# CONFIRMATION OF THE CHANGING PERIOD OF DL CASSIOPEIAE

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Received 12 August 1988

**Abstract**

An extended O-C diagram for the Cepheid variable DL Cas confirms that the period has increased. The new parabolic elements are:

$$JD_{(max)} = 2437932.137 + 8.000536\ E + 0.000000095\ E^2.$$

The data do not, however, distinguish between the parabolic and other functional forms for the elements.

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Conflicting reports on the changing period of DL Cas warranted a closer study of this Cepheid. Hoffleit (1971) concluded that the period had increased. Szabados (1980) stated that his evidence did not confirm this conclusion.

To see what the recent data on DL Cas would show, I inspected Maria Mitchell Observatory plates taken from 1971 to 1987, making magnitude estimates under low-power magnification. Phases were computed with heliocentric elements by Szabados,

$$JD_{(max)} = 2442780.334 + 8.0006690\ E, \qquad (1)$$

and magnitudes were plotted against phase for separate time intervals. To find O-C, I superimposed each of the separate plots over a plot of the average light curve. Since the average curve had been marked with what was adopted as the maximum, each plot could be fitted to the average and could be marked where the adopted maximum fell on it. The phase of this maximum is the deviation, in units of phase, of the observed maximum from the maximum calculated by equation (1). That is, it is (O-C)/P with O, C, and P all expressed in days. An estimate of the error in (O-C)/P was made by moving the plot along the phase axis until the fit was no longer believable. This was done on either side of the best fit. Figure 1 shows the O-C diagram, with these error bars.

Figure 1 also includes data from the unpublished observations, taken from plates in the Maria Mitchell and Harvard College Observatory collections, that Hoffleit (1971) had used in her study. Most points in Figure 1 refer to thousand day intervals. The intervals that had very few observations were grouped with adjacent ones to better define the light curves. There are sixteen points from the new data, and sixteen from Hoffleit's. The remaining four points (shown as open circles) came from published Julian dates and magnitudes by Arp *et al.* (1959), Mitchell *et al.* (1964), Oosterhoff (1960), and Szabados (1980). All of these data were processed in the same way as the recent Maria Mitchell data.

The curve in Figure 1 is a parabola fitted to the O-C points by least squares. The new parabolic elements are:

$$JD_{(max)} = \underset{\pm 0.038}{2437932.137} + \underset{\pm 0.000040}{8.000536}\ E + \underset{\pm 0.000000025}{0.000000095}\ E^2. \qquad (2)$$

The corresponding rate of change of period in days per million years is +8.7 ± 2.2, or somewhat faster than one cycle per million years.

A line through the points did not fit as well. It is possible, however, that the points could be fitted to other upwardly curving functions, such as two connected line segments.

Szabados' (1980) rejection of an increasing period was based on data after JD 2425000. Figure 1 confirms his conclusion that a constant period is satisfactory for this portion. The inclusion of the earlier data, however, shows a clear change in the slope from negative to positive. Thus the new work confirms Hoffleit's conclusion that the period of DL Cas has indeed changed; it has increased, though it is still not possible to tell if the increase was gradual or sudden.

This research was supported by funds from the National Science Foundation grant AST 8619885. I would like to thank Dr. Emilia Belserene for her support and advice.

## REFERENCES

Arp, H., Sandage, A., and Stevens, C. 1959, **Astrophys. Journ. 130,** 80.
Hoffleit, D. 1971, **Inf. Bull. Var. Stars,** No. 607.
Mitchell, R. I., Iriarte, B., Steinmetz, D., and Johnson, H. L. 1964, **Bol. Obs. Tonanzintla y Tacubaya 3,** 153.
Oosterhoff, P. T. 1960, **Bull. Astron. Inst. Netherlands 15,** 501.
Szabados, L. 1980, **Budapest Mitteilungen,** No. 76.

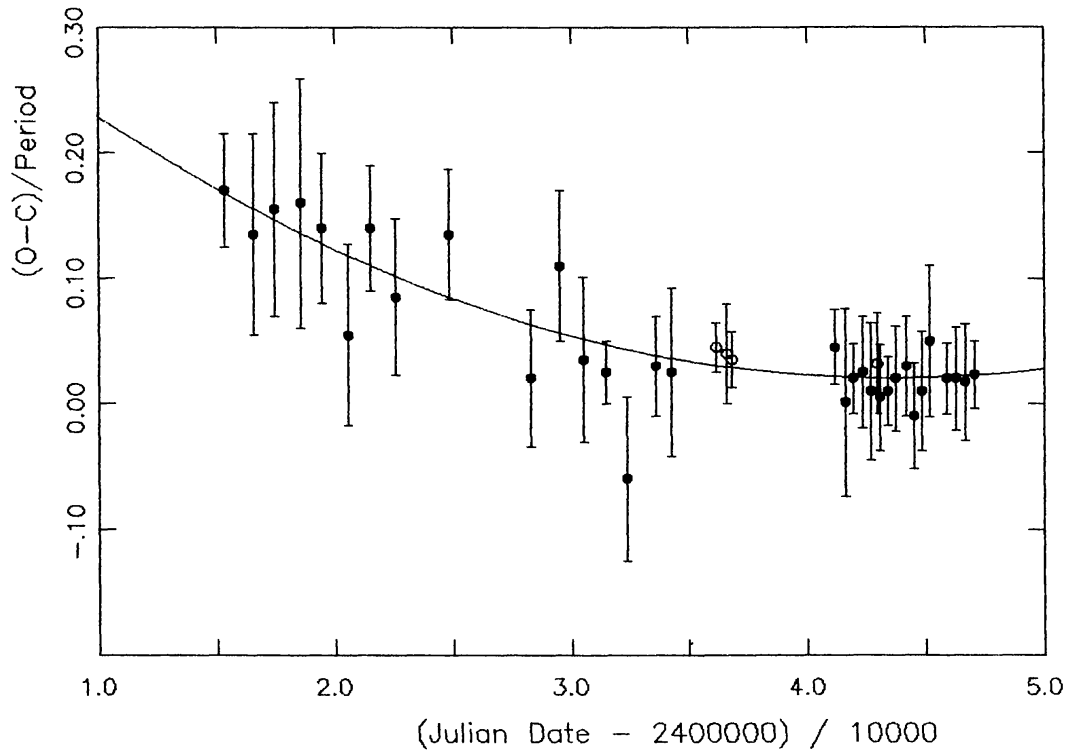


Figure 1. O-C diagram for DL Cas. C is defined by equation (1). The parabola corresponds to equation (2).