Observation Report for the Year 2009, Humacao University Observatory

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Abstract: We report measurements of position angle and separation of 120 binary stars observed during the year 2009. We obtained the data using the 31 inch NURO Telescope at the Anderson Mesa location of Lowell Observatory near Flagstaff, Arizona, in May and September. We gathered the data using the 2K x 2K CCD camera - NASACAM - at the prime focus of the telescope. The data was analyzed at the Humacao University Observatory.

Introduction

We imaged 120 binary systems at the prime focus of the 31 inch NURO telescope in the year 2009. The observation sessions took place on May 28, 29 and 30; a second session took place on September 19, 20 and 21, for a total of six nights at the NURO telescope. Clouds forced the partial cancelation of one night in May. Two students traveled to observe and obtain data in May. Three traveled in September. We used the NASACAM CCD, a 2048 X 2048 array, thermoelectrically cooled below -100 Celsius, with a field of view of approximately 16 arc minutes by 16 arc minutes.

Procedure

All images needed for calibration and the images of the binaries where obtained and sent to the Humacao University Observatory for analysis. Undergraduates pursuing research projects at the observatory calibrated and examined the images to make sure that our targets where present on the CCD images. Doubtful images where discarded. The students used the pixelization of the calibrated images as a tool for the measurement of separation; the position angle was measured directly. Many of the CCD images where also examined using the software that is included with the *Handbook of Astronomical Image Processing for Windows, 2nd Edition,* by Richard Berry and James Burnell, Willman-Bell Inc, Virginia (http://www.willbell.com) 2006. The Handbook includes the CD AIP for Windows (II). There is a feature in the CD that, with some care, will give accurate values for separation and position angle directly from the CCD image. Since there is a reducer on the optical path to the CCD, the images we acquire are mirror reversed with respect to the program's position angle routine, so one must have lots of care when one is measuring position angle with the program. The software does not provide for entering the plate scale of the optical system, so the final number crunching must be done by hand.

There is a systematic error in position angle that occurs when the CCD camera is inserted into the telescope, or the CCD is not "leveled" when the telescope is pointing at the north pole. 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. We correct for this uncertainty by using a mix of images of well known binaries and of those that "don't move". We corrected the position angle of binaries submitted in this article for this effect by using about 30 of them to calculate the systematic error we call the CCD offset.

The table that follows includes 120 entries, all of them for 2009. It follows the standard JDSO format and ordering.

Acknowledgements

This research has made extensive use of the Washington Double Star Catalog, maintained at the U.S. Naval Observatory, and of the NURO telescope, property of the Lowell Observatory. We would like to acknowledge support from the Puerto Rico Space-Grant Consortium and the L.S.AMP of the University of Puerto Rico. We also thank Ed Anderson of the NURO consortium and the University of Northern Arizona for his efforts on behalf of our students.

May 2009 measurements.

Name	RA	DEC	Mags	UPRH ρ	UPRH θ	Date
HJ 154	12 02 49.71	+28 41 15.3	10.0 11.0	21.2	89.66	0.402
GRV 849	12 02 53.16	+23 45 50.8	11.7 12.0	28	230.66	0.402
STI 738	12 03 17.7	+59 24 05	12.24 13.1	6.9	44.66	0.402
STF1594AC	12 03 28.5	+41 24 15	10.09 11.1	11	145.66	0.402
BAL1450	12 03 11.85	+00 43 48.8	11.51 12.4	22.7	208.66	0.402
POU3120	12 04 05.7	+23 11 41	11.09 13.1	14.5	195.66	0.402
BU 458	12 04 17.11	-21 02 21.0	7.87 9.97	29.9	233.16	0.402
KZA 26	12 05 07.7	+43 22 47.4	10.5 10.5	17	108.16	0.402
HJ 4496	12 06 12.76	-18 53 27.9	10.05 10.98	12.2	29.66	0.402
HJ 519	12 30 26.33	+36 07 44.7	10.32 10.35	18.1	188.66	0.402
ES 726AC	12 30 49.2	+53 51 27	10.48 13.6	20	180.66	0.402
STF1650	12 31 32.99	+24 37 13.1	9.54 10.47	16.5	179.16	0.402
LDS4224	12 32 13.2	+31 47 19	14.5 15.4	10.85	311.66	0.402
HJ 211	12 32 21.1	-01 53 33	11.86 12.3	11	278.66	0.402
LDS3049	12 32 26	+30 50 24	14.22 14.63	18.59	122.16	0.402
LDS4225	12 32 28.75	+28 54 12.4	13.3 15.3	16.7	203.66	0.402
LDS3051	12 33 19.	+52 27 00	15.9 17.1	15.5	358.66	0.402
POU3152	13 49 38.9	+23 28 15	12.25 12.30	13.6	2.66	0.402
HJ 542	14 12 18	+36 46	12.0 12.0	12.4	66.66	0.402
POU3162	14 13 24	+24 24	12.02 13.8	6.8	346.66	0.402
κ Bootis STF 1821	14 13 29	+51 47	4.53 6.62	13.3	231.66	0.402

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May 2009 measurements (continued).

