Divinus Lux Observatory Bulletin: Report #19

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Abstract: This report contains theta/rho measurements from 79 different double star systems. The time period spans from 2009.266 to 2009.433. 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 (WDS) catalog, with published measurements that are no more recent than ten years ago. Several systems are included from the 2006.5 version of the WDS catalog as well. There are also some noteworthy items that are discussed pertaining to the following table.

First of all, some observations can be made about four visual binary stars that have been measured for this report. In regards to STF 1788 AB, a theta increase of 2 degrees appears to have taken place during the past ten years because of orbital motion. A calculation of the theta value using the orbital elements yields a one degree increase during this time period. The calculated orbit has a rating of grade 5 in Sky Catalogue 2000.0 Vol. 2.

For visual binary STF 1888 AB, a much larger theta shift has been measured. Since 1999, this value has decreased by 7.5 degrees, which is fairly consistent with a decrease of 8 degrees that is obtained when calculating the theta value using the orbital elements. This orbit is rated at Grade 1 in the Sky Catalogue, so measured results should be expected to track closely with the orbital elements calculations. One other observation that can be made about the STF 1888 star system is that since the AB components have a high common proper motion value, large parametric shifts are occurring relative to the remaining components, which happen to be optical in nature. For example, the rho value for components BE has decreased by 9" since 1932. This situation somewhat mirrors what is occurring with the 61 Cygni system, which I reported on at the STAR workshop in San Luis Obispo, California last year (Arnold 2008).

In regards to STF 2032 AB, a theta value increase of one degree appears to have occurred since 1999, which tracks closely with the value obtained from using the orbital elements. However, the rho value is 5% higher when the calculation is performed with the orbital elements than what the catalogs or recent measurements would indicate. Perhaps this shouldn't be totally surprising since the calculated orbit is rated at grade 4. Incidentally, because of proper motion by the "A" component, a rho value increase of approximately 4% has occurred for "AD" since 1996. The "D" component is optical in nature.

Finally, when considering parameter shifts for visual binary STF 1954 AB, a theta value decrease of one degree appears to have occurred since 1999. Compared to values obtained from using the orbital elements, the calculated theta value is 2.5 degrees larger than that obtained from other catalogs or from what was recently measured. Calculations from the orbital elements also yield a rho value that is 12% larger than the catalogs, or from recent measurements. Again, this shouldn't necessarily be surprising since this orbit carries a rating of grade 5.

Some noteworthy theta/rho shifts might also be mentioned for several double stars as a result of proper motion by one or both of the components. To begin with, J 520 has displayed a theta value increase of about 2 degrees and a rho value decrease of 4.5%, during the past decade, because of proper motions in opposite directions by both components. Second, divergent proper motions by both components of BRT 479 have caused an 8% rho value increase since 1991. Third, proper motion by the reference point star, for PWS 14 AC, is responsible for a 4.5% rho value increase during the past 10 years. Fourth, proper motion by the reference point star, for KUI 82 AB-C, has caused a theta value increase of 3 degrees since 1999. Finally, a 3% rho value decrease appears to have occurred during the past decade, for STF 2573, because of proper motions by both component stars.

One entry in the table below, bearing the "ARN" prefix, represents a double star that has an apparent common proper motion which doesn't appear to have been previously cataloged. This pair, identified with a double asterisk, is listed as ARN 106 (15362-1656), which is located in the constellation of Libra.

Lastly, it appears that a couple of errors may exist in the 2006.5 version of the WDS Catalog for the STF 2319 (18277+1918) multiple star system. First, the theta/rho measurements for "AC" seem to reflect the values for "BC" and vice versa. Additionally, the theta value for "AD" reflects a quadrant flip, being 180 degrees removed from what would be expected if "A" is to be used as the reference point star.

References

Arnold, Dave, 2009, "Considering Proper Motion in the Analysis of Visual Double Stars", in *Small Telescopes and Astronomical Research*, R. Genet, et al., eds., Collins Foundation Press, in press.

NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
STF1758	13329+4908	8.6 8.9	293.0	3.46	2009.293	1
STF1774	13404+5031	6.3 10.5	135.1	17.28	2009.293	2
STF1788AB	13550-0804	6.6 7.2	100.0	3.46	2009.293	3
STF1800AB-C	14020+5713	7.8 10.1	21.1	28.64	2009.293	4
STF1804	14083+2112	8.1 9.2	13.5	4.94	2009.293	5
STF1888AB	14514+1906	4.7 6.8	309.5	6.42	2009.293	6
STF1888BE	14514+1906	6.8 8.4	101.6	273.54	2009.293	6
ARN 11AE	14514+1906	4.7 8.4	100.2	268.60	2009.293	6
ARN 12AF	14514+1906	4.7 9.1	40.5	333.78	2009.293	6
H 125	15128+2756	8.4 9.4	228.2	32.09	2009.266	7
STF 27	15155+3319	3.5 7.8	77.9	104.68	2009.266	8
STF1925AB	15169-0817	8.1 9.9	16.4	5.93	2009.351	9
HJ 4758	15190-0713	9.6 10.2	78.8	5.93	2009.351	10
STF 28Aa-BC	15245+3723	4.3 7.0	170.9	108.63	2009.266	11
HEI 784	15252+0932	10.6 10.7	275.5	3.95	2009.266	12
A 1369AC	15288+3101	10.6 10.4*	259.0	73.57	2009.266	13
STF1954AB	15348+1032	4.1 5.1	73.0	3.95	2009.351	14
ARN 106**	15362-1656	10.6 10.7	293.3	43.94	2009.400	15

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
HJ 1276	15370-0041	9.7 10.2	258.6	5.43	2009.266	16
BU 35AC	15428-1601	7.2 10.7	38.4	123.44	2009.266	17
PRT 5	15448+3534	10.6 10.6	44.0	4.44	2009.400	18
HJ 4804	15459-0921	10.6 10.7	283.3	19.26	2009.266	19
STF1970 AB	15462+1525	3.0 10.0	263.9	31.11	2009.351	20
STF1970 AC	15462+1525	3.0 10.6	212.4	199.48	2009.351	20
STF3097	15509-0902	9.6 9.9	188.1	3.95	2009.266	21
STF1996AB	15565+5717	10.2 10.6	107.6	19.26	2009.266	22
STF1996AC	15565+5717	10.2 10.6	140.8	160.96	2009.266	22
STF1993AB	15598+1723	8.6 8.8	42.5	20.74	2009.315	23
STF1993AC	15598+1723	8.6 10.0	178.8	239.47	2009.315	23
STF2007AB	16060+1319	6.8 7.9	322.1	38.02	2009.315	24
STF2007AC	16060+1319	6.8 10.7	137.1	162.94	2009.315	24
STF2024	16118+4222	5.9 10.7	44.1	23.70	2009.351	25
STF2029	16138+2844	7.9 9.6	187.0	5.93	2009.351	26
STF2032AB	16147+3352	5.6 6.4	238.1	6.92	2009.351	27
STF2032AD	16147+3352	5.6 10.7	82.4	91.84	2009.351	27
PWS 14AC	16278-0104	9.6 10.6	47.1	79.49	2009.400	28
STF2070	16377+1933	7.7 10.3	142.5	29.14	2009.315	29
STF2096AB	16472+0204	6.1 9.7	87.8	23.70	2009.351	30
WEI 31AB	16476+2538	9.9 10.1	317.1	4.94	2009.315	31
H 133	17054+1244	4.9 10.4	306.6	60.24	2009.356	32
STF2146AC	17131+5408	6.9 8.8	233.2	88.38	2009.356	33
STF2144	17174-0752	8.2 10.4	177.7	25.68	2009.356	34
STT 152	17187+2146	7.5 9.7	46.9	52.83	2009.356	35
KUI 82AB-C	17293+2924	9.1 9.1	312.3	49.87	2009.400	36
HJ 4960	17323-0828	10.0 10.2	93.8	5.93	2009.356	37
STF2182AB	17324+2352	9.0 9.9	1.2	5.43	2009.356	38
STF2189AC	17328+4753	7.8 8.9	358.6	65.67	2009.389	39
STF2183AC	17355-0556	8.1 9.9	12.9	28.64	2009.400	40
STF2211AB	17467-0113	9.1 10.5	116.4	10.37	2009.356	41
STF2211AC	17467-0113	9.1 10.6	196.5	106.65	2009.356	41
FOX 208	17515-1529	9.0 10.7	147.3	25.18	2009.356	42
STF2234	17527-0757	9.8 10.6	199.1	16.79	2009.356	43
STF2246	17554+3930	9.3 10.0	99.5	5.43	2009.356	44

