University of South Alabama

Journal of Double Star Observations

VOLUME 1 NUMBER 1 SPRING 2005

Why the JDSO?

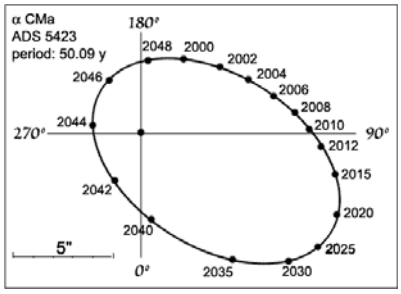
- Promote observation and research in double and multiple stars
- To collect and disseminate double star data obtained by our contributors and readers for use in the astronomical community
- To publish results of research on double stars by amateur and professional astronomers

Welcome to the New *Journal of Double Star Observations*

We are very happy to publish this inaugural issue of the *Journal of Double Star Observations* (JDSO).

Our main goal is to promote observation and research in the field of double and multiple star systems. We intend to collect, publish and disseminate data obtained from our contributors and you, our readers. This inaugural issue has a technical slant, but we also want to publish "fun" articles that showcase the pursuit of double stars and its excitement. Expect to see pieces such as "my favorite double", tips for observing, and profiles of double star observers, etc.

We'll certainly be publishing our share of serious articles, some of which may be peer reviewed. Measurements of position angles and separations of double stars that are published in the JDSO will be added to the Washington Double Star Catalog maintained by the U.S. Naval Observatory. So, any research or observations you make and would like the community to know, consider submitting them to the JDSO.



Apparent orbit of Sirius B, the Little Pup.

Finally, but not least, we want to express our sincere thanks to the contributors to this first issue. Thank you for your enthusiasm for double stars and thank you for helping to make this journal a success.

We are looking forward to publishing the JDSO and we hope you will join us in making it a success.

Inside this issue:

CCD Measurements of Double Stars in the Vicinity of The Blue Snowball

James L. Jones

3190 Douglas Circle
Lake Oswego, OR 97035
Email: nt7t@comcast.net

Abstract: The measurements of approximately 50 double stars within a few degrees of NGC 7662 are reported. These measurements were made with a CCD camera and Schmidt-Cassegrain Telescopes of 8 inches and 11 inches. Precision of the measurements of Theta and Rho are given along with the positions of the primaries. A short discussion of the methodology used is included.

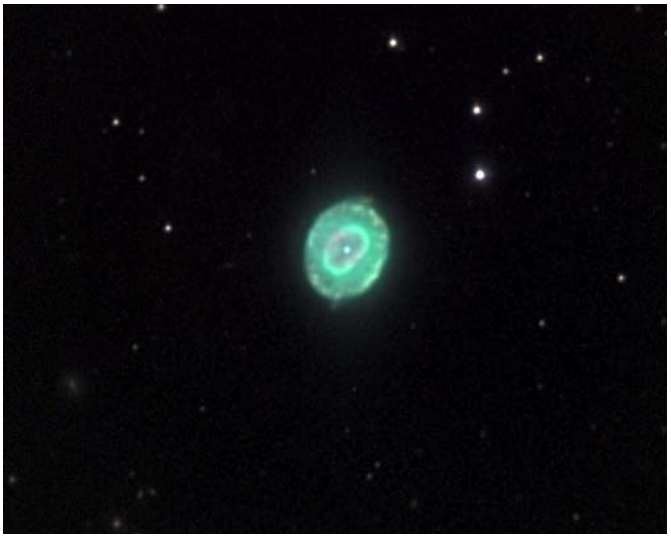
This paper reports on observations and measurements of double stars that lie within a few degrees of NGC 7662. Observations were made using an 8-inch (20 cm) f/10 SCT and an 11-inch (28 cm) f/10 SCT. A Meade f/6.3 focal reducer/field flattener was used on the 11-inch SCT. Notes indicate which telescope was used.

The bulk of the observations were made after October 2002 and were made with a SBIG ST7 CCD camera with a KAF401E non anti-blooming (NAB) sensor. The few observations made before October 2002 were made with a Genesis 15 CCD camera utilizing a similar KAF401E NAB sensor.

The Blue Snowball has long been one of my favorite objects and I don't miss many opportunities to sneak a peak at it. However, being a double star observer, I couldn't help but notice the fine 3-star system (HJ 1877) just to the NE of NGC 7662 and the fairly large number of doubles grouped around NGC 7662 that seem to invite attention.

Finding and measuring "clusters" or groups of doubles is appealing to me because of the efficiency that they offer. There is no need to make large telescope movements to move to the next target. Since most of the doubles in these clusters are frequently discovered by the same observer, it also gives me a feeling of following in the foot steps of an observer who has gone before. Almost all of the doubles included in this paper were discovered by P. S. Chevalier in 1911.

In almost all cases, 20 images were taken of each double in an observing session. Five to ten images were selected from the original 20 based on their "roundness" as measured by the Star Image Tool of Richard Berry and James Brunell's "AIP for Windows" program. The selected images were solved using Herman Rabb's "Astrometrica" program and the UCAC-2 catalog. I find that the pre-selection of images helps eliminate images that might have been degraded by seeing or drive tracking. The precision of each observation was quantified by calculating the standard deviation of its image set.



Adam Block/NOAO/AURA/NSF
The Blue Snowball Nebula

Che 458 (WDS: 23260+4201) appears to be composed of GSC3238.328 and GSC3238.254. This is based on

CCD Measurements of Double Stars in the Vicinity of The Blue Snowball

the Precise Coordinate of 2325600+420050 from the current WDS catalog. Without the benefit of the Precise Coordinate I would have selected the brighter pair GSC3238.304 and GSC3228.476 at 232554.38+420028.5 (USN0-B1.0).

Che 471AB has been measured 4 times since its discovery in 1911. Three measurements were made between 1969 and 1989. These measurements varied between 7.40" and 7.45" for separation and 106.1 degrees and 104.8 degrees for PA. The last measurement (1991) made from TYC2000b data was 5.326" and 116.6 degrees. My measurement (7.48, 104.1) was consistent with the previous three measurements.

In order to aid anyone who wishes to reproduce one or more of my observations and to remove any ambiguity regarding which stars I observed, I have included my measured position of the primary in the notes.

Observations made in different observing seasons are reported as separate observations.

NAME	RA DEC	MAGS	PA	SEP	DATE	N	NOTES
Che 436	23218+4226	10.25,10.99	336.7	30.00	2003.633	1	1
Che 437AB	23223+4204	10.71,10.82	187.5	31.46	2003.633	1	2
Che 437AC	23223+4204	10.71,10.96	45.4	21.41	2003.633	1	3
Che 440	23226+4150	9.49,10.78	125.5	27.22	2004.584	1	4
Che 441	23227+4255	10.01,10.63	41.3	49.60	2004.584	1	5
Che 444	23230+4218	10.35,11.04	150.1	36.42	2002.811	1	6
Che 444	23230+4218	10.35,11.04	150.0	36.42	2004.584	1	7
Che 445	23234+4248	9.69,10.56	253.7	31.32	2002.803	2	8
Che 446	23234+4234	10.64,10.93	191.5	14.97	2002.811	1	9
Che 446	23234+4234	10.64,10.93	191.7	14.99	2004.622	1	10
Che 449	23244+4221	10.86,10.95	33.2	29.38	2003.701	2	11
Che 450 AB	23245+4223	10.84,10.88	335.1	12.04	2003.701	2	12
Che 450 AB	23245+4223	10.84,10.88	335.1	12.03	2004.584	1	13
Che 450 AC	23245+4223	10.84,11.20	26.2	21.04	2003.701	2	14
Che 450 AC	23245+4223	10.84,11.20	26.2	21.08	2004.584	1	15
Che 453 AB	23249+4149	9.69,10.70	34.2	39.21	2003.658	1	16
Che 455	23250+4220	10.85,10.97	302.8	28.95	2003.679	1	17
Che 457	23259+4241	11.60,12.15	120.8	17.32	2003.622	1	18
Che 458	23260+4201	10.71,10.96	262.3	30.15	2003.658	1	19
Che 459	23261+4203	10.35,10.98	4.9	28.08	2003.658	1	20
Che 464	23265+4212	10.30, 11.0	120.3	9.94	2004.584	1	21
Che 466	23268+4157	9.73, 10.30	124.6	19.33	2003.658	1	22
Che 468	23271+4201	8.13, 11.08	85.3	16.88	2004.584	1	23
Che 469	23271+4143	10.65,10.99	66.0	17.71	2003.658	1	24
Che 470	23272+4224	10.33,10.7	203.5	32.00	2003.632	2	25
Che 472	23276+4248	9.44, 10.16	223.9	23.26	2003.581	1	26
Che 473	23276+4227	10.79,10.90	312.7	29.31	2003.630	2	27
Che 476	23278+4244	9.67,10.05	88.4	8.97	2003.581	2	28
Che 476	23278+4244	9.67,10.05	88.9	8.89	2004.584	1	29
Che 477	23278+4218	10.57,10.96	230.1	39.38	2003.638	3	30

(Continued on page 4)

