A CALL FOR PHOTOELECTRIC OBSERVATIONS OF V389 CYGNI

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Abstract

V389 Cygni is one component of the multiple system ADS 14682. The remarkable conclusions reached by Guthnick in 1942, in regard to the interpretation of seemingly incompatible radial velocity and photometric periods, have never been challenged or confirmed. New data, especially photoelectric observations, are needed for a better understanding of this enigmatic object.

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New observations are urgently needed for the extraordinary star, V389 Cygni (= Boss 5442 = BD+29°4324 = HD 201433), 5.5-5.69p, B8 + A2, at $21^h\ 04^m\!.4$ +29° 48'.1(1900). This variable star, component A of the visual binary ADS 14682, is ostensibly a spectroscopic binary. Component B, at a separation of 3".5, is two or three magnitudes fainter.

From radial velocities, Young (1921) derived orbital elements for the spectroscopic binary with a period of $3^d\!.3137$. Stebbins (1928) then observed the star photoelectrically but failed to find the correlation normally expected between light and radial velocity in a binary star. The scatter in the radial velocity curve was so great that Luyten (1936) rejected the orbit, as did Batten (1967), who reported that unpublished radial velocities by Argyle do not confirm the published period. Recently, however, in response to a request (Hoffleit 1977) for new observations, Bolton (1977) reported that about 100 spectra with a dispersion of 12 Å/mm had been taken at the David Dunlap Observatory in 1971-1974. These do confirm a $3^d\!.3$ period, but it is superposed on a long period of about 150 days, possibly also 110 and 270 days. Bolton therefore concludes that the spectroscopic system corresponds to a triple star.

Meanwhile Guthnick (1937-1942), in a series of papers in which he utilized both the then available spectroscopic and photoelectric observations, revised Young's radial velocity period to $3^d\!.31322$ and derived two periods from the photoelectric observations, $1^d\!.12912$ and $1^d\!.19328$, not related to the spectroscopic period. The two photometric periods dominate the light curve alternately, at intervals of from one to three weeks, with intervening stretches of irregularity or non-variability. Curiously, each period returns to dominance with precisely the phase it would have had if there had been no interruption.

Guthnick's two photometric periods are related by the beat period, p, where $1/p = 1/P_1 - 1/P_2$. This relation leads to p = $20^d\!.9999$, a number so close to an exact integer (not clearly revealed in plots of the observations) that one suspects the observed periods of being spurious. Yet no better single period has been found. Figure 1 depicts three spans of observations showing a diversity of characteristics, from practically no variation in the bottom strip, to sections suggesting a secondary variation with a period of about one week, approximately twice the radial velocity period.

Although the radial velocity curve is not related to the light curve in any obvious way, Guthnick did indicate that the deviations of the individual radial velocities from their mean curve do appear to be correlated with the phase of the light curve. I have tested the radial velocity period for spurious periods, and find that a period of $0^d\!.7665126$ satisfies the published radial velocities almost, but not quite, as well as does the published period. (See Figure 2. Bolton's more recent observations are not included, as they have not been published.)

Guthnick concluded his meticulous investigation by suggesting that ADS 14682A is, indeed, a spectroscopic binary with a period of $3^d.3$, both of whose components are cepheid variables. He stated that the lines of only one member are visible in the spectrum, but their orbital shifts are perturbed by the pulsations of both members. However, if the two cepheid periods are as nearly alike as indicated, it seems difficult to understand why the composite spectrum should reveal only one of them, since the period-luminosity relation indicates that their absolute magnitudes cannot differ appreciably. Perhaps the two periods really belong to the same single star which shows a multiplicity of periods analogous to the Blazhko effect. Thus, the picture is not as precise as one could wish.

Guthnick realized that his photoelectric observations represented the combined light of ADS components A and B, separated by only $3''.5$. He considered both of the possibilities that either A or B is the variable: if A, its magnitude would be contaminated by the presence of B by only $0^m.01$; if B, then B must vary by about $1^m.5$ (a reasonable amplitude for a cepheid) in order to produce the observed amplitude of the combined light. Guthnick therefore observed component B visually in the Berlin 65cm refractor in May and October, 1937. He ascertained that B is three magnitudes fainter than A, but he did not detect any variability. Therefore he concluded (1937, p. 4) that A was unquestionably the variable("Es ist daher die visuelle Komponente A zweifellos der Veränderliche"). For component B he found a spectral class A2, somewhat early for a one-day cepheid, but later than the spectral class of component A. Persuasive as his arguments are, extensive new observations, both spectroscopic and photoelectric, are needed to confirm or rectify Guthnick's ingenious interpretation.

It seems astonishing that such an enigmatic object as V389 Cyg should have remained completely neglected by variable star observers for 35 years. Members of the AAVSO equipped with photoelectric photometers could contribute significantly by monitoring this star throughout as many nights as possible. (It would likewise be desirable to have double-star observers examine component B visually in a large telescope in order to verify that B is indeed constant in brightness; most double-star catalogues list it as a magnitude brighter than Guthnick found.)

A finder chart, approximately 20^o x 20^o, had been published by Schneller (1937) showing, as well, the nearby cepheid, DT Cygni (6.06 - 6.56B). The period of this variable is $2^d.5$ and is changing. DT and V389 Cyg could profitably be observed at the same time. Figure 3 gives a finder chart based on the BD chart.

