Measurement of Rasalgethi with a DSLR Camera

Blake Nancarrow

Bradford, Ontario, Canada
RASC Carr Astronomical Observatory, Blue Mountains, Ontario, Canada
astronomy@computer-ease.com

Abstract: In an effort to apply new methods learned, digital images were acquired of Rasalgethi aka STF 2140 AB and nearby calibration stars with a DSLR affixed to a C14 to determine the position angle and separation. On analysing the images in REDUC software, a position angle of 103.3 degrees and separation of 4.90 arc-seconds was calculated.

Introduction

While I learned to visually measure doubles with the Celestron Micro Guide, I was inclined to use a DSLR camera. Ernõ Berkó helped me understand the equipment I would need and process that I should use.

I chose Rasalgethi or Alpha Herculis, WDS ID 17146+1423 (STF2140AB), to practice my data gathering workflow. I prepared a list of calibration stars in the vicinity using the SkyTools planning software.

My observations were made at Carr Astronomical Observatory. I used a Canon 40D (unmodified) camera body on an unguided Celestron 14-inch f/11 SCT with Optec TCF-S temperature-controller focuser. The 'scope was permanently mounted atop a Paramount ME controlled by TheSky6. The OTA primary mirror was not locked. The camera was controlled remotely with the EOS Utility software running on a small netbook computer. The camera was set to use ISO 1000 and capture in RAW format (3888x2592 pixels). The focal length of the C14 is approximately 3.9 metres; no further magnification (i.e. Barlow) was used.

In all the included images, north is up and east is left.

Methods

My observations were made on 15 July 2015 (2015.53) between 12:30 AM and 3:30 AM Eastern Standard Time. Work was conducted at this time to avoid a meridian flip with the equatorial mount. Approximately 100 digital images in total were captured. The altitude of the target stars ranged from +62°
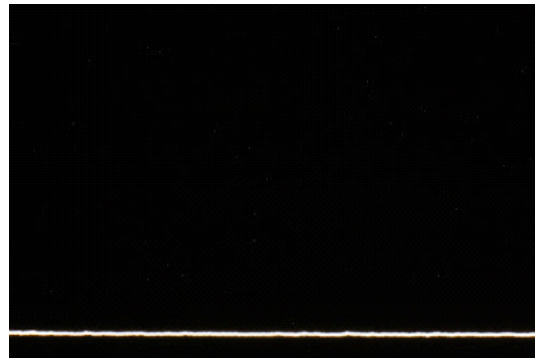
Figure 1. Image captured during drifting process showing alignment to the declination axis.

through +33 during the session.

Using the camera Live View, I focused on the star Unukalhai aka Alpha Serpentis initially moving the C14 primary, then using the Optec hand paddle.

I rotated the camera in the focuser to align the long edge of the frame with the declination axis and captured a couple of long exposure images, drifting Unukalhai with the mount tracking off, to refine the alignment. The camera was not touched after this time. I then slewed Unukalhai to the bottom edge of the frame from centre so to ease verification (Figure 1). I programmed a dozen shots to record the camera orientation, repositioning Unukalhai at the east edge of the field before each exposure.

Measurement of Rasalgethi with a DSLR Camera

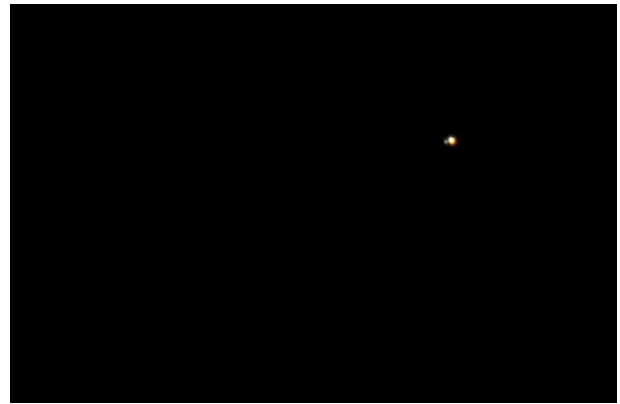*Figure 2. Calibration star HD 159481 aka Σ2185 exposed at 30 seconds.*

Figure 3. Image of Rasalgethi aka Σ2140 captured at 1/15th of a second.

