Photometric analysis using light curve of eclipsing binary SW Lac

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UC **SANTA BARBARA**
Summer Research Academies

What are we studying?

Eclipsing binaries

- Systems of two stars that orbit each other, rotating around a common center of mass
- Binaries produce a light curve
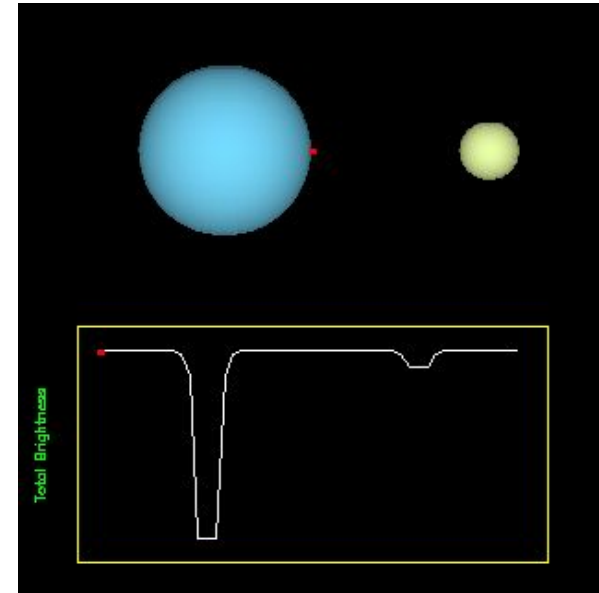 - When one star passes over another, the brightness of the system decreases, creating different minima.

FIG. 1. Artist's impression of an eclipsing binary star and it's varying brightness over time   (astro.sunysb.edu)

Motivation

Driving Questions

- Can we create our own light curve similar to one generated from archival data and compare them **(Fig. 2)**?

- Can we classify what type of binary SW Lac is based on our light curve **(Fig. 3)**?
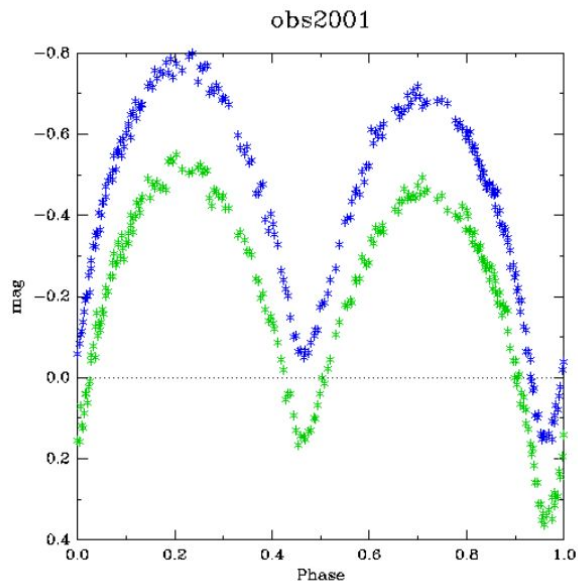
Motivation
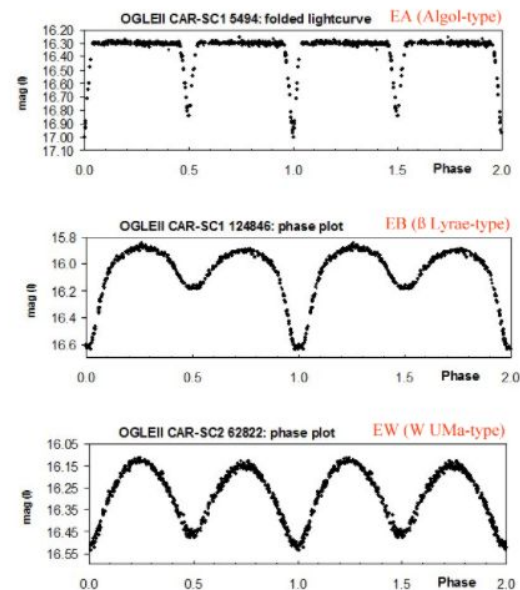

