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THE PERIOD OF V943 AQUILAE I. DISCOVERY OF A SHORTER PERIOD

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Abstract

Previously published elements for the RR Lyrae variable V943 Aql are re-examined after the addition of observations from the Maria Mitchell Observatory plate collection for 1980 through 1991. It was discovered that the O-C diagrams of two different periods fit the data equally well.

The RR Lyrae (RRab) star V943 Aquilae, (R. A. = $19^h\ 00^m\ 36^s$, Decl. = -07° 12'.6 (1950)), has been studied previously for its variation in period. It is reported in Harwood (1960) that Bakos and Lowell both obtained a preliminary period of 0.535 day. Elements published by Meyer (1983) are

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

He concluded that although there was consistency in his data from 1935 to 1975, the period varied more slowly and in an undetermined pattern outside those years. Meyer's (1983) period testing ran from 0.4 to 0.6 day, but initial testing by the author was from 0.2 to 0.9 day.

In order to update the period of V943 Aql, plates of the Maria Mitchell Observatory were inspected to extend the 1935 - 1979 time base to 1991. Estimates of the variable's brightness were made for 1980 through 1991, and a period search program based upon the discrete Fourier transform method of Ferraz-Mello(1981) was then employed. A period of 0.341564 day was confirmed with a high power in the Fourier Transform program. The 0.518760 day period always was the program's second choice.

Since neither period could be eliminated initially, an O-C diagram was made and analyzed for both. O-C diagrams based on each period were fit by both linear and parabolic curves determined by least squares methods. The O-C diagram that assumed the 0.518 day period (Figure 1) appeared to have slightly more scatter for both the linear and parabolic fits than that for the 0.341 day period (Figure 2). The parabolic fit to the 0.518 day period O-C diagram is formally a better description of the data and the quadratic term in the solution is significant compared to its error, indicating that the period is changing.

Conversely, the analysis based on the 0.341 day period yields an O-C diagram which is very well fit by a linear relationship, indicating that the period is constant but needs to be fine tuned. The linear least squares fit in Figure 2 yields the revised elements:

$$JD_{\text{max}} = \underset{\pm 0.0037}{2435592.4756} + \underset{\pm 0.0000002}{0.3415678}\ E. \qquad (2)$$

However, the rms deviations about the linear fits for either of these periods are similar, making it difficult to judge the relative validity of the two periods.

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After investigating further, it was discovered that the two periods are related to one another by the Earth's rotation. The relationship is such that the frequency, or the reciprocal of the periods, differ by nearly one solar day.

$$1/0.341564 - 1/0.518760 = 1/0.999965 \quad (3)$$

Three options for exploring the periods could be considered. One was to re-examine plates which had crucial Julian dates. These plates would be ones which were taken early in the evening or late morning. The second option would be to examine the star on plates taken at a different observatory, or to measure the star directly from another observatory. The third alternative, which would be a thorough and complete analysis, would be to explore whether the periods were time-dependent. A subsequent analysis by Fallon (1992) took this approach.