The mount was then slewed to previously selected calibration stars. Several images were captured for each star. Various exposures were taken to ensure the dimmest element remained visible while avoiding overexposing the bright stars. For each calibration star 3 to 8 images were captured. Exposure times ranged from 30 seconds to 1/125th of a second. The digital image of HD 159481 (STF 2185) in Ophiuchus revealed a multistar system with over 8 elements (Figure 2).

The altitude of Rasalgethi was approximately +36° when imaged. Over 15 digital images were captured for Rasalgethi, again at various exposures. The exposure of Alpha Her at 1/15th of a second reveals the delicate companion B aside the bright primary (Figure 3).

After the session, the drift alignment, calibration star, and target star shots were processed and converted to JPG format using the Canon Digital Photo Professional software. The evening's proceedings with a selection of images were documented on my astronomy blog.

Analysis

All images were converted at full size from Canon CR2 RAW format to Windows BMP with IrfanView 4.51 .

REDUC 5 software by Florent Losse was used with Automatic Centering enabled.

A total of 16 drift images were captured for declination analysis (Table 1). The Δ or image inclination in relation to the celestial equator was measured for each image. The average was calculated at -0.20 with a standard deviation of 0.04.

The calibration images were visually assessed. The best ones selected showed good exposure and little or no vibration. Similarly, the best exposure (file IMG_5171) of Rasalgethi was selected for final analysis.

In September 2015, the first pass at calculating the image scale or E value of the calibration star images was performed using separation values from the SkyTools 3 Professional software. From the 12 images, an average value of 0.56 was obtained. When the inclination and scale average values were applied a single image of Rasalgethi, the position angle of 103 and separation of 4.8 were derived. These compared well to the values shown in SkyTools for alpha Her: 103 and 4.6.

A later pass was conducted using the separation values as found at the time in the WDS. The scale average value 0.56 was obtained. When calculations were performed for the target star, REDUC yielded the values 102 and 5.3.

image file	Δ	notes
IMG_5105	-1.16	different position
IMG_5106	-0.15	
IMG_5107	-0.17	
IMG_5108	-0.18	
IMG_5109	-0.25	
IMG_5110	-0.23	
IMG_5111	-0.28	
IMG_5112	-0.19	
IMG_5113	-0.21	
IMG_5114	-0.21	
IMG_5115	-0.18	
IMG_5116	-0.22	
IMG_5117	-0.20	
IMG_5118	-0.19	
IMG_5119	-0.14	windy
IMG_5120	-0.21	

Table 1. Image files for drift analysis with inclination values from REDUC.

Measurement of Rasalgethi with a DSLR Camera

Another attempt was made in July 2018 again drawing the reference separation values for the calibration stars from the WDS (Table 2). It was noted a couple of the entries had reports post-dating the period when the image data was captured. Nevertheless, E was computed to be 0.28 with a standard deviation of 0.00. The inclination and scale averages were applied to the Rasalgethi image yielding theta 103.3 and rho 4.90. The published values for 17146+1423 [STF2140AB] from 2017 were 104 and 4.8.

Conclusions

I set out to practice digital imaging a double star to be measured and calibration stars for determining the image scale.

The double star STF 2140AB was measured with a DSLR. The separation was found to be 4.9 arc seconds and the position angle was determined to be 103.3 degrees (Table 3).

Acknowledgements

I am grateful for Geoff Gaherty's support while at the early stages of my fascination with double stars. I thank Ernõ Berkó for helping me understand how to capture doubles with a DSLR. I found Jolyon Johnson's video and the text in Bob Argyle's book very helpful in preparing a paper. I thank Dr Roberto Abraham for his guidance in writing a scientific paper. I appreciate the access to the research-grade telescope and mount equipment at the CAO offered through my RASC Toronto Centre membership. And thanks for Florent Losse for providing the REDUC software.

