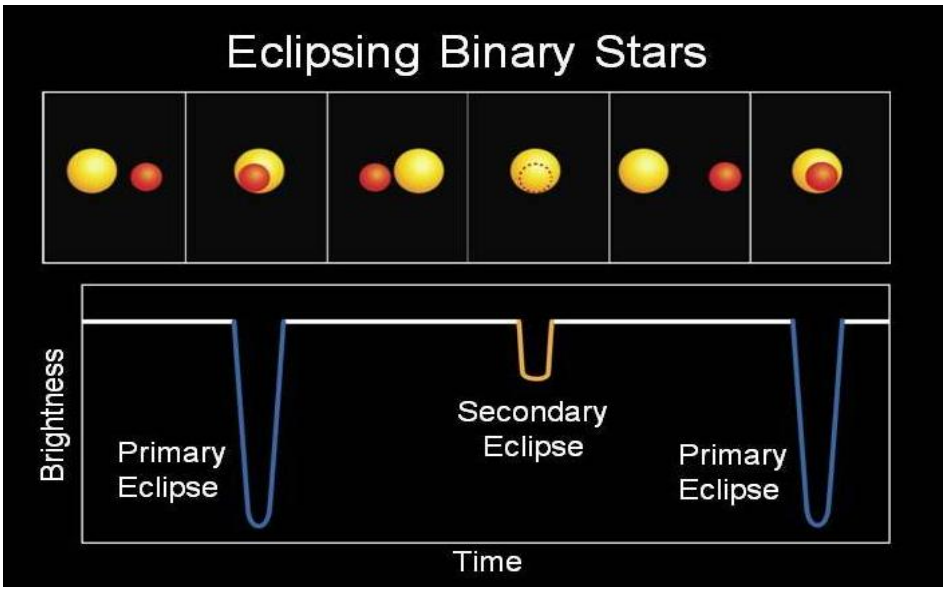
Research Synopsis- Neta Ilan

(High school student) | Research work done via the Bareket observatory, Israel.

Introduction

My project dealt with **Eclipsing Binary Systems**.

A binary star: is a star system consisting of two stars. The gravitational force between them causes them to orbit around their common center of mass.
An eclipsing binary star: These stars appear as a single point of light to an observer, but based on its brightness variation we can say for certain that the single point of light is actually two stars in close orbit around one another. The variations in light intensity from eclipsing binary stars is caused by one star passing in front of the other relative to an observer.
Eclipsing binaries are variable stars, not since the light of the individual components varies but due to the eclipses.
The light curve of an eclipsing binary is characterized by periods of practically constant light, with periodic drops in intensity.



In the picture: a visual description of the eclipses in a binary system- a light curve

Therefore, by measuring the system's brightness in different times (also called "photometric measurements"), I was able to create a light curve, that shows the alteration of brightness depending on time.
From the light curve, I found the period of the system in hours, being exact in minutes.
Moreover, from the photometric measurements, I found physical data on both of the system's components.

Project Objectives

My main objective was to be able to generate a 3 Dimensional simulation which would show the period of the eclipsing binary system RZ Cassiopeia.

Another goal I achieved was finding the following characteristics of the system (while using my photometric measurements): separate magnitudes of components, separate surface temperature, different radiuses, different masses, the location of the point of center of mass, period time, and the radial velocity of the components.

