A NEW EVALUATION OF TY SCUTI

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Abstract

TY Scuti, a classical Cepheid, was analyzed for period changes. It was found to have a constant yet slightly longer period, with new elements:

$$JD_{max} = 2433552.673 + 11.053446\ E.$$

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In 1979 Christian Bailey, a Maria Mitchell Observatory (MMO) assistant, studied TY Scuti, a classical Cepheid near M11 and the open cluster Trumpler 35. His O-C graphs described a parabolic shape, which seemed to imply a gradually increasing period. This O-C diagram was discussed by Belserene (1989) as an example of how to calculate the equation of a parabola by least-squares. The elements implied by the parabola are:

$$JD_{max} = \underset{\pm 0.11}{2433718.16} + \underset{\pm 0.00014}{11.05287}\ E + \underset{\pm 0.00000025}{0.00000049}\ E^2. \qquad (1)$$

These elements suggest an increase in period of $3.2 \times 10^{-5} \pm 1.6 \times 10^{-5}$ day per year.

In order to determine if plates taken in recent years would confirm these elements, I added new data to the O-C diagram. Bailey used ten points to construct his O-C graph, dating from 1938 through 1979. I added magnitude estimates for 1980 through 1989, as well as data from older plates from 1918 to 1938. Thus the entire span of the MMO plate collection was utilized. The new data were transformed into light curves plotted magnitude against phase, using elements listed in the third edition of the **General Catalogue of Variable Stars** (Kukarkin et al. 1970) (GCVS):

$$JD_{max} = 2428755.400 + 11.05302\ E. \qquad (2)$$

A series of data was also recorded in 1981 by an Earthwatch volunteer at MMO, and published magnitudes (Berdnikov 1986) exist as well. As a result, four different sources were used to create light curves for TY Sct.

An average curve was then constructed with data from 1934 through 1937. This curve was superimposed over each of the new light curves to help determine the phases at which their maximum brightness occurred: "(O-C)/P". Finally, these points were plotted against their average Julian Dates. The O-C diagram with these new values added did not fit the original parabola at all. I therefore found it necessary to re-analyze Bailey's data.

Most significantly, the first two points on Bailey's original O-C diagram were positive where they should have been negative, according to his light curves and the method he used to find O-C. These two points with their incorrect signs were largely responsible for the upward curvature. As well, some of his light curves contained very few data points, making it difficult to determine just where the phase of maximum brightness actually fell and adding to the error. When the original O-C diagram was replotted with all the signs correct, the

result was not a parabola at all, but rather a line with a slightly positive slope.

Bailey's data were then regrouped into blocks containing more points, and his light curves redrawn, this time by computer. The result, from the various sources, was thirty light curves. Plotted to the same scale, the different graphs seem to correlate fairly well with one another.

The resulting O-C graph, given in Figure 1, and found by the same methods as Bailey's, turned out to be a line of positive slope, denoting a slightly longer period than the published one, and not a parabola. The elements given by the line on the new O-C graph are:

$$JD_{max} = \underset{\pm 0.021}{2433552.673} + \underset{\pm 0.000030}{11.053446}\ E. \qquad (3)$$

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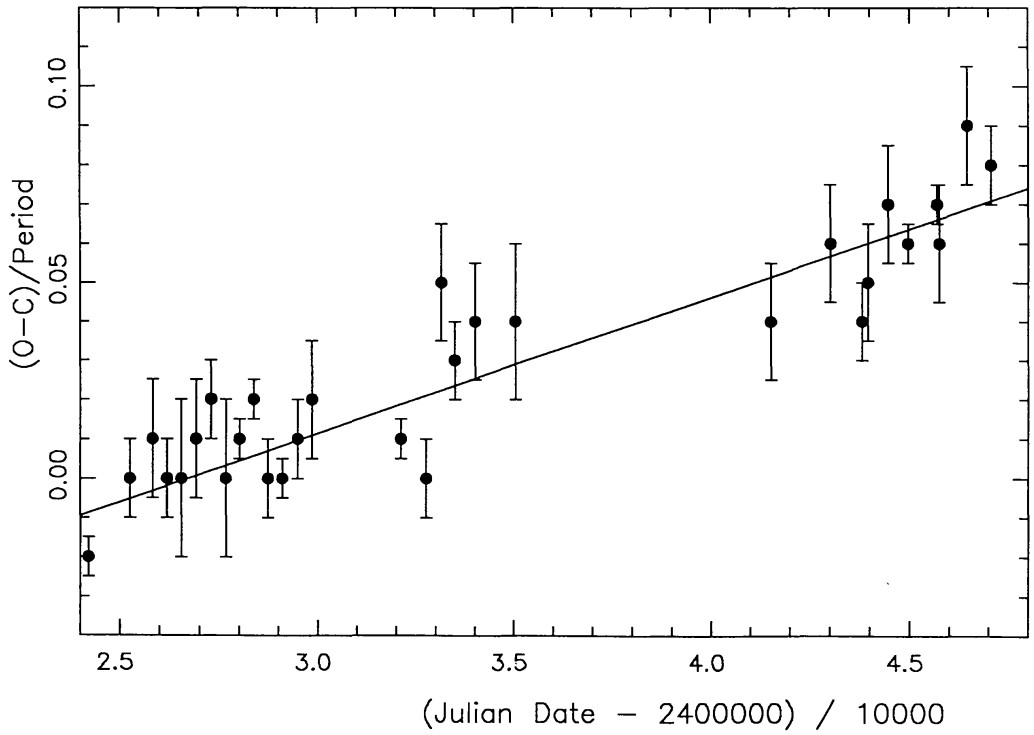

Figure 1. O-C diagram for TY Sct. New elements are given in equation (3).