THE PERIODS OF TY AND TZ CANES VENATICI

LAUREN V. JONES
Maria Mitchell Observatory
Nantucket, MA 02554

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Abstract

The periods of TY and TZ Canes Venatici, both RR Lyrae stars, are studied by means of O-C diagrams. The diagram for TY CVn is definitely not linear but the limited amount of data do not define the functional form. Linear elements approximating the behavior in 1977-1987 are:

$$JD_{(max)} = 2445294.188 + 0.51344266\ E.$$

TZ CVn seems to have a constant period, although slightly different from the published value. The new elements are:

$$JD_{(max)} = 2434967.113 + 0.55187911\ E.$$

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TY CVn is listed in the fourth edition of the **General Catalogue of Variable Stars** (Kholopov et al. 1985) (GCVS) as an RR Lyrae star, subclass RRab, with the following elements:

$$JD_{(max)} = 2435929.430 + 0.5134427\ E. \qquad (1)$$

Kurochkin (1959) used these elements in the determination of his O-C for TY CVn (his number 1249). Similar data taken from the plates at Maria Mitchell Observatory (MMO) were reduced with the same elements. Figure 1 is the combined O-C diagram. It is clear that the period has not been constant. Each of the MMO points is based on a mean light curve representing several months of data, analyzed with a non-linear least-squares method. These data taken alone seem to define a portion of a sine wave lasting one fourth of a cycle, but the data are clearly insufficient to verify this form for the period change and Kurochkin's points do not confirm the impression of a sine wave.

Kurochkin's O-C data points for TY CVn seem to be taken from observations of maxima on individual nights. This means that his data points are less precise, as the probability for scatter from night to night is greater than that of data averaged together over a period of several months. Thus, the accuracy with which Kurochkin's points were found must be taken into consideration when viewing the figure.

Sections of the O-C diagram can be approximated equally well by other functions. A parabola can be fit using the least squares method. Figure 2 is the O-C diagram of the data taken at MMO. Notice that the position of the earliest data seems to indicate that the parabola is not the best-fitting function for these data. Figure 3 is the O-C diagram of all of the MMO data except the first point. The parabola clearly satisfies the second set of data points within the error bars. It implies the following new elements:

$$JD_{(max)} = \underset{\pm 0.003}{2444366.911} + \underset{\pm 0.00000018}{0.51344507} - \underset{\pm 0.37 \times 10^{-10}}{6.23 \times 10^{-8}} E^2 \qquad (2)$$

There is no good reason to exclude the earliest point, however. This causes one to think that other functional forms might be better than the parabola.

In an attempt to make another prediction, I put least square line segments through data MMO points; the slope of the first line segment is clearly positive and the slope of the second one is close to zero (Figure 1). The corresponding linear elements are:

for JD 2440223-2443159:

$$JD_{(max)} = \underset{\pm 0.001}{2441658.982} + \underset{\pm 0.00000010}{0.51345210}\ E; \qquad (3)$$

and for JD 2443159-2446891:

$$JD_{(max)} = \underset{\pm 0.001}{2445294.188} + \underset{\pm 0.0000006}{0.5134427}\ E. \qquad (4)$$

Other functions with changing slope could be chosen instead. The times of future maxima of TY CVn are necessarily unpredictable.

TZ CVn is listed in the fourth edition of the GCVS as an RR Lyrae star with the following elements:

$$JD_{(max)} = 2435953.324 + 0.5518794\ E. \qquad (5)$$

Figure 4 is an O-C diagram based on these elements. The open circles are data from Kurochkin (1959) and the closed circles are MMO data. On this diagram the linearity, and therefore constancy of the period, is quite prominent. A least-squares parabola through the points is not very different from the least-squares line, and the F-Test (Pringle 1975) showed that the parabola was not significantly better. The line corresponds to the following elements:

$$JD_{(max)} = \underset{\pm 0.003}{2434967.113} + \underset{\pm 0.00000028}{0.55187911}\ E. \qquad (6)$$

