, -52.6)	(8.8, 9.1)
16 46 57.72 +59 54 21.4	AB	(25.5, -54.4)	(1.7, 1.2)	(28.4, -47.4)	(2.1, 4.0)
16 52 06.06 +47 50 35.6	AB	(-75.5, 4.4)	(1.4, 1.2)	(-76.4, -2.9)	(5.4, 3.2)
17 14 10.95 +69 04 01.5	AB	(-24.0, -51.0)	(1.2, 0.9)	(-24.7, -55.2)	(1.7, 1.6)
17 18 15.11 +04 58 48.6	AB	(65.9, 2.5)	(1.2, 1.2)	(66.8, -1.0)	(3.2, 3.8)
17 19 52.08 +11 55 08.3	AB	(0.0, 77.9)	(9.1, 9.3)	(1.8, 74.1)	(9.2, 9.2)
17 22 28.31 +14 40 43.2	AB	(10.0, -100.7)	(1.1, 2.0)	(7.3, -108.1)	(7.0, 7.7)
17 22 56.90 +41 12 35.5	AB	(39.8, 47.7)	(0.6, 0.5)	(33.5, 50.2)	(3.0, 8.5)
17 29 09.19 +39 33 18.7	AB	(20.5, -46.4)	(1.9, 4.1)	(13.2, -51.8)	(5.3, 1.9)
17 29 45.13 +38 41 45.2	AB	(1.3, -66.2)	(5.0, 5.2)	(7.9, -67.8)	(9.1, 9.3)
17 33 46.66 +75 02 43.5	AB	(5.5, 63.1)	(8.7, 9.4)	(3.9, 68.3)	(8.6, 9.1)
17 52 36.11 +45 30 55.3	AB	(6.9, -57.4)	(3.7, 0.6)	(1.3, -52.8)	(4.8, 2.7)
17 54 44.23 +16 33 19.0	AB	(-55.4, -47.5)	(1.1, 0.9)	(-55.3, -51.3)	(9.8, 2.5)
18 02 09.22 +71 50 31.8	AB	(0.6, -69.1)	(1.9, 1.3)	(-1.4, -63.3)	(4.6, 3.9)
18 09 26.10 +50 18 54.0	AB	(-89.6, 112.2)	(3.2, 2.1)	(-85.2, 112.5)	(0.7, 1.1)
18 12 47.28 +67 37 05.1	AB	(-26.8, -69.2)	(1.1, 2.2)	(-33.9, -78.8)	(8.6, 2.8)
18 17 02.81 +29 36 45.4	AB	(-38.8, -43.1)	(0.7, 1.3)	(-36.2, -37.8)	(1.8, 0.8)
18 22 29.36 +69 23 40.1	AB	(-4.2, 81.3)	(0.8, 1.5)	(-7.7, 85.5)	(3.9, 3.8)
18 24 11.43 +45 39 47.7	AB	(38.6, 123.4)	(0.8, 0.7)	(37.8, 122.6)	(0.5, 1.4)
18 56 46.54 +40 38 40.5	AB	(26.9, -109.1)	(7.5, 7.7)	(24.0, -115.7)	(7.5, 7.7)
18 57 21.01 +03 01 51.6	AB	(60.3, 30.5)	(8.4, 8.9)	(55.0, 29.4)	(8.2, 8.6)
18 57 50.91 +03 15 14.3	AB	(-5.0, -63.9)	(5.0, 3.0)	(0.5, -73.7)	(6.2, 2.6)
19 11 14.90 +58 23 39.5	AB	(-7.6, -88.4)	(8.4, 9.1)	(-9.8, -89.2)	(8.4, 9.0)
19 22 09.85 +70 50 45.4	AB	(38.3, -69.5)	(4.1, 2.5)	(38.0, -62.7)	(7.4, 8.0)
19 47 27.30 +44 06 43.1	AB	(49.9, 19.0)	(0.8, 0.7)	(51.2, 19.1)	(7.4, 7.8)
19 49 17.28 +40 05 24.1	AB	(60.7, -90.0)	(1.3, 0.7)	(59.5, -88.5)	(2.2, 1.5)
19 49 21.88 +17 44 36.2	AB	(-75.5, -20.1)	(8.8, 9.0)	(-76.0, -29.2)	(7.4, 7.9)
20 15 16.29 +19 37 29.5	AB	(-19.4, -118.9)	(1.3, 0.9)	(-21.7, -116.7)	(14.5, 2.3)
20 16 44.29 +01 58 27.9	AB	(39.0, -160.0)		(39.0, -160.0)	

Table continued on next page.

