THE PERIOD OF V943 AQUILAE
II. DEMONSTRATIONS THAT THE SHORTER PERIOD IS SPURIOUS

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Abstract

The elements of the RRab variable V943 Aquilae have been revised and the period appears to be constant from 1925 to 1990. A spurious period made initial determination of the elements difficult.

V943 Aquilae appears on nearly 1000 plates taken at the Maria Mitchell Observatory (MMO) since 1925. Fraser (1992) examined the MMO photographic plate collection and obtained a strong candidate for a new period of 0.341564 day using a period search program based upon the discrete Fourier transform method of Ferraz-Mello (1981).

Using the measurements of Fraser (1992), the author has continued the analysis of V943 Aql by using the period search program to identify specifically two periods of roughly equivalent merit. Values of 0.341565 and 0.518759 day were used to plot folded light curves for years along the entire range of data. Each showed a moderate amount of scatter and neither one appeared to be a better fit than the other.

The relationship between the two periods is such that their frequencies differ by nearly one solar day:

$$1/0.341565 - 1/0.518759 = 1/0.999977. \quad (1)$$

Therefore, the two periods always seem to be approximately in phase at the times that the MMO has taken plates. Such a connection makes it difficult to separate the true period from the spurious period using only fits to light curves.

Inspired by an approach used by Wheatley (1982), the author attempted to determine if the time of observation had any effect on how well each calculated period fit the data. The time of observation should have no effect on the fit of a true period, and a dependence of the fit would indicate the spurious period. To check for such a relationship, first the predicted magnitudes, based upon each period, were calculated back in time to when each of the plates were taken. This gave four pieces of data for each plate: date photographed, measured magnitude, predicted magnitude based upon P = 0.341565 day, and predicted magnitude based upon P = 0.518759 day. The differences between each calculated magnitude and the measured magnitude were then tabulated. Those differences, a set for each period, were then arranged according to when they were taken during the day. Namely, they were ordered by the decimal fraction of the Julian day at which they were photographed. When these differences were averaged over small intervals of 0.05 Julian day and graphed, the spurious period was revealed (see Figure 1).

The fit to the shorter period is shown to vary widely over the range of observation times, while the fit to the longer period remains roughly constant. This indicates that the longer period is the true period in this case. The graph also shows how easy it was to mistake 0.341565 for the true period. Because of random chance, this false value would occasionally produce better predicted magnitudes than the true value, especially when the observations fell around 0.8 of a Julian day.

A completely new O-C diagram was created and by using the method of least squares, a line and a parabola were fit to the data (see Figure 2). The data are clearly linear and the parabola can be discounted as its error is greater than the value for the quadratic term of the equation. The new elements given by the line of best fit are,

$$\mathrm{Max}(\mathrm{JD}_{\mathrm{hel.}}) = \underset{\pm 0.0041}{2433927.1747} + \underset{\pm 0.00000033}{0.51875924}\,E. \qquad (2)$$

Although there was initial uncertainty as to which period explained the data, the final results suggest that V943 Aql changes brightness with a constant period of 0.518759 day. The calculated error in the rate of change of the period is greater than the value of the rate of change. In contrast to Meyer's earlier conclusions, V943 Aql appears to be a very well behaved variable star.

