

RECENT DATA ON IU CYGNI

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Abstract

IU Cygni is a 31-day Cepheid with a period that varies strongly. The Maria Mitchell data for 1978-1990 are satisfied by these elements:

$$JD_{\max} = 2446129.322 + 31.183 E + 0.00066 E^2.$$

This implies a period increasing at an average rate of $0.00049 + 0.00009$ cycle per year. Representation by one or more abrupt changes during these years is also possible.

IU Cygni has been tentatively classified as a Population II, W Virginis Cepheid, "CW:" in the fourth edition of the *General Catalogue of Variable Stars* (Kholopov *et al.* 1985)(GCVS). It had been listed as a classical Cepheid in the third edition. It has a period that varies strongly, which may, in part, be the reason for changing the classification.

The Maria Mitchell Observatory (MMO) has plates centered near IU Cygni beginning in 1978. Photographic magnitudes were estimated for 402 plates and were grouped into five 2-3 year intervals. A phase vs. magnitude graph was made for each group using the following elements, which had been used by Wachmann (1966):

$$JD_{\max} = 2433600.83 + 31.22266 E. \quad (1)$$

The phase graphs showed that the maxima were not occurring at the same calculated phase each cycle. For example, in 1978 the maxima were occurring when the calculated phase was near 0.5 period whereas in 1990 they were occurring when the calculated phase was near 0.2.

Figure 1 is an O-C diagram for which C, the calculated time of maximum, is defined according to equation (1). The Maria Mitchell results are shown as open circles. The curve through them is a parabola calculated by least squares. The corresponding elements are:

$$JD_{\max} = 2446129.3 + 31.183 E + 0.00066 E^2. \quad (2)$$

$$\begin{array}{ccc} \pm 0.2 & \pm 0.004 & \pm 0.00012 \end{array}$$

These elements suggest a period change at the rate of $+0.00049 \pm 0.00009$ cycle per year. However, this parabola was made from only five data points. Two or more line segments, representing abrupt change, would have done just as well. To decide between the two groupings would have required more maxima than are shown on the MMO plates.

The solid circles in Figure 1 are the observed maxima listed by Wachmann (1966). The line segments correspond to the following elements taken from the GCVS, which relied on Wachmann's paper:

$$\begin{aligned} \text{JD } 2417800\text{-}2429250, & \quad \text{JD}_{\text{max}} = 2429157.6 + 31.22266 E; & (3) \\ \text{JD } 2432700\text{-}2435400, & \quad \text{JD}_{\text{max}} = 2433601.3 + 31.1550 E; & (4) \\ \text{after JD } 2435400, & \quad \text{JD}_{\text{max}} = 2438103.645 + 31.31451 E. & (5) \end{aligned}$$

There are some problems with this interpretation of the O-C diagram. There is no clue as to the period between the first and second line segments. Also, there is a substantial gap between Wachmann's and the MMO data. The GCVS tacitly implies that equation (5) is valid through 1982, but these elements are only justified by Wachmann's data from JD 2435400 (1955) to 2437135 (1960) or, in any case, no later than the listed epoch at JD 2438103 (1962). They clearly do not work for the years beginning from 1978. MMO plates before 1978 with IU Cygni not so well centered have not yet been analyzed so it is not known how well equation (5) would have held up from 1962 to 1978. It seems likely that all of the representations, the parabola as well as the three line segments, are oversimplifications of a more complicated situation.

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References

- Kholopov, P. N. *et al.* 1985, *General Catalogue of Variable Stars*, Fourth Edition, Moscow.
 Wachmann, A. A. 1966, *Astron. Abhand. Hamburger Stern.*, Band VI, Nr. 4.

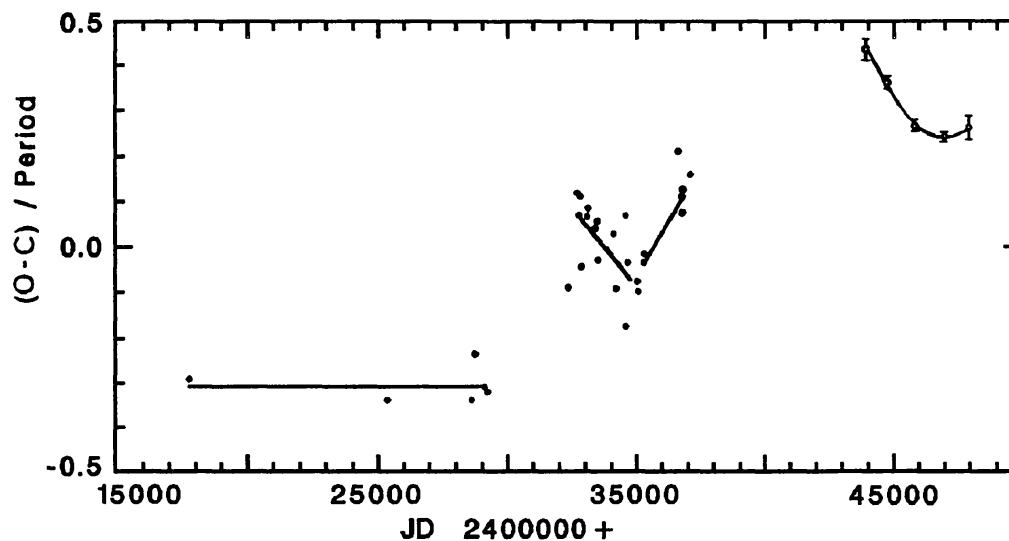


Figure 1. Composite O-C diagram incorporating Wachmann's and MMO's 1978-1990 data. Points are maxima from Wachmann, open circles are MMO maxima, lines represent the period for each JD set, and the parabola represents the current data. C is defined by equation (1).