A Report on Double Star Observations for the Year 2014 by the Humacao University Observatory

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Abstract: We report measurements of separation and position angle of 79 binary pairs. The data were obtained using the NURO Telescope at the Anderson Mesa location of Lowell Observatory, 20 miles east of Flagstaff, Arizona, at an altitude of 7000 feet, on June 12 and 13, 2014. We gathered the data using the 2K x 2K CCD camera,-NASACAM-at the prime focus of the 31 inch telescope. The data was transferred and analyzed at the Humacao University Observatory of the University of Puerto Rico by students undertaking research projects.

Introduction

As before, we are hereby reporting on separation and position angle of binary stars gathered from CCD images obtained at the National Undergraduate Research Observatory (NURO) telescope. The Humacao Campus of the University of Puerto Rico is a member of NURO, a consortium of primarily undergraduate institutions (www.nuro.nau.edu) with access to a 31 inch telescope, property of Lowell Observatory. It is located roughly 20 miles east of Flagstaff, Arizona at Anderson Mesa, at an altitude of 7200 feet. We use the NURO telescope twice a year, usually during the spring and fall. The data presented in this report was acquired at Flagstaff, Arizona on June 12, 13 and 14, 2014. We were rained out on the 14th. In September we were rained out the 3 nights; and we did not travel to Flagstaff because of the negative weather reports. This is the first time in many years that we were rained out. Between June 12 and 13 we obtained quality data to report on a total of 79 binary pairs. They are included in Table 1.

Procedure

After the acquisition of the data it is transfered to the Humacao University Observatory. The observatory belongs to the Department of Physics and Electronics of the Humacao Campus of the University of Puerto Rico The students used the pixelization of the CCD images to obtain the separation and position angle (see Muller, 2003 for details). Then the CCD images where analyzed a second time using the software included in The Handbook of Astronomical Image Processing for Windows, Second Edition, by Richard Berry and James Burnell, Willman-Bell, Inc, Virginia (www.willbell.com).

There is a systematic error in position angle that occurs when the CCD camera is inserted into the telescope. This error can be corrected by using well known binary systems and binary systems that "don't move". Binary systems that "don't move" can be found in the neglected section of the Washington Double Star catalog, as binary stars that have been measured for the last 100 years and show no change in position angle. One can get detailed information on such systems by requesting the information from the database of the Washington Double Star (WDS) catalog. The procedure for doing so is simple and is outlined in Mason, 2006. We use a mix of stars that don't move and other stars well known (normally around 15 -20 of them) to easily calculate this uncertainty which we call 'the offset'; it is incorporated in the position angle data presented here.

The table, with 79 entries, displays first the WDS name of the pair, then the coordinates from the WDS in the second column (both RA and Dec). After that, the

table presents the visual magnitudes for the primary and the secondary. These magnitude values are also obtained from the WDS. Next we display our measurement of position angle (PA) and we further display the measured separation. Finally, in the Date column we include the date of the observation in the usual format. We do not include the note column since we obtain only one image of a binary in that particular night. We must stress that although sometimes more than one image was obtained of a binary in a particular night, in the analysis and calculations of PA and Separation only one image was used. However, it should be noted that 3 or 4 students work separately in the analysis of each image.

Note

Dr Muller has retired from his position at the Humacao Observatory and has been substituted by Dr Desiree Cotto. Her interests include both binary stars (she participated of the binary star project as an undergraduate here in Humacao) and also asteroids. She will continue the analysis of data for the years 2015 and 2016. We wish her many years of astronomy projects.

(Text continues on page 164)

