RECENT PERIOD STUDY OF TWO VARIABLES IN LIBRA

by

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Abstract

New estimates on Harvard patrol plates are used to derive ephemerides for two variables.

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SX Librae

SX Librae (143719) is a Mira type variable star. The General Catalog of Variable Stars (1969) states a variation in photographic magnitude for the star of $10^{m}.4$ at maximum to $15^{m}.2$ at minimum, according to the relation: JD 2428270 + $334^{d}.4$E.

In this paper a new relation that more accurately agrees with the latest available visual data on the star is computed. The Harvard photographic patrol plates (RB) covering the interval JD 2425333 (March, 1928) to JD 2433861 (August, 1951) were utilized.

After identification of the variable, 100 magnitude estimates were recorded, using the magnitude sequence shown on the AAVSO "d" chart for SX Librae. Those comparison stars whose photographic magnitudes appeared to differ from the values shown on the chart were omitted from the study. A graph was constructed plotting magnitude against Julian Date.

Next, using tracing paper, a mean light-curve was obtained. This curve was then placed over individual light cycles that were reasonably well defined, and times of maximum were determined. Twelve maxima were obtained in this manner. I first attempted to refine the current period of the star by applying the method of least squares to these timings. Calculated times of maxima were computed using the elements in the GCVS. This method led to new elements that did not seem to describe the star's activity adequately.

In light of this, a more extensive process was then initiated. Using the twelve maxima, a mean period of $336^{d}.0$ was determined. An early (JD 2426898) well defined maximum was selected as epoch, times of maxima were calculated, and an O-C diagram (Figure 1) was constructed. Next, an unweighted least squares analysis was carried out, leading to a value for the period of $332^{d}.9$, and the line of regression was drawn. The maximum at JD 2427594 was selected as initial epoch. These processes resulted in the following equation:

$$\text{JD } 2427594 + 332^{d}.9E \qquad (1)$$

The new elements were used to calculate the time of maximum for the two visual maxima available. Because only three observers were involved, these maxima must be considered as tentative. The results using equation (1) are listed, together with their corresponding values using the elements listed in the GCVS, in Table I.

TABLE I

Maxima	O-C (days) Equation (1)	O-C (days) GCVS
JD 2441569	-7	-77
JD 2441899	-10	-81

Finally, a light curve (Figure 2) was constructed using equation (1). The brightness of maxima agrees well with the GCVS value, although minimum magnitudes may be slightly fainter than the catalog value.

Although the secular trend of the star's behavior demonstrates a decrease in period from the GCVS value, the scatter among the maxima on Figure 1 indicates that the period itself may be variable.

It is highly recommended that this star be observed more closely, especially during the ascending and minimum branches of its cycle.

C^1 Librae

C^1 Librae is located $\sim 40^s$ east of SX Librae (Figure 3). This star, also variable, had been wrongly identified as SX Librae on AAVSO charts of the area until 1969, when T. Cragg (Mount Wilson) discovered the error.

The period of C^1 Librae was computed in a manner almost identical to that used for SX Librae, using measures on Harvard RB patrol plates.

Because of the paucity of observations at maximum light, a least squares analysis was not carried out on the star. I used the mean period, determined by the first and last maxima, and chose a well defined "bright" maximum as zero point. The following relation was obtained:

$$JD\ 2431237 + 218^d.9E \qquad (2)$$

When an O-C diagram (Figure 4) was constructed using equation (2), it was found that observations of maximum after JD 2430000 could be taking the form of a parabola, indicating a period that is changing at a constant rate. An investigation was carried out adding a third term (KE^2) to equation (2). However, results show that the linear period is far superior when applied to the latest observations.

A satisfactory light curve (Figure 5) was constructed with the aid of equation (2).

To check the validity of the new elements, O-C residuals were determined for three rather uncertain (again, because of the few observers involved) visual estimates of maxima, in 1966 and 1973. Results are listed in Table II.

TABLE II

Maxima	O-C (days)
JD 2439337	1
JD 2439562	7
JD 2442186	4

Although this period must be considered as tentative, it does describe well the activity of C^1 Librae between JD 2431237 and JD 2434000, as well as offering satisfactory predictions

of the later visual timings. Earlier estimates are less well served; discrepancies probably result from irregularities in the period.