CCD Measurements of Double Stars in the Vicinity of The Blue Snowball

NAME	RA DEC	MAGS	PA	SEP	DATE	N	NOTES
Che 480	23279+4201	9.74,10.15	148.4	36.92	2003.657	2	31
Che 482	23280+4216	10.79,10.98	342.3	30.20	2003.602	2	32
Che 483	23281+4213	10.83,11.07	39.1	14.71	2003.622	1	33
Che 484	23282+4245	9.60,10.57	87.5	27.94	2004.629	1	34
Che 485	23283+4316	10.08,10.76	171.8	21.94	2003.723	1	35
Che 486	23283+4238	10.68,11.01	318.9	33.24	3004.646	1	36
Che 487	23284+4155	10.51,10.83	229.1	41.46	2004.653	1	37
Che 488	23285+4230	10.26,10.92	26.1	34.30	2003.655	1	38
Che 490	23288+4227	10.11,10.37	16.6	31.49	2003.655	1	39
Che 491 AB	23288+4154	10.33,10.82	54.1	35.98	2003.658	1	40
Che 491 AC	23288+4154	10.33,10.89	240.9	35.60	2003.658	1	41
Che 492	23288+4144	9.73,10.30	66.7	18.78	2003.658	1	42
Che 493	23289+4230	10.49,10.63	23.4	32.27	2003.655	1	43
Che 494 AB	23290+4245	9.43,10.55	203.1	25.40	2003.581	1	44
Che 494 AC	23290+4245	9.43, 10.83	181.0	10.91	2003.581	1	45
Che 495	23292+4212	10.33,11.00	72.5	14.02	2003.622	1	46
Che 496	23293+4248	10.47,10.89	152.5	34.15	2003.581	1	47
Che 499	23297+4206	10.70,10.75	183.3	27.37	2003.622	1	48
Che 501	23301+4215	10.56,10.68	272.3	24.55	2003.622	1	49
Chef 502	23303+4239	9.82,10.48	19.4	11.65	2003.618	2	50
Che 503	23304+4238	10.54,10.72	353.3	25.68	2003.618	2	51
Hj 1877 AB	23259+4232	12.2,14.10	357.7	20.23	2002.795	1	52
Hj 1877 AB	23259+4232	12.2,14.10	357.9	20.28	2003.634	1	53
Hj 1864	23169+4238	9.79,10.35	205.8	22.86	2004.584	1	54
Hj 1876	23259+2651	11.1, 11.6	211.0	9.30	2004.585	1	55
Hj 1882	23278+3924	9.5, 13.6	332.7	13.79	2004.340	1	56
Ali 1184	23160+4014	12.1, 12.4	50.5	9.40	2004.325	1	57
Che 471 AB	23274+4140	12.36, 12.59	104.1	7.48	2004.584	1	58
Che 471 AC	23274+4140	12.36, 13.0	329.1	12.53	2004.584	1	59

Notes: Object, Measured Position, Separation Standard Deviation, PA Standard Deviation, Aperture

1. Che 436, 2321467+422549, 0.04, 0.07, 20 cm
2. Che 437AB, 2322148+420334, 0.03, 0.06, 20 cm
3. Che 437AC, 2322148+420334, 0.02, 0.09, 20 cm
4. Che 440, 2322348+415001, 0.05, 0.08, 28 cm
5. Che 440, 2322394+425455, 0.03, 0.02,28 cm
6. Che 444, 2322560+421809, 0.09, 0.15, 20 cm
7. Che 444, 2322560+421809, 0.04, 0.04, 28 cm
8. Che 445, 2323216+424734, 0.08, 0.06, 20 cm
9. Che 446, 2323239+423414, 0.11, 0.31, 20 cm
10. Che 446, 2323239+423414, 0.03, 0.06, 28 cm
11. Che 449, 2324213+422109, 0.07, 0.07, 20 cm
12. Che 450AB, 2324308+422251, 0.03, 0.11, 20 cm
13. Che 450AB, 2324308+422251, 0.03, 0.12, 28 cm
14. Che 450AC, 2324308+422251, 0.04, 0.07, 20 cm
15. Che 450AC, 2324308+422251, 0.06, 0.07, 28 cm
16. Che 453AB, 2324553+414858, 0.05, 0.08, 20 cm
17. Che 455, 2325016+422006, 0.06, 0.08, 20 cm
18. Che 457, 2325553+424050, 0.03, 0.07, 20 cm
19. Che 458, 2325544+420028, 0.07, 0.12, 20 cm
20. Che 459, 2326054+420322, 0.12, 0.13, 20 cm
21. Che 464, 2326325+421207, 0.05, 0.21, 28 cm
22. Che 466, 2326510+415701, 0.03, 0.09, 20 cm
23. Che 468, 2327038+420052, 0.03, 0.11, 28 cm
24. Che 469, 2327091+414329, 0.05, 0.23, 20 cm
25. Che 470, 2327098+422400, 0.04, 0.04, 20 cm
26. Che 472, 2327371+424829, 0.02, 0.04, 20 cm
27. Che 473, 2327375+422637, 0.04, 0.04, 20 cm
28. Che 476, 2327484+424334, 0.04, 0.19, 20 cm
29. Che 476, 2327484+424334, 0.01, 0.09, 28 cm
30. Che 477, 2327522+421830, 0.06, 0.06, 20 cm
31. Che 480, 2327559+420101, 0.04, 0.07, 20 cm
32. Che 482, 2327597+421621, 0.07, 0.11, 20 cm
33. Che 483, 2328089+421325, 0.04, 0.11, 20 cm
34. Che 484, 2328144+424448, 0.03, 0.06, 28 cm

(Continued on page 5)

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35. Che 485**,** 2328144+424447, 0.04, 0.08, 20 cm
36. Che 486, 2328187+423800, 0.04, 0.06, 28 cm
37. Che 487, 2328241+415525, 0.02, 0.03, 28 cm
38. Che 488, 2328327+422952, 0.04, 0.10, 20 cm
39. Che 490, 2328517+422717, 0.05, 0.03, 20 cm
40. Che 491AB, 2328518+415430, 0.09, 0.16, 20 cm
41. Che 491AC, 2328518+415430, 0.08, 0.17, 20 cm
42. Che 492, 2328489+414430, 0.10, 0.14, 20 cm
43. Che 493, 2328560+423028, 0.06, 0.19, 20 cm
44. Che 494AB, 2329043+424510, 0.08, 0.21, 20 cm
45. Che 494AC, 2329043+424510, 0.03, 0.04, 20 cm
46. Che 495, 2329140+421144, 0.06, 0.08, 20 cm
47. Che 496, 2329167+424746, 0.05, 0.20, 20 cm
48. Che 499, 2329449+420533, 0.06, 0.15, 20 cm
49. Che 501, 2330113+421440, 0.08, 0.18, 20 cm
50. Che 502, 2329449+420533, 0.02, 0.02, 20 cm
51. Che 503, 2330264+423812, 0.03, 0.10, 20 cm
52. HJ 1877AB, 2325579+423229, 0.03, 0.17, 20 cm
53. Hj 1877AB, 2325579+423229, 0.04, 0.08, 20 cm
54. Hj 1864, 2325589+423229, 0.04, 0.09, 28 cm
55. Hj 1876, 2325589+423229, 0.01, 0.07, 28 cm
56. Hj 1882, 2317005+423747, 0.03, 0.06, 28 cm
57. Ali 1184, 2325568+365033, 0.02, 0.10, 28 cm
58. Che 471AB, 2327261+413937, 0.02, 0.09, 28 cm
59. Che 471 AB. 2327261+413937, 0.02, 0.06, 28 cm

Mr Jones is a retired electrical engineer who lives in Lake Oswego, Or. He has been a double star observer for 6 years and is an occasional contributor to the LIDA group. He also makes photometric observations for the AAVSO.

Visual Double Stars With More Than One WDS Number

Francisco M. Rica Romero

Astronomical Society of Mérida
Coordinator of LIADA's Double Star Section
frica0@terra.es

Abstract: WDS catalog is one of the most important reference for double star observers and we must consider it as something that is ours and so we must maintain it, for example, detecting and communicating errors to the database administrator. In this work the author presents two double stars that had two entries in WDS catalog. The doubles were studied, their nature determined and the errors corrected in WDS

Introduction

Those amateurs that are observing and investigating visual double stars for a long time, know that the WDS catalog is one of the main reference which allows us to investigate, design our observational programs and include our measures and new double stars. For these and other reasons it is not strange that double star observers consider the WDS catalog as something that is ours, which we must care for and love. That is why there exists an interesting, enjoyable and important task to try to improve all the information included in the WDS such as detecting errors of those visual double stars that have more than one WDS number. If you detect one of these double stars, please inform Dr. Brian Mason, project manager of the double star program at the United States Naval Observatory.

In this article I include two cases of double stars included in the 2001 Observational Program of LIADA's Double Star Section: B 509 AC = TDT 2618 and OL224 = MLB 435. The OL 224 case was discovered by LIADA and the case of B 509 AC was pointed out to me by Brian Mason.

