

Observations of an Eclipsing Binary System: PZ Uma

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Background

- PZ Uma was discovered in 2005 within the NSVS database [1]
- It was identified as a W Uma type (low mass contacting) eclipsing binary variable star
- This star was chosen for our observations since it rises close to the zenith in Rochester and has a short period (0.2627 days)
- A possible tertiary component of this system has been inferred from previous research [2]
- Physical properties of both stars may be derived through identifying the period of the system

Methodology

We identified our target through VizieR and conducted observations on the night of March 29th, 2022. Over 200 30-second-long exposures were captured in both B and V passbands over 6.72 hours. Images were cleaned using AstroimageJ and intensity values were measured for PZ Uma and several surrounding stars as references.

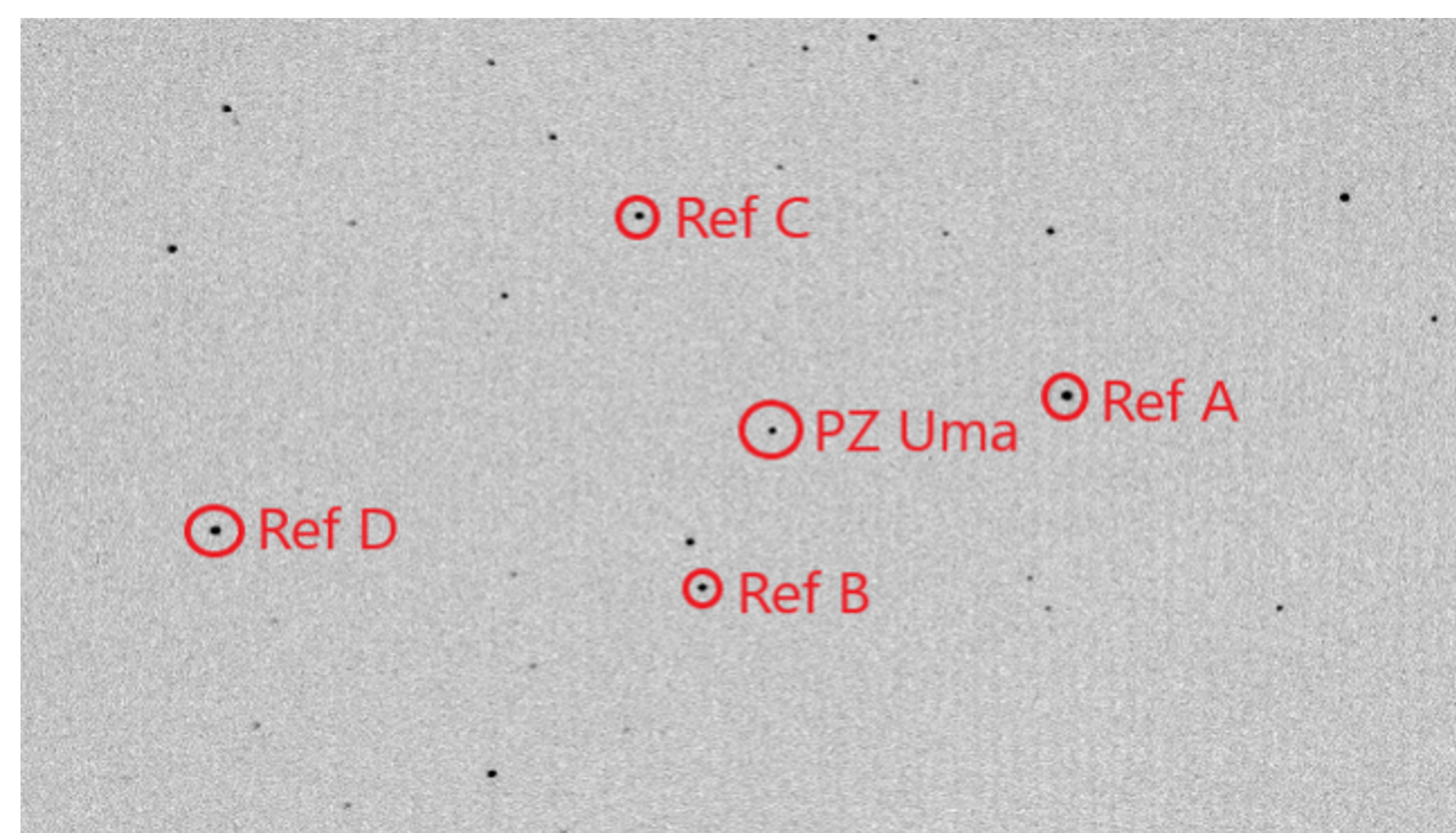


Figure 1: Finding Chart for PZ Uma with reference stars

The systems relative magnitude data are calibrated to the magnitude of Ref C (TYC 3428 225 1) to create the light curves. MATLAB was used for determining the period, O-C values, and creating all light curves.

