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 mo-

Divinus Lux Observatory Bulletin: Report #20

tion 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.