B 509 AC = TDT 2618

After sending our Circular #1 in English to the United Stated Naval Observatory (USNO), Brian Mason sent me a private communication where he wrote to me that B 509 and TDT 2618 are confusing and he had the suspicion that B 509 AC and TDT 2618 could be the same object but he had no confirmation of this. In this work a confirmation is obtained. I obtained the followed data from WDS catalog:

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20542-2730 B   509 AB  1927  108°  3.9″  9m8    14m3
20542-2730 B   509 AC  1927  359°  4.4″  9m8     9m9
20542-2730 TDT2618     1991   57°  2.5″ 10m72  11m21
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In Tycho-2 catalog:

```
TDT2618 A = TYC 6930 863-1; V=10.65; B-V=0.69
TDT2618 B = TYC 6930 863-2; V=11.16; B-V=0.45
```

Consulting Astrographics Catalog 2000, I deduced THETA and RHO from AR and DEC (epoch 1913.571) of two stars of blue magnitudes 11.5 and 11.7 that seems to be B 509 AC. The value of THETA= 348.0º and RHO= 6.09" was obtained. The three possible measures of B 509 AC are:

EPOCH	THETA	RHO	MG_A	MG_B	Note
1913.571	348.0	6"09	11m5	11m7	AC2000; blue magnitudes
1927	359	4"4	9m8	9m9	WDS (for B 509 AC)
1991	57	2"5	10m72	11m21	WDS (for TDT2618)

If these three measures are represented as X-Y, X-t and Y-t plots it can be seen that they make a perfect linear fit (Figure 1). I have calculated the followed data:

- Relative proper motion of the system: +0.041 a.s./year and -0.056 a.s./year in AR and DEC.
- Photometric Spectral type: G5 and F5.5 (if they belong to the main sequence).

According to the large difference in proper motion of the components we can deduce that this pair is an optical double star. In addition this I have studied the nature of this pair using several professional criterion

Visual Double Stars With More Than One WDS Number

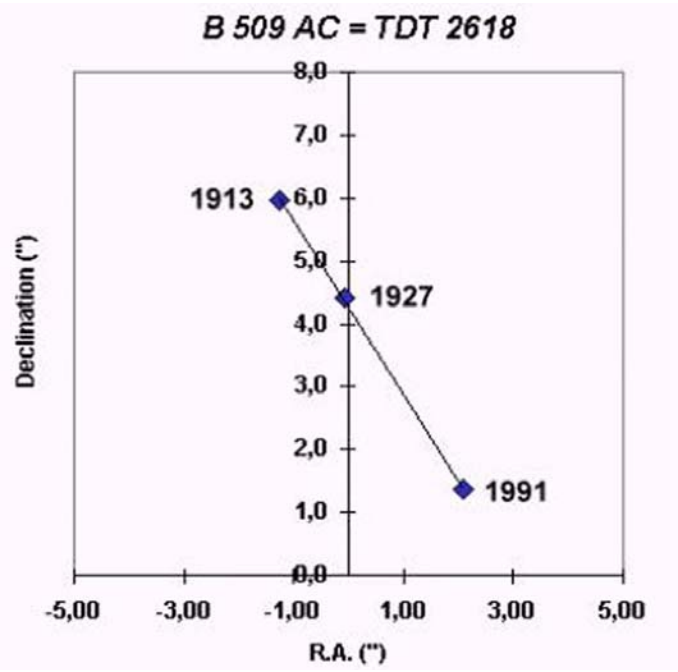


Figure 1: Measures of TDT 2618 with a linear fit

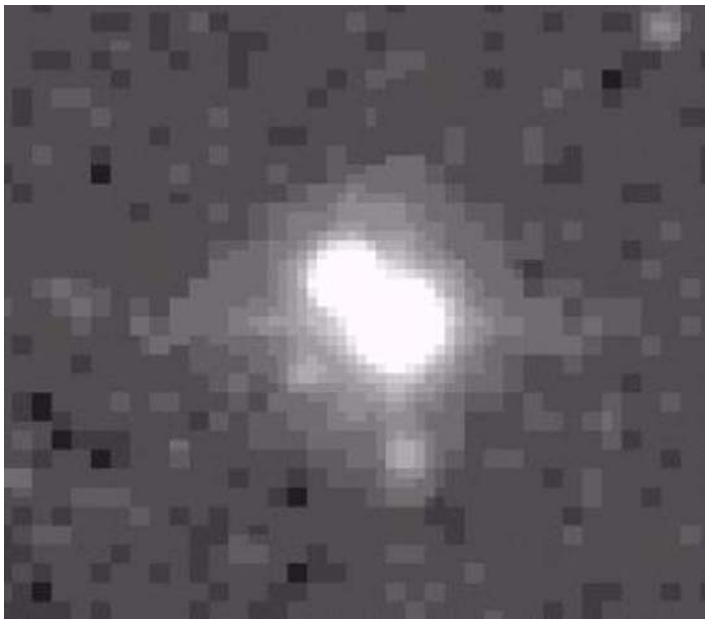


Figure 2: CCD image of double star OL 224, in J infrared band taken with the 2 meters Hopkings telescope.

that confirmed the optical nature.

OL 224 = MLB435 (=ADS 16458)

This double star was measured in the LIADA's 2002 observational program and our study concluded that OL 224 and MLB 435 are the same object. LIADA informed Brian Mason who updated the WDS catalog, rejected MLB 435, and updated the web page of USNO.

OL 224 is composed of two stars of 9.34 and 11.19 magnitudes (from Tycho-2) separated by 6.9" in direction 47º. LIADA analysed all official measures, 11 in total, three of which were LIADA's measures. Since 1895 θ has increased nearly 3º and ρ has not changed.

Proper motions. Tycho-2 annual proper motion of main component are μ(α) = +0.026" and μ(δ) = +0.012"; for secondary: μ(α) = +0.022" and μ(δ) = +0.014". We have plotted the 11 historical measures in a X-t and Y-t plots obtaining a annual relative proper motion of μ(α) = +0.003" and μ(δ) = -0.003" in excellent agreement with Tycho-2 proper motions (a difference of 0"001 was observed).

Nature. LIADA has used seven professional criteria to investigate the OL 224 nature, among them the Aitken and Hablwachs criterions. I modified the Hablwachs criterion and we now consider the probabilities to be common proper motion using a Gaussian distribution. According to the modified Hablwachs' criterion OL 224 has an 87 % probability of being a physical pair.

Other criterion: a 20º x 20º sky area from Tycho-2 was analysed to use the study of probability theory made by E. Grocheva and A. Kiselev (1998). Among the 32,031 stars located in the 20º x 20º area, 173 stars have proper motion similar to those of components. According to the probability theory OL 224 has P_μ=0.005. In this criterion, physical pairs are considered when $P_\mu < 0.01$, so OL 224 is a physical pair.

According to the JHK infrared and BV optical photometry the spectral types are F7V: and G0V. The kinematical data are consistent also with an early-F normal giant in agreement with the professional spectral type in the literature, F2. The study of the photometric and astrometric data showed that OL 224 is a strong candidate to be a physical pair with a possible orbital period of about 40,000 years.

The author has been a scientific computer programmer for 7 years and has been studying double stars for 11 years. He has been a member of the Astronomical Society of Merida (Spain) since 1993 and is also the coordinator of LIADA's Double Star Section in Argentina.

GSC1753-1506: Discovery of a New Binary

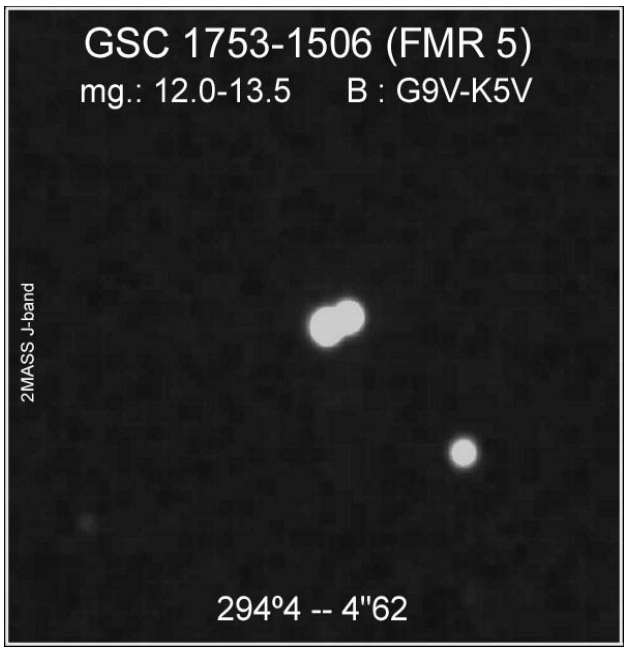
Francisco M. Rica Romero

Astronomical Society of Mérida
Coordinator of LIADA's Double Star Section
frica0@terra.es

Abstract: Double star amateurs observers can contribute to the double star community searching for new uncataloged binaries, but astrophysical criteria are fundamental to reject optical pairs and not increase the great account of non-astrophysical doubles in WDS. This work reports the discovery by LIADA Double Star Section of a new binary, GSC1753-1506, composed of 12.0 and 13.5 magnitudes stars with an angular separation of 4.62" in direction 294º4. Analyzing 2MASS JHK photometry and Tycho-2 data the binary are composed for G9V and K5V stars located at 172 pc. Several professional criteria were used and GSC1753-1506 is a very strong physical candidate

Introduction

The most expert double star amateurs can contribute to science by measuring double stars. Another contribution more important is to discover new binary systems by searching projects or in an accidental way. Nowadays there are several amateurs that include new pairs of stars in the WDS catalog, but sadly most of them don't use any astrophysical criterion and so many of the new pairs are optical ones with no astrophysical interest. Amateurs can use a lot of professional criterion some easy to use and some not so easy. But there is one criterion that is very easy to use and allows us to reject the majority of optical pairs by consulting the proper motions of the components. Why is this data so important? Because physical pairs have very similar proper motions. Those pairs whose components have dissimilar proper motions are optical. Everybody that reports new discoveries must use one or more astrophysical criterion because we must make an effort to reject all optical pairs in the WDS catalog.