Name	RA	DEC	M_1	M_2	UPRH ρ	UPRH θ	Date
HJ 514	12 02 49.7	+28 41 15.3	11.82	13.55	20.75	89.38	2014.419
GRV 849	12 02 53.16	+23 45 50.8	12.03	12.35	28.46	232.52	2014.419
STI 738	12 03 17.6	+59 24 05	12.24	13.1	6.57	38.72	2014.419
STF 1594AC	12 03 28.5	+41 24 15.5	10.09	11.10	11.64	142.72	2014.419
BAL1450	12 03 11.85	+00 43 48.8	11.70	12.46	22.5	209.32	2014.419
POU3120	12 04 05.7	+23 11 4.6	11.09	13.1	13.78	199.52	2014.419
BU 458	12 04 17.11	-21 02 21.0	7.87	9.97	30.14	236.22	2014.419
HJ 1206	12 02 43.4	+04 24 35.4	11.4	11.5	222.5	18.13	2014.419
KZA 26	12 05 07.8	+43 22 46.7	13.0	13.6	17.08	109.22	2014.419
HJ 4496	12 06 12.7	-18 53 27.9	10.05	10.98	11.62	31.72	2014.419
2 Canes Venatici STF1622	12 16 07.5	+40 39 36.6	5.86	8.71	12.07	259.83	2014.419
COU2707	12 30 04.89	+22 22 16.5	11.77	14.1	14.34	342.97	2014.419
HJ 519	12 30 26.3	+36 07 44.7	10.32	10.35	18.7	190.17	2014.419
ES 726AC	12 30 49.06	+53 51 29.7	10.48	13.6	20.44	179.38	2014.419
STF1650	12 31 32.9	+24 37 13.1	9.54	10.47	16.40	180.72	2014.419
STF1649	12 31 36.4	-11 04 20.2	7.97	8.43	15.42	198.22	2014.419
LDS4224	12 32 13.2	+31 47 19.6	13.5	15.0	10.4	313.22	2014.419
HJ 211	12 32 21.1	-01 53 33.3	11.86	11.77	11.15	282.22	2014.419
LDS4225	12 32 28.7	+28 54 12.4	13.3	15.3	16.7	207.72	2014.419
LDS3051	12 33 26.0	+52 26 59.0	19.9	17.1	17.81	357.99	2014.419
HJ 2641	13 08 55.1	+07 59 58.1	12.1	12.8	12.64	222.02	2014.419
POU3152	13 49 38.8	+23 28 15.0	12.25	12.30	14.16	183.72	2014.419
UC 185	13 53 44.49	+12 40 48.4	8.64	13.35	20.45	147.03	2014.419
LDS5799AB	13 56 15.8	+24 09 00.9	13.4	14.4	6.41	89.22	2014.419
HJ 2699BC	14 03 04.5	+11 54 25.3	13.0	13.4	15.40	300.47	2014.419
HJ 542	14 12 21.2	+36 46 12.6	12..9	12.5	12.26	67.22	2014.419
POU3162	14 13 23.9	+24 24 11.9	12.02	13.8	6.64	344.77	2014.419
SWI 1	14 02 33.18	+46 20 23.9	10.05	10.26	5.92	25.72	2014.419
UC 2679	14 06 32.70	+19 18 57.0	16.6	13.7	10.73	74.72	2014.419
LDS4521	15 00 47.5	+23 06 26.3	15.45	16.42	26.19	341.52	2014.419
HJ 1266	15 01 07.9	+04 15 17.0	10.77	12.81	13.12	26.82	2014.419
KZA 80	15 20 42.0	+31 33 15.1	12.13	12.82	25.14	57.02	2014.419
KZA 87	15 24 48.6	+02 93 428.4	10.5	12.0	12.5	1.82	2014.419
POU3188	15 25 38.9	+24 01 26.0	12.04	14.4	10.15	21.32	2014.419
DAM 258AC	15 25 52.3	+45 43 52.5	11.8	14.5	12.08	227.92	2014.419
GRV 907	15 31 20.13	+08 36 31.9	9.40	12.49	21.57	165.22	2014.419

Table concludes on next page.

