

# Astronomical Association of Queensland Measurement of Seven Neglected Double Stars

Graeme Jenkinson

Astronomical Association of Queensland.  
[bluestars@primus.com.au](mailto:bluestars@primus.com.au)

**Abstract:** This paper presents the results of a mid 2015 program of photographic measurements of seven southern multiple stars.

## 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 from a latitude of approximately 27° S.

## Method

Once obtained with the equipment described below, the images were analysed using the astrometric double star program REDUC (Losse, 2008). Approximately 10 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 between the components have been successfully measured.

## Results

For all of the systems shown in Tables 2 through 8, 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).

## Summary

The images were obtained using a Meade DSI CCD camera in conjunction with an equatorially mounted 400mm F4.5 reflector. Image processing was carried out using Losse's REDUC software.

The mean 95% confidence intervals for the new measures were  $\pm 0.944^\circ$  in PA and  $\pm 0.193''$  in separation. The results are summarized in Table 1.

*(Continued on page 504)*

Table 1. Summary of Measurements

System	Last listed measure			New measure			Comment
	PA °	Sep. "	Epoch	PA °	Sep. "	Epoch*	
RSS410 Scorpius	328.0	8.3	1976	323.74	8.18	2015.471	Definite change in PA
B2801AB Scorpius	225.0	10.0	1930	184.96	14.12	2015.471	Significant movement
I 1304 Scorpius	325.0	5.9	1987	326.11	6.16	2015.524	Slight movement
RST3159 Sag	102.0	4.9	1945	102.0	4.9	2015.599	No probable movement
RST1878 Norma	215.0	9.5	1971	212.96	9.02	2015.490	Slight change in PA
I 1357 Cr A	38.0	5.5	1926	36.33	6.45	2015.611	Possible slight movement
B315 Scorpius	307.0	5.2	1928	309.42	4.88	2015.471	Slight movement

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

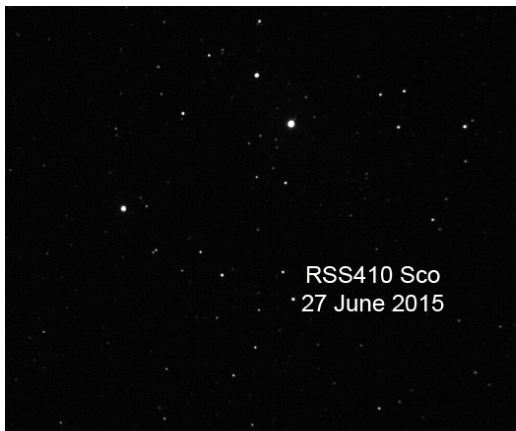
**Astronomical Association of Queensland Measurement of Seven Neglected Double Stars**

*Table 2. Measurements of RSS 410*

<u>RSS410</u>	RA. 16 32.2	DEC. -32 08	Last Measure 1976
<u>Scorpius</u>	MAG. 8.3 & 8.78	PA. 328.0°	SEP. 8.3"
Date	No. images	PA°	Sep"
07 June 2015	10	324.56	7.967
15 June 2015	10	324.77	8.021
19 June 2015	10	322.92	8.162
21 June 2015	10	323.77	8.473
27 June 2015	10	323.47	8.108
01 July 2015	10	322.19	8.443
03 July 2015	10	324.47	8.103
<b>Mean</b>		<b>323.736</b>	<b>8.182</b>
Standard deviation		0.950	0.199
95% CI +/-		0.879	0.184
P(t) movement		0.000	0.169
<b>COMMENTS</b>			
Definite movement in PA since the only previous measure in 1976.			

*Table 3. Measurements of B 2801AB*

<u>B2801AB</u>	RA. 16 12.2	DEC. -23 55	Last Measure 1930
<u>Scorpius</u>	MAG. 8.0 & 14.0	PA. 225.0°	SEP. 10.0"
Date	No. images	PA°	Sep"
07 June 2015	10	184.80	14.071
15 June 2015	10	184.37	14.169
19 June 2015	10	185.04	14.121
21 June 2015	10	185.53	14.139
27 June 2015	10	185.41	14.175
01 July 2015	10	185.08	14.048
03 July 2015	10	184.47	14.109
<b>Mean</b>		<b>184.957</b>	<b>14.119</b>
Standard deviation		0.440	0.047
95% CI +/-		0.407	0.044
P(t) movement		0.000	0.000
<b>COMMENTS</b>			
Significant movement in both axes since the original 1930 measure.			



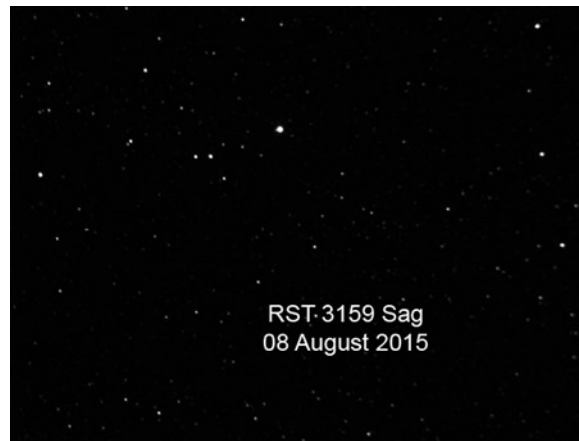
**Astronomical Association of Queensland Measurement of Seven Neglected Double Stars**