Discovery, infrared photometric and kinematics data.

In a routine study of the double star HJ 635 a close pair was observed near the John Herschel double. This object is listed in the GSC catalog as GSC1753-1506 and it is located at α = 01h 11m 34.8s and δ = +28º 23' 28" in Pisces. It was studied by LIADA and using Aladin and Simbad tools from the Stellar Data Center of Strasburg (France) obtained J, H and K infrared photometry from the Two Micron All Sky Survey (2MASS). See Table 1. Individual optical photometry or proper motions were not found in any catalog. Tycho-2 catalog listed an object with V=11.61 and B-V=+0.61 with proper motion of μ(α) =+0.050"±0.003" and μ(δ) =-0.009"±0.003".

Relative astrometry measure.

We measured relative astrometry from 2MASS J, H and K, CCD images taken by a 1.0 telescope using fv, a FITS viewer and editor tools developed at the High Energy Astrophysics Science Archive Research Center

(HEARSAC) at NASA/GSFC. The results obtained were 294º4 and 4.62" in 1997.831.

Spectral types estimate and deduced V magnitudes.

Photometric data were transformed to the spectral type and, when the stars are very red, to the luminosity class using J-H vs H-K two-colour diagram and several tables that relates photometric data with spectral data used by professionals M.S. Bessell & J.M. Brett (1988) and Gerald E. Kron (1988). Several useful tables are from the "Handbook of Space Astronomy and Astrophysics" of the Harvard University. The process transforms the magnitudes of the problem-star in energy in Jy (1 Jy = 10^{-23} erg * sec^{-1} * cm^2 * Hz^{-1}) and compares the spectral distribution of a component with those of the empirical tables.

When the star is not red enough to obtain the luminosity class using only photometry data, then we must use Reduced Proper Motion Diagrams (Eric M. Jones, 1972; C. A. Nelson, 2002; Salim Salir, 2002). These diagrams relate the observational photometric data and proper motions with a parameter that is characteristic of a population star (dwarfs, giants, sub dwarfs, white dwarfs...).

A preliminary study using 19 components with known spectral types results in a mean difference of 0.5 spectral subclass, and the luminosity class was estimated in the 19 components.

GSC 1753-1506 is composed of G9V and K5V stars (if there is no reddening) with V magnitudes of 12.0 and 13.5 (calculated using J, H and K energy distribution). The reddening could be of 0.05 magnitude in B-V color, so the spectral types could be one subclass hotter.

Are both components bounded gravitationally?

Absolute magnitudes and bolometric corrections are from the "Handbook of Space Astronomy and Astrophysics" of the Harvard University. Spectroscopic distances were calculated, and the distance modulus of +6.3 and +6.2 (about 178 parsecs) for the components indicates that both components are likely to be at the same distances.

Abt (1988) obtained the relation between the mass of the primary and the maximum separation of the components. LIADA estimates masses of 0.83 $M_\odot$ and 0.65 $M_\odot$ using professional references (P. Couteau, 1947; Todd J. Henry, 1993). At a mean distance of 179 pc the projected separation is 854 A.U., and the formulae of Abt give a maximum separation of 1821 A. U. So GSC 1753-1506 could not be an optical pair.

Another professional criterion of value is the relative motion of the system (the difference of the components' proper motions) that for physical pairs is the projected relative orbital motion. There is no other relative astrometry, and the components' proper motions are unknown, but if the relative motion is less than 3 m.a.s. * yr^{-1} then GSC 1753-1506 would be a physical pair.

TABLE I. DATA FOR GSC 1753-1506		
	Primary	Secondary
K	+10.04	+10.54
J-H	+0.40	+0.59
H-K	+0.07	+0.12
V	+12.0	+13.4
Spectra	G9V	K5V
Mv	+5.74	+7.3
Bolometric correction	-0.17	-0.49
Mass (Solar Mass = 1)	0.81	0.65
Distance (parsecs)	179	166

To estimate whether the secondary is physically associated, we calculated the Poissonian probability P, which assumes that for a random star field as bright as or brighter than the primary, the companion would be projected by chance within a radius ρ of the primary. This criterion was first used by John Michell in 1767 as a test for the existence of physical double stars. In 1999, a group of professionals used this method to establish the physical association of companions around several planetary nebulae. LIADA results indicated a very small chance probability of 0.08 %. To obtain a more realistic interpretation LIADA analyzed the P values for a subset of visual double stars studied by us in other observational programs. Against physical and optical pairs about 50% and 3.6% respectively, have values of P less than that for GSC 1753-1506. In a population very rich in optical pairs, the probability that GSC 1753-1506 is a physical pair is 78%. If the number of optical and physical pairs are identical then the probability increases to 93%.

Orbital Parameters.

In an orbit one of the most important data is the semi-major axis. We can calculate the expected semi-major axis, E(a), in arc-seconds, using the work of Paul Couteau (1960). To transform the semi-major axis to A.U. we can use the following simple formula:

$$Projected\ separation\ = a\ /\ \pi$$

Where a is the semi-major axis and π is the parallax of the binary. LIADA considered the mean photometric parallaxes of the components. The photometric parallaxes were calculated using spectral types and luminosity class estimated and the absolute magnitude obtained from several professional references.

The orbital period was calculated using the following formula derived from the Kepler Laws:

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

For GSC 1753-1506, E(a)=6.47" that at the distance of the system is 1194 A.U. The approximate orbital period is 34,800 years. Table 2 contains measurements for this binary pair.

TABLE II. BINARY GSC 1753-1506	
θ and ρ	294°4 and 4.62" (1997.831)
Magnitude (spectral types)	12.0 – 13.5
Distance	172 pc
Semi-major axes	6.47" = 1,194 A.U.
Period	34,800 years

Conclusion

Astrometric and photometric data from the 2MASS catalog were used to obtain relative astrometry, spectral types, photometric parallaxes and other astrophysical data for GSC 1753-1506 which was found to be a close pair of weak components. The similar spectrophotometric parallaxes of the components in addition to the results of several professional criteria give us strong evidence that point to a physical association of both components. Nevertheless it is necessary to have more relative astrometric data to confirm the physical nature.

Acknowledgments

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References

- **Abt, H.A.,** 1988, "Maximum Separations Among Cataloged Binaries", AJ 331 922-931
- **Bessell, M. S. and Brett, J.M.**, 1988, "JHKLM Photometry: Standard Systems, Passbands and Intrinsic Colors", PASP 100, 1134-1151
- **Cutri, R.N., et al.**, 2000, Explanatory to the 2MASS Second Incremental Data Release. http://www.ipac.caltech.edu/2mass/releases/second/index.html
- **Eric, M. Jones,** 1972, "Reduced Proper Motion Diagrams", AJ 173 671-676
- **Gerald E. Kron and Roach, F.E.,** 1988, "The Distribution of (B-V) in Two Star Catalogs", PASP 100 90-96.
- **Hog, E. et al.**, 2000, "The Tycho-2 Catalogue of the 2.5 Million Brightest Stars", AJ 335, 27.
- **Lasker, B.M., et al.,** 1992, Guide Star Catalogue Version 1.1
- **Martin V, Zombeck**, 1990, Handbook of Space Astronomy and Astrophysics, Ed. Cambridge University Press, http://ads.harvard.edu/books/hsaa/
- **Nelson, C.A. et al**., 2002, "A Proper Motion Survey for White Dwarfs with the Wide Field Planetary Camera 2", ApJ 573 644
- **Salim, S., Gould, A.,** 2002, "Classifying Luyten Stars Using an Optical-Infrared Reduced Proper-Motion Diagram", ApJ 575 83
- **Wenger, M., Ochsenbein, F., Egret, D., et al.** 2003, SIMBAD astronomical database, http://simbad.u-strasbg.fr/

The Strange Case of STF2417 = Theta Ser

Edgardo Ruben Masa Martin

Double Star Section Coordinator
Syrma Astronomical Society
Valladolid, Spain
ermasa@teleline.es

Abstract: For many years the system STF2417 has been surrounded with mistakes of all kinds including misprints, confusion in the historical measurements, and lost references. In the year 2001, the British amateur Tomas Teague investigated the case and contributed new information, but problems, nevertheless, remained unresolved. In this article the final conclusions are offered after measuring the system and investigating historic documents.

Introduction

Dave Arnold (2001) was not able to identify the C component of the system STF2417, and he requested the help of other observers to clarify the case. I decided to lend a hand to the work being interested by the peculiarity of the matter. A first glance at the data in the WDS for this triple system, makes one think that there is a clear error in some of the measurements (AB, AC or BC). Figure 1 shows the WDS entry for the system. Figure 2 is a 2MASS image of STF2417.

