A DETERMINATION OF THE ELEMENTS OF V943 AQUILAE

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Abstract

The elements of the variable V943 Aquilae are determined from comparisons with a new set of sequence stars. The period of the star is found to have been constant over the range of years from 1935 to 1975, but to have varied in a slower but undetermined fashion outside this range.

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V943 Aquilae is an RR Lyrae (RRab) variable for which Harwood (1960) reports that Bakos and Lowell both obtained a preliminary period of 0.535 day. The sequence stars used for these determinations were those used to find the period of V351 Scuti. Since these stars are separated from V943 Aql by about 1.5 degrees (or about 21 mm on the Maria Mitchell Observatory plates), a set of sequence stars nearer to V943 Aql was chosen. They are shown in Figure 1.

Brightness estimates were made on Maria Mitchell Observatory plates dating from 1927 to July 1982. From these estimates an approximate period of 0.5188 day was found, using a period search program employing the method of Lafler and Kinman (1965).

Light curves for sixteen sets of years were plotted using the 0.5188-day period. A mean light curve was drawn on tracing paper, and this curve was used to obtain the O-C values for the sixteen light curves by noting their phase shifts from the mean light curve. An O-C diagram was drawn. A line was fitted to the data by the method of least squares, and refined elements were obtained. This procedure was repeated twice, in each case using the latest elements. The final O-C diagram is shown in Figure 2. Also shown are error bars representing the estimated maximum possible errors in the O-C values and the linear and parabolic fits to this diagram. The elements corresponding to the line are:

$$JD_{max}(\text{hel.}) = \underset{\pm 0.005}{2431092.166} + \underset{\pm 0.00000051}{0.51875951}\, E. \qquad (1)$$

The elements corresponding to the parabola are:

$$JD_{max}(\text{hel.}) = \underset{\pm 0.007}{2431092.160} + \underset{\pm 0.00000084}{0.51875863}\, E + \underset{\pm 4.82642 \times 10^{-11}}{6.24681 \times 10^{-11}}\, E^2. \qquad (2)$$

Inspection of Figure 2 reveals that the error bars of eleven of the sixteen groups of years intersect the least-squares line and that the error bars of three other groups of years miss the line by less than 0.01 cycle. These facts imply that the fit is fairly good and, hence, that the elements are reasonable. The fit, however, is not entirely satisfactory, for it appears that many of the points (in particular the fifth through fifteenth points) could be fitted better by a line of different slope and intercept.

The significance of the third term in equation (2) was tested by the method described by Pringle (1975) and was found to be probable at the 78% confidence level. This result implies a 22% probability that the E^2 term is due to chance deviations from a line. Thus, the E^2

term is not considered statistically significant. Since this fit gives the following formula for the period:

$$P(\text{days}) = \underset{\pm 0.00000084}{0.51875863} + (\underset{\pm 1.86075 \times 10^{-10}}{2.40836 \times 10^{-10}})(t - 2431092), \quad (3)$$

rejection of the parabola in favor of the line leads to the conclusion that any long-term change in the period must have been less than 2.40836×10^{-10} day/day or 0.088 day/10^6 years.

The hypothesis that a better fit to the fifth through fifteenth points was possible was tested by making a linear least squares fit to these points. The result is shown as a dashed line in Figure 2 and yields the following elements:

$$JD_{max}(\text{hel.}) = 2431174.130 + 0.51875821\ E. \quad (4)$$

Inspection shows that this result is a better fit to these eleven points than the first least squares line. It appears that the star was varying at the constant period given in equation (4) between JD 2428000 and 2444200. Outside of this range of days, the star apparently was varying more slowly, since the slopes of the data there are positive. The exact nature of the variations there remains undetermined, as there is no obvious functional form to the data.

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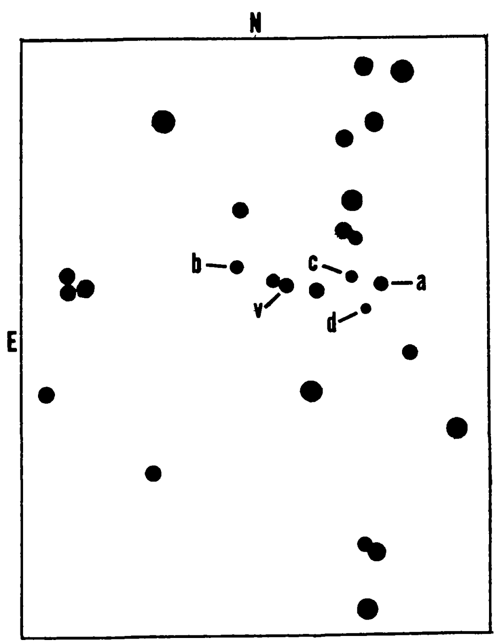