*Table 4. Measurements of I 1304*

<u>I 1304</u>	RA. 16 58.3	DEC. -33 37	Last Measure 1987
<u>Scorpius</u>	MAG. 7.16 & 13.0	PA. 325.0°	SEP. 5.9"
<u>Date</u>	<u>No. images</u>	<u>PA°</u>	<u>Sep"</u>
06 July 2015	11	326.30	6.062
07 July 2015	16	326.79	5.856
09 July 2015	10	326.05	5.815
11 July 2015	10	324.61	6.262
18 July 2015	10	326.60	6.728
21 July 2015	10	326.37	6.066
28 July 2015	10	326.06	6.340
<b>Mean</b>		<b>326.111</b>	<b>6.161</b>
Standard deviation		0.714	0.315
95% CI +/-		0.661	0.291
P(t) movement		0.006	0.071
<b>COMMENTS</b> Possible very slight movement in PA since first 1925 measure.			

*Table 5. Measurements of RST 3159*

<u>RST3159</u>	RA. 18 10.9	DEC. -34 14	Last Measure 1945
<u>Sagittarius</u>	MAG. 9.09 & 14.1	PA. 102.0°	SEP. 4.9"
<u>Date</u>	<u>No. images</u>	<u>PA°</u>	<u>Sep"</u>
29 July 2015	10	100.94	4.403
04 August 2015	10	100.24	4.776
05 August 2015	10	100.11	4.547
07 August 2015	12	100.82	5.166
08 August 2015	10	101.19	5.139
11 August 2015	10	103.65	5.200
18 August 2015	10	103.62	5.225
<b>Mean</b>		<b>101.510</b>	<b>4.922</b>
Standard deviation		1.500	0.343
95% CI +/-		1.388	0.317
P(t) movement		0.421	0.869
<b>COMMENTS</b> Little apparent movement.			



**Astronomical Association of Queensland Measurement of Seven Neglected Double Stars**

*Table 6. Measurements of RST 1878*

<u>RST1878</u>	RA. 16 09.2	DEC. -56 03	Last Measure 1971
<u>Norma</u>	MAG. 6.5 & 13.5	PA. 215.0°	SEP. 9.5"
<u>Date</u>	<u>No. images</u>	<u>PA°</u>	<u>Sep"</u>
15 June 2015	10	214.21	9.315
19 June 2015	10	209.61	8.875
21 June 2015	10	213.96	9.196
28 June 2015	10	213.53	9.138
01 July 2015	10	213.50	8.999
03 July 2015	10	213.38	8.967
04 July 2015	10	212.52	8.628
<b>Mean</b>		<b>212.959</b>	<b>9.017</b>
Standard deviation		1.569	0.227
95% CI +/-		1.451	0.210
P(t) movement		0.014	0.001
<b>COMMENTS</b> Probable slight change in PA.			

*Table 7. Measurements of I 1357*

<u>I 1357</u>	RA. 18 16.1	DEC. -43 16	Last Measure 1926
<u>CrA</u>	MAG. 9.12 & 14.8	PA. 38.0°	SEP. 5.5"
<u>Date</u>	<u>No. images</u>	<u>PA°</u>	<u>Sep"</u>
04 August 2015	10	38.61	6.511
07 August 2015	10	36.64	6.213
08 August 2015	10	35.10	6.493
11 August 2015	10	35.49	6.616
14 August 2015	10	37.85	6.502
15 August 2015	10	35.24	6.375
18 August 2015	11	35.36	6.428
<b>Mean</b>		<b>36.327</b>	<b>6.448</b>
Standard deviation		1.411	0.128
95% CI +/-		1.305	0.118
P(t) movement		0.020	0.000
<b>COMMENTS</b> Possible slight movement over the last 99 years.			



## Astronomical Association of Queensland Measurement of Seven Neglected Double Stars

Table 8. Measurements of B 315

<u>B315</u> <u>Scorpius</u>	RA. 16 44.9 MAG. 9.1 & 13.3	DEC. -30 24 PA. 307.0°	Last Measure 1928 SEP. 5.2"
<u>Date</u>	<u>No. images</u>	<u>PA°</u>	<u>Sep"</u>
07 June 2015	10	308.79	4.949
15 June 2015	10	309.25	4.642
19 June 2015	10	310.36	4.869
27 June 2015	10	308.89	4.777
28 June 2015	10	309.83	4.752
01 July 2015	10	309.18	5.262
03 July 2015	10	309.66	4.944
<b>Mean</b>		<b>309.423</b>	<b>4.885</b>
Standard deviation		0.559	0.199
95% CI +/-		0.517	0.184
P(t) movement		0.000	0.006
<b>COMMENTS</b> Slight increase in PA and decrease in separation appear consistent with the two previous measures.			



(Continued from page 500)

## ACKNOWLEDGEMENTS

This research has made use of the Washington Double Star Catalogue maintained at the U.S. Naval Observatory.

## REFERENCES

Losse, F. Reduc software, V4.5.1. <http://www.astrosurf.com/hfosaf/uk/t/download.htm>

Napier-Munn, T.J. and Jenkinson, G., 2009. "Measurement of some neglected southern multiple

stars in Pavo", *Webb Society Double Star Section Circular 17*, 6-12.

Napier-Munn TJ and Jenkinson G, 2014. "Analysis of Errors in the Measurement of Double Stars Using Imaging and the Reduc Software", *Journal of Double Star Observations*, **10**, 193 - 198.

Argyle, R.W., 2012, *Observing and Measuring Visual Double Stars 2<sup>nd</sup> edition*. Springer.