Results

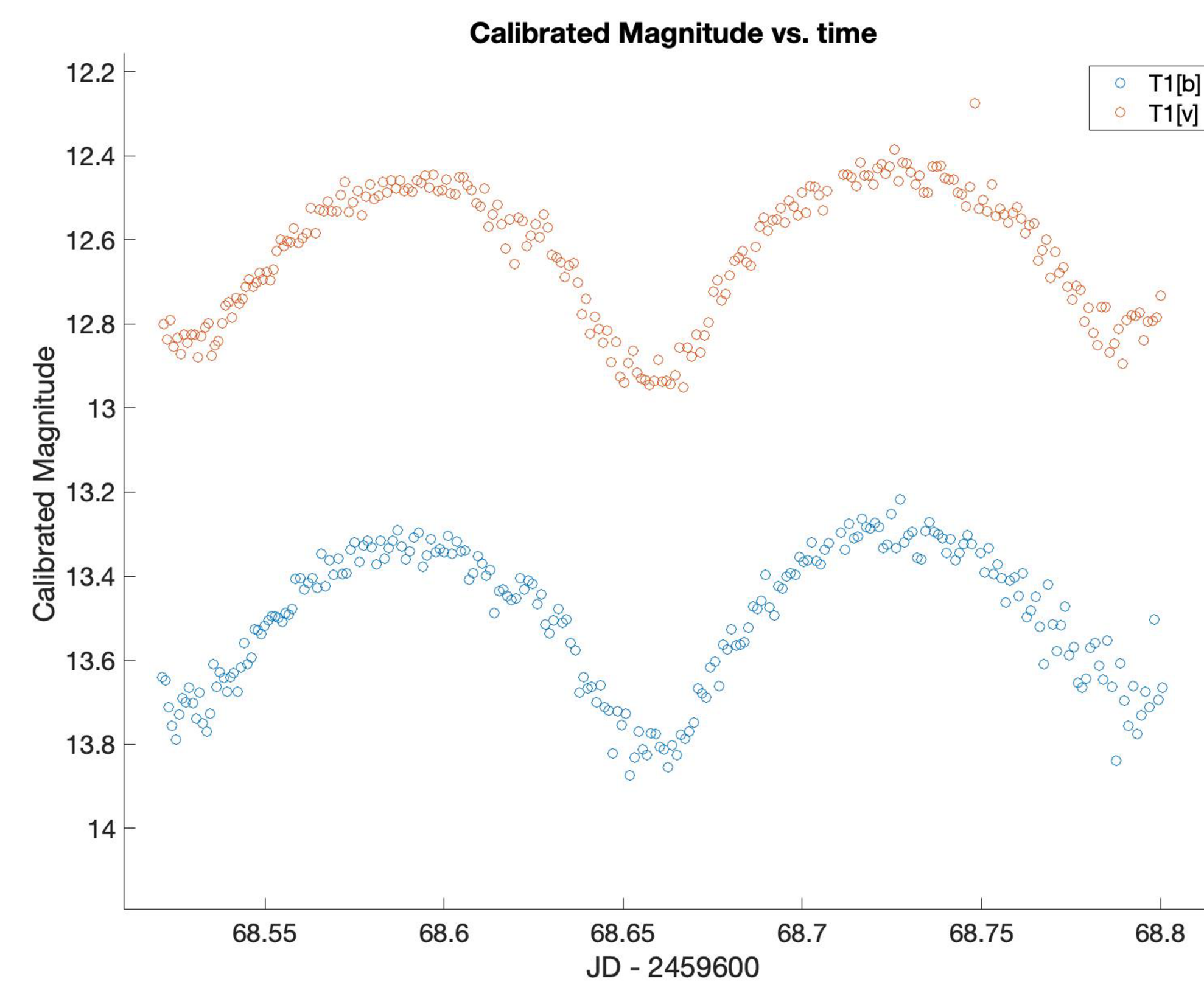


Figure 2: Calibrated magnitude vs Julian Date for target system in b and v filters

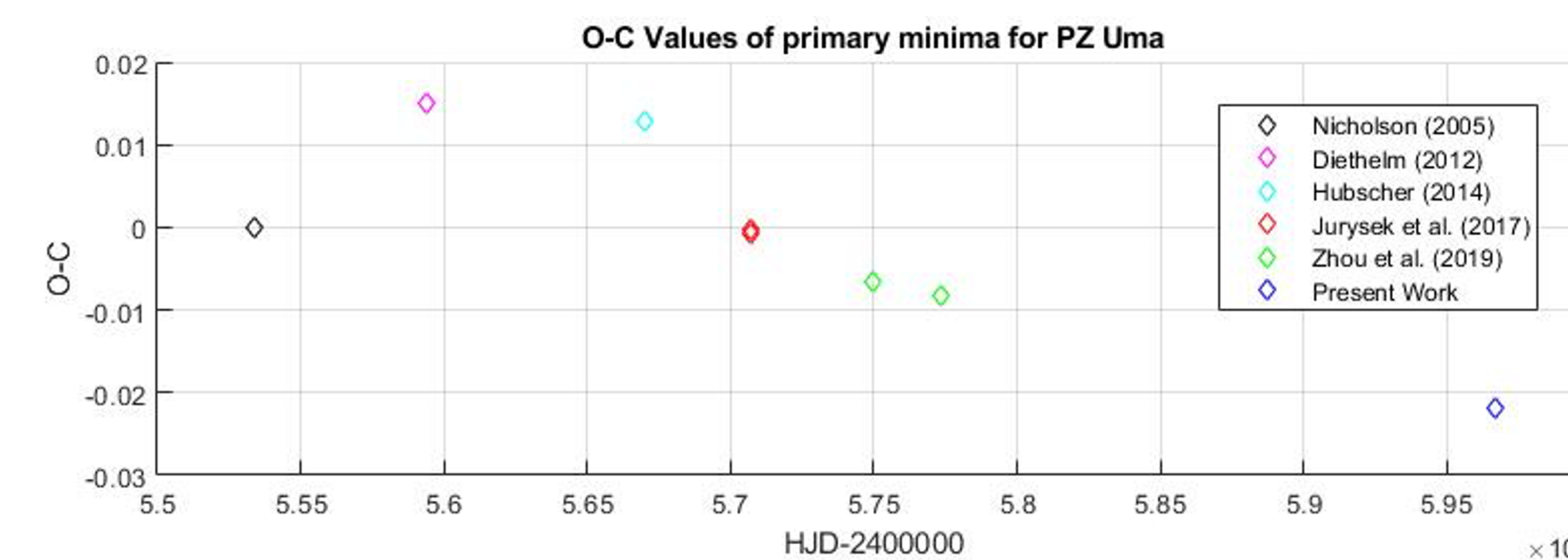


Figure 3: O-C values determined from Nicholson et al.(2005) using period of 0.2627 days

Table 1: Modeled Data of PZ Uma from Zhou et al.(2019)[2]

Star	Model Mass (M_{\odot})	Model Semi Major axis (R_{\odot})	Model Radius (R_{\odot})	Model Period (days)
A	0.77	1.67	0.92	0.261
B	0.14	1.67	0.43	0.261

