A Report on the Observation of Selected Binary Stars with Ephemerides in the *Sixth Catalog of Orbits of Visual Binary Stars*

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Abstract: We observed nine binary stars with ephemerides on the Sixth Catalog of Orbits of Visual Binary Stars with the objective of corroborating the predictions on the Catalog. Our results show agreement with the predictions of separation (ρ), but found a slight difference with the predictions of position angle (Θ). Recent measurements reported in the Washington Double Star Catalog tend to agree with our observations.

Introduction

The *Sixth Catalog of Orbits of Visual Binary Stars*[1] includes close to two thousand orbits of binary stars, with numerical ephemerides included on almost all orbits. It is of interest to test the predictions, since the ultimate judgment in science rests on observations to test the predictions of a model. We selected nine binaries with ephemerides from the catalog and measured their separation and position angle. We compare our observations with the predictions and with recent measurements reported in the Washington Double Star Catalog (WDS)[2].

We obtained our observational data at the 31 inch N.U.R.O.[3] telescope, located at the Anderson Mesa near Flagstaff, Arizona, at an altitude of 7200 feet. The telescope, a Shmidt-Cassegrain, belongs to Lowell Observatory[4]. It was equipped with a 512 X 512 Tek CCD camera cooled to -110 C when we made the measurements presented in this article; the CCD has been replaced.

Method

Our methodology was detailed in an article published in the Double Star Observer[5]. Capturing images with a CCD is made simple using the properties of German Equatorial and fork mounts: with the telescope pointed to the North Pole -or as far north as possible- insert the CCD and level it as precisely as you can. North will always be either straight up or straight down in your images (assuming the CCD is not inserted using a star diagonal or a reducer/corrector in the optical path). Since a "perfect" leveling of the CCD is not possible, this procedure will introduce a systematic error that we call the offset; it can be corrected afterwards using "standard" binaries during the process of calibration of the images. The fact that our measurements of position angle of well known binaries agree with published values attests for the correctness of this simple procedure.

Our images are calibrated the usual way (master flats and master bias) plus the offset. To correct for the offset we image as many well known binaries as possible during our observing run (usually 3 nights in a row) so we end up with between 20 and 30 images of "standard" binaries. Measuring the position angle of these known binaries and comparing the measurements with values from the WDS allows us to correct for the CCD camera offset.

We use two separate procedures for the measurement of both position angle and separation. Agreement between results from those procedures ensures correct handling of the data. The first method, which we detailed in the Double Star Observer[4], basically counts the pixels in the image directly. Pixelizing the image and counting pixels directly using a well known image processing program called Photoimpact[6] allows us to measure separation and position angle with

ease. To check the results from the aforementioned method the students use the Software AIP for Windows[7], which has a routine for the calculation of position angle and separation.

Results

Our results are summarized in the tables below. The first 3 columns of the tables show recent measurements of separation (ρ) and position angle (Θ) in the WDS. The second set of 3 columns show predictions from the Sixth Catalog of Orbits. The last four columns show our measurements. N, the number of observations, is one in all cases

We have been measuring Sigma Corona Borealis often as part of our routine observations of binary stars at the N.U.R.O. telescope but all other binaries in the table constitute first time observing for us. We have chosen to measure these pairs even though they have lots of reported measurements, because we believe there is a lot of scientific merit in making sure the "model" works properly by observing and comparing the results plus the added bonus that you are also checking if your measurements yield reasonable results.

The values in Table I seem to indicate that our ρ values are in close agreement with other observations and also in close agreement with the ephemerides, except for STF 2486 AB where we get a spurious result. However, the results for position angle Θ differ from the prediction although, in general, tend to fall closer to the other reported values in the WDS.

We have used the Data Request form of the WDS[8] to gather information of some of the stars we observed and would like to recommend this efficient service from the WDS.

The information obtained is priceless and gives the reader a clear notion of the binary system one is studying.

(Continued on page 141)

Name: STF1985 R.A.: 15:55:54 Dec. −02:10									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2004	6.0	354							
2005	5.8	349	2005	6.24	353.4	2005.660	5.8±1	348.6±.5	1

Name: STF2032 AB (Sigma Corona Borealis) R.A. 16:14:42 Dec. 33:52									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measurements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	No
						2001.871	6.2±1	235±.5	1
						2002.345	7.1±1	233±.5	1
						2004.391	7.4±1	237±.5	1
2004	7	236				2004.767	7.5±1	236±.5	1
2005	7.2	238	2005	7.1	236.7	2005.682	7.2±1	237.8±.5	1

Name: STF2398 AB R.A. 18:42:48 Dec. +59.38									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2004	12.4	175							
2005	12.2	176	2005	12.2	175.5	2005.682	12.3±1	177.6±.5	1

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Name: STF2486 AB R.A. 19:12:06 Dec. +49:51									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2004	7.3	206							
2005	7.3	206	2005	7.4	205.8	2005.682	8.7±1	204.3±.5	1

Name: STFA 46 Aa-B R.A. 19:41:48 Dec. +50:32									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2003	39.1	134							
2005	39.5	133	2005	39.6	133.2	2005.682	39.3±1	135.5±.5	1

Name: J 838 R.A. 20:21:00 Dec. +10:28									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2003	6.0	116							
2005	6.3	118	2005	6.1	115.4	2005.660	6.3±1	117.6±.5	1

Name: STF 2725 R.A. 20:46:12 Dec. +15:54									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2004	6.1	10							
2005	6.1	11	2005	6.1	11.1	2005.660	6.2±1	13±.5	1

Name: STF 2727 R.A. 20:46:42 Dec. +16:07									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	Θ degree	year	ρ arcsc	Θ degrees	year	ρ arcsc	Θ degrees	N
2004	9.1	266							
2005	9.1	266	2005	9.2	265.6	2005.660	9.0±1	266±.5	1

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Name: STF 2758 AB R.A. 21:06:54 Dec. +38:45									
Recent measurements from WDS			Sixth Catalog Ephemerides			UPR at Humacao Measusrements			
year	ρ arcsc	⊙ degree	year	ρ arcsc	⊙ degrees	year	ρ arcsc	⊙ degrees	N
2004	31.1	151							
2005	30.9	151	2005	31.1	150.8	2005.660	31.6±1	151±.5	1

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Acknowledgements

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References

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2. Washington Double Star Catalog http://ad.usno.navy.mil/wds

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4. Lowell Observatory www.lowell.edu

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Dr Rafael Muller is a faculty member of the Department of Physics and Electronics and coordinator of the Humacao Campus Observatory. Dr Juan Cersosimo is the Chairman of the Department, a radio astronomer who does some optical astronomy on the side. Iliana, Desiree, Valmin, Chaim and Diana are students at Humacao who want to follow careers in astronomy.