THE ERRATIC PERIOD OF V759 CYGNI

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Abstract

The RR Lyrae star V759 Cygni of subclass RRab is shown to have a pulsation period which varies considerably in the 5th decimal place in no simple manner.

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The RR Lyrae variable V759 Cygni was studied by Tsesevich, who employed old Moscow, Simeise, Harvard, and Odessa photographs, as well as visual observations. His report defines preliminary elements

$$JD_{max} = 2433447.437 + 0.360021\ n, \quad (1)$$

revises them to

$$JD_{max} = 2435363.422 + 0.36001476\ n, \quad (2)$$

and concludes from study of the O-C diagram that the period demonstrates marked changes (Tsesevich 1966).

V759 Cyg is visible on about 460 plates taken at the Nantucket Maria Mitchell Observatory between 1950 and 1984. Nantucket plates taken between 1930 and 1950 are also available, but the Tsesevich data for this period are sufficiently thorough. Magnitude estimates were made relative to sequence stars listed in the Tsesevich data. B magnitudes for the sequence stars were determined by flyspanker comparison with a nearby star field with published magnitudes (Wehinger and Hidajat 1973). The derived magnitudes are listed in Table I. From these data, V759 Cyg was found to vary in magnitude approximately between 12.5 and 14.0.

Light curves were plotted for intervals ranging from one to three years, depending on the number of observations available per interval. Times of observed maxima derived from the curves were used to find O-C values (deviations of observed maxima from maxima calculated according to equation (1)). These O-C values were then plotted against Julian Day in Figure 1.

Also shown in Figure 1 are the Tsesevich data. Clearly the O-C diagram shows that the star is not behaving in any simple manner. It is convenient, however, to draw six lines through the points in order to gain some rough understanding of how the period (which is related to the slope of the lines) is changing. These are shown in Figure 1 and have been fitted through a least squares analysis. Table II shows the epoch and period corresponding to each of these segments. Perhaps the most conspicuous feature of the more recent data is a sharp decrease in period occurring near JD 2439000. What could be the cause of the star's erratic behavior?

It would certainly be interesting to fill in the gap on the O-C diagram between JD 2417554 and 2425765. None of the available data would encourage one to predict a smooth curve between the points on either side of the gap. Further work filling in the gap would be useful.

Further inspection of Figure 1 leads one to try fitting parabolas to some of the more recent observations. Again, the curve-fitting is merely an aid in visualizing the changing period and has no astrophysical implications.

Two parabolas were fitted by least squares analysis to the intervals JD 2433515 to 2438421 and JD 2438400 to 2445705, as shown in Figure 2.

This analysis resulted in the new elements,

$$JD_{max} = \underset{\pm 0.007}{2435882.689} + \underset{\pm 0.00000010}{0.3600501}\, n + \underset{\pm 0.30 \times 10^{-9}}{2.26 \times 10^{-9}}\, n^2, \qquad (3)$$

for the interval JD 2433515 to 2438421. These elements imply a rate of change of period in cycles per cycle of $1.26 \times 10^{-8} \pm 0.17 \times 10^{-8}$ or $1.28 \times 10^{-5} \pm 0.17 \times 10^{-5}$ cycles per year.

Similarly, the new elements,

$$JD_{max} = \underset{\pm 0.005}{2444163.736} + \underset{\pm 0.0000005}{0.3600312}\, n + \underset{\pm 0.74 \times 10^{-10}}{7.21 \times 10^{-10}}\, n^2, \qquad (4)$$

resulted from the parabola fitted to the interval JD 2438400 to 2445705. These elements imply a rate of change of period in cycles per cycle of $4.00 \times 10^{-9} \pm 0.41 \times 10^{-9}$ or $4.06 \times 10^{-6} \pm 0.41 \times 10^{-6}$ cycles per year.

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REFERENCES

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Wehinger, P. and Hidajat, B. 1973, Astron. Journ. 78, 401.

TABLE I

Comparison Star Sequence for V759 Cygni

Sequence Star	B magnitude
u	11.8
s	12.9
k	13.0
a	13.0
b	13.2
e	13.7
c	14.5

TABLE II

Segments of O-C Diagram for V759 Cygni

Interval	No. of Points	Epoch	Period
JD 2414430 2417554	4	2415601.133 ±0.001	0.3600125 ±0.0000003
2425766 2432832	13	2429159.608 ±0.004	0.3600153 ±0.0000004
2433515 2435869	16	2434702.116 ±0.005	0.3600332 ±0.0000021
2435724 2438421	17	2437166.310 ±0.007	0.3600639 ±0.0000030
2438400 2441199	5	2439251.016 ±0.002	0.3600240 ±0.0000006
2441199 2445705	7	2443192.274 ±0.006	0.3600397 ±0.0000014

