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A NEWLY DISCOVERED DELTA SCUTI VARIABLE STAR

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We report the discovery of a new short-period variable star (GSC 2683_3076, $RA = 20^{\text{h}}06^{\text{m}}21^{\text{s}}$, $DEC = 35^{\circ}54'19''$, equinox = 2000.0, 10.7 *V*). The new variable star was chosen as one of the comparison stars during the observations of the high amplitude Delta Scuti star V1821 Cyg. The brightness of the star was first suspected to be variable in July 1999. Since then the star has been paid a close attention, and we monitored its photometric behaviour in September and October 1999.

The observations were carried out at the Xinglong Station of Beijing Astronomical Observatory (BAO) by using a red-sensitive Thomson TH7882 576×384 CCD photometer (Wei Ming-Zhi et al. 1990) attached to the 85-cm Cassegrain telescope. The CCD has a imaging size of $13.25 \text{ mm} \times 8.83 \text{ mm}$ which corresponds to a sky field of $12'.3 \times 8'.4$ ($1''.2/\text{pixel}$, a pixel size is $23 \mu\text{m} \times 23 \mu\text{m}$) on the computer screen. Johnson *V* filter was used. Figure 1 gives the identification chart of the new variable and the comparison stars. The magnitude differences of the new variable star relative to four comparison stars C1, C2, C3 and C4 are calculated as $V - (C1 + C2 + C3 + C4)/4$. Here,

C1 = GSC 2683_3426 ($RA = 20^{\text{h}}06^{\text{m}}21^{\text{s}}.42$, $DEC = 35^{\circ}52'24''.5$, 2000.0, 11.8 *V*),

C2 = GSC 2683_2994 (= BD +35°3963p, $RA = 20^{\text{h}}06^{\text{m}}29^{\text{s}}.47$, $DEC = 35^{\circ}54'42''.0$, 2000.0, 10.6 *V*, F8),

C3 = GSC 2683_3318 ($RA = 20^{\text{h}}06^{\text{m}}20^{\text{s}}.46$, $DEC = 35^{\circ}53'08''.0$, 2000.0, 12.1 *V*),

C4 = GSC 2683_2232 ($RA = 20^{\text{h}}06^{\text{m}}14^{\text{s}}.67$, $DEC = 35^{\circ}51'02''.9$, 2000.0, 10.9 *V*).

Depending on the change of seeing from night to night, different exposure times (ranging from 10 to 60 seconds) were used, but we have resampled all of the differential magnitudes to the bins of 60 seconds and normalized to zero. The atmospheric extinction was not taken into consideration in view of the closeness of the observed stars. The differential magnitudes of the comparison stars usually show a typical accuracy (standard deviation) of 0.010 mag. For the nights of good seeing a better value of standard deviation about 0.006 mag was obtained.

A preliminary Fourier analysis shows that the new variable star has a simultaneously excited multiperiodic pulsating character. The light curve can be fitted at least with three sine functions. The frequency contents are: $f_1 = 15.6980$, $f_2 = 9.5161$ and $f_3 = 8.0229$ c/d. Two additional frequencies $f_4 = 11.6849$ and $f_5 = 14.0489$ c/d are likely present. The principal period ($1/f_1$) of the new variable is about 90 minutes with a full amplitude of about 0.025 mag if the light curves are fitted with only one frequency content. Figure 2 shows the differential *V* light curves $V - (C1 + C2 + C3 + C4)/4$ versus

Heliocentric Julian Day on 9 nights between 11 and 21 October 1999. The solid lines represent a general least-squares sine-waves fitting made by using PERIOD98 (Sperl 1998) and MFA (Hao 1991). To identify the spectral type of the new variable, we obtained a spectrum of the star using the 2.16-m telescope equipped with a middle-dispersion Cassegrain spectrometer at the Xinglong Station of BAO on 19 October 1999. According to the intensities of $H\beta$, $H\gamma$ and other characteristic lines and their ratio values, the spectrum of the new variable is similar to that of A9V or F0V star. In terms of the short-periodicity, low-amplitude multiperiodic light variations and the estimated spectral type of the new variable star, it agrees well with the group feature of Delta Scuti stars (Breger 1979). So the new variable is most probably a new Delta Scuti type star.

