

THE CONSTANT PERIOD OF SU CASSIOPEIAE

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Abstract

Recent observations of the s-Cepheid SU Cassiopeiae reinforce the assertion of a previous paper (Szabados 1977) that its period has remained constant since the discovery of its light variation.

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SU Cassiopeiae is one of the shortest-period members of a class of Cepheids called s-Cepheids or DCEPS. S-Cepheids are characterized by small amplitudes and almost sinusoidal light curves, and are described in the **General Catalogue of Variable Stars** (Kholopov *et al.* 1985) (GCVS) as possible first overtone pulsators. Currently there exists a difference of opinion concerning the pulsation mode of this class of stars.

SU Cas was included in a group of bright s-Cepheids observed for the Maria Mitchell Observatory (MMO) by the 0.25-meter Automatic Photometric Telescope (APT) on Mount Hopkins in Arizona. Photoelectric data for SU Cas and comparison and check stars were obtained from the first quarter of 1987 through the first quarter of 1989, with 10-second integrations through U, B, and V filters. The comparison star was HD 15784, which has a V magnitude of 6.64, and the check star was HD 16769, with a V magnitude of 5.95.

The APT observations provided differential magnitudes in the form of variable minus comparison values, and check minus comparison values. Folded light curves were plotted in B and V using these data and elements from the GCVS. Figure 1 shows the V curve. The elements used are:

$$JD_{\max} = 2438000.598 + 1.949319 E. \quad (1)$$

Maximum on these light curves was found to be at phase 0.05, indicating that equation (1) is no longer applicable.

Because Szabados (1977) had made an extensive study of SU Cas' periodicity since its discovery, his published elements were used when making an O-C diagram. They are:

$$JD_{\max} = 2441645.910 + 1.949322 E. \quad (2)$$

Observations of SU Cas were made and published after 1977 by Moffett (1984) and Speil (1985), so three points were available to add to Szabados' O-C diagram. They are listed in Table I. Figure 2 shows Szabados' O-C diagram with the new points added.

O-C points were given error bars according to the weight assigned each of them by Szabados. The error bars are proportional to the square root of the weights of the points. Szabados gave visual and photographic observations weights of either 0.5 or 1, and photoelectric observations weights of either 2 or 3. Of the O-C points added to Szabados' diagram, the visual observations made by Speil were given a weight of 0.5, and the photoelectric observations made by Moffett and the APT were assigned a weight of 3. In addition, Szabados gave three

points zero weight, and these are indicated in Figure 2 by open circles.

A least-squares program was used to fit both a line and a parabola to the O-C data. The mean error of a full-weight observation calculated by the program from the residuals was slightly smaller for the parabola than for the line. However, it was found that the probability that the third term in the parabola equation is due to chance deviations from the line is 29.3 percent. In other words, there is almost a 30 percent chance that the amount of curvature given by the parabola equation (or more) is caused by the scatter in the points. Therefore, the elements implied by the line should probably be favored over those implied by the parabola.

The new elements implied by the parabola are:

$$\begin{aligned} \text{JD}_{\text{max}} = & 2433813.526 + 1.9493223 E + 2.5 \times 10^{-11} E^2. & (3) \\ & \pm 0.006 \quad \pm 0.0000011 \quad \pm 2.4 \times 10^{-11} \end{aligned}$$

The new elements implied by the line are:

$$\begin{aligned} \text{JD}_{\text{max}} = & 2433813.530 + 1.9493219 E. & (4) \\ & \pm 0.004 \quad \pm 0.0000010 \end{aligned}$$

Although Kukarkin *et al.* (1971) claimed SU Cas' period probably varies, Szabados concluded that his O-C diagram did not show any changes in period, and that SU Cas' period has been constant since its light variation was discovered. The three points added to Szabados' diagram seem to support this assertion. The new period which Szabados published was 1.949322 days, and this period remains applicable, even twelve years after its publication.