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NAME	RA DEC	MAGS		PA	SEP	DATE	NOTES
STT 341AB-C	18058+2127	7.1	10.6	174.0	27.16	2009.392	45
STT 341AB-D	18058+2127	7.1	10.4	99.4	39.50	2009.392	45
STT 341AB-E	18058+2127	7.1	10.2	37.6	66.66	2009.392	45
STT 341AB-F	18058+2127	7.1	10.7	356.5	111.59	2009.392	45
STT 341AB-G	18058+2127	7.1	7.6	238.4	133.31	2009.392	45
ARY 2AB	18080+0337	8.7	8.9	359.0	92.33	2009.392	46
ARY 2AC	18080+0337	8.7	9.3	54.4	116.03	2009.392	46
H 93	18130+2815	8.1	8.2	135.9	54.81	2009.389	47
HJ 2824	18154-1648	8.5	9.6	73.6	21.73	2009.392	48
FOX 226	18214-1501	10.7	10.6*	149.6	19.75	2009.389	49
HJ 858	18241+0130	8.6	10.6	229.1	12.34	2009.389	50
STT 352	18264+4649	7.9	9.3	220.8	24.19	2009.389	51
J 520	18269-1429	10.2	10.5	295.9	5.43	2009.389	52
STF2319AB	18277+1918	8.2	8.4	189.8	5.43	2009.392	53
STF2319AC	18277+1918	8.2	10.6	269.1	42.96	2009.392	53
STF2319AD	18277+1918	8.2	9.1	70.4	157.01	2009.392	53
HJ 859	18293-0246	8.8	10.6	221.7	16.79	2009.389	54
STF2321	18300+0111	8.4	9.6	190.4	6.42	2009.427	55
BRT 479	18300-0522	10.0	10.1	281.5	5.93	2009.389	56
STF2348AB-C	18339+5221	5.4	8.6	271.2	25.68	2009.392	57
STT 358AB-C	18359+1659	6.9	8.4	235.4	199.48	2009.389	58
HJ 1339	18404+4606	8.5	10.0	321.6	23.21	2009.389	59
BU 136	18429+0545	9.1	10.2	7.0	4.94	2009.392	60
HDS2654AC	18445-0737	8.4	10.7	320.9	13.83	2009.392	61
STF2431	18588+4041	6.2	9.6	235.8	19.26	2009.392	62
STF2449	19064+0709	7.2	7.7	289.9	7.90	2009.427	63
STF2461AD	19074+3230	5.2	9.0	291.5	137.26	2009.433	64
STF2461AF	19074+3230	5.2	10.5	352.0	166.89	2009.433	64
STF2479AB-C	19083+5520	7.5	9.6	29.6	6.42	2009.427	65
SHJ 289	19135+3902	8.0	8.6	56.3	39.50	2009.427	66
STT 366AB	19142+3413	7.7	10.5	229.9	21.73	2009.433	67
BRT 492	19170-0713	10.0	10.7	188.4	5.43	2009.427	68
STF2500A-BC	19194+1943	8.2	10.7	22.8	19.75	2009.433	69
GLP 8	19248-1438	9.3	10.7	67.6	24.19	2009.427	70
HU 342	19371+1723	9.7	10.3	254.6	4.44	2009.433	71