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Name	RA	DEC	M_1	M_2	UPRH ρ	UPRH θ	Date
GRV 907	15 31 20.13	+08 36 31.9	9.40	12.49	21.57	165.22	2014.419
BRT2420	15 31 33.89	+21 11 16.3	10.84	11.50	12.02	311.39	2014.422
POU3193	15 35 22.3	+24 08 16.8	13.2	13.7	7.55	297.72	2014.422
HJ 258	15 56 55.3	+36 04 32.3	10.40	11.20	16.75	256.42	2014.422
HJ 580	16 02 50.5	+37 05 26.8	9.91	12.7	39.8	9.42	2014.422
STF1999AB	16 04 25.9	-11 26 57.6	7.52	8.05	11.5	99.72	2014.422
ARA 433	16 06 35.8	-18 19 11.6	11.1	11.6	9.86	59.22	2014.422
HJ 582	16 07 16.9	+35 07 41.6	11.11	13.61	22.02	234.52	2014.422
ALI 370	16 07 26.7	+35 48 27.8	12.0	13.0	13.37	148.85	2014.422
POU3214	16 07 48.8	+23 05 29.9	12.1	13.3	13.14	85.72	2014.422
STF2010AB	16 02 04.5	+17 02 49.2	5.10	6.21	29.49	13.42	2014.422
BAL 564	16 11 09.67	-02 06 13.7	11.53	11.8	12.39	282.72	2014.422
STF2032AB	16 14 40.85	+33 51 31	5.62	6.49	7.59	233.72	2014.422
ES 627	16 18 35.7	+51 19 51.5	9.88	10.98	11.49	289.39	2014.422
KZA 120	16 53 22.0	+46 01 30.9	10.5	10.5	10.87	81.72	2014.422
BAL2429	16 54 51.2	+03 18 40.8	12.65	13.6	11.49	55.72	2014.422
ES 1255	17 01 00	+46 16	11.67	12.8	6.75	44.72	2014.422
HJ 2804AB	17 04 33.4	+38 59 27.3	11	13.3	7.55	244.42	2014.422
WFC 186	17 06 05.4	+43 28 57.4	10.81	12.11	18.0	16.72	2014.422
STF2123	17 06 57.5	+06 48 03.0	9.82	9.98	18.23	218.72	2014.422
STF2127	17 07 04.4	+31 05 35.1	8.72	12.30	14.34	282.72	2014.422
SLE 9	17 07 06.2	+20 29 21.7	10.49	12.30	20.97	175.72	2014.422
ARA1121	17 07 06.0	-20 14 43.6	11.8	12.4	8.01	216.02	2014.422
POU3310	17 42 04.7	+23 48 36.2	14.4	14.4	21.67	2.72	2014.422
STF2250AB	17 59 18.0	-06 51 21.2	8.79	9.24	8.7	345.52	2014.422
POU3338	17 59 54.7	+23 30 53.1	9.7	13.5	9.63	324.72	2014.422
STI2369	18 07 29.23	+55 14 31.1	12.3	12.6	15.66	189.72	2014.422
SLE 85	18 07 33.1	+03 13 53.7	11.2	12.5	11.41	181.72	2014.422
SLE 138	18 07 52.3	+30 41 56.6	11.5	12.3	10.24	330.42	2014.422
ES 183	18 08 01.1	+36 42 04.1	9.86	12.7	9.08	165.72	2014.422
BAL2474	18 08 03.4	+03 43 12.1	10.0	11.0	15.72	282.02	2014.422
POU3351	18 08 08.7	+23 27 12.4	12.05	13.9	10.67	159.72	2014.422
SLE 111	18 08 53.9	+27 24 56.6	10.8	12.5	14.16	318.02	2014.422
ES 1417AB	18 09 09.15	+43 13 48.6	9.21	11.5	14.19	209.97	2014.422
STF2293	18 09 53.8	+48 24 05.7	8.08	10.34	14.49	86.72	2014.422
BAL2483	18 14 41.5	+03 42 05.5	12.00	12.7	14.44	197.92	2014.422
SLE 145	18 14 58.3	+03 03 43.6	11.2	11.9	10.84	28.32	2014.422
POU3380	18 17 22.6	+24 56 36.2	12.4	13.3	13.0	75.32	2014.422
HJ 1349	18 48 48.7	+33 19 12.1	8.29	10.7	29.80	95.72	2014.422
BEM 37	19 01 25.4	+53 27 47.3	12.0	11.9	10.88	310.72	2014.422
STF2459	19 07 22.0	+25 58 23.9	9.12	10.07	13.6	234.02	2014.422
AG 375	19 14 13.4	+26 26 28.4	9.89	10.92	17.91	299.39	2014.422
SLE 959AB	20 11 50.1	+37 26 02.4	10.59	12.5	12.40	164.72	2014.422
SLE 959AC	20 11 50.1	+37 26 02.4	10.69	12.5	21.44	179.22	2014.422

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