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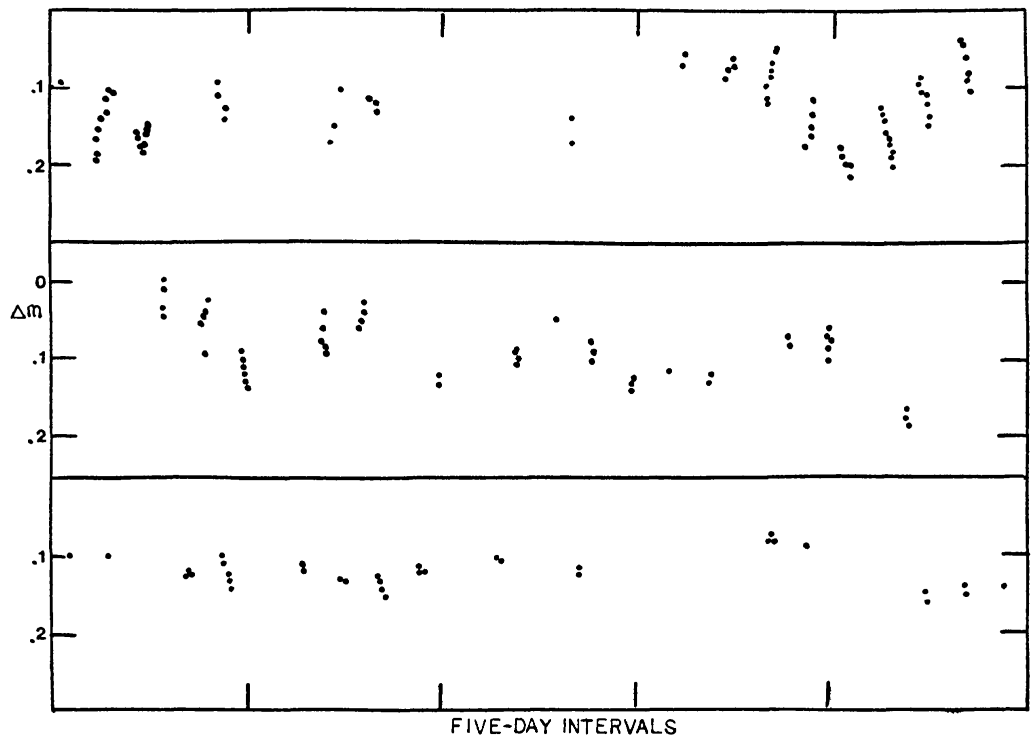

Figure 1. Plots of photoelectric magnitude estimates against JD for three groups of observations: top, JD 2428405 - 430; middle, JD 2429150 - 173; bottom, JD 2429492 - 517. The values plotted are the magnitude differences between V389 Cyg and the comparison star, 35 Vulpeculae.

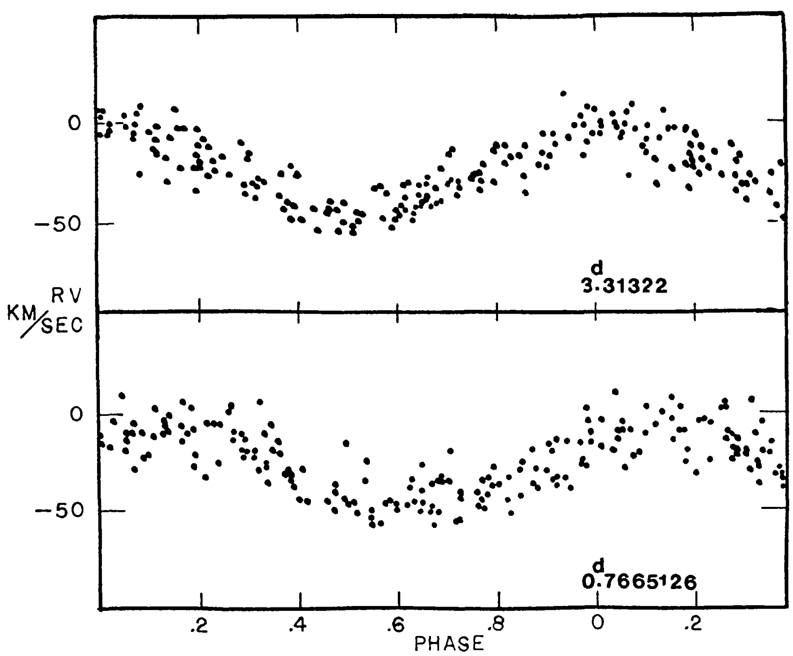

Figure 2. The radial velocities represented by a period of $3^{d}.31322$ (top) and $0^{d}.7665126$ (lower). Abscissa-markers at intervals of 0.2 period.

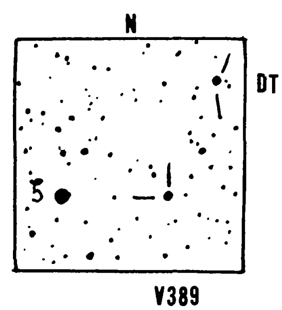

Figure 3. Finder chart, 2^{o} x 2^{o}, for V389 and DT Cyg.