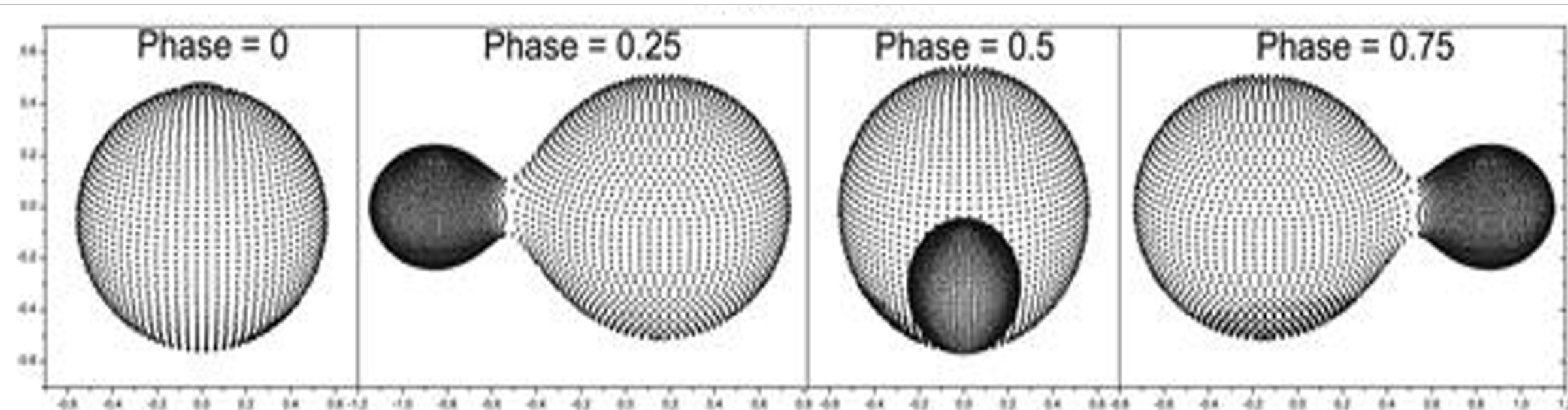


Figure 4: Geometric Model of PZ Uma [2]

Table 2: Calculated data using light curve of PZ Uma and model from Zhou et al.(2019)

Star	Observed Period (days)	Radius of Orbit (R_{\odot})	Radial Velocity (km/s)	Stellar Radius (R_{\odot})
A	0.2606	0.255	49.384	1.16
B	0.2606	1.416	272.980	0.90

Discussion

Overall, One primary minimum (the point at which the smaller star passes behind the larger star) and parts of two secondary minima (the smaller star passes in front of the larger star) were observed. The period of the star was determined to be 0.2606 days and a primary minimum was observed at JD = 2456968.6585. Calculating the expected time of primary minimum from Nicholson et al. (2005) [1] and comparing with our observations resulted in an O-C value of -0.0219 days. While we were able to determine the radial velocity of the stars from Zhou et al. (2019), we were unable to produce accurate measurements of the stellar radii (Table 2). This is most likely due to the contact nature of the system causing highly irregular shapes (Figure 4) and requiring more detailed analysis to study accurately.

Conclusions

- The period is increasingly shrinking since first observations in 2005. The O-C value does not support the conclusion of a tertiary component
- The binary system is brighter in the red passband than the blue passband contrary to catalogue data
- Errors to our results may stem from infrequent exposure time, or the possibility that there may be a third object within this system
- More detailed analysis into the velocity of the stars and the creation of a velocity curve through further observations could help support the existence of a tertiary component

Literature Cited

- [1] New Variable Stars found in the NSVS Database (Nicholson, Sutherland, Sutherland; 2005)
- [2] The W-subtype active contact binary PZ UMa with a possible more massive tertiary component (Zhou; 2019)
- [3] Orbital period cut-off of W UMa-type contact binaries (Zhang; 2020)
- [4] <http://spiff.rit.edu/classes/phys373/phys373.html> (Richmond; 2022)