

Astronomical Association of Queensland 2017 Program: Blue Star Observatory Measurement of Nine Neglected Southern Multiple Stars

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Abstract: This paper presents partial results of a 2017 programme of photographic measurements of ten southern multiple stars. All results were obtained using an Atik 460EX mono CCD camera used in conjunction with an equatorially mounted 400mm F4.5 Newtonian reflector.

Introduction

These latest results are part of an ongoing program commenced in 2008 by the Double Star Section of the Astronomical Association of Queensland. The target stars were selected from the Washington Double Star Catalog (WDSC) and were observed in Queensland, Australia from a latitude of approximately 27° S.

The results are presented in Table 1. The mean 95% confidence intervals for the new measures were $\pm 0.718^\circ$ in PA and $\pm 0.108''$ in separation.

Method

Sets of images were obtained with the equipment

described above, the images were stacked using Atik DAWN software and then analysed using the astrometric double star program REDUC (Losse, 2008). Approximately ten stacked images of each target were taken per night for seven nights and the results averaged to obtain measures of separation and position angle with sufficient confidence.

Full details of the method are given in Napier-Munn and Jenkinson (2009). Some recent work on the errors inherent in the method is described in Napier-Munn and Jenkinson (2014). As proficiency has grown in the use of this equipment with the 400mm reflector, close doubles with considerable magnitude difference

Table 1. Measurements of Nine Southern Multiple Stars

System	Last listed measure			New measure			Comment
	PA °	Sep. ''	Epoch	PA °	Sep. ''	Epoch*	
DON119	275	4.5	1942	276.32	4.4	2017.117	Minimal change in 75 years
RSS152	7	9.5	1976	3.52	12.18	2017.109	Clear movement
DON238	15	6.7	1967	13.05	6.04	2017.109	Change in both axes
A1774	274	3.8	1952	270.52	3.81	2017.237	Clear movement
HJ840	93	5.3	1968	92.42	4.35	2017.237	Change in separation
B810	95	3.6	1930	62.47	3.74	2017.259	Considerable change in PA
HU470	251	3.6	1945	245.79	3.72	2017.270	Clear change in PA
RST5533	82	4.1	1951	342.79	4.43	2017.374	Considerable change in PA
RSS327	227	11.1	1976	221.53	11.39	2017.382	Definite change in PA

* Epochs of new measures given in Besselian years as the average of the observations making up the measure.

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between the components have been successfully measured.

Fellow AAQ members Culshaw, Hughes and Hughes provided invaluable assistance with image processing using Losse's REDUC software, and Janke with processing the original FITS image files into JPEG photographs.

Results

For all of the systems shown below, the WDSC information is first reproduced, showing the epoch 2000 position, magnitudes, separation, PA, and the last

recorded measurement. The new measurements are then given in tabular form, including the mean and standard deviation and 95% confidence limits. Any uncertainties between the images and the last recorded measurements are discussed. Finally a conclusion is given as to whether any movement of the component stars has occurred in PA or separation, based on the P-value for the t-test comparing the new mean values with the cataloged value ($P < 0.05$ is considered as evidence of change).

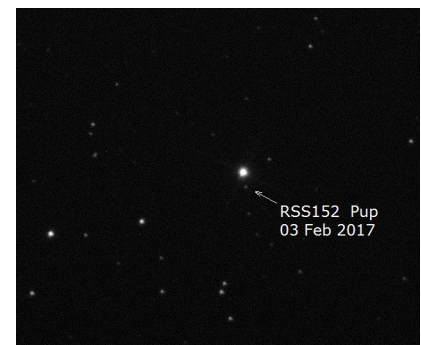
(Text continues on page 600)

DON119 Lepus	RA. 06 07.1 MAG. 9.78 & 13.6	DEC. -22 59 PA. 275°	Last Measure 1942 SEP. 4.5"
Date	No. images	PA°	Sep"
29 Jan 2017	10	276.33	4.419
06 Feb 2017	10	276.79	4.465
08 Feb 2017	10	276.42	4.380
10 Feb 2017	10	275.44	4.366
15 Feb 2017	10	276.28	4.491
17 Feb 2017	10	276.33	4.359
24 Feb 2017	10	276.67	4.318
Mean		276.323	4.400
Std dev		0.434	0.062
95% CI +/-		0.401	0.057
P(t) movement		0.000	0.000
COMMENTS Minimal movement in the last 75 years. Increase in PA consistent with increase shown in previous measures, separation may be closing again.			

Please note that all attached images are aligned with North to the bottom and East to the right

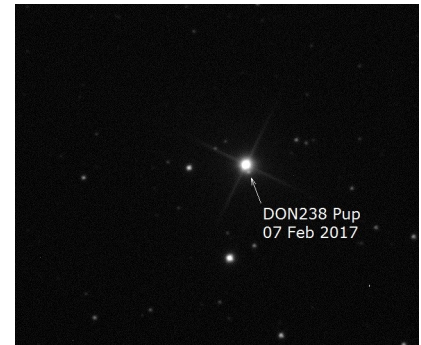


RSS152 Puppis	RA. 08 18.3 MAG. 7.58 & n/a	DEC. -26 21 PA. 7°	Last Measure 1976 SEP. 9.5"
Date	No. images	PA°	Sep"
03 Feb 2017	10	3.26	12.091
06 Feb 2017	10	3.52	12.223
07 Feb 2017	10	3.69	12.226
08 Feb 2017	10	3.34	12.218
10 Feb 2017	10	3.87	12.179
14 Feb 2017	10	3.41	12.129
15 Feb 2017	10	3.54	12.222
Mean		3.519	12.184
Standard deviation		0.210	0.054
95% CI +/-		0.194	0.050
P(t) movement		0.000	0.000
COMMENTS Clear movement in both position angle and separation.			