The photographic magnitude range, $11^m.4$ at maximum to ($13^m.4$ at minimum and the length of the period, would seem to indicate that C^1 Librae may be a long period variable star.

Again, more estimates, at all phases, would help to ascertain the true nature and type of C^1 Librae.

I would like to express my thanks to the Director of the AAVSO, Janet Akyüz Mattei, for suggesting the topic of this paper and for her many helpful suggestions. Also, I wish to express my thanks to Dr. Martha Liller for making the Harvard patrol plates available to me, and to Dr. Charles A. Whitney for his advice on interpretation of the O-C diagrams.

REFERENCE

Kukarkin, B. V. et al. 1969, General Catalog of Variable Stars, Moscow.

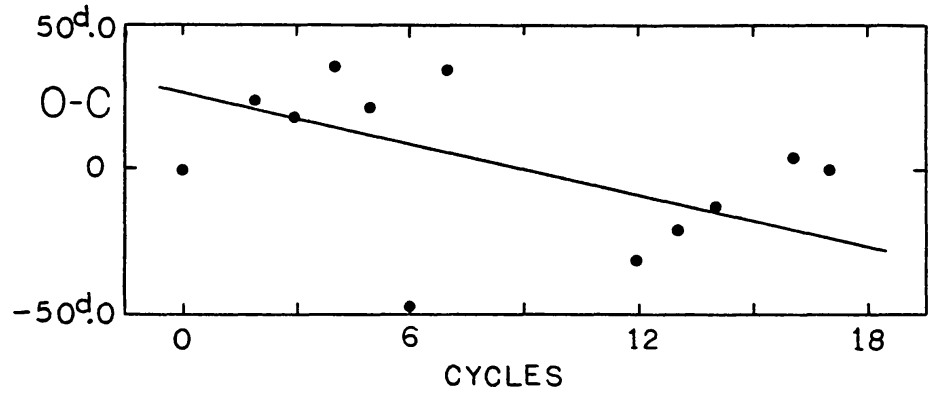

Figure 1. O-C diagram for SX Librae, computed from JD 2426898 + $336^d.0E$. The line represents the least squares solution giving a period of $332^d.9$. All maxima were given the same weight in the investigation.

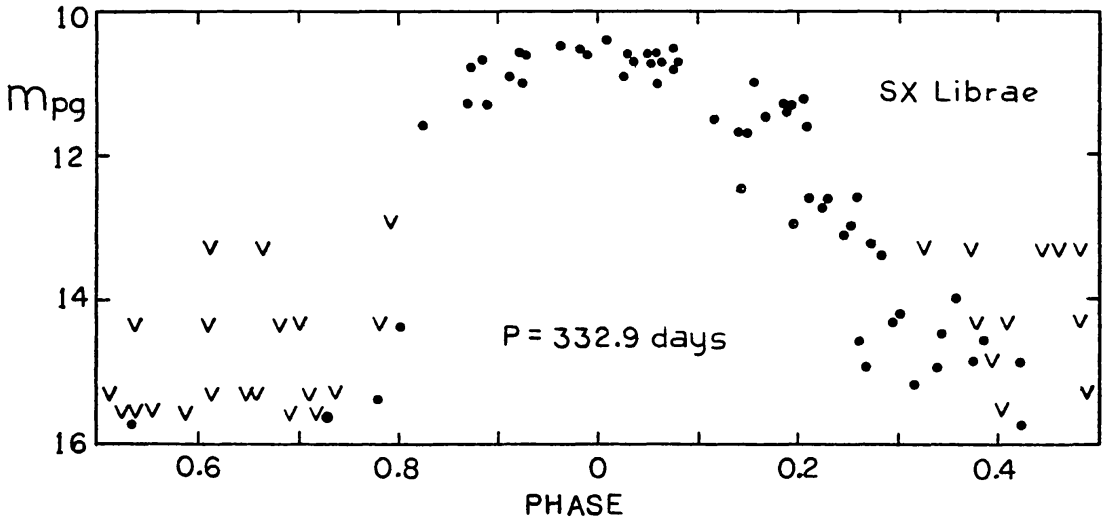

Figure 2. Photographic light curve with phases computed from equation (1).