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NAME	RA DEC	MAGS	PA	SEP	DATE	NOTES
STF2573	19402+6030	6.5 9.8	26.9	17.78	2009.433	72
A 272AC	19402+2611	9.8 10.4	307.8	14.32	2009.433	73
STF2562AB	19428+0823	6.9 8.6	251.2	27.16	2009.433	74
STF2562AD	19428+0823	6.9 9.7	221.7	117.02	2009.433	74
AG 391	19479+1002	7.5 9.1	295.9	52.34	2009.427	75
STF2581	19498-1125	7.3 10.6	286.7	44.44	2009.427	76
BU 361AB	19503+2240	9.3 9.9	348.0	3.95	2009.433	77
SCJ 23	19557-0643	9.0 10.7	24.9	36.54	2009.427	78
ES 201AC	19595+5944	8.8 10.6	94.3	29.63	2009.427	79

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

Notes

1. In Canes Venatici. Sep. & p.a. decreasing. Spect. G0, G0.
2. In Ursa Major. Separation slightly decreasing. Spect. F8V.
3. In Virgo. Common proper motion; sep. & p.a. increasing. Spect. F8V, F8V.
4. In Ursa Major. Separation slightly increasing. Spect. F5.
5. In Bootes. Common proper motion; p.a. decreasing. Spect. F8, F8.
6. Xi Bootis. AB = cpm; sep. & p.a. dec. AE & BE = sep. dec. Spect. G8V, K5V.
7. In Bootes. Relatively fixed. Common proper motion. Spect. G0V, G0.
8. Delta Bootis. Relatively fixed. Common proper motion. Spect. G8III, G0V.
9. In Libra. Common proper motion; p.a. increasing. Spect. G5, G5.
10. In Libra. Sep. increasing; p.a. decreasing. Spect. F8.
11. Mu or 51 Bootis. Relatively fixed. Common proper motion. Spect. F7IV, G0V.
12. In Serpens. Relatively fixed.
13. In Corona Borealis. Sep. & p.a. decreasing. Spect. G8V.
14. Delta or 13 Serpentis. Common proper motion; p.a. dec. Spect. F0IV, F0IV.
15. In Libra. Relatively fixed. Common proper motion.
16. In Serpens. Common proper motion; p.a. decreasing. Spect. F8, F8.
17. In Libra. Sep. & p.a. increasing. Spect. F7IV.
18. In Corona Borealis. Common proper motion; sep. increasing. Spect. G0, G0.
19. In Libra. Relatively fixed. Common proper motion.
20. Beta or 28 Serpentis. AB = relatively fixed. AC = p.a. increasing. Spect. A2IV.
21. In Libra. Position angle increasing. Spect. G0.
22. In Draco. AB = relfixed; c.p.m. AC = sep. inc. Spect. AB = F8, K.
23. In Serpens. AB = sep. dec.; p.a. inc. AC = sep. dec. Spect. AB = A0, A0.
24. In Serpens. AB = sep. inc.; p.a. dec. AC = sep. dec. Spect. AB = G8III, K0.
25. In Hercules. Relatively fixed. Spect. K4III.