FIG 2. Archival SW Lac
Light Curve

FIG 3. Light curves of 3
different eclipsing binaries.
From top to bottom: Algol-type,
Beta Lyrae-type, W UMa-type

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Methodology

Generating a light curve

1. 137 observations obtained from 0.4m telescopes at the Las Cumbres Observatory

2. Aperture photometry used to find brightness of SW Lac relative to a standard star, BD+37 4715.

3. Plotted brightness of SW Lac over time - produce light curve

4. Generated a line of best fit using Fourier fit model

Methodology
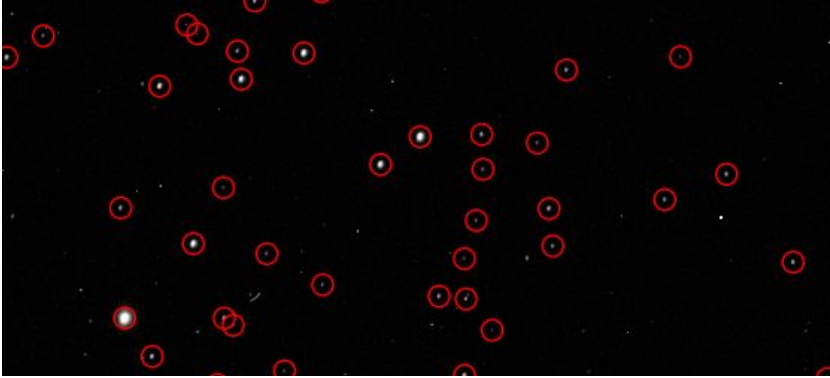
Algorithm using **photutils** to locate stars (red). SW Lac (bottom left) is the brightest star.
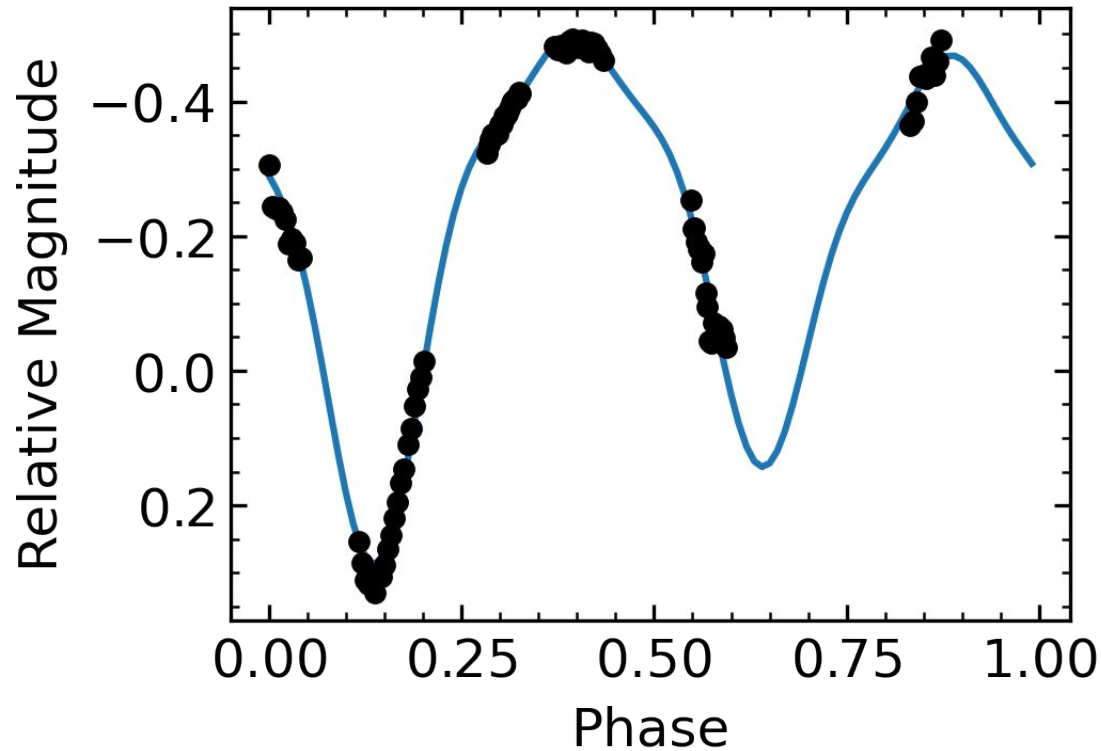