The Problem

It is obvious that if the AB pair is correct (it is a well studied, bright pair, and has no less than 172 official measurements as listed in the appendix), the measurements of one or both of the other two pairs is mistaken. The coexistence of the three measures is geometrically impossible because the direction (PA) is, judging from its WDS entry, practically invariable.

Since this is a widely separated system with no large difference in magnitude, I decided to measure it visually using a Meade MA 12 mm eyepiece on a telescope at the Camino de Palomares Astronomical Observatory, (OACP), in Valladolid, Spain. This observatory is located at latitude 41º 39 ' 59.53296 N; and Longitude 4º 41 ' 42.15818 W; Altitude: 694.651 m.

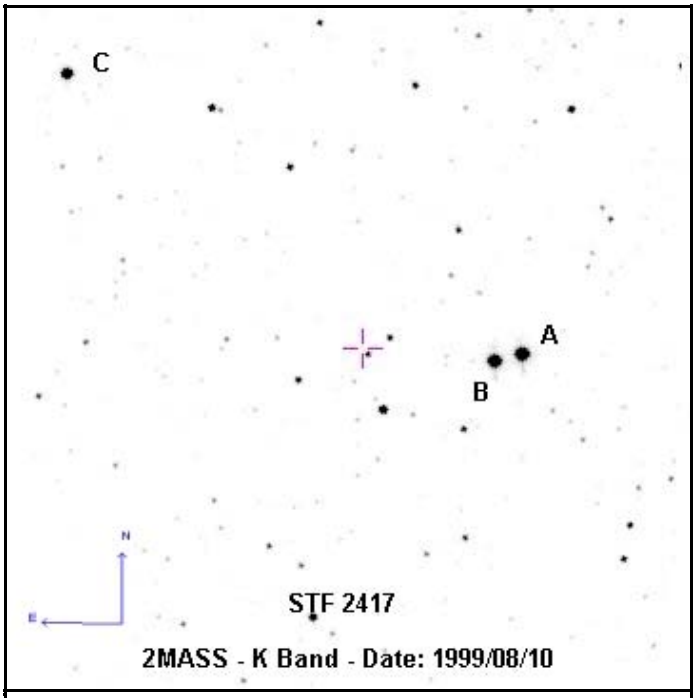

Figure 2: Image of STF2417

I used a Newtonian telescope with a 200 mm objective, focal length = 1000 mm and no Barlow. The scale constant for this optical configuration is 24.82 ±

N° WDS	Doble	Año1	Año2	N	θ1	θ2	ρ1	ρ2	mgA	mgB	Sp	μ(A)	μ(B)
18562+0412	STF2417 AB	1819	2002	99	104	104	22.0	22.5	4.59	4.93	A5V A5Vn	+047 +030	+042 +013
18562+0412	STF2417 AC	1954	1954	1	58	58	26.0	26.0	4.59	7.9		+047 +030	
18562+0412	STF2417 BC	1927	2001	3	56	56	414.1	405.9	4.98	7.9	A5Vn	+056 +028	

Figure 1: Entry in the WDS for the STF2417 system.

0.04 as/division on the linear scale of the astrometric eyepiece, a convenient value for measuring a distance around 22" for the AB pair.

There was no doubt about the AB pair, formed by two almost identical stars. I then tried to locate the C component to measure the AC pair. According to the WDS it should be at a distance of 26 as, at a position angle of 58º and possess a magnitude 7.9. Result: no star of these characteristics was swept up. Nor did I find a dimmer star in the correct position as might have been possible if there was an error in the photometry. Subsequently, I tried to place the BC pair and I found a star, which after their measurements, was in agreement with the catalogue data. So, without a doubt, the error was in the AC subsystem. The results of the measurements that I carried out are shown in Table One.

The Solution

Date	Star	θ	ρ	Nights
2004.627	STF2417 AB	104º	22.338"	2
	STF 2417 AC	58º	421.94"	2
	STF2417 BC	56.96º	407.048"	2

Table 1: Measurements of STF 2417 made by the author.

I requested the historical archive of measures for the system from Brian Mason (manager of WDS). There was, as indicated earlier, 172 measures for AB, one for the AC pair and four more for BC pair. One of the most recent of this last quartet of measurements was by Hipparcos (1991.25), which, given the total reliability of Hipparcos guarantees the accuracy of the BC measurements. One more point in favor of the hypothesis that the error lies in AC.

The only official measurement of AC is shown below in Table 2. The author, Karl W. Kamper (1941-1998), affiliated with the David Dunlap Observatory, Ontario, Canada, measured it in 1954. In WDS references it is said that the source of this measurement is unknown:

KPR9999 KAMPER, K.W.
Unpublished, manuscript or reference not found.

The code for this observer is Kpr9999, the four digits indicating that the origin of the measurement data is ignored. The following step, logically, was to discover something about Kamper. I began to look on the Internet ADS site (Astrophysics Data System, http://adswww.harvard.edu), which is an enormous database maintained by NASA, containing, in electronic form, mountains of astrophysical works. I aimed the search toward Kamper and potential publications on double stars. This search returned 60 references, and among them two were lists of photographic measurements of double stars. Could it be that in those pages the hidden C component of STF2417 system would be included? The answer to this question took only a bit of patience and a page for page review of the scanned writings. And there it was! In the Astronomical Journal (Kamper, 1992) were four measurements for the AB pair on plates that had been taken in the years 1949, 1951, 1954 and 1958, with the 36 inch telescope at the Lick Observatory, they were all in agreement with the historical measures. As you probably guess the observer code WDS assigns to these measurements is indeed Kpr9999. But, there was another entry, and it was exactly the one that I was looking for. In the photographic plate numbered 1820 taken in 1954.41 I found AC measurement, our discord couple: θ = 58º10" and ρ = 425".994 !

Mr. Kamper had measured correctly, and the error, without a doubt, occurred when transcribing the data to the WDS. The shift operator had simply omitted the "4".

How did this happen? I contacted Francisco Manuel Rica Romero, coordinator of LIADA Double Stars Section and sent him the results of my study. Rica has a great deal of experience in this field, and it took him only a couple of days to come up with an explanation. Before the current version of the WDS, the catalog had undergone gradual changes and cosmetic retouches, designed to organize the data more efficiently. In its first version, 1984, the angular distances of the very open pairs, those of more than a hundred arc seconds, were not written entirely in the column corresponding to rho. At that time the measurement was truncated to the tens digit and a new column was added where a figure was located that

Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1954.41	58.10	25.994	.	.	1	Kpr9999	36	H	

Table 2: Measurements of the AC pair of STF2417 by K. Kemper

would reveal the hundreds number that would be necessary to add to obtain the correct rho value. In this way, the WDS entry for a certain pair that had an angular separation of 230".43, would have a value of 30".43 and, in the auxiliary hundreds-column, would be stored a 2, to indicate that it would be necessary to add 200 to the initial value.

Following this hypothesis, Rica wanted to confirm his suspicions and he consulted the entry of STF2417 BC (yes, that's right, the BC pair and later on we will see the reason) in the WDS 1984. It checked that in the rho column was the value 25".994 and in column number 79 - containing the hundreds - appeared a 4, as expected. Surely the error was made during the format change from the 1984 version to that of 1996.

There is one more piece of the puzzle that must be inserted. It is that in the notes corresponding to the system STF2417 in the current version of the WDS, that we read that in the year 2001, Tom Teague (distinguished British amateur double star observer) carried out a study on the nature of the errors in the system. The results of this work were published in *Double Star Observer* (Teague, 2001). In this article he shows that one of the historical measures for the BC pair really corresponded the AC pair.

After Teague's report, that, by the way, repaired the omission of the hundreds digit, the WDS was updated transferring the measure from BC to AC. However, the error was not corrected completely, because the rho value continued being 25".994. The confusion, then, remained in the measurements of this problematic system.

One last point. If in the current version of the WDS there is only the single measurement for AC (Kpr9999) and this came from BC, once it was corrected after the correction of Teague, it seems logical to think that previously there would exist no measurement of AC. I wanted to check it and I consulted the 1996 version of the WDS. My suspicions were confirmed, I didn't find any measurement of AC. This entry is shown in Table 3.

I also got another small surprise. It can be seen that the true historical measure for BC (56º, 414"1) also appears truncated (14.1). This corroborates what we pointed out above; that is to say that the sequence of lamentable misprints that we have been describing had its origin in the WDS form-changes process. Also, it is observed that Kamper's measurement of the AC pair is incorrectly included with the BC measurements.

Conclusions

The conflicting C component is completely identified and their measures should be corrected in WDS. New value: 425"994.

The lost reference on the author (Kpr9999) has been found and it would be convenient to update the historical file of measures of WDS catalogue. New value: Kpr1992 and its bibliographical reference.

Three new measures are contributed for the whole system (AB, AC and BC) that could be included in WDS.

Finally, and after so many eventualities, the case of STF2417 can be closed.

Note: *This system was included in the Third Observational Program (July / September 2004) of LIADA's Double Stars Section.*

18562+0412 STF2417 AB	1822	1984	99	104		21.6	22.3	4.62	4.98	A5V A5Vn
18562+0412 STF2417 BC	1927	1954	2	56	*58*	**14.1**	*26.0*	4.98	7.9	A5Vn

Table 3: Entry for STF2417 in 1996 issue of the WDS.