Name	RA	DEC	Mags		UPRH ρ	UPRH θ	Date
ι Bootis STFA 26AB	14 16 10	+51 22	4.76	7.39	38.9	35.16	0.402
ES 1085	14 16 30	+46 33	8.71	11.7	5.7	177.66	0.402
LDS4521	15 00 47.5	+23 06 26	16.3	17.3	25.7	340.16	0.402
STF1901	15 00 57.70	+31 22 38.2	8.71	10.55	19.1	186.16	0.402
HJ 1266	15 01 08.0	+04 15 17.	10.77	12.1	13.1	25.66	0.402
LDS4543	15 20 41	+26 38	12.6	18.3	54	234.66	0.402
KZA 80	15 20.7 42	+31 33	12.41	12.9	25.1	57.66	0.402
KZA 90	15 27 24	+31 02	12.5	13.0	19.1	298.16	0.402
POU3193	15 35 18	+24 08	13.2	13.7	7.6	299.16	0.402
STF1999AB	16 04 25	-11 26 57	7.52	8.05	12	99.66	0.402
HJ 582	16 07 06	+35 07	11.11	13.61	22	232.66	0.402
ALI 370	16 07 24	+35 48	12.06	12.5	12.4	144.66	0.402
POU3214	16 07 48	+23 06	11.1	13.3	12.4	87.66	0.402
STF2010AB	16 08 04.5	+17 02 49	5.10	6.21	25.9	12.66	0.402
STF2032AB	16 14 40.85	+33 51 31	5.62	6.49	4.5	243.66	0.402
KZA 120	16 53 22.06	+46 01 30.9	10.5	10.5	11.1	81.66	0.402
BAL2429	16 54 51.2	+03 18 41	11.77	12.8	12	49.16	0.402
SLE 76	17 00 18	+33 12	12.07	12.8	8.36	18.66	0.402
STF2123	17 06 57.50	+06 48 03	9.82	9.98	18.2	218.66	0.402
STF2127	17 07 04.42	+31 05 35.1	8.70	12.30	14	280.66	0.402
SLE 9	17 07 06.29	+20 29 21.7	10.49	11.94	20.1	173.91	0.402
ARA1121	17 07 06.2	-20 14 44	11.8	12.4	7.6	216.66	0.402
SLE 110	18 07 14.5	+27 16 04	10.56	13.3	10.8	117.16	0.402
STI2369	18 07 29.23	+55 14 31	12.3	12.6	15.34	191.66	0.402
BAL1952	18 07 34.4	+02 24 08	11.52	12.8	13.9	154.66	0.402
POU3350	18 07 59.9	+24 06 00	11.8	12.0	9.1	61.66	0.408
BAL2474	18 08 03.4	+03 43 12	10.0	11.0	14.9	280.16	0.408
POU3351	18 08 08.8	+23 27 12	12.05	13.9	10.4	152.66	0.408
BAL2483	18 14 41.6	+03 42 05	212.00	12.7	13.06	191.66	0.408
POU3380	18 17 22.	+24 56 36	12.20	13.03	13.2	76.66	0.408
BEM 37	19 01 24	+53 28	11.87	11.90	11.5	309.66	0.408
STF2459	19 07 22.01	+25 58 23.9	9.12	10.07	14.6	236.66	0.408

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September 2009 measurements

Name	RA	DEC	Mags		UPRH ρ	UPRH θ	Date
LDS4622	16 01 47	-04 47 48	12.4	16.2	14.85	38.5	0.715
HJ 580	16 02 50.56	+ 37 05 26.8	9.20	12.2	43	7.5	0.715
BEM 21	16 02 58.26	+51 11 40.4	10.54	11.02	19.04	104	0.715
BAL1911	16 03 20.00	+02 31 26.8	12.19	12.7	17.77	233.5	0.715
STF1999AB	16 04 25.9	-11 26 57	7.52	8.05	11.59	98	0.715
ARA 433	16 06 35.8	-18 19 11	11.6	14.1	10.05	54.5	0.715
HJ 582	16 07 06	+35 07 00	9.7	12.0	22.75	232	0.715
ALI 370	16 07 26.8	+35 48 29	12.06	12.5	12.73	147.5	0.715
POU3214	16 07 48.8	+23 05 29	11.1	13.3	12.40	83	0.715
STF2010AB	16 08 04.5	+17 02 49	5.10	6.21	25.62	12	0.715
HJ 1289	16 10 38.01	+39 28 38.2	11.39	12.3	11.48	239	0.715
GRV 924	16 11 43.26	+35 07 29.1	8.8	12.1	10.35	308.5	0.715
HJ 1288	16 12 40.8	-16 45 18	11.0	12.3	19.0	124	0.715
ES 627	16 18 35.71	+51 19 51.5	9.88	10.98	11.70	288.5	0.715
BAL2429	16 54 51.2	+03 18 41	11.77	12.8	11.40	51	0.715
LDS4705	16 56 24.44	+03 30 29.1	15.2	17.0	13.90	53.5	0.715
BAL1486	17 05 55.9	+00 55 57	10.86	12.4	7.40	12.5	0.715
BAL1931	17 06 09.8	+02 06 05	11.4	11.5	18.10	188.5	0.715
COU 109	17 06 27.9	+22 07 57	10.01	13.1	8.64	139	0.715
SLE 78BC	17 06 49.8	+33 56 00	11.27	12.15	14.70	204	0.715
LDS 988	17 06 56.77	+06 47 48.2			17.8	39	0.715
STF2123	17 06 57.50	+06 48 03	9.82	9.98	18.86	217	0.715
AG 353	17 07 01.4	+12 13 22	9.83	11.7	10.40	249	0.715
STF2127	17 07 04.42	+31 05 35.1	8.70	12.30	14.8	276	0.715
SLE 9	17 07 06.29	+20 29 21.7	10.49	11.94	20.1	174	0.715
GRV 946	17 07 14.12	+25 44 34.5	10.54	11.7	20.5	40	0.715
HJ 1314	18 07 05.32	+32 22 54.6	10.33	11.09	18	151	0.715
SLE 110	18 07 14.5	+27 16 04	10.56	13.3	10.7	110	0.715
BAL1952	18 07 34.4	+02 24 08	11.52	12.8	13.6	154.5	0.715
STF2280AB	18 07 49.5	+26 06 04	5.81	5.84	14.1	177	0.715
BAL2474	18 08 03.4	+03 43 12	10.0	11.0	15.35	282	0.715
POU3351	18 08 08.8	+23 27 12	12.05	13.9	10.25	159	0.715
SLE 111	18 08 53.9	+27 24 56	10.8	12.5	14.7	315	0.715
POU3353	18 08 55.1	+23 19 00	12.26	12.4	15.55	342	0.715