`FITS` file image of SW Lac

FIG. 4 Light curve generated of SW Lac. Solid blue line represents Fourier fitted line of best fit.
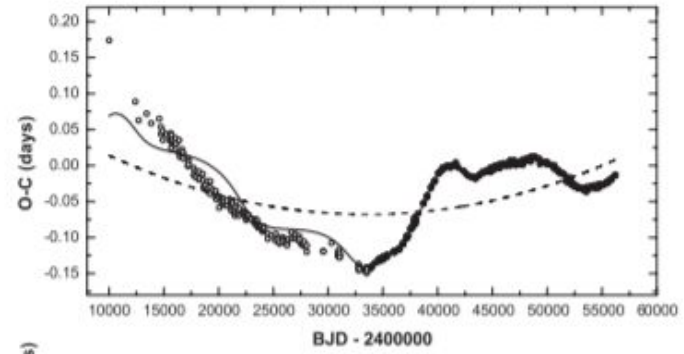
Methodology

O-C diagram of SW Lac (fig. 5)

- *O-C* = Observed Eclipse Time - Calculated Eclipse Time

- *O-C* value calculated using our predicted eclipse time and observed time.

- Added 1 new point to the *O-C* diagram originally produced by Yuan & Şenavcı (2014)

$$Min\ I = JD\ Hel\ 24\ 38708.323 + 0.3207183 * E$$

Equation given by Kreiner, Kim & Nha (2000)
to calculate predicted eclipse time

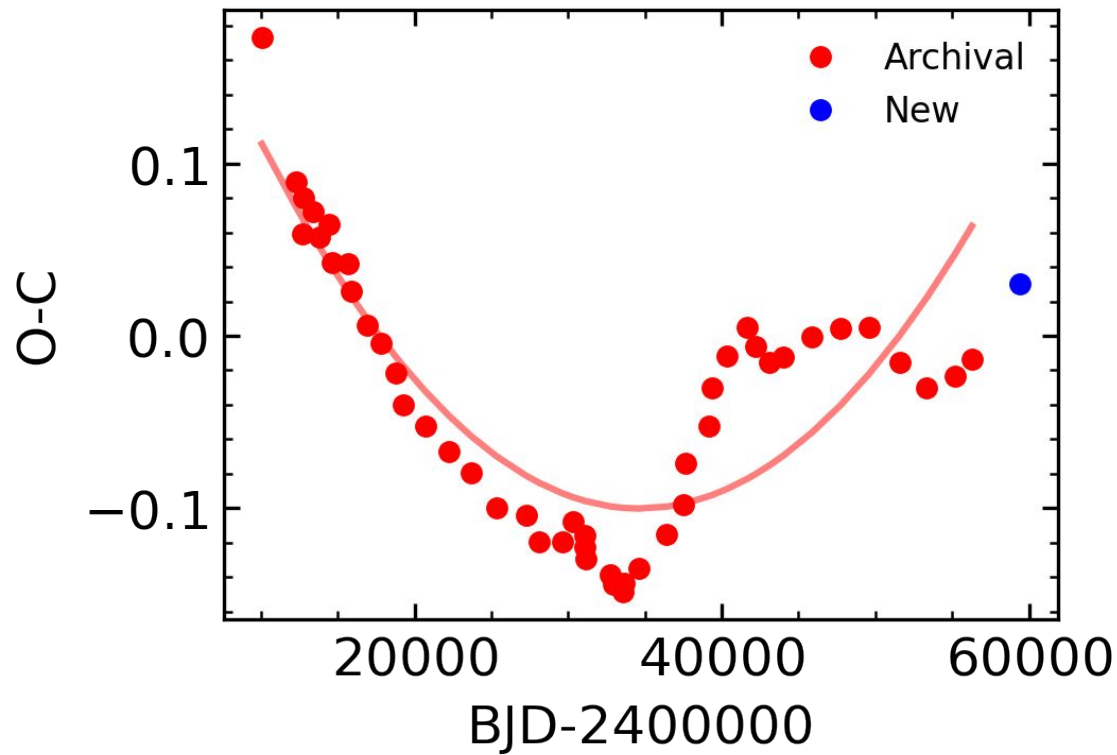*O-C* diagram from Yuan & Şenavcı (2014)