Working Tools

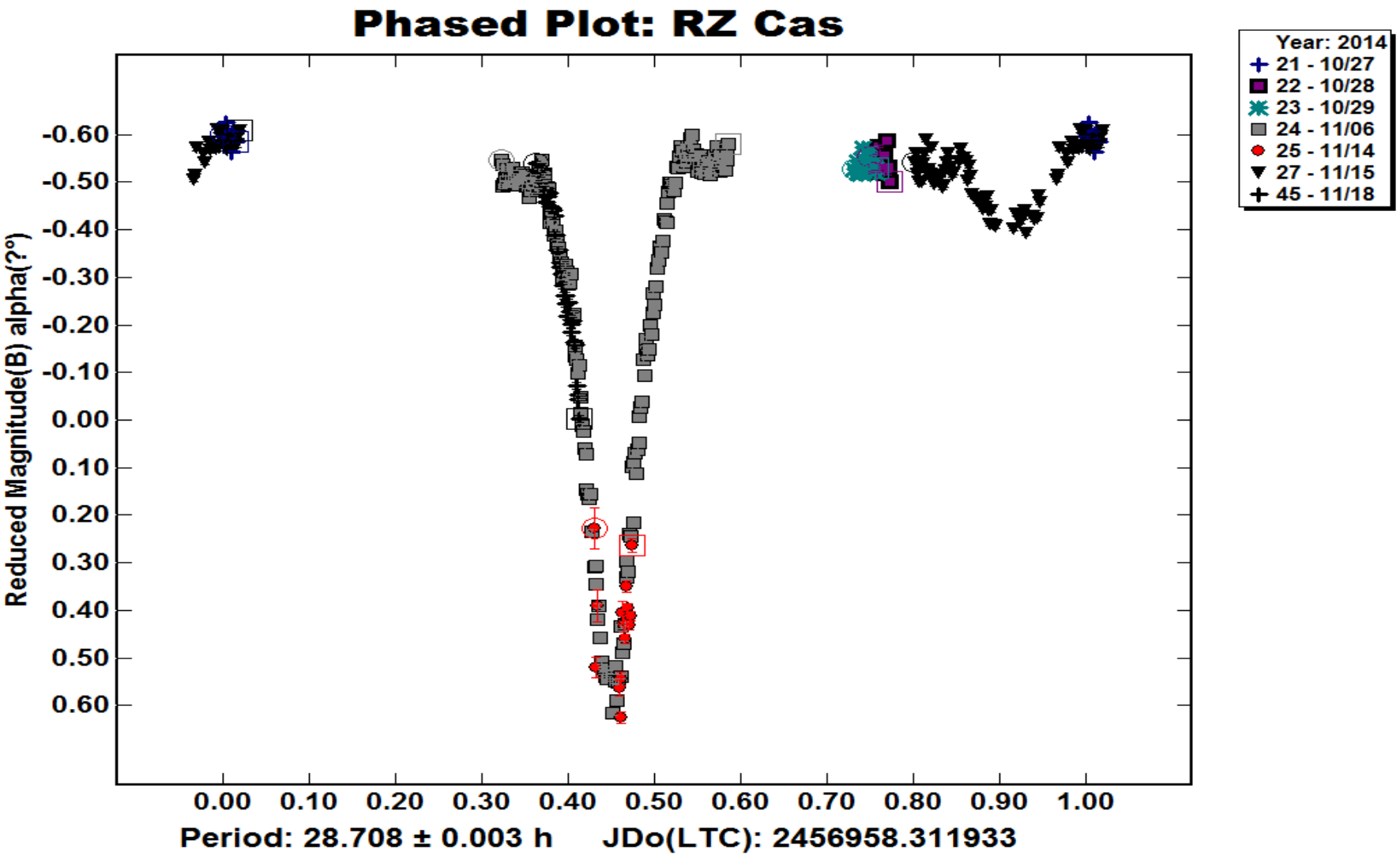
I used a: CELESTRON 14 EDGE HD telescope in order to accomplish my research. It is a Schmidt-Cassegrain telescope with the CCD camera: SBIG ST10MXE.
This particular camera has the quantum efficiency of 90% and is located in the "Bareket Observatory" in Israel.

The control over the telescope is gained by the internet.
During my research on the eclipsing binary RZ Cas, I used the telescope to take approximately 460 images.
The images were taken in the time range of 7 nights, from: 28.10.14 to 18.11.14.