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September 2009 measurements (continued)

Name	RA	DEC	Mags		UPRH ρ	UPRH θ	Date
STF2293	18 09 53.83	+48 24 05.7	8.08	10.34	13.4	85	0.715
HJ 1315	18 09 53.5	+29 41 16	11.85	13.1	10.1	132	0.715
ARA 267	18 09 54	-17 09 38	11.22	11.5	14.9	345.5	0.720
SEI 559	18 10 27.8	+33 55 55	11.0	11.0	11.67	171	0.720
BAL2481	18 10 37.2	+03 27 23	11.3	11.3	10.98	109.5	0.720
AG 217	18 11 05.89	+53 29 37.8	10.77	11.85	14.29	237.5	0.720
ALI 140	18 11 25.14	+35 06 45.5	10.97	11.79	14.43	253	0.720
BAL2483	18 14 41.6	+03 42 05	12.00	12.7	13.1	195	0.720
SLE 145	18 14 58.3	+03 03 43	11.2	11.9	11.94	27	0.720
STF2459	19 07 22.01	+25 58 23.9	9.12	10.07	15.28	230.5	0.720
POU3718	19 08 00.6	+24 58 09	10.69	13.7	14.41	270.5	0.720
HJ 877	19 10 04.2	+19 33 15	10.8	11.1	12.5	295.5	0.720
SLE 931	19 10 20.34	+02 49 58.7	9.9	12.0	11.62	80	0.720
POU3745	19 12 00.7	+23 46 18	12.47	13.7	10.92	21	0.720
HJ 1375	19 12 34	+28 14 47	11.02	13.64	12.39	84	0.720
HLM 18	19 13 15.0	+39 08 57	10.94	11.33	12.7	332	0.720
SLE 935	19 14 26.74	+02 12 06.2	11.0	11.0	8.83	219.5	0.720
ARA1175	19 15 30.0	-19 55 19	11.60	12.5	12.5	14.5	0.720
HJ 2861	19 16 30.4	+07 12 10	10.84	13.8	12.01	56	0.720
BAL1516	19 17 00.2	+01 45 03	11.03	11.1	11.2	272	0.720
HJ 2868	19 17 56.9	+58 07 58	11.9	11.9	11.57	100	0.720
SEI1012	20 13 02.3	+34 50 28	11.0	11.0	14.79	50.5	0.720
CHE 235	20 14 36.6	+14 52 35.2	10.0	11.5	13.8	28.5	0.720
STI2586	21 42 40.45	+56 14 56.9	10.71	11.72	12.55	3	0.720
STI2720	22 21 30.0	+58 36 48	12.1	12.1	14.57	160	0.720
STI2722	22 21 59.1	+56 19 52	10.67	13.1	14.35	72	0.720
STI2872	22 50 16.7	+57 36 20	11.85	11.9	10.88	55	0.720
STF2999AD	23 18 46.4	+05 11 18	8.90	11.9	27.02	20.5	0.720
STI3007	23 36 42.8	+58 19 49	13.2	13.2	9.14	123.5	0.720
STI3012	23 38 24.5	+58 00 27	12.6	12.6	7.96	100.5	0.720
BAL1249	23 41 02.7	+00 43 07	10.36	12.4	14.2	337.5	0.720
STF 23AB	00 17 28.7	+00 19 15	7.88	10.28	9.6	217.5	0.720
BAL1611	00 43 18.50	+02 51 01.2	11.4	11.5	19.5	181	0.720