A STUDY OF V1954 SAGITTARII

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Abstract

The period, amplitude, magnitude, and location of V1954 Sagittarii were investigated because published periods ranged from 6.155 to 6.179492 days and amplitudes from 0.4 to 2.5 magnitudes. The new epoch and period were determined to be JD 2432626.915 and 6.1794493 days, respectively.

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In the summer of 1982, I studied V1954 Sagittarii under the direction of Emilia P. Belserene at Maria Mitchell Observatory. This variable, also known as DH 85 or BV 585, is a Cepheid with a six-day period. Work done previously on this star by Lorella Jones at Maria Mitchell Observatory using Nantucket (NA) and Harvard MF and B plates (Hoffleit 1963), and by V. P. Tsesevich (1964) resulted in similar period determinations. Tsesevich accepted Jones' amplitude of 2.5 magnitudes. In 1965, two studies at Remeis Observatory determined a period of 6.155 days (Strohmeier et al. 1965) and an amplitude of 0.4 magnitude (Schoffet and Köhler 1965). In the General Catalogue of Variable Stars (Kukarkin et al. 1969), V1954 Sgr is suggested to have a close companion in order to help explain the small amplitude given in 1965.

Since the Remeis amplitude was taken from estimated magnitudes and Jones' maximum was extrapolated above her preliminary magnitudes for her comparison star sequence, I determined an amplitude for V1954 Sgr by photographic transfer from stars of known magnitudes in M23 to my sequence of comparison stars. Jones' data were available to me, so I first chose two stars that would extend the light curve to include V1954 Sgr at its brightest.

After taking brightness estimates from the Sagittarius NA plates dated 1958 to 1982, I had overlapped Jones' estimates by about 4 to 5 years. For this overlap of time I plotted her estimates versus mine, from which I drew a calibration curve to convert her estimates to my scale. Thus, estimates on a consistent system were available for 58 years (802 plates), since I could include her estimates from Harvard plates as well as those from NA plates for which she estimated how much brighter the variable was than her brightest comparison star. I then used a technique of image measurement called "fly-spanking" (Stock and Williams 1962; Dinerstein 1973) to compare four Nantucket plates to a scale of stellar images of different intensity. I obtained scale values for my comparison sequence as well as for stars in M23, a nearby open cluster for which the magnitudes had been measured with photoelectric photometry (Hoag et al. 1961). I then plotted the scale values versus known magnitudes (B) for stars in the open cluster and drew a calibration curve for four plates, each of which shows the cluster and the field of the variable. All of the comparison stars were therefore interpolated between known values. The maximum and minimum for V1954 Sgr were found to be magnitude 11.81 and 13.36, respectively, and the amplitude was found to be 1.55 magnitudes. The mean error of the comparison magnitudes ranges from 0.06 to 0.23, being more uncertain at the bright and faint ends of the scale. As I mentioned earlier, studies at the Remeis Observatory had reported an amplitude of only 0.4 magnitude. Perhaps one or both of their comparison stars (they used only two) are variables, or the

estimated magnitudes for their comparison stars are insufficiently accurate. It would be interesting to compare these two stars to the photoelectric photometry; unfortunately, the finding chart given does not unambiguously identify their "b."

In order to determine a more accurate set of elements for the variable, I plotted phase versus brightness covering about one to two years' data on each of 27 graphs. The phase I used was calculated as the fractional part of (JD - Epoch)/Period with Tsesevich's period and epoch (1964). Data for the years 1959-1963 (about 220 points) were then plotted all on one graph and an average light curve was drawn on tracing paper held over this graph with the maximum marked at phase zero. I then placed this traced curve over the one-to-two-year graphs and determined the phase of maximum by shifting the trace along the x-axis (calculated phase). The amount of shift on the abscissa was, therefore, recorded as the observed phase of maximum. An estimate of the largest possible realistic error was found by seeing how much the curve could be shifted and still fit relatively well on the points. This value was also recorded. From the resulting 27 measurements, I drew an O-C diagram, as seen in Figure 1, with observed phase of maximum versus JD - 2400000, and found two possible new sets of elements, using a BASIC computer program which does a least-squares fit and which was written at Maria Mitchell Observatory. The elements for a line were:

$$JD_{max} = 2432626.872 + 6.1794493\ E.$$
$$\pm 0.013 \quad \pm 0.0000129$$

The elements for a parabola were:

$$JD_{max} = 2432626.915 + 6.1794489\ E - 4.1313 \times 10^{-8}\ E^2.$$
$$\pm 0.022 \quad \pm 0.0000119 \quad \pm 1.7641 \times 10^{-8}$$

The parabola seemed to fit the points a little better than the line, both by visual inspection and by having a smaller error in period, which prompted me to check to what degree of certainty the parabola fit the data points. The statistical test used was F-distribution (Pringle 1975), for which I found the parabolic fit was 97% certain. Therefore, the period of V1954 Sgr seems to be changing. The same program that I used to find the new period gave me a rate of change of $-7.90317 \times 10^{-7} \pm 3.37465 \times 10^{-7}$ cycles/year, which indicates a steady decrease in the time between pulsations.