References

The Baader Micro Guide is equivalent to the Celestron Micro Guide. https://www.baader-planetarium.com/en/micro-guide-eyepiece-with-log-pot-illuminator.

SkyTools 3 Professional planning software. https://www.skyhound.com/skytools.html

REDUC software. http://www.astrosurf.com/hfosaf/uk/tdownload.htm

IrfanView software, https://www.irfanview.com/

Author blog post noting local weather conditions with Clear Sky Chart 3 hours prior to session. http://blog.lumpydarkness.com/2015/07/the-sun-through-clear-band.html.

image file	WDS ID	last	ρ	E
IMG_5151	16315+0818 SHJ 233	2015	59.2	0.28
IMG_5158	16435+2043 STTA149	2011	97.7	0.28
IMG_5135	16442+2331 STF2094AC	2013	24.7	0.28
IMG_5191	17249+1320 STF2159	2015	26.4	0.28
IMG_5197	17348+0601 PWS 16AH	2001	187.3	0.28
IMG_5200	17433+1741 STH 4	2010	15.5	0.28
IMG_5156	16354+1703 WEB 6	2015	155.5	0.28
IMG_5168	17037+1336 STFA 33AB	2014	304.9	0.28
IMG_5203	18057+1200 STF2276AC	*2016*	63.8	0.28
IMG_5129	16081+1703 STF2010AB	*2017*	27.0	0.28
IMG_5142	17150+2450 STF3127AD	2009	191.6	0.28
IMG_5192	17016+1457 H 4 122	2014	18.9	0.28

Table 2. WDS separation values for the calibration stars with scale E values from REDUC.

Author blog post with a fast exposure colour image of Rasalgethi showing the B companion. http://blog.lumpydarkness.com/2015/07/shot-rasalgethi.html

Author blog post featuring detailed report of imaging run with drift and all calibration star images. http://blog.lumpydarkness.com/2015/07/performed-full-double-star-imaging-run.html

Washington Double Star catalog. http://www.astro.gsu.edu/wds

How to Write a Double Star Research Paper. Jolyon Johnson YouTube video, 2015, https://www.youtube.com/watch?v=akF3T4on0mA

Observing and Measuring Visual Double Stars, 2/e, Bob Argyle, Ed, 2012. Springer, New York.

"Observing Double stars for Fun and Science", Ronald Tanguay, *Sky and Telescope*, Feb 1999, https://www.skyandtelescope.com/observing/celestial-objects-to-watch/observing-double-stars-for-fun-and-science/

Name	RA+Dec	PA	Sep	Date	N	Note
STF2140AB	17146+1423	103.3	4.90	2015.53	1	1

1.   Canon 40D (unmodified) camera and Celestron 14 inch f/11 SCT.

Table 3. Final calculated separation and position values for Rasalgethi.

Measurement of Rasalgethi with a DSLR Camera

"Double-Star Measurement Made Easy", Thomas Teague, *Sky and Telescope*, pg 112, July 2000.

"Double Star Measures Using a DSLR Camera", Ernõ Berkó, *JDSO*, **4**(4), 144, 2008.

"Double Star Measurements in the Pleiades Cluster Using a DSLR Camera", Michel Michaud, *JDSO*, **8**(4), 249, 2012.

Blake Nancarrow has observed double stars as a young amateur astronomer. His first log entry of a double was made in June 1991. He learned and practiced the Celestron steps, Ronald Tanguay's techniques, and Tom Teague's method, developing his own refined workflow. On reading Ernõ Berkó's 2008 and Michel Michaud 2012 JDSO papers on using a DSLR to capture double star data, he decided to go the digital imaging route.

The Carr Astronomical Observatory on Blue Mountains in south-western Ontario is owned and operated by the Royal Astronomical Society of Canada - Toronto Centre. Nancarrow is one of the site supervisors.