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26. In Corona Borealis. Relatively fixed. Common proper motion. Spect. F4IV, F2.
27. Sigma Coronae Borealis. AB = sep. & p.a. inc. Spect. G0V, G1V.
28. In Ophiuchus. Sep. & p.a. increasing. Spect. G5.
29. In Hercules. Position angle increasing. Spect. K0.
30. 19 Ophiuchi. Sep. increasing; p.a. decreasing. Spect. A3V.
31. In Hercules. Relatively fixed.
32. 60 Herculis. Separation increasing. Spect. A4IV.
33. In Draco. Sep. decreasing; p.a. increasing. Spect. A9III, G5.
34. In Ophiuchus. Position angle decreasing. Spect. K2.
35. In Hercules. Sep. increasing; p.a. decreasing. Spect. K0, F2.
36. In Hercules. Position angle increasing. Spect. K2, A3.
37. In Ophiuchus. Relatively fixed. Common proper motion. Spect. A2.
38. In Hercules. Relatively fixed. Common proper motion. Spect. G0.
39. In Hercules. Common proper motion. Sep. inc.; p.a. dec. Spect. A2V.
40. In Ophiuchus. Separation slightly decreasing. Spect. A2V.
41. In Ophiuchus. AB = relfix, cpm. AC = sep. inc., p.a. dec. Spect. AB = G0, G0.
42. In Serpens. Separation decreasing. Spect. G5.
43. In Ophiuchus. Relatively fixed. Common proper motion. Spect. G5, G5.
44. In Hercules. Common proper motion; p.a. decreasing. Spect. G0, G0.
45. In Hercules. AB-C & AB-G = sep. dec. AB-E & AB-F = sep. inc. Spect. G2V.
46. In Ophiuchus. AB = relfix. AC = p.a. slightly dec. Spect. A, A0, M0.
47. In Hercules. Relatively fixed. Common proper motion. Spect. F8, F8.
48. In Serpens. Separation slightly decreasing. Spect. K0III.
49. In Serpens. Relatively fixed. Common proper motion. Spect. B.
50. In Serpens. Relatively fixed. Common proper motion. Spect. F5, F5.
51. In Lyra. Relatively fixed. Common proper motion. Spect. F2, F8.
52. In Scutum. Sep. decreasing; p.a. increasing. Spect. B5III.
53. In Hercules. AB = relfix; cpm. AD = p.a. inc. Spect. A, B, D = F5, F5, G0.
54. In Serpens. Position angle increasing. Spect. F8.
55. In Serpens. Relatively fixed. Spect. A0.
56. In Scutum. Sep. & p.a. increasing. Spect. G5.
57. In Draco. Relatively fixed. Spect. G9III, F0.
58. In Hercules. Sep. decreasing; p.a. increasing. Spect. F8V, F2.
59. In Lyra. Sep. & p.a. decreasing. Spect. M2.
60. In Serpens. Sep. increasing; p.a. decreasing. Spect. B9, B9.
61. In Scutum. Sep. & p.a. decreasing. Spect. F0, F0.
62. In Lyra. Relatively fixed. Spect. B3V.
63. In Aquila. Common proper motion; p.a. slightly decreasing. Spect. F2V, F2.
64. 17 Lyrae. AD = sep. inc.; p.a. dec. AF = p.a. dec. Spect. AD = F0V, A2.
65. In Cygnus. Common proper motion; p.a. decreasing. Spect. A3, A3.
66. In Lyra. Relatively fixed. Common proper motion. Spect. A0, K0.
67. In Lyra. Relatively fixed. Spect. B8V.
68. In Aquila. Common proper motion; p.a. decreasing. Spect. G0.
69. In Sagittae. Separation decreasing. Spect. A0.
70. In Sagittarius. Relatively fixed. Spect. A0V.
71. In Sagittae. Common proper motion. Sep. & p.a. increasing. Spect. F8.

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72. In Draco. Sep. & p.a. decreasing. Spect. A5V.
73. In Vulpecula. Sep. decreasing; p.a. increasing. Spect. A0.
74. In Aquila. AB = relfix., cpm. AD = sep. inc.; p.a. dec. Spect. F8V, G0V, K2.
75. In Aquila. Sep. & p.a. slightly increasing. Spect. K5, G0.
76. In Aquila. Sep. & p.a. increasing. Spect. F5.
77. In Vulpecula. Sep. increasing; p.a. decreasing. Spect. A5, A5.
78. In Aquila. Relatively fixed. Spect. K.
79. In Cygnus. Sep. & p.a. decreasing. Spect. F8.

Dave Arnold has been conducting a double star research program in Flagstaff, Arizona since April 2001. He has previously published 23 double star research reports in the *Double Star Observer* and 19 reports in the *Journal of Double Star Observations.* Since this project began, he has completed over 4200 double and multiple star measurements, and has published a combination of over 100 new double stars discoveries, or newly added components to existing systems, as of September 2009.