# REVISED PERIOD FOR CT ORIONIS

DANIEL H. HOROWITZ
5930 Sanford road
Houston, TX 77096

Abstract

The star CT Orionis is listed in the GCVS as an RV Tauri variable with a period of 135.52 days. Based on a year of study, during which an AAVSO chart was prepared, a revised period of at most 66 and quite likely as short as 33 days was determined. There is a hint that the light curve exhibits alternating deep and shallow minima which is characteristic of RV Tauri variables, in which case the 66-day period is valid. However, the differences in the magnitudes of alternate minima are quite small and lie within the range of observational error, so a 33-day period with a Cepheid-like pattern is also likely. Additional observations are needed to decide if CT Orionis should be reclassified or if it is an RV Tauri member that might possibly be experiencing atypical behavior.

* * * * *

## 1. Introduction

The Third Edition of the General Catalogue of Variable Stars (Kukarkin et al. 1969) lists CT Orionis as an RV Tauri variable with a period of 135.52 days.

A visual observing program was started in January 1985 and has extended until May 1986, with an intervening gap of five months (May to October, 1985) when the star was close to the sun or too low in the sky. A total Of 94 measurements was recorded.

## 2. Observations

Initially no comparison chart was available for estimating magnitudes. Accordingly, several neighbor stars spanning the observed magnitude range of CT Orionis were selected as references and a relative ranking scale of magnitudes was established. Subsequently, Dr. Dennis Dawson of San Diego State University analyzed these stars photometrically, and the B and B-V results were converted to visual magnitudes using an equation proposed by Stanton (1981). The comparison sequence is illustrated in Figure 1, which is a portion of a newly approved AAVSO finder and comparison chart.

Observed magnitudes range from 10.0 to 11.2 and are plotted in Figure 2. Besides normal observational errors, additional scatter was undoubtedly introduced when the more crudely subdivided ranked magnitudes were converted to absolute magnitudes following the photometric survey.

## 3. Analysis

A modified Jurkevich periodogram program (DuPuy and Hoffman 1985) was employed to make an objective estimate of the period. A value of 33.2 days was obtained (Figure 3), considerably less than the reported 135.52 days. The following elements were determined from the program:

$$JD(min) = 2446537.6 + 33.2\ E \qquad (1)$$

A phase plot based on these elements, and with zero phase corresponding to minimum brightness, appears in Figure 4. The scatter in magnitude about a given phase value seems rather high. Whether this is entirely the result of observational error and the process of converting magnitudes, or a reflection of irregularities in pulsation, cannot be answered at present.

A smoother phase plot can be obtained by averaging magnitudes in phase segments. Figure 5 is a plot based on 15 phase 'bins', each point representing from 4 to 8 observations. A Cepheid-like curve with a possible shoulder near phase 0.6 is evident.

## 4. Discussion

That the observed cyclicity is decidedly shorter than the 135-day period listed in the catalogue is undeniable. The question is whether CT Orionis is an RV Tauri member. We recall that the characteristic light-curve signature of an RV Tauri variable is an alternation of deep and shallow minima, with intervening maxima of approximately equal brightness.

Examination of Figure 2 reveals a hint of alternating deep and shallow minima, in which case the true period (some might say the "double" period) should be twice as long, or 66.5 days. A critic could argue, however, that too few cycles have been monitored to substantiate the RV Tauri behavior, especially since the difference between alternate minima is only 0.1 to 0.2 magnitude, which is comparable to the error level of the estimates.

If the true period is 33 days, the RV Tauri classification of CT Orionis is called into question. Not only would the light curve be uncharacteristic of the group, the period is shorter than that for most RV Tauris, which typically ranges from 50 to 145 days (see Table 2 in Dawson 1979). Still, declassification would be premature. The Cepheid-like character it currently manifests also occurs in other RV Tauris during certain time spans; for example in UZ Oph and SU Gem, two other members I am monitoring. Whereas the 33-day period is atypically short for RV Tauris, at least one other member has a period this short, viz., SX Cen (Table 2 in Dawson 1979). Finally, a feature revealed through color photometry should be noted; namely, in CT Orionis B-V starts decreasing before V starts brightening, and that is one mark of RV Tauri behavior (Dennis Dawson, personal communication).

