

Ludwig Schupmann Observatory Measures of Large Δm Pairs-Part One

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Abstract: Measurements made at the Ludwig Schupmann Observatory (LSO) in theta and rho space of 107 components in 46 large Δm systems are reported. A comparatively small number of these pairs are physical. For optical components the high proper motion of the mostly nearby primaries can provide extremely accurate relative motions especially for those with a century or more of timely measures. Data for many optical pairs are now plotted in the WDS Catalog of Rectilinear Elements of Visual Double Stars. These elements have been used to hone traditional proper motion values [Mason 2006]. In the case of large Δm systems, the frequency of observation is typically rather low and fresh measures of these challenging systems, both optical and physical, are certainly meaningful.

Introduction

Difficulties attending CCD measurements of large Δm pairs are described in an article by the author in the Fall 2007 issue of the JDSO [Daley 2007]. The specialized tailpiece optics used to make the measures reported here is also covered in that article. Keen-eyed observers such as W. S. Burnham, Alvan Graham Clark and the Herschel's, William and John, were dominant in the discovery of these contrasting component pairs. They usually employed the biggest reflectors and refractors of the time. It is only recently, with the introduction of the CCD, that amateurs with small telescopes have an opportunity to measure these systems.

The Measures

The following data is listed in the conventional way. From left to right: the discoverer's designation, WDS identifier (Epoch 2000 RA & Dec), WDS mags rounded off to the first decimal place, (LSO unfiltered CCD magnitudes in bold italics) LSO position angle in degrees, LSO separation in seconds of arc, decimal date of observation, number of nights observed and a notes column. In the notes column entries such as *6m72* signifies 6 previous measures the last being 72 years ago. Other self explanatory items, perhaps of

interest, appear in this column.

There is no note section as all-in-all the work was routine and without surprise; the optical components, for the most part, showing giant motions and the binaries displaying small but detectable position changes in most cases, the motions being reasonably consistent with previous measures- old and recent.

Among the few discoveries are 4 fairly close pairs attendant with systems BAR 1, STF 2579 and AGC 13. The existence (in large numbers) of very faint pairs slowly orbiting bright stars is perhaps fanciful, however, that particular form of stellar architecture certainly interests this writer! Their discovery is probably limited to relatively nearby stars.

Contemporary catalog measures of BU 293AD and BU 1192Aa-P gleaned from 2-MASS images were found to be misidentified. The discovery components were easily recovered and measured. Among the high delta m measures, BU 980 AB was the most challenging. Separated by just under 8 arc seconds, it pushed the system capabilities close to its limit. This result encourages the author to try for a solid measure of Sirius, presently at about the same separation but of a greater delta m.

Figure 1 shows a CCD image of BU 491 (see measures below) observed under excellent seeing

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conditions. Only a 6-second exposure was required at full resolution (no binning) to clearly bring out "C", the magnitude 15 optical component. The light diagonal bar is the attenuation foil dimming the primary by 10 stellar magnitudes. Note the lack of field stars!

This ongoing measurement program is guided by an observation list generated by Brian Mason based on LSO's instrumentation capability and, in general, covers a Δm range of 8 to 12 with the primary component no fainter than 4.5. Measurements are per-

formed with a 9-inch aperture Schupmann medial telescope and an ST-7XE CCD.

References

- B.D. Mason, 2006, "Classical Observations of Visual Binary and Multiple Systems", Proceedings IAU Symposium No. 240.
- Daley, 2007, "A Method of Measuring High Delta m Doubles", Journal of Double Star Observations, **3**, 159-164.

