

SORTING OUT THE PERIOD OF XY CASSIOPEIAE

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Abstract

A survey of Harvard College Observatory and Maria Mitchell Observatory plates was undertaken to clear up confusion surrounding the period of the 10th magnitude Cepheid, XY Cassiopeiae. New elements indicate a probable decrease in the period but do not confirm other period changes referred to in earlier studies.

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There seems to be some confusion over the period of the 10th magnitude Cepheid variable XY Cassiopeiae (SAO 021746). Volume I of the 3rd edition of the **General Catalogue of Variable Stars** (Kukarkin et al. 1969) reports it as having a period of 4.501601 days, the listed source being Oosterhoff (1960). Yet in Oosterhoff's paper itself, XY Cas is given the elements

$$JD_{\max} = 2436811.700 + 4.501691 E. \quad (1)$$

Most likely, the discrepancy is the result of a typographical error. In any case, this study of the star suggests that the period differs from either of those.

Period changes have been reported by Robinson (1929), Dunst (1932), Soloviev (1954), and Tsarevsky (1959). Oosterhoff (1960), Mitchell et al. (1964), and Szabados (1977) represent the data by constant periods.

The present study uses plates taken and stored at the Maria Mitchell Observatory, ranging from 1971 to 1985, along with Harvard College Observatory and Damon patrol plates from 1900 to 1952 and 1971 to 1985. Visual estimates were made relative to a local sequence on approximately 800 plates. Magnitudes of the sequence stars were determined by "flyspanking" (Stock and Williams 1962; Dinerstein 1973) with B magnitudes in NGC 225 (Hoag et al. 1961) as comparison. The new magnitudes, differing from those published by Payne et al. (1931), led to a photographic range of 10.6 to 11.7, for XY Cas. Szabados (1977) gives B = 10.58 to 11.40.

Light curves were drawn up for groups of years using Maria Mitchell Observatory software. An O-C value was assigned for each group by comparing it with a mean light curve on which a nominal maximum had been adopted. These values of O-C are plotted against mean Julian Date in Figures 1 and 2.

A least-squares analysis of the O-C diagram showed that a parabola offered a better fit than a straight line. Indeed, the F-test (Pringle 1975) attached a 98% probability to the notion that the parabola was statistically significant. The parabola is drawn in Figure 1. It corresponds to the following elements

$$JD_{\max} = 2432652.395 + 4.501712 E - 9.8 \times 10^{-9} E^2. \quad (2)$$

$$\pm 0.023 \pm 0.000005 \quad \pm 3.9 \times 10^{-9}$$

The diagram can also be interpreted (Figure 2) as two straight lines corresponding to the elements

$$JD_{\max} = 2423941.527 + 4.501737 E \quad (3)$$

$$\pm 0.010 \pm 0.000010$$

from JD 2415700 to 2436900, after which there is a gap, and

$$JD_{\max} = 2443118.829 + 4.501520 E \quad (4)$$

$$\pm 0.016 \pm 0.000048$$

after JD 2441000. According to either interpretation there has been a period decrease, either smoothly at the average rate of 1.6 days per million years, or more abruptly, by 0.000217 day sometime between JD 2436900 and 2441000. The previously reported period changes are, however, not confirmed by the present work nor by Szabados (1977), who gives

$$JD_{\max} = 2442006.786 + 2.501697 E \quad (5)$$

for JD 2419403 to 2442006.

Obviously, more work needs to be done on this star in order to determine whether this newly determined period change is also illusory, or, if it is real, whether the star is continually varying its period or underwent a single dramatic change. For the present the elements of equation (4), taken from the line which best fits the 11 points after JD 2441000, would seem to offer the best representation for the recent activity of XY Cas.