## 5. Acknowledgement

I thank Dr. Dennis Dawson for suggesting to me that I monitor this variable, for taking time to photometrically measure my sequence stars, and for generally encouraging my efforts. This project is a sterling example of the result which can be achieved when professional and amateur join hands.

## REFERENCES

Dawson, D. W. 1979, Astrophys. Jour. Suppl. Ser. 41, 97.
DuPuy, D. L. and Hoffman, G. A. 1985, Int. Amateur-Prof. Photoelec. Photom. Comm. 20, 1.
Kukarkin, B. V. et al. 1969, General Catalogue of Variable Stars, 3rd Edition, Moscow.
Stanton, R. H. 1981, Journ. Amer. Assoc. Var. Star Obs. 10, 1.

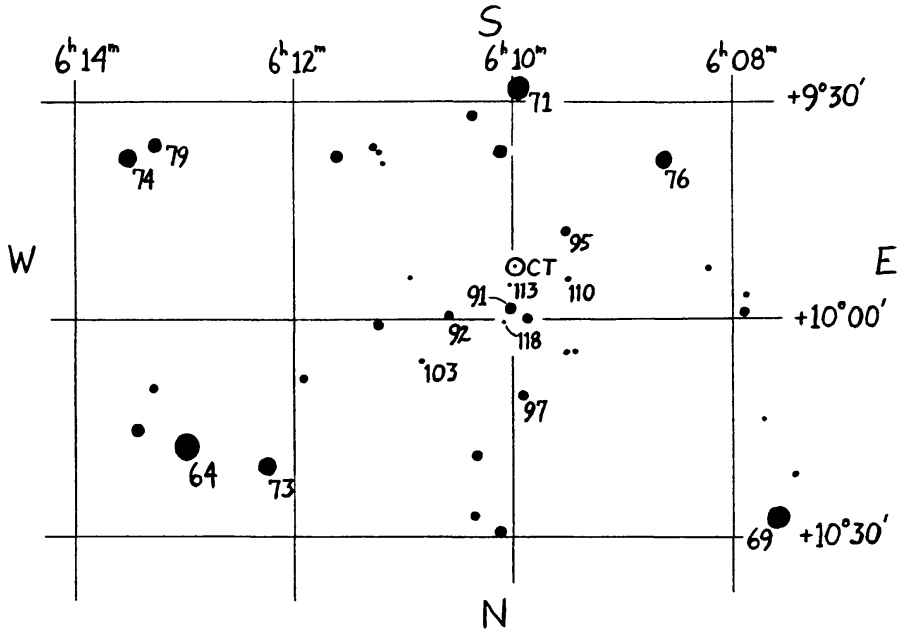


Figure 1. CT Orionis finder and comparison chart.