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DON238 Puppis	RA. 08 20.5 MAG. 6.13 & 12.9	DEC. -22 55 PA. 15°	Last Measure 1967 SEP. 6.7 "
Date	No. images	PA°	Sep"
03 Feb 2017	10	13.91	5.823
06 Feb 2017	10	12.70	6.181
07 Feb 2017	10	12.45	6.046
08 Feb 2017	10	14.28	6.072
10 Feb 2017	10	15.24	6.229
14 Feb 2017	10	11.77	6.380
15 Feb 2017	10	13.15	6.121
Mean		13.053	6.043
Std Dev		0.641	0.157
95% CI +/-		1.020	0.249
P(t) movement		0.009	0.004
COMMENTS Three night's data as highlighted not included in reduction due to poor quality seeing/images. Movement evident in both axes.			



A1774 Crater	RA. 11 03.2 MAG. 5.5 & 10.8	DEC. -11 18 PA. 274°	Last Measure 1952 SEP. 3.8"
Date	No. images	PA°	Sep"
17 March 2017	10	269.65	3.873
18 March 2017	10	271.13	3.739
25 March 2017	10	270.76	3.704
27 March 2017	10	269.51	3.762
04 April 2017	10	271.07	4.039
07 April 2017	10	271.94	3.908
09 April 2017	10	269.59	3.615
Mean		270.521	3.806
Standard deviation		0.948	0.143
95% CI +/-		0.877	0.132
P(t) movement		0.000	0.098
COMMENTS Clear movement evident in PA only.			



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<i>HJ840</i>	RA. 11 24.9	DEC. -17 41	Last Measure 1968
<i>Crater</i>	MAG. 4.1 & 7.9	PA. 93°	SEP. 5.3"
Date	No. images	PA°	Sep"
17 March 2017	10	92.06	4.484
18 March 2017	10	91.83	4.335
25 March 2017	10	91.75	4.165
27 March 2017	10	92.92	4.37
04 April 2017	10	92.24	4.268
08 April 2017	10	94.07	4.3
09 April 2017	10	92.05	4.521
Mean		92.417	4.349
Std Dev		0.823	0.123
95% CI +/-		0.762	0.114
P(t) movement		0.000	0.000
COMMENTS			
Clear evidence of movement only apparent in separation.			



<i>B810</i>	RA. 13 22.0	DEC. -38 13	Last Measure 1930
<i>Centaurus</i>	MAG. 9.69 & 13.5	PA. 95°	SEP. 3.6"
Date	No. images	PA°	Sep"
18 March 2017	10	62.37	3.662
25 March 2017	10	61.69	3.766
07 April 2017	10	62.14	3.794
15 April 2017	10	60.72	3.719
16 April 2017	10	63.01	3.623
21 April 2017	10	63.56	3.81
23 April 2017	10	63.8	3.804
Mean		62.470	3.740
Std Dev		1.083	0.074
95% CI +/-		1.002	0.068
P(t) movement		0.000	0.000
COMMENTS			
Considerable movement has occurred in PA. No clear movement evident in separation.			



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<i>HU470</i>	RA. 13 34.3	DEC. -11 32	Last Measure 1945
<i>Virgo</i>	MAG. 7.9 & 12.9	PA. 251°	SEP. 3.6"
Date	No. images	PA°	Sep"
25 March 2017	10	246.78	3.594
07 April 2017	10	245.72	3.787
08 April 2017	10	243.89	3.697
15 April 2017	10	245.79	3.613
16 April 2017	10	246.65	3.51
21 April 2017	10	245.44	4.173
24 April 2017	10	246.26	3.664
Mean		245.790	3.720
Std Dev		0.973	0.218
95% CI +/-		0.900	0.201
P(t) movement		0.000	0.000
COMMENTS			
Definite change in PA continues the reduction occurring since the first 1901 measure.			



<i>RST5533</i>	RA. 14 20.4	DEC. -30 02	Last Measure 1951
<i>Hydra</i>	MAG. 9.06 & 15.1	PA. 82°	SEP. 4.1"
Date	No. images	PA°	Sep"
01 May 2017	10	343.39	4.416
23 May 2017	10	342.19	4.466
24 May 2017	10	341.92	4.501
26 May 2017	10	342.75	4.381
27 May 2017	10	343.32	4.386
30 May 2017	10	342.04	4.39
02 June 2017	10	343.94	4.475
Mean		342.793	4.431
Std Dev		0.779	0.049
95% CI +/-		0.721	0.045
P(t) movement		0.000	0.000
COMMENTS			
Very large change in PA over 66 years.			



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<i>RSS327</i>	RA. 14 21.6	DEC. -30 53	Last Measure 1976
<i>Centaurus</i>	MAG. 9.18 & n/a	PA. 227°	SEP. 11.1"
Date	No. images	PA°	Sep"
07 May 2017	10	222.53	11.409
23 May 2017	10	221.39	11.286
24 May 2017	10	221.12	11.443
26 May 2017	10	221.27	11.356
27 May 2017	10	221.89	11.39
30 May 2017	10	221.94	11.48
02 June 2017	10	220.59	11.331
Mean		221.533	11.385
Standard deviation		0.637	0.067
95% CI +/-		0.589	0.062
P(t) movement		0.000	0.000
COMMENTS			
Definite change in PA.			



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Acknowledgements

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References

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