Figure 1. Finder chart for V943 Aquilae. The coordinates of the variable are $\alpha = 18^h\ 56^m\ 36^s$, $\delta = -7°\ 20'.6$ (1900). The variable is marked by the letter "v." The comparison stars are marked by the letter letters, with "a" indicating the brightest comparison star and "d" indicating the faintest. The field is about 15m x 20m. North is up; East is to the left.

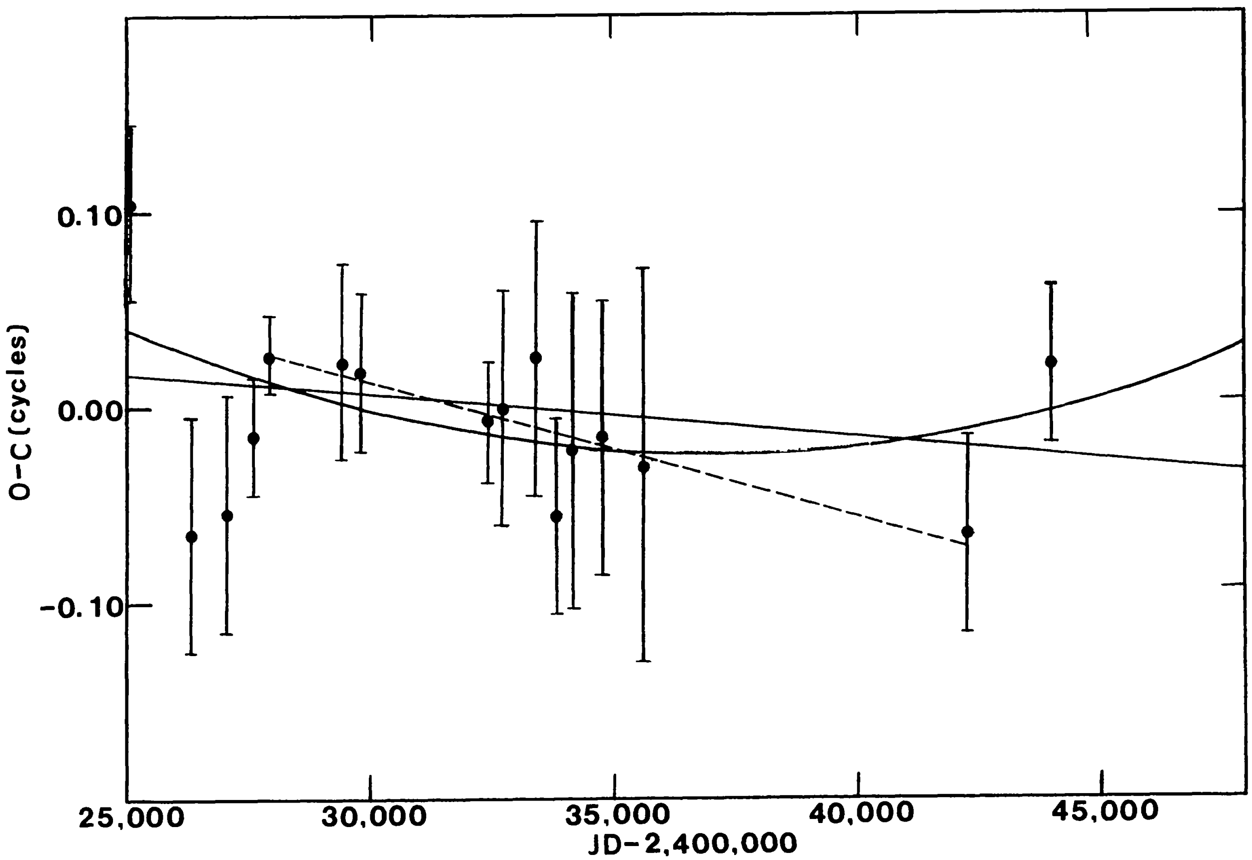

Figure 2. O-C diagram for V943 Aquilae. The solid line indicates the linear least squares solution for all of the data, while the parabola indicates the parabolic least squares solution for all of the data. The dashed line is a linear least squares fit to the fifth through fifteenth points. The error bars represent the estimated maximum possible errors in the O-C values.