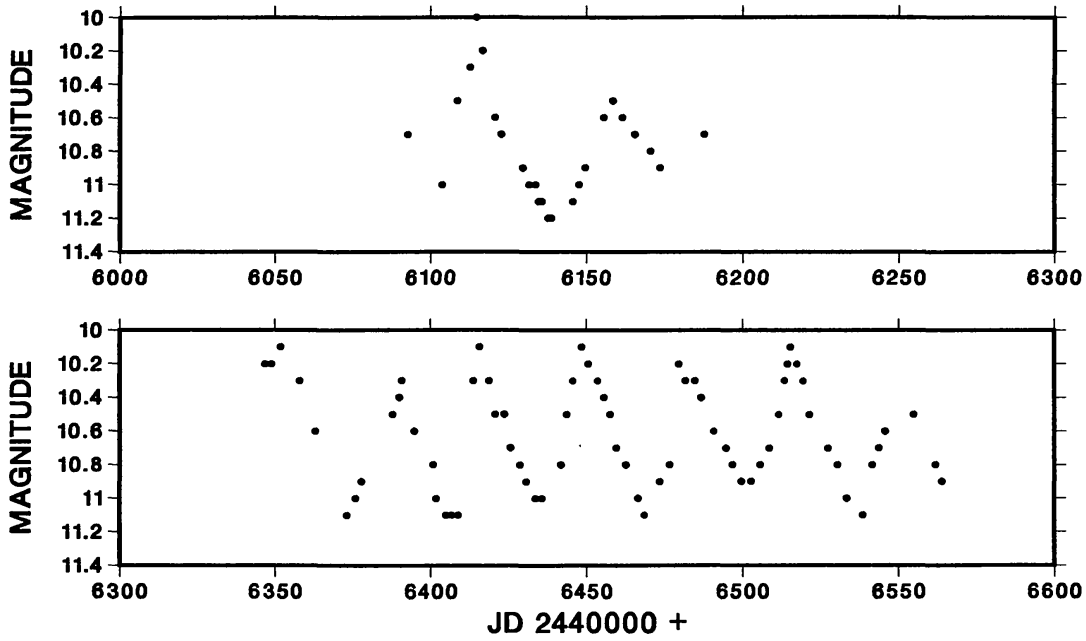


Figure 2. Light curve of CT Orionis based on visual estimates.

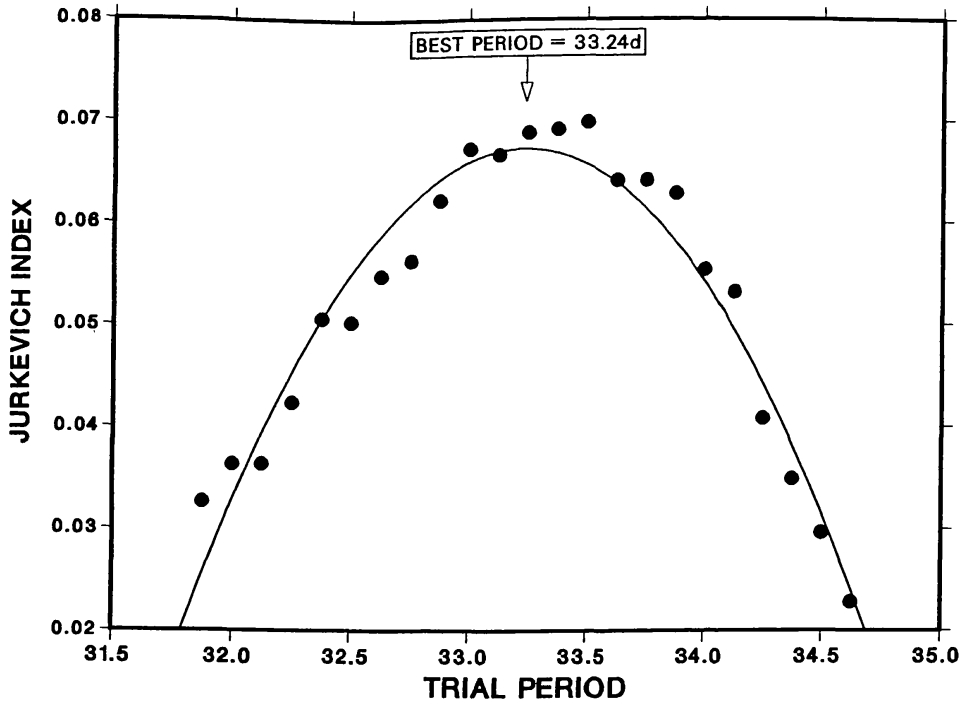


Figure 3. Modified Jurkevich periodogram of CT Orionis. Best period corresponds to maximum of quadratic curve, which represents a least-square fit through the points.