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Kurochkin, N. E. 1959, **Variable Stars (Russian) 12**, 102.
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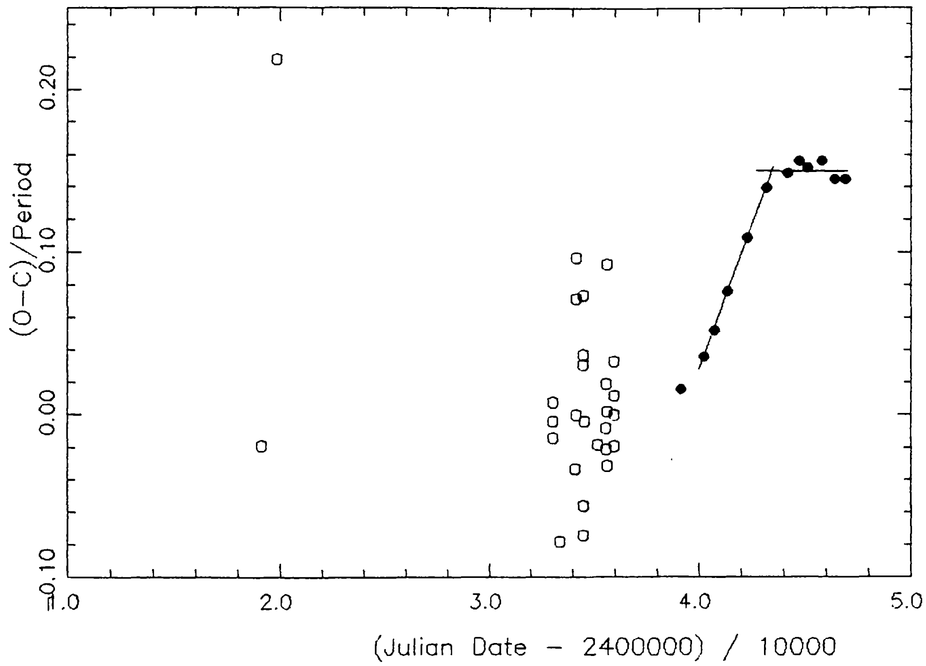

Figure 1. O-C Diagram for TY CVn. Open points are from Kurochkin (1959); filled points are from MMO. Two segments are made from least squares to show slopes that could be used to predict the period.

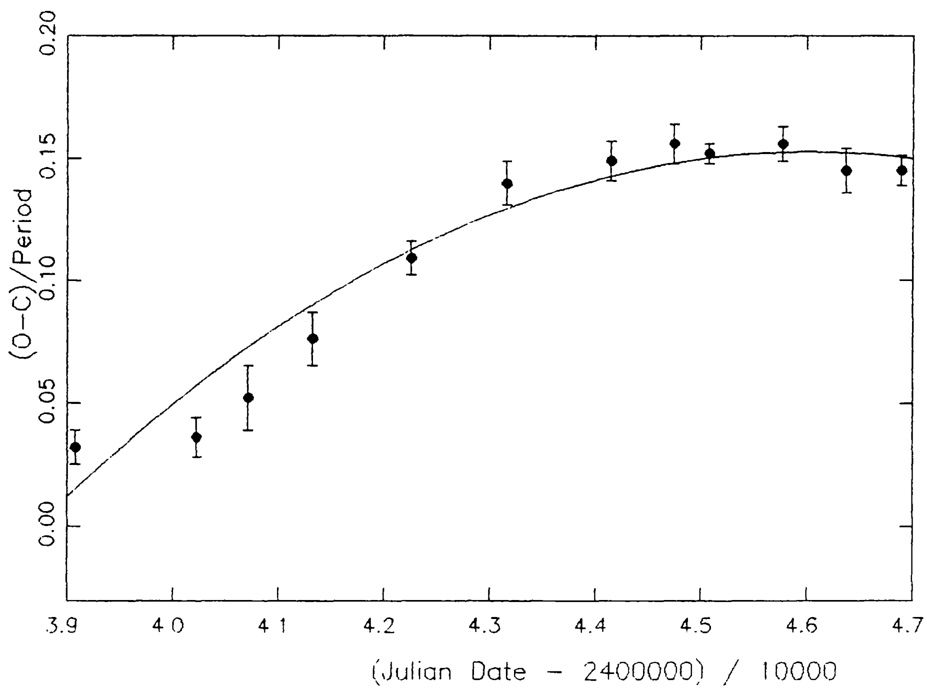

Figure 2. O-C Diagram for TY CVn made from MMO data only. This plot includes the earliest data point which seems to indicate that the parabola drawn is not the best fitting curve.