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Appendix: Historical data for STF2417 in WDS catalogue.

WDS Star No. 18562+0412

RA & DEC (2000)	Disc. Number	Comp	No. Obs.	Magnitudes A	B	Spec. Type	PM/1000 yr RA	DEC	DM No.
18562+0412	STF2417	AB	>99	4.59	4.93	A5V A5Vn	+047	+030	+04 3916

Precise Position of Primary of System or Subsystem (when available)
RA = 18 56 13.1 Dec = +04 12 12

Proper Motion (PM/1000 yr) of Secondary of Subsystem (when available)
RA = +042 Dec = +013

Note? = yes Orbit? = no DM? = yes

	Date Observed	Position Angle	Separation
First	1755	106	22.1
Last	2003	104	22.1

Observations

Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1755.00	105.8	22.05	.	.	1	Bdy1906A	04	A	
1819.63	104.1	22.0	.	.	2	StF1837	04	A	
1822.72	104.0	21.59	5.	5.	1	StF1837	04	A	
1830.05	103.8	21.65	4.0	4.2	8	StF1837	10	A	
1830.62	103.6	25.	.	0.0	1	HJ_1833c	18	B	
1830.75	103.7	21.71	.	.	6	Bes1833a	06	D	
1833.52	104.0	22.08	5.	5.6	1	Da_1835	04	A	
1834.78	103.2	21.76	.	.	2	Wh_1849	06	D	
1836.51	104.6	22.46	.	.	1	Gll1840	10	A	
1836.99	103.8	22.19	.	.	2	Enc1840	10	A	
1838.58	103.4	22.04	.	.	4	Gll1840	10	A	
1841.48	103.9	21.48	.	.	4	Mad1842a	10	A	
1842.74	103.9	21.62	.	.	2	Mad1843	10	A	
1842.77	103.8	21.91	.	.	10	Wh_1849	06	D	
1843.44	104.7	21.08	.	.	1	Mad1844	10	A	
1849.18	104.2	21.80	.	.	2	Mad1856	10	A	
1850.512	103.7	21.391	.	.	1	JMJ1850	08	D	
1851.90	103.4	21.39	.	.	2	Stt1878	15	A	
1852.72	103.9	21.04	.	.	2	Mad1856	10	A	7
1855.42	104.3	20.20	.	.	1	Lut1857		D	
1855.43	104.9	20.74	.	.	1	Lut1857		D	
1856.67	104.6	21.76	.	.	1	Se_1860b	10	A	
1857.20	104.25	20.73	.	.	2	Kon1865	06	D	
1857.81	104.0	21.68	4.3	4.5	1	D__1883	05	A	
1860.28	104.1	21.79	.	.	12	Mad1906A	10	A	
1861.42	103.88	21.776	.	.	7	Auw1862	06	A	
1861.47	104.02	20.88	4.5	4.7	1	Mai1861	08	D	
1863.56	108.5	21.85	.	.	2	Rom1865	10	A	
1863.652	103.7	21.98	.	.	2	Hl_1877a	10	A	
1863.73	103.4	21.61	.	.	5	Eng1865	05	A	
1865.71	104.0	21.78	4.0	4.4	4	D__1884	07	A	
1865.84	103.7	22.01	4.5	5.	1	Knt1877	07	A	
1866.47	103.9	22.14	.	.	1	Tal1868	10	A	
1866.71	103.9	21.94	.	.	6	Kai1872	07	C	
1866.71	103.7	21.70	.	.	6	Kai1872	07	A	
1868.76	103.6	21.56	4.0	4.4	5	Du_1876	10	A	
1869.61	102.82	21.89	5.5	6.0	1	Mai1869	08	D	
1877.37	103.6	21.67	.	.	3	Je_1881b	06	A	
1880.61	104.8	21.40	.	0.0	3	Sne1880	08	D	

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Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1884.58	103.7	21.93	3.8	4.1	3	Per1887	15	A	
1885.63	103.6	21.69	.	.	1	And1899	09	A	
1886.54	103.7	21.97	.	.	5	Per1906A	15	A	
1887.55	103.4	21.95	.	.	2	Mon1899	09	A	
1888.57	103.8	22.01	.	.	2	SBc1899	09	A	
1889.09	103.7	22.08	.	.	2	Kin1928	13	H	
1889.58	103.6	22.01	.	.	5	Gia1891	05	A	
1889.69	103.4	21.90	.	.	10	Amb1919		D	
1890.48	102.5	21.09	.	.	2	Glp1892f	06	A	
1892.06	103.7	21.88	.	.	7	Sp_1909	19	A	
1892.94	283.8	21.82	.	.	5	Coh1894		D	
1893.66	103.1	22.01	4.0	4.3	2	Glp1895	09	A	
1894.55	105.1	22.45	.	.	1	Rsd1899	09	A	
1896.67	104.3	22.06	.	.	2	Col1896	08	A	
1897.15	103.7	22.08	.	.	5	Ser1916	15	A	
1899.66	103.8	22.06	.	.	1	Coh1911	13	A	
1902.48	104.3	22.18	.	.	3	Hu_1911	12	A	
1905.50	103.6	21.93	3.9	4.2	2	Lau1906a	10	A	
1907.61	104.5	22.01	.	.	1	Lau1908b	10	H	
1908.55	104.3	22.01	.	.	3	Dob1927	06	A	
1908.58	106.0	26.415	.	.	1	WFC1998	13	G	
1908.75	102.8	21.900	.	.	5	WFD1914	06	M	
1909.54	103.9	22.04	.	.	1	Dob1927	06	A	
1909.58	103.8	21.91	.	.	1	Gui1912	06	A	
1909.6	107.1	21.397	.	.	2	WFD1928d	08	M	
1909.61	104.3	22.09	.	.	1	Gui1912	13	A	
1909.61	104.2	21.94	4.7	5.0	2	Jan1909b	10	A	
1909.65	103.2	22.29	.	.	2	Roe1910c	06	A	
1910.73	99.3	24.332	.	.	1	WFC1998	13	G	
1910.73	102.1	22.522	.	.	1	WFC1998	13	G	
1911.64	103.3	21.84	.	.	4	Vou1922	10	A	
1912.6	103.8	22.247	.	.	1	WFD1931	08	M	
1914.72	103.0	22.17	.	.	2	Frk1915	06	A	
1916.46	104.6	22.09	.	.	1	Gui1931	06	A	
1917.46	103.9	22.33	.	.	3	Hrc1926		A	
1918.387	103.71	22.054	.	.	2	Hzg1920	20	H	
1920.57	104.3	22.38	.	.	1	Nie1921	10	A	
1920.57	103.7	22.04	.	.	2	Jan1921a	10	A	
1920.84	103.8	22.03	.	.	1	Haa1921a	10	A	
1920.84	103.5	21.95	.	.	1	Jan1921a	10	A	Z
1921.50	103.4	21.41	.	.	1	Haa1921b	10	A	
1921.50	103.7	21.58	.	.	1	Fjl1921b	10	A	
1921.52	103.8	22.24	.	.	2	Dob1927	06	A	
1921.78	103.3	22.21	.	.	2	Gau1924	16	A	
1922.11	103.8	22.54	.	.	2	Blo1931	06	A	
1922.51	102.7	22.43	.	.	4	Gbb1924b	19	A	
1922.98	103.6	21.93	.	.	2	Scl1923	07	A	
1925.597	104.0	22.31	.	.	1	Baz1928	04	A	
1926.70	103.8	22.21	.	.	2	Kom1929	15	A	
1927.18	103.9	21.99	.	.	3	Sil1931	12	A	
1927.27	103.73	22.11	4.5	5.5	1	Ald1936a	26	H	
1927.51	103.77	22.131	4.0	4.2	1	Lbz1929	13	H	Z
1927.51	103.85	22.056	.	.	1	Lbz1929	13	H	Z
1927.57	104.03	22.123	.	.	1	Prz1926	13	H	Z
1927.59	104.3	22.07	.	.	3	Kom1935a	15	A	
1927.59	103.78	22.149	.	.	1	Lbz1929	13	H	Z
1927.62	103.7	22.24	.	.	5	Buc1929	08	A	
1929.64	103.7	21.91	.	.	5	All1930	05	A	
1929.88	103.8	22.02	.	.	2	Dob1930	09	A	
1930.50	102.7	21.25	.	.	3	Arm1934	05	A	
1930.67	103.2	22.21	.	.	4	Baz1933a	05	A	
1931.76	103.7	21.43	.	.	1	All1932	05	A	
1933.65	103.5	22.09	.	.	3	Urb1938	12	H	X
1934.60	103.5	22.451	.	.	7	WFD1969	08	M	