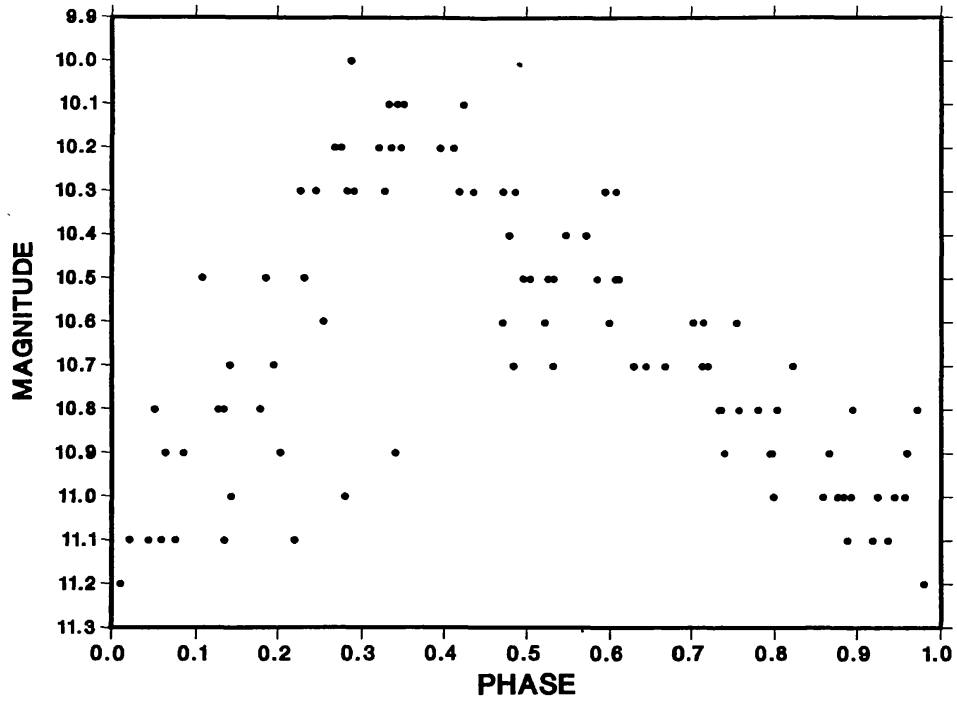


Figure 4. Magnitude-phase diagram of CT Orionis.

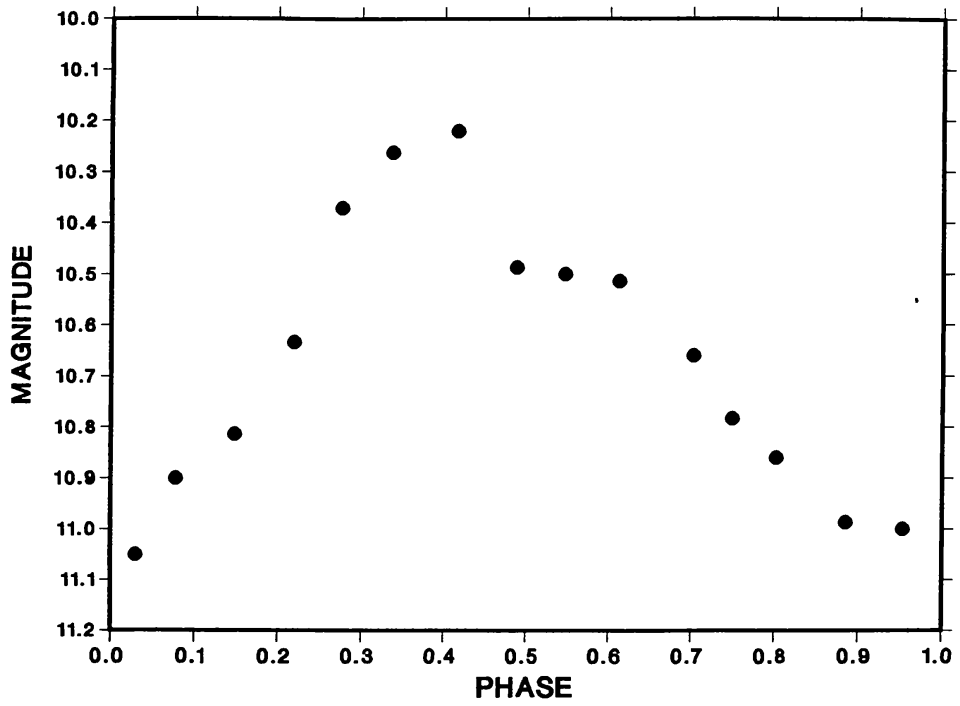


Figure 5. Smoothed magnitude-phase diagram of CT Orionis. Each point represents an average of 4 to 8 observations.