New Northern Hemisphere Common Proper-Motion Pairs from the UCAC-3 Catalog

Table 2 (continued): Proper motion of each component (mas/yr)

RA DEC		m_1	σ_1	m_2	σ_2
20 30 36.61 +19 31 44.1	AB	(-47.7, -16.5)	(2.4, 1.4)	(-51.7, -12.9)	(2.3, 4.5)
20 41 55.13 +02 17 37.7	AB	(75.7, 0.6)	(8.4, 8.9)	(66.5, 4.2)	(8.4, 8.7)
20 42 01.65 +33 49 16.5	AB	(-43.8, 41.8)	(1.0, 1.3)	(-44.3, 41.0)	(2.4, 2.4)
20 45 24.35 +48 16 25.9	AB	(57.9, 86.2)	(1.2, 1.0)	(63.9, 82.1)	(2.9, 3.1)
20 50 53.66 +19 52 44.5	AB	(7.9, -132.9)	(5.2, 3.4)	(12.1, -132.7)	(4.6, 4.1)
21 07 40.74 +30 22 11.7	AB	(-7.1, -70.3)	(0.8, 0.9)	(-6.3, -68.5)	(0.7, 1.0)
21 09 08.25 +32 32 15.0	AB	(-25.8, -96.8)	(2.9, 2.9)	(-25.3, -93.2)	(4.0, 2.4)
21 19 48.98 +27 30 16.6	AB	(98.9, 18.7)	(0.9, 0.7)	(91.6, 22.5)	(2.3, 6.2)
21 20 52.28 +40 09 49.8	AB	(85.8, 59.1)	(7.5, 7.4)	(85.4, 65.0)	(7.5, 7.4)
21 23 32.60 +30 11 45.3	AB	(65.5, 43.4)	(1.5, 0.9)	(65.4, 48.8)	(3.2, 2.3)
21 27 28.18 +16 17 49.6	AB	(-34.1, -61.9)	(2.0, 2.0)	(-27.1, -67.2)	(2.6, 3.6)
21 28 38.77 +41 01 51.0	AB	(63.2, -12.3)	(7.5, 7.5)	(67.5, -19.8)	(7.3, 7.3)
21 33 38.21 +45 22 06.0	AB	(80.8, 19.8)	(1.0, 1.6)	(71.2, 22.5)	(7.3, 7.3)
21 37 55.05 +51 22 43.9	AB	(63.9, 63.6)	(3.4, 7.2)	(71.2, 57.8)	(6.8, 10.0)
21 41 01.38 +11 15 46.9	AB	(-67.1, -123.3)	(0.7, 0.6)	(-71.3, -126.9)	(3.6, 8.2)
21 53 27.04 +09 42 27.2	AB	(35.1, 125.7)	(3.0, 3.9)	(30.7, 131.4)	(4.6, 5.9)
21 58 47.91 +46 18 53.0	AB	(-30.6, -87.7)	(0.7, 1.0)	(-30.0, -91.7)	(1.1, 2.0)
22 01 22.53 +40 08 27.9	AB	(-6.8, -59.7)	(0.8, 1.1)	(-7.1, -53.1)	(8.1, 4.6)
22 07 40.63 +63 02 22.5	AB	(68.4, 29.1)	(3.3, 3.1)	(64.2, 31.3)	(1.9, 2.6)
22 10 59.25 +10 20 23.0	AB	(131.6, -0.9)	(10.3, 10.4)	(133.3, -7.9)	(10.2, 10.4)
22 15 56.53 +49 31 22.0	AB	(39.7, -54.4)	(1.1, 1.3)	(45.8, -53.4)	(4.6, 1.3)
22 19 12.13 +10 11 21.7	AB	(113.8, -58.4)	(2.2, 2.8)	(113.8, -64.4)	(3.7, 7.4)
22 23 27.00 +26 21 04.1	AB	(73.9, -9.4)	(0.8, 1.7)	(76.7, -12.8)	(7.8, 4.7)
22 24 03.15 +43 23 58.9	AB	(-14.9, -55.2)	(0.6, 0.6)	(-14.0, -48.4)	(9.4, 9.5)
22 35 39.45 +19 38 54.7	AB	(47.0, -18.5)	(3.5, 2.1)	(52.3, -26.5)	(7.2, 7.2)
22 37 19.58 +22 24 59.2	AB	(68.9, 10.7)	(10.4, 10.1)	(63.4, 8.5)	(7.7, 7.7)
22 47 32.56 +17 13 25.9	AB	(58.9, 38.0)	(6.4, 5.5)	(53.4, 32.6)	(9.2, 9.6)
22 47 55.50 +03 36 07.3	AB	(68.8, 3.7)	(1.2, 0.5)	(71.5, 5.1)	(1.8, 0.6)
22 50 22.85 +33 43 42.7	AB	(45.9, 28.1)	(1.1, 0.8)	(48.0, 27.7)	(8.3, 8.2)
22 58 15.06 +01 24 14.1	AB	(-46.4, 105.2)	(1.7, 1.2)	(-38.1, 110.5)	(4.6, 12.6)
23 04 09.83 +17 15 04.0	AB	(55.0, -24.9)	(0.8, 1.0)	(56.4, -25.8)	(2.7, 4.1)
23 05 05.62 +38 40 57.8	AB	(-31.1, -55.5)	(0.9, 1.5)	(-32.7, -61.2)	(9.0, 8.8)
23 09 32.80 +49 58 24.9	AB	(-91.1, -109.9)	(6.6, 4.5)	(-97.1, -105.5)	(10.1, 6.0)
23 13 49.67 +25 35 44.7	AB	(70.9, 18.1)	(0.8, 0.5)	(69.5, 15.5)	(2.3, 2.4)
23 16 19.99 +17 50 32.0	AB	(16.4, -112.4)	(0.6, 0.6)	(18.8, -116.1)	(10.8, 10.9)
23 21 08.84 +21 48 09.4	AB	(-59.9, -44.8)	(9.8, 9.8)	(-60.1, -40.4)	(9.8, 9.9)
23 22 50.25 +27 34 28.0	AB	(94.6, -9.1)	(0.6, 0.5)	(96.5, -13.2)	(6.9, 4.9)
23 25 21.95 +12 20 59.9	AB	(-24.2, -55.3)	(4.0, 3.2)	(-19.9, -62.0)	(4.4, 3.9)
23 25 53.66 +22 10 39.6	AB	(53.7, -22.8)	(2.2, 1.7)	(53.9, -28.9)	(9.9, 9.9)
23 26 20.55 +42 08 14.2	AB	(65.4, 0.5)	(0.9, 0.9)	(57.6, 5.1)	(7.4, 7.5)
23 29 30.84 +46 44 18.7	AB	(137.0, -80.0)		(137.0, -80.0)	
23 36 29.20 +67 41 43.9	AB	(-56.0, -39.1)	(7.7, 7.3)	(-64.9, -29.3)	(7.4, 7.3)
23 41 10.44 +00 47 24.2	AB	(-4.0, 59.2)	(1.3, 1.0)	(1.4, 59.3)	(1.3, 1.3)
23 41 17.43 +14 54 51.9	AB	(139.0, 72.0)		(139.0, 72.0)	
23 41 47.71 +09 14 25.1	AB	(-36.1, -45.5)	(2.6, 1.9)	(-33.7, -44.1)	(3.1, 2.4)
23 43 36.60 +39 08 14.8	AB	(-28.9, -42.5)	(1.0, 0.8)	(-37.2, -41.0)	(9.7, 9.4)
23 44 22.25 +71 26 52.5	AB	(-69.8, 3.6)	(1.3, 1.3)	(-72.2, -0.9)	(7.6, 7.2)
23 49 24.30 +36 54 02.8	AB	(115.0, -80.1)	(0.6, 1.1)	(115.1, -80.7)	(11.1, 11.0)
23 49 30.53 +23 25 45.0	AB	(-40.3, -46.9)	(0.7, 0.8)	(-36.8, -56.8)	(7.6, 7.6)
23 58 05.47 +31 09 44.5	AB	(-39.2, 141.6)	(1.9, 1.6)	(-39.0, 145.6)	(10.1, 9.5)
23 58 53.39 +01 48 44.8	AB	(75.9, -30.2)	(7.3, 7.2)	(77.7, -33.0)	(7.5, 7.3)