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Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1936.47	102.6	21.989	.	.	1	WFC1949	05	G	
1936.66	105.5	22.05	.	.	5	Sch1937	10	A	
1937.69	103.76	22.11	.	.	1	Hzg1940	36	H	
1938.52	103.06	21.94	4.0	4.2	5	Sch1939	08	A	
1941.43	103.3	22.61	.	.	3	Kor1948	15	A	
1942.58	103.71	22.18	.	.	6	Ahn1957	05	A	
1949.44	103.72	22.158	.	.	1	Kpr9999	36	H	
1949.453	103.76	22.166	.	.	1	LO_1978	36	H	
1949.68	103.80	22.24	4.0	4.2	1	Kra1951	20	H	
1951.54	103.78	22.151	.	.	1	Kpr9999	36	H	
1952.69	102.8	22.15	.	.	1	Fer1960	05	A	
1952.71	103.8	22.34	.	.	3	All1960	05	A	
1953.497	103.75	22.215	.	.	1	DeO1957	18	H	
1953.514	103.78	22.224	.	.	1	DeO1957	18	H	
1953.522	103.74	22.171	.	.	1	DeO1957	18	H	
1954.41	103.74	22.169	.	.	1	Kpr9999	36	H	
1955.410	103.77	22.182	.	.	1	Gzl1962	20	H	
1955.553	103.53	22.238	.	.	1	Gzl1962	20	H	
1955.64	103.27	22.205	.	.	2	Bot1958	05	H	
1956.55	103.67	22.219	4.5	4.9	1	Bot1962	08	H	
1958.58	103.4	22.24	5.1	5.5	1	Hop1964a	27	A	
1958.59	103.70	22.195	.	.	1	Kpr9999	36	H	
1958.76	104.5	21.65	.	.	1	All1960	05	A	
1958.76	101.1	21.74	.	.	1	Cta1960	05	A	
1962.518	103.89	22.254	.	.	1	Bot1965	20	H	
1962.562	103.67	22.239	.	.	1	Bot1965	20	H	
1962.652	103.73	22.241	.	.	1	Bot1965	20	H	
1973.000	104.0	22.00	4.0	4.2	3	Cll2003	03	A	
1973.355	103.76	22.259	.	.	1	USN1978	26	H	
1973.355	103.74	22.264	.	.	1	USN1978	26	H	
1973.546	103.75	22.267	.	.	1	USN1978	26	H	
1973.546	103.74	22.272	.	.	1	USN1978	26	H	
1976.767	102.0	22.30	.	.	1	Tob2003	02	A	
1980.000	104.0	22.00	4.2	4.5	3	Cll2003	04	A	
1982.117	103.9	21.15	.	.	2	Lef1982	10	B	
1983.734	104.0	22.30	4.2	4.5	1	Tob2003	02	A	
1983.775	102.2	22.24	.	.	1	Doc1984a	05	A	
1983.775	102.5	22.00	.	.	1	Csa1984	05	A	
1983.775	102.8	22.55	.	.	1	Lin1984a	05	A	
1984.48	103.3	22.61	.	.	6	Gel1989	04	A	
1984.771	102.7	22.26	.	.	3	Lin1985b	05	A	
1984.776	102.3	22.55	.	.	4	Doc1985b	05	A	
1987.50	103.6	21.72	.	.	1	Gir1992	10	M	
1988.619	103.8	22.42	.	.	1	Jny2003	08	Z	
1988.657	286.0	22.50	4.4	4.3	1	Scn2003	09	B	
1990.482	283.5	22.40	.	.	1	Tob2003	04	A	
1991.25	103.7	22.37	4.69	5.06	1	HIP1997a	54	T	
1991.72	103.6	22.365	4.59	4.93	1	TYC2000b	07	T	
1992.545	104.1	22.46	.	.	1	Tob2003	04	A	
1992.556	105.5	22.38	.	.	1	Tob2003	04	A	
1992.583	284.0	22.54	.	.	1	Tob2003	04	A	
1992.73	103.6	22.30	.	.	5	Kzn1994	10	M	
1993.66	103.1	22.58	.	.	3	Ctt1995	08	I	
1993.695	103.5	22.33	.	.	1	Tob2003	04	A	
1993.805	104.0	22.80	.	.	1	Roj2003	04	A	
1994.495	103.0	22.70	.	.	1	Roj2003	04	A	
1994.506	103.3	22.44	.	.	1	Tob2003	04	A	
1994.684	104.0	22.80	.	.	1	Roj2003	04	A	
1995.468	103.0	22.70	.	.	1	Roj2003	04	A	
1995.575	103.0	22.90	.	.	1	Roj2003	04	A	
1996.485	104.9	22.51	.	.	1	Tob2003	04	A	
1997.693	104.3	23.05	.	.	1	Lfb1997	05	B	
1997.693	104.3	23.05	.	.	1	Lfb2003	05	A	
1999.61	103.3	22.35	.	.	1	TMA2003	51	F	
2001.33	104.3	22.3	.	.	1	UPR2004	31	F	

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Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
2001.712	104.1	22.63	.	.	1	Dal2002a	09	F	
2002.482	104.59	22.58	4.59	4.93	1	Ni_2003a	12	F	6
2002.731	104.0	22.48	.	.	1	Dal2003a	09	F	
2003.580	103.6	22.09	.	.	6	WSI2004b	26	S	

RA & DEC (2000)	Disc. Number	Comp Obs.	No. A	Magnitudes B	Spec. Type	PM/1000 yr RA	PM/1000 yr DEC	DM No.
18562+0412	STF2417 AC	1	4.59	7.9		+047	+030	

Precise Position of Primary of System or Subsystem (when available)
RA = 18 56 13.1 Dec = +04 12 12

Proper Motion (PM/1000 yr) of Secondary of Subsystem (when available)
RA = Dec =

Note? = no Orbit? = no DM? = no

	Date Observed	Position Angle	Separation
First	1954	58	26.0
Last	1954	58	26.0

Observations

Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1954.41	58.10	25.994	.	.	1	Kpr9999	36	H	

RA & DEC (2000)	Disc. Number	Comp Obs.	No. A	Magnitudes B	Spec. Type	PM/1000 yr RA	PM/1000 yr DEC	DM No.
18562+0412	STF2417 BC	4	5.06	6.84	A5Vn	+056	+028	+04 3917

Precise Position of Primary of System or Subsystem (when available)
RA = 18 56 14.7 Dec = +04 12 07

Proper Motion (PM/1000 yr) of Secondary of Subsystem (when available)
RA = Dec =

Note? = yes Orbit? = no DM? = no

	Date Observed	Position Angle	Separation
First	1927	56	414.1
Last	2001	56	405.9

Observations

Date	P.A.	Sep.	Mag-a	Mag-b	#	RefCode	Aperture	Method	Codes
1927.55	55.82	414.136	4.2	7.3	1	Lbz1929	13	H	
1927.55	55.8	414.14	4.2	7.3	2	Prz1926	13	H	
1991.25	56.0	407.188	5.06	6.84	1	HIP1997b	54	T	
2000.501	.	.	.	.	1	Dal2001b	11	A	S
2001.66	56.1	405.9	.	.	2	Tea2001	09	A	

WDS Index Catalog Notes

AB: Theta (1) Ser. B is BD+04@3917, Theta (2) Ser.
BC: This system analyzed in detail by Teague (TEA01) who determined the source of the errors in all three historical measures (LBZ56, PRZ02, and KPR99 which actually belongs with the AC pair) of this system.

(Continued on page 18)

The Strange Case of STF2417 = Theta Ser

Acknowledgements

This research has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

References

Arnold, David, "Double Star Measurements Made with a Reticle Micrometer and an 8-Inch Schmidt Casssegrain", *Double Star Observer*, **7**, 6-9, 2001

Kamper, K.W., "Photographic measures of double stars from Lick Observatory plates", *Astronomical Journal*, **104**, 231-240, 1992.

Teague, E.T.H., "Σ 2417 BC: An Investigation", *Double Star Observer,* **7**, 11-12, 2001.

The author has been a double star observer since 1991. Since 2002 he has observed from his private observatory called Camino de Palomares Astronomical Observatory (OACP) At present he is coordinator of SYRMA-MED, the Double Star Section of the Syrma Astronomical Society, Valladolid, Spain. Also, he often participates in the observational programs of the Double Stars Section in LIADA group.

Measurement of Neglected Double Stars

John M. Ryan

Salamanca, Spain

Abstract: Using the criterion of Robert G. Aitken "log rho = 2.8-0.2m" to select a group of neglected double stars for measurement will at least give the possibility that the majority of the group are physical doubles and will give the satisfaction that the measurement work could be useful.

I have written two articles for the now defunct "Double Star Observer" where I embarked on the measurement of neglected double stars. The double stars measured for these two articles were selected at random from the WDS neglected lists with just the object of measuring double stars with a CCD camera. I have had experience measuring double stars with the Celestron Microguide, the Retel filar micrometer and a video camera. My experience showed that the CCD camera in conjunction with recent star catalogs is the most accurate.

Working with my mentor Francisco Rica of the LIADA double star section, I have learned that there are various rudimentary methods that will give an indication of whether a double star is physical or optical. One of the easier methods is the criterion of Robert G. Aitken (1964) with his equation "log rho = 2.8-0.2m" where "m" is the apparent magnitude and rho the separation in arcseconds. Also some studies show that rho being less or equal to 10 arcseconds increases the possibility of the double being physical. I have used these two criterions for selecting a group of 45 neglected double stars for this article.