Because of the trouble I had with finding charts, I am publishing not only a finding chart, Figure 2, traced from a photograph of a plate, but also coordinates which I determined using a measuring engine. They are $\alpha = 18^h\ 09^m\ 24^s$ and $\delta = -20°\ 39'.8$ (1900). The estimated uncertainties are $\pm 1^s$ and $0'.1$ for the two measures, respectively.

REFERENCES

Dinerstein, H. 1973, Journ. Amer. Assoc. Var. Star Obs. 2, 52.

Hoag, A. A. 1961, U.S. Naval Obs. XVII, VII, 428, 500.

Hoffleit, D. 1963, Astron. Journ. 68, 207.

Kukarkin, B. V. et al. 1969, General Catalogue of Variable Stars, Moscow.

Pringle, J. E. 1975, Month. Not. Roy. Astron. Soc. 170, 633.

Schoffet, E. and Kohler, U. 1965, Inf. Bull. Var. Stars, No. 100.

Stock, J. and Williams, A. D. 1962, Astronomical Techniques, ed. W. A. Hiltner (University of Chicago Press), 393.

Strohmeier, W., Knigge, R., and Ott, H. 1965, Inf. Bull. Var. Stars, No. 81.

Tsesevich, V. P. 1964, Perem. Zvezdy 15, 196.

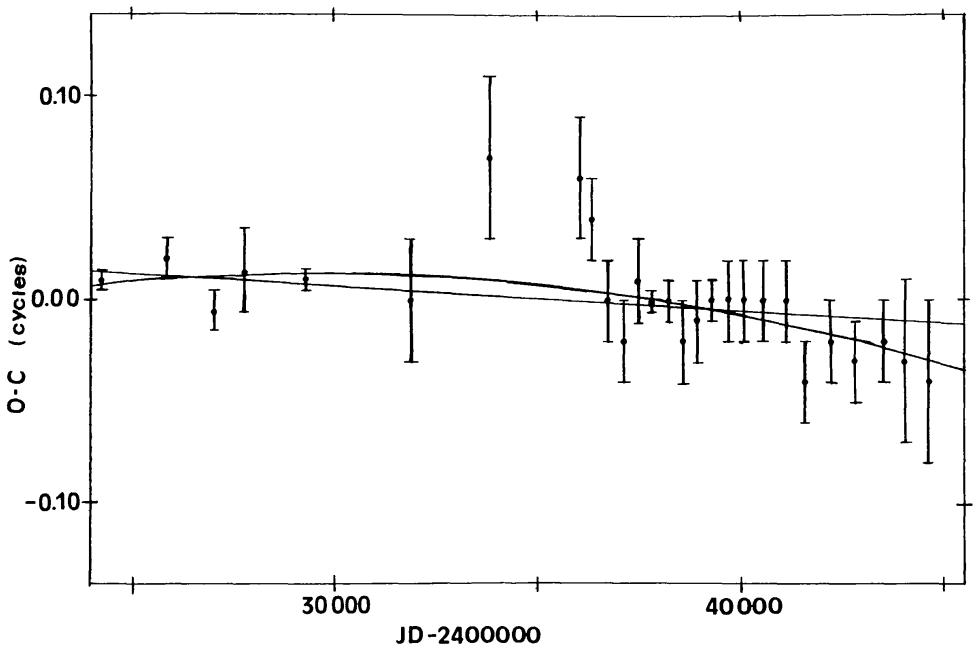

Figure 1. O-C diagram for V1954 Sgr. Both straight line and parabola are shown.

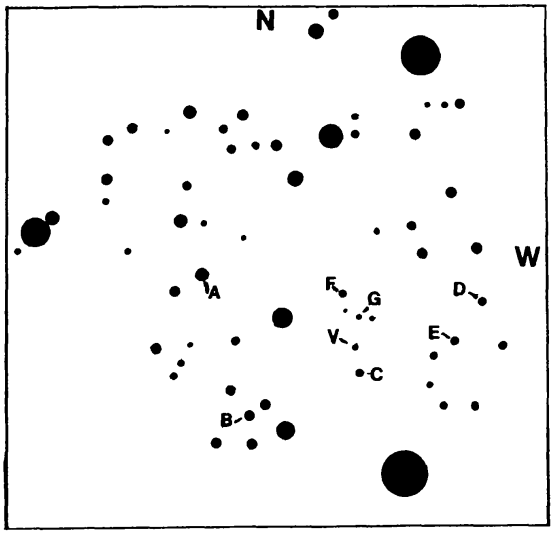

Figure 2. Finder chart for V1954 Sgr and the stellar comparison sequence used. The area covered is approximately 30 arc minutes square.