We have found convincing evidence for the multi-mode variability of the new Delta Scuti star and analyzed its pulsation frequency contents. However, to reveal the details of the star's pulsational behaviour, further observations are needed. Various photometric indices are to be determined. We hope to publish a thorough investigation on this star after a follow-up observation. By the time, multiperiodicity could be further studied and the multiple modes could be identified. At the same time, its location on the H-R diagram could be well positioned.

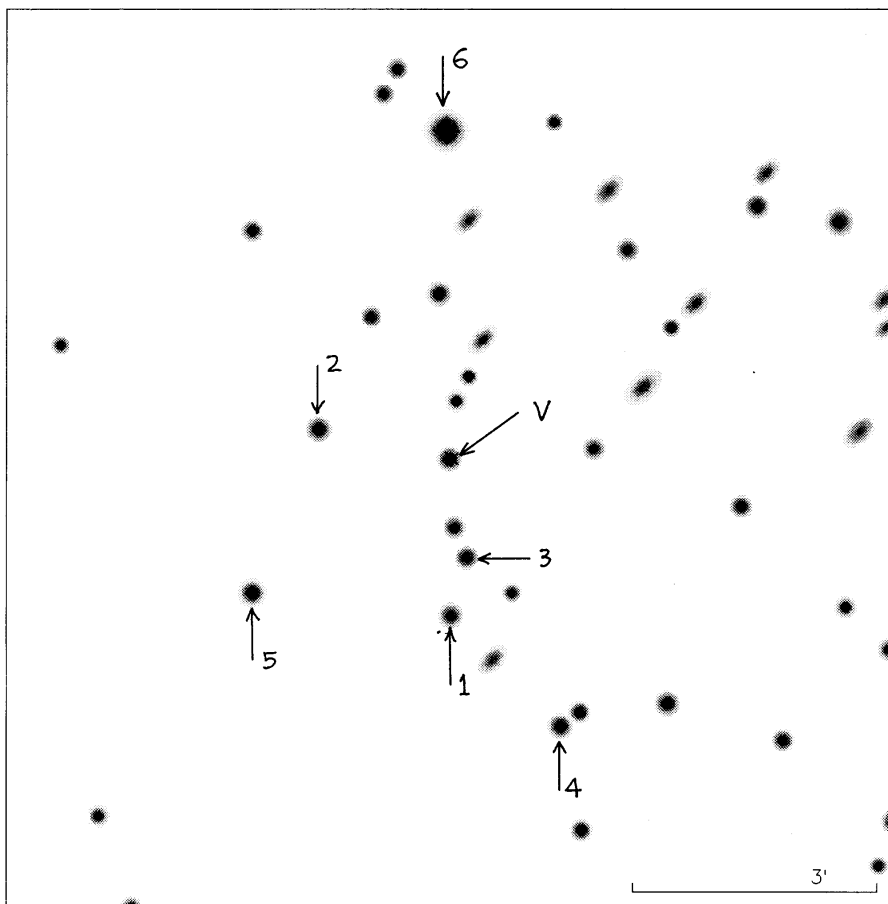


Figure 1. The identification chart of the new variable star (center, covered a cross and labelled V) as well as the comparison stars (labelled 1, 2, 3, 4). The star labelled 5 is the high-amplitude δ Scuti star V1821 Cyg. Star 6 is SAO 69413 (5.5 V, K0). The scale of the field is marked on the right bottom.

