

THE REVISED PERIOD OF V3821 SAGITTARII

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Abstract

The provisional elements of the Algol-type eclipsing binary star, V3821 Sgr, are revised to:

$$JD_{\min} = 2441784.565 + 0.75040129 E - 2.0 \times 10^{-10} E^2.$$

1. Introduction

A provisional period was determined by Hoffleit (1991) for V3821 Sgr, an Algol type eclipsing binary. The elements were:

$$JD_{\min} = 2427239.548 + 0.7503986 E. \quad (1)$$

2. Observations

Although over 900 plates in the Sagittarius region have been taken at the Maria Mitchell Observatory from 1924 to 1991, only 35 minima were observed, making the determination of the period a bit difficult.

The apparent brightness was determined by comparing V3821 Sgr to four comparison stars. The photographic magnitudes for this sequence come from iris photometry calibrated using a photometric sequence in M22. Figure 1 is a finding chart showing the variable and the comparison stars.

3. Analysis

Two types of period searches were used to revise the provisional period. The first used the Lafler-Kinman (1965) period search method. This search yielded the elements:

$$JD_{\min} = 2436775.660 + 0.750432 E. \quad (2)$$

The second period search utilized a Fourier transform fit. This search yielded the elements:

$$JD_{\min} = 2436775.660 + 0.750401 E. \quad (3)$$

Several irregularities appeared in the two sets of light curves using the elements in equations (2) and (3). First, there was a fast decrease in brightness followed by a fast increase in brightness. Second, the eclipse occasionally occurred at a later phase in one year, then occurred at an earlier phase in the next year. Third, many of the light curves contained bright and faint points at the same phase.

It seemed that alternate minima might be the primary and secondary minima in a 1.5-day period. Plotting at this period eliminated some of the problems of bright and faint points at the same phase, but the other irregularities remained. Furthermore,

the magnitude difference between maximum (14.2) and minimum (15.1) in both the primary and secondary minima was 0.9 magnitude. If it is assumed that the stars in this eclipsing binary system have equal luminosities, the difference in magnitude between maximum and minimum should be no more than 0.75 magnitude in the primary and secondary minima. It seemed that the 0.75-day period must be correct, but that the shape of the minimum could not be determined accurately from the available data.

Hence, O-C values were determined to revise the 0.75-day period. This was done by comparing individual light curves, which were in four-year bins, with an average light curve. A straight line and parabola were fitted to these points by least squares. The line corresponded to the elements:

$$\text{JD}_{\min} = 2441784.569 + 0.75040124 E. \quad (4)$$

$$\begin{array}{cc} \pm 0.001 & \pm 0.00000037 \end{array}$$

The parabola corresponded to the elements:

$$\text{JD}_{\min} = 2441784.565 + 0.75040129 E - 2.0 \times 10^{-10} E^2. \quad (5)$$

$$\begin{array}{ccc} \pm 0.001 & \pm 0.00000019 & \pm 0.5 \times 10^{-10} \end{array}$$

Comparison of the parabolic term with the its mean error can be used to estimate its significance. In this case, it is four times its error, which implies a high probability that the parabolic term is real. This significance was also tested using a statistical F-test (Pringle 1975) and was found to be at the 99.15% confidence level. There is less than 1% chance that the non-zero parabolic term is due to random errors in the values of O-C.

These results imply a period decreasing at the rate of ± 0.19 day per million years. The changing period may be interpreted as evidence of an interaction between the two components of the eclipsing binary system.

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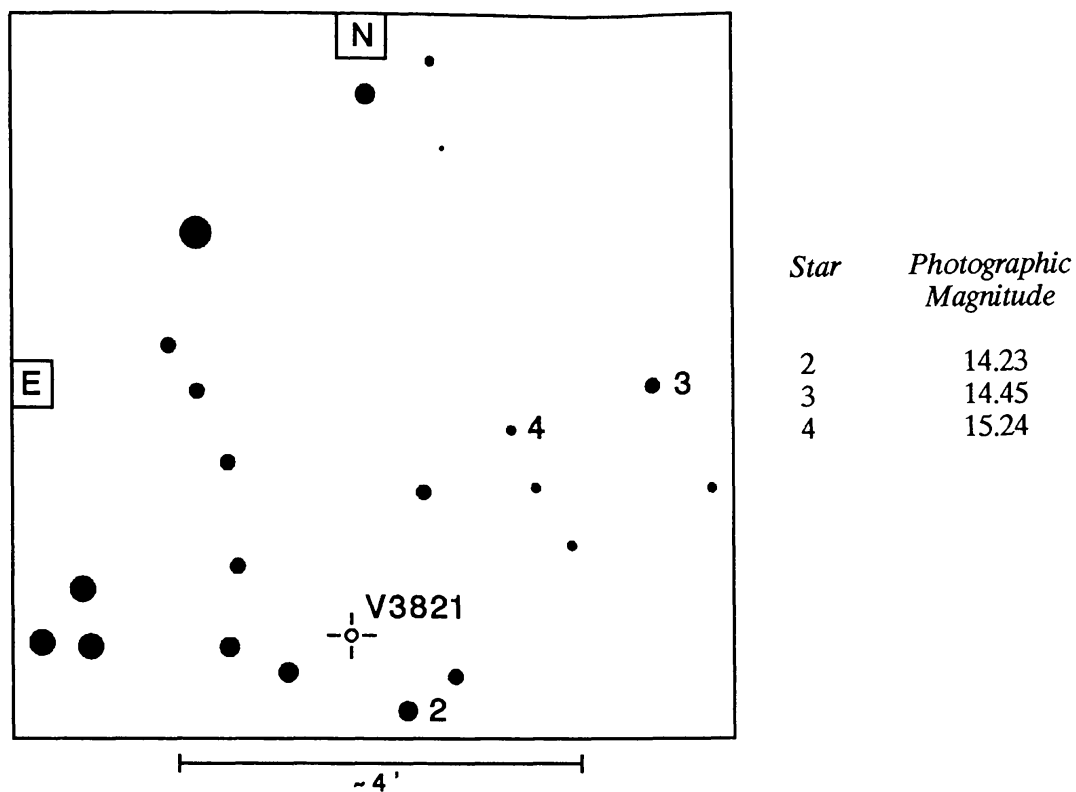


Figure 1. Finder chart for V3821 Sgr ($18^{\text{h}} 23^{\text{m}} 24^{\text{s}}$, $-22^{\circ} 06'2$ (1950)). The variable is labeled V3821, and the sequence of comparison stars is marked in the figure. The field shown is approximately 8 arcminutes square.