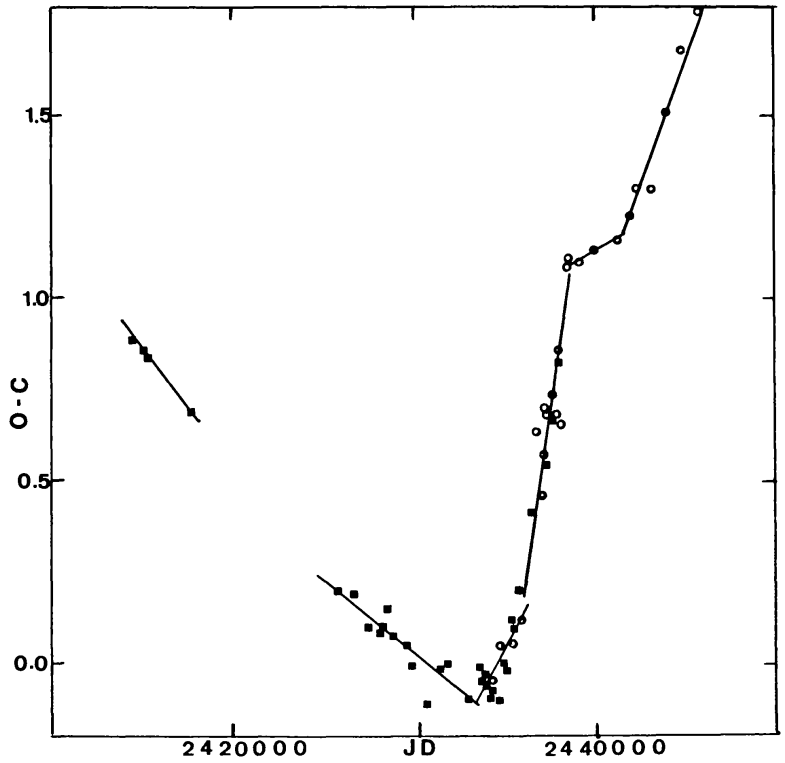

Figure 1. O-C diagram for V759 Cyg. Open circles are Nantucket data; filled squares are Tsesevich data. The heavy lines represent the least squares solutions for elements given in Table II.

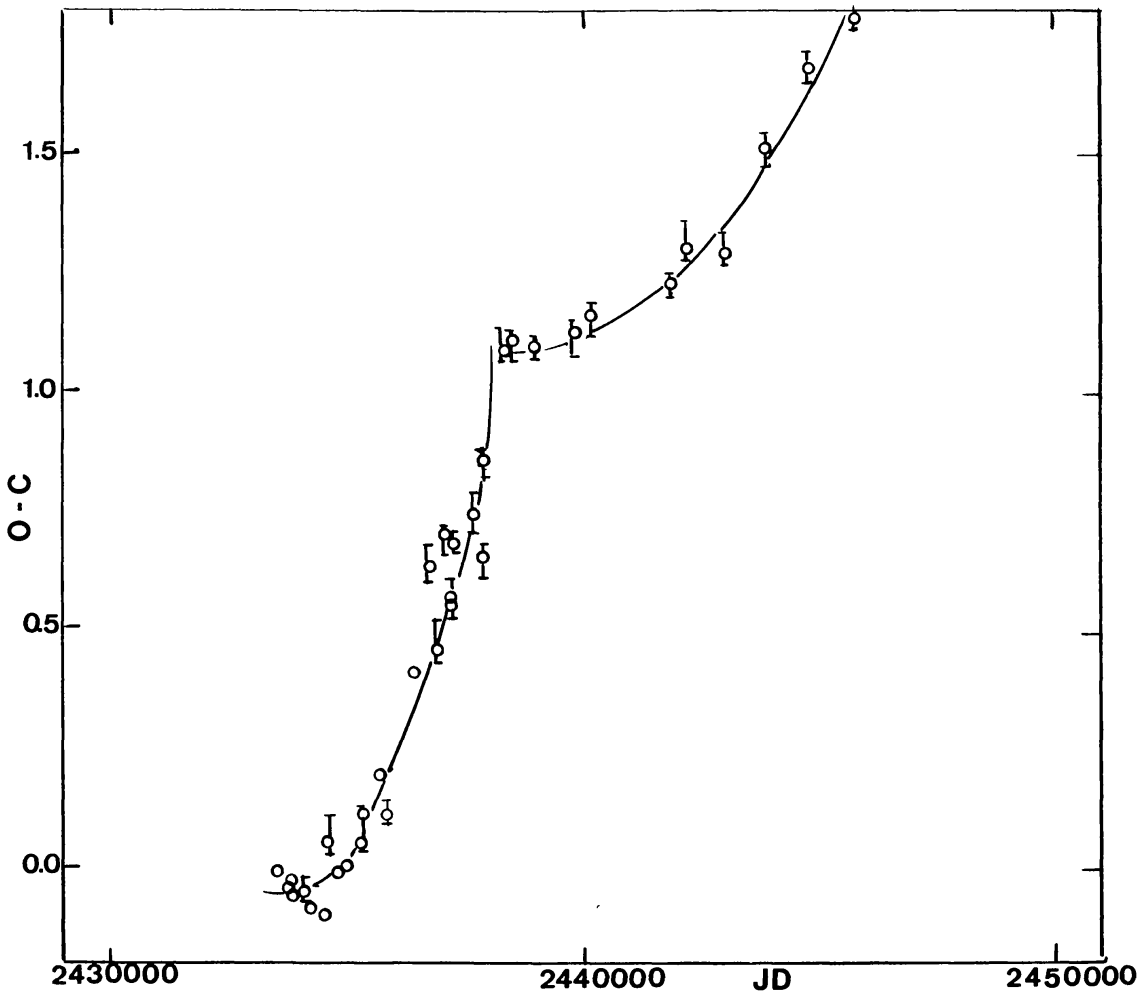

Figure 2. Least squares analysis fit of 2 parabolas to O-C diagram for V759 Cyg. Intervals fitted are JD 2433515 to 2438421 and JD 2438400 to 2445705.