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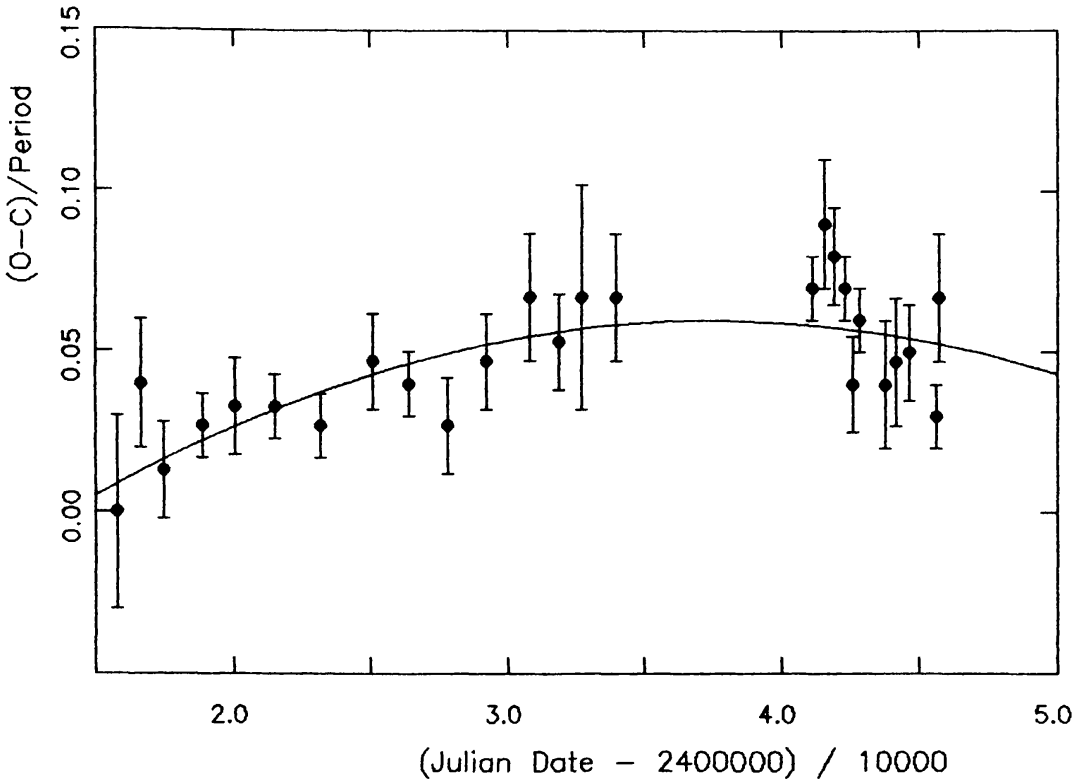


Figure 1. O-C diagram for XY Cas, where C is defined by the elements $JD_{\text{max}} = 2436811.700 + 4.501691 E$. A parabola is shown as the best fit.

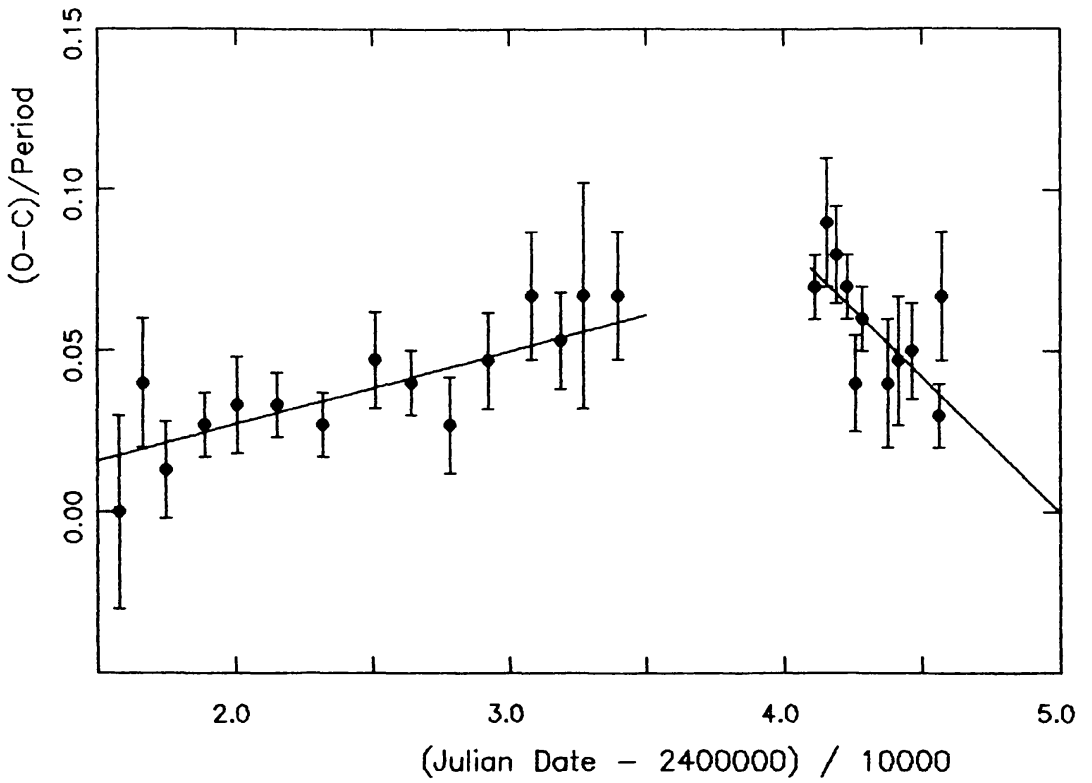


Figure 2. The data of Figure 1 represented by two straight lines.