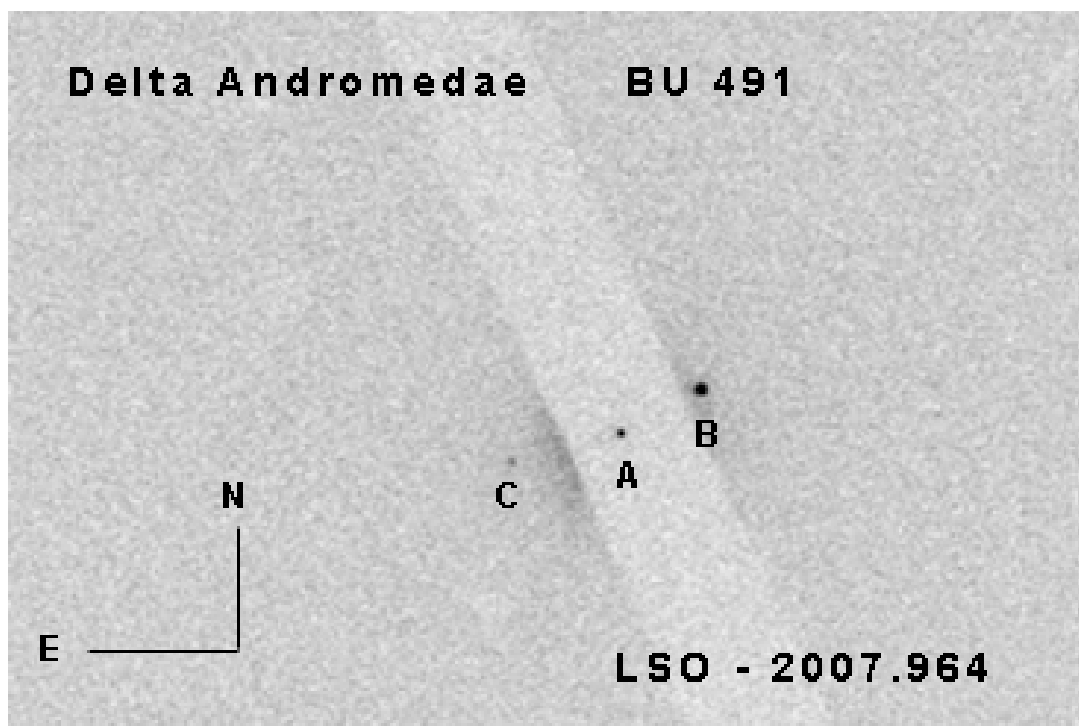


Figure 1: CCD image of BU 491 showing the 15th magnitude C component. The lighter shade diagonal stripe is a result of the attenuation foil.

Designation	WDS Ident	Mags	PA	Sep	Date	n	Notes
H 5 32Aa-B	00084+2905	2.2, 11.1	284.2	90.84	2007.931	1	Alpha And
AGC 15AB	00092+5909	2.4, 13.7	268.4	66.10	2007.931	1	6m72, Beta Cas
BU 491AB	00393+3052	3.2, 12.4	298.8	28.92	2007.964	1	Delta And, binary
BU 491AC	00393+3052	3.5, 15.0	105.1	35.35	2007.964	1	2m48
BU 1349AB	00405+5632	2.5, 14.0	279.2	23.52	2007.964	1	Alpha Cas
BU 1349AC	00405+5632	2.5, 13.0	104.1	32.16	2007.964	1	4m100

Table 1: Measures made at the Ludwig Schupmann Observatory. Table continued on next page

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Designation	WDS Ident	Mags	PA	Sep	Date	n	Notes
H 18AD	00405+5632	2.3, 9.0	281.5	70.19	2007.96	1	
BUP 9AB	00473+2416	4.1, 15.3	7.7	36.91	2007.96	1	Zeta And
BUP 9AC	00473+2416	4.1, 13.6	230.3	97.04	2007.96	1	binary
BUP 9AD	00473+2416	4.1, 10.8	259.8	157.16	2007.96	1	
HJ 1057AB	00568+3830	3.9, 12.9	296.1	51.42	2007.98	1	Mu And
HJ 1057AC	00568+3830	3.9, 11.4	149.8	28.47	2007.98	1	
BAR 1AB	01097+3537	2.1, 14.4	232.3	29.63	2007.98	1	2m74, Beta And
BAR 1AC	01097+3537	2.1, 12.9	275.9	107.74	2007.98	1	5m58
BAR 1AD	01097+3537	2.1, 12.1	148.8	67.37	2007.98	1	6m58
BAR 1AE	01097+3537	2.1, 11.0	303.2	154.71	2007.98	1	2m128
BAR 1AF	01097+3537	2.1, 11.0	81.4	142.87	2007.98	1	3m48
DAL 39AK	01097+3537	2.1, 13.6	89.9	60.21	2007.98	1	
DAL 39KL	01097+3537	13.6, 13.7	181.4	6.03	2007.98	1	new pair, mags unfiltered
STF 93AC	02318+8916	2.1, 13.8	96.4	39.22	2007.19	1	Polaris
STF 93AD	02318+8916	2.1, 14.3	186.5	82.47	2007.19	1	
BU 550AB	04359+1631	0.85, 13.6	113.3	31.56	2007.14	1	16m45, Aldebaran, binary
STFA 2AC	04359+1631	0.85, 11.3	31.8	135.17	2007.14	1	C is an unrelated close
STT 545AC	05597+3713	2.7, 10.7	299.9	55.15	2007.18	1	Theta Aur
BU 1059A-BC	06230+2231	2.9, 9.4	140.8	108.07	2007.19	1	Mu Gem
BU 1059AD	06230+2231	2.9, NA	65.3	58.68	2007.19	1	
LBU 3AE	06230+2231	3.2, 11.5	85.2	79.36	2007.19	1	
BU 1192Aa-P	06290+2013	4.1, 15.1	358.9	24.48	2007.18	1	Nu Gem
BU 1192Aa-Q	06290+2013	4.1, 13.9	13.8	55.05	2007.18	1	
BU 1192Aa-R	06290+2013	4.1, 12.6	256.4	56.53	2007.18	1	
BU 1192Aa-S	06290+2013	4.1, 13.0	12.2	93.13	2007.18	1	
DAL 33Aa-D	06290+2013	4.1, 12.9	56.1	53.33	2007.18	1	new compnt, mag unfitered
STT 77Aa-BC	06290+2013	4.1, 8.0	329.8	113.1	2007.18	1	
FOX 150AB	06528+3358	3.6, 12.6	324.4	80.83	2007.22	1	Theta Gem
FOX 150AC	06528+3358	3.6, 12.7	186.4	98.84	2007.22	1	
DAL 34AD	06528+3358	3.6, 13.6	297.5	20.78	2007.22	1	new compnt, mag unfitered