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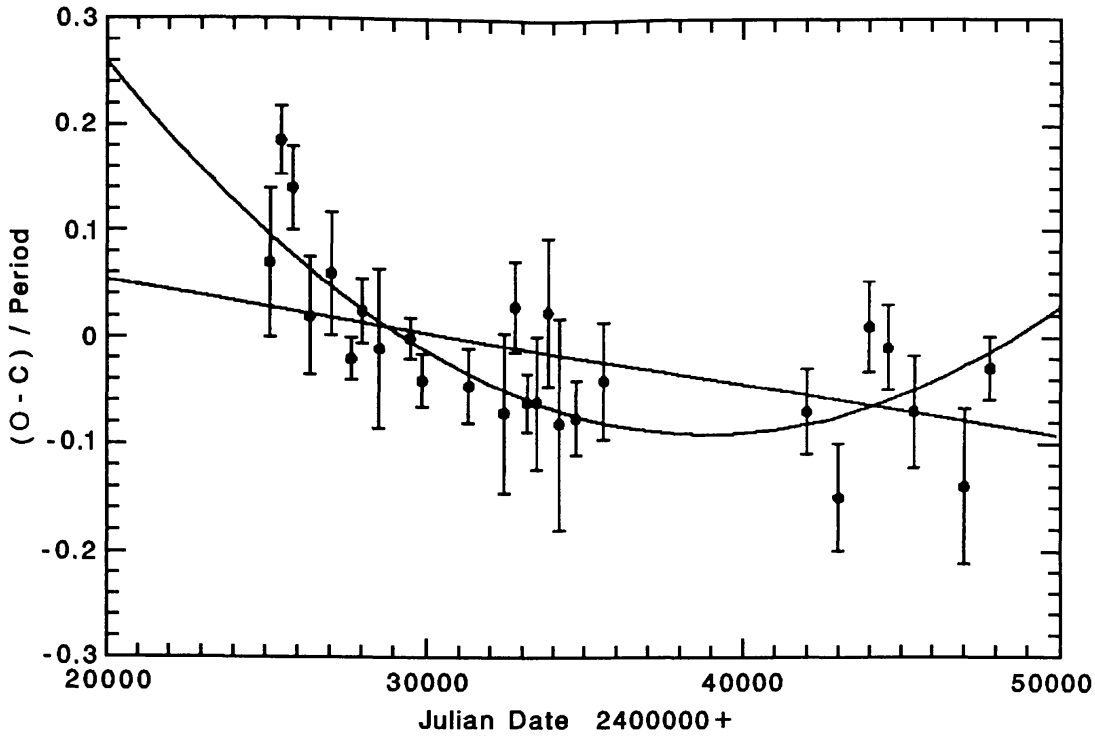

Figure 1. O-C diagram for V943 Aql assuming a period of 0.518760 day. Solid lines indicate both linear and parabolic least squares fits to the data.

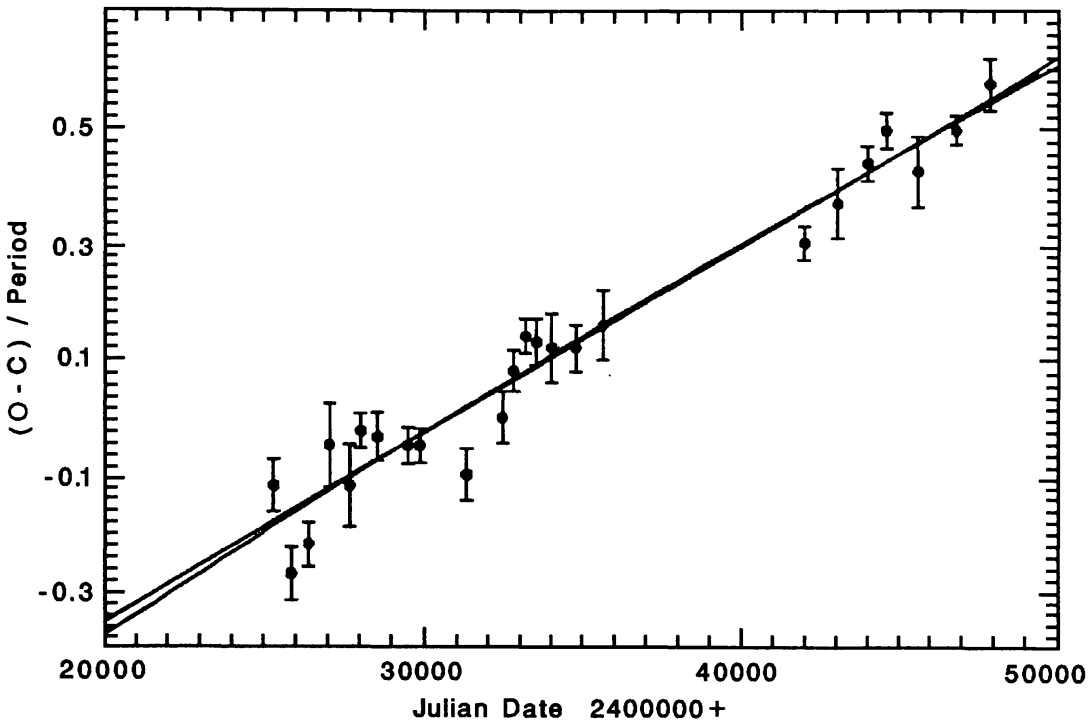

Figure 2. O-C diagram for V943 Aql assuming a period of 0.341564 day. Both linear and parabolic least squares solutions are shown.

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