The telescope I used, in Bareket observatory

Results and Achievements

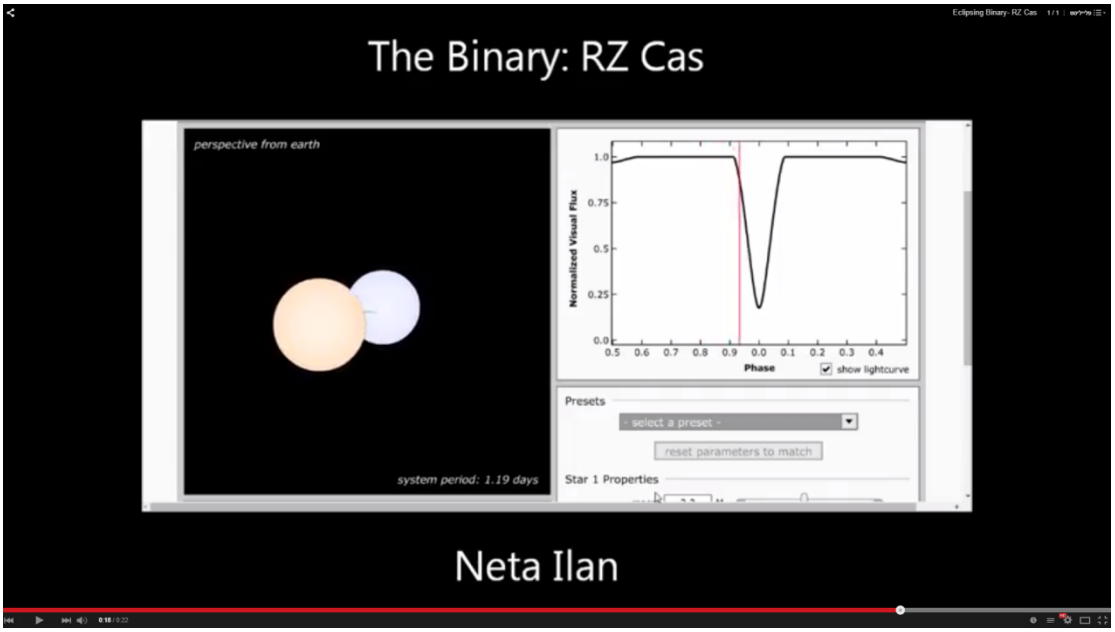
- ✓ By using the software: MPO Canopus, and my images, I generated a light curve for the binary system. (Shown in page 3).
- ✓ I found all of the physical properties I intended to find on each component. (Table on page 4).
- ✓ I generated a 3 Dimensional simulation which shows the period of the eclipsing binary system RZ Cassiopeia. (A QR code in page 4).
- ✓ My biggest accomplishment was due to the comprehensive, detailed research I have conducted. As exemplified in my light curve, the secondary eclipse is shown clearly. Mine, is the first light curve to show this. Until today, all researches have shown only the main eclipse while mentioning the secondary eclipse as minor and un-noticeable.


Phased Plot: RZ Cas
Year: 2014
21 - 10/27
22 - 10/28
23 - 10/29
24 - 11/06
25 - 11/14
27 - 11/15
45 - 11/18
Reduced Magnitude(B) alpha(?°)
-0.60
-0.50
-0.40
-0.30
-0.20
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
Period: 28.708 ± 0.003 h
JDo(LTC): 2456958.311933

Components Physical Properties

	Secondary star	Main star
Spectral type	K3- Sub Giant	A3- Main sequence
Temperature (k)	4400	8750
Absolute magnitude	$1.3L_{\odot}$	$14L_{\odot}$
Star's color		
Radius	$1.97R_{\odot}$	$1.63R_{\odot}$
Mass	$0.719M_{\odot}$	$2.1656M_{\odot}$
Relative distance from the center of mass	3X	X
Relative velocity	Y	3Y

This QR code leads to a video which simulates the period.
It can be scanned by downloading an app on one's phone.



In addition- this is the URL for the video:

https://www.youtube.com/watch?v=uXDUJF0MCyk&list=UUPhVw22vUZl_Mv8p3f52vqg