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References

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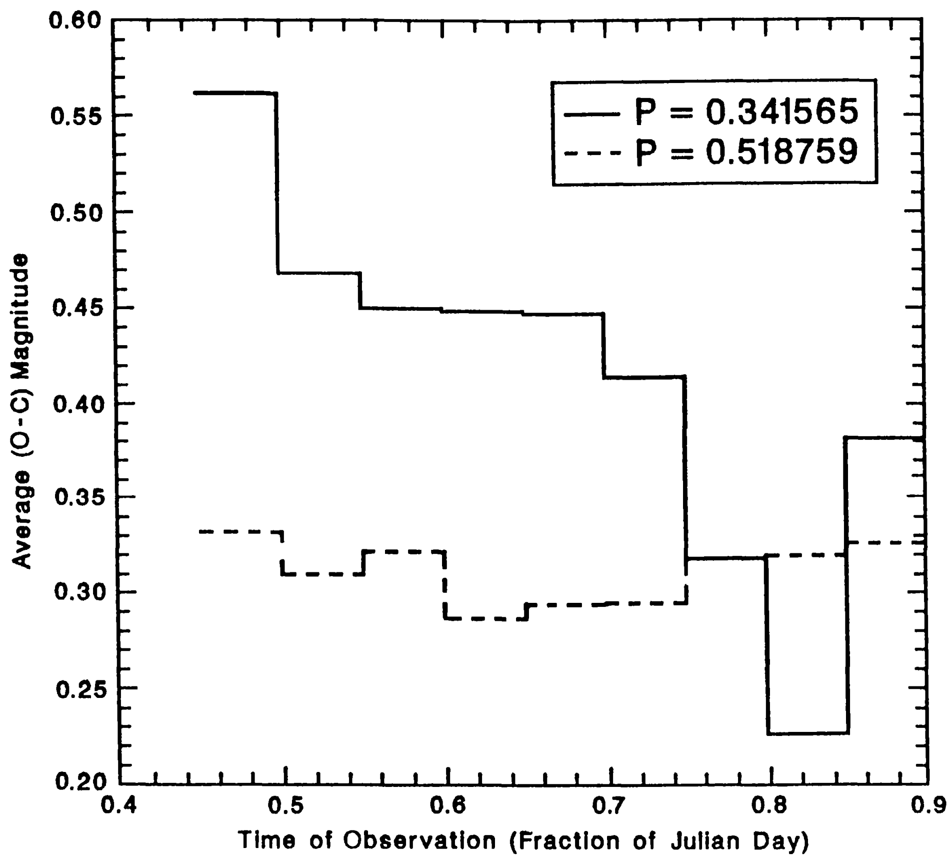

Figure 1. This graph shows the dependence of the spurious period (P=0.341565) of V943 Aql on the time of observation. Notice it has a smaller error around 0.8 Julian days than the true estimated period. This random effect complicated the initial period searches.

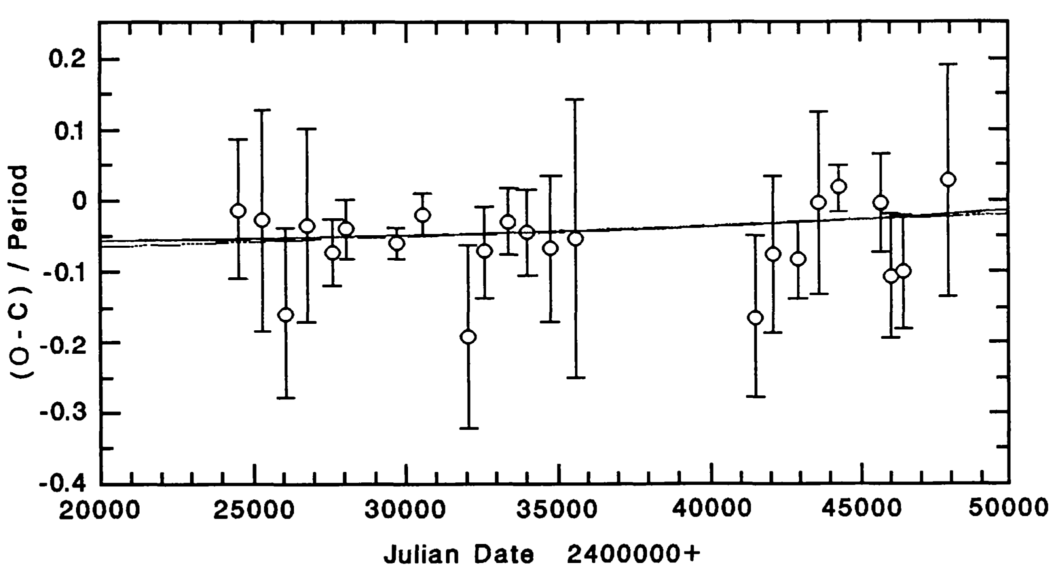

Figure 2. This O-C diagram of V943 Aql shows by its linearity that the period is nearly constant over the entire range of observations.