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TABLE I

O-C Values for SU Cas Since 1977

| <u>Observed Maximum</u> (JD) | <u>O-C</u> (days) | <u>Source</u> |
|---------------------------------|----------------------|----------------|
| 2442593.28 | 0.0 | Speil (1985) |
| 2443996.779 | -0.013 | Moffett (1984) |
| 2447419.804 | 0.002 | present paper |

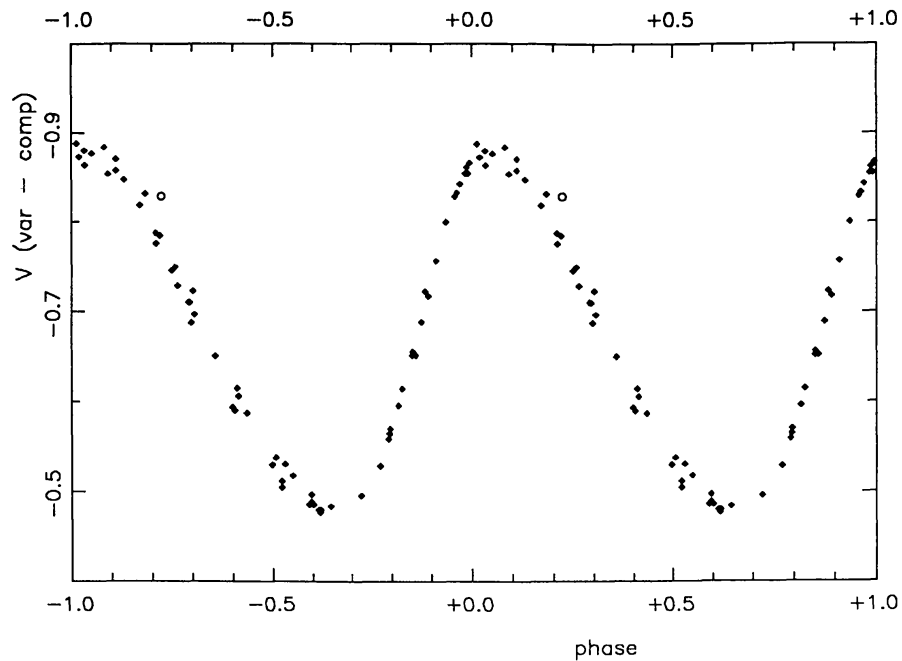


Figure 1. The light curve of SU Cassiopeiae from JD 2446821 through 2447586. Phase is calculated from equation (1). Filled points are APT observations; the open point is of lower weight.

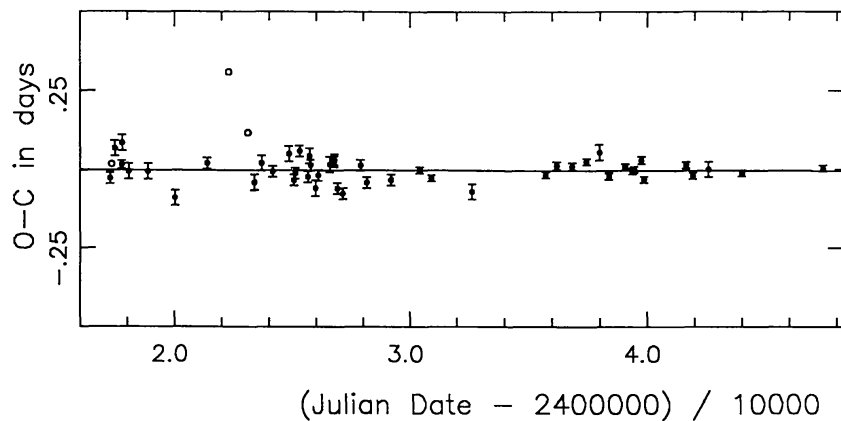


Figure 2. O-C in days plotted against Julian Date for SU Cas. $C = 2441645.910 + 1.949322 E$. The last three points are those which update Szabados' diagram. Open points were assigned zero weight by Szabados.