I began my selection of the possible double stars to be measured by using the program Astroplanner. This program allows a person to enter the neglected double star catalog (or any other catalog) with a set of prerequisites to select a group of desired objects or in this case neglected double stars. I had imposed limits that the primary component would be mag 10 or less with the separation between 4 and 10 arcseconds. The other limits were Right Ascension between 6:00 and 8:59 hours and the Declination between 25º and 70º. Naturally these last limits were necessary to take images in February and at a declination comfortable for my telescope setup. This selection gave me about 70 neglected doubles in this sector of the sky. I then applied the Aitken criterion to this group, and that left me with a group of about 45 doubles for measurement with the confidence that the majority could be physical doubles.

I have a permanent roll off roof observatory in a small village in the western part of Spain. My setup for the measurement consists of a Celestron 9.25 inch SCT telescope mounted on a Losmandy GM8 with the Astrometric go to system for finding the doubles. The CCD camera is a Starlight Xpress MX7-16 which gives a good size image with sufficient reference stars for fixing the plate reference. On the nights of Feb. 10th, 11th and 22nd I obtained four images of each double.

Measuring the doubles on quiet dark cold winter nights under the stars with very little wind is the most pleasurable part of the work. Next comes the hours in front of the computer fixing the plate scales and then measuring the doubles. I use the program Astrometrica with the USNO B1.0 or the UCAC 2 catalogs for fixing the plate scale. I use four images to come up with a decent average but some of the images were on the poor side thus leaving some of the measurements with just three results and one had just two results. Following is the table showing the results of the PA and separation measurements for these neglected doubles.

The average standard deviation in PA was 0.97º. The average standard deviation in separation was 0.15". The deviation in PA tends to be higher for the closer doubles as in this case. The O-C residuals of the plate reductions averaged between 0.15 and 0.4 which has been the norm for all my measurements over the last six years.

Approximately 66% of the measurements were

in reasonable agreement with the listings in the neglected list. The rest, or 33% the difference, was notable to very notable.

As noted the list in this article is just a small sector of the sky. I hope to continue in this manner for the foreseeable future. If there are any questions or comments, I can be reached by contacting me through the Internet at jmryan@wanadoo.es.

Name	RA Dec	MgA	MgB	PA°	Sep"	Date	No.	Notes
ES1729	060306+4100	9.6	11.4	310.50	6.78	2005.153	4	
BRT2343	060830+2228	9.9	12.2	205.16	5.48	2005.153	4	1
ES579 BC	060830+4725	9.6	12.1	114.88	7.55	2005.153	4	
ES2279	061036+3744	9.4	11.5	290.38	6.57	2005.153	4	
J966	061048+3500	9.3	11.5	34.92	6.71	2005.153	4	
COU272	061224+2253	10.0	13.0	306.84	5.07	2005.153	3	
POU1144	061224+2351	10.0	11.7	301.90	5.54	2005.153	4	
POU1156	061306+2352	9.2	11.7	171.76	4.94	2005.153	4	
ES897	062306+5157	9.6	12.2	92.88	6.48	2005.153	4	
ES2564	062618+3802	10.0	11.5	261.90	6.33	2005.153	3	
MLB398	063106+6638	9.3	11.8	155.63	5.14	2005.153	4	
HJ2320	063242+2053	8.6	11.1	322.55	9.70	2005.153	4	
MLB751	063806+2826	10.0	12.0	234.36	6.70	2005.153	4	
MLB260	064154+6515	9.3	12.0	74.77	4.95	2005.153	2	
BRT2216	064342+3911	9.1	11.9	25.97	5.94	2005.153	3	
MLB927	064548+3718	10.0	11.5	272.93	4.54	2005.153	3	
ES1237	064654+4825	9.3	11.5	357.20	4.93	2005.153	4	
POU2047AB	065030+2427	9.8	12.6	215.64	8.34	2005.153	5	2
? ? AC	065030+2427	9.8	12.7?	152.70	8.22	2005.153	5	2
MLB399	065154+6727	9.6	11.6	259.91	6.88	2005.153	3	
MLB195	065342+6253	9.6	12.0	192.15	5.76	2005.153	4	
ES1324AB	070042+4527	10.5	11.8	175.34	6.80	2005.112	4	
ES1893	070054+6331	9.9	11.9	156.40	4.62	2005.115	3	
ES1079	070236+5039	8.2	11.7	326.30	6.35	2005.115	4	
WNO18ABC	070306+5410	0.0	0.0	59.07	9.39	2005.115	3	
ES713AB	070818+5241	8.6	13.7	46.23	6.17	2005.115	3	
STF1022	070924+3634	6.8	10.0	140.95	5.16	2005.115	3	
MLB162	070942+6045	8.7	12.3	111.22	6.36	2005.115	3	
SIN28Aa	071930+4939	8.5	12.9	321.18	9.53	2005.115	4	

(Continued on page 21

Measurement of Neglected Double Stars

Name	RA Dec	MgA	MgB	PA°	Sep"	Date	No.	Notes
ES772AC	072600+5310	9.5	14.4	355.62	10.03	2005.112	4	
ES903	072606+5021	9.3	11.9	246.44	10.75	2005.112	4	
ES589	074830+4746	8.1	14.1	185.33	11.12	2005.112	4	
MLB262	075512+5944	9.5	13.0	264.29	7.37	2005.112	3	
MLB199	075806+6402	9.5	11.8	154.29	7.27	2005.112	4	
ES1387	080024+4243	10.7	11.4	141.10	5.39	2005.112	4	
ES907	080118+5117	10.5	11.7	111.05	6.33	2005.112	4	
STF1195AB	081236+3028	9.0	11.5	333.12	9.10	2005.112	4	
HO38AB	081354+2747	7.6	12.6	86.86	7.85	2005.112	3	
ES1636	081700+3948	10.4	13.1	231.53	10.45	2005.112	4	
HJ780AB	081706+3348	11.3	12.3	207.73	14.60	2005.112	4	3
HJ780BC	081706+3348	10.0	0.0	172.69	12.25	2005.112	4	3
ES714	081936+5316	10.0	13.4	194.27	7.64	2005.112	4	
ES595	083112+4746	9.0	13.7	238.59	9.07	2005.112	4	
ES597	084936+4526	9.2	12.5	266.82	7.20	2005.112	3	
LDS2294	085148+6308	11.0	11.3	13.62	4.8	2005.115	3	
STF3120AC	085606+4341	8.6	14.3	118.66	8.00	2005.112	3	

M denotes the number of images used in the measurements.

Note 1; The entry in the WDS shows the last PA as 21°. This has to be a mistake. The first entry was 208° and my result is 205.16° which agrees with the first entry.

Note 2; This is not a double but a triple. The triple is quite striking in its view; it looks like a large round object sitting on two small ball bearings, one bottom right and one bottom left almost in symmetry. The bottom right is the one listed but the bottom left I could not find in the catalog. The magnitude of the unlisted component is only slightly less than the B one. The only listing for this triple is the initial one of 1907. I cannot see how the discoverer missed the bottom left component.

Note 3; This double by John Hershel escaped my Aitken criterion. It should not be in the list but as I had imaged the triple I added it to my results. In the LIADA double star section, we have been measuring John Hershel doubles and the majority of them are optical and also in general, the current measurements do not agree with the original measurements made by John Hershel such as in this case.

References

Aitken, Robert G, 1964, *The Binary Stars,* Dover Publications, Inc., New York, N.Y.

John M. Ryan is a retired mechanical environmental engineer from the Chicago area in the United States. He is a member of the "s33" group of double star enthusiasts since its inception and a member of the LIADA double star section since 2001. He enjoys cruising around the Spanish countryside on his motorcycle and has a web site at http://jmryan.en.wanadoo.es/LaCalzada.index.html.

Journal of Double Star Observations

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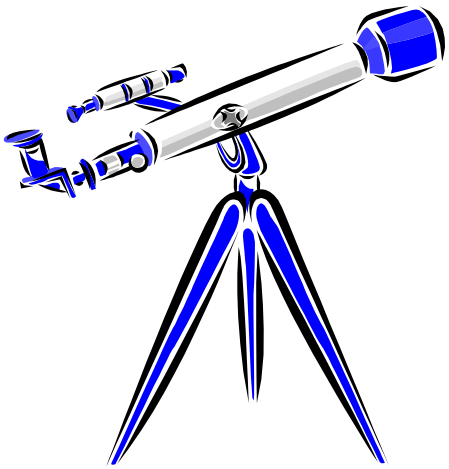
Questions, comments, or submissions may be directed to rkentclark@jaguar1.usouthal.edu or to rmollise@aol.com

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.southalabama.edu/physics/JDSO.

Submissions should be made electronically via e-mail to rclark@jaguar1.usouthal.edu or to rmollise@aol.com. Articles should be attached to the email in Microsoft Word or text format.



Thank you, Ron Tanguay

For many years Ron Tanguay single-handedly assembled, printed, and sent out the *Double Star Observer*. He provided a venue for double star observers to publish their measurements so that they could be used by other astronomers. We expect articles in the DSO will be frequently referenced in this journal.

The DSO was hugely responsible for reviving serious visual double star research in an era dominated by light-buckets and deep sky objects.

Recently Ron stopped publishing the DSO, and so we begin the JDSO. Thank you, Ron, for years of work and for giving amateur double star observers an outlet to promulgate their measurements. We will endeavor to "keep up the good work".

We're on the web!
http://www.southalabama.edu/physics/jdso