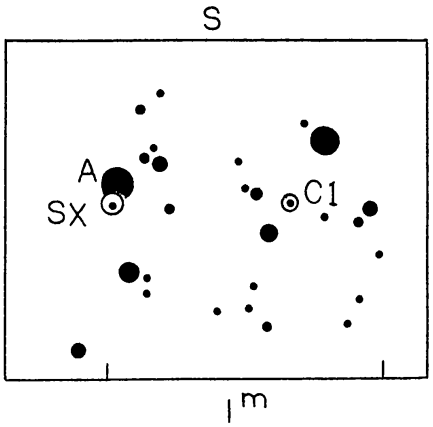

Figure 3. The location of C^1 Librae relative to SX Librae. Star A = BD -19°3943.

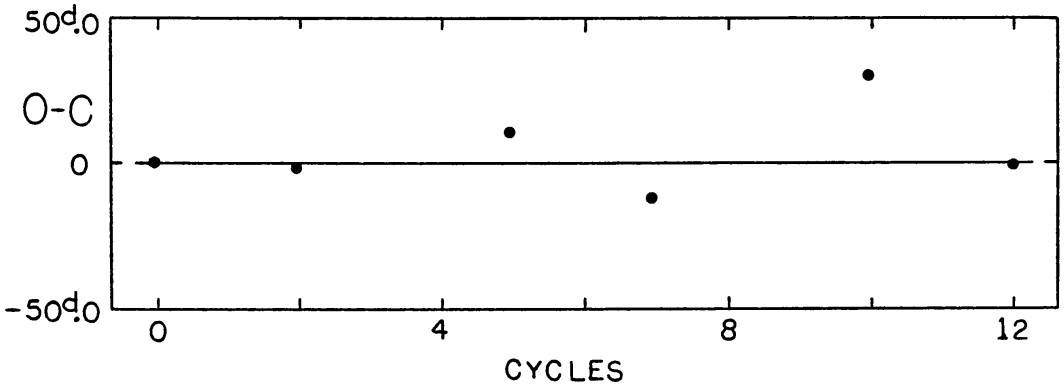

Figure 4. O-C diagram for C^1 Librae, computed from JD 2431237 + $218^d.9$E.

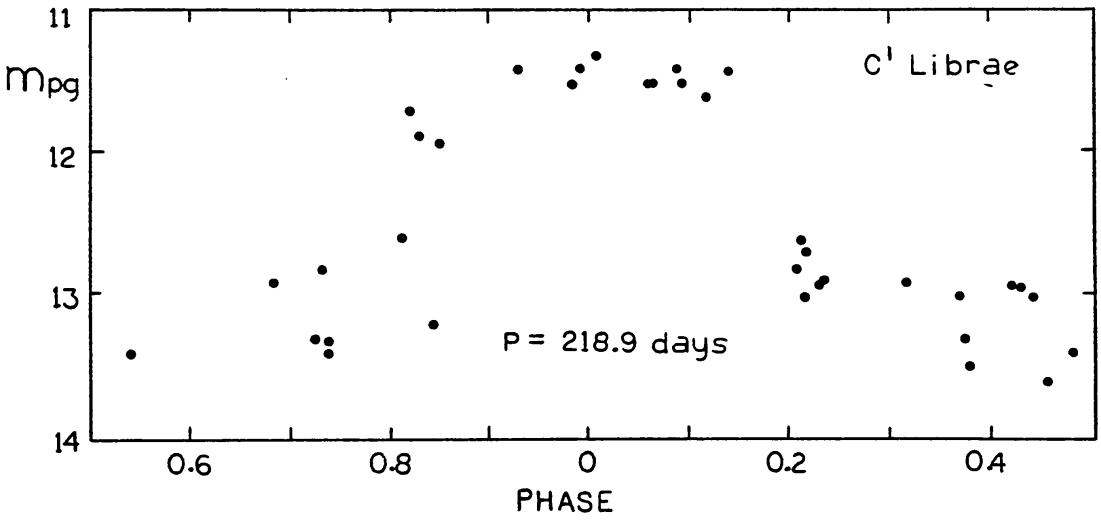

Figure 5. Photographic light curve for C^1 Librae with phases computed from equation (2).