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Designation	WDS Ident	Mags	PA	Sep	Date	n	Notes
STF1190AB	08086-0259	4.3, 10.1	107.7	33.42	2007.26	1	Zeta Mon
STF1190AC	08086-0259	4.5, 9.7	245.9	64.95	2007.26	1	
STF1190AD	08086-0259	4.4, 13.4	283.8	38.08	2007.26	1	1m102
BU 1067AC	08303+6043	3.4, 10.6	145.8	141.08	2007.24	1	Omicron UMa
HJ 457Aa-B	08447+1809	3.9, 12.2	75.2	39.53	2007.26	1	Delta Cnc,
STT 576AC	11141+2031	2.6, 8.6	341.8	204.01	2007.33	1	Delta Leo
BU 1282AD	11141+2031	2.6, 12.1	30.2	96.74	2007.33	1	2m96, appears to be optical
DAL 35AC	11141+2031	2.6, 13.3	36.1	46.53	2007.33	1	new compnt, mag unfiltered
POP1219AB-C	11182+3132	4.4, 15.0	324.2	56.36	2007.37	1	Xi UMa
BU 604AC	11491+1434	2.1, 13.2	23.9	98.75	2007.36	1	6m89, Beta Leo
STF1670AB-C	12417-0127	2.7, 15.1	121.3	93.68	2007.36	1	Gamma Vir
STF1670AB-D	12417-0127	2.7, 12.0	89.8	171.02	2007.36	1	
BUP 150AB	13252-1110	1.0, 12.0	32.9	152.50	2007.43	1	Spica
BU 633AB	17566+5129	2.2, 13.4	151.6	20.84	2007.66	1	8m73, Gamma Dra
BU 633AC	17566+5129	2.4, 12.9	234.3	44.14	2007.66	1	3m109
BU 633AD	17566+5129	2.4, 12.9	10.9	59.31	2007.66	1	4m92
BU 633AE	17566+5129	2.4, 11.9	234.5	95.79	2007.66	1	3m94
BU 633AF	17566+5129	2.4, 11.2	114.0	125.58	2007.66	1	
STF2272AU	18055+0230	4.2, 14.3	324.4	88.11	2007.65	1	17m61, 70 Oph
STF2272AT	18055+0230	4.2, 12.2	47.5	125.85	2007.65	1	22m61
STT 342AB	18073+0934	3.7, 14.	297.1	25.11	2007.66	1	72 Oph, binary
STT 342AC	18073+0934	3.7, 11.	162.5	63.35	2007.66	1	
DAL 36AD	18073+0934	3.7, 14.8	47.2	24.37	2007.66	1	new compnt, mag unfiltered
STT 353AB-C	18208+7120	4.4, 12.7	117.0	72.50	2007.72	1	Phi Dra
H 5 39AB	18369+3846	0.0, 9.5	183.1	81.14	2007.65	1	Vega
STF B 9AC	18369+3846	0.0, 11.1	255.1	75.68	2007.65	1	3m126
STF B 9AE	18369+3846	0.0, 9.5	39.2	89.12	2007.65	1	
STF3136BC	18369+3846		311.8	46.11	2007.65	1	1m143
STF 9CD	18369+3846		29.8	30.29	2007.65	1	1m110
BU 968AB	18448+3736	4.3, 15.8	49.2	22.75	2007.72	1	Zeta Lyr

