Jessie Ferris

AY203-321 Individual Observing Project

Variable Star Light Curve

Project Description

For this project, the Cas Variable Star V523 was observed over a time span of 2 hours and 45 minutes in order to create a light curve that shows the brightness change during an eclipse of the star with its binary. By using the light curve, it is possible to calculate the percentage of light blocked during the eclipse versus when both stars are uncovered.

Data Taken

Date: November 19, 2019

Star: Cas Variable Star V523

Exposures: 240 second exposures on the CCD camera with the red filter every 5 minutes, where the first exposure started at 7:05 pm and the last exposure started at 9:45 pm.

Total Number of Frames Taken: 32

Processing

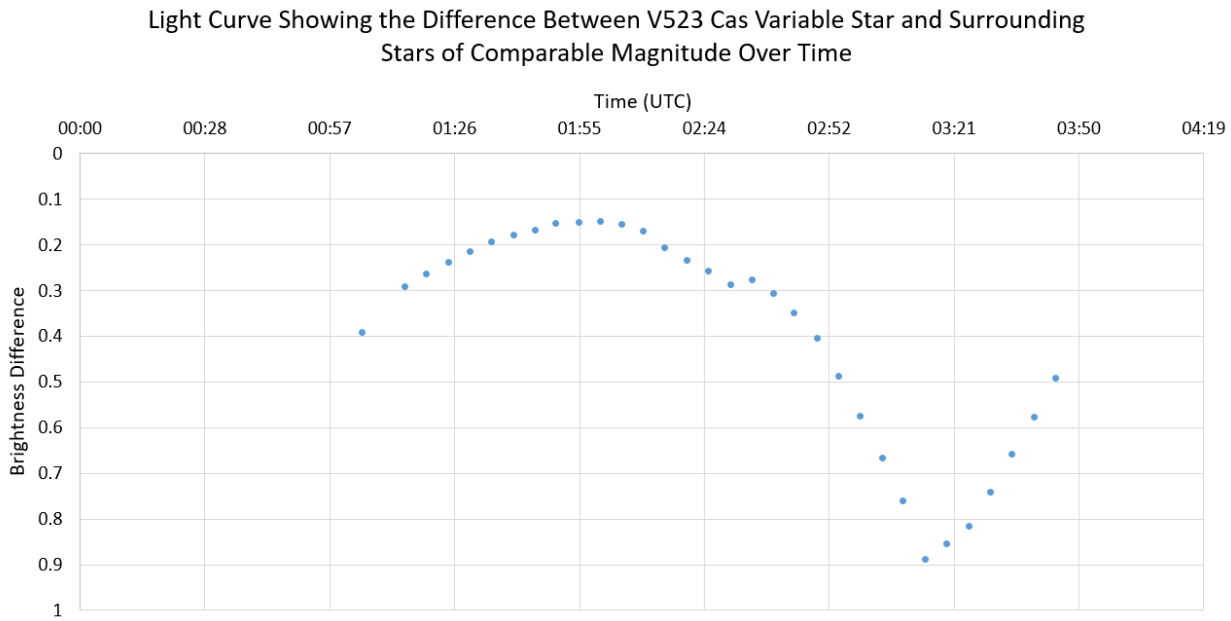
First, I combined all the 4 minute dark frames to create a median dark frame and subtracted it from the frames I took with the CCD camera. Then, I combined the flat frames in the red filter into a median frame, scaled it to 1.0, and divided it out of the frames taken by the CCD camera. The frames were taken over a time period of 2 hours and 45 minutes, so they needed to be aligned on Mira using the register tool. Using the photometry tool on Mira, I marked a target on the specific star and adjusted the radii of the circles so that the innermost circle encompasses the star itself, but the outermost circle doesn't catch any surrounding objects. In this case, the innermost circle was set to 15, the middle circle was set to 25, and the outermost circle was set to 30. Then, I chose 4 other stars that were roughly the same size in the frame and marked a target on those. Finally, I applied the targets to all the frames using the track tool in photometry and used the photometry measurements tool to get the data for creating a light curve, including the magnitude of each target star for each frame.

Outcome

The photometry measurement tool gave me the magnitudes of each target star for each frame. For each of the 32 frames, I calculated the average magnitude of the 4 other stars and subtracted that average from the magnitude of the variable star such that:

$$Magnitude\ difference\ (for\ each\ frame) = Mag_{Variable\ Star} - Mag_{Avg\ of\ Other\ Stars}$$

Then, I graphed the magnitude difference by the time in UTC to get the light curve shown below.



The percentage of light blocked during the eclipse is the magnitude at the height of the eclipse subtracted from the magnitude when the stars are not eclipsing divided by the magnitude when the stars are not eclipsing, such that:

$$Percentage\ Blocked = \frac{Normal\ Magnitude - Magnitude\ at\ Height\ of\ Eclipse}{Normal\ Magnitude} \times 100$$

In this case, the magnitude at the height of the eclipse occurs at time 03:15 and the magnitude when the stars are not eclipsing is at time 02:00. Thus,

$$Percentage\ of\ Light\ Blocked = \frac{-9.7123 - (-7.5976)}{-9.7123} \times 100 = 21.77\%$$

The data that corresponds with the light curve is shown below.