FIG. 5 Graph of *O - C* diagram. Red data points are from archival data and blue data point is our own. Solid red line is generated line of best fit.

Discussions

- Overlaid our light curve over archival data (Fig. 6).

- Curves have similar structure but not perfect match.

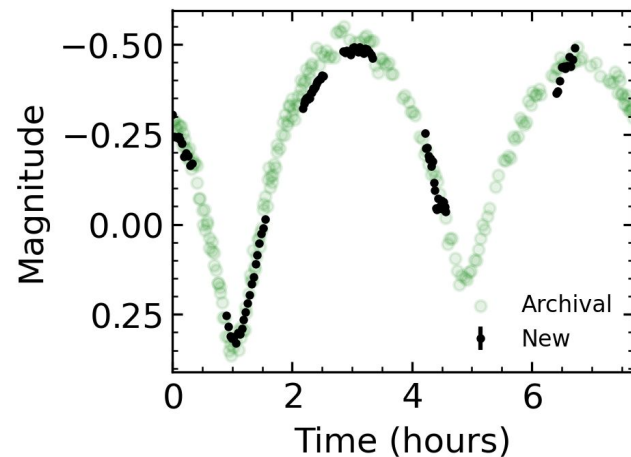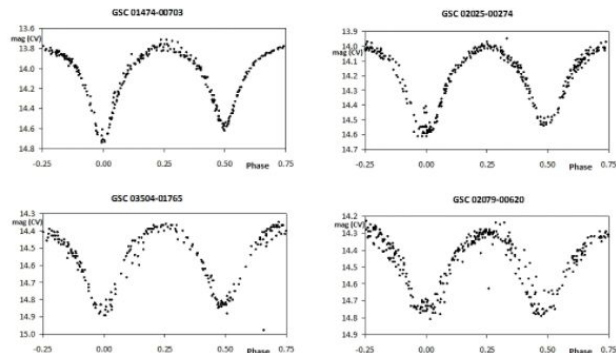- Compared our curve to other light curves of W UMa-type binaries.