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Designation	WDS Ident	Mags	PA	Sep	Date	n	Notes
BU 968AC	18448+3736	4.3, 13.3	269.9	48.78	2007.72	1	4m84
HJ 2839AD	18457+2033	4.2, 13.9	335.9	25.44	2007.71	1	3m72, 110 Her
HJ 2839AE	18457+2033	4.3, 13.7	13.0	61.12	2007.71	1	2m72
HJ 2839AB	18457+2033	4.2, 12.6	56.9	74.76	2007.71	1	3m72
BU 293AC	18501+3322	3.6, 13.0	247.4	47.08	2007.70	1	Beta Lyr
BU 293AD	18501+3322	3.6, 14.3	68.0	64.37	2007.70	1	
BU 293AE	18501+3322	3.6, 9.9	317.4	67.73	2007.70	1	
BU 293AF	18501+3322	3.6, 9.9	18.2	86.81	2007.70	1	
AGC 9AB	18589+3241	3.2, 12.1	306.9	13.57	2007.70	1	Gamma Lyr
BU 287AC	19054+1352	3.0, 11.8	75.8	161.34	2007.70	1	Zeta Aql
BUP 186AC	19126+6740	3.1, 12.4	342.4	81.47	2007.74	1	Delta Dra
BU 653AB	19341+0723	4.4, 13.1	289.1	56.17	2007.73	1	Mu Aql
BU 653AC	19341+0723	4.4, 13.1	299.4	55.74	2007.73	1	
BU 653BC	19341+0723	13.1, 13.1	206.4	9.96	2007.73	1	
J 118	19367-0117	4.4, 13.0	160.5	45.41	2007.73	1	Iota Aql
J 121AB	19401+1801	4.4, 13.2	179.6	30.20	2007.73	1	Alpha Sge
J 121AC	19401+1801	4.4, 14.9	242.3	35.62	2007.73	1	
STF2579AC	19450+4508	3.0, 12.0	67.0	62.97	2007.74	1	Delta Cyg
DAL 37AD	19450+4508	3.0, 14.9	246.0	41.97	2007.74	1	
DAL 37DE	19450+4508	14.9, 15.2	249.7	3.31	2007.74	1	new pair, mags unfiltered
DAL 37AF	19450+4508	3.0, 13.1	65.9	147.48	2007.74	1	
DAL 37FG	19450+4508	13.1, 13.8	310.5	3.19	2007.74	1	new pair, mags unfiltered
DAL 27AD	19508+0852	0.8, 11.7	96.9	31.72	2007.66	1	Altair
STT 532AB	19553+0624	3.7, 11.8	0.9	13.07	2007.75	1	Beta Aql, binary
BU 980AB	19563+3505	3.9, 12.0	205.7	7.75	2007.80	3	13m49, Eta Cyg, binary
HJ 1455AC	19563+3505	3.9, 10.5	333.0	46.15	2007.79	2	
HJ 1455AD	19563+3505	4.0, 10.5	162.7	48.41	2007.79	2	
BU 980AE	19563+3505	3.9, 11.5	246.7	57.02	2007.79	2	
HJ 1495Aa-B	20136+4644	3.8, 13.0	327.1	35.98	2007.86	1	31 Cyg
HJ 5545AB-C	20375+1436	3.2, 13.1	134.2	14.81	2007.86	2	29m46, Beta Del,

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Designation	WDS Ident	Mags	PA	Sep	Date	n	Notes
STF2704AB-D	20375+1436	3.2, 11.0	317.6	46.79	2007.86	2	
STT 594Aa-B	20462+3358	2.5, 11.6	259.2	74.79	2007.86	1	20m37, Eps Cyg,
BU 676Aa-C	20462+3358	2.5, 13.4	265.0	78.72	2007.86	1	cpm, 2 mags brighter in
AGC 13AE	21148+3803	3.8, 12.2	211.7	71.53	2007.90	1	7m93, Tau Cyg
AGC 13AF	21148+3803	3.8, 12.4	257.0	86.92	2007.90	1	2m95
AGC 13AG	21148+3803	3.8, 11.8	184.8	90.37	2007.90	1	cpm
DAL 38AE	21148+3803	3.8, 12.5	108.5	120.88	2007.90	1	
DAL 38EF	21148+3803	12.5, 13.2	107.4	8.48	2007.90	1	new pair, mags unfiltered
BU 1516AB	22415+1050	3.4, 11.6	144.6	57.89	2007.93	1	Zeta Peg
HJ 301AB	22476+1210	4.2, 12.3	95.2	11.06	2007.90	1	Xi Peg , neat CCD binary
STT 600AB	23376+4627	3.8, 13.3	264.2	30.80	2007.93	1	1m99, Lambda And

*The author, an avid but slowing marathon runner, is retired and observes from his backyard observatory in southern New Hampshire. The main instrument is a 9-inch medial refractor equipped with an ST-7 CCD camera. His recently published book, *The Schupmann Telescope*, is available from Willmann-Bell, Inc.*