Journal of Double Star Observations

January 1, 2010
Volume 6, Number 1

The Journal of Double Star Observations is an electronic journal published quarterly by the University of South Alabama. Copies can be freely downloaded from http://www.jdso.org.

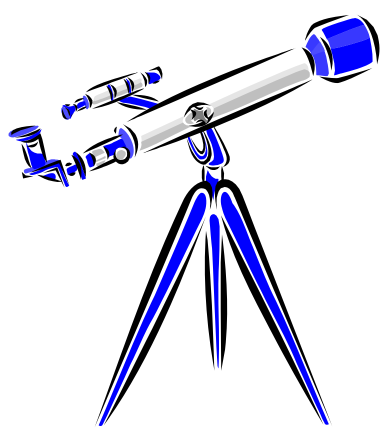
Questions, comments, or submissions may be directed to rclark@jaguar1.usouthal.edu or to rmollise@bellsouth.net

The *Journal of Double Star Observations* (*JDSO*) publishes articles on any and all aspects of astronomy involving double and binary stars. The *JDSO* is especially interested in observations made by amateur astronomers. Submitted articles announcing measurements, discoveries, or conclusions about double or binary stars may undergo a peer review. This means that a paper submitted by an amateur astronomer will be reviewed by other amateur astronomers doing similar work.

Not all articles will undergo a peer-review. Articles that are of more general interest but that have little new scientific content such as articles generally describing double stars, observing sessions, star parties, etc. will not be refereed.

Submitted manuscripts must be original, unpublished material and written in English. They should contain an abstract and a short description or biography (2 or 3 sentences) of the author(s). For more information about format of submitted articles, please see our web site at www.jdso.org

Submissions should be made electronically via e-mail to rclark@jaguar1.usouthal.edu or to rmollise@bellsouth.net. Articles should be attached to the email in Microsoft Word, Word Perfect, Open Office, or text format. All images should be in jpg or fits format.



We're on the web!

http://www.jdso.org