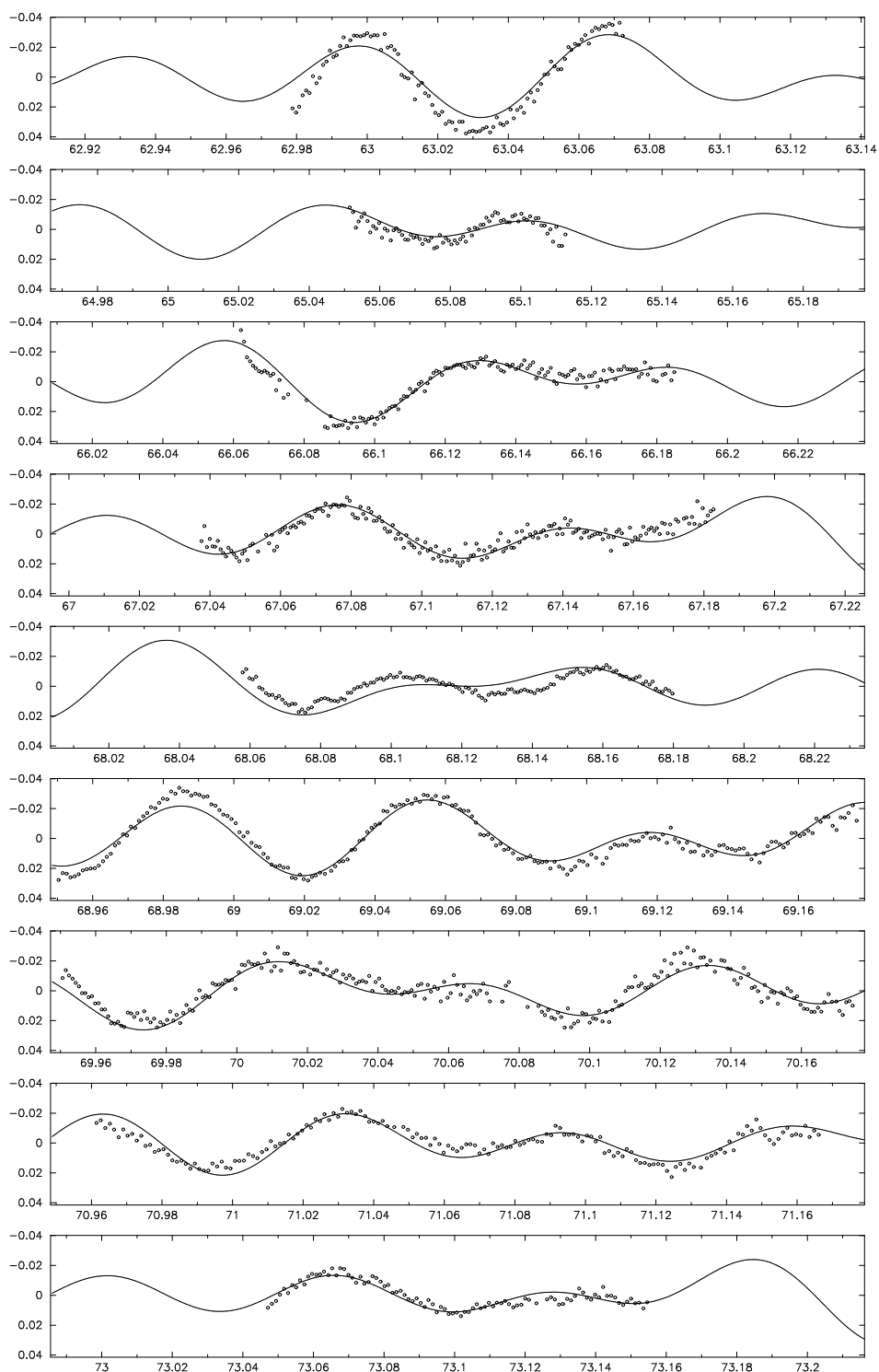


Figure 2. The CCD photometric differential V light curves (dots) of the new variable shown as $V - (C1 + C2 + C3 + C4)/4$ (mag) together with a 5-frequency sine-waves fitting curves represented in solid lines. Time is shown in HJD 2451400 + days.

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