FIG. 6 Archival data compared to our light curve

Discussions

- Our point on *O-C* graph tells us a lot about SW Lac's orbit

- Line of best fit

- Variability in orbit of SW Lac.
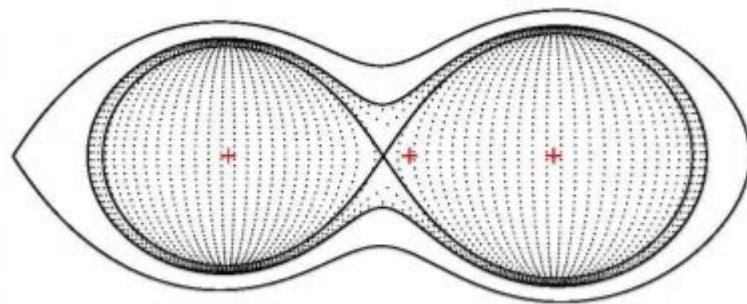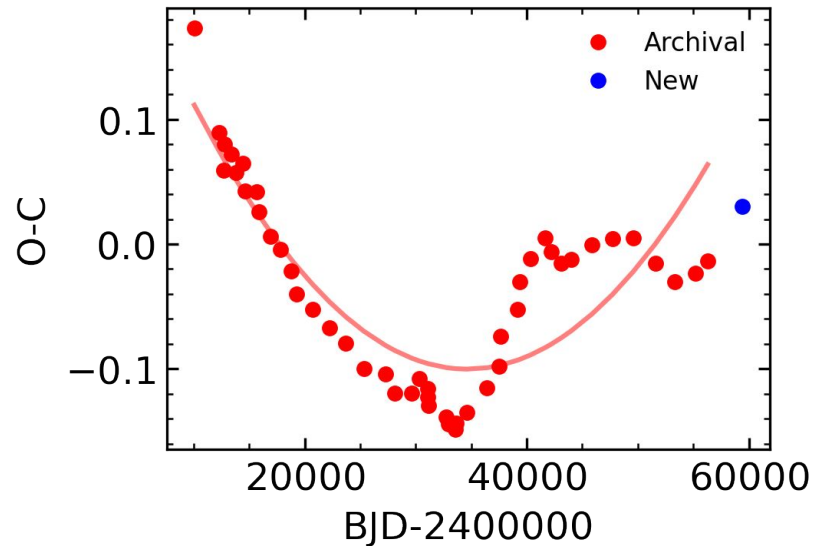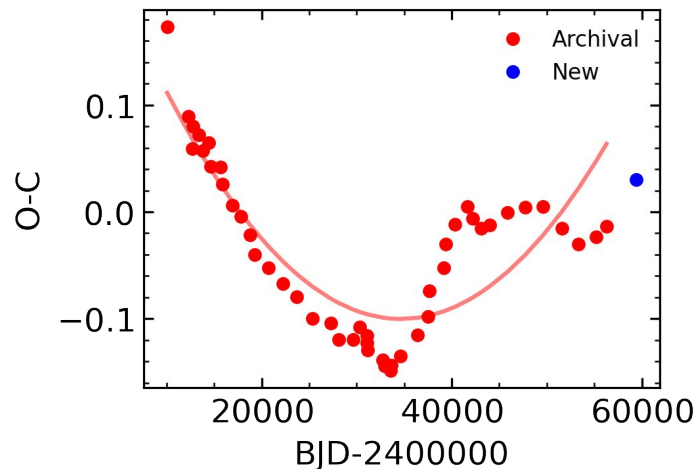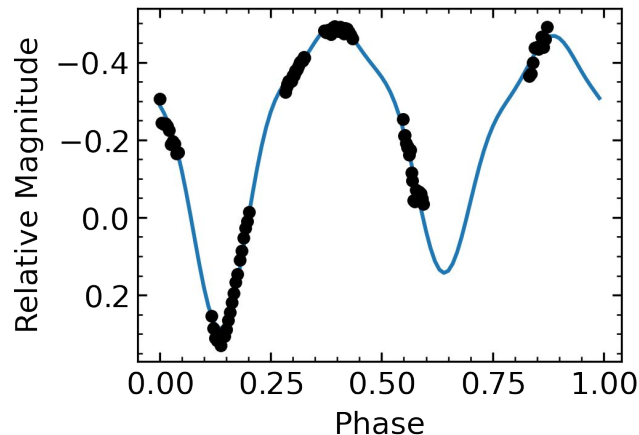
- Uncertainty in observation time

FIG. 7 Geometry of SW Lac

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Conclusions

- Generated and compared light curve of SW Lac w/ literature

- Identify SW Lac as W UMa-type binary.

- Calculated an *O-C* point for SW Lac

- Supports trend from archival diagram.

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