# Divinus Lux Observatory: Report #17

Dave Arnold

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

E-Mail: dvdarnl@aol.com

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

There are also some measured double stars, which appear in the table, that are not listed in the WDS catalog. These measurements, which are listed with the "ARN" prefix, represent possible common proper motion double stars that don't appear to have

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been previously cataloged. The first pair, listed as ARN 101 (02422+4247), is located in the M 34 open star cluster in Perseus. A second pair, ARN 102 (05308+0313), can be found near the STF 721 star system. A third double star, ARN 103 (06332+1719), is in the vicinity of the STF 924 star system.

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

## References


Abt, Helmut A., "Observed Orbital eccentricities," *Binary Stars as Critical Tools and Tests in Contemporary Astrophysics*, W. Hartkopf, E. Guinan, & P. Harmanec eds. (Cambridge University Press, 2007) p. 414.

*Sky Catalogue 2000.0, Volume 2*, Hirshfeld & Sinnott eds. (Cambridge: Sky Publishing Corporation, 1999) pp. 163 - 200.


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

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

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

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

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

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

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

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