Frame	Magn of Other Target Stars	Avg	Magn of V523	Difference	Time (UTC)
Var01.fits	-9.3329	-9.85905	-9.4655	0.39355	1:05
	-9.9805				
	-10.1369				
	-9.9859				
Var02.fits	-9.3337	-9.8596	-9.5653	0.2943	1:15
	-9.9853				
	-10.1388				
	-9.9806				
Var03.fits	-9.3397	-9.8657	-9.6001	0.2656	1:20
	-9.9883				
	-10.1443				
	-9.9905				
Var04.fits	-9.3344	-9.8642	-9.6239	0.2403	1:25
	-9.9879				
	-10.1436				
	-9.9909				
Var05.fits	-9.3344	-9.86395	-9.6469	0.21705	1:30
	-9.9864				
	-10.1431				
	-9.9919				
Var06.fits	-9.3399	-9.865875	-9.6695	0.196375	1:35
	-9.9869				
	-10.1429				
	-9.9938				
Var07.fits	-9.3346	-9.8623	-9.6815	0.1808	1:40
	-9.9823				
	-10.1423				
	-9.99				
Var08.fits	-9.3322	-9.860325	-9.6907	0.169625	1:45
	-9.9844				
	-10.1393				
	-9.9854				
Var09.fits	-9.3349	-9.86325	-9.7076	0.15565	1:50
	-9.9887				
	-10.1429				
	-9.9865				
Var10.fits	-9.333	-9.8609	-9.7085	0.1524	1:55
	-9.9847				
	-10.1402				
	-9.9857				
Var11.fits	-9.3354	-9.863225	-9.7123	0.150925	2:00
	-9.9859				
	-10.1437				
	-9.9879				

Frame	Magn of Other Target Stars	Avg	Magn of V523	Difference	Time (UTC)
Var12.fits	-9.3393	-9.865625	-9.7079	0.157725	2:05
	-9.9877				
	-10.1439				
	-9.9916				
Var13.fits	-9.3344	-9.864325	-9.6918	0.172525	2:10
	-9.9875				
	-10.1427				
	-9.9927				
Var14.fits	-9.197	-9.74875	-9.5398	0.20895	2:15
	-9.8993				
	-10.0201				
	-9.8786				
Var15.fits	-8.9356	-9.494175	-9.2582	0.235975	2:20
	-9.6571				
	-9.7613				
	-9.6227				
Var16.fits	-8.684	-9.245325	-8.9868	0.258525	2:25
	-9.4071				
	-9.5135				
	-9.3767				
Var17.fits	-8.4036	-8.96765	-8.6775	0.29015	2:30
	-9.142				
	-9.2304				
	-9.0946				
Var18.fits	-9.2051	-9.737925	-9.4585	0.279425	2:35
	-9.8652				
	-10.0169				
	-9.8645				
Var19.fits	-9.3421	-9.867175	-9.5581	0.309075	2:40
	-9.9872				
	-10.1467				
	-9.9927				
Var20.fits	-9.3406	-9.868525	-9.5185	0.350025	2:45
	-9.9898				
	-10.1522				
	-9.9915				
Var21.fits	-9.3348	-9.863725	-9.4582	0.405525	2:50
	-9.991				
	-10.1413				
	-9.9878				
Var22.fits	-9.2172	-9.75195	-9.2623	0.48965	2:55
	-9.9022				
	-10.017				
	-9.8714				

Frame	Magn of Other Target Stars	Avg	Magn of V523	Difference	Time (UTC)
Var23.fits	-8.9718	-9.5058	-8.9278	0.578	3:00
	-9.6703				
	-9.7618				
	-9.6193				
Var24.fits	-8.7115	-9.243375	-8.5737	0.669675	3:05
	-9.4071				
	-9.4958				
	-9.3591				
Var25.fits	-8.4162	-8.95155	-8.1892	0.76235	3:10
	-9.1317				
	-9.1992				
	-9.0591				
Var26.fits	-7.9511	-8.4884	-7.5976	0.8908	3:15
	-8.7128				
	-8.7025				
	-8.5872				
Var27.fits	-9.1743	-9.7021	-8.8454	0.8567	3:20
	-9.8306				
	-9.9791				
	-9.8244				
Var28.fits	-9.3471	-9.872425	-9.0535	0.818925	3:25
	-9.9918				
	-10.1532				
	-9.9976				
Var29.fits	-9.3473	-9.871825	-9.1285	0.743325	3:30
	-9.9935				
	-10.1479				
	-9.9986				
Var30.fits	-9.2613	-9.7775	-9.117	0.6605	3:35
	-9.9246				
	-10.035				
	-9.8891				
Var31.fits	-9.0434	-9.55455	-8.9757	0.57885	3:40
	-9.716				
	-9.8021				
	-9.6567				
Var32.fits	-8.8104	-9.319575	-8.8254	0.494175	3:45
	-9.4773				
	-9.5674				
	-9.4232				