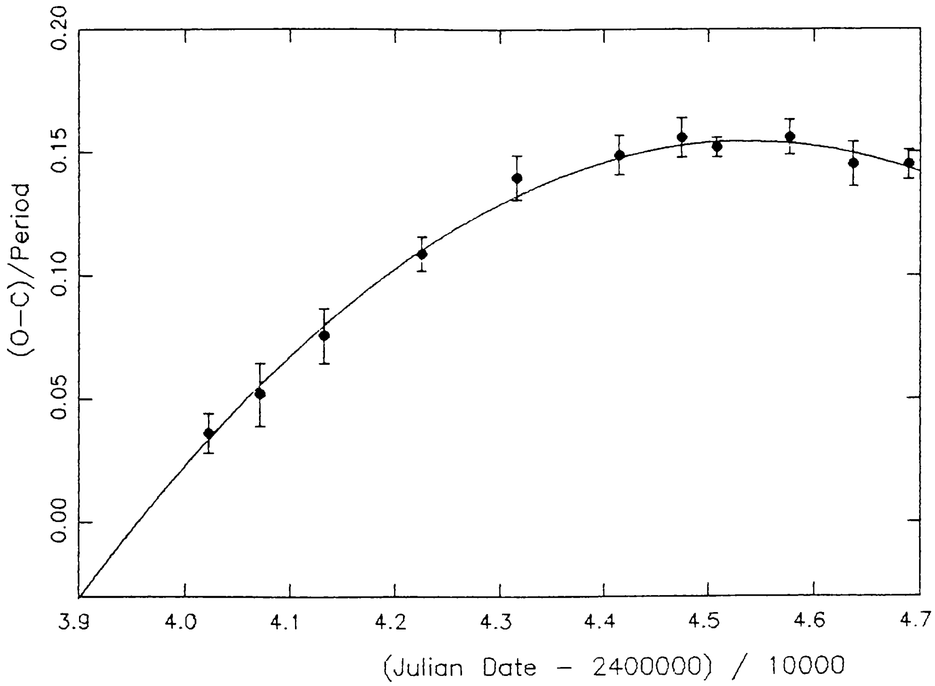

Figure 3. O-C Diagram for TY CVn made only from MMO data. This plot excludes the earliest data point, thereby showing a better fitting parabola.

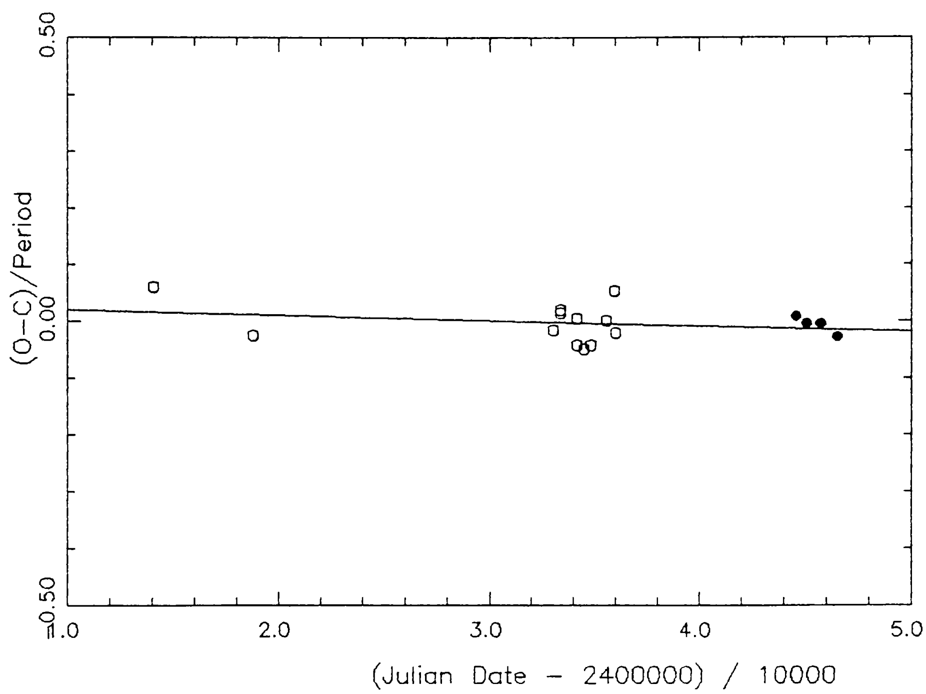

Figure 4. O-C Diagram for TZ CVn. Open points are from Kurochkin (1959), and filled points are from MMO. The data shown clearly demonstrate a constant period as a parabola drawn through the same points would be very close to linear.